

Annexes

Annex 1: Threats

1. Lack of food and low quality prey

Lack of preferred prey species, and consequent reliance by some species/populations on lower-quality prey, is one of the main factors behind low breeding success of the African Penguin, Cape Gannet and Cape and Bank Cormorants (Lewis et al. 2006; Roy et al., 2007; Coetzee et al., 2008; Gremillet et al., 2008; Crawford et al., 2006, 2011). Excluding the Bank Cormorant whose main prey species is pelagic goby in Namibia and West Coast rock lobster in South Africa (Crawford et al., 1985, 2008), the remaining bird species forage mainly for sardine and anchovy. In the Benguela system, relatively discrete stocks of both sardine and anchovy are found to the north and south of an area of intense upwelling near Lüderitz, Namibia (Crawford, 1998).

During the breeding season, which places high energy demands on adults, breeders are restricted to a smaller foraging range and require access to their preferred prey, and lack thereof is a main reason behind poor breeding success recorded in recent decades (Pichegru et al., 2007; Crawford et al., 2008). The lack of prey species is related to two main factors: overfishing and large-scale periodic environmental changes in the ecosystem, such as El Niño.

In the 1950s and 1960s sardine stocks were abundant, and between Namibia and South Africa some 13.5 million tons were harvested by the purse-seine fishery. Large-scale commercial fishing started in Namibia in 1947, when 1 000 tons of sardine were caught (Hampton 2003). As this industry grew, with some 1.4 million tons being landed in 1968, the sardine stocks, however, declined dramatically. Some of these declines and fluctuations were partly attributable to known inter-annual variability and decadal-scale environmental conditions which affect the upwelling system of the Benguela Current (Jarre et al., 2013). The sardine biomass in Namibia dwindled to a few thousand tons in 1995/96 following the 1995 El Niño event. Prior to this (mid-1960s) the fishing industry had switched to harvesting anchovy, but this fishery also soon collapsed when stocks became severely depleted; after 1996, catches were negligible and the resource has remained low (Crawford, 1998; Boyer & Hampton 2001; Kemper, 2006). The sardine stocks recovered slightly off Namibia during the 1990s but remained low, contracting to the north of Namibia (Crawford, 1998).

In South Africa the sardine fishery collapsed in the mid-1960s, before the collapse in Namibia, with the lowest South African sardine catch recorded in 1974 of just 16,000 tons (Crawford, 1998). In the 1960s, South Africa like Namibia began the harvesting of anchovy; 300 tons were landed in 1963. However, as with sardines, the stock was rapidly overexploited and the catch in 1984 was <17,000 tons (Crawford, 1998). Both stocks have since recovered in South Africa and in the 1990s both sardine and anchovy were caught in substantial quantities on the west coast of South Africa and usually provided sufficient resources for seabirds (Adams et al., 1991). However, beginning in the late 1990s there was a progressive, large-scale, eastward displacement of sardine, and to some degree of anchovy. By 2005 the 'centre of gravity' of sardine catches had been displaced some 400 km to the south-east and it was located between African Penguin breeding localities in the Western Cape and Eastern Cape (Crawford et al., 2008). This shift in prey distribution had enormous implications for the breeding success of the African Penguins, which are constrained to forage within

40 km of their colonies (Crawford, 2007; Crawford et al., 2008).

This shift was also been proposed as the explanation behind the decreases in Cape Gannet numbers at the five west coast colonies (Okes et al., 2009). Indeed, the one thriving population is on the east coast, closer to where the bulk of pelagic fish are now caught by the fishery (Fairweather et al., 2006; Pichegru et al., 2007).

The Cape Cormorant has also been affected in a similar manner by overfishing and eastward shift of the sardine stocks which brought on declines in the colonies off the Namibian coastline, although with a delayed effect (Boyer & Hampton 2001; Crawford et al., 2007). The Cape Cormorant populations may have benefitted from erection of guano platforms off northern/central Namibia which facilitated access to the shrinking range of sardine in Namibia, the decrease in Cape Gannet populations that reduced competition for breeding space and by feeding on the pelagic goby which partially replaced the sardine off central Namibia (Mercury and Ichaboe island colonies). However, in Namibia numbers of Cape Cormorants fell substantially after the 1970s (Crawford, 2007). Off South Africa's Western Cape, the numbers of Cape Cormorant remained fairly stable between the 1950s and the 1970s because, in spite of the decreasing abundance of sardine, that of anchovy increased (Crawford et al., 1987; Crawford et al. 2007). The sardine stocks recovered in the 1990s and the Cape Cormorant population remained stable, exploiting both sardine and anchovy, but as the stocks of both prey species shifted eastward the Cape Cormorant populations decreased (Crawford et al., 2007, 2015).

The Bank Cormorant's principal prey in South Africa is the West Coast rock lobster and in both South Africa and Namibia there is a strong correlation between the numbers of breeding pairs and local estimates of available West Coast rock lobster (e.g. Crawford et al. 2008). However the exact relationships between prey quality or availability and Bank Cormorant population trends are not well understood in all cases (Kemper et al., 2007; Crawford et al. 2008; Ludynia et al. 2010). During the breeding season Bank Cormorants forage up to 9 km from their colony during daylight and to depths of about 30 m, thus scarcity of prey in that range will affect their breeding success (Cooper 1985; Wilson and Wilson 1988). The West Coast rock lobster is a commercial species and the fishery operates at shallow depths overlapping with Bank Cormorant foraging ranges and depths (Crawford et al., 2008). The abundance of lobsters was severely affected by mass "walkouts" in the 1990s which coincided with a decrease in the harvested numbers of lobsters and a decrease of Bank Cormorant populations (Crawford et al., 2008). Commercial exploitation rates recovered subsequently, but this was sustained from stocks in deeper waters (likely beyond Bank Cormorant dive range) and also from a reduced minimum size limit, which over the following years would have reduced the availability of rock lobsters to Bank Cormorants (Crawford et al., 2008). In the southern part of their range, a slowing in Cape rock lobster growth rates lead to a smaller stock size that is thought to have negatively impacted the species on the west coast (Cruywagen et al. 1997). East of Cape Point, Bank Cormorant numbers have increased in recent years, reflecting an observed eastward shift in the rock lobster population, thought to be linked to environmental change (Cockcroft et al., 2008; Crawford et al., 2015).

