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# Oiled and injured African penguins *Spheniscus demersus* and other seabirds admitted for rehabilitation in the Western Cape, South Africa, 2001 and 2002

**NJ Parsons[1]* and LG Underhill[2]**

[1] *Southern African Foundation for the Conservation of Coastal Birds, PO Box 11116, Bloubergrant 7443, South Africa*
[2] *Avian Demography Unit, University of Cape Town, Rondebosch 7701, South Africa*
* *Corresponding author, e-mail: nola@sanccob.co.za*

**Following the *Treasure* oil spill incident in 2000 in which 19 000 African penguins *Spheniscus demersus* were oiled, there were no large spills in either 2001 or 2002. In spite of this, the Southern African Foundation for the Conservation of Coastal Birds (SANCCOB) admitted 1 772 African penguins in these two years; 56% of these were oiled in ongoing chronic oiling incidents. Most admissions were in the winter (June–September). The overall release rate was 73%. In addition, 661 Hartlaub's gulls *Larus hartlaubii* (release rate 65%), 384 Cape cormorants *Phalacrocorax capensis* (40%), 245 Cape gannets *Morus capensis* (64%), 122 kelp gulls *L. dominicanus* (48%) and 140 other birds of 30 identified species were admitted. The total number of birds admitted was 3 202, or 4.4 birds per day. Even in years without large spills, SANCCOB makes a substantial contribution to the conservation of seabirds.**

*Keywords*: African penguin, Cape gannet, disease, oiling, rehabilitation, Southern African Foundation for the Conservation of Coastal Birds (SANCCOB), Western Cape

## Introduction

The Southern African Foundation for the Conservation of Coastal Birds (SANCCOB), established in 1968, is the main facility at which oiled and injured seabirds are treated in the Western Cape (Nel *et al*. 2003). When there is a large oil spill and several thousand oiled penguins and other seabirds are admitted, this organisation springs to prominence in the media. The two most recent major incidents were in June 1994, when the *Apollo Sea* oil spill resulted in 10 000 African penguins *Spheniscus demersus* being oiled (Underhill *et al*. 1999), and in June 2000, when the *Treasure* oil spill resulted in 19 000 penguins being oiled (Crawford *et al*. 2000).

Nel *et al*. (2003) provided an overview of the effectiveness of the organisation and its contribution to the conservation of penguins. Earlier analyses of the success of penguin rehabilitation at SANCCOB were undertaken by Morant *et al.* (1981), Adams (1994), Underhill *et al*. (1999, 2000) and Whittington (2002).

This paper describes the patterns of bird admissions to SANCCOB in two normal years without a large oil spill incident impacting seabirds. It demonstrates the ongoing 'background' level of oiling and injury to seabirds, and the need for this organisation even in these non-crisis years.

## Treatment Methods

### *Admission and record keeping*

Penguins admitted to SANCCOB during 2001 and 2002 were individually marked with hospital identity bands around each flipper; waterproof tape on the legs was used for other seabirds. A card was completed for each bird, on which was recorded details of species, admission information, daily fluids given and fish fed, results of weekly blood tests, weekly weights, weekly grading of the plumage, veterinary evaluations and treatments and the outcome details (release or death information). The cause of death was established if possible. More effort was placed into establishing cause of death in 2002 than in 2001 when more post mortems were attempted.

Birds arrived at the centre in various ways. Single birds were collected by members of the public or by SANCCOB volunteers. Birds in breeding colonies were collected by staff maintaining the colonies (such as Robben Island Museum, South African National Parks and Western Cape Nature Conservation Board) as well as organisations working in the colonies (such as the Marine and Coastal Management [MCM] branch of the Department of Environmental Affairs and Tourism, and the Avian Demography Unit, University of Cape Town). Birds were transported to SANCCOB by the organisations involved, by a network of volunteer drivers and with the SANCCOB vehicle. As far as possible, the location at which each bird had been found was recorded.

**Table 1:** African penguin admissions to SANCCOB, 2001–2002

| Reasons for admission | Admitted 2001 | Admitted 2002 | Total | Released | Percentage released |
|---|---|---|---|---|---|
| Oiled | 383 | 608 | 991 | 855 | 86 |
| Weak | 145 | 104 | 249 | 144 | 58 |
| Head, eye and body injuries | 40 | 30 | 70 | 40 | 57 |
| Leg and foot injuries | 49 | 47 | 96 | 43 | 45 |
| Flipper injuries | 16 | 6 | 22 | 14 | 64 |
| Flipper band injuries | 0 | 3 | 3 | 2 | 67 |
| Fishing line/hook injuries | 2 | 0 | 2 | 1 | 50 |
| Arrested Moult | 47 | 44 | 91 | 49 | 54 |
| Clinically normal | 39 | 11 | 50 | 49 | 98 |
| Eggs artificially hatched | 4 | 15 | 19 | 0 | 0 |
| Chicks | 82 | 96 | 178 | 107 | 60 |
| Egg stuck in cloaca | 0 | 1 | 1 | 1 | 100 |
| Total | 807 | 965 | 1 772 | 1 305 | 74 |

