

BREEDING BEHAVIOUR, VOCALIZATIONS AND PLUMAGE OF THE RED-CAPPED ROBIN *Petroica goodenovii* IN CAPERTEE VALLEY, NEW SOUTH WALES

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This paper describes the nesting behaviour, vocalizations and plumage of 12 pairs of Red-capped Robins *Petroica goodenovii* studied during the breeding season from September 2000 to March 2001 in 12 hectares of dry woodland in Capertee Valley, New South Wales. Individuals were reliably identified by plumage, song and territory. Four brown-plumaged breeding males had rust-coloured caps. Fourteen distinct vocalizations were recognized (11 for adults, three for young).

INTRODUCTION

The Red-capped Robin *Petroica goodenovii* occurs in the drier regions of all mainland Australian states (Blakers *et al.* 1984) but despite being a widespread and conspicuous species, information on breeding behaviour and vocalizations is very limited and often anecdotal. The most complete behavioural study of the species was made by Coventry (1988), but was limited to just three pairs and did not include sonagrams. This paper attempts to describe and illustrate the complete vocal repertoire of the species and to match voice with behaviour. Adult males are brightly plumaged in red, black and white but brown males may also pair and breed successfully. There is confusion in the literature regarding the plumage of brown males and females which I hope to partially correct. George (1950, 1951a, 1951b) and Hutton (1991) studied captive nesting behaviour. Disney (1974), Hall (1974) and Hobbs (1986) have studied plumage. Limited information on Red-capped Robins is found in field guides (Stewart 1976; Frith 1984; Simpson 1986; Boles 1988; Schodde and Tidemann 1988; Slater 1989; Pizzey 1997; Morcombe 2000). In a concurrent paper I describe the 2000–2001 breeding biology for the same 12 pairs of Red-capped Robins referred to in this present study (Powys 2004).

METHODS

Study site

The 12 hectare study site in Capertee Valley is located 18 kilometres east of Capertee (33°07'S, 150°08'E) and 380 metres above sea level, on the western slopes of the Great Dividing Range in New South Wales. Mean annual rainfall is 500 millimetres and summers are often hot and dry with low humidity. Aspect is north-east with stony soils supporting dry woodland including Motherumbah *Acacia cheelii*, Black Cypress Pine *Callitris endlicheri*, Narrow-leaved Ironbark *Eucalyptus crebra*, Tumbledown Red-gum *E. dealbata*, with an understorey of native herbs and grasses.

Materials and methods

Birds were not banded but individuals were reliably identified by their plumage irregularities and territory; they were given a code name and territories were mapped with data being compiled for 29 nesting attempts by 12 pairs, as outlined in (Powys 2004). Twenty-five robins were colour-sketched from October to December. Moulting, brown males were re-sketched in January, February and March to monitor their progressive change to full adult plumage (Table 1).

Male Red-capped Robins called often prior to nesting and were located aurally. Vocalizations were taped opportunistically and associated behaviour noted, from September to March. Sub-song from an adult male was recorded at the end of April 2001. Samples of territorial song were recorded from all the breeding males in this study, at various times of the day, and were later analysed both aurally and sonographically to check for individual variation.

Voice was tape recorded with a Sony TCD D10 Pro DAT and Sennheiser ME 67 gun microphone, and analysed on a Macintosh iMac computer using sound processing software Peak LE v2.10 (© BIAS 1997–1999) and sound spectrograph software AudioGraph v.3.2 (© Ralph Sutherland 2000, Canberra, Australian Capital Territory).

RESULTS

Territory establishment and song

Eight red-plumaged males and four brown-plumaged males paired with females and established adjoining territories that averaged 1.02 hectares, in vegetation that was dominated by Motherumbah acacia (Powys 2004). From September to December male Red-capped Robins advertised from prominent perches, giving frequent bouts of Territorial Song *dikerdreeya-dikerdreeya* (Fig. 1a) during daylight hours until paired and nesting, usually within 1–2 weeks. One brown male sang intermittently for three weeks in November–December before attracting a mate and nesting. If a nest failed or if fledglings were nearly independent, males would again give the Territorial Song for one or two days prior to a subsequent nest attempt. This trilled Territorial Song was not loud but carried well at a relatively low frequency (kHz) and was audible within a distance of 150 metres.

Females did not give the Territorial Song prior to nesting, but four different females used the Territorial Song occasionally when feeding nestlings and fledglings (Fig. 1b). One female with fledglings used the Territorial Song when disputing territory with a neighbouring male. H male and H female had similar Territorial Songs; the female consistently gave a slighter weaker version (Figs 1a–b). Sonographic analysis showed consistent individual variation in male Territorial Song which was sometimes discernible in the field. The Scolding call *heh-heh-heh-heh* (Fig. 1c) replaced the males' Territorial Song when the female was

TABLE 1

Table showing plumage and moult details for four brown males November to March.

