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Nesting behaviour of the Yellowish-breasted Racquet-tail *Prioniturus flavicans*

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A nest of the Yellowish-breasted Racquet-tail *Prioniturus flavicans* was discovered on the 5 December 1997 in the Bogani Nani Wartabone National Park, Sulawesi, Indonesia. Observations were made at this nest until the last of three chicks fledged after 88 days. This nest and three separate cavities at which nest-checking behaviour was observed in this species were all in the root balls of arboreal epiphytic ferns. Breeding behaviour was found to be similar to that described for other parrot species. Chicks were provisioned by both parent birds, who delivered food at the same rate and spent a similar amount of time inside the nest. From our observations we suspect the species may be an arboreal root ball cavity-nesting specialist. We estimated the abundance of arboreal fern root balls with cavities to be 0.83 ha^{-1}; however, we were unable to determine whether nest site availability might be a population-limiting factor at this site.

INTRODUCTION

The taxonomy of racquet-tail parrots, genus *Prioniturus*, has been often revised with nine species recognised by Collar (1997) and Juniper and Parr (1998). Six species are endemic to the Philippines, of which three are threatened with extinction (Collar *et al.* 1998). Indonesia, with three species, is the only other country where *Prioniturus* occur. The island of Buru is home to a single endemic species that is classified as near threatened (Collar *et al.* 1994, but see Marsden *et al.* 1997). The remaining two species, the Golden-mantled Racquet-tail *P. platurus* and the Yellowish-breasted Racquet-tail *P. flavicans* both occur on Sulawesi.

P. platurus is distributed across the entire island and has the greater altitudinal range of the two species (Coates and Bishop 1997). In contrast, *P. flavicans* is endemic to the northern peninsula and immediately adjacent offshore islands (Coates and Bishop 1997, Forshaw 1989, Walker and Cahill 2000). It is currently classified as near threatened (Collar *et al.* 1994, but see Walker and Cahill 2000). Most recent authors (e.g. Andrew 1992, Coates and Bishop 1997, Forshaw 1989, Juniper and Parr 1998, and White and Bruce 1986) treat *P. flavicans* as a distinct species; however, Inskipp *et al.* (1996) treated it as conspecific with the Blue-crowned Racquet-tail *P. discurus*, following Salomonsen (1953), the last author to revise the genus.

Very little is known of the ecology of any *Prioniturus* species, with data on nesting and breeding behaviour virtually unrecorded. Available information comes from the few nests that have been identified, sightings of juveniles, and the breeding condition of specimen birds (Forshaw 1989, Lambert 1993). No nesting information has previously been published on *P. flavicans*. In this paper, we present data on the first nesting record of this species, together with data on potential nest site availability.

STUDY AREA AND METHODS

Fieldwork was carried out in the Bogani Nani Wartabone National Park (BNW), Sulawesi, at a lowland rain forest site called Toraut (0°34'N 123°53'E). Within our study area the altitudinal range was 180–400 m a.s.l.

A nest was found opportunistically and was subsequently observed for 166 hours until the cessation of nesting. Nest watches were carried out from a hide constructed 25 m from the nest tree, at least once every three days, alternating between mornings, 06h00-09h00, and afternoons, 14h00-17h00. Extended periods of observation were conducted when possible. It was possible to identify the parent bird, as *P. flavicans* is sexually dimorphic, the male being distinguished by his red crown spot (Coates and Bishop 1997, Forshaw 1989, Juniper and Parr 1998). Potential nest site availability was determined by checking for epiphytic arboreal ferns with suitable cavities in all canopy trees of girth at breast height (GBH) $\geq$ 0.9 m, located in 29 randomly positioned 0.25 ha vegetation plots.

RESULTS

Nest description and location

The nest was a cavity in the root ball of an arboreal epiphytic fern, located 28 m high in the branch fork of a strangler fig *Ficus* growing on a *Koodersiodendron pinnatum* host tree. The combined GBH of these was *c.*2 m with a total height of *c.*35 m. The surrounding forest was tall and relatively undisturbed, with the nest tree at least 0.5 km from the forest edge. The root ball of the fern had a diameter of *c.*1 m with a circular cavity entrance of diameter *c.*12 cm located in its underside.

On three other occasions, at different locations, pairs of *P. flavicans* were observed exploring potential nest sites, all of which were cavities in the root balls of epiphytic ferns. During brooding the female was identified as having a distinctive call when she begged/received food from the male bird outside the nest. This call was a pair, or series of up to ten high, squeaky, nasal '*nia*' calls, which changed in pitch and frequency. On 23 December 1997 this call was heard at another location; however, despite searching, a nest was never located.

Table 1. Nesting chronology and durations of nesting stages. The commencement of each stage was identified by the observation listed. The earliest/latest dates and minimum/maximum durations are given in parentheses.

Nesting stage	Date	Observation	No. days after initiation	Duration of stage (days)
Incubation & Brooding	07.12.97 (±1)	Female entered nest	-	33 (30-33)
Nestling	09.01.98 (±2)	Female out of nest	34 (33-35)	46 (44-48)
Fledging	24.02.98	1st chick fledged	80 (79-81)	
	26.02.98	2nd chick fledged	82 (81-83)	9
	04.03.98	3rd chick fledged	88 (87-89)	

Total duration of nesting: 88 (87-89) days

Nesting chronology

A pair of *P. flavicans* was first observed perched outside, and subsequently entering, the focal nest cavity on 5 December 1997. Four days later, the nest was rechecked, when it was established that the female had already entered the nest to lay. Table 1 shows nesting chronology and length of nesting stages. Nesting coincided with the onset of the wet season.