As a result of the lack of availability of preferred prey species within the seabirds' foraging ranges, seabirds have the choice of starving, of hunting lower-quality prey, not participating in breeding or moving their breeding location. In Namibia, the pelagic goby became the main prey species in the diet of African Penguins following the collapse of the sardine stock in the 1970s. It remained the main prey of penguins at Mercury Island and presumably in the entire northern Benguela upwelling system for over 30 years (Crawford et al. 1985, Kemper et al. 2007; Ludynia et al., 2010). The energetic content of the pelagic goby is about 40% lower than that of sardine or anchovy, and it is therefore unlikely that it would be the preferred prey of the African Penguin, but rather the more available and abundant prey (Ludynia et al., 2010). Low-energy food, however abundant or easy to obtain, has been postulated to negatively affect chick growth and breeding success: it is known as the "Junk-food hypothesis" (Gremillet et al., 2008). The Cape Gannet is another example of a species that facing a scarcity of its preferred prey, has increased its foraging effort five-fold and also turned to scavenging behind trawlers, taking prey of lower energy content, such as hakes *Merluccius* spp. which has half the calorific value of sardine (Pichegru et al., 2007; Gremillet et al., 2008). As a result, fledgling body condition and cognitive abilities at colonies on the west coast of South Africa have decreased, resulting in higher mortality rates (Batchelor & Ross 1984; Pichegru et al., 2007; Okes et al., 2009).

Similarly in Namibia the collapse of the sardine and anchovy fisheries, and no alternative prey, led to a collapse of the Namibian gannet population, which registered a 40% decrease of the global population (Crawford et al., 2007). The eastward shift of the sardine stocks did contribute to a large increase in the number of gannets breeding at South Africa's easternmost colony, at Bird Island, Algoa Bay, currently the only colony showing an increase in numbers (Crawford et al., 2012a). Food scarcity caused high mortality of chicks from starvation in 1956 at Ichaboe Island and in 1970, following the collapse of the Namibian sardine stock, at Mercury, Ichaboe and Possession Islands. At Malgas Island, alternative food of inferior quality has led to reduced breeding output and population declines, in 1986/88; at least 75% of deaths of chicks were attributed to starvation (Pichegru et al. 2007; Crawford et al., 2007).

In conclusion the combined effects of overfishing and the eastward shift in sardine and anchovy stocks has contributed to the lack of food availability and large population decreases for three of the seabird species discussed. Furthermore, although some seabird species have switched to other more abundant and readily available prey, the suggestion that alternate prey is keeping the ecosystem productive and sustains predators (Pennisi 2010), must be balanced against the fact that replacing preferred prey species with lower quality prey will and has resulted in a drastic decline in the energy content in seabirds' diets (Ludynia et al. 2010) and in turn resulted in slower chick growth and lowered recruitment rates to the breeding population. Only a recovery of preferred prey stocks will allow a substantial increase of current population numbers of species such as the African Penguin and Cape Gannet.

2. Oil spills and oiling

All species under review are at risk from oiling and South Africa is a global hotspot for oil pollution (Wolfaardt et al., 2009). Oil pollution causes feathers to clump, leading to a breakdown in their insulative properties. As a result birds become hypothermic and are forced to leave the sea. Birds then dehydrate, mobilize stored energy reserves and may lose up to 13% of their body mass within a

week and unless rescued will starve to death (Underhill et al., 1999; Wolfaardt et al., 2009). There are also toxic effects associated with the ingestion of oil (Birrel, 1995).

The regional oiled seabird cleaning centre, the Southern African Foundation for the Conservation of Coastal Birds (SANCCOB), handled over 50 000 oiled birds from its inception in 1968 until 2005. Most were African Penguins and Cape Gannets (Wolfaardt et al., 2009). Although no major oil spill has yet occurred along Namibia's coast, persistent chronic oiling, from ships discharging waste oil and sunken boats leaking oil, remains a problem. Should a catastrophic oil spill occur between Mercury and Ichaboe islands it would immediately threaten 70% of the Namibian penguin population (Kemper, African Penguin in press). As a flightless bird, the African Penguin is particularly vulnerable to marine pollution such as oil spills, which can cause significant mortality of both oiled birds and abandoned chicks and eggs (Adams, 1994; Crawford, et al., 2000). Cape Gannets are also susceptible to oiling by fish oil from factories and fishing vessels processing fish aboard and, to a lesser extent, from fuel oil discharged by ships (du Toit & Bartlett 2001, Crawford et al., 2000).

In South Africa there have been several oiling incidents due to oil spills from tankers, such as with the sinking of the *Esso Essen* off Cape Point, South Africa in 1968 when at least 500 gannets got oiled and died as result. In 1979, fish oil resulted in the deaths of at least 709 gannets at Lambert's Bay; however improvements in the fish-offloading technique have reduced this risk. Two other major oiling events were the wreck of the bulk ore carriers *Apollo Sea* in 1994 and the *Treasure* in 2000, which oiled 10 000 and 20 000 African Penguins respectively (Wolfaardt et al. 2001).

There are also long-term effects of oiling on penguins and gannets. De-oiled gannets survive slightly less well than un-oiled birds and approximately 27% of rehabilitated African penguins are unable to breed following their release (Wolfaardt et al., 2009). Cape Cormorants also respond poorly to rehabilitation efforts (Crawford *et al.* 2000, J Kemper pers. obs.). As shoreline feeders the Crowned and Bank cormorants are highly vulnerable to oil pollution (du Toit *et al.* 2003), although incidents of oiled cormorants in Namibia have been rare to date (Kemper, in press). In South Africa the potential for catastrophic, large-scale oil spills is likely to increase, given further developments planned along the coast (e.g. the planned expansion of the Coega harbour in Port Elizabeth). Chronic oiling from leaking wrecks, washing of ship's tanks at sea and other sources of oil are a threat to adult and immature seabirds (Wolfaardt et al., 2009). The beach-nesting Damara Tern is at relatively low risk from oil spills – any risk is most likely to come from disturbance from people cleaning oil from the coastline.

