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INITIAL IMPACT OF THE *TREASURE* OIL SPILL ON SEABIRDS OFF WESTERN SOUTH AFRICA

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On 23 June 2000, the bulk ore carrier MV *Treasure* sank off western South Africa between Dassen and Robben islands, which individually currently support the largest and 3rd largest colonies of African penguins *Spheniscus demersus*. Subsequently, more than 19 000 penguins were oiled, almost twice the previous highest number of seabirds oiled during a single event in southern Africa (10 000 penguins after the sinking of the *Apollo Sea* in June 1994). About 19 000 oiled penguins were collected for cleaning and care and about 150 oiled adults died in the wild. Some 19 500 unoiled penguins were caught at Dassen and Robben islands and relocated to Port Elizabeth, 800 km to the east, to remove them from waters affected by the oil. Of all penguins caught, which amounted to 20% of the total species population, less than 2 000 died within the first month, considerably less than in the *Apollo Sea* spill. This can be attributed to improved transport of penguins and the rapid arrival at rescue centres of experts able to administer emergency care. However, resources were severely extended and mortality would probably have been considerably higher had large numbers of birds not been removed from the area affected by the oil. Many relocated birds returned to their home islands within a month of being released, but considerable disruption of pair bonds is expected to result from mortality, different periods in captivity and disruption of moult cycles. This is likely to result in decreased breeding success. Recruitment to colonies will also be reduced by substantial loss of chicks and eggs. Although more than 3 000 orphaned chicks were collected for captive rearing, an estimated 4 000 died at the islands before they could be rescued. Up to 20% of bank cormorants *Phalacrocorax neglectus* at Robben Island, the 3rd largest colony of the species in South Africa, died. There was low success in catching oiled cormorants and in saving those that were caught. Of 53 grown birds of four species of cormorant that were oiled and caught, only 17 survived. Captive rearing of bank cormorant chicks, which it was feared may have been orphaned, proved more successful. Spilt oil had minor impact on gulls, terns and shorebirds in the region.

In the early morning of 23 June 2000, the bulk ore carrier MV *Treasure* sank off western South Africa between Dassen and Robben islands (Fig. 1), both "Important Bird Areas" (Barnes 1998). *Treasure* was carrying about 1 344 tons of heavy fuel oil (viscosity 180 centistokes, pour point 4°C), 56 tons of marine diesel and 64 tons of lubrication oil, of which all but 205 tons of heavy fuel oil spilt into the surrounding water. On 24 June, oiled African penguins *Spheniscus demersus*, including some that were heavily oiled, started to come ashore at Dassen and Robben islands (Fig. 2). Oil moved towards Robben Island, where booms were attached to the end of the breakwater at Murrays Bay Harbour, and deployed in a northerly direction (Fig. 3a) in an attempt to keep oil from reaching that portion of the island's coastline used by most penguins for accessing the breeding area (Fig. 4). The booms parted on the night of 24 June, and oil came ashore between the breakwater and the northern point of the island. This meant that almost all penguins arriving at or leaving the island would become oiled. Additionally, oil covered large portions of the foraging grounds of penguins at Robben Island, which had been determined using transmitters to satellites (Marine & Coastal Management, unpublished information).

A few days later, the oil moved north towards Dassen Island, which it reached on 28 June (Fig. 1). Large quantities of oil came ashore at Whale Bay, the southern portions of Area C and Ichaboe Point, and lesser quantities in Lime Kiln Bay, parts of Waterloo Bay, the northern section of Area G and portions of Boom Point (Fig. 5). Prevailing currents

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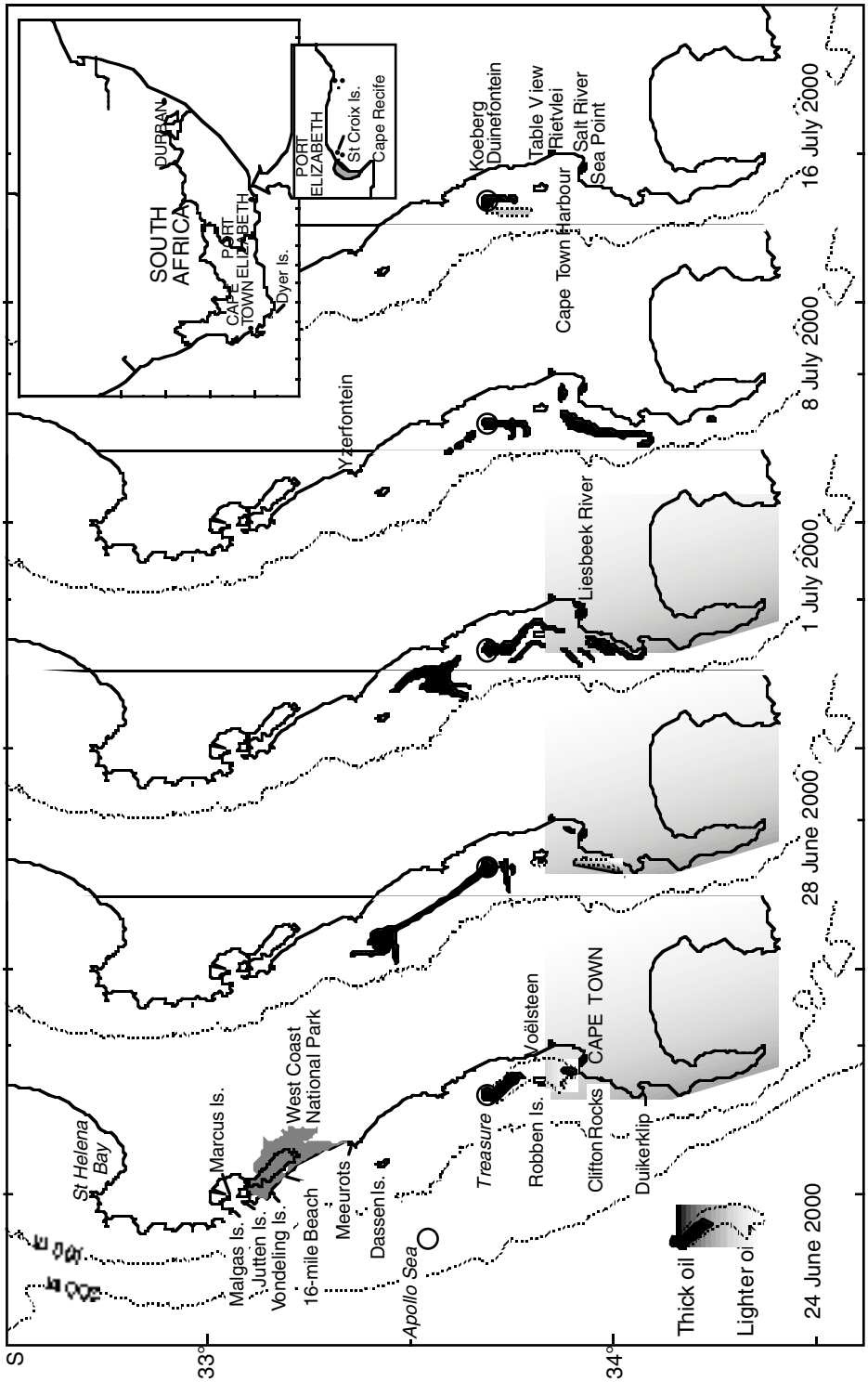

Fig. 1: The distribution of oil on the sea surface on selected days after sinking of the M. V. *Treasure* on 23 June, as determined from aerial surveys of the affected area. The positions where the *Apollo Sea* and the *Treasure* sank are indicated, as well as the locations of rescue centres in the greater Cape Town area. The insert shows Cape Recife, from where relocated birds were released

Fig. 2: Oiled penguins collected at (a) Robben and (b) Dassen islands

continued to move the oil north, leading to concern that seabird colonies at islands farther north, including Vondeling Island and islands in the West Coast National Park, would also be impacted. By 1 July, no oil was observed north of Dassen Island, but large slicks remained between Dassen and Robben islands and south of Robben Island, where they continued to threaten penguins until 16 July (Fig. 1).

