NOTES ON THE ECOLOGY OF THE SLENDER-BILLED THORNBILL *Acanthiza iredalei rosinae*

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ABSTRACT

This study summarises observations of a population of Slender-billed Thornbills *Acanthiza iredalei rosinae* at Clinton Conservation Park, South Australia, 1991-1994. Movements and population dynamics were elucidated by regular bird counts and re-sightings of a total of 37 colour-banded birds. The study suggests: (1) the birds are largely sedentary; (2) the population consists of foraging groups over most of the year and pairs are observed during the breeding season only; and (3) the population density is higher compared with other thornbills. Other aspects of the biology of this subspecies were investigated based on general observations at the study site and information obtained from museum collections.

INTRODUCTION

The Slender-billed Thornbill *Acanthiza iredalei* is a small insectivorous passerine in the family Pardalotidae, occurring in low shrublands of coastal, arid or semi-arid parts of southern Australia (Blakers, Davies and Reilly 1984; Matthew 1994; Recher and Davis 2000). There are three subspecies: the nominate *iredalei* in arid South Australia and Western Australia; *hedleyi* in heath habitats of the Upper South East of South Australia and north-west Victoria; and *rosinae* which is now limited to coastal samphire in Gulf St Vincent, South Australia (Matthew 1994; Schodde and Mason 1999) and considered Vulnerable (Garnett and Crowley 2000). Matthew (1994) summarises the distribution and habitat requirements of subspecies *rosinae*, but there is little published information about its biology.

This paper presents preliminary data on the movements, population dynamics, social behaviour and breeding of the species, based on a field study of *A.i. rosinae*, as well as analysis of collections held in museums.

METHODS

A study was conducted from May 1991 to July 1994 at Clinton Conservation Park (34°10'S, 138°10'E) at the head of Gulf St Vincent, South Australia (Figure 1). The study area is 60 ha comprising 31 ha of samphire flats, and the remainder saline lakes, and sandy ridges covered with shell grit, grasses and open shrubland. The area is separated from the tidal mudflats and sea by a low sandy rise covered with nitre-bush *Nitraria billardierei*, and the saline lakes are drained by tidal channels to 4 m wide. Small areas of grey mangrove *Avicennia marina* are present at the mouth of the tidal channels, and mangroves are also patchily distributed along the coast. Two structurally distinct samphire habitats together occupy about 25 ha of the study area. The first is tall (1–3 m), dense (to 85% cover) shrubby glasswort *Sclerostegia arbuscula* over low beaded glasswort *Sarcocornia quinqueflora*, within 10 m of tidal channels and lake edges; this is the main habitat of *A.i. rosinae*. The second is low (<50 cm) open grey samphire *Halosarcia halocnemoides*, typically on less frequently inundated ground away from tidal channels and lake edges; *A.i. rosinae* occasionally forage in this habitat.

The thornbills were trapped using a 15 m long x 2 m high mist net, set in a tidal channel during low tide, such that the top of the net was no more than 1 m above the top of the channel bank. Birds were trapped at 11 sites in the study area (Figure 1). Tape recordings of calls of *A.i. rosinae* were played to attract the thornbills, which were then directed toward the net by up to three people. All trapped birds were banded with a combination of one coloured band over one metal band (supplied by the Australian Bird and Bat Banding Scheme) on the left tarsus, and two coloured bands on the right tarsus. Exposed culmen, total head length (including bill), tarsus length and wing length were measured using the methods of Lowe (1991). Birds were weighed to the nearest gram, scored for moult (maximum primary moult score of 50) and examined for the presence of a brood patch.

In addition, museum skins of *A.i. rosinae* were examined; their wing, tail, bill and tarsus lengths measured; and sexed according to their labels (Australian National Wildlife Collection; Museum of Victoria; and South Australian Museum, hereafter referred to as SAM).

Population size in the study area was estimated from the ratio of banded birds sighted to total number of birds sighted on each visit. A crude estimate of population size was obtained by multiplying the inverse of this ratio by the total number of birds banded, this being the Petersen method described in Begon (1979). The estimate assumes no loss of banded birds through emigration or mortality, and equal probability of re-sighting colour-banded birds. The method of Bailey (1951) was also used to estimate population size, this being a simple modification of the Petersen method. The number of captures and re-sightings was not sufficient to apply more refined methods such as the Jolly-Seber model (*vide* Dettmann 1995).

