

**Husbandry guidelines for the  
Eastern yellow robin *Eopsaltria australis***



Author: Kirsten Wilkes

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Charles Sturt University

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Course coordinator: Dr Maggie Watson

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Cover photo: Eastern yellow robin (BirdLife Australia).

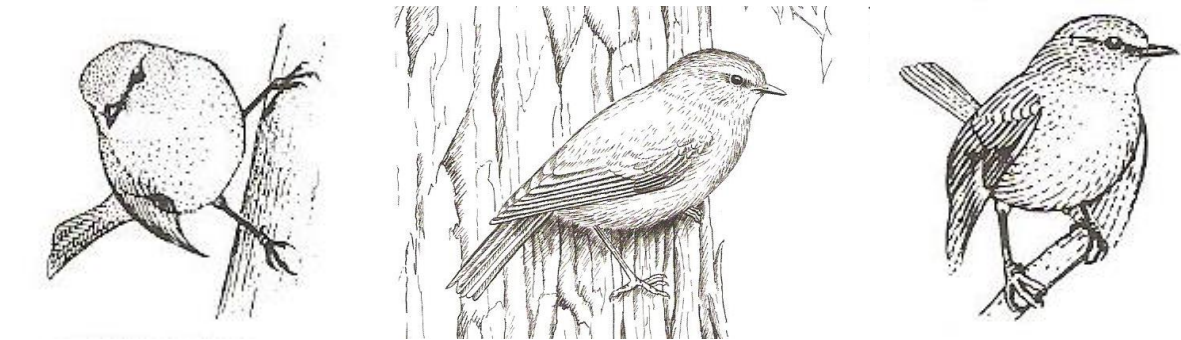
# 1. Introduction

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## 1.1 General features

The Eastern yellow robin, *Eopsaltria australis*, is a small passerine endemic to eastern Australia. It has a distinctive yellow breast and is similar in appearance to the closely related Western yellow robin, *E. griseogularis* (Christidis and Boles 2008; Pavlova et al. 2013). Both species belong to the Family Petroicidae, known as the Austro-Papuan robins. Species in this group tend to have large heads with rotund bodies, an upright stance, pronounced rictal (mouth) bristles, stout bills and brightly coloured underparts (Boles 1988). Characteristics typical of *Eopsaltria* spp. include wing and tail flicks, wing bars visible in flight, and sideways 'trunk perching' (Reader's Digest 2003; Simpson & Day 2004) (Figure 1).

The Eastern yellow robin is mostly sedentary, living in monogamous pairs (Maron et al. 2012) and sometimes breeding cooperatively. It has a home range of 5-6 hectares per pair or group (Debus 2006a). Preferred habitat includes forest, dense woodland and scrub; it rarely ventures across gaps in the vegetation (Debus 2006a; Doerr et al. 2011). It is particularly sensitive to human disturbances (Debus 2006a; Watson, Freudenberger & Paull 2001; Watson et al. 2003; Zanette 2000, 2001).



**Figure 1.** Characteristics typical of the genus *Eopsaltria* – trunk perching (left and middle), and wing and tail flicks (right) (Barrett et al. 2003; Simpson & Day 2004)

## 1.2 History in captivity

The Eastern yellow robin was historically kept at Adelaide Zoo, South Australia, and the last pair was sent to Healesville Sanctuary (C. Romer pers. comm.). Healesville Sanctuary in Victoria is now the only zoo in Australia to keep this species; it has at least one pair in captivity and there is a record of wild Eastern yellow robins breeding inside the lyrebird (*Menura* spp.) aviary (Marchant 1984). There was previously a studbook for the Eastern yellow robin, managed through the Association of Zoos and Aquariums; however, difficulties in obtaining new stock from the wild and from other zoos led to the studbook being disbanded (C. Romer pers. comm.).

Eastern yellow robins are among many native species of 'softbills' that may be privately kept in captivity with the correct license and/or permit for the relevant state or territory. For example, in New South Wales it is listed as an 'advanced bird' in the *Native animal keepers' species list 2014* (OEH 2014). The Eastern yellow robin appears to be kept less commonly than some other species in the Family, such as the red-capped robin *Petroica goodenovii* and hooded robin *Melanodryas cucullata*, based on the limited references made to it in aviculture magazines (e.g. Australian Aviculture, Australian Aviarylif and Australian Birdkeeper) and on aviculture websites (e.g. BirdCare).

## 1.3 Value for education, conservation and research

Most Austro-Papuan robins are naturally confiding, with an inquisitive or even bold attitude (Boles 1988). The Eastern yellow robin is typically confident around humans, often taking handouts from

picnickers (BirdLife Australia n.d.) and following gardeners around (Boles 1988). It is known to be friendly and trustful (Cayley 2011) and may approach squeaky sounds (Morcombe 2000). In addition to its confiding nature, the Eastern yellow robin is brightly coloured and easy to watch. It flits quietly from perch to perch, sitting and waiting with tail occasionally rising and wings flicking, then darting quickly to the ground to pick up prey (Reader's Digest 2003) (Figure 1). The species is well-known in Australia.

The Eastern yellow robin has a wide distribution in eastern Australia compared to other species (including most *Petroica* spp., the pink and red robins), which may be indicative of its ability to adapt to a range of captive environments. However, this species is declining in parts of south-eastern Australia and has gone extinct in some woodland remnants (Debus & Ford 2012), due to the threats facing many woodland bird species (see Debus & Ford 2012; Ford 2011; Watson 2011; Watson et al. 2003; Zanette 2000, 2001). The species therefore has potential value in captivity for both conservation and education.

## 2. Taxonomy

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### 2.1 Nomenclature

Class: Aves  
Order: Passeriformes  
Family: Petroicidae  
Subfamily: Eopsaltriinae  
Genus: *Eopsaltria*  
Species: *E. australis* (Shaw, 1790)

The Eastern yellow robin was described independently in 1790 by George Shaw and John Latham, however Shaw's name appeared first by several months in an appendix to the Journal of a Voyage to New South Wales (the diary of John White, Surgeon-General of the First Fleet) and thus takes precedence over Latham's (Boles 1988). It was first named *Motacilla australis* (Shaw 1790). The current genus name, *Eopsaltria*, means 'dawn harper' because these species are among the first to start calling of a day (Boles 1988).

There has previously been much speculation around geographical variations in the morphology of the 'yellow robins' and therefore possible speciation (e.g. Brown & Brown 1980; Ford 1962). Recent work undertaken on mitochondrial and nuclear DNA phylogenies within the Australasian robin group (Christidis et al. 2011) has established that:

- the genera *Eopsaltria*, *Microeca*, *Peneothello* and *Poecilodryas* are paraphyletic;
- *Eopsaltria* (*australis*, *griseogularis*, *georgiana* and *flaviventris*) is not a monophyletic genus; and
- *E. australis* is most closely related to the Western yellow robin *E. griseogularis*, the white-breasted robin *E. georgiana*, and *Tregellasia* spp. (e.g. pale-yellow robin *T. capito*).

### 2.2 Subspecies

There are two recognised subspecies of the Eastern yellow robin: the northern *E. a. chrysorrhoea* and the southern *E. a. australis* (Schodde & Mason 1999). Christidis et al. (2011) notes that the ND2 (mitochondrial gene) distance between two *E. australis* mtDNA haplotype groups is 5% (Loynes, Joseph & Keogh 2009). This is comparable with the divergence separating *E. australis* and *E. griseogularis* (see below), suggesting that species-level recognition may be warranted. However, the two haplotype groups do not correspond with the two currently recognised subspecies; Pavlova et al. (2013) report that the two major mtDNA lineages are distributed east and west of the Great Dividing Range, rather than northwards and southwards. As such, further phylogenetic work may be required to determine species limits in *E. australis* (Christidis et al. 2011).

### 2.3 Recent synonyms

Ford (1979) recommended that *E. australis* and *E. griseogularis* be considered conspecific; however, they have most recently been retained as separate species (see Christidis & Boles 1994, 2008; Johnstone & Storr 2004). Phylogenetic analyses of the Australasian robins (Petroicidae) has showed that the level of uncorrected ND2 sequence distance separating the two species is 6.5-6.9%, which supports species-level separation (Christidis et al. 2011).

### 2.4 Other common names

Yellow robin, bark robin, creek robin or yellow bob (Reader's Digest 2003); also yellowhammer, yellow-breasted robin, yellow-breasted shrike-robin, golden-tailed robin and wild canary (Boles 1988).

## 3. Natural history

Numerous studies have been conducted on the biology and ecology of the Eastern yellow robin. There are two predominant themes in this research: habitat requirements and the effects of isolation, fragmentation and reduced rainfall (Debus & Ford 2012; Maron et al. 2012; Matthews, Dickman & Major 1999; Stevens & Watson 2013; Watson, Freudenberger & Paull 2001; Westphal & Possingham 2003; Zanette 2000; Zanette, Doyle & Trémont 2000); and breeding biology, including factors affecting nesting success (Berry 2001; Berry & Lill 2003; Debus 2006a, b, c; Debus, Boland & Koboroff 2004; Dow 1980; Littlejohns 1933; Marchant 1984; Poiani & Pagel 1997; Zanette 2001, 2002; Zanette & Jenkins 2000). Publications also exist on the topics of diet (Razeng & Watson 2012) and vocalisation (Keast 1994).

### 3.1 Morphometrics

Adult length is 150-160mm (Morcombe 2000; Pizzey & Knight 2003), weight is approximately 20g (Debus 2006a; Debus & Ford 2012) and wingspan is 22.5cm (Higgins & Peter 2002). Sexes are similar (Reader's Digest 2003) though dimorphic on total head length and wing span measurements (ABSA Inc. 2014; see Figure 2). There is no seasonal variation in morphometrics (Higgins & Peter 2002).

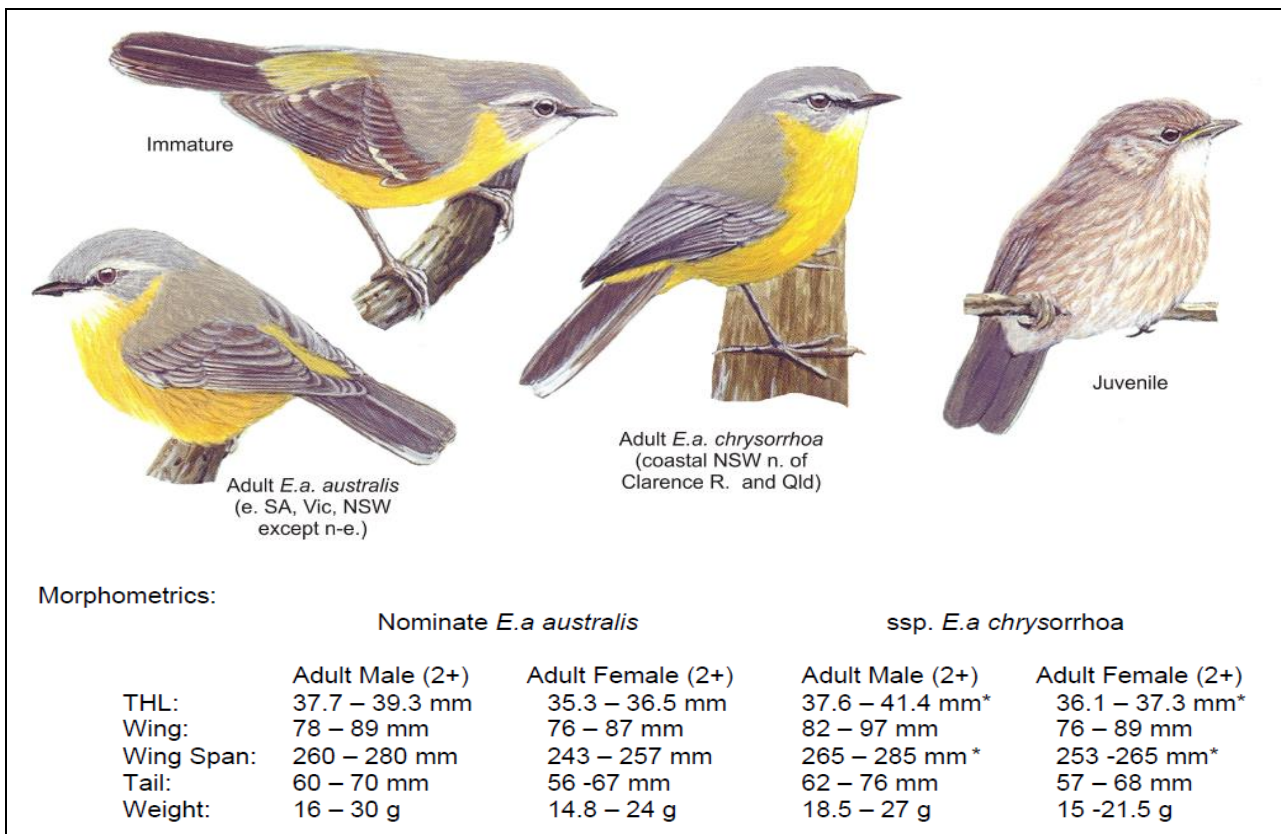


Figure 2. Morphometrics of the Eastern yellow robin *Eopsaltria australis* (ABSA Inc. 2014).

Adults have a yellow breast, white chin and plain mid-grey upper parts. The northern subspecies *E. a. chrysorrhoea* has a bright yellow rump (Pizzey & Knight 2003) and uppertail coverts (Simpson & Day 2004) (see Figure 3). Wings and tail are brown-grey, with a white bar through the base of flight feathers that shows in flight. The species has brown eyes, a black bill and dusky legs (Reader's Digest 2003). Immature birds resemble adults but are more dull (Reader's Digest 2003), while juveniles are rich brown and streaked (Pizzey & Knight 2003) (Figure 3).

Adults of this species should be distinguished from *E. griseogularis*, which is similar but has a white throat and broad grey breast band (Reader's Digest 2003) (Figure 4). The pale-yellow robin is also similar but is whitish-grey from above the bill to below the eye, has yellowish legs and is said to be quieter than the Eastern yellow robin, with less tail-cocking and wing-flirting (Pizzey & Knight 2003).

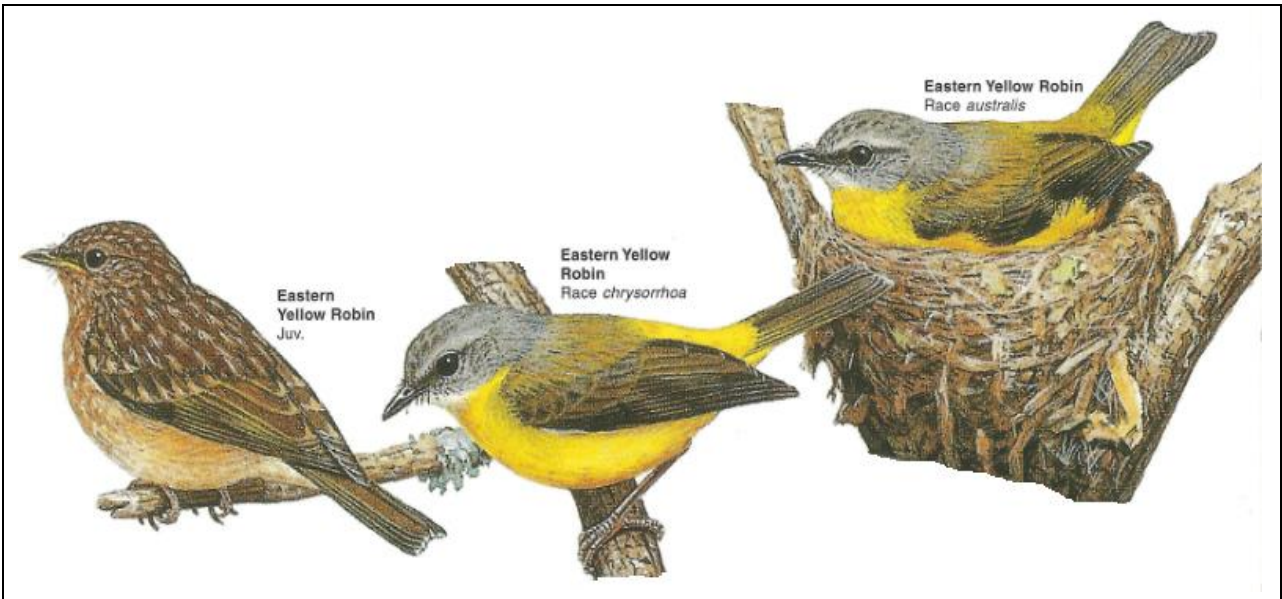


Figure 3. The Eastern yellow robin *Eopsaltria australis* (Simpson & Day 2004).

