

CHAPTER 1. INTRODUCTION

STUDY AREA

Namibian islands

Between Walvis Bay and the Orange River along the Namibian coast are twelve small islands: Hollamsbird, Mercury, Ichaboe, Seal, Penguin, Halifax, Long, Possession, Albatross, Pomona, Plumpudding and Sinclair. Being located in the productive Benguela upwelling region, and inaccessible to terrestrial predators such as black-backed jackal (*Canis mesomelas*) and brown hyaena (*Hyena brunnea*), a number of these islands support breeding populations of both endangered and endemic seabird species (Boyera, Coleb & Bartholomaea 2000; Cordes 1998b).

After initially being occupied by Britain, the islands were administered by the Cape Provincial Administration of South Africa, and were declared nature reserves in 1987. This status was lost in 1994 when they were returned to Namibia with the reintegration of Walvis Bay (Cordes 1998b). Currently, the Namibian Ministry of Fisheries and Marine Resources (MFMR) manages the islands. Three of the islands (Mercury, Ichaboe and Possession) are staffed with personnel who conduct research with a view to the conservation of the seabirds. Access to the islands is strictly controlled (Cordes 1998b).

Ichaboe Island

“Ichaboe Island is one of the most important and densely packed coastal seabird breeding islands in the world”

- Simmons *et al.* 1998: 326

The perennial wind-driven upwelling in the Benguela current is the most intensive and consistent in the vicinity of Lüderitz (24° – 28°S) and is one of the world's strongest upwelling systems (Berruti, Adams & Jackson 1989; Boyera, Coleb & Bartholomaea 2000; Crawford, Cruickshank, Shelton & Kruger 1985). Cold, nutrient-rich water is brought adjacent to the coast by equatorward wind, enhancing primary productivity (Crawford *et al.* 1985; Waldron, Probyn & Brundrit 1997) and resulting in a “highly productive food chain, culminating in large fish stocks” (Boyera *et al.* 2000: 123). These are exploited by both man and marine predators (Crawford *et al.* 1985; Berruti *et al.* 1989).

Ichaboe Island, at 26°17'22"S, 14°56'36"E, is situated within this intensive upwelling region. This 6.5 ha island lies c. 48 km north of Lüderitz and 1.4 km offshore (Nelson 1978; Simmons, Boix-Hinzen, Barnes, Jarvis & Robertson 1998). The island is rocky and unvegetated, with Mount Stromboli, at 7 m above sea level (a.s.l.), forming the highest point. Though coastal fog is prevalent, the annual rainfall is <10 mm (Simmons *et al.* 1998). Ichaboe is surrounded by a three-meter high sea-wall which prevents seals from gaining access and prevents guano, produced by the numerous seabirds, from being washed off. Ramps have been built to allow penguins access to the island over the wall; these form “landing stages” where the penguins congregate. The human settlement has been constructed on the northern tip of the island with a wall separating it from the birds' breeding area. An observation hut, at 9 m a.s.l., affords a 343° view of the sea around the island (Figure 1.1).

