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SURVIVAL OF FOUR SPECIES OF PASSERINE IN KARRI FORESTS IN SOUTHWESTERN AUSTRALIA

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Estimates for survival for four species of passerine resident in Karri forest near Manjimup, south-western Australia were made from recapture (to April 1988) of birds banded between 1976 and 1986. Mean annual survival rates of adults were calculated for Golden Whistlers (78%), White-browed Scrub-wrens (77%), White-breasted Robins (72%) and Red-winged Fairy-wrens (67%). For White-breasted Robins and Red-winged Fairy-wrens, birds were banded as nestlings or juveniles and resighted as well as recaptured. Survival of these known-age birds as adults (calculated from recapture only) was similar to that for adults of unknown age. Survival of known breeding adults was higher than that for all adults (White-breasted Robin male 83%, female 73%; Red-winged Fairy-wren male 80%, female 78%). For older birds, survival estimates based on resightings and recaptures were higher than estimates based only on recaptures, suggesting that older birds were being seen but not recaptured.

INTRODUCTION

In 1976, R. J. and M. N. Brown began banding birds at Smiths Brook; regular banding at a number of sites has continued until the present. In this paper, we present data on the survival of four passerine species: the Golden Whistler *Pachycephala pectoralis*, the White-browed Scrub-wren *Sericornis frontalis*, the White-breasted Robin *Eopsaltria georgiana* and the Red-winged Fairy-wren *Malurus elegans*. In parallel with the general banding, we made detailed studies of the White-breasted Robin (Brown and Brown 1980, unpublished) and the Red-winged Fairy-wren (Rowley *et al.* 1988), in which we tried to locate all breeding groups and their nests and to colour-band all adults and nestlings. The intensive studies of these two species provided resighting data from colour-banded birds, which allowed estimates of survival that can be compared to those arrived at from recaptures.

STUDY SITE AND METHODS

The study site was Smith's Brook Reserve (No. 'A' 14063), south-west of Manjimup, Western Australia. The reserve is 98 ha of forest which includes mature Karri *Eucalyptus diversicolor*, Jarrah *E. marginata* and Marri *E. calophylla*. The farm-land surrounding the reserve is mostly pasture. The vegetation, climate and fire-history of the area is described by Rowley *et al.* (1988).

Birds were caught in mist-nets placed in a variety of habitats and sites in 72 ha of the reserve. An average of 71 banding visits were made each year and 100–125 m of mist-nets were used, depending on the site. Eighteen fixed sites were netted many times each year, apart from minor changes due to fallen trees, etc. Bands were provided by the Australian Bird and Bat-banding Scheme. White-breasted Robins and Red-winged Fairy-wrens were also given unique

combinations of colour-bands. Only birds banded up to the end of 1986 are included. Birds with no recaptures in 1987 or to the end of April 1988 were assumed not to have survived to 1987.

In calculating survival, three different groups are considered. The survival estimates for Golden Whistlers and White-browed Scrub-wrens were based only on recaptures of birds mist-netted as adults or juveniles; data for adults and juveniles are treated separately. For White-breasted Robins and Red-winged Fairy-wrens, in addition to juveniles netted and recaptured, some birds were banded as nestlings and some colour-banded birds were resighted. Three estimates of survival were made:

1. Survival of adults, from recaptures only, based on birds first mist-netted as adults (aged by plumage). This included a few birds banded in the nest and recaptured for the first time as adults; for these birds, survival was calculated from the time of capture as an adult.

2. Survival of juveniles, calculated from recaptures only, based on birds first netted as juveniles. This included some birds banded as nestlings but recaptured as juveniles; for these birds, survival was calculated from the time of first netting.

3. Survival of all birds banded as pullus or juvenile, whether banded in the nest or netted. Survival was calculated from the date of banding, and was based on resighting as well as recapture.

A minimum estimate of survival was calculated as the proportion of birds known to be alive 1–10 years after banding (equivalent to % Known To Be Alive, KTBA, as in Nicholls and Woinarski 1988). The annual survival rate, the proportion of birds alive in one year (x) which are still alive a year later (x + 1) is given by the ratio —

% KTBA (yr x + 1) / % KTBA (yr x).

