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A LONG-TERM BIRD BANDING STUDY IN UPLAND TROPICAL RAINFOREST, PALUMA RANGE, NORTH-EASTERN QUEENSLAND WITH NOTES ON BREEDING

CLIFFORD B. FRITH and DAWN W. FRITH

'Prionodura', PO Box 581, Malanda, Queensland 4885

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This study is the result of a 20-year bird banding project in upland rainforest on the Paluma Range, north-eastern Queensland. During the first 13 years (1978–90) banding was carried out every year but thereafter only during 1995 and 1997, mist-netting being largely (74% of total netting hours) carried out during the first three seasons. Results provide the first long-term information on birds living in Australian upland rainforests, with emphasis on species endemic to the wet tropics or Atherton Region. Species banded were primarily those that forage within the forest subcanopy, understorey, or on the ground. Peak breeding extends from late August or September to December or early January when temperatures and rainfall increase and relatively more food (fruits, flying insects and leaf litter invertebrates) is available. Wing flight feather (primaries and secondaries including the tertials) and tail moult mostly occurs during late November-March, with peaks during January-March (i.e. after breeding activity has declined and wet season rains have started).

Data are presented on biometrics plumages, soft part colours, characters for ageing and sexing, breeding, moult, survival, longevity, territoriality, site fidelity of individual birds and seasonal movements. Seasonal and annual variation in capture rates are given and recapture data presented for most frequently captured individuals.

INTRODUCTION

The avifauna of the upland rainforests of the Paluma Range, located at the southern end of the wet tropics (Atherton Region) of north-eastern Queensland, has been documented previously by Griffin (1974, 1995) and Frith (1984). Data presented herein result from a general avifaunal banding project carried out during 1978–1990, 1995, and 1997 and represent the first of their kind to be published for an Australian tropical rainforest. Several long-term avifaunal banding studies (i.e. >10 years) have been carried out within sclerophyll woodlands and forests: on the Brindabella Range, Australian Capital Territory (Lamm and Wilson 1966; Horey and Wilson 1971; Tidemann *et al.* 1988), in south-western Australia (Brown *et al.* 1990), and at various New South Wales localities (Lane 1969; Hardy and Farrell 1990; Marchant 1992; Leishman 2000). Some of these long-term projects also provided the basis for more intensive studies on most commonly banded species, including information on survival rates (e.g. Morris 1975; Boehm 1974, 1977, 1978, 1982; McFarland and Ford 1987; Robertson and Woodall 1987; Nicholls and Woinarski 1988; Brown *et al.* 1990; Farrell and Hardy 1993; Wilson 1994).

Several species banded during this study are endemic to the Atherton Region, including the Fernwren *Oreoscopus gutturalis*, Mountain Thornbill *Acanthiza katherina*, Bridled Honeyeater *Lichenostomus frenatus*, Bower's Shrike-thrush *Colluricincla boweri*, Tooth-billed Bowerbird *Scenopoeetes dentirostris* and Golden Bowerbird *Prionodura newtoniana* that typically occur within upland rainforest (i.e. above *c.* 400 m asl), and Macleay's Honeyeater *Xanthotis macleayana*, Chowchilla *Orthonyx spaldingii*, Pied Monarch *Arses kaupi*, Victoria's Riflebird *Ptiloris victoriae* and Black-eared Catbird *Ailuroedus melanotis* that occur within both lowland and upland rainforests of the region. The Atherton Scrubwren *Sericornis keri*, endemic to the Atherton Region, is reported to breed on the Paluma Range (Griffin 1995) but was not record during this study.

Some other bird species endemic to Australia have populations isolated within the wet tropics rainforest that represent subspecies distinctive from conspecifics further south (e.g. the Yellow-throated Scrubwren *Sericornis citreogularis cairnsi*, Pale-yellow Robin *Tregellasia capito nana* and Satin Bowerbird *Ptilonorhynchus violaceus minor*). Populations of some other species, also recognized as distinctive north-eastern Australian subspecies, extend beyond (north or south) the Atherton Region (for further details see Schodde and Mason 1999).

Recent genetic studies have presented evidence of subspeciation between the northern and southern wet tropics populations of a few bird species that occur either side of the Black Mountain 'barrier' between Cairns and Mossman (Joseph and Moritz 1994; Joseph *et al.* 1995; Schodde and Mason 1999). For example, the Chowchilla is represented in the north of its range by the subspecies *O. s. melasmenus* and in the south (for which data are presented here) by *O. s. spaldingii*. Similarly, the northern population of the Pied Monarch is of the subspecies *A. k. terraereginae* and the southern population is of *A. k. kaupi*. A similar situation may also be true of the Grey-headed Robin *Poecilodryas* (*Heteromyias*) *albispecularis* (and the Black-eared Catbird — see Frith and Frith 2004: 238) but present data for the northern population are inadequate to make comparisons (Schodde and Mason 1999). Australian Grey-headed Robins are presently treated as a subspecies distinct from those occurring in New Guinea. Populations of Bower's Shrike-thrushes on either side of the Black Mountain 'barrier' may also differ slightly, but supposed differences between their measurements are conflicting (Schodde and Mason 1999).

The aim of this study was to obtain information on the biometrics, plumage, soft part colours, characters for ageing and sexing, breeding, moult, survival, longevity, territoriality, site fidelity and seasonal movements of individuals. The species most frequently caught were inevitably those primarily insectivorous species foraging within the subcanopy, understorey or ground leaf litter. Some data for the Black-eared Catbird, Tooth-billed Bowerbird, Golden Bowerbird, and Victoria's Riflebird appear elsewhere (Frith and Beehler 1998; Frith and Frith 1998, 2001a, 2001b, 2001c, 2004) and are not repeated herein except to be included in totals of net capture rates. Nomenclature follows Christidis and Boles (1994) unless amended by Schodde and Mason (1999) in which case the latter is followed. The Black-eared Catbird *Ailuroedus melanotis* is retained as a species rather than as a subspecies of the Green Catbird *A. crassirostris* (Frith and Frith 2004).

Noteworthy results from this the first long-term banding study published for upland rainforest of the Atherton Region are briefly discussed within the species accounts, but only if data differ from those published for the region summarized in pertinent volumes of the Handbook of :alian, New Zealand and Antarctic Birds (HANZAB).

STUDY AREA

This study was carried out in upland rainforest, at approximately 850–950 metres above sea level, on the Paluma Range, tropical north-eastern Queensland, approximately 80 kilometres north of Townsville. The study area (19°00'S, 146°10'E) was located seven kilometres from the township of Paluma and consisted of two 50 hectare plots each measuring 1 × 0.5 kilometres (for detailed study site description see Frith and Frith 2001c). A narrow dirt road bisected the main study area (SA1), where most netting was carried out. The area was marked with a grid of metal stakes. Eleven permanently marked standard net sites (site numbers 1–5 and 9–15) were established in rainforest either side of the road through SA1 (Fig. 1). A large proportion of our mist-netting was performed at sites 1–4. Sites 1, 3 and 4 were located in disturbed forest with a dense *Calamus*-dominated undergrowth whereas site 2 was within a more open understorey. The second (ungridded) study area (SA2) was of the same dimensions as, and was contiguous with, SA1 and extended northwestwards up a hill to approximately 960 metres above sea level. An old forestry logging snig-track that bisected a narrow ridge provided access. Four permanently marked standard net sites (site numbers 5–8) were established to either side of this track within an area of 250 metres × 100 metres (Fig. 1).

Annual rainfall and temperatures show marked seasonality on the Paluma Range, the dry season extending from April-November, with June-August being the driest and coldest months (Fig. 2a). Rainfall and temperatures increase during September-October and decrease during April-May. The hot wet season is December-March, with most rain falling during January-February. Mean monthly rainfall (Fig. 2a) for the Paluma Range (based on years 1978–90) is presented as well as the actual monthly data for the first three seasons of the study (August 1978–February 1981) when most standard mist-netting was performe

Figure 1. *The location of standard net sites 1–4 and 9–15 in study area 1, and 5–8 in study area 2, on the Paluma Range, north-eastern Queensland. Each study area measured 1 × 0.5 kilometres (= 50 ha per rectangle). Note: finer single lines show creek systems, double parallel lines represent the dirt road from Paluma Township (entering at south) to Paluma Dam (to north) with a side track through SA1; bolder lines show contours (altitudes in m); the dotted line shows a snig-track through SA2 forest.*

Over the same period mean monthly maximum temperatures ranged from 16.7–26.6°C (Fig. 2a) and minima from 9.6–19.8°C. Availability of insects and litter invertebrates each month were monitored from August 1978–February 1981 (Frith and Frith 1985; D. Frith and C. Frith 1990; Fig. 2b).

METHODS

During the first 13 years (1978–90) banding was carried out every year but thereafter only during 1995 and 1997. A banding year was taken as from 1 August to 30 July. Mist-netting was not performed every month of each banding year, but mostly (85%) during the avifaunal breeding season of August-January and largely (74%) during the first three years of the study, from 8 August 1978 to 1 January 1981 apart from June-July 1979 (Table 1). Mist-netting was carried out at standard net sites and randomly placed ones (Table 2).

A total of 2 523 hours of mist-netting was performed over 302 days at 15 standard net sites in SA1 and SA2 (Table 1). At each of the 15 standard net sites two 9.15 × 2.74 metre and two 12.2 × 2.74 metre nets were erected each day, to an effective height of 2.5 metres. From August 1978–November 1982 mist-netting was carried out initially at two sites simultaneously over two days (August 1978–March 1980), then at two sites for one day only (mid March 1980–November 1982). Nets were opened between 0600–0700 hours and closed between 1700–1800 hours. During subsequent years netting was less frequent at two sites simultaneously over two days. Nets were opened only during mornings until capture rates declined, usually between 1030–1100 hours.

Net sites were rotated to avoid the development of net-shyness in birds; thus mist-netting occurred at each site at intervals of at least three to four weeks. The number of net sites used varied from year to year: sites 1–4 within SA1 were the ones most frequently (54% of total

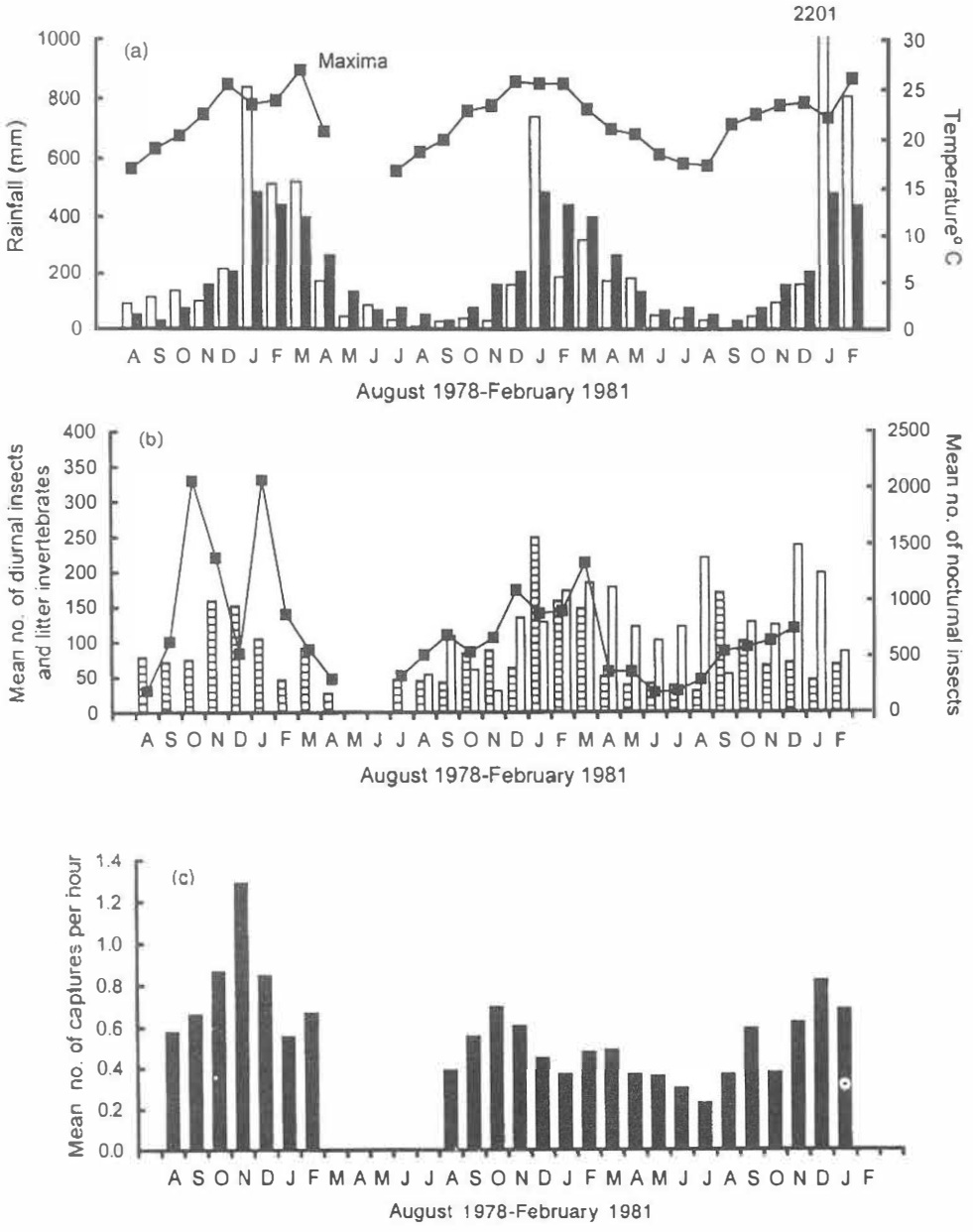

Figure 2 (a). *Monthly rainfall (white columns) and mean monthly temperature (■) during August 1978–February 1981 on the Paluma Range, north-eastern Queensland. For comparative purposes the mean monthly rainfall for 1978–90 (black columns) are also given.* (b) *Mean monthly number of diurnal insects (striped columns), of litter invertebrates (white columns) and of nocturnal insects (■) during August 1978–February 1981, on the Paluma Range, north-eastern Queensland.* (c) *Mean number of bird captures per hour (data for all standard net sites combined and based on a full banding day (from 0600–0700 to 1700–1800 h) during August 1978–January 1981 on the Paluma Range, north-eastern Queensland. Note: mist-netting was not performed during most of January-February due to exceptional rainfall (Fig. 2a).*

TABLE 1

Periods of mist-netting during different months of each avian breeding season at standard net sites in study areas 1 and 2 during 1978–1990, 1995 and 1997 on the Paluma Range, north-eastern Queensland.

