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Breeding biology of the Yellow-bellied Sunbird *Nectarinia jugularis* in Northern Queensland

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The Yellow-bellied Sunbird *Nectarinia jugularis* of northern Queensland nests commonly near human habitation and while many details of its biology are known (see, for example, Frith 1979) the species has not been intensively studied.

The Yellow-bellied Sunbird is the only member of the Nectariniidae in Australia. It is a nectarivore as are the smaller endemic Australian honeyeaters (Meliphagidae) and this study compares the development and biology of members of these two families. From 20 August to 25 November 1984, I recorded details of its breeding biology, and that of the Brown-backed Honeyeater *Ramsayornis modestus*, in tropical open forest near Townsville, Queensland, latitude 19°15′S. Here I report the nest situation, nest distribution, breeding biology and nestling survival of the Yellow-bellied Sunbird.

Study area and methods

The study was done from 20 August to 25 November 1984 in the Townsville Town Common Environmental Park, mostly along the Forest Track (Fig. 1). The Forest Track is in open *Eucalyptus–Melaleuca* woodland on the verge of a shallow seasonal swamp. Principal woodland trees were paperbarks, primarily *Melaleuca dealbata*, in and along the edge of the swamp, and a mixture of *Eucalyptus* and *Acacia* on higher ground. An understory of shrubs was dominated by an introduced species, Chinee Apple *Zizyphus mauritania*.

Coastal Queensland has contrasting rainy and dry seasons. In Townsville, 70% (789 mm) of annual rain falls in the warmest months from December through March. Monthly mean temperatures range from 19.3°C in July to 27.6°C in January. The weather during the study was typical of this pattern. More details on the study area, methods and climate are in Maher (1986, 1988).

Results

The population

I found 14 active nests in different stages of the nesting cycle, five in September, three in October and six in November (Fig. 1). The distribution of these nests in time and space suggests a population of about eight breeding pairs.

Breeding density was estimated for 13.3 ha of the study area where Yellow-bellied Sunbirds nested, including a buffer zone one-half the mean inter-nest distance or 65 m around the nests. Four active nests in September, two in October and five in December gave

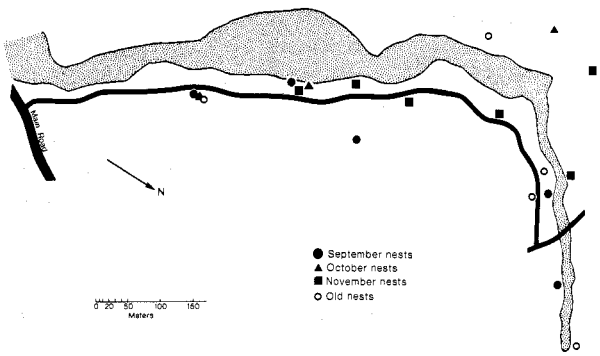

Figure 1 The Forest Track study area in the Townsville Town Common Environmental Park. Stippled area indicates paperbark swamp.

densities of 0.3, 0.2, and 0.4 pairs/ha respectively. The mean distance between neighboring nests on the same area, for all three months, was 125 m (range 63-150 m, *s.d.* = 32, *n* = 8). Blakers *et al.* (1984) and Jones (1983) reported the density of the Yellow-bellied Sunbird in Eucalypt woodland near Townsville to be less — 0.3 birds/ha (i.e. 0.15 pairs/ha).

Nesting season

Nesting began in the last week of August. Four clutches were laid within nine days between 25 August and 2 September. Three clutches in October were initiated on 1, 3, and 20 October and clutches were completed in four of six nests between 16 and 21 November.

Cornwall (1909) reported that the Yellow-breasted Sunbird breeds from September to February with odd pairs breeding both before and after those months. More recent authors, (Lavery *et al.* 1968; Crome & Gill 1979) give essentially the same nesting schedule.

