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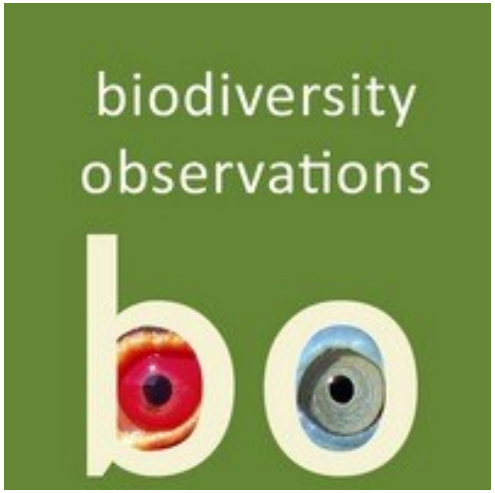

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How dare you? Broad-billed Rollers *Eurystomus glaucurus* usurp a threatened Cape Parrot *Poicephalus robustus* from a nest cavity in the Limpopo province of South Africa

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Abstract

This study documents the first recorded instance of interspecific competition for nesting cavities between the endangered Cape Parrot *Poicephalus robustus* and the Broad-billed Roller *Eurystomus glaucurus*. Both are secondary cavity-nesters occupying overlapping habitats in southern Africa. Despite the Cape Parrot's earlier breeding season, which theoretically affords it priority access to cavities, a roller pair was observed attempting to use an actively occupied Cape Parrot nest. This rare interaction reveals potential interspecies conflict where nest-site selection overlaps. Additional examples from both African and Australasian regions suggest that breeding season timing and cavity characteristics often mitigate competition among avian species. The impact of the roller usurping a Cape Parrot nest was significant as only three out of 13 known nest sites were active in 2024 and only one was known to be successful. Therefore, with Cape Parrot populations having dwindled to fewer than 2,000 individuals and breeding success vulnerable to habitat damage and predation, understanding all limiting factors, including interspecific interactions, is vital for conservation. Long-term monitoring across regional nodes underscores the importance of protecting preferred nesting sites to ensure reproductive success and species longevity.

Introduction

Nearly all parrot species use cavities as nest sites, with most relying on existing cavities made by other birds, insects or natural decay (secondary nesters: Newton 1994, van der Hoek et al. 2017). For these obligate cavity nesters, breeding success is negatively influenced by limited availability of nesting sites (Renton et al. 2015). Furthermore, the best nesting sites are further limited by parrots preferring to re-use their own or conspecific's nest sites, where previous use indicates successful nesting attempts (Renton et al. 2015). Not only is there intraspecific competition, but there are usually other cavity nesting bird species competing for the same nest sites (Renton et al. 2015).

Parrots have evolved several strategies to try and limit competition as well as reduce predation risk. Parrots exhibit adaptive nest site selection particularly when the breeding seasons overlap between different cavity-nesting species (Renton et al. 2015). In Australia, the Palm Cockatoo *Probosciger aterrimus*, the Electus Parrot *Eclectus roratus*, and the Sulfur-crested Cockatoos *Cacatua galerita* (Heinsohn et al. 2003) are able to nest at the same time within the same habitat as each of these species use cavities that differ in orientation, size, and height. In other areas, parrot species breed outside the breeding season of other cavity-nesters in the area to avoid competition, including southern African parrots: Meyer's Parrot *Poicephalus meyeri* (Boyes 2008) and Grey-headed Parrots *Poicephalus fuscicollis* (Symes & Perrin 2004).

Unfortunately, historical and current forest degradation and destruction by human activities have reduced the number of potential nest cavities, such as when trees are removed for firewood, agriculture, or for logging purposes (Newton 1994, du Plessis 1995, Lindenmayer & Laurence 2017). In South Africa, historical

exploitation of keystone forest tree species (especially yellowwood *Afrocarpus* and *Podocarpus* spp.), have been devastating for the threatened and endemic Cape Parrot *Poicephalus robustus*, because they use these species for food and nesting sites (Downs & Symes 2004, Wimberger et al. 2017, Carstens et al. 2022). Given there are less than 2000 individuals left in the wild (Carstens et al. 2020), it is crucial to understand factors affecting their breeding success, but currently little is known about the breeding habitats or their specific nesting requirements (Carstens et al. 2022).

