NOAA Technical Memorandum NMFS-F/NEC-59

Antarctic Marine Living Resources Program

Surveys of Breeding Penguins and Other Seabirds in the South Shetland Islands, Antarctica, January-February 1987

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole, Massachusetts

September 1988

Recent issues in this series

31. **Evidence of Nearshore Summer Upwelling Off Atlantic City, New Jersey.** By Merton C. Ingham and James Eberwine. November 1984. iii + 10 p., 5 figs. NTIS Access. No. PB85-150290.

32. **Secondary Production of Benthic Macrofauna at Three Stations of Delaware Bay and Coastal Delaware.** By Stavros Howe and Wayne Leathem. November 1984. ix + 62 p., 6 figs., 19 tables. NTIS Access. No. PB85-145753/AS.

33. **MARMAP Surveys of the Continental Shelf from Cape Hatteras, North Carolina, to Cape Sable, Nova Scotia (1977-1983). Atlas No. 1. Summary of Operations.** By John D. Sibunka and Myron J. Silverman. November 1984. vii + 306 p., 52 figs., 2 tables. NTIS Access. No. PB85-150985/AS.

34. **Oceanology: Biology of the Ocean. Volume 2. Biological Productivity of the Ocean.** By M. E. Vinogradov, editor in chief. First printed by Nauka Press, Moscow, 1977. Translated from the Russian by Albert L. Peabody. January 1985. x + 518 p., 81 figs., 59 tables. NTIS Access. No. PB85-204683/AS.

35. **Annual NEMP Report on the Health of the Northeast Coastal Waters, 1982.** By John B. Pearce, Carl R. Berman, and Marlene R. Rosen, eds., and Robert N. Reid (benthos), Catherine E. Warsh (water quality), and Edith Gould (biological effects), topic coords. January 1985. xi + 68 p., 29 figs., 5 tables. NTIS Access. No. PB85-219129/AS.

36. **Growth and Survival of Larval Fishes in Relation to the Trophodynamics of Georges Bank Cod and Haddock.** By Geoffrey C. Laurence and R. Gregory Lough. January 1985. xvi + 150 p., 67 figs., 15 tables, 1 app. NTIS Access. No. PB85-220093/AS.

37. **Regional Action Plan.** By Bruce E. Higgins, Ruth Rehfus, John B. Pearce, Robert J. Pawlowski, Robert L. Lippson, Timothy Goodger, Susan Mello Roe, and Douglas W. Beach. April 1985. ix + 84 p., 4 figs., 6 tables, 9 app. NTIS Access. No. PB85-219962/AS.

38. **The Shelf/Slope Front South of Nantucket Shoals and Georges Bank as Delineated by Satellite Infrared Imagery and Shipboard Hydrographic and Plankton Observations.** By J. B. Colton, Jr., J. L. Anderson, J. E. O'Reilly, C. A. Evans-Zetlin, and H. G. Marshall. May 1985. vi + 22 p., 14 figs. NTIS Access. No. PB85-221083/AS.

39. **USA Historical Catch Data, 1904-82, for Major Georges Bank Fisheries.** By Anne M. T. Lange and Joan E. Palmer. May 1985. iii + 21 p., 12 figs., 2 tables. NTIS Access. No. PB85-233948/AS.

40. **Indexing the Economic Health of the U.S. Fishing Industry's Harvesting Sector.** By Virgil J. Norton, Morton M. Miller, and Elizabeth Kenney. May 1985. v + 42 p., 44 figs., 25 tables, 1 app. NTIS Access. No. PB85-217958/AS.

41. **Calculation of Standing Stocks and Energetic Requirements of the Cetaceans of the Northeast United States Outer Continental Shelf.** By Robert D. Kenney, Martin A. M. Hyman, and Howard E. Winn. May 1985. iv + 99 p., 1 fig., 5 tables, 1 app. NTIS Access. No. PB85-239937/AS.

42. **Status of the Fishery Resources Off the Northeastern United States for 1985.** By Conservation & Utilization Division, Northeast Fisheries Center. August 1985. iii + 137 p., 46 figs., 49 tables. NTIS Access. No. PB86-125473/AS.

43. **Status of the Fishery Resources Off the Northeastern United States for 1986.** By Conservation & Utilization Division, Northeast Fisheries Center, September 1986. iii + 130 p., 45 figs., 48 tables. NTIS Access. No. PB87-122115/AS.

(continued on inside back cover)

GENERAL DISCLAIMER

This document may be affected by one or more of the following statements

- **This document has been reproduced from the best copy furnished by the sponsoring agency. It is being released in the interest of making available as much information as possible.**
- **This document may contain data which exceeds the sheet parameters. It was furnished in this condition by the sponsoring agency and is the best copy available.**
- **This document may contain tone-on-tone or color graphs, charts and/or pictures which have been reproduced in black and white.**
- **This document is paginated as submitted by the original source.**
- **Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.**

NOAA Technical Memorandum NMFS-F/NEC-59

This TM series is used for documentation and timely communication of preliminary results, interim reports, or special purpose information, and has not received complete formal review, editorial control, or detailed editing.

Antarctic Marine Living Resources Program

Surveys of Breeding Penguins and Other Seabirds in the South Shetland Islands, Antarctica, January-February 1987

W. David Shuford and Larry B. Spear

Point Reyes Bird Observatory, 4990 Shoreline Highway, Stinson Beach, CA 94970

U. S. DEPARTMENT OF COMMERCE
C. William Verity, Secretary
National Oceanic and Atmospheric Administration
William E. Evans, Administrator
National Marine Fisheries Service
James W. Brennan, Assistant Administrator for Fisheries
Northeast Fisheries Center
Woods Hole, Massachusetts

September 1988

BIBLIOGRAPHIC INFORMATION

PB89-141311

Report Nos: NOAA-TM-NMFS-F/NEC-59

Title: Surveys of Breeding Penguins and Other Seabirds in the South Shetland Islands, Antarctica, January-February 1987.

Date: Sep 88

Authors: W. D. Shuford, and L. B. Spear.

Performing Organization: National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.**Point Reyes Bird Observatory, Stinson Beach, CA.

Type of Report and Period Covered: Technical memo.,

Supplementary Notes: Prepared in cooperation with Point Reyes Bird Observatory, Stinson Beach, CA.

NTIS Field/Group Codes: 47D, 57Z

Price: PC A03/MF A01

Availability: Available from the National Technical Information Service, Springfield, VA. 22161

Number of Pages: 38p

Keywords: *Birds, *Aquatic animals, *Penguins, Graphs(Charts), Tables(Data), Antarctica, South Shetland Islands, Marine biology, Population growth, Surveys, Antarctic Marine Living Resources Program, Adelie penguin, Chinstrap penguin, Gentoo penguin, Macaroni penguin, Southern giant fulmar, Cape petrel, Wilson's storm petrel, Antarctic tern, Kelp gull, Brown skua, South polar skua, American sheathbill, Antarctic blue-eyed shag, Pygoscelis adelie, Pygoscelis antarctica, Pygoscelis papua, Eudyptes chrysolophus, Macronectes giganteus, Daption capense, Oceanites oceanicus, Phalacrocorax atriceps, Chionis alba, Catharacta lonnbergi, Catharacta maccormicki, Larus dominicanus, Sterna vittata.

Abstract: Surveys conducted as part of the Antarctic Marine Living Resources Program in 1987 provided data on the number, size, and location of penguin and Antarctic Blue-eyed Shag colonies and the breeding status of other seabirds in the South Shetland Islands, Antarctica. Several species were encountered at many more sites than previously reported, thus increasing the known breeding localities of American Sheathbills and skuas by threefold, Chinstrap Penguins by twofold, and Cape Petrels and Antarctic Blue-eyed Shags by 50%. The minimum estimate of 1,620,000 breeding Chinstrap Penguins, the most abundant penguin in the study area, is about 2.5 times greater than previous estimates. Although there appears to have been about a 40% overall increase in the Chinstrap Penguin population in the last 20-30 years, about three-fourths of the difference between these counts and previous ones is due to more complete coverage of available nesting habitat in 1987. For the same reason, at least in part, other species of breeding seabirds

Continued on next page

Continued... PB89-141311

were also found to be more abundant than previously reported.

PROGRAM STATEMENT

The U.S. Antarctic Marine Living Resources (AMLR) Program supports U.S. policy regarding the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). The CCAMLR is an international agreement that supports an ecosystem approach to the conservation and management of living resources found in ocean areas surrounding the continent of Antarctica. The Convention mandates a management regime committed to applying measures to ensure that harvesting of Antarctic marine living resources, such as finfish and krill, is conducted in a manner that considers ecological relationships among dependent and related species. Member countries of CCAMLR are: Argentina; Australia; Belgium; Brazil; Chile; European Economic Community; France; German Democratic Republic; Germany, Federal Republic of; India; Japan; Korea; New Zealand; Norway; Poland; South Africa; Spain; Union of Soviet Socialist Republics; United Kingdom; and United States.

U.S. objectives for CCAMLR were established with the signing into law of the Antarctic Marine Living Resources Convention Act of 1984 (P.L. 98-623). The legislation charges the Secretary of Commerce with the design, conduct and implementation of directed scientific research in support of U.S. objectives in the CCAMLR. Responsibility for these activities has been delegated to the National Marine Fisheries Service (NMFS) of NOAA.

The U.S. AMLR Program supports the CCAMLR need for information through analysis of commercial fisheries data and directed research on key species groups in the Antarctic marine ecosystem. This information, along with research done by other member countries, is used by the CCAMLR to detect and record significant changes in critical components of the Antarctic ecosystem. The Scientific Committee of the CCAMLR then makes conservation recommendations to the Commission, which establishes required conservation measures.

The U.S. AMLR Program focuses its field research activities in the southwest Atlantic Ocean, Scotia Arc, and Antarctic Peninsula. Special attention is directed to the vicinity of Bransfield Strait, South Shetland Islands, and the Palmer Archipelago. In addition, the AMLR Program conducts field work in other areas, as needed, to provide comparative data.

ABSTRACT

Surveys conducted as part of the Antarctic Marine Living Resources Program in 1987 provided data on the number, size, and location of penguin and Antarctic Blue-eyed Shag colonies and the breeding status of other seabirds in the South Shetland Islands, Antarctica. We encountered several species at many more sites than previously reported, thus increasing the known breeding localities of American Sheathbills and skuas by threefold, Chinstrap Penguins by twofold, and Cape Petrels and Antarctic Blue-eyed Shags by 50%.

Our minimum estimate of 1,620,000 breeding Chinstrap Penguins, the most abundant penguin in the study area, is about 2.5 times greater than previous estimates. Although there appears to have been about a 40% overall increase in the Chinstrap Penguin population in the last 20-30 years, about three-fourths of the difference between our counts and previous ones is due to more complete coverage of available nesting habitat in 1987. For the same reason, at least in part, other species of breeding seabirds were also found to be more abundant than previously reported.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

Our warmest thanks to the captain, crew, and scientists of the Polish research ship, Professor Siedlecki, who made our survey work not only possible, but most enjoyable. John Bengtson organized the boat logistics and the nearly complete census coverage of the South Shetlands would not have been possible without his foresight and drive. Lisa Ferm, Mike Goebel, Dick Merrick, Everett Schaner, and, especially, Tero Harkonen provided help with censusing and boat operations. Dick Merrick provided penguin counts from Seal Island during his 30 January to 13 February 1987 stay there. David Ainley organized our participation, provided much advice and oversight and, along with John P. Croxall and Wayne Trivelpiece, made helpful suggestions to drafts of this report. Susan Goldhaber and Liz Tuomi helped in preparation of the manuscript, and Ian Gaffney drafted the figures. This is contribution No. 366 of Point Reyes Bird Observatory. This work was supported by the Antarctic Marine Living Resources Program (AMLR), NMFS/NOAA.

INTRODUCTION

Data on the distribution and abundance of breeding penguins and other seabirds of the Antarctic Peninsula and the islands of the Scotia Sea have been summarized recently but information is incomplete (Watson et al., 1971; Croxall and Kirkwood, 1979; Wilson, 1983; Croxall et al., 1984). To fill data gaps, we censused breeding birds along most of the ice-free shoreline of the South Shetland Islands from 29 January to 12 February 1987. This work highlighted the need for careful regional census work to assess population trends accurately (see Jehl and Todd, 1985).

STUDY AREA AND METHODS

Censuses. Our work in the South Shetland Islands (Fig. 1) was conducted in conjunction with the AMLR Program surveys of seals, primarily Antarctic fur seals (Arctocephalus gazella) and southern elephant seals (Mirounga leonina). We surveyed the ice-free shorelines of King George, Nelson, Robert, Greenwich, Livingston, Deception, Snow, Smith and Low Islands, and other small offshore islands in their vicinity (Figs. 2-5). Locations not censused include offshore islands on the north coast of King George Island from Cape Melville to False Round Point and from Stigant Point to Fildes Strait (Fig. 2), the inside of Admiralty Bay, King George Island from Sphinx Hill on the west to Chabrier Rock on the east (Fig. 2), and offshore islands on the north coast of Nelson and Robert Islands as far west as Dee Island off the northeast corner of Greenwich Island (Fig. 3).

Information for some of these areas was obtained from observers who were principally engaged in the censusing of seals. In the Elephant Island group the only sites we surveyed for breeding seabirds were the Seal Islands and Cape Lindsey, Elephant Island (Fig. 4). So as not to bias our censuses, we refrained from consulting previous penguin colony-size estimates for this region (Croxall and Kirkwood, 1979; Jablonski, 1984) until after the completion of our work.

Surveys were conducted primarily from two inflatable boats deployed from the Polish research ship, Professor Siedlecki. Seabirds were viewed through 8-10X binoculars from the stationary boats or while we cruised at approximately 1-3 knots, usually 50-300 m from shore. We occasionally went ashore to census seals and to obtain overviews of very large penguin colonies which were not completely visible from the water.

At all Chinstrap Penguin (Pygoscelis antarctica) colonies, and the one Macaroni Penguin (Eudyptes chrysolophus) colony, we counted adults associated directly with nests or young only, excluding peripheral birds such as those roosting nearby, loafing on beaches, or walking to and from the colonies. At the time of our censuses, Chinstrap and Macaroni adults and chicks were still closely associated with their nest sites. At most Gentoo Penguin (Pygoscelis papua) colonies, we censused adults by the above method, but, because Gentoos breed earlier than Chinstraps, we sometimes estimated adult numbers by counting chicks, a method recommended by Croxall and Kirkwood (1979) when many adults are absent from the colony. Our censuses of penguins were dependent on

the schedule and priorities of the seal investigators, and thus we were able to obtain careful counts at only a few sites. Because of the short time available for most censuses, the distant looks at some colonies, and sub-optimal viewing conditions when looking up to cliffs from a moving boat, we probably missed some small colonies of Gentoo or Macaroni Penguins amidst large Chinstrap colonies.

