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DISTRIBUTION AND ABUNDANCE OF MARINE BIRDS - SOUTH AND EAST KODIAK ISLAND WATERS -

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I. SUMMARY OF OBJECTIVES, CONCLUSIONS AND IMPLICATION WITH RESPECT TO OIL AND GAS DEVELOPMENT

This project is designed to provide information on the seasonal distribution and abundance of birds in Alaska's marine habitats, All waters bordering Alaska are occupied by birds, but there is a great deal of seasonal variation. Local populations are generally highest in the spring and fall migration periods and lowest in the winter. The most important marine habitats from the standpoints of abundance and species richness are the inshore, shelf and shelf edge waters of: 1) the Northwest Gulf of Alaska, especially around eastern Kodiak and the Barren Islands, 2) the Alaska Peninsula South, as around the Shumagin/Semidi Islands and in the Unimak Pass, 3) the Bering Sea, especially around the Pribilof Islands and over the major fishing banks, and 4) the Bering Straits in the vicinity of the Diomede Islands.

Most marine birds are highly mobile and foraging expeditions often cover large areas, especially over offshore waters. Local densities may thus vary greatly (e.g., 0 birds/Km² to over 1,000 birds/I@²) from hour to hour and day to day. Sooty and Short-tailed Shearwaters (Puffinus griseus and j?_. tennuirostris) dominate the marine avifauna during the 'summer and it is not uncommon to encounter tightly knit flocks of 25,000 to 50,000 birds. There are over eighty species. of birds which make extensive use of Alaskafs marine habitats. The most abundant of these are, in general descending order: Sooty/Short-tailed Shearwaters, Common/Thick-billed Murres (Uria aalge and U. lomvia), Northern Fulmars (Fulmarus glacialis), Tufted Puffins (Lunda cirrhata), Least Auklets (Aethia pusilla), Fork-tailed Storm Petrels (Oceanodroma furcata), Black-legged Kittiwakes (Rissa tridactyla), Parakeet Auklets (Cyclorrhynchus psittacula), and Crested Auklets (Act.hi~ cristatella).

The most important factors influencing marine bird distribution and density appear to be: 1) location of suitable breeding areas, 2) physical characteristics of the surface water (salinity, tide rips, etc.), 3) availability of suitable food, 4) bottom topography, 5) reproductive status of the birds, and 6) location of extensive fishing and fish processing operations. All of the above factors are interrelated and affect bird distribution either directly by influencing the birds behavior or indirectly by affecting the birds food supply. "

Our data on distribution and abundance of marine birds indicates that vast numbers of birds are"at risk" to pollution of Alaska's marine habitats. The kinds and numbers of birds involved will vary greatly in time and space but high impact levels, at least on a short-term basis, are inevitable. Each bird species will have a varying and unique degree

of vulnerability to pollution (e.g., oil spills) depending on, in part, the following factors: 1) species spending more time in the water than in the air are the most vulnerable, 2) species forming large dense flocks are more vulnerable than less gregarious species, 3) species breeding in the area are more vulnerable than non-breeding species because productivity is affected, 4) some species are rarer than others and thus are more vulnerable because of the reduced possibility of rebuilding populations by immigration from other areas, 5) year-round residents are more vulnerable to local pollution problems than seasonal residents and migrants, 6) species preferring areas of entrained water are more vulnerable than species which prefer areas of strong currents, and 7) species going through a flightless period at-sea (e.g., heavy molt or precocial young) are more vulnerable than species capable of year-round flight.

II. INTRODUCTION

A. General Nature and Scope of Study

Research during FY77 was primarily directed toward an intensive survey of nearshore and continental shelf habitats east and south of Kodiak Island, i.e., the area proposed for FY78 integrated studies. Shipboard and aerial transects were conducted simultaneously with the food web and colony studies of RU341. Four aerial and two shipboard surveys also covered some areas outside of the Kodiak Basin to fill area and time frame data gaps existing in the 1975-76 records. These data have not yet been analyzed but will be included in our final report. A major effort was also made during N77 to complete the editing, processing and submission of all 033 type data generated to date under RU337 .

B. Specific Objectives

Studies in waters south and east of Kodiak Island were conducted to obtain monthly (March-November) information on: 1) species composition, 2) population levels of individual species, 3) differences or similarities of species and population levels between a) the Chiniak and Sitkalidak areas, b) bays, continental shelf, shelf break, and deep pelagic waters and c) banks (<92 meter depth) and troughs (>93 meter depth) within the continental shelf, and 4) principal feeding locations for dominant species.

C. Relevance to Problems of Petroleum Development

Leasing of portions of the Kodiak Basin for petroleum development is scheduled for October, 1980. The intensive studies of marine birds

and other "fauna "are critical for "development 'of information necessary to 'establish methods 'for preventing or mitigating impacts which will be associated with 'the development of petroleum resources".

Selected "bays and continental shelf areas from Izhut Bay "south and west 'to Kaiugnak Bay have been proposed as sites 'for intensive integrated ecosystem studies in FY78-79. These studies are primarily directed towards a trophic-level food web product but require a data base composed of distribution, abundance and life history elements. In anticipation o'f this project the U.S. Fish and Wildlife Service concentrated its FY77 efforts in the area p'reposed for integrated studies.

The Kodiak area also has some unique environmental characteristics (e.g., a series of offshore banks, troughs and bays) that will allow us to gain insights into the details of marine bird distribution in relation to various oceanographic factors. This will hopefully provide us with clues which can be used in predicting seasonal impacts within other marine habitats.

III . "CURRENT STATE OF KNOWLEDGE

"Published accounts of the avifauna of Kodiak Island and its surrounding waters are few and', for the most part, lacking in details. Gabrielson 'and Lincoln (1959) summarize all published information up to their publication date including accounts by Bretherton (1896), Friedmann (1935), Howell (1948), and Arnold (1948). The major body of knowledge of seabirds of this area has been accumulated since early 1975 in the files and reports of investigators working under grants from the OCSEA Program (i.e., Lensink under RU 337, 338 and 341; Wiens under RU 108; Guzman under RU 239). For summaries of these investigations see: Guzman "(1976)., Lensink and Bartonek (1976a, 1976b, 1976c), Lensink et al. (1976), Wiens '(1976), Gould et al. (1977), Harrison"et al. (1977), Myres and Guzman (1977), Sanger et al. (1977), and Wiens et al. (1977).

Our shipboard and aerial surveys did not generally cover estuarine habitats, coastlines, nor shallow waters immediately offshore. This, 'plus the lack of winter surveys, resulted in our not recording a number of species which regularly use marine waters in the Kodiak area. Several winter and nearshore surveys, however, were conducted by the Fish and Wildlife Service between 1973 and 1977 and summarized in unpublished 'reports ,(Dick"et al., 1976a, Dick et al., 1976b, Dick et al., 1976c, Dick, 1977, Dick et al., 1977, Trapp, 1977). Since 1973, William Donaldson'has coordinated Christmas Bird Counts in Kodiak, and each year a team has covered 'the local bay areas by skiff (Donaldson 1974, 1975,

1976, 1977). Kenton Wohl and Craig Harrison (1977) made an aerial and foot survey of Aiaktalik, Sundstrom and the Trinity Islands on May 25-31, 1977. Information from the above surveys has been incorporated into the species accounts of this report.

Sufficient data now exist to assess the occurrence and abundance of common marine birds in the Kodiak area, excluding the Shelikof Straits, for spring, summer and fall. Winter data are almost lacking. Preferred marine habitats for the more common summer visitors have been documented, but have yet to be confirmed by a second year's study. We still know very little about the following important life history features of local marine birds: 1) distribution, abundance and habitat preferences of different age classes, 2) effects of storms on nearshore and offshore distribution patterns, 3) effect of annual water temperature and salinity variations on distribution patterns, 4) turn over rates between birds over the water and those on colonies, 5) foraging range of resident birds or flocks, and 6) daily movement patterns.

IV. STUDY AREA

This report includes only those data collected in nearshore and offshore waters of east and south Kodiak Island: 56° 00'N to 58° 20'N and 150° 00'W to 154° 00'W (Figures 1 and 2). The coast line of this area is typified by many bays, fjords and islands which provide important shelter for marine birds as well as high quality feeding and breeding sites. The continental shelf consists of a series of banks and troughs which produce a varied and complicated oceanic environment. The whole area lies within the Coastal and Alaskan Stream Domains and is heavily influenced by the Alaska Current System (Favorite et al., 1976). These conditions provide for an extensive fisheries industry (e.g., salmon, crab, shrimp) and the presence of operating canneries and fishing boats plays an important role in the distribution and abundance of local marine birds.

A little over 100 seabird colonies have been identified in this area, three of which contain approximately 60,000 birds each. Combined, these 100+ colonies contain an estimated 286,000 birds of which Black-legged Kittiwakes and Tufted Puffins comprise about 91% (data from the Seabird Colony Catalog currently being compiled by Art Sowls of the U.S. Fish and Wildlife Service, Office of Biological Services). A large number of non-colonial seabirds (e.g., Pigeon Guillemots and Marbled Murrelets) also occur throughout this area.

V. SOURCES, METHODS AND RATIONALE OF DATA COLLECTION

The long-term goal of our studies is to prevent or minimize impacts likely to occur with petroleum development within Alaskan waters.

To accomplish this we need to determine as closely as possible the number, kinds and dispersal patterns of marine birds throughout the area of interest and within well defined environmental parameters. This necessitates the development and standardization of data collecting techniques.

No completely satisfactory method of determining densities of birds at-sea has ever been developed (Bailey and Bourne, 1972). This is especially true for areas which have very high population levels such as Alaskan coastal waters. Most investigators have relied on modifications of the line or strip transect method (Kendeigh, 1944) and reported their results in terms of relative abundance supplemented with anecdotal information (e.g., King and Pyle, 1957; Bailey, 1966; Kuroda, 1966; Shuntov, 1972; Brown et al., 1975). The problems involved in accurate censusing of at-sea populations, using line transect methods or otherwise, are numerous (Bailey and Bourne, 1972; Emlen, 1971; Wiens et. al., 1978). The most obvious basic problems involve human, methodological and logistic factors as summarized below:

A. Individual observers differ in their ability to;

1) observe and identify seabirds,
2) judge distances, and
3) estimate the number of birds in a large flock.

B. At-sea transect results are weakened by;

1) the non-uniform (clumped) distribution patterns of many seabirds,
2) the unequal probability of detecting each seabird (e.g., ship attraction and avoidance),
3) the variability of observation conditions (e.g., seastate and atmospheric conditions),
4) rapid, frequent, and long distance movements of seabirds, and
5) variations in the speed at which the observer moves along the transect path.

C. At-sea censusing becomes expensive and time consuming when trying to:

1) accumulate a sufficient sample size for each area, time period, etc., and
2) assess large geographic regions.

The Fish and Wildlife Service techniques used in this study are basically line or strip transects. They are designed to control, as much as possible, the biases summarized above. The final experimental design,

as described below, is efficient without being unduly complicated and time consuming. The resulting density indices, while not being precise "nose counts", are consistent within the entire database and represent the best approximation of population sizes which can be derived in a large geographical area containing high bird densities. Both AERIAL and SHIPBOARD survey designs are used for RU 337 studies, each having its own unique strengths, weaknesses and value. The two types of survey products cannot be pooled to produce a single density index, rather they are used as complementary studies which are useful for cross-checking density trends and distribution patterns.

A. Shipboard Methodology

Each observer collects as much data as time, conditions and initiative permit. Data are collected in three major categories:

1. Location and Time: the following data are recorded for each transect; a) starting latitude and longitude, b) date and time (GMT), c) ship speed and course made good, d) elapsed time of transect, e) transect width, and f) time zone.

2. Physical Environment: these are recorded for each transect depending on availability and need. Where possible we include at least the following:

   a) a subjective evaluation of observing conditions, b) seastate, c) sea surface temperature, and d) depth.

3. Biological Data: the following bits of data on birds which we collect for each sighting are listed in the order we consider to be most important to least important;

   a) identification of species, b) number of individuals (within 300 meters of the ship), c) behavior (sitting or flying), d) birds seen outside of transect zone (300+ meters), e) color phase, f) sex, g) age, h) behavior (other than in "c" above, and i) flight direction.

We employ five major experimental designs: Transect Censuses, Ship Follower Surveys, Station Surveys, General Observations, and Collecting. Only transect censuses have been analyzed for this report although some anecdotal information has been included from the other designs.

Our transect censuses are based on a 10 minute (temporal) cruising time and a 300 meter transect width. The ship must be moving along a straight

path at a constant speed (usually 8-11 knots). The observer counts all birds observed forward of mid-ship to the projected end of the transect (maximum of 3,000 meters at 10 knots) and laterally, on one side, to 300 meters. The extended forward scan insures the detection of birds which may leave the area or dive before the ship reaches them. This is important for ship avoiding species. Only those birds observed within the transect boundaries during the actual time of the transect are counted. Ship following birds are recorded separately and not included in density estimates.

In theory, we would like to get an instantaneous count of birds within the transect zone. This is, of course, next to impossible from shipboard. Flying birds present a particular problem in this respect. If the observer counted all the individuals flying through the transect zone the eventual estimate of birds/Km^2 would be greatly exaggerated. We use several techniques to reduce this sort of bias:

1. Periodic instantaneous estimates are made of flying birds within a discrete portion of the transect area. These counts are then converted to the number of birds estimated to be within the transect area during the time of the transect. For example, at a speed of 10 knots we make three counts, using a 1000 x 300 meter area, beginning at the start of the transect. These counts are merely added together to produce the number of birds within the transect zone.

2. In the case of large flocks streaming across the bow, the number of birds crossing per minute within a specific distance (1,000 m for shearwaters, 500 m for storm petrels) can be 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 meter zone is also measured. With these two pieces of data the number of birds per Km^2 can be calculated. This density is then used to estimate the number of birds within the transect area during the time of the census.

   Distances were determined where possible by a range finder using the design developed by Dennis Heinemann under RU 108 (Wiens et.al. 1977 and 1978). In bay situations, distances were estimated by observers who had been using the range finder under good conditions and had verified their estimating ability.

   As the transect progresses, the observer frequently encounters birds outside of the counting zone. Such observations, especially of species not being seen in the count area or of large concentrations, are logged but not included in density estimates.

The timing and number of transects on each day of the cruise depend on the ships' and observers' routine and on the weather. For the Kodiak study, continuous 10-minute transects were made while the ship was underway and as observation conditions permitted. Observations from May through August were made aboard a 58' chartered vessel, the Yankee Clipper, which has a Westport, semi-planning hull. Navigation and position fixes were determined by radar and fathometer. The position of the radar on the flying bridge prevented observation from that vantage point so that all observations were made from the pilot house, ca. 4 meters above water level. The visibility forward and abeam from the pilot house was excellent. The September cruise was made aboard the NOAA ship Surveyor and the November cruise was made aboard the NOAA Ship Miller Freeman.

B. Aerial Methodology

Aerial surveys were completed along a pre-determined set of tracklines in the Gulf of Alaska east of Kodiak Island on 8-9 March, 20 April, 19 May, and 17 June, 1977 (Table 1). The specific date for each survey was contingent upon availability of survey aircraft, availability of survey personnel, and the vicissitudes of Gulf of Alaska weather conditions. When preflight consultations with National Weather Service personnel in Anchorage indicated the probability of storms, surface fog, or wind velocities in excess of 30 km/hour along the trackline, the survey was postponed. Surveys were designed within the 6-hour fuel limitation of the survey aircraft and included segments sampling nearshore, offshore, continental shelf (180 m depth), continental slope (180-1,800 m depth), and oceanic habitats. Surveys came no closer than 5 Km from any known colony sites and each survey included approximately 580 Km of continental shelf, 220 Km of continental slope, and 270 Km of oceanic trackline. The March survey required two days and a 30 Km section of trackline passing through Ugak Island could not be surveyed due to inclement weather. Otherwise, all portions of survey trackline were completed each month. Surveys were generally carried out between 10:00 and 16:00. Survey tracklines were chosen to follow whole degrees of meridians and parallels whenever possible.

The survey aircraft was a modified Grumann turbo-goose with improved forward and lateral visibility. The aircraft was equipped with a Global VLF Navigation System (Karant, 1976) which utilizes the very low frequency radio band and provides a continuous readout of longitude and latitude capable of locating tracklines within 200 m. It was flown on surveys at an altitude of 30 m and a groundspeed of 200 Km/hour.

Three biologists were utilized simultaneously on surveys. Two sat on either side of the aircraft and recorded observations to the lowest

t axon 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. Transect width was estimated using a clinometer (SUUNTO CO., Finland), aircraft altitude, and elementary trigonometric functions. The third biologist monitored the Global VLF and recorded positions every one minute of latitude (1,8 Km) for north-south censuses and every five minutes of longitude (5 Km) for east-west censuses. Supplementary data for each transect segment included weather, sea state, ceiling, wind, and observations of marine mammals. Approximately every 30 minutes the biologists switched seating arrangements to combat observer fatigue and to allow a different individual to ease his eyestrain by diverting his attention to the Global VLF. Observability varied somewhat due to overcast, glare, and sea state but with experienced observers there factors are minimized and data of reasonably consistent quality are collected. Experimental design eliminated the worst of sea conditions and we experienced generally overcast conditions in which glare could be no problem. Each participating observer in these surveys had at least 100 hours of prior aerial observation experience in the marine environment.

With the above qualifications in mind we herein present the data in the following forms:

1. Maximum density index (maximum). "This is the maximum possible density in any given area at any given time.

2. Mean transect densities (X).

3. Two Standard Errors (2SE) for each mean of transect densities This gives the estimated density range to be expected at the 95% confidence level.

4. Frequency (F). The percent of the total transects on which a species was recorded.

5. Density indices are given for birds on the water or feeding and for flying birds. This allows some subjective evaluation of biases in our estimates. Birds on the water or feeding are also more directly indicative of habitat use since flying birds often represent individuals moving between extra limital areas rather than being "employed" over the specified area.

The basic unit of analysis in this report is the number of birds encountered per square kilometer of observation area (B/Km^2) per 10-minute transect. In viewing and interpreting these counts the

reader must keep in mind the following qualifiers:

1. *Because of the inherent biasis in any census technique, the* B/Km^2 values *represent "best approximations" rather than actual "nose counts". Small birds on the water may be underestimated while large* flying *birds may be overestimated.*

2. *Because at-sea individuals and* flocks *are* highly mobile, *each transect density is unique and represents a single point in space and time.*

3. *Number of observations for many species are low. This is especially true for the most gregarious species, for all uncommon species and for species with restricted habitat preferences.*

4. *All of the data presented in this report were collected under a rigidly maintained experimental design. Observations or counts may then be viewed as accurate indices for intra-data comparisons.*

VI. RESULTS

Data from this study are presented below in a species account format. Each account is preceded by *a brief summary of the species local distribution, abundance and chronology based on literature records, unpublished U. S. Fish and Wildlife Service reports and data obtained during RU 337 studies. These accounts deal strictly with marine waters, Shorebirds and freshwater bird populations are thus not included in this report. Population estimates are based on a total bay area of 2,780 square kilometers and a continental shelf area of 26,000 square kilometers. These estimates should be interpreted as the number of birds employed over the water at any one time. They do not include birds occupied on colony sites, shoreline loafing and roosting sites, nor inner-bay and estuarine sites. Figures* 3-12 *show the locations of all transects taken during this study.*

COMMON *LOON (Gavia immer)*

This species may be found in low numbers throughout the year as a migrant or occasional resident.

We have three records: 1 bird in Sitkalidak *Straits (March 8, 1977), 2 birds over the south shelf (May 30, 1977), and 2 birds over the north shelf (July 14, 1975).*

YELLOW-BILLED LOON (Gavia *adamsi)*

This species occurs as an occasional winter resident or migrant.

One bird was recorded over the south shelf (May 30, 1977).

ARCTIC LOON (Gavia arctica)

Low numbers may be found throughout the year as migrants or occasionally as residents.

Our records-consist of: 1 bird in Sitkalidak *Straits (May 30, 1977), 1 bird in south oceanic waters (October 2, 1975), 3 birds over the northern shelf (November 2,* 1977), *1 bird over the southern shelf-break (November* 4, *1977), and two single birds over the south shelf (November* 5 *and 8, 1977).*

RED-THROATED LOON (Gavia stellata)

This species may be found in low numbers throughout the year as migrants or breeding residents.

We did not find this species on our surveys.

RED-NECKED GREBE (Podiceps grisegena)

Found in small numbers throughout the year as migrants or residents. They are generally restricted to nearshore waters in protected bays.

We did not observe this species during our study.

HORNED GREBE (Podiceps auritus)

This grebe is a fairly common winter resident in bay areas.

No Horned Grebes were seen during our surveys.

BLACK-FOOTED ALBATROSS (Diomedea *nigripes)*

This is a common non-breeding summer resident over the shelf-break and deeper oceanic waters.

As many as 17 individuals were noted following a ship at one time. Our earliest record is one *bird seen on April 20, 1977, over deep, oceanic waters southeast of Kodiak. Our latest record is of four birds following the ship over the shelf-break on September 7, 1977. Some birds* occasion- *ally follow ships* or *stray into shallower waters of* the *continental* shelf.

Two birds were seen in the Kiliuda Trough area on August 14, 1977, and two followed the ship for several hours over Middle Albatross Bank on September 6, 1977.

LAYSAN ALBATROSS (Diomedea immutabilis)

Small numbers may be found as non-breeding summer residents over the deeper shelf-break and oceanic waters.

We noted a maximum of two birds following the ship at any one time. Our earliest date is of one bird over the southern shelf-break on May 12, 1976. The latest record is of one bird following the ship across the south shelf-break on November 4, 1977. As with Black-foot's, Laysan's occasionally follow ships or wander into shallower waters of the continental shelf. A few birds were noted over the outer part of Middle Albatross Bank in October, 1975, September, 1977, and November, 1977.

NORTHERN FULMAR (Fulmarus glacialis)

This is a non-breeding resident in the Kodiak area. Although a small number of birds breed in the Barren Islands, the nearest major colony occurs in the Semidi Islands. We do not know if any of the Fulmars using the Kodiak area are breeding birds from these colonies.

Northern Fulmars are rare in Kodiak bays but common over the entire shelf, slope and oceanic area (Tables 2, 3 & 4). We estimate a stable population of approximately 20,000 birds over the Kodiak continental shelf throughout the summer (Figure 19). Shelf densities show small migration peaks in early spring and late fall. Associated with the April peak was a temporary influx of light phased birds.

PALE-FOOTED SHEARWATER (Puffinus carneipes)

This is an occasional visitor or more rarely a non-breeding resident of the Kodiak area. Breeding occurs only in the southern hemisphere.

We have five records of single birds within the study area: Portlock Bank (May 19, 1977), north shelf break (May 19, 1977), inner edge of South Albatross Bank (May 29, 1977), south shelf break (June 17, 1977), and Chiniak Trough (June 17, 1977).

NEW ZEALAND SHEARWATER (Puffinus Gulleri)

This species may appear within the study area as an occasional visitor or more rarely as a non-breeding resident with breeding restricted to the southern hemisphere.

We have eight records of single birds within the study area: two over the Chiniak Trough (April 20, 1977), one oceanic (May 19, 1977), four oceanic (June 17, 1977), and one over the northern shelf-break (June 17, 1977).

SCALED PETREL (*Pterodroma* inexpectata)

Scaled petrels are commonly found over oceanic waters of the Kodiak area as non-breeding summer residents with breeding being restricted to the northern hemisphere.

Our earliest record is May 19, 1977, and latest in September 7, 1977. We have sightings from near Chirikof Island (54.7°N + 155.2°W) on October 23; 1976. The highest local density index obtained was 1.6 B/Km^2 from an aerial survey on June 17, 1977, over oceanic waters (Table 3). We have no records of birds occurring over Kodiak's continental shelf.

SOOTY/SHORT-TAILED SHEARWATER (*Puffinus griseus*/*P. tenuirostris*)

Data. for these two species has been combined because of the difficulty in telling them apart in the field. Both species are non-breeding summer residents in the Kodiak area and both breed in the southern hemisphere. Short-tailed Shearwaters were dominant from May through June comprising 89% of all birds identified to species on shipboard surveys. Sooty Shearwaters were dominant from July through September comprising 93% of all identifiable birds.

Shearwaters are abundant over the continental shelf, while lower numbers occur in bays and over the deeper slope and oceanic waters (Tables 1, 2, 3 & 5). We estimate that 1.5-2.0 million shearwaters occur over the Kodiak shelf in summer with an additional 20-40 thousand in bay areas. Highest local densities tended to be where steep slopes occurred between bank and trough areas. The largest single flock encountered was 60,000 birds, mostly Short-tailed Shearwaters, in the area west-southwest of Ugak Island. Several flocks of 20-30 thousand birds were observed at scattered locations over the continental shelf. The population tends to increase from a few birds in March to a peak in July, then decreases through November (Figures 13 & 20). Aerial survey data indicates a May peak which may represent birds migrating through the area. Both aerial and shipboard data indicate a tendency for birds to move into bay areas as the season progresses.

FORK-TAILED STORM PETREL (Oceanodroma furcata)

This species is a summer resident in the Kodiak area but we do not know if any are breeding adults. The nearest known colonies are located in the Barren Islands and in Ugaiashak Island.

Fork-tailed Storm Petrels are common over continental shelf and deeper waters, but only during June and July were large numbers found within bay areas. These birds may have moved into bays to avoid stormy conditions over deeper waters (Tables 1, 2, 3, & 6). Aerial data show a definite May peak in numbers throughout the area, while shipboard data show peaks in July and September. We estimate a stable population of 10-30 thousand birds within the study area and perhaps as many as 150,000 occurring during migration periods.

LEACH'S STORM PETREL (Oceanodroma leucorhoa)

This species is an uncommon summer resident over the shelf-break and oceanic waters surrounding Kodiak Island. The nearest known breeding colonies are on the Barren and Semidi Islands.

All but one of our records are from shelf-break and oceanic waters between May 12 and July 26. The one exception was of a single bird over the north shelf on June 17, 1977.

DOUBLE-CRESTED CORMORANT (Phalacrocorax auritus)

Small numbers may be found in major Kodiak bays throughout the year. Dick (1977) estimated 200-300 wintered in Chiniak Bay in 1976-77.

We have scattered summer and winter records within bay and nearby continental shelf areas. Our data, however, is too skimpy to allow interpretation of variation in seasonal abundance or chronology of movements within the area.

PELAGIC CORMORANT (Phalacrocorax pelagicus)

The species is an uncommon year-round resident in bay and nearshore Kodiak waters. Dick (1977) placed the wintering Chiniak Bay population at between 400 and 600 birds.

We found this species to be uncommon in bays and rare over continental shelf waters. Our survey data is inconclusive but indicates a summer population of between 200 and 1,500 birds and a winter population of over 3,000 within Kodiak bays (Table 7).