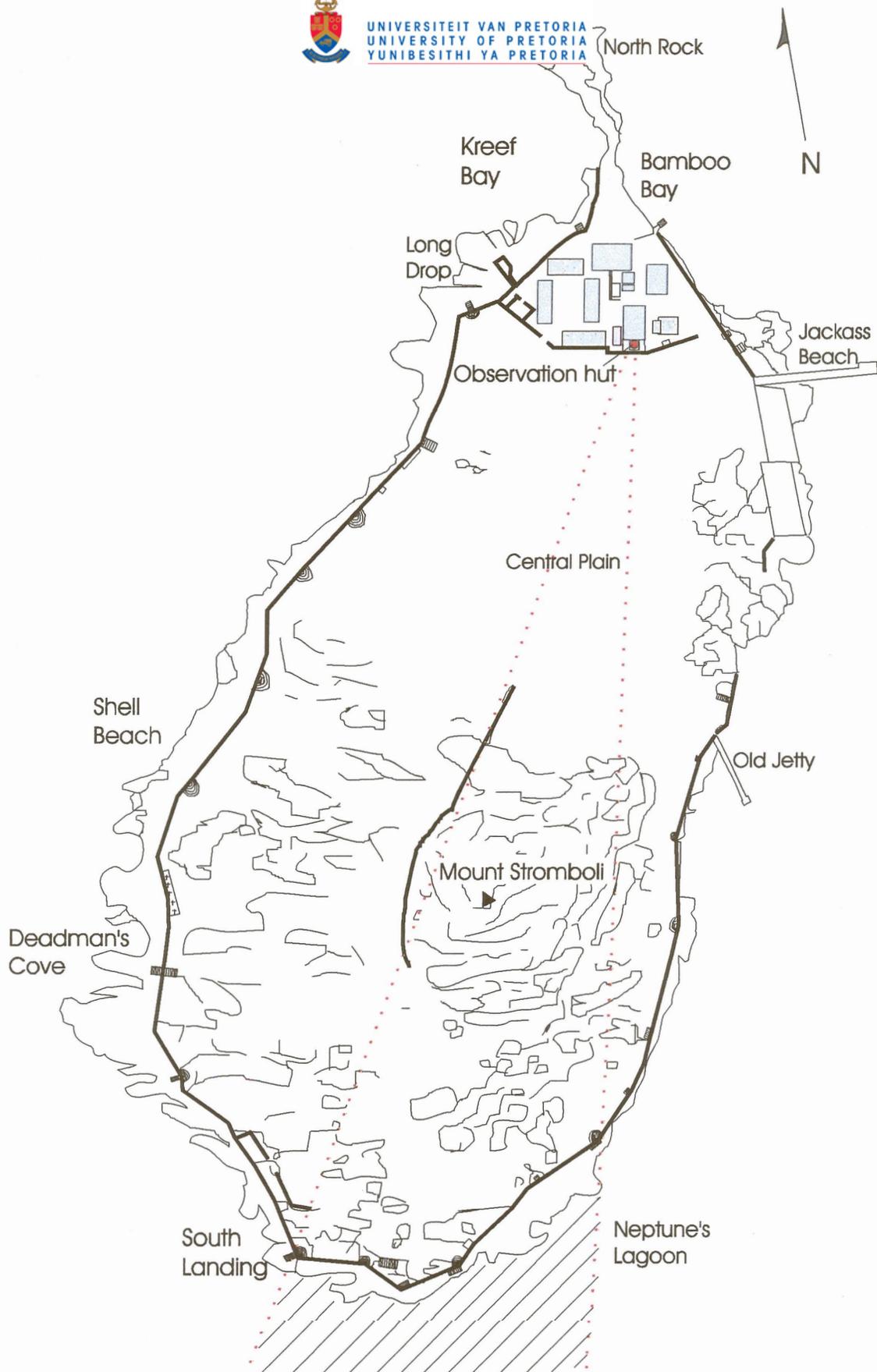


Figure 1.1. Map of Ichaboe Island (6.5 ha), showing position of settlement and observation hut (in red). The shaded area indicates the “summit shadow”, which is the area (17°) of sea not visible from the observation hut.

Seabird breeding populations

Seabirds are long-lived birds with low adult mortality rates. They utilise the open ocean to obtain all or much of their food (Berruti *et al.* 1989). Ichaboe Island supports breeding populations of numerous seabird species (Table 1.1). More detail concerning these seabird species is summarised in Table 1.2.

Table 1.1. Peak active nest counts of seabirds at Ichaboe Island during the 1999-2000 breeding season (MFMR unpublished data).