In addition to African penguin, seabirds at risk from the *Treasure* spill included bank cormorant *Phalacrocorax neglectus*, Cape cormorant *P. capensis,* crowned cormorant *P. coronatus*, great (white-breasted) cormorant *P. carbo*, kelp gull *Larus dominicanus*, Hartlaub's gull *L. hartlaubii* and swift tern *Sterna bergii*. The African penguin, bank, Cape and crowned cormorants and Hartlaub's gull are endemic to southern Africa; the races of kelp gull and swift tern found in the region occur nowhere else. Numbers of African penguin decreased throughout the 20th century, recently at a rate that has led to its classification as Vulnerable (Crawford 1998, Barnes 2000). The bank cormorant also is considered Vulnerable, whereas Cape and crowned cormorants are Near-threatened (Barnes 2000).

In terms of numbers of seabirds affected, the previous most serious oil spill in South Africa was that of the *Apollo Sea*, which sank between Dassen and Robben islands (Fig. 1) on 20 June 1994 (Morant *et al.* 1981, Adams 1994, Underhill *et al.* 1999). Oil from that spill came ashore on Dassen Island at West Bay and House Bay, and later also on Robben Island. This resulted in about 10 000 penguins being oiled, of which 4 718 were successfully cleaned by Southern African National Foundation for the Conservation of Coastal Birds (SANCCOB) and later returned to the wild (Crawford *et al.* 1997a, Underhill *et al.* 1999). The other 5 000 birds died, many during transportation from the islands to SANCCOB's rescue stations or in the first few days after arriving at the stations (Williams 1995). Soon after the *Treasure* sank, it became apparent that a much larger number of birds than affected by the *Apollo Sea* was at risk of becoming oiled, and that unless steps were take to minimize this number, it may prove beyond the capacity of SANCCOB to care for them.

This paper discusses steps taken to minimize the

Fig. 3: A boom being deployed from the breakwater at Murrays Bay Harbour (a) and application of peat-based absorbents to rocks at (b) Robben Island and (c) Dassen Island

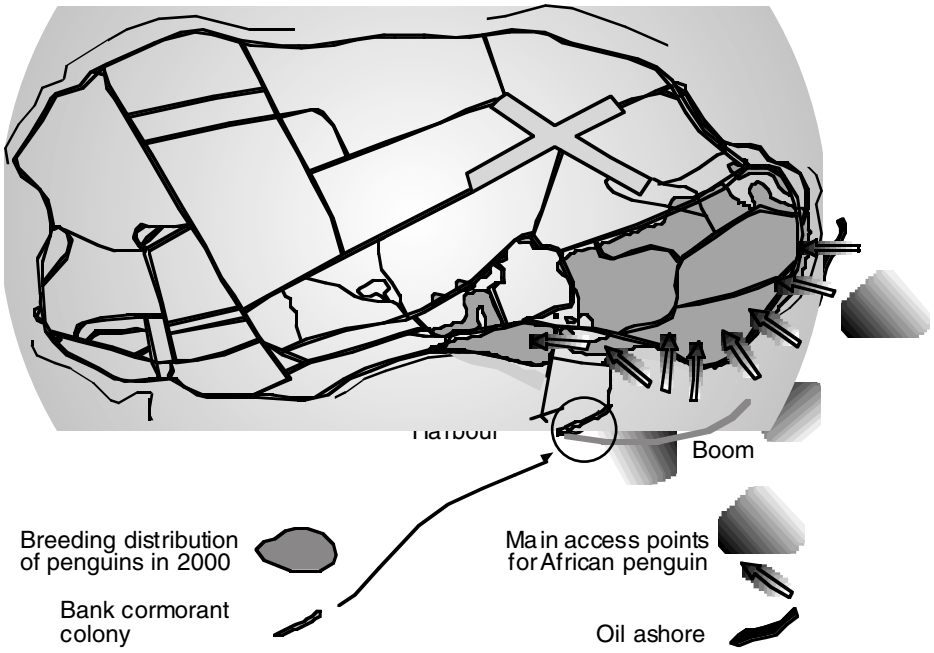

Fig. 4: Robben Island, illustrating the area used by African penguins for breeding in 2000, the main access points to the breeding area, the location of the bank cormorant colony, the deployment of booms on 24 June and that portion of the coastline affected by oil

numbers of birds that became oiled and remedial measures that were implemented for those that were oiled. It also assesses the initial impact of the *Treasure* oil spill on the seabirds off western South Africa. It is not yet possible to report the final impact of the spill because many seabirds are, at the time of writing, at the rescue centres. Additionally, it will be several years before follow-up studies are able to assess the long-term impact of the spill on the seabird colonies.

STATUS OF SEABIRD COLONIES AT RISK FROM THE OIL SPILL

African penguin

In the early 1990s, there were approximately 56 000 breeding pairs representing 180 000 adult African penguins (Crawford *et al.* 1995b). Counts of the breeding populations at Dassen and Robben islands were conducted from 22 to 27 April 2000 and 17 May to 14 June 2000, and totalled 17 181 and 5 705 breeding pairs respectively. Assuming a ratio of 3.2 adults per breeding pair, a factor computed for Robben Island between 1988 and 1993 (Crawford and Boonstra 1994), the populations at Dassen and Robben islands in 2000 were estimated to be 55 000 and 18 000 adults respectively, making these colonies the largest and 3rd largest for the species (Fig. 6). Together they accounted for about 40% of the total population.

The nest count at Dassen Island in 2 000 was the highest on record, suggesting that the colony has increased above its level in 1978 (11 220 pairs), when the first nest count was undertaken (Shelton *et al.* 1984, Crawford *et al.* 1995b). The colony at Dassen Island had 1.45 million birds in adult plumage in 1910 (Shannon and Crawford 1999), but this decreased to fewer than 8 000 breeding pairs in the early 1990s. At Robben Island, numbers have increased steadily since the island was recolonized in 1983, except in 1995, after the loss of about 1 200 birds in 1994 to the *Apollo Sea* spill (Crawford *et al.* 1995a, 1999a).

At Robben Island, most egg laying takes place from February to April (Crawford *et al.* 1995a). Off western South Africa, the main breeding season of penguins