RESULTS

There were 18 visits to the study area from May 1991 to July 1994. A total of 37 birds was trapped and banded from August to December 1991. Intensive searches for these individuals were made on subsequent visits to sites 1–11; sites 1–10 were searched with equal effort and site 11 was surveyed only twice.

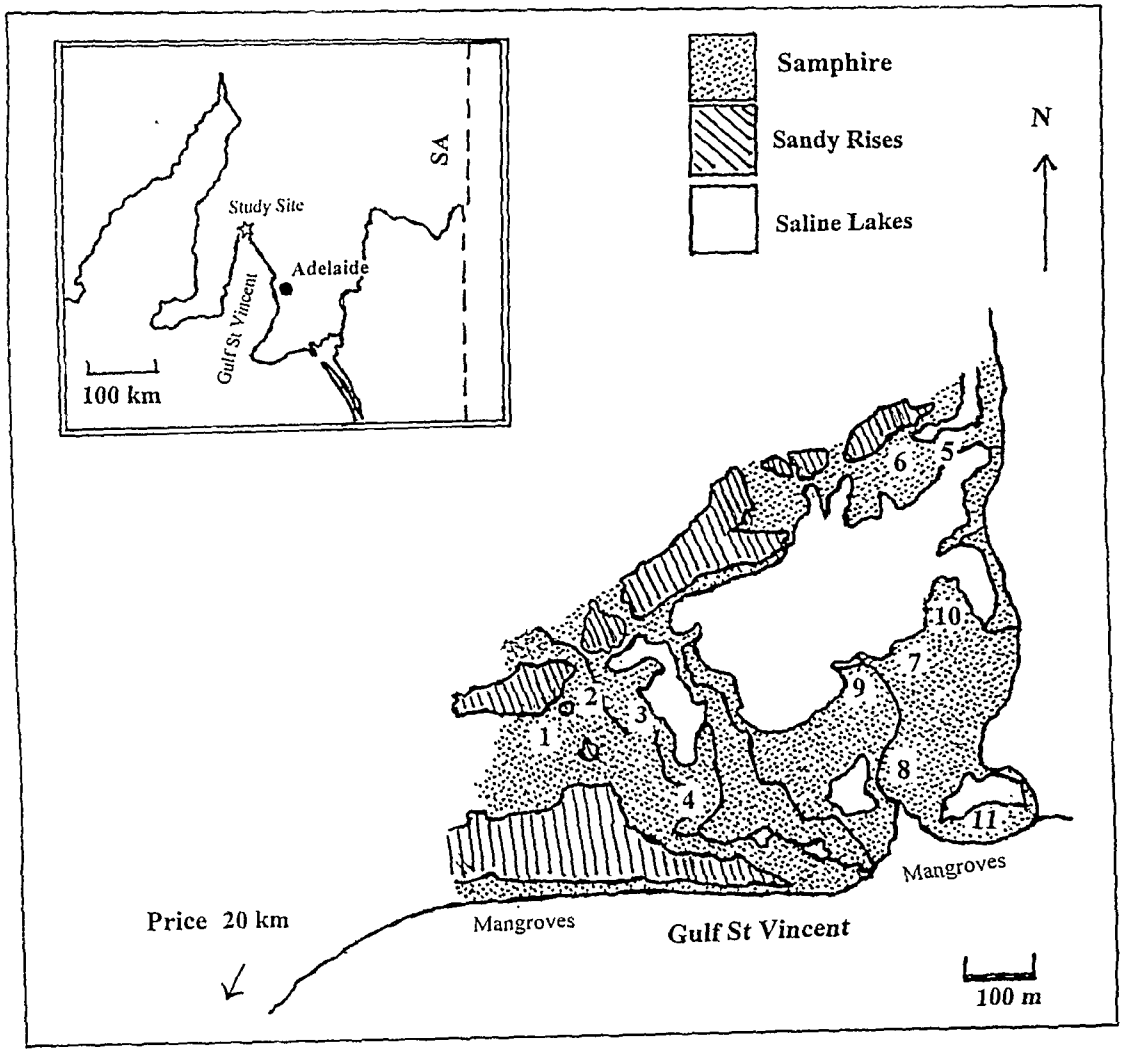

Figure 1. Map showing the study area at Clinton Conservation Park and banding sites 1–11. Location of the study area is indicated on the inset.