Survival (expressed as percentage of birds known to be alive) was plotted on a log scale against time in years. For each species, a portion of this graph after year 1 was more or less a straight line, which indicated a constant survival rate; that is, the proportion of birds surviving from one year to the next was the same. After some years the lines tended to become irregular, possibly due in part to an increase in the mortality of older birds, in part to trap-shyness and also to the smaller numbers of banded birds at risk for the longer periods. The method of Caughley (1977, p.104) was used to calculate a weighted mean annual mortality rate for the period of the straight line part of the survival curve (Appendix 1).

More elaborate methods are frequently used to calculate survival rates from banding data (Robertson and Woodall 1987; MacFarland and Ford 1987), when large numbers of birds are banded and few are recaptured. These methods depend on a basic assumption (inadequately tested, Caughley 1977) that survival rates of birds are constant. Data from long-term studies of resident

TABLE 1

Banding and Recapture data for Adult Golden Whistlers at Smiths Brook.

Year	New birds banded	Elapsed time to last recapture (years) <1	1	2	3	4	5	6	7	8	9	10
1977	58	7	2	6	5	1	3	4	4	—	5	
1978	35	6	8	1	—	2	1	—	—	—	2	
1979	41	5	3	3	1	3	—	2				
1980	30	1	1	—	2	—	1	1	1			
1981	29	6	2	—	3	—	1					
1982	28	2	4	2	—	2						
1983	21	3	—	—	4	3						
1984	27	9	—	1	3							
1985	10	2	1									
1986	8	1										
Total	287											

TABLE 2

Adult Golden Whistlers at Smiths Brook known to be alive (KTBA).

Year	Birds banded	Number known to be alive after: (years) 1	2	3	4	5	6	7	8	9	10
1977	58	30	28	22	17	16	13	9	5	5	
1978	35	14	6	5	5	3	2	2	2	2	
1979	41	12	9	6	5	2	2				
1980	30	6	5	5	3	3	2	1			
1981	29	6	4	4	1	1					
1982	28	8	4	2	2						
1983	21	7	7	7	3						
1984	27	4	4	3							
1985	10	1									
1986	8										
Total	287	88	67	54	36	25	19	12	7	7	

birds, as described in this paper, provide an opportunity for testing this assumption, and therefore average survival rates were calculated only over periods of time where the survival curve was a straight line, indicating a constant survival rate. Most of the birds in the study populations of these four species were banded, although the total numbers banded were not very large. Many were recaptured frequently. Particularly for birds recaptured one year or more after their initial banding, it is reasonably certain that subsequent disappearance probably indicated death.

RESULTS

Golden Whistler

Adults were banded in all months of the year, and juveniles from November until 30 June of the following year. Of 287 adults banded, 130 (45.3%) were recaptured at least once, and 88 (30.7%) were recaptured one or more years after banding. Of 92 birds banded as juveniles, only eight (8.7%) were recaptured, with seven (7.6%) recaptured more than one year after banding; these are not analysed further. Adult Golden Whistlers appeared to be resident, but few juveniles became established as residents, due either to high juvenile mortality or dispersal.

The numbers of adults banded and those recaptured for the last time one or more years after banding are shown in Table 1, and from this, the number of birds known to be alive one or more years after banding was derived; birds last recaptured in, for example, year 9 must have been alive in years 1–8 (Table 2). The oldest bird was banded as an adult male in full plumage (=not less than three years old, Disney 1976) on 19 July 1977 and last recaptured on 21 May 1987, 9 years and 10 months later. Seven birds were recaptured more than nine years after banding (3.1%). In the first year after banding, about 70 per cent of birds either died or dispersed, but thereafter survival of adults was very high. Approximately 10 per cent of all birds banded as adults survived for at least six years after banding (Table 3). The survival curve over the period 1–8 years after banding is a more or less straight line (Fig. 1) and mean annual survival over this period was calculated as 78 per cent (Appendix 1).