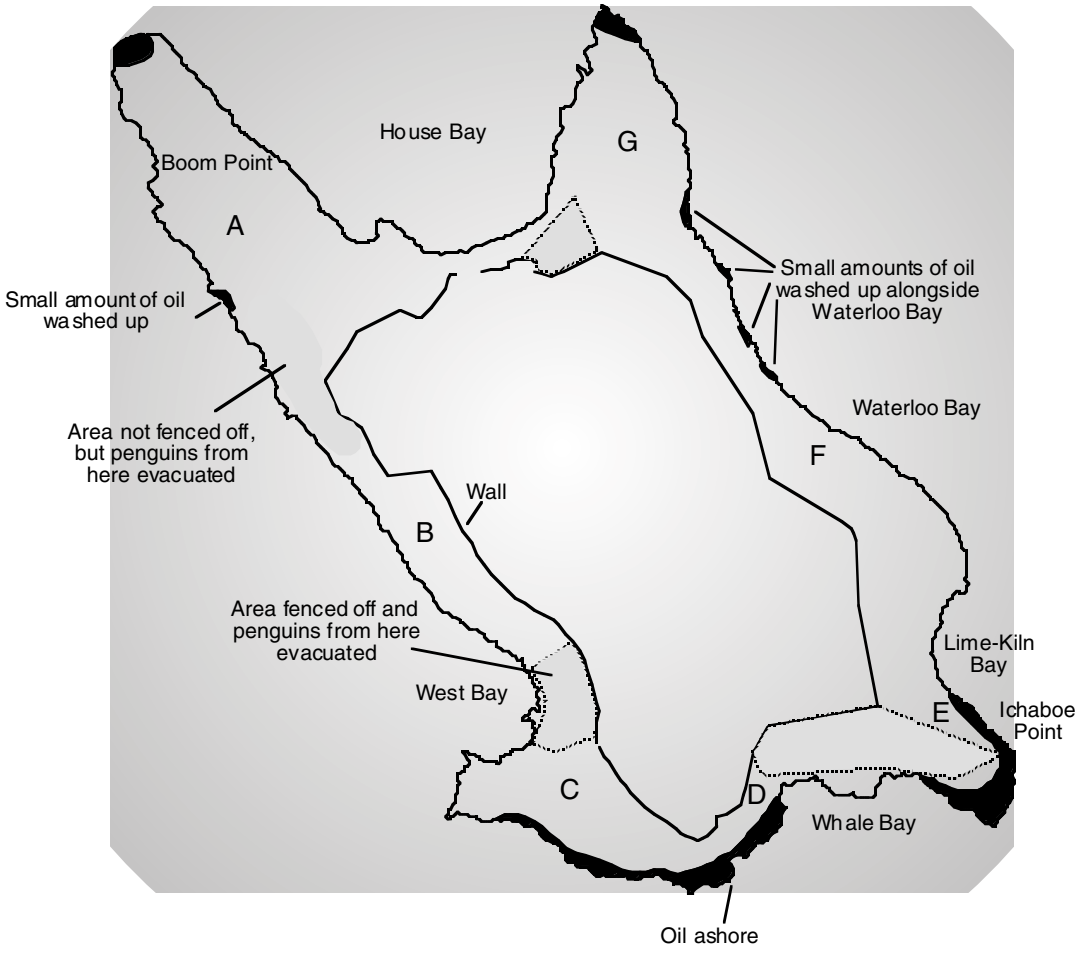

Fig. 5: Dassen Island, showing the position of the interior wall that was used to prevent African penguins from leaving for sea, where additional fencing was erected to keep penguins ashore, from where clean penguins were evacuated and those portions of the coastline that were affected by oil

extends from February until September (Crawford *et al.* 1995b). At the dates when the counts were undertaken in 2000, breeding had finished at 139 nests (1%) at Dassen Island, whereas a further 1 444 nests (8%) were occupied, but without eggs or chicks. The equivalent values for Robben Island were 298 (5%) and 230 (4%) nests respectively. At both localities, it is probable that some more pairs had completed breeding by the time that *Treasure* sank, because of the period that elapsed since counting was undertaken. The incubation stage lasts about 40 days and chicks fledge after a further 60–120 days (Randall 1989).

On 21 June 2000, two days before *Treasure* sank, a sample of 65 active nests was checked at Robben Island. Of these, 9% had only adults present, 20% had eggs, 63% had chicks mainly covered with downy feathers, and 8% had chicks mainly in final fledging plumage. The mean clutch size of nests with eggs was 1.85 eggs, whereas nests with chicks had on average 1.64 chicks. Assuming that 90% of nests (5 135) were active at the time, and that the sample was applicable to the entire colony, 1 027 nests would have had eggs and 3 645 would have contained chicks. There would have been about 6 000 chicks at Robben Island.

From 15 to 23 June 2000, 1 075 active nests were checked at Dassen Island. Of these, 269 (25%) had just

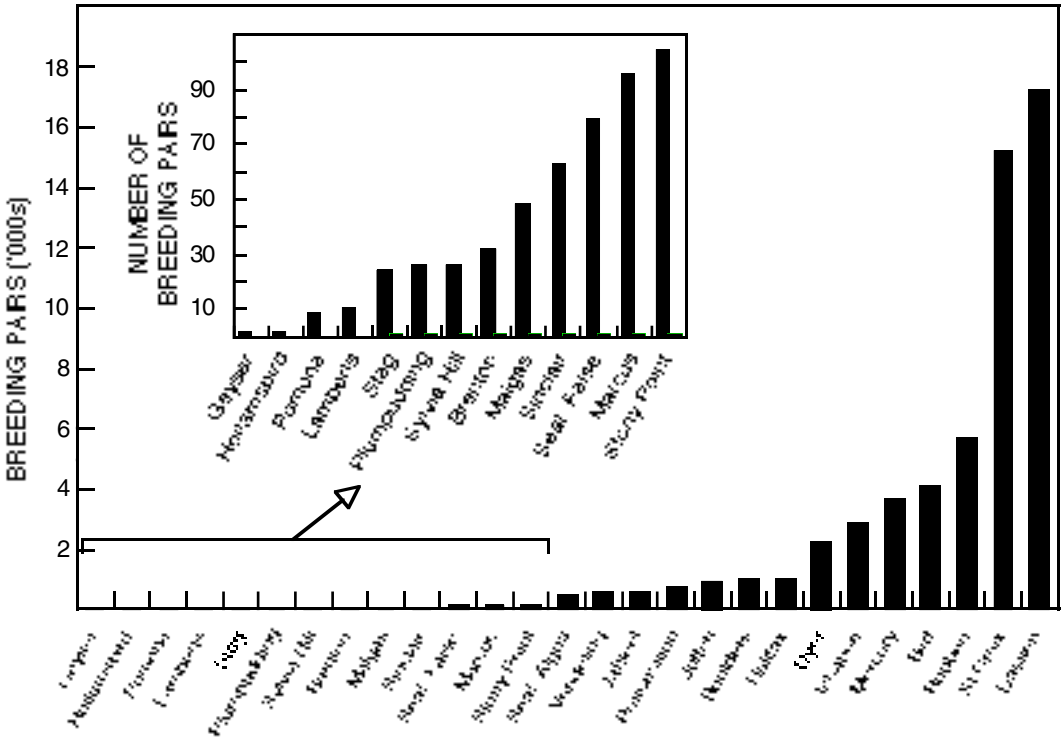

Fig. 6: The estimated numbers of pairs of African penguins breeding at the 27 extant colonies (from information in Crawford *et al.* 1995b, Marine & Coastal Management unpublished data)

adults present, 420 (39%) had eggs and 386 (36%) had chicks. If it is assumed that 36% of nests that were active at the time of the count in April (15 598) had chicks when *Treasure* sank and that, similarly to Robben Island, each nest with chicks had an average of 1.64 chicks, there would have been about 9 000 chicks at Dassen Island. Many of these were close to fledging (ACW pers. obs.).

In 2000, 528 pairs of penguin nested at Vondeling Island and 1 042 pairs at Jutten, Malgas and Marcus islands in the West Coast National Park. Foraging ranges established for African penguins (Heath and Randall 1989, Crawford and Whittington 1997) meant that birds from these islands might have travelled to areas affected by the oil.

Bank cormorant

The global population of bank cormorants decreased from 8 672 pairs in the period 1978–80 to 4 888 pairs in the period 1995–97. In the latter period, the colony at Robben Island was the 3rd largest in South Africa, and that at Clifton Rocks, just south of Table Bay, the 2nd largest. Both colonies numbered slightly more than 100 pairs. The colony at Dassen Island decreased from 211 pairs in 1978 to just 36 pairs in 1995 (Crawford *et al.* 1999b). When *Treasure* sank, 41 pairs were breeding at Dassen Island; on 15 March 2000, 120 pairs were breeding at Robben Island. Other colonies at risk from the *Treasure* oil spill included those at Meeurots, Koeberg Harbour, Voëlsteen and Duikerklip (Fig. 1).

Off western South Africa, the main breeding season for bank cormorants is from March until November (Crawford *et al.* 1999b). On 14 June 2000 at Robben Island, many nests were empty but some had chicks and a few had eggs.

Other cormorants and gannets

The total population of Cape cormorants numbered 247 000 pairs in the period 1977–81 (Cooper *et al.*

1982), but just 72 000 pairs in 1996 (Crawford 1999, Barnes 2000). The global population of crowned cormorants was 2 655 pairs in 1977–81 (Crawford *et al.* 1982a) and is thought to be stable (Barnes 2000). In the period 1977–81, the marine population of great cormorants in southern Africa was 2 524 pairs (Brooke *et al.* 1982), but numbers at islands off the Western Cape have subsequently decreased (Marine & Coastal Management unpublished data).

Off western South Africa, the main breeding season for Cape and crowned cormorants is from September to February and from December to March respectively, although breeding may take place throughout the year (Crawford *et al.* 1999c). Neither species was breeding at Robben Island from 17 May to 14 June 2000; at the time *Treasure* sank, 57 pairs of Cape cormorant and 23 pairs of great cormorant, but no crowned cormorants, were breeding at Dassen Island. Great cormorants last bred at Robben Island in 1951 (Crawford and Dyer 2000). Substantial numbers of Cape cormorant often breed and roost at islands in the West Coast National Park (Cooper *et al.* 1982).

Malgas Island in the West Coast National Park supports a large colony of Cape gannets *Morus capensis*, most of which forage to the south of this island (Crawford 1999).