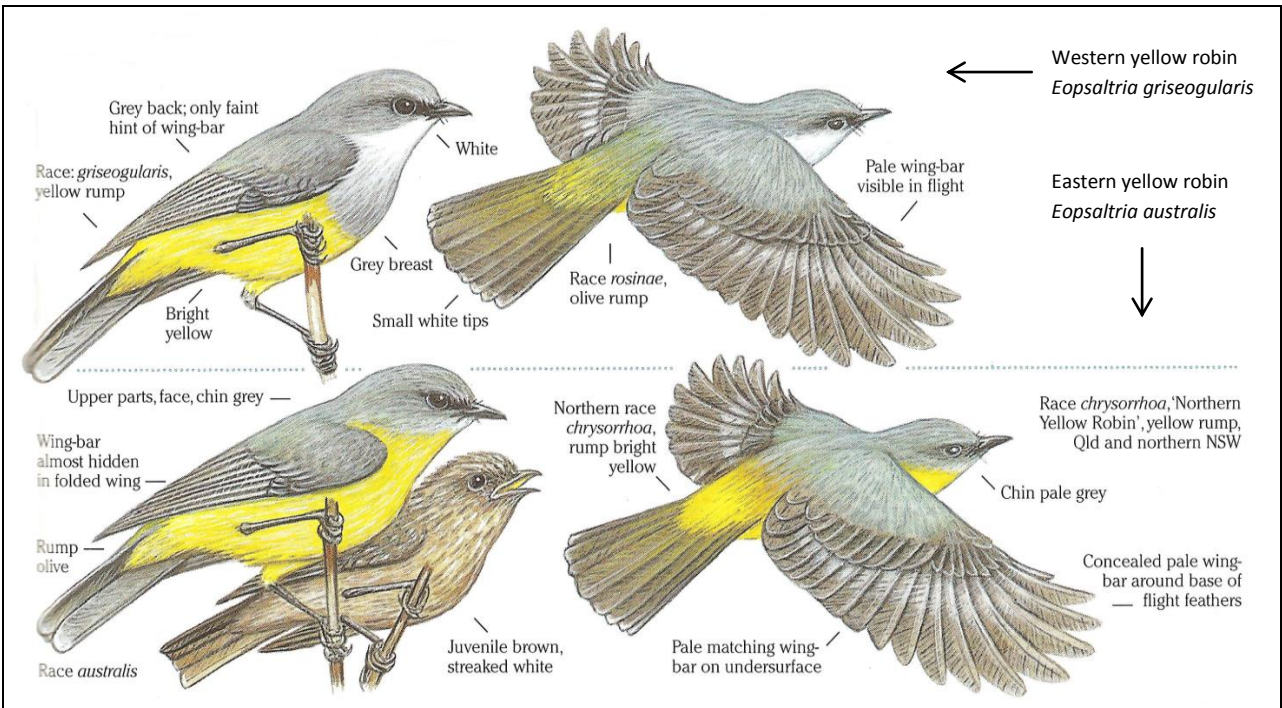


Figure 4. Comparison of the Western yellow robin (top) and Eastern yellow robin (bottom) (Morcombe 2003).



### 3.2 Distribution and habitat

The Eastern yellow robin occurs in Queensland, New South Wales, Victoria, South Australia and the Australian Capital Territory (Figure 5). It is geographically separated from the Western yellow robin; their ranges do not overlap in south-east South Australia (Higgins & Peter 2002). The species is usually sedentary but may move locally in winter, from the highlands to the lowlands in south-eastern Australia (Pizzey & Knight (2003) describe the species as an ‘altitudinal migrant’), or from the dense, shrubby forests where they breed to more open woodland in the non-breeding season (Reader’s Digest 2003).

The Eastern yellow robin occurs mainly along the east and south-east coast and adjacent areas, though it does extend into woodland with scrubby cover on inland slopes (Reader’s Digest 2003). Its habitat is broadly described as wet open forest, woodland and coastal thickets (Simpson & Day 2004), and includes vine forest, scrubby eucalypt woodland/forest, timbered gullies, swamp woodlands, coastal tea-tree and banksia scrubs, mallee, broombush, cypress-pine thickets, mulga, brigalow, snow gum woodlands, orchards and golf courses (Pizzey & Knight 2003). It is also seen in parks (BirdLife Australia n.d.) and well-planted gardens from about Cooktown in Queensland to Naracoorte in South Australia (Slater 1996). Common to all of its habitats is an understorey of shrubs 5-8 metres high and little ground cover (Reader’s Digest 2003).



**Figure 5.** Distribution of the Eastern yellow robin *Eopsaltria australis* (compiled distribution map provided by BirdLife International species range maps (The Atlas of Living Australia n.d.)).

### 3.3 Conservation status

The Eastern yellow robin is not currently listed as threatened at any level (Table 1).

**Table 1.** Conservation status of the Eastern yellow robin *Eopsaltria australis*.

Level	Category	Relevant list/legislation
International	Lower risk (least concern); increasing population	IUCN Red List
National	Not listed	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
Queensland	Not listed	Nature Conservation (Wildlife) Regulation 2006 under the <i>Nature Conservation Act 1992</i>
New South Wales	Not listed	<i>Threatened Species Conservation Act 1995</i>
Victoria	Not listed	<i>Flora and Fauna Guarantee Act 1988</i> ; Advisory List of Threatened Vertebrate Fauna in Victoria (2013)
South Australia	Not listed	<i>National Parks and Wildlife Act 197</i>
Australian Capital Territory	Not listed	<i>Nature Conservation Act 1980</i>

In some areas the species is known to be declining or locally extinct (Debus 2006; Debus & Ford 2012; Stevens & Watson 2013; Watson et al. 2003) while other sources suggest it is widespread and common (Radford & Bennett 2005) with an increasing population (Barrett et al. 2003, 2007; IUCN 2012). There may be regional differences in the species' population trends.

### 3.4 Diet in the wild

The Eastern yellow robin eats a range of insect prey including ants, bugs, spiders, moths, grasshoppers, wasps and flies (Reader's Digest 2003). In translocation experiments, it has been fed mealworms *Tenebrio molitor* during transport (Debus & Ford 2012). A study on the diet of declining insectivorous bird species found that the most important prey group for the Eastern yellow robin is the Coleoptera (beetles and weevils), followed by the Formicidae (ants), Diptera (flies and mosquitoes) and Lepidoptera (moths and butterflies) (Razeng & Watson 2012). Eastern yellow robins will occasionally eat fruit and seeds, and items such as bread crumbs and cheese (Higgins & Peter 2002).

To feed, birds pounce on insect prey from an elevated perch (Boles 1988). The species tends to start feeding earlier in the day and continue later than most birds, moving about until dark (Boles 1988; Reader's Digest 2003). In the non-breeding season, Eastern yellow robins usually feed alone but may join mixed foraging flocks of insectivorous birds or forage as a family unit (Reader's Digest 2003). The species is common in parks and gardens and may take handouts at picnic areas (BirdLife Australia n.d.).

### 3.5 Longevity

#### 3.5.1 In the wild

The Eastern yellow robin was first banded in January 1956 and has been recorded as banded a total of 21,027 times (ABBBS 2015). The average time between recoveries of individual birds is 1 year and 5.9 months. The maximum is 14 years and 7.7 months for a bird originally banded in 1988 near Grenfell, New South Wales, and recovered on the same property nearly 15 years later in 2002 (ABBBS 2015), establishing that the species' maximum longevity in the wild is at least this long. An individual was re-trapped in the Australian Capital Territory 12 years and 10 months after banding (Tidemann et al. 1988). Marchant (1987) reported many banded individuals with a known age of 7-10 years. Life expectancy for birds that reach independence is around 3.5 years (Marchant 1985). Debus (2006a) states that adult survival in Eastern yellow robins is high (75%).

#### 3.5.2 In captivity

Maximum and average age of captive Eastern yellow robins is unknown; however, captive birds tend to live longer than those in the wild (Gill 2007; C. Romer pers. comm.). A hooded robin in captivity at Adelaide Zoo is known to be at least 15 years old; a pied honeyeater *Certhionyx variegatus* at the same zoo is at least 17 years old (C. Romer pers. comm.). A pekin robin in a captive population in Brazil lived to be more than 18 years of age, while the life expectancy for pekin robins in captivity is said to be around 15-20 years (da Cruz et al. 2011).

#### 3.5.3 Techniques used to determine age in adults

The following information is provided by the Australian Bird Study Association Inc. (ABSA Inc. 2014) for the Eastern yellow robin:

- within three months of fledging, all traces of mottled brown juvenile plumage has been replaced with adult-like body plumage;
- immature birds retain juvenile grey-brown remiges (flight feathers of the wing) and retrices (flight feathers of the tail), and usually some dark brown coverts with white tips;
- immature birds can be identified for up to one year by yellow soles to their feet;

- immature birds have pointed tail feathers; and
- early in the second year, moult to adult plumage occurs.

Therefore, adults are more than two years, and immature birds are one (in autumn/winter) or less than two (in spring). Zanette (2001) could not establish reliable morphological characters to determine the age of Eastern yellow robins, which indicates that ageing adult birds may be difficult.

## 4. Housing requirements

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### 4.1 Exhibit design

Marchant (1985) states that ‘Eastern yellow robins live in a variety of habitats ... but probably they always need a shady environment with a rather sparse low ground cover and plenty of perches below about three metres from the ground whence they can spot their prey.’ Temperature may not be that important (see Section 4.6 below), although the species may prefer lower ground temperatures, brought about by a dense understorey (Cousin 2004a). For Eastern yellow robins in the wild, increased nest success is positively correlated with increased shrub and sapling density (Debus 2006c, see also Barrett et al. 2007), most likely a result of protection for both nests and newly fledged young. While predation is not a factor in captivity (provided the aviary is predator-proof), the species may nonetheless do better if provided with a variety and density of native plantings similar to that of its wild habitat (see Figure 6). C. Romer (pers. comm.) suggests dense *Melaleuca* sp. bushes, which have been used by hooded robins to breed in captivity. Plants can be provided in large pots if they are unable to be planted directly into the ground. As noted elsewhere, it is important for this species to have ready access to perches and clear ground for feeding, so use of long grass should be avoided. Birdcare (2008) recommends ‘covered flights’ for softbill species, which enable plenty of space for flying and ensure the ground is kept dry. Materials can include wire/mesh, wood, plastic or metal. The mesh or netting should be buried at least 30cm into the ground, preferably attached to concrete footings, to ensure the aviary is predator-proof. A smaller gauge wire can be used for the lower 50-100cm of the aviary for additional protection.



**Figure 6.** An example of a planted aviary; this one is used for finches (will\_36, [www.aussiefinchforum.net](http://www.aussiefinchforum.net), viewed 2 June 2015).

## 4.2 Holding area design

The holding area may be a simpler and smaller version of exhibit described above. It must, at a minimum, include a range of perches (see Figures 7 and 8) and clear access to the ground, food and water, and protection from the elements (achieved by covering one end of the cage or aviary; this also adds to the birds' sense of security in what might be an unfamiliar environment). Additional furnishings, including native plantings, can be reduced if birds are only being kept in the holding area for a short period of time. In this way, a bird's basic needs are met whilst human access is maximised, allowing for easier capture and handling for routine and other examinations. If holding areas are used for longer periods (i.e. more than a few days), additional furnishings should be included to reduce the risk of behavioural or health problems.

## 4.3 Spatial requirements

### 4.3.1 National regulations

States and territories are currently developing nationally consistent animal welfare standards and guidelines, including for exhibited animals. The New South Wales Department of Primary Industries is leading the development of these standards and is being assisted by representatives of the state and territory governments, zoo operators and animal welfare organisations (Department of Agriculture 2015).

The proposed guidelines include that:

- operators are required to ensure that holding enclosures comply with spatial requirements recommended by relevant taxon standards (S3.29); and
- operators are required to ensure that, in cases where no holding enclosure spatial requirements are stipulated by relevant taxon standards, the spatial dimensions of a holding enclosure are a minimum of one third of a non-walk through display enclosure (S3.30) (DPI n.d.).

### 4.3.2 State and territory regulations

Relevant legislation, policies and guidelines relating to animal welfare are outlined in Table 2.



**Figure 7.** An example of a range of natural wooden perches provided in an aviary for budgerigars (K. Wilkes, 2013).



**Figure 8.** An Eastern yellow robin 'trunk perching', illustrating its need for a range of perches and vegetation (Lawler, in Boles 1988).

**Table 2.** Regulations of relevance to determining spatial requirements for birds in captivity in states and territories.

Jurisdiction	Regulations (legislation, policies and guidelines)
New South Wales	<i>Exhibited Animals Protection Act 1986</i> <i>Exhibited Animals Protection Regulation 2010</i> <i>Prevention of Cruelty to Animals Act 1979</i> <i>Prevention of Cruelty to Animals Regulation 2012</i>
Victoria	<i>Prevention of Cruelty to Animals Act 1986</i> Code of practice for the housing of caged birds Code of practice for the public display of exhibition of animals Code of Practice for the welfare of wildlife during rehabilitation
South Australia	<i>Animal Welfare Act 1985</i> <i>Animal Welfare Regulations 2012</i> General guidelines for the management of protected wildlife in captivity in South Australia
Western Australia	<i>Animal Welfare Act 2002</i> Code of Practice for Exhibited Animals in Western Australia
Northern Territory	<i>Animal Welfare Act 2000</i>
Queensland	<i>Animal Care and Protection Act 2001</i> <i>Animal Care and Protection Regulation 2012</i> Code of Practice of the Australasian Regional Association of Zoological Parks and Aquaria - Minimum standards for exhibiting wildlife in Queensland ( <i>Nature Conservation Act 1992</i> )
Australian Capital Territory	<i>Animal Welfare Act 1992</i> <i>Animal Welfare Regulation 2001</i> Welfare of captive birds code of practice 1995
Tasmania	<i>Animal Welfare Act 1993</i> Animal welfare standards

#### 4.3.3 Minimum area of enclosure

As a guide, the Victorian *Code of practice for the housing of caged birds* (DEPI 2014) specifies the minimum enclosure measurements for a bird the size of an Eastern yellow robin (Table 3). Red-capped robins have been successfully kept and bred in an aviary of dimensions 5m x 5m (Fitzgerald 2003), while C. Romer (pers. comm.) suggests that an Eastern yellow robin pair should be kept in an aviary of approximate size 10m long x 6m wide x 3-4m high. Pairs of pekin robins in Brazil are kept in planted, walk-in aviaries 2.5-3.5m high and 8-35m<sup>2</sup> in area (da Cruz et al. 2011). Birdcare (2008) note that softbills require lots of flying space in a planted aviary of up to 4m x 1.8m x 2.1m high for a single pair, and 3m x 2m x 2.1m at a minimum. Note that additional aviaries may be needed to house young if breeding is successful (Birdcare 2008).