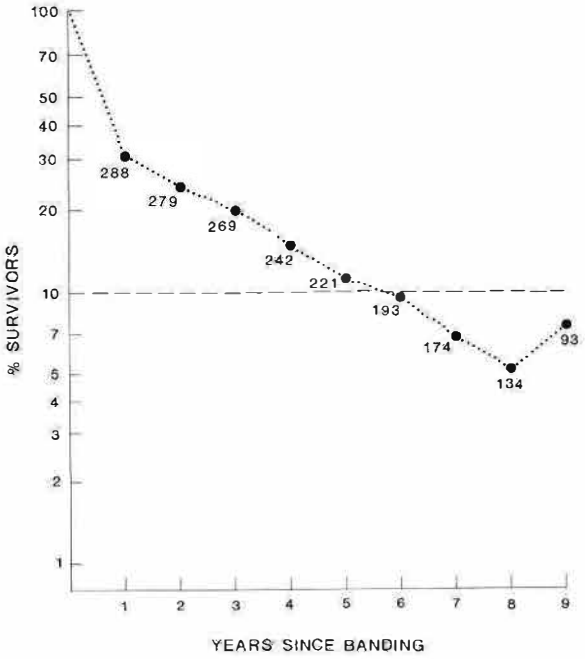

Figure 1. *Survival curve (survival since banding) for adult Golden Whistlers banded at Smiths Brook 1977–1986. The number at each point is the number of birds banded which could have survived for that period after banding.*

TABLE 3

Adult Golden Whistlers: Minimum estimates of survival and survival rate based on all birds known to be at risk and to have survived for each number of years.

Years known to be alive	Number banded	Number surviving	Survival %KTBA	Survival rate*
0	287	287	100	30.7
1	287	88	30.7	78.2
2	279	67	24.0	83.8
3	269	54	20.1	74.1
4	242	36	14.9	75.8
5	221	25	11.3	86.7
6	193	19	9.8	70.4
7	174	12	6.9	75.4
8	134	7	5.2	—
9	93	7	7.5	—
10	58	0	0	—

*see Appendix 1 for method of calculation.

White-browed Scrub-wren

The White-browed Scrub-wren is a year-round resident. Adults were banded in all months of the year, and juveniles from October onwards. Of 288 adults, 169 (58.6%) were recaptured at least once, and 128 (44.4%) were recaptured one or more years after banding. Of 121 birds banded as juveniles, 42 (34.7%) survived for at least one year after banding. The oldest bird was banded as an adult male on 31 May 1977 and last recaptured 11 years later on 8 May 1988.

The number of adults known to be alive one or more years after banding was derived from the recapture data and survival after banding calculated in a similar manner as for the Golden Whistler; these data are presented in a condensed form in Table 4. The survival curve for adult White-browed Scrub-wrens (Fig. 2) shows an initial steep drop in the first year after banding, then a more or less straight line from 1–5 years, and a steeper slope from 6–10 years. For the period 1–5 years, mean annual survival rate was calculated (from Table 4) as 77 per cent; for the period 5–9 years, numbers of birds banded is lower, but survival was calculated as approximately 59 per cent. The survival curve for birds banded as juveniles is also shown in Figure 2. After initial higher mortality (including dispersal) in the first year after banding, survival is the same or slightly higher than for birds banded as adults. As with the Golden Whistler, about 10 per cent of all birds banded survived for at least six years after banding.

