Nest construction behaviour, including the repair and re-use of a depredated nest, in the Variegated Fairy-wren (*Malurus lamberti*)

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Abstract

Documenting the diversity of nest construction behaviours is essential for understanding a species' life-history. The Variegated Fairy-wren *Malurus lamberti* is a socially complex species whose nest building habits remain poorly described. Here, we report three nest construction behaviors that were observed during the 2024 breeding season at our study site in south-east Queensland, which have not been reported in Variegated Fairy-wren. In one instance, a female began constructing two nests simultaneously to then only finish one. Another involved the building of a nest before abandoning it to build another with no apparent signs of predation or reason for failure at the initial nest. Finally, a female was observed repairing then laying eggs in a nest that was previously damaged following depredation. These observations provide insight into the flexibility of nest building behaviors in this species.

Introduction

Most birds build nests, but surprisingly little is known about whether or how they learn to build them (Guillette and Healy 2015). Despite speculation over the past 150 years that birds learn and modify their nest building behaviours with experience, the consensus has generally been that nest building is an innate behaviour (Healy *et al.* 2023). Recent research has shown that nest building

behaviours can be learned as a result of personal experience or by watching the behaviour of other individuals (e.g. Walsh *et al.* 2009; Guillette *et al.* 2016); however, data remains sparse, including a general dearth of natural history observations of nest construction activities by wild birds in their natural environment.

Fairy-wrens (Maluridae) are small insectivorous passerines that are distributed throughout Australia and New Guinea. They are well-studied, being used as model organisms to examine their social behaviours (Buchanan and Cockburn 2013; Boersma et al. 2023) and coevolution with the brood parasitic cuckoos that exploit their reproductive efforts (Langmore et al. 2003; Langmore 2013; Feeney et al. 2013; Feeney et al. 2025). While female fairy-wrens are known to build nests reflecting individual preferences in aspect, height, morphology and substrate (e.g. Rowley 1965; Tidemann 1983), behaviour during the construction process is largely undocumented (but see Dixel et al. 2025). Here, we present detailed observations of the three unique construction behaviours by female Variegated Fairy-wrens *Malurus lamberti*, including an instance of previously unreported repair and reuse of an old nest.

Study Site and Species

Observations were made between September and November 2024 on the western side of Lake Samsonvale (27°16'06.8"S 152°51'31.4"E) in southeastern Queensland, Australia. At this site, Variegated Fairy-wrens are intensively monitored as part of a long-term investigation into the ecology and natural history of the birdlife at this location (e.g. Feeney et al. 2018; Thrasher et al. 2018; Kennerley et al. 2019; Richardson et al. 2019; Poje et al. 2019; Carr et al. 2020; Boersma et al. 2023; Resendiz et al. 2024; Kessler et al. 2024; Feeney et al. 2025; Corneliussen et al. 2025; Salett et al. 2025; Dixel et al. 2025). Variegated Fairy-wrens have social group structures that can range from pairs to complex groups consisting of multiple breeding male and female individuals (plural breeding groups; Boersma *et al.* 2023) alongside non-breeding auxiliaries. Each individual at our study site is fitted with an Australian Bird and Bat Banding Scheme (ABBBS) band as well as a unique combination of three unique colour bands. Individuals are banded either following targeted mist-netting or as nestlings in the days before fledging, allowing for observers to consistently track the behaviour and ecology of individual birds over time (Rowley 1965).