Species	Date	Breeding pairs
Cape cormorants <i>Phalacrocorax capensis</i>	18 Dec 1999	18 112
Cape gannets <i>Morus capensis</i>	17 Dec 1999	16 453 (aerial census)
African penguins <i>Spheniscus demersus</i>	20 Oct 1999	1731
Bank cormorants <i>P. neglectus</i>	20 Jan 2000	737
Crowned cormorants <i>P. coronatus</i>	20 Nov 1999	260
Kelp gulls <i>Larus [dominicanus] vetula</i>	18 Dec 1999	74
White-breasted cormorants <i>P. lucidus</i>	20 Nov 1999	9

Table 1.2. Demographic and biological details of the seabird species breeding on Ichaboe Island, Namibia.

Species	Endemicity, Conservation status	Global population	Breeding season	Clutch (mean)	Weight (mean): male; female (g)	References
Cape cormorant	Endemic, Near-threatened	72 000 pairs (1996)	Sept - Mar	2.4	1306; 1155	Berruti 1995; Berruti <i>et al.</i> 1989; Cooper <i>et al.</i> 1982; Crawford 2000c; Crawford <i>et al.</i> 1999; Maclean 1985
Cape gannet	Endemic, Vulnerable	100 000 pairs (1997)	Aug - Mar	1	2619; 2670	Berruti <i>et al.</i> 1989; BirdLife International 2000; Crawford 2000d; Crawford 1997; Maclean 1985
African penguin	Endemic, Vulnerable	153 000 adults (2000)	year-round	2	2836	Berruti <i>et al.</i> 1990; BirdLife International 2000; Crawford 2000a; Maclean 1985
Bank cormorant	Endemic, Vulnerable	4888 pairs (1997)	Aug - Dec (Namibia)	2	2107; 2150	Berruti <i>et al.</i> 1991; Cooper 1981; Crawford 2000b; Maclean 1985
Crowned cormorant	Endemic, Near-threatened	2665 pairs (1981)	Oct - Mar (Namibia)	2.8	800	Berruti <i>et al.</i> 1989; Crawford <i>et al.</i> 1999; Barnes 2000; Maclean 1985
Kelp gull	Endemic subspecies	11 000 pairs (1981)	Sept - Mar	2.1	924.3	Berruti <i>et al.</i> 1989; Crawford <i>et al.</i> 1982; Maclean 1985
White-breasted cormorant	Not threatened in SA	2524 pairs (1981)	Sept - Jan (Namibia)	3.1	3100; 2950	Berruti <i>et al.</i> 1989; Maclean 1985

The current study focused on the species described below.

- *Cape cormorants*

In February 1980, there were 45 805 nests of Cape cormorants at Ichaboe (Berruti 1995); the 1999 peak count of 18 112 active nests represents a local decline of 60% over 19 years. However, it is not easy to determine population trends for this species, as the birds readily move between breeding areas, are known to desert their nests frequently, and have an extended breeding period (Berruti *et al.* 1989). In Namibia, the main breeding season is from September to April (Maclean 1985), after which these birds move outside their normal breeding range (Cooper, Brooke, Shelton & Crawford 1982).

The Cape cormorant is the most numerous of the guano-producing seabirds and is endemic to the southern African coast, breeding at 69 localities along the South African and Namibian coastlines (Crawford, Dyer & Upfold 1999). These birds move considerable distances outside the breeding range in winter, but are not generally found farther than 20 km offshore. The global breeding population is estimated to be 554 064 birds, 61.6% of which occur in Namibian waters. This population decreased from 247 000 pairs in 1977-1981 (Cooper *et al.* 1982) to 72 000 pairs in 1996 (Crawford 2000c). In the spring of 1991, more than 14 000 Cape cormorants died as a result of an outbreak of avian cholera *Pasteruella multocida* (Crawford, Allwright & Heyl, 1992).

