

DISTRIBUTION OF PENGUINS AT SEA IN THE SOUTHEASTERN ATLANTIC AND SOUTHWESTERN INDIAN OCEANS

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ABSTRACT

Over a seven-year period a total of 14 452 SCAR/BIOMASS Seabird Mapping Scheme 10-minute cards was collected on 29 voyages in the southeastern Atlantic and southwestern Indian Oceans. A total of 1 164 penguins of six species was recorded on 119 (0,8 %) of these cards. These records are mapped by species and discussed in relation to previously published data. All of the island groups within the study area as well as the African Continent have records of vagrant penguins indicating long distance movements, although few penguins were actually recorded at sea.

INTRODUCTION

Penguins (Spheniscidae) comprise an estimated 90 % of the total biomass of all Subantarctic and Antarctic seabirds (Siegfried 1985). Evidence is now accumulating that in recent years several species of Southern Ocean penguins have been increasing in numbers and extending their breeding ranges (e.g. Sladen 1964, Conroy 1975, Croxall & Kirkwood 1979, Wilson 1983). Relatively little is known about the distribution of penguins at sea. Because of their inconspicuousness at sea and perhaps because of their small foraging ranges when breeding (e.g. Williams & Siegfried 1979, Lishman 1985), several studies of the distribution of seabirds at sea in the Southern Ocean have omitted penguins from their analyses (e.g. Griffiths *et al.* 1982, Abrams 1983, Cooper 1985a).

This paper lists all sightings of penguins made away from their breeding localities in the southeastern Atlantic and southwestern Indian parts of the Southern Ocean by members of the FitzPatrick Institute from 1979 to 1985. These data are supplemented with previously published information, especially that given by Watson *et al.* (1971). Since Watson *et al.*'s maps were produced there have been a number of papers published which include records of penguins at sea (e.g. Condy 1979, Harris 1982, Thurston 1982). The published and unpublished data are related to what is known of the penguins' breeding localities and population sizes within the region studied.

METHODS AND STUDY AREA

A total of 14 452 SCAR/BIOMASS seabird mapping scheme 10-minute cards (BIOMASS Working Party on Bird Ecology 1984), collected by members of the FitzPatrick Institute, was checked for at-sea records of penguins, including those not identified to species. The cards were collected on 29 voyages (26 on the M.V. *S.A. Agulhas*, two on the R.S. *Africana*, and one on the R.V. *Knorr*) in the southeastern Atlantic and southwestern Indian Oceans (here defined as being within 30 - 70S and 40W - 60E, Fig. 1) during the period May 1979 to May 1985.

Most voyages were to Gough Island (40 21S, 09 53W) in the southern Atlantic Ocean, generally in September to November; to Marion Island (46 54S, 37 45E) in the Prince Edward group, southern Indian Ocean, generally during April to May and September; and to SANAE (70 18S, 2 24W) Dronning Maud Land, Antarctica, generally in December to February. All unpublished and published records of penguins away from their breeding localities in the southeastern Atlantic and southwestern Indian Oceans, as defined above, comprising at-sea records as well as records of penguins on icebergs, sea-ice, the Antarctic continental iceshelf and vagrants seen on Southern Ocean islands (both cold temperate and Subantarctic) and the African Continent, have been mapped by species. Breeding localities have been taken from Wilson (1983) and Cooper (1985b).

RESULTS

Penguins were recorded on only 119 (0,8 %) of 14 452 10-minute cards, representing 1 164 individuals of six species (excluding records of Jackass Penguin *Spheniscus demersus* on the African continental shelf: this species is not considered here). A total of 207 individuals recorded (17,8 %) was not assigned to species, mainly as a result of difficulties in separating Macaroni *Eudyptes chrysolophus* and Rockhopper *E. chrysocome* Penguins at sea. Results are given and discussed for each species below.

Emperor Penguin *Aptenodytes forsteri*

There are seven records of Emperor Penguins representing some 524 individuals ranging from 57 - 70S (Fig. 2). Two of these records are of birds on the ice at SANAE, one was of a single individual and the second record is of a concentration of c. 500 birds on fast ice at 70 03S, 1 49W. While the M.V. *S. A. Agulhas* was moored at the ice-face at SANAE in 1983, up to 12 Emperor Penguins swam around the ship (pers. obs.). Three of the five at-sea records are fairly close to the Antarctic Continent, the fourth is of six birds on an iceberg at 66S, 12W, whereas the fifth record is of two individuals together at 57 24S, 9 10W in July 1979, representing the most northerly at-sea record for the area, although the species has reached South Georgia (54S, 37W) on at least eight occasions, at least seven being juveniles (Clark 1986 and references therein). There is one record of a single bird in April 1979 at the South Sandwich Group (Cordier *et al.* 1981).

Much of Watson *et al.*'s (1971) data come from La Grange (1962)

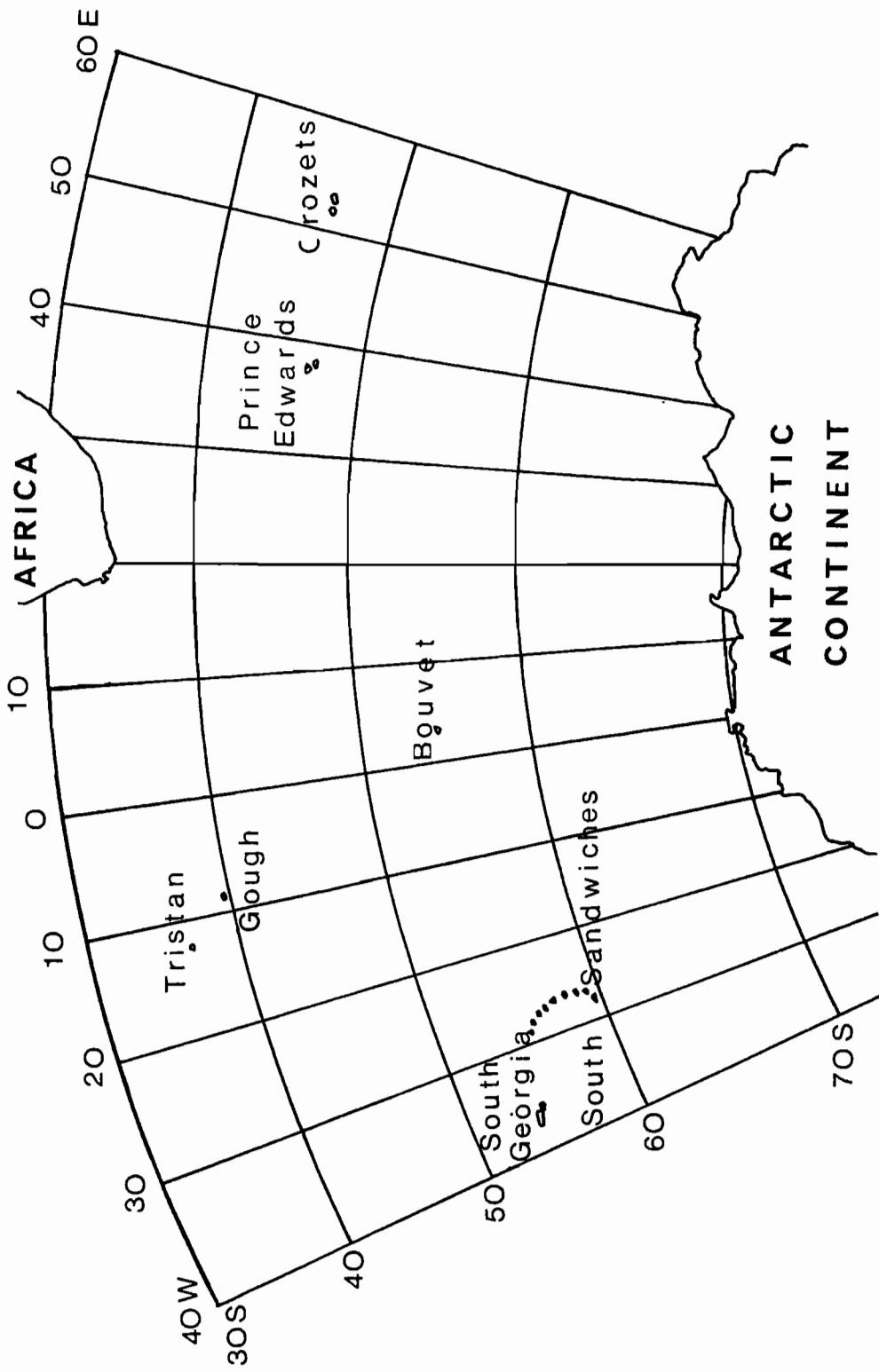


Figure 1
Subantarctic islands mentioned in the text.