Table 1a. Mean values (sd; range; n) of measurements of unsexed *A.i rosinae* captured at Clinton Conservation Park, South Australia from August to December 1991. Lengths in millimetres; weights in grams. Culmen measured from tip of bill to feathering at base of forehead.

	Adults		Juveniles	
Weight	6.3	(0.78; 5–8; 23)	6.0	(0.23; 5–6; 6)
Wing	47.1	(2.87; 41–51; 29)	44.4	(2.30; 42–46; 5)
Total Head Length	24.4	(0.57; 23.5–25.4; 29)	23.7	(0.26; 23.2–23.9; 6)
Culmen	8.8	(0.74; 7.3–10.1; 29)	8.3	(0.25; 7.7–8.7; 5)
Tarsus	17.6	(0.63; 16.1–19.0; 27)	17.3	(0.76; 16.5–18.0; 6)

Table 1b. Mean values (sd; range; n) of measurements of skins of *A.i. rosinae*. Lengths in millimetres. Bill measured from tip to front of skull. * denotes T-test significant at 5% level. ns denotes not significant.

	Adult Male		Adult Female		T-test
Wing	48.8	(1.40; 45–51; 27)	47.5	(1.01; 47–50; 9)	*
Tail	40.0	(1.74; 36–44; 27)	37.8	(2.63; 36–44; 9)	ns
Bill	10.2	(0.53; 9.3–11.1; 27)	10.0	(0.59; 9.0–10.6; 8)	ns
Tarsus	19.1	(0.86; 17.6–21.1; 26)	18.6	(0.57; 17.4–19.4; 9)	ns

Measurements and plumage

Measurements of unsexed live birds and sexed skins are summarised in Tables 1a and 1b. I was not able to ascertain any reliable sexing criteria. Mean wing length is greater in adult males compared with adult females (two-tailed T-test; $P<0.05$), but there is considerable overlap between the sexes. Of 37 birds captured in the study area, seven were juveniles or birds undergoing post-juvenile moult. A photograph of one of these juveniles is shown in Matthew and Rogers (1997). Juveniles can be distinguished by their dull bluish iris (cream or whitish in adults), yellow gape (dark in adult), distinct light-brown fringes to the secondaries, tertials and greater secondary coverts (narrower and light greyish-brown in adult), brownish lores (cream in adult) and indistinct brownish supercilium (not present in adult). Juveniles also have white scaly skin on an otherwise dark abdomen. A fledgling captured in early September was recaptured three months later. It had nearly finished post-juvenile body moult, and had worn fringes to the remiges and wing-coverts. This latter bird closely resembled an adult but had a light bluish-grey iris. It is probable that first-year birds are indistinguishable from adults once they are over three months old, but more data are needed.

Adults undergo a complete post-breeding moult each year (unpubl. data). Primaries moult outward, starting at the innermost primary. One adult captured in late October 1991 was starting moult of primaries (primary moult score 3), but had not yet started tail moult. The other 29 adults captured from August to December had worn primaries. Tail moult was recorded from two birds in August and December, before primary moult had started. Four adults collected from December to March had active moult of primaries. These and observations of Mayr and Serventy (1938) indicate that post-breeding moult starts in spring or summer and is finished in autumn. Little is known about post-juvenile moult. Three juveniles captured in late October had nearly finished body moult, but had not yet started moult of the remiges or rectrices. Examination of museum skins suggests that post-juvenile moult is partial and does not involve primaries or secondaries.