Cape cormorants are susceptible to disturbance while breeding and frequently desert their nests, leaving the eggs and chicks exposed to predation by kelp gulls; they also desert breeding colonies when food is scarce. These birds compete with commercial fisheries for sub-surface epipelagic fish. Pilchard *Sardinops ocellatus*

contributed 89-90% by mass to the diet of these birds in the 1950s (Crawford, Underhill, Raubenheimer, Dyer & Martin 1992). After the collapse of pilchard stocks in 1974, gobies *Sufflogobius bibarbatus* formed their main prey (Cooper *et al.* 1982; Crawford 2000c), which they catch by pursuit diving (Berruti *et al.* 1989).

- Cape gannets

The breeding colony of Cape gannets at Ichaboe, one of only six world-wide, was once the largest gannetry in the world, numbering 144 000 in 1956 (aerial census count, Rand 1963; Nelson 1978); the 1999 count is 11% of this value. An 88% decline in this colony occurred between 1956 and 1980 (Berruti 1985). Likewise, the area occupied by breeding gannets decreased from 5.52 ha in 1956 to 0.56 ha in 1996 (Crawford 2000c), a decrease of 90% over 40 years. The global population fell by 31% during this time (Crawford 2000d); currently there are between 80 000 and 100 000 breeding pairs (Crawford 1997).

Gannets plunge from the air onto prey in the upper 13 m of the water column (Adams & Klages 1999; Berruti *et al.* 1989). These birds historically thrived on pilchard or sardine (Crawford, Shelton, Cooper & Brooke 1983), which are their preferred prey items (Berruti *et al.* 1989; Adams & Klages 1999). Pilchard contributed 93-99% by mass of the Cape gannet diet in the 1950s. The Namibian gannet population was adversely affected when the pilchard stocks collapsed in the late 1960s due to commercial fishing (Crawford *et al.* 1992; Klages, Willis & Ross 1992), as these birds were not able to effectively exploit the now abundant goby stocks (Crawford *et al.* 1985). Gannets now feed on anchovy and saury *Scomberesox saurus* (Crawford 2000d). They forage farther offshore than cormorants and are known to scavenge hake *Merluccius* spp. and other fish from demersal trawlers

(Crawford 2000d; Crawford, Cruickshank, Shelton & Kruger 1985; Crawford *et al.* 1992).

Cape gannets start breeding in August and September (Jarvis 1970; Maclean 1985); these birds usually breed for the first time at four years of age (Berruti 1985). The majority of fledglings leave the breeding islands during March and April; the adults also leave the islands once breeding has ended (Jarvis 1970).

The Cape gannet is classified as Vulnerable in the most recent BirdLife International / IUCN Red List, because of its small breeding range, a decline of the foraging quality of surrounding waters due to commercial fisheries over-exploiting its prey, and to marine pollution (BirdLife International 2000).

- *African penguins*

During the early 1990s, the breeding population of African penguins at Ichaboe island was estimated at over 9000 (Crawford *et al.* 1995; Randall 1995), but has decreased since then (Crawford, David, Shannon, Kemper, Klages, Roux, Underhill, Ward, Williams & Wolfaardt 2001). The Namibian population numbered 6800 pairs in 1985, 17% of the 1956 count (>40 000 pairs; Berruti *et al.* 1989). The number of adult African penguins has decreased from >1.45 million in 1910 to 153 000 in 1991-1994. A decrease of 13% per generation since 1976 qualifies the species as Vulnerable (Crawford 2000a), while they may be regarded as locally Endangered in Namibia (Crawford *et al.* 1990). Heat, flooding, predation by kelp gulls, disease, parasites and starvation cause mortality to eggs and chicks; oiling, entanglement, disease, predation (by Cape fur seals, killer whales and sharks) and starvation kill older birds (Best *et al.* 1997).

African penguins breed essentially throughout the year, peaking from September to November off central Namibia (Crawford *et al.* 1995; Randall 1995; Sparks and Soper 1987; Williams 1988). Penguins feed on anchovy and sardine, catching their prey by pursuit diving (Berruti *et al.* 1989; BirdLife International 2000); more recently gobies form their main prey (Crawford *et al.* 1985).