Observations

Simultaneously building two nests before committing to one

At approximately 07:45 on the 14th of October, 2024, the female LSOS (left leg: light blue over silver; right leg: orange over silver) was observed by RJ carrying nesting material to a grass tussock tucked against common lantana *Lantana camara*. She was observed bringing material and building a nest at this site (nest A; Fig. 1a) twice more over the following ~10 minutes. Then, over the proceeding 35 minutes, the next four times she emerged from the nearby forest with nesting material, she flew to a separate grass tussock which was approximately 15m from nest A, where she was building a second nest (nest B; Fig. 1b). Following this 45 minute bout of building across the two nests, LSOS and her male partner (LECR; left leg: light blue over emerald green; right leg crimson red over royal purple) began foraging together and no further nest construction behaviours were observed. Both nests A and B were in a very early stage of build (suspected first day of build), comprising spider webs/fine strands of bark and a loose frame and B appearing slightly more developed than A. Over the following 8 days (15th to 22nd of October) RJ observed no activity and observed no progress at either nest during this time. On the 23rd of October at approximately 07:30, LSOS was observed collecting materials and building nest A on four occasions over a 15 minute period. During this time nest B remained untouched. Nest A continued to be built over the next 7 days, albeit at a slower pace than other nearby female Variegated Fairy-wrens, who all built and began laying eggs within a week. Finally, on the 5th of November, 18 days after building was first observed, LSOS laid her first egg in nest A and then her final egg the following day on the 6th of November. Nest B never progressed past a loose grass frame. Nest A ultimately failed during incubation when a rodent (Muridae) entered the nest and consumed the eggs, which was captured on a trail camera.

Building a nest before abandoning it to build another

The second nesting strategy we observed involved a female building a nest to completion before abandoning it to build a second nest to which she later committed. This was observed twice in the same female (XALR; left leg: missing band, gold; right leg: light blue over royal purple) by RJ during the 2024 breeding season. The female in this instance was part of a large and complex plural social group, comprising HEYE (left leg: hot pink over emerald green; right leg: yellow

over emerald green) as the dominant male and XALR as the dominant female, as well as YARR (left leg: yellow over gold; right leg: royal purple over royal purple), GALE (left leg: green over gold; right leg: light blue over emerald green) and an unbanded bird as secondary males and CELH/R (left leg: crimson red over emerald green; right leg: light blue over hot pink or royal purple) as a secondary female. This strategy was first observed when RJ saw XALR building a nest on the 3rd of September (nest A), which was completed with soft lining on the 6th of September. After a few weeks with no changes observed at the nest and no evidence of disturbance (e.g. predation), XALR was observed building a new nest (nest B; Fig. 2b) on the 20th of September. This nest was nearly complete when it was found, suggesting that XALR started building this nest a few days prior. We saw no reason for why nest A was abandoned. On the 24th of September she laid her first egg of three in nest B; however, it was ultimately unsuccessful after the interior became wet from rain approximately two weeks after incubation began.

We observed the same building and abandonment pattern by XALR with her next nesting attempt. On the 12th of October, RJ observed XALR beginning to build a new nest (nest C; Fig. 2a, image depicts early building stage). The last day XALR was observed building this nest was the 20th of October, where she was seen adding lining to the interior of the nest. No activity was seen at the nest for the following 20 days; however, on the 9th of November RJ observed XALR building a new nest (nest D; Fig. 2b), which was near complete. Again, RJ saw no reason why nest C was abandoned. XALR laid eggs in nest D, which was subsequently brood parasitized by a Horsfield's Bronze-cuckoo *Chalcites basalis* before being depredated during incubation, possibly due to a snake given the circular hole in the back of the nest.

Repairing and reusing an old nest

On the 30th of October at approximately 05:45, RJ observed the female YAOS (left leg: yellow over gold; right leg: orange over silver) carrying nesting material to a clump of grass. She was part of a plural breeding group, comprising her as a primary female, XEXS (left leg: missing band, emerald green; right leg: missing band, silver) as a primary male, NHYS (left leg: black over hot pink; right: yellow over silver) as a secondary female and WANS (left leg: white over gold; right leg: black over silver) as a secondary male. Inspection of the nest revealed faeces

within, on the lip of the nest entrance and on top of the nest, as well as a hole in the back of the nest with the inner lining trailing down to the ground, suggesting that this nest was previously inhabited by chicks and that the nest had been depredated possibly by a snake (Fig. 3a). As it was within this group's territory, it was likely either YAOS or NHYS's previous nest as it was not found while it was active; however, whether it was a previous nest of YAOS or NHYS is unknown. Regardless, our observations suggest that YAOS was attempting to repair it. Three days later, on the 2nd of November, the hole in the back of the nest had been repaired, and despite the lining still trailing to the ground new lining had been added and an egg had been laid in the nest (Fig. 3b). Ultimately, YAOS laid three eggs in the nest before it was parasitized with one Horsefield's Bronze-cuckoo egg and depredated during incubation.

