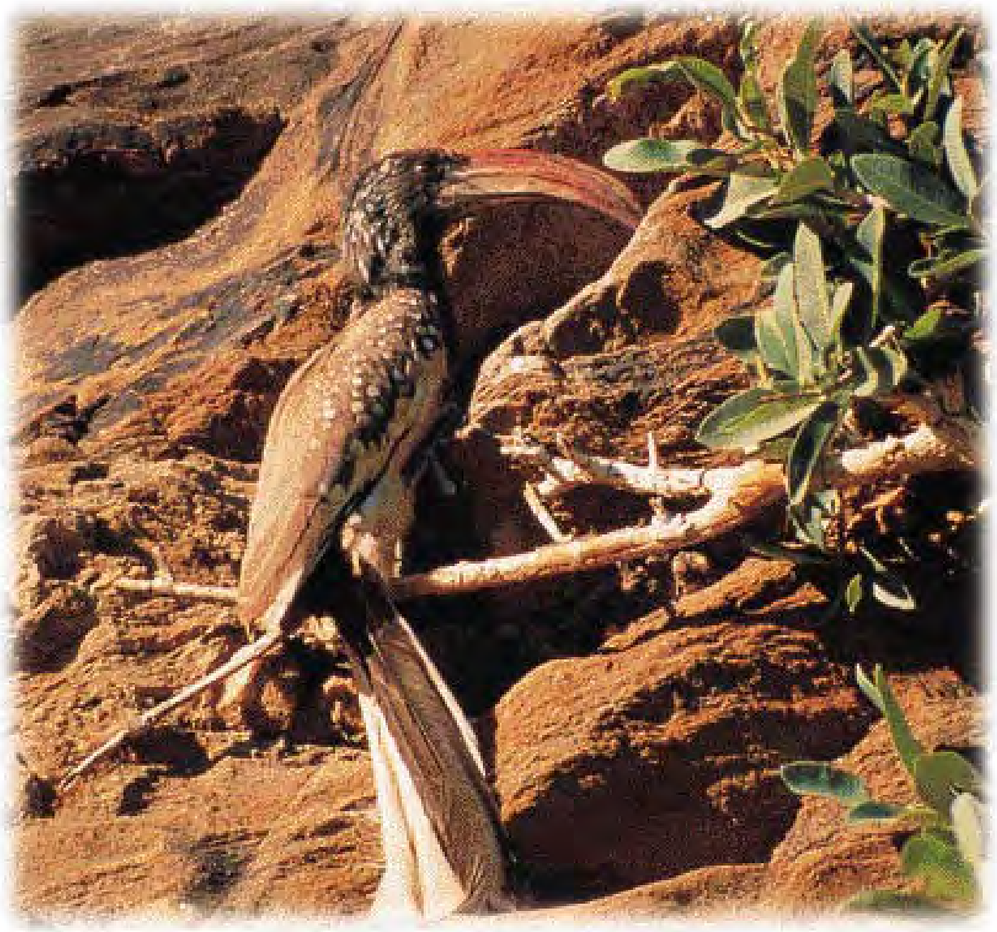
PLUGGING THE GAP

Monitoring Monteiro's Hornbills



The male Monteiro's Hornbill, like the males of other hornbill species, epitomises parental care beyond the call of duty. Few, if any, other bird species take better care of both brood and female throughout the breeding season.

Text and photographs by
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Large and loud, hornbills are conspicuous birds in the African bush. Yet, despite their prominence, little is known about their breeding habits, largely because the female retreats into a cavity – a tree hollow or a cliff crevice – to lay her eggs. Furthermore, in all species except the Ground Hornbills, she seals herself inside her chosen cavity by constructing a hard plug around the entrance.

Until recently, the only way to enter this hidden world of hornbills was either to break open the sealed plug or to drill a separate entrance into the nest chamber. Researchers have now come up with a third possibility: to persuade the birds to use an artificial nest, a wooden box with an entrance hole in the side and a hinged lid on top that allows observers easy access.

