Was poor breeding productivity of African Black Oystercatchers on Robben Island in 2004/05 caused by Feral Cats, Kelp Gulls, Mole Snakes or the Sumatra tsunami?

Justine Braby[1] & Les G. Underhill[2]

[1]African Penguin Conservation Project, PO Box 583, Namibia. justine.braby@namdeb.com
[2] Animal Demography Unit, Department of Zoology, University of Cape Town, Rondebosch 7701, South Africa

Braby, J. & Underhill, L.G. 2009. Was poor breeding productivity of African Black Oystercatchers on Robben Island in 2004/05 caused by Feral Cats, Kelp Gulls, Mole Snakes or the Sumatra tsunami? pp. xx–xxx. In: Harebottle, D.M. Craig, A.J.F.K., Anderson, M.D., Rakotomanana, H. & Muchai, M. (eds). *Proceedings of the 12th Pan-African Ornithological Congress, 2008.* Cape Town, Animal Demography Unit.

Keywords: African Black Oystercatcher, *Haematopus moquini*, Robben Island, South Africa, predation, breeding success, productivity

Although the breeding population of African Black Oystercatchers on Robben Island, South Africa, increased from 2001/02 to 2003/04 and past breeding productivity there has been good, nesting success in 2004/05 was disastrously low. Sixty-one pairs laid 120 eggs of which only 15% hatched; of the chicks only a third (six) resulted in fledged young. This equates to 0.01 fledglings per pair, much lower than the estimated 0.33 fledglings per pair needed to maintain stable populations. We consider whether this was due to predation by Feral Cats, Kelp Gulls or Mole Snakes or nests being washed out by the large waves arising from the Sumatra tsunami. We conclude that predation by Feral Cats, whose population increased from about six in 1999 to 100 in 2004, is the most likely cause.

Introduction

The 12-month period July 2004 to June 2005 was the fourth consecutive year of monitoring of African Black Oystercatchers *Haematopus moquini* on Robben Island, near Cape Town, South Africa. Monitoring commenced in the 2001/02 breeding season (Calf & Underhill 2002a, b), and continued in the 2002/03 (Calf & Underhill 2003) and 2003/04 breeding seasons (Calf & Underhill 2005b). Further information on Robben Island and its other shorebirds is available in Underhill *et al.* (2001).

The African Black Oystercatcher breeds along the southern African coast from southern KwaZulu-Natal, South Africa, to southern Namibia; it is classified as "Near-threatened" both in South Africa and globally, with the 1% threshold for a site to be deemed "internationally important" for the species set at 55 individuals (BirdLife International 2004, Brown & Hockey 2007, Hockey *et al.* 2005, Underhill 2000, Wetlands International 2006). This species breeds in the austral summer on both rocky and sandy shores on the mainland, and on the offshore islands between Nelson Mandela Bay (formerly Algoa Bay) in the Eastern Cape, and Ichaboe Island, north of Lüderitz (Hockey *et al.* 2005, Underhill 2000). Adults are territorial and remain on their breeding territories almost continuously; they are long-lived, mate-faithful and have a naturally low reproductive rate (less than one fledgling per pair per year) (Hockey *et al.* 2005). The key factor leading to the threat classification of this species is its low breeding productivity. Losses of eggs and chicks are attributable to a variety of causes: predation by birds, mammals and reptiles, human disturbance in a variety of forms, and exceptional tidal events (Calf 2004, Calf & Underhill 2005a, Hockey *et al.* 2005).

In general, breeding productivity of African Black Oystercatchers on the offshore islands of the southern Africa is relatively high. This paper examines the poor productivity of the species on Robben Island in the 2004/05 breeding season. Tjørve & Underhill (2006) described the increasing trend in the size of the African Black Oystercatcher population on Robben Island over the three breeding seasons 2001/02 to 2003/04. This paper describes how this increase was maintained, and the consequential development of a "club" of non-breeding adults.