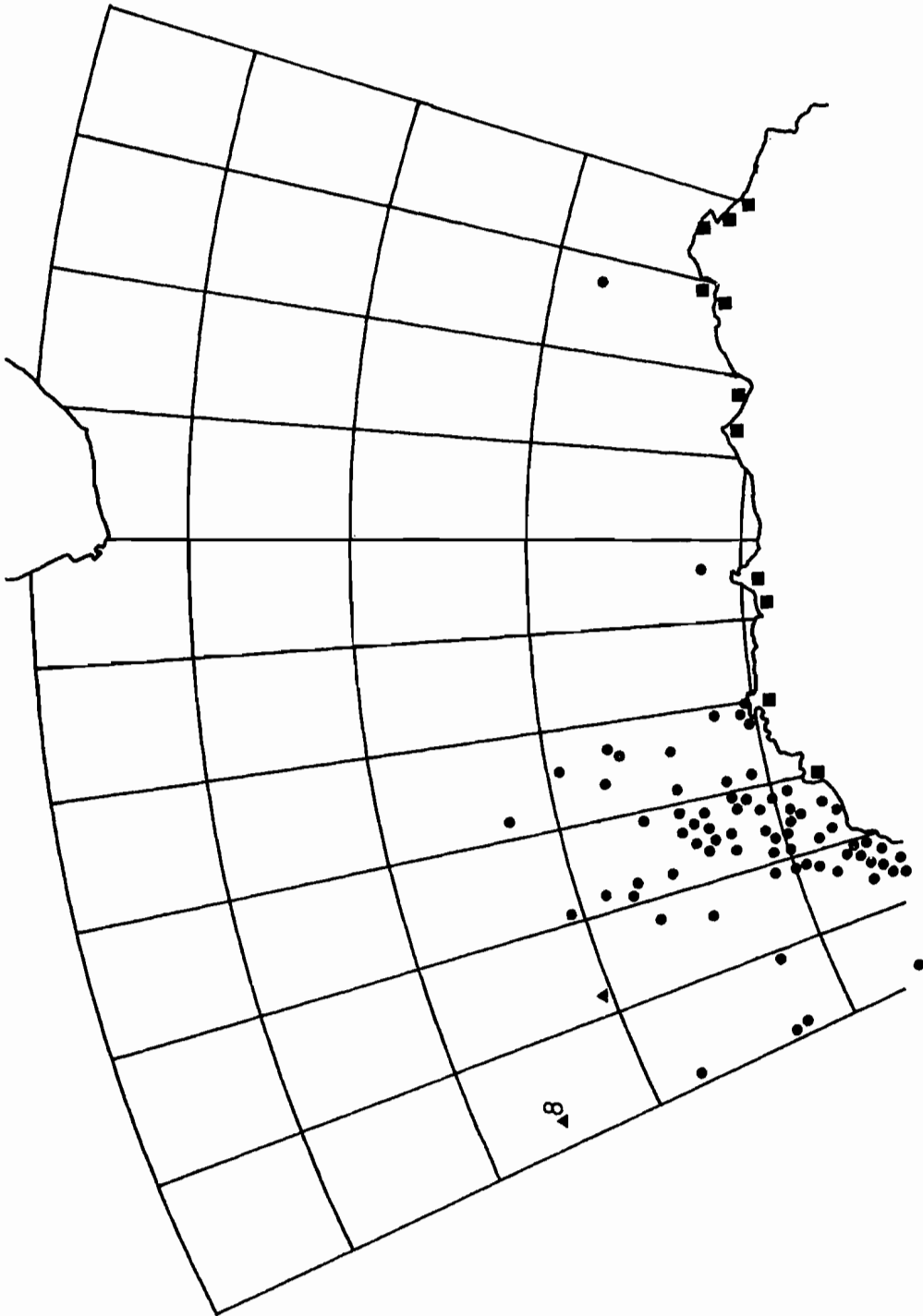


Figure 2

At-sea distribution of the Emperor Penguin in the southeastern Atlantic and southwestern Indian Oceans. ● = sightings; ■ = breeding localities; ▲ = Subantarctic island and African continental records.

concerning at-sea sightings and birds on the ice-shelf near SANAE. Clarke (1907) recorded Emperor Penguins as abundant on the ice at 74S, 22W; the first birds were noticed in 1903 at 69S, 21W and the last at 67S, 39W, whereas the first bird reported in 1904 was at 72S, 18W. Wilkins (1923) first noticed Emperor Penguins at 67 40S, 17E and saw *c.* 100 birds close to the continent. Bierman & Voous (1950) was referenced by Watson *et al.* (1971) but it seems the latter have failed to map birds at 67S, 16W (two birds); 65S, 11W (one bird); 65S 23W (one bird) and 63S, 22W (two birds).

Cline *et al.* (1969) recorded Emperor Penguins at 74S, 39W in the Weddell Sea in 1968 with most birds seen in the south. He counted a total of 310 Emperor Penguins with a mean density of 1,3 birds per statute square mile. This represented only 3,3 % of all birds counted and most birds were alone or in pairs.

Additional data, not available to Watson *et al.* (1971), are provided by Thurston (1982) covering British Antarctic Survey (BAS) records from 1959 - 1964 during seven voyages between South Georgia and Halley Bay. Emperor Penguins were recorded between 9W - 27W depending on the ships' routes, usually in ones and twos, but occasionally in groups of up to 10 individuals. The most northerly record was of a single bird at 59S, 19W; and a total of 35 was the maximum recorded on any one day. Very few juveniles were recorded. Earlier BAS data (Tickell & Woods 1972) did not include penguins within 50 nautical miles of breeding grounds. The only at-sea records of Emperor Penguins given by them are of birds to the west of the study area of this paper.

Condy (1979) recorded 39 Emperor Penguins out of 813 penguins identified (4,8 %) in 288,17 km of the King Haakon VII Sea, representing a density of 0,14 individuals km. Mean group size was 1,17 and the ratio of Emperor Penguins to Adélie Penguins *Pygoscelis adeliae* was 1:19,9. Most of the Emperor Penguins were moulting and were observed on large smooth-surfaced ice-floes; group size was not influenced by the amount of ice coverage.

Wilson (1983) gives the world population of Emperor Penguins as *c.* 200 000 pairs. Between 40W and 60E he listed 11 colonies comprising some 28 000 pairs, but some of these colonies may now be extinct. Condy (1979) listed three small additional breeding colonies near SANAE holding less than 300 birds on bay ice. No birds were present at either locality in 1976 or 1977 when there was considerably less ice (Condy 1979). La Grange (1962) recorded a colony of 80 birds at Otterbukta (near SANAE) in November and December 1961 where none was seen the previous year. These changes probably reflect annual variations in local ice conditions.

Emperor Penguins have not been recorded from the Prince Edward Islands, Gough Island, the Tristan da Cunha group, Bouvet Island or continental Africa.