Accuracy of censuses. We report estimates of breeding penguins and Antarctic Blue-eyed Shags as the total number of adults. Because we could not estimate other breeding species adequately, we report their suspected or confirmed breeding status only. Among-site differences existed in censusing conditions (e.g., diverse topography, boat versus land vantage points, and time available for censusing) and, thus, the accuracy of our censuses varied considerably. Accordingly, we assigned each penguin estimate to one of four categories of accuracy:

1) Detailed counts of individuals in small colonies (<500 birds) or estimates of individuals by blocks of 10, 50, or 100 in larger colonies -- these were made from the land by walking along colony boundaries; we guess accuracy to be ±5-10% (see Jehl and Todd, 1985).

2) Rough estimates by blocks of 100's or 1,000's, from a moving boat, or by walking around major portions of extensive colonies to make partial counts and mental extrapolations from these -- the accuracy of estimates under 5,000 is probably ±10-20%, between 5,000 and 25,000 ±20-30% and over 25,000 ±30-50%.

3) Gross estimates were guesses based on mental comparison with detailed counts of other penguin colonies or prior experience with known-sized colonies of other seabirds. These were made for very large and expansive colonies when time or vantage points were limited, and were the least reliable of all; accuracy likely ±50-100%.

4) Casual observations were verbal descriptions from observers concerned with other work, or our own for localities where it was not possible to see a substantial proportion of the colony due to time and vantage point limitations.

RESULTS AND DISCUSSION

The following species accounts summarize the results of our surveys on the distribution and abundance of all breeding species encountered. To facilitate direct comparisons with the numbers of breeding sites and individuals in the South Shetlands reported by Croxall et al. (1984), the number of sites from our surveys reported below does not include those in the Elephant Island area.

Adélie Penguin (Pygoscelis adeliae)

Because this species had finished breeding before our effort began, we gathered no information on breeding distribution.

Chinstrap Penguin (Pygoscelis antarctica)

We recorded 91 chinstrap colonies (Table 1, Fig. 6). Although this species occurred throughout the study area, most of the breeding sites and population were located on the northern or western sides of the islands (Table 1). Taking into account the margin of error in our estimates, breeding failure before our arrival, and the lack of quantitative population estimates for several large colonies, a conservative estimate of the minimum population of chinstraps breeding in the study area is 1,620,000. This is about 2.5 times Croxall et al.'s (1984) estimate of about 660,000 birds nesting at 45 sites in the South Shetlands.

Although conditions for conducting the census were not optimal, our estimate of 480,250-641,300 Chinstraps on King George Island compares well with a more detailed 1980/81 estimate of 604,874 (Jablonski, 1984). A comparison of estimates at 23 sites in the South Shetlands with reliable data for both 1987 (Table 1, sites with *) and for prior counts at these sites reported by Croxall and Kirkwood (1979) gives totals of 376,740 and 270,900 Chinstraps, respectively. This suggests that Chinstrap populations in the South Shetlands have increased roughly 40% in about the last 20-30 years. However, since the total estimate of breeding Chinstraps on these islands in 1987 is about 2.5 times the previous estimate, it appears that about 110% of this recent 250% increase in the population estimate is due to our more complete coverage of available nesting habitat in 1987 compared with prior surveys. On the other hand, it is likely that the size of many of the previously uncensused colonies has also increased over time.

Areas where we encountered large populations unreported by Croxall and Kirkwood (1979) were on the north shore of King George Island (also reported by Jablonski 1984), on Low Island, and to a lesser extent, on Livingston, Snow, and Smith Islands (Table 1). In particular, the populations on Low Island added most substantially to the increase. We estimated 760,000 chinstraps there compared to about 40,000 estimated from cursory surveys as reported by Croxall and Kirkwood (1979).

Gentoo Penguin (Pygoscelis papua)

We encountered 21 Gentoo colonies, primarily on the southern sides of the islands (Table 1, Fig. 7). Our data indicate a minimum nesting population of 18,000 Gentoos in the study area. This figure is probably low because: no correction was possible to take breeding failure, which occurred before our arrival, into account; we probably missed some Gentoo colonies in areas we could not survey, and in areas where they were not visible due to their location within large Chinstrap colonies censused from a distance (e.g., Harmony Point, Nelson Island). Croxall et al. (1984) estimated that about 40,000 Gentoo's nested at 24 sites in the South Shetlands. We found Gentoo Penguins at 10 sites not reported by Croxall and Kirkwood (1979). However, the significance of this is unclear because Gentoo colony locations frequently change from year to year (W. Trivelpiece, pers. commun.).

Macaroni Penguin (Eudyptes chrysolophus)

Seal Island was the only site where breeding Macaroni Penguins were observed. One colony of 40 adults and 12 chicks and a second of 85 adults and

13 chicks were found on the east and north sides of the island, respectively. As noted above, we could have missed small numbers of birds nesting within Chinstrap colonies, especially since we could not thoroughly investigate the few sites where the species has been reported co-occurring with Chinstraps south of the Elephant Island group (Croxall and Kirkwood, 1979).

Southern Giant Fulmar (Macronectes giganteus)

We recorded Southern Giant Fulmars at 37 sites scattered throughout the study area (Table 1, Fig. 8). Croxall et al. (1984) estimated that about 630 birds bred at 43 sites. Because these fulmars breed in loose colonies on flat or gently sloping terrain atop coastal bluffs and offshore islands or rocks, our observations made primarily from boats are inadequate for making population estimates due to the limited visibility available to us from boats. For example, at Penguin Island (off King George), we counted about 65 fulmars from a boat while Jablonski (1980) reported 1,012 birds, based on nest counts on land. Croxall et al. (1984) report an association of this species with penguin colonies but the fulmar's apparent absence as a breeder in some areas where very large numbers of penguins nest (e.g., north-central King George Island) suggests that other factors may be important for nest site selection. Perhaps the availability of bluffs or cliffs from which birds can launch themselves into the wind is also a factor.

Cape Petrel (Daption capense)

We recorded Cape Petrels at 18 apparent nesting sites (Table 1, Fig. 9). Since this species nests in crevices primarily on steep cliffs and bluffs, boat surveys are adequate for detecting only the presence or absence of breeding birds. Croxall et al. (1984) estimated 2,000 to 20,000 birds at more than 10 sites in these islands. Although time limitations prevented us from conducting a more thorough census, we suspect that the present breeding population size is on the low end of the range reported by Croxall et al. (1984).

Wilson's Storm-Petrel (Oceanites oceanicus)

We recorded Wilson's Storm-Petrels flying around suitable breeding habitat of cliffs and scree slopes at only seven sites in the study area (Table 1), and so were unable to estimate population size reliably. Since storm-petrels are primarily nocturnal at colonies, surveys from boats are inadequate for censusing this species. Croxall et al. (1984) estimated that two million birds bred at more than 57 sites. More land-based work is needed to clarify population status in the region, particularly because no satisfactory estimates of storm-petrel populations in the Antarctic have been made to date.

Antarctic Blue-eyed Shag (Phalacrocorax atriceps)

We recorded 1,221 Blue-eyed Shags at 34 potential or confirmed breeding sites, primarily on the northern sides of the islands (Table 1, Fig. 10). Croxall et al. (1984) estimated that 1,400 birds bred at 21 sites.

American Sheathbill (Chionis alba)

We recorded sheathbills at 64 sites scattered throughout the study area (Table 1, Fig. 11), primarily at penguin colonies. Although our counts were not accurate for estimating total population size, the bulk of the population apparently occurs on the northern sides of the islands in association with Chinstrap penguins. Croxall et al. (1984) estimated that 1,300 birds nested at 26 sites in the South Shetlands.

Skua spp. (Brown Skua Catharacta lonnbergi and South Polar Skua C. maccormicki)

We recorded skuas at 76 sites (Table 1, Fig. 12). Most birds appeared to be C. lonnbergi, but many were not identified to species. Identification to species, made difficult by our often distant views, was amplified by hybridization of the two species in the South Shetlands. Because Brown Skuas have feeding territories in penguin rookeries, whereas South Polar Skuas do not (Trivelpiece and Volkman, 1982), we were more likely to overlook the latter species. Croxall et al. (1984) estimated that 840 C. lonnbergi bred at more than 20 sites and 20 C. maccormicki bred at six sites in the South Shetlands. Although our counts were not adequate for estimating population size, occurrence of skua at 76 sites suggests a much larger breeding population in this region than has been reported. Indeed, at Point Thomas, King George Island, where both species breed, the 44 C. maccormicki nesting there in 1987 (W. & S. Trivelpiece, pers. commun.) is twice the Croxall et al. (1984) estimate for the whole region. South Polar Skua numbers have increased in recent decades at King George Island (W. & S. Trivelpiece, pers. commun.), as well as in the South Orkneys (Hemmings, 1984).

Kelp Gull (Larus dominicanus)

We recorded Kelp Gulls at 80 sites scattered throughout the study area (Table 1, Fig. 13), but our counts were inadequate for determining population size. Croxall et al. (1984) estimated that 4,200 birds bred at more than 80 sites.

Antarctic Tern (Sterna vittata)

We recorded Antarctic Terns at 45 sites (Table 1), primarily on the northern shores of the islands (Fig. 14). Our counts were inadequate for determining population size. Croxall et al. (1984) estimated that 70,000 birds bred at 44 sites.

OVERVIEW

The adequacy of regional coverage and accuracy of population estimates for breeding penguins of the South Shetland Islands was previously considered "good" relative to other areas in the Antarctic (Croxall et al., 1984). However, it is clear from the number of "new" colonies we encountered and other recent surveys (i.e., Jabloński, 1984) that regional population estimates are inadequate even for species heretofore considered well-censused (e.g., Chinstrap Penguin). For example, Low Island, which supports roughly one-third of the South Shetland Chinstrap population (Table 1), has had minimal prior coverage and Smith and Snow islands, to our knowledge, have

never been censused before (Croxall and Kirkwood, 1979). Our extensive but rough survey indicates that the South Shetland Chinstrap population is, at minimum, two to three times larger than previously thought (Croxall et al., 1984). Because our work was conducted within a short time period, during one year, by one team of observers, which has rarely been the case in other regional assessments, we also have a basis on which to appreciate the relative sizes of the various penguin colonies.

Regional survey coverage of seabirds nesting in crevices and cliffs, and seabirds breeding in more dispersed aggregations (gulls, terns, skuas) has been considered inadequate and patchy, respectively (Croxall et al., 1984). It is, therefore, not surprising that we encountered higher numbers of suspected or confirmed breeding sites for Cape Peterels, American Sheathbills, and skuas than were previously reported. This further suggests that prior regional population estimates for most species of seabirds besides penguins (Croxall et al., 1984) have been rough at best or that populations have been on the increase in recent years. As a result of the survey reported here, we now have a good indication of the number of breeding sites currently existing for most species.

Much attention has been focused on the apparent increase in numbers of Antarctic and sub-Antarctic penguins and other species during this century. This change is thought to be due to increased availability of krill resulting from intense harvesting of baleen whales (Sladen, 1964; Emison, 1968; Conroy and White, 1973; Conroy, 1975; Croxall and Kirkwood, 1979; Smith and Tallowin, 1979; Croxall et al., 1981; Croxall et al., 1984). For the South Shetlands, it has also been suggested that Chinstraps have increased in the last 20 years due to the exposure of suitable nest sites by the retreat of glacial ice cliffs (Jabloński, 1984). However, population changes have been well-documented with census data at only one penguin colony (Croxall et al., 1981), and no adequate data exist for a broad region. Recently, penguin population monitoring programs have gained more attention in the scientific community in response to increased commerical harvest of krill for human use (BIOMASS, 1983, 1984). Much of this work is focused on reproductive success and diet studies. If changes in the size of penguin populations are to be documented, there is still a need for accurate census work in coordination with ecological studies. While it is beyond the scope of this report to suggest methods for future penguin censuses, it is clear that much more detailed work than that reported here will be needed if penguin data are to provide a sensitive tool for monitoring the health of the Antarctic ecosystem.

LITERATURE CITED

BIOMASS. 1983. Meeting of the Biomass Working Party on Bird Ecology, Cambridge 1982. BIOMASS Rep. Ser. 27.

BIOMASS. 1984. Meeting of the Biomass Working Party on Bird Ecology, Wilderness, South Africa 1983. BIOMASS Rep. Ser. 34.

Conroy, J. W. H. 1975. Recent increases in penguin populations in Antarctica and the sub-antarctic. Pp. 331-336 in B. Stonehouse (Ed.) The Biology of Penquins. MacMillan, London.

Conroy, J. W. H., and M. G. White. 1973. The breeding status of the King Penguin (Aptenodytes patagonia). Brit. Antarc. Surv. Bull. 32:31-40.

Croxall, J. P., and E. D. Kirkwood. 1979. The breeding distribution of the penguins on the Antarctic Peninsula and islands of the Scotia Sea. Brit. Antarc. Surv., Cambridge.

Croxall, J. P., P. A. Prince, I. Hunter, S. J. McInnes, and P. G. Copestake. 1984. The seabirds of the Antarctic Peninsula, islands of the Scotia Sea, and Antarctic continent between 80° W and 20° W: Their status and conservation. Pp. 637-666 in J. P. Croxall, P. G. H. Evans, and R. W. Schreiber (Eds.) Status and Conservation of the World's Seabirds. Int. Counc. Bird Preserv., Tech. Publ. No. 2.

Croxall, J. P., D. M. Rootes, and R. A. Prince. 1981. Increases in penguin populations at Signy Island, South Orkney Islands. Brit. Antarc. Surv. Bull. 54:47-56.

Emison, W. B. 1968. Feeding preferences of the Adelie Penguin at Cape Crozier, Ross Island. Pp. 191-212 in O. L. Austin, Jr. (Ed.) Antarctic Bird Studies. Ant. Res. Ser. Vol. 12. Am. Geophys. Union, Washington, D. C.

Hemmings, A. D. 1984. Aspects of the breeding biology of McCormick's Skua Catharacta maccormicki at Signy Island, South Orkney Islands. Brit. Antarc. Surv. Bull. 65:65-79.