| BROWN-PLUMAGED MALES | | |
|----------------------|-------------------|--|
| BB MALE | November | Grey-brown upper, strongly rust-coloured forehead cap, pale breast, whitish stripe on lower wing. |
| | December | Unchanged. |
| | 21 January | 3 red patches on breast and red mark on side of forehead, black smudge on head, grey-brown upper. |
| | 30 January | More red on breast, red cap almost complete, black replacing brown on head, back and wings, white wing mark extends to coverts. |
| | 7 February | Fairly even red on breast, black plumage almost complete but a few brown flecks, white stripe in wings developed further. |
| AB MALE | 20 February | Moult complete, strong cadmium red colour on cap and breast, deep matt black on head, back and wings, full length white wing stripe, shiny black legs, dark beak. |
| | November | Grey-brown upper, strongly rust-coloured forehead cap, pale buff-washed breast with a double band of faint pink spots. Obvious whitish wing stripe extends to coverts. |
| | December | More faint pink spots on breast, otherwise unchanged. |
| | 23 January | Red cap developing but still brown streaked, 3 faint red smudges on breast, some black flecks around eyes and below beak. |
| | 29 January | More black on face, red cap prominent, crescent of red on middle breast, grey-brown back and wings, white wing stripe extends to coverts. |
| NH MALE | 3 February | Fairly even development of red and black, with patchy black and brown on back, head and wings, white wing stripes, red cap, and patchy red on breast. |
| | 2 March | Moult complete, strong orange-red breast smaller than BB male, red cap has 1 brown fleck on it, thin brown ring around eye, white wing stripe complete, dark beak. |
| | November | Grey-brown upper with pale neck, streaky rust-coloured forehead cap, pale beak, pale breast, thin whitish stripe on lower wing. |
| | December | Unchanged. |
| | 0 January | Black marks on neck and around eyes, otherwise unchanged. |
| MB MALE | 7 February | 1 or 2 bright red feathers in cap, slight buff wash on upper breast, black developing on face and wings. |
| | 13 February | 2 faint pink spots on breast, red mark on cap, mixed black and brown on head, back and wings, no white in wing. By 16 Feb pink spots changed to red spots. |
| | 21 February | Black plumage almost complete, cap half red, 2 red smudges on breast, full length white stripe appearing on wings. |
| | 3 March | Black plumage almost complete if dusty looking, red cap almost complete, red on breast extends to chin but incomplete. |
| | 13 March | Moult almost complete, dark black head and back, orange-red breast, still a few brown streaks on cap. |
| MB MALE | November | Grey-brown upper, strongly rust-coloured forehead cap, pale grey breast with 3-4 pink spots, whitish stripe on lower wing. |
| | December late-Dec | Unchanged. Abandoned territory and moult details not known. |

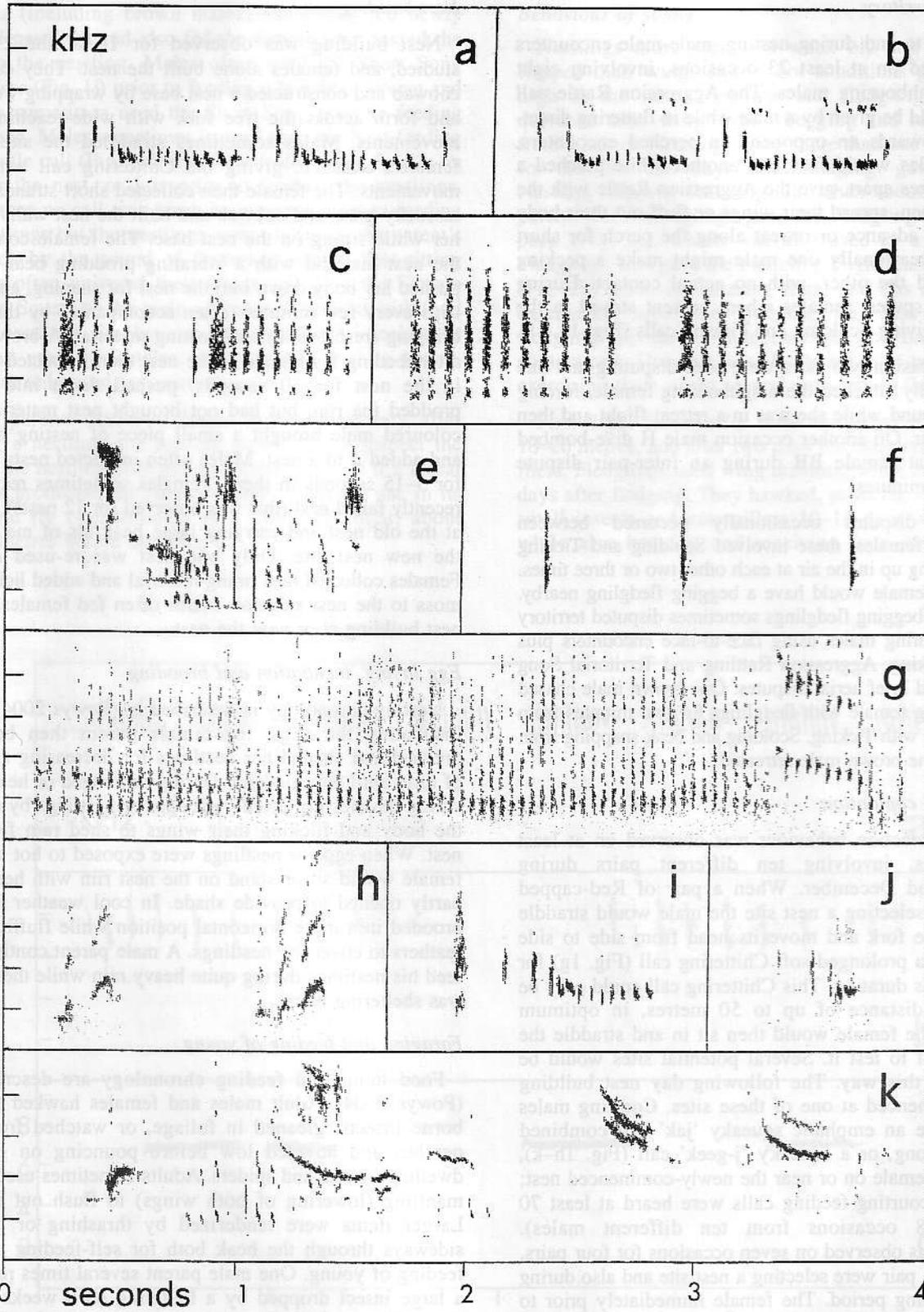
incubating; nesting males answered neighbours' Territorial Songs with the Scolding call rather than the Song.