**Table 3.** Suggested cage dimensions for a bird of approximate length 20cm (DEPI 2014) (note: alternative dimensions are recommended for 'display cages' (indoor and outdoor)).

	Minimum floor area (sq cm)	Number of birds	Minimum height (cm)	Increased floor area for each additional bird (sq cm)
Indoor cage dimensions	1600	1	34	800
Outdoor cage dimensions	7200	1	60	3600

#### 4.4 Position of enclosures

Enclosures should be positioned to allow some access to natural weather elements (wind, sun, rain) whilst also providing protection from these elements at the bird's discretion. Ideally, a planted, outdoor aviary should be used which has complete or mostly complete roof cover and three sides closed in at one end (usually the end opposite the aviary entrance). A range of designs are appropriate (Figure 9).



**Figure 9.** Examples of aviaries used for keeping softbills, showing various designs and positions (Stafford 2015).

#### 4.5 Weather protection

As noted above, a semi-open aviary design is ideal, as it provides birds with some exposure to natural weather elements but also protection.

#### 4.6 Temperature requirements

The Eastern yellow robin has a wide distribution and will therefore tolerate wide range of temperature conditions. Marchant's (1985, 1987) observations of the species' breeding habits provide evidence of this; for example, the year in which breeding was observed to begin the earliest was also the coldest (1981), and in 1977, a drop in average maximum temperatures of 10°C in August/September did not inhibit the start of laying. The end of the breeding season was found to be more constrained by weather than the start, and was seemingly often brought to an end by low rainfall and high temperatures (Marchant 1985). The species may generally prefer lower ground surface temperatures, which tend to be associated with higher abundances of leaf litter invertebrates, as shown for the Western yellow robin (Cousin 2004a).

#### 4.7 Substrate

A natural substrate is recommended in the open end of the aviary; for example, soil, sand or gravel with a loose covering of leaves, twigs and bark, or mulch, which can be easily raked off and replaced (C. Romer pers. comm). Fitzgerald (2003) used crushed red granite and washed river sand for red-capped robins. Large rocks and logs may be positioned on the ground as natural features (Fitzgerald 2003); Eastern yellow robins may also perch on these. Cousin (2004b) noted the following characteristics of ground substrate favoured by the Western yellow robin ('pounce sites'): leaf litter ( $73.3 \pm 2.3\%$ ), followed by plant material ( $10.1 \pm 1.2\%$ ), bare ground ( $13.2 \pm 2.1\%$ ) and log ( $3.0 \pm 0.7\%$ ). There was no seasonal variation in these characteristics (Cousin 2004b). Short grass is acceptable and can make an aviary more visually appealing; however, caution should be taken in smaller or mixed aviaries, for grass cannot be easily removed or replaced and may become soiled beneath favourite perches. It is particularly important for the Eastern yellow robin that grass not be allowed to grow tall and thick, for this is known to interfere with ground-pouncing foraging strategies through diminished prey visibility and/or accessibility (Maron & Lill 2005; also true for the Western yellow robin, see Cousin 2004b). The substrate used in the sheltered or covered end of the aviary can be the same as the open end; alternatively, concrete may be used and is easily cleaned.

#### 4.8 Nest boxes and/or bedding material

This species does not require nest boxes, for it builds open cup nests for breeding. See Section 10.10.

#### 4.9 Enclosure furnishings

Furnishings can include: logs, rocks, natural (wooden) perches of varying thicknesses, shrubs and trees (dead and/or living), grass and a range of substrates. Plantings must be included, particularly during the breeding season; see Section 10.10 for vegetation requirements (e.g. a selection of potential nest sites including forks in branches, at a range of heights, plus nesting materials such as cobwebs and bark, which should be replaced regularly (C. Romer pers. comm.)). Provided the aviary contains most elements of the species' natural habitat, additional behavioural enrichment furniture should not be necessary.

### 5. General husbandry

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#### 5.1 Hygiene and cleaning

Aviaries and cages should be cleaned at appropriate intervals, depending on factors including the number of birds and size of the aviary/cage, which determine how quickly the area becomes soiled. A range of cleaners are available; the Material Safety Data Sheet should always be consulted to check which chemicals are safe for birds (Fair et al. 2010). As Eastern yellow robins are insectivorous, the bottom of the aviary should be cleaned more frequently than those for seed-eating birds (for example by raking out old material). Food dishes should be cleaned daily using a safe and effective disinfectant such as sodium hypochlorite (household bleach) diluted 1/10, followed by a thorough rinse with water (Fair et al. 2010). Wooden materials, including perches, should be replaced regularly (C. Romer pers. comm.). Replacement of such materials should be timed to avoid the pre-breeding and breeding season in aviaries with breeding pairs. It is recommended that a year-long timeline for maintenance activities is established, to ensure cleaning and other important activities occur to schedule, reduce disturbance and are recorded appropriately. An example of such a timeline, for cranes, is shown in Figure 10. For a smaller operation, the timeline may be more specific to the captive individuals and aviaries used.

While robins make far less mess than larger birds and are relatively easy to keep in terms of cleaning and hygiene (C. Romer pers. comm.), birds should nonetheless be rotated through different aviaries to periodically enable complete disinfecting. To disinfect an area where birds have been kept, the *Hygiene*

protocols for the prevention and control of diseases (particularly beak and feather disease) in Australian birds (DEH 2006) recommend that:

- once premises (including surfaces in the aviary) have been thoroughly cleaned of organic matter, they can be treated with 2% Virkon S solution and left for 24 hours, ensuring that surfaces are covered by disinfectant solution for at least 10 minutes;
- once equipment has been thoroughly cleaned of visible organic matter, it can be immersed in 2% Virkon S for at least 10 minutes, taking care that parts of the equipment are not uncovered by the solution during that period; and
- any wooden equipment, such as perches and nest boxes, be disposed of and replaced.

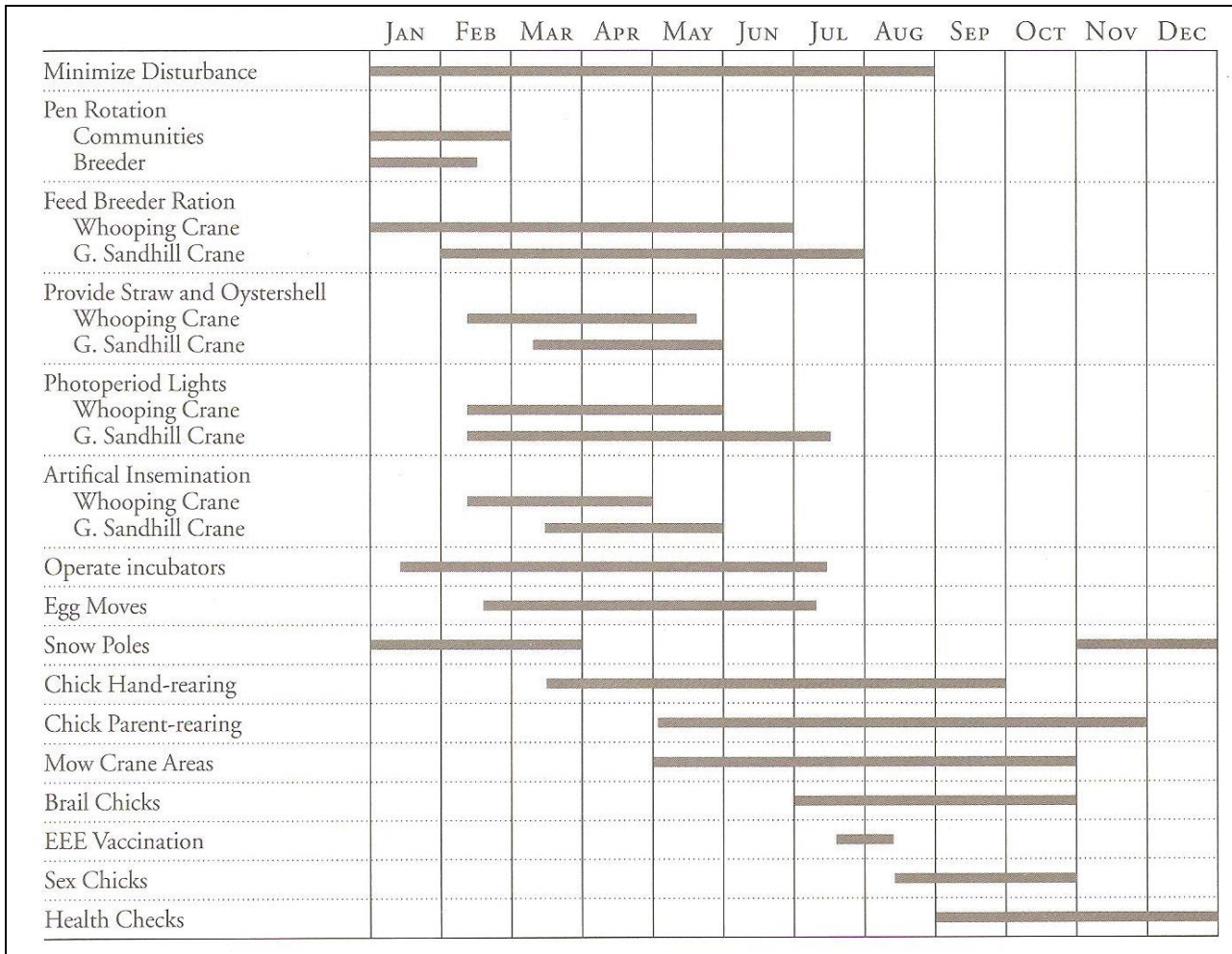


Figure 10. Example of a timeline of maintenance activities for cranes (Swengel & Carpenter 1996).

## 5.2 Record keeping

Good record keeping is fundamental to the successful husbandry and breeding of captive birds. Various computerised systems have been developed to assist with record keeping, such as the Animal Record Keeping System and other programs produced by the International Species Information System. The Patuxant Records System was developed for crane colonies at Patuxent and International Crane Foundation, United States of America, to capture the range of information required for few species but many breeding adults (Ellis et al. 1996). While complex, this system can be modified to suit smaller colonies. It is important to have a system in place before birds are introduced and to ensure all relevant handlers and keepers are aware of the system and their responsibilities in using it.



Details that must be recorded for each individual, at a minimum, include:

- identification (such as bands, plus cage/aviary identification (number, location));
- morphometrics, including weight;
- sex and age (if known; for example, date of hatching or capture from the wild);
- history (e.g. previous owners/institutions, breeding history, details of captivity (such as whether it was housed with other birds));
- any health problems, treatments and quarantine history;
- examinations by veterinarians (dates, results of health checks);
- any behavioural problems;
- introductions and interactions with other birds of the same and other species (if relevant);
- breeding (including attempts, whether successful, number of eggs/clutches, young raised, pairings);
- diet (including any changes).

Daily records should also be made as a matter of practice. Details that may be recorded daily include a visual health check (does the bird appear healthy and well), food (quantity, types, time of day), water (time replaced), cleaning (equipment or surfaces cleaned, chemicals used, time of day), maintenance activities (such as raking of the floor area or replacement of furnishings), any notable interactions with other birds, and any unexpected or unusual behaviours.

### **5.3 Methods of identification**

Colour-fast and metal leg bands have been used to identify Eastern yellow robins in studies of wild birds, allowing the birds to be identified at a distance of at least 30 metres with 8x binoculars (e.g. Marchant 1987). Dark blue and black colour bands are difficult to see in some lighting conditions and are not recommended for this species (Marchant 1987). Note that bands are not always visible in this species due to its sideways perching habit, which always obscures one leg from the viewer (Marchant 1987). For more information on banding equipment, see *Chapter 3 – Bird Banding Supplies* in Lowe (1989) and the *Recommended band size list – Birds of Australia and its Territories* (ABBBS 2000), which should be followed at all times. These guidelines specify band size 02 for the Eastern yellow robin. Pulli may be banded when 6 to 8 days old but no older, as they may not settle back and stay at the nest (Marchant 1987). Females may be caught and handled during the nest-building period and will not desert their nests, but care should be taken not to catch females once laying has commenced (Marchant 1987).

### **5.4 Routine data collection**

Aside from the record keeping noted above (see Section 5.2), it is recommended that data be collected to aid longer-term assessment and evaluation of growth, behaviours and general health. For example, data collected from a breeding pair of Eastern yellow robins and their young could include a range of morphometric measurements (e.g. weight, wingspan and total length). This would enable not only a comparison between different clutches from the same or different pairs within the same institution, but also a comparison with other institutions and with data for wild birds (e.g. Marchant 1987). Such data, if collected consistently and accurately, could add significant value to the published literature for this species, as it presently includes very little information for birds in captivity. Over time it may be possible to identify trends, thresholds and reliable indicators of health or behavioural problems; in this way captive stock can assist in the further development of scientific knowledge.

## 6. Feeding requirements

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### 6.1 Captive diet

The species' diet in the wild is discussed in Section 3.4. Its captive diet should be as similar as possible, depending on what is commercially available or can be sourced locally. Fresh water must also be provided, in a sturdy, shallow bowl and refreshed daily. Ideally, food should be varied over time to mimic natural variation in the availability of particular insects and their larvae. Razeng & Watson (2012) did not find that Eastern yellow robins (or indeed, any other ground-foraging insectivores in the study) increased their intake of calcium-rich food types during the breeding season, as has been observed in passerines elsewhere in the world. Live food and other food items offered to captive robins are described in Table 4. An insect trap can be supplied in the aviary to attract other insects (Fitzgerald 2003). The larger proportion of the diet must be live food; pekin robins are fed at a rate of five insects per bird per day in the non-breeding season (da Cruz 2011). Feeding should occur at least daily, or twice a day in summer, increased to several times a day as necessary during the breeding season (Birdcare 2008). A regular routine is advisable to minimise stress on the birds (Birdcare 2008).

### 6.2 Supplements

The above-mentioned diet should provide the species with most of its needs and supplements are not usually necessary. It is important to offer a variety of live foods, not just one or two kinds that are cheap and readily available, for this can lead to malnutrition (Trollope 1983; Vince 1980). Commercial insectivorous mixtures and powders, typically given in food or water (Fair et al. 2010), are useful for enhancing the nutritional value of a diet (e.g. vitamin intake), as much care is taken to ensure these formulations provide a balance of vitamins and minerals suitable to the relevant species group. As insects and spiders are generally low in calcium (Razeng & Watson 2012), robins may need to acquire calcium from occasional consumption of calcium-rich prey (e.g. isopods and millipedes) or via non-food items (such as carbonaceous stones or calcareous grit) (Razeng & Watson 2012), which should therefore be supplied in captivity.