King Penguin *Aptenodytes patagonicus*

King Penguins were recorded on 11 10-minute cards representing 47 individuals ranging from *c.* 44 - 51S (Fig. 3). Most of the

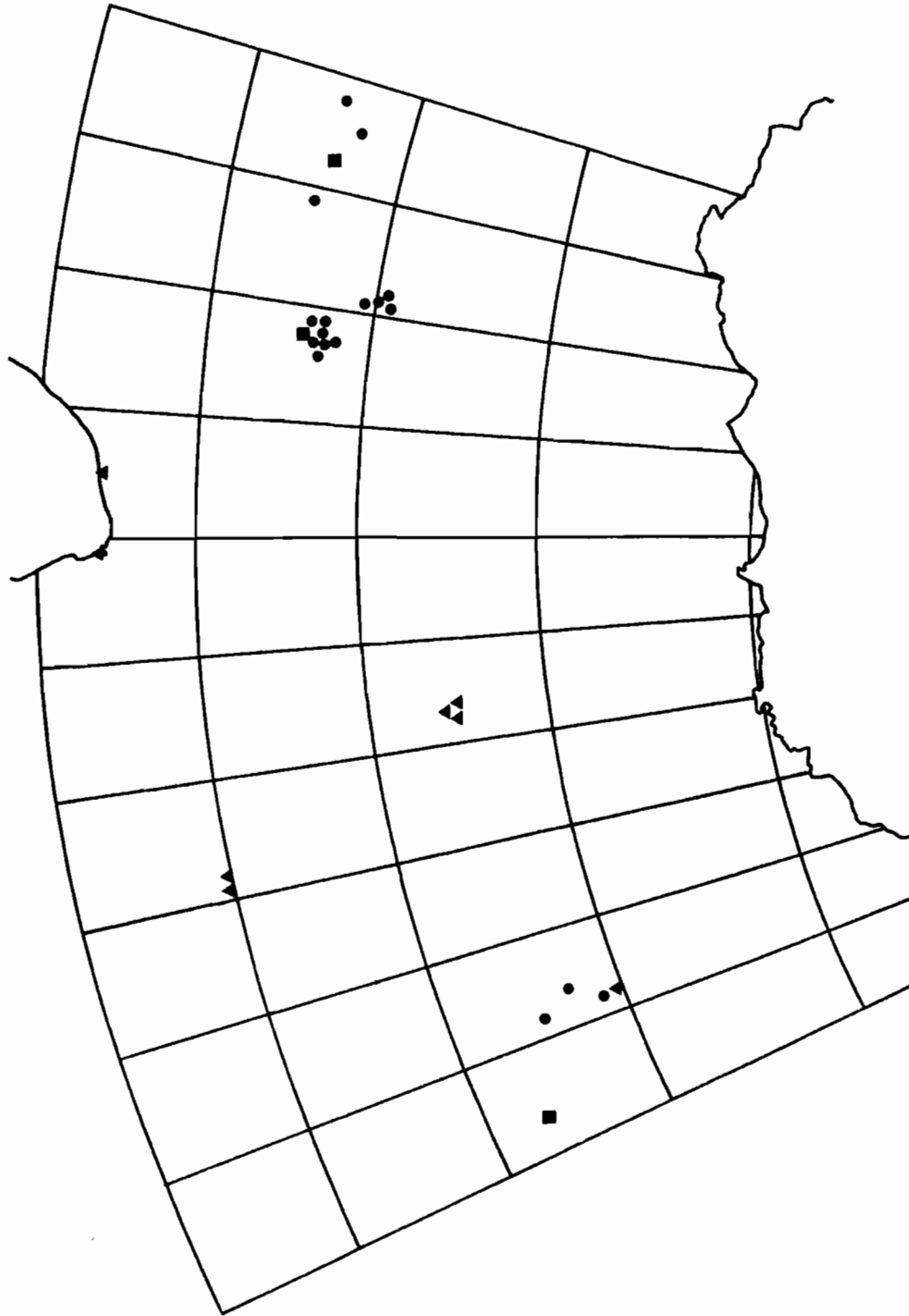


Figure 3

At-sea distribution of the King Penguin in the southeastern Atlantic and southwestern Indian Oceans. Key as in Fig. 2.

at-sea sightings were fairly close to the Prince Edward Islands. More birds have been recorded to the south, although ships' tracks are more frequent to the north of Marion Island. Harris (1982) also recorded King Penguins at sea south of Marion Island as well as a single bird east of the Crozet Islands. Weimerskirch *et al.* (1985), analysing French banding recoveries from 1951 - 1982, reported 24 King Penguins banded on the Crozet Islands and recovered elsewhere. One of these was at Macquarie Island (a distance of 5 600 km) and another at Kerguelen Island (1 500 km). The remaining 22 birds (11 juveniles and 11 adults) were recovered at Marion Island (900 km away). Most of these recoveries were made between November and January, which is the moulting period. Weimerskirch *et al.* (1985) suggested that the dispersal range of the Crozet Island population could exceed 900 km, mostly involving juvenile and nonbreeding birds. Watson *et al.* (1971) give two at-sea records: an occurrence southeast of the Crozet Islands and one individual south of the South Sandwich Islands.

King Penguins are capable of long-distance migration. The species has been recorded twice at Gough Island: a single bird in June 1961 (La Grange 1961, Swales 1965) and another one ashore for one day on 6 February 1976 (M.N. Bester pers. comm.). King Penguins have been recorded at Bouvet Island on at least three occasions: one bird in 1977 (Fevolden & Sømme 1977); two birds from December 1978 to January 1979 (Haftorn *et al.* 1981); and three birds in January 1981, two of which were moulting juveniles and the third was an adult (Watkins 1981). None was seen ashore on 21 December 1982 at Nyrøysa, Bouvet Island (pers. obs.) and Harris (1982) did not record any nearby in December 1980. There is no evidence to suggest that breeding occurs at Bouvet Island.

Watson *et al.* (1971) included the South Sandwich Islands as possible breeding sites, as far as can be established, this remains unconfirmed. Wilkins (1923) recorded King Penguins at Zavodovski Island, South Sandwiches in 1922. Croxall & Kirkwood (1979) considered that juveniles from South Georgia visit the South Sandwich Islands and Kemp & Nelson (1931) recorded birds from Zavodovski and Saunders Islands, South Sandwiches in February and March 1930. Cordier *et al.* (1981) recorded one bird at Thule Island, South Sandwiches in April 1979.

There have been two definite records for continental Africa: one of a bird found alive at Bloubergstrand, (33 47S, 18 27E) southwestern Cape, South Africa on 12 January 1977 (Cooper 1978a), and the second was of an adult found alive on 28 January 1982, 13 km east of the Sundays River, (33 42S, 26 03E) eastern Cape, South Africa (Ross & Cockcroft 1985). Both individuals commenced moulting soon after discovery. A possible earlier record was of a bird at Llandudno, (34 00S, 18 20E) southwestern Cape in about 1975 (Cooper 1978a). Records of birds in the Cape Town harbour area in July and August 1985 are known to refer to ship-assisted individuals and these are discounted from this analysis. African mainland records could refer to either Atlantic or Indian Ocean populations.

King Penguins were adversely affected by sealers and populations have been increasing at most sites (Conroy 1975). At South Georgia c. 34 000 pairs breed (Croxall *et al.* 1984). At the Prince Edward Islands c. 228 000 pairs breed (Williams *et al.*

1979, Williams 1984), about one half of the world's population.

Gentoo Penguin *Pygoscelis papua*

Eight records of 31 birds exist between 45 - 54 S, all but three of these being very close to the Prince Edward Islands (Fig. 4). Two exceptions are of two different individuals at c. 45S, OE, of interest since there are so few published at-sea records (Watson *et al.* 1971). The third record is of a single bird at 54S, 28W close to the South Sandwich Islands.