**Table 2:** Cape gannet, Cape cormorant, kelp gull and Hartlaub's gull admissions to SANCCOB, 2001–2002

| Reasons for admission | Cape gannet | | | Cape cormorant | | | Kelp gull | | | Hartlaub's gull | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Admitted | Released | % Released | Admitted | Released | % Released | Admitted | Released | % Released | Admitted | Released | % Released |
| Oiled | 162 | 141 | 87 | 4 | 2 | 50 | 4 | 4 | 100 | 12 | 9 | 75 |
| Weak | 40 | 11 | 28 | 102 | 19 | 19 | 25 | 16 | 64 | 43 | 24 | 56 |
| Injured | 34 | 6 | 18 | 44 | 2 | 5 | 42 | 12 | 29 | 117 | 18 | 15 |
| Botulism | 0 | 0 | – | 0 | – | 0 | 45 | 23 | 51 | 35 | 13 | 37 |
| Infections | 7 | 0 | 0 | 72 | 12 | 17 | 1 | 0 | 0 | 0 | 0 | – |
| Chicks | 1 | 0 | 0 | 147 | 118 | 80 | 3 | 3 | 100 | 420 | 355 | 85 |
| Eggs | 0 | 0 | – | 12 | 0 | 0 | 0 | – | 0 | 22 | 5 | 23 |
| Other | 1 | 0 | 0 | 3 | 0 | 0 | 2 | 0 | 0 | 12 | 5 | 42 |
| Total | 245 | 158 | 64 | 384 | 153 | 40 | 122 | 58 | 48 | 661 | 429 | 65 |

The number of birds admitted alive to SANCCOB in 2001 and 2002 totalled 3 324, of which 1 772 were African penguins (53%) and 1 552 were other species of seabirds and waterbirds (Tables 1, 2, 3). The sections of this paper deal first with African penguins, and then with the remaining species.

### *Treatment of penguins*

On admittance to the centre, all penguins received fluids (orally and subcutaneously if necessary), deworming treatment, vitamin and iron injections and were sprayed with Newcastle Disease vaccine (La Sota strain). A blood sample was taken and evaluated. Oiled birds received an oral solution of activated charcoal, to which any oil present in the digestive tract will bind. Birds were placed in suitable pens, or the intensive care unit (ICU), depending on their habitus (their general condition and appearance). Oiled penguins were washed once their hydration and habitus had improved. In the washing process, they were first sprayed with a light oil (BD1, produced by Frylab) which helped to lift the pollutant (except in the case of diesel) and were then placed in a basin of warm water (temperature approximately 40°C) containing Light Duty Concentrate; Golden Neo-Life Diamite, and Savlon (Savlon Antiseptic Solution, Pharmedica, active ingredient Chlorhexidene gluconate 0.3g $100ml^{-1}$). The oil was rubbed and washed off the birds, which were placed in several basins of clean water until no more oil was visible.

They were then rinsed with water under pressure from a spray attachment until all soap and oil had been removed from the feathers, placed into an enclosed pen with an infra-red lamp until they were dry (generally overnight), and then moved to a pen where they were given fluids and fish, and where they started to swim. Fluids were administered to each bird until its hydration was normal. Sardine *Sardinops sagax* were fed twice daily. Vitamins were given (in the fish) daily. Penguins were assessed daily by veterinary staff. Once a week, a blood sample was evaluated, and birds were weighed. Once hydration was normal and any treatments completed, they were forced to swim in freshwater for 20 minutes three times daily. Their plumage was graded weekly. Once the feathers were waterproof after 20 minutes of swimming, they were forced to swim for one hour three times daily. Conditions for release were masses of 2.8kg for adult penguins and 2.6kg for juveniles, the feathers needed to be waterproof after swimming for one hour and the blood parameters to be normal. Penguins were released from a boat close offshore of the penguin colony at Robben Island. During major oil spills these procedures need to be

**Table 3:** Species of seabird and waterbird for which fewer than 25 individuals were admitted to SANCCOB during 2001–2002