Daily egg and nestling dates from 62 nests from the RAOU nest record scheme, grouped in half-month intervals, give a more detailed picture (Fig. 2). The data are 472 daily records of nests with eggs and 419 daily records of nests with nestlings. Data were extrapolated as far as possible from egg-laying, hatch and fledging dates using a 14-day incubation period and 15-day nestling period as determined in this study.

Approximately 75% of breeding is in the warm spring and early summer period from September to December and 90% of breeding is in 6.5 months from August through to the first half of February. Breeding declines at the beginning of the peak rainy season, January to March, and there is very little breeding in the four and a half months from the latter half of February to June. A few pairs begin breeding in July but most did not begin until late August.

Nest

The Yellow-bellied Sunbird builds a pendulous nest (Gibson-Hill 1950; Potter 1948) characteristically placed at the ends of branches of a bush or vine. It tends to be situated towards the interior of vegetation rather than the periphery, often with the nest entrance facing inwards. Nest sites are typically under the canopy of larger trees. Cornwall (1909) and Macgillivray (1918) both report that nests are often suspended over water.

Yellow-bellied Sunbird nests are usually low. Pizzey (1980) reports them to be 2-6 m above the ground and Gibson-Hill (1950) found them to be 0.6-7.6 m high with two-thirds of them below 3 m. In this study nests were suspended from branches 0.8-2.7 m above the ground. The mean height of 28 nests was 1.45 m (*s.d.* = 0.53). The RAOU Nest Record Scheme provided height estimates of 68 additional nests, some from gardens or around human habitations and others from habitats that were deemed more natural on the basis of the description provided. Yellow-bellied Sunbird nests in gardens were 1.7 m above the ground on average (range 0.3-6 m, *s.d.* = 0.94, *n* = 45) not different (*t* = 0.0852) from the mean in 'natural' habitat which was also 1.7 m (range 0.75-4.6 m, *s.d.* = 0.99, *n* = 23).

On the study area 78% (21) of 28 nests were attached to branches of Chinee Apple, 7% (two nests each) were on *Lantana camara* and *Acacia brachycarpa*, 4% (one each) were on 'vine' and *Melaleuca* and 14% (4) were suspended over evident animal paths.

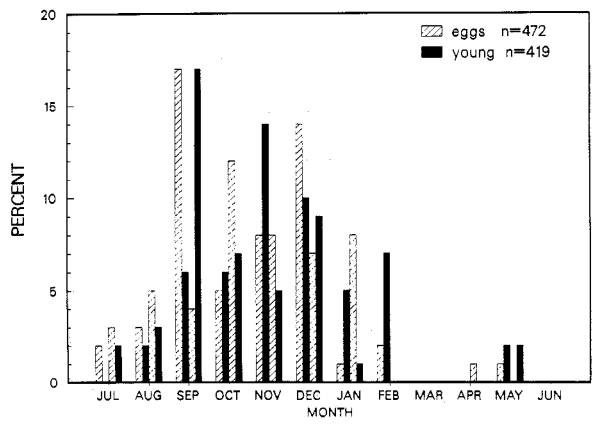

Figure 2 Per cent distribution of egg and nestling dates grouped in half month intervals. Data from RAOU nest record scheme.

Clutch

I recorded 11 clutches, eight with two eggs and two with one egg; mean = 1.7. One one-egg clutch was with a second egg that was dessicated.

Records from the RAOU Nest Record Scheme provided data on 22 clutches stable for at least 48 hours (Courtney & Marchant 1971). Twenty-one of these nests had two eggs and one had one egg; giving a mean clutch size for this sample of 1.95 eggs.

Incubation

I determined an incubation period of 14 days, range 13-15 days, $n = 3$. The period used was from the laying of the second egg, when incubation begins, to hatch of one or both eggs.

Nestling period

One nestling fledged in this study at age day 13. RAOU records of the nestling period of 12 nestlings from six nests showed that nine fledged at age 15 days, and one each at age 13, 14 and 16 days. The median of all records was 14.7 days ($s.d. = 0.9$, $n = 13$).