Pairing

Red-capped Robin pairs stayed together for the duration of the breeding season and were apparently monogamous, both birds defending their territory while they were nesting and feeding fledglings. One pair continued to defend their territory for three months without re-nesting, following a nest failure. Five pairs deserted their territories in

December-January after repeated nest failures. Juveniles sometimes stayed within their parents' territory after independence, while the parents were re-nesting. Assuming that brown males were less than two years old (Boles 1988), and that females with indistinct or no rust-coloured cap were less than two years old (George 1950), mixed-age pairings occurred when older coloured males paired with younger females, and two younger brown males paired with older females (those females had extensive rust-coloured caps). Other pairs appeared similarly aged.

Figure 1 opposite. Sonagrams showing calls from adult Red-capped Robins. a. Territorial Song: 2 linked phrases, dikedreeya-dikedreeya, H male, 2 Dec. 00, 0747 hours. Each phrase typically began with 2-3 ticks followed by a 10-12 note trill usually rising in the middle and ending with a tick. The double phrase was always about 2s duration, at 2-4 kHz, and with more than 2 seconds between calls. b. Territorial Song: dikadreeya-dikadreeya, H female, 25 Jan. 01, 0629 hours. (H male and H female had similar songs; the female gave a slighter weaker version.) c. Scolding Call: two 'whinneys' from a coloured male (in response to a goanna), 7 Feb. 00, 1330 hours. This call comprised a harsh whinney-like call of 0.5-1 second duration, HEH-heh-heh-heh. In a 3 minute sequence of calls from a pair reacting to a goanna near nest, male and female consistently gave different versions; the male's call (Fig. 1c) was more emphatic at the start, began with a tick, and the phrase was faster and shorter than the female's. This call was harmonically complex at 1-6 kHz, with 5-12 notes per phrase uttered at a rate of 10-16 notes per second. (In Figs 1c and 1d gaps between 'whinneys' have been shortened from more than 1 second.) d. Scolding Call: two 'whinneys' from a female (in response to a goanna), 7 Feb. 00, 1330 hours. e. Aggression Rattle: squeak and rattle from H male (in defence of fledgling), 24 Oct. 00, 1711 hours. This call comprised a loud staccato rattle, drrrrrt, of about 1 second duration and was given by males and sometimes females. Often the call was extended into a series of rattles. Typically the rattling call incorporated a high-pitched 9 kHz squeak and several ticks. The rattling notes were uttered at 22 notes per second. In the field, this call sounded sharper and faster than the Scolding call. f. Ticking: three ticks from a coloured male (edited to shorten gaps between ticks), 17 July 99, 1013 hours. A single sharp tick of 2-6 kHz was given at varying intervals by males and females in agitation, contact, and as a warning. g. Chittering: 'chittering' from H male (choosing nest site with female), 4 Nov. 00, 1708 hours. This call comprised a prolonged undulating, soft chittering call, ttttttttt. This call reached 12 kHz and was harmonically complex. There were 12-24 notes per second with high notes uttered at a faster rate. (Fig. 1g was edited at 3.3 seconds to include high-pitched notes at 8 kHz). h. Short courting-feeding call: two rising squeaky j-geek? calls from H male (choosing nest site with female), 4 Nov. 00, 1816 hours. i. Short courting-feeding call combined with Short song: jak-dikedreeya, (from male H before feeding female), 24 Nov. 00, 0837 hours. j. Short Song: dikedree, H male (just before feeding fledgling) 29 Oct. 00, 1628 hours. This call comprised a shortened version of the Territorial Song. k. Short courting-feeding call: rising jeek? call at 4 kHz, followed by soft rattle more than 1 second of Nest-feeding soft rattle from H male (offering food to incubating female before female accepts food near the nest), then Female Begging Squeal, with three 4-10 kHz down-slurred squeals, skeeeer!, from H female as she is fed by H male. 24 Nov. 00, 0844 hours. (gaps between squeals were edited and shortened slightly).



Defence of territory

Both prior to and during nesting, male-male encounters were observed on at least 23 occasions, involving eight different neighbouring males. The Aggression Rattle call (Fig. 1e) would be given by a male while in fluttering direct-line flight towards an opponent. In perched encounters, opposing males would face one another while perched a few centimetres apart, give the Aggression Rattle with the beak wide open, spread their wings or fluff out their body feathers, and advance or retreat along the perch for short distances. Occasionally one male might make a pecking action toward the other, with no actual contact. During male-male disputes, females were present stayed in the background giving Scolding and Ticking calls (Fig. 1d, 1f).

On one occasion two pairs were seen disputing and one male physically attacked the neighbouring female, forcing her to the ground while she was in a retreat flight and then pecking at her. On another occasion male H dive-bombed and pecked at female BB during an inter-pair dispute lasting 5–10 minutes.