GADWALL (Anas strepera)

This species is a rare to uncommon winter resident and migrant. The high Christmas bird count was 11 in 1976 (Donaldson, 1977).

We have no records for this species.

PINTAIL (Anas acuta)

Pintails are rare to uncommon winter residents and migrants. Five birds were seen in December 1973 (Donaldson, 1974), and one in December 1976 (Donaldson, 1977) on Christmas bird counts in the Chiniak Bay area.

We recorded one bird over the northern shelf (September 22, 1975).

AMERICAN GREEN-WINGED TEAL (Anas crecca)

This species occurs as a rare or uncommon winter resident or migrant. Three birds were recorded in the Kodiak area in December, 1974 (Donaldson, 1975).

We have no records for this species.

AMERICAN WIGEON (Anas americana)

These birds are rare or uncommon winter residents or migrants. The largest number recorded on Christmas bird counts in the Chiniak Bay area was 7 in 1976 (Donaldson, 1977).

We did not record this species on our surveys.

SHOVELER (Anas clypeata)

The Shoveler is a rare visitor to the Kodiak area. Two birds were observed by Wohl and Harrison (1977) on a late May survey of Aiaktolik and Sundstrom Islands.

We have no records for this species.

CANVASBACK (Aythya valisineria)

This species is a very rare visitor or migrant. Wohl and Harrison (1977) recorded two birds on a survey of Aiaktalik and Sundstrom Islands in late May.

RED-FACED CORMORANT (Phalacrocorax urile)

This cormorant is uncommon throughout the year in the Kodiak Area. Dick (1977) found fewer than 50 in Chiniak Bay in the winter of 1976-77.

We found this species to be less common than Pelagic Cormorants but occurring in essentially the same overall distributional pattern (Table 8). Our summer estimate for Kodiak bays is 200+ and our winter estimate is around 800.

WHISTLING SWAN (Olor columbianus)

Whistling swans have been reported to breed on Kodiak Island (Gabrielson *and Lincoln, 1959) and were observed on Sitkinak Island on May 30, 1977, by* Wohl *and Harrison (1977).*

We have no records for this species.

BLACK BRANT (Branta *nigricans)*

This species is an uncommon winter resident and migrant in the Kodiak area.

We have two records: 26 birds in Chiniak *Bay (May 2, 1975) and 14 birds over the northern shelf (May 5, 1975).*

EMPEROR GOOSE (Philacte canagica)

Small numbers winter in the Kodiak area from at least December through May. As many as 300 may have wintered in Chiniak *Bay in 1976-77 (Dick, 1977), and Trapp (1977) recorded 106 on his early March survey between* Chiniak *Bay and the* Aliulik *Peninsula.*

We have a record of 12 birds seen in the Sitkalidak *Straits on March 8, 1977.*

MALLARD (*Anas* platyrhynchos)

Mallards are common year round residents and migrants within the protected waters of the study area. Dick (1977) estimated 300-400 to have wintered in Chiniak *Bay in 1976-77.*

We have one record of *a pair on April 20 over the Stevenson Trough area,*

We have one record of a single bird flying over the northern shelf on June 1, 1972.

GREATER SCAUP (*Aythya marila*)

Greater Scaups may be found throughout the year but are most common as a winter residentsin bays and fjords. Dick (1977) estimated 500-700 wintering on Chiniak Bay in 1976-77.

We have one record of a few birds in Chiniak Bay (May 27, 1977).

LESSER SCAUP (*Aythya affinis*)

The Lesser Scaup is a rare winter visitor to the Kodiak area. Two birds were recorded on the 1976 Christmas bird count (Donaldson, 1977).

We did not observe this species on our surveys,

COMMON GOLDENEYE (Bucephala clangula)

The Common Goldeneye is a rare summer and common winter visitor favoring protected waters of the Kodiak area. Dick (1977) estimates 700-1,000 wintered in the Chiniak Bay area in 1976-77. A high of 615 was recorded in the 1976 Christmas bird count (Donaldson, 1977).

"We have one sighting of a goldeneye (species unknown) over the northern shelf (September 22, 1975).

BARROW'S GOLDENEYE (Bucephala islandica)

This species is a rare or uncommon winter resident that favors protected bays and coves. A high of 84 were found on the 1973 Christmas bird count (Donaldson, 1974).

We have no records of this species.

BUFFLEHEAD (Bucephala albeola)

Buffleheads are rare summer and common winter residents occurring in protected bays and coves. Dick (1977) estimates 200-300 wintered in Chiniak Bay in 1976-77. Christmas bird count numbers range from 68 to 145 (Donaldson, 1974, 1975, 1976, 1977).

We did not see this species during our surveys.

OLDSQUAW (Clangula hyemalis)

This species is an abundant winter resident and migrant. Dick (1977) found this to be the most abundant duck, 3,000-5,000 birds, wintering on Chiniak Bay in 1976-77.

We have many records of this species between January 8 and May 28. These records are scattered over the entire shelf and bay area with highest densities occurring in bays and along shorelines.

HARLEQUIN DUCK (Histrionics histrionics)

This species is common throughout the year in bays and along rocky coasts, generally remaining close to shore. Dick (1977) estimated 700-1$00 wintered in Chiniak Bay in 1976-77.

We have many records along rocky shorelines and in bays throughout the study area from March through September.

STELLER'S EIDER (Polysticta stelleri)

This species is an abundant winter resident particularly in sheltered waters along rocky shorelines. Dick (1977) found this was the second most abundant duck wintering in Chiniak Bay. He estimated 1,500 - 2,000 in the winter of 1976-77.

We have one record of a single bird over the southern shelf (March 8, 1977).

COMMON EIDER (Somateria mollissima)

This eider is a relatively common year round resident. Dick (1977) estimated that no more than 200 wintered on Chiniak Bay in 1976-77. Kodiak Christmas bird counts varied from a low of 2 birds in December 1973 to a high of 375 in December 1975 (Donaldson, 1974, 1975, 1976, 1977).

Our records show fair numbers in both north and south bays from March 8 to May 27.

KING EIDER (Somateria spectabilis)

King Eider are rare to uncommon winter residents. Dick (1977) estimated that 20-25 birds wintered on Chiniak Bay in 1976-77. The highest Christmas

bird count was 11 in December, 1973 (Donaldson, 1974).

We 'nave records of a few birds in the Sitkalidak Straits (April 21, 1977) and along northern shorelines (March 7, 1977) .

WHITE-WINGED SCOTER (Melanitta deglandi)

This species is a fairly common winter resident and rare summer visitor. Dick (1977) estimated 200-300 birds wintered on Chiniak Bay in 1976-77. A range of 4-124 birds were recorded on Christmas bird counts (Donaldson, 1974, 1975, 1976, 1977).

We have many records scattered between March 1 and September 11. Most of these birds were in north or south bays but six were from the north and south shelf areas (May - July, 1977).

SURF SCOTER (Melanitta perspicillata)

Surf Scoters are rare to uncommon winter residents and rare summer visitors in the study area. Dick (1977) estimated fewer than 50 wintered in Chiniak Bay in 1976-77. Kodiak Christmas bird counts ranged from 6-28 birds (Donaldson, 1974, 1975, 1976, 1977) .

We have three records: 2 birds in Marmot Straits (March 7, 1977), 4 birds in Sitkalidak Straits (June 22, 1977), and 1 bird in Sitkalidak Straits (September 8, 1977).

' COMMON SCOTER (Melanitta nigra)

This sea duck is an uncommon summer and common winter resident. Dick (1977) estimated 1,000 - 1,500 wintered in Chiniak Bay in 1976-77.

We have five records between January 8 and April 20. These records were from north bay and shelf and south bay and shelf areas.

COMMON MERGANSER (Mergus merganser)

This species is a rare to uncommon winter resident. Dick (1977) estimated that only a few "10'S" wintered in the area. The maximum Christmas bird count was 7 in 1976 (Donaldson, 1977).

We did not record this species during our surveys.

RED-BREASTED MERGANSER (Mergus *serrator)*

This merganser is an uncommon year round resident or visitor which is somewhat more abundant than Common Mergansers. A high of 24 birds was found in the 1974 and 1976 Christmas bird count (Donaldson, 1975, 1977).

We have no observations of this species.

RED PHALAROPE (Phalaropus fulicarius)

Red Phalaropes are uncommon migrants and occasional summer visitors to the Kodiak area. No breeding records have been documented for this region.

Most of our records are from continental shelf areas (Table 9). The exception was 61 birds recorded in the southern part of Marmot Bay on June 6, 1977.

NORTHERN PHALAROPE (Lobipes lobatus)

This is a common summer resident and migrant in the study area. Birds breed in suitable habitat over most of Kodiak Island.

We found these birds common within Kodiak bays and sporadic over the continental shelf from May through September (Tables 3 & 10). The earliest U.S. Fish and Wildlife Service record for Kodiak waters is May 20, and the latest is October 14. We estimate a rather stable *summer bay population of about 3,000 birds.*

POMARINE *JAEGER (Stercorarius* pomarinus)

This is a common non-breeding summer resident and migrant within the Kodiak Basin. Known breeding areas are far to the north.

We found this species to be uncommon in bays and common over shelf waters from May through September. Bay densities remained fairly constant except for a possible migration peak in September. Shelf densities were highest in mid-summer and lowest in May-June and September (Tables 2, 3 *&* 11, *Figure 21). The high* July density *was partly due to an actual increased density and partly to the observation of 175 jaegers harassing birds within a flock of 10,000 shearwaters near Ugak Island on July 29. Increased July-August densities may have resulted from an early departure of non-breeding birds from the breeding grounds as postulated by Maher (1974). We*

estimate a total Kodiak bay population of 200-400 birds and a shelf population generally around 1,000 - 3,000 but sometimes reaching 10,000 or greater.

PARASITIC JAEGER (Stercorarius parasiticus)

This jaeger is a fairly common summer resident and migrant within the study area. Scattered pairs breed on suitable habitat throughout the Kodiak Basin.

Our records indicate this species to be fairly common within bays and over the continental shelf from June through September (Tables 1, 3 & 12). We estimate a rather stable bay population of 100-200 birds with perhaps an August peak of around 400. The shelf population is probably on the order of 500 - 1,000 birds.

LONG-TAILED JAEGER (Stercorarius longicaudus)

This is an uncommon *summer visitor and migrant. There are no breeding records for the Kodiak Basin.*

We have scattered records from May through August over the continental shelf, shelf-break, and oceanic waters. Our only non-shelf records are five sightings (total of 10 birds) in July and two sightings (total of two birds) in August in Marmot Bay (Tables 3 & 13).

SKUA (Catharacta skua)

This species is a rare visitor to the Gulf of Alaska. It breeds in the southern hemisphere.

We have three records: 1 *bird on May 19, 1977, at* 56°00'N *x* 150°30'W; *2 birds on July 31, 1976, at* 56°41'N *x* 152°30'W; *and 1 bird in* Chiniak *Bay on July 31, 1976.*

GLAUCOUS GULL (Larus hyperboreus)

This gull is a rare to uncommon visitor or non-breeding resident which may be found at any time of the year. Dick (1977) thought that a few "10'S" wintered in Chiniak Bay in 1976-77.

We have nine records scattered throughout the study area, excluding oceanic waters, from March 6 through July 15.

GLAUCOUS-WINGED GULL (Larus glaucescens)

Glaucous-winged Gulls are common to abundant residents throughout this region. They breed at all suitable locations within the Kodiak Basin and hybridize with Herring Gulls at colonies outside of the study area such as in Cook Inlet. Dick (1977) estimated 1-2 thousand were present in the town of Kodiak and 2-3 thousand in Chiniak *Bay during the 1976-77 winter.*

We found this species to be common in all areas surveyed. They were most concentrated in bays but could be found throughout the area at any time of the year. Bay populations remained stable through the summer but shelf populations tended to decrease (Tables 1, 2, 3 & 14, Figure 22). We estimate a summer bay population of 4,500 - 7,500 and a summer shelf population of 2-10 thousand. Winter populations are probably considerably higher.

SLATY-BACKED *GULL (Larus* schistisagus)

This species is an accidental visitor to the Gulf of Alaska.

We have one sight record by Patricia Baird at 58°04'N *X* 150°12'W *on January 30, 1977.*

HERRING GULL (Larus argentatus)

This species is a rare to uncommon year-round non-breeding resident and visitor to the study area. Dick (1977) thought that a few were present in Chiniak *Bay throughout the winter.*

We have 21 records scattered throughout the study area from February 4 through November 16.

THAYER'S GULL (Larus thayeri)

This is an accidental visitor to the Kodiak Basin.

We have one record of a single bird over the northern bank area on September 22, 1975.

MEW GULL (Larus canus)

This is a common resident within the study area. Breeding colonies are scattered through suitable coastal and island habitat along most of Kodiak Island. Dick (1977) estimated 1-2 thousand wintered on Chiniak Bay during 1976-77.

Mew Gulls were not well represented on our surveys, possibly because they tended to stay close to shore. Most of our records are for bay areas although we have a few shelf records in April and May (Tables 1, 3 & 15). Our maximum estimate for Kodiak bays is about 10,000 birds.

BLACK-LEGGED KITTIWAKE (Rissa tridactyla)

Black-legged Kittiwakes are the most abundant gull in the Kodiak Basin. They are primarily summer residents in the area but many remain throughout the winter.

Kittiwake populations are concentrated in bays during the summer and over the shelf and oceanic waters in the winter. The movement into' bays begins in late June or early July and is quite rapid (Tables 1, 2, 3 & 16 Figures 14 & 23). We estimate the summer bay population to be 30-65 thousand birds and the summer shelf population to be 15-30 thousand. The early June shelf population is probably in excess of 100,000 birds. Our information on size and number of colonies in the Kodiak area indicates that the above population estimates are very conservative, and a total kittiwake population of over 200,000 is not unlikely.

RED-LEGGED KITTIWAKE (Rissa brevirostris)

This Bering Sea breeding species is a rare but apparently fairly regular winter resident or visitor to the Kodiak Basin.

We have one record of two birds over the southern shelf on November 14, 1976, and four records (a total of 12 birds) over the northern and southern shelf between February 6 and 8, 1977.,

SABINE'S *GULL* (Xema sabini)

This is a rare or uncommon migrant in the Kodiak Basin. Individuals and small flocks pass through this area on their way to and from their more, northerly breeding grounds.

We noted a small influx of birds into the study area in late July and a few birds were still present in September. Most of these records were over the continental shelf but 13 birds were seen in Marmot Bay from July 17-19.

ARCTIC TERN (Sterna paradisaea)

This is a common to abundant breeding species and migrant throughout the Kodiak Basin. Their wintering grounds are far south of Alaskan waters.

This species was common within bay areas and uncommon over the continental shelf except in migration (Tables 1, 3 & 17; Figure 24). Our data show an early May and an August migration peak over shelf waters. We estimate a rather stable summer population of 1-2 thousand birds in bays and 250 - 1,300 over the nearby continental shelf.

ALEUTIAN TERN (Sterna aleutica)

This tern is an uncommon breeding resident in the Kodiak Basin. Birds leave the area soon after the young fledge but we do not know where they go or what migration route they use.

These birds were uncommon within bays and rare over the continental shelf from at least late May through August (Tables 1 & 18). We have an unusual pelagic sight record by Craig Harrison of one bird at 55° 55'N X 151° 02'W on July 26, 1977. Our estimate of the summer Kodiak bay population is 200 - 700 birds and for the nearby shelf it is 300 - 800.

COMMON/THICK-BILLED MURRE (Uris aalge/U. lomvia)

These two species are combined in our data analysis because of the difficulty in telling them apart in the field. Murres are one of the most abundant birds in Alaskan waters. They are year-round residents but there are only a few, relatively small, colonies of Common Murres and no known breeding Thick-billed Murres in the study area.

Murres were equally common within bays and over shelf waters throughout the summer and into November. In March birds were concentrated over the shelf break. Densities were lowest in July and highest in May and November (Tables 1, 2, 3 & 19, Figures 15 & 25). Our population estimates for bays ranged from 2,500 in July to 29,000 in November. For the shelf area the population ranged from 21,000 in July to 170,000 in November. Most of the summer birds, especially in the Sitkalidak Straits

area, were non-breeding Common murres as judged from the plumage and gonads of collected specimens. We have a small number of sightings of Thick-billed Murres scattered over the area throughout the year.

PIGEON GUILLEMOT (Cepphus columba)

This is a common summer and winter resident along rocky coast lines and in bays. Dick (1977) estimated 150-300 wintered in Chiniak Bay during 1976-77.

We found this to be a common bird within bays and uncommon over the shelf throughout the summer (Tables 1 & 20; Figure 26). Our estimates of the summer population are 1,800-2,500 for bays and 1,000-4,500 for the outer coastline and shelf area.

MARBLED/KITTLITZ'S MURRELET (Brachyramphus marmoratum/ B. brevirostris)

These two species are combined in this report because of the difficulty of telling them apart in the field. Both are summer and winter residents in bays throughout the Kodiak area. Marbled Murrelets are common to abundant and far outnumber the uncommon Kittlitz's Murrelet. Dick (1977) estimated 150-300 Marbled Murrelets in Chiniak Bay during the 1976-77 winter. He collected two Kittlitz's in April.

We found murrelets throughout the shelf and especially within the bays during our study (Tables 1, 3 & 21). We estimate a summer bay population of 5-9 thousand and a shelf population of 16-25 thousand.

ANCIENT MURRELET (Synthliboramphus antiquus)

This is an uncommon summer and winter resident in the Kodiak Basin. Some birds probably breed within the study area but no colonies have been located as of this date. Dick (1977) recorded two individuals from Chiniak Bay during the winter of 1976-77.

We found this species to be rare in Kodiak bays with our only record being a single bird in June. Sightings were more regular over shelf waters with birds recorded from May through August (Table 22). We estimate a mid-summer shelf population of 9-15 thousand birds.

CASSIN'S AUKLET (Ptychoramphus aleutica)

This species is an uncommon to common year-round resident within the Kodiak area but no current breeding records exist. The nearest breeding colony is in the Shumagin Islands.

We first recorded this species in June and the population peaked in August (Tables 1, 2 & 23). There is at least one May record for this area in the U.S. Fish & Wildlife Service files. We estimated a peak bay population of around 3,000 and a peak shelf population of 45,000.

PARAKEET AUKLET (Cyclorrhunchus psittacula)

This auklet is an uncommon year-round resident or visitor in the area with most of the population remaining over deep pelagic waters. No current breeding records exist for the Kodiak area but we suspect that at least one small colony exists in southwest Kodiak.

We found a few birds in Kodiak bays in July and August and estimate a maximum summer shelf population of about 8,000 (Tables 3 & 24).

CRESTED AUKLET (Aethia cristatella)

This is a fairly common winter resident within the Kodiak Basin. The nearest known colony is to the west in the Shumagin Islands. Dick (1977) estimated 500 - 1,000 wintered in Chiniak Bay in 1976-77. He also noted thousands in the Whale Passage area in January.

We noted a few birds in bays and over the shelf in November, and birds were found aggregated in deep water in March (Tables 3 & 25). There is one record of a single bird over the southern shelf on July 16, 1976.

LEAST AUKLET (Aethia pussila)

This is a rare visitor to the Kodiak Basin. The nearest breeding is at a small colony in the Shumagin Islands.

We have two records for the study area: 2 birds in Rolling Bay (immediately west of Sitkalidak Island) on May 29, 1977, and 3 birds over the shelf on August 14, 1977.

RHINOCEROS AUKLET (Cerorhinca monocerata)

This is a rare to uncommon non-breeding visitor and winter resident in the Kodiak area. The nearest breeding colonies are on Ugaiushak and the Barren Islands.

We have scattered records in March, June and September, but our data is too meager to allow a status assessment.

HORNED PUFFIN (Fratercula corniculata)

This is a common breeding resident and ocassional *winter resident within the Kodiak Basin. Dick (1977) found only a few birds in Chiniak Bay in the winter of 1976–77.*

We found this species-to maintain rather consistent densities within bays during the summer. Shelf densities, on the other hand, were highest in the spring and fall *with a low point in August (Tables 1,2,3, & 26; Figure 28). We estimated the summer bay population to be around 1–3 thousand birds. Shelf population estimates ranged from a summer low of 3,000-4,000 to fall high of 40,000.*

TUFTED PUFFIN (Lunda cirrhata)

Tufted Puffins are the most abundant breeding species within the Kodiak study area. Only a few birds, however, remain through the winter and these tend to be very pelagic in their distribution. Dick (1977) did not find this species wintering on Chiniak *Bay in 1976-77. His first record was on March 27.*

We found this species abundant everywhere we went within the study area. Populations over the shelf remained very constant through the summer with a slight tendency toward higher densities in the early *spring and fall. Bay densities rose rather steadily from May through August and then dropped sharply in September (Tables 1, 2, 3 & 27; Figures 16 & 27). We estimated the maximum summer population in bays to be 50-60 thousand birds. Shelf population estimates range from a low of 70,000 in mid summer to about 150,000 in spring and fall.*

VII & VIII DISCUSSION AND CONCLUSIONS

During the 1977 Kodiak field surveys we recorded 54 species of marine oriented birds. We have also included in this report anecdotal information on an additional 20 species which are known to occur in the area. The most abundant species within the Kodiak area are Sooty and Short–tailed Shearwaters. These species occur as non–breeding summer residents. The next most abundant species are Tufted Puffin, Common Murre *and Black-legged Kittiwake all of which are breeding residents (Figure 18).*

We found that distribution patterns segregated out fairly well according" to whether the species was behaviorally oriented toward oceanic (e.g., albatrosses) , continental shelf (e.g., shearwaters), or protected bay waters (e.g., Aleutian tern). We found no differences in density between

bank and trough areas of the continental shelf. In fact it appears that the steeper slopes which occur between banks and troughs are probably the most important part of the shelf habitat. We have not yet been able to analyze the differences between north and south Kodiak waters. There are some species which seem to prefer one of these areas over the other, but overall there does not appear to be much difference.

Overall bird densities (Tables 3 & 28, Figures 17 & 29) were highest in mid-summer although aerial surveys indicate a migration peak in May. We estimate a summer population for all south and east Kodiak bays of 100-175 thousand birds. The summer Kodiak shelf population is estimated to be 1.9-2.2 million birds.

IX. NEEDS FOR FURTHER STUDY

The need for further studies depends entirely on two qualitative factors involving final decision making processes and user needs. What questions will be asked and what level of confidence is required of the answers? These factors must then be evaluated in terms of funds available and cost effectiveness.

A study of seabird populations in the winter and early spring is needed if avian assessments of the area are to be complete. This could be accomplished by an aerial survey in January and shipboard surveys in January and April. Surveys should be identical to those completed in the FY77 studies. The small amount of winter data we have suggests that there is an almost complete turnover in species occurrence and density in the Kodiak region from summer to winter. Many species leave the area about the same time other species enter it while still other species apparently shift from one habitat to another within the area. The nature, reasons for and magnitude of these changes is critical to our understanding of the local ecosystem and we do not feel that the small amount of data to be gained by the FY78 integrated Kodiak studies will be sufficient.

A low level monitoring program should be maintained through at least FY80 . This could be accomplished by having a qualified bird observer on board a few selected cruises on a "non-interference" basis. Such a program would serve the following purposes:

1. *It would allow the detection of large scale changes in distribution and density patterns related to greater-than-annual cycles.*

2. The accumulation of data would considerably increase the confidence with which we can use the FY77 data. This is especially important for uncommon, rare and vagrant species.

3. It would maintain and allow updating of the FY77 database until actual assessments and decisions are made. Of particular importance in this regard would be the detection of any environmental degredation or new sources of pollution and their basic effects on the local avifauna.

Studies similar to the FY78-79 Kodiak integrated program will be needed in other lease sale areas such as the NEGOA area, Middleton and Kyak Islands in particular.

Shipboard and/or aerial studies should be incorporated into any future studies of local areas and colonies.

There are still many area and seasonal gaps in our pelagic data base. Some of these are obviously irrelevant to OCSEAP's needs while others, e.g. , winter data for the Northeast Gulf of Alaska, are important. Perhaps the most important of these data gaps are for nearshore waters, especially in highly productive bays and fjords.

X. SUMMARY OF JANURAY-MARCH QUARTER

No field work was conducted during the January-March Quarter. Effort was concentrated on the processing of digital data and the development of computer program for data analysis.

To date only two sets of 033 type data have not been sent to Dr. Hal Petersen for final verification. One of these sets has not yet been keypunched. All other data sets have been verified by both the U.S.F.W.&S. and Dr. Hal Petersen's computer program, and are ready for final format conversion (1975-76 data) or final submission to NODC (1977 data).

The initial computer programs for data analysis are just about completed. Preliminary descriptions of the first two of these programs have been sent to the Juneau Project Office. Some minor modifications are still needed and the final versions of all analysis programs will be incorporated into the RU 337 final report.