### 6.3 Presentation of food

In the wild, birds feed on the ground, dropping on prey from vantage points on horizontal perches or vertical tree trunks, as dictated by the vegetation available (Marchant 1985). Prey varies considerably but consists mostly of invertebrates in larvae or adult form (see Section 3.4). In captivity, natural feeding behaviours should be encouraged by providing live food on the ground (in a shallow bowl to prevent escape) within three metres of a range of potential perches. Food should not be placed directly beneath these perches, for it is likely to become soiled by faeces and the discarded remains of prey items. If possible, food should be partially hidden for behavioural enrichment purposes and to replicate the effort applied to catching prey in the wild; this may be achieved by including dry leaf litter in a food tray of dimensions 60cm x 90cm (and a depth of 12cm to prevent escape) to partially conceal the food (Birdcare 2008). Multiple food stations should be provided if kept with other species (Birdcare 2008). Other recommended techniques include plantings of native flora species in and around the aviary to encourage insects to come within reach of the birds, and the use of insect traps, to enable opportunistic feeding (including feeding on the wing; Eastern yellow robins have occasionally been observed hawking (Marchant 1985)). The process known as 'meating off', where captive insectivores are progressively encouraged to take inanimate foods, is unlikely to be necessary for wild-caught Eastern yellow robins, as they predominantly eat on the ground (where live food can be provided in trays, as described above) and are known to readily accept inanimate food items, both in captivity and in the wild (such as when they take crumbs from picnickers). Should 'meating off' be required, see Meaden (1979) and Vince (1980) for techniques.

**Table 4.** Conservation status of the Eastern yellow robin *Eopsaltria australis*.

Food	Information	Reference/s
<b>Live food</b>		
Mealworms	Fed to caged birds during a translocation experiment (Debus & Ford 2012). Commercially available and a good live-food choice for captive birds.	Debus & Ford 2012; C. Romer pers. comm.
Crickets	Commercially available, e.g. Pisces Enterprises crickets.	C. Romer pers. comm.
Bush-fly maggots	Eaten by red-capped robins in captivity.	Fitzgerald 2003
Green lace-wings	Eaten by red-capped robins in captivity.	Fitzgerald 2003
Vinegar flies	Eaten by red-capped robins in captivity.	Fitzgerald 2003
Cockroaches	Commercially available. Sometimes known as ‘woodies’.	C. Romer pers. comm.
<b>Other food</b>		
Wombaroo insectivore powder	<p>Can be mixed with finely mashed hard-boiled egg or a meat mix. Available with a yellow colour enhancer which may be suitable for Eastern yellow robins in order to keep their plumage bright in captivity.</p> <p>According to Wombaroo Food Products (2014), the powder:</p> <ul style="list-style-type: none"> <li>contains 52% protein, with the full complement of amino acids;</li> <li>is suitable for all insect or meat eating species including magpies, kookaburras, birds of prey, seabirds, waders, wrens and robins;</li> <li>is enriched with omega-3, carotenoids, vitamins and minerals to enhance feather condition and chick health;</li> <li>can be used as an ideal live-food substitute or high protein boost for all birds; and</li> <li>contains added taurine, an essential nutrient for growing passerine chicks.</li> </ul> <p>Ingredients: whey protein, soy protein, meat meal, fish meal, blood meal, mannan oligosaccharides, -glucans, lysine, methionine, vegetable oils, omega-3 and omega-6 fatty acids (including EPA &amp; DHA), carotenoids, taurine, vitamins A, B1,B2,B6, B12,C,D3,E,K, nicotinamide, pantothenic acid, biotin, folic acid, choline, inositol, calcium, phosphorus, potassium, sodium, magnesium, zinc, iron, manganese, copper, iodine, selenium.</p> <p>Analysis: Protein (min) - 52%, Fat (min) - 12%, Carbohydrate (min) - 18%, Fibre (max) - 5%, Calcium - 2%, Taurine - 400mg/kg, Carotenoids - 50mg/kg, Metabolisable Energy (ME) - 15.0 MJ/kg.</p>	Fitzgerald 2003; C. Romer pers. comm; Wombaroo Food Products 2014.
Meat mix	Minced meat can be mixed with Wombaroo powder (above).	C. Romer pers. comm; Wombaroo Food Products 2014
Boiled egg	See ‘Wombaroo insectivore powder’ above.	Fitzgerald 2003; C. Romer pers. comm.
Nectar	May be eaten by robins if housed with other species which have this in their diet.	C. Romer pers. comm.
Cheese	May be eaten by robins if housed with other species which have this in their diet.	C. Romer pers. comm.
Grated carrot	May be eaten by robins if housed with other species which have this in their diet.	C. Romer pers. comm.
Seeds	May be eaten by robins if housed with other species which have this in their diet.	C. Romer pers. comm.
Wheat germ	May be eaten by robins if housed with other species which have this in their diet.	C. Romer pers. comm.
Egg and biscuit mix	Commercially available, e.g. ‘Healthy Bird Egg and Biscuit Mix’. A high protein soft food for finches and canaries. May be given dry or mixed with water to a crumbly texture, do not make it wet. Ingredients: egg powder, glucose, crushed biscuit, bread crumbs, maw seed, vitamins and calcium (Health Bird n.d.). May be eaten by robins if housed with finches or canaries.	Healthy Bird n.d.; C. Romer pers. comm.

## 7. Handling and transport

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### 7.1 Timing of capture and handling

For birds in the wild, S. Debus (pers. comm.) recommends catching the species in the early morning. This is when birds are typically most active and it maximises daylight hours for any required handling and transportation prior to release. A similar approach should be taken for caged birds – capture between early morning and mid-afternoon is acceptable, while capture in the late afternoon or evening is not recommended. Note that Eastern yellow robins tend to rise earlier and settle later in the day than many other small passerines (Boles 1988; Reader's Digest 2003).

### 7.2 Catching bags

Individuals can be temporarily held within a light, opaque cloth bag such as those used in bird banding studies. For example, see the calico 'bird holding bags' for sale through ABSA Inc. (2015), available in two sizes (25x20cm and 30x35cm) for around \$2 each, either of which would be suitable for this species (Figure 11). S. Debus (pers. comm.) has used 'large bags' hung in a well-ventilated car to hold individual robins during short trips between capture and release sites. For short trips (< 1 hour), Eastern yellow robins tend to be more settled in these bags compared to boxes/cages (S. Debus pers. comm.).



**Figure 11.** Calico bags used for temporarily holding birds such as the Eastern yellow robin (K. Wilkes).

### 7.3 Capture and restraint techniques

Eastern yellow robins may be caught relatively easily and safely using mist nets (see Debus & Ford 2012; Marchant 1987) (Figure 12); this is the preferable method of capture in larger aviaries. Mist nets are available through ABSA Inc. (2015) at a range of different lengths, heights and mesh sizes, at a cost of \$70-180 each. Call playback and 'pishing' can be used to lure Eastern yellow robins into nets (Higgins & Peter 2002; Maron et al. 2012). For birds in the wild, DEWHA (2010) provides the following advice regarding the use of mist nets:

- mist-netting is most useful in densely vegetated habitat where visibility of nets will be low;
- early morning is typically the most appropriate time to use mist nests;
- open nets should be checked at least every half hour or more frequently if temperatures are unusually hot or cold, drizzle occurs or a likely predator is spotted nearby;
- nets should be closed immediately at the onset of rain;
- more birds tend to be caught if the nets are set along lines cut through moderately dense vegetation than if existing tracks or open areas with little understorey are used (Robertson & Liley 1998); and
- netting will be most useful in conjunction with other survey methods.

Further guidance on using mist nets is outlined in the *Australian bird bander's manual* (Lowe 1989).



**Figure 12.** Mist-netting in Namadgi National Park, Australian Capital Territory, 2012. Left: a mist net in position, rolled up to avoid catching birds outside of the study period. Right: Setting up a mist net (K. Wilkes).

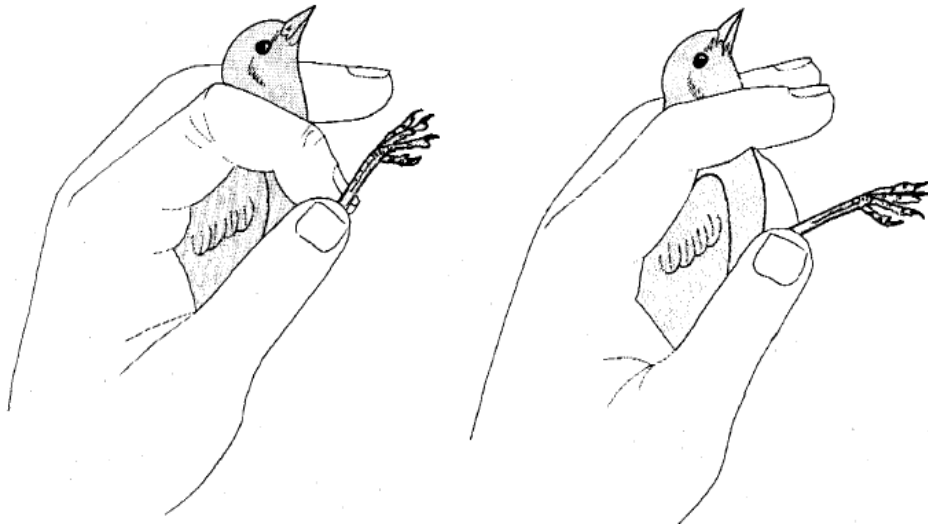
In cases where mist netting is not possible (e.g. in mixed aviaries or where there is a lot of aviary furniture or plantings which make it difficult), birds may be caught using a hand net (e.g. a ‘finch net’, which has a wooden or metal frame and a long handle). In some cases birds may also be caught by hand. It is advisable to have two people present to make the procedure as quick as possible and limit unnecessary handling and stress on the bird. Some perches or other furniture may need to be removed first. If possible, separate the bird from others in the aviary; this can be achieved using an erect sheet. When using a hand net, it is preferable to try to catch the bird as it flies away from you, in order to minimise injury risk.

#### 7.4 Weighing and examination

The ringer’s grip is a commonly employed method for handling small birds. The bird’s back is rested on the handler’s palm, the neck is held loosely between the first and second fingers, and the other fingers form a loose cage around the bird (Figures 13 & 14). An alternative method is shown in Figure 15; this grip is often used following weighing and examination, prior to release. As a general rule, however, handling of birds should be minimised to avoid unnecessary stress on the birds. A bird’s weight should be measured in grams using scales or balances supplied by ABSA Inc.; weigh the bird plus its holding bag and then minus the weight of the bag. Other measurements which can be taken while the bird is in the hand include total length, wing span, tail length, wing length, length of primary and secondary feathers, head-bill length, head depth, head width (maximum), bill length, culmen length, bill depth and width, tarsus length and claw length. Comprehensive, illustrated measurement guides are provided in Disney (1974) and Lowe (1989) (see Appendix 1).



**Figure 13.** A licenced bander holding a rose robin *Petroica rosea* (female) in the ringer’s grip (K. Wilkes).



**Figure 14.** Two variations of the ringer's grip (Lowe 1989).



**Figure 15.** An alternative handing grip for small passerines. Bird banding in Namadgi National Park, Australian Capital Territory. Left: thornbill, *Acanthiza* sp.. Right: rose robin *Petroica rosea* (female) (note band on right leg) (K. Wilkes).

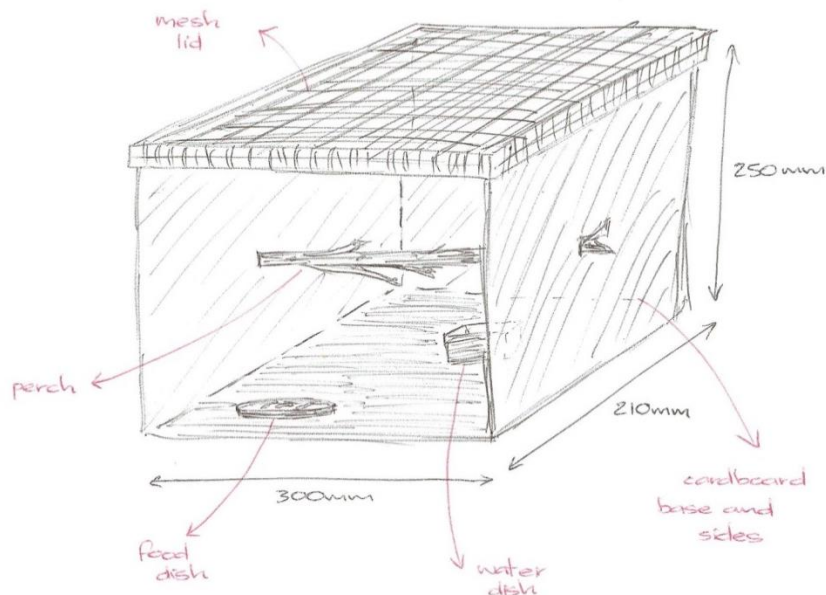
## 7.5 Release

S. Debus (pers. comm.) recommends releasing birds well before dusk, to enable them time to find a suitable roosting site and settle in to their new environment before dark. Birds should only be released in a location with appropriate habitat (see Section 3.2). S. Debus (pers. comm.) further recommends banding and attaching any required transmitters when the birds are first caught and moved to their transportation/holding box or bag (rather than immediately prior to release), thus giving them time to adapt to the feel of the devices before release. S. Debus (pers. comm.) noticed significant variation in the way individuals respond to having transmitters attached; some are calm while others appear to panic, flying erratically for the first few minutes of release before settling.

## 7.6 Transport requirements

### 7.6.1 Box design

In order to translocate a number of individual Eastern yellow robins, Debus & Ford (2012) captured the birds in mist-nests, colour-banded them, and transported the birds to their release site in 'small covered box-cages'. These boxes are described as being around A4<sup>2</sup> in size, made of cardboard (a disused packaging box of the right dimensions is adequate), with a mesh top (corners folded to make a 'lid') and cloth laid over the top (S. Debus pers. comm.) (see Figure 16).



**Figure 16.** A transport box similar to that used by S. Debus (pers. comm.) for moving Eastern yellow robins (K. Wilkes).

### 7.6.2 Furnishings

Transport boxes (described above) should contain a perch for the birds to use during transport. S. Debus (pers. comm.) noted that Eastern yellow robins will use such perches, if provided, rather than sitting on the floor of the box. The perch should be sturdy and of an appropriate thickness for the species (up to around 1cm in diameter), fixed into the box such that it cannot move or become dislodged. No flooring material is necessary for short trip (S. Debus pers. comm.), particularly if the box is not intended for re-use.

### 7.6.3 Water and food

Debus & Ford (2012) provided caged individuals with water and a few mealworms in their boxes for transportation. Mealworms were provided in small dishes, about the size of a petri dish, to prevent escape; S. Debus (pers. comm.) noted that some robins ate the mealworms en route. Water is similarly provided in a small sturdy dish, partially filled to reduce spillage, though birds are unlikely to drink from the dish and it may not be necessary on short trips (< 1 hour) (S. Debus pers. comm.).

### 7.6.4 Animals per box

Only one bird should be kept in a box of the dimensions described above, to eliminate any aggression or stress associated with multiple birds in a confined space. If larger boxes or cages are used for transport it may be possible to temporarily keep more than one robin in the box, though this has not been tested.

### 7.6.5 Timing of transportation

Transport should occur during the day, preferably around mid-morning following early morning capture. Long trips (> 1 hour) are best avoided but if they are necessary, particular care should be taken to ensure birds are not exposed to temperature extremes or dehydration, for example by carrying out the transportation in the early morning and/or using a vehicle with air conditioning in warmer climates. If transportation is necessary at dusk or night, birds should be kept in a secure location overnight and released in the morning.