Jablonski, B. 1980. Distribution and numbers of birds and pinnipeds on Penguin Island (South Shetland Islands) in January 1979. Polish Polar Res. 1:109-116.

Jablonski, B. 1984. Distribution and numbers of penguins in the region of King George Island, South Shetland Islands in the breeding season 1980/81. Polish Polar Res. 5:17-30.

Jehl, J. R., and F. S. Todd. 1985. A census of the Adelie Penguin colony on Paulet Island, Weddell Sea. Antarc. J. U.S. 19:171-172.

Sladen, W. J. L. 1964. The distribution of the Adelie and Chinstrap Penguins. Pp. 359-365 in R. Carrick, M. W. Holdgate, and J. Prevost (Eds.) Biologie Antarctique. Hermann, Paris.

Smith, R. I. L., and J. R. B. Tallowin. 1979. The distribution and size of King Penguin rookeries on South Georgia. Brit. Antarc. Surv. Bull. 49:259-276.

Trivelpiece, W., and N. J. Volkman. 1982. Feeding strategies of sympatric South Polar Catharacta maccormicki and Brown skuas C. lonnbergi, Ibis 124:50-54.

Watson, G. E., J. P. Angle, P. C. Harper, M. A. Bridge, R. P. Schlatter, W. L. N. Tickell, J. C. Boyd, and M. M. Boyd. 1971. Birds of the Antarctic and sub-Antarctic. Antarctic Map Folio Series 14. Am. Geogr. Soc., New York.

Wilson, G. J. (Ed.). 1983. Distribution and abundance of Antarctic and sub-Antarctic penguins: a synthesis of current knowledge. BIOMASS Sci. Ser. 4.

Table 1. Censuses of breeding penguins and shags and assessment of the breeding status of other seabirds on the South Shetland Islands, Antarctica (Figs. 1-5). Penguin colony size expressed as total adults. Most censuses were of breeding adults, but a few of gentoo penguins were based on chick counts (c). Accuracy of penguin colony estimates: 1 = detailed counts; 2 = rough estimate; 3 = gross estimate; 4 = casual observations (see Methods). * = sites where chinstrap data is compared in the text with that reported by Croxall and Kirkwood (1979). FUSG = Southern giant fulmar (Macronectes giganteus), PETC = Cape petrel (Daption capense), STWI = Wilson's storm-petrel (Oceanites oceanicus), SHBE = Antarctic blue-eyed shag (Phalacrocorax atriceps), SHAM = American sheathbill (Chionis alba), SKUA = Brown and South Polar skuas (Catharacta lonnbergi and C. maccormicki), GUKE = kelp gull (Larus dominicanus), and TEAN = Antarctic Tern (Sterna vittata). Breeding status codes: P = possible breeder, ie. occurring in "appropriate" breeding habitat; PR = probable breeder, ie. exhibiting territorial behavior; @ = confirmed breeder, ie. nest(s) with eggs or pre-fledged young.

		Penguins		Other Seabirds							
# Location	Date	Chinstrap	Gentoo	FUSG	PETC	STWI	SHBE	SHAM	SKUA	GUKE	TEAN
Elephant Island											
1. Seal Islands	1/30	20,000 & 125 Macaroni[2][1]	-	@	@	PR	6	@	P	P	PR
2. Cape Lindsey	1/30	120[2]	-	-	P	P	3	P	-	P	-
King George Island											
3. 4-5 km West Cape Melville near Melville Peak	1/31	-	-	-	-	-	-	-	-	@	PR
*4. Cape Melville	1/31	8000-9000[2]	-	P	PR	P	200-300	P	P	P	P
5. Spit opposite Trowbridge Is.	1/31	-	-	-	-	-	-	P	P	@	P
6. Trowbridge Is.	1/31	2000[2]	-	-	-	-	-	-	-	-	-
7. Taylor Point & one offshore rock	1/31	-	-	@	-	-	100	P	P	P	P
8. Carolyn Bluff & hillside to North	1/31	5000-6000[2]	-	-	-	-	-	-	-	-	-
*9. Southeast corner North Foreland	1/31	10,000[2]	-	@	-	-	-	-	@	-	-
*10. North Foreland proper	1/31	50,000[3]	?	?	?	?	?	?	?	?	?
11. Hole Rock	1/31	-	-	-	-	-	30	-	-	-	-
12. Emerald Cove	1/31	200[2]	-	PR	-	-	1	P	-	@	-
13. Brimstone Peak	1/31	10,000[4]	-	P	-	-	-	P	P	P	P
14. Brimstone Peak to next point to West	1/31	5000-7000[2]	-	-	-	-	-	-	-	-	-
15. Gam Point	1/31	-	-	-	-	-	-	-	-	-	P
*16. False Round Pt.	1/31	100,000-175,000[3]	-	P	-	-	-	-	@	P	-
17. Small point just East of Pottinger Point	1/31	500-600[2]	-	-	-	-	-	P	P	P	-
18. Pottinger Point	1/31	150,000-200,000[3]	-	-	-	-	-	@	@	P	-
19. Kellick Island	1/31	30,000-50,000[3]	-	-	-	-	-	P	P	P	-
20. Owen Island	1/29	25,000+[2]	-	-	-	-	-	P	P	P	P
*21. Tartar Island/Round Pt.	1/29	30,000-40,000[2]	-	-	-	P	-	P	P	P	P
22. Vicinity of Davey Pt.	1/29	25,000 (10,000 & 15,000)[2][1]	-	-	-	-	15@	-	P	@	PR
23. Stigant Point	1/29	13,550[1]	-	-	-	P	-	P	P	PR	-
24. Offshore rocks, Bell Point	2/1	3000-5000 (3 groups)[2]	-	-	-	P	20@	P	P	PR	-

25. Northwest side of Fildes Peninsula	2/1	150[2]	-	PR	PR	-	15	P	P	P	P
26. Nebles Point	2/11	-	2500[2]	-	-	-	-	-	P	P	-
*27. Barton Peninsula	2/12	3500[2]	-	@	-	-	-	P	P	-	-
28. Stranger Pt.	2/12	150-200[2]	1500-2000(c)[2]	-	-	-	-	P	P	-	-
29. Northwest Telefon Rocks	2/12	2000[2]	10[2]	-	-	-	-	P	P	-	-
30. Demay Pt.	2/12	3000[2]	-	-	-	-	-	-	-	-	-
31. Chabrier Rock	2/12	2500[2]	-	P	-	-	75@	-	-	-	-
32. Rocks near Low Head	2/12	-	75 (c)[2]	-	-	-	-	P	P	P	-
*33. Lions Rump	2/12	400[2]	3000 (c)[2]	-	-	-	-	-	P	P	-
34. Penguin Island	2/12	>1000[4]	-	@	P	-	-	P	P	P	P
*35. Turret Point	2/12	300[2]	-	@	-	-	100@	P	P	PR	PR
Nelson Island											
36. Vicinity of Rip Pt.	2/1	a 500-1000 b 100[2] c 15,000-20,000	2 -	@	PR	-	14	P	P	P	P
37. Nancy Rock	2/1	"covered with penguins"[4]	?	?	?	?	?	?	?	?	?
38. Withen Island	2/1	"covered with penguins"[4]	?	?	?	?	?	?	?	?	?
39. Pt. 3-4 km East of Harmony Point	2/1	1500-2000[2]	-	P	P	-	4	P	P	P	-
40. From site 39 to Harmony Pt.	2/1	-	-	P	P	-	1	-	P	P	P
41. Harmony Point	2/1	> 300,000[3]	-	@	-	-	1	-	@	P	-
42. The Toe	2/11	20,000-25,000[2]	-	-	-	-	-	P	P	P	-
43. Duthoit Point	2/11	-	700-800[2]	-	-	-	100@	P	P	P	-
44. Pt. 2-3 km North of Duthoit Pt.	2/11	-	900[2]	P	-	-	-	-	P	P	-
Robert Island											
45. Newell Point	2/1	15,000-20,000[2]	-	P	P	P	35@	P	@	P	P
46. Pt. 4-5 km West of Newell Point	2/1	-	-	@	-	-	1	-	PR	P	-
47. Next pt. to West of site 46	2/1	-	-	@	-	-	-	-	P	@	-
48. Heywood Is.	2/1	"almost as many as Harmony Pt., Nelson Is."	?	?	?	?	?	?	?	?	?
49. Long pt. Northwest corner of island	2/1	-	-	@	PR	-	8	-	P	@	P
*50. Edwards Point	2/11	40[2]	-	-	-	-	-	-	-	-	-
51. Robert Point	2/11	5000[2]	-	@	-	-	-	P	@	-	-
52. Kitchen Point	2/11	2500[2]	-	@	-	-	45@	-	-	P	PR
53. Salient Point	2/11	-	-	-	-	-	-	-	-	PR	P
Greenwich Island											
54. Canto Point	2/1	-	-	P	-	-	-	-	P	-	-
55. Large is. North of Dee Island	2/1	"large colony"[4]	?	?	?	?	?	?	?	?	?

56. Mt.Plymouth to Duff Pt.	2/2	-	-	P	-	-	9	-	P	PR	-
57. Romeo Island	2/2	500[2]	-	-	-	-	-	-	P	-	-
58. Unnamed Island	2/2	-	-	-	-	-	-	-	-	PR	P
59. Rock East of Cave Is.	2/2	-	-	-	-	-	40@	P	-	-	-
60. East Cave Is.	2/2	-	-	-	-	-	-	-	-	PR	-
61. Triangle Pt.	2/10	-	1000[2]	-	-	-	15@	P	-	-	-
62. Spit Pt.	2/10	-	4000-5000[2]	-	-	-	-	P	P	P	-
63. Fort Point	2/10	3500[2]	250[2]	-	-	-	-	P	P	-	-
64. Hardy Cove	2/11	-	-	-	-	-	-	-	P	@	-
Livingston Island											
65. Zed Island	2/2	8000[2]	-	-	-	-	-	P	P	P	P
66. Williams Pt. & Dunbar Is.	2/2	-	-	P	-	-	17	-	P	P	PR
67. Desolation Is.	2/2	18,000[2]	-	-	-	-	-	P	P	P	P
68. Wood Island	2/2	5000-6000[2]	-	-	-	-	-	-	-	-	-
69. Siddons Pt.	2/2	-	-	-	-	-	1	-	-	P	P
70. Black Pt.	2/2	-	-	P	-	-	-	P	P	P	P
*71. Cape Shirreff	2/2	20,800[1]	750[1]	P	-	-	3	-	P	P	P
72. Telmo Island	2/3	-	-	-	-	-	-	P	P	PR	-
73. Mercury Bluff	2/3	-	-	-	-	-	-	-	P	-	P
74. Rowe Pt. to Lair Pt.	2/3	-	-	-	-	-	35@	-	P	P	PR
*75. Lair Point	2/3	50[1]	200[1]	-	-	-	-	-	@	PR	-
*76. Robbery Beach	2/3	-	-	-	-	-	-	-	-	PR	PR
77. Window Island	2/3	50-100[2]	-	-	PR	-	-	P	-	P	PR
78. North Byers Pen.	2/3	-	-	-	-	-	-	-	-	PR	@
79. Kermone Is.	2/3	-	-	-	-	-	-	P	P	P	-
*80. Start Pt. to Devils Pt.	2/4	5000-6000[a,2]	2000[b,2]	@	P	-	120@[a]	P	P	@	P
[a = rock off Devils Pt.; b = 1 km NE Devils Pt]											
81. Rugged Is.	2/4	-	-	-	-	-	-	P	-	PR	PR
82. Long Rock	2/9	-	-	-	-	-	-	-	-	PR	-
83. Pt. just East of Devils Point	2/9	-	-	@	P	-	-	P	P	PR	PR
84. Vietor Rock	2/9	200[2]	-	-	-	-	-	-	-	-	-
85. Pt Northwest of Vietor Rock	2/9	100[2]	-	-	-	-	-	-	-	-	P
*86. Elephant Point	2/9	1500[2]	500[2]	P	-	-	-	-	P	P	P
87. Island just off Elephant Pt.	2/9	500[2]	50[2]	-	-	-	-	-	-	-	-
*88. Hannah Pt. West	2/9	2500[2]	50[2]	-	-	-	-	-	-	-	-
89. Hannah Pt. East	2/9	-	150-200[2]	PR	PR	-	20@	-	-	PR	PR
90. 1-2 km Northwest Miers Bluff	2/9	80[2]	20[2]	-	-	-	-	-	-	-	-
91. Miers Bluff	2/9	5000[2]	-	-	-	-	-	P	-	P	P

92. Cove 3-4 km Northeast Miers Bluff	2/9	200[2]	-	-	-	-	-	-	-	-	-
93. East side False Bay	2/10	-[2]	50	-	-	-	-	-	P	-	-
94. Barnard Pt. West	2/10	750 (2 groups)[2]	-	-	-	-	-	P	P	-	-
95. Barnard Pt. East	2/10	several thousand[4]	?	?	?	?	?	?	?	?	?
96. Rugged Rocks off Renier Pt.	2/10	3000[2]	-	-	-	-	40@	P	-	-	-
*97. Half Moon Is.	2/10	6000[2]	-	-	-	-	-	-	-	P	P
Deception Island											
*98. Bailey Head	2/8	100,000-150,000[3]	-	-	-	-	-	P	-	-	-
99. Macaroni Point	2/8	>1000[4]	-	-	-	-	-	-	-	-	-
*100. Bluff West of site 99	2/8	400[1]	-	-	-	-	-	P	-	PR	-
101. Shoreline 2-3 km West of Macaroni Pt.	2/8	-	-	-	P	-	-	P	P	P	-
102. Stretch of shoreline 2-3 km North of site 103	2/8	-	-	-	P	-	-	-	-	PR	-
103. Unnamed point	2/8	-	-	-	P	-	-	-	-	P	-
*104. Mainland pt. Northeast of New Rock	2/8	15,000[2]	-	-	-	-	-	-	-	PR	-
*105. Pt. 5-6 km Northwest of South Point	2/8	15,000[2]	-	-	-	-	-	-	-	-	-
*106. First bluff West of South Point	2/8	4000-5000[2]	-	-	-	-	-	P	P	-	-
*107. Entrance Point	2/8	4000 (5 groups)[2]	-	-	-	-	-	-	-	-	-
*108. Pt. Northwest of Entrance Point	2/8	250[2]	-	-	-	-	-	-	-	-	-
Snow Island											
109. Cape Timblon	2/4	-	-	P	-	P	15	-	P	P	PR
110. Byewater Pt.	2/4	700 (4 groups)[2]	-	-	-	-	6@	-	P	-	P
111. Pt. 2-3 km South of Byewater Pt.	2/4	2350-2850 (3 groups)[2]	-	@	-	-	5	-	P	P	PR
112. Castle Rock	2/4	5000[2]	-	-	PR	-	-	P	-	-	-
113. Monroe Point	2/4	2000[2]	-	-	-	-	-	P	P	P	-
114. Cape Conway	2/8	400[2]	-	-	-	-	-	P	-	PR	-
115. Tooth Rocks	2/8	-	-	-	P	-	-	-	-	P	-
116. Pt. 1-2 km East of Cape Conway	2/8	2000-2500[2]	200-300[2]	-	-	-	-	P	-	P	-
117. Hall Pen. West/South pt.	2/8	2000[2]	-	-	-	-	-	P	P	-	-
118. Hall Pen. East/North pt.	2/8	3000[2]	-	P	-	-	-	-	-	-	-
119. Presidents Head	2/8	100[2]	-	@	P	P	-	-	P	@	PR