| Common name | Species | Weak | Injured | Oiled | Total Admitted | Released |
|---|---|---|---|---|---|---|
| Rockhopper penguin | *Eudyptes chrysocome* | 3 | 1 | | 4 | 1 |
| Shy albatross | *Thalassarche cauta* | 1 | | | 1 | 0 |
| Black-browed albatross | *T. melanophris* | 1 | | | 1 | 1 |
| Southern giant petrel | *Macronectes giganteus* | 4 | 1 | | 5 | 3 |
| Northern giant petrel | *M. halli* | 4 | 3 | | 7 | 3 |
| Giant petrel species | *Macronectes* spp. | 3 | 2 | | 5 | 0 |
| Antarctic fulmar | *Fulmarus glacialoides* | 1 | | | 1 | 0 |
| Pintado petrel | *Daption capense* | 1 | | 1 | 2 | 1 |
| White-headed petrel | *Pterodroma lessonii* | 1 | | | 1 | 0 |
| Kerguelen petrel | *Lugensa brevirostris* | 1 | | | 1 | 0 |
| Prion species | *Pachyptila* spp. | 1 | | | 1 | 0 |
| White-chinned petrel | *Procellaria aequinoctialis* | 7 | | 2 | 9 | 6 |
| Cory's shearwater | *Calonectris diomedea* | | | 1 | 1 | 1 |
| Shearwater species | | 1 | | | 1 | 0 |
| Wilson's storm petrel | *Oceanites oceanicus* | 3 | 1 | 1 | 5 | 1 |
| Red-billed tropic bird | *Phaethon aethereus* | 1 | | | 1 | 0 |
| Great white pelican | *Pelecanus onocrotalus* | 3 | 2 | | 5 | 4 |
| Red-footed booby | *Sula sula* | | 1 | | 1 | 0 |
| White-breasted cormorant | *Phalacrocorax lucidus* | 16 | 5 | 1 | 22 | 14 |
| Bank cormorant | *P. neglectus* | 8 | | | 8 | 1 |
| Reed cormorant | *P. africanus* | 1 | 2 | | 3 | 1 |
| Crowned cormorant | *P. coronatus* | 12 | 4 | 3 | 19 | 2 |
| Darter | *Anhinga melanogaster* | | 1 | | 1 | 0 |
| African black oystercatcher | *Haematopus moquini* | 1 | 2 | | 3 | 1 |
| Curlew sandpiper | *Calidris ferruginea* | 1 | | | 1 | 0 |
| Sanderling | *C. alba* | 1 | | | 1 | 0 |
| Subantarctic skua | *Catharacta antarctica* | 2 | | | 2 | 2 |
| Sabine's gull | *Larus sabini* | | 1 | | 1 | 1 |
| Swift tern | *Sterna bergii* | 3 | 3 | | 6 | 2 |
| Sandwich tern | *S. sandvicensis* | | 1 | | 1 | 1 |
| Common tern | *S. hirundo* | 6 | 9 | | 15 | 3 |
| Arctic tern | *S. paradisaea* | 1 | 1 | | 2 | 2 |
| Antarctic tern | *S. vittata* | 1 | | | 1 | 1 |
| Tern species | *Sterna* spp. | 1 | 1 | | 2 | 0 |
| Total | | 90 | 41 | 9 | 140 | 52 |

streamlined in order to cope with the large number of birds (Kuyper and Williams 2004).

### *Treatment of other seabirds*

Other seabirds were handled in the same manner as penguins, but with some variations. In the washing process, flying seabirds had warm Canola oil rubbed into the oiled feathers and were left to stand for 5–15 minutes before being washed. Gulls and terns did not receive the vitamin and iron injections on admission and were not blood-sampled or weighed on a weekly basis. Nor were these species strictly evaluated for waterproof feathers, but had to be able to fly competently. Cormorants and gannets were sprayed with water when swimming, to stimulate preening, and had to be waterproof after a 45-minute swim before being released. In all cases, the condition of the bird, and especially the musculature on the keel bone, was evaluated to be satisfactory prior to release. Most flying birds were released offshore of Robben Island, except for great white pelicans *Pelecanus onocrotalus*, which were released onto Rietvlei, and gulls and terns, which were usually released at Milnerton beach.

## African Penguins

### *Admission and release statistics*

Following the mega-oiling incident in 2000 (Crawford *et al*. 2000), there were no large oil spills in either 2001 or 2002. SANCCOB admitted 807 and 965 penguins in 2001 and 2002 respectively (Table 1). The most frequent reason for admission was oiling: over the two years, 56% of all penguin admissions were of oiled birds (43% in 2001 and 62% in 2002). Most of the oiling incidents occurred in winter, when prevailing north-westerly winds and currents carry oil onshore (RJM Crawford, MCM, pers. comm.). Nearly two-thirds (64%) of all admissions of penguins were in winter (June–September, Table 4). Similarly, along the Californian coast, Hampton *et al.* (2003) reported an increased incidence of oiled birds in winter.

Of the oiled penguins admitted, 86% were released. The release rates for oiled penguins in these years were similar to the overall release rate of 84% recorded between 1996 and 2000 (Nel *et al.* 2003). Extent of oiling on each bird was recorded. There was no correlation between extent of oiling and the outcome of rehabilitation (Table 5).

Over the two-year period, half of the oiled penguins were removed from two colonies, Dyer Island (31%) and the Boulders (19%, Table 6). Localities in the Western Cape east of Cape Point accounted for 68% of oiled penguins. This is surprising, given that the annual penguin census showed that <10% of penguins in the Western Cape in these two years bred at colonies east of Cape Point (du Toit *et al.* 2004). Many of the oiled birds from Dyer Island were dehydrated and emaciated on arrival (NJP pers. obs.); this is a consequence of the logistic difficulties of getting oiled penguins from Dyer Island to SANCCOB (weather-dependent access to the island, and the long distance by road, frequently undertaken in several stages). In spite of this, the release rates of oiled penguins from Dyer Island (84%) were close to the release rate of 86% for oiled birds from all other localities.

There were 14% of birds described as 'weak' when admitted. Weakness is an expert evaluation of the habitus of the bird: a weak penguin is often lying down, does not attack when handled and the beak is relatively easy to open. Weak birds were often non-oiled juveniles, which came ashore too exhausted to be able to escape capture and were brought to SANCCOB mainly by members of the public. For these birds, the release rate was 58%. Other non-oiled penguins were admitted with wounds and injuries and with arrested moult. Apart from the oiled penguins arriving from Dyer Island, oiled penguins were generally much stronger clinically on arrival than non-oiled penguins and had a higher release rate.