Gulls, terns and other shorebirds

For the period 1976–1981, the southern African population of kelp gulls was estimated to be 11 200 pairs. The largest colony was at Dassen Island, which had 2 892 pairs. Kelp gulls do not breed at Robben Island (Crawford *et al.* 1982b). The colony at Dassen Island increased to 4 541 pairs in 1992 (Crawford *et al.* 1994). In western South Africa, kelp gulls breed from August to February, but mainly from October to December. Many birds disperse away from Dassen Island between April and June (Crawford *et al.* 1997b).

The overall population of Hartlaub's gull is approximately 12 000 pairs (Williams *et al.* 1990). None bred at Robben Island in 2000, but 741 pairs nested at Dassen Island. About 1 500 pairs of Hartlaub's gull bred in the greater Cape Town area in 2000, including 1 215 at Century City, 268 in Cape Town Harbour and five in Sea Point. Those in Cape Town Harbour were rearing chicks at the time of the spill.

The southern African population of swift terns is approximately 6 000 pairs (Cooper *et al.* 1990), of which 4 192 pairs (70%) nested at Dassen Island in 2000. Breeding had been completed by the time of the *Treasure* spill, although parents were still feeding their fledged young in the vicinity of islands. No swift terns bred at Robben Island in 2000.

The global population of African black oystercatchers *Haematopus moquini* was estimated in the early 1980s to be about 4 800 birds (Hockey 1983). Although this is likely to have increased, the species is classified as Near-threatened (Barnes 2000). The numbers of breeding pairs on Dassen and Robben islands are 100 and 35 respectively.

MINIMIZATION OF THE IMPACT ON SEABIRDS

The plumage of seabirds is affected by oil. Feathers become clumped, leading to a breakdown in their insulative properties. As a result, birds become hypothermic and are forced to leave cold waters (Erasmus *et al.* 1981). They dehydrate, mobilize stored energy reserves and may lose up to 13% of their body mass within a week (Morant *et al.* 1981). Unless rescued, they will eventually starve. Oil ingested by preening can cause ulceration of the mouth, oesophagus and stomach, and in severe cases can lead to substantial blood loss. Oil absorbed into the system can cause red blood cells to rupture, leading to anaemia (Birrel 1995). Further, an immuno-suppressent effect makes birds more susceptible to diseases (Morant *et al.* 1981) such as pneumonia and aspergillosis. Ingested oil may produce a greater diversity of pathogenic bacteria (Kerley and Erasmus 1987). If a bird gets oil in its eye, it can lead to ulceration of the cornea and blindness unless treated.

Standard practice during oil spills is to catch and treat oiled birds as soon as possible. In the *Treasure* spill, this ideal was tempered by the realization that, if measures were not taken to prevent uncontaminated penguins from becoming oiled, the quantity of oiled birds might increase rapidly to an unmanageable number. Accordingly, for penguins, strategies were adopted that aimed to attain the twin objectives of minimizing the numbers of birds becoming oiled and providing those that became oiled with rapid care.

At Robben Island, the strategy involved two components. First, attempts were made to catch all penguins congregating along the shoreline, because this provided a much higher rate of capture than at the breeding areas. At breeding areas, only conspicuous oiled birds were collected. Second, an attempt was made to clear all landing areas of oil. Moveable rocks contaminated with oil were initially piled together and dusted with an absorbent peat-based dust that rendered them dry. They were later returned to the beach area. The rocky coastline and intertidal region

Fig. 7: The nets used to capture African penguins at (a) Robben Island and (b) Dassen Island

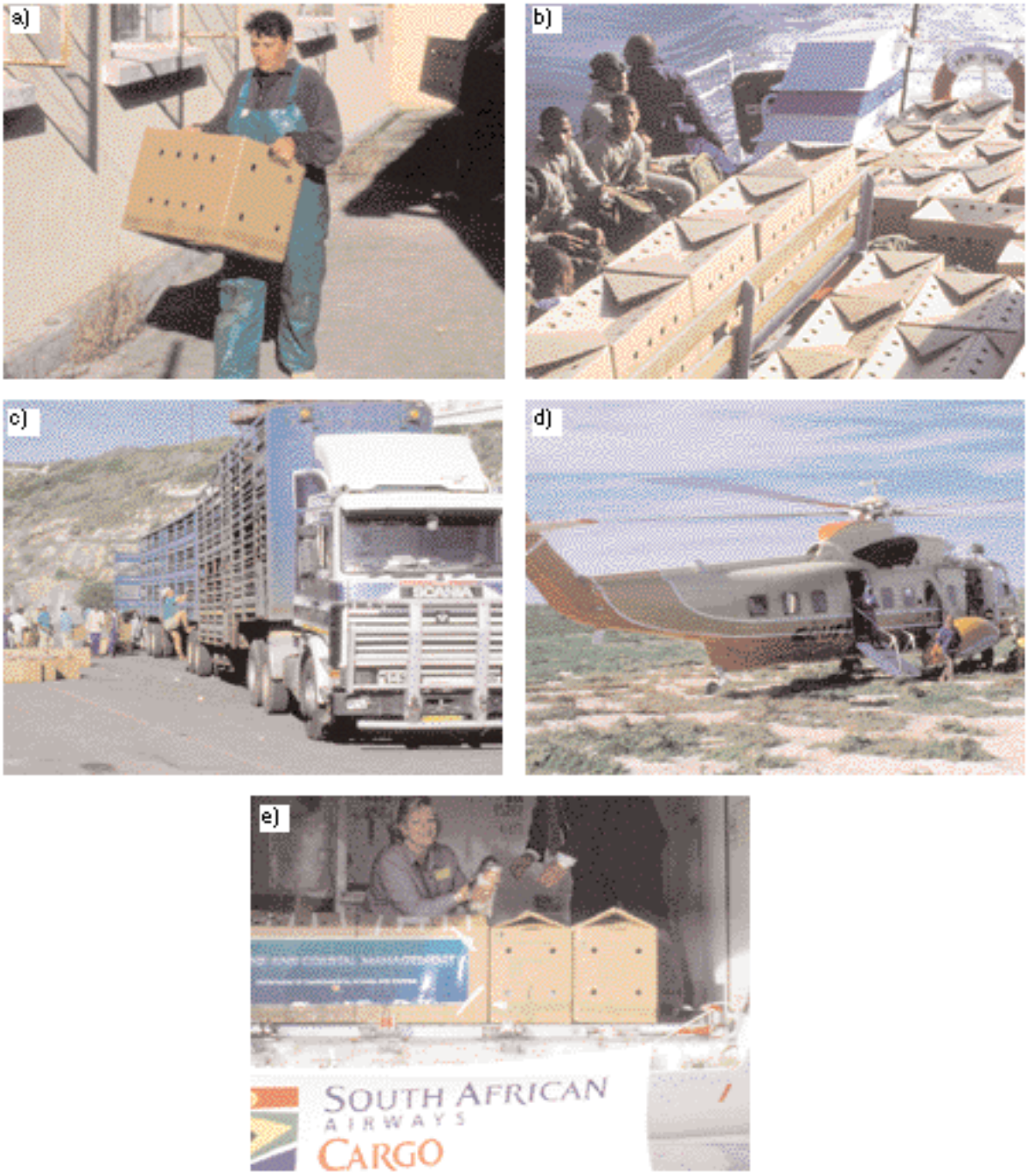

Fig. 8: Boxes used for the transportation of African penguins by (a) hand, (b) boat, (c) truck, (d) helicopter and (e) cargo plane

were cleaned by rubbing fine absorbent material into the oil on the rocks and brushing it off with hard bristle brushes (Fig. 3b,c). Kelp contaminated with oil was removed and buried on the island. A survey showed the Robben Island coastline to be mostly clean of oil by 5 July.