3. Predation

This is another major threat to most of the seabird species discussed. Predators include the Cape fur Seal, Kelp Gull, Great White Pelican and Black-backed jackal.

The Cape fur seal is a conspicuous seabird predator which has been recorded hunting and feeding on Cape Gannet (du Toit et al., 2004; David et al., 2003; Makhado et al. 2006), Cape Cormorant (Marks et al., 1997), Crowned and Bank Cormorants (du Toit et al., 2004) and the African Penguin (Shaughnessy 1978; Crawford et al., 2001; du Toit et al., 2004). Machado et al. (2006) calculated that 29% of Cape Gannets fledging at Malgas Island, South Africa, were killed by Cape fur seals during the 2000/01 breeding season; this increased to 83% during the 2003/04 breeding season. Up to 7.1% of the fledging Cape Cormorants at Dyer Island may fall victim to seals annually (Marks et al., 1997). In 2005, bull seals came ashore at Bird Island, Lambert's Bay, and killed 200 adult Cape Gannets and

caused abandonment of the entire colony there, some 11 000 pairs (Wolfaardt and Williams 2006). In Namibia individual seals prey on gannets at sea, particularly on fledglings (du Toit 2001, du Toit *et al.* 2004, MFMR unpubl. data). At Ichaboe Island, Namibia, seal predation accounted for an estimated 0.9% of the African Penguin population (du Toit *et al.*, 2004). While there is no question that seal–seabird interactions can have a negative impact on locally breeding seabirds, this predation seems to form an extension of play behaviour, predominantly in sub-adult males and does not seem to be a common behaviour in seals (du Toit *et al.*, 2004). Selective culling of individual predatory seals is being carried out at Lambert’s Bay, Malgas, Dyer (South Africa) and Ichaboe (Namibia) islands (K. Ludynia pers. comm).

The Kelp Gull and the Great White Pelican are two other important predators, although of less significance than the seal. Kelp Gulls are known predators of the eggs and small chicks of the African Penguin (van Heezik & Seddon, 1990; du Toit *et al.*, 2003), Bank Cormorant (du Toit *et al.*, 2003), Cape Cormorant (Voorbergen *et al.*, 2012) and Crowned Cormorant (du Toit *et al.*, 2003). In Namibia and at some South African colonies the African Penguin formerly bred in burrows excavated into guano; however, due overexploitation of guano deposits at virtually all islands off southern Africa, unless there is sandy habitat available (e.g. at Dassen Island) penguins now breed on the surface where they are exposed to predation by Kelp Gulls (Hockey & Hallinan 1981, van Heezik & Seddon 1990). At Dyer Island, Kelp Gull predation occurred on an estimated 3.8% of the total number of Cape Cormorant eggs and 2.0% of the chicks on the island, or the equivalent of 5% of fledglings, compared to the 24% predation by seals (Voorbergen *et al.*, 2012). Human disturbance has been shown to facilitate Kelp Gull predation on eggs and chicks and increase the mobbing of cormorant fledglings (Voorbergen *et al.*, 2012). The threat of Kelp Gull predation is exacerbated by population increases at some mainland breeding sites (e.g. Western Cape, South Africa) in recent years and may be related to increased availability of food at rubbish tips and reduced persecution (Steele & Hockey, 1990).

The Great White Pelican targets chicks of the three cormorant species reviewed here, as well as chicks of the Cape Gannet (de Ponte Machado, 2007). Over the past two decades, pelicans have been observed to prey extensively on nest-bound chicks of other seabird species, although so far this behaviour is exclusive to coastal seabird populations in southwestern Africa (de Ponte Machado, 2007). The Western Cape pelican population increased from 185 pairs in 1985 to 370 pairs in 2006, driven by increased protection at the breeding sites, and subsequent availability of agricultural offal (Crawford *et al.* 1995). Predatory interactions were recorded on four offshore islands off the west coast of South Africa: Dassen, Malgas, Jutten and Schaapen between 2004 and 2007 (de Ponte Machado, 2007). In 2006 predation by pelicans caused almost complete breeding failure of Bank, Cape and Crowned Cormorants at Dassen Island (Mwema, 2010). Pelicans have since been managed by a chasing programme at Malgas Island resulting in fewer records of pelican predation events, although the disturbance caused by rangers chasing pelicans has led to an increase in gull predation (B Dyer pers comm. to RMW). On Malgas Island Crowned Cormorants have been observed building their nests on elevated structures and constructing nest ‘towers’ on tops of rocks within the Cape Gannet colony, a strategy believed to be directed at avoiding predation by pelicans (Crawford *et al.*, 2012b).

Other less important or under reported predators are Orcas (Williams *et al.* 1990), the Great White Shark (Randall *et al.*, 1988), Sacred Ibis and Grey Heron (Williams & Ward, 2006), and feral cats

(Crawford et al., 2012a). Orcas occasionally specialize on cormorants around breeding islands (Williams *et al.* 1990). At St. Croix Island, South Africa, sharks were responsible for the highest number of identifiable natural causes of death from recovered African Penguin carcasses, although the level of impact on the penguin population has yet to be assessed (Randall et al., 1988). On Dyer Island, South Africa, a similar study on shark-penguin interactions was conducted, but sharks were not found to be responsible for a single attack. This was attributed to the presence of a very large seal colony, with high predation rates by sharks on seals (Johnson et al., 2006). Sacred Ibis and Grey Heron have been recorded preying on chicks and eggs of Cape and Crowned Cormorants on Malgas and Lambert's Bay (Penguin) islands, South Africa (Williams & Ward, 2006; T. Cook pers. obs.) and on Swift Tern chicks (Sacred Ibis) at Robben Island (PAW pers. obs.). On Bird Island, Lambert's Bay their combined impact on breeding was estimated to be greater than the impact of gull predation and may merit attention (Williams and Ward, 2006). At Robben Island, feral cats remain a threat to breeding Crowned Cormorants and Swift Terns, although cat numbers are currently much reduced (Crawford et al., 2012b). Crowned Cormorant chicks at Shark Island, Lüderitz are also targeted by feral cats (J Kemper pers. obs.). The Damara Tern is vulnerable to predation from black-backed jackals (Braby et al., 2009).