Movements

Twenty of 37 colour-banded birds were re-sighted from a total of 51 re-sightings of

banded birds. Individuals not re-sighted could have died, moved away from the study area or been overlooked through lack of search effort. Thirty-seven of the 51 re-sightings were seen well enough to confirm their identity. Tables 2 and 3 summarise movements based on re-sightings. Over half of these 37 re-sightings were within 100 m of the original site of capture, and only two were over 500 m, suggesting most movements were within territories. The longest distance moved was 650 m, by a juvenile banded at site 7 in September 1991 and re-sighted at site 1 in December 1993. This same bird was re-sighted at sites 6, 7 and 10 from December 1991 to July 1992 and probably had dispersed from the parental territory. A further two of the seven juveniles were re-sighted. Both of these were captured originally at site 7 in September 1991; one was re-sighted at the same site in July 1992, and the other re-sighted on four occasions at site 6 (300 m from site 7) from 1992 to 1994.

At least 50 birds were observed outside the study area (in most suitable habitat within 1 km) in 1991 and 1992, and on no occasion were banded birds seen. There were only three movements of birds between the western side (sites 1–4) and eastern side (sites 5–11) of the study area (Table 3). One of these was an adult breeding at site 1 in August 1991, re-sighted twice in autumn 1992 at site 1, and re-sighted in December 1993 at site 7. Another was an adult captured at site 4 in August 1991 and re-sighted

Table 2. Summary of movements (distance from site of capture) made by colour-banded *A.i. rosinae* at Clinton Conservation Park, from May 1991 to July 1994.

Distance (metres)	Time after banding (months) 1–6	7–12	>12	Total movements
0–100	6	12	2	20
100.1–200	3	0	0	3
200.1–300	3	1	0	4
300.1–400	1	5	1	7
400.1–500	1	0	0	1
>500	0	0	2	2
Total movements	14	18	5	**37**

Table 3. Number of re-sightings of colour-banded *A.i. rosinae* at each site (the numbers in parenthesis indicate the number of individuals re-sighted). (A) = number of *A.i. rosinae* banded at each site; and (B) = number of A resighted over course of study.

Banding		Re-sighting											
Site	**(A)**	**(B)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	2	1	2 (1)	-	-	-	-	-	1	-	-	-	-
2	4	4	-	5 (4)	-	-	-	-	-	-	-	-	-
3	1	1	-	1	-	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	1	-	-	-	-
5	2	1	-	-	-	-	-	1	-	-	-	-	-
6	1	1	-	-	-	-	1	2 (1)	-	-	-	-	-
7	11	7	1	-	-	-	-	5 (2)	4 (4)	1	-	3 (3)	-
8	2	0	-	-	-	-	-	-	-	-	-	-	-
9	1	1	-	-	-	-	-	-	-	1	2 (1)	-	-
10	1	1	-	-	-	-	-	3 (1)	-	1	-	-	-
11	10	2	-	-	-	-	-	-	-	-	-	-	2 (2)
Totals	**37**	**20**											

in September 1991 at site 7. The other was of the young bird discussed above.

Social organisation

Figure 2 shows the proportion of birds seen in pairs or groups throughout the year. Pairs were observed from June to September, with almost 30% of birds seen in pairs in August. Once breeding had finished and young were fledged (in October), birds were seen only in groups of three or more. Non-breeding birds probably remain in groups throughout the breeding season. All birds were in groups of over ten in January and February. There were no observations of three or more birds defending the same territory. Pairs were not observed from October to March. It appears that certain individuals remained in association with others over periods of several months or longer. There were seven instances where at least two captured together were re-sighted together at the site of original capture. Of four captured together at site 2 in August 1991, three were re-sighted together at the same site six months later. Little interaction occurred between birds from the western and eastern sides of the study area (Table 3).

These observations suggest that populations consist of clans, similar to the social organisation described for Buff-rumped Thornbills *A. reguloides* (Bell 1985), but more data are needed to confirm this. The re-sighting data suggest different clans were present in the vicinity of sites 1–4, and the vicinity of sites 5–10. Of ten birds captured at site 11, only two were re-sighted, and these were seen together at the same site over six months later (Table 3). These observations suggest another clan was present in the south-east of the study area. Banded individuals in large groups were followed over periods of up to 1 h and seen to forage over an area of about 10 ha of suitable samphire habitat in the non-breeding season. Nonetheless, this study was not adequate for defining territories of foraging groups.