Year[1]	Months of mist-netting[2]	Reference numbers of standard net sites[3,4]	Total number of netting days at sites	Total number of netting hours at sites	Number of birds banded	Number of birds recaptured	Total number of captures
1978/79	Aug-Mar	1 to 8	68	631.25	376	90	466
1979/80	Aug-July	1 to 4, 9 to 15	94	990.75	237	224	461
1980/81	Aug-Jan	1 to 4, 9 to 15	24	249.75	76	72	148
1981/82	Oct-Jan, May	1 to 4, 9 to 14	16	148.5	59	64	123
1983	Sept-Nov	1 to 4, 9 to 12	8	79.0	22	36	58
1983/84	Sept-Dec, Mar	1 to 4, 9 to 14	22	102	75	62	137
1984/85	Aug-Nov, Jan	1 to 4, 9 to 14	20	94.25	52	37	89
1985	Sept-Oct	1 to 4	8	38.5	25	18	43
1986	Nov-Dec	1 to 4	8	35.75	33	24	57
1987	Sept-Oct	1 to 4	8	33.25	55	11	66
1988	Nov	1 to 4	8	32.5	30	17	47
1989	Oct, Dec	1 to 4	8	36.5	19	14	33
1990	Sept	3 and 4	2	15.5	9	4	13
1995	Oct	3 and 4	4	16	15	8	23
1997	Oct	3 and 4	4	19.75	17	3	20
Total			302	2 523.25	1 100	684	1 784

[1]a banding year was from August to July. [2]see Table 3 for the number of hours per month. [3]see Figure 1. [4]four nets at each standard-net-site: two 9.1 x 2.74 metres and two 12.2 x 2.74 metres nets; see Methods.

TABLE 2

A list of all bird species and numbers banded and recaptured at standard and random net sites in study areas 1 and 2 during different months[1] of the year, during 1978–1990, 1995, and 1997 on the Paluma Range, north-eastern Queensland.

Species		Number of birds banded	Number of birds recaptured	Total number of captures	Number of captures per month J	F	M	A	M	J	J	A	S	O	N	D
Shining Bronze Cuckoo	*Chrysococcyx lucidus*	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0
Little Kingfisher	*Alcedo pusilla*	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0
Buff-breasted Paradise-Kingfisher	*Tanysiptera sylvia*	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Noisy Pitta	*Pitta versicolor*	3	0	3	1	0	0	0	0	0	0	0	0	0	1	1
White-throated Treecreeper	*Cormobates leucophaeus*	19	8	27	4	0	2	2	0	0	0	2	7	8	2	0
Fernwren	*Oreoscopus gutturalis*	58	50	108	9	6	1	3	1	4	4	13	13	13	27	14
Yellow-throated Scrubwren	*Sericornis citreogularis*	113	114	227	21	9	6	4	2	1	8	27	45	31	41	32
Large-billed Scrubwren	*S. magnirostris*	130	116	246	11	8	13	4	9	8	2	36	49	48	27	31
Brown Gerygone	*Gerygone mouki*	8	0	8	1	2	0	0	0	0	0	0	2	3	0	0
Mountain Thornbill	*Acanthiza katherina*	30	7	37	0	0	0	0	2	0	1	4	8	9	4	9
Lewin's Honeyeater	*Meliphaga lewinii*	6	1	7	1	0	1	0	0	0	0	3	0	0	0	2
Bridled Honeycater	*Lichenostomus frenatus*	60	23	83	2	1	7	3	2	1	0	5	26	12	18	6
White-cheeked Honeyeater	*Phylidonyrus nigra*	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Eastern Spinebill	*Acanthorynchus tenuirostris*	22	7	29	3	5	3	0	0	0	1	2	9	1	3	2
Pale-yellow Robin	*Tregellasia capito*	32	6	38	2	3	0	0	1	0	1	10	10	7	1	3
Grey-headed Robin	*Poecilodryas albispecularis*	265	237	502	28	16	21	6	4	2	9	66	102	120	82	46
Chowchilla	*Orthonyx spaldingii*	9	2	11	0	0	0	0	0	0	1	3	4	0	1	2
Eastern Whipbird	*Psophodes olivaceus*	7	4	11	1	0	0	0	0	0	2	0	4	1	3	0
Golden Whistler	*Pachycephala pectoralis*	28	16	44	8	4	1	0	1	1	2	2	10	6	7	2
Bower's Shrike-thrush	*Colluricincla boweri*	57	33	90	5	2	9	1	1	0	0	2	28	12	17	13
Yellow-breasted Boatbill	*Machaerirhynchus flaviventer*	3	0	3	0	0	0	0	0	1	0	1	1	0	0	0
Black-faced Monarch	*Monarcha melanopsis*	3	0	3	1	1	0	0	0	0	0	0	0	0	0	1
Spectacled Monarch	*M. trivirgatus*	19	2	21	3	4	0	0	1	0	0	0	2	3	3	5
Pied Monarch	*Arses kaupi*	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Rufous Fantail	*Rhipidura rufifrons*	63	46	109	15	18	21	2	0	0	0	0	0	2	34	17
Grey Fantail	*R. fuliginosa*	64	26	90	8	6	5	3	0	2	3	9	16	9	20	9
Victoria's Riflebird	*Ptiloris victoriae*	5	1	6	0	0	1	0	0	0	1	1	0	2	0	1
Black-eared Catbird	*Ailuroedus melanotis*[2]	57	24	81	1	4	2	1	1	0	0	11	27	17	10	5
Tooth-billed Bowerbird	*Scenopeetes dentirostris*[3]	23	14	37	3	0	1	0	0	0	0	0	8	8	7	10
Golden Bowerbird	*Prionodura newtoniana*[4]	22	8	30	1	0	3	0	1	0	0	1	5	4	9	6
Satin Bowerbird	*Ptilonorhynchus violaceus*	2	0	2	0	0	0	0	0	1	0	0	1	0	0	0
Mistletoebird	*Dicaeum hirundinaceum*	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1
BassianThrush	*Zoothera lunulata*[5]	6	2	8	2	0	0	0	0	0	0	0	3	0	0	3
Total number	33	1 120	747	1 867	131	89	98	31	26	21	35	198	381	317	317	221

[1]lack of captures during a month is not indicative of the absence of the species from the Paluma Range; see Results and Discussion. [2]capture data for individuals caught at nests are excluded. [3]capture data for those caught at courts are excluded. [4]capture data for those caught at bowers and nests are excluded. [5]the possibility that captures also included the Russet-tailed Thrush *Z. heinei* cannot be overlooked; see Results and Discussion.

number of hours) used over the study period as a whole, sites 5–8 in SA2 were used during the first season only (11%) and sites 9–15 in SA1 from the second to the seventh season (35%; Table 1).

As the period of netting at each standard net site varied, capture data were standardized by expressing results as the mean numbers of net area-hours per capture and the mean numbers of captures per 10^4 net area-hours. Net area-hours for each net were calculated using effective net height multiplied by total net length and the numbers of hours a net area was open (*cf.* Tidemann *et al.* 1988). Diurnal variations in capture rates between 0630–1830 hours are expressed as the number of captures per two-hour period. Capture rates for each month and for the entire study appear in Table 3. Variation in capture rates during the first three avifaunal breeding seasons are discussed in relation to climate and the relative availability of invertebrates (Fig. 2a, 2b).

Netting at random sites was carried out during various months of each year (for untimed periods) at courts of Tooth-billed Bowerbirds, bowers of Golden Bowerbirds, and at nests of both Black-eared Catbirds and Golden Bowerbirds. Data for these random captures of bowerbirds at such predictable focal points of activity are excluded from our analysis. For these details see Frith and Frith (2001c). Data for Black-eared Catbirds caught by nets set at courts and bowers (as opposed to their nests), and for other (non-bowerbird) bird species caught at all random net sites that were located less than 300 metres from standard net sites, are included. Results for these individuals are incorporated because some, which were first banded at standard net sites, were subsequently retrapped at random net sites, or vice versa. Standard and random net sites were plotted accurately so that distances individual birds moved from their original point of banding to recapture sites could be measured. For the 15 standard net sites the central point between the four nets was used in order to measure distances between them but for the random net sites the court/bower/nest structure was the focal point because the location of these were precisely plotted (Frith and Frith 2001c).

During July and August 1981 Stephen Garnett mist-netted for two mornings (11 h 15 min) at random within SA1. His resultant data are combined herein. Other banders also mist-netted randomly within SA1, during 30 November–2 December 1990 (S. G. Lane, J. W. Hardy and F. van Gessel) and 3–5 May 1992 (D. Rogers), but only their recapture data for individual birds originally banded by us are used herein (39 of the total of 747 recaptures; Table 2). Conversely, we retrapped nine individuals originally banded by others. These other banders placed nets along, or close to, the edge of the road that bisected SA1, near to our standard net sites, but their exact locations were not plotted. Because of this the distance from where we banded individual birds was estimated directly to the nearest point on the road or track. By doing this the distance the recaptured individuals had moved since being banded were possibly underestimated, but as so few birds are involved such a potential discrepancy is insignificant. Previously published longevity records for individual birds originally banded during this study and retrapped by others (i.e. as 'Anon' under 'Recovery Round-up' in *Corella*) are only referred to if they exceed our longevity records.

Each bird captured was banded with a metal band provided by the Australian Bird and Bat Banding Scheme, Environment Australia. Birds were placed in black cotton bags, taken to an immediately local banding station for processing and returned to the point of capture for release. Biometric data are presented for each species in addition to sex and age group, when plumage and/or soft part differences permitted their identification. Body weight was recorded with a Pesola balance to 0.1 g degree of accuracy. Wing, tail, tarsus, bill and total head lengths were measured in a standardized way (Rogers 1989; Frith and Frith 2001c). Only body weight, wing length, and tail length were measured and recorded from recaptured individuals. Student's two-tailed *t*-tests were used for statistical comparisons. Means are given ± one standard deviation. As few juvenile individuals were netted their measurements are excluded from consideration.

Nomenclature for ages and plumages defined in Marchant and Higgins (1990) and Higgins *et al.* (2001) is followed. A juvenile plumage is the first post-nestling one, which is either replaced (partially or completely) by one or more recognizable immature plumages or by adult plumage. First immatures are typically recognized by their retention of some juvenile plumage characters, particularly those of the flight feathers, but some immatures may be indistinguishable from adults. Thus, the possibility that some individual birds considered to have been adults might include some first immatures, lacking juvenile traits, cannot be entirely ruled out. For sexually dimorphic species the term 'female-plumaged' is used in referring to possible immature males whose plumage is identical to that of adult females. The terms 'adult' and 'immature' are not necessarily indicative of sexual maturity, as immature males of some species (e.g. the Golden Whistler *Pachycephala pectoralis*) might breed in female plumage (Marchant and Higgins 1990).

A bird is defined as female by its plumage, size, and/or the presence of a brood patch if it is established that only the female of the species incubates because a review of brood patches states that 'though both genders may have the potential to develop a brood patch, it is a general observation that it only occurs in the gender actually involved in incubation.' (Lea and Klandorf 2002, p. 100). Brood patches were recorded on a subjective scale of 1–3, with regard to their size and degree of vascularization — '1' indicating a small brood patch and '3' a large one (Rogers *et al.* 1986; Rogers 1989). For sexually dimorphic species whose first year immature male plumage resembles that of adult females (e.g. Yellow-throated Scrubwren) age was taken into account. A bird was assumed to be female if recaptured more than a year after its last capture and still wearing female plumage.

Birds were not methodically examined for body moult, but if visibly active was recorded as such. Moult in the wing flight feathers (primaries, secondaries) and tail were recorded in more detail, but not the sequence of moult therein. In the species accounts, the month during each season that body, wing, and tail moult were first recorded and the month it was completed, or nearly so, were noted. Moult cycles for some species are defined and presented but our data are not compared with those in HANZAB unless they differ from Atherton Region records therein. Subcutaneous fat deposits were subjectively scored on a scale of 1–4 (as detailed in Rogers 1989).

Recapture rates were calculated for those species most frequently (>20 captures) recaptured in SA1 over the whole study period (Tables 2 and 4). Recapture data do not include birds caught twice during a single day. The recapture rate is defined as the number of individuals recaptured as a percentage of the total number banded.

Survival rates were calculated for species most frequently recaptured in SA1 from August 1978–December 1989 when banding was carried out every year (Tables 8–12). In calculating survival estimates only birds recaptured at least once in years following banding are used, because other long-term banding studies have shown that factors such as movements of young birds, mortality, and even net shyness may be responsible for the post-banding disappearance of some individuals. Mean annual survival rate was calculated in two ways: first, for mean annual survival rates, the number (a) of banded birds present and the number (b) still present one year later were calculated (i.e. Method 1 of Nicholls and Woinarski 1988, based upon Lack 1954); secondly, an estimate of mean monthly survival rates was obtained by calculating the percentage of individuals known to be alive at successive yearly intervals from the date of their original capture (based on Method 3 of Nicholls and Woinarski 1988). From mean annual survival an expectancy of further life was then calculated (*cf.* Fry 1980). Standard and random net sites are referred to collectively as capture sites herein. The term 'capture' refers to all birds caught, including recaptures.

RESULTS AND DISCUSSION

Thirty-one species were caught at the 15 standard net sites over 302 netting-days, involving 2 523 hours during 1978–1997. A total of 1 784 captures was recorded which included 1100 individuals and 684 recaptures (Table 1). An additional 83 captures (20 individuals and 63 recaptures) were made at random net sites, plus a further two species (Buff-breasted Paradise-Kingfisher *Tanysiptera sylvia* and Pied Monarch) that were not caught in standard net sites. Thus a total of 33 species was netted at both standard and random net sites during this study, involving 1 867 captures (1 120 individuals and 747 recaptures). Capture rates appear in Table 2. Thirty of the 33 species netted were passerines (1 864 captures).

At least 25 of the 33 species banded are breeding residents on the Paluma Range and are present throughout

TABLE 3

Monthly periods of mist-netting at 15 standard net sites in study areas 1 and 2 during 1978–1990, 1995 and 1997 on the Paluma Range, north-eastern Queensland.

	MONTHS												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Netting period													
Number of days	24	16	16	6	6	4	4	40	62	52	40	32	302
Total number of hours	224.8	169.5	166.8	67.3	61.3	43.0	42.5	358.0	501.5	354.0	288.3	246.5	2523.3
Mean number of hours	9.4	10.6	10.4	11.2	10.2	10.8	10.6	9.0	8.1	6.8	7.2	7.7	8.4
Total number of nets[1]	96	64	64	24	24	16	16	160	248	208	160	128	1208
Capture rates													
Number of captures	129	88	91	25	24	13	10	179	382	329	283	231	1784
Total number of net-area-hours[2]	23 981	18 088	17 797	7 180	6 533	4 590	4 539	3 8217	53 544	37 802	30 787	26 303	26 9353
Mean net-area-hours per capture	185.9	205.5	195.6	287.2	272.2	353.1	453.9	213.5	140.2	114.9	108.8	113.9	151.0
Mean captures per net-area-hours (10^4)	53.8	48.7	51.1	34.8	36.7	28.3	22.0	46.8	71.3	87.0	91.9	87.8	66.2

[1]four nets (two 9.15 × 2.74 m and two 12.2 × 2.74 m) were erected each day at each standard net-site; see Methods. [2]net-area-hours are effective net height (2.5 m) × net lengths (9.1 m or 12.2 m) × mean number of hours nets were open × number of nets (after Tidemann *et al.* 1988; see Methods).