The next largest category, 10% of admissions, consisted of abandoned chicks. These came mainly from the breeding colonies at Robben Island, the Boulders and Dyer Island. In some years, chicks are abandoned mainly in November and December, when parents enter moult. These chicks are identified by being underweight relative to their age. In 2002, two groups of chicks were removed from the Boulders colony; one group was abandoned by their parents in winter due to storms and flooding, and the other was removed because of

**Table 4:** Monthly admissions of African penguins to SANCCOB, 2001–2002

| Months | 2001 | 2002 | Total | Percentage |
|---|---|---|---|---|
| January | 44 | 19 | 63 | 3.6 |
| February | 19 | 7 | 26 | 1.5 |
| March | 29 | 10 | 39 | 2.2 |
| April | 27 | 112 | 139 | 8.0 |
| May | 35 | 61 | 96 | 5.5 |
| June | 102 | 193 | 295 | 16.9 |
| July | 196 | 158 | 354 | 20.3 |
| August | 83 | 121 | 204 | 11.7 |
| September | 115 | 149 | 264 | 15.1 |
| October | 56 | 73 | 129 | 7.4 |
| November | 38 | 30 | 68 | 3.9 |
| December | 66 | 4 | 70 | 4.0 |
| Total | 810 | 937 | 1 747 | 100.1 |

**Table 5:** Number of oiled African penguins with extent of oiling compared to outcome of rehabilitation for 2001 and 2002

| Extent of oiling on bird (%) | Released | Percentage released | Died | Percentage died (%) | Total |
|---|---|---|---|---|---|
| 1–10 | 82 | 85 | 14 | 15 | 96 |
| 11–20 | 81 | 84 | 16 | 16 | 97 |
| 21–30 | 64 | 89 | 8 | 11 | 72 |
| 31–40 | 120 | 88 | 16 | 12 | 136 |
| 41–50 | 270 | 87 | 41 | 13 | 311 |
| 51–60 | 80 | 81 | 19 | 19 | 99 |
| 61–70 | 47 | 90 | 5 | 10 | 52 |
| 71–80 | 61 | 86 | 10 | 14 | 71 |
| 81–90 | 42 | 86 | 7 | 14 | 49 |
| 91–100 | 8 | 100 | 0 | 0 | 8 |

**Table 6:** Areas of origin of oiled African penguins admitted by SANCCOB, 2001–2002

| Area of origin | 2001 | 2002 | Total | Percentage |
|---|---|---|---|---|
| West Coast: Lambert's Bay to Table Bay, including the Waterfront | 37 | 33 | 70 | 7.0 |
| Dassen Island | 14 | 4 | 18 | 1.8 |
| Robben Island | 55 | 46 | 101 | 10.2 |
| Granger Bay to Cape Point | 18 | 101 | 119 | 12.0 |
| False Bay (excluding the Boulders) | 15 | 11 | 26 | 2.6 |
| The Boulders | 80 | 108 | 188 | 19.0 |
| South Coast: Cape Hangklip–Mossel Bay (excluding Stony Point, Betty's Bay) | 37 | 34 | 71 | 7.2 |
| Stony Point, Betty's Bay | 16 | 59 | 75 | 7.6 |
| Dyer Island | 91 | 212 | 303 | 30.6 |
| Eastern Cape (Port Elizabeth) | 15 | 0 | 15 | 1.5 |
| Unknown | 5 | 0 | 5 | 0.5 |
| Total | 383 | 608 | 991 | 100 |

**Table 7:** Duration of stay at SANCCOB of African penguins in 2001 and 2002

| | Releases | | Deaths | | Total | |
|---|---|---|---|---|---|---|
| Reason for admission | Number of birds | Average duration of stay (days) | Number of birds | Average duration of stay (days) | Number of birds | Average duration of stay (days) |
| Oiled birds | 855 | 26 | 136 | 8 | 991 | 24 |
| Non-oiled adults | 90 | 30 | 91 | 13 | 181 | 22 |
| Non-oiled juveniles | 253 | 38 | 147 | 14 | 400 | 29 |
| Chicks | 107 | 65 | 93 | 22 | 200 | 45 |
| Total | 1 305 | 32 | 467 | 14 | 1 772 | 27 |

building operations. Chicks admitted to SANCCOB were fed until they reached fledging weight; 60% were released. The proportion of chicks reared in this way do not change ultimately return as adults to breed is not distinguishable from that of naturally reared chicks (Whittington 2002).

The average period spent at SANCCOB during 2001 and 2002 for all penguins (died or released) was 27 days (Table 7). This is less than half the average of 56 days for the period 1970–1979, during which period birds that were released averaged 78 days in captivity and those which died 25 days (Morant *et al.* 1981). In 2001 and 2002, oiled penguins and non-oiled adult penguins that were released spent on average 26 days and 30 days respectively at SANCCOB; non-oiled juveniles and chicks artificially reared spent on average 38 days and 65 days respectively at the centre prior to release (Table 7). The longer periods in these latter two categories are because of the time needed to rear chicks to fledging and the poor condition on arrival of most juvenile penguins. Oiled and non-oiled penguins that were diagnosed positive for avian malaria (see below) had average stays about 70% longer than those that were found to be negative (Table 8). The longer stays for birds clinically affected by malaria, *Plasmodium* spp., were because they were ill and because the 10-day treatment extended their stay. In addition, their blood smears had to be negative for parasites prior to release.