Boundary disputes occasionally occurred between neighbouring females, these involved Scolding and Ticking Calls and flying up in the air at each other two or three times. Usually one female would have a begging fledgling nearby. Females with begging fledglings sometimes disputed territory with neighbouring males using face-to-face encounters plus Scolding, Ticking, Aggression Rattling and Territorial Song from both, and brief aerial disputes. One brown male chased a neighbouring female with fledglings for two minutes from perch to perch with Ticking, Scolding and beak snapping from both, before the brown male retreated.

Courting and copulation

Nest site selection behaviour was observed on at least 18 occasions, involving ten different pairs during November and December. When a pair of Red-capped Robins were selecting a nest site the male would straddle a suitable tree fork and move its head from side to side while giving a prolonged soft Chittering call (Fig. 1g) for 15–60 seconds duration. This Chittering call could only be heard for a distance of up to 50 metres, in optimum conditions. The female would then sit in and straddle the tree fork as if to test it. Several potential sites would be examined in this way. The following day nest building usually commenced at one of these sites. Courting males typically gave an emphatic squeaky 'jak' call combined with Short Song, or a squeaky 'j-geek' call (Fig. 1h–k), then fed the female on or near the newly-commenced nest; (male Short courting-feeding calls were heard at least 70 times on 18 occasions from ten different males). Copulation was observed on seven occasions for four pairs, both when the pair were selecting a nest site and also during the nest building period. The female immediately prior to being fed by the male typically gave the Female Begging Squeal (Fig. 1k) while quivering her wings. After feeding the perched female, the male then flew in several tight circles around her, and during the 1–3 second mating contact the female perched in a submissive posture while the male fluttered behind her. Nest selection behaviour and copulation was also observed for pair H just one day after depredation of their nestlings; the pair immediately re-nested.

Nest building

Nest building was observed for 16 of the 29 nests studied, and females alone built the nest. They collected cobweb and constructed a nest base by wrapping web back and forth across the tree fork with wide-reaching head movements. Males sometimes straddled the site in the female's absence, giving the Chittering call with head movements. The female then collected short strands of dry tussocky grass and cobweb and built the nest walls around her while sitting on the nest base. The female compacted the nest material with a vibrating prodding beak action, pushed her body down into the nest for shaping, and made trips every few minutes (often accompanied by the male) bringing fresh beakfuls of nesting material. A brown male after feeding his female at the nest then inspected and sat in the nest for 30 seconds, pushed down into it and prodded the rim, but had not brought nest material. One coloured male brought a small piece of nesting material and added it to a nest. Males often inspected nests and sat for 5–15 seconds in them. Females sometimes recycled a recently failed nest (this was observed for 12 nests), tearing at the old nest and carrying large beakfuls of material to the new nest site. Only one nest was re-used *in situ*. Females collected nest lining material and added lichen and moss to the nest exterior. Males often fed females during nest building at or near the nest.

Egg laying, incubation and brooding

Nesting chronology is described in (Powys 2004). After incubating the eggs, the female parent then brooded, preened and shaded her nestlings for decreasing amounts of time until they fledged. During prolonged or heavy rain sitting females protected their eggs or nestlings by angling the body and flicking their wings to shed rain from the nest. When eggs or nestlings were exposed to hot sun, the female would sit or stand on the nest rim with her wings partly opened to provide shade. In cool weather females brooded in a more horizontal position while fluffing their feathers to cover the nestlings. A male parent continued to feed his nestlings during quite heavy rain while the female was sheltering them.

Foraging and feeding of young

Food items and feeding chronology are described in (Powys 2004). Adult males and females hawked for airborne insects, gleaned in foliage, or watched from low perches and hovered low before pouncing on ground-dwelling insects and spiders. Adults sometimes used wing-mantling (lowering of both wings) to flush out insects. Larger items were tenderized by thrashing or passing sideways through the beak both for self-feeding and the feeding of young. One male parent several times retrieved a large insect dropped by a fledgling (two weeks out of the nest), and when the item jammed in the beak of the fledgling, the male re-positioned the item and pushed it in. Winged insects were always pushed head-first into the throat of nestlings and fledglings. Older nestlings could manage to swallow quite large items whole; a 13 day-old nestling took several minutes to swallow by degrees a 5 centimetre long grasshopper that had been fed to it by the male parent.

Males (including brown males) sometimes fed newly hatched nestlings and also fed the female who passed the food to the nestling. Males often used the Short Song *diker-dree* (Fig. 1j) prior to feeding a female or young and females sometimes used the Short Song prior to feeding her young. Males sometimes instead gave the Nest-feeding Soft Rattle call (Fig. 1k), just prior to feeding a female on or near the nest, or just prior to feeding the nestlings. Sometimes no call was given by a parent prior to feeding the nestlings but the nestlings were alerted to the parent's approach by the sound of fluttering wings. Nest-sitting females often quivered their wings and gave the Female Begging Squeal as the male approached the nest with food for the nestlings. Emphatic squeaky 'jak' and 'j-geek' calls were not used by females, nor by males feeding young, and were only used by courting males.

Both parents removed faecal sacs immediately after feeding a nestling; the feeding parent would inspect the rear of the nestling after giving a food item and if a faecal sac was produced, the parent would collect the sac in its beak and fly (sometimes with a fluttering flight) about 20–30 metres before dropping it.