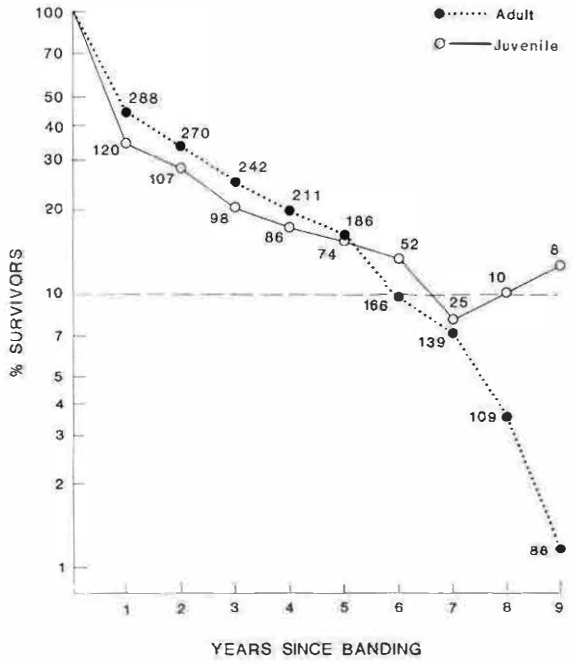

Figure 2. *Survival curve (survival since banding) for adult and juvenile White-browed Scrub-wrens banded at Smiths Brook 1977–1986. The number at each point is the number of birds banded which could have survived for that period after banding.*

White-breasted Robin

White-Breasted Robins are co-operative breeders, resident year-round (Brown and Brown 1980). In the breeding season, females remain within a small nesting territory, while males forage over a wider area. In the non-breeding season, females and juveniles remain in and around the breeding area while males range more widely. Adults were caught in all months of the year. During the breeding season, most young were banded in the nest, while others were caught as fledged juveniles.

Of 365 birds caught as adults (including any birds not identifiable as juveniles), 216 were recaptured at least once (59.2%), and 130 (35.6%) were recaptured one or more years after banding. Of 309 birds first netted as juveniles, 86 (27.8%) survived for at least one year after banding. From recaptures, the oldest bird was a female banded on 13 July 1977, classified at that time as free-flying, and last recaptured nine years later on 17 July 1986. Another female, also classified at the time as free-flying, was banded on 13 April 1978 and was still breeding in August 1987.

The number of adults known to be alive one or more years after banding was derived from the recapture data as for the Golden Whistler (Table 5). After the initial drop in the survival curve for adults (Fig. 3), survival was more or less constant for the first six years after banding, and then fell more rapidly. For the period 1–6 years after banding, mean survival rate was calculated from Table 5 as 72 per cent. Since the number of birds which

TABLE 4

Adult White-browed Scrub-wrens at Smiths Brook known to be alive (KTBA).

Year	Birds banded	Number known to be alive after: (years) 1	2	3	4	5	6	7	8	9	10
1977	56	29	21	18	12	10	8	5	2	1	1
1978	32	16	12	9	6	5	3	3	2		
1979	21	8	7	4	4	4	3	2			
1980	30	11	10	7	5	4	1				
1981	27	10	9	8	8	6	1				
1982	20	9	5	4	2	1					
1983	25	15	13	9	5						
1984	31	14	14	3							
1985	28	15	1								
1986	18	1									
Total	288	128	92	62	42	30	16	10	4	1	1
No. banded at risk	288	288	270	242	211	186	166	139	109	88	56
Survival % KTBA	100	44.4	34.1	25.6	19.9	16.1	9.6	9.6	3.7	1.1	1.8
Survival rate	44.4	76.8	75.1	77.7	80.9	59.6	100.0	38.5	29.7	—	—

61 birds were recaptured less than one year after banding but not subsequently.

TABLE 5

Adult White-breasted Robins at Smiths Brook known to be alive (KTBA).

Year	Birds banded	Number known to be alive after: (years) 1	2	3	4	5	6	7	8	9	10
1977	78	31	28	23	16	12	11	5	1	1	0
1978	47	25	18	11	8	4	1	1			
1979	28	15	10	8	8	5	3	2			
1980	45	11	8	4	2	1	1				
1981	31	8	6	4	2	1					
1982	24	11	9	6							
1983	30	12	8	5	1						
1984	38	12	6	3							
1985	22	4									
1986	22	1									
Total	365	130	93	64	37	23	16	8	1	1	0
No. banded at risk	365	365	343	321	283	253	229	198	153	125	78
Survival % KTBA	100	35.6	27.1	19.9	13.1	9.1	7.0	4.0	0.7	0.8	0
Survival rate	35.6	76.1	73.4	65.9	69.5	76.9	57.1	17.5	—	—	—

86 birds were recaptured less than one year after banding but not subsequently.

could have survived for eight or nine years after banding was greater than 100, the lack of recaptures beyond seven years after banding is unlikely to be the result of low numbers. Ten per cent of adults banded survived for at least five years after banding.