Watson *et al.* (1971) do not map at-sea records for the area, although they reported birds heard calling at 44S, 41W (some 1 000 km north of South Georgia) (Murphy 1936). Harris (1982) recorded four birds at 54 42S, 33 44W, very near South Georgia where they breed, and a single bird at 48 36S, 37 16E just south of the Prince Edward Islands where they also breed. Voisin (1980) reported birds at 46 51S, 38 08E.

Since Watson *et al.* (1971), there has been a record of the Gentoo Penguin ashore at Gough Island in 1977 (Voisin 1979). This record, and the FitzPatrick Institute sightings at 45S, OE, show that this species is capable of long-distance movements with the nearest breeding locality being the South Sandwich Islands, over 2 000 km away. This species has not been recorded at Bouvet Island, some 2 000 km from the South Sandwich Islands (Watkins 1981).

The Gentoo Penguin is the least abundant pygoscelid penguin with a total population of c. 280 000 pairs, 70 % of which are found in the Falkland Islands and South Georgia (Wilson 1983). Approximately 90 000 pairs breed at South Georgia (Croxall *et al.* 1984). The population at the South Sandwich Islands is not well known. Wilson (1983) gives a figure of c. 1 000 pairs; with birds breeding on Thule, Candlemas, Saunders and Visokoi Islands (Croxall & Kirkwood 1979), and probably Bristol (Wilkinson 1956) and Zavodovski Islands as well (Kemp & Nelson 1931). Croxall *et al.* (1984) gave a figure of 2 000 pairs for the South Sandwich Islands. Harris (1982) did not mention this species in the vicinity of the South Sandwiches; however, no landings were made, and, under similar conditions, none was seen in January 1983 (pers. obs.). Gentoo Penguins breed at the Prince Edward Islands with a population of 1 543 pairs in 1984 (N.J. Adams pers. comm.) and the population at the Crozet Islands is in the "thousands" (Jouventin *et al.* 1984). There is no evidence to suggest any expansion in numbers. The species has not been reported from continental Africa.

Adélie Penguin *Pygoscelis adeliae*

A total of 23 sightings of 125 birds has been made (Fig. 5). These birds are all south of 50S with some being hundreds of kilometres from land, usually on ice-floes. The largest group was of 19 individuals. Records of two birds at 52S are the most northerly for the area.

Most of Watson *et al.*'s (1971) records come from 60 - 70S and 20W - OE. Watson *et al.*'s (1971) map. Sinclair (1980) has published a photograph of two Adélie Penguins at

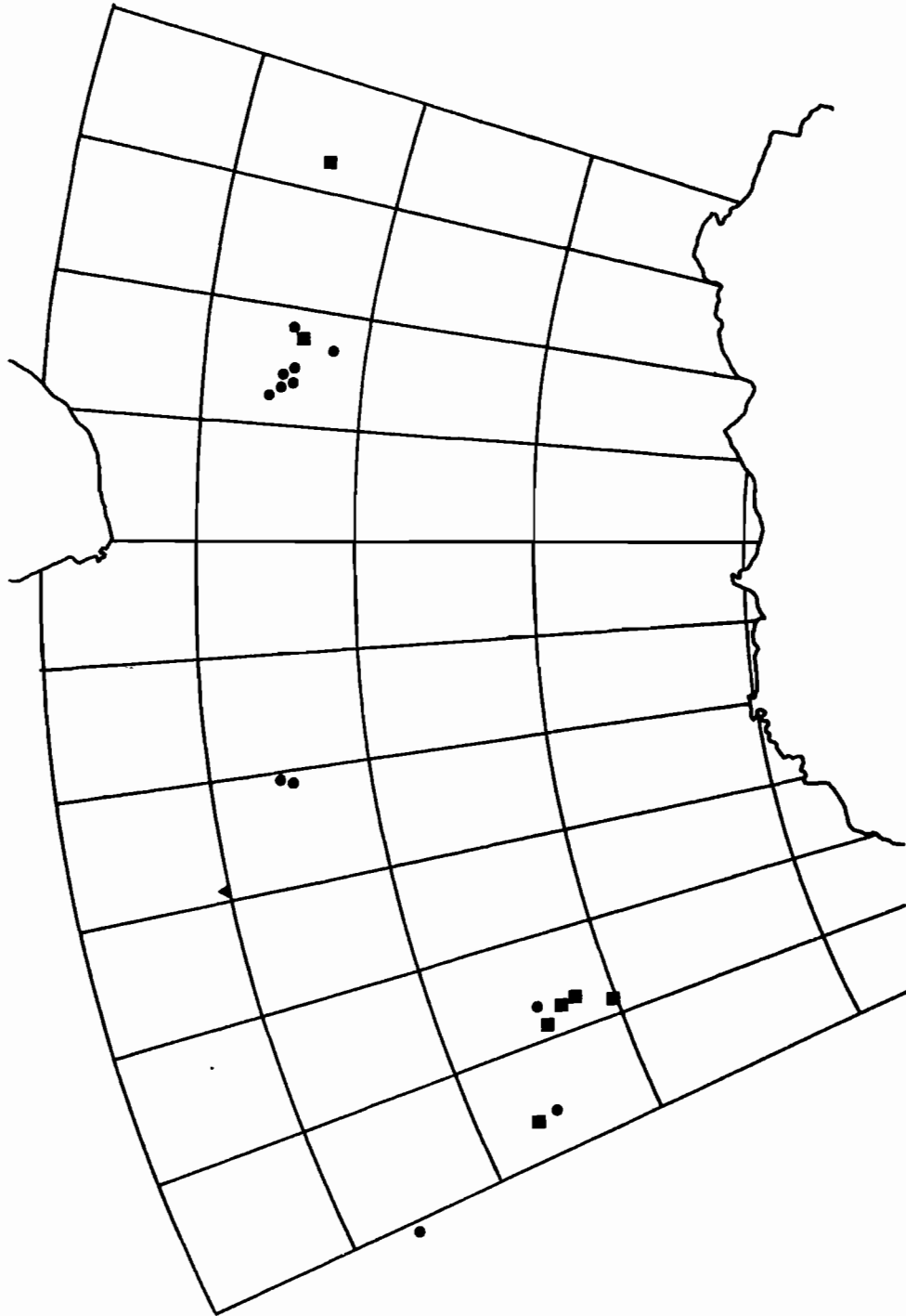


Figure 4

At-sea distribution of the Gentoo Penguin in the southeastern Atlantic and southwestern Indian Oceans. Key as in Fig. 2.



Figure 5

At-sea distribution of the Adélie Penguin in the southeastern Atlantic and southwestern Indian Oceans. Key as in Fig. 2.

Polarsirkelbukta near SANAE. Although Adélie Penguins were numerous on bay-ice near SANAE in January 1983, very few were observed either sailing to or from SANAE (pers. obs.). Clarke (1907) reported birds being numerous on the ice, at 70S, 21W and at 73 30S, 21 38W. The northern limit was 61 25S, 12 47W as well as 20 - 30 at sea on an iceberg on the return to the South Orkney Islands. Wilkins (1923) reported one bird seen soon after leaving South Georgia but no large numbers until Zavodovski Island, South Sandwiches was reached. Kock & Reinsch (1978) mentioned one pelagic record of Adélie Penguins at 59 08S, 40 00W.

Bierman & Voous (1950) recorded birds at 66 35S, 14W and 64S, 22W. Their most northerly record was at 61 55S, 23 00W and the most southerly at 67S, 17W. Birds were recorded in a narrow latitudinal zone and only between 13 45W and 24 55W. The species was most numerous at 64 35S, 22 50W some 600 km from the South Sandwich Group, with 89 being counted.

Cline *et al.* (1969) recorded Adélie Penguins from 68 - 74S at *c.* 39W. They recorded 6 571 birds, comprising 69,5 % of all birds counted, with a mean density of 28 per statute mile. Flock size varied from 10 - 25. Most Adélie Penguins were at the northern end of the pack-ice, unlike Emperor Penguins.