Methods

Fieldwork protocols established in earlier years were maintained (Calf & Underhill 2002a). All oystercatchers were counted during a 3–4 hour survey along the perimeter of the island, a distance of *c.*10 km. From earlier years it was known that egg-laying commences in early November; thus from the beginning of November fieldwork was expanded to include frequent searches for nests. Once a nest was located, it was numbered and marked, and its coordinates determined using a GPS unit; nests were monitored until either the eggs disappeared or they hatched. Hatchlings were monitored until they disappeared, presumably mainly due to predation, or they fledged. The target monitoring frequency was one visit in 4–5 days; the shortest period between nest visits was 12 hours.

When nests were found, the eggs were measured (length and two breadth measurements (mm) taken at right angles to each other to 0.1 mm with dial calipers) and weighed (g) to 0.1 g on an electronic balance. Fresh egg mass (g) was estimated using the method of Underhill & Calf (2005): fresh mass = 0.000533 × length × breadth1 × breadth2. Thus it was possible to estimate the loss of mass from the start of incubation until the nest was discovered, and therefore the number of days of incubation and the date incubation started (Underhill & Calf 2005): incubation days = (fresh mass – observed mass)/(0.00502

Table 1. Counts of African Black Oystercatchers on Robben Island, South Africa, between July 2004 and June 2005

Date	Count
4 July 2004	270
11 August 2004	287
31 August 2004	349
4 September 2004	328
14 September 2004	333
1 October 2004	266
27 November 2004	283
17 December 2004	239
27 December 2004	235
10 January 2005	290
19 January 2005	288
5 February 2005	243
11 March 2005	336
21 May 2005	262
23 June 2005	259

Table 2. Breeding productivity of African Black Oystercatchers on Robben Island, South Africa, during the 2004/05 breeding season

Observed number of breeding pairs	61
Observed number of nests	75
Observed number of pairs that relaid	12
Observed number of re-laid nests	14*
Estimated number of eggs	120
Estimated number of eggs hatched	18
Estimated no. of nests (and pairs) at which at least one egg hatched	12
Observed number of chicks fledged	6
Number of nests (and pairs) from which at least one chick fledged	6

* two pairs laid three clutches

× fresh mass), and date of start of incubation = observation day – incubation days. The pattern of events at individual nests was exhibited using the graphical display devised by Parsons & Underhill (in prep.). The density function of the dates on which incubation started was calculated using a kernel approach similar to that outlined by Matanyaire *et al*. (2002). From this density function, the key percentiles of the breeding season were estimated.

Calf (2004) reported observing Mole Snakes *Pseudaspis cana* depredating oystercatcher eggs on Robben Island. A watch was therefore kept for the prevalence of Mole Snakes on the shoreline during the 2004/05 breeding season. Another factor that could have influenced breeding success was the occurrence of the Sumatra tsunami on 26 December 2004, which is known to have had impacts farther north in the Atlantic Ocean (Joseph *et al*. 2006). Sea level data were therefore obtained to examine the possibility of extreme wave heights washing out nests.

Results

The African Black Oystercatchers on Robben Island were counted on 15 occasions between July 2004 and June 2005 (Table 1). Counts ranged between 235 and 349 birds, median 283. A striking feature of surveys made in the study period was the occurrence of flocks of oystercatchers, as opposed to pairs and single birds. For example, the maximum count of 349 made on 31 August 2004 included a flock of 41 and another of 22.

Breeding

The breeding activities of African Black Oystercatchers on Robben Island were monitored on 33 days between Nov 2004 and Apr 2005. At least 61 pairs bred on the island during the 2004/05 breeding season (Table 2): 59 pairs were found at nests with eggs; one nest was found with fresh yolk in it indicating recent predation; and one pair was observed alarming, and although no chick was found the nest site was located. At least 75 clutches were laid (Table 2). Ten pairs laid a second clutch, and two pairs laid three clutches (Table 2). Of the 73 nests found with eggs, 43 had two eggs and 30 had one; no three-egg clutches were found during this breeding season. Mean clutch size of nests with eggs was 1.6 eggs. Assuming that the two nests in which eggs were not found had the modal clutch size of two, the total number of eggs laid was 120 or 2.0 eggs per breeding pair including relay clutches. Of these, only 15% hatched and of the chicks that hatched, only a third (six) fledged; equivalent to 0.01 fledglings per breeding pair (Table 3).

