Amytornis
WESTERN AUSTRALIAN JOURNAL OF ORNITHOLOGY
Volume 2 (2010) 15-24
ARTICLE

Notes on the moult and biology of the Red-headed Honeyeater (*Myzomela erythrocephala*) in the west Kimberley, Western Australia

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Abstract. The Red-headed Honeyeater (*Myzomela erythrocephala*) is a bird of the mangrove forests of coastal northern Australia. Many aspects of its biology are poorly known. This article reports the findings of an eight-year banding study involving the capture of 627 Red-headed Honeyeaters at a west Kimberley site. Data from these birds and the 243 recoveries that occurred revealed some interesting and previously unknown aspects of Red-headed Honeyeater breeding and moulting biology, including a correlation between gape colour change and breeding status in adult females. The study also indicates the need for further research into breeding activity, male gape colour changes, wing moult strategies and the development of juvenile males into adults in Red-headed Honeyeaters.

Keywords. Meliphagidae, nectarivore, banding study, breeding biology

Introduction

The Red-headed Honeyeater (*Myzomela erythrocephala*) occurs in the monsoonal coastal zone of northern Australia from the west Kimberley to the Cape York Peninsula, mostly inhabiting mangrove forests and nearby thickets and scrub (Johnstone 1990; Higgins *et al.* 2001). Whilst widely dispersed within this region, the reporting rate in the New Atlas of Australian Birds is relatively low; less than 20% in sites where at least 15 surveys were conducted (Barrett *et al.* 2003).

Few banding studies have been conducted on Red-headed Honeyeaters. A species search on the Australian Bird and Bat Banding Scheme (ABBBS) website (http://www.environment.gov.au/biodiversity/science/abbbs/) reveals that only 1634 birds have been banded since 1984, yielding 515 recoveries. The description of the Red-headed Honeyeater in Higgins *et al.* (2001) indicates several aspects of the species' biology that are poorly known or in need of further study, including breeding biology and social organisation. The information presented here, which illuminates some of these aspects, was obtained over an eight year period as a by-product of a larger banding study undertaken by the author on the movement and ecology of passerines in the coastal vine thickets of the Broome Peninsula. This provided an opportunity to examine timing of breeding, the development of juveniles into adults, changes of plumage in the breeding season and moult progression. Detailed observations from small samples of birds have been included where they provide indications of previously unknown trends.

Methods

Study Area

The study site (17°46'57"S, 122°12'17"E) is located at the western margin of the range of the Red-headed Honeyeater, approximately 23 km north of the town of Broome, near the southern margin of Willie Creek, a tidal estuary. The site, which is less than 2500 m^2, is situated less than 500 m from the ocean on the narrow, east-facing sandy slope of a low rocky limestone ridge, immediately adjacent to an area of low mangroves (*Avicennia marina*), which is flooded on bi-monthly high tides. The vegetation is largely comprised of low perennial shrubs below 2 m in height. The dominant species are *Flueggea virosa* and *Crotalaria cunninghamii*. *F. virosa* flowers immediately after the first rains, producing large numbers of small, nectar-rich yellow or cream flowers, whereas *C. cunninghamii*

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flowers from the end of the wet season until late in the dry season. The flowers of *C. cunninghamii* are large, green, bird-shaped and known for their high nectar content (Noury and Lombard 2005).

Red-headed Honeyeaters do not occur permanently at the site, and were rarely caught in mist nets before 08:00 hrs, implying that they roost some distance away. Attempts to follow the birds on foot back to their home territory were not made due to access difficulties and the presence of crocodiles. Visual observations of groups of birds moving methodically through stands of *C. cunninghamii* strongly suggested that the birds visited the site primarily to feed.

Capture and banding

From January 2001 to December 2008 a total of 47 banding sessions occurred. Birds were caught in mist nets erected in mid to late afternoon and left open until dusk. The nets were re-opened at first light and left open until temperatures became too high for birds to be safe. On average, banding sessions lasted for six to eight hours, although this varied depending on the time of the year and the strength and onset time of the westerly sea breeze. Seven or eight 12 x 2.7 m nets with 31 mm mesh were erected in the same general locations at each visit, although exact net lines had to be moved each year as new *C. cunninghamii* bushes grew each wet season. Decisions on exact net locations were based on maximising the capture of Red-headed Honeyeaters. Initially, nets were also set in the adjacent mangroves, but this was discontinued in 2004 due to the low number of captures.

