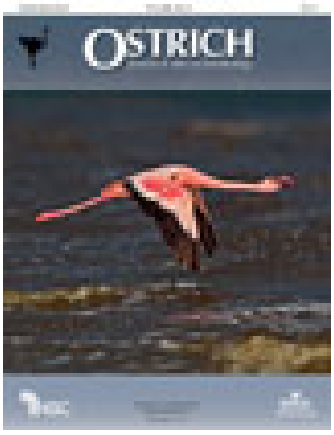

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Egg-capping in the Southern Ground-Hornbill Bucorvus leadbeateri

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Short Note

Egg-capping in the Southern Ground-Hornbill *Bucorvus leadbeateri*

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'Egg-capping' describes occurrences of the empty shell from a hatched egg slipping over an unhatched egg from the same clutch. It is a rare phenomenon, occurring typically in <2% of nests monitored. Here I report the first two observed cases of egg-capping in the endangered Southern Ground-Hornbill *Bucorvus leadbeateri*. In north-eastern South Africa, egg-capping occurred in 4.3% of nests that contained two eggs with one or more surviving to hatching.

Keywords: Associated Private Nature Reserves, *Bucorvus leadbeateri*, egg-capping, Southern Ground-Hornbill

Although Derrickson and Warkentin (1991) were the first to use the term 'egg-capping', the phenomenon was first reported by Tinbergen et al. (1962) who considered the possibility of the misplaced egg-shell inhibiting pipping of the unhatched Black-headed Gull *Larus ridibundus* eggs. Egg-capping may lower hatchability in two ways: (1) by reducing embryonic gas exchange or (2) by interfering with the pipping process (Derrickson and Warkentin 1991). It is thought to be more likely to occur when (1) eggs hatch asynchronously, (2) egg sizes diminish with laying order, (3) nests have a deep cup, and (4) parents seldom remove egg-shells from the nest (Derrickson and Warkentin 1991; Verbeek 1996). Egg-capping can be more common in cases of interspecific brood parasitism due to greater levels of hatching asynchrony and egg-size differences between parasite and host species (Hauber 2003).

The breeding biology of the Southern Ground-Hornbill *Bucorvus leadbeateri* (SGH) is well known (Kemp and Kemp 1980; Kemp 1990; Knight 1990; Kemp 1995). It nests in large natural cavities, laying 1–2 eggs, 3–14 d apart (Kemp 1990). The first laid egg is usually larger than the second, with large variations in volume (4–27% difference in volume within clutches; Kemp 1990). The species usually raises only one chick to fledging, the second egg probably being an 'insurance egg'. If the first hatched chick is healthy, the second chick is mostly ignored, ultimately succumbing to dehydration a few days after hatching. Breeding attempts have been recorded in the Associated Private Nature Reserves (APNR; 24°02′–24°33′ S and 30°48′–31°28′ E) since 2000. Due to a scarcity of natural cavities in the APNR, artificial nest boxes were erected and used successfully since 2002. I report here the first two observed occurrences of egg-capping in this species.

Ninety-four nesting attempts have been recorded over 10 seasons from 2000–2013. Regular nest visits prior to egg-laying facilitated accurate lay- and hatch-date estimates, which enabled some nests to be visited during the hatching stage to detect possible egg-capping occurrences. A total of 72 nests (76.6%) were confirmed as having two eggs during initial nest checks, of which 57 (79.2%) had at least one egg surviving to hatching. Of these, 47 nests (82.5%) were visited at the hatching stage, each containing one nestling and an egg. Egg-capping was detected at two of these nests (4.3%) and in two of 94 eggs laid (2.1%). The first was observed in December 2011 (hereafter nest A; Figure 1a) and the second at a different nest in December 2012 (hereafter nest B; Figure 1b). In both cases, the empty egg shell and remaining fertile second egg were carefully separated and the nest visited again after a few days. Chicks hatched successfully in both cases.

Egg dimensions were only measured from 2012 (using Vernier callipers to the nearest 0.1 mm). Egg mass was recorded using a digital microscale (Giros® PG-300, accuracy to 0.1 g) 1–7 d post-laying. Of the three clutches where eggs were measured, the first egg was 1–12% broader than the second egg, with egg-capping occurring where the difference in egg width was greatest (Table 1). The percentage difference in egg volume between first and second laid eggs was greatest in a nest where egg-capping occurred (Table 1). In all nests where laying order was known, first eggs were consistently heavier than second eggs, including in both nests where egg-capping occurred (Table 1). In all four cases where egg dimensions were recorded in nests without egg-capping, first-laid eggs were longer and broader than second-laid eggs (Table 1). Egg mass in nest A was typical of nests where egg-capping did not occur, but eggs in nest B were heavier than previously recorded eggs (Table 1).