TABLE 4

Recapture rates for more frequently caught bird species (>20 captures) at standard and random net sites in study area 1[1] during 1978–1990, 1995 and 1997 on the Paluma Range, north-eastern Queensland

	Number of birds		Total number	Number of times individuals recaptured										Recapture
Species[2]	banded	recaptured	of captures	1	2	3	4	5	6	7	8	9	10	rate (%)[3]
Cormobates leucophaeus	14	8	22	3	1	1								35.7
Oreoscopus gutturalis	43	40	102	7	4	2	3	2	1					44.2
Sericornis citreogularis	92	103	195	22	20	8	3	1						58.7
S. magnirostris	111	114	225	24	7	9	3	2	3			1		44.1
Acanthiza katherina	23	7	30	4		1								21.7
Lichenostomus frenatus	52	23	75	11	3	2								30.8
Acanthorynchus tenuirostris	18	6	24	4	1									27.8
Tregellasia capito	21	6	27	4	1									23.8
Poecilodryas albispecularis	244	229	473	42	18	13	11	4	1	1	2	1	1	38.5
Pachycephala pectoralis	24	15	39	2	1	1					1			20.8
Colluricincla boweri	50	29	79	12	6			1						38.0
Monarcha trivirgatus	19	2	21	2										11.0
Rhipidura rufifrons	58	45	103	9	6		2			1			1	32.8
R. fuliginosa	59	26	85	8	6				1					25.4
Total/percentage	828	662	1 500	154	74	37	22	10	6	2	3	2	2	37.7

[1]data for study area 2 are excluded from this analysis as we only mist-netted there during our first banding year; see Methods. [2]bowerbirds are excluded; see Introduction. [3]the number of individuals recaptured as a percentage of the number banded.

the year. The rarely sighted Little Kingfisher *Alcedo pusilla* may also be so but requires confirmation (Griffin 1995). Buff-breasted Paradise-Kingfishers arrive (at lower elevations than our study area) in mid November to breed, and depart during late February–early March (pers. obs). While most Noisy Pittas *Pitta versicolor* move to lower altitudes during winter months, some individuals remain (see species account). Black-faced Monarchs *Monarcha melanopsis* are absent from the Paluma Range in winter (Griffin 1995), although some individuals (probably immatures) have been seen in the Atherton Region during this season (Blakers *et al.* 1984). Spectacled Monarchs *Monarcha trivirgatus* and Rufous Fantails *Rhipidura rufifrons* are also absent during winter and possibly move to lower altitudes and/or drier open-forest (Bravery 1970; Griffin 1995; Higgins and Peter 2005). On the Atherton Tableland, Yellow-breasted Boatbills and Pied Monarchs may move to open-forest during March-June (Bravery 1970), but this is unrecorded for the Paluma Range (Griffin 1995). Whilst Bridled Honeyeaters were recorded during every month of the year some individuals may move into adjacent wet sclerophyll forest on the western edge of the Paluma Range during colder months (Dettman 1995; Higgins *et al.* 2001).

Excluding the honeyeaters and Victoria's Riflebird, which are mixed feeders, and the bowerbirds and Mistletoebird *Dicaeum hirundinaceum* which are mainly frugivorous, all other passerines (85% of captures — Table 2) caught were 'insectivorous', feeding mostly upon arthropods. Most capture/recapture records were of insectivorous birds that forage primarily in the understorey/subcanopy (e.g. Large-billed Scrubwren *Sericornis magnirostris*, Pale-yellow Robin, Rufous Fantail) or upon or near to the forest floor (e.g. Fernwren, Yellow-throated Scrubwren, Grey-headed Robin — Table 2). Whilst other frequently caught species, such as White-throated Treecreeper *Cormobates leucophaeus*, Bower's Shrike-Thrush, Golden Whistler, and Grey Fantail *Rhipidura fuliginosa* forage mostly in the subcanopy/canopy they also do so in lower strata, particularly in wetter months (Frith 1984).

The number of net area-hours per capture at 15 standard net sites averaged 151 (range 116–205). Conversely, the number of captures per 10^4 net area-hours averaged 66.2 (range 47–80). Less than two birds per hour were caught at each standard net site. A comparison between capture rates at sites 1-4 in SA1, where the larger proportion (54%) of netting was performed, showed that nets at sites 1, 3 and 4 caught more birds than nets at site 2. The number of captures per 10^4 net area-hours averaged 70, 75 and 87 at sites 1, 3 and 4 respectively but only 50 at site 2. This was probably because sites 1, 3 and 4 had dense *Calamus*-dominated undergrowth about them while site 2 had slightly more open rainforest.

Mean number of captures per 10^4 net area-hours at standard net sites varied considerably from month to month, being as low as 22 in July and as high as 92 in November (Table 3). Annual capture rates started to increase at the beginning of the breeding season, in late August-early September, when birds establish/re-establish territories (Table 3). Captures were notably high during the peak breeding months of October-December when temperatures and rainfall increase and flying insect and leaf-litter invertebrates increase in abundance (Frith and Frith 1985; D. Frith and C. Frith 1990; Fig. 2a, 2b). Flowering also mostly peaks during these months (Frith and Frith 1985) with fruiting following flowering. Capture rates decreased during the heavy wet season rains of January and February when, while food resources typically peak, fledglings are provisioned by their parent(s) and adults are moulting. It is also possible, however, that lower capture rates reflected more frequently wet nets being more visible to birds. Capture rates were notably low during the colder months of June and July, when food is sparse (Table 3; Fig. 2). Capture rates averaged 0.9 per two-hour period between 0630–1030 and 1630–1830 hours and 0.5 per two-hour period during the rest of the day. Thus capture rates were higher during early morning and late afternoon, when insectivorous birds more actively forage (Frith 1984).

A comparison of capture rates between each of the first three seasons of the study, when mist-netting was carried out regularly throughout each month and day, showed they varied considerably between seasons, particularly during breeding months. From August-January during the breeding seasons of 1978/79, 1979/80, and 1980/81 the number of captures per hour averaged 0.8, 0.5, and 0.6 respectively (Fig. 2c). Lower capture rates during the latter two seasons related to the monthly August-November rainfall being well below the seasonal average (32% for 1979 and 55% for 1980 — Fig. 2a). Drier conditions resulted in relatively sparse availability of arthropods during those two seasons (Fig 2b; Frith and Frith 1985; D. Frith and C. Frith 1990). Moreover, it was exceptionally dry during 1979 and many birds failed to breed as a result (Frith and Frith 1998, 2001b; D. Frith and C. Frith 2000).

Distances between capture points of species more frequently recaptured in mist nets in SA1 indicate that many of these are relatively sedentary. Recaptures rates ranged from 11% to 59% between species in SA1 (Table 4). Recapture rates were notably high (>40%) for ground-foraging species with the exception of Chowchillas which are difficult to capture in mist nets (Jansen 1993; Frith *et al.* 1997).

Many Bridled Honeyeaters were captured because, although they are mixed feeders and most frequently seen in the canopy foraging upon flowers, they descend to lower strata in search of arthropods (Frith 1984). In constrast, the Macleay's Honeyeater that was common in the study area was not netted once as it forages predominantly in the forest canopy (Crome 1978; Frith 1984; Griffin 1995; pers. obs.). The recapture rates of breeding summer visiting Spectacled Monarchs (11%) and Rufous Fantails (33%), are surprisingly different. This possibly reflects the fact that Rufous Fantails more frequently forage just above the ground (<1 metre) whereas the monarch forages more in the understorey/lower canopy (Crome 1978; Frith 1984; Higgins and Peter 2005).

In the following species accounts table numbers are not repeatedly referred to for recapture rates (Table 4), biometrics (Table 5), monthly seasonality of wing flight feather and tail moult (Table 6), and monthly seasonality of individuals carrying fat loads of scales 2 and 3 (Table 7). The only species found with a fat scale of 4, in some individuals, was the Black-eared Catbird (Frith and Frith 2001c). Data analysed in these tables involve those species most frequently captured (Table 2). Species and subspecies of birds that are endemic to the Atherton Region are indicated by an asterisk (*). The six species captured only once (Table 2), are not discussed below and their biometrical data are excluded from Table 5. Differences between our data and previously published information are only commented on if significant.

Noisy Pitta *Pitta versicolor intermedia*

One adult was captured during each of November, December and January. Birds called regularly during September-April, but some were seen and heard during all winter months (K. Davis, pers. comm.; pers. obs.). Thus, not all birds on the Paluma Range descend to lower altitudes in winter (*pace* Griffin 1995; Nielson 1996). During the exceptionally dry year of 1979 when animal food was relatively sparse, an adult was found on the road weighing 56.3 grams. This is well below the average weight of 91 grams (range 86–97 g) (Table 5).

A nest with three eggs was found on 27 November; on 9 December it still contained three eggs but they had hatched by 14 December. An adult with a fledgling (*c.* 2 weeks out of nest) was seen on 20 January, and another adult with a fledgling on 26 January. No brood patch or fat was recorded. One individual had some flight feather moult in January.

White-throated Treecreeper *Cormobates leucophaeus minor**

A total of 27 captures: 19 individuals (7 adult males and 12 adult females) and eight recaptures. Distances between capture sites of individual adults averaged 139 ± 75 (range 56–294) metres. Recapture rate was 36 per cent, with no individual being caught more than three times (Table 4). The longest period between banding and recovery was for a male (adult when banded) of 2 years, 11 months, 9 days caught at four different net sites, at an average distance of 98 (56–141) metres apart, suggesting sedentariness.

TABLE 5

Measurements (mm) and weights (g) of 22 species of birds caught in mist nets on the Paluma Range, north-eastern Queensland[1].

Species	Age and sex of captures[2]	Number of captures	Wing length					Tail length					Bill length					Tarsus length					Total head length					Weight				
			Mean	SD	Min	Max	n	Mean	SD	Min	Max	n	Mean	SD	Min	Max	n	Mean	SD	Min	Max	n	Mean	SD	Min	Max	n	Mean	SD	Min	Max	n
Pitta versicolor	Adult	3	119	0.58	119	120	3	45	1.00	44	46	3	29.7	0.50	29.3	30.0	2	41.5	0.69	40.7	41.9	3						91.3	5.68	86	97.3	3
Cormobates leucophaeus	Adult	27	81	2.99	75	86	21	61	3.53	50	65	19	17.8	1.10	15.9	20.0	16	20.8	0.99	18	22.2	16	34.1	0.57	33.5	35.0	7	17.6	0.92	14.9	19.3	27
	Adult male	11	82	2.58	78	88	10	61	2.72	57	65	10	18.1	1.28	16.1	20.0	7	20.9	1.02	19.2	22.2	7	33.0	1.71	30.5	34.2	4	17.9	0.66	16.9	18.9	11
	Adult female	16	80	2.91	75	84	11	61	4.40	50	65	9	17.3	0.92	15.9	18.1	9	20.4	1.06	18	21.1	9	34.0	0.59	33.6	34.1	3	17.5	0.82	16.1	19.3	16
Oreoscopus gutturalis	All ages	108	67	2.83	59	75	88	50	2.57	44	58	84	20.0	0.68	18.2	22.2	51	23.3	1.10	21.5	26.8	51	39.2	0.80	37.6	40.6	32	20.0	1.27	17.4	23.2	105
	Adult	106	67	2.85	59	76	86	50	2.54	44	58	82	20.0	0.70	18.2	22.2	49	23.3	1.10	21.5	26.8	49	39.2	0.80	37.6	40.6	32	20.0	1.27	17.4	23.2	103
	Juvenile/immature	2	65				2	46				2	19.9	0.14	19.8	20.0	2	23.2	0.07	23.1	23.2	2						20.4	1.70	19.2	21.6	2
Sericornis citreogularis	All sexes/ages	227	66	2.31	61	75	163	53	2.54	42	59	154	15.5	1.68	11	17.7	103	27.1	0.98	23.7	28.8	104	34.7	1.27	28.5	39.1	42	17.0	1.19	14.1	21.0	214
	Adult male	118	67	1.93	62	70	84	54	2.65	43	59	81	15.8	1.59	11.1	17.7	52	27.5	0.77	24.7	28.8	52	35.1	0.92	33.7	37.0	18	17.4	1.02	14.6	20.7	113
	Adult female	83	65	2.09	61	75	56	53	2.43	42	57	52	15.0	1.94	11	16.9	31	26.6	0.85	23.7	27.9	32	34.4	0.71	33.2	36.0	14	16.7	1.31	14.1	21.0	77
	Immature	1	61				1	48				1	15.0				1	27.2				1						19.1				1
S. magnirostris	All sexes/ages	246	56	2.47	49	65	170	43	2.40	33	48	168	15.2	1.39	10.9	17.3	100	20.5	0.84	18.5	22.8	98	31.7	0.89	30.0	33.7	75	9.7	0.80	7.9	11.9	225
	Adult	233	56	2.50	49	65	160	44	2.42	33	48	158	15.2	1.42	10.9	17.3	93	20.5	0.85	18.5	22.8	91	31.7	0.90	30.0	33.7	74	9.8	0.78	7.9	11.7	214
	Adult female	37	54	2.27	52	58	23	42	2.39	38	45	23	14.0	0.83	11.2	16.8	12	20.3	0.78	18.9	21.2	12	31.4	0.99	30.0	32.9	12	9.7	0.85	7.9	11.7	35
	Juvenile/immature	13	54	1.06	52	55	10	42	1.60	40	45	10	15.0	0.98	13.0	16.2	7	20.4	0.50	19.6	21.0	7	31.7				1	9.6	0.90	8.3	11.0	11
Gerygone magnirostris	Adult	8	50	1.41	48	52	8	43	2.80	41	49	8	11.7	0.64	10.9	12.7	8	17.6	0.79	16.6	18.8	8	26.1				1	5.7	0.43	5	6.2	8
Acanthiza katherina	Adult	37	52	2.44	46	58	34	44	2.56	37	50	33	12.1	0.73	10.9	14.0	29	17.4	0.78	16.2	19.0	28	26.7	0.62	25.5	27.6	14	7.2	0.58	5.5	8.2	33
	Adult female	4	49	0.58	49	50	3	43	1.16	42	44	3	12.8	1.44	11.2	14.0	3	16.8	0.40	16.4	17.2	3	26.0	0.50	25.5	26.5	3	6.8	0.35	6.4	7.0	3
Meliphaga lewinii	Adult	7	95	5.66	91	99	5	84	1.41	83	85	5	27.0				1	24.4	1.63	23.2	25.5	5	47.0				1	33.8	3.11	31.6	36.0	5
Lichenostomus frenatus	Adult	83	106	4.38	91	117	78	92	4.10	80	101	72	26.8	1.46	22.5	29.8	51	25.3	1.05	23.2	28.1	51	47.7	1.46	44.2	50.0	24	35.4	2.72	28.2	42.1	81
	Adult female	19	102	1.99	99	106	19	91	4.21	83	101	18	25.6	1.29	24.1	28.4	11	25.1	1.43	23.2	28.1	11	46.0	1.36	44.2	47.5	4	33.5	2.67	28.2	38.5	19
Acanthorynchus tenuirostris	Adult	29	68	4.48	60	76	25	58	3.58	52	64	25	28.5	1.79	25.2	31.2	19	18.4	0.65	17.2	19.2	19	42.6	2.52	40	46.5	6	12.6	0.97	10.5	14.9	27
	Adult female	2	63	2.12	61	64	2	54	1.41	53	55	2	26.3	0.85	25.7	26.9	2	18.5	0.21	18.3	18.6	2						12.7	0.42	12.4	13.0	2
Tregellasia capito	All sexes/ages	39	75	2.91	70	81	36	51	1.98	47	55	35	14.8	0.65	13.8	16.0	29	20.0	0.89	18.2	21.8	29	34.3	0.84	32.9	35.4	9	13.5	1.10	11.5	16.4	38
	Adult male and female	37	75	2.88	70	81	34	52	1.94	47	55	33	14.8	0.63	13.9	16.0	27	20.0	0.91	18.2	21.8	27	34.3	0.84	32.9	35.4	9	13.5	1.01	11.5	16.2	35
	Adult female	2	75	4.51	71	81	3	47	4.90	41	50	3	14.2	0.42	13.9	14.5	2	19.9	0.50	19.5	20.2	2	35.0				1	12.9	1.28	11.5	14.0	3
	Juvenile/immature	2	73	3.50	70	75	2	49				2	14.0	0.21	13.8	14.1	2	19.7	0.71	19.2	20.2	2						14.4	2.90	12.3	16.4	2
Poecilodryas albispecularis	All sexes/ages	502	109	4.14	100	119	390	76	3.38	62	88	377	22.2	1.20	17.2	25.0	238	32.0	1.08	29.6	34.5	235	46.4	1.68	42	49.3	167	36.5	3.86	27.2	47.1	468
	Adult male and female	461	110	4.13	100	119	352	76	3.35	62	88	340	21.9	1.23	17.2	25.0	200	31.9	1.08	29.6	34.5	197	46.4	1.67	42	49.3	159	36.4	3.91	28.1	47.1	427
	Adult female	88	108	2.00	103	112	71	75	2.65	62	79	67	21.4	0.79	20.2	23.2	24	31.6	1.17	29.9	34.5	24	45.4	1.02	43.2	47.8	32	33.9	2.62	27.2	40.6	84
	Juvenile/immature	41	107	3.86	102	116	38	74	3.29	67	81	37	21.6	0.94	20	23.9	38	32.4	0.97	30.5	34.3	38	45.7	1.92	43.7	48.7	8	37.0	3.41	27.2	45.0	41
Orthonyx spaldingii	Adult	11	123	4.69	118	135	10	97	5.58	90	107.4	11	24.0	1.06	22.7	25.8	8	44.0	2.20	41.5	47.6	9	51.4	1.78	49.2	53.8	5	143.5	17.20	122.5	177.5	11
	Adult male	3	130	7.07	125	135	2	104	2.87	102	107.4	3	24.0	0.85	23.4	24.6	2	47.6	0.07	47.5	47.6	2	53.8				1	168.8	12.37	160	178.0	2
	Adult female	8	122	2.26	118	125	8	95	3.74	90	100	8	23.9	2.00	22.7	25.8	6	43.0	1.07	41.5	45.0	7	50.8	1.29	49.2	52	4	134.2	6.70	122.5	140.0	8
Psophodes olivaceus	Adult	11	91	2.06	87.7	94	9	121	3.19	115	125.1	9	22.2	1.25	20	23.8	7	30.2	1.33	28.2	32.5	7	45.6	1.10	45	47.2	4	50.2	2.07	46.1	52.5	9
	Adult female	5	91	2.45	88	94	4	122	2.65	119	125	4	21.4	1.56	20	23.1	3	31.2	1.26	30	32.5	3	45.0				2	49.8	2.19	46	53.0	7
Pachycephala pectoralis	Adult	44	90	2.87	85	97	35	71	2.63	66	77	35	16.7	0.83	14.7	18.6	26	21.7	1.05	20.3	24.8	26	38.2	0.69	37.2	39	9	24.1	1.82	20	27.6	44