4. Human disturbance and harvesting

All species under review are vulnerable to human disturbance; the Bank, Cape and Crowned cormorants, and Damara Tern are particularly sensitive however. The African Oystercatcher is also heavily disturbed during the peak of its breeding season, which coincides with the main holiday period when large numbers of people flock to coastal areas. These species are easily startled, the Cape Cormorant may even cause a mass panic (Jarvis & Cram 1971), and will abandon their nests leading to loss of eggs or chicks to predators (Berry, 1974; Cooper, 1987; de Villiers & Cooper, 2002; du Toit et al., 2003). Development projects such as harbour extensions or housing developments caused the Bank Cormorant to abandon breeding at four localities and a reduction in numbers at six other sites in South Africa. A colony of Crowned Cormorants at Shark Island, Lüderitz, became extinct by 2005 following the disturbance caused by the extension of the harbour and a new housing development nearby (J Kemper pers. obs.).

The Damara Tern is impacted by land reclamation, dredging and hotel construction on breeding areas, in addition to increased urban development associated with the main coastal settlements, which is already putting pressure on the coastal Walvis-Swakopmund Important Bird Area (IBA) and Walvis Bay IBA, also a Ramsar site. Further, breeding Damara Terns are particularly vulnerable to recreational activities in colonies (such as off-road vehicles, quad-bikes, horse-riding and hiking) during the peak breeding season (Braby et al. 2001). Disturbance by recreational and artisanal fishers and SCUBA divers may disturb Cape and Bank Cormorants breeding or roosting and roosting Swift Terns on small inshore rocks and islets. Illegal collection of rock lobsters by both commercial and recreational fishers may also be an issue, with poachers causing disturbance by landing on breeding islands at night. Cape Gannets and Bank Cormorants are sensitive to disturbance, including guano scraping, and may abandon their nests and disrupt chick feeding (de Villiers & Cooper 2002, du Toit et al., 2003; MFMR unpubl. data).

5. Lack of breeding habitat

Lack of suitable or optimal breeding habitat affects the African Penguin and the three cormorant species. Lack of breeding habitat can be due to human interference, such as construction, displacement by other seabird species, increasing seal numbers or lack of suitable nest building material, e.g. guano. Penguins prefer to nest in excavated burrows in guano or sand, but in the absence of these they will nest under bushes or boulders, in buildings or on bare ground. In South Africa the collection of guano is prohibited. In Namibia guano was last harvested commercially at Ichaboe Island in 2010; however a new license was issued in 2012, despite recommendations that no more guano should be harvested within the Namibian Islands' Marine Protected Area (Kemper, African Penguin in press). As a result, the lack of guano has reduced the availability of quality burrowing habitat for the penguin (Kemper, 2006). Guano harvesting also affects the Cape Gannet by decreasing its breeding success and causing delayed onset of breeding (Crawford & Cochrane 1990). Disturbance created by guano harvesting may disturb breeding adults and can disrupt chick feeding (du Toit *et al.* 2003).

By nesting on the surface, eggs and chicks are exposed to temperature extremes impacting breeding success and they become easy targets for Kelp Gulls (du Toit *et al.*, 2003; Pichegru, 2012). At some penguin colonies artificial structures have been introduced to assist breeding, such as at Halifax Island (Kemper 2007a), at Boulders in Cape Town and at Dyer Island (Underhill 2006) also at Bird Island, Algoa Bay (Pichegru 2012). A few artificial pipes were introduced on Seal Island in False Bay in 1991 which have been beneficial to the small penguin colony situated among a dense seal colony (Crawford *et al.* 1995).

Displacement by Cape fur seals also plays an important role in limiting available breeding habitat for the African Penguin, Cape Gannet and the three cormorant species (Crawford *et al.*, 1989, du Toit *et al.*, 2003). Breeding at Hollamsbird Island ceased after gannets were displaced by Cape fur seals (Shaughnessy 1984). Gannets at Mercury Island were threatened with displacement by Cape fur seals from the early 1980s, until seals were cleared from the island during the early 1990s (Crawford *et al.* 1989).

Management of seals at Mercury Island enabled the Bank Cormorant population to increase after they had been displaced by seals during the 1980s (Crawford *et al.* 1989). Four sets of artificial platforms near Swakopmund and Walvis Bay were built to provide additional breeding habitat and promote breeding of Cape Cormorants, as well as subsequent guano collection (Berry 1976).

Crowned Cormorants are also limited by the availability of nesting habitat. Lack of suitable breeding locations is evidenced by Crowned Cormorant behaviour; at both Lambert's Bay and Malgas Island, pairs nested on roofs of buildings and when a new lighthouse was erected in 2004 at Marcus Island, immediately 26 pairs built nests on it (Crawford *et al.*, 2012b). Nesting attempts on some artificial structures (e.g. stacked lobster traps), and the inclusion of human debris in nests, have caused entanglement and subsequent death of adults and chicks (Kemper, Crowned Cormorant in press). Crowned and Bank cormorants are sometimes displaced by White-breasted Cormorants *Phalacrocorax carbo* (du Toit *et al.* 2003; MFMR unpubl. data).

6. Fisheries impact

Aside from indirect impacts of fishing on seabirds – as described above where fisheries compete with seabirds and/or have caused massive depletion in prey stocks, bycatch and entanglement in

fishing gear can cause significant conservation problems for seabirds. Fisheries impacts on seabirds can be both positive and negative – for example the Cape Gannet has likely been negatively impacted by competition with the purse seine fishery, but is sustained by discards from the hake trawl fishery. Lack of food has been considered in detail above. However, other than impacting the food resource, seabirds are vulnerable to some fisheries-associated impacts such as bycatch on longline and trawl fisheries (Petersen *et al.* 2007, Watkins *et al.* 2008), ingestion of hooks or drowning after getting hooked (Petersen *et al.* 2007; 2008), and entanglement in gillnets, lobster traps and in discarded fishing tackle (Cooper, 1985).

