

Additional notes on the life history of the Tagula Honeyeater *Microptilotis vicina* in Papua New Guinea

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Abstract. We revisited a location to study previously individually marked Tagula Honeyeaters *Microptilotis vicina* in 2019, 3 years after the original 2016 study on Junet Island, Louisiade Archipelago, Papua New Guinea. Re-encountered Tagula Honeyeaters indicated sedentary behaviour across years and an average annual adult survival rate of ≥ 0.75 . We made the first observations of building and laying at two nests, and recorded nesting habits in the species. Tagula Honeyeaters showed the general trend in the honeyeater family of only the female building the nest and incubating. Nests were similar to those previously observed and to those of related species. Clutch-size in both nests was two and laying was on consecutive days. Eggs were white to off-white, with a ring of liver-brown spots and markings around the larger end. Incubation began on the day that the second egg was laid and lasted 14 days in both nests. Males visited the nest area only after the eggs hatched. At one nest, the nestling period was suspected to be 12 days. These limited observations of the only endemic island representative in *Microptilotis* indicate that, like plumage characters, breeding parameters remain similar within the genus.

Introduction

The honeyeater family Meliphagidae is a prominent and diverse assemblage centred in the Australo–Papuan region (Higgins *et al.* 2017). Members comprise the largest passerine family in Australia and are readily observable in most habitats in the region, from temperate Australian mangroves to the New Guinea highlands (Ford 2001; Pratt & Beehler 2014). Yet surprisingly little detailed information on life histories is available for many commonly encountered species, and information such as incubation and nestling periods remain unknown for well over half the species (Bird *et al.* 2020).

The genus *Microptilotis* exemplifies this lack of knowledge. There are nine species in this complicated group (*sensu* McCullough *et al.* 2019) and, apart from the Australian Cryptic and Graceful Honeyeater forms [*Microptilotis gracilis imitatrix* (Cryptic Honeyeater) and *M. g. gracilis* (Graceful Honeyeater): see Nielsen 2018; Gill *et al.* 2020], the clade is dominated by New Guinean species (McCullough *et al.* 2019). The clutch-sizes of four of the nine species have not been recorded and aspects on life history such as developmental periods remain unknown for nearly all New Guinean representatives (Coates 1990; Higgins *et al.* 2020). This paucity of knowledge applies to the endemic Tagula Honeyeater *M. vicina* of the Louisiade Archipelago in Papua New Guinea, a restricted island species of the genus (BirdLife International 2020).

To address this knowledge gap, we present new observations of the breeding biology and survival of the Tagula Honeyeater. This includes the first observations of clutch-size, developmental periods and parental roles. This information will contribute to understanding the diversity of strategies on life history in honeyeaters.

Study area and methods

Observations of Tagula Honeyeaters were made opportunistically on Junet Island (11°17'S, 153°12'E) from late August to November 2019. They built on previous investigations of the species around Bwailahine in the south-east of the island, particularly in 2016 (Figure 1; and see Goulding *et al.* 2020). This area supports a patchwork of disturbed and secondary rainforest of varying ages amongst subsistence gardens. Remnant patches of less-disturbed rainforest occur mostly along drainage lines.

We caught Tagula Honeyeaters using 6- and 12-m-long mist-nets in different habitats around the village and marked them with both colour-bands and metal Australian Bird and Bat Banding Scheme (ABBBS) bands. Standard morphometric measurements were taken following methods in Lowe (1989). Depth and width of bill were measured at the mid-nares point and the wing-length was measured when adpressed against a ruler in a natural folded position. The sex of individuals was determined where clearly evident, with reference to morphometric ranges previously identified for sex using molecular methods (Goulding *et al.* 2020).

In addition to mist-netting in 2019, Tagula Honeyeaters were located by methodically working through the habitat surrounding the village whilst listening for their vocalisations. Birds observed were scrutinised for colour-band combinations that would allow identification.