TABLE 5 — *continued*

Species	Age and sex of captures[2]	Number of captures	Wing length					Tail length					Bill length					Tarsus length					Total head length					Weight				
			Mean	SD	Min	Max	n	Mean	SD	Min	Max	n	Mean	SD	Min	Max	n	Mean	SD	Min	Max	n	Mean	SD	Min	Max	n	Mean	SD	Min	Max	n
	Adult male	11	93	2.54	89	97	10	72	3.11	66	77	10	16.9	0.55	16.2	18.0	8	21.1	0.37	20.6	21.7	8	39.0				1	23.4	1.97	20	26.8	11
	Adult female	18	91	1.29	89	92	11	70	1.90	68	74	11	16.3	1.42	14.7	18.0	4	23.0	2.02	20.6	24.8	4						24.9	1.67	22	27.6	18
Colluricincla boweri	All sexes/ages	90	106	2.80	99	113	78	82	2.89	75	93	70	26.5	1.52	21.2	32.2	56	28.3	1.07	25	31.2	55	50.7	1.50	46.3	54.2	19	43.5	2.76	37	49.6	87
	Adult males	25	106	2.01	102	110	24	82	3.52	76	93	22	26.5	1.06	25.1	28.6	14	27.9	1.13	25	29.3	14	50.9	0.89	50	52.2	6	43.2	3.36	37	49.6	25
	Immature male	4	106	1.00	105	107	4	81	3.87	75	84	4	26.5	1.83	24.1	28.5	4	29.0	1.16	27.9	30.0	4	54.2				1	42.6	0.97	41.8	44.0	4
	Adult female	29	106	3.55	101	113	22	82	1.96	79	86	19	26.7	0.83	25.1	28.1	13	28.0	1.26	26.3	31.2	13	51.9	1.41	49.9	51.9	2	44.4	2.67	37.2	48.8	28
Machaerirhynchus flaviventer	Adult	3	59	1.15	58	60	3	56	0.67	55	56	3	16.5	0.69	15.7	16.9	3	15.5	0.38	15.1	15.8	3	33.0				1	9.3	0.40	9	9.7	3
	Adult male	1	60				1	55				1	16.9				1	15.9				1						9.7				1
	Adult female	2	58				2	56				2	16.3	0.85	15.7	16.9	2	15.5	0.50	15.1	15.8	2	33.0				1	9.1	0.07	9	9.1	2
Monarcha melanopsis	Adult	3	86	2.52	84	89	3	69	1.53	68	71	3	21.0	0.44	20.5	21.3	3	18.9	0.46	18.4	19.2	3						21.7	1.36	20.9	23.3	3
M. trivirgatus	Adult	22	75	2.18	71	78	18	73	2.29	69	77	17	16.5	0.52	16	17.7	14	18.3	0.85	17	20.2	14	34.1	0.78	32.3	34.9	11	12.9	1.13	10.8	14.5	20
Rhipidura rufifrons	All sexes/ages	109	76	3.05	70	82	88	86	3.21	77	93	83	14.5	0.77	12.7	17.2	52	19.2	1.07	16.9	21.9	52	29.1	1.02	27.2	31.2	24	11.4	0.88	9.6	14.0	104
	Adult	106	76	3.03	70	82	85	86	3.24	77	93	81	14.6	0.78	12.7	17.2	50	19.2	1.06	16.9	21.9	50	29.1	1.02	27.2	31.2	24	11.4	0.86	9.6	14.0	101
	Juvenile/immature	3	72	1.16	71	73	3	84				1	15.0				1	20.2				1						11.8	0.17	11.7	12.0	3
R. fuliginosa	All sexes/ages	90	76	3.63	70	88	62	86	4.32	77	97	60	12.7	0.63	11.7	14.9	39	17.5	1.03	15.5	20.3	38	26.0	0.91	24.5	28.1	24	8.8	0.70	6.9	10.5	88
	Adult	78	76	3.71	70	88	53	86	4.41	77	97	52	12.6	0.57	11.7	13.9	30	17.3	0.87	15.5	18.9	30	26.0	0.91	24.5	28.1	24	8.8	0.68	6.9	10.5	76
Zoothera lunata[3]	Adult	8	140.6	5.40	130	147	8	108.3	4.33	99	112	8	36.1	3.01	31.8	41.0	6	32.9	2.33	29.5	35.6	6						130.5	6.00	121.3	138.0	7

[1] = data for single captures of a species are excluded, as are data for bowerbirds and Victoria's Rifebird; see Introduction and Table 1

[2] = the possibility that some individuals in adult plumage were in first immature plumage without remnants of juvenile plumage cannt be overlooked; see Methods

[3] = the possibility that captures also included the Russet-tailed Thrush *Z. heinei* cannot be overlooked; see Results and Discussion

TABLE 6

The total and monthly number of captures of adult birds of species (see Table 4) examined for moult (wing flight feather and tail), and the percentage of them in moult during each month, during 1978–1990, 1995, and 1997 on the Paluma Range, north-eastern Queensland.

Species [1]	Number examined	January		February		March		April		May		June		July		August		September		October		November		December	
		No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No	%	No.	%
Cormobates leucophaeus	27	4	25	-	-	2	100	2	50	-	-	-	-	-	-	2	0	7	0	8	0	2	0	-	-
Oreoscopus gutturalis	94	9	22	5	60	1	100	3	33	3	33	1	0	5	0	12	0	8	13	16	13	21	19	10	20
Sericornis citreogularis	202	18	50	6	33	6	83	4	75	2	100	1	0	8	0	38	3	36	17	26	8	32	9	25	24
S. magnirostris	183	10	100	4	75	11	55	4	50	6	0	6	0	1	0	24	4	41	2	25	8	23	9	28	7
Acanthiza katherina	34	-	-	-	-	-		-	-	2	100	-	-	1	0	4	0	7	0	7	0	4	0	9	11
Lichenostomus frenatus	81	2	0	1	100	7	29	3	0	2	0	1	0	-	-	5	0	26	0	11	0	17	0	6	17
Acanthorynchus tenuirostris	29	3	67	5	40	3	33	-	-	-	-	-	-	1	0	2	0	9	0	1	0	3	0	2	50
Tregellasia capito	33	1	0	1	0	-	-	-	-	1	0	-	-	1	0	9	0	9	0	6	0	2	0	3	67
Poecilodryas albispecularis	368	14	71	6	100	12	100	6	67	3	0	9	0	0	0	50	0	97	1	90	2	56	14	25	12
Pachycephala pectoralis	43	8	63	4	75	1	100	-	-	1	100	1	0	2	0	2	0	10	0	6	0	6	17	2	50
Colluricincla bowen	84	2	100	5	80	9	56	1	0	1	0	-	-	-	-	2	0	27	4	9	0	16	13	12	42
Monarcha trivirgatus	21	2	0	4	0	-	-	-	-	-	-	-	-	-	-	-	-	3	0	3	0	3	33	6	17
Rhipidura rufifrons	94	11	18	20	20	15	0	1	100	-	-	-	-	-	-	-	-	-	-	2	0	30	0	15	13
R. fuliginosa	61	1	0	-	-	5	80	2	0	-	-	1	0	3	0	5	0	12	8	7	43	18	6	7	0
Totals / %	1354	85	56	61	46	72	54	26	50	21	29	20	0	22	0	155	1	292	4	217	5	233	9	150	18

[1] = bowerbirds are excluded - see Introduction

TABLE 7

The total and monthly number of captures of adult birds of species (see Table 4) examined for fat, and the percentage of them with fat scale (=Sc) 2 and 3, during 1978–1990, 1995, and 1997 on the Paluma Range, north-eastern Queensland.

Species [1]	Number examined	January			February			March			April			May			June			July			August			September			October			November			December		
		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%		No.	%	
			Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3		Sc 2	Sc 3
Cormobates leucophaeus	21	4	75	25	-	-	-	2	50	0	-	-	-	-	-	-	-	-	-	-	-	2	50	0	5	100	0	6	83	0	2	0	50	-	-	-
Oreoscopus gutturalis	91	5	40	40	5	60	40	1	0	0	5	20	0	3	100	0	1	0	100	3	33	67	10	40	30	9	56	33	16	56	25	19	32	26	13	62	23
Sericornis citreogularis	190	18	50	11	6	33	50	5	20	0	4	50	25	2	100	0	1	0	100	3	0	67	21	57	14	40	50	33	28	39	54	37	49	30	25	48	28
S. magnirostris	196	10	50	10	4	25	0	11	18	0	4	25	0	8	0	13	7	29	29	1	0	0	28	29	7	42	43	14	35	37	9	23	35	0	23	39	9
Acanthiza katherina	35	-	-	-	-	-	-	-	-	-	-	-	-	2	0	0	-	-	-	1	0	0	4	50	0	7	43	29	8	13	0	4	50	25	9	44	11
Lichenostomus frenatus	67	2	0	0	1	0	0	6	0	0	3	33	0	2	0	0	1	0	0	-	-	-	5	0	0	15	39	0	10	20	10	16	37.5	0	6	67	0
Acanthorynchus tenuirostris	28	3	0	67	5	40	0	3	33	0	-	-	-	-	-	-	-	-	-	1	0	100	2	50	0	9	56	0	-	-	-	3	33	33	2	50	0
Tregellasia capito	34	1	0	0	2	0	0	-	-	-	-	-	-	-	-	-	-	-	-	1	0	100	9	78	0	10	60	10	7	86	0	1	100	0	3	67	0
Poecilodryas albispecularis	405	15	47	7	6	50	0	11	27	0	6	67	0	2	100	0	-	-	-	-	-	-	60	43	8	103	57	6	95	65	14	72	57	17	35	49	6
Pachycephala pectoralis	43	8	63	13	4	75	0	1	100	0	-	-	-	1	100	0	1	0	0	2	50	0	2	50	50	10	50	40	6	50	50	6	50	17	2	100	0
Colluricincla bowen	90	2	0	0	5	100	0	9	89	0	1	100	0	1	0	100	-	-	-	-	-	-	2	50	50	29	55	24	11	55	36	17	71	24	13	46	23
Monarcha trivirgatus	22	3	33	0	4	50	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	33	0	3	0	0	3	67	0	6	50	0
Rhipidura rufifrons	86	13	31	0	11	9	0	15	13	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	0	31	13	0	15	13	0
R. fuliginosa	66	1	0	0	2	0	0	3	0	0	2	0	0	-	-	-	2	0	0	3	33	0	7	0	0	15	20	0	7	43	0	17	12	7	7	0	0
Totals / %	1374	85	42	12	55	40	9	67	28	0	25	40	4	21	38	9	13	15	31	15	20	40	152	42	10	297	51	14	233	52	19	251	42	15	159	44	11

[1] = bowerbirds are excluded see Introduction

Adult males averaged slightly larger than females (sexed by diagnostic plumage and by the presence of a brood patch as only females incubate — Higgins *et al.* 2001) notably in wing length, but differences between the sexes for any measurements including weights were not significant ($P > 0.10$; Table 5). However, differences in wing lengths for 16 males of this subspecies measured by Boles and Longmore (1983) and analysed by Higgins *et al.* (2001) were significantly ($P < 0.01$) longer than those of four females.

