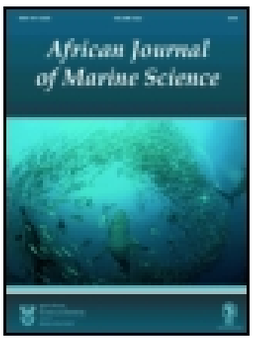

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DISTRIBUTION, POPULATION SIZE AND CONSERVATION OF THE CAPE GANNET *MORUS CAPENSIS*

R. J. M. CRAWFORD, P. A. SHELTON, J. COOPER AND R. K. BROOKE**

The Cape gannet is endemic to the southern African coast where it currently breeds at six islands: Mercury, Ichaboe and Possession off South West Africa and Bird (Lambert's Bay), Malgas and Bird (Algoa Bay) off South Africa. Previously, breeding also occurred at Hollams Bird, Halifax and Seal (False Bay) Islands. Equivocal records for Marcus, Dassen and Dyer Islands are not accepted. Off South West Africa, gannets were breeding at Hollams Bird, Mercury and Ichaboe Islands at least as early as 1828, but they only occupied Halifax and Possession Islands sometime between that date and c. 1885, possibly as a result of displacement of gannets from Ichaboe Island during exploitation of accumulated guano deposits in the early 1840s. Gannets bred at Hollams Bird Island until at least 1938, but had ceased breeding at Halifax Island by 1928. Off South Africa the earliest records of breeding are 1648, 1687, 1755 and 1912 for Malgas, Seal (False Bay), Bird (Port Elizabeth) and Bird (Lambert's Bay) Islands respectively. Gannets have not been reported at Seal Island since the late 17th century. On the west coast of Africa the Cape gannet is a regular nonbreeding winter visitor as far north as 4°20'N 6°00'E, but west of 6°E it is rare. On the east coast of Africa it is a common winter visitor as far north as Delagoa Bay, but farther north it is rare. Within its normal range the Cape gannet seldom occurs farther off shore than 100 km; it hardly ever moves inland. Aerial censuses of Cape gannets at breeding islands in 1967, 1969, 1978, 1980 and 1981 are compared with an aerial census conducted in 1956 and other published estimates of abundance. Between 1956 and 1980 the estimated number of breeding pairs at all colonies decreased from c. 150 000 to c. 80 000 and numbers decreased at all three extant gannetries off South West Africa. These decreases are attributed to a greatly diminished food resource following the collapse of the South West African pilchard stock after the late 1960s. The number of gannets decreased at Bird (Lambert's Bay) and Malgas Islands between 1956 and the late 1960s but subsequently increased, trends that are related to performances of the Western Cape pilchard and anchovy resources respectively. At Bird Island (Algoa Bay) gannets were up to 3,5 times more abundant in the late 1970s than in 1956. Other marine resources located east of Cape Point have shown similar large increases in recent years. Rates of increase of gannets at islands off South Africa during the 1970s would have required an unrealistically high survival for the first year had other population parameters remained constant. It is possible that birds emigrated from the South West African Islands. Few gannets have been reported oiled, and conservation of the species seems to be mainly affected by greatly reduced prey availability and injudicious guano harvesting. Human exploitation of juvenile gannets off the West African coast is difficult to assess.

Die malgas is endemies langs die Suider-Afrikaanse kus waar dit tans op ses eilande broei. Hulle is Mercury-, Ichaboe- en Possession-eiland teenoor Suidwes-Afrika en Voëleiland (Lambertsbaai), Malgaseiland en Voëleiland (Algoabaai) teenoor Suid-Afrika. Vroeër is daar ook op die eilande Hollandsvoël, Halifax en Rob (Valsbaai) gebroei. Daar bestaan onsekere gegewens vir Marcus-, Dassen- en Dyereiland. Teenoor Suidwes-Afrika het malgasse beslis reeds in 1928 gebroei by Hollandsvoëleiland, Mercury- en Ichaboe-eiland, maar hulle het Halifax- en Possession-eiland eers op 'n tydstip tussen daardie datum en ongeveer 1885 beset, moontlik omdat malgasse van Ichaboe-eiland af weggetrek het tydens ontginning van opgehoopte ghwano in die jare net na 1840. Malgasse het tot minstens 1938 by Hollandsvoëleiland gebroei, maar het teen 1928 opgehou om by Halifax-eiland te broei. Die eerste aantekeninge van broeibedrywighede teenoor Suid-Afrika is gedateer 1648, 1687, 1755 en 1912 vir Malgas- en Robeiland (Valsbaai), Voëleiland (Port Elizabeth) en Voëleiland (Lambertsbaai) onderskeidelik. Sedert die laat 17de eeu is geen malgasse by Robeiland gerapporteer nie. Aan die weskus van Afrika is die malgas 'n gereelde nie-broeiende winterbesoeker tot so ver noord as 4°20'N 6°00'O, maar is wes van 6°O skaars. Aan die ooskus van Afrika is dit 'n bekende winterbesoeker so ver noord as Delagoabaai, maar verder noord is dit skaars. Binne sy normale verspreidingsgebied kom die malgas selde verder as 100 km van die kus af voor; dit beweeg byna nooit land in nie. Lugsensusse van malgasse wat in 1967, 1969, 1978, 1980 en 1981 by broeieilande opgeneem is, word vergelyk met 'n lugsensus in 1956 en ander gepubliseerde talrykheidsramings. Tussen 1956 en 1980 het die aantal broeipare by alle malgaskolonies volgens raming van ongeveer 150 000 tot ongeveer 80 000 verminder. By al drie die malgaskolonies wat nog teenoor Suidwes-Afrika bestaan, het getalle gedaal. Hierdie dalings word toegeskryf aan 'n drastiese verminderde voedselbron as gevolg van ineenstorting van die Suidwes-Afrikaanse sardyn na die laat sestigerjare. Die aantal malgasse het tussen 1956 en die laat sestigerjare by Voëleiland (Lambertsbaai) en Malgaseiland gedaal, maar het daarna gestyg. Hierdie tendense hou onderskeidelik verband met die stand van die Wes-Kaapse sardynbron en dié van die ansjovis. By Voëleiland (Algoabaai) was malgasse in die laat sewentigerjare tot 3,5 maal talryker as in 1956. Ander mariene hulpbronne oos van Kaappunt het die afgelope jare dergelike groot vermeerderings getoon. Aanwaskoerse van malgasse op eilande teenoor Suid-Afrika gedurende die sewentigerjare sou 'n onrealisties hoë oorlewingskoers vir die eerste jaar vereis het as ander bevolkingsparameters konstant gebly het. Dit is moontlik dat voëls van die Suidwes-Afrikaanse eilande af geëmigreer het. Daar was min gerapporteerde gevalle van malgasse wat met olie besmet is. Die bewaring van die spesie word skynbaar veral geraak deur grootliks verminderde beskikbaarheid van prooi en onoordeelkundige ghwanoversameling. Dit is moeilik om die ontginning deur mense van jong malgasse teenoor die Wes-Afrikaanse kus te takseer.

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The Cape gannet *Morus capensis* (Aves: Sulidae) is an endemic seabird of the coast of southern Africa (Clancey 1980) and with the Cape cormorant *Phalacrocorax capensis* (Cooper *et al.* 1982) and jackass penguin *Spheniscus demersus* (Crawford and Shelton 1981) is one of the three most important guano-producing seabirds in southern Africa. It is also a predator of valuable commercially exploited pelagic surface-shoaling fish such as pilchard *Sardinops ocellata* and anchovy *Engraulis capensis* (Davies 1955, 1956, Rand 1959a, Matthews 1961, Jarvis 1971a, Crawford and Shelton 1978, 1981, Batchelor 1982, Furness and Cooper 1982, Cooper in press). The three abundant species of seabirds in the Saldanha Bay fishing ground, South Africa, consume an estimated 12 918 metric tons of pilchard and anchovy per year of which 18,3 per cent is taken by the Cape gannets (Furness and Cooper *op. cit.*).

Pilchard and anchovy exhibit large fluctuations in biomass and recruitment (Newman and Crawford 1980, Armstrong *et al.* 1983). As a result, conventional assessments based on production curves and dynamic-pool models have often failed to provide adequate warning of changes in population size, as have more direct techniques such as ichthyoplankton, acoustic and aerial surveys (Butterworth 1980). At three of the islands used as breeding sites by the Cape gannet, guano production has been significantly correlated with prey availability (Crawford and Shelton 1981). The effects of fisheries on seabirds, including the Cape gannet, in southern Africa have been reviewed by Burger and Cooper (in press), who conclude that seabird conservation and fisheries management are interlinked and that ". . . a greater knowledge of the responses by seabirds to changes in the availability of their prey is essential for seabird conservation and in the use of seabirds to monitor fish stocks."

In 1956 the total population of Cape gannets was estimated at about 352 000 adults (Rand 1963a, b). Decreasing guano yields in later years led to the suggestion that numbers had subsequently decreased (Jarvis 1971a). However, at one colony at least, Bird Island (Algoa Bay), the population has increased since 1956 (Randall and Ross 1979). In view of the uncertainty about population trends, a complete aerial census of breeding Cape gannnets was conducted in 1978. Further census information was obtained in 1980 and 1981.

The Cape gannet is called *Morus capensis* by Clancey (1980), but *Sula bassana capensis* by White (1965). Two unrelated problems of taxonomy arise: firstly, whether to recognize the genus *Morus* for the gannets as opposed to *Sula* for the boobies; secondly, whether there is one species of gannet with three subspecies or three closely related species. The arguments are set out at length by Nelson (1978a) and we have nothing new to add. However, we have decided to follow the standard work for southern Africa (Clancey *op. cit.*) and to call the Cape gannet *Morus capensis*, implicitly accepting two genera in the Sulidae and three species in *Morus*. One of us (Brooke 1981a) has argued briefly in favour of this view.

This report covers the distribution, population trends and conservation of the Cape gannet.

METHODS

During 1978—1981, the South African Air Force, under contract to the Sea Fisheries Research Institute, photographed the six extant colonies of Cape gannets. Bird Island (Lambert's Bay) and Bird Island (Algoa Bay) were surveyed in 1978, 1980 and 1981, Ichaboe, Possession and Malgas Islands in 1978 and 1980 and Mercury Island in 1978 and 1981. The camera was housed in the base of an aircraft and vertical shots were taken through a 75-mm lens and with 70-mm monochrome Ilford FP3 film of ASA rating 200. Census techniques are described in more detail by Shelton *et al.* (1982).

In early November 1978, trial flights were conducted over Malgas Island to examine the influence of altitude and time of day on photographic results. Shots were taken at 300, 450, 600 and 900 m. Birds were most easily identified on those taken at 300 m and, because the entire colony was included on a series of negatives taken at this altitude, it was decided to photograph all breeding islands of the gannet from 300 m. On sequences taken earlier than 09h00 or later than 16h00, shadows made individual birds difficult to distinguish. Therefore the surveys were restricted to the intervening period. This choice was also influenced by the advantage of having results compatible with those of 1956, when photography was conducted between 10h30 and 15h00 (Rand 1963a).

In order to obtain ground truth of the surveys, the five West Coast islands were visited between October and December 1978 and Bird Island (Algoa Bay) in December 1979. Distributions of breeding colonies of the various seabird populations were recorded on charts of the islands. However, on aerial photographs Cape gannets were easily distinguished from other species.

At Mercury, Ichaboe, Possession and Bird (Algoa Bay) Islands diel variations in the number of birds present in six small breeding groups of Cape gannets were noted to investigate the significance of time of

day on aerial estimates. Counts were made through binoculars from distances of 10—20 m. Additionally, at Bird Island (Algoa Bay) photography from the top of the lighthouse tower provided similar data for one larger group.

At Bird Island (Lambert's Bay), a series of aerial photographs was taken half an hour after sunrise and at midday between October 1973 and February 1975 to study diel fluctuation in numbers by season. Photographs were taken with monochrome Ilford high-speed 35-mm film through a 105-mm lens. A high-winged aeroplane was chartered for the purpose, and photographs were taken through a window as the aircraft banked tightly while circling the island. The shots were almost vertical as a result. A second observer on the causeway counted Cape gannets flying south from the island between dawn and the arrival of the aircraft, it having been previously established that very few birds left in a northerly direction. The counts in Table I and Appendix 1 are composites of birds counted by the observer plus those on the photographs.

In order to count the number of Cape gannets on the photographs, the negatives were projected onto sheets of white paper on a wall. With a close-up lens, adult birds, which appeared as black dots, were marked with a pen and simultaneously tallied with a mechanical counter. A repeat count was made of the early morning photograph taken on 24 October 1974 to test the accuracy of the counting. The result was satisfactory. One of us (J.C.) checked each counted photograph for unmarked and, thus, uncounted birds; these were added to the total tally. In nearly all cases, the whole colony was contained on a single photograph, so that problems of under- or double-counting in areas of overlap seldom arose. Only the number of adults was counted, not the number of nests. Because birds leaving the island were counted between dawn and the time of initiation of aerial photography, counts represent the number present at dawn even though the photographs were only taken half an hour after sunrise. This time was chosen as being the earliest moment at which there was sufficient light for efficient photography and at which excessively long shadows could be avoided.

At Mercury, Ichaboe and Possession Islands nesting densities were also calculated. Areas of 2 m^2 were marked out with flag poles joined together by rope and the number of nests within each area was counted. Nests falling on the perimeter of an area were included if more than half the nest was judged to lie inside the boundary. Because these observations were conducted in the middle of the breeding season, given by Rand (1959a) and personally observed to be between late November and early December, unused nests from previous years were readily distinguished.

Aerial photographs that had not been counted, also taken by the South African Air Force, were available for Mercury, Ichaboe, Possession, Bird (Lambert's Bay) and Malgas Islands for November 1967, and for Mercury, Malgas and Bird (Algoa Bay) Islands for November 1969. Methods used to count gannets in aerial photographs have been described by Shelton *et al.* (1982). The published literature has been examined for further breeding records and for information on nonbreeding distribution.

