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Return to Robben Island of African Penguins that were rehabilitated, relocated or reared in captivity following the *Treasure* oil spill of 2000

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Following an oil spill from the *Treasure* off the coast of South Africa in June 2000, about 19 000 oiled African Penguins *Spheniscus demersus*, including 14 825 from Robben Island, were caught for rehabilitation and subsequent release. A further 19 500 penguins that were not oiled — mostly birds in adult plumage, including 7 000 from Robben Island — were relocated some 700km to the east, to prevent them becoming oiled. Additionally, 3 350 orphaned chicks, including 2 643 from Robben Island — were collected for rearing in captivity and release to the wild. Some four years later — by the end of December 2004 — 70% of rehabilitated adults, 40% of relocated birds and 34% of captive-reared chicks had been seen back at Robben Island. Another 7% of birds relocated from Robben Island had been sighted at other localities. Rates of re-sighting rehabilitated birds were similar at Robben and Dassen Islands, but a greater proportion of relocated birds was seen at Dassen Island, where birds collected for relocation were mostly from breeding areas. The lower proportion of relocated birds seen at Robben Island is thought to result from this intervention causing some pre-breeding birds to move to other colonies. All three conservation interventions are considered to have been successful, but it is premature to assess their relative contributions to the conservation of the species. Three relocated birds tracked by satellite took 15–21 days to return to their home colonies. This rapid return may have resulted from breeding attempts being interrupted. After remaining at their home islands for 4–5 days, two of the tracked birds then left these islands for 19–36 days. We surmise that, after they had searched unsuccessfully for their mates, they abandoned breeding for the year 2000.

Introduction

The African Penguin *Spheniscus demersus* breeds around the coast of southern Africa from Hollamsbird Island, central Namibia to Bird Island (Algoa Bay, Eastern Cape, South Africa). The population has declined drastically over the last century, falling from several millions in the early 20th century to around 180 000 at the start of the 21st century (Crawford *et al*. 1995b, Shannon and Crawford 1999). Causes of the decline include loss of habitat through removal of guano, collection of eggs, oil spills, and competition with fisheries for food (Crawford *et al*. 1995b). While guano-scraping and egg collection have now stopped, oil pollution seems to be increasing (Nel *et al*. 2003). African Penguins are particularly susceptible to oil pollution. They may be attracted to patches of oil in the sea because fish are often associated with oil slicks (Kerley *et al*. 1987). Once their feathers are oiled, penguins lose their waterproofing and swim ashore. They may ingest oil as they try to preen their feathers, and the oil can cause external and internal injuries such as blindness and ulceration (Birrel 1994, Crawford *et al*. 2000).

In the Western Cape, there are regular small oiling events caused, for example, by the illegal washing out of tanks at sea. These lead to the oiling of a number of penguins each year, ranging from several hundred to a few thousand (Nel *et al*. 2003). Over the last 30 years, oiled penguins have been cleaned and rehabilitated by SANCCOB (Southern African Foundation for the Conservation of Coastal Birds), with a steadily increasing success rate (Nel *et al*. 2003).

The regular small oiling events are punctuated by irregular large oil spills. In 1968, the *Esso Essen* ran aground, leading to the oiling of some 3 000 penguins. In 1972, a spill of unknown origin led to the oiling of 4 000 penguins. In 1994, the *Apollo Sea* sank, and around 10 000 penguins were oiled (Underhill *et al*. 1999). However, by far the largest event occurred in 2000, when the *Treasure* sank between Robben and Dassen Islands, north of Cape Town. Around 1 400 tons of fuel oil were spilt. Some 18 946 oiled African Penguins were collected, including 14 825 from Robben Island, 3 516 from Dassen Island (Crawford *et al*. 2000) and an estimated 600 from islands around Saldanha Bay and from mainland beaches. All these birds were taken to SANCCOB for cleaning (Crawford *et al*. 2000). Penguins arriving at the rehabilitation centres were stabilised, washed and fed, until they were fit to be released. About 1 660 oiled penguins died at the rehabilitation centres, including 800 in poor condition that were euthanased (Crawford *et al*. 2000, Wolfaardt *et al*. 2001). Eventually, 17 287 (91%)

of the oiled penguins were successfully cleaned and returned to the wild.

A further 7 161 penguins were evacuated from Robben Island and 12 345 from Dassen Island, to prevent them becoming oiled. Oil had covered the entire landing beach at Robben Island and several access areas at Dassen Island. Penguins using these beaches to arrive at or depart from the islands would have become oiled (Crawford *et al*. 2000). These 19 506 clean penguins were transported 800km by road to Port Elizabeth, where they were released at Cape Recife to swim back to the Western Cape, taking sufficiently long for the oil slick to disperse and the oil to be cleared from the landing beaches before their return (Crawford *et al*. 2000). In addition, 3 350 of the larger chicks at Robben (2 643) and Dassen (707) Islands that had been orphaned were collected, to be hand-reared before being returned to the wild (Crawford *et al*. 2000).