All Tagula Honeyeaters banded in 2016 were adults when caught, partially removing age-class issues such as the high mortality often observed in young birds (e.g. Naef-Daenzer & Gruebler 2016). A crude finite survival rate was made under the assumption of a closed system and constancy across sexes and adult years. This adjusted annual (adult class) survival rate ($Adj.I_x$) was based on what could be considered a most simple conceptual approach to measuring survival (e.g. Krebs 1999) and calculated

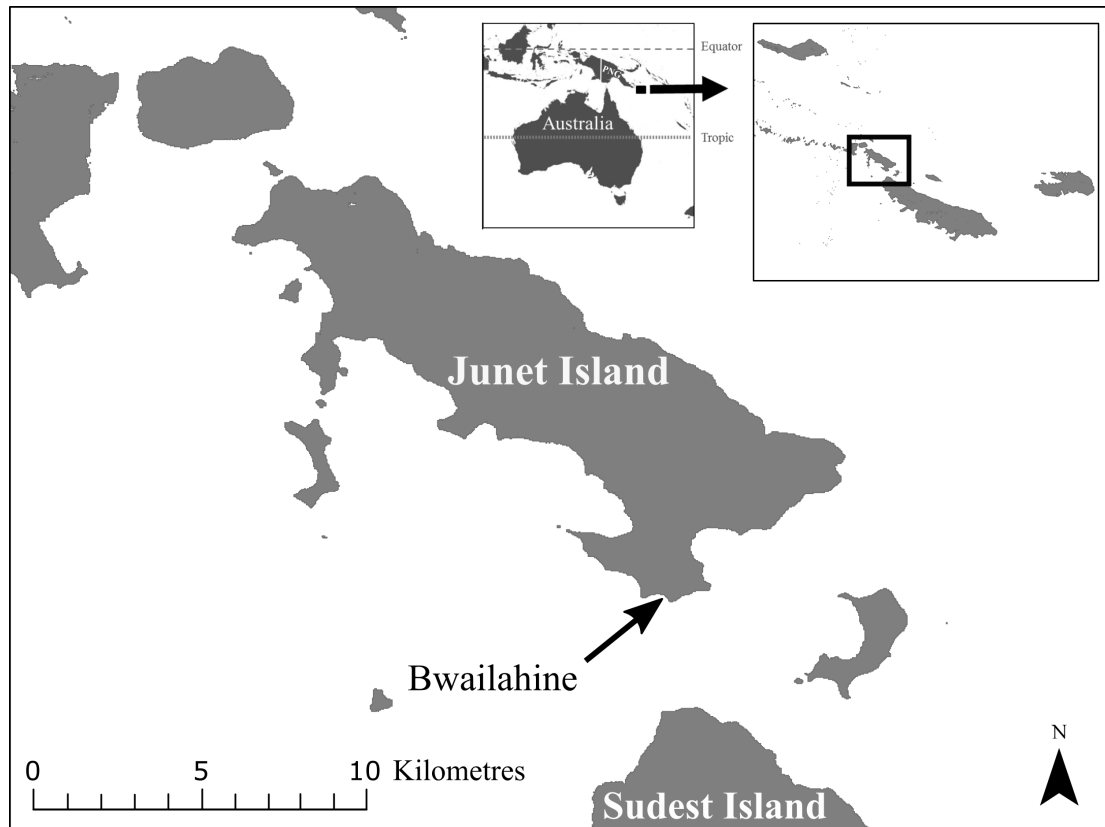


Figure 1. The location of Bwailahine Village, Junet and Sudest (Tagula) Islands, Papua New Guinea.

from the formula: $Adj.I_x = [N_{x+1}/N_x]^{SP/AP}$, where N_x and N_{x+1} represent the original number of birds banded and those later re-encountered, respectively, and SP and AP of the fractional exponent are the desired standardised period (i.e. 1 year) and the actual period since the reference time (i.e. 3 years).