Penguins were caught along the shoreline of Robben Island by catching teams of up to 14 people. Up to 10 members of the team attempted to isolate groups of penguins from the sea. Initially two persons moved rapidly between penguins and the sea. They were followed by six others carrying six frames of 112.5 × 54 cm, each covered with mesh netting. The frames were joined together and were opened to create a barrier between the penguins and the sea (Fig. 7). Two persons followed the nets to prevent penguins escaping behind the nets. The penguins were then moved away from the sea with the nets. The other team members prevented penguins from reaching vegetated areas and forced them to collect against the nets. Smaller groups of penguins could be encircled by the nets. The birds were placed into boxes measuring 57.5 × 35.5 cm × 41.5 cm, four per box, for removal from Robben Island, but three per box for longer journeys (Fig. 8). These boxes had been designed for transportation of African penguins after the *Apollo Sea* spill. Each is fitted with 32 ventilation holes and two carrying holds. Clean penguins and oiled birds were placed in separate boxes. All were taken to one of SANCCOB's holding stations, with clean birds later being moved to Sea Point and taken from there by truck to Cape Recife near Port Elizabeth.

At Dassen Island, the initial effort was directed at collecting oiled penguins, but once oil approached the island attempts were also made to prevent clean birds from leaving for sea. From 27 June to 1 July, the wall that circles the interior of the island (Fig. 5) was repaired to prevent penguins nesting within its confines from reaching the sea. Clean penguins outside the wall were moved inside the wall. Seawards of the wall, fencing was deployed around three areas where there were dense concentrations of penguins to contain them on land (Figs 5, 9). The technique of fencing breeding colonies to reduce the number of birds becoming oiled was employed at Dyer Island in 1971 after sinking of the *Wafra* (Morant *et al.* 1981). Clean penguins were evacuated from Dassen Island from 2 to 4 July, and trucked from Yzerfontein to Cape Recife (Fig. 8). Thereafter, effort reverted to collecting oiled penguins. As at Robben Island, peat-based absorbents were used to clear oil from rocks. Kelp contaminated by oil was collected and taken to the mainland. The coastline was mostly clear of oil by 8 July.

Natural survival of adult African penguins is 82–90% per annum. At Robben Island the mean number of chicks fledged per breeding pair per year is 0.47 (range 0.32–0.59). Post-fledging survival of first-year birds is thought to be about 0.5 during the first eight months at sea, by which stage the birds are 1-year old. The usual age at first breeding is four years (Crawford *et al.* 1999a). These values mean that only about 32% of chicks that fledge survive to breed. As not all chicks will fledge, the proportion of chicks surviving to breed will be less. Therefore, priority was given to keeping adult birds alive, and second priority immature birds. Adult and immature birds were often caught together.

The decision to relocate the clean penguins, rather than keep them in captivity until the oil had cleared, was taken because all available human resources were required to keep the oiled penguins alive. For this reason also, it was not possible to feed the clean penguins before they were released, even though some had been held away from the sea for several days. All birds held at Sea Point prior to relocation were allowed to swim at least once, and many were given 120 mℓ of half-strength Darrows Solution, a fluid electrolyte (mineral) and energy replacement, before being trucked to Cape Recife, but this was not done for birds relocated from Dassen Island. Each mℓ of full-strength Darrows Solution contains 1.5 mg potassium chloride, 2 mg sodium chloride, 2.5 mg sodium citrate and 2.5 mg glucose. Clean and washed little penguins *Eudyptula minor* were successfully relocated to prevent their coming into contact with oil after the *Iron Baron* ran aground in Tasmania, Australia (Hull *et al.* 1998).

The selection of Cape Recife as a destination for the clean penguins was based on four considerations. First, Cape Recife is an important feeding area for penguins from St Croix Island, the second largest colony (Heath and Randall 1989, Fig. 6). Therefore, there was likely to be sufficient food for the relocated penguins on release. Second, it was advantageous to keep the penguins from the area affected by the oil for as long as possible, to provide sufficient time for salvors to remove remaining oil from *Treasure*, for the sea to disperse oil that had spilt from the vessel, and for oil to be cleared off the coastlines at Dassen and Robben islands. In 1979, 87% of a batch of penguins released at Robben Island after cleaning at SANCCOB returned to St Croix Island (Randall *et al.* 1980). At the same time, it was desirable that penguins should be subjected to as little stress as possible. It took 9–14 hours to truck the penguins from Sea Point and Yzerfontein to Cape Recife. A longer journey was deemed unsuitable, especially given that

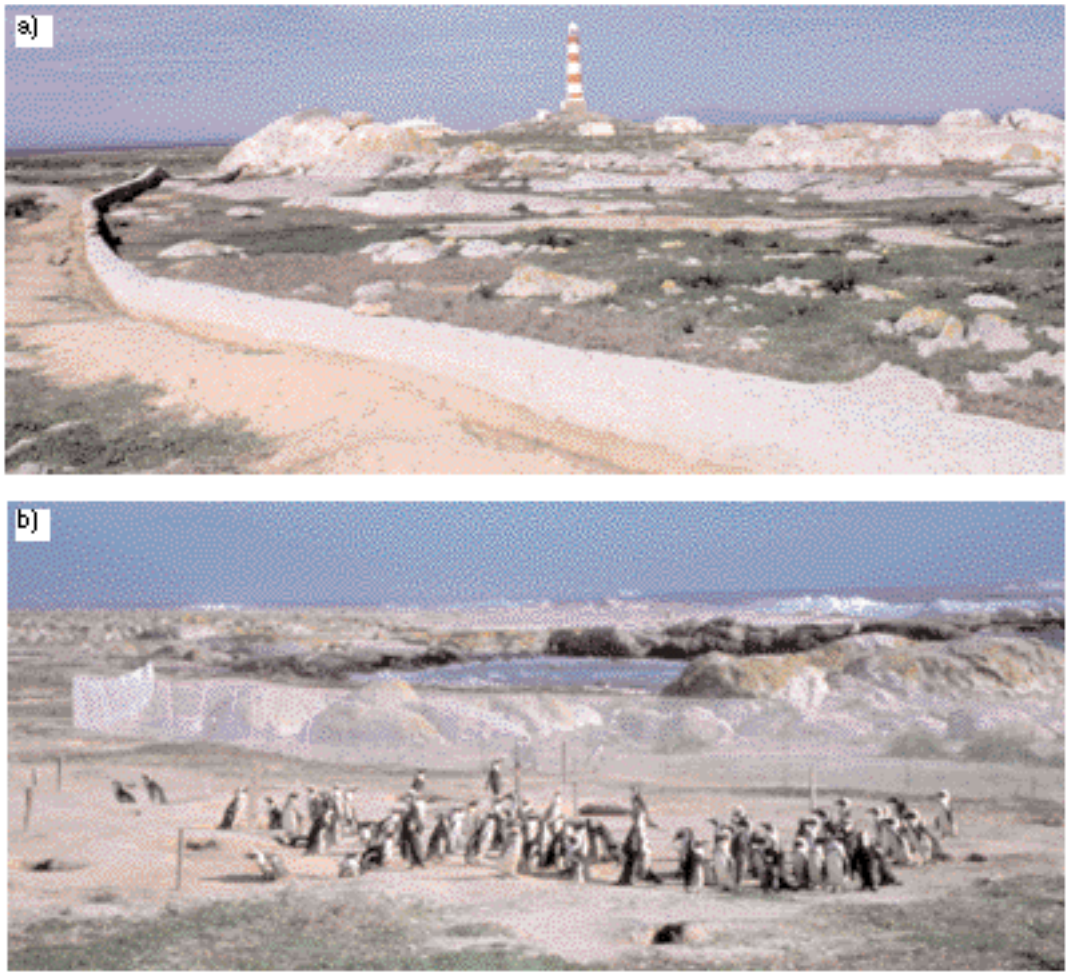

Fig. 9: Clean penguins were prevented from going to sea at Dassen Island by (a) keeping them inside the wall that was initially built to facilitate collection of penguin eggs by forcing birds to nest on the seaward side of the wall, and (b) erecting fences around dense colonies situated on the seaward side of the wall

large numbers of the penguins had been kept away from the sea, and hence would not have eaten, for several days. Third, staff of the Port Elizabeth Museum (Bayworld) and Marine & Coastal Management were able to supervise the release of penguins to sea at Cape Recife. Fourth, in 1981, African penguins had made an unsuccessful attempt to colonize Cape Recife (Shelton *et al.* 1984), which also indicated that the waters around Cape Recife were suitable for them. Although it may be construed that the failed attempt to establish a colony suggested the area was not suitable, this was thought to result from factors operating on land, not at sea.