Determining the availability of suitable cavities is difficult given the heights and advanced decay stage of trees in which these potential nest sites are found, and thus one suggested solution is to observe competition for these resources through antagonistic species interaction around nest sites (Renton et al. 2015). In this regard, for Cape Parrots, a Trumpeter Hornbill *Bycanistes bucinato*r, has been recorded to have inspected an occupied Cape Parrot nest site (Wirminghaus et al. 2001), and a variety of bird species have inhabited unoccupied artificial nest boxes erected for Cape Parrots (Wimberger et al. 2017), but otherwise, there is no information on species interactions at natural Cape Parrot nest sites.

Breeding habits of Cape Parrots in their most southern distribution has been previously described (Carstens et al. 2022), but nothing is known about the breeding success of Cape Parrots within their most northern range, in Limpopo province of South Africa. In this paper the breeding success of 13 nest sites are described as well as, for the first time, an interaction between a pair of Broad-biller Rollers *Eurystomus glaucurus* usurping a nest site from a pair of Cape Parrots.

Methods

The Cape Parrot Project (CPP) is a conservation NPO focused on conservation research, habitat restoration, and community participation, using these as tools to safeguard the future of the Cape Parrot. CPP established a field base in the Magoebaskloof region in Limpopo in 2022 to collect long-term data on Cape Parrots, having commenced its work in the Amathole region of the Eastern Cape, a stronghold of the Cape Parrot, in Hogsback in the Eastern Cape in 2009.

This current observation took place in the Magoesbaskloof region (23°49′S, 29°59′E), between 660 and 1550 m above sea level at the northeastern tip of the Drakensberg mountain range in Limpopo, South Africa. Magoesbaskloof is predominantly characterised by a mix of indigenous Mistbelt Forest patches on the mountain slopes and exotic pine plantations. The area experiences annual summer rainfall (~887 mm), with a temperature range of 5–30°C. In addition to Cape Parrots, there are eight other bird species in the study area that nest in tree cavities (Table 1).

Table 1: Cavity nesting species in the Afro-temperate forests of Limpopo and their breeding seasons (Chittenden et al. 2016, Gibbon Multimedia Pty Ltd, 2024).

Common Name	Species Name	Cavity Nester	Breeding season
Barbet, Black collared	*Lybius torquatus*	primary + secondary	Sep - Feb
Hornbill, African Grey	*Lophoceros nasutus*	secondary	Sep - Feb
Hoopoe, African	*Upupa africana*	secondary	Aug - Feb
Owl, African Wood	*Strix woodfordii*	secondary	Jul - Aug
Parrot, Cape	*Poicephalus robustus*	secondary	Jun - Jan (as early as May, per. obs.)
Roller, Broad-billed	*Eurystomus glaucurus*	secondary	Sep - Dec
Trogon, Narina	*Apaloderma narina*	secondary	Nov - Feb
Woodpecker, Cardinal	*Dendropicos fuscescens*	primary	Jul - Dec
Woodpecker, Olive	*Dendropicus gresiocephalus*	primary	Aug - Nov

As part of CPP's routine monitoring, each year at the onset of the breeding season (in Limpopo this starts in May), each cavity known to have previously been utilised by Cape Parrots for breeding is visited monthly by a researcher to scout for breeding-related Cape Parrot activity, such as excavating and nest maintenance, detailed further in Carstens et al. (2022) for Cape Parrots in Hogsback. Observations begin half an hour before sunrise to avoid starling the parrots which normally leave the cavities at first light and conclude 2.5 hours later when activity has subsided for the morning and/or the last three hours of the day.

Once it is suspected that breeding has commenced, observations are undertaken weekly until the breeding season ends in January, or until the breeding pair and the fledglings are known to have vacated the cavity. Once nest observations commence, the observer positions themselves close enough to the cavity tree to see individual parrots, sometimes allowing for sighting of their heads at the cavity entrance. This not only allows the observer to determine whether a male or female (distinguishable by a unique red colouring on the female's forehead) is in the cavity at a specific time, but to also hear and, on occasion, see the fledglings (distinguished by a lack of red on the edges of their wings and ankles).