Each individual caught was banded on the right tarsus with a numbered metal band (ABBBS) and examined for gape colour, plumage colour and breeding condition. Processing of birds was, in nearly all cases, undertaken by the author, thereby reducing observer bias. Gape colour was recorded as black, yellow or horn, the term 'horn' being used when the gape was colourless, bone coloured or pale brown. Primary moult was scored and head bill and wing length measurements taken according to the conventions in Lowe (1989). Fully grown primary wing feathers were characterised visually as being worn, slightly worn or not worn. Particular attention was paid to the plumage of re-trapped birds. Birds were sexed primarily on the basis of plumage but, in the case of possible juveniles, wing length measurements were also used.

Brood patches were scored on a scale of 0 to 3 (Lowe 1989) where:

0. No active brood patch;
1. Loss of feathers from thorax to cloaca; inflamed and shiny skin;
2. Well developed brood patch with heavy vascularisation and inflamed skin;
3. Fully developed brood patch with heavy blister-like swelling and a whitish 'waterbed' appearance

Juvenile birds were distinguished from adults primarily by plumage and the presence of juvenile characteristics such as a bare underwing, loose under-tail coverts, and wing and tail bars. Juvenile birds may look similar to adult females, and it is recognised that the above mentioned method is not infallible, particularly for older juvenile or immature females. Young male birds were classified as immature rather than juvenile once 25% of their head or rump feathers had become red. Wing measurements were analysed using the program SHEBA (Rogers 1995) which uses pairs of normally distributed data to estimate the size range of each sex, thus allowing the calculation of sexing criteria.

Results and Discussion

As of December 2008, 627 Red-headed Honeyeaters had been banded at the study site, comprising 106 adult males, 196 adult females and 325 immatures and juveniles. 243 re-traps had been made, a recapture rate of 28%, which allowed the progression of moult and development into adult plumage to be tracked.

Figure 1 details total captures of birds each month at the study site, highlighting how Red-headed Honeyeater numbers varied considerably during the year. The average catch was 18.5 birds (standard deviation ±18.49); the largest catch being 78 in July 2002; the lowest nil in late September 2008, October 2003 and 2007, and November 2005. Variation in Red-headed Honeyeater catch numbers is not considered to be a result of capture methodology, but due to annual variability in the nectar available from flowering shrubs and seasonal variations in weather conditions. Far fewer or no birds were caught once *C. cunninghamii* had stopped flowering (usually around October) until the first rain fell and *F. virosa* started flowering (usually in December).

Plumage and bare parts

Male plumage

Red-headed Honeyeaters are sexually dimorphic, with males having vivid bright red heads and rumps and a distinct black loral stripe, whilst females and juveniles only have red on their forehead and chin, with grey-brown heads and necks (Figure 2; Higgins *et al.* 2001). The recapture of juvenile and immature males on 76 occasions provided an opportunity to track their development into adult plumage. Change may occur very rapidly. In one instance, a bird captured at 09:00 hrs with a few pin feathers in its grey-brown rump had produced a 3 mm red feather in the rump when recaptured at 16:30 hrs the same day. Whilst this reveals that individual feathers can grow very quickly, the case