### 7.6.6 Release from box

When releasing birds in the wild, the carrying box or cage should be placed at the release site for at least several minutes prior to release, allowing the bird to observe its new environment. Care should be taken as birds may be more vulnerable to predation if released in unfamiliar territory, particularly if they have

newly attached transmitters/bands. Four of six Eastern yellow robins released at one site in 2006 were killed by predators on release, mostly by a grey butcherbird *Cracticus torquatus* (Debus & Ford 2012). The timing of release during daylight hours is unlikely to affect the likelihood of predation (S. Debus pers. comm.). While predation is not an issue in captivity, care should still be taken to release birds in a quiet, stress-free manner, with the open side of the box or cage facing a clear space. A number of different perching options should be provided, preferably by way of live plantings.

## 8. Health requirements

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### 8.1 Daily health checks

On a daily basis, the zookeeper or carer should observe all captive birds closely, looking for any signs of illness, injury, stress, or abnormal behaviour. Such symptoms could include listlessness, ‘fluffed’ feathers, closed eyes, unusually drooping wings, limping, a change in stool consistency, obstructed nares, decreased food consumption or panting (Fair et al. 2010). An illness is usually well-advanced in birds by the time it is observed and must be treated with a degree of urgency (Fair et al. 2010). Rapid access to a veterinarian is desirable (Birdcare 2008). Ill or injured birds should always be isolated immediately until the cause can be identified.

### 8.2 Detailed physical examination

#### 8.2.1 Chemical restraint

da Cruz et al. (2011) describe a procedure used to treat cataracts in a similar sized pekin robin; the bird was restrained and anesthetized using isoflurane gas administered via a mask, and heart rate was monitored using a Doppler heart monitor.

#### 8.2.2 Physical examination

Parameters that may be observed and monitored are outlined in Table 5. Routine diagnostic procedures include faecal examination, crop swabs and blood samples (Dorrestein 2003). For blood testing in Eastern yellow robins, small samples of blood (<75 µl) may be extracted using brachial venipuncture, enabling up to four smears to be made immediately on glass slides (Maron et al. 2012). Necropsies can be undertaken on dead birds – Dorrestein (2003) describes common procedures.

**Table 5.** Checklist of parameters to consider when physically examining Eastern yellow robins.

Parameter	What to check for
Weight	Within normal range for age/sex
Eyes	Clear, open, functioning
Legs	No malformations, fractures
Feathers	Healthy, clean, free of faeces/dirt/food
Cloaca	Free from faeces build-up, no blood, no signs of diarrhoea
Beak and nares	No fluids or blockages
Wings	Normal range of movement
Respiration	Listen for audible respiratory sounds (Dorrestein 2003)
Moult	State of moult normal (Dorrestein 2003)
Pectoral muscle mass	Normal range; no obvious muscle loss
Abdomen	No swellings; blow the feathers apart to look (Dorrestein 2003)
skin	No lesions or parasites (Dorrestein 2003)



### 8.3 Routine treatments

Birds can suffer from gastrointestinal worms such as roundworms, threadworms and tape worms. It is recommended that Eastern yellow robins, and any other birds kept in captivity, are wormed regularly using a liquid wormer. New birds should be quarantined for around a month and wormed at least twice before they join a mixed aviary. Pekin robins are treated annually with topical ivermectin (6 drops per bird) and an oral dose of fenbendazole (3 drops per bird) (see da Cruz et al. 2011).

### 8.4 Known health problems

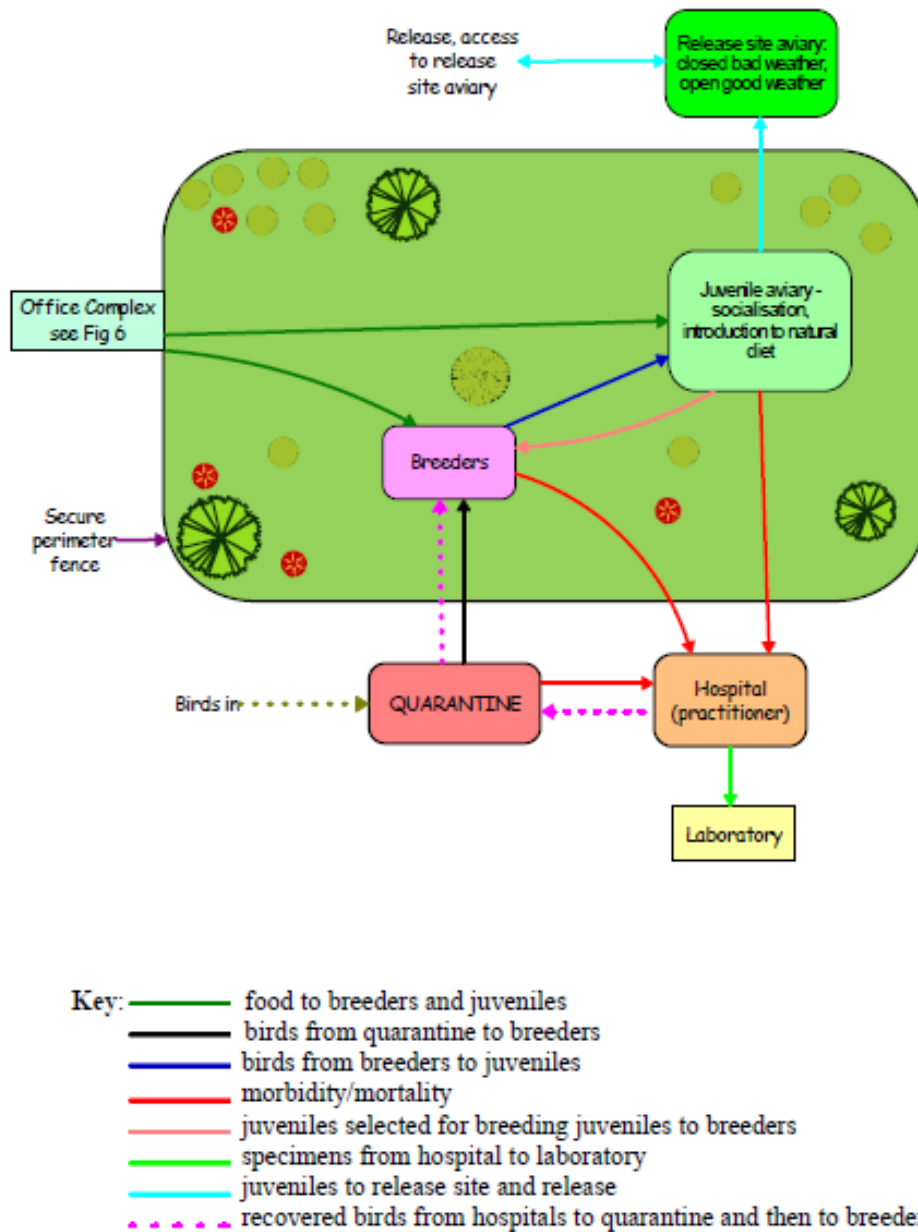
Health problems known to occur in a captive population of pekin robins include: cataracts, pneumonia caused by aspergillosis, infestation by *Filaria* sp., respiratory depression, gout, rickets, and misshapen legs and feet (da Cruz et al. 2011). Ticks and lice can also be a significant issue in captive bird populations. While some of these problems occur equally in wild birds, factors to reduce or eliminate them in captivity include: adequate nutritional management of live insects offered (numbers and variety); spacious, adequately built, fully planted enclosures; and adequate nutrition and nesting material for hand-reared young. Dorrestein (2003, 2009) and Joseph (2003) provide information on bacterial and parasitic diseases that affect passerines, as well as diagnostic approaches and management (see Table 6).

**Table 6.** Infectious and parasitic diseases that can affect passerines (note: some may not affect robins) (Joseph 2003).

Disease	Signs and symptoms
<b>Viral diseases</b>	
Paramyxovirus	Conjunctivitis, anorexia, yellow diarrhoea, voluminous stools with undigested starch and fat (as a result of pancreatic insufficiency), dyspnea, and occasionally neurologic signs.
<b>Bacterial infections</b>	
E.g. <i>Escherichia coli</i> and <i>Salmonella</i> spp.	Symptoms vary; may include diarrhoea, septicaemia, metritis, conjunctivitis, or rhinitis.
<b>Fungal infections</b>	
<i>Candida albicans</i>	Regurgitation, anorexia, crop stasis, diarrhoea.
Avian gastric yeast	Chronic weight loss, dysphagia, vomiting, regurgitation, diarrhoea, death.
<i>Aspergillus</i> spp.	Respiratory signs, vomiting and diarrhoea.
<i>Microsporium gallinae</i> and <i>Trichophyton</i> spp.	Feather loss on the head and neck region and hyperkeratosis of the skin.
<b>Parasites</b>	
Coccidiosis, e.g. <i>Sospora serini</i> and <i>Isoospora canaria</i>	The duodenum may become edematous and hemorrhagic with trophozoites present in the affected duodenum. Wet mounts of the droppings may reveal large numbers of the oocysts.
Atoxoplasmosis, e.g. <i>Sospora</i> spp.	Acute infections; huddling, ruffled feathers, diarrhoea, coelomic distension due to hepatomegaly, neurologic signs, death.
Cryptosporidiosis	Weight loss, depression, faecal pasting, pale/bulky droppings, occasional feather loss at head.
Toxoplasmosis	Respiratory signs, iridocyclitis, chorioretinitis, parophthalmia, and blindness.
Triehomoniasis, Giardiasis, and Cochlosomiasis	These flagellated protozoa inhabit the gastrointestinal tract and may be associated with clinical signs of regurgitation, gagging, diarrhoea, and emaciation.
Plasmodium	Intraerythrocytic parasites responsible for the disease avian malaria.
<b>Other parasites</b>	
Cestode infections	Commonly seen in the insectivorous finches fed live insects.
Nematodes	White plaques in the mouth and pharynx; eggs have a bipolar plug and may be found in wet mounts from swabs of oral lesions or faeces.
Mite infections	Respiratory distress, wheezing, coughing, sneezing, nasal discharge, loss of voice, gasping.

## 8.5 Quarantine requirements

For captive birds to remain disease-free, it is best to maintain a closed flock with strict hygiene and quarantine procedures. This includes eliminating exposure to free-flying wild birds and regulating all food, utensils and humans with access to the birds (DEH 2006). New stock should be held in quarantine and certified disease-free before integrating them with existing stock (DEH 2006). The recommended quarantine and treatment period for diseased birds is at least 45 days; otherwise, new birds should generally be kept in quarantine for a minimum of 30 days (Fair et al. 2010). Figure 17 shows how a quarantine facility can be integrated into a captive bird breeding facility.



**Figure 17.** A design for breeding, showing bird movement between modules, including a quarantine station (DEH 2006).

## 9. Behaviour

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### 9.1 Activity

Eastern yellow robins roost at night, but may continue to forage for a short time after sunset (Higgins & Peter 2002). There is one known example of a bird in a torpor-like state; it had roosted approximately 1.5 metres off the ground on a cold winter night, with feathers and body fluffed out so that it resembled a ball, and was closely approachable (Farnes pers. comm., in Higgins & Peter 2002).

### 9.2 Social behaviour

Eastern yellow robins tend to occur in primary (breeding) pairs. Such pairs may have one or more helpers/attendants – young males that are typically the pair's offspring from the previous year (Marchant 1987). There are occasional reports of large groups of up to 12 individuals (Higgins & Peter 2002); Marchant (1987) noted that as many as five birds could be netted around a single nest after the first bird is trapped. Young females disperse from their natal territory and do not attend others' nests. First-year pairs may attempt to breed but are often unsuccessful and usually do not have attendants (Marchant 1987). Pairs with an attendant have higher breeding success than pairs that are unattended (see Section 10), thus enabling the system to perpetuate (Marchant 1987).

Established pairs are reported to have a home range of 5-6 hectares Debus (2006a), though Marchant (1985, 1987) observed many pairs with territories of 0.8-2 hectares, suggesting that territory size may be in part determined by habitat characteristics (such as food availability; see Stevens & Watson (2013)). Nests of adjacent pairs are usually about 50 metres apart, though they can be as close as 15-20 metres (Marchant 1985). Marchant (1987) noted that females of primary pairs seldom move further than about 25 metres from their nest.

In the wild, established pairs hold territories for several years but usually only defend them in the breeding season (Marchant 1987). Boundary disputes are not common, and rarely involve violence or even physical contact (see Figure 18). It is Marchant's (1987) view that long-established pairs may not be prone to leaving their territories and the dawn-chorus of males may be enough to deter intrusion. Before an attack, the aggressor points itself at its opponent, crouched with sleeked plumage, then launches from a distance of up to 30 or 40 metres, gliding towards the opponent with stiff outstretched wings in a parachute-like flight (Marchant 1987). The birds will then chase each other, making an agitated piping and scolding noise, with the chased usually giving in. The chaser will then land on or near the abandoned branch, slowly cocking its tail several times in an exaggerated manner (Marchant 1987).

Disputes *within* a territory are typically aggressive and may end in violence, often involving the 'wide gape' response which in other circumstances is used to repel intruders (Marchant 1987). It is thought that these disputes therefore represent efforts by primary males to repel unwanted attendants or young rival males, rather than the maintenance of pair bonds (Marchant 1987). In one case, two Eastern yellow robins were observed clashing in mid-air and then fluttering to the ground, struggling (Marchant 1987). Another aggressive situation that may arise within a territory is between immature or young birds, tussling for dominance; the aggressor gapes widely, fluffs out its feathers, sidles up to its opponent and even nudges it aside, forcing the opponent to move meekly away (Marchant 1987).



**Figure 18.** An upright, inquisitive stance adopted by an Eastern yellow robin when another flew nearby; subtle displays such as this are often enough to prevent disputes within this species (K. Wilkes).

### 9.3 Reproductive behaviour

The Eastern yellow robin breeds from July to January (Reader's Digest 2003), or late winter through to mid-summer. While allopreening has not been observed in this species, courtship feeding (Figure 19) becomes more frequent and regular as breeding starts (Marchant 1985). Highest song levels in this species occur in August during the pre-breeding courtship period, dropping to 10% of this level as hatching commences and rising again post-breeding, before declining steadily with the approach of moult (Keast 1994). Copulation is inconspicuous, carried out silently and never preceded by display or ceremony (Marchant 1987). The female crouches slightly with a tremor of her wings; the male mounts without preliminaries and flies away immediately afterwards (Marchant 1987).

Females alone build the nest, which takes 10-15 days early in the season and 8-10 days in the late season (Marchant 1985). Males and attendants engage in courtship feeding while the nest is being constructed, then feed the female on the nest while she incubates (Marchant 1987) (Figure 20). Males also undertake around 75% of the feeding of young (Marchant 1985) (Figure 21). Females may perform 'injury feigning' if disturbed from brooding, flopping or fluttering to the ground and puffing out her body feathers, waving her wings and silently creeping over the ground (Marchant 1985). Males and attendants remove faecal sacs and drop them at a regularly used perch 20-30 metres from the nest, where they accumulate into a conspicuous pile; females remove hatched egg shells and drop them at the same location (Marchant 1985).