It is important to know whether these major interventions (cleaning and relocating so many birds and captive-rearing chicks) are effective strategies in an oil spill. To this end, all the released oiled birds were fitted with steel flipper bands, as were 3 362 of those that were relocated to Port Elizabeth and 1 787 of the chicks reared in captivity. Three of the relocated birds were also fitted with satellite tracking devices, so that their journeys home could be monitored (Crawford *et al*. 2000). The return to Dassen Island of rehabilitated and relocated penguins that were banded has been documented for the period up until 31 May 2001 by Wolfaardt *et al*. (2001). In this paper, we report on the return to Robben Island of these categories of birds and of chicks raised in captivity, up until the end of December 2004. We also describe the return to Robben and Dassen Islands of the three penguins that were fitted with satellite transmitters, and the behaviour of two of these penguins (following their return) in the periods during which they were tracked.

Methods

To investigate the effectiveness of the three conservation interventions, we aimed to estimate the proportions of each of the three categories of penguins that were rescued at Robben Island and that returned there: oiled and cleaned (rehabilitated); relocated; and orphaned chicks. Proportions were based on re-sightings and recoveries of banded individuals, so we needed to know approximate numbers of birds in each category that had been banded. African Penguins, especially pre-breeding birds, may visit other colonies (Randall *et al*. 1987, Whittington 2002). Therefore, we attempted to estimate the proportions of rehabilitated and relocated birds that were in adult and immature plumage when rescued. No record was kept of these proportions at Robben Island. Further, some birds rescued at Robben Island may have been visitors to the island, rather than residents there (Underhill *et al*. 1999), and we attempted to estimate this number.

Of the 3 516 oiled African Penguins removed from Dassen Island, 2 744 (78%) were in adult plumage and 772 (22%) in immature plumage (Crawford *et al*. 2000). It was assumed that this ratio applied also at Robben Island, i.e. that 11 563 of the oiled birds from Robben Island were in adult plumage and 3 262 in immature plumage. No records were kept of the origins of birds admitted to SANCCOB. It was assumed that there was no difference in survival during rehabilitation of birds in different plumages or from different localities, and that birds admitted in immature plumage did not moult into adult plumage during rehabilitation. Hence, about 13 500 birds from Robben Island would have been rehabilitated and released to the wild: 10 550 in adult plumage and 3 000 in immature plumage. All rehabilitated birds were banded.

Of the 19 506 birds that were relocated to Port Elizabeth, 2 232 from Robben Island and 1 130 from Dassen Island were banded (Crawford *et al.* 2000, Wolfaardt *et al*. 2001). A small number (241) of the relocated penguins died during transport, or at Cape Recife shortly after release (Crawford *et al*. 2000). On a proportional basis, this will reduce the number of banded birds from Robben Island that were successfully released at Cape Recife to 2 204.

Of the oiled penguins treated at SANCCOB, 306 were birds that had already been banded. Of these, 247 (81%) were from Robben Island, 30 (10%) from Dassen Island, four (1%) from islands near or in Saldanha Bay, and 25 (8%) from other localities (Whittington, unpubl. data). Therefore, about 8% of the birds may have been visitors to colonies affected by the spill, although it is unlikely that similar proportions of birds were banded at different colonies. Assuming that 8% of the penguins at Robben Island at the time of the spill were visiting birds, then about 9 700 of the oiled adults and 2 750 of the oiled immature birds rehabilitated and released after the *Treasure* spill would have belonged to the Robben Island colony. Similarly, 2 028 of the banded birds successfully released at Cape Recife would have been from Robben Island.

In total, 1 787 chicks reared in captivity up until fledging were banded and returned to the wild: 1 055 at Robben Island and 732 at Dassen Island. The colonies of origin of individual chicks were not known.

Information on African Penguins rehabilitated, relocated or reared in captivity following the *Treasure* spill was collected by a variety of means. Some reports, mainly of dead birds, were submitted to SAFRING (Southern African Bird Ringing Unit) by members of the public. Others were made by research and conservation staff working at penguin colonies, e.g. during the annual census of numbers of penguins breeding at colonies or during investigation of the moult of penguins at Robben Island. A large effort was put into gathering ring numbers of penguins at Robben Island, by Earthwatch volunteers. The Earthwatch project began in March 2001. Most re-sightings were made using telescopes or binoculars, to observe birds on the landing beaches and along the paths they take to and from the colony, over a portion of the colony that in 2001 contained 87% of the nesting penguins. These observations were conducted either early in the morning, when the birds were going to sea, or in the late afternoon, when they were returning. Observations were carried out on most days when Earthwatch teams were at Robben Island (about 70 each year). If the same penguin was seen on different days, each observation of the penguin was recorded, but a maximum of one record per bird was captured for any particular day.