Release rates of sick, injured and oiled penguins from SANCCOB have improved over the years from an average of 52% in the 1970s to 78% in the 1990s and 74% in 2001 and 2002 (Nel *et al.* 2003, Table 1). The bird care, washing techniques, treatments and veterinary supervision have refined due to experience and knowledge gained over the last few decades (Kuyper and Williams 2004). The duration of stay at SANCCOB has decreased by about 50%.

**Table 8:** Duration of stay at SANCCOB of African penguins that were released, comparing birds that were positive and negative for malaria on blood smear in 2001 and 2002

| Category of admission | Blood smear result | Number of birds | Average duration of stay (days) |
|---|---|---|---|
| Oiled | Malaria positive | 170 | 41 |
| Oiled | Malaria negative | 685 | 23 |
| Non-oiled | Malaria positive | 174 | 59 |
| Non-oiled | Malaria negative | 276 | 35 |
| Total | | 1 305 | 33 |

Minimising time spent in captivity is important biologically, because this limits the exposure and spread of diseases and reduces the disruption of the normal annual cycle (e.g. Underhill and Crawford 1999). It also has economic value, reducing the cost of treating each penguin.

There was an annual average of 547 oiled African penguins admitted to SANCCOB between 1970 and 1979 and 343 between 1980 and 1989 (Nel *et al.* 2003). Between 1990 and 1999 there was an average of 925 oiled penguins admitted each year excluding birds affected by the *Apollo Sea* spill (Nel *et al.* 2003). Therefore, the incidence of chronic oiling increased during the last decade (Nel *et al.* 2003). There was an average of 496 oiled penguins admitted for 2001 and 2002. Chronic oil pollution in California is thought to arise from operational discharges by tanker vessels that exceed the limit allowed, illegal tank and bilge tank washing and shipwrecks discharging oil (Hampton *et al.* 2003). Oil slicks of unknown origin off the South African coast are thought to be mainly due to ships illegally washing their bilge tanks (Morant *et al.* 1981, Nel *et al.* 2003) and contribute to chronic oiling.

The success of any wildlife rehabilitation programme must ultimately be measured by the long-term survival and reproduction of the rehabilitated wildlife. By the 1970s, it was known that a large proportion of oiled and cleaned African penguins survived after release and rejoined their breeding populations (Morant *et al.* 1981). More recent analyses have shown that the survival of rehabilitated penguins after release was no different from the survival of never-oiled birds (Whittington 2003). Breeding productivity of oiled penguins rehabilitated after the *Apollo Sea* spill in 1994 on Dassen Island was, on average, no different to that of penguins not affected by the oil spill (Wolfaardt and Nel 2003). There were some adverse effects of oiling and rehabilitation noted in these birds, but these were restricted to the first few years following rehabilitation (Wolfaardt and Nel 2003). A small proportion of rehabilitated penguins did not attempt to breed in the six years following the *Apollo Sea* spill. Causes for this remain unclear and the subject of further study (Wolfaardt and Nel 2003).

### *Avian malaria*

Malaria infections (*Plasmodium relictum* and *P. elongatum* identified by Brossy (1992) and *P. juxtanucleare* by Grim *et al.* 2003) were a primary cause of concern at SANCCOB during 2001 and 2002. Of penguins admitted in these two

years, the percentages diagnosed positive for malaria (on blood smear) at some stage during their stay at SANCCOB were 34% and 17% for 2001 and 2002 respectively. A diagnosis of malaria as a cause of death was made by at least one of the following: a positive blood smear, a postmortem evaluation (Grim *et al*. 2003), a positive kidney impression smear and histopathology. Of the 467 deaths of penguins over the two years, 109 (23%) were attributed to malaria infection (29% in 2001 and 19% in 2002). The mortality associated with malaria in winter was less than in summer: 57% of those birds diagnosed positive from November 2001 to March 2002 died, as opposed to 10% from April to October 2001 and 17% from April to October 2002. Of the deaths attributed to malaria in 2001, 83% were of juvenile penguins; in 2002 this figure was 68%.

The percentages of penguins diagnosed positive for malaria by blood smear at some stage and which were subsequently released was 79% in 2001 and 74% in 2002. This was comparable to the overall release rate (Table 1). Penguins that were diagnosed positive at some period during their stay at SANCCOB stayed about 70% longer in the centre than other birds in the same category of admission group (Table 8).