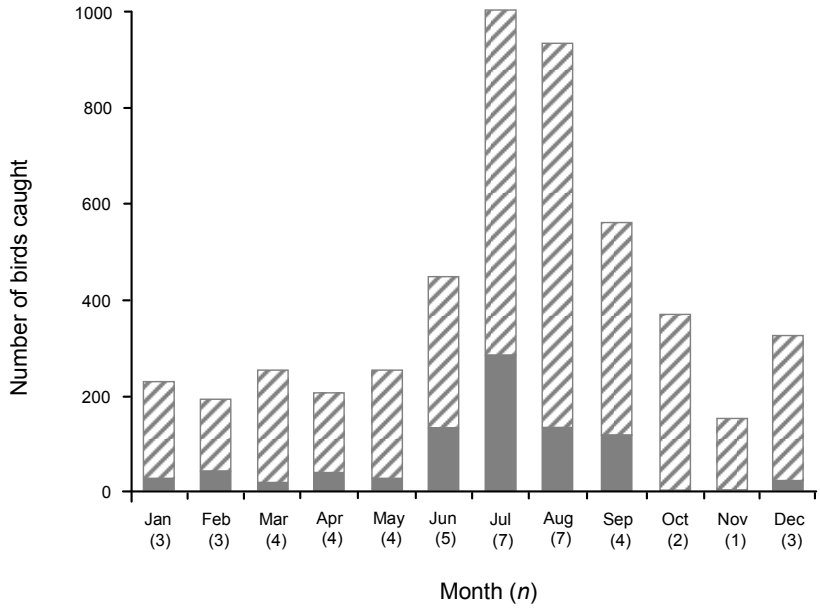

Figure 1. Monthly captures of Red-headed Honeyeaters (solid bars) and other species (hashed bars) at the banding site from 2001-2008. *n* = number of banding sessions.

Table 1. Case histories showing the timeframes involved in the transition from juvenile to adult male plumage in Red-headed Honeyeaters.

Band Number	Date captured/ recaptured	Description of key characters in a juvenile male's development of adult plumage and appearance
019 70966	27 June 2008	Bright red forehead and chin, yellow fleshy gape, very loose undertail coverts and bare underwing
	9 August 2008	Bright red forehead and chin, trace of red around the eye, no trace on the crown or rump
	8 November 2008	Bright red forehead and chin, 4 red feathers on rump, no trace of red on crown
019 13162	17 January 2004	Bright red forehead and chin, yellow slightly fleshy gape, trace of red on rump, no trace of red on crown
	17 June 2004	25% red crown and rump; dark brown lores, black/yellow gape
019 37052	15 April 2006	Bright red forehead and chin, yellow slightly fleshy gape, 10% red on rump, trace of red on crown
	30 July 2006	25% red crown, 50% rump; dark brown lores, black gape with slightly yellow inner
019 02580	24 April 2003	Yellow gape, no red on rump or crown, juvenile characteristics
	19 July 2003	No red on rump or crown, yellow gape
	17 January 2004	50% red crown and rump, dark brown lores, yellow non-fleshy gape
019 03304	17 July 2003	Bright red forehead and chin, yellow fleshy gape, no trace red on the crown or rump
	17 January 2004	50% red rump and crown
	7 February 2004	75% rump, dark brown lores, yellow non-fleshy gape

histories in Table 1 provide some indication of the longer timeframes involved in the transition from juvenile to adult plumage, showing that it can take months to assume full adult male plumage.

From these examples it appears that juvenile males retain their juvenile plumage for at least three to five months post fledging, and that moulting of body feathers to attain red plumage takes a similar period of time. It is not known how long it takes for juvenile males to reach breeding age. The analysis was constrained, in part, by the inability to determine the exact age of 'juvenile' birds that had no red on their crown or rump. Some males may attain full adult plumage in their second year (Table 2), however, other juveniles do not progress so quickly (Table 3).

Male gape colour

Field identification and bare part descriptions in Higgins *et al.* (2001) notes that gape colour in adult males

Figure 2. Male Red-headed Honeyeaters at different stages of plumage development. (L-R) juvenile with typical plumage and yellow gape; immature with more advanced plumage, though still with brown lores and slightly yellow gape; male with full adult plumage and black gape. Photo: Theunis Piersma.

can be either black or yellowish. Initial observations in this study suggested that all males gained a black gape to accompany their adult plumage. Of 189 adult males caught or re-trapped, 90% had a black gape accompanying their adult plumage. For the remaining birds, the gape colour was either not described (3%), or described as being yellow or horn (7%). Examination of male birds nearing adult plumage (having 75% red crown and at least 50% red rump), revealed that whilst 24% were described as having a black or dark gape, 67% still had a yellow or horn gape, and 10% were noted as having a dark gape with yellow at the inner corner. It was assumed that the birds with yellow or horn gapes were males that had recently moulted into adult plumage and that the gape colour would shortly change from yellow to black.