Smith Island											
120. Cape Smith	2/4	4500[1]	-	-	-	-	-	-	P	-	-
121. Cape James	2/5	10,000[2]	-	-	-	-	-	P	P	P	-
Low Island											
122. Large is. off Northeast pt. of Cape Wallace	2/5	50,000[3]	-	-	-	-	60@	P	-	-	-
123. Other offshore rocks/ islands Cape Wallace	2/5	8100[2] (8000 & 100)	-	-	-	-	-	P	P	P	PR
124. Cape Wallace	2/5	150,000-300,000	5-600[2]	@	-	-	-	P	P	P	-
125. First bluff South of Cape Wallace	2/5	50,000-100,000[3]	-	P	-	-	-	P	P	P	-
126. Vicinity Jameson Pt.	2/5	40,000-70,000[3]	-	P	-	-	-	P	P	P	-
127. Pt. South of Jameson Pt.	2/5	1500[2]	-	-	-	-	-	P	P	PR	-
128. Islands, Jameson Pt. to Cape Gary	2/5	2750[2] (5 groups)	-	-	-	-	50@	P	P	P	-
129. Cape Gary	2/5	200,000[3]	-	-	-	-	20@	@	P	-	-
130. Pt. 2-3 km East of Cape Gary	2/5	6000[2] (2 groups)	-	P	-	-	-	P	-	-	-
131. Rock 1 km South of Cape Hooker	2/5	4500[2]	-	-	-	-	-	P	P	-	P
132. Cape Hooker	2/5	15,000-20,000[2]	-	-	-	-	-	P	P	-	-
133. Two pts. North of Cape Hooker	2/5	100[2]	-	-	-	-	-	P	P	-	-
134. Promontories on North-central coast	2/5	100[2]	-	-	-	-	-	P	-	P	PR

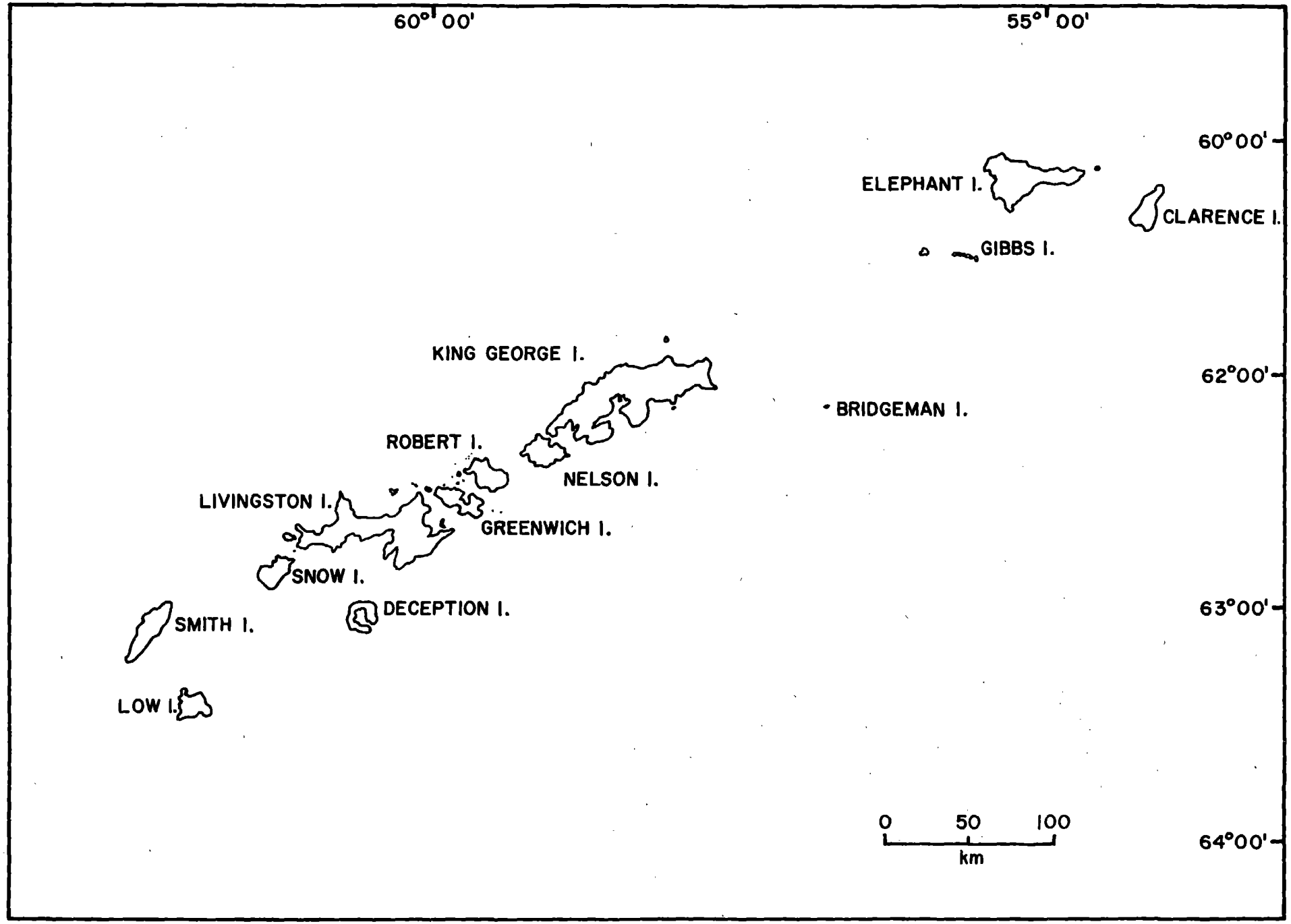


Figure 1. South Shetland Islands, Antarctica study area.

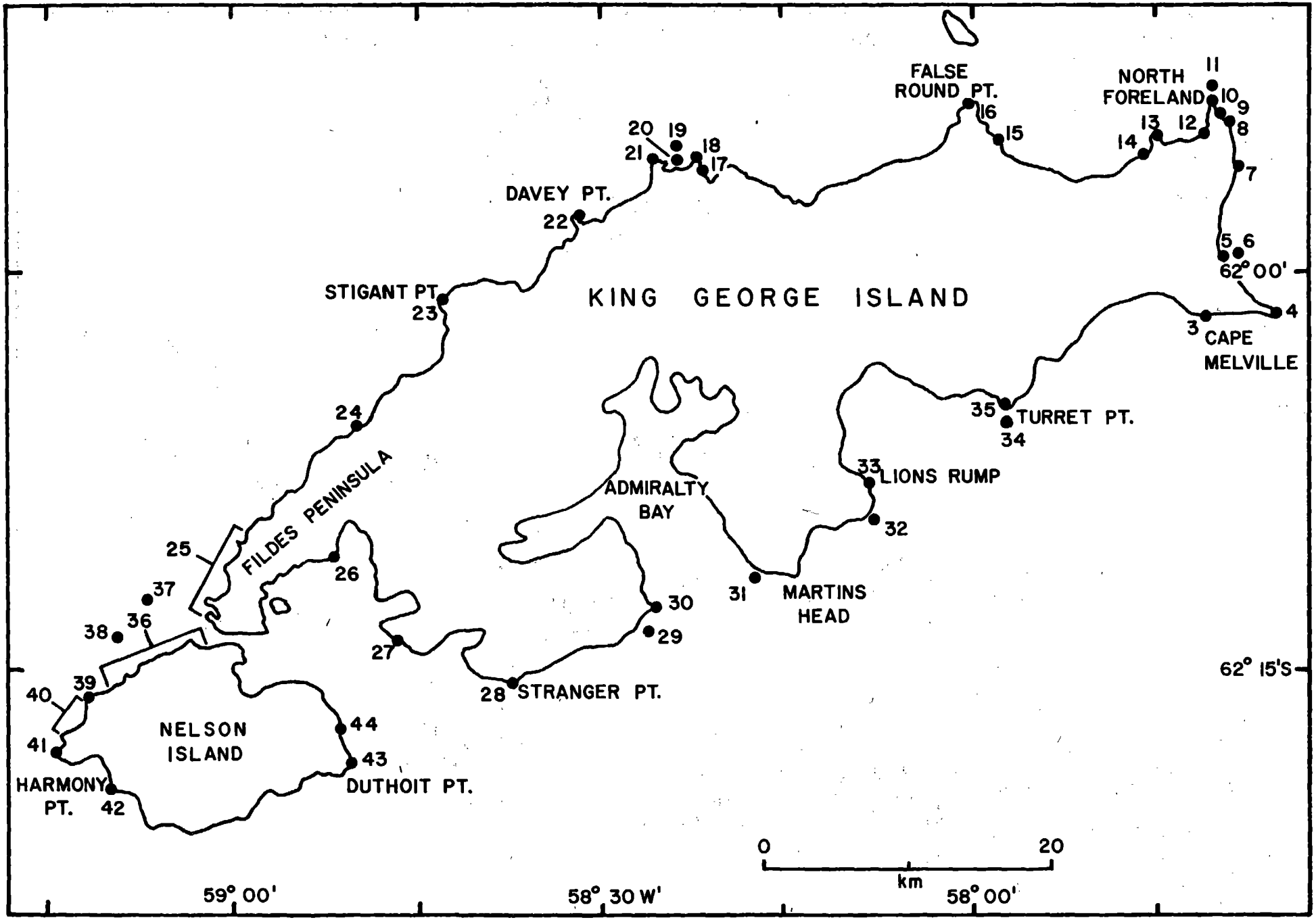


Figure 2. King George and Nelson Islands, South Shetland Islands; survey sites (Table 1) indicated by numbered dots and bracketed stretches of coastline.

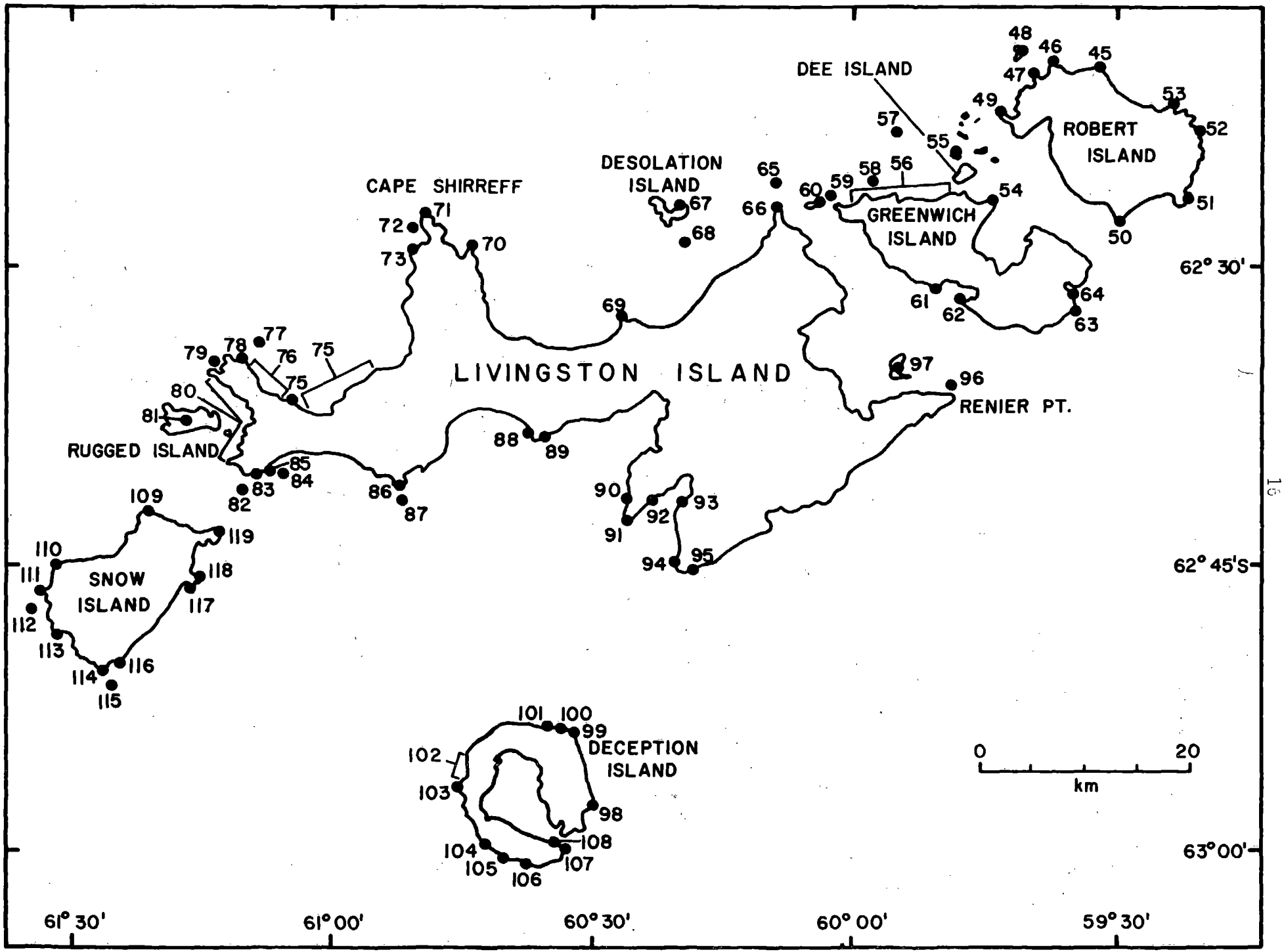


Figure 3. Robert, Greenwich, Livingston, Deception, and Snow Islands, South Shetland Islands; survey sites (Table 1) indicated by numbered dots and bracketed stretches of coastline.