The Cape Gannet is the only species under review which is vulnerable to direct mortality from longline and trawl fishing operations. Low numbers of Cape Gannets are killed as incidental bycatch of longline and trawl fisheries (Albatross Task Force, unpublished data); however the scale of the impact is poorly known at present. Entanglement in plastic debris, discarded fishing tackle, gillnets, or potential drowning in rock lobster traps while foraging, affects the African Penguin, and all three cormorant species (Cooper 1985; Roux & Kemper, Bank Cormorant in press). Crowned Cormorants do not overlap with commercial fisheries activities, but are presumed to be at risk from drowning in fixed gillnets, although there is no gillnet effort in Namibia and it is limited in extent in South Africa (S Lamberth and K Hutchings, pers. comm. to RMW). The scale of negative, direct impacts of fisheries is unknown but unlikely to be significant for any species other than the Cape Gannet.

At Ilha dos Tigres in Angola, disturbance by artisanal fishers (and their dogs) including collection of Cape Gannets for human consumption is suspected (Dyer, 2007; Simmons *et al.*, 2006). Furthermore, non-breeding gannets, including recently fledged birds, are at risk in Angolan waters, and possibly farther north, by fishermen deliberately targeting them by setting baited hooks on float lines (Roux *et al.* 2007). The extent and impacts are difficult to assess and merit further investigation (Crawford *et al.* 1983, Roux *et al.* 2007). In Angola, there are anecdotal reports of local people trapping and killing seabirds, including (mostly migrating) Damara Terns, including within the Iona National Park (T. de Wit pers. comm. in J. Braby, 2011). The scale of the problem is, however, unknown.

7. Disease

Cape Cormorants are sensitive to disease with thousands dying in the early 1950s along the Cape coast and KwaZulu-Natal as a result of coccidiosis associated with lice (La Cock, 1985), and again in 1977 thousands to tens of thousands of emaciated Cape Cormorants, mainly adults, died off KwaZulu-Natal and the Eastern Cape (Crawford *et al.*, 1980). In the 1950s many died from pneumonia at Walker Bay. In 1979, conjunctivitis killed c. 5000 chicks at Ichaboe Island. Resistance of young birds to bacterial infection may be reduced by hunger stress. In 1991, more than 14 000 Cape Cormorants died from avian cholera *Pasteurella multocida*, possibly precipitated by poor feeding over the preceding two years (Crawford *et al.* 1992; Williams and Ward 2002; Ward and Williams 2004; Waller and Underhill 2007). In the early 2000s avian cholera again caused substantial mortality on Dyer Island as well as at Dassen Island and Lambert's Bay (Waller and Underhill, 2007). In Namibia, no definite diagnosis has been made for avian cholera; however dead or dying birds at Sandwich Harbour in the years 2000 to 2004 (R Braby unpubl. data) may have died of cholera given that Kelp Gulls were also found dead and were assumed to be the natural vector (Williams & Parson 2004). Cape Cormorants and African Penguins appear to be susceptible to incidents of paralytic

shellfish poisoning following toxic plankton blooms, through the ingestion of contaminated prey (J Kemper unpubl. data).

8. Environmental change

The Benguela Current Large Marine Ecosystem (BCLME) displays a high degree of variability over a broad spectrum of time and space scales, such as variability over short seasonal time scales, inter-annual and inter-decadal (Shannon & Toole, 2003). However, sustained environmental events such as Benguela Niños, Agulhas intrusions and changes in winds, will impact the system as a whole in unpredictable ways, which could affect primary productivity and availability of prey species to all seabirds (Timmerman et al. 1999; Shannon & Toole, 2003). The level of this threat is, however, hard to gauge. Coastal and island breeding seabird species are all vulnerable to these changes. For instance sand-swamping of eggs is the major cause of mortality for Damara Terns breeding in the Struis Bay colony (A.J. Williams unpubl. data). During rough seas and during rain storms the Cape Gannet, Crowned Cormorant and African Penguin are vulnerable to flooding of nests, particularly of ground nests and those constructed among washed-up seaweed (Crawford *et al.* 1986; Kemper, 2006; MFMR unpubl. data). Burrows are also prone to flooding. Significant sea-level rise will cause major loss of nesting habitats as the sea inundates areas currently used by seabirds. In Namibia, the African Penguin is also vulnerable to hot easterly winds during winter which may cause heat stress, due to lack of adequate burrowing habitat. This may force adult birds to desert their nests, leaving eggs and chicks exposed to heat and predators (Kemper, 2006). The Cape Cormorant is particularly sensitive to fluctuating environmental conditions and resulting periodic food scarcity can cause mass abandonment of nests or mass mortality of chicks or post-fledglings (Crawford et al., 1980; Duffy *et al.* 1984; Crawford et al., 1992; du Toit et al. 2003). Climate change scenarios predicting increases in the frequency or intensity of extreme environmental conditions (Roux 2003) may exacerbate all these threats. Potential sea level rise will affect seabirds that nest on low-lying islands, and is one of the more easily identifiable threats associated with climate change.

9. Mining and oil and gas exploitation

Mining development near breeding areas may threaten the population of Damara Terns known to breed along the c. 1 000 km Diamond Coast between Swakopmund and Oranjemund. Furthermore, the central Namib Desert in Namibia is experiencing a “uranium rush” which could mean a significant increase in mining development in the region, increasing the pressure for residential and infrastructural development along the coast. The massive expansion of prospecting licenses for offshore resources, particularly hydrocarbons, is cause for significant concern. In South Africa, virtually the entire coast has been divided into exploration blocks and is currently subject to active seismic surveying. The infrastructure development that will follow the discovery of exploitable resources could pose significant risks if in proximity to seabird breeding locations. However of more concern is the risk from accidental spills from drilling operations and spills from transporting oil from wells/platforms.

Another deeply concerning threat is the proposal to mine phosphates from the seabed. This involves ‘crawler’ excavators that remove up to 2 m of substrate across vast areas of continental shelf. The short-term impacts of disturbance and sedimentation/clouding of the water column are likely to be extreme. However it is the long-term impacts of removing phosphates from the marine system, and the potential loss of this organic fertilizer, that could cause irrevocable and highly significant impacts on the entire marine ecosystem. The Namibian government has placed a moratorium on marine

phosphate mining.