However, observations of three re-trapped birds challenged this assumption. In July 2002 an immature male bird was caught that had a black gape. The same bird was re-trapped in June 2005, this time described as having a yellow gape. Another individual was first caught as an immature in July 2002 and described as having a black gape. In June 2003 it was recorded as an adult with a yellow gape. The third individual was initially caught as an immature in July 2005 and recorded as having a yellow gape, brown lores and a 50% developed red crown and rump. In September the following year it was described as an adult male, with a black gape. However, in December 2007, the bird was again described as having a yellow gape. To date, a change of gape from black to yellow has only been recorded in three birds. While this may represent an error in the field notes, there may be a seasonal or other temporal change in the gape colour of male Red-headed Honeyeaters, similar to that reported in male Brown Honeyeaters (Higgins *et al.* 2001). Further study is needed to tell if changes in adult male gape colour are a rare event or a regular occurrence.

Female plumage

The majority of the 196 adult females caught in this study had grey-brown backs and rumps, which conform to the plumage description of Higgins *et al.* (2001). However, Higgins *et al.* (2001) also notes that uppertail coverts can sometimes be fringed red. This is confirmed by two birds re-trapped in this study. One individual was initially caught as an adult female in July 2001 and recaptured in July and September 2002. On none of these occasions were any red feathers detected on the rump. However, when the bird was re-trapped in June 2005 a trace of red on the rump was noted. In the second example, a female trapped in July 2002 had one red feather in its rump. A trace of red was still present in June 2003 when the bird was recaptured.

Female gape colour and breeding status

In 86% of cases, newly captured adult female birds were recorded as having a yellowish gape, which conforms to the description given in Higgins *et al.* (2001). However, of the other 28 birds, 19 had horn coloured gapes and the other nine birds had horn/yellow gapes. All but one of these birds were captured between April

Table 2. Times taken for juvenile male Red-headed Honeyeaters to attain adult plumage.

Band number	Date caught as juvenile	Date re-trapped with full adult plumage	Elapsed time
019 89716	July 2002	July 2003	13 months
019 18449	July 2004	September 2005	15 months
019 30638	July 2005	April 2006	10 months
019 89718	July 2002	July 2003	13 months

Table 3. Changes over time in immature male Red-headed Honeyeater plumage.

Band number	Date caught as juvenile	Plumage description 12 months or more later	Elapsed time
019 03315	July 2003	June 2004: 75% red crown and rump; brown not black lores; black gape	12 months
019 30316	June 2005	September 2006: brown not black lores, 75% red rump, slightly yellow gape	16 months

and September, suggesting a possible correlation between horn gape colour and breeding status. This is supported by the data, which show that 58% of females with horn gapes also had fully developed (stage 2 or 3) brood patches, as did two of the birds with horn/yellow gapes. In comparison, only 2% of females with a yellowish gape had a fully developed brood patch.

The possibility of gape colour change associated with breeding status was tested by examination of data for re-trapped females. This showed that two of the six birds with well developed brood patches also had horn gapes. Both of these birds had yellow gapes when they were previously caught. One re-trapped female exemplifies the possibility of rapid gape colour change. In July 2002 the bird was caught and identified as an adult female with a horn gape. The following year, on 6 June 2003, the bird was re-trapped, this time having a yellow gape. However, on 19 July 2003 the bird was again re-trapped; this time the gape was horn, a change that took place over a six week period. However, on neither occasion when the bird was caught with a horn gape, was a brood patch present.

There is no published information for this species on the duration of the egg-laying period, or for how long females have large swollen brood patches. It is possible that this is a relatively short period. It is also possible that gape colour change may occur early in the breeding cycle to signal that a female is ready to breed. An area of further study could be to investigate other honeyeaters where females change gape colour when breeding, and compare the timing and period of gape colour change with the period when breeding birds have an active brood patch.

Moult of wing primaries in adult birds

Moult of primaries in adult post-breeding birds is known to occur throughout the year, though mainly from August to April (Higgins *et al.* 2001). This is, in part, based on data from birds in Broome collected by the Broome Bird Observatory. No comment is made about differences between the timing of male and female moult, or the time it takes new primaries to become worn.

Table 4 shows the monthly distribution of active and completed moult in adult male and female birds in this study, using data collected from January 2002 to December 2008. Birds with completed moult (all new, unworn primaries) are shown as a percentage of adults of that sex caught each month. The sample of birds with unworn primaries was surprisingly small, particularly in males. Only 7% of males and 21% of females had primary feathers which did not show any wear. Similarly, the incidence of active moult was low in both males and females, but particularly in males; only 8% of adult males caught or re-trapped and 19% of females were in active moult.