Nest inspections are mostly concentrated at 21 known natural nest cavities within the Woodbush Forest, where the parrots use multiple tall (living and dead) exotic bluegums *Eucalyptus salgina* for gathering, roosting, and nesting. These nests have been discovered by CPP through careful exploration and observation over 2022–2024 breeding seasons. A natural cavity, in this context, is defined as a hole in a tree where parrots have been directly observed engaging in roosting and/or breeding. Exotic plant species have also been used by Cape Parrots for nesting in their southern region, namely *Pinus sp.*, but predominately in this region, parrots occupy indigenous Outeniqua Yellowwood *Afrocarpus falcatus* trees (65% of all nests, Carstens et al. 2022).

The focus of this study is within an area designated as "4 Nests", where thirteen cavities are found within seven snags, all in Salingna Gum *Eucalyptus saligna* ranging in decay Stage 6–8. Decay Stages 6–8 are at the most advanced end of the tree successional stage, where Stage 1 described living trees with some signs of branches dying and Stage 8 described dead trees (Downs & Symes 2004). Situated at 1550 m a.s.l., they are clustered within 217 m of one another and all have recorded breeding activity (Table 2).

Table 2: *Description of natural cavities within "4 nests" area inside Woodbush Forest within Magoebaskloof, Limpopo Province that are used for breeding and/or roosting behaviour. All cavities occur within Salingna Gum (Eucalyptus saligna) ranging in decay stage 6-8 (Downs & Symes 2004). Placed in order of discovery.*

Cavity name	Tree ID	Snag decay stage	2022	2023	2024
Lekone Nest 1	1	Stage 6	Discovered, Breeding, successful	Inactive	Inactive
Monyamane 1	2	Stage 6	Discovered, Breeding, successful	Inactive	Bees
Bees Nest 1	3	Stage 6	Discovered, Breeding, successful	Roosting	Roosting
Bees Nest 2	3	Stage 6	Inspecting	Bees	Bees
Bees Nest 3	3	Stage 6	Inspecting	Bees	Bees
Bees Nest 4	3	Stage 6	Inspecting	Bees	Bees
Half Cast Nest	4	Stage 8	n/a	Discovered, Breeding, successful	Breeding, unsuccessful
Monyamane 2	2	Stage 6	n/a	Discovered, Inspecting	Inactive
Monyamane 3	2	Stage 6	n/a	Discovered, Excavating	Inactive
Eagle nest	5	Stage 7	n/a	Discovered, Inspecting	Inactive
Taras Nest	6	Stage 6	n/a	n/a	Discovered, Breeding, successful
Lekone Nest 2	1	Stage 6	n/a	n/a	Discovered, Roosting, Breeding, unsuccessful
Unmarked Tree near Bees nest	7	Stage 6	n/a	n/a	Discovered, Inspecting

Each snag is approximately 30 to 40 m tall, with cavities positioned between 20 to 30 m above the ground. Besides being used for nesting, this cluster of trees serves as one of the Cape Parrots'major gathering and roosting points within the forest, with groups of parrots (a maximum of 15 having been observed) consistently visiting the area throughout the year. During 2024, nest site inspections started on 14 May and ended on 7 January.

Results

Between 2022–2024, 13 cavities were monitored for nesting activity, but only three active nests were noted as active in the "4 Nests" area within Woodbush Forest in 2024 (Table 2): (1) "Half-cast nest" where breeding behaviour was observed from 14 May until 23 May, when the nest was vacated after a branch fell on the male Cape Parrot standing at the cavity entrance. Thereafter, a Cape Parrot was observed briefly in the cavity on 5 June, but no further activity followed this appearance; (2) "Taras nest" was occupied from 16 July until 10 December, where two fledglings had left by the next nest check on 7 January 2025. On 19 September, the male from this pair was seen to chase another male from the entrance of their cavity in what appeared to be territorial behaviour; (3) "Lekone nest 2" was active from 9 October until 14 November, when it was usurped by Broad-Billed Rollers, detailed below.