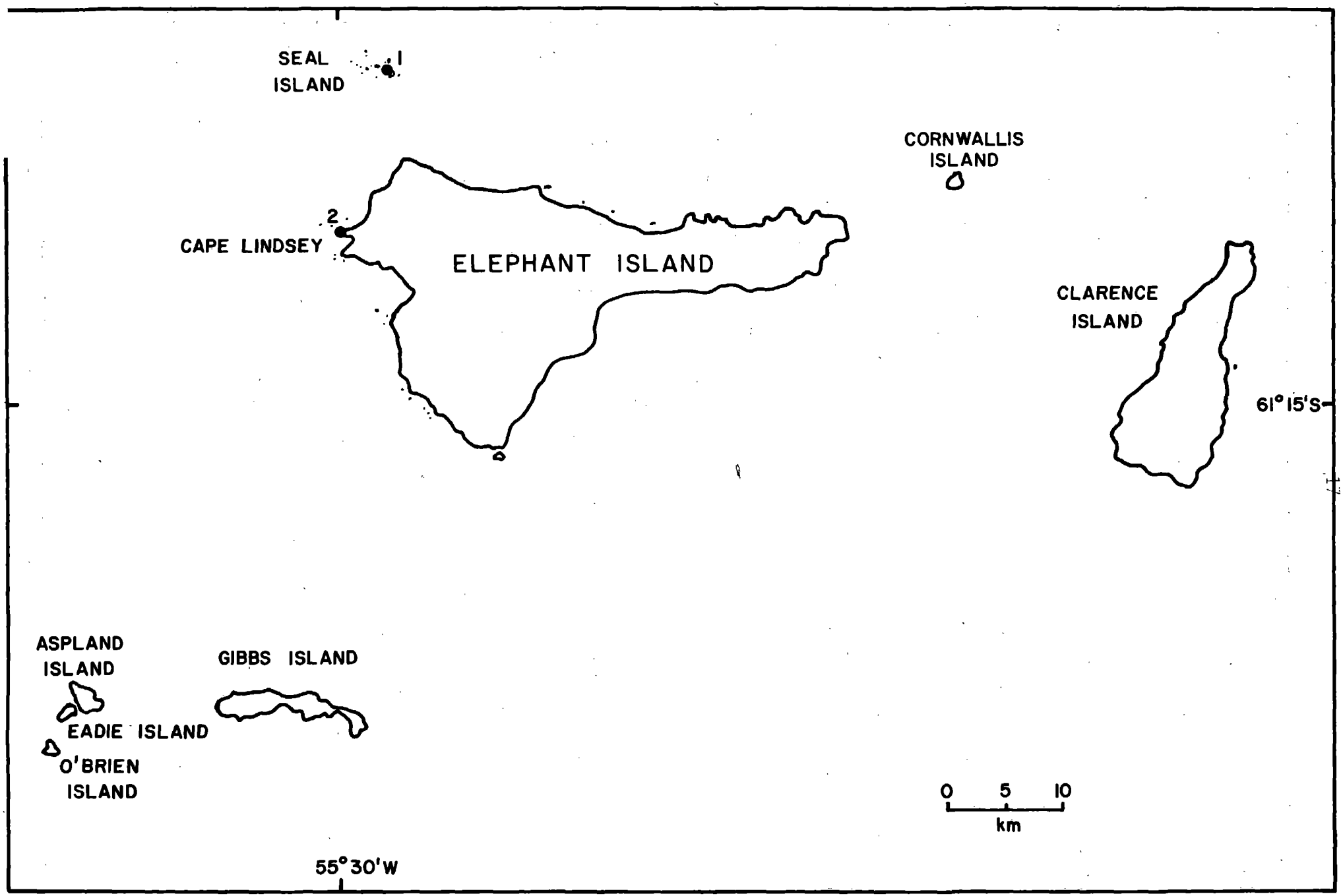


Figure 4. Elephant Island group of the South Shetland Islands; survey sites (Table 1) indicated by numbered dots.

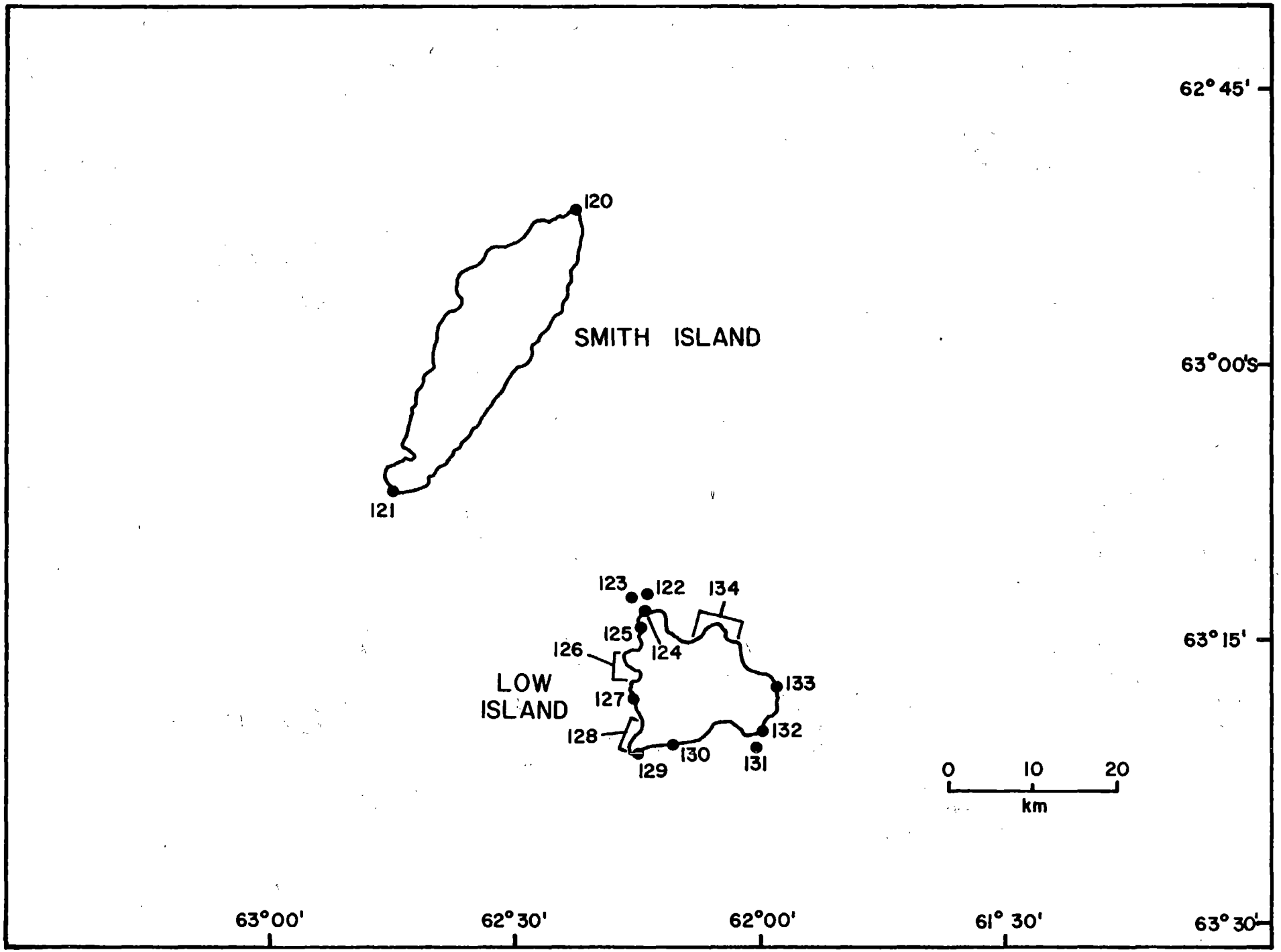


Figure 5. Smith and Low Islands, South Shetland Islands; survey sites (Table 1) indicated by numbered dots and bracketed stretches of coastline.

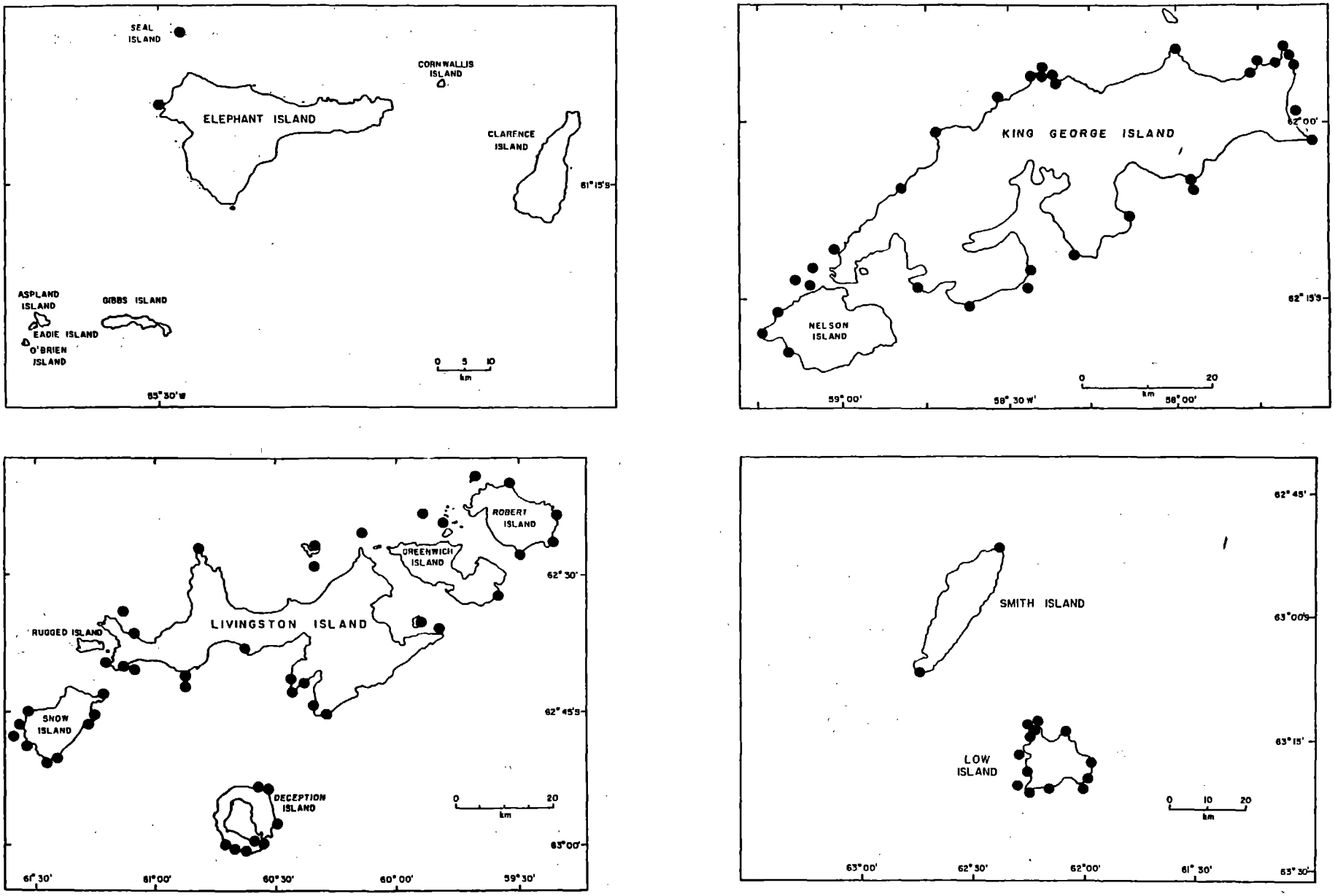


Figure 6. Breeding distribution of Chinstrap Penguins in the South Shetland Islands during Jan-Feb 1987; colony sites indicated by dots (Table 1).

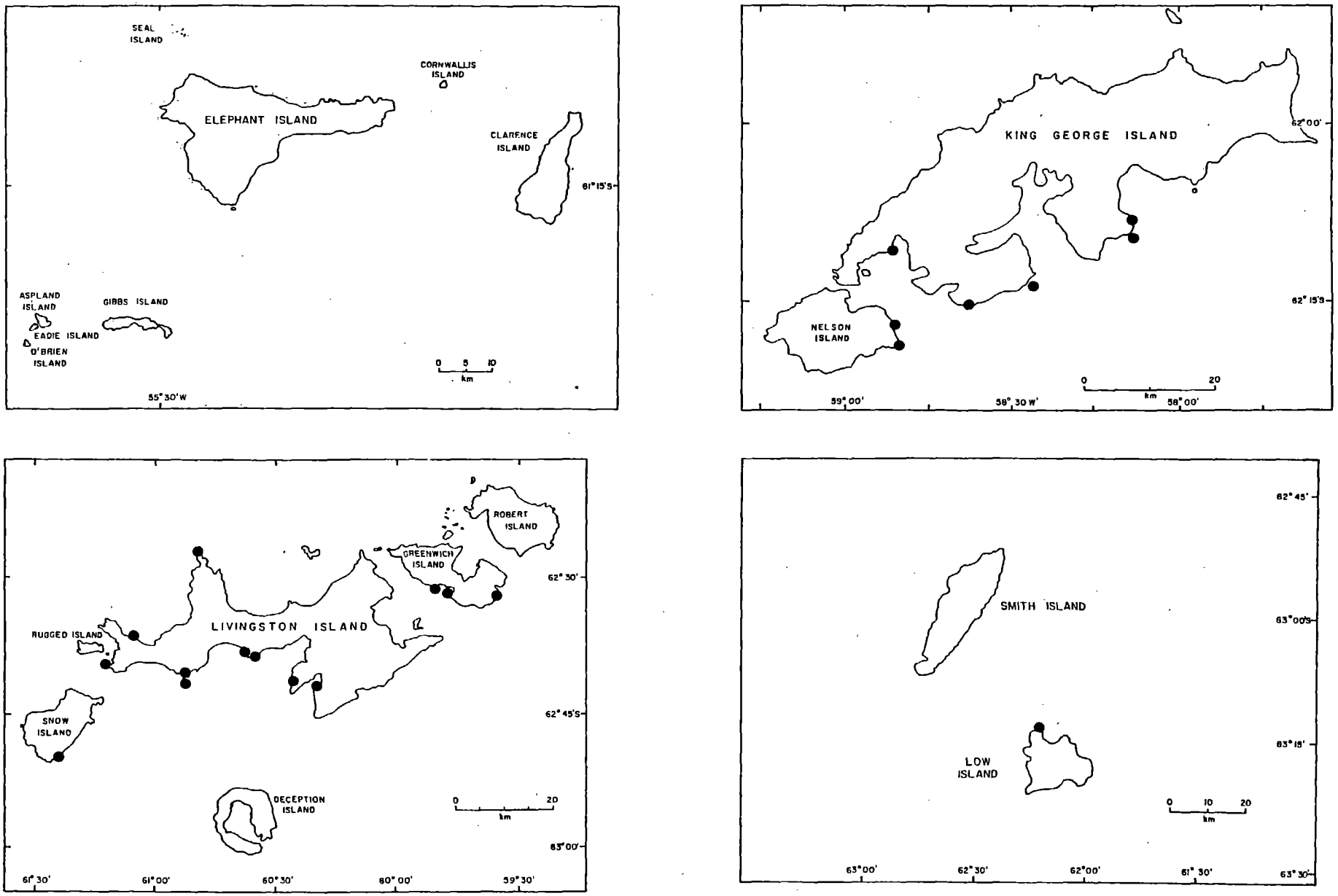


Figure 7. Breeding distribution of Gentoo Penguins in the South Shetland Islands during Jan-Feb 1987; colony sites indicated by dots (Table 1).