Three of the penguins that were relocated to Cape Recife were fitted with ST-10 Argos satellite transmitters (PTTs)

(Crawford *et al*. 2000). One of the birds (named 'Peter') was from Robben Island and the other two (named 'Pamela' and 'Percy') were from Dassen Island. All three birds were in adult plumage but, despite their names, their sexes were not definitely established. They were judged to be male or female from their sizes; males average larger than females, but measurements overlap (Cooper 1972).

Percy's transmitter was removed shortly after his return to Dassen Island. Pamela returned to Dassen Island and departed on another trip before again returning to the island and having her transmitter removed. Peter returned to Robben Island and also went on another trip before returning again. This bird was not found while the instrument was attached, and his instrument was not recovered. The birds' tracks were plotted by joining the positions of successive satellite fixes. The speeds of Peter and Pamela when outbound from, and inbound to, their islands and while foraging (subsequent to their return from Cape Recife) were estimated when distances travelled were greater than or equal to 20km. Birds were assumed to be outbound or inbound when there was little deviation in the direction travelled, and assumed to be foraging when they were between outbound and inbound segments of trips. Information was inadequate to distinguish between daytime and nocturnal swimming. Speeds greater than 15km/h were discarded, as were fixes indicating speeds above this value. Speeds above 12km/h have been attained by African Penguins when porpoising (i.e. swimming in a porpoise-like style) (Wilson and Wilson 1990).

Results

Numbers of individual rehabilitated birds seen at Robben Island between September 2000 and December 2004 are shown in Table 1. The proportions re-sighted from 1 September 2000 to 31 December 2000, 31 December 2001, 31 December 2002, 31 December 2003 and 31 December 2004 were as follows: 8.3%, 42.0%, 48.5%, 52.3% and 54.4% of oiled birds from Robben Island, estimated to have been returned to the wild (12 445). They represent 10.6%, 53.9%, 62.2%, 67.0% and 69.8% of oiled birds in adult plumage from Robben Island estimated to have been returned to the wild (9 707). Between the same dates the proportions of re-sightings of relocated penguins were 0.3%, 28.3%, 34.0%, 38.4% and 40.5% of banded birds, thought to be from Robben Island and successfully released at Cape Recife (2 028). Additionally, 61 birds — 3.0% of those thought to be from Robben Island and successfully released (and 7.4% of all birds relocated from Robben Island that have subsequently been re-sighted) — have been recorded at other localities, mainly in the Western Cape but not at Robben Island. Of banded birds relocated from Dassen Island to Cape Recife, only 12 (1.1%) have been seen at Robben Island.

Numbers of chicks — that were artificially reared in captivity until they fledged, banded, released to the wild and since seen at Robben Island during different periods between September 2000 and December 2004 — are shown in Table 3. The proportions of the 1 787 chicks released that were re-sighted at Robben Island from 31 September 2000 increased from 1.7% at the end of 2000 to 12.1%, 16.4%, 18.8% and 20.1% to the end of 2001, 2002, 2003 and 2004 respectively (Table 3). They represent 2.8%, 20.6%, 27.8%, 31.8% and 34.1%, respectively, of those fledged chicks that were banded and released at Robben Island (1 055). However, of the 364 birds released as fledged chicks that were seen at Robben Island by 31 December 2004, 107 were released at Dassen Island.

The three penguins equipped with transmitters all returned rapidly to their breeding colonies. Peter was released at Cape Recife on 30 June 2000 and had returned to Robben Island by 18 July; Pamela was released on 2 July and was back at Dassen Island by 23 July. Percy was released on 5 July and was back at Dassen Island by 20 July. Their return journeys took about 18, 21 and 15 days, respectively. Peter and Pamela swam near to the coastline of St Francis Bay, whereas Percy cut across the mouth of this bay (Figure 1). Peter and Percy travelled relatively close to the coastline between Cape St Francis and Plettenberg Bay, whereas Pamela swam farther from the coast. All three birds travelled away from the coast between Plettenberg Bay and the mouth of the Gouritz River, with Peter continuing to do so until rounding Cape Agulhas. By contrast, Pamela and Percy were relatively near the coast when they rounded Cape Agulhas. The paths of all three penguins were similar between Danger Point and the Cape Peninsula (Figure 1).