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Annex 2: Conservation, research and recommendations

African Penguin *Spheniscus demersus*

Conservation measures:

- A Biodiversity Management Plan for the African Penguin was gazetted in 2013 by Cape Nature and the Department of Environmental Affairs (DEA). It outlines the major threats and specifies what actions need to be taken to mitigate these (Department of Environmental Affairs 2013).
- Oiled penguins are successfully rehabilitated by various rehabilitation centres (Southern African Foundation for the Conservation of Coastal Birds (SANCCOB), and SA Marine Rehabilitation and Education Centre (SAMREC)) and released successfully. There is little difference in the survival rates of oiled birds that have been rehabilitated and those of unoiled birds (Underhill, et al., 1999, Whittington 1999), although long-term breeding success may be diminished (Wolfaardt et al., 2008).
- Fibreglass nest boxes have been provided at some colonies affected by the lack of guano, and were thought to improve breeding success (Kemper et al., 2007b). However, these boxes can overheat and reduce hatching success by at least one third compared to natural burrows. Alternative materials such as wooden frames or concrete pipes can increase breeding success compared to open nests (Pichegru et al. 2012).
- Feral cats have been eliminated from Dassen Island and nearly so from Robben Island (B Dyer pers comm to RMW) but can breed rapidly.
- Kelp Gull numbers are controlled and kept at a minimum by SANParks at Bird Island, and this is successful in increasing penguin breeding success there.
- At Dyer Island measures have been put in place by CapeNature to deal with Kelp Gull numbers and where Cape fur seals are implicated in penguin predation they are controlled. This is not however the case on other islands where seals are a problem, such as Dassen and Robben islands.
- SANCCOB does background disease monitoring.

Research:

- Birdlife South Africa is carrying out several projects under the banner of: “African Penguin *Spheniscus demersus* conservation: priority interventions for a BirdLife Species Champion” including working towards driving changes in the management and policies relating to the African Penguin and the small pelagic fishery, establishing a new colony and tracking adult penguins outside of the breeding season.
- Island closure project (2008 – 2014). This is a project looking into the effects of experimental exclusions of purse-seine fishing around penguin colonies. Fishing within a 20 km radius of St. Croix and Bird islands was stopped for three consecutive years while the area around neighbouring colonies (<50 km away) remained open. Foraging behaviour and breeding output were compared in relation to fish catches and small pelagic fish distribution. Although, results varied between colonies, at St Croix Island, where the largest penguin colony is located, chick growth and breeding success were negatively affected by fish catches in the vicinity, but were positively affected by closures with foraging efforts decreasing by 30%. As a result a permanent purse-seine fishing exclusion zone has been recommended. This work is carried out by the Department of Agriculture, Forestry and Fisheries (DAFF), Department of Environmental Affairs (DEA), PFIAO, BLSA, ADU and others.
- Tracking juvenile African Penguins (Richard Sherley, Animal Demography Unit)

- Models are being developed of the influence of various driving forces on penguin colonies by MARE with the aim to understand the main drivers at colonies and advise on means to mitigate decreases (e.g. Weller et al. 2014).
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Recommendations:

- Enforcement of Namibian regulations pertaining to the Marine Resources Act (Act 27 of 2000) and to the Namibian Islands' Marine Protected Area is crucial to ensure sound conservation management of the species.
- In Namibia detailed management plans are required for each island to ensure that conservation management strategies are implemented.
- Island-specific oil contingency plans need to be drawn up for all breeding colonies. The Namibian National Oil Spill Contingency Plan requires revision. Effective, realistic measures must be put in place in the event of an oil spill.
- In Namibia the legislation on oil pollution should be reviewed for vessels illegally discharging oil at sea and must be strictly enforced.
- Guano harvesting on all seabird breeding islands should cease (Currie et al. 2009).
- Research and monitoring programmes on all breeding colonies
- Monitoring of seal populations at and near the islands should also be continued and individual predators that target seabirds should be removed.
- There are currently no detailed published data available on the diet composition of African penguins off South Africa since the eastward shift of prey there. In particular, more information is needed to assess whether the continuous decline in numbers of African penguins in South Africa is related to a switch in diet composition or possibly to reduced quality of sardine and anchovy around the breeding sites (e.g. Ludynia et al., 2010).
- In order to mitigate the present mismatch in the distributions of breeding localities and food off South Africa, further attention needs to be given to a) establishing zones around breeding colonies in which fishing of prey is excluded; and b) establishing one or more colonies closer to the present distribution of food (this includes the potential use of captive-reared penguins in colony formation).
- Other endeavours to increase production and decrease mortality should be implemented, as specified in South Africa's Biodiversity Management Plan.
- Consideration should be given to identifying and protecting important non-breeding feeding areas of penguins throughout the Benguela system.
- Ecosystem approaches to management of fisheries need to be implemented, e.g. ascertaining and implementing thresholds that ensure sufficient prey for dependent predators (e.g. Cury et al. 2011).
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Bank Cormorant *Phalacrocorax neglectus*

Conservation measures:

- Current conservation actions include full protection of breeding colonies of Bank Cormorants at localities, mainly islands in South Africa and Namibia.
- Monitoring of population size is conducted at several South African breeding colonies annually.
- The capacity to hand-rear Bank Cormorants from eggs is being developed by SANCCOB, in case the wild population needs to be bolstered in future.

Research:

- Research is under way at PFAO and the ADU, under the supervision of Richard Sherley, Timothee Cook, Les Underhill and Peter Ryan:
 1. Involving the testing of the food-shortage and heat-stress hypotheses for the decline of Bank Cormorant numbers (completed by 2015).
 2. Research into the drivers behind decreases in the abundance of West Coast rock lobster in South Africa, an important component of Bank Cormorant diet, which is suspected to drive part of the population dynamics in South Africa. This hypothesis will be tested using a modelling approach (with bird counts on the one hand and biomass estimates of rock lobster on the other - provided by Ocean and Coasts, DEA and DAFF).
 3. Future research should focus on using a modelling approach that will test a suite of environmental variables (air temperature, sea-surface temperature, rainfall, wind, etc.), as well as biological variables, like seal abundance (a potential competitor) or abundance of other benthic organisms (plant or animal). Gaining further information on basic demographic parameters, particularly adult and juvenile survival, and how these respond to environmental variability should also be given priority.
- Bank Cormorants are also the focus of ongoing research into regime shifts in the inshore environment being conducted by the Marine Research Institute at UCT (Blamey, Howard, Agenbag and Jarre, 2012).