For the 309 birds caught as juveniles, the loss in the first year after banding was higher, but after that, survival paralleled that of adults (Fig. 3); no birds first caught and banded as juveniles were recaptured beyond seven years after banding, although 74 banded birds had been banded long enough to be available for capture.

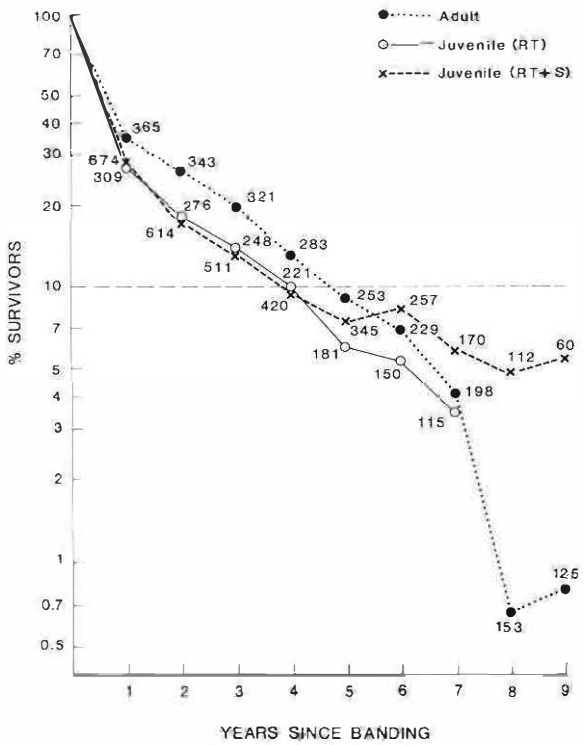

Figure 3. *Survival curve (survival since banding) for adult and juvenile White-breasted Robins. Two curves are shown for juvenile survival. The unbroken line is based only on recaptures of birds netted and banded as juveniles (RT). The dashed line is based on sighting and recapture of all birds banded as nestlings or juveniles (RT + S). The number at each point is the number of birds banded which could have survived for that period after banding.*

The detailed study of the White-breasted Robin by RJB and MNB provides data for a comparison of survival as indicated by retrapping with that from resighting. A total of 647 nestlings and juveniles were banded over 11 breeding seasons from 1976-77 to 1986-87. Survival of these birds for the first four years after the breeding season of their hatching, estimated from retrapping and resighting, was almost identical to that estimated from the recapture of birds first captured as juveniles (Fig. 3). After year 4, survival based on sightings was higher. Two out of 14 birds (both males) banded in the 1976-77 breeding season were still alive for the 1987-88 breeding season in their twelfth year. The oldest known age bird was a male hatched in 1978 and still alive as a breeding male in November 1988.

The breeding male and female in each group were known from sightings, and the survival from one breeding season to the start of the next (1 July) was calculated over nine seasons, 1978–1986. Over 161 breeder-years, annual survival of breeding males was 83 per cent and of breeding females was 73 per cent. Many of these birds were of unknown age. For males and females together, annual survival was 78 per cent, compared with the survival rate for adults estimated from retraps of 72 per cent. Established breeders do not in general disperse out of the study area, which is one explanation for this higher calculated survival rate; there is also some indication that older birds are not easily caught and may be under-represented among birds retrapped.

Red-winged Fairy-wren

Red-winged Fairy-wrens are also co-operative breeders, resident year-round, in groups which occupy permanent territories (Rowley *et al.* 1988). The offspring of the breeding pair remain in the territory as helpers for one or more years. Females are more likely to disperse than males, with most dispersal occurring before the start of their third year of life. During the breeding season, most young were banded in the nest; some were netted as fledglings.

TABLE 6

Adult Red-winged Fairy-wrens at Smiths Brook known to be alive (KTBA).