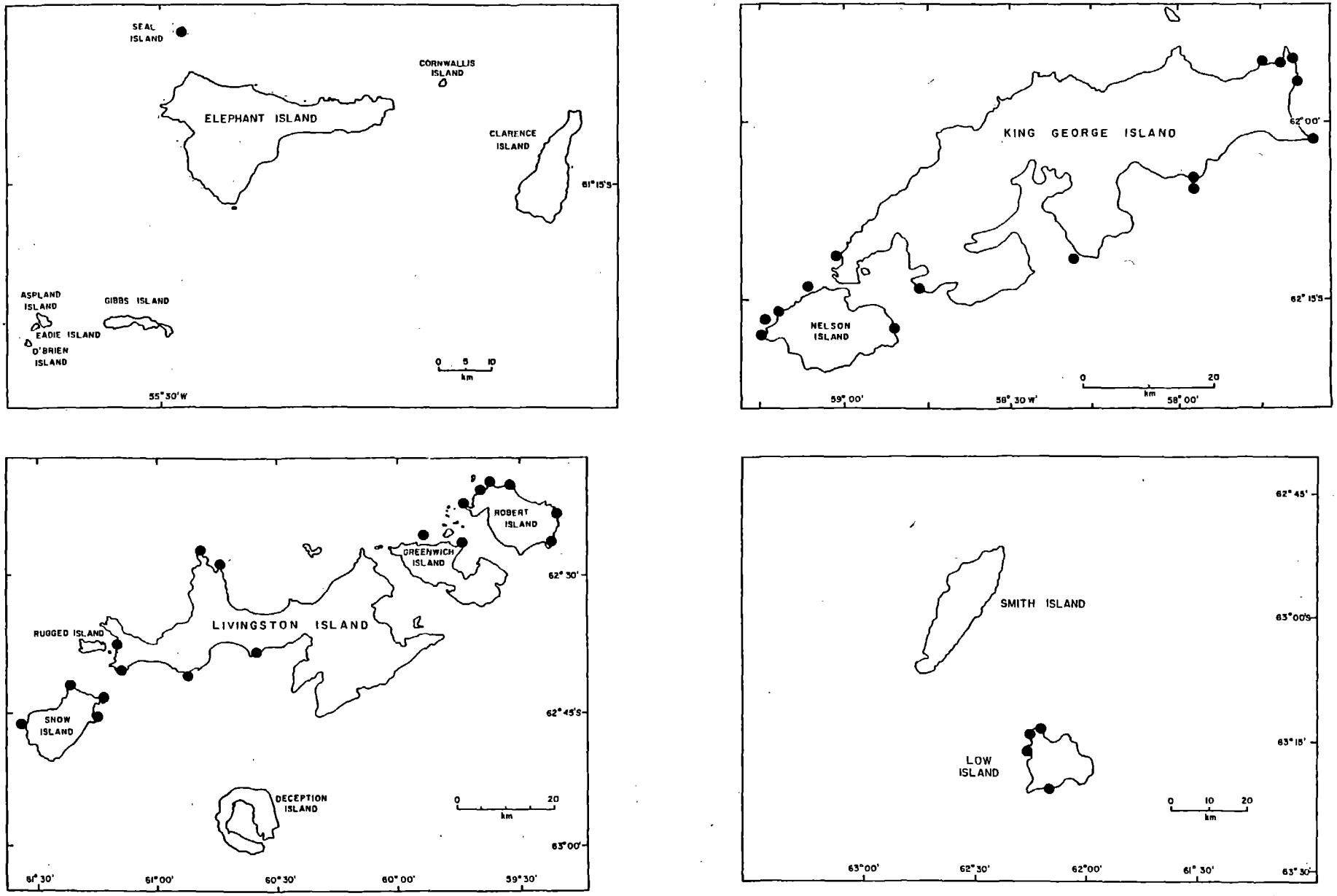


Figure 8. Breeding distribution of Southern Giant Fulmars in the South Shetland Islands during Jan-Feb 1987; dots indicate sites of suspected or confirmed breeding (Table 1).

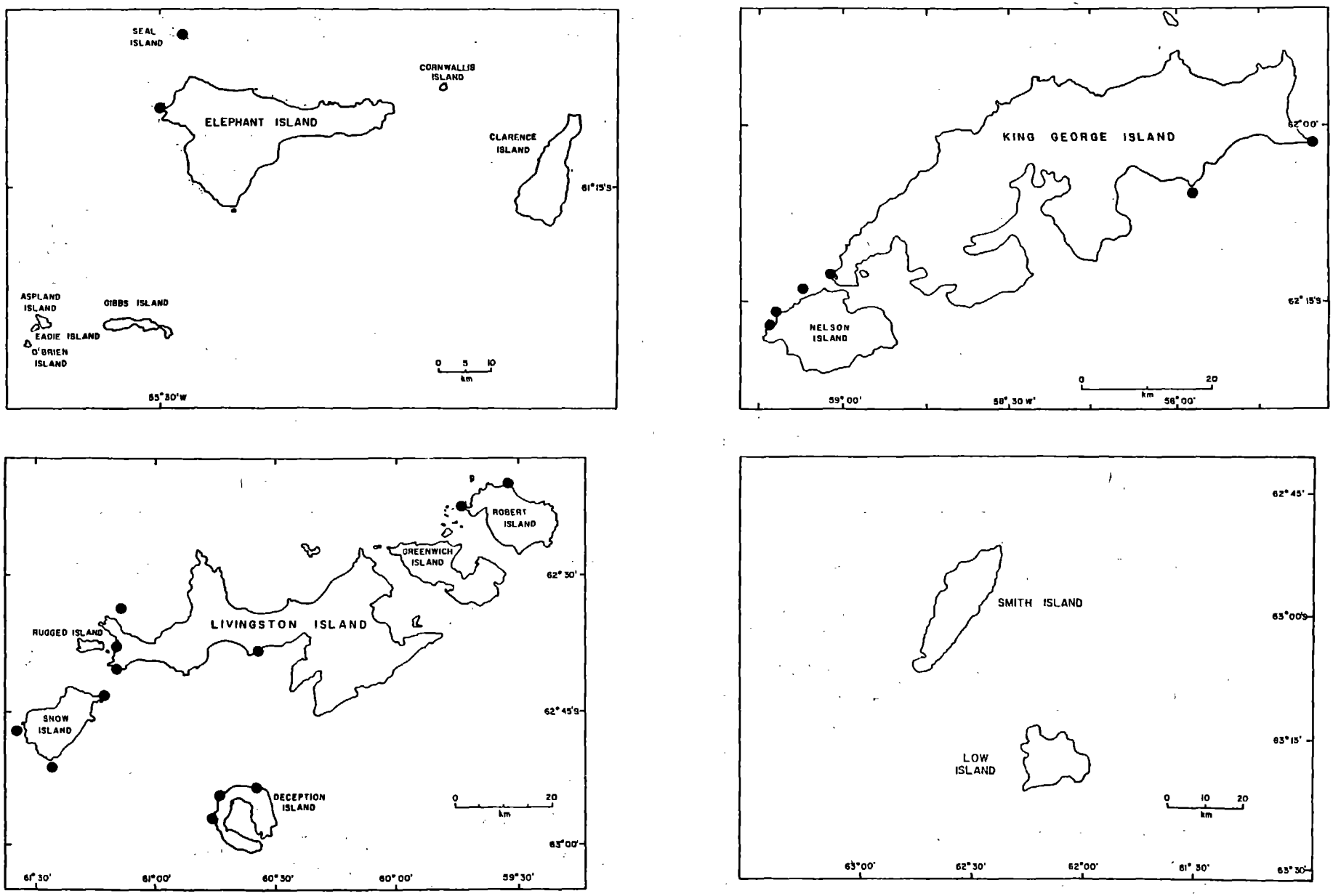
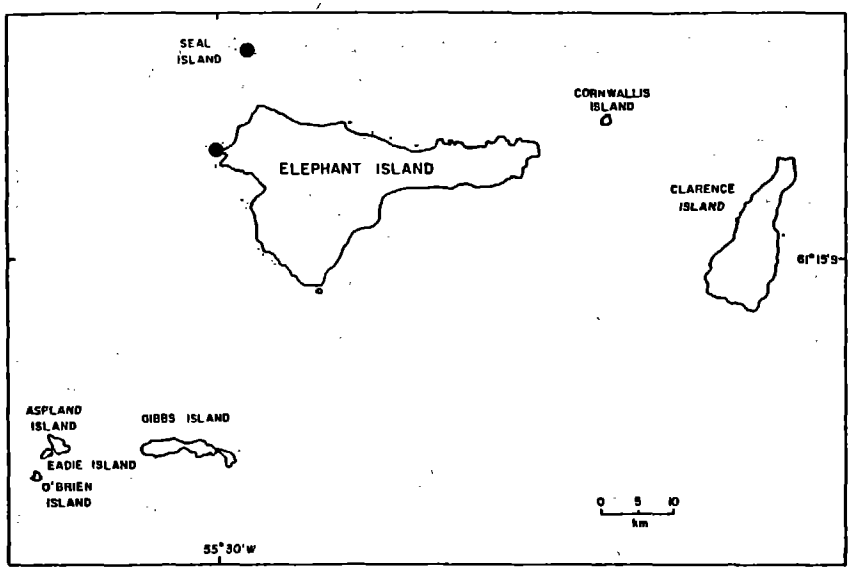
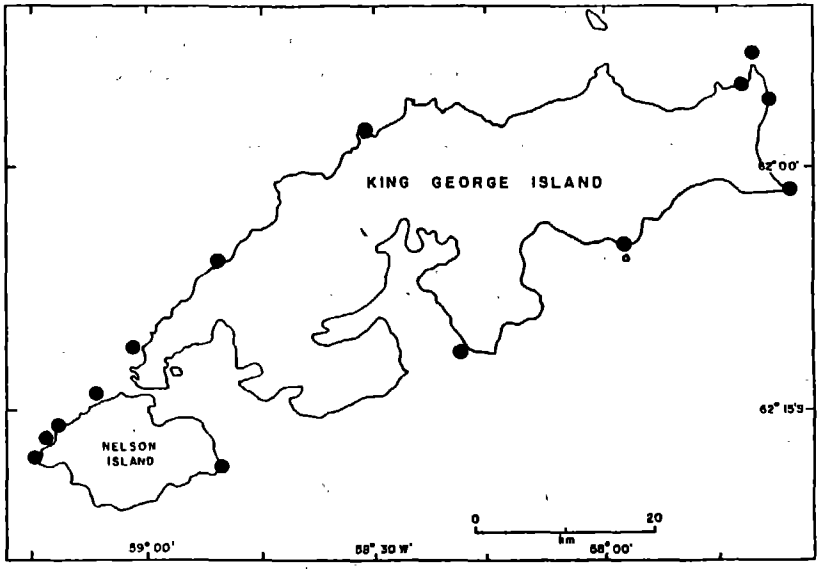
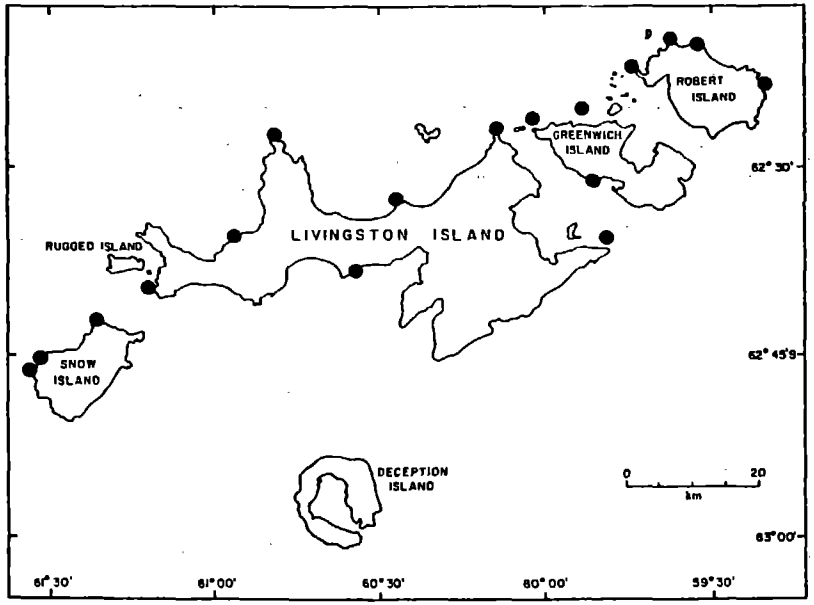


Figure 9. Breeding distribution of Cape Petrels in the South Shetland Islands during Jan-Feb 1987; dots indicate sites of suspected or confirmed breeding (Table 1).