DISTRIBUTION

The Cape gannet at present breeds on six islands off southern Africa extending from Mercury Island off South West Africa (Namibia) to Bird Island (Algoa Bay) in South Africa (Fig.1, Appendix 1). Cape gannets do not roost at islands where they do not breed (personal observation), and therefore historical records of the presence of gannets on an island may be equated with the claim that they were breeding. Cape gannets were first reported on Mercury Island on 22 October 1828 and on Ichaboe Island on 6 October 1828 (Morrell 1832). Possession Island was reported to be ". . . exclusively occupied by penguins, but now the malagas [Cape gannet] has come there" (Angra Pequena and West Coast Claims Joint Commission 1885). Morrell (*op. cit.*) did not report the presence of gannets during his visit from August to October 1828 when breeding would have started if the birds had been there. Eden (1846) visited Possession Island on 14 May 1845, but he did not report that he saw any Cape gannets. However, his visit would have been after the end of the breeding season of gannets (Rand 1959a).

From 1843 to 1845 the accumulated guano deposits of Ichaboe Island were exploited. Up to 4 500 labourers were ashore on the 6,5 ha island in October 1844 (Ex-member of the Committee 1845), and it is extremely unlikely that Cape gannets were able to breed there at that time. It is therefore possible that the colonization of Possession Island in the 19th century was undertaken by birds displaced from Ichaboe at the time of the "guano rush".

The earliest record of Cape gannets breeding at Bird Island (Lambert's Bay) in the Western Cape is of one or two pairs present in 1912 (Jarvis 1971b). This information was based on that of local informants who also stated that gannets were not present in 1907. The colony apparently increased in size rapidly after 1912 (Jarvis *op. cit.*). Gill and Zeederberg (1928) state "The malagas [Cape gannets] are recent

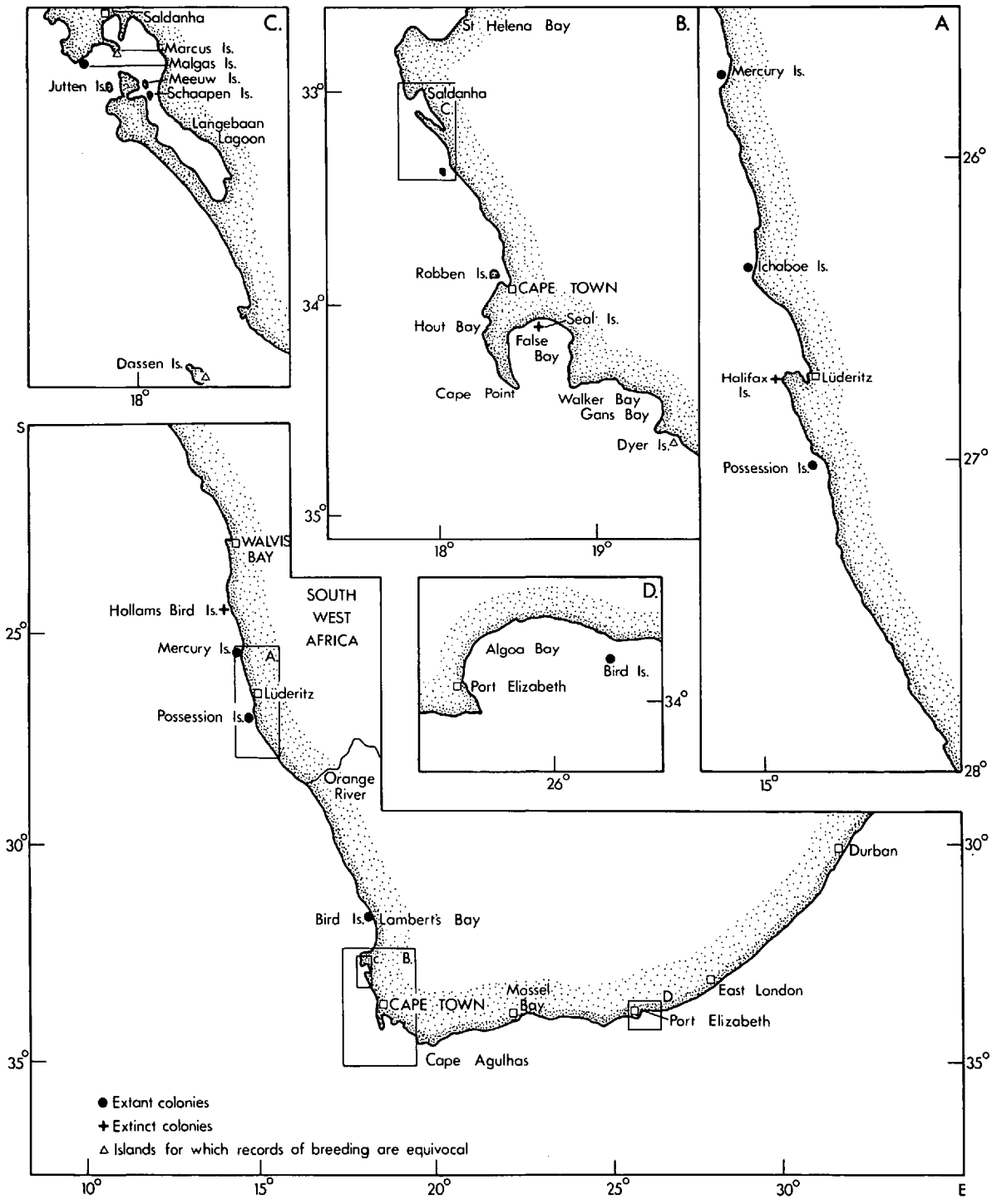

Fig. 1: Locations of extant and extinct breeding colonies of Cape gannets, and islands for which records of breeding are equivocal (some of the southern African locations mentioned in the text are also shown)

colonists." Green (1950) reports that early 20th century photographs showed ". . . breeding flats covered with penguins, and with not a gannet in sight." Jackson (1902), in his 1901 report on the guano islands, stated that two "colonial islands" (those off the Cape Province, South Africa) supported Cape gannets: Malgas Island and Bird Island (Algoa Bay). By inference, it can be assumed that gannets were not present on Bird Island (Lambert's Bay) in 1901. The information given by Jarvis (*op. cit.*) is therefore likely to be correct.

Breeding by Cape gannets was first reported on Malgas Island in Saldanha Bay, Western Cape, on 23 October 1648 (see discussion of Marcus Island below). The earliest evidence for Cape gannets breeding on Bird Island (Algoa Bay) is for October 1755, by the survivors of the wreck of the *Doddington* (Ross 1978).

The Cape gannet has been reported as breeding or being present in the past on six other southern African islands. While acceptable evidence exists for breeding on three of these islands, evidence for breeding on the other three islands is equivocal and is not accepted. The evidence for each island is discussed separately.

Cape gannets bred on Hollams Bird Island off South West Africa in the 19th century from at least 1828 (Morrell 1832) until at least 1938 (Shaughnessy 1983 and references therein, Andersson 1861, Speight 1940). Hollams Bird Island is 125 km north of Mercury Island. The present breeding range therefore extends 125 km less to the north than does the historical range.

According to Capt. J. Spence, Cape gannets bred on Halifax Island off South West Africa in the mid 19th century. He stated (Angra Pequena and West Coast Claims Joint Commission 1885) "Halifax Island used to be exclusively occupied by penguins, but now it has penguins, malagas [Cape gannets] and duikers [cormorants]." Spence was a Director of De Pass, Spence & Co., which held the lease of the northern guano islands (off South West Africa). His statement, under oath to a commission of inquiry and in reply to a request for information on which guano-producing birds occurred on which islands, is likely to be correct and is therefore accepted. Also, his statements for species occurring on other nearby islands are all acceptable, because the species mentioned are still present (personal observation) as well as having been mentioned in the later literature. As has been suggested for Possession Island, Halifax Island may have been colonized by Cape gannets at the time of the 1843—1845 guano rush. Sclater (1906) lists Halifax Island as a breeding site though the evidence he had for the statement is not known. Gill and Zeederberg (1928) state "penguins only" for Halifax Island, so it may be assumed that Cape gannets did not breed at Halifax for any great length of time. Halifax Island no longer supports Cape gannets (personal observation) and they were not reported by Rand (1963b).

De Flacourt is quoted by Strangman (1936, p. 78), Raven-Hart (1967, p. 173) and Burman and Levin (1974, p. 12) as being the source of information for Cape gannets breeding on Marcus Island, Saldanha Bay, Western Cape on 23 October 1648 when birds and eggs were collected. We consider that the record, as interpreted by Strangman (*op. cit.*) and later authors, is a mistake for the well-known colony on the nearby Malgas Island. Shaughnessy (1983) agrees with us. A careful reading of De Flacourt's description of the positions of the five islands within Saldanha Bay shows that his "Isle aux Margaux", which he describes as being north of the entrance to the Bay, is in fact Malgas Island (Fig. 1), and not Marcus Island as claimed by Strangman (*op. cit.*) and later authors. Therefore, De Flacourt's "Isle de Sansy", which he describes as being south of the entrance to the bay is Jutten Island (Fig. 1) and not Malgas Island. The Standard Encyclopaedia of Southern Africa (Bulpin 1972) has also followed the interpretation of Strangman (*op. cit.*). "Isle de Thomas Pan", which is described as being further within the Bay than Isle aux Margaux and Isle de Sansy, is therefore Marcus Island (Fig. 1) and not Jutten Island. De Flacourt (Strangman *op. cit*) discussed all five Saldanha Bay islands, including "Isle à la Biche" or Schaapen Island and "Isle aux Cormorans" (now called Meeuw Island) which were correctly identified by Strangman (*op. cit.*), stating that each island had its particular birds. It is therefore significant that he described Cape gannets as being present on only one island within the Bay. No other evidence exists for the occurrence of Cape gannets on Marcus Island.

Morrell (1832, p. 312) reported Cape gannets from Dassen Island, Western Cape. Following Shaughnessy (1983), this record is rejected because Morrell did not land on Dassen Island and he was not always a reliable reporter (Best and Shaughnessy 1979). No other evidence exists for this claimed colony.

Shaughnessy (1983) discusses a report of the Cape gannet breeding on Seal Island, False Bay, Western Cape, based on the reported collection of eggs and birds ("malagasen") on 26 November 1687 by Simon van der Stel (Brock *et al.* 1976, pp. 16 an 18). Shaughnessy (*op. cit.*) shows that Cape gannets were not reported at Seal Island from the late 18th century onwards by a variety of visitors, and therefore Van der Stel's record, which we accept, is the only one for the island.

Some evidence exists that the Cape gannet previously bred on Dyer Island, southern Cape. Eggs collected in January 1919 by F. Andrews, the headman of Dyer Island (Green 1950), are reported in a South African Museum egg catalogue as being derived from this locality (R.K.B. personal observation). However, Symons (1924), who had access to the notes of the then late F. Andrews, states that the Cape gannet does not breed on Dyer Island. The explanation seems to be that the eggs sent by Andrews came from another island, because he had ". . . three sons and a grandson in the island service" (Green (*op. cit.*). Layard and Sharpe (1884) cite a Capt. Roe who obtained specimens of breeding great white pelicans *Pelecanus onocrotalus* from Dyer Island about 1869 (Brooke in press). Roe further reported that ". . . the old birds [pelicans] feed them [their chicks] with fish and young cormorants and Solan Geese". Solan goose is an old name for gannets (Nelson 1978a,b). The quotation implies that Cape gannets bred on Dyer Island, because their young were eaten. There is no doubt that pelicans will take chicks of other species, e.g. Cape cormorant *Phalacrocorax capensis* (Crawford *et al.* 1981), as food. In 1912 and 1913 much material was collected on Dyer Island for the South African Museum and the Naturhistoriska Museet in Göteborg, Sweden (Brinck 1955). One of us (R.K.B.) has examined all the specimens and catalogues in the South African Museum which might contain relevant records and has received from Dr S. Mathiasson of the Göteborg Museum a list of all their bird material from Dyer Island. There is nothing suggestive of Cape gannets breeding there. Neither Jackson (1902) nor Gill and Zeederberg (1928) mention Dyer Island as a gannet colony. It is possible that the Cape gannet bred on Dyer Island around 1869, though the evidence is equivocal and we do not accept the claim. There is no good reason to think that they did so around 1919.

The authoritative Dorst and Mougin (1979) give the nonbreeding range of the Cape gannet as "In winter north to the Gulf of Guinea in the west and Mombasa, Kenya, in the east. Straggler Amsterdam Island." This is reasonably accurate, but it is possible to be more precise and also to evaluate the extreme records, some of which they do not mention.

All ringed Cape gannets recovered north of Moçâmedes Province, Angola, in the west and Maputo Province, Moçambique, in the east are listed in Appendix 2. Brooke (1981b) lists recoveries for the Moçâmedes Province. Most of these recoveries have been previously documented from another point of view. From Appendix 2 it is clear, as Broekhuysen *et al.* (1961) said, that far more Cape gannets migrate up the west coast of Africa than up the east coast, and they travel further north on the west coast.

On the west coast of Africa the Cape gannet is a regular nonbreeding winter visitor to Angola (Broekhuysen *et al.* 1961, Traylor 1963, Brooke 1981b, Appendix 2); Gabon (Chapin 1932, Rougeot 1948, 1959, Broekhuysen *et al. op. cit.*, Appendix 2); Equatorial Guinea (Broekhuysen *et al. op. cit.*, Appendix 2); Fernando Poo Island or Bioko (Fry 1961, Basilio 1963); Cameroun (Good 1952, Broekhuysen *et al. op. cit.*, Louette 1981, Appendix 2); Nigeria, east of 6°00'E, 4°20'N (Broekhuysen *et al. op. cit.*, Appendix 2). West of 6°E the Cape gannet is a rare visitor or straggler which has been visually recorded in Ghana (Good *op. cit.*, Broekhuysen *et al. op. cit.*). In The Gambia an injured immature bird found on 6 July 1976 (Gore 1981) was probably a Cape gannet, judging by the date.