Thurston (1982) gave data for seven voyages between South Georgia and Halley Bay. These observations were made in the early sixties but were not available to Watson *et al.* (1971). Thurston's (1982) most northerly record is of four Adélie Penguins at 65S, 17W, and the most southerly, one bird at 76S, 27W. In two 24-hour periods he recorded 287 (72S, 19W) and 193 (71S, 21W) with 40 and 57 being the maxima observed at any one time.

Condy (1979) counted 774 Adélie Penguins in 288,17 km in the King Haakon VII Sea in January and February 1977. These were 95,2 % of all penguins counted, with a mean group size of 3,72 birds, and a density of 2,69 individuals km. Most of these birds were moulting on small, smooth-surfaced ice-floes. The moult and movements of this species on ice-floes are discussed by Penny (1967). On the second phase of the Second International BIOMASS Experiment, (SIBEX 2, March 1985) numerous small groups of Adélie Penguins (3 - 10 birds) were observed on small ice-floes near the Antarctic Continent at *c.* 60E, but none was observed in the same area in April 1984 during SIBEX 1 (pers. obs.).

Croxall *et al.* (1984) gave a world population of *c.* 5 - 10 million pairs. Within the study area, birds breed on the South Sandwich Islands (*c.* 30 000 pairs, Croxall *et al.* 1984). Croxall & Kirkwood (1979) map only Candlemas as a breeding locality. Birds probably also breed on Thule, Bellinghousen, Montagu, Saunders and Zavodovski (Holdgate & Baker 1979). Cordier *et al.* (1981) gave a figure of *c.* 10 000 pairs for Thule in November 1979. At Bouvet Island, approximately 60 pairs breed (Fevolden & Sømme 1977) and the species also breeds at least 17 Antarctic continental colonies in the region (Wilson 1983, Cooper 1985b). Adélie Penguins have increased in numbers, but not as much as have Chinstrap Penguins (*Pygoscelis antarctica* (Croxall *et al.* 1984). There are no records from the Tristan da Cunha group, Gough Island, the Prince Edward Islands,

the Crozet Islands, or the African Continent. There are two sight records of birds ashore at South Georgia in November 1972 and February 1976 (Prince & Payne 1979).

Chinstrap Penguin *Pygoscelis antarctica*

There are 19 FitzPatrick Institute at-sea records involving some 379 birds, all between 50 - 70S (Fig. 6). The largest group was of c. 200 on an iceberg at 55 30S, 28W near the South Sandwich Islands. Some sightings were several hundred nautical miles from land. Sightings at sea between 50 - 60E on SIBEX 1 and SIBEX 2 may have been of birds originating from Heard Island. Watson *et al.* (1971) recorded birds between 50 - 70S with more sightings to the west than to the east. Clarke (1907) recorded Chinstrap Penguins between the South Orkneys and South Sandwich Islands: south from the South Sandwich Islands, birds were met at intervals until 69S, 23W. On the return voyage, the first birds were seen at 67S. Bierman & Voous (1950) recorded their northermost bird at 55 40S, 7 10E, whereas their most-southerly record was of a moulting bird on drifting ice at 67S, 16 05W. These records are on Watson *et al.*'s (1971) map, although birds collected by Bierman & Voous (1950) at 57S, 9E (one bird) and at 57S, 6E (two birds) are not clearly indicated. Watson *et al.*'s most northerly at-sea record was of a bird at 47S, 9E. Sladen's (1964) map illustrated increasing sightings in the eastern part of this area. Kock & Reinsch (1978) recorded Chinstrap Penguins seen near the Antarctic coast as well as in the open ocean. Their most northerly record was at 51 29S, 6 00E. Their records extended the range given in Watson *et al.* (1971) eastwards and they recorded Chinstrap Penguins as being the most numerous species north of the pack ice, although groups of over 100 were rare. They also mentioned the species' pelagic occurrence being connected with presence of icebergs.

Cline *et al.* (1969) saw far fewer Chinstrap Penguins than either Adélie or Emperor Penguins. They saw only 23 birds representing 0,2 % of all birds identified, with a density of 0,1 statute mile. Thurston (1982) recorded c. 270 birds on isolated ice-floes at 56S, 28W, north of Zavodovski Island, South Sandwiches. Harris (1982) excluded penguins on ice-floes from his counts. He gave at-sea records of 13 at 54 42S, 33 44W; four at 55 04S, 3 29W; seven at 56 05S, 13 04W and two at 57 18S, 23 27W.

The Chinstrap Penguin has increased in numbers the most rapidly of all penguin species (Stonehouse 1985) and has been recorded from several Subantarctic islands as well as continental Antarctica since Watson *et al.*'s (1971) map was produced. There is one record of an adult bird in March 1983 at Gough Island (Enticott 1984); the nearest breeding locality being Bouvet Island some 3 000 km away. There are two records for Marion Island: an immature bird which moulted with Macaroni Penguins in February 1977 (Williams & Burger 1978) and a nonmoulted bird in February 1983 (Cooper 1984). There is also a record of a bird on the iceshelf with Adélie Penguins near SANAE in January 1980 (McQuaid & Rickett 1984). The population at Bouvet Island is in the region of 10 000 individuals (Haftorn *et al.* 1981). The Chinstrap Penguin has not been recorded breeding at the Prince Edward or Crozet Islands.