Behaviour of young

Nestlings more than one week old self-preened and flapped their wings and in hot conditions gaped and sat high in the nest. Nestlings and fledglings called and quivered their wings while begging and receiving food from a parent. Nestlings when more than one week old and for the first few days after fledging, gave the trilled Nestling Begging Call (Fig. 2a) when about to be fed by parent. Older fledglings gave the Fledgling Begging Call *peep* (Fig. 2c), which was also used as a contact call. Fledglings also gave the Fledgling Flight Call *tika-tika-tika* (Fig. 2b) when in fluttering flight and this call was used extensively soon after fledging, then less often as the fledgling approached independence, and functioned as a contact call. This call was also heard from nestlings when exercising their wings several days before fledging.

First flight distance for three fledglings at nest H6 was 10–20 metres, and after two days the fledglings were active fliers. Fledglings used wing mantling when foraging, seven days after fledging. They hawked, pounced, caught and ate small insects and caterpillars 10–14 days after fledging, while also begging and receiving food items from the

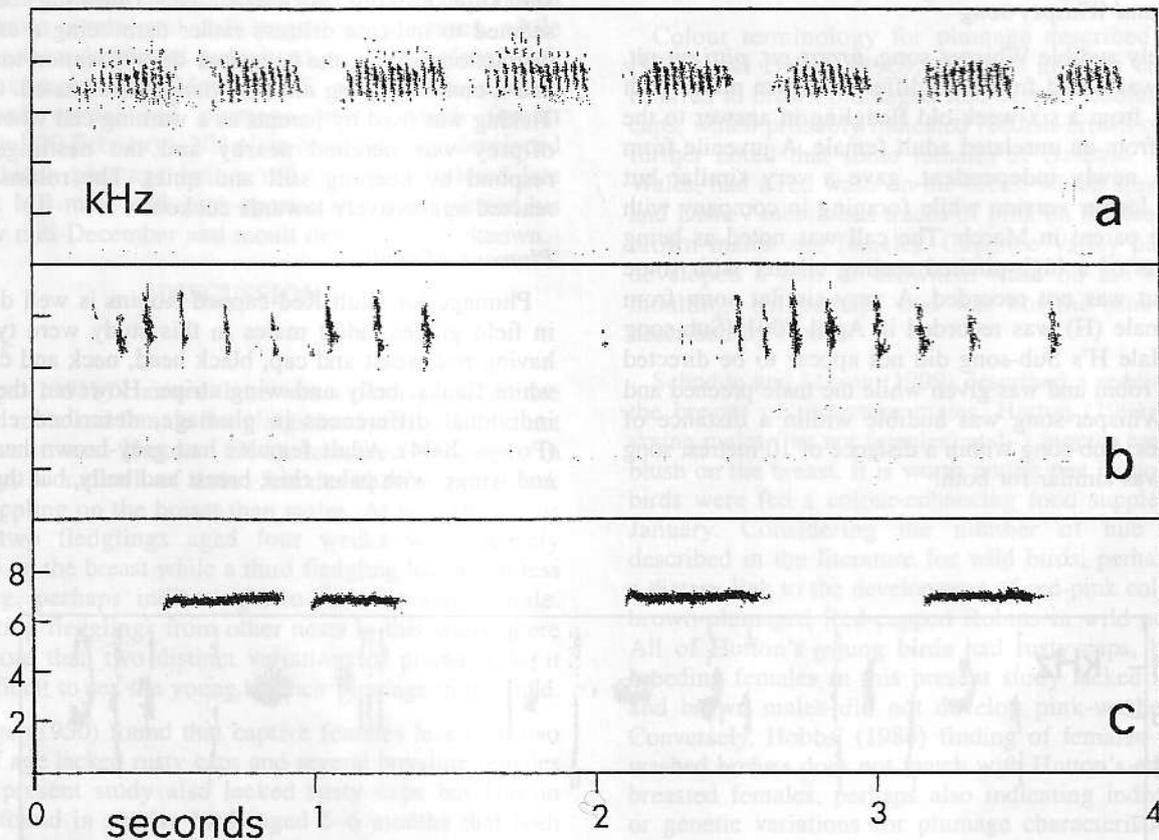


Figure 2. Sonagrams showing calls from young Red-capped Robins. a. *Nestling Begging Call*: trills from H1 nestling (1 day before fledging), 28 Sept. 00, 1105 hours. A pulsed trill at 7–8 kHz, trrrrrr, trrrrrr, trrrrrr. There were about 10–12 notes per trill, and 2 trills per second. b. *Fledgling Flight Call*: A high-pitched 6–9 kHz series of ticks tika-tika-tika from H6 fledgling (10 days after fledging), 25 Jan. 01, 0621 hours. Delivery rate was about 7 ticks per second, duration of call depended on length of flight. c. *Fledgling Begging Call*: peep calls from H6 fledgling (10 days after fledging), 25 Jan. 01, 0621 hours. A strong peep, fairly level in pitch at 7 kHz was given frequently by fledglings as a begging and contact call. Each peep was about 0.5 seconds in length, gaps between peeps were variable.

parents, and they followed after the foraging parents. When parents had a food item they called to their young with the Short Song or the Territorial Song; if the young did not come to the parent then the parent went to the young.

Independence

Parental feeding of the young decreased as the fledglings approached independence. At five to six weeks after fledging, a parent would sometimes fly aggressively at its begging young and give the Aggression Rattle. The young then ceased to give the Fledgling Begging Call but continued to forage with their parents in early independence. Young from nest NH2 used Ticking and Scolding calls when newly independent, and used the Aggression Rattle prior to independence.