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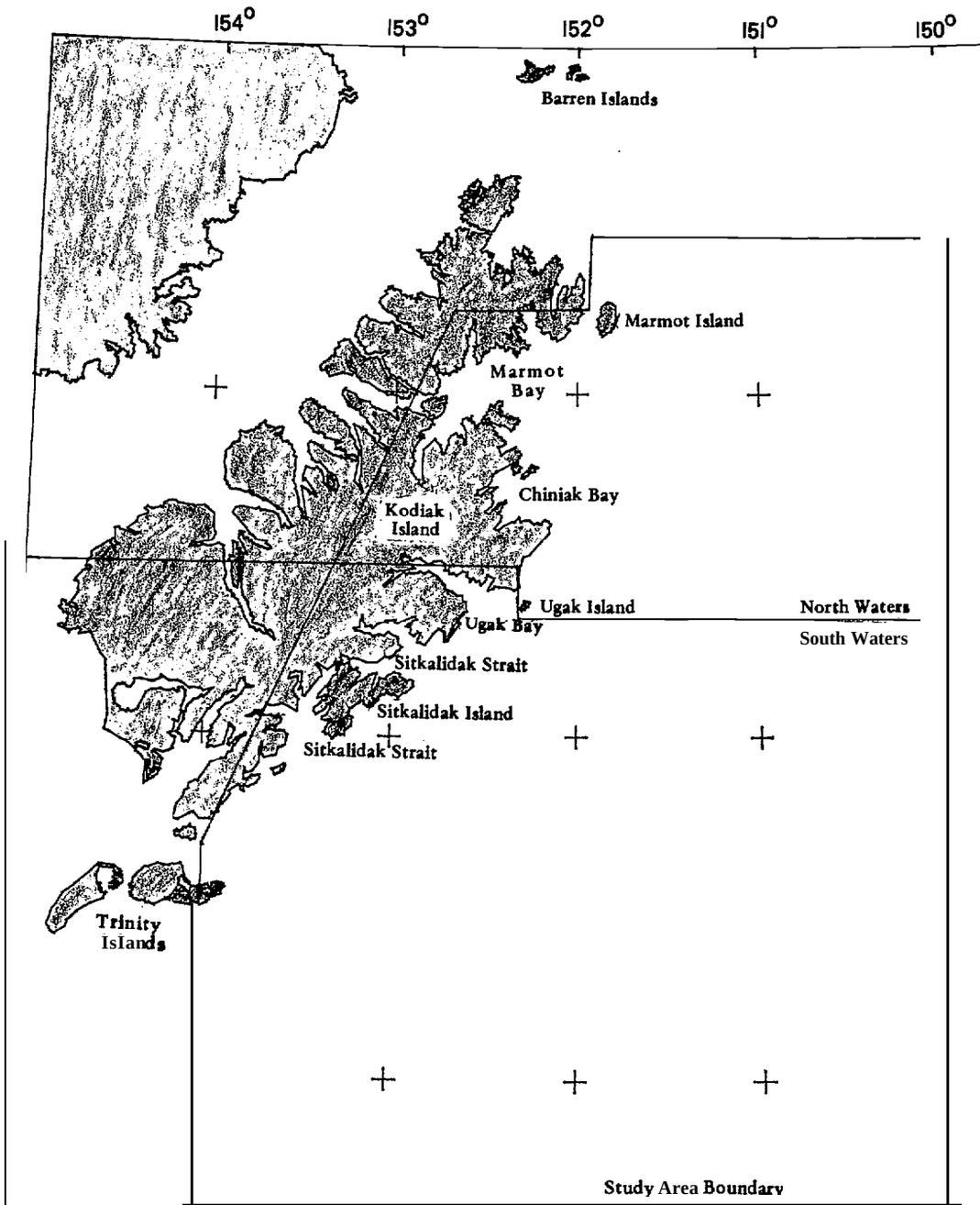

Figure L Study Area

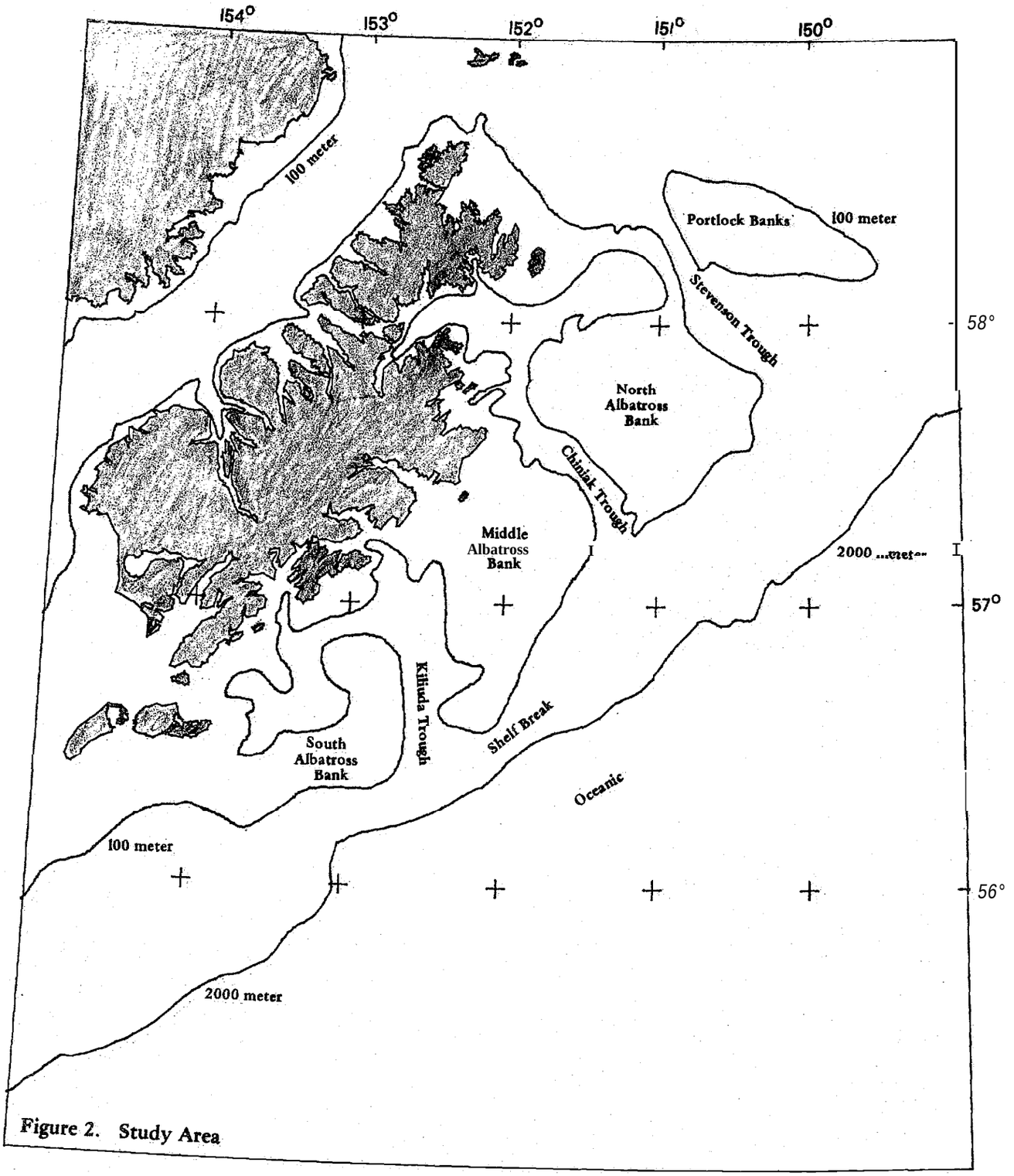

Figure 2. Study Area

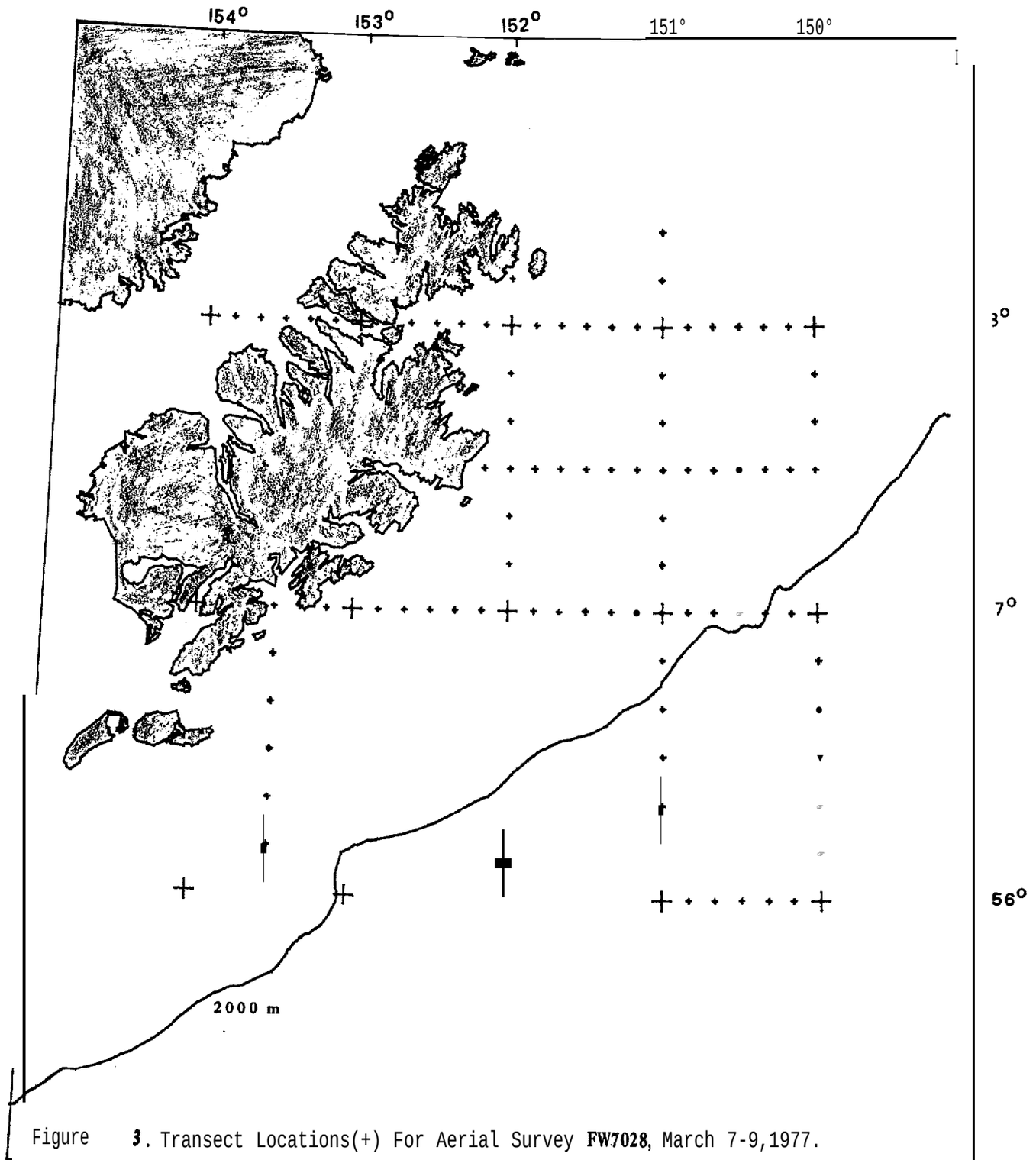

Figure 3. Transect Locations(+) For Aerial Survey FW7028, March 7-9,1977.

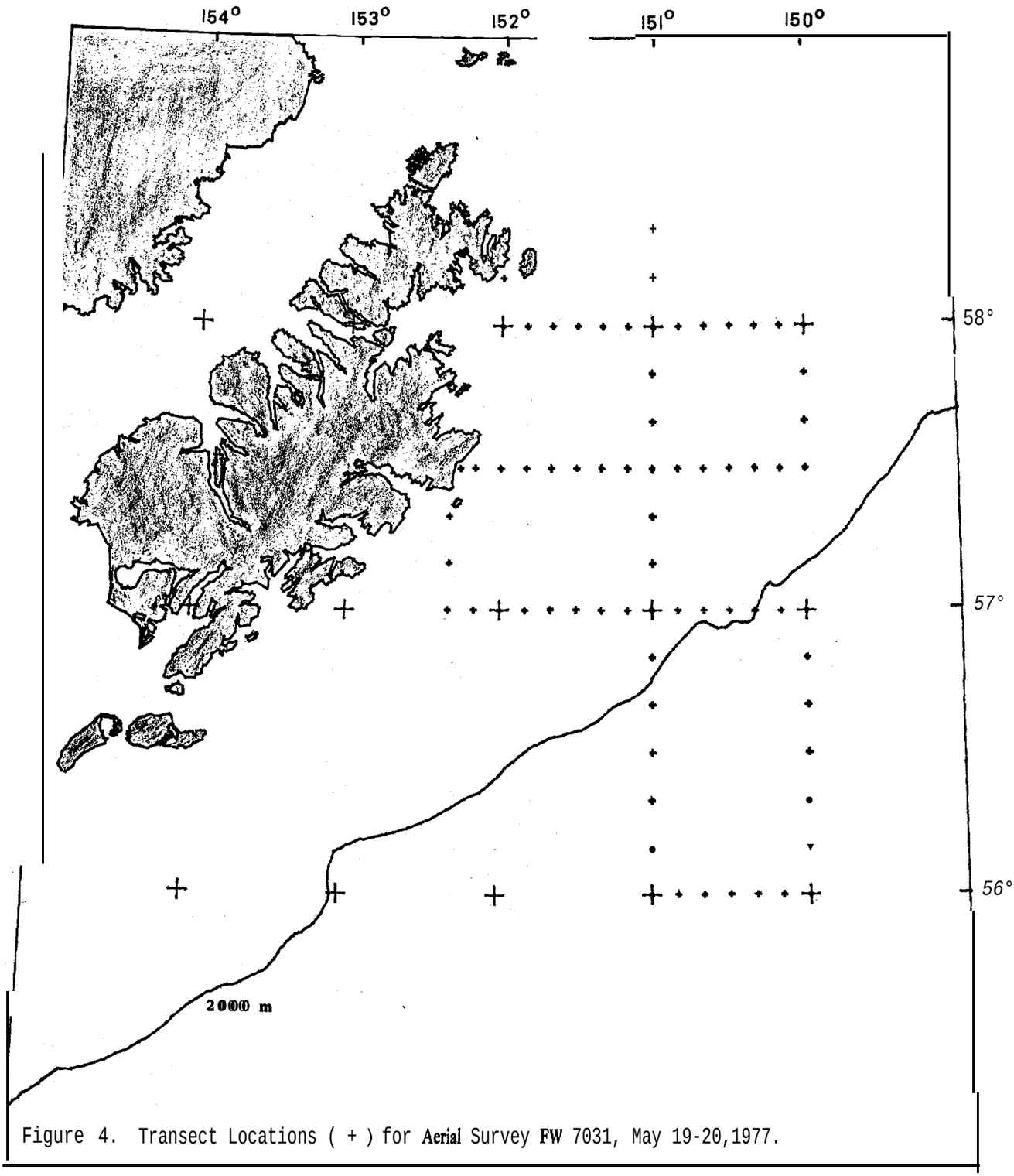

Figure 4. Transect Locations (+) for Aerial Survey FW 7031, May 19-20,1977.

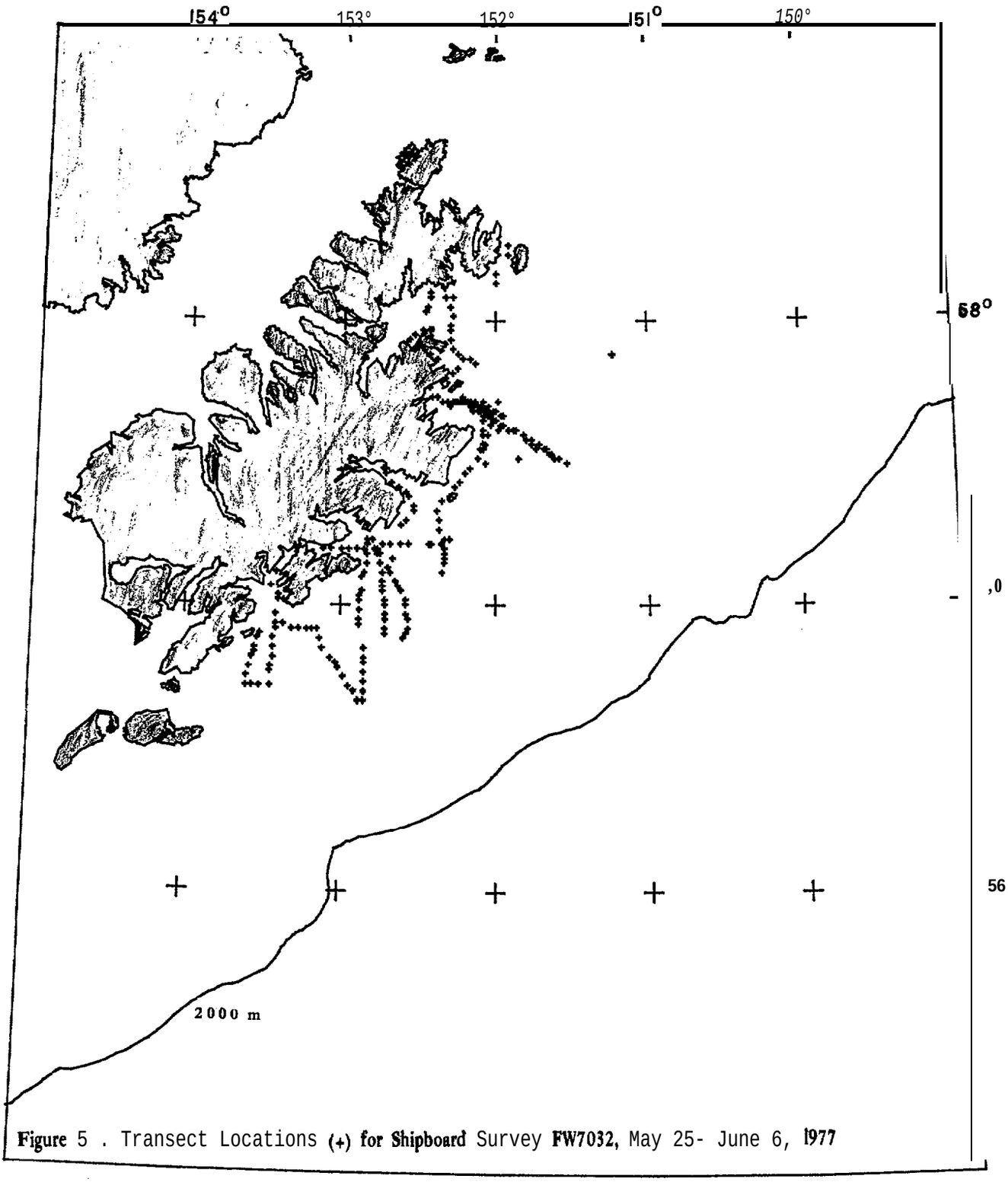

Figure 5 . Transect Locations (+) **for Shipboard** Survey **FW7032,** May 25- June 6, **1977**

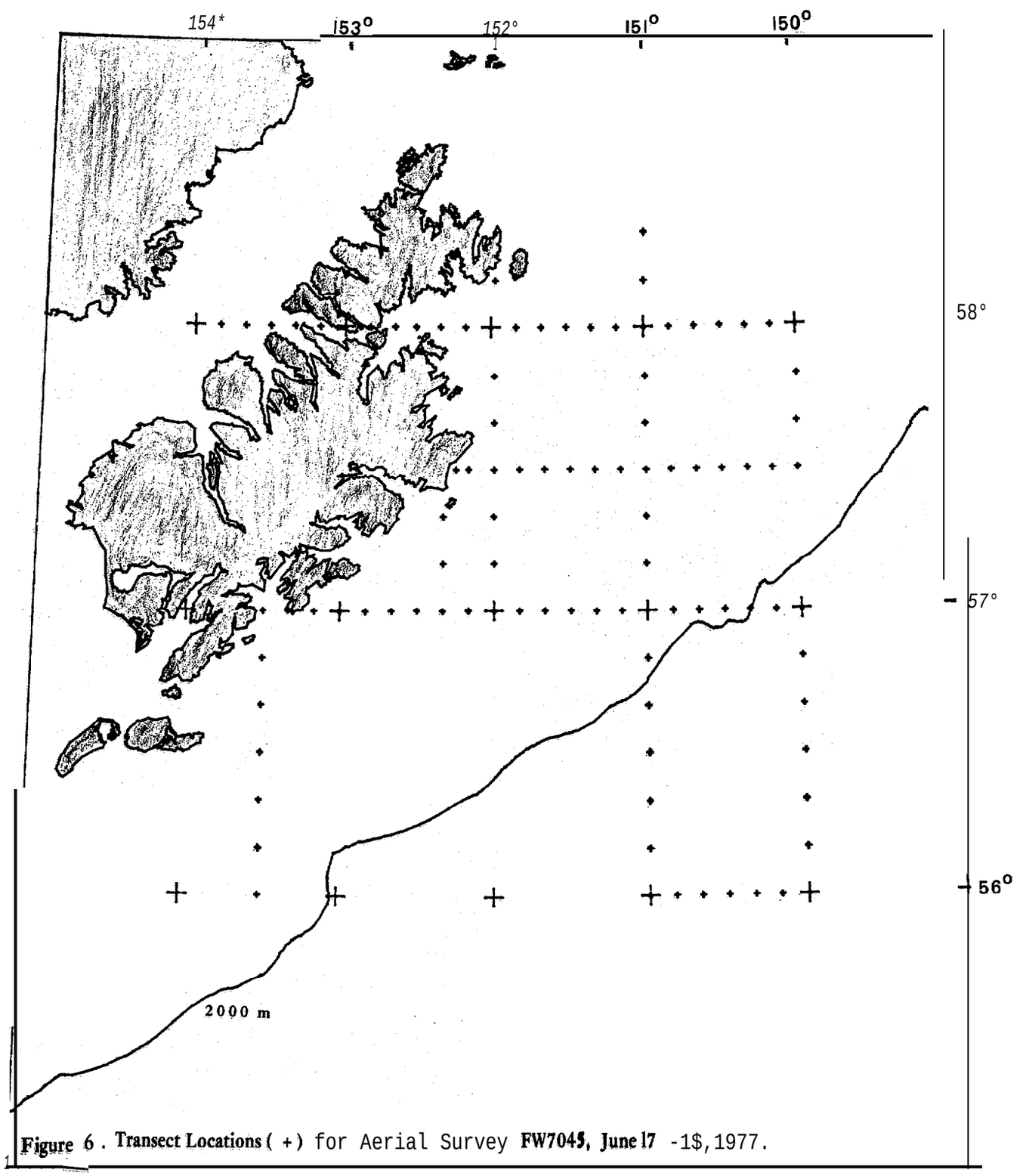

Figure 6 . Transect Locations (+) for Aerial Survey FW7045, June 17 -1$, 1977.

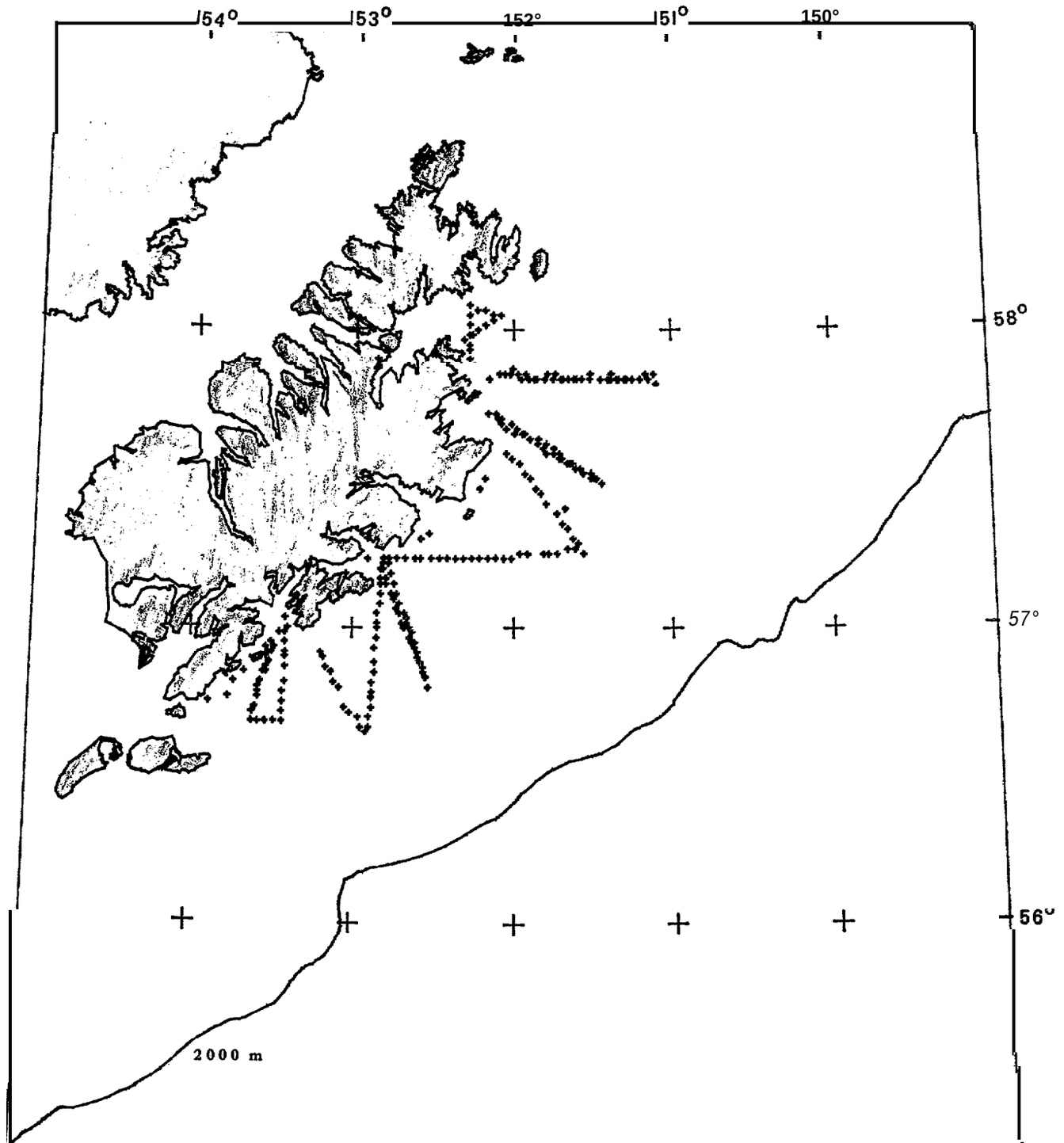

Figure 7 . Transect Locations (+) for Shipboard SuweyFW7t333, June 18-28,1977.