Breeding

Nests of *A.i. rosinae* are dome-shaped and constructed principally from dry seagrass and spider egg sacs, other materials such as wool, samphire and dry grass, and bound with spider's silk, and lined with feathers from various species

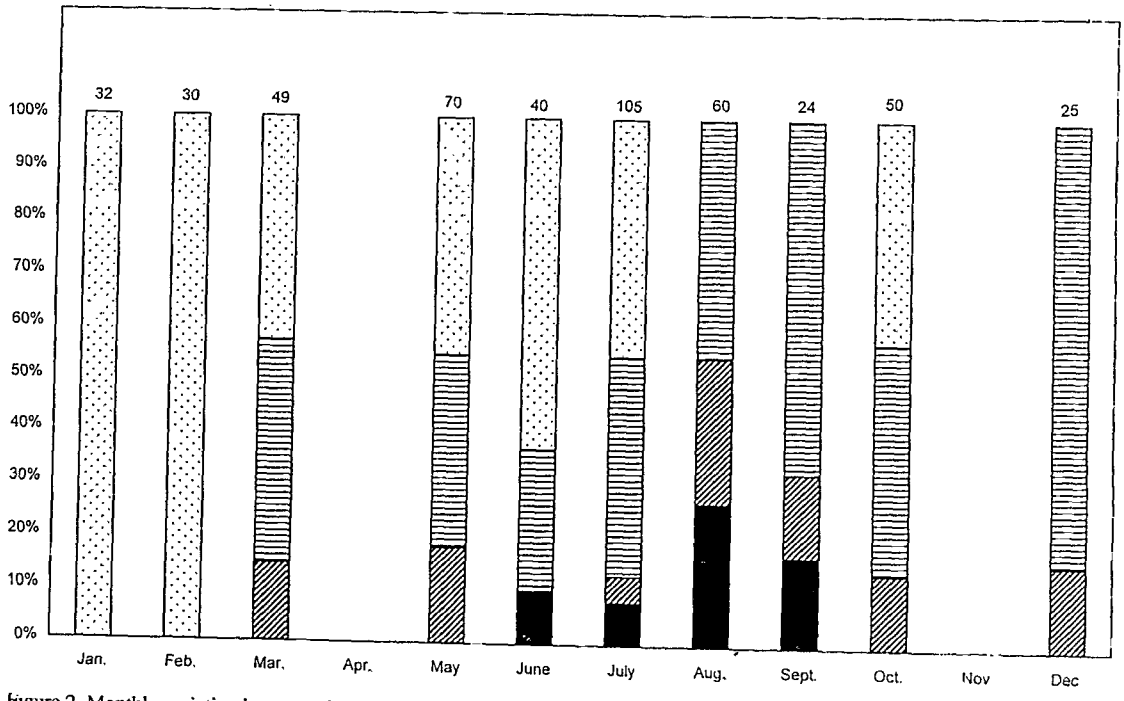

Figure 2. Monthly variation in group size of *A.i. rosinae*. Columns show percentage of total birds seen in pairs (bold) and in groups of 3–4 (diagonal bars), 5–10 (horizontal bars) and >10 (dotted). Total number of birds seen in each month is shown above each column.

including Grey Teal *Anas gracilis*, Superb Fairy-wren *Malurus cyaneus* and White-browed Scrubwren *Sericornis frontalis* (SAOA 1928; data from Ragless Collection). Nests are usually placed less than 1 m above the ground in a samphire or low shrub such as salt bluebush *Maireana oppositifolia* (McGilp 1925; data from Ragless Collection and nest held in SAM). Nests measure about 100 mm high and 75 mm wide, with a 30 mm wide side-entrance about halfway along the longest axis. Nests are constructed as early as July (G. Ragless, pers. comm.). Two to four eggs are laid between July and November (data from Ragless Collection and SAM), and the usual clutch size (C) is 3 eggs (C2 x 2, C3 x 17, C4 x 5). Eggs are tapered oval (longitudinal cross section), slightly lustrous and white with reddish brown freckling often concentrated as a penumbral ring at the larger end. Eggs' dimensions are: 16.7 mm (sd = 0.67; range 15.7–18.3; n = 13) x 12.2 mm (0.58; 11.2–13.0; 13). Eggs were measured in the Australian National Wildlife Collection.