In 1980, Nature Conservation officials in Namibia conducting research on cavity-breeding birds in the Daan Viljoen Game Reserve near Windhoek erected a batch of such nest boxes to find out which species would use them. Several hornbill pairs moved into the boxes that summer. Twenty years later, 240 nest boxes are spread over an area of 15 square kilometres, making this the oldest and largest nest-box study in Africa. The hornbills took advantage of the housing surplus, and now breed at the highest densities recorded anywhere in Africa – seven to nine pairs per square kilometre. Surprisingly, the near-endemic Monteiro's Hornbill *Tockus monteiri*, which normally nests in rock crevices, has become the most abundant nest-box occupant in the reserve.

If one feature were to be singled out as the most bizarre in hornbill behaviour, it would be the female's habit of retiring into a cavity to breed and closing the entrance with a plug. Functioning as an efficient anti-predator device, the nest plug is responsible for shaping a hornbill's anatomy, physiology and behaviour. Contrary to popular belief, it is not the male that incarcerates his mate as much as the female who shuts the male out. She constructs the plug from a mixture of mud, her own faeces and the macerated carcasses of selected invertebrates brought to her by the male.

The most common invertebrate used by the Monteiro's Hornbills in the Daan Viljoen Reserve was found to be millipedes (Order: Myriapoda). In fact, from the deserts of Namibia to the tropical forests of West Africa and South-East Asia, most hornbills incorporate millipedes in their nest plugs, displaying a remarkable convergence of habit. The millipedes in the arid Namibian landscape, with their large size, chitinous exoskeletons and moist body contents, represent an ideal construction material: pick one, crush it, mix it with the other ingredients, and apply – in no time the plug is made. But probably even more important is the millipedes' 'pest-control' quality. When attacked or crushed, they secrete copious quantities of a yellowish substance that is not only extremely ▷

Monitor lizards, together with tree rats and baboons, constitute the worst predators on hornbill nests in Namibia.

In the Daan Viljoen Game Reserve, perched at the edge of the Khomas Hochland escarpment, researchers and hornbills await the onset of rains and the start of the breeding season.

A Monteiro's Hornbill nest, closed with a plug made up of mud, faeces and crushed millipedes.

Monteiro's Hornbills are able to carry more than one food item – in this case crickets – to the nest. This is not only an energy-saving strategy, but perhaps also minimises advertising the nest site in a predator-riddled environment.

distasteful, it also serves as an antibiotic against bacterial infection and fungal growth. Our preliminary experiments, showing that millipede secretions inhibit the growth of bacteria and fungi in nest boxes, suggest that hornbills are harvesting millipedes to benefit from their antibiotic secretions.

The female hornbill carefully constructs the plug with sideways movements of the bill, generally closing the nest entrance within a day. She then remains incarcerated inside the breeding chamber for 60 days, until the brood is old enough to be left alone in the nest. Throughout this period the male, passing food through a narrow slit in the plug, attends to his mate's every nutritional need.

Before the female starts to lay eggs, she goes through a 'cooling off' interval that may last between three and 15 days. The purpose of this delay is currently being investigated – she could be testing the safety of her nest and/or the provisioning ability of her mate. If either should fail to meet her standards, she will break the plug, emerging after several hours of pecking. In the course of our research it soon became obvious that if a female is handled prior to laying she will desert the nest site. We have also noticed that a female breeding with a new partner delays a little longer than normal, which suggests that an untested male has to go the extra mile to prove his foraging and food provisioning skills before his mate will settle down to egg-laying.

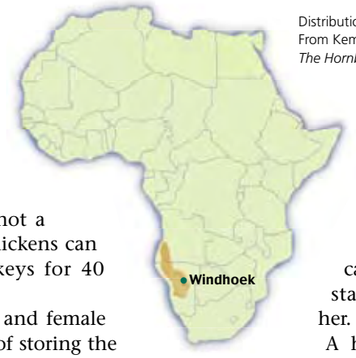
When the female enters the breeding chamber, her egg follicles are well developed but the eggs are not yet shelled. This avoids the risk of the fragile egg shells being crushed, and of the female incurring internal injuries when she squeezes through the narrow opening to the nest cavity. Once she is settled in the nest chamber and is ready to begin the egg-laying process, she has to rapidly mobilise enough calcium to produce the shells. During this period, the male Monteiro's Hornbill searches rocky outcrop crevices for the leached, calcium-rich shells of *Dorcasia* snails. He carries them back to the nest and crushes them into fragments small enough to be presented to his sealed-in partner. A month and a half later he will again seek out snail shells, when the female needs to strengthen her skeleton and muscles before she leaves the nest after the long period of immobility. Soon after the first egg has been laid, the female moults completely, becoming flightless and utterly dependent on her single, loyal partner. The nutritional costs of this moult are also 'sponsored' by her untiring consort.