On 9 October, a Cape Parrot breeding pair was observed at Lekone 2 by a CPP field researcher during regular monthly observations whereafter weekly nest observations began. This was a previously unused cavity in a tall bluegum snag, which the pair had just recently started excavating. Another cavity had already been identified in this snag below this cavity and had been used by parrots for breeding two years previously (referred to as Lekone 1).

At Lekone 2 (Figure 1) the pair could be seen regularly visiting the cavity and then flying off to forage. Upon returning, the pair perched in the surrounding tall dead trees where the male would occasionally allofeed the female. From 6 November, only the male foraged and returned to feed the female. Upon the male's return to the nest, he would vocalise on a nearby branch and the female would immediately leave the nest to be fed. We assumed she was incubating the eggs due to similar behaviour described for incubating Cape Parrots in Hogsback (Carstens et al 2022). After being fed for c. 10 minutes the female returned to the cavity to incubate while the male left to roost elsewhere. Roosting is confirmed during evening observations and is assumed where the parrot does not return to the nest within 30 minutes after sunset.

On 14 November, a single pair of Broad-billed Rollers was observed visiting the area. During the next days, up to 19 November, the rollers were observed aggressively interacting with and chasing off the pair of Cape Parrots around the cavity. The rollers would also chase off small groups of parrots that were gathering nearby by directly flying/ charging towards them. By 26 November, the rollers had successfully displaced the breeding parrot pair and exhibited nesting behaviours (Figure 1). This included behaviours such as one individual foraging

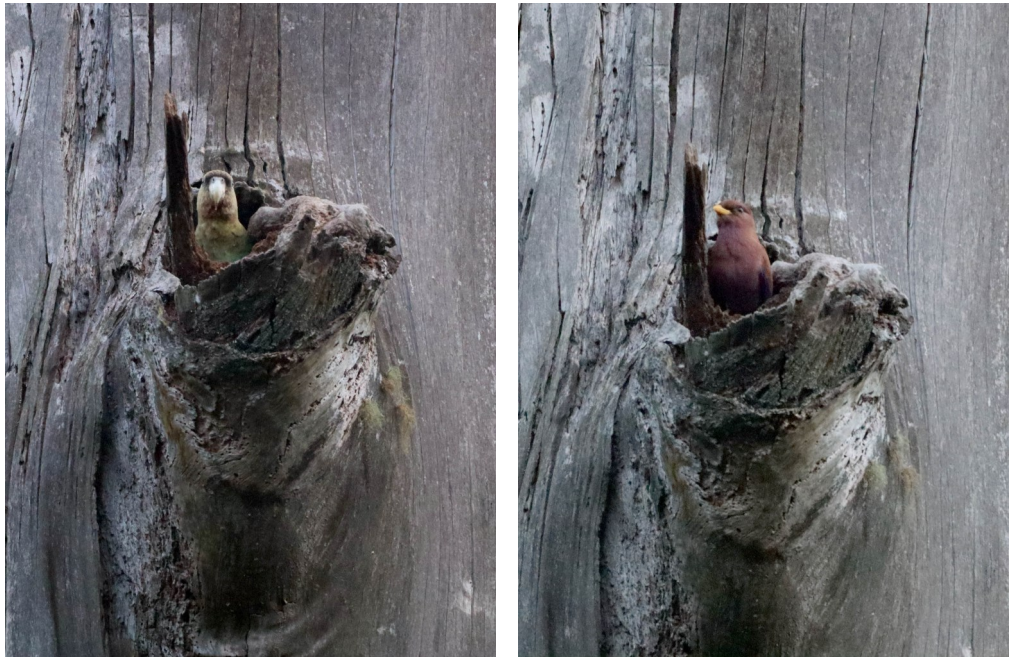

Figure 1. Left: Cape Parrot at Lekone nest site 2 (29 October 06:50). Right: Broad-billed Roller at same cavity entrance after displacing Cape Parrots (26 November 18:19) (Photos by Otto Makola).

while the other individual remained in the cavity until the former's return, when it would then perch at the highest point of the cavity tree and call for the other in the cavity to feed. The pair would also leave to forage together and return briefly to roost in the cavity for the night. The last observation was made on 26 November because it was confirmed that the breeding Cape Parrot pair had lost their nesting cavity to the Broad-billed Roller pair.