The African penguin is classified as Vulnerable in the most recent BirdLife International / IUCN Red List, because of the rapid decline in population numbers, attributable to habitat degradation from guano collecting, historical egg-collecting and at-sea factors such as oiling and scarcity of food (BirdLife International 2000).

- *Bank cormorants*

Ichaboe supported 46% of the world bank cormorant population in the 1970s (Cooper 1981). The breeding population numbered 2625 pairs on Ichaboe in 1995-97, down from 4345 in 1978-80 (Crawford, Dyer, Cordes & Williams 1999). The global population numbered 4888 breeding pairs in 1995-97, down from 8672 recorded in 1978-80. These losses occurred mainly at Ichaboe and Mercury Islands, where 68% of the global population was previously situated (BirdLife International 2000; Crawford *et al.* 1999).

Bank cormorants feed mainly on goby and rock lobster *Jasus lalandii* (Simmons *et al.* 1998). In 1994, natural factors (weather anomalies) resulting in the severe depletion of all fish stocks, including pelagic gobies, in the region of Ichaboe Island resulted in a loss of about 1800 breeding pairs between 93-94 and 94-95 (Crawford *et al.* 1999).

These birds breed from August to December in Namibia (Crawford *et al.* 1999; Underhill, Tree, Oschadleus, & Parker 1999). The birds seldom occur farther than 10

km offshore. In the non-breeding season dispersal by the juveniles is believed to be more extensive than the movement of the relatively sedentary adults (Underhill *et al.* 1999).

- *Kelp gulls*

In January 1993, there were 19 active nests of kelp gulls; this number has increased to 74 nests in December 1999 (MFMR, unpublished data). The kelp gull is the most numerous gull species in the southern hemisphere, where it is widespread, with over one million pairs estimated. The southern African population of the endemic subspecies *Larus [dominicanus] vetula* exceeded 11 000 breeding pairs in 1976-81, the majority of which (9000 pairs) occurred in South Africa (Crawford *et al.* 1982; Crawford, Nel, Williams & Scott 1997). Artificial supplementation of food for these birds, such as at rubbish dumps, have caused population increases. Kelp gulls prey on the eggs and chicks of other seabird species; human disturbance causes seabirds to desert their nests, which results in increased predation of exposed eggs and chicks by kelp gulls.

Cape fur seals

A small colony of Cape fur seals *Arctocephalus pusillus pusillus* (up to 1000) breeds on a rock 200 m to the south-west of the island (Figure 1.2), the annual pup production of which has increased from 41 in 1991 to over 200 in 1998 (MFMR, unpublished data). This colony was considered non-breeding by David (1995), on account of the small number of pups born there annually.



Figure 1.2. Aerial photograph of Ichaboe Island, showing the proximity of the island to the mainland (c. 1.4 km) and the position of the seal colony at Little Ichaboe (red circle), which lies 200 m south-west of the island. The picture is orientated with north to the left.

The Cape fur seal (*Arctocephalus pusillus pusillus*, Otariidae; Harrison & King, 1980; Shaughnessy 1979) is the only indigenous breeding pinniped in southern Africa, and is sexually dimorphic for size (Shaughnessy 1985). It breeds at 24 colonies between Cape Cross in Namibia and Algoa Bay in South Africa, with 65% of the population occurring in Namibia (David 1987; Miller, Oosthuizen & Wickens 1996). Population numbers of Cape fur seals have increased since their over-exploitation in the early 1900s (Shaughnessy 1985) and numbered about 1.5-2 million

animals at the close of the 20th century (Butterworth, Punt, Oosthuizen & Wickens 1995). Juvenile and subadult seals form aggregations of their own age groups and congregate at non-breeding colonies (such as at Cape Frio), dispersing to breeding colonies upon reaching sexual maturity (David 1995; de Villiers, Oosthuizen, Roux & Kotze 1997). The adult males may have separate feeding grounds from that of the females (David 1995).