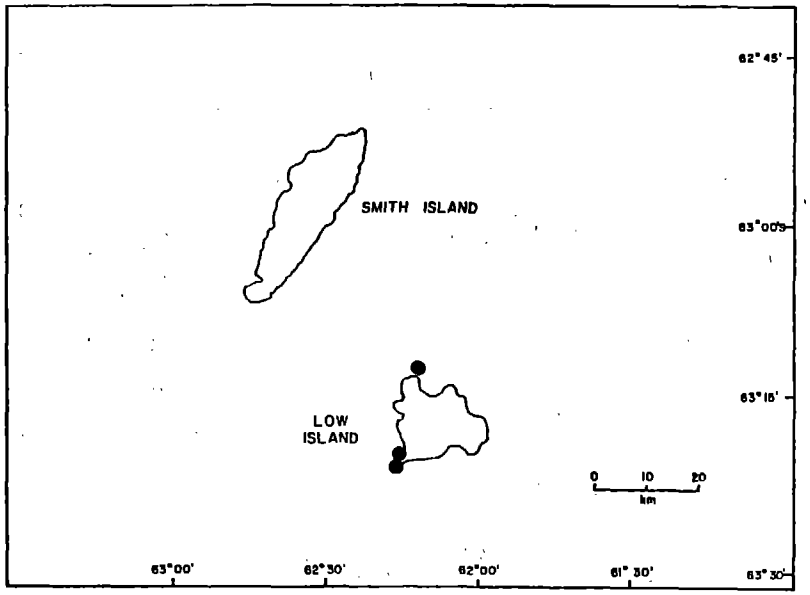
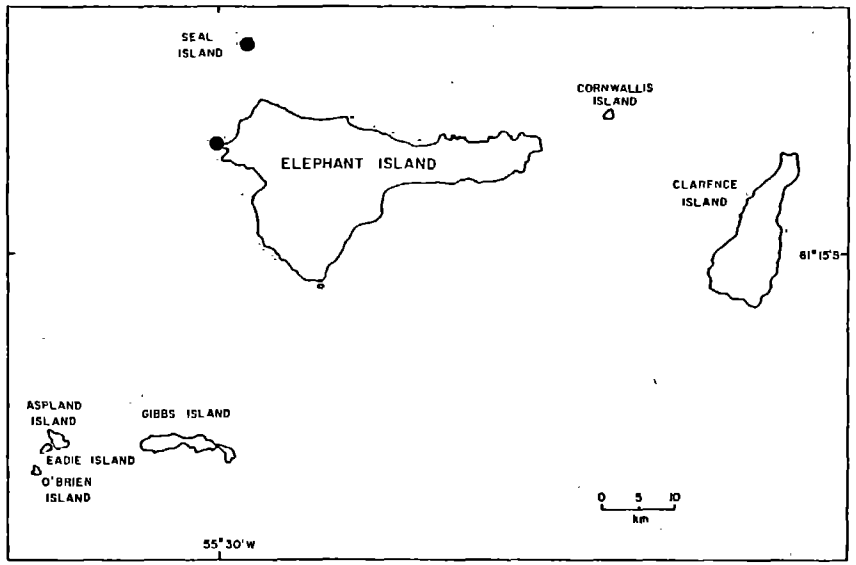
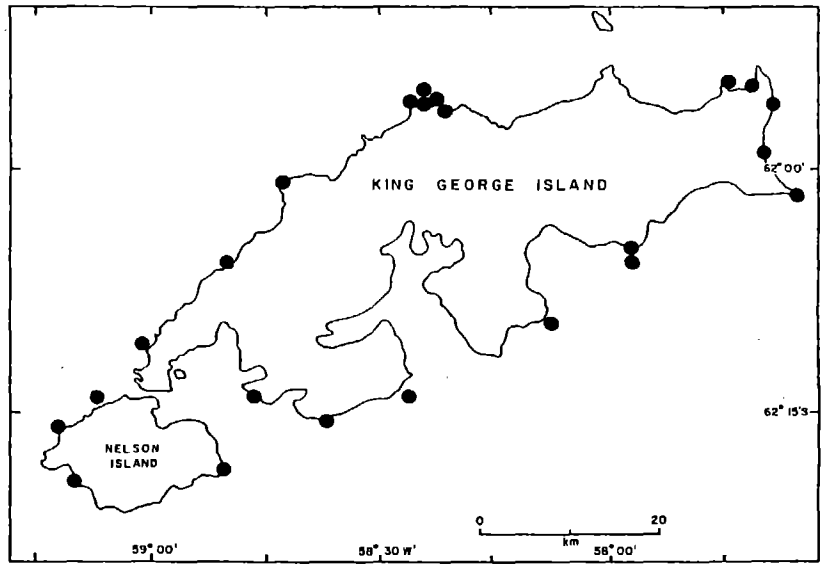
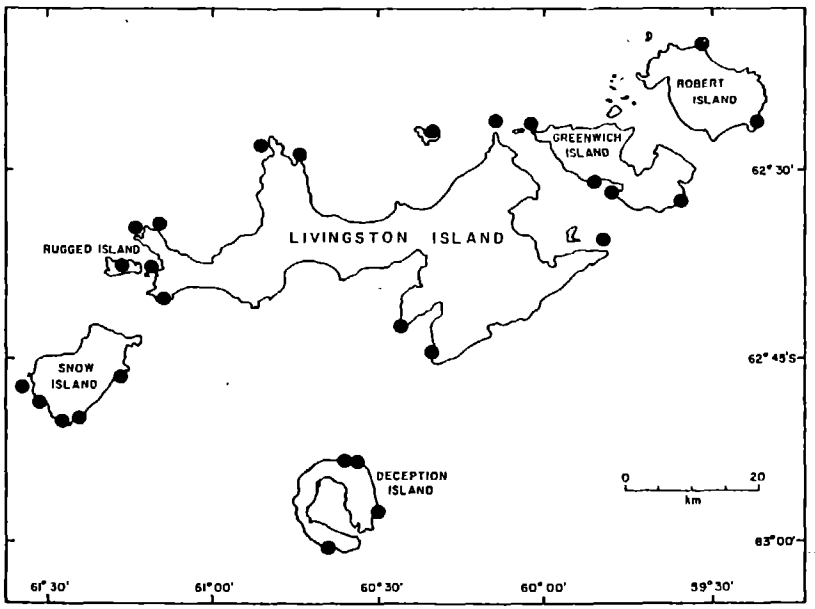


Figure 10. Breeding distribution of Antarctic Blue-eyed Shags in the South Shetland Islands during Jan-Feb 1987; dots indicate sites of suspected or confirmed breeding (Table 1).







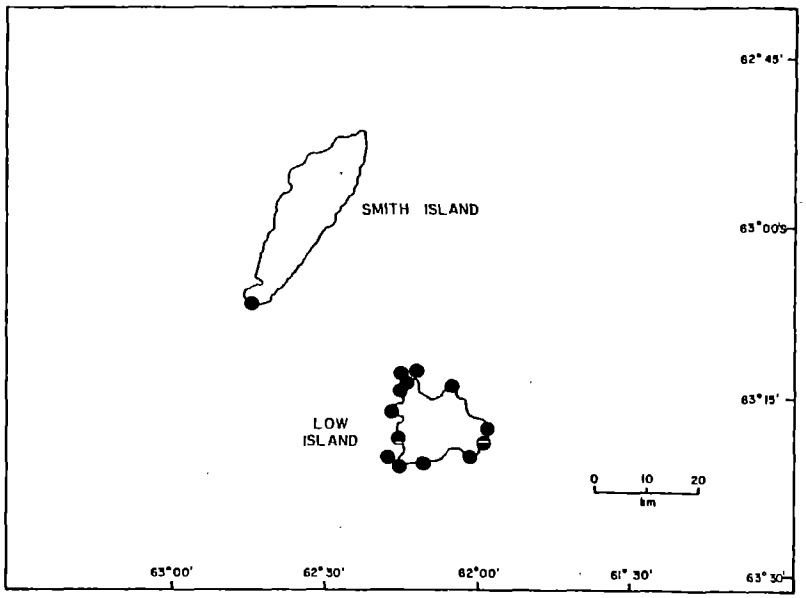
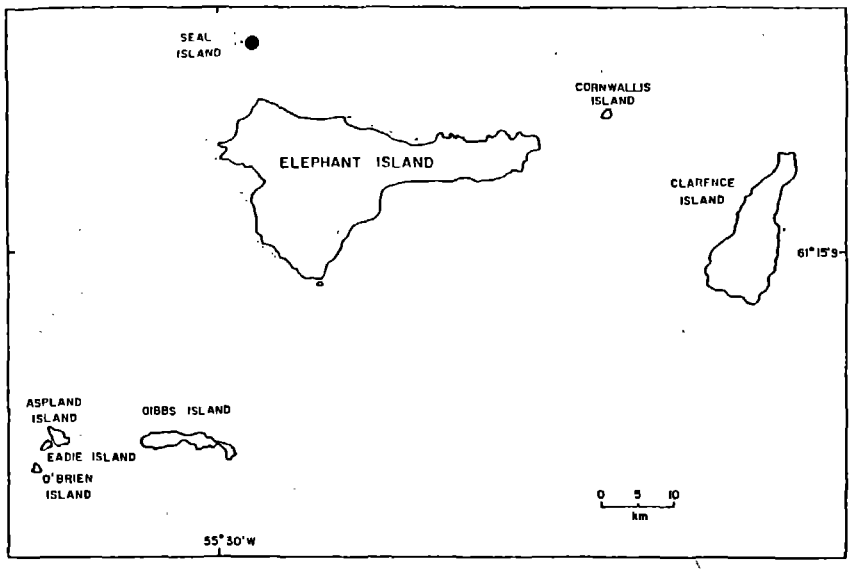
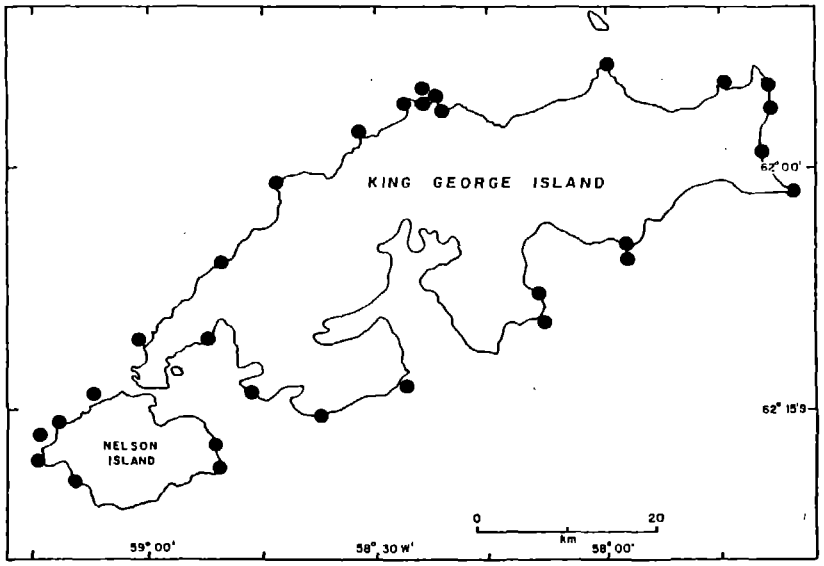
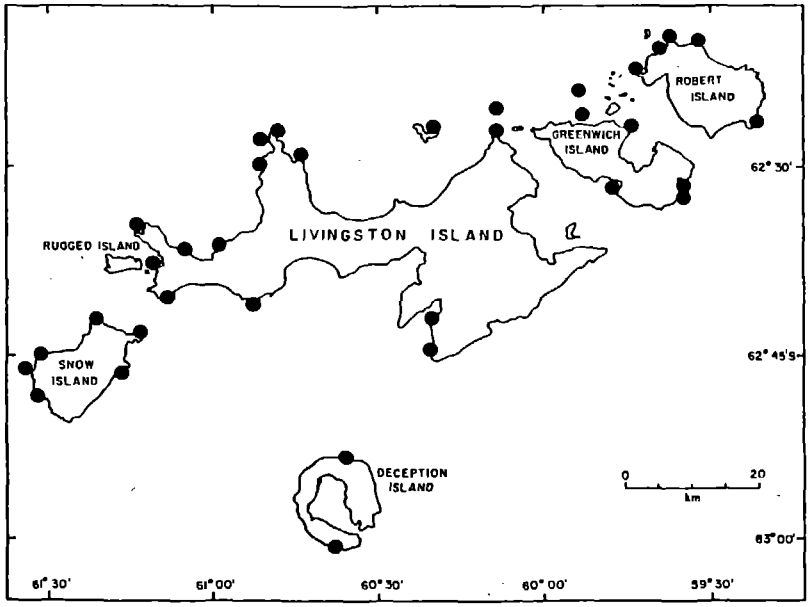


Figure 11. Breeding distribution of American Sheathbills in the South Shetland Islands during Jan-Feb 1987; dots indicate sites of suspected or confirmed breeding (Table 1).







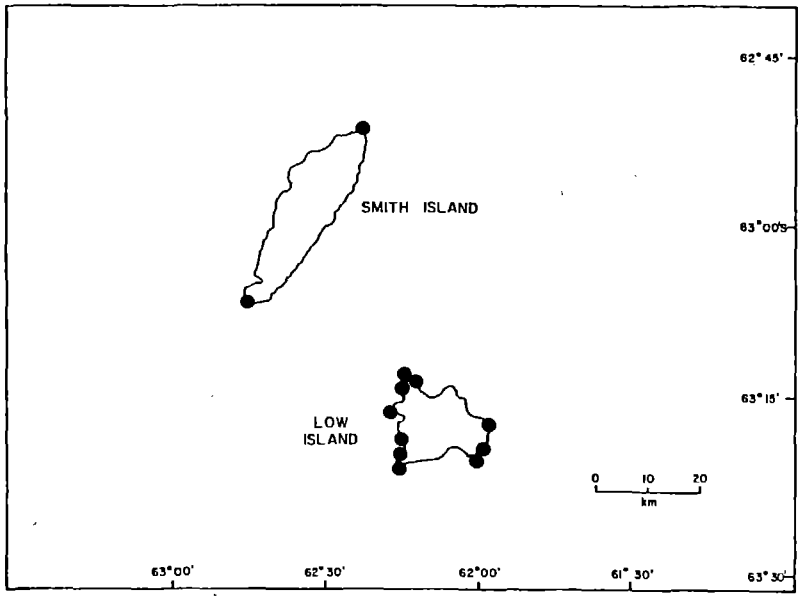


Figure 12. Breeding distribution of skuas (primarily Brown Skuas) in the South Shetland Islands during Jan-Feb 1987; dots indicate sites of suspected or confirmed breeding (Table 1).