Gore (1981) assumed that the Cape gannet does not reach The Gambia and attributed the record to the North Atlantic gannet *M. bassanus*. However, this assumption is incorrect because a ringed Cape gannet has been recovered at 21°40'N off the former Spanish Sahara by a Soviet trawler on 30 May 1966 (Appendix 2). This is the most northerly acceptable record for the west coast of Africa. The most southerly record of a ringed North Atlantic gannet is from Guinea Bissau (Cramp and Simmons 1977). It is clear that off West Africa both gannet species occur and that their ranges overlap, although the North Atlantic gannet is much the commoner. Records off West Africa of immature birds in which the diagnostic characters of the species are not readily visible without measurement must therefore be regarded as indeterminate. However, the weight of evidence would favour the North Atlantic gannet during the northern winter when they migrate southwards and the Cape gannet during the northern summer when they migrate northwards.

On the east coast of Africa the Cape gannet is a regular nonbreeding winter visitor to Natal (Cyrus and Robson 1980) and to Delagoa Bay, Maputo Province, Moçambique (Broekhuysen *et al.* 1961, Brooke *et al.* 1981). North of that it is a rare visitor or straggler. Reports for Moçambique are those of Finsch and Hartlaub (1870), Broekhuysen *et al.* (op. *cit.*, Clancey (1970), Brooke *et al.* (*op. cit.*), Appendix 2; for Zanzibar and Pemba Islands off the coast of Tanzania that of Pakenham (1979); for Kenya that of Van Someren (1932) who reported two collected off Vanga (4°40'S) just north of the Tanzanian frontier. Sight records from Mombasa, Kenya, by Van Someren (*op. cit.*), Jackson and Sclater (1938) and other authors are rejected by Britton (1980) as unsubstantiated or the result of confusion with other species, particularly the masked booby *Sula dactylatra*: see

also Pakenham (*op. cit.*). Therefore, Vanga is the most northerly accepted locality of occurrence on the east coast of Africa.

Within its normal range the Cape gannet does not occur very far off shore, staying generally on the continental shelf (e.g. Summerhayes *et al.* 1974). Approximately 70 per cent of Cape gannets reported at sea off the south-western Cape in the 1950s were within 50 km of land and very few were more than 100 km off shore (Cooper in press). There are a few published records of one or two Cape gannets seen over pelagic waters in the South Atlantic though it is not always possible to be quite sure where they were really seen: Ramsay (1913a, b), Blyth (1930), Winterbottom (1936, 1958), Hammond (1958), Berlioz (1961), Bourne and Radford (1961), Britton and Britton (1968), Lambert (1971), Chapman (1982), Appendix 2. Gross (1960) records an adult not far from Ascension Island on 7 May 1959 and another on 11 May which, from the details of his journey, must have been on or about the Tropic of Cancer, the most northerly sight record known to us. We have not traced any records of Cape gannets in the Indian Ocean away from the continental shelf other than Segonzac's (1972) record from New Amsterdam Island discussed below and found to be indeterminate. However, such birds must be found occasionally because a Cape gannet has reached Australia (Cameron 1981, Venn 1982), as discussed below.

Cape gannets do not normally occur inland, and indeed only land at their breeding sites, unless they are oiled or otherwise ill when they may come ashore anywhere. Flying Cape gannets have occasionally been seen crossing the 500-m-wide causeway to Marcus Island (Fig. 1), but they do not even overfly nonbreeding islands, such as Dassen Island which they prefer to skirt just off shore (J.C. personal observation). The record of Morrell (1954) of two gannets flying over Table Mountain (33°58′S, 18° 25′E) utilizing thermals is more likely to apply to the great white pelican, which often travels in this manner (J.C. personal observation). However, Rowan (1953) reports at least four adult Cape gannets "land bound" ashore in Hout Bay. Several flew inland on release. Rowan (*op. cit.*) ascribes this "strange invasion" as being caused by a heavy sea mist which presumably resulted in the birds becoming disorientated.

The Cape gannet has not been recorded in Madagascar (Milon *et al.* 1973). An adult gannet was seen on 7 March 1970 off New Amsterdam Island by Segonzac (1972). He attributed the record to the Cape gannet rather than to the Australasian gannet *M. serrator* on the grounds of the strong westerly winds then blowing. However, a vagrant Australasian gannet was ringed on Possession Island, Crozet group, in 1980 and was recaptured later in 1980 and in both of the following two years on Marion Island (Brown and Oatley 1982). Furthermore, an Australasian gannet was handled and photographed in the Cape gannet breeding colony at Bird Island (Lambert's Bay) on 25 January 1982 (R. J. Cassidy, Transvaal Museum, personal communication). The New Amsterdam Island record could therefore as easily have been of an Australasian gannet as of a Cape gannet. Without a detailed description, which was precluded by the circumstances of observation, the record of Segonzac (*op. cit.*) should therefore be considered as one of an indeterminate gannet.

A Cape gannet was collected at the Bass Rock, Scotland, breeding colony of the North Atlantic gannet in May 1831 (Nelson 1978b, who discusses the record and supports its acceptance, though a contrary opinion is expressed by the British Ornithologists' Union 1980). There is a photographic record with an adequate description of a Cape gannet at the Australasian gannet breeding colony at Wedge Light, Port Phillip Bay, Victoria, Australia, from November 1980 to January 1981 (Cameron 1981, Venn 1982). This individual paired with an Australasian gannet and successfully reared a chick (Venn *op. cit.*). It will be noted that vagrant gannets have a well developed tendency to join breeding colonies of other species of gannets. In addition to the Cape gannets at the Bass Rock colony of the North Atlantic gannet and the Wedge Light colony of the Australasian gannet and the Australasian gannet at the Bird Island (Lambert's Bay) colony of the Cape gannet, the tendency is manifest in the Australasian gannet at Marion Island. This bird spends the summer (the breeding season) in a colony of king penguins *Aptenodytes patagonicus*, but the winter elsewhere (Brown and Oatley 1982).

POPULATION TRENDS AND SIZE

The first comprehensive census of nesting Cape gannets was conducted in October and November 1956 by Rand (1959a, 1963a, b). He used counts of gannets on aerial photographs to estimate colony sizes. Some colonies were also photographed from the air in November 1967 and November 1969 (Shelton *et al.* 1982). Survey techniques for the period 1978–1981 were selected in order to ensure compatibility with these earlier censuses, so that population trends could be examined (Shelton *et al. op. cit.*). However, before comparing counts of gannets from aerial photographs it is pertinent to mention some possible

Table I: Counts of adult Cape gannets at Bird Island (Lambert's Bay) from aerial photographs combined with ground counts of birds seen leaving in the early morning

Date	Number at dawn	Number at noon	Noon number as percentage of dawn number
Oct. 1973	6 821	—	—
13 Dec. 1973	10 537	—	—
23 Jan. 1974	6 929	5 715	82,5
24 Jan. 1974	—	5 596	—
20 Feb. 1974	3 871	3 114	80,4
21 Mar. 1974	4 164	1 314	33,9
16 May 1974	223	166	74,4
29 Aug. 1974	3 338	—	—
24 Oct. 1974	5 606	4 753	84,8
	5 722*	4 753	83,1
21 Nov. 1974	5 258	—	—
22 Nov. 1974	—	4 469	85,0
9 Jan. 1975	3 274	2 132	65,1
14 Feb. 1975	2 193	1 823	83,1

* Repeat count of the same photograph

sources of error.

The range of replicate counts of Cape gannets on aerial photographs was 16,87 per cent of the mean, experienced workers obtaining the highest counts and an inexperienced worker the lowest (Shelton *et al.* 1982). It is probable that workers of a similar range of experience were used for all surveys (Shelton *et al. op. cit.*), but an increased quality of photographic prints for recent years may have resulted in a relatively higher proportion of gannets being counted (cf. Shaughnessy in press).

The number of gannets present at a particular island fluctuates throughout the day (Fig. 2, Table I). There is a tendency for numbers to be highest in the late evening and sometimes also in the early morning, although this is not invariably the case (Fig. 2). At Bird Island (Lambert's Bay), where counts of gannets on aerial photographs were highest during the spring/summer breeding season as expected, the number present at noon ranged between 34 and 85 per cent of those estimated to be present at sunrise (Table I). It is likely that various factors including state of breeding, availability of fish and weather conditions may influence the number of gannets at a breeding colony at any given time. Information presented on Figure 2 indicates that, between 10h30 and 15h30, the period during which the 1956 survey was conducted (Rand 1963a, b), the mean ratio of gannets present to the number of nests for 14 observations was 1,48 and the variance 0,43.

Counts of gannets on aerial photographs of the six extant colonies are listed in Appendix 1, together with other estimates of population size. Information presented on Figure 2 has been used as indicated to estimate numbers of breeding pairs and, wherever estimates were considered compatible, population sizes have been expressed in units of the 1956 populations.

Five aerial censuses of Mercury Island were conducted between 1956 and 1981, and from 1967 to 1981 the breeding population fluctuated between 27 and 50 per cent of the 1956 level (Appendix 1). Therefore each of the four most recent surveys indicates a substantial reduction in numbers since 1956, a fact which has been attributed by Crawford and Shelton (1981) to the collapse of the South West African pilchard stock. Frequency of occurrence of pilchards in the diet of gannets sampled off South West Africa decreased from 85 per cent in 1957—1958 to 1 per cent in 1978—1979 (Matthews 1961, Crawford and Shelton. *op. cit.*).

In November 1978 a count of the number of nests from vantage points was considerably less than the estimate obtained from aerial photography. Suitable vantage points could not always be selected because excessive disturbance to breeding populations of other seabirds would have resulted. The aerial estimate is therefore considered more reliable.

The number of gannets at Ichaboe Island has decreased since 1956, especially from 1967 (Appendix 1). In 1980 the population was approximately 12 per cent of that in 1956. The trend at Possession Island has been similar, with a 77 per cent reduction since 1956. Again the collapse of the South West African pilchard stock is believed to have been responsible for the reduced number of gannets (Crawford and Shelton 1981). As the pilchard stock collapsed, the range of distribution of pilchard shoals probably contracted towards the north (Crawford *et al.* in press), so gannets breeding at Ichaboe and Possession Islands may have experienced a greater shortage of food than those at Mercury Island further north.

At Bird Island (Lambert's Bay) the count of gannets on aerial photographs taken during November 1967 was only 53 per cent of that for 1956 (Appendix 1). The population had apparently increased by 1971 (Jarvis and Cram 1971), and by 1981 it was approximately 50 per cent larger than in 1956. The initial decrease has been related to a similar trend in the biomass of the pilchard stock of the Western Cape, and the subsequent rise to an increase in biomass of the anchovy population in the Western Cape (Crawford and Shelton 1981). Pilchards dominated the diet of gannets sampled off the Western Cape in the mid 1950s (Davies 1955, 1956, Rand 1959a), but during 1978 and 1979, frequency of occurrence of anchovy in their diet was 78 per cent and of pilchards 2 per cent (Crawford and Shelton *op. cit.*).

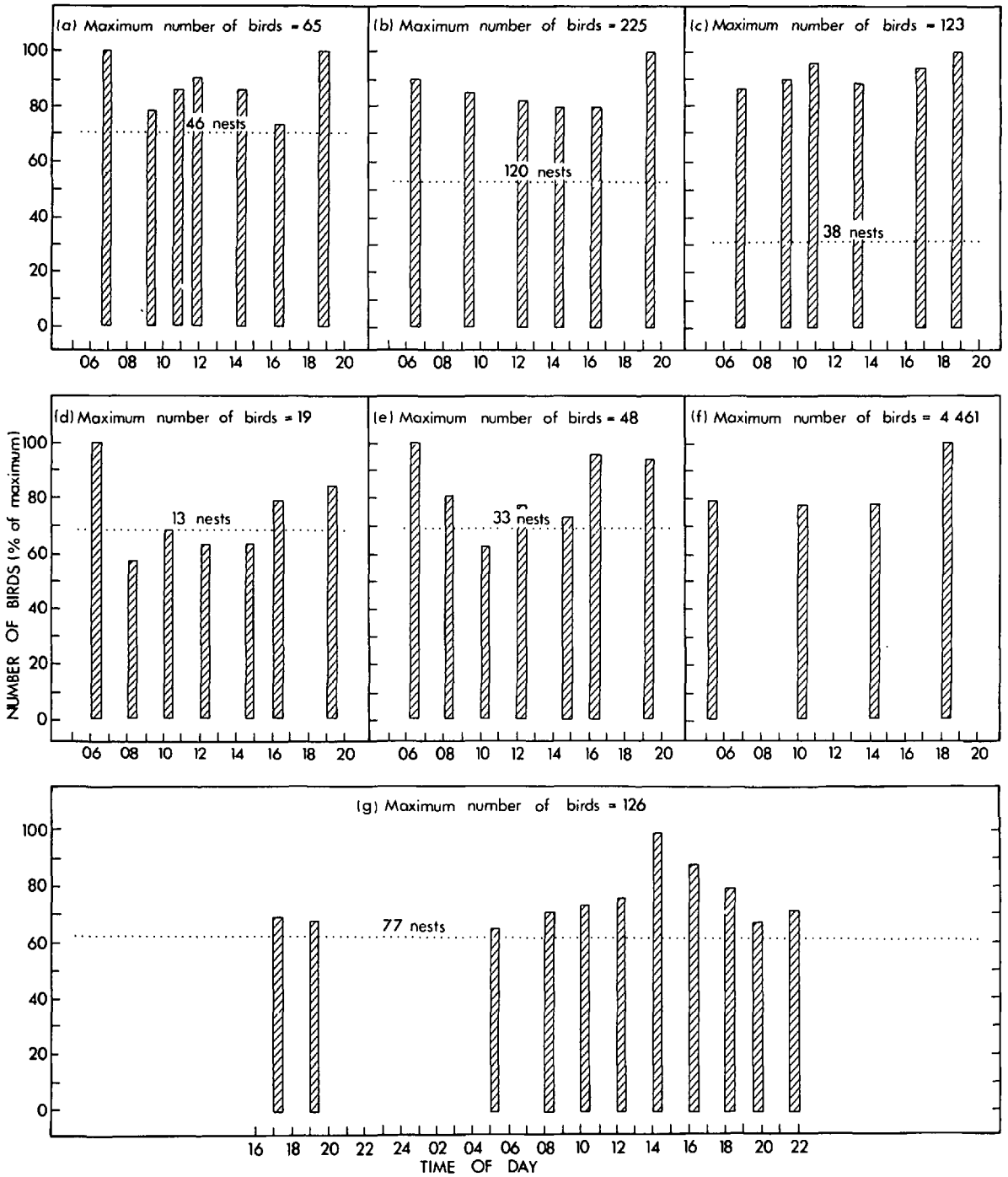

Fig. 2: Fluctuations in observed numbers of Cape gannets at breeding colonies as a function of time of day; a) Mercury Island, 23 November 1978; b) Mercury Island, 23 November 1978; c) Ichaboe Island, 27 November 1978; d) Possession Island, 5 December 1978; e) Possession Island, 5 December 1978; f) Bird Island (Algoa Bay), 6 December 1979; g) Bird Island (Algoa Bay), 5—6 December 1979

In the Saldanha Bay region, anchovy constituted 60 per cent of the diet of gannets during the period 1977—1979 (Furness and Cooper 1982).