Nests were found by observing adult behaviour, such as individuals carrying nesting material or repetitively following travel routes. Periods were defined by the time between the first and last events in a developmental stage, e.g. the incubation period was defined as the number of days between when the last egg was laid (Day 0) and the last egg hatched (Nice 1954). Similarly, the nestling period was defined as the number of days from the day when the last egg hatched (Day 0) to the day that the last chick left the nest.

Results

Three of seven Tagula Honeyeaters captured and colour-banded around Bwailahine in 2016 (Figure 2) were relocated in 2019 (Goulding *et al.* 2020). A suspected additional banded individual was fleetingly seen in poor light but the faded band combinations were not identified. This was close to 3 years since their initial capture between November and December 2016. One of the 2016-colour-banded Honeyeaters was found dead in the study area in 2017 by a local resident (R. Adrian pers. comm. 2019), leaving two or three individuals unaccounted for. Each relocated individual was determined to be 1+ years at the time of initial capture, thus c. 4+ years by the end of this study period. The resightings indicate an annual adult

survival rate of at least 0.75 (conservative) but potentially up to 0.83 in this location ($n = 7$).

The resightings add further support for sedentary behaviour in this species across years. Male 40267 was encountered within its 2016 estimated home-range area (See Figure 2 in Goulding *et al.* 2020). Furthermore, an untracked but colour-banded male (40261) of the UT2 pair nested within 5 m of its 2016 nesting location (see below). This individual was found utilising the same area between this and where it was first captured in 2016. Similarly, another colour-banded but untracked male (40265) was recaptured at the same location that it was caught in 2016.



Figure 2. An adult female Tagula Honeyeater being tracked in 2016. Photo: William Goulding

Three *Tagula* Honeyeater nests were located by local resident R. Adrian, two of which could be reached and confirmed as containing a brood of two (2017–2018). This brings the total number of observed brood-sizes in this species to five; in each case, the brood-size was two. The mean height (\pm standard error) above the ground of nests observed in the 2016–2019 period was 6.8 ± 1.2 m (range 2.6–12 m, $n = 8$). Five of the eight nests located were at the edge of steep stream embankments, in understorey trees protected by thick upper-forest strata. In general, all nests were in sheltered positions that offered protection from wind and rain.

The following summarises opportunistic observations made at two nests in 2019.

Nest construction

One nest was found at the beginning of construction on 2 September. The first observations were of an unbanded female slinging spider-webs across a plant fork, with 15 visits in 1 hour (1430–1530 h). Her mate was later identified as colour-banded male 40261 of the 2016 UT2 pair. This nest was within 5 m of the 2016 nesting attempt by this male and an unbanded female (see Figure 2 in Goulding *et al.* 2020). A second nest was found 160 m away on 4 September. Both nests were at the same advanced stage, nearing completion and in the last stages of nest-lining. Nest construction was carried out silently by only the female. When adding internal material to the nest, she did so with her bill before squeezing onto the nest and

using her feet to stamp down the material. One nest had an external diameter of 70 mm (internal diameter 54 mm) and external height of 86 mm (internal depth 57 mm). It had four main layers. The outer structure of spider-webs was adorned with old leaves and their vascular remnants, lichen, and spider egg-casings. Inside this was a distinct layer of coarse palm fibres and sections of old palm pinnae. Next was a layer of very fine palm fibres, and innermost was a plumose layer of fine white seed comas (seeds removed). This dense white lining was 13 mm thick, as measured in a disused nest (Figure 3a–c).

Laying period

Nests checked on 7 September were complete but empty. Laying of the first egg in both nests was on 8 September, occurring early in the day and before 1630–1645 h, when nest contents were confirmed (one egg in each). The following morning, one female arrived at her nest at 0900 h, incubated for 20 minutes, and then left; she had not incubated during the night. It is suspected that this was when laying of the second egg occurred. Both nests were unattended for the middle of the day but by 1600–1630 h that afternoon both females were on their nests and, when checked, incubating two eggs (Day 0 incubation period). This indicates that laying occurs on consecutive days. Eggs were white to off-white, with those of both clutches having a ring of liver-brown markings around their broader end (Figure 3a).