Monteiro's Hornbills lay between two and eight eggs in a clutch, the number being smaller in years of poor rainfall and when food becomes scarce later in the breeding season. Unlike chickens, which can produce an egg a day, hornbills lay eggs at intervals of two to four days. Thus, in an average clutch of four eggs, the last egg may be laid seven to eight days after the first. In a clutch of six, half a month can elapse between the laying of the first and last eggs.

Most birds mate repeatedly during the laying period, so females do not have to store sperm over the several days during which eggs are produced. Successive eggs are fertilised by successive matings, which allows for some family planning and for different males to fertilise the eggs in a single

clutch. In the case of hornbills, however, the female has to carry and store a full load of sperm before sealing herself in. Assuming that she mates on the day she enters her nest, a female Monteiro's Hornbill is thus able to store viable sperm for at least 21 days. Long-term sperm storage is not a common feat in birds, although chickens can keep sperm for 35 days and turkeys for 40 days.

Birds are notorious philanderers, and female hornbills, being physically capable of storing the sperm of several males far in advance for later use, might be expected to show a high degree of infidelity. However, by using genetic fingerprinting techniques to test the paternity of 38 families of Monteiro's Hornbill, we have found no significant evidence to suggest that females regularly sneak a fling on the side. We believe that the potential for the male to take drastic retaliatory steps if he suspects that his mate is unfaithful is enough to persuade her to be one of the finest examples of monogamy in birds. Once a female has moulted in the nest cavity, she faces certain death by starvation if the male abandons her.



Distribution of Monteiro's Hornbill.
From Kemp, A.C. 1995. *Bird Families of the World: The Hornbills – Bucerotiformes.* Oxford University Press.

The differences in age and size within a brood of hornbill chicks are considerable, setting the stage for brood reduction through sibling competition, starvation and occasionally siblicide.

Despite the lack of space in the nest box, Monteiro's Hornbill chicks patiently await fledging day. When they do emerge, they will be able to fly without needing to exercise.

A hornbill's complex breeding strategy carries additional costs. As a consequence of their slow laying constraints and the initiation of incubation with the first-laid egg, hornbills are locked into an extended hatching period, also known as hatching asynchrony. Because the chicks hatch at intervals of two to five days and are fed from the time they hatch, a size hierarchy is quickly established within the brood. The smaller, late-hatched chicks have difficulty competing with their older siblings and many die within a few days of hatching. We are currently testing whether this process of brood reduction is simply a result of the female being sealed in, or whether it represents an example of adaptive family planning. In Namibia's dry environments, food supplies are strongly dependent on rainfall, a very unpredictable commodity. Because food availability is so difficult to predict a month in advance of the chicks' hatching, hornbill parents may need to adopt a flexible approach to family planning.

The very low survival rate of the last-hatched chicks suggests that the Monteiro's Hornbill has indeed taken this route to maximise its breeding output. The clutch laid is invariably optimistic, and often ridiculously large. In years of exceptional rainfall, a pair may raise the whole brood, but when food is scarce the brood is allowed to trim itself to an optimum size through the quick elimination of the youngest nestling(s).

These are some of the most fascinating results from the Daan Viljoen Hornbill Project, which has not only improved our understanding of these birds, but has also become an ideal platform on which to base pro-active plans for the conservation of them and their habitats. Although no southern African *Tockus* hornbill is currently in danger of extinction, the same cannot be said for their □ West African or Asian counterparts.

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