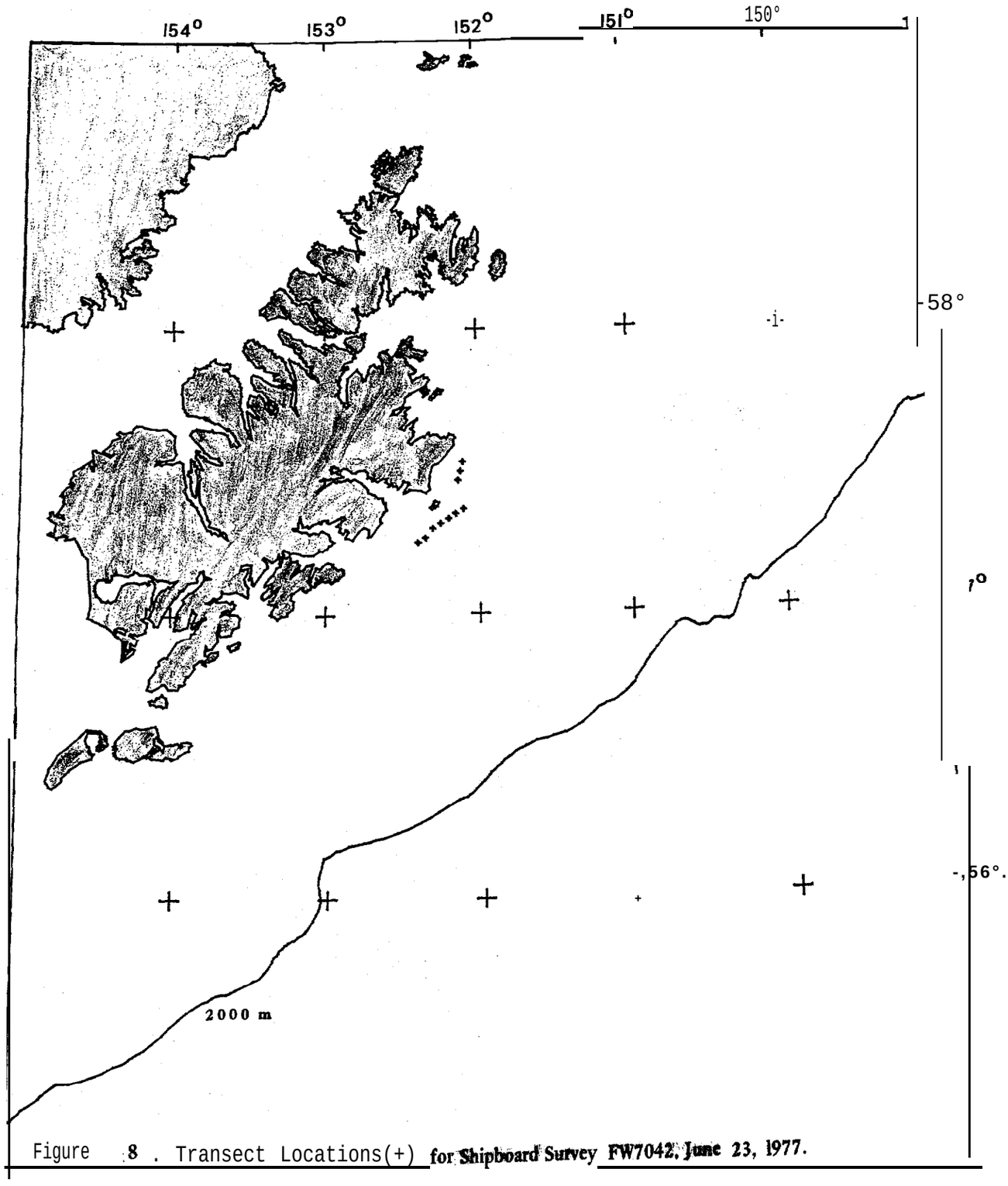

Figure 8. Transect Locations(+) for Shipboard Survey FW7042, June 23, 1977.

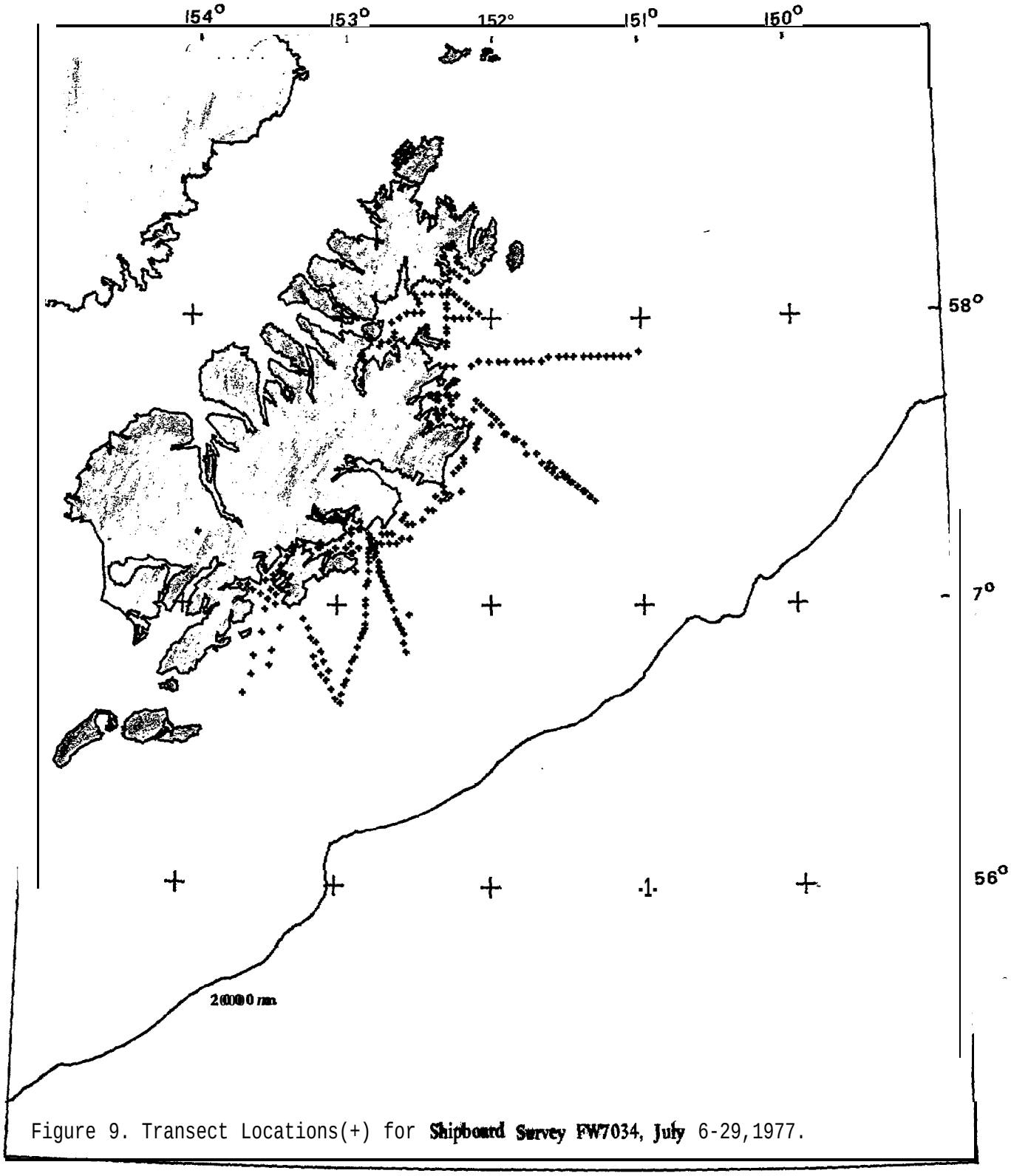

Figure 9. Transect Locations(+) for Shipboard Survey FW7034, July 6-29,1977.

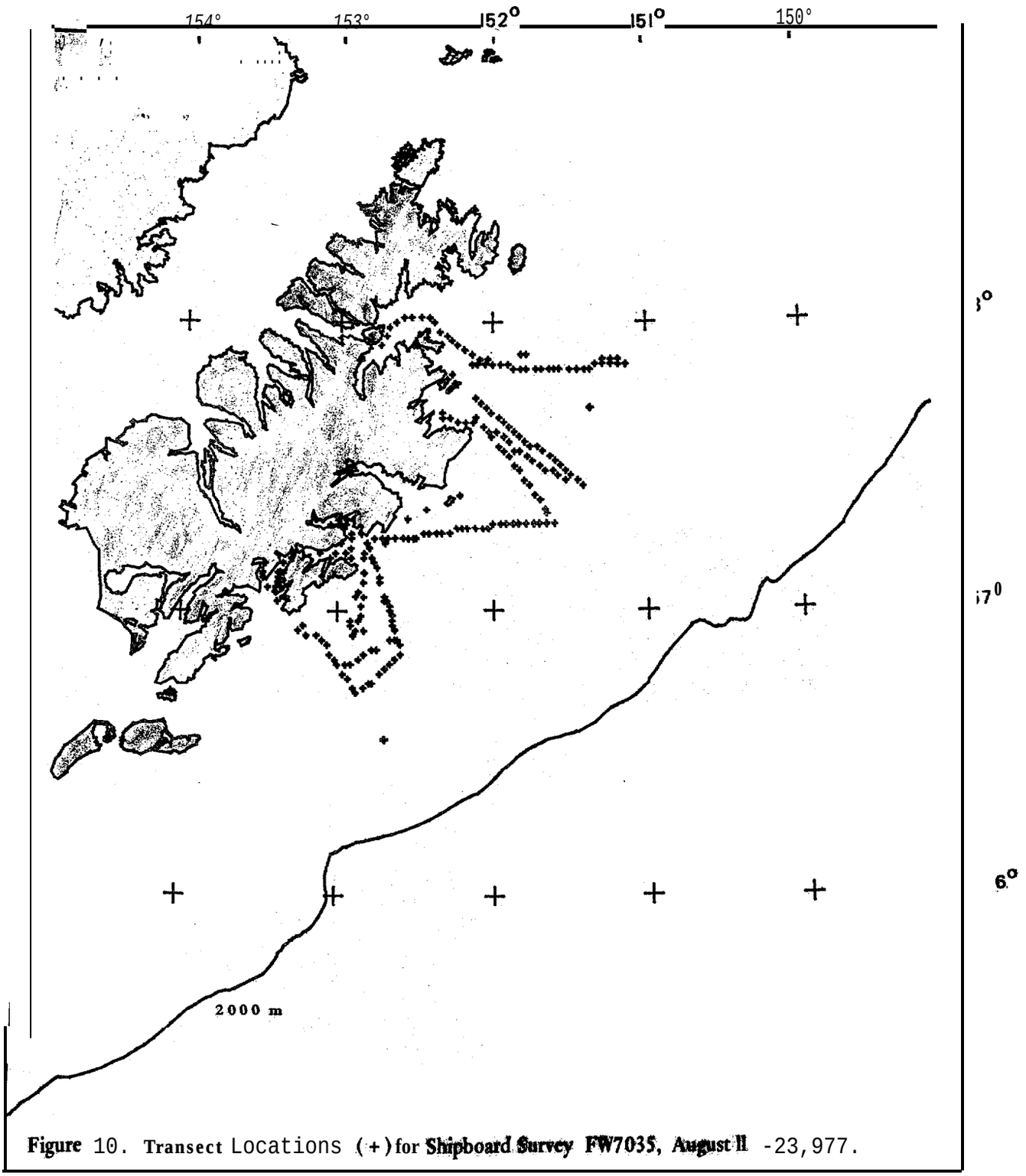

Figure 10. **Transect** Locations (+) **for Shipboard Survey FW7035, August ll** -23,977.

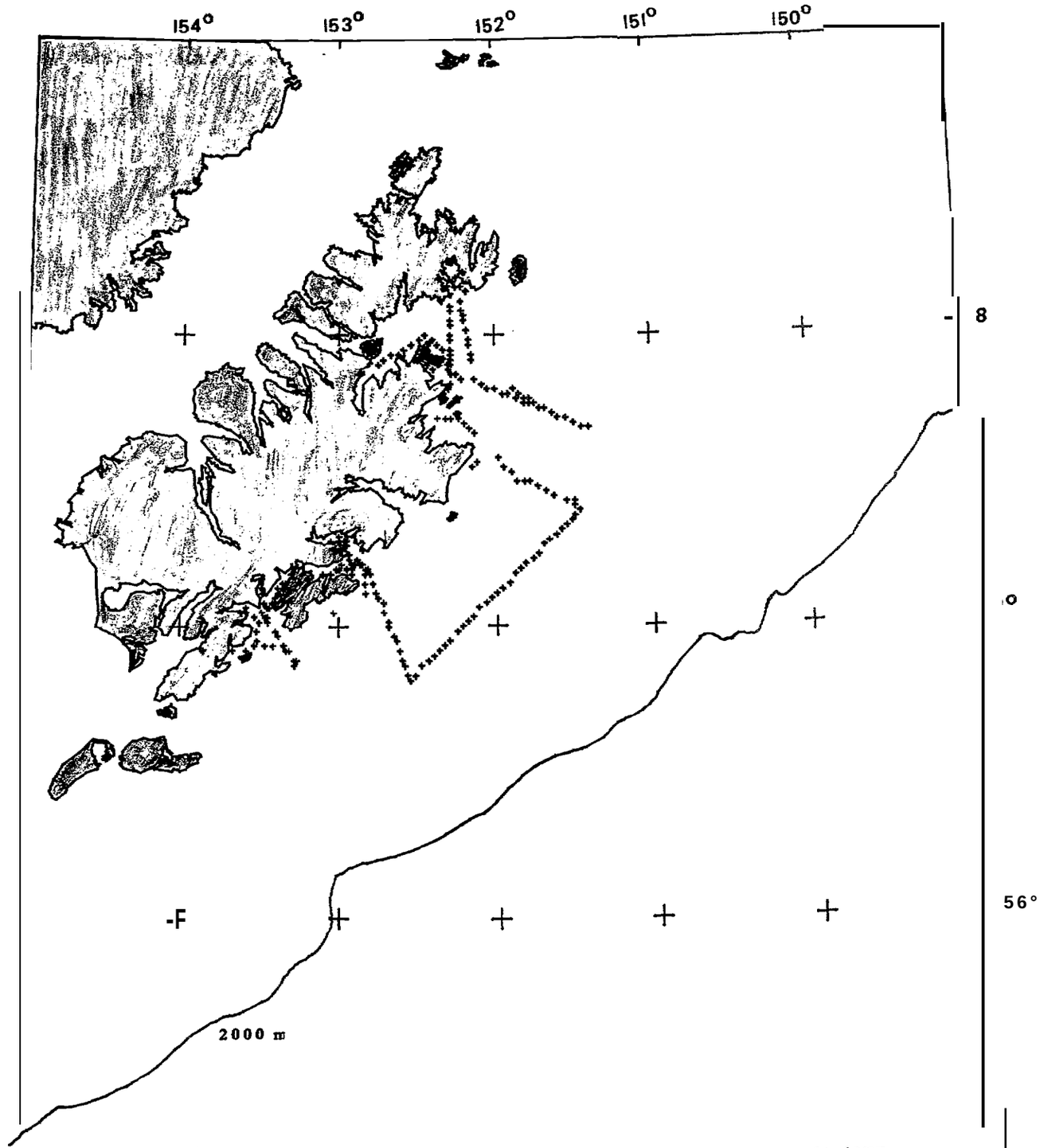

Figure 11. Transect Locations (+) for Shipboard Survey FW7036, September 7 - 19, 1977.

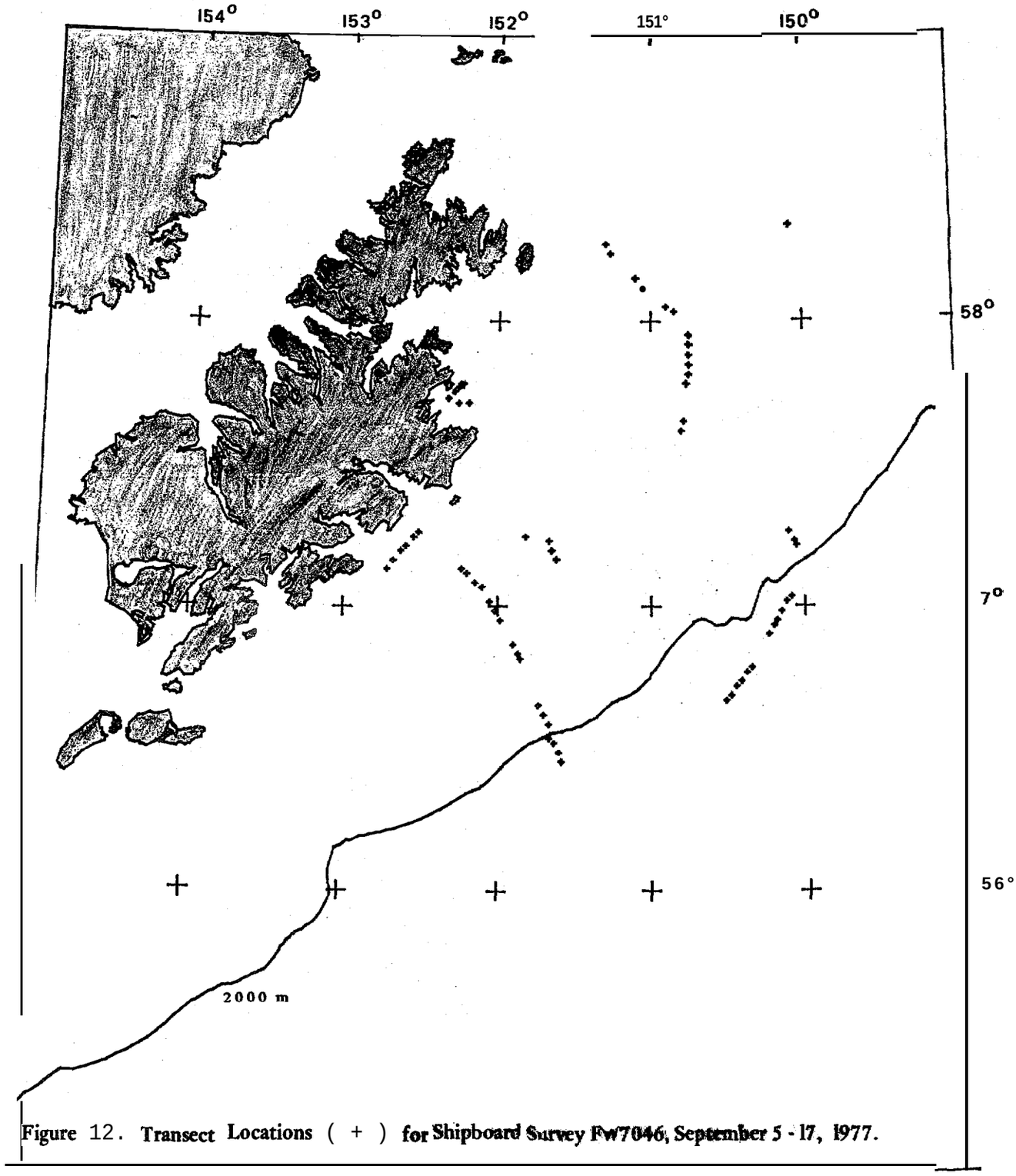

Figure 12. Transect Locations (+) for Shipboard Survey Fw7046, September 5 - 17, 1977.

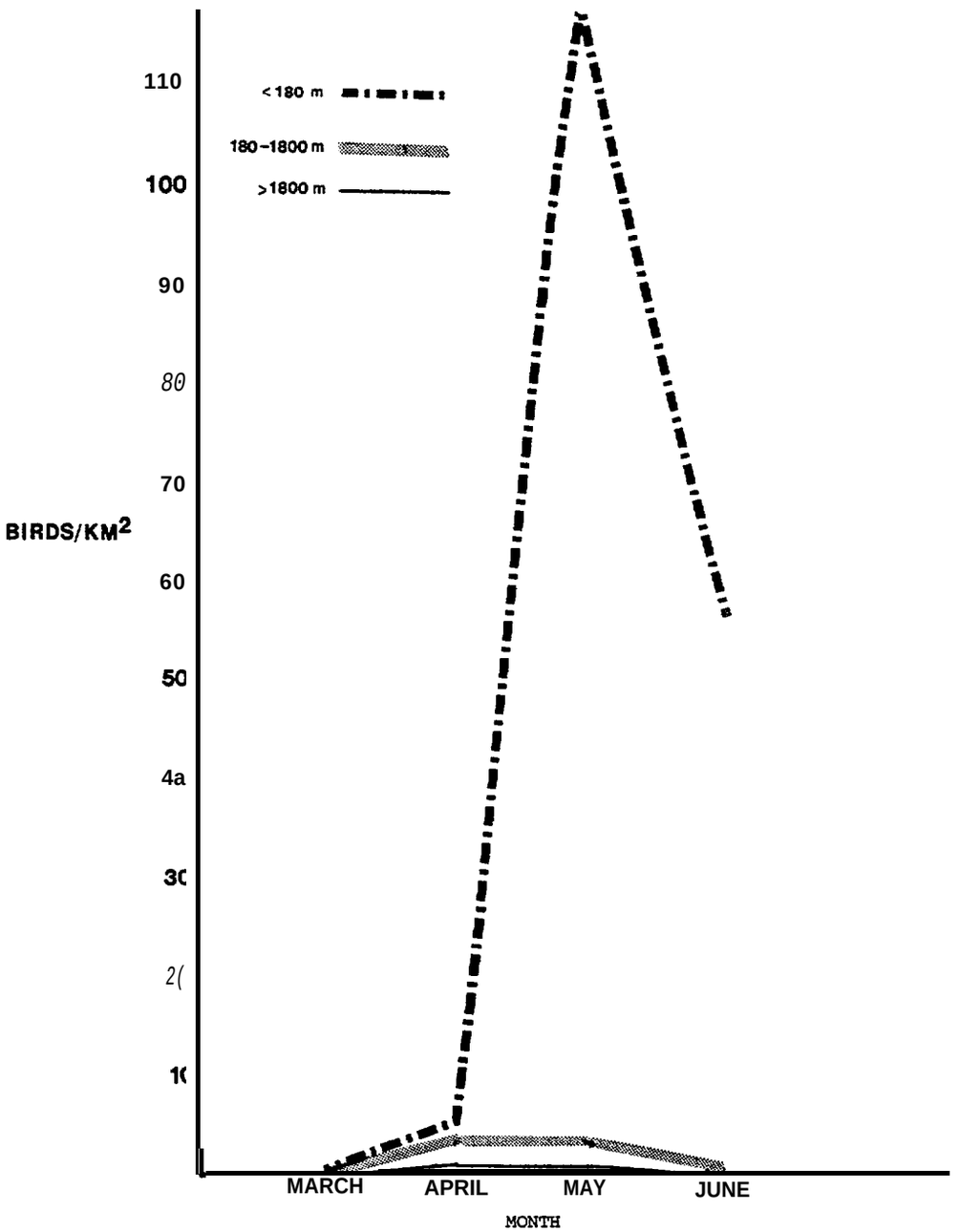

Figure 13. Sooty/Short-tailed Shearwater Density Indices From Aerial Surveys Of Kodiak Island Waters, 1977.

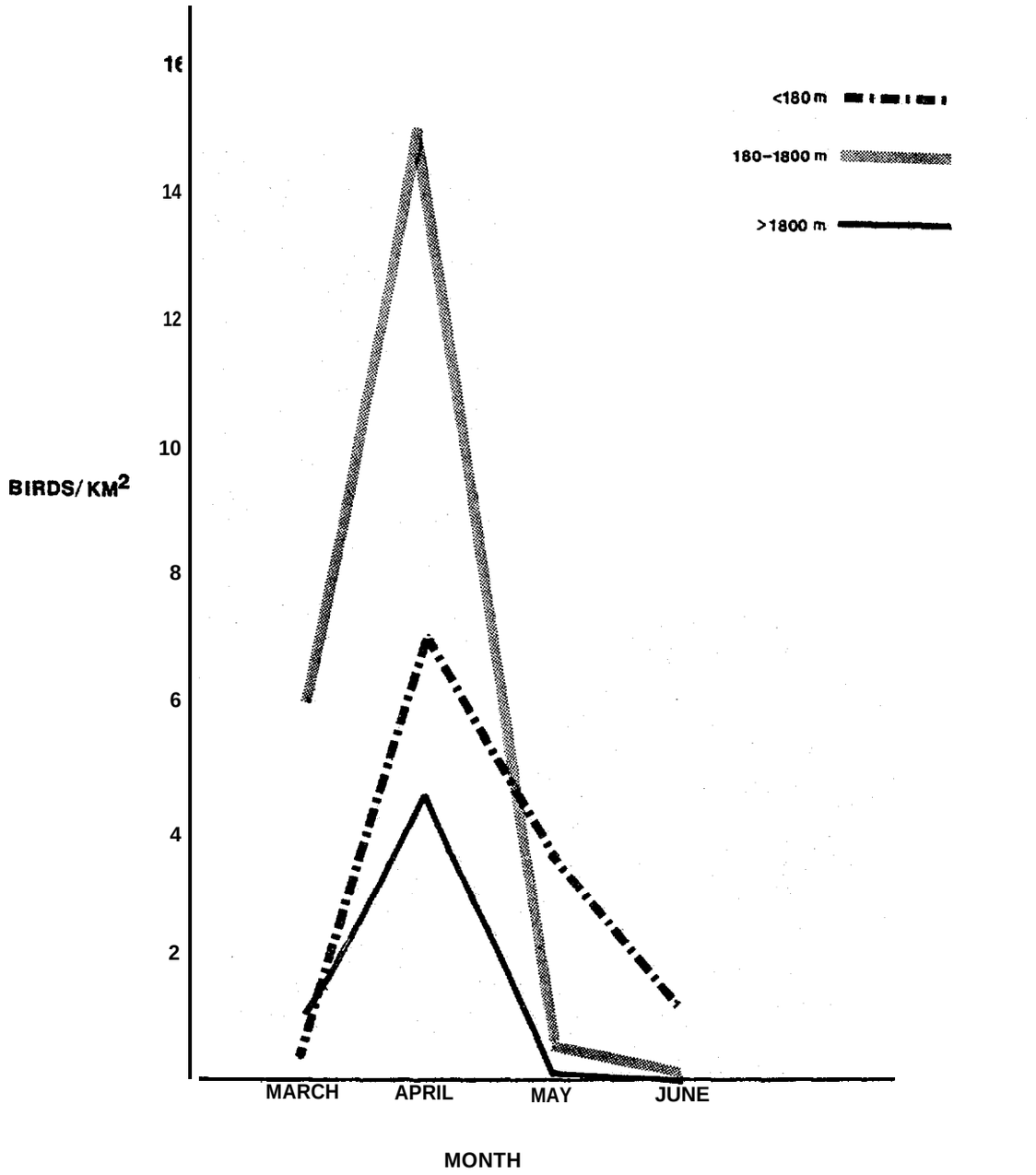

Figure 14. Black-legged Kittiwake Density Indices From Aerial Surveys of Kodiak Island Waters, 1977.