The diet of fur seals ranges “from marine invertebrates to penguins” (Bonner 1981:190); Cape fur seals fed mainly on medium-sized pelagic schooling fish such as Cape mackerel (*Scombus japonicus*), horse mackerel (*Trachurus trachurus*), and pilchard in the 1970s (Bonner 1981). More recently bearded goby, and the juveniles of horse mackerel and hake have become their main prey in Namibian waters (Shaughnessy 1985; Roux 1998).

SEABIRD POPULATION DECLINES: HISTORICAL FACTORS

Guano collection

In his memoirs published in 1832, an American sealing captain, Captain Benjamin Morrel Jr, noted that Ichaboe was covered in the manure of birds (guano) to a depth of 25 ft. The response to this by an astute businessman from Liverpool, Andrew Livingston, resulted in the “guano rush” between 1843 and 1845. During this time Ichaboe Island was scraped bare, and c. 300 000 t of this valuable nitrogenous fertilizer were shipped to Britain (Cordes 1998b; Williams 1988; Randall 1995).

“There’s an island (Ichaboe) that lies on West Africa’s shore,
Where penguins have lived since the flood or before,
And raised up a hill there, a mile high or more,
This hill is all guano, and lately ’tis shown,
That finer potatoes and turnips are grown
By means of this compost, than ever were known;
And the peach and the nectarine, the apple, the pear,
Attain such a size, that the gardeners stare,
And cry, “Well, I never saw fruit like that ’ere!”
One cabbage thus reared, as a paper maintains,
Weighed twenty-one stone, thirteen pounds and six grains,
So no wonder Guano celebrity gains.”

- Ex-member of the Committee (1845); (Best *et al.* 1997)

Concessions were granted for guano harvesting at Ichaboe in 1847; these were terminated in the 1890s. The South African government managed the guano collection from then until 1975, when private concessions were again leased out (Best, Crawford & van der Elst 1997). From the early 1980s to 1991, guano was only taken from Ichaboe, which yielded *c.* 1200 t annually (Cordes 1998b). The harvesting of guano at islands ceased in the 1990s when these concessions were not renewed (Best *et al.* 1997). In 1994 the islands (listed previously) offshore of Namibia were returned to Namibia (Cordes 1998b), and guano was harvested from Ichaboe Island in the winter of 2000 by private enterprise under a concession granted by the MFMR.

Injudicious harvesting of guano results in habitat degradation and disturbance to breeding seabirds; this exacerbates the decline in their populations (Simmons *et al.* 1998). During the height of the guano rush (October 1844), up to 4500 labourers were ashore at Ichaboe. The constant human presence and intense disturbance disrupted breeding and possibly displaced the birds to Mercury, Halifax & Possession islands (Crawford *et al.* 1983, 1995). The commercial collection of guano reduced the breeding success of Cape gannets. Rain water accumulates and floods nests in areas that have become basin-shaped after removal of guano. The quantity of nesting material is limited, and onset of breeding can thus be delayed by more than a month (Crawford & Cochrane 1990; Jarvis 1970).

Exploitation of birds

From the early part of the 20th century (and probably before) until 1968, up to 700 000 penguin eggs were removed annually from islands where these birds breed (Cordes 1998a). Man has also contributed to seabird population decline by killing them in large numbers for food or sport, and for use as bait in rock-lobster traps; this may still occur off west Africa in the non-breeding range, but is difficult to assess, as is deliberate killing of birds by fishermen (Crawford *et al.* 1983; Jarvis 1970).