Little is known about the breeding habits of this subspecies. One female was recorded with a scale 2 brood patch on 14 October. Active wing flight feather, tail, and body moult was recorded during January-March, moult being near-complete or complete by April; no moult was noted during August-November. Highest fat scales were noted during November and January, but monthly samples were small.

Fernwren *Oreoscopus gutturalis**

A total of 108 captures: 58 individuals (56 adults, and 2 immatures) and 50 recaptures (all adults). Distances between capture sites of individual adults averaged 137 ± 61 (range 44–350) metres. The recapture rate was high (44%). Of 43 individuals banded in SA1 only 19 were recaptured: 11 individuals were retrapped once or twice and the remainder three to six times (Table 4). The individual retrapped six times was caught during two seasons at three net sites averaging 123 ± 45 metres apart.

The longest period between banding of an adult and its recovery was 8 years, 2 months, 14 days. Over this period the individual concerned was caught five times, the first being at a net site 113 metres from the one it was subsequently retrapped at four times. Another individual, also adult when banded, was last caught 6 years, 9 months, 26 days later. This individual was retrapped once at 150 metres from its original point of capture. These data indicate a sedentary species that holds relatively small territories, at least when breeding. Moreover, one adult captured five times during April 1980–October 1983 and another caught six times during August 1980–October 1985 were caught on four occasions at the same four net sites 81 metres apart. On two of the four occasions, in November 1982 and October 1983, both were caught in the same net together. Thus, a mated pair appeared to hold a territory over several seasons. During October 1983 one bird of the pair was recorded with a large white eyebrow and the other a smaller, duller, one with a scale 3 brood patch.

In earlier literature females were described as being duller, having less black on the breast, being slightly paler on the crown, and/or having a less distinctive white eyebrow than males, but these traits are now considered to express individual variation (Higgins and Peter 2002). That said, of pairs photographed visiting nests, observed nest building or feeding young, one individual (assumed to be male) appeared to have a more distinctive white eyebrow than its mate (pers. obs.). Whether one or both sexes incubated was not observed. Thus, captures were not sexed because, although there is a slight difference in size between sexes with adult males being significantly larger than females in wing length, there is considerable overlap in size ranges (Higgins and Peter 2002).

The two young birds captured were readily distinguishable from adults by their duller, browner plumage and lacking an eyebrow. One caught in December was beginning to moult from juvenile into immature plumage; its iris was dark grey brown. The plumage of the second young individual caught in February, was worn and more like that of adults but its iris was dark red brown unlike the dark brown of adults. Thus, juveniles moult a few months after fledging into a first immature plumage that is similar to adults, the timing of this being previously unknown (Higgins and Peter 2002).

Breeding was recorded during August-February. Nests were found under construction or complete but empty during August-September (n = 7), nests contained eggs during August-November (n = 12) and nestlings during September-February (n = 6). Eight birds had a brood patch (sexes undetermined) when caught; two in October (scale 3), two in November (scales 2, 3), three in December (scales 1, 2, 3) and one in January (scale 2). Fledged juveniles/immatures were seen during October (n = 2), December (n = 1) and February (n = 2). Wing flight feather moult started during October and was complete, or nearly so, by April-May. Tail moult started during September-October and was complete, or nearly so, by April-May. Flight feather and tail moult peaked during December-February. Body moult occurred during September-June. Most individuals carried some fat throughout the year, but some monthly samples were small.

Yellow-throated Scrubwren *Sericornis citreogularis cairnsi**

A total of 227 captures: 113 individuals (59 adult male, 53 female-plumaged of which 28 were confirmed females, and 1 immature) and 114 recaptures (all adults). Distances between capture sites of individual adults averaged 114 ± 49 (range 31–244) metres. A female-plumaged bird (not included in the above calculations) banded in September 1978 at SA2 was recaptured an exceptional 770 metres distant in January 1980. As this distance was so much greater than all others perhaps this individual was immature when banded (although juvenile traits were not noted) and was thus not territorial. When recaptured again in December 1980, still in female-plumage, it was 214 metres from its previous capture. The recapture rate was high (59%). Of 92 individuals banded in SA1 54 were recaptured: 42 individuals were retrapped once or twice, and 12 individuals three to five times (Table 4).

Seven males were caught at the same net site over a period of two (n = 3), three (n = 3) and seven (n = 1) seasons; and five females were similarly recaptured at the same net site over a period of two (n = 3), three (n = 1), five (n = 1) and nine (n = 1) seasons. The latter female had a brood patch when first caught, suggesting she was resident in the area. The banding to recovery period of this female was 7 years, 10 months, 8 days. That of one adult male was 6 years, 10 months, 3 days. This individual was caught at three net sites during this period, at a mean distance of 143 metres apart. The number of times that some individuals were recaptured at the same net site or at a nearby site(s) indicates a sedentary life style and suggests that these scrubwrens occupy relatively small home ranges or territories, at least when breeding.

Calculated mean annual survival rate of 93 individuals using Method 1 is 58 per cent, and using Method 2 is 61 per cent, indicating a mean expectancy of further life after banding of 1.9 and 2.1 years respectively (Table 8). These are possibly underestimates, however, resulting from few marked birds being recaptured during the latter part of the study.

All captures were of birds in adult plumage save one female-plumaged individual that had remnants of juvenile plumage and a brown iris (as opposed to the darker red-brown of adults). Although adults are sexually dimorphic, first year immature male plumage resembles that of adult females so that it is possible some captures identified as female may have been first immature males. Measurements in Table 5 are only for adult females whose sex was confirmed by the presence a brood patch (as only females incubate — Huggett 2000), or by age. Analysis of the large data set in Table 5 clearly shows a significant difference between the adult sexes, males being larger than females and significantly so in wing length, tarsus length and body weight ($P < 0.001$) and tail length ($P < 0.01$). Moreover, analysis of adult and first immature museum specimen data showed a significant difference ($P < 0.05$) in wing lengths and body weights between males and females, based on 10–13 birds of each sex (Higgins and Peter 2002). Because of considerable overlap in measurements and weights, however, these characters were not used to differentiate between first immature males and females.

Two nests (each being built by a pair of birds) were found, on 24 October and 3 November. Seven females had a brood patch when caught: one in November (scale 1), three in December (scales 2,2,3), and three in January (scales 1,3,3). An immature was caught in a net together with an adult female on 28 February, another immature was in the company of both parents on 22 February, and another was similarly escorted on 21 March. Active flight feather moult was not observed in any of the 62 individuals examined during September-October. The first signs of this moult occurred in November. One individual showed signs of tail moult as early as 8 August. Whilst this may have represented the replacement of accidentally lost feathers it could have been the start of tail moult as this has been recorded as early as July in this subspecies (Hall 1974). That said, six of 36 captures started tail moult in September, suggesting that tail moult starts before wing flight feather moult. Flight feather and tail moult were most active during January-March, and were complete, or nearly so, by April-May. Some body moult was noted during August-May. Birds carried some fat during most months of the year, but had more (scale 3) during October-December.

Large-billed Scrubwen *Sericornis magnirostris viridior**

A total of 246 captures: 130 individuals (104 unsexed adults, 18 adult females, 8 juveniles to first immatures) and 116 recaptures (111 adults and 5 first immatures). Distances between capture sites of individual adults averaged 110 ± 48 (range 25–230) metres. The recapture rate was 44 per cent. Of 111 individuals banded in SA1, 49 were recaptured: 24 individuals were retrapped once, 24 individuals two to six times and one nine times (Table 4).

Eighteen individuals were caught at the same net site over a period of three (n = 7), four (n = 4), five (n = 4), nine (n = 1) and 11 (n = 2) seasons. The four longest-lived individuals were banded as adults. The longest period between banding and last recapture of an individual was 11 years, 2 months, 23 days, it being caught 10 times at six different net sites averaging 119 ± 51 (56–175) metres apart. Another individual, last recaptured 10 years 10 months 9 days after banding (Anon 1991), was netted three times at two net sites approximately 25 metres apart. Similarly a third individual, a female, was last recaptured 10 years 27 days after banding, being netted four times at two net sites 138 metres apart. A fourth individual, last recaptured 10 years 11 days after banding (Anon 1992), was caught five times at four net sites at an average of 103 ± 60 (31–220) metres apart. One first immature individual, first caught in September 1983, was recaptured at the same net site the following year in adult plumage and was last recaptured in October 1989 at a net site 100

TABLE 8

Survival of 93 individually marked Yellow-throated Scrubwrens captured from August 1978–December 1989 in study area 1 on the Paluma Range, north-eastern Queensland.

Year[1]	Number of individuals banded	Number of individuals surviving 79/80	80/81	81/82	82	83/84	84	85	86	87	88	89	Totals
78/79	26	18	13	8	4	4	2	1	1	0	0	0	51
79/80	27		17	12	6	6	2	2	1	0	0	0	46
80/81	14			4	3	0	0	0	0	0	0	0	7
81/82	5				3	1	0	0	0	0	0	0	4
82	1					1	0	0	0	0	0	0	1
83/84	6						0	0	0	0	0	0	0
84/85	0							0	0	0	0	0	0
85	1								0	0	0	0	0
86	4									1	1	1	3
87	6										1	1	2
88	3											0	0
89	0												0
Total number of birds present	93	18	30	24	16	12	4	3	2	1	2		112
Total number of these birds present one year later	5	13	20	13	7	4	3	2	0	1	2		65
Annual survival (%)		72	67	54	43	33	75	67	0	100	100		61

[1]a banding year was from August to July; see Table 1.

metres from its first capture point. Two individuals banded by us were reported as being retrapped by others some four kilometres from our banding site (Anon 1991, 1992), but this is erroneous and results from a discrepancy in latitude and longitude recorded by the two parties (19°00'S, 146°10'E by us and 18°50'S, 146°08'E by others). The number of times that some individuals were recaptured at the same net sites or at a nearby net site(s) indicates their sedentary life style and suggests that these scrubwrens, which forage mainly in the understorey and subcanopy (*cf.* Frith 1984), hold relatively small territories at least when breeding.

Calculated mean annual survival rate of 108 individuals by Method 1 is 74 per cent and by Method 2 is 77 per cent, indicating a mean expectancy of further life after banding of 3.4 and 3.9 years respectively (Table 9). The latter figures are possibly underestimates, however, resulting from few marked birds being recaptured during the latter part of the study.

Eighteen of 122 adults banded were sexed as female by the presence of a brood patch because, although the incubation regime remains unknown for this species, only females of some other *Sericornis* do so (Higgins and Peter 2002). Although males have a longer wing, tail, bill and tarsus than do females (differences between the sexes being significant for some data sets for the subspecies *viridior*), other captures were not sexed because there is considerable overlap between the sexes in size ranges (Higgins and Peter 2002).

First immatures are difficult to impossible to separate from adults, although some may be recognized by their retention of juvenile plumage characters (Higgins and Peter 2002). The plumage of the eight young birds banded ranged from clearly having a juvenile plumage with softer feathering than that of adults, a conspicuous gape and/or a grey iris, through to more of an adult-like first immature plumage with some remnants of juvenile plumage and with a grey-brown to brown through to the more red-brown iris of adults.

Nineteen presumed females had a brood patch when caught: one in September (scale 1), five in November (all scale 2), eight in December (scales 1,1,1,2,2,2,3,3) and five in January (scales 2,3,3,3,3). Juveniles/immatures were mist-netted in December (n = 1), January (n = 1), February (n = 3) and March (n = 3). Parents of two young gave a distraction display close to the net. A juvenile/immature was also seen in the company of one or two adults on 21 January, 22 February, and one on 7 April was being fed by its parent(s). A nest in December contained an estimated week-old Fan-tailed Cuckoo *Cacomantis flabelliformis* — a common brood parasite of this scrubwren (Brooker and Brooker 1989; Jansen 1990).

Wing flight feather moult was not observed in the 117 captures examined during September-December, although in January 10 birds were all actively moulting them (Table 6). Tail moult started earlier than wing moult with 10 (of 117) individuals doing so during August-December. Wing flight feather and tail moult were most active during January-March, and complete, or nearly so, by April. Some body moult occurred during September-June. Individuals carried no fat during most of the year, but did (at scale 3) during September-January.

Brown Gerygone *Gerygone mouki mouki**

A total of eight captures: eight individuals, no recaptures. All individuals had adult plumage but were not sexed. Although there is no difference in plumage, adult males of the subspecies *richmondi* have a significantly longer wing and tail than adult females but it is not known if this is the case in other subspecies, including the nominate form, for which data are too few for meaningful analysis (Higgins and Peter 2002).

Two adults were observed at a nest entrance on 30 January but nest contents were unconfirmed, and on 20 March an immature was seen being fed by a parent as well as feeding itself. None of our captures had an apparent brood patch. Wing flight feather, tail, and body moult were

TABLE 9

Survival of 108 individually marked Large-billed Scrubwrens captured during August 1978–December 1989 in study area 1 on the Paluma Range, north-eastern Queensland.

Season[1]	Number of individuals banded	Number of individuals surviving											
		79/80	80/81	81/82	82	83/84	84	85	86	87	88	89	Totals
78/79	23	18	16	12	7	5	4	2	2	1	1	1	69
79/80	33		11	5	4	2	1	1	1	1	1	1	28
80/81	8			1	1	1	1	1	1	1	1	0	8
81/82	8				1	0	0	0	0	0	0	0	1
82	4					2	2	1	1	1	1	1	9
83/84	10						1	1	1	1	0	0	4
84/85	5							1	1	1	1	1	5
85	5								1	1	0	0	2
86	1									0	0	0	0
	8										2	2	4
88	1											0	0
89	2												0
Total number of birds present	108	18	27	18	13	10	9	7	8	7	7		124
Total number of these birds present one year later		16	17	12	8	8	6	7	7	5	6		92
Annual survival (%)		89	63	67	62	80	67	100	88	71	86		77

[1]a banding year was from August to July; see Table 1.

recorded in two individuals in February. One adult carried fat (scale 2) in January.