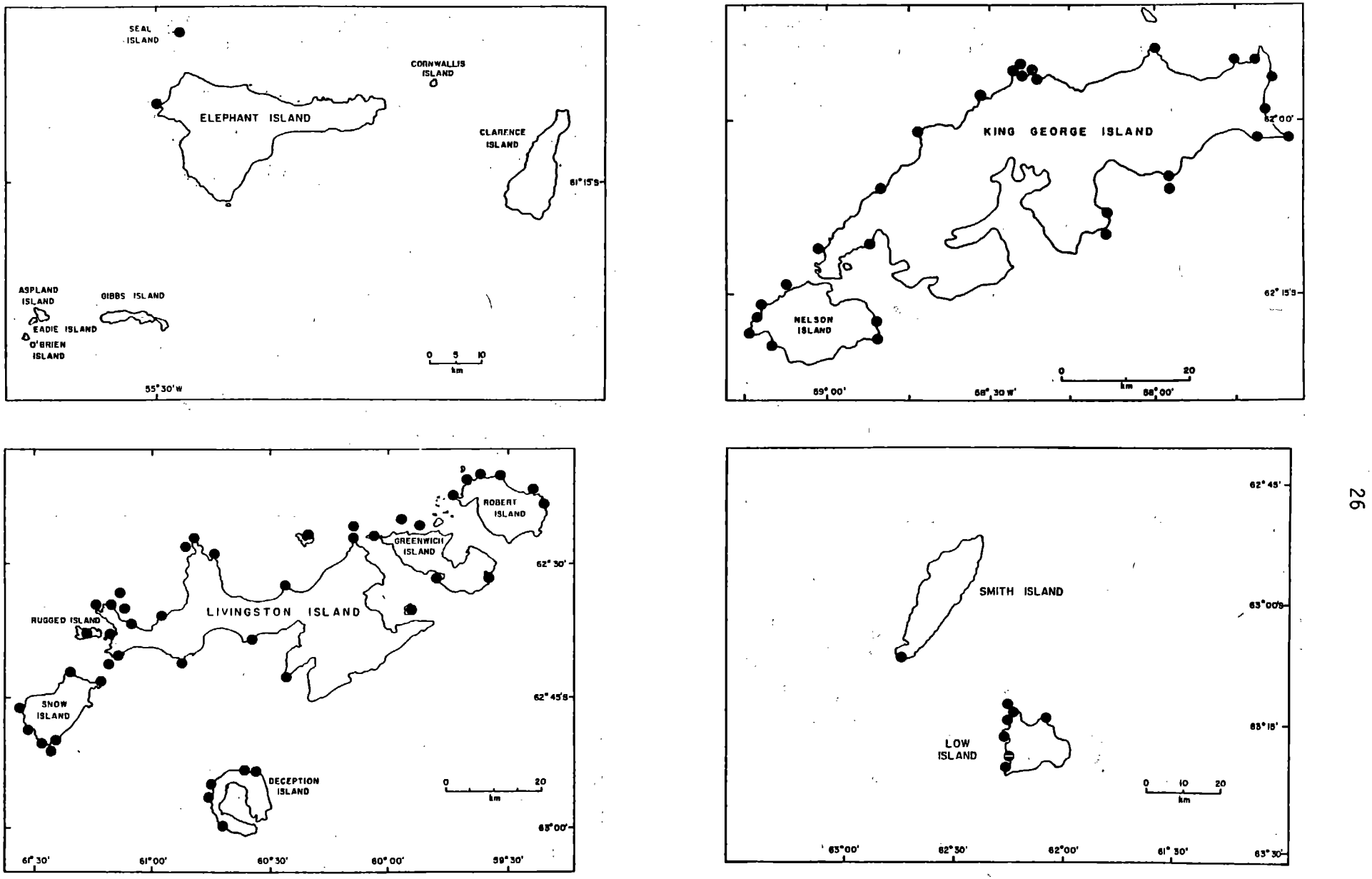


Figure 13. Breeding distribution of Kelp Gulls in the South Shetland Islands during Jan-Feb 1987; dots indicate sites of suspected or confirmed breeding (Table 1).

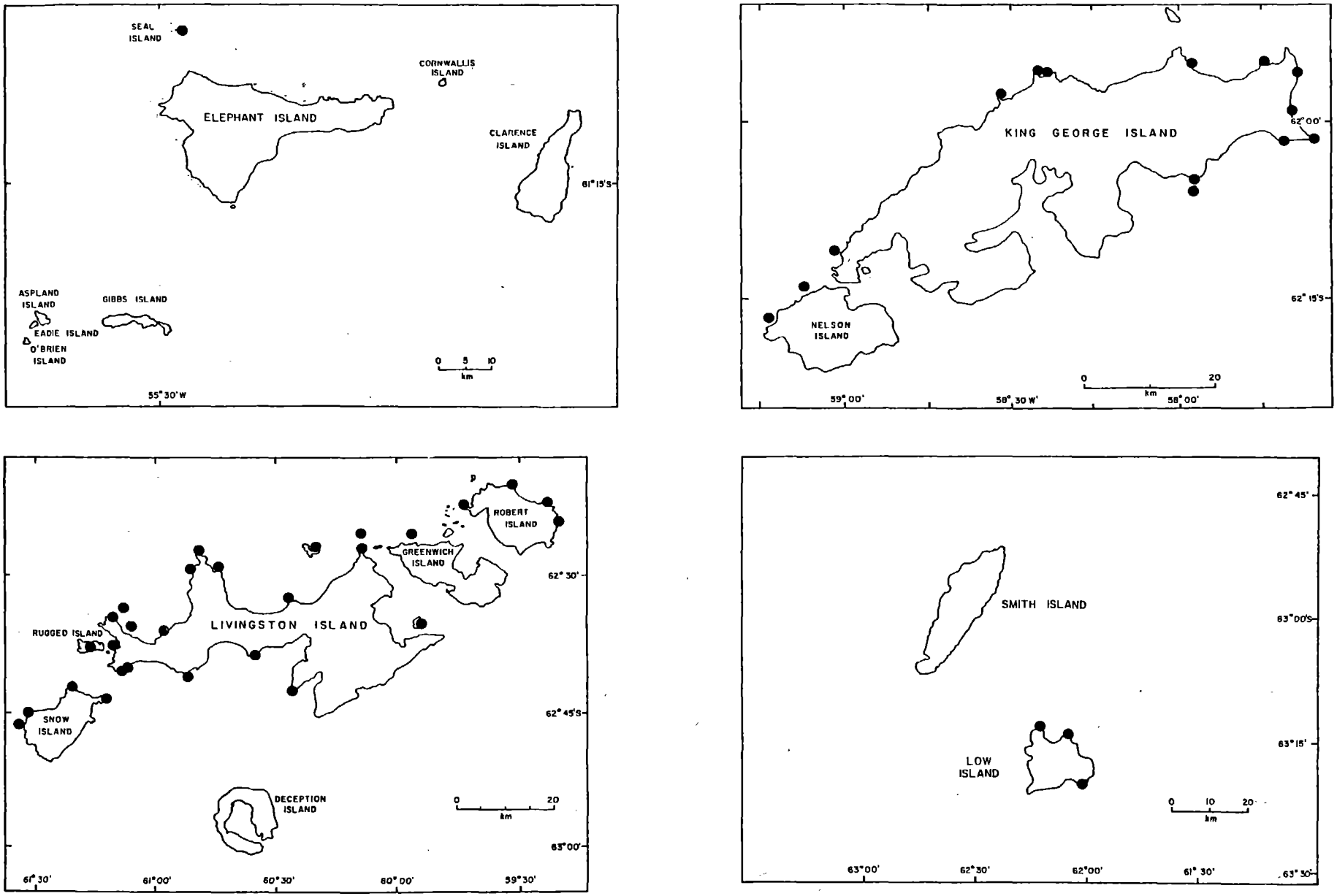


Figure 14. Breeding distribution of Antarctic Terns in the South Shetland Islands during Jan-Feb 1987; dots indicate sites of suspected or confirmed breeding (Table 1).

(continued from inside front cover)

44. **NOAA's Northeast Monitoring Program (NEMP): A Report on Progress of the First Five Years (1979-84) and a Plan for the Future.** By Robert N. Reid, Merton C. Ingham, and John B. Pearce, eds., and Catherine E. Warsh (water quality), Robert N. Reid (sediments & bottom organisms), Adriana Y. Cantillo (trace contaminants in tissues), and Edith Gould (biological effects), topic coords. May 1987. xi + 138 p., 13 figs., 1 table, 9 app. NTIS Access. No. PB87-210100.

45. **Food and Distribution of Juveniles of Seventeen Northwest Atlantic Fish Species, 1973-1976.** By Ray E. Bowman, Thomas R. Azarovitz, Esther S. Howard, and Brian P. Hayden. May 1987. xi + 57 p., 10 figs., 19 tables. NTIS Access. No. PB87-215851/AS.

46. **Influence of Freshwater Inflows on Estuarine Productivity.** By James G. Turek, Timothy E. Goodger, Thomas E. Bigford, and John S. Nichols. May 1987. iii + 26 p. NTIS Access. No. PB87-213666/AS.

47. **MARMAP Surveys of the Continental Shelf from Cape Hatteras, North Carolina, to Cape Sable, Nova Scotia (1977-1984). Atlas No. 2. Annual Distribution Patterns of Fish Larvae.** By Wallace W. Morse, Michael P. Fahay, and Wallace G. Smith. May 1987. viii + 215 p., 27 figs., 2 tables. NTIS Access. No. PB87-232831/AS.

48. **Indexed Bibliography of the Bay Scallop (Argopecten irradians).** By Barbara D. Sabo (Gibson) and Edwin W. Rhodes. May 1987. iii + 85 p. NTIS Access. No. PB87-231411/AS.

49. **Northeast Fisheries Center Framework for Inshore Research.** By Research Planning & Coordination Staff, Northeast Fisheries Center. July 1987. vi + 44 p., 2 figs., 2 tables. NTIS Access. No. PB87-232286/AS.

50. **Status of the Fishery Resources Off the Northeastern United States for 1987.** By Conservation & Utilization Division, Northeast Fisheries Center. October 1987. iii + 132 p., 48 figs., 50 tables. NTIS Access. No. PB88-148549.

51. **An Annotated List of the Fishes of Massachusetts Bay.** By Bruce B. Collette and Karsten E. Hartel. February 1988. x + 70 p., 1 fig., 1 table. NTIS Access. No. PB88-179247/AS.

52. **An Evaluation of the Bottom Trawl Survey Program of the Northeast Fisheries Center.** By Survey Working Group, Northeast Fisheries Center. March 1988. ix + 83 p., 33 figs., 13 tables. NTIS Access No. PB88-201983/AS.

53. **Contaminants in Hudson-Raritan Estuary Water and Influence of Cold Storage upon Its Chemical Composition.** By Anthony Calabrese, Lawrence J. Buckley, and J. Christopher Powell. May 1988. vii + 37 p., 10 figs., 11 tables. NTIS Access. No. PB88-225628/AS.

54. **Epizootic Ulcerative Syndromes in Coastal/Estuarine Fish.** By Carl J. Sindermann. June 1988. v + 37 p., 8 figs., 1 table.

55. **A Plan for Study: Response of the Habitat and Biota of the Inner New York Bight to Abatement of Sewage Sludge Dumping.** By Environmental Processes Division, Northeast Fisheries Center. June 1988. iii + 34 p., 5 figs., 3 tables, 4 app.

56. **Characterization of the Middle Atlantic Water Management Unit of the Northeast Regional Action Plan.** By Anthony L. Pacheco, ed. July 1988. v + 322 p., 136 figs., 21 tables.

57. **An Analysis and Evaluation of Ichthyoplankton Survey Data from the Northeast Continental Shelf Ecosystem.** By Wallace G. Smith, ed. August 1988. xiii + 132 p., 53 figs., 12 tables, 1 app.

58. **An Indexed Bibliography of Northeast Fisheries Center Publications and Reports for 1987.** By Jon A. Gibson. August 1988. iii + 20 p.

PUBLICATIONS AND REPORTS OF THE NORTHEAST FISHERIES CENTER

NOAA's National Marine Fisheries Service (NMFS) seeks to "achieve a continued optimum utilization of living resources for the benefit of the Nation." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Center (NEFC) supports the NMFS mission by "planning, developing, and managing multidisciplinary programs of basic and applied research to: (1) better understand the living marine resources (including marine mammals) of the Northwest Atlantic, and the environmental quality essential for their existence and continued productivity; and (2) describe and provide to management, industry, and the public, options for the utilization and conservation of living marine resources and maintenance of environmental quality which are consistent with national and regional goals and needs, and with international commitments." To provide its data, information, and advice to constituents, the NEFC issues publications and reports in three categories:

Technical Memorandums--Issued irregularly as NOAA Technical Memorandum NMFS-F/NEC series. Series includes data reports of long-term or large area studies; synthesis reports for major resources or habitats; annual reports of assessment or monitoring programs; documentary reports of oceanographic conditions or phenomena; manuals describing field and lab techniques; literature surveys of major resource or habitat topics; findings of task forces or working groups; and summary reports of scientific or technical workshops. Issues do not undergo exhaustive technical review and editing, but are reliable sources of information. Limited free copies are available from authors or the Center. Issues are also available from the National Technical Information Service, 5285 Port Royal Rd., Springfield, VA, 22161.

Research Documents--Issued irregularly as the Woods Hole Laboratory Reference Document, Narragansett Laboratory Reference Document, and Sandy Hook Laboratory Report series. Series include: data reports on field and lab observations or experiments; progress reports on continuing experiments, monitoring, and assessments; and background papers for scientific or technical workshops. Issues receive minimal internal scientific review and no technical editing. No subscriptions. Free distribution of single copies.

Information Reports--Issued in several series, including: Monthly Highlights (monthly); End-of-Year Report (annual); News Release (irregular); Fishermen's Report (up to four times per year); and The Shark Tagger (two times per year). Content is timely, special-purpose data and/or information. Level of scientific review and technical editing varies by series. All series available through free subscription except for The Shark Tagger which is available only to participants in the NMFS Cooperative Shark Tagging Program.

To obtain a copy of a Technical Memorandum or a Research Document, or to subscribe to an Information Report, write: Information Services Section, Northeast Fisheries Center, Water St., Woods Hole, MA 02543. An annual list of NEFC publications and reports is available upon request at the above address.