Peter and Pamela both undertook several trips away from their home islands after returning to them. Peter travelled in Table Bay or further north. After his initial return to Robben Island, he remained at or close to the island for five days until 23 July, and then travelled to St Helena Bay, passing north of Bird Island, Lambert's Bay (Figure 2). He arrived back at Robben Island on 11 August, this trip having lasted

Table 1: Numbers of individual African Penguins (that had been oiled in the spill from the *Treasure* and subsequently cleaned, banded and returned to the wild) which were seen at Robben Island between the dates shown in the first column and at the head of each of the other columns.

Since/to	31 December 2000	31 December 2001	31 December 2002	31 December 2003	31 December 2004
1 September 2000	1 033	5 231	6 041	6 504	6 904
1 January 2001		4 454	5 321	6 339	6 140
1 January 2002			1 743	2 751	3 348
1 January 2003				1 362	2 125
1 January 2004					1 009

Table 2: Numbers of individual African Penguins from Robben Island (that had been caught, banded and relocated to Cape Recife) which were seen at Robben Island between the dates shown in the first column and at the head of each of the other columns

Since/to	31 December 2000	31 December 2001	31 December 2002	31 December 2003	31 December 2004
1 September 2000	6	573	689	779	827
1 January 2001		571	687	778	826
1 January 2002			208	356	434
1 January 2003				180	272
1 January 2004					121

Table 3: Numbers of individual orphaned African Penguin chicks (which, following the *Treasure* spill were reared in captivity until fledged, and subsequently released at Robben Island) which were seen at Robben Island between the dates shown in the first column and at the head of each of the other columns

Since/to	31 December 2000	31 December 2001	31 December 2002	31 December 2003	31 December 2004
1 September 2000	30	217	293	336	364
1 January 2001		193	269	313	343
1 January 2002			93	147	186
1 January 2003				66	108
1 January 2004					53

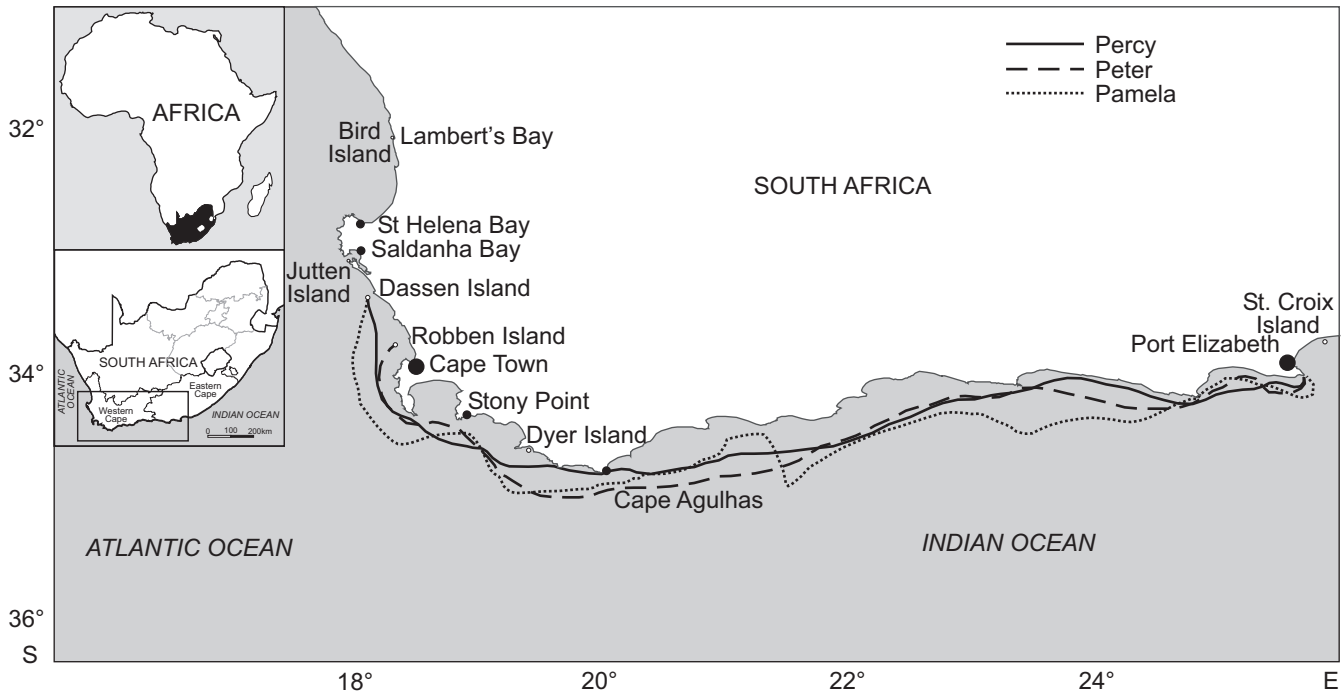

Figure 1: The routes followed by three African Penguins (dashed line represents 'Peter', dotted line represents 'Pamela', solid line represents Percy), which were fitted with satellite transmitters and relocated to Cape Recife near Port Elizabeth (see Crawford *et al*. 2000 for further details)