**Figure 19.** Courtship feeding at nest, Goomboorian, Queensland (Webster, in Boles 1988).



**Figure 20.** A female Eastern yellow robin on her nest, Gold Creek Reservoir (Flickr: Chillibones, 4 August 2014).



**Figure 21.** An Eastern yellow robin feeding young (left) and nestlings (right) (Waterhouse, in Boles 1988).

#### **9.4 Bathing**

Bathing has been observed but not described (Wolstenholme 1922); the species has been seen evicting a house sparrow from a pool of water in order to bathe, pecking at it until it moved away. One occasion of sunning has been described by Cooper (1969, in Higgins & Peter 2002), whereby over a 17 minute period an individual crouched on the ground, tipping its body towards the sun, fanning its tail and spreading its wing at right angles from the body. This was followed by rolling to do the same on the other side then laying on its back with wings outstretched. Eventually the bird flew to a nearby branch and commenced preening. Sunning is usually performed in order to encourage lice to move and therefore allow easier preening.

#### **9.5 Behavioural problems**

As previously noted, Eastern yellow robins are not normally aggressive towards humans and would cause little injury if they were. The author is not aware of any behavioural problems with captive birds, aside from some aggressive interactions with other birds, noted in Sections 9.10 and 9.11 below.

#### **9.6 Signs of stress**

Robins are generally easy to keep (C. Romer pers. comm.; Stafford 2015). They should however be closely monitored if kept with other species in captivity, particularly during the breeding season; competition over food and aggressive interactions with other birds is likely to increase stress levels (Fitzgerald 2003; C. Romer pers. comm.; Stafford 2015). Techniques to reduce stress include behavioural enrichment (see Section 9.7 below), regular feeding times and limited handling and disturbance.

## 9.7 Behavioural enrichment

The husbandry information provided in Section 4 should be sufficient to prevent behavioural problems. Some of the most important factors include:

- partial concealment of live food, which encourages birds to seek it out as they might in the wild, thus providing exercise and mental stimulation (Birdcare 2008);
- presentation of a variety of foods, including live food and commercially-available mixes;
- inclusion of native plantings, including a range of potential nest sites and perches (some perches and/or food trays may be located strategically to increase visibility to the public);
- natural substrates and furnishings, changed regularly; and
- an aviary that is large enough to enable natural flight, movement and other behaviours.

## 9.8 Introductions and removals

Before introducing an Eastern yellow robin individual to an aviary containing the same or other species (see Sections 9.9 and 9.10 below), it should first be quarantined for 30-45 days. After this, it should be housed for a minimum of seven days in an adjacent aviary or cage, such that intra- and/or interspecific interactions can be observed. If no aggressive interactions take place, and particularly if the relevant birds exhibit positive signals (such as a desire to be near each other), it may be possible to introduce the individual to its intended aviary. Once released, all birds in the aviary should be observed closely during the following weeks to ensure aggressive interactions are not occurring.

When removing an Eastern yellow robin individual from an aviary, care should be taken if that individual is part of an established pair. The species forms monogamous pair bonds and may suffer some distress if removed from a partner. In the wild, individuals will re-partner if one in the pair dies (Marchant 1985), which indicates that any distress from removal in captivity may only be temporary (particularly if the relevant individuals are introduced to an alternative mate). Removal of young birds is unlikely to have negative consequences, though sometimes attendants will have a strong drive to continue feeding young even when they are removed from their breeding pair, and may try to assist other breeding individuals if housed in the same aviary (Marchant 1985).

## 9.9 Intraspecific compatibility

The Eastern yellow robin may be kept singularly or in established (breeding) pairs. In captivity, young are always removed at the end of a breeding cycle and moved to another aviary or zoo (particularly given the need for exchanging breeding stock) (C. Romer pers. comm.). Given that pairs in the wild may have one or more attendants, it may be possible to replicate this in captivity, but only in a large aviary and under close observation. More than one breeding pair may also be kept in the same aviary but again it would be important for the aviary to be large and for the behaviour of males to be watched closely. It is natural for the male of an established breeding pair to chase other individuals out of its territory; this could include young from the previous year, attendants (of any age) and rival males. Such intraspecific interactions can be aggressive (Marchant 1987) and the aggressed individual/s should be removed immediately if this behaviour is observed. In captivity, males have been reported to kill conspecifics (Le Souëf 1916). Note that in the non-breeding season, established pairs in the wild are rarely seen in close contact (Higgins & Peter 2002).

## 9.10 Interspecific compatibility

In the wild, aggressive interactions have been recorded between flame robins *Petroica phoenicea* and Eastern yellow robins (Robinson 1993, in Higgins & Peter 2002). When breeding, Eastern yellow robins will tolerate other species of birds except when they are very close to the nest; the exception to this are thornbills (*Acanthiza* spp.), which have been observed unmolested right at the nest (Marchant 1985). Females will chase away birds of other species when they land in the nesting bush, including:

- Lewin's honeyeater *Meliphaga lewinii*
- golden whistler *Pachycephala pectoralis*
- rufous whistler *Pachycephala rufiventris*
- grey shrike-thrush *Colluricincla harmonica*
- grey fantail *Rhipidura albiscapa* (Marchant 1985).

In the non-breeding season (autumn-winter), Eastern yellow robins are social and tolerant of other species, often joining mixed foraging flocks of insectivorous birds in winter (Reader's Digest 2003). According to Higgins & Peter (2002), the species has been observed foraging alongside:

- superb lyrebird *Menura novaehollandiae*
- buff-rumped thornbill *Acanthiza reguloides*
- white-throated treecreeper *Cormobates leucophaea*
- golden whistler *Pachycephala pectoralis*
- scarlet robin *Petroica boodang*
- grey fantail *Rhipidura albiscapa*
- brown thornbill *Acanthiza pusilla*
- yellow-rumped thornbill *Acanthiza chrysorrhoa*
- white-browed scrubwren *Sericornis frontalis*
- speckled warbler *Pyrrholaemus sagittatus*.

In captivity, Eastern yellow robins are reported to be quite aggressive, though not as aggressive as the hooded robin (C. Romer pers. comm.; Stafford 2015). Male hooded robins have been known to chase pied honeyeaters *Certhionyx variegatus* aggressively in captivity, most likely due to their black and white plumage, and there is one record of a male hooded robin attacking a Burke's parrot *Neopsephotus bourkii*, which subsequently died (C. Romer pers. comm.). However, hooded robins are kept at Adelaide Zoo in the same aviary as regent honeyeaters *Anthochaera phrygia*, regent parrots *Polytelis anthopeplus* and flock bronzewings *Phaps histrionica* (C. Romer pers. comm.). Fitzgerald (2003) reports that red-capped robins are successfully kept with silvereyes *Zosterops lateralis*, though the robins did not breed when the silvereyes were present, possibly due to competition over food (the silvereyes bred in the enclosure and therefore had young to feed). Red-capped robins have also been kept in captivity with mixed flocks of native finches (up to nine pairs of finches in a 5m x 5m aviary) (Fitzgerald 2003). Stafford (2015) comments that Eastern yellow robins, while not being as aggressive as hooded robins, are 'still a bird that you've got to watch and think about what you mix with them'.

## 9.11 Suitability to captivity

As noted in Section 1.3, Eastern yellow robins are naturally confiding, with an inquisitive attitude around humans (BirdLife n.d.; Boles 1988; Cayley 2011). They are brightly coloured, long-lived and sing throughout the year (Keast 1994). For similar reasons, the pekin robin *Leiothrix lutea* was once exported by the thousands and became one of the most widely kept softbills in captivity, prior to limitations on trading brought about by the Convention on the International Trade of Endangered Species of Fauna and Flora in 1997 (da Cruz et al. 2011). Eastern yellow robins are not aggressive towards humans. If a female is approached on the nest, she will puff out her feathers and gape widely (Marchant 1985).

Females can also be caught and handled during the nest-building period and will not desert their nests (Marchant 1987). Eastern yellow robins are relatively easy to feed in captivity (C. Romer pers. comm.) and may also breed successfully, provided that breeding pairs are kept on their own or in a large aviary with compatible species (see Section 9.10).

## **10. Breeding**

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### **10.1 Mating system**

Eastern yellow robins form monogamous pairs (Maron et al. 2012) and sometimes breed cooperatively (Dow 1980; Marchant 1985, 1987), with around one in five nests 'attended' by immature birds (Marchant 1987). Extra-pair matings between a primary female and her attendant/s has not been recorded, but may occur (Marchant 1987). Bigamy has been occasionally observed in this species; Marchant (1984) recorded two females sitting on a nest, one on top of the other, and in 1986 recorded a nest with five eggs from two females (Marchant 1987). First-year breeding pairs do not tend to form lasting pair-bonds or permanent territories (Marchant 1987). Only first-year males are known to attend other nests. First-year females are 'unobtrusive' and not known to act as attendants (Marchant 1987).

### **10.2 Ease of breeding**

Marchant (1987) states that his study population 'essentially seemed to be of two parts: established pairs that bred year after year with reasonable success, and young birds that either acted as attendants or took no part in breeding or bred without success'. This indicates that successful breeding in captivity may in part depend on age and whether the pair is established or can be persuaded to become so. Hooded robins are known to breed relatively easily and double-clutch in captivity (C. Romer pers. comm.), while red-capped robins have also been bred successfully in captivity (Fitzgerald 2003). It may be important for pairs to be housed on their own in order for breeding to occur (Fitzgerald 2003; C. Romer pers. comm.). The following information relates to Eastern yellow robins in the wild, with a focus on elements that may be relevant to captive-breeding.

Breeding success in the wild is poor. Of 231 nests observed by Marchant (1985), 75 (or 32%) produced some young while 156 (68%) failed to produce any. Some pairs made five or six unsuccessful attempts in a season. There was no significant difference between pairs with and without attendants in terms of their ability to produce young; however, the likelihood of chicks surviving to fledging was significantly higher if the pair was attended (Marchant 1985). More recently, Debus (2006a) produced similar results, with 33% nest success (n=40) over three breeding seasons. This translates to 0.6 fledglings raised per pair per attempt, and 1.0 per year; again there was no difference between pairs with and without attendants (Debus 2006a).

Marchant (1985) observed that nests that failed were usually lost during laying (8%), in the first four days of incubation (23%) or in the first week after eggs hatched (36%). Some broods were observed to be lost due to heat or storms, or as a result of the female dying (Marchant 1984), while others disappeared at night, probably due to nocturnal mammals. Debus (2006a) found that predation accounted for 71% of failed nests, with inclement weather, desertion and poor attachment of nests potentially accounting for the remainder. Berry (2001) found the nest predation rate for Eastern yellow robins to be 50%, with other causes including destruction by fire, death of adults, structural failure of nests, and abandonment. In captivity, nesting success is likely to be much higher given the ability to control variables including temperature, food availability and predation; the effect of food shortages on breeding success has been widely reported for this species (e.g. Barrett et al. 2007; Marchant 1985; Stevens & Watson 2013; Watson 2011; Zanette, Doyle & Trémont 2000; Zanette & Jenkins 2000).



Over many years, Marchant (1984, 1985, 1987) never observed a nest predated during daylight hours, though predators were sometimes suspected (including goannas *Varanus* spp., laughing kookaburras *Dacelo novaeguineae* and pied currawongs *Strepera graculina*). Similarly, Debus (2006a) was seldom able to confirm the identity of predators, but suspected the pied currawong, Australian magpie *Gymnorhina tibicen*, grey shrike-thrush *Colluricincla harmonica*, black-faced cuckoo-shrike *Coracina novaehollandiae* and grey butcherbird *Cracticus torquatus*. Predators of Eastern yellow robin nests in an urban environment include the black rat *Rattus rattus*, brown antechinus *Antechinus stuartii* and ringtail possum *Pseudocheirus peregrinus* (Matthews, Dickman & Major 1999). In captive environments, care should be taken to ensure the full range of potential predators cannot access the Eastern yellow robins or their nests.

In a wild population of Eastern yellow robins near Moruya, New South Wales, a fire in 1980 was found to have no immediate effect on breeding success, with nests started at about the same time as in previous years and within only a few days of the fire (Marchant 1987). However, the population decreased the following year, and had not recovered four years later (Marchant 1987). The author attributes this to the growth of a thick grassy ground cover following the fire rather than to direct destruction of nests, suggesting that the species is initially resilient to disturbance but avoids sites with thick or tall grass in the longer term; a conclusion supported by Barrett et al. (2007) and Maron et al. (2012). Debus & Ford (2012) translocated Eastern yellow robins to an area formerly occupied by the species. Some individuals not only survived this treatment but went on to breed, establishing a small population at the new site. This provides further evidence of the species' resilience, and suggests that wild-caught birds may breed successfully in captivity.

Breeding can occur throughout most of the year (see Section 10.6). In his study population, Marchant (1987) found that breeding tended to occur in earnest from August-September through until January. The start of breeding could not be correlated with the weather; Marchant (1985) comments that the proximal factors controlling the start of breeding are 'no doubt ... a subtle combination of climatic factors that control the supply of food and other requirements'. The end of the breeding season is thought to be controlled by drought and heat in December/January (Marchant 1985). Again, if variables such as temperature are controlled in captivity, the breeding season may be extended somewhat, though there are likely to be some natural constraints (e.g. the beginning of moult in January).

### **10.3 Reproductive condition**

Captive pekin robins in Brazil are brought into breeding condition primarily through increased provisioning of mealworms, crickets and waxworms to a rate of 6-8 of each insect per bird per day, compared to a normal rate of 5 insects per bird per day (da Cruz 2011). A similar approach could be taken for Eastern yellow robins.

### **10.4 Techniques used to control breeding**

Possible techniques to control breeding include:

- separating adult (> 1 year old) males and females
- removing eggs
- removing all suitable nesting material and/or places for building nests.

Separation of the sexes is considered the only viable option for controlling breeding in the Eastern yellow robin, for the following reasons. If eggs are removed, females will continue to attempt breeding throughout the season by replacing single eggs or whole clutches, either in the same or a new nest. It is a labour-intensive method and may cause the breeding pair some stress and/or a reduction in condition, and as such it is not recommended. Similarly, complete removal of nesting places is unlikely to be achievable, given the species' tendency to nest almost anywhere, including open and precarious

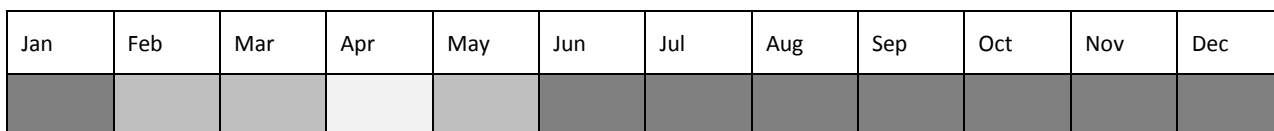
positions (Marchant 1985) and at a range of heights. To remove all nest site possibilities would require moving everything from the aviary except the most basic perches, which may have negative impacts on the birds' behaviours and would not be good for amenity/aesthetics. Likewise, females use a wide range of nesting materials and complete removal of such material from the aviary is not recommended. The separation of sexes or keeping of individual birds is unlikely to have any long-term negative impacts, given that they live largely on their own in the non-breeding season, and are able to re-pair if separated from their mate in the wild (Marchant 1985, 1987). To encourage breeding, spare cock birds may be kept nearby a breeding pair (Birdcare 2008).