Recommendations:

- In the eventuality that rock lobster is shown to be a potential primary driver of population dynamics, full protection of rock lobsters should be considered around every island or mainland colony where Bank Cormorants breed.
- Efforts should be made to census the entire South African and Namibian population annually so that trends can be assessed more accurately.
- Increased public awareness of the conservation problems facing this species is needed, particularly in terms of the species' sensitivity to human disturbance and reliance on rock lobster.
- Efforts to reduce illegal cleaning of oil tanks at sea and to ensure complete salvage of oil from ships wrecked around breeding colonies would benefit this species.
- The species can breed successfully on man-made structures (Sherley et al., 2012). Additional, protected breeding habitat should be provided in the region of relatively good rock lobster abundance between Robben Island and Cape Hangklip as well as at localities such as Vondeling Island, where Bank Cormorants compete with seals for space.
- The enforcement of regulations relating to the Marine Resources Act (Act 27 of 2000) and the Namibian Islands' Marine Protected Area are crucial. Management plans need to be developed for each Bank Cormorant breeding locality to ensure that conservation management strategies are implemented.
- A Namibian island-specific oil contingency plan is needed. The National Oil Spill Contingency Plan needs to be revised and effective, realistic measures must be put in place to be prepared in the event of a catastrophic spill. Oil pollution legislation should be reviewed for vessels illegally discharging oil at sea and existing legislation should be strictly enforced.
- Guano harvesting on Namibian islands where Bank Cormorants breed should be prohibited (Currie et al. 2009).
- Key demographic parameters, such as adult survival, juvenile recruitment, post-fledging movements and aspects of Bank Cormorant foraging ecology, particularly at Ichaboe Island, need to be investigated.

- Monitoring of seal populations at and near breeding localities should be continued and individual seals specialising on seabirds should be removed.
- Means to catch oiled Bank Cormorants before they are certain to die need to be developed.

Cape Cormorant *Phalacrocorax capensis*

Conservation measures:

- Current conservation actions involve full protection of breeding colonies of Cape Cormorants at islands that fall under the jurisdiction of South African National Parks, CapeNature, and Robben Island Nature Reserve as well as the Namibian Islands Marine Protected Area.

Research:

- Present research focuses on understanding how Cape Cormorants explore their environment in search of food. Specifically, GPS and Temperature-Depth Recorders are deployed on birds to describe their foraging behaviour. This will enable characterisation of their geographical foraging niche and help establish, through time-budget data, their energetic needs. Research results can be used in an ecosystem approach to fisheries to integrate the needs of Cape Cormorants in the management of small pelagic fish stocks in the Benguela.
- Opportunistic information on diet is obtained from regurgitations and pellets and banding of chicks is undertaken to estimate movements and survival.
- Information is needed on foraging distributions of Cape Cormorants in southern Africa both during breeding and outside the breeding period.
- It is planned to investigate how colony size of Cape Cormorants is influenced by the overall population size and whether the contribution of smaller colonies to the overall population size is changing.
- Other research proposals include specifically addressing the food shortage hypothesis. Although fishing is suspected to be partly responsible for the decline of Cape Cormorant numbers, this remains difficult to demonstrate.

Recommendations:

- An assessment of the overall population of Cape Cormorants that updates the previous assessment (2006/07, Crawford et al. 2007) should be conducted as soon as possible.
- Future research should concentrate on exploring how different indexes of fish abundance, including catch biomass, at different geographical and temporal scales influence population dynamics at different colonies.
- An important conservation action is to secure food in the vicinity of important colonies, especially at Dyer Island, and that spread of disease continues to be restricted.
- In Namibia, the species requires concerted monitoring action across its breeding range, including annual aerial surveys of the guano platforms and main breeding islands during the peak breeding season, which may differ between localities.
- The commitment to implement an Ecosystem Approach to Fisheries (EAF) by the Namibian Ministry of Fisheries and Marine Resources requires incorporation of the foraging needs of Cape Cormorants into fishery management plans. These should include quota limitations, as well as seasonal and spatial catch restrictions.
- In Namibia, management plans need to be developed for all breeding localities, particularly to ensure minimal disturbance at these and to manage potential disease outbreaks

- A proposal by the Ministry of Fisheries and Marine Resources to grant tourism concessions at Namibia's Penguin Island and/or Seal Island (Currie *et al.* 2009) need to enforce access restrictions during the Cape Cormorant breeding season.

Cape Gannet *Morus capensis*

Conservation measures:

- SANCCOB successfully rehabilitates oiled birds.
- Monitoring of the breeding population size is conducted at all three South African colonies and of breeding success, survival and diet at two colonies annually by the Department of Environmental Affairs.
- BirdLife South Africa through the Albatross Task Force Programme is addressing the bycatch issue in South Africa's trawl fishery through the use of bird scaring lines.
- Progress is also being achieved in the longline fisheries, through the use of bird scaring lines and other mitigating measures, such as avoiding offal dumping during longline setting, night setting and line weighting.
- The Albatross Task force in Namibia is addressing the issue in their longline and trawl fisheries using similar strategies.

Research:

- Research into the foraging patterns of Cape Gannets is being undertaken by the Percy FitzPatrick Institute of African Ornithology at the University of Cape Town in collaboration with the Department of Environmental Affairs and Agriculture, Forestry and Fisheries. This research will help to identify marine Important Bird Areas in the region.
- DEA O&C monitor diet of birds at Malgas Island and Bird Island, Algoa Bay.
- Students at the Nelson Mandela Metropolitan University are working on various aspects of gannet foraging, ecology and breeding at Bird Island (Algoa Bay) over the last few years.