Mountain Thornbill *Acanthiza katherina**

A total of 37 captures: 30 individuals (27 unsexed adults, 3 adult females) and seven recaptures. Distances between capture sites of individual adults averaged 93 ± 50 (range 31–128) metres. The recapture rate was low (22%), with four of the five recaptures being recaught only once and one individual three times (Table 4). One adult female first captured with a brood patch in December 1986, was next recaptured at the same net site 8 years 9 months 21 days later. Three individuals banded during season 1979 were retrapped during season 1983, each at the same net site where banded. Our data indicate this is a sedentary species, as was suggested in the absence of evidence by Higgins and Peter (2002).

There is no discernible differences in plumage between the sexes. Only three of 30 adult individuals banded were sexed as females based upon their brood patch because, although the incubation regime remains unknown for this species, only females of some other *Acanthiza* species incubate (Higgins and Peter 2002). Other captures were not sexed, because there is considerable overlap between the sexes in size ranges (Higgins and Peter 2002), even though there appears to be a slight difference in size between the sexes, with adult males being significantly larger than females in wing length.

Two presumed females had a brood patch in October (both at scale 2) and one in December (scale 1). Two nests were found in November each with large young being fed by two adults. An adult was seen feeding a bronze cuckoo, *Chalcites* sp., on 13 October. Little moult was recorded in the 34 individuals examined, partly because no birds were captured during January-February when moult is most active (Higgins and Peter 2002). No wing flight feather moult was recorded, but one had new primaries in May. One individual had started tail moult in December and another was completing it in May, and body moult was recorded in November and in May. Most birds carried some fat (scales 2, 3) during November-December, but some monthly samples were small.

Lewin's Honeyeater *Meliphaga lewinii mab*

A total of seven captures: six individuals (adults) and one recapture two seasons later. Few birds were captured, possibly because this honeyeater mostly forages in the canopy (Frith 1984). There is no discernible difference in plumage between the sexes. Thus, captures were unsexed because, although adult males of this subspecies are significantly larger in wing tail, bill, and tarsus, there is considerable overlap between the sexes in size ranges (Higgins *et al.* 2001).

Little is known about the incubation regime in *Meliphaga* species, and none of our birds showed a brood patch. Single birds were seen nest building as early as 31 August and as late as 24 March, and a bird was sitting on a nest in November. Four birds were recorded in active wing flight feather, tail, and body moult in January. Two individuals during August, and one in March, had fat at scale 2.

Bridled Honeyeater *Lichenostomus frenatus**

A total of 83 captures: 60 individuals (47 unsexed adults, 13 adult females) and 23 recaptures. Distances between capture sites of individual adults averaged 110 ± 73 (range 75–300) metres. Recapture rate was 31 per cent. Of 52 individuals banded in SA1 only 16 were recaptured: 11 were retrapped once, and the rest two or three times (Table 4). The longest period between banding and recovery of an individual banded as an adult was 7 years, 6 months and 22 days, this being longer than previously recorded for the species (Higgins *et al.* 2001). The individual concerned, possibly a male (based on weight), was caught four times (March 1980, April 1980, November 1982, and October 1987) at two net sites 81 metres apart. A period of 5 years 10 months was also recorded for a female banded as an adult. It was caught at the same net site four times during November 1978 (with a scale 1 brood patch), November 1979 (with a scale 2 brood patch), May 1980, and September 1984. Thus data indicate sedentariness in this species.

Calculated mean annual survival rate of 52 individuals using Method 1 was 73 per cent and using Method 2 was 64 per cent, indicating a mean expectancy of further life after banding of 3.2 and 2.3 years respectively (Table 10). The life expectancy resulting from Method 2 is possibly an underestimation, however, resulting from few marked birds being recaptured during the latter part of the study.

This species is considered a sedentary resident, especially above 600 metres above sea level, although a proportion of the population is said to descend to lower altitudes in winter, or westward into drier areas (Higgins *et al.* 2001). On the Paluma Range, Bridled Honeyeaters may move west into ecotone habitat (rainforest and wet sclerophyll forest dominated by the Flooded Gum *Eucalyptus grandis*) during colder months (Dettman 1995). That birds do move between rainforest and ecotone habitats was substantiated by the fact that an individual first banded in ecotone habitat on 14 June 1982, by a Townsville banding group, was retrapped in SA1 on 2 December 1986 some 2.5 kilometres from its point of banding. Bridled Honeyeaters change their diet from a predominantly insectivorous one during wetter months to a predominantly nectarivorous one during colder drier months, when fewer insects are available (Frith 1984; Fig. 2b). Thus the movement of at least some birds from rainforest into the western ecotone during winter may occur because of a greater abundance of nectar in the latter at that time.

There is no discernible difference in plumage between the sexes. Thirteen of 60 adult individuals were sexed female on brood patch development. Although the incubation regime remains unknown for this species, only females of some other *Lichenostomus* species develop a brood patch (Higgins *et al.* 2001). Other captures were not sexed because, although males are significantly larger than females in wing, tail, bill and tarsus lengths and in body weight, there is considerable overlap between the sexes in size (Higgins *et al.* 2001).

On 26 September a bird was seen carrying lichen to a half completed, suspended nest approximately 11 metres above ground. On 14 October lichens and tendrils were being collected as nest material from below one metre

TABLE 10

Survival of 52 individually marked Bridled Honeyeaters during August 1978–December 1989 in study area 1 on the Paluma Range, north-eastern Queensland.

Season[1]	Number of individuals banded	Number of individuals surviving											
		79/80	80/81	81/82	82	83/84	84	85	86	87	88	89	Totals
78/79	11	3	2	2	1	1	1	0	0	0	0	0	10
79/80	19		10	8	7	5	4	2	2	1	0	0	39
80/81	3			0	0	0	0	0	0	0	0	0	0
81/82	3				1	1	1	1	1	0	0	0	5
82	2					0	0	0	0	0	0	0	0
83/84	3						1	1	1	1	1	0	5
84/85	2							0	0	0	0	0	0
85	3								0	0	0	0	0
86	1									0	0	0	0
87	3										0	0	0
88	2											0	0
89	0												0
Total number of birds present	52	3	12	10	9	7	7	4	4	2	1		59
Total number of these birds present one year later		2	10	8	7	5	4	4	2	1	0		43
Annual survival (%)		67	83	80	78	71	57	100	50	50	0		64

[1]a banding year was from August to July: see Table 1.

above ground near a road edge, and on 16 October another individual was collecting nest material. Fourteen presumed females had a brood patch when caught: one in September (scale 1), two in October (scales 2,2), nine in November (scales 1,1,1,2,2,2,2,2,3) and two in December (scales 2,2). On 19 October two fledglings were perched 3.6 metres high in a sapling with at least two adults feeding them at a fast rate, and on 29 October a young bird estimated to have been out of the nest one week was observed. Moult data were few. Wing or tail moult was not observed in 54 captures examined from September-November. Wing moult was recorded for only 1 individual in December and tail moult for another in February. Flight feather and tail moult was complete, or nearly so, in April-May. Body moult appears to start before that of wing or tail. One bird had some body moult as early as August, but seven others had body moult during December-May. Most captures carried some fat (scales 2–3) during September-December.

Eastern Spinebill *Acanthorhynchus tenuirostris cairnsensis**

A total of 29 captures: 22 individuals (20 unsexed adults, 2 females) and seven recaptures. Distances between the capture sites of individual adults averaged 141 ± 39 (range 100–188) metres. Recapture rate was 28 per cent, with four individuals being recaught once and one individual twice within two years of banding. Few birds were captured, mainly because they forage in the canopy and particularly in the upper half of it (Frith 1984).

Although females do differ slightly from males in head, neck, and underpart plumage, captures were unsexed save for two presumed females wearing a brood patch. Although females typically incubate one male is reported to have done so (Higgins *et al.* 2001). In the three other subspecies (*tenuirostris*, *dubius* and *halmaturinis*) adult males are significantly larger ($P < 0.01$) in all body measurements and weight than adult females and presumably this is the same for *cairnsensis*. Although unsexed, our sample of 29 captures adds considerably to the previously available biometrics of six individuals of this northern subspecies.

Nesting of this subspecies is mostly recorded for November-December but two females each had a scale 1 brood patch in September and another a scale 2 in January. Wing flight feather and tail moult occurred during December-March, peaking in January-February and being mostly to fully complete by March. No moult was recorded during July-November. Most birds carried fat (at scale 3) during November and January, but some monthly samples were small.

Pale-yellow Robin *Tregellasia capito nana**

A total of 38 captures: 32 individuals (28 unsexed adults, 2 adult females and 2 juveniles/immatures) and six recaptures (all adults). Distances between capture sites of individual adults averaged 119 ± 13 (range 113–137) metres. Recapture rate was 24 per cent, with four individuals being retrapped once and one individual twice within two years of banding.

There is no difference in plumage between the sexes but as only females incubate two of the 30 adults were confirmed female by the presence of a brood patch. Other captures were not sexed because, although males are larger than females, significantly so in wing, tail, and tarsus lengths, there is considerable overlap in size ranges (Higgins and Peter 2002).

One young bird, captured in February possessed a blackish bill grading to orange-yellow at its cutting edges, a dark grey iris and a distinct yellow gape as is typical of juveniles while another bird captured in January was in immature plumage, with rufous feathering and a grey-brown iris (unlike the darker brown of adults), and some rufous head feathering. Neither bird was moulting.

Nests containing eggs were found during September and October (n = 3). One capture had a scale 1 brood patch in October and another a scale 2 one in November. An adult was observed feeding a fledgling on 26 December and another doing so on 17 February. Two young were caught during January and February (see above), and a young bird was seen feeding itself on 27 February. Only

three of 33 captures had active moult; one in flight feather moult in December, one in tail moult the same month, and one in body moult in January. Most individuals caught during September-December carried fat of scales 2 or 3.

Grey-headed Robin *Poecilodryas (Heteromyias) albispecularis cinereifrons**

A total of 502 captures: 265 individuals (204 unsexed adults, 22 adult females, and 39 juveniles/immatures) and 237 recaptures (170 unsexed adults, 65 adult females, and 2 immatures). Adult recaptures included five (of 15) birds banded as nestlings (D. Frith and C. Frith 2000), eight in immature plumage, and the remainder as adults. Distances between capture sites of individual adults averaged 108 ± 60 (range 25–281) metres. Recapture rate averaged 39 per cent. Of 244 individuals banded in SA1, 94 were recaptured: 42 individuals were retrapped once, another 42 two to four times, and the remainder up to 10 times (Table 4).

The distance that 22 adults moved over 6–13 seasons averaged 97 ± 40 (range 44–175) metres and another six were recaptured at the same net site where they had been for seven, nine (n = 3), and 11 (n = 2) seasons. It would appear that older individuals, having once established a territory, move little distance (at least when breeding). The distance eight immatures, subsequently caught as adults, moved from their point of first capture averaged 139 ± 43 (range 100–233) metres, but the mean distance the five nestlings had moved from their nests to be recaught as adults was greater (mean = 200 ± 98; range 100–360 m). The number of times that some individuals were repeatedly recaptured at the same net sites, or a nearby one(s), emphasizes the sedentariness of this species.

The longest period between banding and recovery was 13 years 5 months 13 days, for an individual banded as a nestling (Anon 1993; D. Frith and C. Frith 2000). Another individual, banded as a nestling, was retrapped 12 years 15 days later. Four birds banded in adult plumage were last retrapped 11 years 2 months 14 days, 11 years 2 months 19 days, 11 years 4 months 4 days and 12 years 3 months 15 days later. Four of the above six individuals were last retrapped by other banders (Anon 1991, 1992, 1993). We note that reports by other banders indicate birds were retrapped at least four kilometres from their banding site but a discrepancy in latitudes and longitudes (19°00'S, 146°10'E by us and 18°50'S, 146°08'E by others) is responsible for these erroneously supposed bird movements.

Calculated mean annual survival rate of 100 individuals using Methods 1 and 2 is 77.5 per cent and 78 per cent, indicating a mean expectancy of further life after banding of 4.0 and 3.0 years, respectively (Table 11). These are possibly underestimations, however, resulting from few marked birds being recaptured during the latter part of the study.

There is no discernible difference in plumage between the sexes. Twenty-two of 226 adult individuals were sexed as female by the presence of a brood patch when first caught or recaptured. Others were not sexed because, although adult males average significantly larger than adult females in wing, tail, bill, and tarsus length and in body weight, there is much overlap between size ranges (Higgins and Peter 2002).

The plumage of the 41 young birds caught ranged from a juvenile one with softer feathering, rufous-brown feathering on the head, a gape and/or grey to dark grey iris, through to a more adult-like first immature plumage retaining juvenile remiges, rectrices, and a few other characters including distinctive brown tipping to retained juvenile secondary coverts (Higgins and Peter 2002). Two young birds caught in January with obvious traces of juvenile plumage were in active wing and body moult, and two others caught in February-March had active wing, tail, and body moult, suggesting they were moulting into first immature plumage. One young bird caught on 15 January still had rufous feathering on the head but lacked this when retrapped on 19 March. Four first immatures wore adult plumage the following season.

TABLE 11

Survival of 100 individually marked Grey-headed Robins captured from August 1978–December 1989 in study area 1 on the Paluma Range, north-eastern Queensland.

Season[1]	Number of individuals banded	Number of individuals surviving											
		79/80	80/81	81/82	82	83/84	84	85	86	87	88	89	Totals
78/79	51	38	26	20	18	17	14	12	12	9	7	4	177
79/80	20		17	13	9	8	6	4	4	3	3	2	69
80/81	5			5	3	3	1	1	1	0	0	0	14
81/82	4				4	2	0	0	0	0	0	0	6
82	1					0	0	0	0	0	0	0	0
83/84	5						4	2	1	1	1	1	10
84/85	4							4	4	3	2	2	15
85	2								2	1	1	1	5
86	2									2	2	1	5
87	3										3	2	5
88	1											1	1
89	2												0
Total number of birds present	100	38	43	38	34	30	25	23	24	19	19		293
Total number of these birds present one year later		26	33	30	30	21	19	22	17	16	13		227
Annual survival (%)		68	77	79	88	70	76	96	71	84	68		78

[1]a banding year was from August to July; see Table 1.

Nesting begins on the Paluma Range in late August-early September, peak breeding months being September-November (D. Frith and C. Frith 2000). Only females incubate. Thirty one female captures had a brood patch when caught: two in August (scales 1,1), three in September (scales 1,1,1), eight in October (scales 1,1,1,1,2,2,3,3), eleven in November (scales 1,1,1,1,1,2,2,3,3,3,3), five in December (scales 1,2,2,2,2) and two in January (scales 1,2). Wing flight feather moult started in November and continued through to April, by which time it was complete or nearly so. Tail moult started earlier, in September, and continued through to April when complete or nearly so. Flight feather and wing moult peaked during January-March. Body moult was recorded during September-May. Birds carried some fat throughout most months but more so (scale 3) during August-November.