Figure 3. *Tagula* Honeyeater nests. (a) A mirror-view of a clutch of two eggs in one nest, showing the halo of liver-brown markings around the broad end of each egg. (b) At both nests, the colour-banded males did not become involved until the nestling period (male shown here). (c) Each of the two nests was built in a fork under leaves, obscuring the nest from above and offering shelter from rain. Photos: William Goulding

Incubation period

At both nests, only the female was observed incubating. This observation is supported by the lack of brood-patches in all captured Tagula Honeyeaters that could be confidently sexed as male ($n = 30$). Furthermore, at both these nests the male was not seen for the entire incubation period. Females were silent and did not vocalise within a radius of ~15 m of the nest-site. Upon arrival, each female was observed to silently land and slip onto the nest. The typical incubating posture was low in the nest, in what appeared to be a tight fit with the head slightly bent back, exposing only the tip of the bill and rectrices above the rim of the nest. An incubating female lowered her head and bill almost completely into the nest when attempting to avoid detection. Noises that aroused interest tended to elicit a slight raising of the head to allow a glimpse above the rim to seek the sound source. Close disturbances resulted in a silent and rapid exit from the nest.

The nests were checked during the late afternoon of 22 September and both contained two eggs. Hatching occurred in both on 23 September, ending 14 days of incubation (Day 14 incubation period; Day 0 nestling period). Nests were checked visually at 1700 h to confirm that both contained two chicks and the hatching of both eggs in each clutch occurred within the same day. At one nest, the female arrived at 1030 h, standing on the rim and poking into the nest for *c.* 30 seconds before flying off with half an eggshell. This process was repeated at 1109 h. After the second eggshell was removed, the returning female perched beside the nest and loudly called *chirriru chirriru tweeu*. This was the first time that an adult was observed vocalising near its nest.

Nestling period

Only the female brooded young nestlings. At 1025 h on 24 September (Day 1 nestling period), the female at one nest was brooding and her colour-banded mate arrived with food. She then left and flew to a nearby branch while the male fed a nestling. Both adults then flew off. Similarly, at 1100 h at the second nest, the male came to the nest where the female was brooding. Both instances were the first observations of a male at the nest. Both adults continued to feed the chicks during the day but the number of visits was not recorded. These nests could not be checked again until 3 October (Day 10 nestling period), which was after and during a period of heavy rain. One nest appeared undisturbed, was inactive and empty. The other nest received four visits by the adults at 0615–0645 h, four at 1010–1045 h, and three at 1640–1700 h. The heads of both chicks could be seen when food was delivered but the chicks remained quiet whilst begging (Figure 3b). This was during particularly heavy rain. The next day (Day 11 nestling period), the female brought food to the nestlings at 0803 h. She returned at 0824 h with a caterpillar. She landed on the side of the nest and vocalised with the caterpillar in her bill but did not immediately feed the nestlings. Heavy rain made it difficult to observe when or if she fed the nestlings or to make further observations. At 0530 h on 5 October (Day 12 nestling period), an adult (poor light and rain obscured bands/identity) came and fed the nestlings. However, heavy rain hindered further observations. The

observer returned at 1230 h and observed the nest for 30 minutes; no activity occurred and upon inspection the nest was found intact but empty. Subsequent visits to the nest area and surrounding forest failed to locate the adults or fledglings again before we left the island.

Fledglings

Fledglings from the two nests were not located. However, recent fledglings were seen with adults on two occasions in other locations in 2019 (Hebwaoni and Humoiwa Bay, Junet Island). They were suspected of having only recently fledged because of their poor flight, short remiges and rectrices, and begging behaviour. In both instances, there was only a single fledgling being attended by one adult (30 August, 6 September): the adult led the fledgling through shrub and understorey layers, often leaving it to make forays for food before returning and delivering items. In each case, the adult regularly used a quiet and monotonic *pu* call to maintain contact (Figure 5f in Goulding *et al.* 2020) and when it returned with food or was nearby the fledglings begged with a soft *weef-weef*. These two observations of recent fledglings, combined with the nestling periods observed, indicate that nesting likely started in late July and early August.