The return of the relocated penguins to waters of the Western Cape was monitored by attaching satellite transmitters (ST-10s supplied by Telonics) to three penguins. The first (named Peter), caught at Robben Island, was released at Cape Recife on 30 June. The other two (Pamela and Percy), caught at Dassen Island, were released at Cape Recife on 3 and 5 July. The sex of the three penguins was not determined, but on the basis of size the first and third to be released were thought to be males and the second a female. Their progress was plotted on the website http:

Fig. 10: A ST-10 instrument attached to Percy

//www.uct.ac.za/depts/stats/adu/oilspill/sapmap.htm. One instrument had a transmission cycle of 8 hours on and 24 hours off, whereas the other two were switched on for 12 hours and off for 12 hours. All three instruments were equipped with a saltwater switch that suppressed transmission when the instruments were under water. The instruments had dimensions of $9.1 \times 4.8 \times 2.1$ cm and a mass of 125 g. Each was fitted by gluing strips of Velcro© to the underside of the instrument and to the penguin's back and then joining the two pieces of Velcro (Fig. 10). This permits recovery of the instrument if the bird is caught. The ST-10s transmitted to satellites overpassing the region and information on positions was downloaded to the Argos Services centre in Toulouse, France. In addition to the three birds fitted with the ST-10s, several thousand were fitted with individually numbered stainless-steel flipper bands.

At Robben Island, orphaned chicks were collected from 27 June until 17 July, after the coastline had been cleared of many adult penguins. Most small chicks were not collected. At Dassen Island, larger orphaned chicks were collected after 4 July from localities where large numbers of adults had been removed (Whale Bay, West Bay and Area G). Rescued chicks were taken to SANCCOB and other rescue stations for captive rearing. The same boxes used to transport adult penguins were used for chicks, with 3–5 chicks per box depending on the size of the chicks.

At Robben Island, Dassen Island and in Cape Town Harbour, attempts were made to capture oiled cormorants. They were caught by hand, in the nets used to catch penguins and with hoop nets. All chicks were removed from the bank cormorant colony at Robben Island on 26 June and taken to SANCCOB for captive rearing. The boxes used to transport penguins were also used for cormorants, with up to three adult cormorants per box.

As during the *Apollo Sea* oil spill (Erasmus 1995), the facilities at SANCCOB were insufficient to cater for the large numbers of birds involved. Therefore, a temporary rescue station for oiled penguins was established at Salt River (Fig. 11). About 3 500 oiled penguins were cared for at SANCCOB's Rietvlei premises and more than 16000 at Salt River. Clean penguins from Robben Island were transferred to Sea Point, where they were held for 24–48 h before being trucked to Cape Recife (Fig. 12). Penguin chicks were reared (Fig. 13) at Salt River (723), Duinefontein (Mr and Mrs MacDonald – about 1 557), Tableview (Mr and Mrs Campbell – 206) and Sea Point (52). Additionally, 466 chicks were flown to Durban and 30 to Port Elizabeth for rearing at the Oceanographic Research Institute and Bayworld respectively. They were first stabilized by keeping them overnight at Sea Point, and then flown in large crates, up to 20 chicks per crate depending on chick size.

IMPACT OF THE SPILL ON SEABIRD COLONIES

A total of about 19 000 oiled African penguins was collected, of which 14 825 were caught at Robben Island, 3 516 at Dassen Island and about 500 at other localities, including Vondeling Island (23) and the West Coast National Park (194 – Jutten Island 65, Malgas Island 49, Marcus Island 4, 16-mile Beach 76). Oiled birds were caught as far north as St Helena Bay. Most of the oiled penguins were in adult plumage although some immature birds were also af-

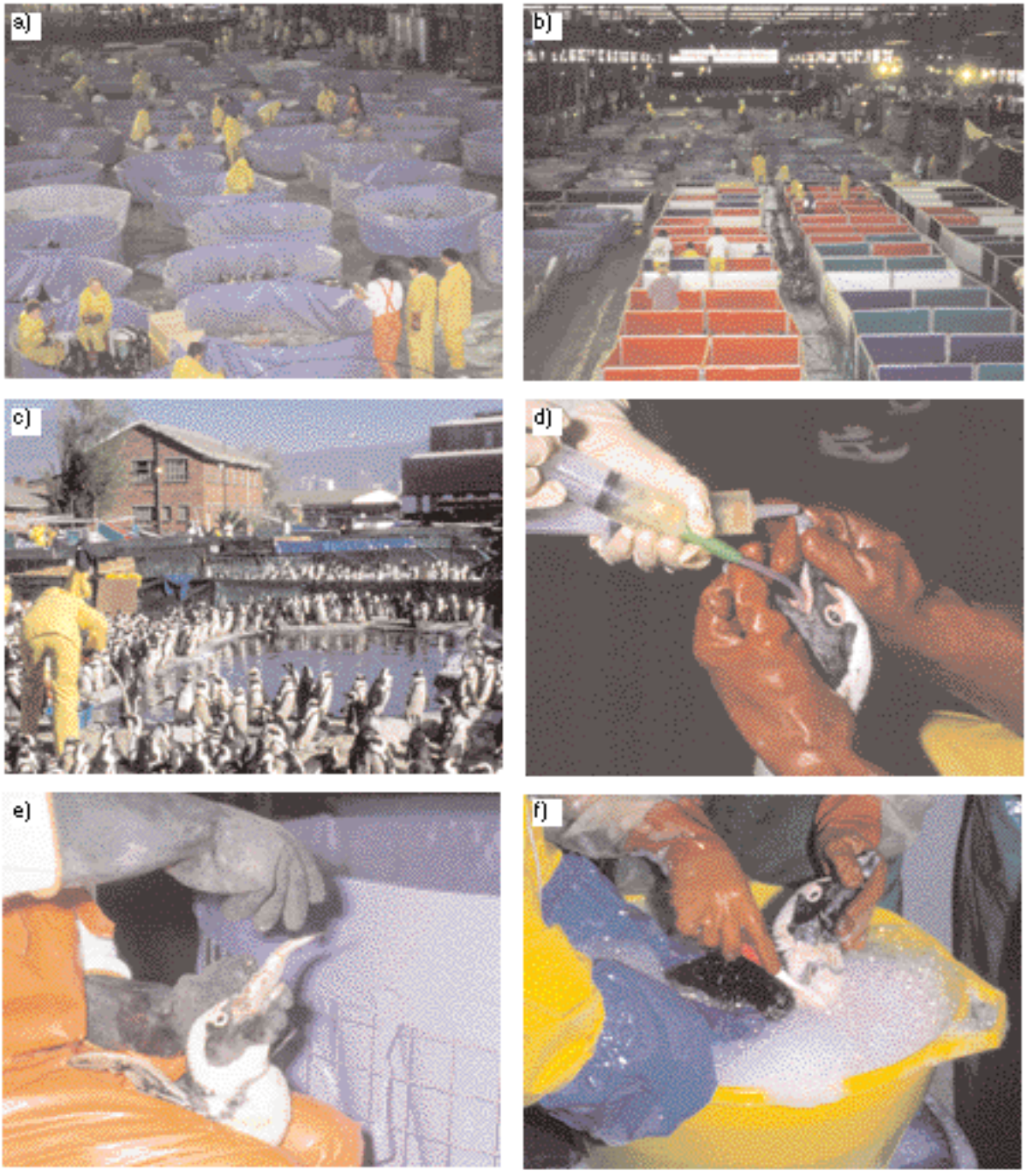

Fig. 11: Facilities were established at Salt River to care for oiled penguins. These included (a) and (b) holding pens and (c) swimming facilities. Treatment administered to birds included (d) rehydration, (e) feeding and (f) washing

Fig. 12: Facilities at the Sea Point Research Aquarium of Marine & Coastal Management allowed large numbers of clean penguins to be held before they were trucked to Cape Recife

fected. At Dassen Island, 2 744 of those oiled were adults and 772 were immature birds. Additionally, 7 161 unoiled birds were removed from Robben Island and 12 345 from Dassen Island. Therefore, excluding chicks, 21 986 birds were taken from Robben Island and 15 861 from Dassen Island. By 18 August 2000, about 1 900 penguins (other than chicks) had died after being caught. These included 213 unoiled birds that died during trucking to Cape Recife, 28 that were later found dead at Cape Recife, and 800 oiled birds in poor condition that were euthanased at Salt River because it was not possible to provide them with sufficient care.