In July 1991 and July 1994, some *A.i. rosinae* were seen pursuing others in flight, and several were seen conducting aerial displays by flying high and dropping rapidly back into the samphire. This behaviour was also seen once in May 1992. In early September 1991, one was seen carrying a feather in the bill and actively displaying it to another bird. This was possibly a male encouraging a female to begin nesting. This behaviour may be analogous to petal carrying in fairy-wrens (Schodde 1982; Higgins, Peter and Steele 2001). These observations suggest that courtship occurs from late-autumn to early-spring. At least five pairs were observed in August and September 1991, and these defended an area of less than 1 ha against conspecific birds. Territorial aggression was in the form of aerial chases and was not shown toward other species such as *Malurus cyaneus* or *Sericornis frontalis*. Once a pair from one breeding territory was observed chasing off another pair approaching from an adjacent breeding territory.

Of 27 adults captured from August to October, five had highly developed brood patches; four of these five were captured in late August. It is not known if males and females incubate, but both members of two pairs (defending territories) captured in August and September 1991 had very obvious brood patches. A bird was flushed from a nest containing young at site 1 on 11 August 1991, these young presumably being brooded. The flushed bird and another nearby (presumably the partner) maintained contact with each other but did not approach the nest while I remained in the area. By 16 August, the nest contained four chicks, which were almost completely covered in feathers and fed by at least two unbanded adults on average every five minutes. An adult was observed removing a faecal sac from the nest. It is not known if helpers assist parents with feeding young. The chicks had left the nest by 25 August and there was a group of dependent fledglings with a territorial pair of adults (probably parents) in the immediate vicinity of the nest, which had been re-lined with feathers. The two adults were trapped, the largest having a slight brood patch and the smallest being a female with distinct brood patch and eggs in the oviduct (external examination). This suggests that multi-brooding can occur, but in this case the nest was inundated by a very high tide and deserted by 8 September 1991. The female was not re-sighted, but the other adult, presumably a male, was re-sighted along with three unbanded birds at the nest site in March 1992 and with several unbanded birds at site 7 in December 1993. It is possible the adult female had died and the male moved to another clan. At least four groups of fledglings were seen in September 1991, at sites 1, 6, 7 and 9. Fledglings kept low to the ground and were difficult to observe, but could be located by their thin and shrill calls. At least two birds were seen feeding a fledged juvenile Horsfield's Bronze-Cuckoo *Chrysococcyx basalis* in early October 1991 at site 7.

Feeding

Birds in the study area were often seen gleaning food from the samphires *Sclerostegia arbuscula* and *Halosarcia halocnemoides*. I also observed birds hawking for small moths, and taking food items from the mud surface. In October 1991, a group of about 20 was seen gleaning small flies that were attracted to the flowers of *Avicennia marina*. Occasionally birds were seen feeding in *Nitraria billardierei*. Stomach contents of *A.i. rosinae* (in SAM) contained remains of small flies, fly larvae, beetles, spiders and caterpillars.

Population density

Crude estimates of population size were derived from re-sighting data collected on seven visits to the study area from December 1991 to May 1992.

All birds colour-banded in the study had been banded by December 1991. The ratio of banded to total birds seen in this period ranged from 1:5 to 1:7. There was no apparent decrease in this ratio from December 1991 to May 1992, so it is assumed that there was no major loss due to mortality in this period. Assuming all 37 banded birds survived in this period, the maximum population size in the study area was estimated as 185 (1:5 ratio) to 259 (1:7 ratio) using the Petersen method. The method of Bailey (1951) gave lower estimates of 111–148. It is known that at least 18 banded birds survived from December 1991 to May 1992. Using this number (known to be alive), the minimum population size was estimated as 90–156 (i.e.1:5–1:7 ratio range) using the Petersen method. The ratio of banded to total was 1:8 in June 1992 and 1:10 in July 1992, suggesting one or more of the following: significant mortality in winter; movement away of colour-banded birds; and/or movement of non-banded birds into the study area. The population density from December 1991 to May 1992 was estimated as a minimum of 2.9 and maximum of 8.4 birds per hectare of suitable samphire habitat (not including sandy rises or lakes). This equates to between 1.5 and 4.3 birds per hectare (including unsuitable habitat). The ratio of banded to total birds was 1:12 in December 1993, and 1:16 on two visits in July 1994. This decrease in ratio is consistent with an annual mortality rate of at least 25%, but more refined studies are needed to calculate annual survival rate.