An unexpectedly large percentage of penguins were malaria positive (on blood smear) within the first five days of admission: 30% in 2001 and 35% in 2002. Given that the period of asexual development of the parasite within the bird is 14 days (Beier and Trpis 1981), this implies that these birds must have been either recently infected and parasitaemic on admittance to the centre or that there was recrudescence (a relapse of malarial parasites of a subclinical infection when the parasitaemia dropped below detection by blood smear) of the infection (Stoskopf and Beier 1979, Cranfield *et al*. 1994). Recrudescence should occur at all times of the year, but the incidence of malaria and the increases in antibody levels are low in winter and high in summer, indicating that parasitaemic birds on admission must have newly acquired infections (DU Bellstedt, University of Stellenbosch, pers. comm.).

In summary, malaria infection in the penguins does not affect the overall release rate but does increase the duration of stay at SANCCOB of infected birds. The incidence of malaria is highest in the summer months when most of the deaths occur and most birds that die are juveniles. There is a high percentage of birds being admitted with parasitaemia indicating that malaria is present at breeding colonies, although SANCCOB is situated in an area with a possible parasite reservoir and potential vector species to spread the disease (Grim *et al.* 2003, MR Cranfield, Baltimore Zoo, pers. comm., DU Bellstedt, pers. comm.).

Collaborative research related to malaria infections continued through 2001 and 2002. As part of this, blood smears were evaluated weekly to detect parasitaemia (parasites present in the blood) and used as an indicator of malaria in the absence of other diagnostic tools. Parasitaemia does not reveal the prevalence of malaria infection (Graczyk *et al.* 1995, Stoskopf and Beier 1979, Cranfield *et al.* 1994), nor does it correlate with mortality (Fix *et al.* 1988). ELISA (Enzyme-linked immunosorbent assay, measuring antibody levels) and PCR (polymerase chain reaction, a molecular technique used in parasite identification) methods were investigated. The antibody response is an indicator of previous infection, but also does not correlate with individual parasitaemia (Graczyk *et al.* 1994) or mortality. Natural immunity (as measured in antibody levels) to malaria proved to be important for survival and increased after arrival to the center, especially in spring and summer when the incidence of malaria is greatest (DU Bellstedt, pers. comm.). Birds that died may not have responded fast enough to infection and further research to establish whether oiling may reduce antibody production is currently being undertaken.

**Other Sea Birds**

Four species accounted for 91% on the non-penguin admissions to SANCCOB: 661 Hartlaub's gulls *Larus hartlaubii*, 384 Cape cormorants *Phalacrocorax capensis*, 245 Cape gannets *Morus capensis* and 122 kelp gulls *L. dominicanus* (Table 2).

Of the 162 oiled Cape gannets, 87% were released (Table 2). Most of the oiled gannets were admitted following two unknown oiling incidents near Malgas Island in Saldanha Bay in 2002, where 66 birds were oiled in June and 68 in September. The release rate of 86% for oiled gannets was comparable to that of the oiled penguins (Tables 1, 2). Gannets that arrived weak and dehydrated often died within 48 hours. In flying birds, weakness is evaluated as birds struggling to stand and hold their heads up, and unable to hold their wings close to their bodies. Gannets admitted with wing injuries were generally euthanased because of poor prognosis for recovery. These factors explain the poor release rate for weak and injured gannets (Table 2).

Most fully grown Cape cormorants were weak on admission and frequently died within 48 hours. Hence, the low release rate (19%) for weak cormorants (Table 2). The release rates for other cormorant species were similarly low (Table 3). There were 32% of fully grown Cape cormorants admitted with infections; most of these were caused by *Babesia* spp., which is a blood-borne parasite causing anaemia (Table 2). In 2002, 147 Cape cormorant chicks that were artificially reared after nests were removed from a building at the Koeberg Nuclear Power Station; 80% of the chicks were released (Table 2). Of the birds that died, 68% were hatchlings when removed. Of the 50 eggs that were removed, none produced chicks that fledged. In circumstances in which cormorant chicks need to be removed from nests and artificially reared to fledging, it is recommended that capture of chicks be delayed for as long as possible.

For kelp gulls, the most frequent reason for admission was botulism (diagnosis based on symptoms only), poisoning caused by the bacterium *Clostridium botulinum*; 51% of these birds were released. The most common form of injury was to the wing; 29% of injured kelp gulls were released (Table 2).

For Hartlaub's gulls, most of the fully grown birds that were admitted were injured; for these the release rate was 15% (Table 2). Most of the 420 chicks admitted had been removed under permit from MCM from the roofs of buildings

**Table 9:** Estimated chronic oiling rate of African penguins in the Western Cape, by decades since 1970, and in 2001–2002. The estimated penguin populations per period are based on multiplying average nest counts in the region by 3.2 (Crawford and Boonstra 1994, Underhill *et al.* submitted). The average number admitted oiled is from Nel *et al*. (2003) and this paper; these averages exclude birds oiled in major spills

| Period | Estimated penguin population in the Western Cape | Average number admitted oiled per year | Chronic oiling rate |
|---|---|---|---|
| 1970s | 135 000 | 547 | 1 in 250 |
| 1980s | 70 000 | 343 | 1 in 204 |
| 1990s | 60 000 | 925 | 1 in 65 |
| 2001–2002 | 110 000 | 496 | 1 in 222 |

where they were a nuisance, either due to noise or pollution. The release rate of these chicks was 85% (Table 2).