Year	Birds banded	Number known to be alive after: (years) 1	2	3	4	5	6	7	8	9	10
1977	31	31	31	27	20	14	11	8	3	2	
1978	22	22	22	20	12	9	8	5	2		
1979	16	14	10	7	4	1					
1980	100	33	23	17	14	10	7	1			
1981	42	10	10	6	4	3	1				
1982	27	10	8	6	2	1					
1983	36	14	10	8	1						
1984	62	16	11	3							
1985	44	14	3								
1986	26	9									
Total	406	173	128	94	57	38	27	14	5	2	0
Banded at risk	406	406	380	336	274	238	211	169	69	53	31
Survival % KTBA	100	42.6	33.7	28.0	20.8	16.0	12.8	8.3	7.2	3.8	0
Survival rate	42.6	79.1	83.1	74.3	76.9	80.0	64.8	86.7	52.8	0	—

103 birds were recaptured less than one year after banding but not subsequently.

Of 406 birds banded as adults, 276 (68%) were recaptured at least once and 173 (43%) were recaptured one or more years after banding. The oldest bird (a female) was banded on 13 July 1977 and last recaptured on 5 April 1987, 9 years and 9 months later; she must have lived for at least ten years. At least since September 1980, she was the breeding female in her group.

The number of adults known to be alive one or more years after banding was derived from the recapture data in a similar manner as for the Golden Whistler (Table 6). The survival curve (Fig. 4), after the initial drop in the first year after banding, is more or less a straight line for years 1–8. For this period, mean survival rate derived from Table 6 was 67 per cent. Ten per cent of adults banded survived for at least 6.5 years after banding.

A total of 198 birds was first netted as juveniles, of which 57 (29%) survived for one year after banding and 34 (17%) for two years. The survival curve for these birds shows that after two years survival rate was similar to that of adults. The higher loss between one and two years probably reflects female dispersal. Including all birds banded as nestlings or juveniles, 434 nestlings and juveniles were banded over seven breeding seasons from 1980-81 to 1986-87. Their survival, based on retraps and resightings, is shown in Fig. 4; these estimates of survival are higher (41% to one year and 23% to two years) than those based only on retraps, but the annual survival rates are similar (as shown by the similar slopes of the survival curves), up till five years after banding. After this time numbers at risk are too low to be sure whether the disparity between the two curves is due to low numbers or to difficulty in retrapping older birds. Ten out of 84 young (12%) banded in the 1980 and 1981 breeding seasons were still alive in 1987.

Annual survival of known breeding males over 169 breeder-years and seven breeding seasons was 80 per cent, and for females, 78 per cent from 182 breeder years. For the sexes combined, annual survival of breeders was 81 per cent, compared with the survival rate estimated from retraps of 67 per cent. Such a difference could arise if older birds were being seen but not retrapped.

DISCUSSION

Fry (1980) attempted to substantiate the hypothesis that birds of the tropics and warm temperate regions of the world lived longer than did birds of the northern cool temperate regions, so much studied by ornithologists. Some retrap data from the Australian Bird Banding Scheme supported his argument. For a number of species, Fry calculated the percentage of retraps occurring at yearly intervals from one year onwards, and found that for many Australian species, 10 per cent of retraps had survived for at least three years after banding. For Northern Hemisphere cool temperate passerines, this figure was close to two years for many species, with many more birds banded. Longevity records also supported the hypothesis; Fry (1980) found similar numbers of species with recorded longevity of greater than seven years in Australia, North America and Europe, although Australia had only about 1 per cent of the number of birds banded. A few years later, Woinarski (1985) drew a similar conclusion, but generalisation was again hampered by lack of data. Longevity of greater than seven years was recorded for 15 out of the 43 species of passerine banded in the long-term New Chums Road project in the Brindabella Range, ACT (Tidemann *et al*. 1988).

Although considerable attention is given to longevity records, survival data are far more important; they provide an estimate of the length of life for all individuals rather than just exceptionally long-lived ones. An intensive banding study, following the same birds in the same area over many years, can provide a measure of survival. Even so, a true picture of survival comes only from following a large number of known-age individuals, preferably banded as nestlings or juveniles, so that survival and mortality at different ages can be seen.