### 10.5 Occurrence of hybrids

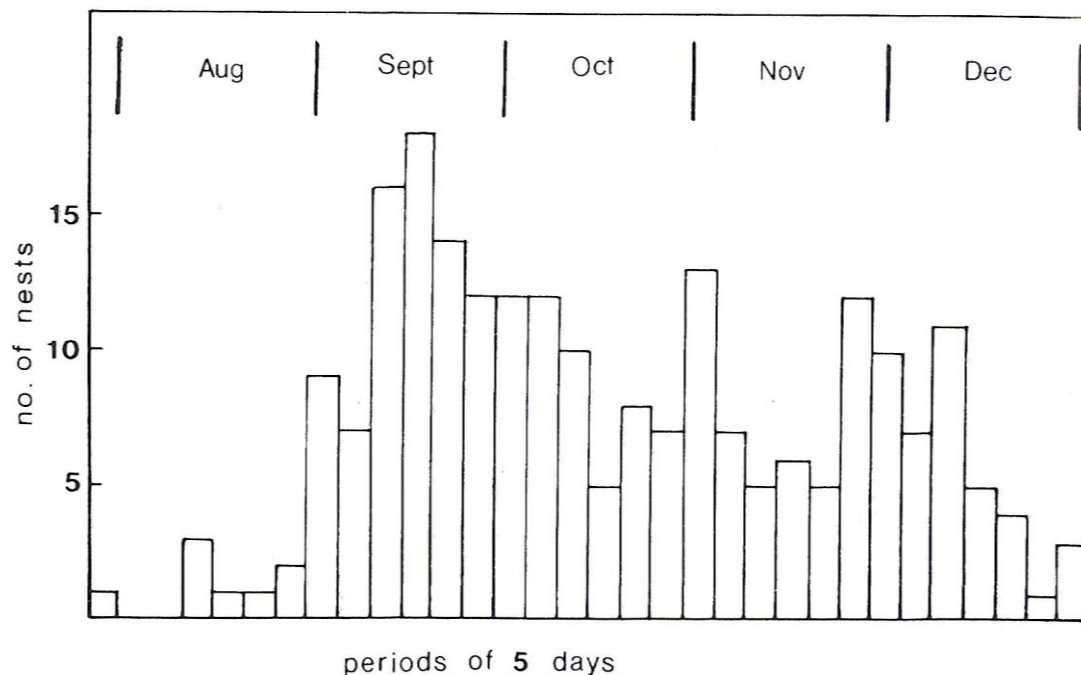
There are no known instances of hybridisation in this species.

### 10.6 Timing of breeding

Breeding usually occurs from June/July through to January (Reader's Digest 2003; Simpson & Day 2004) (Figure 22) though the main breeding season is from August to December (Marchant 1985) (Figure 23), i.e. late winter to early summer. Marchant (1985) notes that laying quickly falls off after mid-December and rarely occurs in January, when the birds begin to moult. During the approach to the breeding season, the species may exhibit behaviours such as courtship feeding, which allows an observer to distinguish between the sexes (Marchant 1987).



**Figure 22.** Breeding season for the Eastern yellow robin (dark grey = main breeding season, mid grey = casual breeding, or after unseasonal rain, light grey = no breeding) (Simpson and Day 2004).



**Figure 23.** Starting of laying of Eastern yellow robins at Moruya, New South Wales, 1975-82, shown as the number of nests started in each period of five days from 1 August (Marchant 1985).

### **10.7 Age at first breeding and last breeding**

Eastern yellow robins can start breeding at one year of age (Zanette 2001) but are rarely successful, often abandoning their attempts to breed to disperse or attend the nests of their parents or neighbours (Marchant 1987). The age of the oldest known breeding adult in the wild is 10 years (Marchant 1987).

### **10.8 Ability to breed every year**

Eastern yellow robins are able to breed every year (Marchant 1987).

### **10.9 Ability to breed more than once per year**

Established pairs can raise three broods in a season (Marchant 1985). If a primary pair has one or more attendants, the pair may produce more broods per season, as it reduces the effort of the primary male (Marchant 1987). Breeding success has been found to be around 30% in the wild, not differing annually but significantly better for nests with attendants (Marchant 1985).

A fire that occurred in the area of a study population in 1980 was found to significantly impact on breeding success in the years following, possibly as a result of the grasses growing back far more thickly than previously (Marchant 1985). This suggests that a reduction in food reduces breeding success (number of clutches and/or size of clutch). Conversely, an increase in food availability may trigger increased breeding success, but only up to a point (noting the likely physiological and timing constraints). For example, a female may not be capable of producing more than four eggs per clutch, and there may not be enough time to raise more than three broods in a season, given incubation and nestling periods. A successful nesting cycle takes around 40 days, theoretically enabling a pair to raise 2-4 broods annually, though most only raise two (due to conditions and a high failure rate) (Marchant 1985).

Observations by Marchant (1985) suggest that a pair will attempt to nest again if a clutch is removed. For example, on two occasions a pair was recorded re-using the same nest for a new clutch when the previous clutch was lost. In another case, a female laid a single egg in a nest from which her previous nestling had been lost, even though the nest still contained an infertile egg. Marchant (1985) observed that once a pair started to breed, it would continue trying to do so, successfully or unsuccessfully, until conditions became unsuitable in December or January.

### **10.10 Nesting, hollow and other requirements**

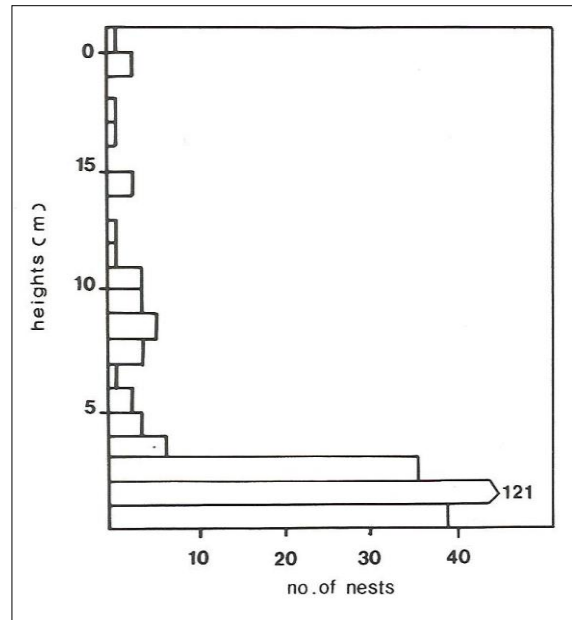
The nest is a cup of bark strips, fine twigs, moss, skeleton leaves and grass bound with cobweb (Table 7, Figure 24). It is often adorned with hanging strips of camouflaging grey bark (Reader's Digest 2003). The nest is lined with fibres or grass, 50-70mm x 30-40mm deep inside. It is usually built in a slender fork or low crotch in a tree. Of 242 nests observed by Marchant (1985), most (53%) were in small live trees and shrubs, 17% in large trees, 13% in small dead trees and shrubs, 9% on bark or twigs fallen into shrubs, and 4% in unusual sites such as Burrawangs and fallen dead trees (Table 7). The vast majority of these nests were less than three metres off the ground (Marchant 1995) (Figure 25). New nests are made for each attempt at breeding, though occasionally the same nest is used if a clutch is lost (Marchant 1995).

### **10.11 Breeding diet**

Females are fed on the nest by males and attendants (Marchant 1985). There is no information available to suggest that a particular diet triggers breeding or that the species' diet (composition or quality) differs in the breeding and non-breeding seasons. The quantity of food can, however, impact on breeding success. In smaller remnant patches in the wild, where breeding robins have less food than in larger continuous patches, females will lay lighter eggs and clutches, spend less time on the nest and more time foraging during the incubation period (Zanette, Doyle & Trémont 2000). In pekin robins, insufficient quality and quantity food in captivity has also been found to be the cause of health problems and poor breeding success (da Cruz 2011).



**Figure 24.** Eastern yellow robin nest and eggs, Linfield, Sydney (Waterhouse, in Boles 1988).



**Figure 25.** Distribution of nests of Eastern yellow robins at Moruya (n = 242), in intervals of one metre above the ground (Marchant 1985).

**Table 7.** Summary of nesting requirements of the Eastern yellow robin (Marchant 1984, 1985, 1987).

Nest requirement	Details
Altitude	From sea-level (~30 metres from the beach) to about 1100 metres above sea-level.
Tree/shrub species	Small live trees or shrubs (e.g. acacias, gum saplings, casuarinas, <i>Melaleuca</i> , <i>Kunzea</i> , <i>Persoonia</i> , <i>Helichrysum</i> spp.); large trees (e.g. <i>Eucalyptus</i> , <i>Angophora</i> spp.); fronds of <i>Macrozamia</i> spp. (for a more complete list of species, see Marchant 1984).
Location in tree/shrub	Upright or vertical fork; sloping branch or fork; horizontal support; against tree trunk at the junction of small side branches; on bends of trunks. Often beneath some form of natural concealment (e.g. hanging leaves or bark).
Height above ground	0-7 metres above the ground, occasionally up to 25 metres. Rarely at ground-level.
Material used	Long strips of bark (e.g. from stringy barks); grass; skeletal leaves; moss; cobwebs; dead leaves (whole or fragments); rootlets; narrow grass stems; tendrils; fern fibres; thin pliable twigs or needles; feathers (including from an emu <i>Dromaius novaehollandiae</i> at Healesville Sanctuary); hair; lichen.

### 10.12 Oestrous cycle and incubation period

Eastern yellow robins, at least for the last egg, lay towards the end of the morning (Marchant 1980). Almost all eggs are laid between 7-11am (Marchant 1980). Laying has been observed to be at intervals of approximately 27 hours, which is slightly unusual, as most other small passerines lay at 24 hour intervals (Marchant 1985).

The incubation period is 15-16 days (Reader's Digest 2003). In a study of 14 Eastern yellow robin clutches, incubation period for marked eggs averaged 16.1 days with a range of 15.8 – 16.2, while the incubation period for unmarked eggs averaged 15.18 days with a range of 14.2 – 16.2 (Marchant 1980). The female incubates for about 80% of the time and broods the young for a similar amount of time for at least the first eight days but less later on, though she will sometimes shelter them from the sun up until fledging (Marchant 1985).

### 10.13 Clutch size

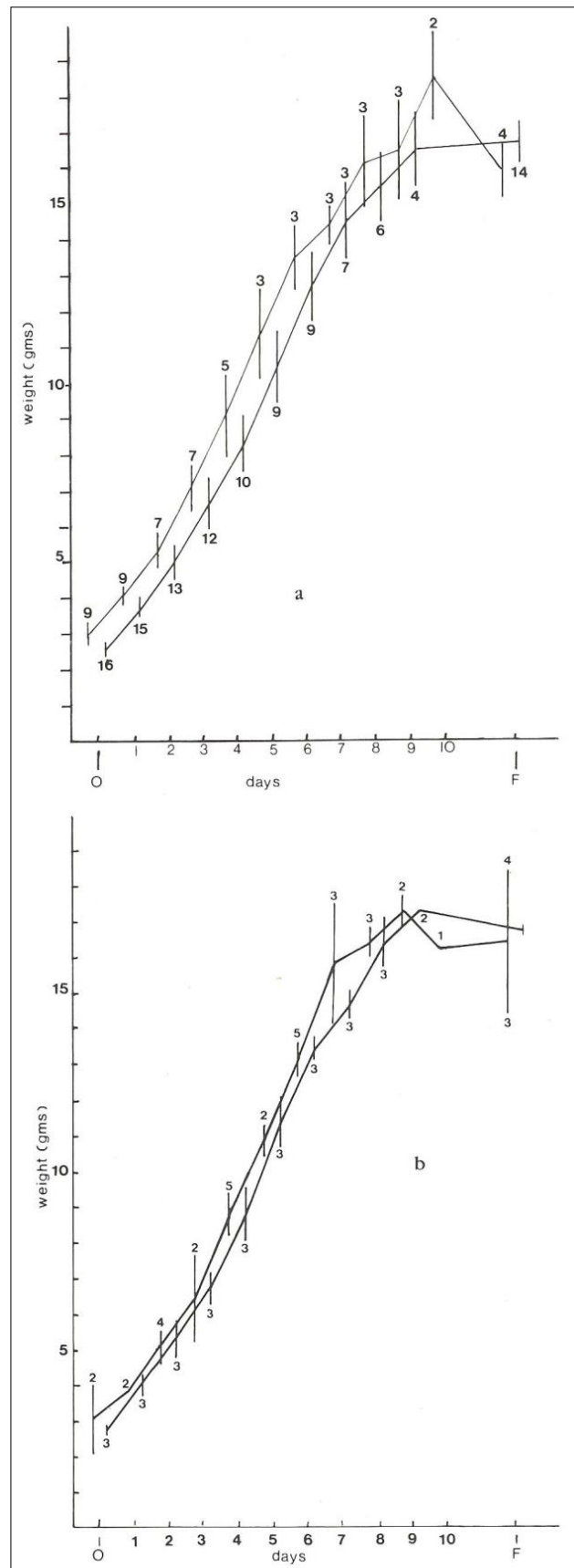
Clutch size is between one and three eggs, usually two (Reader's Digest 2003; Simpson & Day 2004). In a population of Eastern yellow robins near Moruya, New South Wales, clutch size averaged 2.3 eggs (Marchant 1985). Clutch size has been found to be significantly smaller early in the season compared to late, and for pairs without attendants compared to those with attendants (Marchant 1985). In addition, clutches in the study population were found to be significantly smaller in 1980-82 compared to 1975-79, following a fire in 1980 (Marchant 1985). Eggs are oval, 22 x 16 mm, grey-green to pale blue, with red-brown and purple-brown spotting that is sometimes evenly distributed and sometimes concentrated in cap at larger end (Reader's Digest 2003). The sex ratio of hatchlings is unknown.

### 10.14 Age at first fledging

Marchant (1985) observed that 36% of nests that were lost occurred in the first week after eggs hatched. This suggests that the immediate post-hatching stage is high risk for the species, possibly due to attention drawn to the nest by feeding activities, but partly also other factors. For example, some chicks were lost due to heat and exposure, both when newly hatched and later when fully feathered at 8-9 days old.

Marchant (1980) showed that nestling period for Eastern yellow robins averaged 12.6 days, with a range of 10.1 – 13.2 days. As a general rule, young fledge in 10-14 days (Marchant 1985; Reader's Digest 2003). Marchant (1985) describes the nestling period for this species as 'short and curtailed by the nestlings leaving the nest well before they are full grown and hiding in the ground cover for about a month ... this suggests that it is safer for them to hide away from the nest'. Young are incapable of extended flight until five days post-fledging (Zanette 2000).

A female can start a new clutch approximately 40 days after she laid the last (Marchant 1985) or 21 days after the fledging of her young (Zanette 2000). She may be attended by her



**Figure 26.** Growth curves of weight (g) for Eastern yellow robins at Moruya (Marchant 1985), shown as means  $\pm$  2 s.e. from day of hatching (O) to fledging (F). **(a)** Broods of two; left-hand or upper curve of pairs with attendants,  $\bar{n}$  in sample above; right-hand or lower curve, of simple (established) pairs,  $\bar{n}$  in sample below. Offset for clarity. **(b)** Broods of three. Same conventions.

independent young (males only) from the previous year. The male of the breeding pair may chase away young from previous broods (of the same or previous years) or any other individual in its territory if seen as a rival or an unwelcome/unnecessary attendant.

### **10.15 Age of removal from parents**

Young are fully independent at around 40 days. At the start of the year, there is a period of about three months when a proportion of the young from the previous breeding season disperse; the rest stay in their natal area and either breed the following season or become attendants to established pairs (Marchant 1985). There is likely to be another period of dispersal around June/July. Females disperse significantly further than males (an average of seven versus one kilometre) (Debus & Ford 2012) and do not attend the nests of established pairs (Marchant 1987).