Discussion

While Variegated Fairy-wrens are less studied than many of their congeners, the gamut of research into the Australian fairy-wrens has shown that they are a highly social clade of birds with complex social structures. Individuals have been demonstrated capable of displaying behavioural plasticity that can be regulated by learning (Feeney and Langmore 2013); although, the degree to which this plasticity translates to nest construction behaviours remains largely unexamined. The observations presented here provide new insights into the diversity and flexibility of nest building behaviours in the Variegated Fairy-wren.

Reasons for adaptive nest building decisions have previously been associated with local predation pressure, sexual selection and the energetic costs associated with nest building and incubation (Mainwaring et al. 2014; Macqueen and Ruxton 2023). Therefore, these behaviors likely represent a tradeoff between energy expenditure and providing an appropriate environment for the effective rearing of offspring (Dawson et al. 2011; Ardia 2013). Regarding nest abandonment, this has been documented in Superb Fairy-wrens (e.g.. Nias 1985), and Beckmann and Martin (2016) conclude that frequent nest abandonment in Grey Fantail *Rhipidura albiscapa* is likely an anti-predator response, where less concealed nests are abandoned more often.

Nest re-use by small, non-cavity nesting passerines is uncommon (Wuczyński and Hałupka 2024) but reduced risk of predation has been suggested to drive nest reuse in some cases

(Sonerud 1985; Lima and Dill 1990). Considering that the nest was repaired and reused after depredation, we consider this explanation unlikely. Méro et al. (2022) proposed energetic costs or avoidance of brood parasites as possible driving factors of nest reuse in Great Reed Warbler *Acrocephalus arundinaceus*. While Variegated Fairy-wrens are parasitized by several cuckoo species at this site, this is the first time we have observed nest reuse in this species despite monitoring over 1,000 nests during the past decade.

Records of fairy-wrens repairing or reusing nests is rare, but not unheard of. McGlip (1926) reported that a Purple-backed Fairy-wren *Malurus assimilis* repaired then reused a nest for a second clutch. Further, Superb Fairy-wrens have been documented to reuse their nests (de Warren 1926). McGarvie (1957) recorded a Superb Fairy-wren usurping a nest from a European Goldfinch *Carduelis carduelis* and adding a roof, which constitutes atypical nest use behaviour. Superbs often gather nest lining material from previously used nests, suggesting that interactions with old nests is not uncommon (Rowley 1965; Tidemann 1983). Though examples of the nest building behaviors we observed have been recorded in the literature, we remain reluctant to speculate as to why any of these behaviours were exhibited, and see explaining them as an opportunity for future research.

In summary, we present observations of several previously undocumented nest construction behaviours in the Variegated Fairy-wren. While we are unsure what pressures prompted these behaviours, we consider it important to formally document them in order to highlight the diversity of behaviours they are capable of exhibiting under natural conditions.

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Figure 1. Photograph of nests built simultaneously by female LSOS. Nest (a) was built to completion and received eggs while nest (b) did not progress in construction beyond a loose grass frame.

Figure 2. Photographs of nests built by female XALR. The nest depicted in (a) was never observed with eggs and presumed abandoned. The image depicts an early stage of nest construction even though it was built to completion. She subsequently built nest (b) completely and laid eggs. This nest was ultimately brood parasitized then depredated.

Figure 3. Photograph (a) depicts a nest that had been used previously by Variegated Fairy-wrens, but the nest owner is unknown. A presumed snake depredation event created a hole in the back side of the nest– the arrow points to sunlight entering the inside of the nest due to the damage. Photograph (b) depicts repairs made to the same nest by female YAOS–the image shows material hanging below the nest after the depredation event, but the hole is now repaired.