A total of 140 birds, including a further 30 identified species, was admitted (Table 3). Some 90 were admitted weak, 41 injured and nine oiled. If rare birds die, SANCCOB's policy is to freeze the bodies, and offer them to museums as specimens. Occasionally, extremely rare or vagrant species are encountered. There were two records of unusual species in 2001 and 2002.

An adult red-billed tropic bird *Phaethon aethereus* admitted to SANCCOB (Table 3) was the sixth record of the species off southern Africa (Underhill and Chipps 2002). It had landed exhausted on the deck of a deep-sea salvage tug on 9 January 2001, approximately 210km offshore. It died six days after admission and was found on post mortem to have a bacterial plug proximal to the bifurcation of the trachea.

A red-footed booby *Sula sula* was admitted to SANCCOB on 10 March 2001 after being transferred from a wildlife rehabilitation centre in Durban, where it had been found in the harbour. It was the second record of the species for South Africa; the other was a bird found in Cape Town and brought to SANCCOB. There are two records off Namibia and one off Moçambique (Ryan 1997, Dyer and Chesselet 2002). The booby was admitted with head and beak injuries, with broken tail feathers and bumblefoot. It was not releasable and stayed at SANCCOB until it died in October 2002. The post-mortem showed hepatitis of unknown aetiology. It was a pale-phase adult female.

## Conservation Overview

An average of 4.4 birds per day were admitted to SANCCOB during 2001 and 2002. These were years with no large oiling incidents. This provides an estimate of the chronic oiling rate. For the African penguin, there are sufficient data to estimate trends in the chronic oiling rate since 1970 (Table 9). Apart from the 1990s, and excluding large oiling events, about one penguin in each 225 penguins off the Western Cape has been admitted to SANCCOB oiled each year. During the 1990s, this figure was one in 65; the 1990s appear to have been a period during which a large number of small incidents resulted in substantial numbers of penguins being oiled. During 2001 and 2002, the chronic oiling rate returned to a 'normal' value.

Between the establishment of SANCCOB in 1968 and 2002, there have been four major oiling incidents in which more than 3 000 penguins were oiled, involving 36 000 penguins, or about 1 000 per year, averaged over the 35-year period. The chronic oiling rate is currently about half of the long-term average rate resulting from catastrophic major incidents. Strenuous efforts are therefore needed, not only to reduce the frequency of major incidents, but also to reduce the background chronic oiling rate (Shannon and Crawford 1999), which has averaged one bird in about 225 per year.

Three of the five species most frequently admitted to SANCCOB in 2001 and 2002 are in IUCN threat categories: African penguin and Cape gannet are Vulnerable, and Cape Cormorant is Near-threatened (Barnes 2000). For the two Vulnerable species, the overall release rates of treated birds, 73% for the penguin and 64% for the gannet, were encouragingly high, with even higher release rates for birds admitted oiled: 86% and 87% respectively. The conclusion is that SANCCOB is both an effective facility for treating oiled and injured seabirds, and that it is making a substantive contribution to the conservation of threatened species.

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## References

ADAMS, N. J. 1994 — Patterns and impacts of oiling on African penguins *Spheniscus demersus*: 1981–1991. *Biol. Conserv.* **68**(1): 35–41.

BARNES, K. N. (Ed.) 2000 — *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. Johannesburg; Birdlife South Africa: 169 pp.

BEIER, J. C. and M. TRPIS 1981 — Incrimination of natural culicine vectors which transmit *Plasmodium elongatum* to penguins at the Baltimore Zoo. *Can. J. Zool.* **59**: 470–475.

BROSSY, J. J. 1992 — Malaria in wild and captive jackass penguins *Spheniscus demersus* along the Southern African coast. *Ostrich* **63**: 10–12.

CRANFIELD, M. R., GRACZYK, T. K., BEALL, F. B., IALEGGIO, D. M., SHAW, M. L. and M. L. SKJOLDAGER 1994 — Subclinical avian malaria infections in African black-footed penguins (*Spheniscus demersus)* and induction of parasite recrudescence. *J. Wildl. Dis.* **30**: 372–376.

CRAWFORD, R. J. M. and H. G. v. D. BOONSTRA 1994 — Counts of moulting and breeding jackass penguins *Spheniscus demersus* — a comparison at Robben Island, 1988–1993. *Mar. Ornithol*. **22**(2): 213–219.

CRAWFORD, R. J. M., DAVIS, S. A., HARDING, R., JACKSON, L. F., LESHORO, T. M., MEYER, M. A., RANDALL, R. M.,

UNDERHILL, L. G., UPFOLD, L., VAN DALSEN, A. P., VAN DER MERWE, E., WHITTINGTON, P. A., WILLIAMS, A. J. and A. C. WOLFAARDT 2000 — Initial impact of the *Treasure* oil spill on seabirds off western South Africa. *S. Afr. J. mar. Sci.* **22**: 157–176.

DU TOIT, M., UNDERHILL, L. G. and R. J. M. CRAWFORD 2004 — *African Penguin Populations in the Western Cape, South Africa, 1992–2003.* University of Cape Town, Cape Town; Avian Demography Unit: 16 pp.