Broekhuysen and Rudebeck (1951) estimated that 79 000 gannets were present at Malgas Island during the 1950/51 breeding season. They estimated that the main colony occupied an area of approximately 17 400 m^2 and that the density of birds was 4 per square metre. The number of birds nesting or roosting outside the main colony was estimated at 9 000. Rand (1963a) believed that this pioneer estimate contained "fundamental errors" primarily because his measurement of the area occupied by the main colony in 1956 (9 900 m^2) was little more than half that estimated by Broekhuysen and Rudebeck (*op. cit.*). Rand's (*op. cit.*) estimate of the breeding population of gannets in 1956 was c. 19 500 pairs (Appendix 1) and on the basis of the overall 2,5 nests·m^{-2} reported by Broekhuysen and Rudebeck (*op. cit.*), he suggested that the census of Broekhuysen and Rudebeck in fact amounted to 122 000 birds. Davies (1956) reported it as 131 000 birds and commented "While it is generally believed that a decrease in the numbers of gannets on Malgas Island has occurred since 1951, and a known decrease occurred in 1954, it is neither apparent nor likely that the numbers have decreased to the extent of 90 400 birds."

Product of area occupied and nest density as supplied by Broekhuysen and Rudebeck (1951) gives an estimate of 43 500 pairs for the main colony and, supposing the 9 000 peripheral birds were all breeding, the maximum number of pairs would have been 48 000, as compared with the 19 500 estimated by Rand (1963a). Despite the controversy that surrounds it, we have included the estimate of Broekhuysen and Rudebeck in Appendix 1 together with a rough estimate made by Stewart and Currey (1957). However, we have rejected the estimate of 40 000 given by Nelson (1978a) for 1958, which he attributed to aerial photography. This figure approximates the population size of 39 000 estimated by Rand (*op. cit.*) for 1956 and, as far as we can ascertain, no aerial photographs were taken during 1958. Counts of aerial photographs suggest that the number of gannets at Malgas Island had decreased by the mid 1960s, but increased subsequently (Appendix 1). These trends parallel the fluctuations in the pilchard and anchovy stocks off the Western Cape (Crawford and Shelton 1981).

Trends in the population of gannets at Bird Island (Algoa Bay) have been discussed by Randall and Ross (1979) and Batchelor (1982). Numbers of breeding pairs were estimated at 8 380—13 960 for the 1755/56 nesting season from diaries of survivors of the shipwrecked *Doddington*, and a minimum of 12 000 for the 1858/59 season from records of egg collections (Ross 1978). Between 1936 and 1945, estimates of the number of gannets fluctuated between 20 000 and 37 000 birds (Courtenay-Latimer and Gibson-Hill 1946, Courtenay-Latimer 1954). The first aerial survey was conducted in 1956 and produced a count of 20 567 birds (Rand 1963a). Randall and Ross (*op. cit.*) measured surface area of the gannet colony on subsequent aerial photographs and noted that the population increased after 1956. Our counts of numbers of birds on aerial photographs suggest that the population in 1969 was not noticeably larger than that in 1956, but they confirm that a large increase was apparent by the late 1970s (Appendix 1).

Since the start of the 1970s, and in some instances from an earlier date there have also been large increases in the numbers of jackass penguins and Cape cormorants breeding at islands east of Cape Point, in indices of abundance of snoek *Thyrsites atun* and red fishes in waters east of Cape Point and in activity of purse-seiners operating east of Cape Point (Nepgen 1979b, Crawford 1981, Crawford and Shelton 1981, Cooper *et al.* 1982, Crawford and Crous 1982). Snoek are important predators of pilchard and anchovy (Nepgen 1979a, 1982).

During the late 1970s the size of the Western Cape anchovy stock was approximately double that of the mid and late 1960s (Armstrong *et al.* 1983). Adult anchovy are frequently encountered in waters east of Cape Point (Crawford 1980) and, between 1978 and 1981, anchovy formed an important component of the diet of gannets at Bird Island, Algoa Bay (Batchelor 1982). Pilchard and saury *Scomberesox saurus* were also of considerable importance in the diet of these gannets. Our estimate of the number of breeding pairs for the 1978/79 season, from counts of birds on aerial photographs, differs from that of Batchelor (*op. cit.*) by only two per cent. Batchelor followed the technique documented by Randall and Ross (1979) of estimating population size from density of nests and area of the breeding colony. He gave no estimate for the 1980/81 season but noted "The area of the colony during the 1980/81 breeding season could not be accurately determined from the available aerial photographs since they were taken obliquely; however a careful comparison of the colony shape with that of the 1979/80 breeding season suggests that total area and therefore the population size had remained relatively unchanged."

Our estimate of the gannet population at Bird Island (Algoa Bay) for November 1980, again derived from counts of gannets on aerial photographs, differs

Table II: Density of nests of Cape gannets at the six extant colonies recorded by various authors for the period 1950—1981

Island	Breeding season	Density of nests (number·m^{-2})		Number of measurements	Source
		Mean	Range		
Mercury	1978/79	4,25	2,75 — 6,25	3	
Ichaboe	1956/57	3,48	up to 4,54		Randall and Ross (1979) from data in Rand (1963b)
	1978/79	4,33	3,75 — 5,25	6	
Possession	1978/79	5,60	4,50 — 6,50	5	
Bird (Lambert's Bay)	c. 1967/68	3,57		Area of 33,58m^2	Jarvis (1974)
Malgas	1950/51	2,50			Broekhuysen and Rudebeck (1951)
	1956/57	c. 2,25			Randall and Ross (1979) from data in Rand (1963a)
Bird (Algoa Bay)	1956/57	2,34			Randall and Ross (1979) from data in Rand (1963a)
	1974/75	2,85	2,69 — 3,08	10	Randall and Ross (1979)
	1974/75	2,63		large group	Randall and Ross (1979)
	1978/79	2,85	2,69 — 3,11	10	Batchelor (1982)
	1980/81	2,85	2,65 — 3,21	10	Batchelor (1982)

from Batchelor's (1982) estimate for the 1979/80 season by 0,3 per cent. The discrepancy between our estimate for November 1969 and that of Randall and Ross (1979) is difficult to explain. The photograph is of poor quality and errors are inherent in both counting techniques. The errors associated with aerial photography have been discussed earlier. Ranges of nest densities reported by Randall and Ross (*op. cit.*) and Batchelor (*op. cit.*) were 13,68, 14,74 and 19,65 per cent of the means (Table II) and are similar to that (16,87 per cent) recorded by Shelton *et al.* (1982) for replicate counts of gannets on aerial photographs. On aerial photographs differentiation between breeding and non-breeding birds is not always easy (personal observation), and density of nests at any particular island may vary from year to year (Table II). At Bird Island (Algoa Bay) the density of nests was 22 per cent higher in the 1974/75 season than in 1956/57 (Randall and Ross *op. cit.*).

There appear also to have been inter-season differences at Ichaboe and Malgas Islands as well as inter-island discrepancies (Table II), although our estimates were based on small (2 m^2) areas and may have been influenced by edge effect. Randall and Ross (1979) obtained no correlation between number of birds and guano harvest at Bird Island (Algoa Bay). Taking counts of gannets on the aerial photographs of 1956 and 1969 and the population estimates of Courtenay-Latimer (1954), Crawford and Shelton (1978) demonstrated a similarity between trends in numbers of gannets and guano harvests at Bird Island (Algoa Bay), Ichaboe, Bird (Lambert's Bay) and Malgas Islands.

The estimates of the total number of breeding pairs of Cape gannets for the years 1956, 1967, 1978 and 1980 are presented in Table III. A consistent decrease in overall population size is apparent, a decrease which has been strongly influenced by trends at the islands off South West Africa. The total population in 1980 was 54 per cent of that in 1956. Ichaboe Island was the most important colony in 1956 and 1967, but had been replaced by Bird Island (Algoa Bay) by 1978. Bird (Algoa Bay) and Malgas Islands both had more gannets than Ichaboe Island in 1980. The largest number of breeding pairs at any particular island was the 97 239 estimated for Ichaboe Island in 1956, and the smallest, the 1 318 estimated for Mercury Island in 1981.

Population decreases at colonies off South West Africa since 1967 may be contrasted with increases at all islands off South Africa. This finding suggests that gannets from the South West African islands may have emigrated to South African islands as a direct result of the severe depletion in pelagic fish resources off South West Africa that commenced with the collapse of the pilchard stock after the late 1960s. In order to investigate this possibility, instantaneous coefficients of population growth (r) were calculated for all colonies that showed moderate growth at any stage during the period 1956—1981 (Table IV). Demographic data for Cape gannets and a life table presented by Furness and Cooper (1982) were also used to investigate changes in first-year survival that would have been required to achieve the observed growth rates on the assumption that other parameters remained constant.

Furness and Cooper (1982) calculated a first-year survival of 36 per cent as necessary to maintain a stable state. They assumed that all gannets with nests attempted to breed, although Nelson (1966) found that 16,8 per cent of pairs of North Atlantic gannets with nests at Bass Rock, Scotland, did not. Furness and Cooper (*op. cit.*) assumed losses or mortality of

Table III: Estimated numbers of breeding pairs of Cape gannets at the six gannet colonies, at islands off South West Africa off the Western Cape, off South Africa, and overall during 1956, 1967, 1978 and 1980 (all four surveys were conducted in a similar manner) — origin of information is indicated in Appendix 1

Location	Population			
	1956	1967	1978	1980
Mercury Island	3 917	1 385	1 939	1 318+
Ichaboe Island	97 239	78 430	28 427	11 335
Possession Island	13 477	9 251	5 397	3 038
All islands off South West Africa	114 633	89 066	35 763	15 691
Bird Island (Lambert's Bay)	4 157	2 208	4 659	5 410
Malgas Island	16 347	14 191	21 736	20 236
Islands off Western Cape	20 504	16 399	26 395	25 646
Bird Island (Algoa Bay)	13 898	13 976*	48 528	38 816
All islands off South Africa	34 402	30 375	74 923	64 462
South Africa and South West Africa combined	149 035	119 441	110 686	80 153

\+ Value for 1981
* Value for 1969

eggs, chicks and adults of Cape gannets to be 20, 5 and 10 per cent respectively. At Bird Island (Lambert's Bay), Jarvis (1974) recorded egg losses of 15—40 per cent and chick mortalities of 3 per cent. The high egg loss was a direct result of heavy guano scraping (Jarvis *op. cit.*).

Necessary first-year survival to attain the observed growth rates ranged from 45 to 89 per cent (Table IV). Jarvis (1974) suggested that the most dangerous phase in the life history of the Cape gannet is that soon after fledging. He noted "These birds have to learn to fly and fish, apparently without aid from adults. Possibly because of this a high percentage die during their first few weeks of independence." If this is the case, it is unlikely that first-year survival would be maintained at a level of more than 50 per cent over

Table IV: Estimated instantaneous coefficients of population growth for colonies of Cape gannets showing moderate growth at any stage during the period 1956—1981, and first-year survival necessary to achieve the observed growth assuming population parameters to be constant—demographic data and life tables used are those presented by Furness and Cooper (1982)

Island	Mercury	Bird (Lambert's Bay)				Malgas	Bird (Algoa Bay)				
Period	1969-78	1967-78	1978-80	1980-81	1967-81	1969-78	1969-78	1956-69	1969-74	1974-78	1956-78
Source of r	Final column of Appendix 1							Randall and Ross (1979)		Batchelor (1982)	
Instantaneous coefficient of population growth (r)	0,0683	0,0679	0,0747	0,1342	0,0736	0,0516	0,1383	0,0368	0,0356	0,0246	0,0343
Breeding adults in year x (N_x)	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000	1 000
Eggs laid	500	500	500	500	500	500	500	500	500	500	500
Chicks hatched	400	400	400	400	400	400	400	400	400	400	400
Chicks fledged	380	380	380	380	380	380	380	380	380	380	380
Adults dying	100	100	100	100	100	100	100	100	100	100	100
Breeding adults in year $x + 1$ ($N_x e^r$)	1 071	1 070	1 078	1 144	1 076	1 053	1 148	1 037	1 036	1 025	1 035
Recruits required (= adults dying + increase in adults)	171	170	178	244	176	153	248	137	136	125	135
4 year olds	171	170	178	244	176	153	248	137	136	125	135
3 year olds	190	189	198	271	196	170	276	152	151	139	150
2 year olds	211	210	220	301	217	189	306	169	168	154	167
1 year olds	235	233	244	335	241	210	340	188	187	171	185
Necessary first-year survival (%)	62	61	64	88	63	55	89	49	49	45	49

a series of years. Therefore, different explanations for population increases must be sought.

Egg losses should be fairly constant from year to year and the chick mortalities listed in the life table cannot be decreased much further. Age at first breeding could have decreased and a mortality of 10 per cent for adults may be too high, but to counter this it is assumed that all birds at nests actually breed. Emigration of gannets from the South West African colonies to Bird (Lambert's Bay), Malgas and Bird (Algoa Bay) Islands after the late 1960s is the probable main reason for population increases on these islands. During the initial period of food stress off South West Africa, gannets may also have moved from Possession and Ichaboe Islands to the more northerly Mercury Island where they may have been better positioned to exploit the northern shoals of fish. Purse-seiners from Lüderitz were eventually forced to operate on the northern fishing grounds only (Crawford *et al.* in press).