19 days. Subsequent trips away from the island were of shorter duration. By contrast, Pamela travelled mainly south of Dassen Island. She remained at, or close to, Dassen Island for four days and then departed on a long journey that took her to the east of Cape Agulhas (Figure 3). She was back at Dassen Island on 1 September, 36 days later. As with Peter, her subsequent foraging trips were of shorter duration. All these foraging trips, as well as the return journeys of the three penguins, were within waters less than 200m deep.

Many of the fixes were estimated to be accurate to within at least 1km. While foraging, Peter had an average speed of 2.11km/h (± 1.64, n = 9), while Pamela's average speed was 6.98km/hr (± 11.75, n = 25), giving an overall average

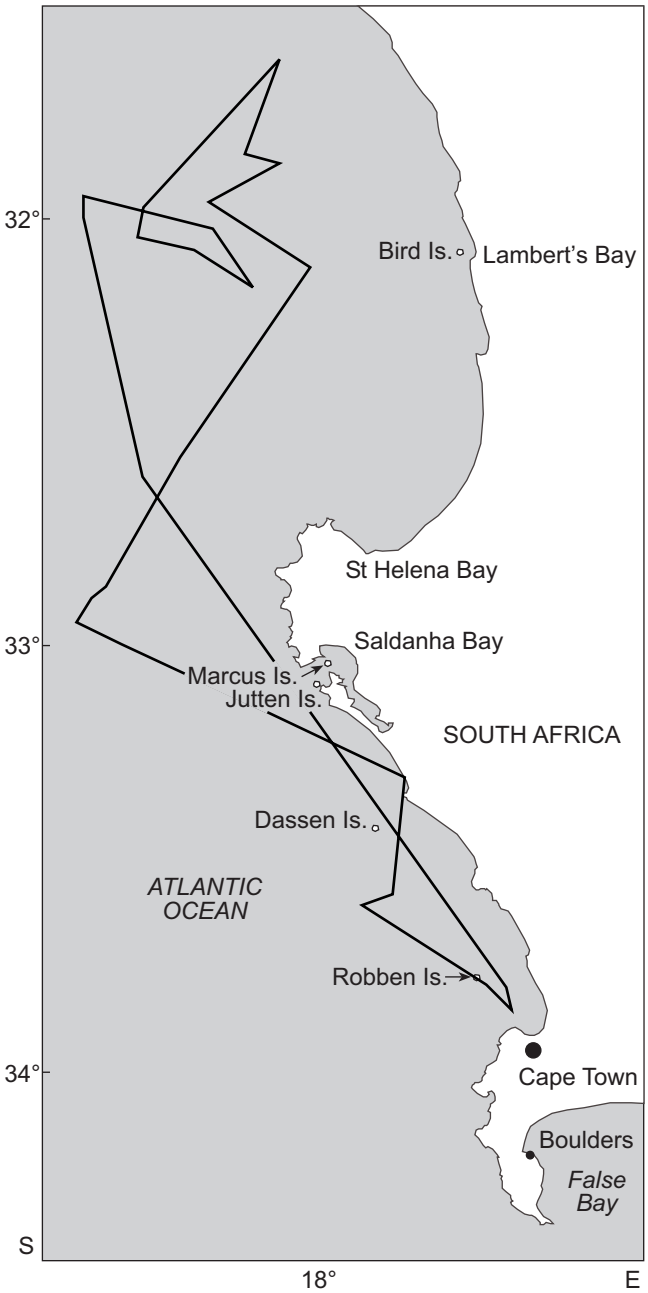

Figure 2: Positions obtained for Peter during July–September 2000, after his return to Robben Island

of 5.69km/h (± 10.28, n = 34). On outbound trips, Peter had an average speed of 9.40km/h (± 12.07, n = 6). There was no outbound trip for Pamela that had a relatively straight initial distance of > _ 20km. On inbound trips, Peter had an average speed of 12.36km/h (± 12.32, n = 6) and on one inbound trip, Pamela swam at a speed of 3.94km/h, giving an overall average for the two birds of 11.15km/h (± 11.68, n = 7).

Discussion

The proportion of oiled and rehabilitated African Penguins from Robben Island estimated to have been returned to the wild that had been re-sighted by the end of December 2004 — 52% overall and 67% of those in adult plumage when oiled — is similar to the 69% that were seen in three years after being oiled and rehabilitated following the *Apollo Sea* spill of 1994 (Underhill *et al*. 1999).

