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Cave breeding by African Penguins near the northern extreme of their range: Sylvia Hill, Namibia

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Only three mainland sites are known among the total 27 breeding colonies of the African Penguin, *Spheniscus demersus*: two in South Africa and one in Namibia. The latter is a unique cave site near the northern extreme of the species' range on the edge of the Namib Desert. To determine the colony size, long-term viability and any difference in breeding ecology relative to more southern sites we combined data from previous visits to the site with four visits in 2001. We found that about 240 to 300 birds use the Sylvia Hill cave, and about 90 nests are active with a laying peak in January. Eggs are laid on top of guano mounds not in burrows as is usual for this species. Smaller clutches (1.68 eggs/nest) but larger broods ($\bar{x}$ = 1.31 chicks/nest) were apparent in this colony than those farther south. Larger mean clutches farther south suggest a latitudinal trend in clutch size for Namibia's penguins. We found no evidence for a population decline over 17 years, and thus no evidence that birds at the periphery of their range moved southwards into core areas. We conclude that the colony is healthy and thriving despite a general decline in penguin numbers in southern Africa.

Introduction

The African Penguin, *Spheniscus demersus*, breeds around the coast of southwestern Africa, and has experienced a 90% decline in numbers in the last 100 years (Crawford 2000, Whittington *et al.* 2000). The species currently breeds at 24 islands and at least three mainland sites (Crawford 2000). In Namibia, where African Penguins are Critically Endangered (Simmons and Brown in prep.) they breed at eight islands and at least one mainland site. All large island breeding colonies are well monitored in Namibia (Rand 1963, Crawford *et al.* 1989, Cordes *et al.* 1999, Kemper *et al.* 2001) and South Africa (Crawford *et al.* 1990, Crawford *et al.* 1995, Whittington *et al.* 2000). Hollams Bird Island (24°38'S, 14°32'E) is the northernmost penguin breeding locality, but rarely holds more than a handful of penguins and breeding may have ceased since the island was last censused in 1988 (Williams and Dyer 1990). Sylvia Hill, a cave site on the edge of the southern Namib Desert, is possibly now the northernmost penguin breeding locality. It is currently Namibia's only confirmed mainland breeding site for African Penguins and has been poorly monitored until now. Two more caves to the south of Sylvia Hill, whose locations were reported by Loutit and Boyer (1985), were recently relocated and one cave was recently found to support breeding penguins (Bartlett *et al.* 2003). Cave-breeding is common among the African Penguin's close relative, the Humboldt Penguin, *Spheniscus humboldti*, off the coast of Peru and Chile (Williams 1995), but for the African Penguin is so far only confirmed from Sylvia Hill and a shallow, dry, gravelly cave on Plumpudding Island, Namibia.

The Sylvia Hill penguin colony was first reported by Finkeldey (1984), censused in 1984 by Loutit and Boyer (1985) and again in 1999/2000 by Simmons (2000). Here we collate published and unpublished information on the status of penguins breeding at Sylvia Hill and compare aspects of the breeding ecology of birds at this northern colony with better-known colonies farther south.

Methods

We counted individual penguins and active nests (defined as nests containing eggs or chicks), and examined nest contents in the cave on four occasions — November and December 2000 and twice in March 2001 — to determine the number of breeding birds and their productivity (eggs and chicks). All surveys were undertaken in the early or mid-morning when the spring tide was lowest and thus allowed access to the cave. Our visits were timed to coincide with the assumed peak of breeding. In breeding colonies where penguins are forced to nest on the surface, gull predation and exposure of eggs or young chicks to the elements are frequent causes of breeding failure; a situation which can be exacerbated by human disturbance (Hockey and Hallinan 1981). During each visit, disturbance was kept to a minimum. Birds rarely left the cave, but some did make their way to the back of the cave. Those on eggs or small chicks generally remained on their nests.