It is apparent that population trends of Cape gannets over the period 1956—1981 were influenced to a large extent by prey availability. Other factors may also influence population size, e.g. gannets may be disturbed by human activities. Jarvis (1974) attributed a high egg loss at Bird Island (Lambert's Bay) to heavy guano scraping. Randall and Ross (1979) noted that only 1 308 chicks fledged from 2 948 nests at Bird Island (Algoa Bay) in the 1976/77 breeding season. They suggested that the most likely cause for this low rate was a heavier-than-usual rainfall in October and November 1976, aggravated by mismanagement of the island. Excessive guano scraping had resulted in certain sections of the colony becoming basin-shaped, and water accumulated in these basins. Many eggs may therefore have been lost as a result of becoming swamped by water (Randall and Ross *op. cit.*). Three years later the gannet colony at Bird Island (Algoa Bay) showed signs of a slight decrease (Batchelor 1982, Appendix 1). Hewitt (1938) observed that construction of a breakwater at Bird Island (Lambert's Bay) during the 1937/38 season interfered with ". . . bird life and the yield of guano . . ." and Zeederberg (1910) commented on the effect of diamond prospecting on the birds of Possession Island during 1909. Such activities are quite likely to disturb birds, leading to a reduction in numbers. We have already suggested that disturbance at Ichaboe in the 1840s probably led to the colonization of Halifax and Possession Islands. Disease caused mortality of gannets at Malgas Island in November 1938 (Hewitt 1939, Coles 1941). Large numbers of chicks died as well as adults. The headman at that time estimated mortality to be 2 000 birds (Coles *op. cit.*).

CONSERVATION

The Cape gannet has not been formally regarded as a candidate for conservation management in southern Africa as have other endemic and sympatric seabirds such as the jackass penguin, the bank cormorant *Phalacrocorax neglectus* and the crowned cormorant *P. coronatus* (Siegfried *et al.* 1976). However, concern has previously been expressed over its vulnerability to oiling (Rowan 1969), to disturbance at its breeding sites (Jarvis and Cram 1971) and to the effects of commercial fisheries (Jarvis 1971b). Jarvis (*op. cit.*) has discussed the conservation of the Cape gannet in detail.

The first detailed report of Cape gannets being oiled is of some 700 at Robben Island in August 1953 (Rand 1971). Earlier, Rand (1952) stated that a few dead, oiled gannets were seen after oil pollution off the Western Cape in August 1952. Jarvis (1971a) reported 26 newly fledged gannets oiled at Bird Island (Lambert's Bay) in February and March 1967. In April 1968, the *Esso Essen* spilt oil off Cape Point, and at least 500 Cape gannets were oiled and later died after collection for treatment or were washed up dead (Rowan 1969, Westphal and Rowan 1971). A total of 416 of these gannets was found on beaches of the Cape of Good Hope Nature Reserve and attempts were made to clean them (Jarvis *op. cit.*).

More recently, relatively few gannets have been reported oiled. Of 79 Cape gannets received at a seabird rehabilitation centre in Cape Town over the five-year period 1975—1979, only 16 (19,3 per cent) were oiled (Morant *et al.* 1981). Oiled gannets during this period formed only 2,0 per cent of the total of 749 oiled birds received, nearly all of which were jackass penguins (Morant *et al. op. cit.*). Of 553 gannets found dead on beaches in southern Africa on beach patrols of the African Seabird Group from February 1977 to March 1983, only nine (1,6 per cent) were oiled (G. Avery, South African Museum, *in litt.*). Another indication of the low oiling rate of Cape gannets is that only two oiled gannets were seen at Dassen Island in March 1972 (J. C., personal observation), when an estimated 4 000 jackass penguins were oiled (Morant *et al. op. cit.*).

Cape gannets are susceptible to oiling by fish oil originating as waste from fishmeal factories. In 1974, fish oil resulted in the deaths of at least 709 Cape gannets at Bird Island, Lambert's Bay (Percy Fitz-Patrick Institute of African Ornithology 1974). Improvements in techniques of fish off-loading, with a switch from a wet to a dry method, have apparently reduced this risk. Little is known of other types of pollutants affecting gannets, but relatively low levels

of DDE, DDT, Dieldrin and PCB's (polychlorinated biphenyls) have been reported from eggs of the Cape gannet (National Institute for Water Research, unpublished data).

Cape gannets are susceptible to disturbance while breeding. Jarvis and Cram (1971) describe how visitors to the gannet colony at Bird Island (Lambert's Bay), which is connected to the mainland by a causeway, affected prospecting birds at the edges of the colony and caused chicks to leave their nests. The area open to the public was fenced off in 1974, and gannets are now rarely disturbed by visitors (personal observation). Earlier attempts to restrict close access by visitors to the birds reduced disturbance to such a level that guano yields increased (Jarvis 1971a, Jarvis and Cram *op. cit.*).

Breeding success of Cape gannets is reduced by the commercial collection of guano in a number of ways. Paving of the colony at Bird Island (Lambert's Bay) with flat stones to facilitate guano scraping has resulted in increased egg loss when eggs fall into the cracks between stones. Jarvis (1971a) showed that this was the result of scraping having removed the guano which would otherwise have been used in nest construction in the following season. He observed a higher breeding success in areas with abundant nest material, and recommended that sand be spread over the paved gannet-breeding area after guano collection so that no shortage of nest material would occur in the next breeding season. However, this method of conservation management has never been attempted.

At Bird Island (Algoa Bay), guano scraping without the replacement of alternative material has led to parts of the breeding colony becoming basin-shaped and tending to accumulate water from rainfall (Randall and Ross 1979). Such swamping caused a low breeding success in the 1976/77 breeding season (Randall and Ross *op. cit.*).

The collection of guano may reduce breeding success of the Cape gannet in a more direct manner. Guano scraping normally commences before all Cape gannet chicks have fledged (personal observation), because the guano must be collected while it is relatively dry, i.e. before the start of the winter rains. Wet guano is practically impossible to handle. If guano scraping commences too early then smaller chicks which are displaced from their nests may not be able to reunite with their parents. In 1977 this occurred at Malgas Island and approximately 800 dead chicks, mostly in downy or down-dropping stages, were counted over the period 21—23 March 1977 (J. C. Sinclair, Percy FitzPatrick Institute, *in litt.* to J. C.). Similar incidents have occurred in recent years at Possession and Ichaboe Islands (P. D. Shaughnessy and B. H. Smith, formerly Sea Fisheries Research Institute, *in litt.* to J. C.).

In order to preclude such chick mortality, guano scraping should take place only when all gannet chicks have fledged. Further, and because guano scraping can also seriously affect other breeding seabird species (e.g. Berry *et al.* 1974, Hockey and Hallinan 1981, Brooke *et al.* 1982), the advisablility of guano collection at all should be carefully considered from a conservational as well as an economic viewpoint (Cooper *et al.* in press).

In the past, Cape gannets were intentionally killed by man for food and for use as bait in rock-lobster traps (Jarvis 1971a). While this practice has now, according to Rand (1971), virtually ceased, Cape gannet wings with broken humeri are still occasionally found during African Seabird Group beach patrols, strongly suggesting the birds have been caught at sea for food (Cooper 1977; G. Avery, South African Museum, *in litt.*).

Juvenile Cape gannets off West Africa are caught by the local inhabitants from canoes or with baited lines (Rand 1959b, Broekhuysen *et al.* 1961). One correspondent (see Broekhuysen *et al. op. cit.*) reported them being killed "in hundreds" in the French Cameroons (Cameroun). Catching of roseate terns *Sterna dougallii* in West Africa has seriously reduced their European populations in recent years (Dunn 1981). The population of the Cape gannet may also be affected by such a practice. However, some of the gannets captured were, as described by Broekhuysen *et al.* (*op. cit.*), weak and emaciated and would probably have soon died. Therefore the real effect of man-induced mortality of juvenile gannets remains uncertain.

Cape gannets may be accidentally killed by man. Jarvis (1971b) reports gannets being entangled in fishing nets, hooked on fishing lines and even being killed diving onto the decks of boats covered with fish. Net-entangled dead gannets are occasionally seen on beaches during beach patrols and they often become entangled in fishing nets and trawls at sea (personal observation). However, this type of accidental man-induced mortality is considered to have only a minor effect.

The Cape gannet feeds on surface-shoaling fish of commercial importance (Rand 1959a, Jarvis 1971a, Crawford and Shelton 1981, Cooper in press), and the species may be affected by competition with the commercial fishery. Although Cape gannets have recently "switched" from larger to smaller prey species which may be less energetically efficient to catch (Cooper *op. cit.*, Burger and Cooper in press), they have also broadened their food supply by scavenging from demersal trawlers (Sinclair 1978, Cooper *op. cit.*). However, the scavenged fish is

primarily hake *Merluccius* spp. (Cooper *op. cit.*) which is non-oily and is energetically a less suitable food source. Batchelor (1982) found that Cape gannet chicks reared in captivity on hake grew more slowly than those fed on pilchards even though similar quantities were consumed.

Cape gannets at some breeding localities have decreased in number, and this has been related to the availability of food. It is recommended that, when decisions are made on the management of the pelagic surface-shoaling fish populations off southern Africa, the conservation management of the Cape gannet (and the other species of breeding seabirds) should not be ignored.

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LITERATURE CITED

ANDERSSON, C. J. 1861 — *The Okavango River: a Narrative of Travel, Exploration and Adventure.* London; Hurst and Blackett: 371 pp.

ANGRA PEQUENA AND WEST COAST CLAIMS JOINT COMMISSION 1885 — *Proceedings of the Angra Pequena and West Coast Claims Joint Commission, March -September 1885.* Cape Town; Saul Solomon: 118 pp. + 48 pp. of Minutes and 45 pp. of Appendices.

ARMSTRONG, M. J., SHELTON, P. A., PROSCH, R. M. and W. S. GRANT 1983 — Stock assessment and population dynamics of anchovy and pilchard in ICSEAF Division 1.6 in 1982. *Colln scient. Pap. int. Commn SE. Atl. Fish.* **10**(1): 7—25.

ASHTON, E. H. 1954a — Third progress report: bird ringing 1951—1952. *Ostrich* **25**(1): 2—12.

ASHTON, E. H. 1954b — Fourth progress report: bird ringing 1952—1953. *Ostrich* **25**(3): 130—138.

ASHTON, H. 1956 — Fifth progress and ringing report (Part 1). *Ostrich* **27**(1): 5—13.

ASHTON, H. 1957 — Sixth ringing report. *Ostrich* **28**(2): 98—115.

BASILIO, A. 1963 — *Aves de la isla de Fernando Poo.* Madrid; Coculsa: 202 pp.

BATCHELOR, A. L. 1982 — The diet of the Cape gannet *Sula capensis* breeding on Bird Island, Algoa Bay. M.Sc. thesis, University of Port Elizabeth: 53 pp.

BERLIOZ, J. 1961 — Notes ornithologiques de voyage en Afrique du Sud. *Oiseau Revue fr. Orn.* **31**(1): 30—51.

BERRY, H. H., SEELY, M. K. and R. E. FRYER 1974 — The status of the jackass penguin *Spheniscus demersus* on Halifax Island off South West Africa. *Madoqua ser. 2.* **3**: 27—29.

BEST, P. B. and P. D. SHAUGHNESSY 1979 — An independent account of Captain Benjamin Morrell's sealing voyage to the south-west coast of Africa in the *Antarctic*, 1828/29. *Fish. Bull. S. Afr.* **12**: 1—19.

BLYTH, R. O. 1930 — On the winter distribution of some sea-birds. *Br. Birds* **23**(12): 314—317.

BOURNE, W. R. P. and M. C. RADFORD 1961 —Notes on observations of sea-birds received during 1960. *Sea Swallow* **14**: 7—27.

BRINCK, P. 1955 — Swedish exploration of South African animal life during 200 years. *S. Afr. Anim. Life* **1**: 11—61.

BRITISH ORNITHOLOGISTS' UNION 1980 —Records Committee: tenth report (March 1980). *Ibis* **122**(4): 564—568.

BRITTON, H. A. and P. L. BRITTON 1968 —Seafowl observed on a voyage, Cape Town to Southampton, 24th January to 5th February, 1968. *Bull. Br. Orn. Club* **88**(5): 93—96.

BRITTON, P. L. (Ed.) 1980 — *Birds of East Africa.* Nairobi; East Africa Natural History Society: 271 pp.

BROCK, B. B., BROCK, B. G. and H. C. WILLIS 1976 — *Historical Simon's Town.* Cape Town; Balkema: 217 pp.

BROEKHUYSEN, G. J., LIVERSIDGE, R. and R. W. RAND 1961 — The South African gannet *Morus capensis.* 1. Distribution and movements. *Ostrich* **32**(1): 1—19.

BROEKHUYSEN, G. J. and G. RUDEBECK 1951 — Some notes on the Cape gannet, *Morus capensis. Ostrich* **22**(3): 132—138.

BROOKE, R. K. 1981a — The place of South Africa in the world of seabirds and other marine animals. In *Proceedings of the Symposium on Birds of the Sea and Shore 1979.* Cooper, J. (Ed.). Cape Town; African Seabird Group: 135—147.

BROOKE, R. K. 1981b — The seabirds of the Moçâmedes Province, Angola. *Gerfaut* **71**(2): 209—225.

BROOKE, R. K. — The rare and vulnerable birds of South Africa. *Rep. S. Afr. natn. scient. Progm.* (In press.)

BROOKE, R. K., COOPER, J., SHELTON, P. A. and R.J.M. CRAWFORD 1982 — Taxonomy, distribution, population size, breeding and conservation of the whitebreasted cormorant, *Phalacrocorax carbo*, on the southern African coast. *Gerfaut* **72**(2): 188—220.

BROOKE, R. K., COOPER, J. and J. C. SINCLAIR 1981 — Additional records of seabirds on the coast of Mozambique. *Cormorant* **9**(1): 30—40.

BROWN, C. R. and T. B. OATLEY 1982 — Bird ringing at Marion and Prince Edward Islands, 1977—1982. *S. Afr. J. Antarct. Res.* **12**. (In press.)