One hundred and fifteen of the eggs were measured, and their fresh masses estimated (Table 3). From the observed masses when the nests were found, the dates that incubation started were estimated. The first nests were found on 21 Nov; however, the earliest incubation start date was estimated to be about 10 Nov (Fig. 1).

Incubation

The estimated incubation start dates were combined to generate the kernel probability density function (Fig. 2). The distribu-

Table 3. Average breeding productivity of African Black Oystercatchers on Robben Island, South Africa, during the 2004/05 breeding season

Nests per breeding pair	1.23
Eggs per breeding pair	1.97
Hatching success (% eggs hatched)	15%
Hatching success (% pairs with at least one hatchling)	20%
Hatchlings per breeding pair	0.30
Fledging success (% hatchlings which fledged)	33%
Fledging success (% pairs with at least one fledgling)	10%
Fledglings per breeding pair	0.098

Table 4. Dimensions and estimated fresh mass of 115 eggs of African Black Oystercatcher on Robben Island, South Africa, during the 2004/05 breeding season

	Length (mm)	Breadth (mm)	Fresh mass (g)
Mean	61.6	42.3	58.7
Range	57.2–67.5	39.6–45.2	49.8–69.3
Standard deviation	2.1	1.0	3.8

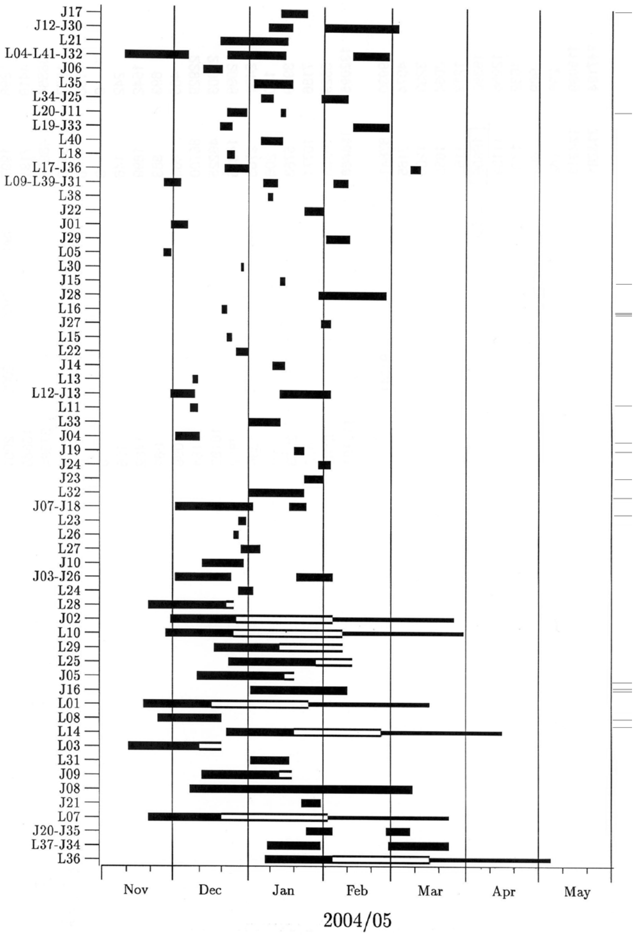

Fig. 1. The nesting phenology of African Black Oystercatchers on Robben Island, South Africa, during the 2004/05 breeding season. The y-axis shows the codes for individual nests; where there is more than one, they relate to relayings by the same pair. Nests are arranged clockwise, starting and ending at Murrays Bay Harbour. Thick bars represent the incubation period, parallel lines the chick phase, and thin bars the post-fledging period. The date of departure of fledglings was not recorded, so the post-fledging period is given as the average of 50 days (Parsons 2006).