Results

Penguin habitat and nests

The breeding cave, located at 25°08.27'S, 14°50.89'E, is northwest of Sylvia Hill on the edge of the Namib sand sea. It lies at the bottom of a steep, sandy 50m cliff and is inaccessible to Black-backed Jackals (*Canis mesomelas*) and other terrestrial predators. It is only accessible to humans across a 1.5m gap at low tide. A second cave nearby was used in the early 1980s before it became accessible to jackals (P Bridgeford, NamibRand Nature Reserve, pers. obs.). The entrance to the breeding cave is roughly 8m high. The cave is 20m wide and about 30m deep from the entrance to the back. The penguins have built nest mounds, some of which are at least 50cm high, out of compacted guano and sediments washed into the cave. The height of the nest cones suggests a very long occupancy. Nest cones are spaced approximately 40cm to 50cm apart, with a shallow depression in the centre of each cone acting as a nest bowl. The majority of the nest mounds are used, suggesting that the cave is close to maximum breeding capacity. More of the anterior nests are used than those at the back of the cave. Few ticks, so obvious on some islands (Daturi 1986, Kemper 2001), were observed in this colony. Many eggs were completely covered in dark mud and wet guano, which may influence their hatchability. The cave floor between nests mainly consists of slippery mud and guano — ankle-deep in places. While the back is drier, the front of the cave is used by non-nesting penguins, and is washed clean by the high tide. There was no sign of nesting materials in any nests; this is unusual for the species in this region (JK pers. obs.).

Breeding season and population size

During the four counts a maximum of 37 active nests were counted in December, and a maximum of 243 penguins in adult plumage were present in early March 2001 (Table 1). These figures suggest that peak breeding occurs sometime in late December or early January. To corroborate this idea we combined data from all surveys from 1984 to the present (Table 1) to obtain the number of active nests in each month. Results suggest that breeding peaks in January, beginning in September and finishing in March or April, a duration of eight months (Figure 1). The highest number of active nests in the 2000/2001 season (37), was slightly lower than the 45 active nests found in early January 2000 (Simmons 2000).

To estimate the total number of nests started in this colony, we followed the same procedure as above, but included only those nests with eggs each month. Given that incubation lasts on average 38 days (Randall and Randall 1981), our greater than monthly sampling should ensure that nests with eggs represented new nests, unless eggs were addled. Peak laying took place from November to January and a total of about 90 breeding attempts is estimated to be initiated annually (Figure 1).

Counts of birds in adult plumage peaked in February and March when 235 to 243 birds were seen. This does not represent the total population using the locality as some penguins will be away foraging (Collar and Stuart 1985). Based on maximum counts, the total population is likely to be about 300 penguins (Rand 1963). Extrapolating from maximum nest counts (Crawford and Boonstra 1994) gives a smaller population of about 150 birds. This is clearly an under-estimate, possibly because Crawford and Boonstra (1994) include defended sites in their definition of an active nest. Constants derived for extrapolating population totals from maximum nest counts for colonies close to Sylvia Hill range from 3.57 for Halifax Island to 6.12 for Mercury Island (JK unpublished), giving total adult population estimates varying between 161 and 275. Given that 235 birds were present in 1984 and 243 birds were present 17 years later (Table 1), there is no evidence for a decline or increase in this cave colony. There was a distinct lack of juveniles on every visit (Table 1). However, African Penguins spend long periods at sea after fledging and are known to wander extensively until

Table 1: Numbers of penguins in adult and juvenile plumage, and eggs, chicks and active nests at Sylvia Hill cave, 1980–2001

Date	Adults in cave[1]	Juveniles	Eggs	Chicks	Nests	Source
June 1980	40	–	–	–	6	Finkeldey (1984)
June 1983	60	–	–	–	15	Finkeldey (1984)
February 1984	235 (17 in north cave)	27	–[a]	9	20	Loutit and Boyer (1985)
February 1991	120 (105 in north cave)	–	–	–	–	PB[2]
November 1992	99	–	1	24	25	PB[2]
March 1994	200	–	–	–	–	PB
September 1994	160	–	3	2	5	PB
December 1994	210	20	18	4	16 examined (of 26 active)	RES, PB
May 1996	92	0	0	0	0	PB
January 2000	169	12	45	22	44 examined (of 45 active)	RES
May 2000	120 (incl. large young)	–	0	0	0	AL
November 2000	191	2	>20	6	25	JK
December 2000	154	5	40	17	37	RES
March 2001	243	1	8	12	13	JK
March 2001	175	0	4	7	8	RB, KA

[1] Two caves are known but the north cave became accessible to jackals sometime after February 1991 and penguins rarely use it (PB)
[2] Did not enter cave
[a] At least 2 nests with eggs; clutch size not given
PB = P Bridgeford, AL = A Lenssen, RB = R Braby, RES = RE Simmons, JK = J Kemper, KA = K Alberts