BULPIN, T. V. 1972 — Guano islands. In *Standard Encyclopaedia of Southern Africa* **5**. Potgieter, D. J. (Ed.). Cape Town; Nasou: 388—391.

BURGER, A. E. and J. COOPER — The effects of fisheries on seabirds in South Africa and Namibia. In *Marine Birds: Feeding, Ecology and Commercial Fisheries.* Nettleship, D. N., Sanger, G. A. and P. Springer (Eds.). Ottawa; Canadian Wildlife Services Special Publications. (In press.)

BURMAN, J. and S. LEVIN 1974 — *The Saldanha Bay Story.*

Cape Town; Human and Rousseau: 165 pp.
BUTTERWORTH, D. S. 1980 — The value of catch-statistics-based management techniques for heavily fished pelagic stocks, with special reference to the recent decline of the Southwest African pilchard stock. *Colln scient. Pap. int. Commn SE. Atl. Fish.* 7(2): 69—84.
CAMERON, M. 1981 — Cape gannet photographed at Wedge Light, Port Phillip Bay. *Geelong Nat.* **18**(2): 34—35.
CHAPIN, J. P. 1932 — The birds of the Belgian Congo, part 1. *Bull. Amer. Mus. Nat. Hist.* **65**: 756 pp.
CHAPMAN, S. E. 1982 — Notes on seabird reports received 1980—81. *Sea Swallow* **31**: 5—24.
CLANCEY, P. A. 1970 — A handlist of the birds of southern Moçambique, part 1. *Mems. Inst. Invest. cient. Moçamb. ser A.* **10**: 145—302.
CLANCEY, P. A. (Ed.). 1980 — *S.A.O.S. Checklist of Southern African Birds.* Johannesburg; Southern African Ornithological Society: 325 pp.
COLES, J. D. W. A. 1941 — An epizootic in seabirds: a visit to Dassen and Malagas Islands. *Jl S. Afr. vet. med. Ass.* **12**(1): 23—30.
COOPER, J. 1977 — Editorial. *Cormorant* **3**: p. 3.
COOPER, J. — Changes in resource division among four breeding seabirds in the Benguela upwelling system, 1953—1978. In *Proceedings of the Fifth Pan-African Ornithological Congress, Lilongwe, 1980.* Ledger, J. A. (Ed.). (In press.)
COOPER, J., BROOKE, R. K., SHELTON, P. A. and R. J. M. CRAWFORD 1982 — Distribution, population size and conservation of the Cape cormorant *Phalacrocorax capensis. Fish. Bull. S. Afr.* **16**: 121—143.
COOPER, J., WILLIAMS, A. J. and P. L. BRITTON — Distribution, population sizes and conservation of breeding seabirds in the Afrotropical Region. International Council for Bird Preservation Technical Publication. (In press.)
COURTENAY-LATIMER, M. 1954 — Investigation on the Cape gannet (*Morus capensis*). *Ostrich* **25**(3): 106—114.
COURTENAY-LATIMER, M. and C. A. GIBSON-HILL 1946 — A preliminary note on the Bird Island group in Algoa Bay. *Ostrich* **17**(2): 75—86.
CRAMP, S. and K. E. L. SIMMONS 1977 — *The Birds of the Western Palearctic* **1**. Oxford; Oxford University Press: 722 pp.
CRAWFORD, R. J. M. 1980 — Seasonal patterns in South Africa's Western Cape purse-seine fishery. *J. Fish Biol.* **16**(6): 649—664.
CRAWFORD, R. J. M. 1981 — Catch per standard-boat-day and deployment of effort in the South African purse-seine fishery, 1964—1976. *Investl Rep. Sea Fish. Inst. S. Afr.* **122**: 24 pp.
CRAWFORD, R. J. M., COOPER, J. and P. A. SHELTON 1981 — The breeding population of white pelicans *Pelecanus onocrotalus* at Bird Rock platform in Walvis Bay, 1949—1978. *Fish. Bull. S. Afr.* **15**: 67—70.
CRAWFORD, R. J. M. and H. B. CROUS 1982 —Trends in commercial handline catches of redfishes along the southern Cape coast, Republic of South Africa. *Koedoe* **25**: 13—31.
CRAWFORD, R. J. M. and P. A. SHELTON 1978 — Pelagic fish and seabird interrelationships off the coasts of South West and South Africa. *Biol. Conserv.* **14**(2): 85—109.
CRAWFORD, R. J. M. and P. A. SHELTON 1981 — Population trends for some southern African seabirds related to fish availability. In *Proceedings of the Symposium on Birds of the Sea and Shore, 1979.* Cooper, J. (Ed.). Cape Town; African Seabird Group: 15—41.
CRAWFORD, R. J. M., SHELTON, P. A. and L. HUTCHINGS — Aspects of variability of some neritic stocks in the southern Benguela system. In *Proceedings of the Expert Consultation to Examine Changes in Abundance and Species Composition of Neritic Fish Stocks, San José, Costa Rica, April 1983.* (In press.)
CYRUS, D. and N. ROBSON 1980 — *Bird Atlas of Natal.* Pietermaritzburg; University of Natal: 320 pp.
DAVIES, D. H. 1955 — The South African pilchard (*Sardinops ocellata*). Bird predators, 1953—4. *Investl Rep. Div. Fish. S. Afr.* **18**: 32 pp.
DAVIES, D. H. 1956 — The South African pilchard (*Sardinops ocellata*) and maasbanker (*Trachurus trachurus*). Bird predators, 1954—55. *Investl Rep. Div. Fish. S. Afr.* **23**: 40 pp.
DORST, J. and J.-L. MOUGIN 1979 — Pelecaniformes. In *Checklist of Birds of the World* **1**. *2nd Ed.* Mayr, E. and G. W. Cottrell (Eds.). Cambridge, Mass.; Museum of Comparative Zoology: 155—193.
DUNN, E. 1981 — Roseates on a lifeline. *Birds* **8**(6): 42—45.
EDEN, T. E. 1846 — *The search for Nitre and the True Nature of Guano, Being an Account of a Voyage to the South-West Coast of Africa*; etc. London; R. Groombridge: 133 pp.
EX-MEMBER OF THE COMMITTEE 1845 —The African guano trade. *Naut. Mag., enlarged ser.* **11**: 617—666.
FINSCH, O. and G. HARTLAUB 1870 — Die Voegel ost-Afrikas. Leipzig; Winter: 897 pp.
FRY, C. H. 1961 — Notes on the birds of Annobon and other islands in the Gulf of Guinea. *Ibis* **103a**(2): 267—276.
FURNESS, R. W. and J. COOPER 1982 — Interactions between breeding seabird and pelagic fish populations in the southern Benguela region. *Mar. Ecol. Prog. Ser.* **8**(3): 243—250.
GILL, E. L. and W. ZEEDERBERG 1928 — Guano islands of South Africa. In *Official Yearbook of the Union and of Basutoland, Bechuanaland Protectorate and Swaziland (9).* Pretoria; Union Office of Census and Statistics: 41—43.
GOOD, A. I. 1952 — The birds of French Cameroon, part 1. *Mém. Inst. fr. Afr. noire. Ser. Sci. nat.* **2**: 1—203.
GORE, M. E. J. 1981 — *Birds of the Gambia.* London; British Ornithologists' Union: 130 pp.
GREEN, L. G. 1950 — *At Daybreak to the Isles.* Cape Town; Howard Timmins: 220 pp.
GROSS, A. O. 1960 — Birds observed at sea during a voyage to and from Africa. *Mass. Audubon* **44**: 111—116.
HAMMOND, C. E. 1958 — Notes on sea reports. *Sea Swallow* **11**: 6—13.
HEWITT, J. H. C. 1938 — The government guano islands. *Fmg S. Afr.* **13**: 589—590.
HEWITT, J. H. C. 1939 — The government guano islands. *Fmg S. Afr.* **14**: 592—593.
HOCKEY, P. A. R. and J. HALLINAN 1981 —Effect of human disturbance on the breeding behaviour of jackass penguins *Spheniscus demersus. S. Afr. J. Wildl. Res.* **11**(2): 59—62.
JACKSON, C. H. 1902 — *Report of the Superintendent of the Government Guano Islands for the Year 1901.* Cape Town; Government Printer, G. 33—1902: 1—6.
JACKSON, F. J. and W. L. SCLATER 1938 — *The Birds of Kenya Colony and the Uganda Protectorate.* **1**. London; Gurney and Jackson: 542 pp.
JARVIS, M. J. F. 1971a — Interactions between man and the South African gannet *Sula capensis. Ostrich* **Suppl. 8**: 497—513.
JARVIS, M. J. F. 1971b — Ethology and ecology of the South African gannet *Sula capensis.* Ph.D. thesis, University of Cape Town: 253 pp.
JARVIS, M. J. F. 1974 — The ecological significance of clutch size in the South African gannet (*Sula capensis* (Lichtenstein)). *J. Anim. Ecol.* **43**(1): 1—17.

JARVIS, M. J. F. and D. L. CRAM 1971 — Bird Island, Lambert's Bay, South Africa: an attempt at conservation. *Biol. Conserv.* 3(4): 269—272.

LAMBERT, K. 1971 — Seevogelbeobachtungen auf zwei Reisen in oestlichen Atlantik mit besonder Berueecksichtigung des Seegebietes vor Suedwest Afrika. *Beitr. Vogelkd.* 17(1): 1—32.

LAYARD E. L. and R. B. SHARPE 1884 — *The Birds of South Africa.* London; Bernard Quaritch: 890 pp.

LOUETTE, M. 1981 — The birds of Cameroun. An annotated check-list. *Verh. K. Acad. Wet. Lett. Schone Kunst. België* 163: 1—295.

MATTHEWS, J. P. 1961 — The pilchard of South West Africa *Sardinops ocellata* and the maasbanker *Trachurus trachurus.* Bird predators, 1957—1958. *Investl Rep. mar. Res. Lab. S. W. Afr.* 3: 35 pp.

McLACHLAN, G. R. 1962 — Eighth ringing report. *Ostrich* 33(3): 29—37.

McLACHLAN, G. R. 1964 — Tenth ringing report. *Ostrich* 35(2): 101—110.

MILON, P., PETTER, J. J. and G. RANDRIANASOLO 1973 —Oiseaux. *Faune Madagascar* 35: 1—263.

MORANT, P. D., COOPER, J. and R. M. RANDALL 1981 —The rehabilitation of oiled jackass penguins *Spheniscus demersus,* 1970—1980. In *Proceedings of the Symposium on Birds of the Sea and Shore, 1979.* Cooper, J. (Ed.). Cape Town; African Seabird Group: 267—301.

MORRELL, B. 1832 — *A Narrative of Four Voyages to the South Sea, North and South Pacific Ocean, Chinese Sea, Ethiopic and Southern Atlantic Ocean, Indian and Antarctic Ocean from the Year 1822–1831.* New York; J. and J. Harper: 492 pp.

MORRELL, R. F. 1954 — (Gannets using thermals.) *Cape Bird Club News Sheet* 23: 1—2.

NELSON, J. B. 1966 — Population dynamics of the gannet (*Sula bassana*) at the Bass Rock, with comparative information from other Sulidae. *J. Anim. Ecol.* 35(3): 443—470.

NELSON, J. B. 1978a — *The Sulidae.* Oxford; Oxford University Press: 1012 pp.

NELSON, J. B. 1978b — *The Gannet.* Berkhamstead; T. and A. D. Poyser: 336 pp.

NEPGEN, C. S. de V. 1979a — The food of the snoek *Thyrsites atun. Fish. Bull. S. Afr.* 11: 39—42.

NEPGEN, C. S. de V. 1979b — Trends in the line fishery for snoek *Thyrsites atun* off the south-western Cape, and in size composition, length-weight relationship and condition. *Fish. Bull. S. Afr.* 12: 35—43.

NEPGEN, C. S. de V. 1982 — Diet of predatory and reef fish in False Bay and possible effects of pelagic purse-seining on their food supply. *Fish. Bull. S. Afr.* 16: 75—93.

NEWMAN, G. G. and R. J. M. CRAWFORD 1980 — Population biology and management of mixed-species pelagic stocks off South Africa. *Rapp. P. -v. Réun. Cons. perm. Int. Explor. Mer* 177: 279—291.

PAKENHAM, R. H. W. 1979 — *The Birds of Zanzibar and Pemba.* London; British Ornithologists' Union: 134 pp.

PERCY FITZPATRICK INSTITUTE OF AFRICAN ORNITHOLOGY 1974 — Fish oil kills seabirds. *Afr. Wildl.* 28(4): 24—25.

RAMSAY, L. N. G. 1913a — Section X — South Atlantic voyage from Gough Island to Cape Town, thence to St. Helena. *Sci. Res. Scotia* 4: 291—293.

RAMSAY, L. N. G. 1913b — Section XI — South Africa. *Sci. Res. Scotia* 4: 295—297.

RAND, R. W. 1952 — Oil contamination — a sea bird menace. *Bokmakierie* 4(3): p. 63.

RAND, R. W. 1959a — The biology of guano producing seabirds. The distribution, abundance and feeding habits of the Cape gannet, *Morus capensis,* off the south-western coast of the Cape Province. *Investl Rep. Div. Fish. S. Afr.* 39: 36 pp.

RAND, R. W. 1959b — Conservation of the Cape gannet. *Ostrich* Suppl. 3: 31—33.

RAND, R. W. 1963a — The biology of guano-producing seabirds. 4. Composition of colonies on the Cape Islands. *Investl Rep. Div. Sea Fish. S. Afr.* 43: 32 pp.

RAND, R. W. 1963b — The biology of guano producing seabirds. 5. Composition of colonies on the South West African islands. *Investl Rep. Div. Sea Fish. S. Afr.* 46: 26 pp.

RAND, R. W. 1971 — Some hazards to seabirds. *Ostrich* Suppl. 8: 515—520.

RANDALL, R. and G. J. B. ROSS 1979 — Increasing population of Cape gannets on Bird Island, Algoa Bay, and observations on breeding success. *Ostrich* 50(3): 168—175.

RAVEN-HART, R. 1967 — *Before van Riebeeck.* Cape Town; C. Struik: 216 pp.

ROSS, G. J. B. 1978 — Historical status of gannets and other seabirds on Bird Island, Algoa Bay. *Cormorant* 4: 18—21.