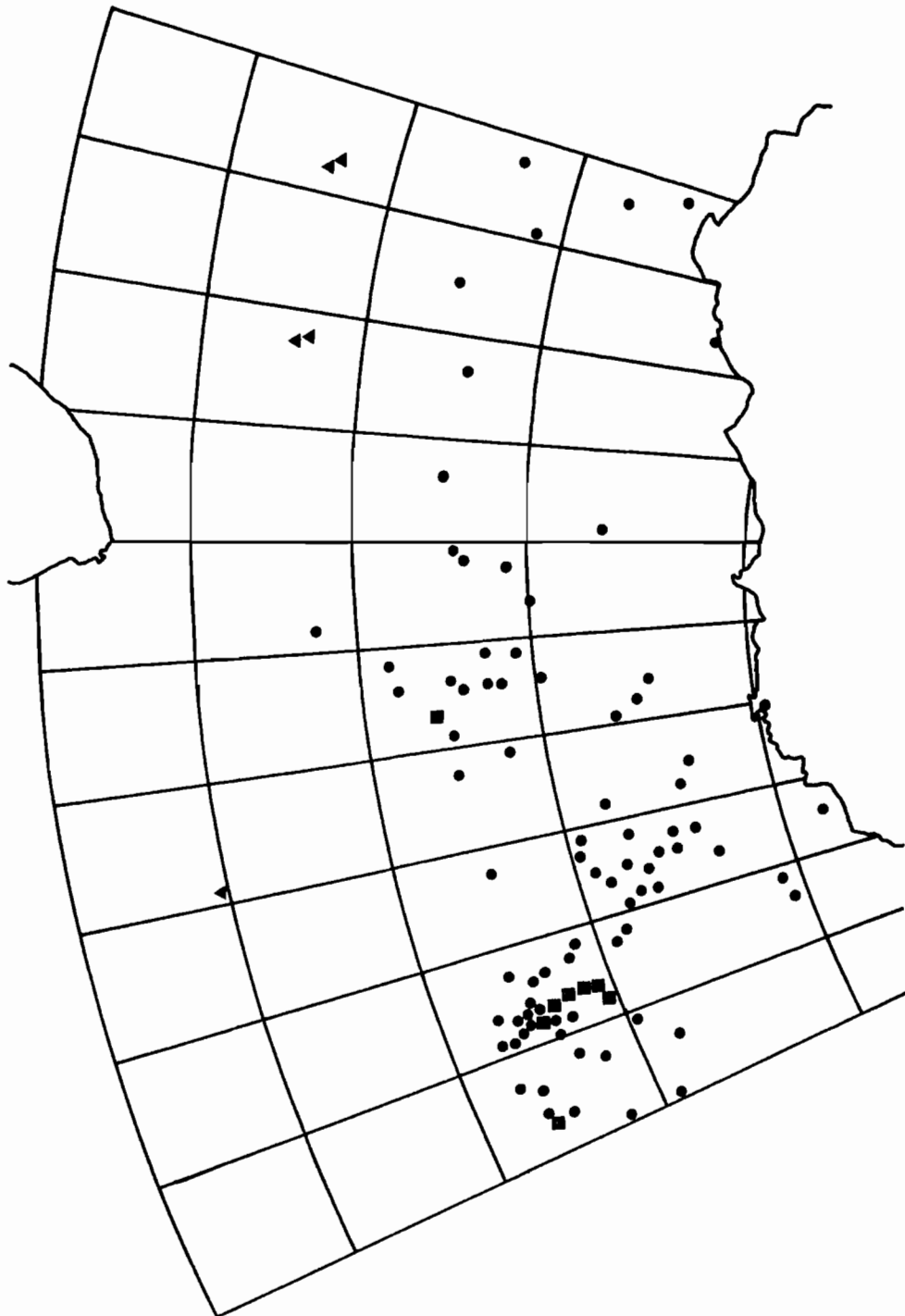


Figure 6

At-sea distribution of the Chinstrap Penguin in the southeastern Atlantic and southwestern Indian Oceans. Key as in Fig. 2.

The South Sandwich Islands' population is extremely large and has not been properly surveyed. Wilson (1983) listed 32 000 pairs with some islands uncounted. Holdgate & Baker (1979) reported thousands at Bellinghausen, Bristol, Montagu, Visokoi, Saunders, Vindication, Candelmas and Zavodovski Islands. None, as yet, has been recorded at Cook or Leskov Islands. Cordier *et al.* (1981) gave a figure of 20 000 - 30 000 pairs for Thule in November 1979. This population was estimated from the sea as c. 30 000 birds in January 1983 (pers. obs.). Croxall *et al.* (1984) estimated five million pairs for the whole group and this is undoubtedly the species' stronghold, this figure being larger than Wilson's (1982) estimate for the world population.

Rockhopper Penguin *Eudyptes chrysocome*

There are 13 at-sea sightings of 69 birds between 38 - 55S (Fig. 7). Five sightings involved 27 birds close to Gough Island and two sightings of four birds close to the Prince Edward Islands. More pelagic records are of a bird some 600 nautical miles NNE of Gough Island in October 1982; two separate individuals some 300 nautical miles NW of the Crozet Islands in May 1983; and two groups of four and 30 birds some 400 nautical miles WNW of the Prince Edward Islands in September 1979. A single bird was seen just north of the South Sandwich Islands in January 1983.

The only at-sea record shown by Watson *et al.* (1971) was of a bird at approximately 37S, 44E. Although there are relatively few at-sea records of Rockhopper Penguins, evidence of the species' mobility comes from a total of 41 individuals recorded from continental Africa (Cooper 1978b, Cooper *et al.* 1978, Cooper 1979a, 1980, 1982, Sinclair *et al.* 1984, J. Cooper *in litt.*). Continental records involve both subspecies, with the northern subspecies *moseleyi* being recorded more frequently. Most birds were moulting juveniles in January - February, with a smaller number of adults spread throughout the year. Cooper *et al.* (1978) tentatively deduced that birds of the northern subspecies came from Tristan da Cunha and/or Gough Islands, whereas birds of the southern subspecies came from the Prince Edward Islands.

The world population is estimated at c. 6,75 million pairs (Wilson 1983). Croxall *et al.* (1984) list two pairs for South Georgia, the birds first breeding in 1975 (Prince & Payne 1979). Rockhopper Penguins do not breed on the South Sandwich Islands.

The Tristan da Cunha group population, excluding Gough Island, (subspecies *moseleyi*) has been estimated at 280 000 pairs by Elliott (1957) and as c. 150 000 pairs by Richardson (1984). A recent (1984) count of the Gough Island Rockhopper Penguin population was of a minimum of 144 000 pairs (B.P. Watkins pers. comm.).

Birds on the Prince Edward and Crozet Islands belong to the southern race *chrysocome*. Williams *et al.* (1979) estimated the Prince Edward Islands population as 128 290 pairs, and Jouventin *et al.* (1984) estimated the Crozet Islands' population as "10's of 1 000's". There is no reliable record from Bouvet Island, although the species was mentioned by Dickinson (1966) and Lunde (1965) as occurring there.

41 RECORDS

SOUTH AFRICA

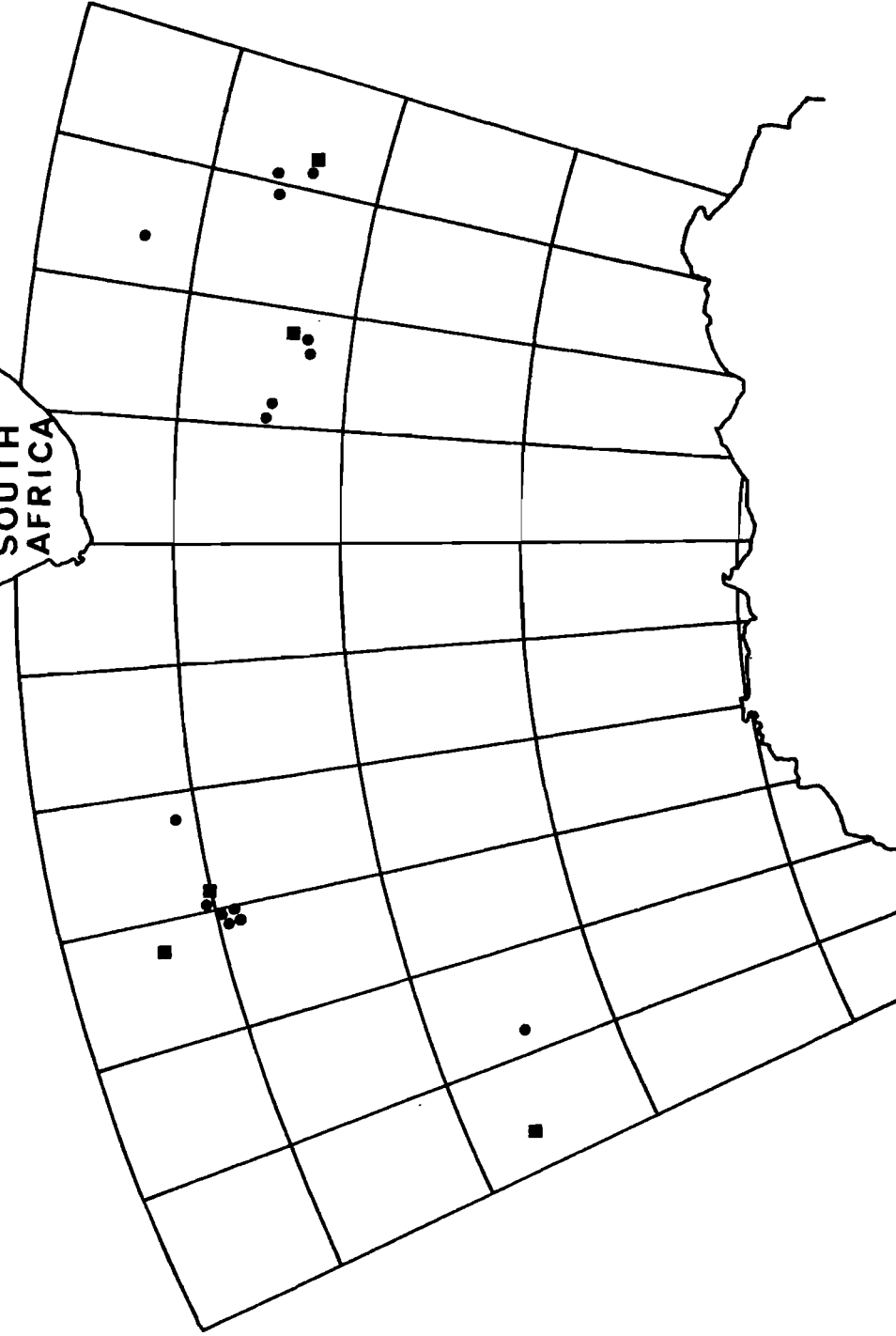


Figure 7

At-sea distribution of the Rockhopper Penguin in the southeastern Atlantic and southwestern Indian Oceans. Key as in Fig. 2.