If two young had fledged from a nest, both parents fed both young non-exclusively but sometimes separately. Both parents equally fed the fledglings to independence, with two exceptions. In October female H spurned two young 15 days after fledging and built a new nest. Male H then solo fed the two young for another 18 days to independence. In January female AB solo fed one fledgling while male AB was moulting into adult plumage. The time from fledging to independence was 33–40 days when the young were aged 7–8 weeks (see Powys 2004).

Sub-song and Whisper-song

A scarcely audible Whisper-song, *prrrrt-pit, pitti pit-pit*, repeated, was heard from two different brown males with fledglings, from a six-week-old fledgling in answer to the male and from an unrelated adult female. A juvenile from nest AB2, newly independent, gave a very similar but somewhat louder version while foraging in company with the female parent in March. The call was noted as being short bursts of a high-pitched reeling chatter with some Ticking but was not recorded. A very similar song from an adult male (H) was recorded in April 2001 (Sub-song Fig. 3). Male H's Sub-song did not appear to be directed at another robin and was given while the male preened and foraged. Whisper-song was audible within a distance of three metres; Sub-song within a distance of 10 metres; song structure was similar for both.

Bathing and preening

If water was available adult Red-capped Robins would bathe before preening, and young bathed three weeks after fledging. Some territories did not have water unless it rained. Where a water source was shared between territories, disputes occurred. Ground sun-bathing sometimes occurred with adults; the bird would squat, fluff its feathers and spread its tail and remain motionless for up to one minute or more while sunning itself.

Nest success and reaction to predators

Nest success rate and potential predators are outlined in (Powys 2004). When female H flew to the nest to incubate but saw a hawk, she perched instead on the rim of the nest, ready for flight. Incubating and brooding females constantly watched for predators. When a goanna was near a nest both adults gave Scolding calls and occasional Ticking and fluttered around the goanna. When a wallaby and joey were close to an incubating female, the male gave the Scolding call with occasional Ticking. A female fluttered around her nest for several minutes, once following the too-close approach of an observer to a nest with eggs and again when she had nestlings the female fluttered around the nest for eight minutes soon after a nearby Brown Falcon had flown away. In the latter case, when the female eventually returned to brood her young, she kept looking skywards. The fluttering behaviour seemed to indicate distress rather than being a calculated distraction display; the behaviour drew attention to the nest and it continued long after the danger had passed. Constant Ticking was used by parents as a warning call when a bird-of-prey was perched nearby and the nestlings would respond by keeping still and quiet. The robins always reacted aggressively towards cuckoos.

Plumage of adults

Plumage for adult Red-capped Robins is well described in field guides; adult males in this study were typical in having red breast and cap, black head, neck and chin, and white flanks, belly and wing stripe. However, there were individual differences in plumage, described elsewhere (Powys 2004). Adult females had grey-brown head, back and wings, with paler chin, breast and belly, but the overall

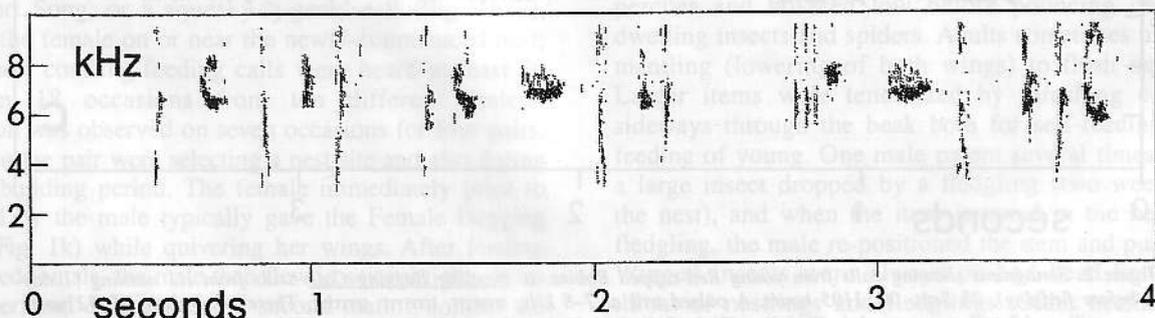


Figure 3. Sonagram showing sub-song from an adult male Red-capped Robin. Sub-song: from H male, 28 April 01. Part of a one-minute sequence of very soft, high-pitched reeling chatter, including elements of the Aggression Rattle, Ticking, and Territorial Song, rendered in part as pritti-PREE-pritti-prit-PRRT-pit. Much of this song was 6–8 kHz, with overtones (not shown) at 12–14 kHz.

hue varied with individuals. Darker plumaged females had a larger rust-coloured cap; paler females had a very slight, or no, rusty cap.

Plumage of fledglings

All fledglings had pale unmarked throats and pale breasts flecked with darker grey-brown markings, but the density of flecking varied in same-age fledglings and some birds also had buff-washed flanks. The flecking on the upper body was more uniform between individuals. The breast flecking was less obvious as fledglings approached independence. Wing stripes were tan-coloured at fledging, but paler buff at independence. Both fledglings from nest AD3 had a pale rust wash on the forehead at independence plus an un-flecked grey-beige breast. Both fledglings from nest NH2 were still strongly flecked on the breast at independence and did not have a rust wash on the forehead. Of three fledglings from nest H6, two were lightly flecked on the breast at independence while a third had no flecks, and none had a rust-washed forehead. One 17-weeks old fledgling still had pale eye ring.