ROUGEOT, P. C. 1948 — Nouvelles notes sur les palmipèdes du Gabon. *Oiseau Revue fr. Orn.* 18(1): 94—97.

ROUGEOT, P. C. 1959 — Sur la migration du fou du Cap *Morus capensis* Falk (1823) le long des côtes du Gabon. *Ostrich* Suppl. 3: 331—332.

ROWAN, M. K. 1953 — (Gannets inland.) *Cape Bird Club News Sheet* 14: p. 4.

ROWAN, M. K. 1969 — Oiling of marine birds in South Africa. In *International Conference on Oil Pollution of the Sea, Rome, 1968.* Barclay-Smith, P. (Ed.). Winchester; Wykeham Press: 121—124.

SCLATER, W. L. 1906 — *The Birds of South Africa* 4. London; R. H. Porter: 545 pp.

SEGONZAC, M. 1972 — Données recentes sur la faune des îsles Saint Paul et Nouvelle Amsterdam. *Oiseaux Revue fr. Orn.* 42 spec.: 3—68.

SHAUGHNESSY, P. D. 1983 — Historical population levels of seals and seabirds on islands off southern Africa, with special reference to Seal Island, False Bay. *Investl Rep. Sea Fish. Res. Inst. S. Afr.* 127.

SHAUGHNESSY, P. D. — Population size of the Cape fur seal *Arctocephalus pusillus.* 1. From aerial photography. *Investl Rep. Sea Fish. Res. Inst. S. Afr.* (In press.)

SHELTON, P. A., CRAWFORD, R. J. M., KRIEL, F. and J. COOPER 1982 — Methods used to census three species of southern African seabirds, 1978—1981. *Fish. Bull. S. Afr.* 16: 115—120.

SIEGFRIED, W. R., FROST, P. G. H., COOPER, J. and A. C. KEMP 1976 — South African red data book — Aves. *Rep. S. Afr. natn. scient. Progms* 7: 108 pp.

SINCLAIR, J. C. 1978 — The seabirds of a trawling voyage. *Bokmakierie* 30(1): 12—16.

SPEIGHT, W. L. 1940 — The South African guano islands. *Fertil. Feedg Stuffs J.* 25(13): 242—245.

STEWART, W. S. and A. C. CURREY 1957 — Malagas Island — Saldanha Bay — South Africa. *Sea Swallow* 10: 15—17.

STRANGMAN, E. 1936 — *Early French Callers at the Cape.* Cape Town; Juta: 223 pp.

SUMMERHAYES, C. P., HOFMEYER, P. K. and R. H. RIOUX 1974 — Seabirds off the southwestern coast of Africa. *Ostrich* 45(2): 83—109.

SYMONS, R. E. 1924 — A visit to Dyer's Island. *S. Afr. J. nat. Hist.* 4(4): 253—259.

TRAYLOR, M. A. 1963 — Check-list of Angolan birds. *Publ. Cult. Comp. Diamantes Angola* 61: 1—250.

VAN SOMEREN, V. G. L. 1932 — Birds of Kenya and Uganda, being addenda and corrigenda to my previous paper in

"*Novitates Zoologicae*", XXIX, 1922. *Novit. zool.* 37: 252—380.
VENN, D. R. 1982 — The Cape gannet (*Sula capensis*), a new record for Australia. *Victorian Nat.* 99: 56—58.
WESTPHAL, A. and M. K. ROWAN 1971 — Some observations on the effects of oil pollution on the jackass penguin. *Ostrich* Suppl. 8: 521—526.
WHITE, C. M. N. 1965 — *A Revised Checklist of African non-Passerine Birds.* Lusaka; Government Printer: 299 pp.
WINTERBOTTOM, J. M. 1936 — Five African voyages. *Ostrich* 7 (2): 90—98.
WINTERBOTTOM, J. M. 1958 — (A voyage from South Africa to England.) *Cape Bird Club News Letter* 47: 1—2.
ZEEDERBERG, W. R. 1910 — Report of the Superintendent of the Government guano islands for the year 1909. In *Report of the Department of Agriculture for the Year ended 1909, with appendices.* Cape Town; Parliament of the Colony of the Cape of Good Hope, G. 10—1910: 189—192.

APPENDIX 1

Schedule of counts of Cape gannets *Morus capensis* at the six extant breeding localities

Mercury Island 25°43'S, 14°50'E

Date	Time	Census technique	Parameter censused	Number	Estimated number of breeding pairs		Index of population size (1956=1,00)
					Rand (1963b)	This paper	
20 Nov. 1956	10h30-15h30	aerial photography	adults	5 797α	c. 4 650α	3 917β	1,00
15 Nov. 1967		aerial photography	adults	2 050		1 385β	0,35
25 or 26 Nov. 1969		aerial photography	adults	1 552		1 049β	0,27
20—23 Nov. 1978		counts from vantage points	nests	1 102		1 102	
28 Nov. 1978	13h45	aerial photography	adults	2 754		1 939γ	0,50
14 Dec. 1981	14h15	aerial photography	adults	1 871		1 318γ	0,34

Ichaboe Island 26°17'S, 14°56'E

20 Nov. 1956	10h30-15h30	aerial photography	adults	143 913α	c.115 000α	97 239β	1,00
15 Nov. 1967		aerial photography	adults	116 077		78 430β	0,81
28 Nov. 1978	13h30	aerial photography	adults	80 447		28 427δ	0,29
9 Dec. 1980	14h50	aerial photography	adults	32 077		11 335δ	0,12

Possession Island 27°01'S, 15°12'E

21 Nov. 1956	10h30-15h30	aerial photography	adults	19 946α	c. 15 500α	13 477β	1,00
14 Nov. 1967		aerial photography	adults	13 691		9 251β	0,69
28 Nov. 1978	12h15	aerial photography	adults	5 505		5 397ϵ	0,40
9 Dec. 1980	14h10	aerial photography	adults	2 962		3 038ζ	0,23

Bird Island (Lambert's Bay) 32°05'S, 18°18'E

Date	Time	Census technique	Parameter censused	Number	Estimated number of breeding pairs		Index of population size (1956=1,00)
					Rand (1963a)	This paper	
23 Nov. 1956	10h30-15h30	aerial photography	adults	6 152η	c. 5 000η	4 157β	1,00
13 Nov. 1967		aerial photography	adults	3 268		2 208β	0,53
c. 1971		rough estimate	breeding pairs	c.5 000θ		c. 5 000θ	1,20
13 Dec. 1973	sunrise	aerial photography ι	adults	10 537		c. 5 000	1,20
21 Nov. 1974	sunrise	aerial photography ι	adults	5 254			
22 Nov. 1974	12h00	aerial photography	adults	4 469		3 020β	0,73
27 Nov. 1978	13h00	aerial photography	adults	6 895		4 659β	1,12
12 Dec. 1980	16h15	aerial photography	adults	8 007		5 410β	1,30
15 Dec. 1981	14h15	aerial photography	adults	9 158		6 187β	1,49

Malgas Island 33°03'S, 17°55'E

1950/51 breeding season		product of estimates of area of colony and density of birds	total popu-lation	79 000κ			
23 Nov. 1956	c. 13h00	aerial photography	adults	24 194η	c. 19 500η	16 347β	1,00
c. 1957		rough estimate	all indi-viduals	>50 000λ			
10 Nov. 1967		aerial photography	adults	21 002		14 191β	0,87
25 or 26 Nov. 1969		aerial photography	adults	20 225		13 666β	0,84
27 Nov. 1978	10h00	aerial photography	adults	32 169		21 736β	1,33
12 Dec. 1980	17h00	aerial photography	adults	29 949		20 236β	1,24

α Rand (1963b)
β Estimated using information presented in Figure 2 for all colonies for the period 10h30—15h30
γ Estimated using information presented in Figure 2 for Mercury Is. for the period 13h30—14h30, 23 Nov. 1978
δ Estimated using information presented in Figure 2 for Ichaboe Is. for the period 13h00—13h30, 27 Nov. 1978
ϵ Estimated using information presented in Figure 2 for Possession Is. for the period 12h00—12h30, 5—6 Dec. 1978
ζ Estimated using information presented in Figure 2 for Possession Is. for the period 14h00—14h30, 5—6 Dec. 1978
η Rand (1963a)
θ Jarvis and Cram (1971)
ι Modified to account for gannets leaving the island prior to the onset of aerial photography — see Methods section for fuller details
κ Broekhuysen and Rudebeck (1951)
λ Stewart and Currey (1957)

Appendix 1 continued overleaf

Appendix 1 *(continued)*

Bird Island (Algoa Bay) 33°50'S, 26°17'E

Date	Time	Census technique	Parameter censused	Number	Estimated number of breeding pairs				Index of population size (1956 = 1,00)
					Rand (1963a)	Randall and Ross (1979)	Batchelor (1982)	This paper	
1755/56 breeding season		estimated from egg collections	breeding pairs	8 380—13 960ν					
1858/59 breeding season		estimated from egg collections	breeding pairs	Minimum of 12 000ν					
1936		no details	total population	36 000ξ					
1937		no details	total population	20 000ξ					
1939		no details	total population	25 000ξ					
1940		no details	total population	37 000ξ					
1941		no details	total population	32 000ξ					
1945		no details	total population	25 000ρ					
26 Nov. 1956	c.15h00	aerial photography	adults	20 567η	16 500η			13 898β	1,00
		aerial photography	area occupied by nesting gannets (m^2)	7 045σ			20 078τ		
25 or 26 Nov. 1969		aerial photography	adults	20 684				13 976β	1.01
		aerial photography	area occupied by nesting gannets (m^2)	11 362σ			32 381τ		
1974/75 breeding season		aerial photography	area occupied by nesting gannets (m^2)	13 567σ					
		A x $d\psi$	breeding pairs			38 692ψ			2,78
1977/78 breeding season		aerial photography	area occupied by nesting gannets (m^2)	14 979τ					
		A x $d\psi$	breeding pairs				42 690τ		3,07
23 Nov. 1978	09h15	aerial photography	adults	57 981				48 528υ	3,49
1978/79 breeding season		aerial photography	area occupied by nesting gannets (m^2)	16 617τ					
		A x $d\psi$	breeding pairs				47 370τ		3,41
1979/80 breeding season		aerial photography	area occupied by nesting gannets (m^2)	13 578τ					
		A x $d\psi$	breeding pairs				38 697τ		2,78
10 Nov. 1980	13h40	aerial photography	adults	56 459				38 816φ	2,79
17 Dec. 1981	14h00	aerial photography	adults	51 262				35 243φ	2,54

β Estimated using information presented in Figure 2 for all colonies for the period 10h30—15h30

η Rand (1963a)

ν Ross (1978)

ξ Courtenay-Latimer (1954)

ρ Courtenay-Latimer and Gibson-Hill (1946)

σ Randall and Ross (1979)

τ Batchelor (1982)

υ Estimated using information presented in Figure 2 for Bird Is. (Algoa Bay) for the period 08h00—10h30, 6 Dec. 1979

φ Estimated using information presented in Figure 2 for Bird Is. (Algoa Bay) for the period 12h00—14h30, 6 Dec. 1979

ψ Product of area occupied by nesting gannets (A) and density of nests (d)

APPENDIX 2

Recoveries of ringed Cape gannets *Morus capensis* north of Moçâmedes Province (Angola) and Maputo Province (Moçambique) listed to illustrate aspects of the non-breeding range