Recommendations:

- The Namibian regulations pertaining to the Marine Resources Act (Act 27 of 2000) and the Namibian Islands' Marine Protected Area need to be strictly enforced.
- The prevention of oil pollution by increasing controls over the cleaning of ship's tanks and the maintenance of seabird rehabilitation centres are essential. In Namibia, management and oil contingency plans need to be drafted for each island.
- Fisheries management needs to implement additional measures to promote the growth of sardine stocks, such as reduced quotas, no-take areas or closed seasons, and to take the forage needs of threatened top predators such as the Cape Gannet, into account.
- The Namibia National Plan of Action for Seabirds, which stipulates mitigation measures to reduce seabird bycatch needs to be ratified by the Namibian government, implemented and enforced.
- The impacts of the longline and trawl fisheries on the Namibian gannet population need to be further quantified.
- Monitoring programmes should continue on the breeding islands, with aerial surveys conducted during the peak breeding season at least every second year.
- Research on the distribution and foraging ecology of non-breeding Cape Gannets should be prioritized to improve conservation management strategies.
- In Namibia, guano scraping should cease at all breeding islands, until populations have recovered to at least their mid-1950 levels.

African Oystercatcher *Haematopus moquini*

Conservation measures:

- South Africa has banned the use of vehicles on beaches.
- Monitoring of numbers present is conducted at several South African islands annually.

Research proposed:

- There are small scale projects in various places measuring breeding success, e.g. in the East London area, probably one or two in the Overberg region.

Recommendations:

- Continue to monitor numbers and breeding success in selected areas/main range.

Crowned Cormorant *Phalacrocorax coronatus*

Conservation measures:

- Colonies at Mercury, Ichaboe, Lüderitz Bay and Possession Islands are partially protected, while Sperrgebiet is fully protected being a national Park (Barnes 1998). The colonies at Bird Island, Lamberts Bay, (but some breeding takes place on roofs of the adjacent town), Dassen, Dyer and Vondeling islands are Provincial Nature Reserves. Robben Island is a World heritage site. Malgas, Marcus, Jutten, Schaapen, Meeuw and Caspian islands are all part of the National Park system and are listed as Ramsar sites.
- Monitoring of population size is conducted at several South African breeding colonies annually.
- Management practices at breeding islands currently minimise disturbance:
- Selective culling of Cape fur seals observed killing seabirds has occurred since 1993 at Malgas Island. This has an immediate but short-term effect on seabird mortality rates (David et al. 2003).
- Selective culling of seals is also carried out on Mercury Island, Namibia (David et al., 2003) and at Lambert's Bay and Dyer Island, South Africa.

Research:

- The Percy FitzPatrick Institute and the Animal Demography Unit (Department of Zoology, University of Cape Town), under the supervision of Timothee Cook and Peter Ryan are studying the foraging strategies of Crowned Cormorants. Specifically, Temperature-Depth Recorders and accelerometers are deployed on birds and will enable the characterisation of their foraging niche. Future research should also try to deploy GPSs on this species.

Recommendations:

- Because Crowned Cormorants are highly dependent on the inshore benthic zone for foraging, full protection of the inshore marine environment within a radius of 5 km around breeding colonies should ensure adequate food.
- Crowned Cormorants have very specific nesting habitats and management should ensure that sufficient appropriate nesting sites are available, especially in areas where breeding habitat is

scarce. This has been done successfully at Ichaboe Island, where stacks of old lobster traps (with netting removed) were erected (P Bartlett pers. comm.).

- Limit and manage human access to colonies to avoid unnecessary disturbance, through the development of island-specific management plans.
- Plans by the Ministry of Fisheries and Marine Resources to award tourism concessions at the Namibia's Penguin and/or Seal Island (Currie et al. 2009) need to take the needs of Crowned Cormorants into account and should implement and enforce access restrictions during the breeding season.
- The Namibian National Oil Spill Contingency Plan needs to be revised and updated and legislation on marine pollution (including fishing tackle) needs to be more strictly enforced.

Damara Tern *Sterna balaenarum*

Conservation measures:

- Most breeding localities in Namibia fall within national parks although some near Swakopmund are not legally protected (although fenced off to reduce human disturbance, especially from off-road vehicles) and are at risk to coastal development. The main breeding area in the Eastern Cape, South Africa, falls within the Greater Addo Elephant National Park.
- The banning of off-road vehicles on South African beaches in 2001 reduced disturbance along breeding beaches and increased breeding success (Williams et al., 2004). Similar results were obtained in Namibia, by restricting vehicle access over the course of two breeding seasons (Braby et al., 2009).
- Monitoring of population size is conducted at the De Mond breeding colony in South Africa annually.

Research proposed:

- Reasons for abandonment of breeding sites by Damara Terns in South Africa should be researched. Examples include the colony at Dreyer's Pan near Kleinsee and the well-monitored colony at Struis Bay.
- Studies on diet composition and linkages with relevant fish populations in South African waters need to be undertaken.
- Tern population fluctuations in relation to oceanic upwelling and El Niño Southern Oscillation events need to be assessed.
- Information is needed on demographic parameters of Damara Terns, such as survival and age at breeding.

Recommendations:

- The numbers of Damara Terns breeding at different colonies need to be accurately assessed, and an updated assessment of the South African population, including at the Alexandria dune fields, is needed.
- Colonies within tourist areas need to be protected.
- The species shows very low dispersal abilities, a trait that is consistent with seabirds adapted to stable environments; thus protection of their current breeding sites is crucial for their survival (Braby et al., 2012). Given that off-road disturbance and mining are probably the biggest sources of mortality and colony abandonment, vigilance in keeping colonies undisturbed, and protecting them formally, are priorities for the few colonies remaining in South Africa, and elsewhere.

Caspian Tern *Sterna caspia caspia*

Conservation measures:

- Monitoring of population size is conducted at several South African breeding colonies annually.

Research proposed:

- Information is needed on demographic parameters of Caspian Terns in southern Africa, such as survival and age at breeding.

Recommendations:

- A dedicated survey to assess the South African population (perhaps over 3 years) should be initiated.

Swift Tern *Sterna bergii bergii*

Conservation measures:

- Island breeding colonies are protected with nature reserve status. Some occur within working salt pans and while not protected and disturbed by workmen, are off limits to public disturbance.
- Removal of cats from Robben Island should improve breeding success.
- Monitoring of population size is conducted at all South African breeding colonies annually.

Research proposed:

- Students at PFIAO are currently studying movements of fledged young using colour rings.
- Information is needed on demographic parameters of Swift Terns in southern Africa, such as survival and age at breeding.
- Information is needed on foraging distributions of Swift Terns in southern Africa both during breeding and outside the breeding period.

Recommendations:

- Limit pelican predation on this species (if a problem) on west coast islands.

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