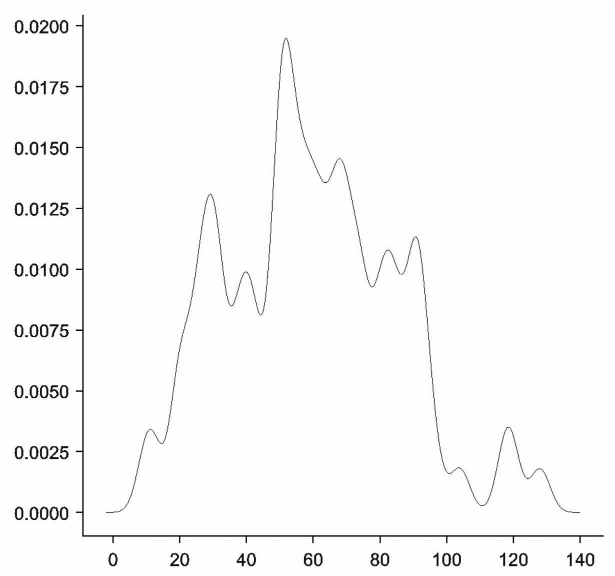

Fig. 2. Probability density function of estimated dates of start of incubation at each African Black Oystercatcher nest on Robben Island, South Africa, during the 2004/05 breeding season. The density function was computed using the kernel method. (X-axis: days since 1 November 2004 with Day1 = 1 November; Y-axis: probability density function scaled so that the area under curve = 1).

tion of estimated start dates for all nests showed major peaks of egg-laying activity at around day 29 (29 Nov) and day 52 (22 Dec), and smaller modes at around day 40 (10 Dec) and day 67 (6 Jan) and even smaller modes at later dates (Fig 2). The median egg-laying date was estimated from the kernel density function to be day 58 (28 Dec); the lower quartile was 10 Dec and the upper quartile was 16 Jan. The period within which incubation started in 90% of nests was estimated to be the 82 days from 20 Nov to 10 Feb.

Predation

Eggs were depredated at 62 nests. Excluding nest J08 at which eggs were present for an estimated 96 days (Fig. 1), the mean period for which eggs were incubated prior to predation was estimated to be 11.4 days, and the median period 8.5 days. This takes into account the estimated period of incubation prior to finding the nests. At nest J08, two eggs were laid; one was found slightly damaged outside the nest at the time of the estimated end of incubation. The rate of mass loss of the remaining egg after this date was 0.14 g/day, too slow for normal incubation, which would have been 0.26 g/day (Underhill & Calf 2005).

On three occasions clutches probably disappeared during the night. Nest L13 was intact with two eggs at 19h40 on 11 Dec, but at 08h15 on 12 Dec, both eggs were missing. At nest L26, a one-egg clutch was lost between 16h30 on 27 Dec and 07h00 the following morning. Nest J10 (one egg) was lost on the same night as L26, between 16h40 and 08h15.

An estimated 200 hours over 33 days was spent monitoring the oystercatchers on Robben Island during the 2004/05 breeding season. Mole Snakes were observed close to the shoreline on only four occasions; none were close to active nests.

Tsunami waves

The first oceanic waves associated with the Sumatra tsunami passed southern Africa, and Robben Island, at about 18h00 (local time) on 26 Dec 2004 (Fig. 3). The tsunami waves continued for several days. Fieldwork was conducted on 27 Dec from 08h00 to 19h00, the period during which the largest waves passed Robben Island. It is certain that no nests were destroyed as a result of this event so the poor breeding success of 2004/05 cannot be attributed to the tsunami.