Data for egg-shell removal were available for 42.5% of nests (20 of 47). At the study site, egg shells were most often removed by the female from the nest within 1–2 d

after hatching of individual chicks (84%). Nest camera footage taken at two artificial APNR nests in 2003 showed that shells were removed (in one case consumed) a few hours after the chick hatched. In three nests, egg shells were removed 3–7 d post-hatching.

Figure 1: Occurrences of egg-capping at two Southern Ground-Hornbill *Bucorvus leadbeateri* nests in (a) December 2011 and (b) December 2012 in the Associated Private Nature Reserves, South Africa (photos by K Carstens)

Despite the relatively modest sample size, egg-capping frequency in the SGH was greater than in other species reported (0.2–3.3% of nests for eight species; Arnold 1992; Derrickson and Warkentin 1991; Sandercock 1996; Verbeek 1996). This greater frequency may likely be explained by SGHs satisfying three of four factors known to increase the likelihood of egg-capping occurring described by Derrickson and Warkentin (1991). First, the eggs hatch 3–14 d apart, creating an extended opportunity for the egg shell of the first egg to slip over the second egg before the second egg hatches. Second, egg size diminishes with laying order allowing the egg shell of the first-hatched egg to fit over the second egg. The difference in egg volume at nest B surpassed the others in this study and those described by Kemp (1990). In addition, the difference in egg-breadth at nest B was greater than in other nests, facilitating egg-capping. Third, the thick, concave nest bowl further increases the likelihood of egg-capping where eggs and nestlings are closely packed. Egg shells and second eggs are more likely to gravitate to the centre in a deeper cup than in shallow nests or scrapes (Verbeek 1996). The only factor not met by SGH is that females are diligent in egg-shell removal, with egg-shells most often being removed 1–2 d after hatching. If this were not the case, the frequency of egg-capping may be even higher in this species.

No previous occurrences of egg-capping in this species have been observed in the APNR (PFIAO unpublished data) or Kruger National Park (AC Kemp, A Botha and S Ronaldson pers. comm.). First, the possibility of detecting egg-capping is low since nest-visiting protocols differ between study sites, with few nests across their range visited at the interval between first- and second-eggs hatching. Second, egg-capping is easily overlooked, or if observed, failure to note its significance would lead to low reporting rates (Verbeek 1996).

I did note that the moist organic material on the inside of the empty egg shell had dried against the second egg and had become stuck, possibly making it tricky for the empty shell to be loosened and removed by the incubating female. It is unknown whether the egg shell, if left in that position, could have inhibited hatching, particularly if the additional egg shell should slip over and adhere to the shoulder of the egg where pipping would occur. Whether the chick could overcome this obstacle during pipping by strength of the complexus muscle alone, or by help from the incubating female, remains a possibility but as yet unknown in this species.

Table 1: Southern Ground-Hornbill *Bucorvus leadbeateri* egg characteristics in nests in the Associated Private Nature Reserves, South Africa. Egg characteristics are provided where lay order was known. Volume was calculated using volume = length × breadth² × 0.51 (Hoyt 1979). Percentage difference in volume (V) was calculated using (V1 – V2)/V2 × 100 (Edwards and Collopy 1983). Nest A and B, occurrence of egg-capping in a nest in December 2011 and 2012, respectively; E1, first-laid egg; E2, second-laid egg

Nest	Length × Breadth (mm)		Volume (cm³)		Difference in volume (%)	Mass (g)	
	E1	E2	E1	E2		E1	E2
No egg-capping	73.6 × 50.4	67.6 × 49.7	95.3	85.2	14.5	88.2–112.2 (101.1)	80.8–101.5 (90.3)
(n = 2)[a]	68.8 × 50.0	65.0 × 46.0	87.7	70.1	25.1		
Nest A	–	–	–	–	–	101.4	94.6
Nest B	71.5 × 56.6	72.5 × 50.5	116.8	94.3	32.1	115.7	102.9

[a] For mass, n = 16, with averages in parentheses

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