Ringing locality	Ring number	Age at ringing	Ringing date	Recovery date	Recovery locality			Published
West Africa								
Lambert's Bay	546—14323	pullus	09.04.66	30.05.66	21°40'N	13°55'W	Off ex-Spanish Sahara	
Malgas Is.	536—07437	pullus	25.02.54	22.07.54	4°19'N	6°14'E	Brass, Nigeria	Ashton 1956
Algoa Bay	536—06026	pullus	24.03.54	23.07.54	4°43'N	7°05'E	Port Harcourt, Nigeria	Ashton 1956
Algoa Bay	536—00418	pullus	25.03.54	14.07.54	5°23'N	7°55'E	Arochuku, Nigeria	Ashton 1956
Malgas Is.	536—09389	pullus	25.02.54	15.07.54	4°57'N	8°19'E	Calabar, Nigeria	Ashton 1956
Malgas Is.	536—05746	pullus	24.02.54	31.07.56	4°01'N	9°12'E	Victoria, Cameroun	Ashton 1956
Malgas Is.	10370	pullus	08.02.57	12.07.57	4°01'N	9°12'E	Victoria, Cameroun	
Algoa Bay	536—06994	pullus	25.03.54	31.07.54	4°01'N	9°12'E	Victoria, Cameroun	Ashton 1956
Malgas Is.	536—09554	pullus	25.02.54	13.07.54	4°03'N	9°42'E	Douala Bay, Cameroun	Ashton 1956
Malgas Is.	536—09233	pullus	25.02.54	13.07.54	4°03'N	9°42'E	Douala Bay, Cameroun	Ashton 1956
Lambert's Bay	30329	pullus	03.03.59	30.06.59	3°30'N	8°40'E	Bioko/Fernando Poo	
Malgas Is.	546—03899	pullus	14.03.55	03.07.55	3°10'N	10°25'E	Near Bipindi, Cameroun	Ashton 1957
Malgas Is.	526—02699	pullus	03.04.53	11.06.53	2°57'N	9°55'E	Kribi, Cameroun	Ashton 1954b
Malgas Is	536—03177	pullus	24.02.54	17.07.54	2°57'N	9°55'E	Kribi, Cameroun	Ashton 1956
Malgas Is.	536—07766	pullus	25.02.54	28.08.59	1°51'N	9°45'E	Bata, Equatorial Guinea	McLachlan 1964
Malgas Is.	536—07724	pullus	25.02.54	28.08.59	1°51'N	9°45'E	Bata, Equatorial Guinea	McLachlan 1964
Algoa Bay	536—00901	pullus	25.03.54	19.07.54	1°51'N	9°45'E	Bata, Equatorial Guinea	Ashton 1956
Algoa Bay	536—02516	pullus	25.03.54	16.07.54	1°51'N	9°45'E	Bata, Equatorial Guinea	Ashton 1956
Algoa Bay	536—02512	pullus	25.03.54	16.07.54	1°51'N	9°45'E	Bata, Equatorial Guinea	Ashton 1956
Malgas Is.	526—01265	pullus	03.04.53	07.07.53	1°35'N	9°37'E	Rio Benito, Equatorial Guinea	Ashton 1954b
Malgas Is.	536—03768	pullus	25.02.54	25.07.54	1°35'N	9°37'E	Rio Benito, Equatorial Guinea	Ashton 1956
Malgas Is.	536—03422	pullus	25.02.54	25.07.54	1°35'N	9°37'E	Rio Benito, Equatorial Guinea	Ashton 1956
Malgas Is.	546—00408	pullus	21.02.55	15.07.55	1°35'N	9°37'E	Rio Benito, Equatorial Guinea	
Malgas Is.	28410	pullus	09.02.59	28.08.59	1°35'N	9°37'E	Rio Benito, Equatorial Guinea	
Malgas Is.	28458	pullus	09.02.59	28.08.59	1°35'N	9°37'E	Rio Benito, Equatorial Guinea	
Lambert's Bay	30284	pullus	03.03.59	28.08.59	1°30'N	7°30'E	Off Rio Muni, Equatorial Guinea	
Malgas Is.	526—01259	pullus	03.04.53	15.07.53	0°23'N	9°27'E	Libreville, Gabon	Ashton 1954b
Malgas Is.	536—07030	pullus	25.02.54	20.07.54	0°23'N	9°27'E	Libreville, Gabon	Ashton 1956
Algoa Bay	536—00372	pullus	25.03.54	10.07.54	0°23'N	9°27'E	Libreville, Gabon	Ashton 1956
Malgas Is.	536—03302	pullus	24.02.54	21.07.54	0°37'S	8°43'E	Cap Lopez, Gabon	Ashton 1956
Algoa Bay	536—00482	pullus	25.03.54	21.07.54	0°37'S	8°43'E	Cap Lopez, Gabon	Ashton 1956
Malgas Is.	536—05874	pullus	24.02.54	11.07.54	0°43'S	8°47'E	Port Gentil, Gabon	Ashton 1956
Malgas Is.	536—07463	pullus	25.02.54	11.07.54	0°43'S	8°47'E	Port Gentil, Gabon	Ashton 1956
Malgas Is.	536—07910	pullus	25.02.54	09.07.54	0°43'S	8°47'E	Port Gentil, Gabon	Ashton 1956
Malgas Is.	536—09707	pullus	25.02.54	28.07.54	0°43'S	8°47'E	Port Gentil, Gabon	Ashton 1956
Malgas Is.	546—03764	pullus	22.02.55	11.07.55	0°43'S	8°47'E	Port Gentil, Gabon	Ashton 1957
Malgas Is.	546—04163	pullus	12.03.55	17.07.55	0°43'S	8°47'E	Port Gentil, Gabon	Ashton 1957
Malgas Is.	12830	adult	04.11.58	12.08.62	0°43'S	8°47'E	Port Gentil, Gabon	
Malgas Is.	536—07510	pullus	25.02.54	15.06.54	1°55'S	9°19'E	Iguela, Gabon	Ashton 1956
Malgas Is.	10473	pullus	08.02.57	29.06.57	2°30'S	9°40'E	Sette Cama, Gabon	
Malgas Is.	526—00915	pullus	04.04.53	20.09.54	2°30'S	9°40'E	Sette Cama, Gabon	Ashton 1956
Malgas Is.	12803	pullus	04.11.58	23.09.65	3°25'S	10°39'E	Mayoumba, Gabon	
Possession Is.	15895	pullus	25.02.58	29.06.59	4°29'S	11°29'E	NW of Pointe Noire, Gabon	
Lambert's Bay	30436	pullus	03.03.59	29.06.59	4°29'S	11°29'E	NW of Pointe Noire, Gabon	
Possession Is.	15767	pullus	25.02.58	15.05.58	4°48'S	11°51'E	Pointe Noire, Gabon	
Malgas Is.	B02744	pullus	19.01.52	25.10.57	4°48'S	11°51'E	Pointe Noire, Gabon	McLachlan 1962
Malgas Is.	536—03119	pullus	25.02.54	03.06.56	4°48'S	11°51'E	Pointe Noire, Gabon	Ashton 1957
Malgas Is.	536—05215	pullus	25.02.54	18.08.54	4°48'S	11°51'E	Pointe Noire, Gabon	Ashton 1956
Malgas Is.	536—07681	pullus	25.02.54	19.07.54	4°48'S	11°51'E	Pointe Noire, Gabon	Ashton 1956
Malgas Is.	536—08036	pullus	12.03.55	13.07.55	4°48'S	11°51'E	Pointe Noire, Gabon	Ashton 1957
Malgas Is.	546—03471	pullus	12.03.55	10.11.55	4°48'S	11°51'E	Pointe Noire, Gabon	Ashton 1957
Algoa Bay	536—02589	pullus	25.03.54	15.07.54	4°48'S	11°51'E	Pointe Noire, Gabon	Ashton 1956
Algoa Bay	536—06181	pullus	25.03.54	15.05.54	4°48'S	11°51'E	Pointe Noire, Gabon	Ashton 1956
Malgas Is.	546—03776	pullus	12.03.55	15.07.55	5°33'S	12°12'E	Cabinda, Angola	Ashton 1957
Malgas Is.	546—03782	pullus	12.03.55	10.08.55	5°33'S	12°12'E	Cabinda, Angola	Ashton 1957
Lambert's Bay	546—14281	pullus	09.04.66	26.07.66	6°10'S	12°00'E	S. of Congo Mouth, Angola	
Algoa Bay	536—01017	pullus	25.03.54	28.05.54	6°48'S	13°14'E	Tamboca, Angola	
Malgas Is.	09772	pullus	12.04.57	19.08.61	7°14'S	12°55'E	Near Ambrizete, Angola	
Possession Is.	17523	pullus	01.03.58	29.07.66	7°14'S	12°52'E	Ambrizete, Angola	
Lambert's Bay	30220	pullus	03.03.59	15.12.64	7°14'S	12°52'E	Ambrizete, Angola	
Malgas Is.	536—03233	pullus	24.02.54	03.09.54	7°14'S	12°52'E	Ambrizete, Angola	Ashton 1956

Appendix 2 *(continued)*

Ringing locality	Ring number	Age at ringing	Ringing date	Recovery date	Recovery locality			Published
Algoa Bay	536—01197	pullus	25.03.54	06.08.54	7°14'S	12°52'E	Ambrizete, Angola	Ashton 1956
Algoa Bay	536—02886	pullus	25.03.54	28.05.54	7°14'S	12°52'E	Ambrizete, Angola	Ashton 1956
Algoa Bay	536—06066	pullus	25.03.54	04.08.54	7°14'S	12°52'E	Ambrizete, Angola	Ashton 1956
Lambert's Bay	657—02959	pullus	15.05.67	29.08.67	8°10'S	13°00'E	NW of Luanda, Angola	
Malgas Is.	536—05653	pullus	24.02.54	04.08.54	8°19'S	12°53'E	Off Luanda, Angola	Ashton 1956
Lambert's Bay	657—02445	immature	12.04.67	18.05.67	8°48'S	13°14'E	Luanda, Angola	
Malgas Is.	C01214	pullus	03.04.53	15.07.53	8°48'S	13°14'E	Luanda, Angola	
Malgas Is.	526—01865	pullus	03.04.53	10.03.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1954b
Malgas Is.	526—04420	pullus	03.04.53	12.08.53	8°48'S	13°14'E	Luanda, Angola	Ashton 1954b
Malgas Is.	526—04773	pullus	03.04.53	05.07.53	8°48'S	13°14'E	Luanda, Angola	Ashton 1954b
Malgas Is.	536—03423	pullus	24.02.54	08.07.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Malgas Is.	536—03562	pullus	24.02.54	08.07.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Malgas Is.	536—05319	pullus	24.02.54	02.08.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Malgas Is.	536—07039	pullus	25.02.54	07.07.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Malgas Is.	536—07906	pullus	25.02.54	23.10.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Malgas Is.	546—03875	pullus	14.03.55	02.08.55	8°48'S	13°14'E	Luanda, Angola	Ashton 1957
Algoa Bay	536—05964	pullus	24.02.54	08.07.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Algoa Bay	536—02864	pullus	22.03.54	02.08.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Algoa Bay	536—02866	immature	22.03.54	02.08.54	8°48'S	13°14'E	Luanda, Angola	
Algoa Bay	536—00187	pullus	25.03.54	15.06.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Algoa Bay	536—00376	pullus	25.03.54	13.06.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Algoa Bay	536—00589	pullus	25.03.54	15.08.54	8°48'S	13°14'E	Luanda, Angola	
Algoa Bay	536—00860	pullus	25.03.54	26.05.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Algoa Bay	536—02285	pullus	25.03.54	02.08.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Algoa Bay	536—06707	pullus	25.03.54	24.09.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Algoa Bay	536—06905	pullus	25.03.54	02.08.54	8°48'S	13°14'E	Luanda, Angola	Ashton 1956
Ichaboe Is.	26609	pullus	15.10.58	06.07.61	9°00'S	11°00'E	South Atlantic	
Lambert's Bay	546—14250	pullus	09.04.66	19.09.66	9°41'S	13°09'E	Near Cabo Ledo, Angola	
Malgas Is.	28202	pullus	09.02.59	28.08.59	10°00'S	14°00'W	South Atlantic	
Lambert's Bay	30014	pullus	03.03.59	05.07.59	10°44'S	13°44'E	Porto Amboim, Angola	
Malgas Is.	536—09114	pullus	26.02.54	19.05.58	10°44'S	13°44'E	Porto Amboim, Angola	McLachlan 1962
Malgas Is.	28259	pullus	09.02.59	05.07.59	10°44'S	13°44'E	Porto Amboim, Angola	
Malgas Is.	546—00776	pullus	19.02.55	15.09.55	11°15'S	13°30'E	N. of Lobito, Angola	Ashton 1957
Ichaboe Is.	B01046	pullus	08.05.51	15.07.51	12°35'S	13°25'E	Benguela, Angola	
Lambert's Bay	657—02434	immature	12.04.67	13.05.67	12°35'S	13°25'E	Benguela, Angola	
Malgas Is.	B01692	pullus	15.01.52	01.07.52	12°35'S	13°25'E	Benguela, Angola	Ashton 1954a
Malgas Is.	B01698	pullus	15.01.52	01.07.52	12°35'S	13°25'E	Benguela, Angola	Ashton 1954a
Malgas Is.	526—02626	pullus	03.04.53	30.07.53	12°35'S	13°25'E	Benguela, Angola	Ashton 1954b
Malgas Is.	536—09207	pullus	25.02.54	04.06.54	12°35'S	13°25'E	Benguela, Angola	Ashton 1956
Algoa Bay	536—01264	pullus	25.03.54	10.05.54	12°35'S	13°25'E	Benguela, Angola	Ashton 1956
Algoa Bay	536—01506	pullus	25.03.54	20.04.55	12°35'S	13°25'E	Benguela, Angola	Ashton 1957
Algoa Bay	536—01510	pullus	25.03.54	20.05.54	12°35'S	13°25'E	Benguela, Angola	Ashton 1956
Algoa Bay	536—02054	pullus	25.03.54	05.05.54	12°35'S	13°25'E	Benguela, Angola	Ashton 1956
Algoa Bay	536—02727	pullus	25.03.54	23.06.54	12°35'S	13°25'E	Benguela, Angola	Ashton 1956
Algoa Bay	536—06941	pullus	25.03.54	07.03.55	12°35'S	13°25'E	Benguela, Angola	Ashton 1957
Ichaboe Is.	25298	pullus	14.10.58	17.08.65	12°37'S	13°13'E	Off Benguela, Angola	
Possession Is.	19243	pullus	13.10.58	14.08.65	12°37'S	13°13'E	Off Benguela, Angola	
East Africa								
Malgas Is.	536—03093	pullus	24.02.54	24.06.54	12°58'S	40°30'E	Porto Amelia, Moçambique	Ashton 1956
Malgas Is.	536—07315	pullus	25.02.54	11.06.54	13°39'S	40°34'E	Lurio Bay, Moçambique	Ashton 1956
Algoa Bay	536—02951	pullus	25.03.54	16.07.54	16°39'S	39°32'E	Ponta Caldeira, Moçambique	Ashton 1956
Malgas Is.	09417	adult	06.02.57	02.08.66	17°21'S	38°00'E	N. of Quelimane, Moçambique	
Algoa Bay	536—02355	immature	22.03.54	19.07.54	17°50'S	37°07'E	Zalala, Moçambique	Ashton 1956
Malgas Is.	03552	adult	11.04.56	15.09.62	19°44'S	35°08'E	Off Beira, Moçambique	
Malgas Is.	B02341	pullus	19.01.52	07.08.54	19°49'S	34°52'E	Beira, Moçambique	Ashton 1956
Algoa Bay	536—02799	pullus	22.03.54	14.11.57	19°49'S	34°52'E	Beira, Moçambique	McLachlan 1962
Malgas Is.	536—09100	pullus	25.02.54	09.06.54	21°40'S	35°28'E	Bazaruto Island Moçambique	Ashton 1956
Malgas Is.	526—02355	pullus	05.04.53	19.07.54	24°45'S	34°44'E	Quissico, Moçambique	
Malgas Is.	536—03885	pullus	24.02.54	15.06.54	25°02'S	33°34'E	Limpopo Mouth, Moçambique	Ashton 1956
Malgas Is.	536—05167	pullus	25.02.54	11.05.54	25°02'S	33°34'E	Limpopo Mouth, Moçambique	Ashton 1954b
Malgas Is.	536—09607	pullus	25.02.54	15.04.54	25°02'S	33°34'E	Limpopo Mouth, Moçambique	Ashton 1954b
Malgas Is.	526—02913	adult	04.04.53	09.54	25°02'S	33°34'E	Limpopo Mouth, Moçambique	Ashton 1956
Algoa Bay	11457	pullus	22.04.58	15.08.62	25°02'S	33°44'E	Limpopo Mouth, Moçambique	