At Dassen Island, 45% of penguins that were oiled and rehabilitated were re-sighted within one year of the *Treasure* spill (Wolfaardt *et al*. 2001). At Robben Island, 42% of all birds and 54% of those in adult plumage were re-sighted within a period of about 18 months. These rates are similar, although an intensive programme of re-sighting at Dassen Island was instituted immediately after the *Treasure* spill (Wolfaardt *et al*. 2001), whereas at Robben Island, effort to re-sight penguins was relatively low before the Earthwatch project began in March 2001.

Of birds successfully relocated to Cape Recife to prevent their becoming oiled, some 28% of those thought to be from Robben Island had been re-sighted by 31 December 2001, within about 18 months of their release. Approximately double this proportion (55%) of those from Dassen Island had been seen by 31 May 2001, within less than a year of their release (Wolfaardt *et al*. 2001). This is also greater than the proportion (40%) seen at Robben Island up to the end of December 2004, a period of four years.

We are not sure why there is this difference in proportions of birds re-sighted between the birds relocated from Robben and Dassen Islands. It is possible that at least some birds are more difficult to see at the densely-vegetated Robben Island, and most searches covered only 87% of the colony. Because of the thick vegetation, and since 13% of the island was not covered, some of the birds would not have been seen. Although these factors would narrow the discrepancy in proportions of relocated birds observed at the two islands, it is unlikely that they would account for the entire difference. Another possibility is that the proportion of birds that were visiting Robben Island was greater than we have estimated it to be. However, the proportions of rehabilitated birds seen at Robben and Dassen Islands within a similar period of time were approximately equivalent, and there is no clear reason why a greater proportion of birds that were visiting Robben Island should have been caught for relocation than for rehabilitation.

At both Robben and Dassen Islands, oiled birds were caught along the shorelines, but there was a difference between the two localities, in terms of birds selected for relocation. Those from Robben Island were caught along the shoreline, whereas most of those from Dassen Island were caught within breeding areas that had been fenced off, thereby preventing birds from moving out to sea (Crawford *et al*. 2000). Since the birds from Dassen Island were re-located at the peak of the breeding season, we expect that a large proportion of the relocated birds from this island were active breeders. As active breeding birds, they are likely to have returned to the island relatively quickly. The re-sighting effort at Dassen Island was most intensive in the first six months following the spill, which would have been the optimal time to re-sight the returning birds. On the other hand, many of those relocated from Robben Island may have been pre-breeding birds younger than about four years of age. Those aged two years and most of those aged three years would have been in adult