Discussion

Our observations of Tagula Honeyeaters further support their being sedentary and that mature birds have a high average annual survival rate of ≥ 0.75 . Females of each pair built the nest, which in one instance neared completion within 3 days and in which laying began 7 days after construction began. The nests were similar in materials and construction to previously recorded nests. In the two nests observed, two eggs were laid and were similar in appearance to descriptions of eggs of some congeners (see below). Laying occurred on consecutive days and was suspected to have occurred in the mornings. Incubation began after the second egg was laid, on the same day. In both nests, only the female incubated and she did so for 14 days. Incubation was conducted in silence and in the absence of the male. A male was not observed at a nest until after hatching. The few observations of brooding of young nestlings were of only the female. The nestling period could not be confidently determined but was cautiously suspected to be 12 days for one nest.

Our observations suggest an annual survival rate higher than modelled estimates of ~0.64 for this species and congeners (Bird *et al.* 2020). However, this is based on low numbers from a single location and broad assumptions. Some support comes from the adoption of both resighting and netting approaches, which has been shown to improve the accuracy of survival estimates (Martin *et al.* 2017). However, further investigation is required to accurately determine whether this species exhibits the high adult survival rates observed in some tropical and island bird species elsewhere (e.g. Martin *et al.* 2017).

We could not know if what we observed were the first nesting attempts for each pair for the season, nor whether this species will raise two broods, as has been reported for some other honeyeater species (Ford 2001). However,

when considering these and previous observations of breeding attempts later in the year (Goulding *et al.* 2020), the species is suspected of following the general breeding pattern of a July–August onset that tapers off from the end of the year (December–February). This agrees with what has been observed in other insectivorous and omnivorous birds of tropical eastern Australia and New Guinea (e.g. Bell 1982; Higgins *et al.* 2001). This overlaps the slightly drier and calmer period in these islands, although the climate of these islands varies little during the year (Kinch 1999). The arrival of the monsoon trough with a general (slight) increase in rain and the rough weather that comes with the westerly winds in December–January would likely negatively affect nesting success through aspects such as food-provisioning rates (Öberg *et al.* 2015). Although we did not determine the outcome of the two nests, both became empty during a period of heavy rainfall and winds.

The synchrony between the two observed nests could have been by chance or because of broader environmental cues (Ball & Ketterson 2008). However, these two pairs of Tagula Honeyeaters were using adjoining forest habitat. Other pairs further away were not reproducing at the same stage, e.g. one had a fledgling when these pairs were building nests. Consequently, it could be possible that earlier attempts failed and particular social cues and interactions specifically between these adjoining pairs contributed to this synchrony in subsequent breeding (e.g. Birkhead & Biggins 1987).

All nest-site locations observed displayed similarities in their protected positions and placement, with the majority (five of eight) in riparian vegetation overhanging banks and close to or above streams. These riparian areas are generally less disturbed and contain remnant vegetation in what are otherwise heavily disturbed subsistence-gardening landscapes surrounding villages (Goulding *et al.* 2018). However, one of the observed nests was in a more-intact forest area on Tagula, or Sudest, Island and this was being built in a similar riparian gully over a stream. This indicates that these nesting locations offer more than just an escape from the disturbances related to subsistence gardening. This tendency to nest above water has been noted in congeners (Higgins *et al.* 2001), suggesting further advantages when nesting in such locations. Protection against land-predators seems unlikely given the general paucity of non-volant predators on these islands but this deserves further investigation. Irrespective of proximity to water, these riparian gullies are notable in the landscape for offering protection against abiotic factors that are considered important to nesting success, namely, strong winds, rain, and excessive temperatures (Nice 1957).