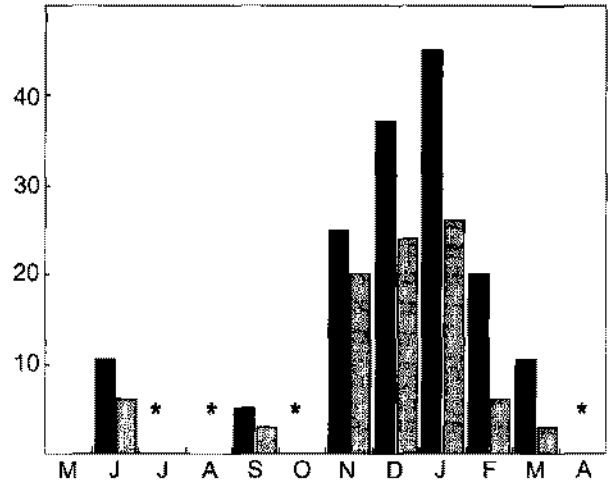

Figure 1: Number of African Penguin active nests (eggs and chicks) based on 11 visits (black) and number of African Penguin nests containing eggs (grey) based on eight visits to Sylvia Hill cave. Asterisks denote no data

they begin to breed (Randall 1995, Crawford and Whittington 1997). No juvenile moulters and only a few adult moulters were seen.

Clutch size and brood size

An average clutch size of 1.68 eggs/nest (n = 31 nests; Table 2) in 2001 was similar to that of the previous year (1.73 eggs/nest, n = 26 nests; Simmons 2000). Clutch size was marginally higher in March 2001 near the end of the breeding season, than in December 2000 (Table 2). Also of note is the relatively large number of single egg clutches (10 of 25 or 40% in December 2000). In many other colonies of African Penguins single eggs are uncommon (Randall and Randall 1981) and comprise about 1% of all clutches (Williams 1995). Using clutch size data from Mercury, Halifax and Possession Islands (JK unpublished), the proportion of clutches containing one egg differed significantly between the four localities (χ^2 = 20.72, 3 df, P < 0.01).

Average brood size (1.35 chicks/nest, n = 31 nests) was slightly larger than the brood size recorded in early January of the previous year (1.22 chicks/nest, n = 18 nests; Simmons 2000). We were unable to ascertain fledging success for individual nests.

Discussion

Surveys since 1984 found that: (i) about 240 to 300 birds may use the site, (ii) there has been no apparent change in numbers of birds in adult plumage over 17 years, (iii) the breeding season appears to be fairly well defined, extending over eight months and peaking in early January, (iv) the total number of breeding attempts initiated in the cave is about 90 per year, and (v) the clutch size appears slightly smaller, but the brood size slightly larger than in colonies farther south. The major differences between this and other breeding colonies are the conditions under which birds nest. Here they breed in a predator-free but wet, guano-covered environment, and lay their eggs on top of guano mounds, not in burrows or on open stony ground.

Population trends

Our study indicates that unlike most other Namibian island colonies which are declining (Cordes *et al.* 1999, Kemper *et al.* 2001), this northern mainland colony is stable. The adult population at Mercury Island, 65km south, increased by 7% per year between 1991 and 2000. This increase is, at least partly, attributed to an influx of penguins from the south, particularly Ichaboe Island, where numbers dropped drastically during the mid 1990s and simultaneously rose at Mercury Island (Kemper *et al.* 2001). It appears that the northernmost Namibian penguin breeding colonies are currently healthier than those south of Mercury Island, a trend most likely related to the abundance and distribution of fish prey (Crawford *et al.* 1985, 2001). Despite these encouraging trends near the northern extremity of its breeding range, the overall Namibian population of the African Penguin contin-

Table 2: Average clutch and brood size of the Sylvia Hill penguins, from nests with eggs and chicks recorded in the 2000–2001 season. Previous year's data from early January 2000 (Simmons 2000) in [brackets]

		Nests containing				
Date	1 Egg	2 Eggs	3 Eggs	1 Chick	2 Chicks	Source
12 November 2000		20 nests total		4	1	JK
18 December 2000	10 [7]	15 [19]	0	7 [14]	5	RES
8 March 2001	1	2	1	6	3	JK
21 March 2001	0	2	0	5 (mobile chicks)	1	RB/KA

Average clutch size:	**December:** 40 eggs in 25 nests	= 1.60 eggs/nest	
	March: 12 eggs in 6 nests	= 2.0 eggs/nest	[1.73 eggs/nest]
Average (combined)		= 1.68 eggs/nest	
Average brood size:	**November:** 6 chicks in 5 nests	= 1.2 chicks/nest	
	December: 17 chicks in 12 nests	= 1.42 chicks/nest	
	March: 19 chicks in 14 nests	= 1.36 chicks/nest	[1.22 chicks/nest]
Average (combined)		= 1.35 chicks/nest	

RES = RE Simmons, JK = J Kemper, RB = R Braby, KA = K Alberts

ues to decline (Kemper *et al.* 2001), and it is unlikely that Mercury Island or Sylvia Hill will be able to support many more penguins in future.