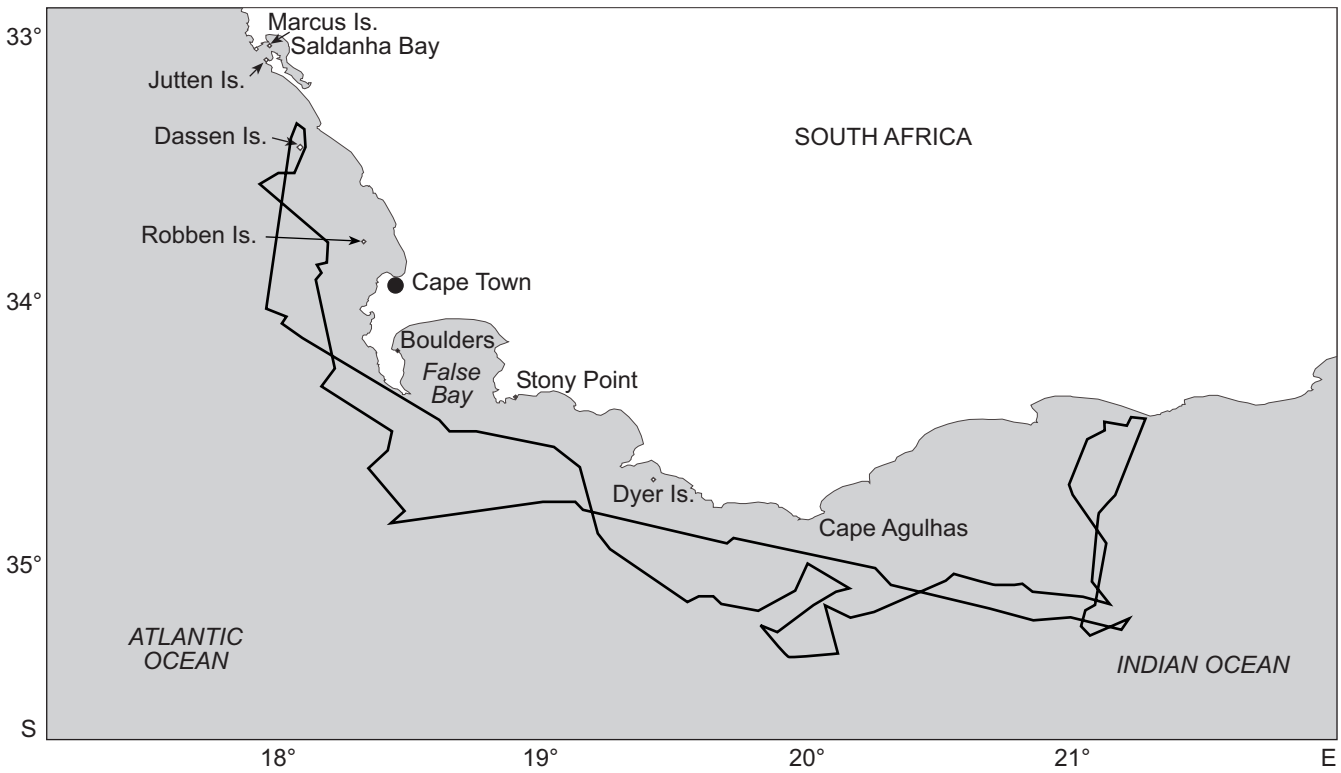

Figure 3: Positions obtained for Pamela during July–September 2000, after her return to Robben Island (conventions are as for Figure 2)

plumage but not breeding (Crawford *et al*. 1999). This seems the most plausible reason for the discrepancy in re-sighting rates at the two islands, for individuals that were relocated. If correct, it means that the relocation process may deter pre-breeding individuals from returning to their home colonies. They may choose to move elsewhere to breed. It is noteworthy that a substantial proportion (7.4%) of all banded birds from Robben Island that were relocated and subsequently re-sighted was not seen at Robben Island. The equivalent value for Dassen Island is 3.1%, but this is based on a much smaller number of observations. Following the *Apollo Sea* spill in 1994, at Dassen Island there were decreases in numbers of penguins breeding in areas where many had been oiled, but increases in some other areas (Crawford *et al*. 1997). Disturbance may have caused some pairs to relocate nest sites to other parts of the island. It is likely that this could be accomplished without the loss of mates.

African Penguins breeding for the first time are able to move to non-natal localities if these are deemed more favourable at the time than their natal colonies, whereas birds already breeding almost invariably return to their home colonies because they have a high fidelity to mates and will encounter their mates at their home colonies (Randall 1983, Crawford *et al*. 1995a, Crawford 1998). A lack of sufficient food is another factor that may cause African Penguins breeding for the first time to emigrate from their natal colonies (Crawford 1998). In spite of the possible non-return of some pre-breeding birds to Robben Island, following their relocation to Cape Recife, the number of pairs that bred there increased by 18% between 2000 and 2001. This is thought to be attributable to a high proportion of adults breeding and good recruitment to the colony in 2001, as a result of favourable feeding conditions (Wolfaardt *et al*. 2001). However, numbers breeding at Robben Island decreased in 2003 (du Toit *et al*. 2004).

Rehabilitated African Penguins have often returned quickly to their home colonies. For example, one bird from Robben Island which was oiled during the *Apollo Sea* spill and released on the adjacent mainland was back at its nest the day after release (Underhill *et al*. 1999). One bird that was oiled at St Croix Island, rehabilitated at SANCCOB and released at Robben Island, returned to St Croix, a distance of 890km, in 11 days, at an average 3.4km/h (Randall *et al*. 1981). This distance is similar to that travelled by birds from Cape Recife to Robben and Dassen Islands. As with these rehabilitated birds, many of the relocated birds returned quickly to their home islands, some within 10–11 days of release (Crawford *et al*. 2000), including the three birds fitted with PTTs. Similarly, many Little Penguins *Eudyptula minor* returned rapidly to their colonies after being relocated after an oil spill off Tasmania, Australia (Hull *et al*. 1998). The rapid return to their home islands of some rehabilitated African Penguins may result from birds being removed from colonies during breeding attempts. Other birds take longer to return to their colonies. Oiled African Penguins from St Croix Island, rehabilitated and released at Robben Island, returned to St Croix Island in periods ranging from 11–164 days (Randall *et al*. 1981).

After spending several days at their home colonies, both Peter and Pamela left on long trips, presumably to forage. African Penguins undertake long foraging trips before and after moulting. The pre-moult fattening period lasts on average 34 days (Randall and Randall 1981), which is similar to

the period that Pamela was away from Dassen Island (36 days), although when Pamela was caught on Dassen Island to have her transmitter removed, she did not appear to be about to moult. Peter spent 19 days away from Robben Island but went on subsequent foraging trips as well. These two birds may have abandoned breeding for the 2000 season, as a result of failure to relocate their mates. After the sinking of both the *Apollo Sea* and the *Treasure*, and substantial disruption of breeding, adults at Robben Island moulted earlier than normal (Crawford *et al.* 1995a, Underhill and Crawford 1999, Hemming 2001).