Macaroni Penguin *Eudyptes chrysolophus*

There are no definite at-sea records of Macaroni Penguins from the FitzPatrick Institute data (Fig. 8). Watson *et al.*'s (1971) only at-sea record was of a bird recorded at c. 48S, 9W. Bierman & Voous (1950) recorded two birds at 65 40S, 11 00W and another at 66 10S, 12 15W, 1 350 km from the South Sandwich group and 1 450 km from Bouvet Island; these records do not appear to be on Watson *et al.*'s (1971) map. Watson *et al.* (1971) recorded a single bird ashore at Inaccessible Island, Tristan da Cunha Group on 3 March 1938 (Hagen 1952, Elliott 1957). Harris (1982) reported 29 Macaroni Penguins at 54 42S, 33 44W and 13 birds, 40 nautical miles south of South Georgia.

The lack of at-sea records can in part be explained by the difficulty in distinguishing this species from the Rockhopper Penguin. However, Macaroni Penguins, like Rockhopper Penguins, are capable of long-distance dispersals; there are six records for continental Africa (Ross *et al.* 1978; Cooper 1979b, 1980, Berruti 1982, Cooper 1983, J. Cooper *in litt.*). All these birds were moulting and occurred between February and April. It is by no means certain from which ocean these continental African individuals originated (Ross *et al.* 1978).

The world population is in excess of eight million pairs (Wilson 1983). South Georgia (including the Willis Islands) holds 5 400 000 pairs (Croxall *et al.* 1984). Wilson (1983) stated that Macaroni Penguins occur on most of the South Sandwich Islands, although figures are available only for Saunders, Vindication, Candlemas and Bellinghausen Islands, with a total of c. 300 pairs. Others breed at Thule, Bristol, Montagu, Visokoi and Zavodovski (Croxall & Kirkwood 1979). Croxall *et al.* (1984) gave a total of 3 000 pairs for the South Sandwich Islands.

Approximately 100 000 individuals were counted on Bouvet Island in 1979 (Haftorn *et al.* 1981). The population at the Prince Edward Islands was estimated at 457 000 pairs (Williams *et al.* 1979). The Crozet Islands' population was estimated as "millions" (Jouventin *et al.* 1984).

Watson *et al.* (1971) mapped the Royal Penguin *E.c. schlegelii* as occurring at Marion Island, the reference being Voous (1963). It is considered that he mistook whitefaced Macaroni Penguins for Royal Penguins (Berruti 1981). There is no definite record of the Royal Penguin at Marion Island.

Magellanic Penguin *Spheniscus magellanicus*

The Magellanic Penguin has been recorded twice from South Georgia (Prince & Payne 1979): a bird seen from 3 - 26 February 1961 (Tickell 1965) and a one-year old bird captured on 9 March 1972 (Prince & Payne 1979). The FitzPatrick Institute record of a single unidentified penguin at 31 31S, 39 37W in July 1983 may well have been a Magellanic Penguin. There is a report of a Magellanic Penguin photographed at Nightingale Island, Tristan da Cunha group in 1983/1984 (R. Grundy pers. comm.). Both Elliott (1957) and Richardson (1984) mentioned penguins, which

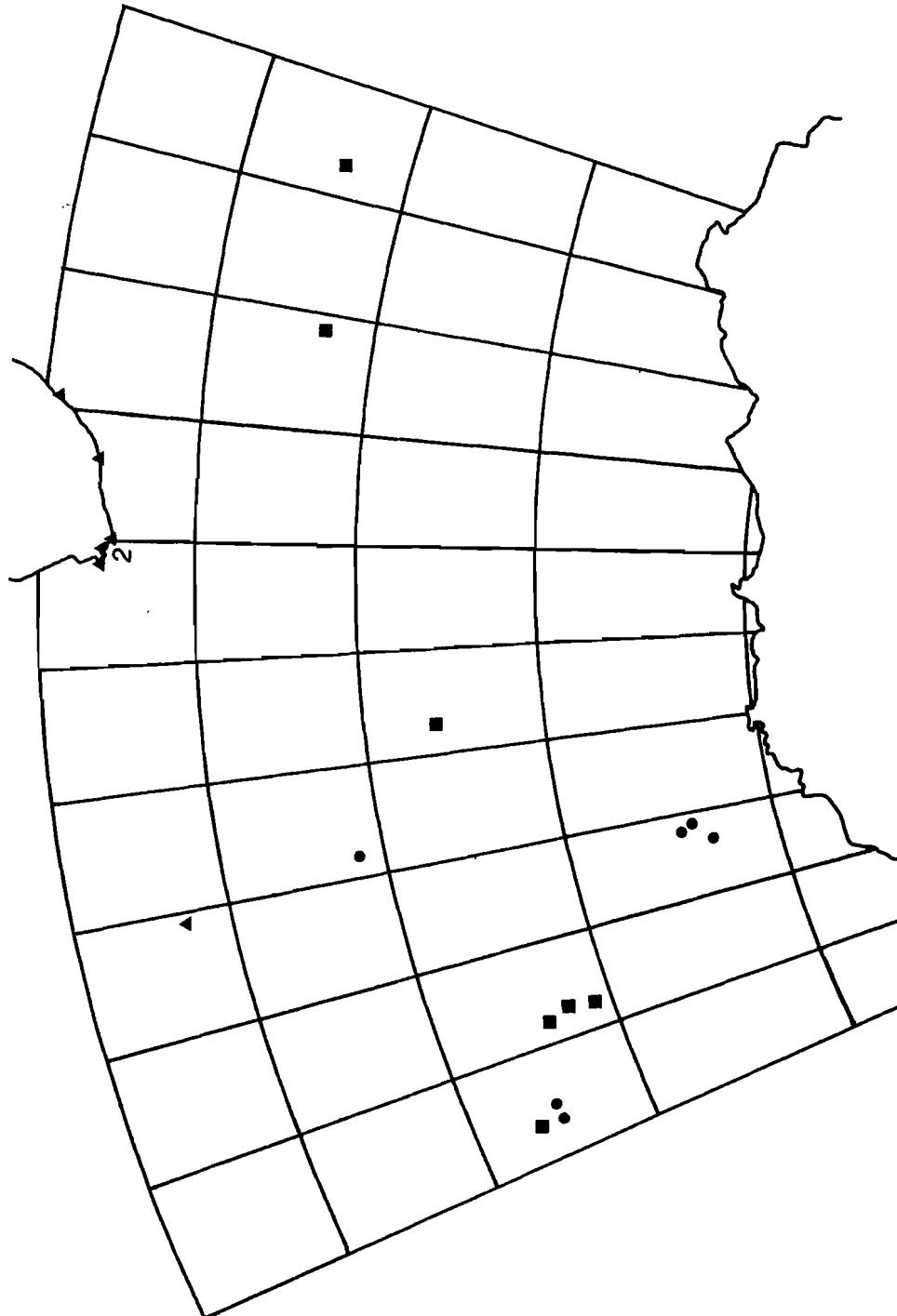


Figure 8

At-sea distribution of the Macaroni Penguin in the southeastern Atlantic and southwestern Indian Oceans. Key as in Fig. 2.

may have been Magellanic Penguins, seen ashore periodically at Tristan da Cunha by islanders.