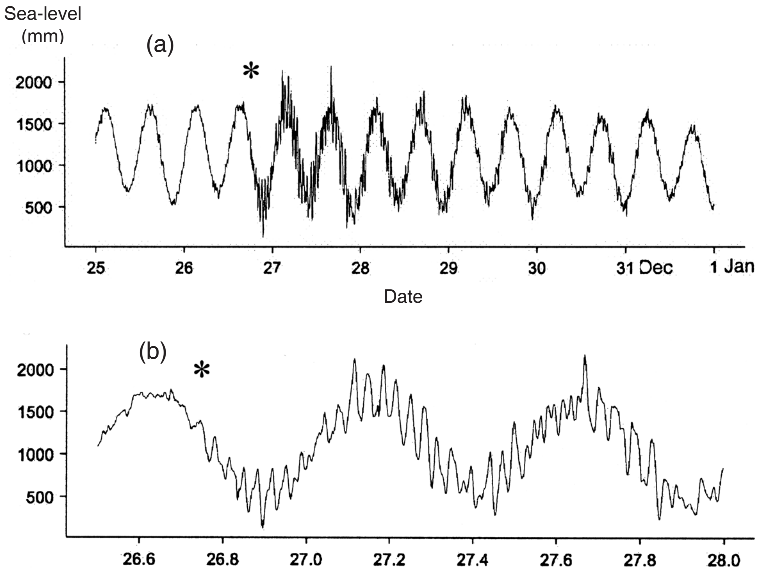

Fig. 3. Sea-level (mm above chart datum) in Table Bay, Cape Town, South Africa, (a) between 00:01 on 25 Dec 2004 and 00:01 on 1 Jan 2005 (South African Standard Time) and (b) detail of the first three tidal cycles after the arrival of the tsunami waves. The sea levels were recorded at 3-minute intervals. The * represents the approximate time of arrival in Table Bay of the Sumatra tsunami (data supplied by the South African Navy Hydrographical Office).

Discussion

The 2004/05 breeding season was the fourth of intensive monitoring of nesting African Black Oystercatchers on Robben Island. The numbers of pairs which bred in the four years since 2001/02 were fairly constant (57, 67, 49 and 61 respectively); however, the numbers of fledglings declined drastically, from 59 in 2001/02, 35 in 2002/03, 19 in 2003/04, and only six in 2004/05 (Tjørve & Underhill in press, Table 1). The key factor in the reduction of breeding productivity was the steady increase in egg-loss or the percentage of pairs that failed to produce any hatchlings: 21%, 34%, 60% and 80% respectively (Table 2, Tjørve & Underhill in press).

Despite the reduced productivity, the increasing trend in the numbers of African Black Oystercatchers on Robben Island over 2001–June 2004, noted by Tjørve & Underhill (2006), continued. During the three years immediately preceding our study period, Tjørve & Underhill (2006) recorded medians (maxima) of 179 (193), 214 (251) and 221 (258) during Aug 2001 to Jun 2002 (15 surveys), Jul 2002 to Jun 2003 (23) and Jul 2003 to Jun 2004 (23), respectively. Therefore the median of 283 birds in our 2004/05 study period continued this upward trend (Table 1). Over the four year period 2001/02 to 2004/05, the median increased by 58%, or 12% per year. Only three of the 2004/05 surveys, all during the breeding season, recorded smaller numbers than the previous maximum of 258 in April 2004 (Table 1, Tjørve & Underhill 2006). The increase in 2004/05 was due mainly to the presence, for the first time during the four-year period, of substantial numbers of oystercatchers in flocks. These probably represent a "club" of young birds that have not secured territories. Together with the observation that the number of breeding pairs remained fairly constant despite the annual increases in the total numbers of birds, we suggest that this indicates that the oystercatcher breeding population of the Robben Island shoreline has reached carrying capacity.

Human disturbance on the shoreline of Robben Island has decreased during the four years of oystercatcher monitoring (LGU pers. obs). The first breeding season of the four was the year of greatest productivity, but was also the year of greatest human disturbance. That year coincided with a period in which intensive road works were completed. In particular, the road around the perimeter of the island was rebuilt, with labourers frequently observed entering the inter-tidal zone over an extended period. The education campaign, whereby island residents were informed of the need to minimize activities on the shoreline during the oystercatcher breeding season, was successful. In the first year of monitoring, several residents walked along the perimeter road with their dogs, especially in the evenings, but by the 2004/05 breeding season, it was a rare event to see any residents on the shoreline. In addition, even though the number of tourist buses along the southern perimeter of the island increased, their impact on breeding oystercatchers appeared to decrease, because fewer stops close to active nests were made (LGU pers. obs). There is probably also an element of habituation in the behaviour of oystercatchers in this section of the island to tourist buses.