Analysis is hindered by the lack of data on how long it takes for new primary feathers to wear, the absence of robust samples from October to December, the small sample of actively moulting males and the possibility that some immature females have been identified as adults (particularly in the February sample). Within these limitations, the data suggest that primary moult was centred around the second half of the year, and completed by the end of the year so that birds have unworn primaries in the early part of the year following.

Consideration of the correlation between active moult and the breeding season suggested that the females moulting in July and August may be birds that bred earlier in the year in March or April. This is not without precedent, as the author has observed that Brown Honeyeaters in the same banding study also moult once breeding has been completed. Alternatively, the presence of three females with well developed brood patches and active moult in the study sample could indicate that moult and breeding occur simultaneously, or that moult can be suspended for breeding to occur. In summary, whilst further study is needed,

Table 4. Timing of primary wing moult in adult Red-headed Honeyeaters.

Month	Number of adult males in the sample (*n*=179)	% of males with new, unworn primaries (*n*=13)	Males with active moult (*n*=14)	Number of adult females in the sample (*n*=262)	% of females with new, unworn primaries (*n*=54)	Females with active moult (*n*=49)
January	3	100	0	4	25	2
February	8	37.5	1	25	56	5
March	3	33.3	0	2	100	0
April	13	0	0	12	16.7	3
May	7	0	1	8	12.5	3
June	30	0	3	46	15.2	4
July	71	2.8	4	77	13	13
August	16	0	0	39	20.5	9
September	24	0	5	38	0	9
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	4	100	0	11	81.8	1

the data suggest that west-Kimberley birds may have a different moult strategy, commencing moult earlier in the year than birds in the Northern Territory and Queensland (Higgins *et al.* 2001).

Higgins *et al.* (2001) refers to Broome birds having unconventional primary moult, indicating that primary moult does not always commence at feather P1. In this study, 7% of actively moulting adult males and 25% of actively moulting adult females exhibited unconventional moults, mostly commencing moult from P3 or P4. This phenomenon has previously been observed by the author and colleagues in a number of other passerine species in the Broome region. The cause is unknown, but is possibly a means of conserving energy when conditions are not ideal.

Primary wing moult in juvenile and immature males

The progress of primary wing feather moult in juvenile and immature birds is difficult to define conclusively. Data on young males from this study are summarised in Table 5 using the plumage descriptors that are recorded in the field and showing the percentage of birds with active or inactive primary wing moult at each stage of plumage change. Very few (6%) of the juvenile males with no trace of red on their crown or rump were in active moult. Once body moult commenced and red feathers appeared on the rump or crown, almost half the birds in the sample (48%) had also begun active primary moult. One bird in the study had completed primary moult but still had active moult in the secondaries.

No data were available to confirm the exact time that immature birds take to moult their primaries. The process varied markedly between individuals, with the second example (Table 6) progressing far more quickly than the third in the same period. The examples also suggest that primary moult takes months rather than weeks, probably mirroring the estimation earlier in this article of the 3+ months required for immature males to moult body plumage.

Bearing this in mind, what is inconsistent in the data in Table 5 is the low percentage of birds which have new primaries and either 25% or 50% red rumps and crowns. If nearly 50% of males undertake primary moult when they have a trace of red in rump or crown, it is expected that this would be reflected in the sample of birds with new primaries and 25 or 50% body colour. The fact that it is not, suggests the possibility of rapid feather wear in immature birds and, again, that further work is needed to increase the sample size.

Sexing by size

Higgins *et al.* (2001) observes that adult Red-headed Honeyeaters differ in size, males being larger than females, and notes that further work is needed to establish sexing criteria. In this study, adult birds were sexed based on plumage. Data on adult birds where wing length was recorded are displayed in Figure 3 and summarised in Table 7. There is a slight overlap of birds with a wing length of 57 mm (10.7% of females and 1.1% of males). As wing length is affected by feather wear, new primaries being longer than worn feathers, this may impact on the extent of overlap. Of the 19 females with wing lengths of 57 mm, 11 were in active moult or had new primaries. The primaries of 14 of the 20 male birds with wing lengths of 58 mm were recorded as being worn or very worn, as were the primaries of the male bird with a wing length of 57 mm. Wing length data were analysed using the SHEBA program (Rogers 1995). Analysis was conducted twice,

Table 5. Progression of primary moult in juvenile and immature male Red-headed Honeyeaters.