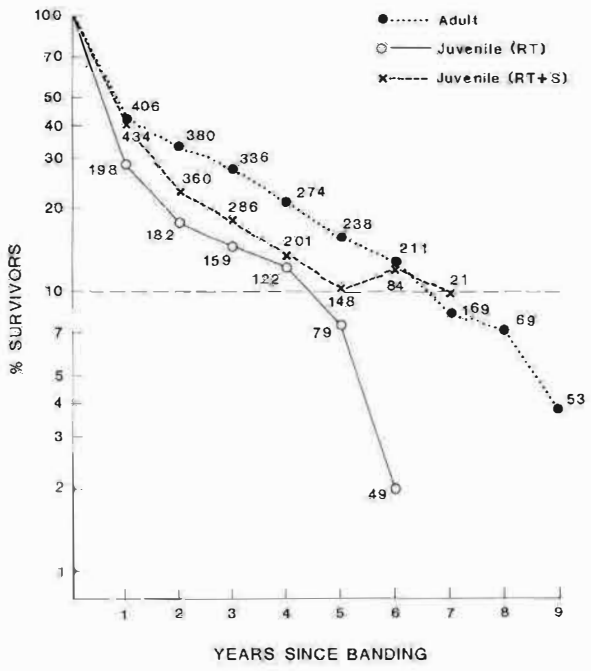

Figure 4. *Survival curve (survival since banding) for adult and juvenile Red-winged Fairy-wrens. Two curves are shown for juvenile survival. The unbroken line is based only on recaptures of birds netted and banded as juveniles (RT). The dashed line is based on sighting and recapture of all birds banded as nestlings or juveniles (RT + S). The number at each point is the number of birds banded which could have survived for that period after banding.*

TABLE 7

Summary of survival and longevity for four species.

	Survival rate (%)	Longest interval*	10% survival†
Golden Whistler	78	9 y 10 m	6
White-browed Scrub-wren	77	10 y	6
White-breasted Robin	72	9 y	5
Red-winged Fairy-wren	67	9 y 9 m	6

*Longest interval between date of first and last capture in years and months.

†Time to which 10% of birds survived in years.

In this study, we report data for four species of small passerines studied in the same area for more than ten years, which shows that many birds do indeed live a long time (Table 7). For all four species, the maximum interval between first and last captures was over nine years, giving a longevity of over ten years. This was not something attained by only a very occasional exception. For the White-breasted Robin, 10 per cent of birds banded survived to at least five years, and for the other species, to six years after banding. The survival rates calculated for the four species are high, well above those reported for many European passerines (Lack 1954; Dobson 1987). Similar high survival has been found in studies of other species (McFarland and Ford 1987; Robertson and Woodall 1987; Nicholls and Woinarski 1988), and Ford (1985) remarked on the high survival of species studied to that date. More detailed comparisons of survival and reproductive rates in Australian and northern temperate passerines have been made by Rowley and Russell (in press). Reasons suggested for high survival in Australia include relatively mild winters and the low incidence of long distance migration in passerines.

Comparisons of survival estimated from retraps only and from retrapping plus resighting for the White-breasted Robin and the Red-winged Fairy-wren gave similar survival rates, but suggested that inclusion of resightings gave a higher estimate of the percentage of birds surviving at each age. Similar comparisons for Black-capped Chickadees *Parus atricapillus* in Missouri, United States, gave the same result (Elder and Zimmerman 1983).