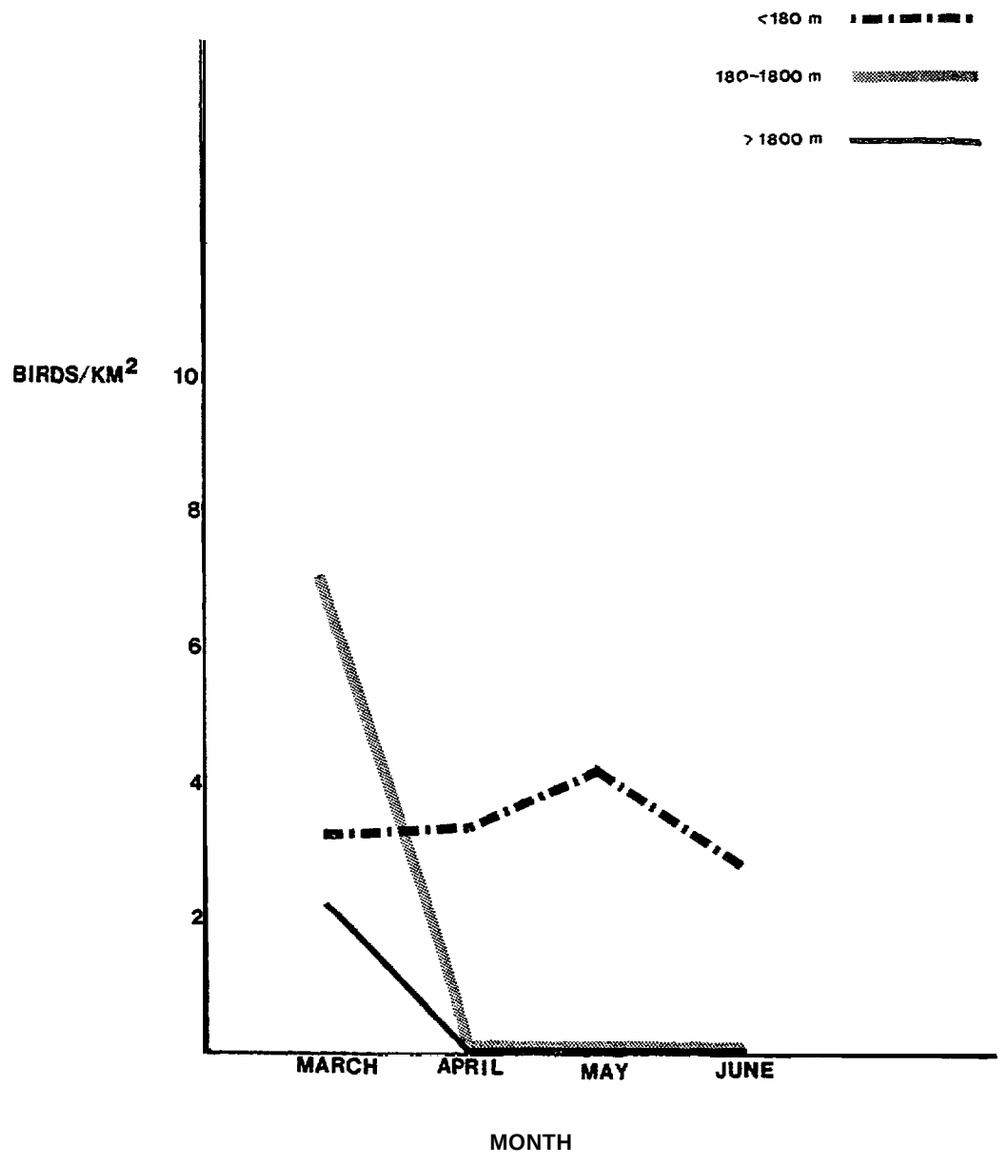

Figure 15. Common/Thick-billed Murre Density Indices From Aerial Surveys of Kodiak Island Waters, 1977.

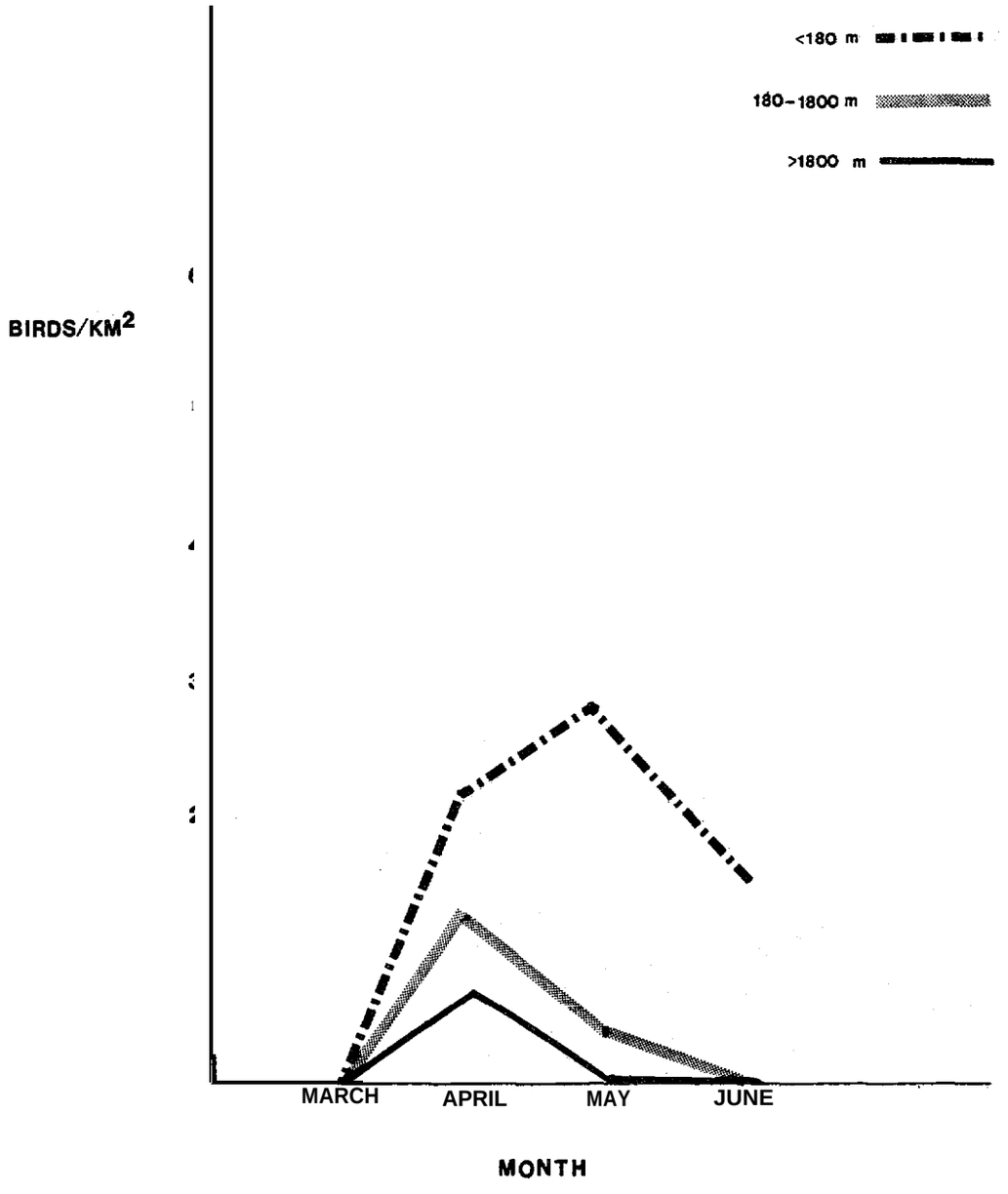

Figure 16. Tufted Puffin Density Indices From Aerial Surveys of Kodiak Island Waters, 1977.

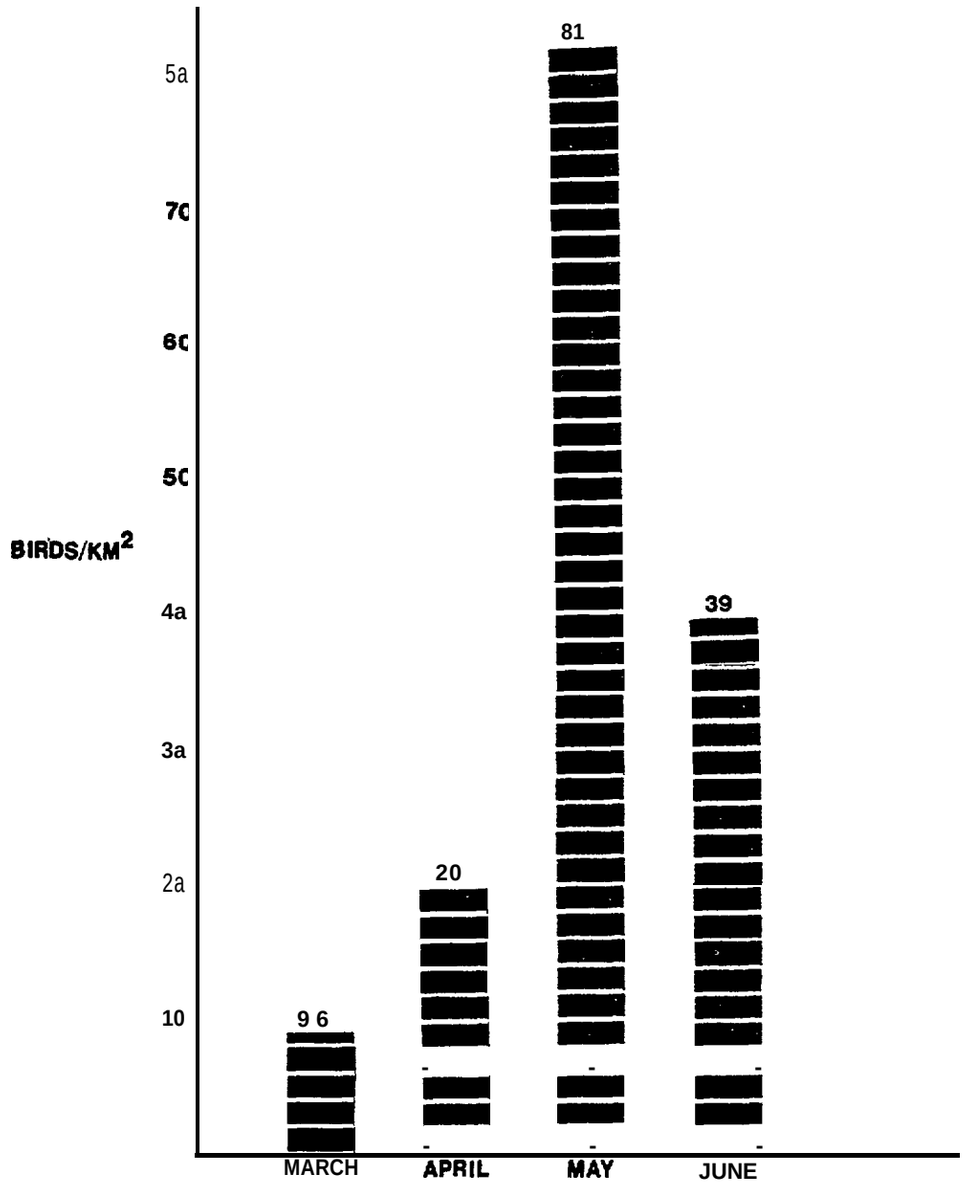

Figure 17. Total Bird Density Indites From Aerial Surveys of Kodiak Island Waters, 197?.

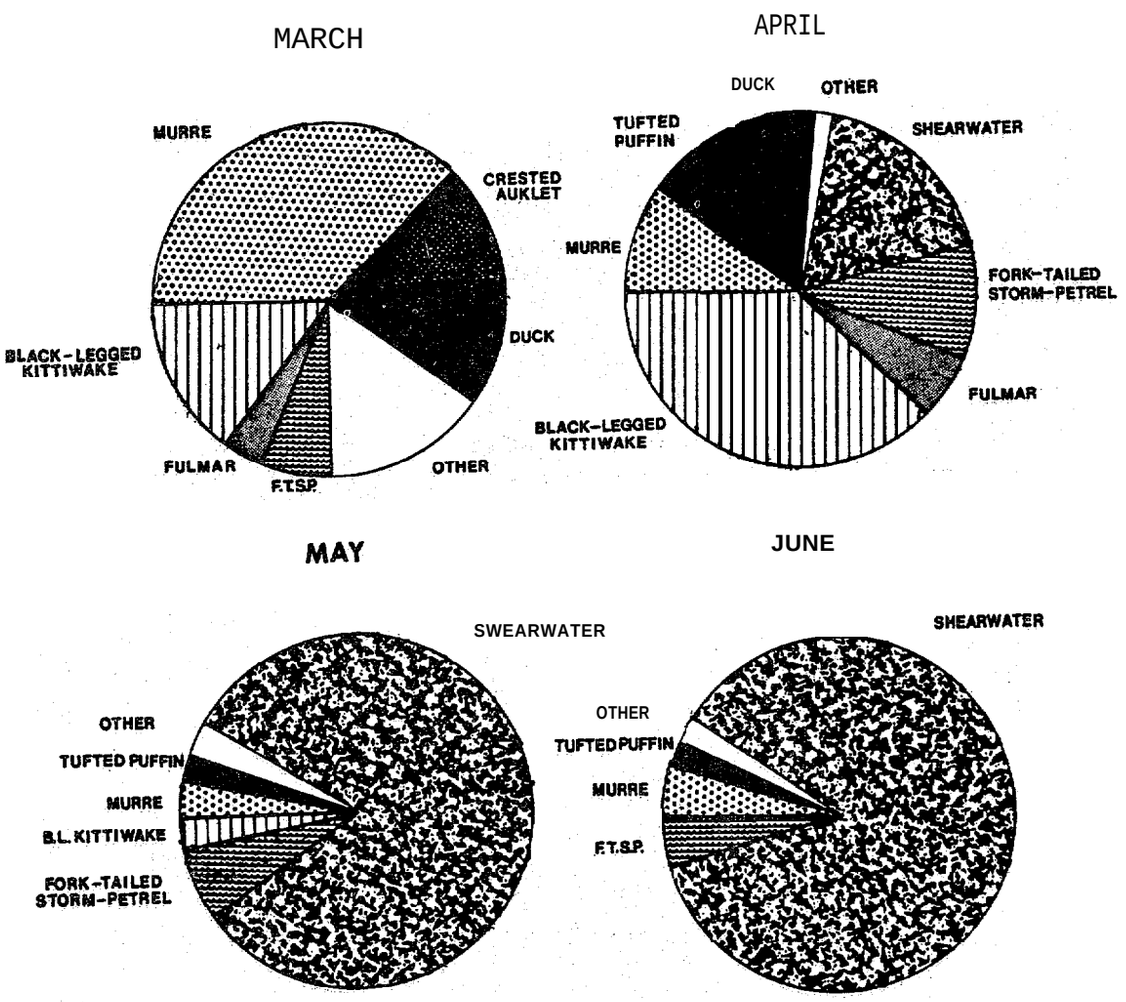

Figure 18. Relative seabird species composition from Aerial Surveys of Kodiak Island Waters, 1977.

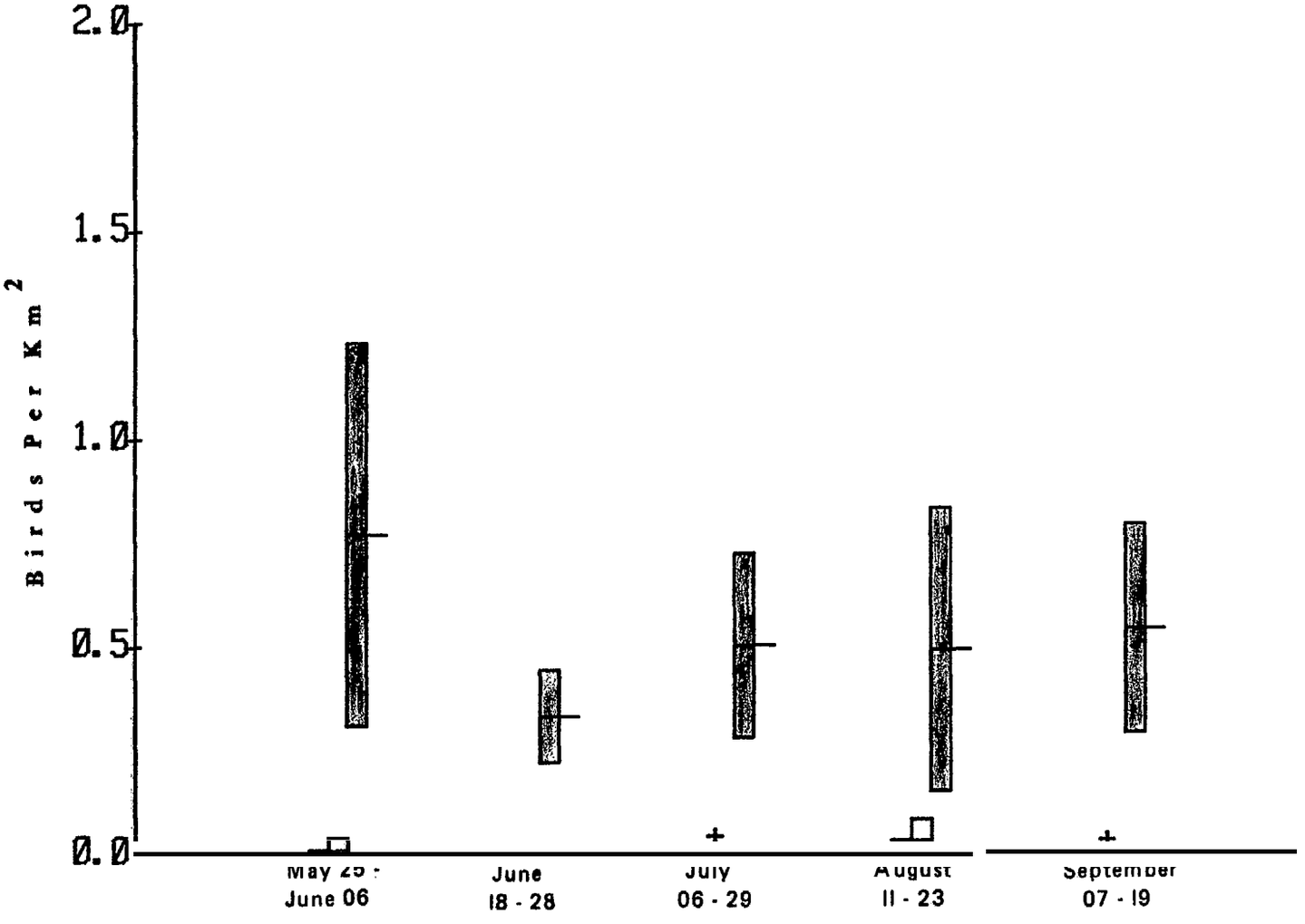

Figure 19. Northern Fulmar Density Indices From Shipboard Surveys. Mean ± 95% Confidence Limits For Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

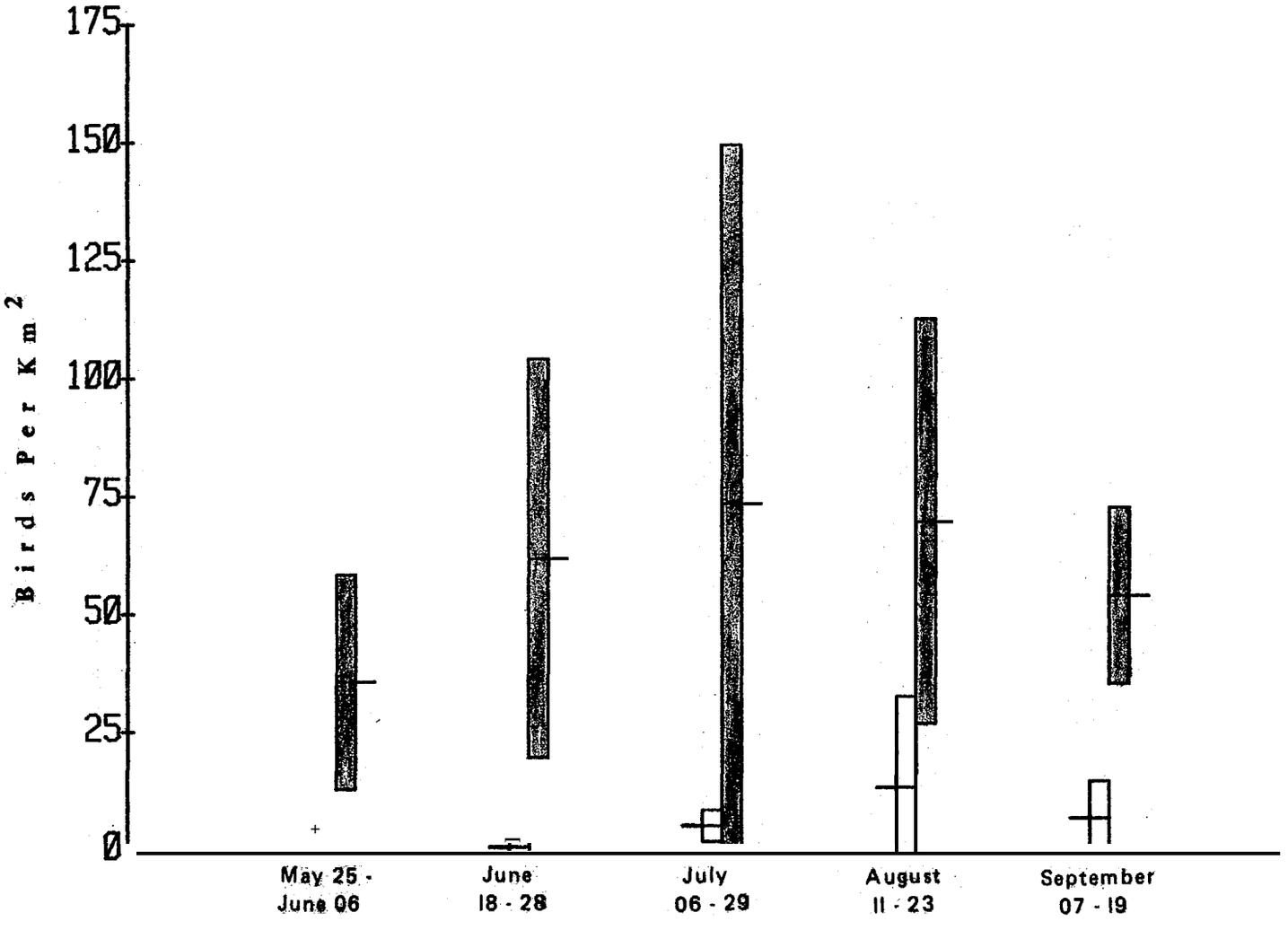

Figure 20. Total Shearwater Density Indices From Shipboard Surveys. Mean ± 95% Confidence Limits for Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

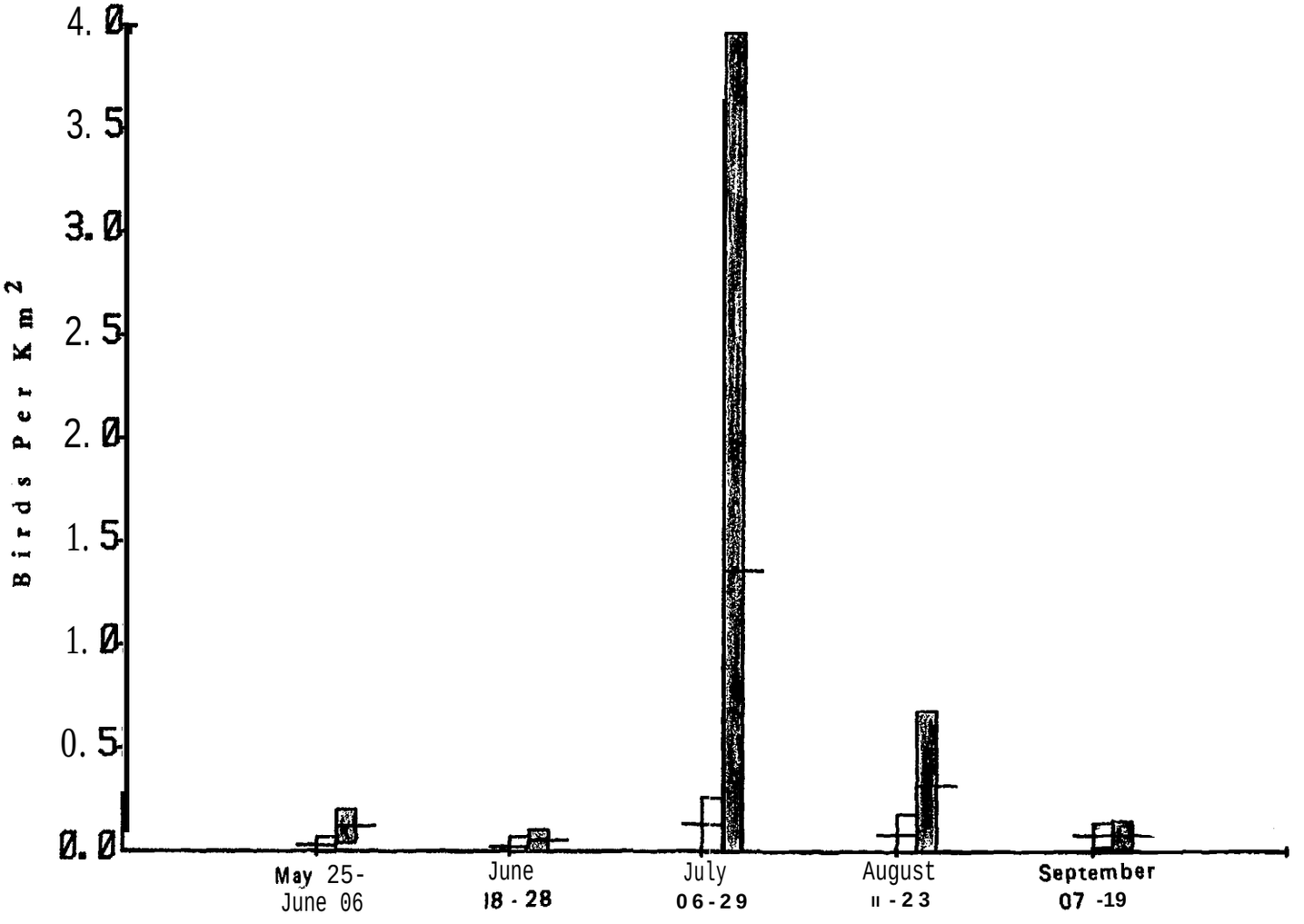

Figure 21, Pomarine Jaeger *Density Indices* From Shipboard Surveys. Mean* 95% Confidence Limits For Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