Some 3 350 penguin chicks were collected for captive rearing, 707 from Dassen Island and the remainder from Robben Island. Of these, 319 were euthanased and a further 48 had died by 18 August 2000. A few chicks not removed from Robben Island may have been reared by adults that remained there, and a much larger number at Dassen Island. However, it is likely that about 3 000 chicks died at Robben Island and 1 000 at Dassen Island.

In addition to birds that were caught, four African penguins that died from oiling were counted at about 250 nests at Robben Island. If this is extrapolated to the entire colony, about 90 adult penguins would have died in the breeding area. A further 10 were dead on the coastline and 19 died on the shoreline at Dassen Island. At Vondeling, about 20 oiled penguins were not caught and are likely to have died. Four were found dead on 16-mile Beach and one at Jutten Island. Mortality of adults and immature birds in the wild probably was about 150 birds.

Therefore, the total mortality of African penguins caused by the oil at 18 August 2000 was about 2 000 adults and immature birds and 4 350 chicks.

Although most of the penguins relocated to Cape Recife left there almost immediately, a few lingered at the release site for several hours. On 6 July, 1 740 penguins were released, of which 16 were still there on 7 July. On 8 July, 1 845 were released, two of which remained at Cape Recife until 9 July. Relocated birds started to arrive back at Dassen and Robben islands from 14 July onwards. The three birds equipped with ST-10s arrived back at their islands between 18 and 25 July. Probably many of the relocated birds had re-

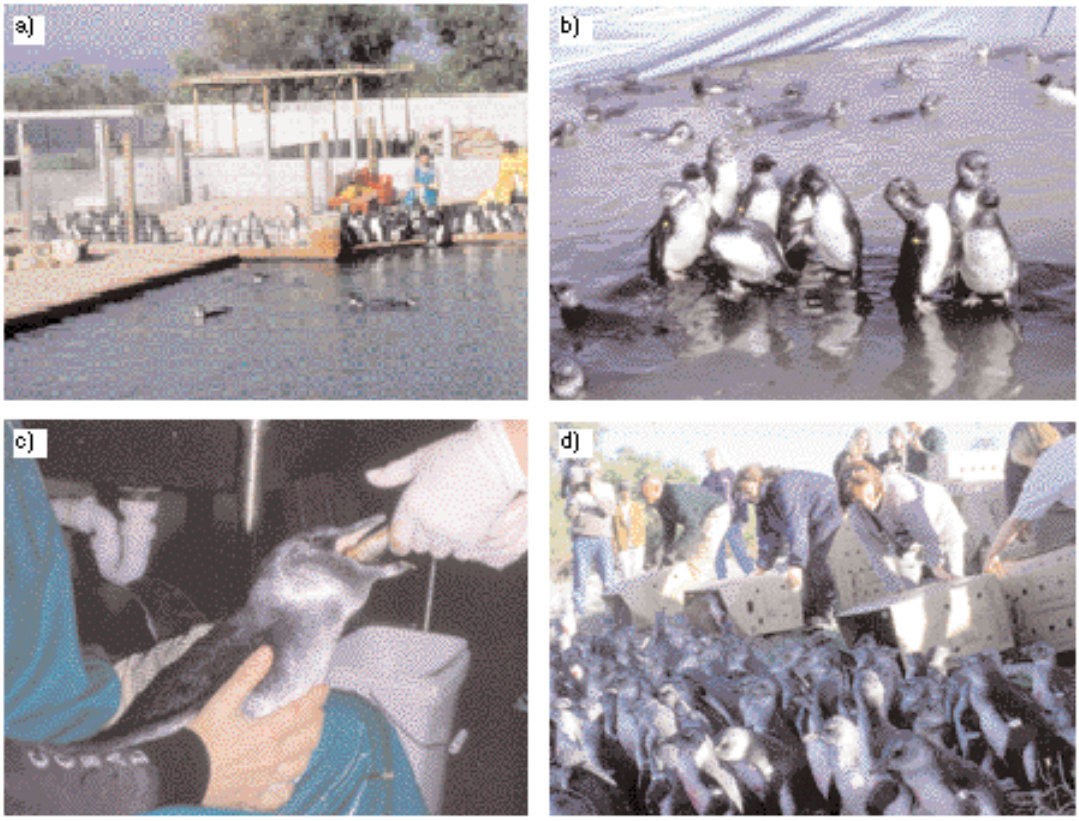

Fig. 13: Orphaned chicks were cared for at a number of centres. Shown are swimming facilities at (a) Duinefontein and (b) Oceanographic Research Institute, Durban, (c) feeding operations at Sea Point and (d) the release of chicks at Robben Island

turned to their islands by 31 July. Fortunately, oil had been removed from the coastlines of Robben and Dassen islands, and the waters around them were relatively clear of oil by the date the penguins began arriving home. The last oil was removed from the *Treasure* on 18 July. A thorough analysis of the relocation intervention will be reported at a later date, once more information is available.

In all, 21 oiled bank cormorants were caught at Robben Island, of which 12 died at SANCCOB. The remaining nine were returned to Robben Island between 1 and 8 August. At least one adult bank cormorant also died at Robben Island, and several more oiled birds that could not be caught are thought to have died. The total mortality of adult birds may have approached 50 individuals. In addition, 33 chicks were collected for captive rearing, of which five died. Of these, 13 fledged chicks were released at Robben Island on 8 August 2000. At Ichaboe Point on Dassen Island, breeding stopped at four nests because of disturbance caused by clearing the coastline of oil that had washed ashore.

Other oiled birds caught included 22 Cape cormorants, of which 16 died in captivity; five crowned cormorants, all of which died; two great cormorants, both of which were released; 30 Cape gannets from the West Coast National Park; and one Hartlaub's gull that died. Additionally, two Cape cormorants and one crowned cormorant died after capture at Dassen Island. For both Hartlaub's and kelp gulls, small numbers were observed to be lightly oiled on Dassen and Robben islands, in Cape Town Harbour and at several places along the shoreline of the Cape Peninsula. Hartlaub's gulls with oil on their plumage were also observed at an inland gathering area on the Liesbeek River in Observatory.

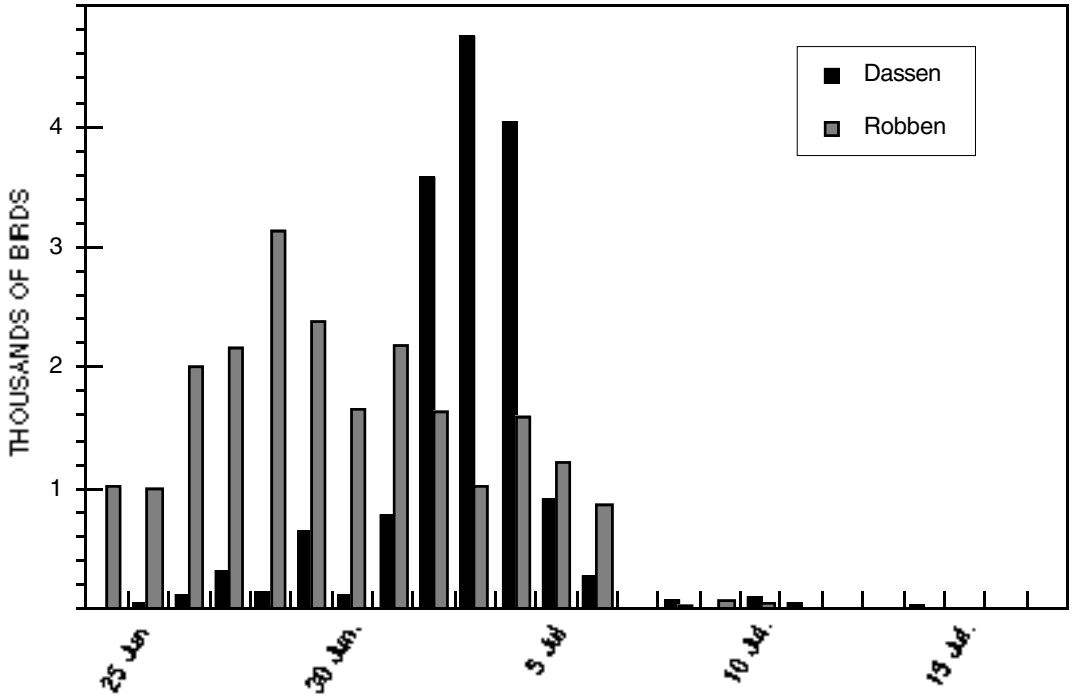

Fig. 14: Numbers of penguins removed from Robben and Dassen islands, 24 June–17 July, excluding chicks. At Robben Island, all birds removed on 24 June and after 6 July were oiled. From 25 June to 6 July, a mix of clean birds for relocation and oiled birds for rehabilitation was taken from the island. At Dassen Island all birds removed from 2 to 4 July were clean; birds removed on all other days were oiled