Plumage of brown males

Table 1 details plumage changes in four brown males November to March. Three brown males moulted into full adult plumage in one stage January-March, but their mature plumage was acquired in different ways. AB male retained pink breast spots and full-length wing stripes while breeding then developed partial red plumage before black (moult completed 2 March). BB plain-breasted male developed partial red plumage before black (moult completed 20 February). NH plain-breasted male developed partial black plumage before red (moult completed late March). MB male with pink-spotted breast abandoned his territory mid-December and moult details are not known.

DISCUSSION

Plumage

George (1951b) claimed there was a plumage difference between male and female fledglings in captivity but did not say what it was. Hutton (1991) described fledglings in captivity; in a clutch of three, females showed more dark grey stippling on the breast than males. At nest H6 in this study, two fledglings aged four weeks were densely stippled on the breast while a third fledgling had much less stippling, perhaps indicating two females and a male. Comparing fledglings from other nests in this study, there were more than two distinct variations of plumage, so it was difficult to sex the young by their plumage in the field.

George (1950) found that captive females less than two years of age lacked rusty caps and several breeding females in this present study also lacked rusty caps but Hutton (1991) found in captive birds aged 5–6 months that both sexes had rusty caps, the males' cap being stronger in colour than the females'. Field guides (Stewart 1976; Simpson 1986; Schodde and Tidemann 1988; Slater 1989; Pizzey 1997) wrongly state that brown male Red-capped Robins lack rust-coloured caps, although Coventry (1988) described a banded immature male with a russet cap that later moulted in one stage to full adult plumage. The small

but strongly rust-coloured caps of three brown males in this study may be diagnostic of gender (the rust caps of females, where obvious, tended to be larger and duller), and the full-length white wing stripe in an otherwise brown bird also proved to be diagnostic of gender. Pink spots were not a definite male indicator as one female had a pink spot on her breast. Strongly territorial behaviour and long bouts of singing prior to nesting were also diagnostic of gender, although females sometimes briefly gave the Territorial Song after nesting.

Confusion in plumage descriptions for brown males has led to some inaccurate voice and behavioural descriptions, for example Stewart (1976) described a 'dance' between male and female Red-capped Robins but this may have been an interaction between rival coloured and brown males. In Capertee Valley such 'dance' action always indicated aggressive bluff encounters on perches or on the ground between rival males (coloured-to-coloured and brown-to-coloured), rival females, and rival male-to-female. Dance action never occurred between mated pairs.

Hall (1974) reported post-moult transitional plumage for two young males as being a mixture of grey and adult plumage. Hutton (1991) noted that second-year brown males in captivity moulted to full adult plumage in one stage over 2–3 months. Three brown males studied in Capertee Valley moulted to full adult plumage in one stage over 2–3 months.

Colour terminology for plumage described by Hobbs (1986) and Disney (1969, 1974) is unclear; both authors referred to brown-plumaged Red-capped Robins with 'red' caps, which probably indicated reddish-brown caps. Hobbs further noted that some females at Dareton, New South Wales, had a red wash on the breast which appeared pink, and Disney mentioned traces of pink on the breast of both brown males and females. Capertee Valley pale females developed a buff or brownish wash on the breast after moulting, but perhaps this was not the pink colour as described by Hobbs.

Schodde and Mason (1999) described a reddish wash on the breasts of immature males. Hutton (1991) described young males (but not females) at 4–5 months having a pink blush on the breast. It is worth noting that Hutton's captive birds were fed a colour-enhancing food supplement each January. Considering the number of hue variations described in the literature for wild birds, perhaps there is a dietary link to the development of red-pink coloration for brown-plumaged Red-capped Robins in wild populations. All of Hutton's young birds had rusty caps, but several breeding females in this present study lacked rusty caps, and brown males did not develop pink-washed breasts. Conversely, Hobbs' (1986) finding of females with pink-washed breasts does not match with Hutton's captive pale-breasted females, perhaps also indicating individual and/or genetic variations for plumage characteristics in wild birds. Morcombe (2000) described brown birds in coastal populations as having a slight brown tint along the flanks compared to paler inland birds, and Schodde and Mason (1999) also found a trend towards paler inland birds. In Capertee Valley, plumage of brown birds was variable according to age and stage of moult, and did not indicate a trend one way or the other.

TABLE 2

Table comparing descriptions of vocalizations for the Red-capped Robin from this study with those of Coventry (1988) and Hutton (1991).

| POWYS | COVENTRY | HUTTON |
|---|--------------------------------------|---|
| Territorial Song (m, sometimes f) | Song (m) | Territorial/identity call (m) |
| Scolding — agitation (m and f) | Scolding (m and f) | |
| Ticking — agitation/warning (m and f) | Ticking — contact call (m and f) | Ticking — warning call (m and f) |
| Aggression Rattle (m, f and juv) | | |
| Chittering — nest site selection call (m) | | |
| Short squeaks — courting-feeding (m) | | Short squeaks — communication (m and f) |
| Female Begging Squeal (f) | 'Rubbing glass call' (m and f) | Short squeaks — communication (m and f) |
| Short song (m and f) | Short song (m) | Short song (f) |
| Nest-feeding soft rattle (m) | Rapid clicks — nest-feeding (m) | |
| Sub-song/Whisper Song (m, f and juv) | | |
| Nestling Begging Call — trill | Nestling begging chirrup | Nestling harsh squeak |
| Fledgling Begging Call — peep | Fledgling call — thin piping whistle | |
| Fledgling Flight Call — tika-tika-tika | | |