Chowchilla *Orthonyx spaldingii spaldingii**

A total of 11 captures: nine individuals (2 adult males, 7 adult females) and two recaptures. Few of this common bird were caught because they are difficult to capture in mist nets (Jansen 1993; Frith *et al.* 1997). Both recaptured individuals were caught at the same net site as their original capture, the male 7 months 26 days later and the female 2 years, 8 months and 23 days later, emphasising the sedentary nature of older, territorial birds.

Adults are sexually dimorphic, with males being significantly ($P < 0.01$) larger than females in wing, tail, bill and tarsus lengths and exclusively so in body weight by being up to 50 gram heavier (Jansen 1993; Frith *et al.* 1997; Table 5).

This species breeds during most of the year, with Paluma nesting peaking during July-December (Frith *et al.* 1997). Thirty active nests were examined during May-January. The nestling of a January nest fledged on 3 March. Females only incubate and individuals were recorded with a brood patch during August (scale 3), September (scale 1), November (scale 3), and December (scale 2). Juveniles, identified by their lack of adult throat and breast colour and rich variegated rufous, mottled plumage with conspicuous black/rufous wing bars, were observed associating with an adult pair or a flock during August (n = 2), September (n = 1), November (n = 2) and December (n = 3). Single immatures, being browner than adults and retaining some juvenile wing and tail plumage and a few rufous-brown feathers on the head and/or distinct wing bars, were observed in flocks during February, September and November. Two of these immatures had the full white throat and breast of adult males and the third the rufous one of adult females. Little moult information is available and our data are few, with one male and one female showing some wing moult in December. Another female had one new central tail feather 14 millimetres long and in pin in August, but whether this was due to accidental feather loss or the start of annual moult is unknown. Only two females were noted carrying fat (scale 2), one in August and the other in December.

Eastern Whipbird *Psophotes olivaceus lateralis**

A total of 11 captures: seven individuals (4 unsexed adults, 3 adult females) and four recaptures. As only females incubate, three individuals (two later retrapped once) were confirmed as female by their brood patch. Distances between capture sites of individual adults averaged 105 ± 53 (range 31–156) metres. The longest period between banding and recovery is 7 years, 2 month and 17 days for a female first banded in adult plumage and retrapped by another bander (Anon 1991). The distance that this individual was recaptured from its point of banding was less than 150 metres and not at least four kilometres as reported, this error resulting from a discrepancy in latitudes and longitudes (19°00'S, 146°10'E by us and 18°50'S, 146°08'E by others).

There is no discernible difference in plumage between adult sexes. Captures were not sexed because, although adult males are significantly larger than females in tail length and body weight, there is considerable overlap in size ranges (Higgins and Peter 2002).

A nest containing one egg was found on 23 September, and another containing two young with their primaries just bursting from pin on 12 September. Nest building was recorded once in November. Three times during November newly-fledged to half fully grown young (1 or 2) were observed accompanying an adult(s), and during March a large immature accompanied an adult. Two captures had a brood patch during September (scales 1, 2) and another in October (scale 3). No moult was recorded in July (n = 2) or during September-November (n = 7), but a single March bird had active wing flight feather and tail moult. Fat was carried (scales 2 and 3) in March, and September-November.

Golden Whistler *Pachycephala pectoralis pectoralis*

A total of 44 captures: 28 individuals (10 adult males, 4 adult females, and 14 unsexed female-plumaged) and 16 recaptures (1 adult male, 14 adult females and 1 unsexed female-plumaged). Distances between capture sites of individual adults averaged 130 ± 41 (range 81–220) metres. Recapture rate was 21 per cent. Of 24 individuals banded in SA1 only five were recaptured: four were retrapped only one to three times but the fifth bird, a female of unknown age, was retrapped eight times, the last time 11 years after banding (Table 4). During this period she was retrapped at four adjacent net sites at a mean distance of 110 ± 272 (range 81–160) metres apart, and had a brood patch during three breeding seasons.

Adults are sexually dimorphic, but males do not attain adult plumage until early in their third year and some may not do so until early in their fourth (Higgins and Peter 2002). As males sometimes breed in immature plumage and, because both sexes incubate and develop brood patches (Rogers *et al.* 1986), only 4 of the 18 female-plumaged captures were confirmed as female by their still possessing female plumage when recaptured during a subsequent season(s). Other captures in female-plumage were unsexed because, although second year immature and adult males are significantly larger in wing and tail length than females of this subspecies, there is considerable overlap in size ranges (Higgins and Peter 2002).

Four females had a brood patch when caught: two in November (scales 2,2) and two in January (scales 2,2). Two

nests were being built in November, each by a female-plumaged individual, and on 7 December a nest containing two eggs was found. These hatched the following day. A female was feeding a young bird on 15 February. In July one individual had two newly partly-grown tail feathers, possibly due to accidental feather loss. One individual had started tail moult in November and another in December. Wing flight feather and tail moult peaked during January-February and by May was complete. Most individuals carried some fat throughout the year, with larger amounts (scale 3) during September-November, although samples were small or lacking for some months.

Bower's Shrike-thrush *Colluricincla boweri**

A total of 90 captures: 57 individuals (14 adult males, 13 adult females, 26 unsexed female-plumaged, and 4 immature males) and 33 recaptures (adults). Distances between capture sites of individual adults averaged 130 ± 53 (range 35–250) metres. Recapture rate was 38 per cent. Of 50 individuals banded 19 were recaptured: 18 individuals were retrapped only once or twice, but one individual female was recaptured five times during four seasons at four net sites averaging 131 ± 53 (range 100–175) metres apart. The longest period between banding and recovery was 8 years 10 months 25 days for an adult female, which was caught at two net sites 138 metres apart. Another female was recaptured at the net where it was banded, seven years later. These results indicate the sedentary nature of these individuals.

Calculated mean annual survival rate of 24 individuals from 1978–1988, based upon four net sites in SA1 only, was 50 per cent (C. Frith and D. Frith 1990). Updating these figures to include captures for all net sites in SA1 (n = 50) increases this figure to 76 per cent using Method 1 and 59 per cent using Method 2, resulting in a mean expectancy of further life after banding of 2.4 and 1.9 years respectively (Table 12).

Adults are sexually dimorphic. Females have a pale bill and retain the apparently juvenile characters of a rufous superciliary stripe, pale eye-ring feathers, and rufous lores. Adult males have no superciliary stripe and have pale greyish lores, grey eye-ring feathers, and a black bill (C. Frith and Frith D. 1990). As only females incubate, 13 of 39 female-plumaged individuals were confirmed as adult by the presence of a brood patch (when first caught or retrapped). However, 26 female-plumaged individuals could not be sexed as there is little variation in sizes and body weights between sexes, or between birds of different ages (Higgins and Peter 2002; Table 5). Moreover, immature males retain female plumage characters for more than a year, with the female-like grey bill darkening with age (C. Frith and D. Frith 1990; *pace* Higgins and Peter 2002). Four immature males had the bill black (as of adult males) but also had traces of rufous in their brows and lores. One of these was banded in October 1981 but when retrapped in October 1983, and again in September 1984, still had a slight rufous wash to the feathers from nostrils back to over the eye. This latter situation is similar to that in Grey Shrike-thrushes *C. harmonica*, in which birds do not attain full adult plumage until at least their third year (Disney 1974).

Breeding occurs from September-January (C. Frith and D. Frith 1990). Only females incubate. Fourteen females had a brood patch when caught: one in September (scale 2), one in October (scale 2), six in November (scales 1,2,2,2,2,3), five in December (scales 1,2,2,2,3) and one in January (scale 1). Nests (n = 15) were found containing eggs or young during October-January, fledglings being seen during January-February. One individual had started tail moult in September, and in November another showed tail moult and yet another some wing flight feather moult. Most birds showed wing flight feather and tail moult during December-March, this peaking in January-February. Slight body moult was recorded in April. Most individuals carried some fat throughout the year, with larger amounts (scale 3) during September-November, but samples were small or lacking for some months.

TABLE 12

Survival of 50 individually marked Bower's Shrike-thrushes captured from August 1978–December 1989 in study area 1 on the Paluma Range, north-eastern Queensland.

Season[1]	Number of individuals banded	Number of individuals surviving											
		79/80	80/81	81/82	82	83/84	84	85	86	87	88	89	Totals
78/79	9	3	1	1	0	0	0	0	0	0	0	0	5
79/80	25		5	4	4	4	3	1	1	0	0	0	22
80/81	3			1	1	0	0	0	0	0	0	0	2
81/82	2				1	1	1	0	0	0	0	0	3
82	0					0	0	0	0	0	0	0	0
83/84	1						0	0	0	0	0	0	0
84/85	4							0	0	0	0	0	0
85	1								1	0	0	0	1
86	1									1	1	0	2
87	2										0	0	0
88	1											0	0
89	1												0
Total number of birds present	50	3	6	6	6	5	4	1	2	1	1		35
Total number of these birds present one year later		1	5	5	5	4	1	1	0	1	0		23
Annual survival (%)		33	83	83	83	80	25	100	0	100	0		59

[1]a banding year was from August to July; see Table 1.

Yellow-breasted Boatbill *Machaerirhynchus flaviventer secundus**

A total of three adult captures: a female in June, a male in August, and a female in September. Adult sexes are similar in plumage, but females are paler and duller than males overall, and similar in size and weight, except for tarsus length which is significantly longer in males than in females in this subspecies (Higgins and Peter 2005), but our data are too few to confirm this (Table 5).

Boatbills were rarely sighted and it could not therefore be ascertained whether they moved to open-forest during March-June, as occurs on the Atherton Tableland (Bravery 1970). This subspecies is known to breed during August-January, but no nests were seen. No brood patch or moult was recorded, but the June and August individuals had some fat (scale 2).

Black-faced Monarch *Monarcha melanopsis*

A total of three adult captures: in December, January and February. Whilst there is no discernible difference in plumage between adult sexes, male wing, bill and tail are significantly longer than those of females (Higgins and Peter 2005) but our data are too few to use this in sexing captured birds.

This is a summer breeding visitor about Paluma from mid September-late March/April (Griffin 1995). Breeding is known during November-February (Lavery *et al.* 1968) but no nests were seen, and captures lacked brood patches. None was moulting, but December-January individuals carried fat (scale 2).

Spectacled Monarch *Monarcha trivirgatus melanorrhoa*

A total of 21 adult captures: 19 individuals (adults) and two recaptures. Recapture rate was 11 per cent, both individuals concerned being recaptured at their banding net site within a single season. There is no discernible difference in plumage between adult sexes. Captures were not sexed because, while the wing of males is significantly longer than in females and the tarsus of females is longer than in the males in this subspecies, there is considerable overlap in size ranges (Higgins and Peter 2005). The presence of a brood patch is not a criterion for sexing because incubation roles of the sexes remain unconfirmed. Both probably incubate, as in other monarchs for which data are available (Boles 1988).

Birds were mist-netted only during September-February, because this species apparently moves to lower altitudes in winter (Griffin 1995; herein). Nests were under construction during December (n = 3) and contained eggs during November-December (n = 2). One capture had a brood patch in January and two in February. A bird in immature plumage (similar to adults but with a greyer face) was seen on 22 February. Tail moult was noted in one individual in November and another in December. Individuals mostly carried fat (scale 2) from November-February, but monthly samples were small.

Rufous Fantail *Rhipidura rufifrons intermedia*

A total of 109 captures: 63 individuals (60 adults, 3 juvenile/first immatures) and 46 recaptures (adults). Distances between capture sites of individual adults averaged 141 ± 56 (31–269) metres. An adult first caught in November 1978 was subsequently caught an exceptional 500 metres distant in January 1979, and again in March 1980. As this distance (not included in the above calculations) is considerably greater than those recorded for other adults it may have been returning to the Paluma Range for the season (see below). Recapture rate was 33 per cent, and whilst 15 of 19 individuals were recaptured once or twice, two were recaptured four times, one individual seven and another 10 times (Table 4). The individual captured 10 times involved five net sites at an average distance of 156 ± 59 metres apart (a banding and recovery period of 5 years 2 months 6 days). Even within one season the same individual was caught at three adjacent net sites during October-November at an average distance of 189 ± 75 metres apart. Another two individuals, also adult when banded, were recaptured 4 years 1 month 27 days and 4 years 11 months 4 days later. One of these individuals was captured seven times at two net sites (being caught at both net sites during 2 seasons) only 113 metres apart, and the other five times also at two net sites 125 metres apart. The recaptures of some individuals clearly emphasizes the sedentariness of the species, at least during the breeding season.

There is no discernible difference in plumage between adult sexes. Captures were not sexed because, although wing and tail measurements of this subspecies are significantly longer in adult males than in adult females, there is considerable overlap in size ranges (Higgins and Peter 2005). As both sexes incubate (Boles 1988) the presence of a brood patch is not a criterion for sexing.

The three young birds captured on 18 February, 28 March and 3 April had a dark brown iris similar to that of adults. The March bird was juvenile but with its breast and abdomen still downy and a tail two thirds grown. Its upper breast was rufous-grey and not mottled, legs pale purplish-flesh, and bill blackish. The April bird had all the juvenile characteristics, with distinctly rufous upperparts, blackish mottling on the upper breast, and pale purplish-flesh legs. Its upper mandible was brownish and the lower one yellowish brown. The February bird was adult-like but with remnants of rufous edging to feathers, dark greyish bill, and greyish-flesh legs.

Paluma Range birds move to lower altitutudes in winter, whilst others may be passage migrants. Birds are most frequently seen during November-December (*pace* Griffin 1995) through to March. A brood patch (scale 1) was recorded for four individuals in January and three in February. A nest was being built in November, and four times in March an adult together with a juvenile/immature were seen. A young bird was caught in each of February, March, and April (see above). Our moult data are few. One individual was commencing wing moult in November and two more in December. One individual was in wing moult in January. In April at least nine of 15 captures had completed moult. Individuals mostly carried fat (scale 2) from November-March.

Grey Fantail *Rhipidura albiscapa (fuliginosa) keasti*

A total of 90 captures: 64 individuals (52 adults, 12 juveniles to first immatures) and 26 recaptures (all adults). Distances between capture sites of individual adults averaged

133 ± 38 (31–200) metres. Recapture rate was 26 per cent with 14 of 15 birds being recaptured only once or twice, although one, possibly a female, was recaptured six times. The period between banding and recovery for the latter individual, banded in adult plumage, was 6 years 1 month 20 days. It was caught at four net sites during different seasons at an average 147 ± 47 (100–200) metres apart. Another individual, also banded as an adult, was caught three times during three seasons at the same net site and was last caught 5 years 1 month 8 days after banding. Recaptures emphasize the sedentariness of this species.