Besides nest losses due to disturbance by humans and their dogs, and losses due to vandalism, there are three candidate nest predators on Robben Island: Moles Snakes, Kelp Gulls *Larus dominicanus* and Feral Cats *Felis catus*.

In spite of Calf's (2004) observations of Mole Snakes eating oystercatcher eggs, snakes large enough to consume them are relatively uncommon on Robben Island. Although they are clearly involved in egg predation, it is unlikely that they were responsible for the observed increase in the level of egg predation.

The numbers of Kelp Gulls on the island have increased during the four-year study period, especially with the establishment of a breeding colony in 2000, which has increased in size annually (Calf *et al.* 2003, LGU pers. obs). It is therefore likely that Kelp Gulls are responsible for a part of the increase in egg predation suffered by the oystercatchers. However, both the gulls and snakes are diurnal predators and three observations were made of eggs probably disappearing at night. This suggests that Feral Cats may also be a major predator of oystercatcher eggs because cats are largely active at night. Moreover the increase in egg predation coincided with an increase in the cat population.

One hundred and seven Feral Cats were removed by a combination of trapping and hunting between Nov 1998 and Feb 1999 (Aitken 1999, B.M. Dyer pers. comm.), leaving a residual population of about six. Since then, however, numbers have increased to an estimated 100 cats in 2004 (J. Kieser pers. comm.).

The taking of oystercatcher eggs by cats may be a learned behaviour. Tjørve & Underhill (in press) demonstrated that there was considerable variation in nest success along different sections of the island's shore and it seems likely that low success occurred where cats had learnt how to find oystercatcher nests. By 2004/05, the only section that appeared not to experience egg predation was the one immediately north of Murrays Bay Harbour (Fig. 1).

Population models show that on average oystercatchers need to fledge 0.33 young per pair per year to maintain stable populations (Hockey 2001). Therefore the figure we recorded in 2004/05 of only 0.01 fledged young per pair was extremely low and represents a disastrous decline since the 2001/02 season when the average was a relatively healthy 0.87 fledglings per pair (Calf & Underhill 2002a). This is a critical problem because Robben Island supports around 5% of the world population of the African Black Oystercatcher and is therefore of major importance for the species. It would seem that the priority is to completely exterminate the cats. It may also be necessary to control the size of the Kelp Gull colony.

Acknowledgements

Our research on Robben Island is supported by the National Research Foundation, Earthwatch Institute and University of Cape Town Research Committee. We value the logistical support of the Robben Island Museum and the Marine and Coastal Management Branch of the Department of Environmental Affairs and Tourism. Mario Leshoro, environmental officer at Robben Island Museum, assisted with fieldwork. Frank Shillington, Department of Oceanography, University of Cape Town, provided information about the Sumatra tsunami, and Ruth Farre, South African Navy Hydrographical Office, provided the data upon which Fig. 3 is based.

References

Aitken, A.P. 1999. *Analysis of diet and genetic variability of feral cats* (Felis catus) *on Robben Island.* Unpubl. B.Sc. (Hons) report. Department of Zoology, University of Cape Town.

BirdLife International 2004. *Threatened birds of the world 2004.* BirdLife International, Cambridge.

Brown, M. & Hockey, P.A.R. 2007. The status and distribution of African Black Oystercatchers *Haematopus moquini* in KwaZulu-Natal, South Africa. *Ostrich* 78: 93–96.