Vocalizations and behaviour

Behavioural observations for Capertee Valley mostly corroborate with those of Coventry (1988) who described seven vocalizations for Red-capped Robins at Cooma. The fourteen vocalizations found in this present study expand on Coventry's findings, and differ only slightly in matching voice with behaviour. Coventry (1988) found that male Red-capped Robins at Cooma gave a shortened version of the Territorial Song before feeding the nest-building female, but only gave a short series of five or six rapid clicks before feeding the nestlings; the females' approach to the nest was silent. At Capertee Valley, males gave the Short Song before feeding the nest-building female but also often gave the Short Song before feeding the nestlings and only occasionally gave the rapid clicking call. Females sometimes gave the Short Song before feeding the nestlings and both males and females sometimes gave the full Territorial Song before and after the nestlings had fledged. Both male and female often approached the nest without calling but the wing flutter sound alerted the young. All vocalizations for Red-capped Robins in this study were diagnostic of behaviour.

Table 2 compares vocalizations described in this study, with those by Coventry (1988) and Hutton (1991). Previously undescribed calls are the Aggression Rattle, Chittering, two short courting-feeding calls, Sub-song/Whisper-song, and Fledgling Flight Call.

Chisholm (1949, 1960) noted mimicry of a Scarlet Robin *Petroica multicolor* trill by a male Red-capped Robin during October in Victoria, and Coventry (1988) also observed a breeding male Red-capped Robin giving a Scarlet Robin trill. Red-capped Robins in Capertee Valley gave no mimicry during the study period. When a Speckled Warbler *Chthonicola sagittata* mimicked the Territorial Song of the Red-capped Robin in December, the male Red-capped Robin responded aggressively.

Coventry (1988, 1989) found that some calls of the Red-capped Robins and Scarlet Robins are very similar. In March 2001 for this present study, calls given by a wandering male Scarlet Robin when in conflict with a pair of Red-capped Robins, were very similar to the Red-capped Robin calls. Ticking calls of the two species were very similar and the Aggression Rattle of the Red-capped Robin

was very similar to an aggression call given by the Scarlet Robin [Powys, paper in progress].

Squeals from the female Scarlet Robin are said to be the same or similar to those of Red-capped Robin females (Coventry 1989). Robinson (1990) noted 'distinctive wheezing calls' during nest site selection from male Flame *Petroica phoenicea* and Scarlet Robins, and these calls may parallel the Chittering of the Red-capped Robin male, but sonographic analyses are needed to confirm these two comparisons.

This paper gives information for only one region in New South Wales and it would be interesting to compare these findings with vocalizations, behaviour and plumage for Red-capped Robins in other areas of Australia.

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...habitat type was significantly different between forest habitats (Kruskal-Wallis test: $\chi^2 = 6.26$, $df = 2$, $p = 0.037$) with transitional sites having a higher mean density (31.20 ± 3.8 birds per transect) than both rainforest (13.45 ± 1.91) and wet sclerophyll (11.82 ± 4.00) sites. There was no significant difference between *Sarothamnus* densities in rainforest and wet sclerophyll forest. Although the mean density of shrub foliage was similarly higher in transitional (78.22 ± 7.02 percent) forest as compared to rainforest (67.83 ± 3.18) and wet sclerophyll

...of the 30 sites. A total of 212 *Sarothamnus* were observed at the 30 sites. 64 in transitional sites, 92 in rainforest sites and 56 in wet sclerophyll sites. They were predominantly recorded looking or moving through shrubs in the understory vegetation, generally in pairs or small groups consisting of pairs with one to five juveniles. Although we were unable to obtain accurate counts of the numbers of fledglings in each forest type, there was no indication of juveniles being more abundant in any particular habitat type.

Mean *Sarothamnus* density was significantly different between forest habitats (Kruskal-Wallis test: $\chi^2 = 6.26$, $df = 2$, $p = 0.037$) with transitional sites having a higher mean density (31.20 ± 3.8 birds per transect) than both rainforest (13.45 ± 1.91) and wet sclerophyll (11.82 ± 4.00) sites. There was no significant difference between *Sarothamnus* densities in rainforest and wet sclerophyll forest. Although the mean density of shrub foliage was similarly higher in transitional (78.22 ± 7.02 percent) forest as compared to rainforest (67.83 ± 3.18) and wet sclerophyll

...The White-browed Scrubwren (*Sarothamnus*) is one species that appears to be closely associated with a shrub layer being found in a wet sclerophyll forest type (Recher et al. 1985; Higgins and Brown 2000). In south-eastern Queensland, White-browed Scrubwren occur commonly in subtropical rainforest, wet sclerophyll forests (Singer 1995), as well as the transitional forest but exists as a significant ecotone between these major vegetation types. In this study we assessed the density of the species within these forest types in an attempt to determine how forest type and shrub layer density may influence the habitat preferences of the species.

Birds were surveyed in Brisbane Forest Park (27°20'S, 153°42'E), approximately ten kilometres west of Brisbane. The 10 x 100 metre transects, located along existing paths or walking tracks, were established within each of these different vegetation types (rainforest, transitional forest and wet sclerophyll forest) using a vegetation map of the area (Department of Natural Resources 1995). Transitional forest sites were identified as having significant elements of both rainforest and sclerophyll forest, primarily in the form of numerous tall eucalypts with an understorey of rainforest species. The starting point of each transect was determined by using random numbers which were used to indicate the number of paces from the entrance of the track.

A fixed-width strip of five metres either side of existing walking paths was used to assess *Sarothamnus* densities at