Plumage	*n*	Birds with new primaries	Birds with active primary moult	Birds with no active primary moult and worn or slightly worn primaries
No red on rump or crown	69	94.2%	5.8%	0%
Trace red in rump or crown	23	4.4%	47.8%	47.8%
25% red rump and crown	25	8%	24%	68%
50% red rump and crown	42	0%	11.9%	88.1%
75+% red rump and crown	34	11.8%	5.8%	82.4%

Table 6. Time taken for immature birds to undertake primary wing moult. Moult scores follow Lowe (1989).

Example: Band number	Date caught	Primary wing moult	Time elapsed between capture and recapture
Example 1: 019 13155 (immature male)	17 January 2004	$4^2\,2^1\,0^7$	
	20 March 2004	$5^5\,4^1\,2^1\,1^1\,0^2$	9 weeks
Example 2: 019 13308 (immature male)	7 February 2004	0^{10} slightly worn	
	20 March 2004	$5^5\,4^1\,2^1\,1^1\,0^2$	6 weeks
Example 3: 019 13298 (immature female)	7 February 2004	$5^1\,4^1\,2^1\,0^7$	
	20 March 2004	$5^2\,4^2\,3^1\,1^1\,0^4$	6 weeks

once using the sexes assigned to the birds in the field, and once treating every bird as unsexed and using their measurements to calculate the average wing length of each sex. Results from the two approaches, presented in Table 8, are almost identical.

The analysis of sexing criteria indicates that if a single-value sexing criterion is used, in which birds with a wing of less than 57.2 mm are treated as female and birds with a wing of greater than 57.2 mm are treated as male, then 2.8% of birds will be incorrectly sexed (Table 9). To provide a higher level of confidence it is necessary to have maximum/minimum wing length values where birds can be sexed with 95% confidence and a 'grey zone' where it is not possible to determine sex from wing length. Data from this study indicate that birds with a wing of 56 mm or less can be confidently sexed as female, birds with a wing of 58 mm or more can be confidently sexed as male and that birds with wing lengths between those values can not be confidently sexed. This analysis confirms the observation in Higgins *et al.* (2001) that the wing lengths of male west Kimberley Red-headed Honeyeaters are longer than those of females and reveals that the difference is so substantial that most, but not quite all, adult Red-headed Honeyeaters can be sexed on wing length.

Female first breeding age

Determining the age of first breeding in Red headed Honeyeaters requires the capture of a young juvenile female and her subsequent recapture with an active brood patch. To date in the study, only one bird has met these criteria – an individual initially caught in July and again in August 2004. On both occasions juvenile characteristics including a fleshy yellow gape and tail bar were recorded in the field notes, and the bird was aged as 1. In September 2005 this bird was re-trapped, this time having an active (stage 3) brood patch. From this it may be inferred that at least some females are able to breed in the year following their birth.

Breeding season

There is little known about the breeding biology of the Red-headed Honeyeater (Higgins *et al.* 2001). Johnstone (1990) reports breeding records for the Kimberley in March and September. Johnstone and Storr (2004) state that eggs are probably laid in most months, but in the Kimberley have only been reported in March, April, May and September. No breeding in Western Australia (WA) was reported in the New Atlas of Australian Birds for the years 1998-2002 (Barrett *et al.* 2003). Noske (1996) reported birds breeding in Darwin Harbour, Northern Territory, from June to October, coinciding with the flowering of *Bruguiera exaristata* mangroves.

No nests were found during this study. Information on the breeding season has been obtained both from examination of adult birds for an active brood patch and from the percentage of juvenile birds in each catch. No brood patches were recorded on adult males, therefore only data for 262 newly caught and re-trapped adult females are presented. Nineteen of the 262 adult females examined had stage 2 or 3 brood patches. Based on the presence of brood patches in adult fe-

Table 7. Wing length (WL) data for adult Red-headed Honeyeaters.

	Males	Females
n	90	177
Mean	59.16	55.33
Minimum	57	53
Maximum	62	57
Standard deviation	1.02	0.95
No. of birds with WL of 57 mm	1 (1.1%)	19 (10.7%)

Table 8. Parameter Estimates of adult Red-headed Honeyeater wing lengths.