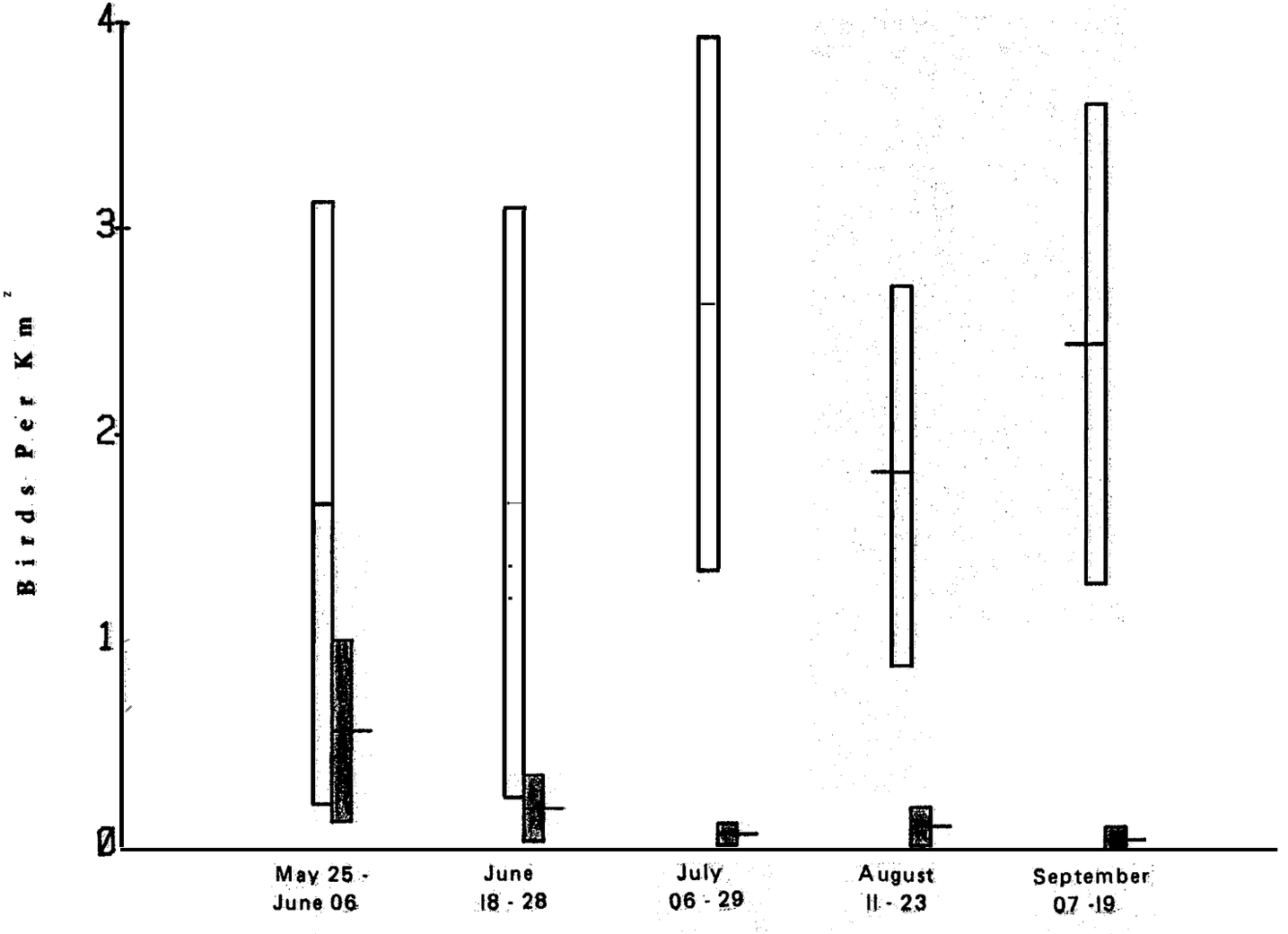

Figure 22. Glaucous-winged Gull Density Indices From Shipboard Surveys. Means ± 95% Confidence Limits For Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

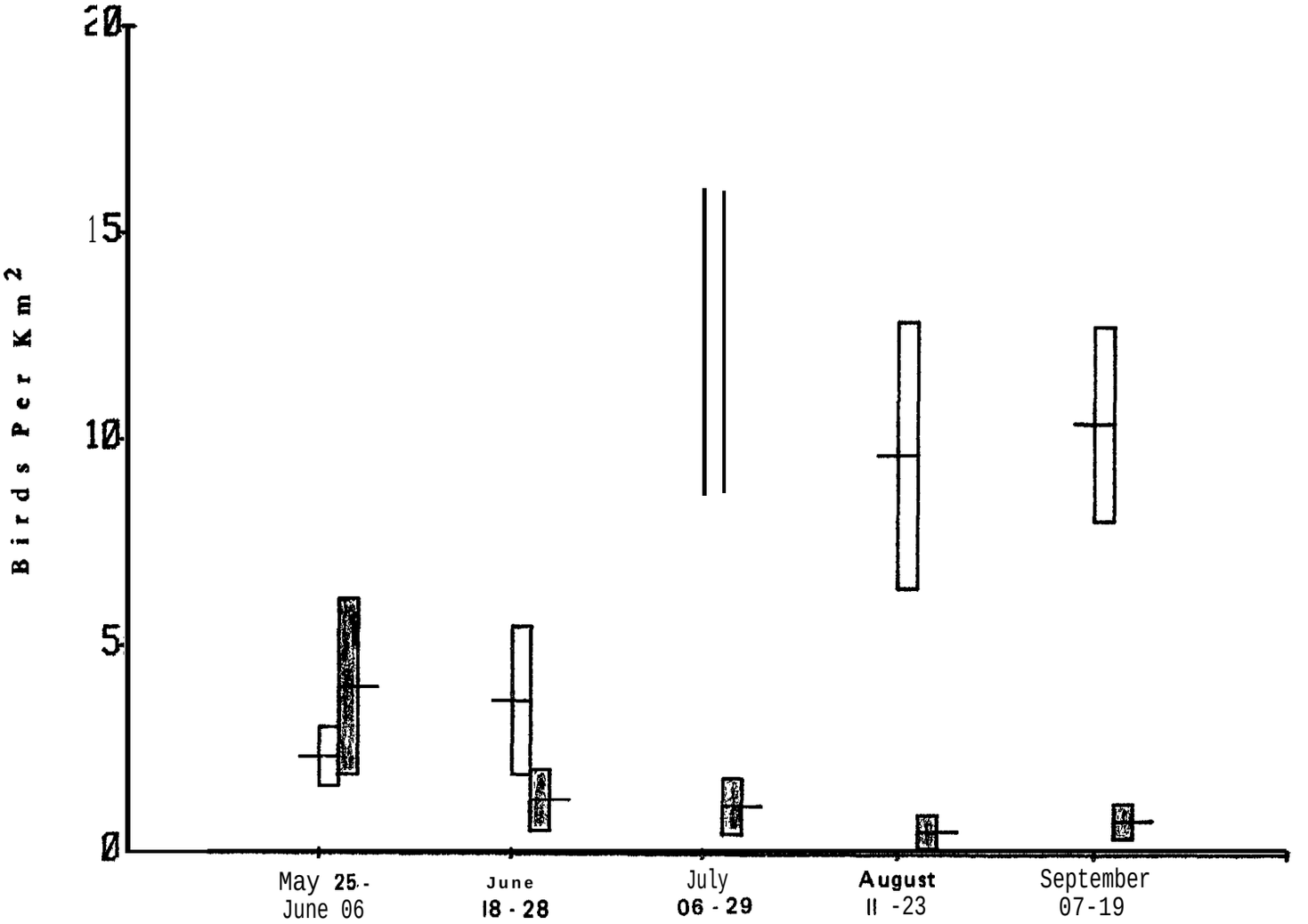

Figure 23. Kittiwake Density Indices From Shipboard Surveys. Mean ± 95% Confidence Limits for Bay"(⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

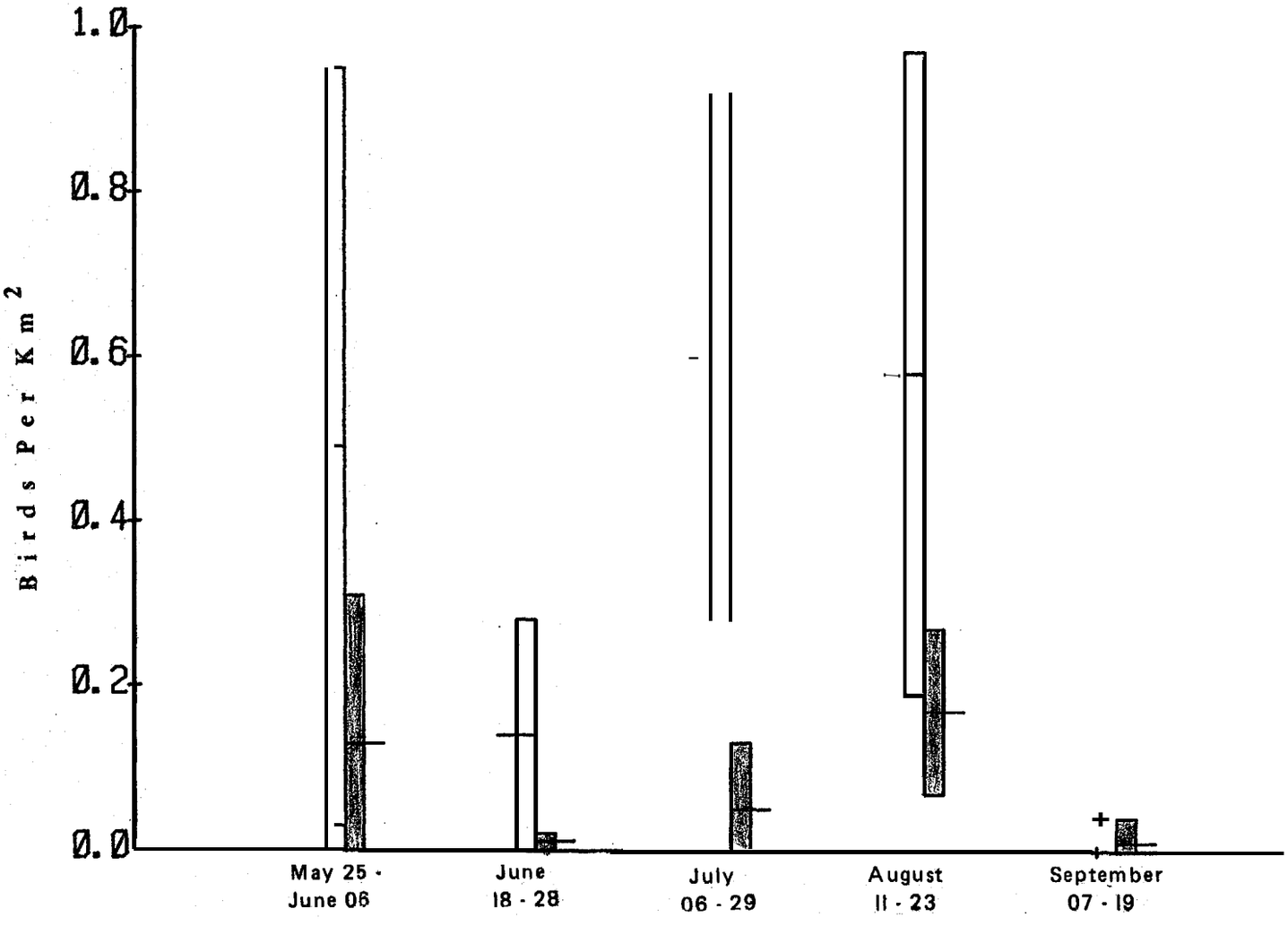

Figure 24 Arctic Tern Density Indices From Shipboard Surveys. Mean ± 95% Confidence Limits For Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

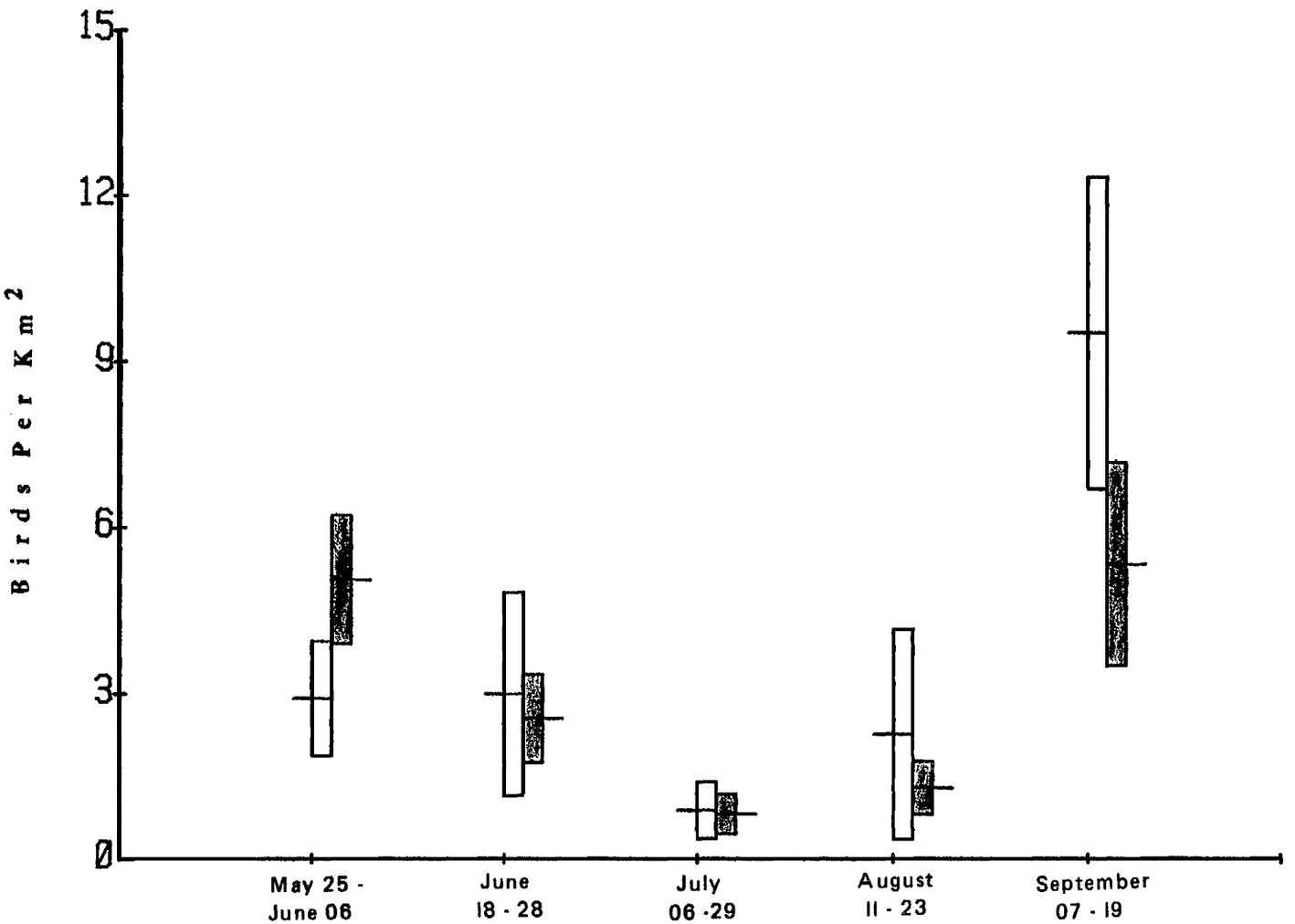

Figure 25 . Total Murre Density Indices From Shipboard Surveys. Mean ± 95% Confidence .imits For Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

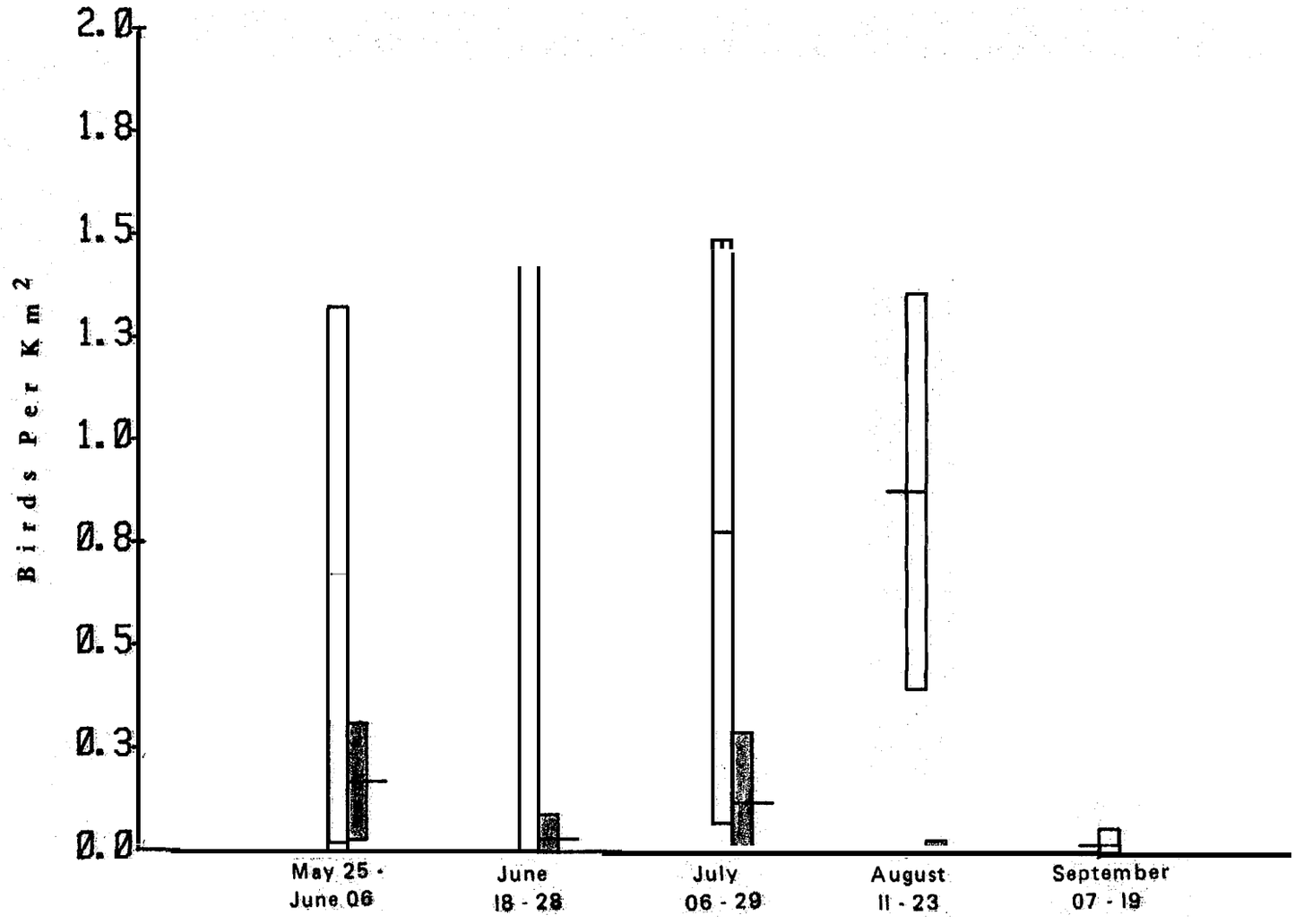

Figure 26 . Pigeon Guillemot Density Indices From Shipboard Surveys. Mean ± 95% Confidence Limits For Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

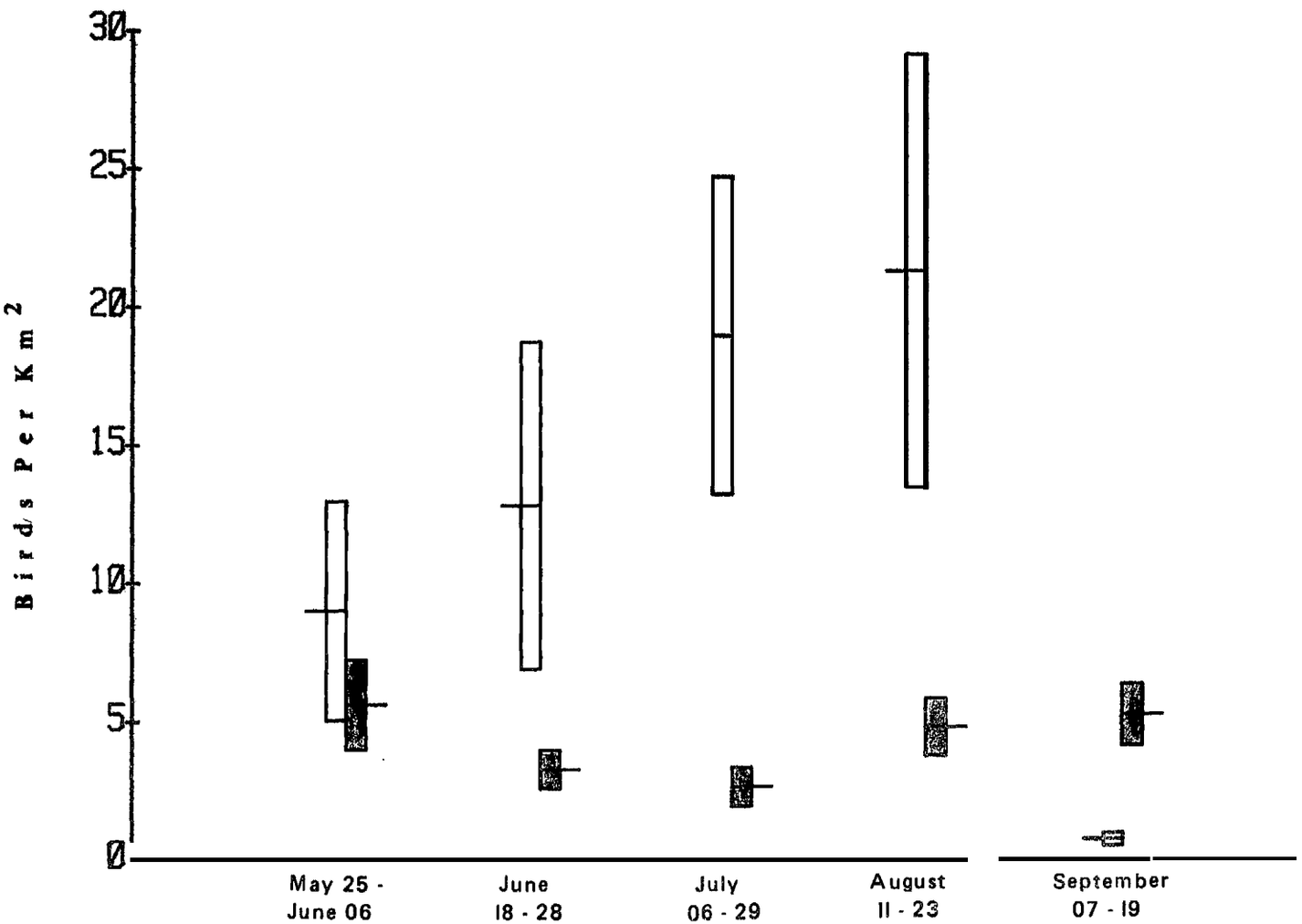

Figure 27. Tufted Puffin Density Indices From Shipboard Surveys. Mean ± 95% Confidence Limits For Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

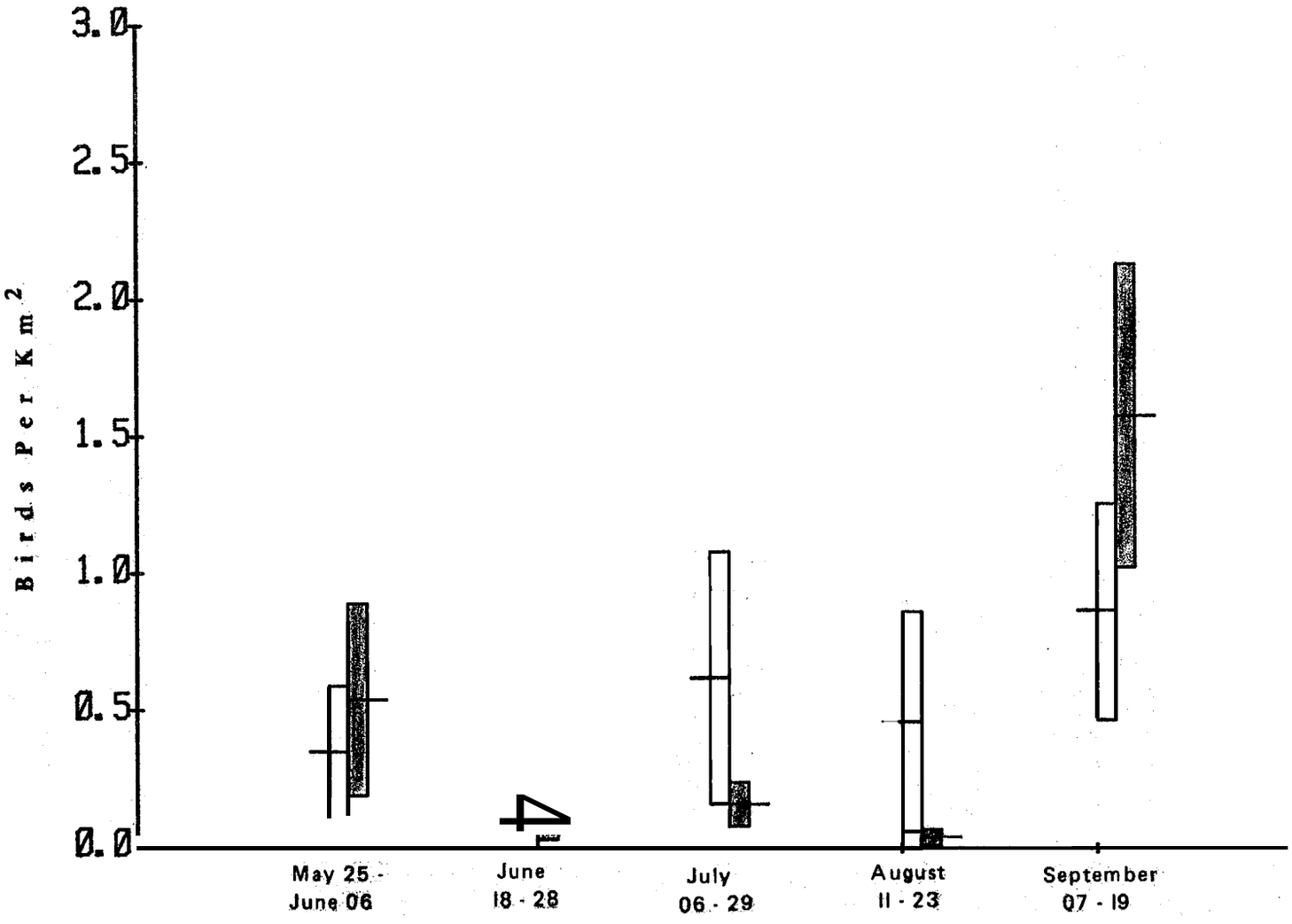

Figure 28. Horned Puffin Density Indices From Shipboard Surveys. Mean ± 95% Confidence Limits For Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

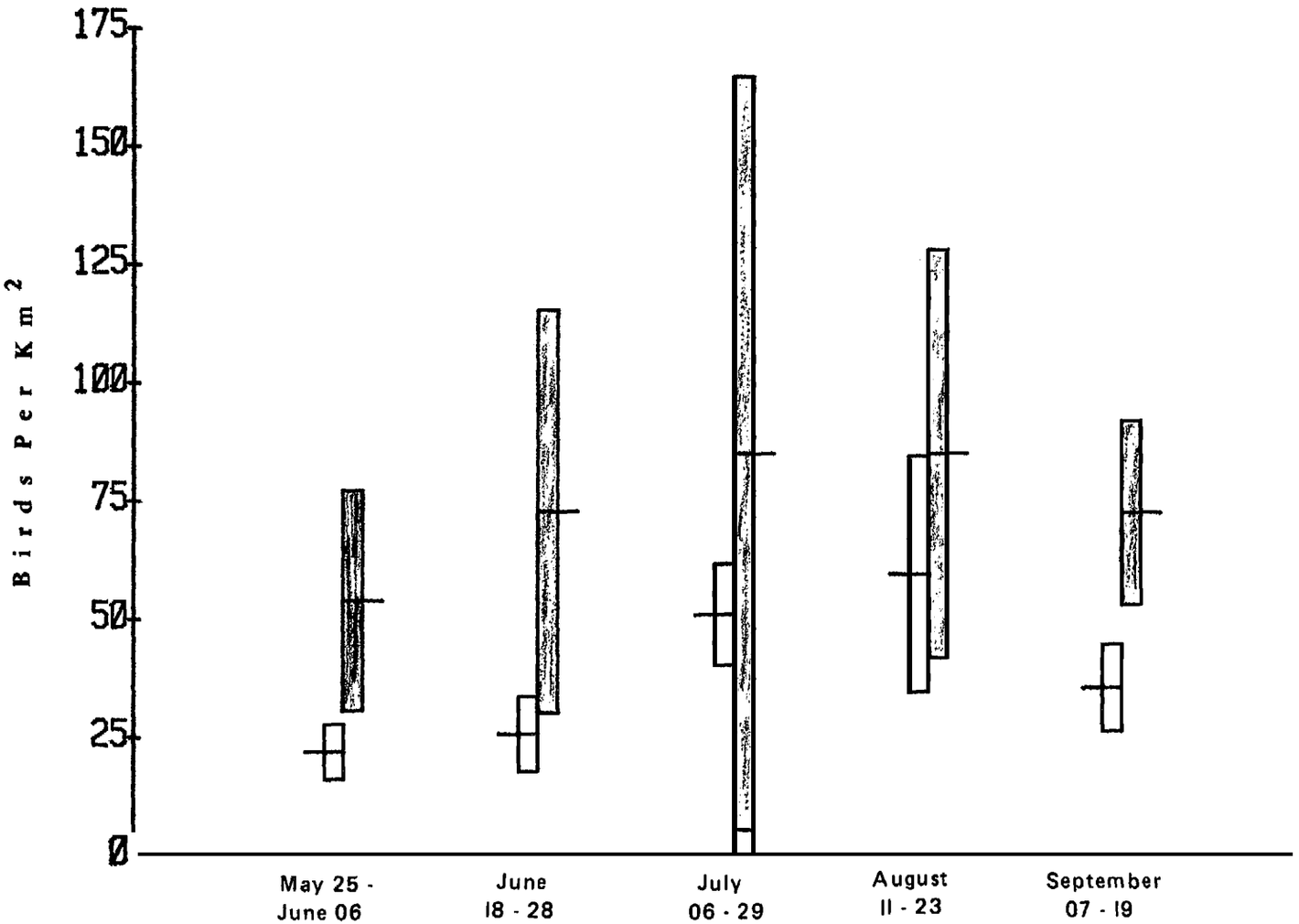

Figure 29. Total Bird Density Indices From Shipboard Surveys. Mean ± 95% Confidence Limits for Bay (⊣) and Shelf (⊢) Areas of South and East Kodiak Island, 1977.