Unidentified penguins

Watson *et al.* (1971) did not plot unidentified penguins. The FitzPatrick Institute data give a total of 37 sightings of 207 birds from 31 - 69S (Fig. 9). The largest groups were 90+ at 55 38S, 27 54W, and 30 at 47 18S, 37 48E; the remaining 33 records comprise groups of penguins between one (16 records) and seven (one record).

Published records are of six crested penguins *Eudyptes* spp. at 45S, 33W (Thurston 1982). Harris (1982) gave six records of unidentified penguins: two records near South Georgia; one record near the South Sandwich Islands; one record near Marion Island; and two records of individuals east of Bouvet Island (53 53S, 11 15E) and west of Bouvet Island (55 04S, 3 29W). Van Oordt & Kruijt (1954) observed 10 - 12 crested penguins in 1952 at 47 10S, 24 30E, some 600 miles away from the Prince Edward Islands. Voisin (1980, 1983) recorded unidentified penguins at 46 51S, 38 08E; 46 11S, 51 16E and 37 25S, 12 08W.

A large proportion of the records are of crested penguins fairly close to Subantarctic islands such as the South Sandwich group, Prince Edward Islands and the Crozet Islands. However, some birds have been seen hundreds of kilometres from these islands e.g. Thurston's (1962) record at 45S 33W; two individuals at 57 07S, 9 20W; one at 52 08S, 3 03W; Harris' records at 53 53S, 11 15E and 55 04S, 3 29W; and two separate birds east of Gough Island (39 34S, 4 46W and 38 25S, 2 53W).

The eight records from the FitzPatrick Institute data set south of 60S are unlikely to be of crested penguins. Most of these records are of unidentified birds on ice-floes, probably Adélie or Chinstrap Penguins.

DISCUSSION

Penguins are notoriously difficult to identify or even observe at sea. Porpoising penguins are more difficult to identify than are surface-swimming birds and most penguins at sea tend to swim rapidly away from a moving vessel by porpoising, making identification even more difficult. The distributions as mapped at least partially reflect ships' tracks within the area and are therefore biased to a degree. It has proven impossible to map all ships' tracks since these are not given by many of the references cited.

Penguins may be attracted to a stationary vessel and these birds, especially if heard calling, stand more chance of being seen. However, many cruises (especially relief voyages) spend no time at all on station except at or near islands, thus reducing the chance of detecting at-sea penguins. Both Emperor and Chinstrap Penguins have been observed calling while approaching or circling stationary vessels (pers. obs.). Routh (1949) cited three species (King, Adélie and Macaroni Penguins) which have come up the stern slipways of whaling vessels either by walking up themselves or else by riding up on whales being

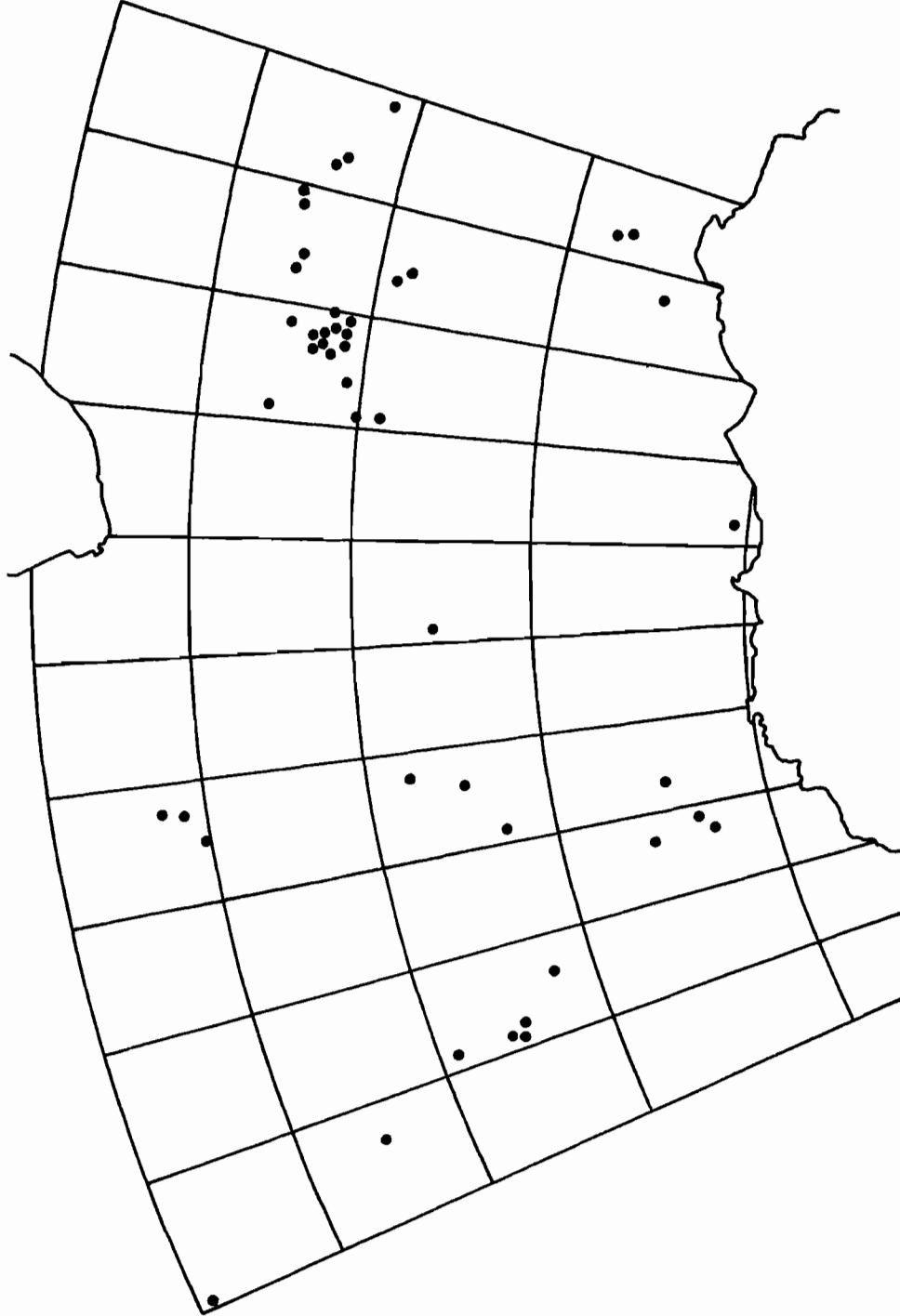


Figure 9

. At-sea distribution of unidentified penguins in the southeastern Atlantic and southwestern Indian Oceans. Key as in Fig. 2.

hauled aboard. Kock & Reinsch (1978) also recorded Chinstrap Penguins coming up the slipway of the F.R.V. *Walter Herwig* in January 1975.

The position of observation on a ship may also be important when observing penguins. With birds avoiding a moving ship, the bridge or bow may be a better observation point than the stern where birds in front of the ship are less visible. Another source of bias may be the effect of ice. On ice-floes or in pack-ice, resting penguins contrast with the ice and are conspicuous. In the open ocean the chances of seeing resting or swimming penguins are less. Therefore, species normally present to the north of the ice (such as crested penguins) may tend to be underestimated compared to species more commonly found at more southerly latitudes (such as Emperor, Adélie and Chinstrap Penguins).

It is clear from the continental African records of three penguin species, together with records for all the Subantarctic islands in the study area, that although few birds are actually recorded at sea, penguins in the Southern Ocean regularly undertake long-distance movements. Such records are in contrast to the limited foraging ranges of breeding penguins (e.g. Williams & Siegfried 1979, Lishman 1985, N.J. Adams pers. comm.).

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