Calf, K.M. 2004. Mole snake *Pseudaspis cana* predation of African Black Oystercatcher *Haematopus moquini* eggs. *Wader Study Group Bulletin* 104: 103–104

Calf, K.M., Cooper, J. & Underhill, L.G. 2003. First breeding records of Kelp Gulls *Larus dominicanus vetula* at Robben Island, Western Cape, South Africa. *African Journal of Marine Science* 25: 391–393.

Calf, K.M. & Underhill, L.G. 2002a. Productivity of African Black Oystercatchers *Haematopus moquini* on Robben Island in the 2001/02 breeding season. *Wader Study Group Bulletin* 99: 45–49.

Calf, K.M. & Underhill, L.G. 2002b. *Productivity of African Black Oystercatchers* Haematopus moquini *on Robben Island in the 2001/02 breeding season.* ADU Research Report 44. Avian Demography Unit, University of Cape Town.

Calf, K.M. & Underhill, L.G. 2003. *Population dynamics and productivity of African Black Oystercatchers* Haematopus moquini *on Robben Island, South Africa, in the 2002–2003 breeding season.* ADU Research Report 51. Avian Demography Unit, University of Cape Town.

Calf, K.M. & Underhill, L.G. 2005a. Tidal impact on breeding African Black Oystercatchers on Robben Island, Western Cape, South Africa. *Ostrich* 76: 219–221.

Calf, K.M. & Underhill, L.G. 2005b. *Population dynamics and productivity of African Black Oystercatchers* Haematopus moquini *on Robben Island, South Africa, in the 2003–2004 breeding season.* ADU Research Report 67. Avian Demography Unit, University of Cape Town.

Hockey, P.A.R. 2001. Update on breeding performance. *Oystercatcher Tidings* 2: 2–3.

Hockey, P.A.R., Dean, W.R.J. & Ryan, P.G. (eds) 2005. *Roberts Birds of Southern Africa*. 7th ed. John Voelcker Bird Book Fund, Cape Town.

Joseph, A., Odametey, J.T., Nkebi, E.K., Pereira, A., Prabhudesai, R.G., Mehra, P., Rabinovich, A.B., Kumar, V., Prabhudesai, S. & Woodworth, P. 2006. The 26 December 2004 Sumatra tsunami recorded on the coast of West Africa. *African Journal of Marine Science* 28: 705–712.

Matanyaire, S.D., Calf, K.M. & Underhill, L.G. 2002. Estimating the distribution of the start of incubation: the African Black Oystercatcher *Haematopus moquini* as an example. 2002 International Wader Study Group Annual Conference. Hel, Poland. *Wader Study Group Bulletin* 99: 9.

Parsons, N.J. 2006. *Quantifying abundance, breeding and behaviour of the African Black Oystercatcher* Haematopus moquini. Ph.D. thesis, University of Cape Town.

Parsons, N.J. & Underhill, L.G. in prep. Quantifying and displaying annual commitment by parents to breeding, illustrated by African Black Oystercatchers *Haematopus moquini* at Koeberg Nuclear Power Station, Western Cape, South Africa.

Tjørve, K.M.C. & Underhill, L.G. 2006. Population increase of African Black Oystercatchers *Haematopus moquini* on Robben Island, South Africa. *Ostrich* 77: 229–232.

Tjørve, K.M.C. & Underhill, L.G. (in press.) Influence of disturbance and predation on breeding success of the African Black Oystercatcher, *Haematopus moquini,* on Robben Island, South Africa. *Waterbirds*.

Underhill, L.G. 2000. African Black Oystercatcher *Haematopus moquini*. In: Barnes, K.N. (ed.) *The Eskom Red Data Book of the birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa, Johannesburg. p. 142.

Underhill, L.G. & Calf, K.M. 2005. How far is an egg through incubation? *Wader Study Group Bulletin* 106: 39–41.

Underhill, L.G., Whittington, P.A. & Calf, K.M. 2001. Shoreline birds of Robben Island, Western Cape, South Africa. *Wader Study Group Bulletin* 96: 37–39.

Wetlands International 2006. *Waterbird population estimates*. 4th Ed. Wetlands International, Wageningen.