Table 1. Frequency of Major Seabird Species in Kodiak Bays, Shipboard Surveys, 1977*

	Percent Occurrence on Transects					
Cruise	7032	7033	7034	7035	7036	7047
Month	M-J	Jun	Jul	Aug	Sep	Nov
Number of Transects	78	40	156	68	113	16
Sooty/Short-tailed Shearwater	06	15	21	34	36	00
Fork-tailed Storm Petrel	00	00	12	15	00	00
Pelagic Cormorant	03	00	02	04	02	56
Red-faced Cormorant	03	00	01	00	04	19
Northern Phalarope	00	05	00	10	08	00
Parasitic Jaeger	01	03	04	12	05	00
Glaucous-winged Gull	29	30	37	37	47	63
Mew Gull	+	00	+	01	04	63
Total Kittiwake (1)	60	78	62	66	81	38
Arctic Tern	14	10	17	19	+	00
Aleutian Tern	08	03	05	18	00	00
Total Murre (2)	47	58	24	32	61	81
Pigeon Guillemot	10	15	21	25	01	00
Marbled Murrelet	12	08	13	15	09	00
Cassin's Auklet	00	00	01	03	20	00
Horned Puffin	15	10	19	13	33	00
Tufted Puffin	64	88	60	68	35	00

* Major Species are those which occurred on at least 10% of all transects
(1) All probably Black-legged Kittiwakes
(2) 95% or more Common Murres

*Table 2. Frequency of Major Seabird Species in Kodiak Shelf Areas, Shipboard Surveys, 1977**

	Percent Occurrence on Transects						
Cruise	7032	7033	7034	7035	7036	7046	7047
Month	M-J	Jun	Jul	Aug	Sep	Sep	Nov
Number of Transects	154	193	144	168	82	35	124
Northern Fulmar	22	**20**	**21**	20	30	17	35
Sooty/Short-tailed Shearwater	**41**	**62**	**46**	71	89	66	52
Fork-tailed Storm Petrel	00	14	12	36	12	26	00
Pomarine Jaeger	07	03	05	11	07	06	00
Glaucous-winged Gull	23	09	07	07	06	20	60
Total Kittiwake (1)	49	34	24	15	29	43	50
Total Murre *(2)*	68	49	20	31	63	54	74
Cassin's *Auklet*	01	00	05	24	39	17	08
Horned Puffin	16	06	10	04	54	14	26
Tufted Puffin	67	68	48	64	79	46	27

*Major Species are those which occurred on at least 10% of all transects
(1)Almost all Black-legged Kittiwakes
(2)95% or more Common Murres

Table 3. Density Indices (Birds/Km2) From Aerial Suveys Over Kodiak Island Waters, 1977.

	MARCH Water Depth (m)			APRIL Water Depth (m)			MAY Water Depth (m)			JUNE Water Depth (m)		
	<180	180-1800	>1800	<180	180-1800	>1800	<180	180-1800	>1800	<180	180-1800	>1800
Loons	+	-	-			-	-	-	-	-	-	-
Black-footed Albatross	-	-	-	-	-	+	-			-	-	
Northern Fulmar	0.2	0.4	0.7	1.0	2.6	0.6	0.1	0.5	0.9	0.4	0.3	0.5
Pale-footed Shearwater	-	-	-	-	-	-	+	+	-	+	+	-
New Zealand Shearwater	-	-	-	0.1	-	-	-	-	+	-	0.1	0.1
Sooty/Short-tailed Shearwater	-	-	+	4.6	2.5	0.4	111.0	2.8	0.5	55.0	+	0.2
Scaled Petrel	-	-	-			-	-	-	+	-	+	1.6
Fork-tailed Storm Petrel	-	-	2.8	3.2	0.6	0.4	5.8	9.7	1.1	1.4	3.3	1.3
Leach's Storm Petrel	-	-				-	-	-	-	+	0.2	-
Cormorants	0.3	-	-	0.1	-	-	+	-	-	-	-	-
Mallard		-	-		-	-	-	-	-	-	-	-
Oldsquaw	0.8	-	-	0.3	+	-	-	-	-	-	-	-
Harlequin Duck	+1	-	-	-	-	-	-	-	-	-	-	-
Unidentified Eiders		-	-	-	-	-	-	-	-	-	-	-
King Eider	0.1	-	-			-	-	-	-	-	-	-
Unidentified Scoters	+8	-	-	0.4	-	-	-	-	-	-	-	-
White-winged Scoter		-	-	2.2	-	-	-	-	-			-
Surf Scoter	0.1	-	-	-	-	-	-	-	-	-	-	-
Common Scoter	-	-	-	0.1		-	-	-	-	-	-	-
Northern Phalarope	-	-	-	+	-	-	-	+	-	-	-	-
Unidentified Jaegers	-	-	-	+	-	+	0.1		0.1	-	-	-
Pomarine Jaeger	-	-	-	-	-	-	+	-		-	-	-
Parasitic Jaeger		-	-	-	+	-	0.1	+	0.1	-	-	-
Long-tailed Jaeger	-	-	-	-	-	-		+	-	-	-	-
Skua	-	-	-	-	-	-	-	-	+	-	-	-
Glaucous Gull	-	-	-			-	-	+	-	-	-	-
Glaucous-winged Gull	0.4	1.1	+	0.6	0.1	0.1	0.1	-	-	0.2	+	

Table 3(continued).

	MARCH Water Depth (m)			APRIL Water Depth (m)			MAY Water Depth (m)			JUNE Water Depth (m)		
	180	180-1800	1800	180	180-1800	1800	180	180-1800	1800	180	180-1800	1800
Mew Gull				+	-	-	+					
Black-legged Kittiwake	0.3	6.0	0.9	6.8	15.0	4.4	3.6	0.5	0.1	1.2		
Arctic Tern					0.2	-	0.8	0.5		+	-	
Common/Thick-billed Murre	3.2	6.9	2.2	3.3	-	0.1	4.1	+		2.9		
Marbled/Kittlitz's Murrelet							+			0.3		
Parakeet Auklet				+	-	-	+			+		
Crested Auklet			5.9									
Rhinoceros Auklet										+		
Horned Puffin	0.1	0.2	-	0.1	-	-	+			+		
Tufted PUffin		+	+	2.0	1.1	0.6	2.7	0.3	+	1.5		
Unidentified Alcids	+	0.2	1.7	0.3	+	-	+			0.1		
Total Birds	6.4	15.0	14.0	25.0	22.0	6.6	130.0	15.0	3.0	63.0	4.1	3.7

Depths taken from National Ocean and Atmospheric Administration charts 531 and 16580

Table 4. Northern Fulmar Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			**0.00**	0.41	0.98	28.47	0.98	29.45
$\bar{x}$			**0.00**	**0.05**	0.01	0.72	0.05	0.77
2 S.E.				**0.07**	0.03	0.44	0.03	0.46
FW7033								
Jun.	40	193						
MAXIMUM			**0.00**	**3.24**	0.00	2.95	**0.00**	3.93
$\bar{x}$			**0.00**	**0.04**	0.00	2.29	**0.00**	0.33
2 S.E.				**0.04**		0.09		0.11
FW7034								
Jul.	156	144						
MAXIMUM			**0.00**	**4.32**	+	7.56	+	9.72
$\bar{x}$			**0.00**	**0.11**	+	0.39	+	0.50
2 S.E.				**0.09**		0.18		0.22
FW7035								
Aug.	68	168						
MAXIMUM	-		**0.00**	**1.20**	1.20	27.00	**1.20**	27.00
$\bar{x}$			0.00	**0.03**	0.03	0.46	**0.03**	0.49
2 S.E.				**0.03**	0.05	0.34	**0.05**	0.34
FW7036								
Sep.	113	82						
MAXIMUM			**0.00**	1.35	+	5.40	+	6.48
$\bar{x}$			**0.00**	**0.06**	+	0.48	+	0.54
2 S.E.				**0.06**		0.23		0.25
FW7046								
Sep.	3	35						
MAXIMUM			**0.00**	**0.83**	0.00	1.66	**0.00**	1.66
$\bar{x}$			**0.00**	**0.02**	0.00	0.14	**0.00**	0.17
2 S.E.				**0.05**		0.13		0.14
FW7047								
Nov.	16	124						
MAXIMUM			**0.00**	?	0.00	?	**0.00**	15.4
x			**0.00**	?	0.00	?	**0.00**	1.2
2 S.E.								0.5

MAXIMUM = Maximum B/KM2 on any one transect
x *= Mean transect density*
2 S.E. = Two standard errors of the mean
B/KM2 = *Birds Per Square Kilometer*

Table 5. Sooty/Short-tailed Shearwater Density Indices From Shipboard *Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	*SHELF*	BAYS	SHELF	BAYS	SHELF	*BAYS*	*SHELF*
Fw7032								
May-Jun.	*78*	*154*						
MAXIMUM			5.89	844.30	2.95	646.54	5.89	1129.0
X			0.11	20.23	0.11	15.69	0.22	35.9
2 S.E.			0.17	16.46	0.11	12.60	0.23	22.7
FW7033								
Jun.	**40**	**193**						
MAXIMUM			26.51	3485.2	9.82	1589.6	**36.32**	**3485.2**
X			0.72	42.3	0.40	20.2	**1.12**	**62.5**
2 S.E.			1.36	38.1	0.53	17.0	**1.86**	**42.3**
FW7034								
Jul.	**156**	**144**						
MAXIMUM			**130.79**	**5399.6**	54.00	536.4	146.39	5399.6
X			**4.36**	**61.6**	1.70	12.8	6.05	74.4
2 S.E.			**2.80**	**75.4**	0.97	8.8	3.30	76.0
FW7035								
Aug.	68	168						
MAXIMUM			**629.95**	**3243.0**	48.60	881.21	646.15	3246.2
X			**11.40**	**46.0**	3.14	24.86	14.53	70.9
2 S.E.			**18.71**	**40.5**	2.14	11.16	19.31	42.8
Fw7036								
Sep.	113	82						
MAXIMUM			22.68	311.02	361.17	539.96	364.77	549.41
X			0.83	30.98	7.46	24.32	8.29	55.30
2 S.E.			0.59	13.26	7.74	13.34	7.87	18.61
Fw7046								
Sep.	3	35						
MAXIMUM			0.00	113.81	27.00	696.54	27.00	696.54
X			0.00	18.44	14.84	42.94	14.84	61.38
2 S.E.				11.36	38.40	44.39	38.40	44.21
FW7047								
Nov.	16	124						
MAXIMUM			0.00	?	**0.09**	?	**0.09**	**414.6**
X			0.00	?	0.01	?	**0.01**	**8.0**
2 S.E.					**0.01**	-	**0.01**	**7.3**

MAXIMUM = Maximum *B/KM2 on any one transect*
X · *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 6. Fork-tailed Storm Petrel Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAY'S	SHELF	BAYS	SHELF
Fw7032								
May-Jun.	78	154						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7033								
Jun.	40	193						
MAXIMUM			0.00	3.24	0.00	6.00	0.00	6.00
X			0.00	0.03	0.00	0.19	0.00	0.21
2 S.W.				0.04		0.09		0.09
FW7034								
Jul.	156	144						
MAXIMUM			21.60	1.08	25.20	5.40	33.60	5.40
X			0.19	0.01	0.49	0.22	0.69	0.22
2 S.E.			0.29	0.01	0.38	0.12	0.55	0.13
FW7035								
'Aug.	68	168						
MAXIMUM			6.30	1.08	6.48	5.40	9.00	5.40
X			0.09	0.01	0.41	0.68	0.50	0.70
2 S.E.			0.19	0.02	0.29	0.18	0.38	0.18
FW7036								
Sep.	113	82						
MAXIMUM			?	0.00	?	3.24	+	3.24
X			?	0.00	?	0.16	+	0.16
2 S.E.						0.11		0.11
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.83	0.00	3.32	0.00	3.32
X			0.00	0.02	0.00	0.41	0.00	0.43
2 S.E.				0.05		0.29		0.30
FW7047								
Nov.	16	124						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00 ,	0.00	0.00	0.00	0.00	0.00
2 S.E.								

MAXIMUM = *Maximum* B/KM2 *on any one transect*
x = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 7. *Pelagic Cormorant Density Indices From Shipboard Surveys of* Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			0.00	0.00	6.48	1.20	6.48	1.20
$\bar{x}$			0.00	0.00	0.11	0.01	0.11	0.01
2 S.E.					0.17	0.02	0.17	0.02
FW7033								
Jun.	40	193						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
$\bar{x}$			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7034								
Jul.	156	144						
MAXIMUM			0.00	0.00	1.08	0.00	1.08	0.00
$\bar{x}$			0.00	0.00	0.02	0.00	0.02	0.00
2 S.E.					0.02	-	0.02	-
FW7035								
Aug.	68	168						
MAXIMUM			2.61	0.00	1.08	0.00	3.24	0.00
$\bar{x}$			0.03	0.00	0.05	0.00	0.08	0.00
2 S.E.			0.06	-	0.05	-	0.10	-
FW7036								
Sep.	113	82						
MAXIMUM			0.00	0.00	2.16	0.00	2.16	0.00
$\bar{x}$			0.00	0.00	0.03	0.00	0.03	0.00
2 S.E.					0.04		0.04	
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.00	0.90	0.00	0.90	0.00
$\bar{x}$			0.00	0.00	0.60	0.00	0.60	0.00
2 S.E.					1.58		1.58	
FW7047								
Nov.	16	124						
MAXIMUM			1.80	?	6.30	?	6.30	0.08
$\bar{x}$			0.20	?	1.00	?	1.20	0.02
2 S.E.			0.30	-	0.90	-	0.90	?

MAXIMUM = Maximum B/KM2 on any one transect
$\bar{x}$ = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 8. *Red-faced Cormorant Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			0.00	0.00	1.20	0.98	1.20	0.98
$\bar{x}$			0.00	0.00	0.03	0.01	0.03	0.01
2 S.E.					0.04	0.01	0.04	0.01
FW7033								
Jun.	40	193						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
$\bar{x}$			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7034								
Jul.	156	144						
MAXIMUM			0.00	0.00	1.08	0.00	1.08	0.00
$\bar{x}$			0.00	0.00	0.01	0.00	0.01	0.00
2 S.E.					0.01		0.01	
FW7035								
Aug.	68	168						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
$\bar{x}$			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7036								
Sep.	113	82						
MAXIMUM			0.00	0.00	2.40	0.00	2.40	0.00
$\bar{x}$			0.00	0.00	0.07	0.00	0.07	0.00
2 S.E.					0.06		0.06	
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
$\bar{x}$			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7047								
Nov.	16	124						
MAXIMUM			0.00	?	2.50	?	2.50	0.08
$\bar{x}$			0.00	?	0.30	?	0.30	0.01
2 S.E.					0.30		0.30	?

MAXIMUM = *Maximum* B/KM2 on any one transect
$\bar{x}$ = Mean transect *density*
2 S.E. = Two *standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 9. Red Phalarope *Density Indices From Shipboard* Surveys of Kodiak Island *Waters,* 1977.

	NUMBER OF TRANSECTS		B/KM2 *ON WATER* & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			**11.78**	**0.00**	**0.00**	**0.00**	**11.78**	**0.00**
$\bar{X}$			**0.20**	**0.00**	**0.00**	**0.00**	**0.20**	**0.00**
2 S.E.			**0.32**	-			**0.32**	-
FW7033								
Jun.	**40**	**193**						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7034								
Jul.	**156**	**144**						
MAXIMUM			**0.00**	+	**0.00**	+	**0.00**	+
$\bar{X}$			**0.00**	+	**0.00**	+	**0.00**	+
2 S.E.								
FW7035								
Aug.	**68**	168						
MAXIMUM			**0.00**	**0.00**	**0.00**	1.20	0.00	1.20
$\bar{X}$			0.00	0.00	0.00	0.01	0.00	0.01
2 S.E.						0.02	-	0.02
FW7036								
Sep.	113	82						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7046								
Sep.	3	35						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7047								
Nov.	16	124						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
x			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								

MAXIMUM = Maximum B/KM2 on any one transect
$\bar{X}$ = Mean transect density
2 S.E. = Two standard errors of the mean
B/KM2 = Birds Per Square Kilometer

Table 10. Northern Phalarope *Density Indices From Shipboard Surveys* of *Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	[illegible]
FW7032								
May-Jun.	78	154						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7033								
Jun.	40	193						
MAXIMUM			3.93	0.00	0.00	0.00	3.93	0.00
X			0.12	0.00	0.00	0.00	0.12	0.00
2 S.E.			0.21				0.21	
FW7034								
Jul.	156	144						
MAxIMuM			12.76	“9.60	49.09	8.64	61.85	9.60
x			0.23	0.08	0.99	0.06	1.22	0.14
2 S.E.			0.20	0.14	0.82	0.12	0.96	0.18
FW7035								
Aug.	68	168						
MAXIMUM			33.48	0.00	3.60	0.00	33.48	0.00
X			0.93	0.00	0.12	0.00	1.05	0.00
2 S.E.			1.23		0.13		1.30	
FW7036								
Sep.	*113*	*82*						
MAXIMUM			6.00	2.16	7.85	1.08	13.74	2.16
X			0.14”	0.03	0.09	0.01	0.23	0.04
2 S.E.			0.15	0.05	0.14	0.03	0.27	0.06
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.00	1.80	20.70	1.80	20.70
X			0.00	0.00	0.60	0.64	0.60	0.64
2 S.E.					3.16	1.22	3.16	1.22
FW7047								
Nov.	16	124						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								

MAXIMUM = Maximum B/KM2 on any one transect
X = Mean transect density
2 S.E. = Two standard errors of the mean
B/KM2 = Birds Per Square Kilometer

Table 11. Pomarine Jaeger Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Ju.	78	154						
MAXIMUM			0.00	2.16	1.08	3.93	1.08	3.93
x			0.00	0.04	0.03	0.09	0.03	0.12
2 S.E.				0.04	0.04	0.07	0.04	0.08
FW7033								
Jun.	40	193						
MAXIMUM			0.98	3.60	0.00	2.16	0.98	3.60
x			0.02	0.02	0.00	0.02	0.02	0.05
2 S.E.			0.05	0.04	-	0.03	0.05	0.05
FW7034								
Jul.	156	144						
MAXIMUM			5.40	188.98	6.00	1.08	6.00	188.98
X			0.07	1.32	0.07	0.04	0.13	1.36
2 S.E.			0.09	2.60	0.09	0.03	3.21	2.60
FW7035								
Aug.	68	168						
MAXIMUM			0.00	1.08	2.86	30.24	2.86	30.24
X			0.00	0.01	0.08	0.31	0.08	0.32
2 S.E.				0.01	0.10	0.36	0.10	0.36
Fw7036								
Sep.	113	82						
MAXIMUM			1.20	1.08	1.20	1.35	2.40	1.35
X			0.02	0.03	0.06	0.06	0.08	0.08
2 S.E.			0.03	0.04	0.05	0.06	0.06	0.07
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.00	1.96	1.80	1.96	1.80
X			0.00	0.00	0.95	0.08	0.95	0.08
2 S.E.					2.99	0.12	2.99	0.12
FW7047								
Nov.	16	124						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
x			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								

MAXIMUM = *Maximum B/KM2 on any one transect*
X = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 12. *Parasitic Jaeger Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	**78**	**154**						
MAXIMUM			**0.00**	**0.00**	**1.08**	**6.00**	1.08	**6.00**
$\bar{X}$			**0.00**	**0.00**	**0.01**	**0.05**	0.01	**0.05**
2 S.E.					**0.03**	**0.08**	0.03	**0.08**
FW7033								
Jun.	**40**	**193**						
MAXIMUM			**2.16**	**0.00**	**0.00**	**2.16**	2.16	**2.16**
$\bar{X}$			**0.05**	**0.00**	**0.00**	**0.01**	0.05	**0.01**
2 S.E.			**0.11**			**0.02**	0.11	**0.02**
FW7034								
Jul.	**156**	**144**						
MAXIMUM			**1.54**	**0.98**	**2.40**	**16.20**	2.40	**16.20**
$\bar{X}$			**0.02**	**0.01**	**0.05**	**0.19**	0.07	**0.19**
2 S.E.			**0.02**	**0.01**	**0.05**	**0.23**	0.05	**0.23**
FW7035								
Aug.	**68**	**168**						
MAXIMUM			**1.20**	**2.16**	**2.16**	**1.35**	2.16	**3.24**
$\bar{X}$			**0.03**	**0.02**	**0.12**	**0.01**	0.15	**0.03**
2 S.E.			**0.04**	**0.03**	**0.10**	**0.02**	0.11	**0.04**
Fw7036								
Sep.	**113**	**82**						
MAXIMUM			**0.00**	**0.00**	**1.20**	**0.00**	1.20	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.06**	**0.00**	0.06	**0.00**
2 S.E.					**0.05**		0.05	
Fw7046								
Sep.	**3**	**35**						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	0.00	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	0.00	**0.00**
2 S.E.								
FW7047								
Nov.	**16**	**124**						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	0.00	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	0.00	**0.00**
2 S.E.								