Nest, egg and nestling survival

Data on survival are from twelve nests, seven with eggs. Eggs in all nests hatched, however, one of eleven eggs was infertile (91% hatch). Only one nestling survived to fledge, nest success of the seven nests with eggs was 14% and nestling survival 10%.

The daily rate of loss and survival was determined after Mayfield (1961, 1975) whose method of summing data on a daily basis allows statistically valid use of incomplete data. Survival was determined for three periods of the nesting cycle: (1) pre-egg laying, from discovery until the second egg was laid; (2) incubation, from laying of the second egg; and (3) the nestling period from hatch to fledging. Daily nest survival during incubation (Table 1) was very high (99.0%) while daily nest survival in the nestling stage was much lower (90.7%). On these bases, survival of eggs for a 14-day incubation period would be 87% and only 23% of nestlings would survive a 15-day nestling period. The probability of survival from egg laying to fledging is 20%.

Causes of nest loss

Seven (88%) of eight nests which failed during the study were torn down or ripped open, one (12%) had contents removed without trace and one nestling was killed in the nest.

Discussion

A 20% probability of nest success from clutch completion as determined here is low, but it is comparable with 27% nest success of the Brown-backed Honeyeater in the same area (Maher 1988). It is also similar to the 23.1% nest success reported by Skutch (1966) for 30 species of passerines with open or roofed nests in Central America.

Predation is usually the greatest cause of nesting failure in the tropics (Ricklefs 1969; Skutch 1985) as well as in the temperate zone (Nolan 1963) and apparently accounted for all losses of nests and young Yellow-bellied Sunbirds in this study. I did not see any predation but 88% of the failed nests were apparently preyed upon in the same manner as nests of the Brown-backed Honeyeater on the same study area (Maher 1986).

Compared with the Brown-backed Honeyeater population on the same study area (Maher 1986, 1988), the Yellow-bellied Sunbird was more widely dispersed with an average inter-nest distance of 125 m compared

Table 1 Survival of Yellow-breasted Sunbird nests during the nesting cycle.

Nesting stage	Total days	Days with loss	Loss per day (%)	Survival per day (%)	Days	Survival per period (%)
Pre-laying[1]	51.5	1	1.9	98.1	10	82
Incubation[2] (nest)	102.5	1	1.0	99.0	14	87
(egg)[3]	167.0	1	0.6	99.4	92	
Nestling (nest)	54.0	5	9.2	90.7	15	23
(young)[4]	83.5	1	1.2	98.8	83	

[1] Discovery to laying of second egg. [2] From laying of second egg.
[3] One infertile egg. [4] Loss of one of two young.

with an October average of 42 m for the Brown-backed Honeyeater. Similarly, maximum calculated densities of the two species were 2 pairs/ha for the Brown-backed Honeyeater and 0.4 pairs/ha for the Yellow-bellied Sunbird; a five-fold difference. Both species prefer the same introduced shrub, Chinee Apple, to support their nests but the Yellow-bellied Sunbird places its nest significantly lower than the Brown-backed Honeyeater does (mean 1.45 m *vs* 2.7 m, $t = 5.685$, $P < 0.001$, $d.f. = 83$). The Yellow-bellied Sunbird also prefers more sheltered nest sites than the Brown-backed Honeyeater, i.e. towards the centre of bushes and in sites beneath larger trees and shrubs. The use of more sheltered nest sites by the Yellow-bellied Sunbird may be because nests are vulnerable to destruction by rain and high wind. The Yellow-bellied Sunbird population around Mackay took two years to recover after the cyclone of 1918 apparently wiped it out (Cornwall 1919, 1921).

Many other details of the breeding cycle of the two species are similar but Yellow-bellied Sunbird nestlings grows significantly more slowly (Maher 1991) and remains in the nest on average almost two more days than those of the Brown-backed Honeyeater (14.7 *vs* 12.7 days). A longer nesting period should have significant consequences for the nestling success of the Yellow-bellied Sunbird. Two additional nestling days, using figures derived in this paper, would reduce the probability of nestling survival from 23% to 19%.

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