Nest provisioning

Egg laying, incubation and brooding - The female carried out all incubating and brooding during our observations. The male bird provisioned the female with food, either by entering the nest or calling her to join him in a nearby tree where he passed the food to her (Table 2). Food transfers outside the nest commonly took place at the same location, in the dead branches in the canopy top of a nearby tree. The female always returned promptly after her begging call ceased, indicating that she probably did not forage for her own food during these excursions. These were the only times the female was observed to leave the nest, except the few occasions she left to perch in front of the nest and preen.

We observed 20 provisionings by the male, 11 where the male transferred food inside the nest and 9 outside. The provisioning rate was 0.45 deliveries h^{-1} during our observations. The female usually fed twice in the morning, and twice again in the afternoon. Both morning and afternoon comprised one 'inside nest' and one 'outside nest' food transfer. Eight morning watches were extended until 12h00, during which provisioning activity later than 09h00 was only observed once, at 10h15.

Nestling Period

Both parent birds provisioned the nestlings, usually returning to the nest site together (Table 2). The overall provisioning rate was 0.54 deliveries h^{-1}. Male and female delivery rates were found to be not significantly different when their relative proportions, equivalent to 0.28 and 0.26 deliveries h^{-1} respectively, were statistically tested using a z-test (z = 0.74, n.s.). In general, the chicks were fed twice during the morning (65% of watches, range 1-3), once by each parent. In the afternoons chicks were again fed twice, or sometimes three times (57% and 29% of watches respectively, range 1-3). Whilst the total provisioning contribution (no. of deliveries x mean time spent inside the nest) was higher for the female (no. deliveries = 28, total time inside nest = 175 min) it did not differ significantly from the male's effort (no. deliveries = 31, total time inside nest = 125 min) during nestling (z = 0.57, n.s.).

The only observed threat to the nest came from a female Sulawesi Dwarf Hornbill *Penelopides exarhatus*. During nesting both the host tree and strangler fig fruited. Whilst feeding in the tree the hornbill became aware of the nest and attempted to smash her way into the nest. After seven minutes however, we intervened and scared her from the tree.

Fledging

Three chicks successfully fledged from the nest. Only one chick was ever seen at the nest entrance at any one time. All chicks were similar in size and had lost all down when they were first observed. Their coloration resembled the adult female, although with only a blue wash on the crown, not a contrasting blue patch.

Two chicks fledged at 06h54 and 08h32, respectively. Whilst the third chick was not seen to fledge it must

Table 2. Duration of provisioning visits to the nest. During incubation and brooding the values represent the time spent inside the nest by the male feeding the female and the time spent by the female outside the nest whilst being fed by the male. During the nestling stage the values represent the time both birds spent inside the nest feeding /attending to the chicks.

Nesting Stage	Bird	n	Mean (secs)	± SD	Min	Max
Incubation & Brooding	Male	8	263	109	137	442
	Female	7	626	423	234	1450
Nestling	Male	29	243	157	2	570
	Female	21	376	224	78	840
	Sum of male & female	50	299	198	2	840

have fledged between dusk and 06h00. During a watch the morning after the third chick fledged, no activity was recorded at the nest or in the immediate vicinity of the nest tree.

Potential nest site availability

We checked a total of 661 trees for arboreal epiphytic ferns with globular root balls. Of these, 91 (13.8%) supported an epiphytic fern with 6 (6.6%) of these, or 0.91%, of all trees checked, containing a cavity. Arboreal epiphytic fern density was estimated at 12.6 ha^{-1} for the Toraut site. Density of epiphytic ferns with cavities in their root balls was estimated at 0.83 ha^{-1}.

DISCUSSION

There are no previous records of *Prioniturus* using cavities in the root balls of arboreal epiphytic ferns as nesting sites. Other parrots, however, have been recorded using them. Marsden and Jones (1997) observed three species of Indonesian parrot nesting in arboreal root ball cavities. They found these same species to also use cavities in trees. Whilst *P. flavicans* might also nest in tree cavities, as the focal nest and three other potential nesting cavities were all in the root balls of epiphytic ferns, we suspect *P. flavicans* might be an arboreal root ball cavity nesting specialist.

We did not observe *P. flavicans* excavating a cavity, nor did we observe any other animal species using or excavating cavities in the root balls of epiphytic ferns. As such it is not known if *P. flavicans* excavate their own nests. Parrots are able to excavate nesting cavities; the (closely) related *Geoffroyus* parrots, which possess similar bills to *Prioniturus* parrots, and *Charmosyna* lorikeets, which nest in arboreal epiphytic root balls, have both been recorded excavating nests (Forshaw 1989).

The density of *P. flavicans* at Toraut has been estimated at 0.16 birds ha^{-1} (Walker and Cahill 2000) or a maximum of 0.08 breeding pairs ha^{-1}. Assuming all arboreal root ball cavities are suitable and available to *P. flavicans*, the density of nest sites is at least 10 times as great as breeding pairs, even if they are unable to excavate their own cavities. However, further research on the nesting of *P flavicans* is required before nest site availability, and its possible role as a population-restricting factor at Toraut, can be more accurately assessed. This should aim to determine the reliance of *P. flavicans* on arboreal epiphytic ferns as nesting sites and their ability to excavate cavities. If *P. flavicans* is a secondary nester, the status and ecology of the primary nesting species needs to be investigated and the level of competition for cavities determined. Such baseline ecological data are essential in producing informed conservation strategies for the species. They will also provide valuable ecological information on this poorly known genus of parrot.

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