Survival estimates based on all birds netted and banded as adults include birds of unknown age, and thus are only valid if survival does not change with age. For three species, enough birds were banded as juveniles for us to plot survival curves for birds of known age. The survival curves for birds of known and unknown age are parallel for years 1-6 for White-browed Scrub-wrens and Red-winged Fairy-wrens and 1–7 for White-breasted Robins, indicating similar survival rates. After that we cannot yet be sure what happens. All three show an increase in mortality rate in birds of unknown age, six or seven years after banding, but not enough known-age birds have been followed to the end of their life to know if there is an increase in mortality with age. Estimates of survival from a sample of birds of unknown status cannot distinguish between death or dispersal, so the estimates of survival are in general minimum estimates. Once a bird becomes established in a territory as a breeding bird, its disappearance almost always means death. For the White-breasted Robin and the Red-winged Fairy-wren, the status of birds as breeders was known, and the survival rates calculated for breeders should be a better estimate of true survival. Survival of breeding adults was more than 70 per cent for males and females of both species, which gives rise to calculated maximum longevity of greater than 10 years, as observed in the field.

That the patterns of survival shown by these four species of passerine living in the same high rainfall, relatively stable forest habitat are so similar is not sufficient to answer the question of whether there are real differences between the biology of Australian species and those of north temperate areas. Although the studies reported here and by others (Robertson and Woodall 1987; McFarland and Ford 1987) are beginning to provide some support for the idea, many more long-term intensive banding studies in a variety of habitats are needed.

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APPENDIX 1

The method used to calculate a weighted mean mortality rate for part of the survival curve is fully explained by Caughley (1977, p.104). For example, in the terminology used in this paper, the weighted mean per cent annual mortality calculated for years 1–7 for the Golden Whistler as

$$100 \times \frac{\%\ \text{KTBA (yr 1)} - \%\ \text{KTBA (yr 8)}}{\%\ \text{KTBA (yr 1)} + \%\ \text{KTBA (yr 2)} \ldots \%\ \text{KTBA (yr 7)}}$$

$$= 100 \times \frac{.255}{1.177} \text{ (from Table 3)}$$

$$= 21.7$$

Per cent annual survival is 100 − 21.7=78.3.

This is equivalent to the mean survival rate calculated in Method 3 of Nicholls and Woinarski (1988), except that it covers only the straight line part of the survival curve for which survival rate is constant, and does not include in the average the period of higher mortality in the first year after banding, part of which is probably due to dispersal. Caughley (1977) uses standard Life Table terminology, so that %KTBA is equivalent to his l, and per cent annual mortality is q.

REVIEW

Australian Cockatoos: Experiences in the Field and Aviary. S. Sindel and R. Lynn, 1989. Singil Press, Sydney, Australia. 252 pp. $A49.95.

This is the second of a planned series of six books covering the Australian Psittaciformes, which document the authors' personal experiences in field and aviary. The first of these, 'Australian Lorikeets' (see *Corella* **11**: 132), has become a standard reference for aviculturists, and I have little doubt that this book will achieve the same status. Both authors are highly regarded in the aviculture field of ornithology, but sadly Robert Lynn did not live to see publication of this book and appreciate the impact it will have on the aviculture, and possibly conservation, of Australian cockatoos.

The preliminary chapters discuss the housing, diets, management and diseases of Australian cockatoos in the aviary situation. The chapter on diseases was written by the eminent avian veterinarian James Gill. Each of the 13 Australian cockatoos is dealt with in a separate chapter in which such matters as classification, earliest reports, range, habitat, breeding in the wild, avicultural history, sexing, display, nesting requirements and aviary mutations are discussed. The authors also describe their most memorable personal experiences with each species in their natural habitats. The species accounts include distribution maps and numerous colour photographs which illustrate mature birds, developing nestlings, and some mutations.

Many species of Australian cockatoo have suffered declines in the wild, primarily from loss of habitat and, in some cases, illegal trapping for the pet bird trade and aviculture. The authors have done a most commendable job in documenting the requirements for captive propagation of these birds. This hopefully will inspire aviculturists and result in an improvement in successful captive breeding, and perhaps reduce the demand for wild trapped birds. The wealth of information presented in this book will be of interest and value to anyone seeking to learn more of the biology of Australian cockatoos.

Unfortunately, this is a limited production book which is not available through retail bookshops. Copies have been distributed to the larger avicultural societies for sale to members, but copies may be purchased by mail order from Canley Heights Veterinary Clinic, Shop 6, Haden Street, Canley Heights, NSW 2166.

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