	Males			Females		
Method	**Mean**	**SE**	***n***	**Mean**	**SE**	***n***
Observed (sexed birds)	59.16	1.02	89	55.33	0.95	176
SHEBA (unsexed birds)	59.17	1.03	88	55.35	0.97	177

males, the data suggests that the main breeding season for Red-headed Honeyeaters at this study site is from July to September (Figure 4). The presence of brood patches in individual birds in the months of March, April and June indicates that a smaller number of individuals also breed prior to the main breeding period.

Information on the timing of breeding can also be gained by examining the percentage of juvenile birds in each catch (Figure 4). Ideally these new juveniles should be clearly different from birds in the pre-existing cohort. In the case of Red-headed Honeyeaters, identifying immature from juvenile males is assisted by their acquisition of red plumage; however distinguishing juvenile from immature or adult females is more problematic. The breeding season must be inferred from determining the months where there is an increase in the presence of new juveniles and other months when young birds are almost a year old and it is no longer possible to distinguish them from adults. The identification of such a trend is further complicated by the lack of knowledge on juvenile dispersal from nesting sites.

In this study, a gradual decline in the percentage of juveniles present or identifiable in the early part of the year was evident, as birds hatched the previous year moult into immature males or become indistinguishable from adults (Figure 4). Subsequently there was an increase in the presence of juveniles from June to September (Figure 4). This is consistent with the brood patch data and suggests that the breeding season for Red-headed Honeyeaters at the location of the study site peaked from July to September, with a smaller number of birds that breed from March onwards producing young who reach the study site in June. However, as no birds were caught at the site in October, the end of the breeding season remains unconfirmed.

Movements

This banding study was not designed to measure Red - headed Honeyeater movement, however some results have been obtained incidentally. A bird that was initially banded at Broome Bird Observatory (BBO) in 1998 was re-trapped at the study site 4 years 9 months

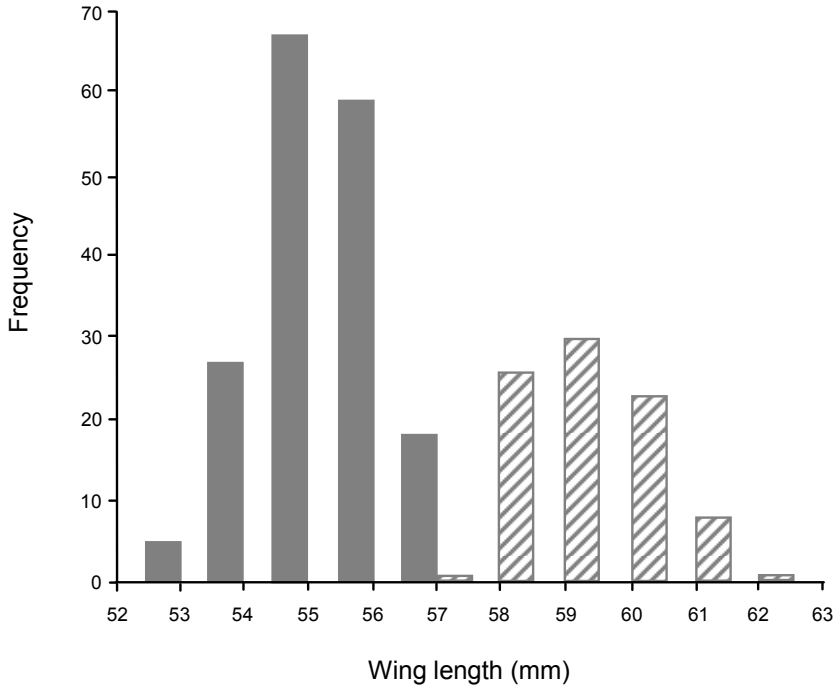

Figure 3. Distribution of the wing lengths in adult female (*n*=177, solid bars) and male (*n*=88, hashed bars) Red-headed Honeyeaters.