Nest architecture appears similar amongst those few reported for *Microptilotis* species. The white lining seems a common feature of the nests of species that nest at lower elevations but appears to be replaced by a different (light-brown) plant down in the upland Mottle-breasted *M. mimikae* and Mountain Honeyeater *M. orientalis* nests (Mack 1994). However, it is not known whether the white material used by different lowland species comes from the same plant, e.g. Le Souëf (1900, p. 615) described the Elegant Honeyeater *M. cinereifrons* in Papua New Guinea using white down material from the pod of a 'native cottontree'. However, nesting Graceful Honeyeaters in the Bloomfield area in northern Queensland have been reported using a similar white material from a 'scrub

vine' (F. Hislop in North 1907, p. 111). In agreement, the reported white down material used in nests of the Graceful and Yellow-spotted Honeyeaters *Meliphaga notata* near Cardwell was thought to be from a climbing *Parsonsia* (synonym *Lyonsia*) species (Campbell & Barnard 1917). Several species of *Parsonsia* vines are found in the Louisiade Archipelago (Middleton 1997) and the observed seed comas in the only recently split *Parsonsia* seed-pod encountered matched the material used in the Tagula Honeyeater nests.

The clutch-size of two is as expected given the observed brood-sizes ($n = 5$; Goulding *et al.* 2020) and clutch-sizes of related species (Higgins *et al.* 2017). Furthermore, the eggs that we observed match descriptions for many other meliphagids, often with similar coloured markings concentrated in a ring about the broad end (Beruldsen 1980). However, some species have been described as having eggs that are pink or reddish in colour, including those of closely related species (e.g. Elegant & Graceful Honeyeaters: Le Souëf 1900; Beruldsen 1980).

The 14-day incubation period is similar in congeners, such as 12–13 or 14–15 days in the Elegant Honeyeater (Le Souëf 1900; E. Lindgren in Coates 1990) and 15 days in the Graceful Honeyeater (Higgins *et al.* 2001). Interestingly, these species are smaller than the Tagula Honeyeater, which might be expected to have a longer incubation period, given the correlation between body size and the length of stages in life history (e.g. Stirnemann *et al.* 2016). However, the similar-sized and related Yellow-spotted Honeyeater also has a reported incubation period of c. 15 days (Marshall 1933). Overall, there is little variation in incubation period across the species for which information is available.

The Tagula Honeyeater nestling period deserves further investigation. However, available information would not discount a 12- or even a 10-day incubation period, given that similarly short periods are noted in the only other *Microptilotis* species for which this information is available: 10–11 days in the Graceful Honeyeater (Higgins *et al.* 2001).

The lack of young birds caught during the study, and the few observations of adults, feeding only single fledglings, might suggest that nesting success and juvenile survival are low. However, given that most of our observations were of unbanded birds feeding single fledglings, further investigation is needed to determine whether or not brood division was occurring (e.g. Smith 1978). The extreme caution and silent behaviour of adults throughout the nesting process, particularly by females, could be interpreted as an indicator of high nest-predation. This behaviour was altered only twice: once, when the female vocalised near the nest when hatching occurred, possibly as a signal (stage and location) to the hitherto absent male; and, once, when she brought food on the day before suspected fledging at one nest (Day 11 nestling period). Otherwise, both adults always remained silent when feeding nestlings, which begged quietly even at an advanced age (Day 11 nestling period). The high adult survival rate is perhaps also an indication of low nesting success and juvenile survival rates (e.g. Martin 1996).

Further investigation is required to confirm whether the results of our observations are representative. However, they do consolidate previous observations of this endemic

species (Goulding *et al.* 2020), making it one of the better known *Microptilotis* species. Limited information on life history for the majority of its congeners offers little for comparison. However, what is available perhaps suggests that these traits differ little within the *Microptilotis* clade. Diversity of nesting biology within this group will not be known until knowledge is gained of other species, particularly sympatric species and closely related endemic montane species.

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