

BREEDING BIOLOGY AND BEHAVIOUR OF THE SCARLET ROBIN *Petroica multicolor* AND EASTERN YELLOW ROBIN *Eopsaltria australis* IN REMNANT WOODLAND NEAR ARMIDALE, NEW SOUTH WALES

S. J. S. DEBUS

Division of Zoology, University of New England, Armidale, New South Wales 2351
E-mail: sdebus@une.edu.au

Received: 13 January 2006

The breeding biology and behaviour of the Scarlet Robin *Petroica multicolor* and Eastern Yellow Robin *Eopsaltria australis* were studied at Imbota Nature Reserve, on the New England Tableland of New South Wales, in 2000–2002 by colour-banding and nest-monitoring. Yellow Robins nested low in sheltered positions, in plants with small stem diameters (mostly saplings, live trees and shrubs), whereas Scarlet Robins nested high in exposed positions, in plants with large stem diameters (mostly live trees, dead branches or dead trees). Yellow Robin clutch size was two or three eggs (mean 2.2; $n = 19$). Incubation and nestling periods were 15–17 days and 11–12 days respectively ($n = 6$) for the Yellow Robin, and 16–18 days ($n = 3$) and 16 days ($n = 1$) respectively for the Scarlet Robin. Both species were multi-brooded, although only Yellow Robins successfully raised a second brood. The post-fledging dependence period lasted eight weeks for Yellow Robins, and six weeks for Scarlet Robins. The two robins appear to differ in their susceptibility to nest predation, with corresponding differences in anti-predator strategies.

INTRODUCTION

The Scarlet Robin *Petroica multicolor* and Eastern Yellow Robin *Eopsaltria australis* (hereafter Yellow Robin) are small, socially monogamous passerines. The pair-breeding Scarlet Robin (approximately 13 g) inhabits open forest and woodland of eastern and south-western Australia, and the facultatively co-operatively breeding Yellow Robin (approximately 20 g) inhabits wet forest to semi-arid scrub in eastern Australia, with an equivalent allospecies (the Western Yellow Robin *E. griseogularis*) in south-western Australia. Only females build the nest, incubate and brood; both sexes feed nestlings and fledglings; and some Yellow Robin pairs have one or two auxiliaries (typically yearling sons) that help to feed the nesting female and young (Marchant 1985, 1987; Robinson 1990a; Higgins and Peter 2003).

Most aspects of the biology of these two robin species are well known (summarized by Higgins and Peter 2003). However, knowledge is deficient on the post-fledging period and transition to independence for these and most other Australian passerines (Russell 2000). Nestling growth-related morphology, fledgling growth and post-juvenile moult are little known for the robins considered here (Higgins and Peter 2003).

This paper describes the social organization, aspects of breeding, and juvenile morphology and maturation of the two robin species, as part of a study of their breeding and population parameters in the New England region of New South Wales (Debus 2006a). I studied the comparative ecology of the two robins in a woodland patch, while investigating possible causes of their decline in fragmented landscapes (Debus 2006b,c). Although some of this information on breeding biology and behaviour is not new, it supplements or confirms previous information, or

provides empirical data on aspects that may vary geographically with seasonal conditions, or with habitat or landscape context.

STUDY AREA AND METHODS

The study was conducted across three breeding seasons (egg-laying in August to January inclusive) from July 2000 to February 2003, a drought period (see Debus 2006a). The site was Imbota Nature Reserve (formerly Eastwood State Forest, approximately 270 ha), ten kilometres south-east of Armidale (30°30' S, 151°40' E) on the Northern Tablelands of New South Wales (1 000 m above sea level). The study area and methods are described elsewhere (Debus 2006a); Imbota NR consists of eucalypt grassy woodland with a patchy midstorey of shrubs and eucalypt saplings (for dominant trees and shrubs see Table 1).

Free-flying robins were captured by placing mist-nets in observed foraging areas, and around fledglings or nests with chicks (but not nests with eggs, to avoid desertion); call-playback with a mounted specimen was also used as a net lure (successfully for Scarlet Robins). New fledglings were caught by hand.

Robins of all ages, from nestlings to adults, were banded and individually colour-banded from July 2000 onwards (bands supplied by the Australian Bird and Bat Banding Scheme). Almost all the Yellow Robins in Imbota NR were banded; within each year, most of the adult male and about half the female Scarlet Robins were banded. Robin nests were monitored daily or almost so, and found mostly at the building stage by following nest-building females. For nests checked at intervals of greater than one day, the date of laying, hatching, fledging or failure was taken as the mid-point between penultimate and final checks. Fledgling Yellow Robins and Scarlet Robins, colour-banded as nestlings or new fledglings, were observed approximately weekly until independence (Yellow Robin: 18 broods; Scarlet Robin: four broods), to give a composite picture of growth, moult and maturation. Juveniles of each species (four Yellow, four Scarlet) were also retrapped in their natal territory one or more times between fledging and independence. For results on behaviour and vocalizations, terminology and interspecific comparisons follow data in Higgins and Peter (2003).