Marine pollution and overfishing

While most of the threats to seabirds at their breeding colonies are no longer of importance, or are being managed, at-sea factors contributing to population decline are more difficult to assess (Monaghan 1996). The main threat is reduced prey availability, especially of sardine and Cape anchovy, which are commercially fished by Namibia and South Africa (Best *et al.* 1997; BirdLife International 2000; Boyera *et*

al. 2000; Cooper *et al.* 1982; Crawford *et al.* 1992, 1995; Cordes 1998a). Other threats include entanglement in marine debris and fishing gear – Cape gannets are sometimes caught in demersal trawls – and incidental mortality from swallowing or being caught by hooks from longline fishing activities (Jarvis 1970). The birds, specifically penguins, are affected by oil spills (chronic spills from fuel oil and bilge tanks, crude oil from tankers and fish oil from factories and fishing fleets), which remains a great hazard (Berruti *et al.* 1989; Best *et al.* 1997; Crawford 2000a; Crawford *et al.* 1995; Monaghan 1996).

SEAL-SEABIRD PREDATION

Apart from competing with seabirds for food (Bonner 1981; King 1983; Miller, Oosthuizen & Wickens 1996; Shaughnessy 1979) and breeding space (King 1983; David 1987; Williams 1988; Best *et al.* 1997), individual seals of several species have developed a taste for seabirds, especially penguins (Bonner 1981; Rebelo 1984; Williams 1988; Hofmeyr & Bester 1993; Best *et al.* 1997; Cobley & Bell 1998).

The increase in Cape fur seal numbers since their overexploitation in the 1800s has resulted not only in an increase in their (real or perceived) competition with local fisheries (Shaughnessy 1985; David 1987; Harwood 1992; Crawford *et al.* 1992; Wickens, Japp, Shelton, Kriel, Goosen, Rose, Augustyn, Bross, Penney & Krohn 1992), but also the decline in some seabird numbers, especially penguins (see earlier). Predation of seabirds by Cape fur seals at southern African offshore islands has been observed since the early 1900s (Shaughnessy 1978). If several seals specialise in seabird predation, the local seabird colony, such as the one on Ichaboe Island, may suffer the loss of hundreds of individuals per year (Williams 1988). On account of the

continued decline in seabird population numbers, the relative importance of this mortality factor could increase.

RATIONALE FOR STUDY

Though there are a number of studies on seal-seabird predation, these are predominantly short-term and opportunistic. Intensive studies on the predation of both adult and juvenile African penguins, Cape gannets, Cape cormorants and bank cormorants by Cape fur seals are lacking, if only for the reason that this has not been observed at one locality before. The existence of a detailed database consisting of eight years' incidental observations of seal-seabird predation at Ichaboe Island, essentially by the same observer (P.A. Bartlett, MFMR), presented the opportunity to investigate the behavioural aspects of this predation, as it relates to each prey species. The application of systematic methods of observation would enable the evaluation of the incidental data as well as the quantification of factors influencing seal-seabird predation.

Key questions

This study aims to address a number of key questions that formed the focus of the research, each of which is addressed in a separate chapter:

- × Does predatory behaviour vary between individual seals and bird species preyed upon?
- × What is the difference between incidental and systematic observations regarding predation events?
- × Which parameters affect predatory activity?

- × Is there a difference in the relative impact of seal predation on different seabird species?

Each question has a corresponding null hypothesis.

Null hypotheses

- × Predatory behaviour does not differ amongst individual seals or bird species preyed upon.
- × There is no difference between incidental observations, focal event sampling and continuous observations as methods for observing seal-seabird predation.
- × Environmental, spatial and temporal parameters do not influence seabird predation by seals.
- × The impact of seal predation does not differ between seabird species.

Ichaboe is an important breeding site for seabirds, with the guano produced contributing to its economic importance; the decrease in population numbers of these birds therefore deserve urgent attention. This study serves as an exploratory investigation into seal-seabird predation as noted at Ichaboe Island over a ten-year period. A systematic form of sampling technique (focal event sampling) is applied for the first time in behavioural observations at sea.

In the process of testing the hypotheses relevant to the key questions for this study, additional questions are generated. The quest for answers will further enhance our knowledge of the behaviour in question.