Discussion

This interspecific competition for nesting cavities is the first to be recorded between the Cape Parrot and the Broad-billed Roller. Like the Cape Parrot, the Broad-billed Roller is a secondary cavity-nester, preferring to nest in existing holes found in woodland and forest snags (Brooke 1971). The Broad-billed Roller is an intra-African migrant, travelling from the northern part of its range during the dry season, to breed in southern Africa during the wet season (September–April, Brooke 1971).

Similarly, other secondary cavity nesters in the region only start to breed around August (Table 1), which would allow for the Cape Parrot to have first choice in finding a cavity to breed in, with earliest reports of breeding behaviour of Cape Parrots made in May (pers. obs). Despite the Cape Parrots having access to the cavity before the rollers, as well as the other available cavities in multiple snags within this area, these rollers selected a cavity that was already in use by the Cape Parrot pair.

Interspecific aggression has been observed between other African parrots and rollers. Aggression has been observed between Rüppell's Parrot *Poicephalus rueppellii* and the Purple Roller *Coracias naevius* as well as Rüppell's Parrot and other cavity nesting species, including hornbills: Southern Red-billed Hornbill *Tockus rufirostris*, African Grey Hornbill *Lophoceros nasutus*, Southern Yellow-billed Hornbill *Tockus leucomelas* and starlings: Burchell's Starling *Lamprotornis australis* and Cape Starling *Lamprotornis nitens* (Selman et al. 2004). In another instance, Meyer's Parrots directly competed with Lilac-breasted Rollers for a nest cavity and were also seen to be chased away from potential nest cavities by Burchell's Starlings. For both of these parrots, the interspecific competition occurred pre-breeding season and thus the authors proposed that they were not limited by nesting site availability because, by the time of the breeding season, the parrots had found nesting sites to use (Selman et al. 2004, Boyes 2008).

Besides one report of a cavity-nesting species (Trumpeter Hornbill) interfering with an occupied Cape Parrot nest site (Wirminghaus et al. 2001), interspecies aggression appears to be low for Cape Parrots, although Red-winged Starlings *Onychognathus morio* and Crowned Hornbills *Tockus alboterminatus* have been observed using artificial nest boxes erected for the use of Cape Parrots, although these had not yet been occupied by parrots (Wimberger et al. 2017). However, given the low recorded breeding success for Cape Parrots, as detailed in this study as well as that recorded for a population in their southern distribution (58%, Carstens et al. 2022), the aggressive usurping of a Cape Parrot nest by Broad-Billed Rollers is significant.

Furthermore, Cape Parrots are also prone to losing nesting sites due to deteriorating nesting trees, such as examples of a branch falling on parrot in this study, and a tree canopy with an active nest collapsing during strong winds in the Hogback area (Carstens et al. 2022). Cape Parrots are also targeted by nest predators, although this has not yet been observed in Limpopo. Samango Monkeys *Cercopithecus albogularis* and African Harrier-Hawks *Polyboroides typus* were suspected to cause the failure of two nests in Hogsback (Carstens et al. 2022).

With fewer than 2,000 individuals left in the world, long-term monitoring of Cape Parrot populations is needed to determine long-term breeding trends. The CPP is currently well-positioned to continue this work with the field station at the southern node (Hogsback) having been since 2009 and the northern (Magoebaskloof) node starting up in 2022. In addition to behavioural observations made by field staff, determination of breeding success is also being trialed through the use of camera traps set up at nesting sites as well as the use of acoustic monitors to pick up nestling calls. To monitor changes in breeding seasons for Cape Parrots and other cavity nesting species, CPP is collecting long-term weather data and food availability through phenology transects set up in the forests.

Continuous nest site monitoring has allowed us to record the re-use of Lekone 2 by Cape Parrots in the current (i.e. 2025) breeding season in Limpopo. It is currently being used as a roosting site, but its use as a breeding site is likely and we hope they will be able to guard this nest from any Broad-Billed Rollers this time.

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