DISCUSSION

This article presents data concerning the ecology of *Acanthiza iredalei rosinae* in South Australia. They occur in groups outside the breeding season, and a proportion of the population forms pairs that defend small territories during the breeding season. Similar observations have been made for *A. reguloides*, Striated Thornbills *A. lineata* (Bell 1985; Bell and Ford 1986; Recher, Davis and Holmes 1987) and Yellow-rumped Thornbills *A. chrysorrhoa* (Ford 1963). The breeding biology, social organisation and feeding ecology of *Acanthiza iredalei* are still poorly understood. Recher and Davis (2000) studied the breeding biology, foraging behaviour and habitat requirements of nominate *A.i. iredalei* in tidal samphire habitat at Bush Bay, Western Australia. They found that nesting pairs forage in territories ranging from 6700 m^2 to 8200 m^2 and only females brood. Their observations did not provide any evidence of cooperative breeding, but they do not dismiss the possibility of this occurring in some instances. Cooperative breeding is found in other thornbill species, including *A. chrysorrhoa, A. reguloides, and A. lineata* (Ford 1963; Bell and Ford 1986; Nicholls *et al.* 2000).

This study provides some evidence that populations consist of clans, as has been described for *A. reguloides* (Bell 1985; Bell and Ford 1986). Bell (1985) and Bell and Ford (1986) found that *A. reguloides* occur in clans of 10–15 in late-summer to winter, then split into small groups or pairs in the breeding season. They also found that the female builds the nest and incubates, and the parental male, plus one or more non-breeding helpers (often young from the previous year), assist with rearing the young. Much more data are needed on *A.i. rosinae*, but it appears they are similar to *A. reguloides* in their social organisation. It is not known if pairs hold the same breeding territory each year as in *A. reguloides* (Bell 1985). This study suggests that multiple broods may occur in *A.i. rosinae,* as has been described for other thornbills (Ford 1963; Bell 1985; Bell and Ford 1986), but more data are needed. Parasitism of nests by cuckoos is probably as important in reducing nest success in *A.i. rosinae* as it is in other thornbills (Ford 1963; Bell 1985; Bell and Ford 1986). McGilp and Parsons (SAOA 1928) found one of five nests of *A.i. rosinae* occupied by a young *Chrysococcyx basalis*.

The population density of *A.i. rosinae* found in this study is high compared with most estimates of other thornbill species (Blakers, Davies and Reilly 1984), particularly when the estimates based on preferred habitat are considered. Estimates of population density for other thornbill species include 0.02–0.56 birds/ha for Yellow Thornbill *A. nana*, 0.03–5.6 birds/ha for *A. lineata* and 0.02–1.58 birds/ha for *A. reguloides* (Blakers, Davies and Reilly 1984). Mean annual adult survival rates have been estimated as 68% for *A. lineata,* 59% for Brown Thornbill *A. pusilla* (Wilson 1995), and 54% for *A. reguloides* (Bell and Ford 1986). Limited data here suggest a maximum annual survival rate of about 75% in the population of *A.i. rosinae* studied, but more refined studies are needed. The results of this study also suggest that *A.i. rosinae* are sedentary, as about half the re-sightings were within 100 m

of the site of capture. The maximum distance of 650 m moved by a young bird is consistent with dispersal of young to nearby clans recorded in *A. reguloides* (Bell 1985). This does not exclude the possibility that some move greater distances, but further work is required to confirm this. The fairly specific habitat requirements, small total population size (Matthew 1994) and apparently sedentary nature may make this subspecies very sensitive to habitat changes. The declaration that this subspecies is Vulnerable (Garnett and Crowley 2000) is wise given these observations.

More research is therefore needed to: 1) determine if helpers assist with rearing young; 2) determine if one or more birds incubate; 3) confirm the presence of clans and refine our knowledge of social organization; and 4) refine estimates of the density of populations (and therefore total population size of *A.i. rosinae*), annual recruitment and mortality.

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