Breeding season and moulting season

The breeding season appears to follow a similar pattern to that at Mercury and Ichaboe Islands (Crawford *et al.* 1995), with breeding taking place between September and April, and a breeding peak between November and January. Counts from June to August are required to ascertain whether there is a secondary breeding peak, as is the case on Halifax Island (Berry *et al.* 1974, Collar and Stuart 1985), where peaks of breeding occur in July and December. On most Namibian islands, moulting activities peak in April and May (Crawford *et al.* 1995). Since moulting penguins are land-bound and will come ashore just before the feather-shedding phase of moult, high adult count totals during February and March could indicate an imminent moult peak.

Clutch size and brood size

Clutch size at Sylvia Hill, which averaged 1.68 eggs/nest, appears to be lower than at other colonies, where clutch size approaches two eggs/nest (Randall and Randall 1981, Seddon 1999). Average clutch sizes on Mercury (25.43°S), Halifax (26.37°S) and Possession Islands (27.01°S) further south are 1.84, 1.90 and 1.92 respectively (JK unpublished), suggesting a possible latitudinal decline in clutch size. There may be several reasons for the observed lower clutch size at Sylvia Hill. Firstly, small sample size and irregular surveys may not reflect a real trend. Secondly, visits may have coincidentally occurred when birds had just begun laying and clutches were incomplete, although visits were timed during the middle of the breeding season (Figure1). Thirdly, eggs may be lost by rolling out of the nest, while the incubating bird changes position on the nest or during incubation change-overs, and are lost on the muddy cave floor. This is common on the steep-sided Mercury Island, where up to 8% of nests lose eggs in this manner — some nests at the bottom of steep slopes contain as many as five eggs (R Jones, Ministry of Fisheries and Marine Resources, Namibia, pers. comm.). While egg-rolling is a factor in explaining the low clutch size at Mercury Island, it occurs rarely on flat terrain (for example on Halifax and Possession Islands), where eggs accidentally kicked out of the nest are easily retrieved (JK pers. obs.). Lastly, environmental conditions may be less conducive to breeding at the northern edge of the species' range. However, presently food resources (in terms of abundance and composition) are generally better in the north than south of Lüderitz (Crawford *et al.* 1985, Crawford *et al.* 2001).

Brood size (i.e. hatchlings produced per nest) averages 0.97, 1.01 and 1.12 on Mercury, Halifax and Possession Islands respectively. The larger brood size at Sylvia Hill (1.31 chicks per nest) could result from the protected nature of the cave site, where nest contents are sheltered from gull predation and temperature fluctuations.

Conservation implications

The entire breeding distribution of the African Penguin is currently centred around three island groups or cores, each with different population dynamics and discrete food supplies. These are Mercury and Ichaboe Islands in Namibia, close to the northern boundary of the species' distribution; Dassen and Robben Islands at the centre, and St Croix and Bird Islands near Port Elizabeth, at the southeastern end of its range. Together these cores support at least 75% of the entire population (Crawford *et al.* 1995, Crawford *et al.* 1999), while other, non-core, localities continue to lose birds, particularly in Namibia (Cordes *et al.* 1999, Crawford *et al.* 2001, Kemper *et al.* 2001). A decrease in food availability is suggested as the main cause for the decline of local populations (Cordes *et al.* 1999, Crawford *et al.* 1985, Crawford 1991, Crawford *et al.* 1995, Crawford *et al.* 2001, Kemper *et al.* 2001). Populations decrease through lower survival, lower breeding success and possibly emigration to where food remains plentiful. As food resources fluctuate, depleted populations could be 'replenished', as is the case at Robben Island, where the growth of the colony is largely attributed to immigration (Crawford *et al.* 1999). This process can possibly be facilitated if there are healthy breeding colonies nearby. Non-declining breeding localities close to the northern edge, such as Sylvia Hill and Mercury Island are therefore a potential source of birds for replenishing breeding localities further south if the food supply improves.

We recommend that continued monitoring of the colony at Sylvia Hill be made a priority. A concerted effort of ringing more penguins at the cave should be made to determine the survival of adults in the colony and the survival and dispersal of juveniles from the colony.

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