Nests heights were measured directly with a 2.4 metre pole graduated in centimetres or, for higher nests, estimated from a

TABLE 1

Nesting substrate types (*n*, %), nest height (m), and diameter at breast height (cm) of stem of nest plant (range, mean \pm SD) for Eastern Yellow Robins and Scarlet Robins at Imbota Nature Reserve, New South Wales.

Nest site	Yellow Robin	Scarlet Robin
<i>Eucalyptus caliginosa</i> :		
live tree	12 (21)	28 (52)
dead branch	1 (2)	7 (13)
dead tree	0	3 (6)
live sapling	24 (41)	5 (9)
dead sapling	0	1 (2)
<i>E. melliodora</i> :		
live sapling	4 (7)	0
<i>E. blakelyi</i> :		
dead branch	0	5 (9)
live mistletoe	0	1 (2)
live sapling	2 (3)	0
dead sapling	1 (2)	0
<i>E. viminalis</i> :		
live sapling	1 (2)	0
<i>E. bridgesiana</i> :		
live tree*	1 (2)	0
<i>Angophora floribunda</i> :		
live tree	1 (2)	0
Dead <i>Acacia</i> :		
<i>A. filicifolia</i>	1 (2)	1 (2)
<i>A. implexa</i>	1 (2)	3 (6)
Live <i>Cassinia</i> shrub:		
<i>C. quinquefaria</i>	7 (12)	0
<i>C. leptocephala</i>	1 (2)	0
Live <i>Olearia elliptica</i> shrub	1 (2)	0
Nest height (m)	0.6–11.0 (2.7 \pm 2.5)	1.8–14.0 (7.2 \pm 3.4)
Tree/shrub stem dbh (cm)	1.0–59.0 (9.9 \pm 11.9)	6.0–68.0 (28.5 \pm 16.8)
Total nests	58	54

*Dead-topped tree, nest in epicormic shoots on trunk.

two-metre person holding the base of the pole upright at arm's length below the nest. The circumference of nest-plant main stem or trunk was determined with a tape-measure and converted to diameter; for nests below breast height (e.g. in shrubs or saplings), the stem was measured just below the base of the nest. Two-sample *t*-tests were used to compare Yellow Robin and Scarlet Robin nest heights and nest-plant diameter at breast height (dbh).

RESULTS

Social organization

Over three years, a mean of 28 per cent of Yellow Robin pairs at Imbota NR had a helper or two at the nest (see Debus 2006a for further details). Six of 11 Yellow Robin helpers were known (from their later status as breeding birds), and the remainder were suspected from their behaviour (e.g. feeding the nesting female, or interactions with the primary male), to be male. In 2000 an unbanded female replaced an incubating female, building and laying within 14 days of the other's death. In 2002 four females changed mates or territories: two left their mates and replaced absent females in nearby territories, and two found vacancies in other territories after their original mates disappeared. Helper males occasionally visited other pairs several territories away from their natal site, but were repelled and returned to their own territories.

Scarlet Robins occurred as pairs or, in a few cases, territorial males that temporarily lacked a mate (one or two males in each year: see Debus 2006a for details). In spring

2001 unpaired, singing male Scarlet Robins, apparently in search of mates, moved up to 500 metres or one to two territories away from their own territory (where they had been banded as breeding males in 2000). Some males that lost their mate shifted their territory or occupied another vacant territory. One pair moved into the neighbouring area formerly occupied by a pair and unmated male after those birds disappeared. There were no known cases of adult females changing mates; known females that disappeared were not resighted elsewhere in Imbota NR. One female briefly visited another (non-neighbouring) territory one kilometre away after a breeding failure, but returned for another attempt with her mate.

Parental behaviour

For Yellow Robins and Scarlet Robins, only females gathered nesting material, built nests, and incubated and brooded. Both sexes fed nestlings and fledglings, often splitting broods of two (colour-banded) fledglings so that the male had charge of one juvenile and the female had charge of the other.

A helper male Yellow Robin (banded, later a breeding male) was once seen carrying nesting material, and a breeding male Yellow Robin (paired with a known female) appeared once to sit briefly on a nest with eggs or chicks. A male Scarlet Robin once covered a nest by crouching over it, though he did not sit, at the hatching stage.

In both robin species, males courtship-fed prelaying females, and called incubating females to receive food (Yellow Robin: soft 'chop-chop' call; Scarlet Robin: soft, brief version of the song). Males sometimes fed females on the nest, or passed food to chicks via the sitting female, although sitting females also left the nest to forage. Female Yellow Robins begged with calls similar to those of juveniles (soft, plaintive whistles), but female Scarlet Robins gave no audible begging calls. Parent robins with food called to fledglings in the same manner as males to females in the respective species.

The response to potential nest predators (humans) was similar for both robin species. Incubating females flushed if approached to within a variable distance of the nest (10–20 m for the wariest Yellow Robins, to less than 5 m for the more confiding individuals of both species). Brooding females performed an apparent injury-feigning distraction display on the ground if nestlings were approached to within 1–2 metres, and both sexes defended new fledglings by flying past the observer and scolding if the young were approached to within 1–2 metres.