In spite of oiling of the intertidal feeding areas of African black oystercatchers, only one dead oystercatcher was found at Dassen Island and none at Robben Island. The single mortality observed was probably a result of ingesting oil. The absorbent peat used to clean oil off the shores was non-toxic to intertidal invertebrates, and probably did little additional damage to potential food for oystercatchers. The impact of the spill on African black oystercatchers was probably minimal. No other species that feed in the intertidal zone were recorded to be harmed by the spill.

DISCUSSION

The number of African penguins removed from Robben Island (22 000) exceeded the estimated number of birds in adult plumage at the colony (18 000) by 4 000 individuals. Additionally, a few thousand penguins remained at Robben Island (RJMC pers. obs.). This discrepancy can be attributed to the collection of immature birds in addition to adults, but mainly to birds from other breeding colonies coming ashore at Robben Island after they became oiled. During the *Apollo Sea* oil spill, penguins from as far afield as colonies in Namibia and Algoa Bay were oiled and came ashore at islands and mainland coastlines in the Western Cape (Underhill *et al.* 1999). African penguins frequently visit other colonies (Randall *et al.* 1987, Crawford *et al.* 2000), including Robben Island (Crawford *et al.* 1995a).

Most of the seabirds oiled by the *Treasure* spill had been caught by 7 July (Fig. 14). Including unoiled birds that were relocated, about 39 000 adult and immature penguins were handled, almost four times as many as after the *Apollo Sea* sank and more than 20% of the total population of the species, but deaths were considerably fewer than losses in the early stages of the *Apollo Sea* spill. At the end of August, mortality of penguins attributable to the *Treasure* spill amounted to 2 000 adults and immature birds combined.

In the *Apollo Sea* spill, 53% of deaths (equivalent to 2 700 birds) took place in the first 48 h after collection.

Large numbers of birds died while being transported as a result of inadequate ventilation (Williams 1995). Subsequently, the introduction of a well-ventilated box, and clear guidelines as to how many birds may be transported in each box, have greatly reduced transportation mortality. Additionally, early losses at rescue centres were reduced by ensuring that skilled teams were available to provide expert care for the oiled birds on arrival. Many experts having experience in the treatment of oiled birds were flown to South Africa from abroad, including staff of the International Bird Rescue and Research Centre. The benefits of employing such a strategy, and of all care being coordinated through a central rehabilitation agency, in this instance SANCCOB, have been demonstrated by the reduced mortality in the early stages of care.

Two results suggest that the mortality rate of penguins in the initial stages of the spill may have been considerably higher had a greater number of birds been oiled. First, it was necessary to euthanase 800 penguins that were in poor condition because it was not possible to provide them with adequate care. Second, catching teams had insufficient time to search thoroughly the breeding areas at Robben Island for oiled birds, with the resultant death of an estimated 90 individuals. Resources for both catching of and caring for penguins were extended to their limits. This was in spite of the catching operation being greatly facilitated by favourable weather conditions that prevailed for the 10 days immediately following the spill, and that undoubtedly served to reduce mortality at islands.

Of 19 506 birds relocated, 241 were lost during and immediately after transportation to Cape Recife. Most of these birds (160) died during two trucking events. Examination at necropsy indicated that the deaths may have been caused by carbon monoxide poisoning, probably from exhaust fumes that leaked into the truck. Several birds also died at the release site. They may have been weak as a result of not being able to feed for an extended period, perhaps five days or more. Unfortunately, there was insufficient skilled manpower to feed relocated birds before their release, although this clearly would have been desirable. It is likely that the relatively low losses attributable to the relocation process would have been greatly exceeded by losses at rescue stations had several thousand more birds been oiled. Therefore, the relocation intervention appears justified.

Released African penguins return quickly to their islands. One bird oiled at St Croix Island, Algoa Bay, in 1979, rehabilitated at SANCCOB and released at Robben Island, returned to St Croix Island in 11 days. It averaged 3.4 $km \cdot h^{-1}$ over this period (Randall *et al.* 1981). One bird from Robben Island 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). A total of 16 birds from Robben Island oiled after the Cape Town Harbour oil spill of 1998 was back at the island within one day; one returned in 2.5 h and three others within 3 h (Whittington 1999). Some penguins relocated to Cape Recife in the *Treasure* intervention returned to their islands within 10–11 days of being released at Cape Recife. Similarly, many little penguins returned rapidly to their colonies after being relocated during an oil spill off Tasmania, Australia (Hull *et al.* 1998).

As in the *Apollo Sea* oil spill, great damage to the penguins resulted from oil from the *Treasure* beaching at Dassen and Robben islands. In the *Apollo Sea* event of 1994, the number of birds oiled at Dassen Island was about three times that at Robben Island. At Dassen Island, oil came ashore at West Bay and House Bay and the numbers of birds breeding in areas adjacent to these landing sites decreased in 1995 (Crawford *et al.* 1997a). Following the sinking of the *Treasure*, the use of peat to remove oil from coastlines reduced the numbers of birds becoming oiled.

In the *Treasure* spill, the number of birds oiled at Robben Island was about 4.5 times that at Dassen Island. It approached the estimated adult population for Robben Island and, although many may have been visitors, probably at least half the adults at the island were oiled. In 1994, 2 400 penguins were oiled at Robben Island and in the following (1994–95) moult season the moult of adults was considerably less synchronized than normal (Underhill and Crawford 1999).

African penguins at Robben Island show high mate fidelity (Crawford *et al.* 1995a). The massive disruption to the colony there in 2000, when most birds probably suffered separation from their mates, can be expected to influence the 2001 breeding season. The probable death of more than 1 000 birds from this colony, the need to keep some birds in captivity longer than others and asynchronous moult cycles all are likely to cause breeding penguins to seek new partners. Experience with a partner may improve breeding success for long-lived seabirds (Wooller *et al.* 1989), so breeding success at especially Robben Island, but also Dassen Island, may decrease in 2001.

The proportions of oiled cormorants saved were much smaller than that of penguins. Cormorants are more difficult to catch than penguins because they fly until they become weak. The bank cormorant colony at Robben Island is likely to have been severely affected, with only a few of the oiled birds saved but most of the chicks reared to fledging. Up to 20% of the colony may have been lost. Normally, flying birds are less susceptible to oiling than penguins in

southern African waters because they fly over oil at sea (Morant *et al.* 1981, Adams 1994). However, oil from the *Treasure* was washed alongside the breakwater at Robben Island, which is used by bank cormorants for breeding, and came ashore near the colony at Ichaboe Point, Dassen Island. The impact of the *Treasure* spill on the bank cormorant colonies at Koeberg Harbour, Voëlsteen, Clifton Rocks and Duikerklip was not assessed, and no attempts were made to rescue oiled birds at these colonies. This resulted from the need to catch large numbers of penguins at Dassen and Robben islands and the considerably higher capture rates that were attained for penguins than for cormorants. However, bank cormorants and crowned cormorants are much less numerous than African penguins and merit high priority in future rescue operations.

Very few gulls and terns were badly oiled, in spite of large numbers of these birds being in the vicinity of the oil. This can be attributed to their feeding behaviour being surface seizing, dipping and plunging, rather than the pursuit diving used by penguins and cormorants (Berruti *et al.* 1989). Gulls and terns feed at or near the surface of the water, and gulls often forage away from the marine environment, whereas birds travelling for any distance underwater run the risk of surfacing through oil (Culik *et al.* 1991).

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