There is no discernible difference in plumage between the sexes. Captures were not sexed because, although the wing of adult males is significantly longer than that of adult females in this subspecies, there is considerable overlap in size ranges (Higgins and Peter 2005). Moreover, according to Rogers *et al.* (1986), only females, identified on measurements and cloacal condition, develop a brood patch but as both sexes do incubate (Boles 1988; Higgins and Peter 2005) this criterion was not used to sex birds.

The plumage of the 12 young birds captured ranged from clearly juvenile, with conspicuous rufous feathering with grey legs and grey-brown iris, through to a more adult-like first immature plumage with remnants of rufous feathering and with darker grey to brownish-black legs and the dark brown iris of adults (Higgins and Peter 2005).

Grey Fantails resident throughout the year are very dark, almost black, but paler birds (probably migrants from the south) winter in this area between April and August or early September of most years (Griffin 1995). No individuals were recorded as being paler during this study but the possibility that some captures may have been migrants cannot be overlooked. Birds were caught every month of the year except May, possibly due to fewer netting hours during that month. One capture had a brood patch during October (scale 1), four in November (scale 1,2,2,3) and one in December (scale 1). One newly-fledged juvenile was caught on 6 December and 11 other juveniles to first immatures from 10 January–19 March. A bird was carrying nest material on 28 October, one bird was seen incubating/brooding on 16 November, a pair completing a nest on 2 December, and an adult with an adult-sized fledgling was sighted on 3 February. One individual was caught as early as August with only six tail feathers, all of which were worn, but whether it had started to moult or its feather loss was accidental was unknown. Five captures had some tail moult in September (n = 1), October (n = 3) and November (n = 1). Flight feather moult was not recorded during September-December. Body moult was recorded from August-March. All March captures were actively in tail, wing and body moult. Most individuals carried some fat during September-November.

Victoria's Riflebird *Ptiloris victoriae**

A total of six captures: five individuals (1 adult male, 1 adult female and 3 unsexed female-plumaged birds) and one recapture with a brood patch and thus female. It was retrapped 100 metres from its banding location 3 years, 6 months and 23 days later. The longest period of life was for a male that took a minimum of, and doubtlessly much longer than, 3.3 years to acquire adult plumage and survived at least 15 years before being killed by a domestic cat in Paluma. Because this species primarily forages in the subcanopy/canopy (Frith 1984; Grant and Litchfield 2003) few were mist-netted.

Black-eared Catbird *Ailuroedus melanotis maculosus**

A total of 102 captures: 75 individuals (16 adult males, 22 adult females and 37 unsexed adults) and 27 recaptures. Seventeen nestlings were also banded but none recaptured (Frith and Frith 2001b). Excluding 21 captures at nests the remaining 81 (57 individuals and 24 recaptures) were caught at standard or random net sites. At these, 14 individuals were retrapped once and five twice. Six recaptures were originally banded as adults at nests.

Many catbirds were netted because they forage in the understorey and on the ground and because sometimes they attack and eat small birds entangled in mist nets (Frith and Frith 2001b, 2004). Catbirds were also netted around Paluma Township. The combined data is published elsewhere (Frith and Frith 2001a, 2001b, 2001c, 2004).

Tooth-billed Bowerbird *Scenopeetes dentirostris**

A total of 74 captures: 50 individuals (28 adult males, 9 immature males, 13 unsexed adults) and 24 recaptures (Frith and Frith 2001c). Of a total 74 captures only 37 (23 individuals and 14 recaptures) were at standard net sites, all others being caught at random nets erected at the courts of males. At the standard net sites six individuals were captured once, one caught twice and two caught three times. Four recaptures were of individuals banded at courts. Most recaptures were male court owners at courts close to our standard net sites, or of visitors to them. For further information on banding, biometrics, moult, survival, longevity, breeding and seasonality see Frith and Frith (2001a, 2001c, 2004).

Golden Bowerbird *Prionodura newtoniana**

A total of 175 captures: 109 individuals (36 adult males, 4 subadult males, 27 immature males, 12 confirmed females, 30 unsexed female-plumaged birds) and 66 recaptures. Of these only 30 captures (22 individuals and 8 recaptures) were caught at standard net sites, all others being caught at bowers or nests. At standard net sites five individuals were retrapped once and one retrapped three times. Three recaptures were originally banded at bowers. For further information on banding, biometrics, moult, survival, longevity, and breeding see Frith and Frith (1998, 2001a, 2001c, 2004).

Satin Bowerbird *Ptilonorhynchus violaceus minor**

Two individuals caught: one adult male at a Golden's Bowerbird bower that it was visiting to steal lichen decoration for its own bower and a female-plumaged individual caught at a standard net site on 9 October 1985. The latter individual had begun moulting body plumage and had one secondary missing. It was retrapped in adult male plumage on 1 October 2002, 16 years 11 months 22 days after being banded, at a bower approximately two kilometres from where it was originally banded (Anon 2002). Although this is the longest period of life recorded for the northern subspecies *minor* such longevity is not

unusual for the nominate southern form, of which some individuals survive greater than 20–30 years (Anon 2003; Frith and Frith 2004).

The subspecies *minor* breeds from August-February (Frith and Frith 2004). On the Paluma Range three nests were found containing eggs, on 3 November, 22 November, and 23 January. These nests had one to three day old nestlings in them on 10 November, 4 December, and 30 January respectively. Although the latter nest was not subsequently examined its single nestling, if successful, would have fledged in mid-February. A female was tending a well-plumaged fledged immature on 20 April.

Bassian/Russet-tailed Thrush *Zoothera* species

A total of eight captures: six individuals (adults) and two recaptures. Recaptures were caught 119 metres and 56 metres distant from their original point of capture within two years of banding. At the start of this study the then White's (Scaly) Thrush *Zoothera dauma* was considered the only *Zoothera* species in Australia (Schodde 1975), but this was subsequently split into the Russet-tailed *Z. heinei* and Bassian Thrush *Z. lunulata* (Ford 1983; Holmes 1984; Schodde and Mason 1999), the pertinent subspecies of each in the Atherton Region being *Z. h. heinei* and *Z. l. cuneata* respectively. Both species have been identified, by their calls, in upland rainforests of the Paluma Range (Griffin 1985).

Bassian Thrushes have a notably longer wing and tail than Russett-tailed Thrushes (Ford 1983). Based on these criteria, in particular wing length, our eight captures would be Bassian Thrushes and it is, therefore, for this species that data are given in Table 5. However, the possibility that data include one or more Russet-tailed Thrushes cannot, however, be ruled out because *Zoothera* thrushes have been seen during all months of the year on the Paluma Range, and both species may breed there (*cf.* Griffin 1995).

One individual mist-netted during September had a small brood patch. A nest was found on 30 October containing two eggs that hatched on approximately 13 November, and another on 7 December containing two nestlings ready to fledge. Birds were also observed sitting on nests on 6 November and 8 January but nest contents were unconfirmed. On 16 February a juvenile, one to two weeks out of nest, was accompanied by its parents.

CONCLUSION

Capture rates

It is widely acknowledged that it is difficult to compare capture rates between long-term mist-netting studies because of differing avifaunas, climates, habitats, numbers, sizes and placement of nets, and periods that nets were erect each hour/day/month/year. For example, such difficulties in attempting to compare capture rates resulting from a study in forests of the Southern Highlands of Papua New Guinea with those performed in lowland rainforests of Brown River near Port Moresby in that country are discussed by Frith and Frith (1993). Similarly it is equally difficult to compare capture rates from the present study with other long-term ones carried out elsewhere in Australia. Firstly, other published long-term banding projects in Australia have been carried out in drier sclerophyll habitats and, secondly, data are analysed by different methods to suit the specific aims of the studies in question (e.g. those of Hardy and Farrell 1990 and Leishman 2000). Because of variability in monthly and annual netting patterns, and resulting samples, standardising data (as did Tidemann *et al.* 1988) provides, however, an accurate means of comparing capture rates.

Results of the present study demonstrate that (a) capture rates were higher at nets located at sites within relatively dense undergrowth (sites 1, 3 and 4); (b) monthly capture rates were highest during September-December, when pairs establish or re-establish territories and breed (Table 3); (c) daily capture rates were highest during the morning (0630–1030) and afternoon (1630–1830), and (d) there was considerable variation in capture rates between years, particularly during breeding seasons, in relation to relative availability of arthropod food resources that correspond to wet season rains or the relative severity of dry seasons (Fig. 2).

Seasonality

Breeding seasons of north-eastern Queensland birds are well documented (Lavery *et al.* 1968; Lavery 1986; HANZAB volumes) with relatively small differences in the altitude of rainforest affecting the start of annual nesting. For example, on the Atherton Tableland, where seasonal temperatures increase earlier and heavier winter rains fall ensuring greater leaf litter invertebrate abundance (Jansen 1993; Frith *et al.* 1997), the nesting of birds such as Grey-headed Robins and Black-eared Catbirds begins three to four weeks earlier than on the Paluma Range (D. Frith and C. Frith 2000; Frith and Frith 2001b).

The Paluma Range avifaunal breeding season typically starts in late August-early September, as annual temperatures initially rise (Fig. 2a). Peak nesting is during late September-December when temperatures and rainfall increase and flowers, fruit, flying insect, and leaf litter invertebrate foods are annually most abundant (Frith and Frith 1985; D. Frith and C. Frith 1990; Fig. 2a, 2b). As a generalisation, eggs are mainly laid during late September and October and nestlings are present during November-December. However, Chowchillas start annual egg laying as early as May (Frith *et al.* 1997) and Fernwrens in July (Higgins and Peter 2002; herein). That these two species forage on the ground almost exclusively upon invertebrates, which remain relatively abundant during the drier, colder months of May-July, may be significant (Frith 1984; D. Frith and C. Frith 1990; Jansen 1993; Frith *et al.* 1997; Fig. 2b). Yellow-throated Scrubwrens, which also forage predominantly on the ground, do not, however, start to breed until September (Higgins and Peter 2002) but it is possible their later nesting reflects foraging techniques and diet. Heavy rains during January-February reduce or bring to an end nesting activities, with most nestlings departing nests immediately prior to or during early wet season rains. Annual food resources typically peak as newly fledged offspring are provisioned by their parent(s), and birds are moulting.

Annual flight feather and wing moult predominantly occurred during December to March on the Paluma Range, it being most active during the wetter months of January to March (Frith and Frith 2001c; Fig. 3). For some species

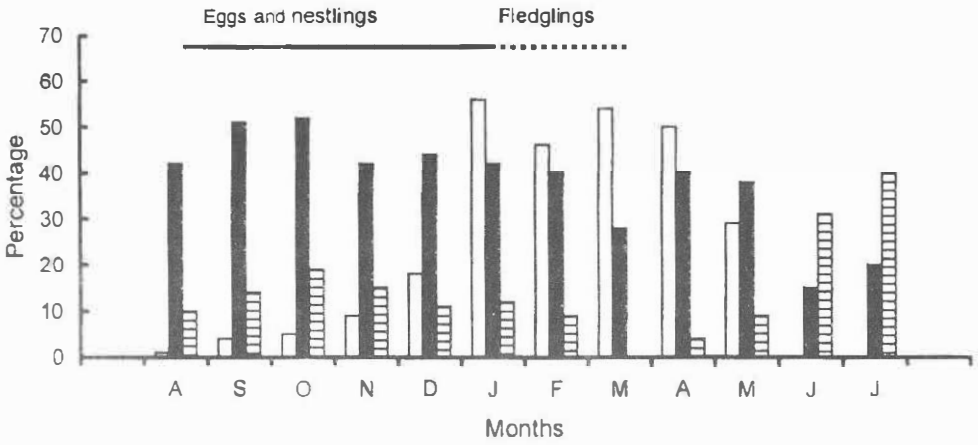

Figure 3. *The percentage of adult birds, involving the 14 most frequently captured bird species (Table 4), in moult (white column), with a fat deposit scale 2 (black column) and scale 3 (striped column) during a banding year (August-July) on the Paluma Range, north-eastern Queensland. The months that eggs and nestlings were mostly present in nests are denoted by a solid black line, and the months that fledglings were mostly seen by a dotted line.*

tail moult commenced before wing flight feather moult, as early as September-October. Body moult began before that of wing and tail, as early as August for some species, peaked during December-March, and was complete by late May or June.

Subcutaneous fat increased in birds at the start of their breeding seasons, peaked during September-October when most species were incubating, and decreased during November-January when nestlings and fledglings were being provisioned (Fig. 3). Toward the end of the moult fat loads increased, immediately prior to the annual dry (leaner) winter. A similar fat load cycle is described for bowerbirds of the area (Frith and Frith 2001c). Some species (e.g. Fernwrens, Yellow-throated Scrubwrens) carried greater fat loads (scale 3) during June-July and, although monthly samples were small, this might be related to a relatively greater abundance of leaf litter invertebrates at that time of year.

Sedentariness

Capture locations of species more frequently recaptured (Table 4) indicate that many are relatively sedentary, as has been found to be typical of many species by other long-term Australian banding studies in drier sclerophyll forests. It is clear from such studies, and other sources such as the 'Recovery Round-up' pages in *Corella* and records summarized in Baker *et al.* (1999), that many small passerines, especially those of woodlands and forests, exhibit high site-fidelity. For example scrubwrens, thornbills, robins, whistlers, and fantails may remain within a small area for many years (Marchant 1982; Wilson 1994; Huggett 2000; Higgins and Peter 2002). Results of this study also clearly indicate this. Rufous Fantails, present on the Paluma Range only during the summer months, return to the same location there to remain sedentary during each breeding season.

High recapture rates were notably typical of species that forage predominantly upon, or near to, the forest floor and within the understorey (Table 4). Given the sedentary nature of most rainforest understorey species, and their relatively high densities, most of each year's offspring must disperse from their natal territory or perish (Bell 1982a, 1982b). Thus, newly-banded juvenile and immature birds showed a lower recapture rate than adult birds at our net sites. Individual birds recaptured more frequently than others were invariably longer-lived ones. This emphasizes the sedentary nature of older and territorial birds.

Survival and longevity

Based on long-term banding projects, mostly in sclerophyll woodlands and forests, several studies detail the survival rates of various Australian passerines. Survival rates resulting from these studies are, however, particularly difficult to compare when estimates are derived from different methods of capture and analysis (Brown *et al.* 1990; Rowley and Russell 1991). Australian passerines are typically often long lived (Fry 1980; Brown *et al.* 1990; Rowley and Russell 1991; Yom-Tov *et al.* 1992; Baker *et al.* 1999). Results presented herein further substantiate this, as does work on bowerbirds (Frith and Frith 2001c, 2004). Such high survival rates are typical of Australian passerine birds living in relatively stable environments with year-round availability of food (Woinarski 1985; Yom-Tov 1987; Karr *et al.* 1990; Yom-Tov *et al.* 1992; Martin 1996).

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