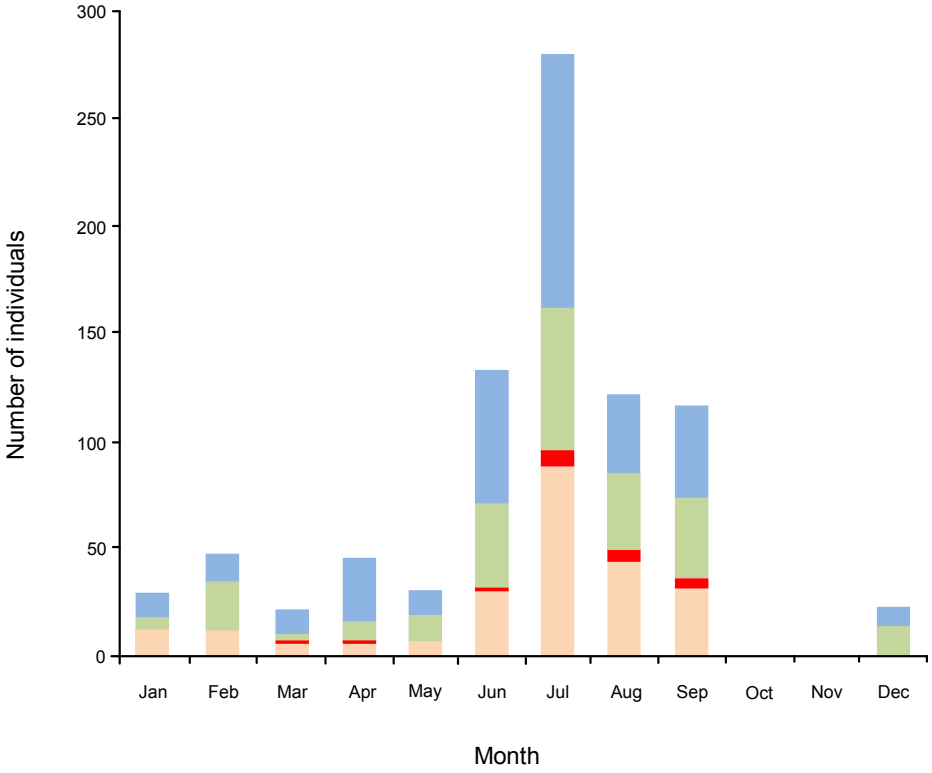

Figure 4. Numbers of Red-headed Honeyeaters captured at the banding site from 2001-2008. Actively breeding females with brood patches (red), adult females without brood patches (green), adult and immature males (blue) and juveniles (pink).

Table 9. Sexing Criteria in adult Red-headed Honeyeaters using wing length.

Minimum probability correct	Maximum size for females (*n*=177)	Minimum size for males (*n*=88)	Percentage correct	Percentage undetermined	Percentage incorrect
95%	56	58	81.13%	18.67%	0.20%
50%	57.211	57.211	97.22%	-	2.78%

28 days later. It had moved 27 km, achieving the longest recorded movement of this species (ABBBS 2009). As a result of the author's continuing passerine banding project, some Red-headed Honeyeaters have been trapped in other locations in the vicinity of Broome. Eight birds have been captured quite far from mangrove habitat, for example in stands of *Grevillea refracta* by the Broome race course or in the coastal thicket behind the sand dunes near Gantheaume Point Lighthouse. Both these sites are more than 5 km from the nearest habitat where the species is known to occur regularly. Each capture has coincided with a period when trees and shrubs at the capture site were flowering, indicating that flowering of food plants may influence movements (Higgins *et al.* 2001). The sample consists of four adult females, and one adult and three juvenile males, which does not allow any hypothesis to be constructed regarding how sex impacts on birds tendency to disperse.

Longevity

The longest recorded life span of a recaptured individual is 7 years 1 month 16 days (ABBBS 2009). This was a bird originally banded as a first year female at the study site in July 2002 and recovered in August 2009, at the same site, with a horn gape and a stage 1 brood patch, having not been sighted in the intervening years.

Acknowledgements. I am grateful to Helen Macarthur who accompanied me on many of the banding sessions from which these data are drawn, to Joseph Roe of the Goolarabaloo traditional owners group for allowing me to access the country, to Perry de Rebeira who inspired my initial interest in bird banding and has continued to provide wise counsel and to David Drynan of ABBBS who has always been supportive. Preparing a paper for publication requires expertise that this voluntary ban-

der did not previously have and, without the help and encouragement of several people, it would not have been completed. Thanks are therefore due to Sue Baigent and James Brazill-Boast who provided practical support with graphics and statistical analysis, to Danny Rogers and Belinda Cooke who provided numerous constructive suggestions on earlier drafts and to Ken Rogers for analysing the wing length measurements.

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