DYER, B. M. and Y. CHESSELET 2002 — First Atlantic records of the red-footed booby *Sula sula* and brown booby *S. leucogaster* in southern Africa. *Mar. Ornithol*. **30**: 36–37.

FIX, A. S., WATERHOUSE, C., GREINER, E. C. and M. K. STOSKOPF 1988 — *Plasmodium relictum* as a cause of avian malaria in wild caught Magellanic penguins. *J. Wildl. Dis.* **24**: 610–619.

GRACZYK, T. K., CRANFIELD, M. R., BROSSY, J. J., COCKREM, J. F., JOUVENTIN, P. and P. J. SEDDON 1995 — Detection of avian malaria infections in wild and captive penguins. *J. Helminthol. Soc. Wash.* **62**: 135–141.

GRACZYK, T. K., CRANFIELD, M. R., MCCUTCHAN, T. F. and E. J. BICKNESE 1994 — Characteristics of naturally acquired avian malaria infections in naïve juvenile African black-footed penguins (*Spheniscus demersus*). *Parasitol. Res.* **80**: 634–637.

GRIM, K. C., VAN DER MERWE, E., SULLIVAN, M., PARSONS, N., MCCUTCHAN, T. F. and M. R. CRANFIELD 2003 — *Plasmodium juxtanucleare* causing mortality in black-footed penguins (*Spheniscus demersus)* at a rehabilitation center. *J. Zoo. Wildl. Med*. **34**: 250–255.

HAMPTON, S., KELLY, P. R. and H. R. CARTER 2003 — Tank vessel operations, seabirds and chronic oil pollution in California. *Mar. Ornithol.* **31**: 29–34

KUYPER, S. and A. J. WILLIAMS 2004 — *Proceedings of the Penguin Workshop Following the Sinking of the "Treasure" in June 2000.* University of Cape Town, Cape Town; Avian Demography Unit: 54 pp.

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 of Birds of the Sea and Shore, 1979.* Cooper, J. (Ed.). Cape Town; African Seabird Group: 267–301.

NEL, D. C., CRAWFORD, R. J. M. and N. J. PARSONS 2003 — The conservation status and impact of oiling on the African penguin. In *Rehabilitation of Oiled African Penguins: a Conservation Success Story.* Nel, D. C. and P. A. Whittington (Eds). Cape Town; BirdLife South Africa and Avian Demography Unit: 1–7.

RYAN, P. G. 1997 — Red-footed booby *Sula sula*. In *The Atlas of Southern African Birds.* Vol. 1. Harrison, J. A., Allan, D. G., Underhill, L. G., Herremans, M., Tree, A. J., Parker, V. and C. J. Brown (Eds). Johannesburg; BirdLife South Africa: p. 763.

SHANNON, L. J. and R. J. M. CRAWFORD 1999 — Management of the African penguin *Spheniscus demersus* – insights from modelling. *Mar.Ornithol.* **27**: 119–128.

STOSKOPF, M. K. and J. R. BEIER 1979 — Avian malaria in African black footed penguins. *J. Amer. Vet. Med. Assoc.* **175**: 944–947.

UNDERHILL, L. G. and A. CHIPPS 2002 — Red-billed tropicbirds *Phaethon aethereus* in the southeastern Atlantic Ocean. *Atlantic Seabirds* **4**: 115–118.

UNDERHILL, L. G. and R. J. M. CRAWFORD 1999 — Season of moult of African penguins at Robben Island, South Africa, and its variation, 1988–1998. *S. Afr. J. mar. Sci.* **21**: 437–441.

UNDERHILL, L. G., BARTLETT, P. A., BAUMANN, L., CRAWFORD, R. J. M., DYER, B. M., GILDENHUYS, A. NEL, D. C., OATLEY, T. B., THORNTON, M., UPFOLD, L., WILLIAMS, A. J., WHITTINGTON, P. A. and A. C. WOLFAARDT 1999 — Mortality and survival of African penguins *Sphenisicus demersus* involved in the *Apollo Sea* oil spill; an evaluation of rehabilitation efforts. *Ibis* **141**: 29–37.

UNDERHILL, L. G., WHITTINGTON, P. A., CRAWFORD, R. J. M., WILLIAMS, A. J. and A. C. WOLFAARDT 2000 — Five years of monitoring African penguins *Spheniscus demersus* after the *Apollo Sea* oil spill: a success story made possible by ringing. *Vogelwarte* **40**: 215–218.

WHITTINGTON, P. A. 2002 — Survival and movements of African penguins, especially after oiling. Ph.D. thesis, University of Cape Town, South Africa: 286 pp.

WHITTINGTON, P. A. 2003 — Post-release survival of rehabilitated African penguins. In *Rehabilitation of Oiled African Penguins: a Conservation Success Story.* Nel, D. C. and P. A. Whittington (Eds). Cape Town; BirdLife South Africa and Avian Demography Unit: 8–17.

WOLFAARDT, A. C. and D. C. NEL 2003 — Breeding productivity and annual cycle of rehabilitated African Penguins following oiling. In *Rehabilitation of Oiled African Penguins: a Conservation Success Story.* Nel, D. C. and P. A. Whittington (Eds). Cape Town; BirdLife South Africa and Avian Demography Unit: 18–24.

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