MAXIMUM = *Maximum* B/KM2 *on any one transect*
$\bar{x}$ = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = Birds *Per Square Kilometer*

Table 13. *Long-tailed Jaeger Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			0.00	0.00	0.00	4.80	0.00	4.80
x			0.00	0.00	0.00	0.04	0.00	0.04
2 S.E.						0.06		0.06
FW7033								
Jun.	40	193						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7034								
Jul.	156	144						
MAXIMUM			1.20	0.98	2.16	0.98	2.16	0.98
X			0.01	0.01	0.04	0.01	0.04	0.02
2 S.E.			0.02	0.01	0.04	0.02	0.04	0.02
FW7035								
Aug.	68	168						
MAXIMUM			0.00	0.00	1.08	1.08	1.08	1.08
x			0.00	0.00	0.03	0.01	0.03	0.01
2 S.E.					0.04	0.02	0.04	0.02
FW7036								
Sep.	113	82						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7047								
Nov.	16	124						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								

MAXIMUM = *Maximum B/KM2 on any one transect*
x = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 14. Glaucous-winged Gull Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			**50.76**	**32.40**	10.80	3.60	50.76	33.48
X			**1.19**	**0.24**	0.48	0.33	1.67	0.57
2 S.E.			**1.43**	**0.42**	0.33	0.12	1.46	0.44
FW7033								
Jun.	*40*	*193*						
MAXIMUM			**19.63**	13.74	3.93	**3.93**	**19.63**	**13.74**
X			**1.25**	**0.11**	0.43	**0.09**	**1.68**	**0.20**
2 S.E.			**1.35**	**0.15**	0.29	**0.06**	**1.43**	**0.16**
FW7034								
Jul.	156	144						
MAXIMUM			**80.09**	**1.20**	18.90	**1.96**	80.09	**1.96**
x			**1.34**	**0.02**	1.31	**0.07**	2.65	**0.08**
2 S.E.			**1.16**	**0.02**	0.49	**0.05**	1.29	**0.05**
FW7035								
Aug.	68	168						
MAXIMUM			**5.40**	**0.00**	21.60	5.40	21.60	5.40
X			**0.31**	**0.00**	1.53	0.12	1.84	0.12
2 S.E.			**0.25**		0.82	0.09	0.90	0.09
FW7036								
Sep.	113	82						
MAXIMUM			**52.80**	**0.00**	16.20	**1.08**	**54.80**	1.08
X			**1.03**	**0.00**	1.43	**0.06**	**2.46**	0.06
2 S.E.			**0.99**		0.52	**0.06**	**1.16**	0.06
FW7046								
Sep.	3	35						
MAXIMUM			**0.00**	**0.00**	0.00	**3.60**	**0.00**	3.60
X			**0.00**	**0.00**	0.00	**0.39**	**0.00**	0.39
2 S.E.						0.31		0.31
FW7047								
Nov.	16	124						
MAXIMUM			**17.8**	?	3.1	?	20.8	**8.5**
X			**12.8**	?	2.0	?	14.7	**1.1**
2 S.E.			?		?	-	?	**0.3**

MAXIMUM = Maximum B/KM2 *on any one transect*
x · *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 15. *Mew Gull Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
Fw7032								
May-Jun.	78	154						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7033								
Jun.	40	193						
MAX IMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7034								
Jul.	156	144						
MAXIMUM			0.00	0.00	1.20	0.00	1.20	0.00
X			0.00	0.00	0.01	0.00	0.01	0.00
2 S.E.					0.02	-	0.02	-
FW7035								
Aug.	68	168						
MAXIMUM			0.00	0.00	3.60	0.00	0.60	0.00
X			0.00	0.00	0.05	0.00	0.05	0.00
2 S.E.					0.11	-	0.11	-
FW7036								
Sep.	113	82						
MAXIMUM			1.08	0.00	11.88	0.00	12.96	0.00
x			0.01	0.00	0.13	0.00	0.14	0.00
2 S.E.			0.02	-	0.21	-	0.23	-
FW7046								
Sep.	3	35						
MAXIMUM			0-00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7047								
Nov.	16	124						
MAXIMUM			31.3	0.00	*6.3*	*0.00*	*31.3*	*0.00*
X			2.5	0.00	*1.0*	*0.00*	*3.5*	*0.00*
2 S.E.			4.0	-	*0.8*	-	*3.9*	-

MAXIMUM = Maximum B/KM2 on any one transect
X = Mean transect density
2 S.E. = Two standard errors of the mean
B/KM2 = Birds Per Square Kilometer

Table 16. *Black-legged/Red-legged Kittiwake Density Indices From Shipboard Shipboard Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	**78**	**154**						
MAXIMUM			14.04	138.23	11.88	49.20	16.20	138.23
$\bar{x}$			0.33	1.97	**2.00**	2.05	2.33	4.02
2 S.E.			0.38	1.95	**0.58**	0.81	0.71	2.12
FW7033								
Jun.	**40**	**193**						
MAXIMUM			22.68	54.00	**9.00**	27.00	**30.24**	*61.85*
$\bar{x}$			1.37	0.42	**2.33**	0.88	**3.70**	*1.30*
2 S.E.			1.28	0.56	**0.79**	0.38	**1.79**	*0.74*
FW7034								
Jul.	*156*	*144*						
MAXIMUM			130.79	19.20	**79.52**	36.72	*133.19*	**36.72**
$\bar{x}$			5.52	0.19	**6.84**	0.97	*12.37*	**1.15**
2 S.E.			2.68	0.27	**2.12**	0.60	*3.69*	**0.68**
FW7035								
Aug.	*68*	*168*						
MAXIMUM			32.40	1.08	**70.19**	27.00	**70.19**	**28.08**
$\bar{x}$			1.86	0.01	**7.73**	0.55	**9.59**	**0.55**
2 S.E.			1.39	0.01	**2.80**	0.39	**3.21**	**0.40**
FW7036								
Sep.	**113**	**82**						
MAXIMUM			12.96	5.40	**68.03**	10.80	**68.03**	10.80
$\bar{x}$			0.88	0.10	**9.47**	0.71	**10.35**	0.82
2 S.E.			0.43	0.14	**2.33**	0.37	**2..34**	0.41
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.00	**48.60**	5.81	**48.60**	**5.81**
$\bar{x}$			0.00	0.00	**22.91**	1.16	22.91	1.16
2 S.E.					**70.21**	0.54	70.21	0.54
FW7047								
Nov.	16	124						
MAXIMUM			25.0	?	**3.8**	?	**26.3**	*9.2*
$\bar{x}$			1.7	?	**0.6**	?	**2.3**	*0.9*
2 S.E.			3.1		**0.5**		**3.3**	*0.2*

MAXIMUM = Maximum B/KM2 on any one *transect*
$\bar{x}$ = Mean transect density
2 S.E. = Two standard errors of the mean
B/KM2 = *Birds Per Square Kilometer*

Table 17. *Arctic Tern Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			**2.16**	**4.32**	**14.73**	**8.64**	**16.69**	**12.96**
$\bar{X}$			**0.08**	**0.04**	**0.41**	**0.10**	**0.49**	**0.13**
2 S.E.			**0.09**	**0.06**	**0.41**	**0.12**	**0.46**	**0.18**
FW7033								
Jun.	40	**193**						
MAXIMUM			2.16	0.98	1.20	0.00	2.16	0.98
$\bar{X}$			0.08	0.01	0.06	0.00	0.14	0.01
2 S.E.			0.12	0.01	0.09	-	0.14	0.01
FW7034								
Jul.	156	144						
MAXIMUM			*1.80*	*2.16*	*16.87*	*5.40*	*16.87*	*6.40*
$\bar{X}$			*0.02*	*0.01*	*0.58*	*0.04*	*0.60*	*0.05*
2 S.E.			*0.03*	*0.03*	*0.32*	*0.07*	*0.32*	*0.08*
FW7035								
Aug.	68	168						
MAXIMUM			0.00	**3.24**	**8.40**	**4.05**	**8.40**	**4.05**
$\bar{X}$			0.00	**0.03**	**0.58**	**0.13**	**0.58**	**0.17**
2 S.E.				**0.04**	**0.39**	**0.09**	**0.39**	**0.10**
FW7036								
Sep.	113	82						
MAXIMUM			?	**0.00**	?	**1.08**	+	**1.08**
$\bar{X}$			?	**0.00**	?	**0.01**	+	**0.01**
2 S.E.			-		-	**0.03**		**0.03**
FW7046								
Sep.	3	**35**						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.83**	**0.00**	**0.83**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.02**	**0.00**	**0.02**
2 S.E.						**0.05**		**0.05**
FW7047								
Nov.	16	**124**						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								

MAXIMUM = Maximum B/KM2 on any one transect
$\bar{X}$ = *Mean transect density*
2 S.E. = Two standard errors of the mean
B/KM2 = *Birds Per Square Kilometer*

Table 18. Aleutian Tern Density Indices From Shipboard Surveys of Kodiak *Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			1.08	2.16	2.95	**0.00**	2.95	**2.16**
$\bar{x}$			0.01	0.01	0.14	**0.00**	0.15	**0.01**
2 S.E.			0.03	0.03	0.13		0.13	**0.03**
FW7033								
Jun.	**40**	**193**						
MAXIMUM			2.70	0.00	0.00	**0.00**	**2.70**	**0.00**
$\bar{x}$			0.07	0.00	0.00	**0.00**	**0.07**	**0.00**
2 S.E.			0.14				**0.14**	
FW7034								
Jul.	**156**	**144**						
MAXIMUM			0.90	0.00	5.40	**1.08**	**5.40**	**1.08**
$\bar{x}$			0.01	0.00	0.08	**0.01**	**0.08**	**0.01**
2 S.E.			0.01		0.08	**0.01**	**0.08**	**0.01**
FW7035								
Aug.	**68**	**168**						
MAXIMUM			0.00	0.00	2.40	**2.70**	2.40	**2.70**
$\bar{x}$			0.00	0.00	0.22	**0.03**	0.22	**0.03**
2 S.E.					0.12	**0.04**	0.12	**0.04**
Fw7036								
Sep.	**113**	**82**						
MAXIMUM			0.00	0.00	0.00	**0.00**	**0.00**	**0.00**
$\bar{x}$			0.00	0.00	0.00	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.00	0.00	**0.00**	**0.00**	**0.00**
x			0.00	0.00	0.00	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7047								
Nov.	**16**	**124**						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{x}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								

MAXIMUM = *Maximum* B/KM2 *on any one transect*
x = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 19. *Common/Thick-billed Murre Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
Fw7032								
May-Jun.	**78**	**154**						
MAXIMUM			**16.20**	**43.20**	**16.20**	**21.60**	**16.20**	**43.20**
$\bar{X}$			**1.59**	**3.85**	**0.95**	**1.22**	**2.91**	**5.07**
2 S.E.			**0.83**	**1.08**	**0.58**	**0.52**	**1.04**	**1.16**
FW7033								
Jun.	**40**	**193**						
MAXIMUM			14.40	40.25	28.80	6.87	29.70	40.25
$\bar{X}$			1.89	2.16	1.11	0.39	3.00	2.55
2 S.E.			1.09	0.78	1.48	0.16	1.84	0.79
FW7034								
Jul.	*156*	*144*						
MAXIMUM			*32.40*	*12.96*	*2.40*	*2.40*	*32.40*	*12.96*
$\bar{X}$			*0.80*	*0.76*	*0.09*	*0.06*	*0.89*	*0.82*
2 S.E.			*0.52*	*0.35*	*0.06*	*0.05*	*0.52*	*0.36*
FW7035								
Aug.	68	168						
MAXIMUM			*51.84*	*24.84*	*1.08*	*5.40*	*51.84*	*24.84*
$\bar{X}$			*2.23*	*1.04*	*0.03*	*0.25*	*2.26*	*1.29*
2 S.E.			*1.90*	*0.46*	*0.04*	*0.13*	*1.90*	*0.48*
FW7036								
Sep.	**113**	**82**						
MAXIMUM			**90.71**	45.36	4.91	**1.35**	**90.71**	**45.36**
$\bar{X}$			**9.37**	5.29	0.12	**0.04**	**9.50**	**5.33**
2 S.E.			**2.82**	1.82	0.11	**0.05**	**2.82**	**1.83**
FW7046								
Sep.	**3**	**35**						
MAXIMUM			**0.00**	**18.90**	**5.40**	**17.10**	**5.40**	**18.90**
x			**0.00**	**2.29**	**3.38**	**1.34**	**3.38**	**3.63**
2 S.E.				**1.44**	**5.60**	**1.39**	**5.60**	**1.80**
FW7047								
Nov.	16	124						
MAXIMUM			26.4	?	*44.2*	?	*53.3*	*106.2*
$\bar{X}$			6.0	?	*4.3*	?	*10.4*	*6.5*
2 S.E.			4.2	-	*5.5*	-	*7.5*	*3.0*

MAXIMUM = *Maximum* B/KM2 *on any one transect*
$\bar{X}$ = Mean *transect density*
2 S.E. = *Two standard errors* of *the mean*
B/KM2 = Birds Per Square Kilometer

Table 20. Pigeon Guillemot Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	"SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			20.52	8.10	7.85	3.24	20.52	9.00
$\bar{X}$			0.50	0.09	0.17	0.08	0.67	0.17
2 S.E.			0.60	0.11	0..22	0.07	0.65	0.14
FW7033								
Jun.	40	193						
MAXIMUM			14.04	2.16	2.16	3.24	14.04	5.40
$\bar{X}$			0.53	0.01	0.11	0.02	0.64	0.03
2 S.E.			0.77	0.02	0.14	0.03	0.78	0.06
FW7034								
Jul.	156	144						
MAXIMUM			54.90	8.64	5.40	3.60	54.90	8.64
$\bar{X}$			0.54	0.09	0.24	0.02	0.78	0.12
2 S.E.			0.70	0.14	0.12	0.05	0.71	0.17
FW7035								
Aug.	68	168						
MAXIMUM			6.48	0.00	4.80	1.08	9.60	1.08
$\bar{X}$			0.53	0.00	0.35	0.01	0.88	0.01
2 S.E.			0.33		0.22	0.02	0.48	0.02
FW7036								
Sep.	113	82						
MAXIMUM			2.16	0.00	0.00	0.00	2.16	0.00
$\bar{X}$			0.02	0.00	0.00	0.00	0.02	0.00
2 S.E.			0..04				0.04	
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
$\bar{X}$			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7047								
Nov.	16	124						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
$\bar{X}$			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								

MAXIMUM = *Maximum* B/KM2 *on any one transect*
$\bar{x}$ = *Mean transect density*
2 S.E. = *Two standard errors* of *the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 21. *Marbled\Kittlitz's* Murrelet *Density Indices From Shipboard Surveys of Kodiak* Island *Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			37.80	14.73	6.48	3.60	44.28	16.69
x			2.28	0.25	0.67	0.06	2.95	0.31
2 S.E.			1.42	0.21	0.32	0.06	1.56	0.25
FW7033								
Jun.	40	193						
MAXIMUM			*5.89*	16.80	*19.20*	*11.78*	22.80	16.80
X			*0.57*	*0.44*	*1.13*	*0.40*	1.70	0.84
2 S.E.			*0.43*	*0.22*	*1.06*	*0.20*	1.31	0.33
FW7034								
Jul.	*156*	*144*						
MAXIMUM			70.79	16.20	50.40	14.04	121.19	30.24
X			1.85	0.30	1.29	0.30	3.14	0.60
2 S.E.			1.16	0.27	0.76	0.25	1.81	0.50
FW7035								
Aug.	*68*	*168*						
MAXIMUM			18.90	7.56	12.00	8.10	24.00	10.80
X			1.29	0.26	1.06	0.36	2.35	0.62
2 S.E.			0.77	0.15	0.62	0.17	1.21	0.26
FW7036								
Sep.	*113*	*82*						
MAXIMUM			10.80	3.24	7.20	2.16	16.80	5.40
X			0.50	0.04	0.35	0.03	0.85	0.07
2 S.E.			0.29	0.08	0.20	0.05	0.42	0.13
Fw7046								
Sep.	3	35						
MAXIMUM			0.00	?	1.96	?	1.96	+
x			0.00	?	0.95	?	0.95	i-
2 S.E.					2.99	-	2.95	-
FW7047								
Nov.	16	124						
MAXIMUM			0.00	?	0.00	?	0.00	2.5·
X			0.00	?	0.00	?	0.00	0.03
2 S.E.								?

MAXIMUM = Maximum B/KM2 on any one transect
x · *Mean transect density*
2 S.E. = *Two standard errors* of *the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 22. Ancient Murrelet Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			0.00	1.96	0.98	0.00	0.98	1.96
$\bar{x}$			0.00	0.03	0.01	0.00	0.01	0.03
2 S.E.				0.04	0.03		0.03	0.04
FW7033								
Jun.	40	193						
MAXIMUM			0.00	7.85	0.00	7.56	0.00	7.85
$\bar{x}$			0.00	0.15	0.00	0.21	0.00	0.35
2 S.E.				0.13		0.15		0.19
FW7034								
Jul.	156	144						
MAXIMUM			0.00	17.67	0.00	19.63	0.00	19.63
$\bar{x}$			0.00	0.26	0.00	0.30	0.00	0.57
2 S.E.				0.29		0.37		0.46
FW7035								
Aug.	68	168						
MAXIMUM			0.00	1.08	0.00	2.70	0.00	2.70
$\bar{x}$			0.00	0.01	0.00	0.04	0.00	0.04
2 S.E.				0.01		0.04		0.04
FW7036								
Sep.	113	82						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
$\bar{x}$			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
$\bar{x}$			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.						-		
FW7047								
Nov.	16	124						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
$\bar{x}$			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								

MAXIMUM = Maximum B/KM2 on any one transect
$\bar{x}$ = Mean transect density
2 S.E. = Two standard errors of the mean
B/KM2 = Birds Per Square Kilometer

Table 23. Cassin's *Auklet Density Indices From Shipboard Surveys of* Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			0.00	0.00	0.00	1.08	0.00	*1.08*
X			0.00	0.00	0.00	0.01	0.00	*0.01*
2 S.E.						0.01		*0.01*
FW7033								
Jun.	40	193						
MAXIMUM			0.00	0.00	0.00	0.00	0.00	0.00
X			0.00	0.00	0.00	0.00	0.00	0.00
2 S.E.								
FW7034								
Jul.	*156*	*144*						
MAXIMUM			0.00	5.40	1.20	3.24	1.20	6.48
X			0.00	0.16	0.01	0.04	0.01	0.20
2 S.E.				0.13	0.02	0.05	0.02	0.16
FW7035								
Aug.	68	168						
MAXIMUM			45.36	14.04	2.16	5.40	45.36	14.04
X			1.03	0.89	0.03	0.20	1.06	1.08
2 S.E.			1.52	0.35	0.06	0.12	1.55	0.40
FW7036								
Sep.	*113*	*82*						
MAXIMUM			*6.84*	11.88	7.56	*14.04*	14.04	*21.60*
X			*0.29*	0.68	0.34	*1.06*	0.62	*1.73*
2 S.E.			*0.18*	0.37	0.24	*0.59*	0.35	*0.80*
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.83	0.00	2.70	0.00	2.70
X			0.00	0.05	0.00	0.18	0.00	0.23
2 S.E.				0.07		0.18		0.20
FW7047								
Nov.	16	124						
MAXIMUM			0.00	?	0.00	?	0.00	4.6
X			0.00	?	0.00	?	0.00	0.2
2 S.E.				–		–		0.1

MAXIMUM = Maximum B/KM2 on any one transect
x = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 24. *Parakeet* Auklet *Density Indices From Shipboard Surveys of* Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			0.00	1.08	**0.00**	**0.00**	**0.00**	**1.08**
$\bar{X}$			0.00	0.01	**0.00**	**0.00**	**0.00**	**0.01**
2 S.E.				0.01				**0.01**
FW7033								
Jun.	40	193						
MAXIMUM			0.00	2.16	**0.00**	**3.60**	**0.00**	*3.60*
$\bar{X}$			0.00	0.02	**0.00**	**0.02**	*0.00*	*0.04*
2 S.E.				0.02		**0.04**		*0.04*
FW7034								
Jul.	156	144						
MAXIMUM			6.00	11.88	**0.00**	*7.85*	6.00	11.88
$\bar{X}$			0.04	0.26	*0.00*	*0.05*	0.04	0.31
2 S.E.			0.08	0.25		*0.11*	0.08	0.27
FW7035								
Aug.	68	168						
MAXIMUM			0.00	0.00	*1.08*	*0.00*	**1.08**	**0.00**
$\bar{X}$			0.00	0.00	*0.02*	*0.00*	**0.02**	**0.00**
2 S.E.					*0.03*	-	**0.03**	-
FW7036								
Sep.	113	82						
MAXIMUM			0.00	0.00	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			0.00	0.00	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7046								
Sep.	3	35						
MAXIMUM			0.00	0.83′	**0.00**	**0.90**	**0.00**	**0.90**
$\bar{X}$			0.00	0.02	**0.00**	**0.03**	**0.00**	**0.05**
2 S.E.				′ 0.05		**0.05**		**0.07**
FW7047								
Nov.	16	124						
MAXIMUM			0.00	?	**0.00**	?	*0.00*	*1.7*
$\bar{X}$			0.00	?	**0.00**	?	*0.00*	*0.03*
2 S.E.								?

MAXIMUM = *Maximum B/KM2 on any one transect*
$\bar{X}$ = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = Birds Per Square Kilometer

Table 25. *Crested* Auklet *Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 *ON WATER & FEEDING*		B/KM2 *FLYING*		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	*154*						
MAX IMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7033								
Jun.	40	*193*						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7034								
Jul.	156	*144*						
MAXIMUM			0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7035								
Aug.	68	**168**						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
Fw7036								
Sep.	113	**82**						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7046								
Sep.	3	**35**						
MAXIMUM			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
$\bar{X}$			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
2 S.E.								
FW7047								
Nov.	16	**124**						
MAXIMUM			**5.8**	?	**1.7**	?	7.5	12.7
$\bar{X}$			**0.7**	?	**0.2**	?	0.9	0.2
2 S.E.			**0.8**	-	**0.3**		1.0	0.2

MAXIMUM = Maximum B/KM2 on any one transect
$\bar{X}$ = Mean transect density
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 26. *Horned Puffin* Density Indices *From Shipboard Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 *ON* WATER *& FEEDING*		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
Fw7032								
May-Jun.	*78*	*154*						
MAXIMUM			**6.48**	**2.16**	**3.24**	**24.00**	*6.48*	**24.00**
$\bar{X}$			**0.20**	**0.05**	**0.15**	**0.50**	*0.35*	**0.54**
2 S.E.			**0.19**	**0.04**	**0.13**	**0.35**	*0.24*	**0.35**
FW7033								
Jun.	**40**	**193**						
MAX IMUM			**0.00**	**2.95**	**1.20**	**3.93**	**1.20**	3.93
$\bar{X}$			**0.00**	**0.04**	**0.10**	**0.06**	**0.10**	0.10
2 S.E.				**0.04**	**0.10**	**0.05**	**0.10**	0.07
FW7034								
Jul.	**156**	**144**						
MAXIMUM			**30.24**	**2.16**	**4.91**	**3.24**	*33.48*	*3.24*
$\bar{X}$			**0.38**	**0.05**	**0.24**	**0.10**	*0.62*	*0.16*
2 S.E.			**0.40**	**0.04**	**0.12**	**0.07**	*0.46*	*0.08*
FW7035								
Aug.	*68*	*168*						
MAXIMUM			**9.72**	**1.08**	**7.20**	**1.08**	*10.80*	*1.08*
$\bar{X}$			**0.19**	**0.02**	**0.27**	**0.02**	*0.46*	**0.04**
2 S.E.			**0.29**	**0.02**	**0.25**	**0.02**	*0.40*	**0.03**
Fw7036								
Sep.	**113**	**82**						
MAXIMUM			**15.60**	**10.80**	**7.2o**	**5.40**	16.80	**12.15**
$\bar{X}$			**0.52**	**1.08**	**0.35**	**0.50**	0.87	**1.58**
2 S.E.			**0.32**	**0.43**	**0.20**	**0.24**	0.39	**0.55**
Fw7046								
Sep.	*3*	*35*						
MAXIMUM			**0.00**	**1.66**	**1.96**	**8.10**	**1.96**	**8.10**
$\bar{X}$			**0.00**	**0.05**	**0.95**	**0.33**	**0.95**	**0.38**
2 S.E.				**0.10**	**2.99**	**0.49**	**2.99**	**0.49**
FW7047								
Nov.	*16*	*124*						
MAXIMUM			**0.00**	?	**0.00**	?	**0.00**	**21.5**
$\bar{X}$			**0.00**	?	**0.00**	?	**0.00**	**0.7**
2 S.E.								**0.4**

MAXIMUM = Maximum B/KM2 on any one transect
$\bar{X}$ = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*

Table 27. *Tufted Puffin Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.*

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	78	154						
MAXIMUM			87.47	38.88	32.40	36.72	96.21	*75.59*
X			6.30	3.39	2.71	2.24	9.01	*5.63*
2 S.E.			3.28	1.13	1.28	0.77	3.96	*1.62*
FW7033								
Jun.	40	193						
MAXIMUM			93.95	37.80	20.62	12.76	100.43	37.80
X			8.39	1.73	4.44	1.56	12.82	3.30
2 S.E.			5.55	0.58	1.69	0.34	5.90	0.69
FW7034								
Jul.	*156*	*144*						
MAXIMUM			278.08	7.56	135.59	16.20	279.88	23.76
x			11.70	0.77	7.28	1.90	18.98	2.67
2 S.E.			5.16	0.27	2.37	0.53	5.73	0.69
FW7035								
Aug.	68	168						
MAXIMUM			*117.71*	*28.08*	*112.49*	*30.24*	*173.87*	*33.48*
X			*7.27*	*2.39*	*14.02*	*2.44*	*21.29*	*4.83*
2 S.E.			*4.49*	*0.71*	*5.13*	*0.68*	*7.83*	*1.03*
FW7036								
Sep.	113	82						
MAXIMUM			*3.93*	25.92	*3.60*	7.56	4.91	*25.92*
x			*0.55*	5.04	*0.19*	0.23	0.74	*5.27*
2 S.E.			*0.19*	1.07	*0.12*	0.21	0.23	*1.09*
FW7046								
Sep.	3	35						
MAXIMUM			0.00	18.28	2.95	9.90	2.95	18.28
X			0.00	3.72	2.18	0.49	2.18	4.21
2 S.E.				2.06	3.40	0.61	3.40	2.04
FW7047								
Nov.	16	124						
MAXIMUM			0.00	?	0.00	?	13.9	1.7
X			0.00	?	0.00	?	0.3	0.1
2 S.E.				–		–	0.3	0.1

MAXIMUM = Maximum B/KM2 on any one transect
x = *Mean transect density*
2 S.E. = Two standard errors of the mean
B/KM2 = *Birds Per Square Kilometer*

Table 28. Total Bird Density Indices From Shipboard Surveys of Kodiak Island Waters, 1977.

	NUMBER OF TRANSECTS		B/KM2 ON WATER & FEEDING		B/KM2 FLYING		TOTAL B/KM2	
	BAY	SHELF	BAYS	SHELF	BAYS	SHELF	BAYS	SHELF
FW7032								
May-Jun.	*78*	*154*						
MAXIMUM			**106.9**	**844.3**	**48.1**	**699.8**	**126.4**	**1138.8**
$\bar{X}$			**13.4**	**30.4**	**8.5**	**23.5**	**21.9**	**53.9**
2 S.E.			**4.6**	**17.1**	**2.1**	**12.7**	**5.8**	**23.2**
FW7033								
Jun.	**40**	**193**						
MAXIMUM			*97..2*	*3495.0*	*49.5*	**1590.7**	**109.1**	**3498.9**
$\bar{X}$			*15.2*	*47.6*	*10.5*	**24.9**	**25.7**	**72.5**
2 S.E.			*6.5*	*.38.2*	*3.4*	**17.0**	**7.9**	**42.4**
FW7034								
Jul.	156	144						
MAXIMUM			*471.6*	*5618.8*	*135.6*	*547.2*	*479.7*	*5664.2*
$\bar{X}$			*28.0*	*66.4*	*22.7*	*18.3*	*50.7*	*84.7*
2 S.E.			*9.1*	*78.4*	*4.2*	*9.1*	*10.7*	*79.6*
FW7035								
Aug .	*68*	*168*						
MAXIMUM			**650.7**	**3244.1**	**139.5**	*883.4*	*790.1*	*3250.5*
$\bar{X}$			*27.7*	*52.4*	**31.5**	*32.1*	*59.2*	*84.6*
2 S.E.			*20.0*	*40.6*	**7.7**	*11.4*	*24.8*	*43.0*
Fw7036								
Sep.	*113*	*82*						
MAXIMUM			114.5	320.7	*368.4*	*544.0*	*393.6*	*568.3*
$\bar{X}$			14.3	43.5	*20.9*	*28.5*	*35.2*	*72.0*
2 S.E.			3.4	14.1	*8.1*	*13.4*	*9.2*	*19.3*
Fw7046								
Sep.	3	35						
MAXIMUM			**0.0**	*122.1*	*55.8*	**711.8**	**55.8**	711.8
$\bar{X}$			*0.0*	*24.6*	*47.4*	**48.4**	**47.4**	**73.0**
2 S.E.				*13.2*	*42.1*	*45.6*	*42.1*	*45.2*
FW7047								
Nov.	16	**124**						
MAXIMUM			**30.8**	?	**3.9**	?	*34.6*	*452.3*
$\bar{X}$			**19.7**	?	**3.5**	?	*17.3*	*20.9*
2 S.E.			?		?	–	?	8.6

MAXIMUM = *Maximum B/KM2 on any one transect*
$\bar{X}$ = *Mean transect density*
2 S.E. = *Two standard errors of the mean*
B/KM2 = *Birds Per Square Kilometer*