Scarlet Robins were highly cryptic, sitting females being almost invisible. Nest-building females tended not to approach the nest while being watched, or flew erratically when carrying material. Incubating females 'froze' on the nest if a predator flew past overhead, and flushed suddenly in erratic flight, wing-bars and tail-edges flashing, if approached within about one metre by a Pied Currawong *Strepera graculina* or human. Adults with food for nestlings were cautious, going indirectly to the nest via several trees, and waiting several minutes before the final approach flight; they also crouched cautiously, in cryptic pose, on the approach perch or on the nest rim before feeding the young. By contrast, most Yellow Robins readily built or lined nests or fed nestlings, without such caution, if observed from a discreet distance (20 m).

Both robin species removed and carried away nestling faecal sacs almost until the fledging stage, but I did not observe whether sacs were dropped or swallowed. On the last day or two in the nest, the nestlings' droppings accumulated outside the nest or on the vegetation or ground below.

Two nest-building female Scarlet Robins once performed a descending 'butterfly flight' (Higgins and Peter 2003) as they left their nests, when clear of the tree. Brooding females also used butterfly flight as they dropped from the nest to perform a distraction display on the ground. In all cases the pale wing-bars flashed conspicuously.

Parent Yellow Robins performed enticement behaviour at the fledging stage, when predators or perceived predators (humans) were near the nestlings: for example, when a currawong was nearby, or the nestling(s) had just been banded. After the predator or human had retreated, the parent flew to inspect the nest and, instead of feeding the begging nestling(s), jumped about the nest in an agitated manner, giving a soft version of the 'chop-chop' call interspersed with single piping notes, then departed. The nestling(s) then jumped from the nest, fluttered to the ground and 'froze' in litter or sought cover. Adults similarly enticed new fledglings to follow them to other cover if an

observer handled them or approached their hiding-place closely. Some nestling Yellow Robins, within 1–2 days of fledging age, jumped out when replaced in the nest after banding. They either remained in the nest after being replaced again, and fledged naturally (one brood), or they stayed out of the nest and either reached independence or disappeared, presumed dead, within a few days of leaving the nest (two broods respectively).

After a newly fledged Scarlet Robin had been caught by hand and replaced on its log perch, the agitated female gave a series of 'chup' calls as she flew to nearby shrubs. The juvenile followed along the ground, climbed a shrub, and perched there for the next two days until it could fly well.

Vocalizations

Adult robins gave several previously undescribed calls. Yellow Robins engaged in social encounters with members of their group, involving mild chases, displacements or dominance, gave soft trills (apparently by the submissive bird) audible only at close range (less than 10 m). A contact call between mates, apparently when one was trying to locate the other, or when a food-bearing adult was trying to locate a hidden fledgling, was a single rising whistle.

The long, rattling pre-copulatory call of female Scarlet Robins (Higgins and Peter 2003) was a good indication that a nest, almost ready for laying, was nearby. Adult Scarlet Robins defending nests or fledglings gave harsh grating notes (two per second) similar in quality to the 'scolding' of Speckled Warblers *Chthonicola sagittata*, though more rhythmic. A male Scarlet Robin defending a newly started nest against a Pallid Cuckoo *Cuculus pallidus* gave a series of loud, shrill squeaks (two notes per second).

The begging call of fledgling Scarlet Robins was a single soft, high-pitched plaintive note, similar in quality to the contact call of the Chestnut-rumped Thornbill *Acanthiza uropygialis* and apparently similar to the thin piping whistle of fledgling Red-capped Robins *Petroica goodenovii*.

Nest sites and nest-building

Most Yellow Robin nests in Imbota NR ($n = 58$) were in rough-barked saplings (48%; stringybarks 41%), live stringybark trees (21%) or live non-*Acacia* shrubs (16%; *Cassinia* 14%), whereas most Scarlet Robin nests ($n = 54$) were in live stringybark trees (52%), dead branches in live trees (22%; stringybarks 13%, gums 9%) or in dead stringybarks or acacias (13%; 6% and 7% respectively) (Table 1). The two robin species also differed in mean nest height (Yellow 2.7 vs Scarlet 7.2 m; $t_9 = -7.91$, $P < 0.001$) and nest-plant stem diameter (Yellow 9.9 vs Scarlet 28.5 cm; $t_9 = -6.67$, $P < 0.001$) (Table 1).

Yellow Robins took a mean of seven days (6–16 days, $n = 4$ nests) from the start of nest-building to laying, with one other case of less than nine days. The longest time (16 days) was for a first nest of the season that had a latent period of five days from an apparently finished and lined nest to laying of eggs. Two other first nests of the season also had latent periods of six and 10 days from apparently finished and lined nest to laying.

Scarlet Robins took a mean of eight days (6–11 days, $n = 8$ nests) from start of nest-building to laying, with two