Peter and Pamela, after return to their home islands, left for long trips in opposite directions. Peter headed north to St Helena Bay (Figure 2), where shoals of young anchovy *Engraulis capensis* and sardine *Sardinops sagax* are frequently encountered in winter (Crawford 1980). These fish form a major portion of the diet of African Penguins (Crawford *et al*. 1995a). Pamela swam east of Cape Agulhas, where she spent substantial time south-west of Mossel Bay (Figure 3), where there is a quasi-permanent ridge of cool upwelled water associated with high chlorophyll production (Probyn *et al*. 1994). This ridge may attract planktivorous fishes such as anchovy and sardine.

The average swimming speed of Peter and Pamela when they were presumed to be foraging (5.7km/h) was about half of that when they were outbound on or inbound from foraging trips (11.2–12.1km/h). This speed is probably an underestimate, given the infrequent sampling rate derived from satellite tags and the assumption of straight-line differences between successive fixes (Ryan *et al*. 2004). A study at St Croix Island indicated that speeds during nocturnal swimming away from the colony were c. 2.8km/h, while speeds during daytime foraging were c. 5.3km/h, and c. 6.9km/hr on return to the colony (Heath and Randall 1989). Wilson and Wilson (1990) found that, when swimming underwater, African Penguins had average speeds of 7.3km/h (± 0.5), while average speeds when porpoising and swimming on the surface were 12.3km/h (± 2.3) and 1.5km/h (± 0.6), respectively. Petersen *et al*. (2005) recorded average swimming speeds of 4.2km/h for African Penguins that were commuting and 3.3m/s for those foraging. Over a short distance (200m), African Penguins at Dassen Island travelled at 3.6km/h when leaving the island and 6.2km/h when returning to it (Siegfried *et al*. 1975).

Although signals showed that Peter had returned again to Robben Island, he was not seen there until 1 April 2004 (PJ Barham, pers. obs.). This illustrates the fact that birds are still being seen for the first time after their rehabilitation or relocation. The survival of oiled African Penguins after rehabilitation is high (Underhill *et al*. 1999). It was estimated to be 79%, similar to the 81% estimated for non-oiled adult birds at Robben and Dassen Islands (Whittington 2002, 2003). Six years after the *Apollo Sea* oil spill, at least 60% of penguins rehabilitated in that spill had been recorded breeding, so that the rehabilitation of these birds is considered to have conservation value (Wolfaardt and Nel 2003). In Tasmania, the minimum estimates for post-release survival of rehabilitated oiled Little Penguins were 59% and 44% at different localities, which were significantly lower than survival of non-oiled birds (Goldsworthy *et al*. 2000).

At Dassen Island, the proportion of relocated birds sighted within a year of release was greater than the proportion of rehabilitated oiled birds seen (Wolfaardt *et al*. 2001), indicating that relocated birds also have a high rate of survival. Although the proportion of relocated birds seen at Robben Island was smaller, it is unlikely that their survival was lower than that of birds from Dassen Island. Relocation may have caused some pre-breeding birds from Robben Island to move to other localities. A substantial proportion of birds relocated from Robben Island has been seen at other localities. This may have slowed growth of the Robben Island colony, but the main objective of the relocation of birds — to reduce mortality — was met. Capacity to cope with more than the 19 000 oiled penguins collected at the time of the *Treasure* oil spill was limited. Indeed, some 800 birds in poor condition had to be euthanased, because it was not possible to provide them with adequate care (Crawford *et al*. 2000). Relocation was implemented to reduce the intake of oiled birds, and appears to have been an effective conservation measure.

Of 437 orphaned African Penguin chicks that were reared until they fledged at Dassen Island after the *Apollo Sea* oil spill and released with flipper bands in August 1994, 47 (10.8%) were re-sighted by June 1999. Most of these were re-sighted at Dassen Island within two years of release (Whittington 2002). For chicks raised in captivity, banded and released to the wild after the *Treasure* oil spill, the proportion seen was higher (18.8–31.8% within 3.5 years). Some of these young birds have already bred (PJ Barham pers. obs.). Therefore, this intervention also had conservation value.

Hitherto, the breeding success of rehabilitated oiled penguins has been approximately 70% of that of other birds, including relocated birds and chicks reared in captivity that are now breeding (PJB, pers. obs.). However, further monitoring is required before the conservation value of the three interventions applied can be properly assessed.

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