### **10.16 Growth and development**

#### *10.16.1 Developmental stages*

Precise information on developmental stages is not available for this species; however, the following information has been recorded of wild birds. Nestlings are fed around 3-4 times per hour on average, mostly by the primary male and attendants, in bursts that are followed by no feeding for long periods (Marchant 1985). When the female is on the nest, food is usually given to her for provision to the young or eating herself (Marchant 1985). Nestlings are well-feathered by their eighth day; at this point the female significantly reduces the amount of time spent brooding (Marchant 1985). On leaving the nest a few days later, fledglings flutter to the ground and hop into thick cover where they hide for the next 3-4 weeks, during which time they are dependent on adults and attendants (Marchant 1985). They emerge and become fully active around 30 days after leaving the nest. Young retain some juvenile plumage until around 90 days old and can be recognised as immature birds until at least one year old by the yellow soles of their feet (Marchant 1985). Young are not sex distinguishable.

#### *10.16.2 Measurements*

The first nestling to hatch (i.e. from the first egg laid) weighs slightly more than the later ones and fledges first (Marchant 1985). Nestlings are at their heaviest at around nine days old and lose weight in the last 2-3 days in the nest (Figure 26). Young are around 82% of the adult weight (20 grams) at fledging (Marchant 1985). Food shortage can significantly reduce both the average weight and average head-bill length of nestlings, as shown by Zanette, Doyle and Trémont (2000).

## **11. Artificial incubation and rearing**

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Eastern yellow robins are likely to re-lay if a clutch is removed, particularly at the beginning of the breeding season. As such, artificial incubation and rearing could produce additional young if desired. However, to the author's knowledge this practice has not been undertaken for Eastern yellow robins, most likely because the species is not threatened and has a high natural breeding rate. The following information is provided for species of a similar size and/or with similar requirements.

### **11.1 Incubator type**

For yellow-tufted honeyeaters *Lichenostomus melanops*, Healesville Sanctuary has used Marsh Rolex fan forced incubators (Krake and Thomas 2000) (Figure 27). Eggs are placed in a shallow tray lined with cotton wadding and are turned four times daily, manually, to prevent damage to the small eggs (Krake and Thomas 2000). Oates (2009) recommends Brinsea octagon 20 or 40 digital high performance egg incubator (Figure 28) for white-browed woodswallows *Artamus superciliosus*. It is important that temperature and humidity can be controlled.



Figure 27. A ROLL-X flowing air incubator by Lyon Technologies (Hotspot for birds 2014).



Figure 28. The Brinsea Octagon incubator range has models to suit a wide range of breeder's requirements (Brinsea 2013).

### 11.2 Incubation temperatures and humidity

Krake and Thomas (2000) recommend that incubators are run at 37°C and 65% relative humidity, for yellow-tufted honeyeater eggs.

### 11.3 Desired egg mass loss (%)

For yellow-tufted honeyeater eggs, daily weight loss is 1.7% and total weight loss is 22% (Krake and Thomas 2000).

### 11.4 Hatching temperature and humidity

For yellow-tufted honeyeater, hatching temperature is maintained at 37°C and relative humidity is increased to 80% two days before hatching to ensure egg membrane does not become dry (Krake and Thomas 2000).

### 11.5 Normal pip to hatch interval

Artificially incubated yellow-tufted honeyeater chicks have hatched within 24 hours of the first signs of pipping (Krake and Thomas 2000). For white-browed woodswallows the average interval is two days (Oates 2009).

### 11.6 Brooder types/ design

As robins are naturally good parents and hand-rearing is a time-consuming exercise, chicks should only be raised by hand if parents are unable to rear fledglings or when parents abandon their chicks (da Cruz et al. 2011). Oates (2009) proposes the following for white-browed woodswallows: a small bucket with sawdust, breeder's choice cat litter or paper towel as a medium; or, a cage lined with a pillowcase, covered with towels (for warmth) and chicks placed inside a knitted pouch. Helmeted honeyeaters *Lichenostomus melanops cassidix* at Healesville Sanctuary have been raised in a purpose-built, thermostatically controlled portable room, with chicks housed in white plastic tubs approximately 60 x 60 x 60cm with fly wire fronts (Krake and Thomas 2000). Inadequate nest material during hand-rearing of pekin robin chicks has caused a number of health problems, including misshapen legs (da Cruz et al. 2011), so this factor should be considered carefully for Eastern yellow robins. Examples of a hatching basket, chick container and brooder used for hand-raising parrots are shown in Figures 29-31; these designs are simple and hygienic, and could be modified to suit small passerines.

### 11.7 Brooder temperatures

Helmeted honeyeater chicks were raised in a portable room (see above) initially set at 28°C and then gradually reduced to ambient temperature once the chicks were 40 days old (Krake and Thomas 2000). White-browed woodswallow chicks should be raised at 34°C when they are 1-3 days old, then 25-30°C for older chicks (Oates 2009).

### 11.8 Diet and feeding routine

Hand-raised pekin robins in Brazil are fed around 14 times per day, at 1 hour intervals. Their diet consists of around 20 insects (such as mealworms, crickets) and 6 small pieces of diced fruit per day (da Cruz et al. 2011). For white-browed woodswallows, Oates (2009) suggests offering food every three hours, by placing the item on the end of a toothpick (culling any insects prior to feeding) and offering the food from above, as a parent would. As a general rule, as the chick gets older it is best to increase the amount of food but decrease the number of feedings (Oates 2009). All food offered should be room temperature or slightly warmer. For Eastern yellow robins, attempt to copy the natural feeding routine observed in wild birds; nestlings are fed around 3-4 times per hour on average, in bursts that are followed by no feeding for long periods (Marchant 1985). Keep in mind that the natural nestling period for Eastern yellow robins is around 12 days, followed by around a month of post-fledging feeding by the parents, with independence reached at around 40 days. Health problems in hand-reared pekin robin chicks have been associated with using the same forceps to feed chicks and remove faecal sacs, and also feeding moist diets to chicks (da Cruz et al. 2011), so these behaviours are best avoided as a precaution.

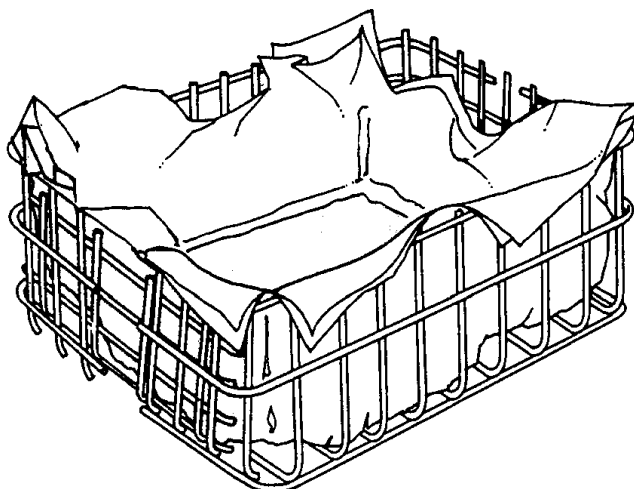


Figure 29. Tissue lined [parrot] hatching basket without cover (Stoodley & Stoodley 1983).



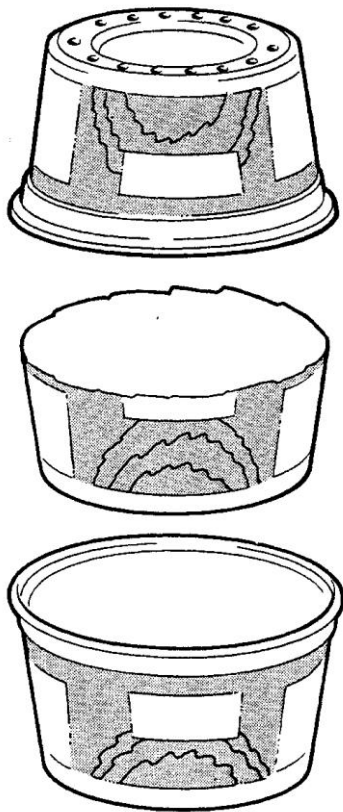


Figure 30. Newly hatched [parrot] chick container made from margarine tubs (Stoodley & Stoodley 1983).

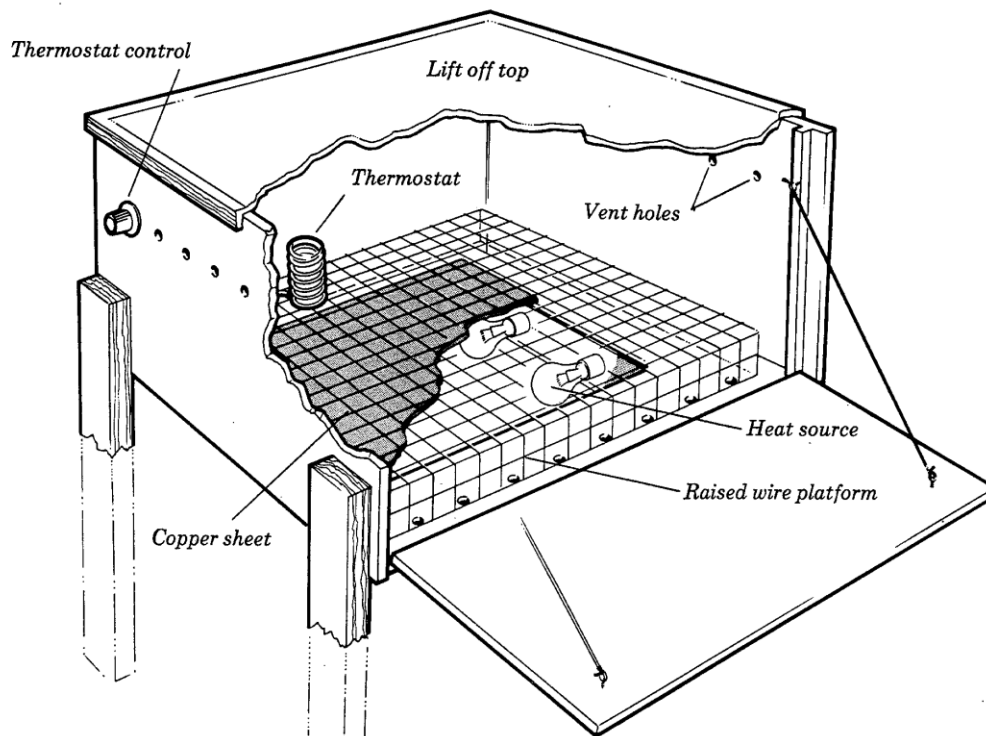


Figure 31. Brooder design used for parrots (Stoodley & Stoodley 1983).

### **11.9 Specific requirements**

There are no known specific requirements (e.g. nest substrates) for the Eastern yellow robin.

### **11.10 Pinioning requirements**

Pinioning is not necessary or recommended for Eastern yellow robins. Considering the *New South Wales guidelines for the pinioning of birds* (DPI 1995), the usual justifications for pinioning are unlikely to be met for this species – it does not need to be displayed in an open enclosure (i.e. one without a roof or flight netting), it does not need to be pinioned in order for visitors to get closer (given its friendly nature and relatively small aviary size), it is not required to attract wild birds to the enclosure, and its escape can be prevented using other methods (e.g. by using a double-door system). The NSW guidelines do not allow pinioning of the Order Passeriformes; the same is likely to be true elsewhere.

### **11.11 Data recording**

Information recorded for chicks should be similar to that outlined in Section 5.2. Some additional data must be recorded when hand-rearing chicks, including any important milestones in a chick's life (such as when it begins eating on its own), any physical problems, weight gain, medical treatments, changes to diet or supplements, socialisation with other chicks, exposure to humans, behavioural changes, and characteristics and frequency of defecation (Wellington et al. 1996). Basic information such as age and sex should of course be recorded. It is important that records are accurate and well-managed.

### **11.12 Identification methods**

As noted in Section 5.3, Eastern yellow robin pulli may be banded when 6-8 days old (pre-fledging) but no older, as they may not settle back in the 'nest' (artificial or natural). Fledging usually occurs naturally between 10-14 days. When hand-rearing, post-fledged chicks may be banded. Following ABBBS (2000), band size O2 should be used for this species. Other methods of identification may include the use of separate enclosures (i.e. identification of individuals based on which cage or brooder they are kept in) or identification by size or weight, if kept with young of different ages. Young are not sex-distinguishable.

### **11.13 Hygiene**

Basic principles to ensure hygiene when handling and managing chicks include:

- washing hands with disinfectant before handling chicks or equipment associated with chicks;
- disinfecting equipment between feeds;
- regularly changing bedding/substrate medium as necessary to keep clean and dry;
- not using the same equipment for feeding and removing faecal sacs (as noted above);
- ensuring handling is kept to a minimum;
- keeping chicks warm whilst allowing air-flow in a sanitised environment;
- keeping chicks clean and dry, by cleaning off any faeces on feathers and any spilt food or water;
- changing-over and disinfecting food and water dishes regularly; and
- discarding unused or uneaten food.

### **11.14 Behavioural considerations**

Given that Eastern yellow robins are generally raised in clutches of two, it may be advisable to hand-rear more than one chick at a time if possible. This may also assist with socialisation. Chicks naturally fledge at around 12 days and then hide in the undergrowth for around a month while they continue to be fed by their parents (Figure 32); this natural behaviour should be encouraged and facilitated in a hand-rearing situation through the use of props and adequate space for practicing flight, hiding, perching and movement away from the nest, including the provision of cover and perches at a range of heights above the ground.



**Figure 32.** Juvenile Eastern yellow robins, Mount Eccles National Park, Victoria (McLennan, in Boles 1988).

### **11.15 Use of foster species**

The author is not aware of any examples of this species being cross-fostered. If attempted, it would be advisable to use a similar species (small passerine) with broadly similar feeding and breeding habits. It may be particularly important to ensure the brooding period of the foster species is similar, and that the foster parents are willing and able to continue feeding the young for up to a month post-fledging. The most workable solution may be to use a foster species for brooding and feeding nestlings, followed by hand-rearing once the chicks are 6-8 days old.

### **11.16 Weaning**

Fledglings should be weaned as they would be in the wild, with a gradual reduction in food as they near independence at around 40 days old. A reduction in hand-provided food should be complimented with a gradual increase in food provided in the cage/enclosure in a wide tray, partly concealed by leaf-litter, to encourage natural feeding behaviours (see Section 6.3).

### **11.17 Rehabilitation procedures**

When individuals (including previously injured birds and hand-reared young) are introduced to an aviary, care should be taken to make this introduction safe and gradual, so as not to stress the birds. It is advisable to take a stepped approach; for example, by moving them to a small aviary on their own in the first instance, allowing them to adapt and become comfortable, before moving them to a larger mixed aviary or one with conspecifics. Individuals should be monitored closely for a few days following each change to their housing environment. If they experience any unusual aggression from other birds or appear to be unwell, remove them immediately to a safe and familiar environment.

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## 15. Personal communications

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**Charlie Romer**, Senior Bird Keeper, Adelaide Zoo, South Australia. Experience with keeping passerines, including the Eastern yellow robin and hooded robin.

**Steve Debus**, PhD, Adjunct Lecturer, School of Environmental and Rural Science, University of New England, Armidale. Research interests include ecology, biology and behaviour of birds, conservation and management of threatened bird species, and distribution, status and ecology of New South Wales birds.



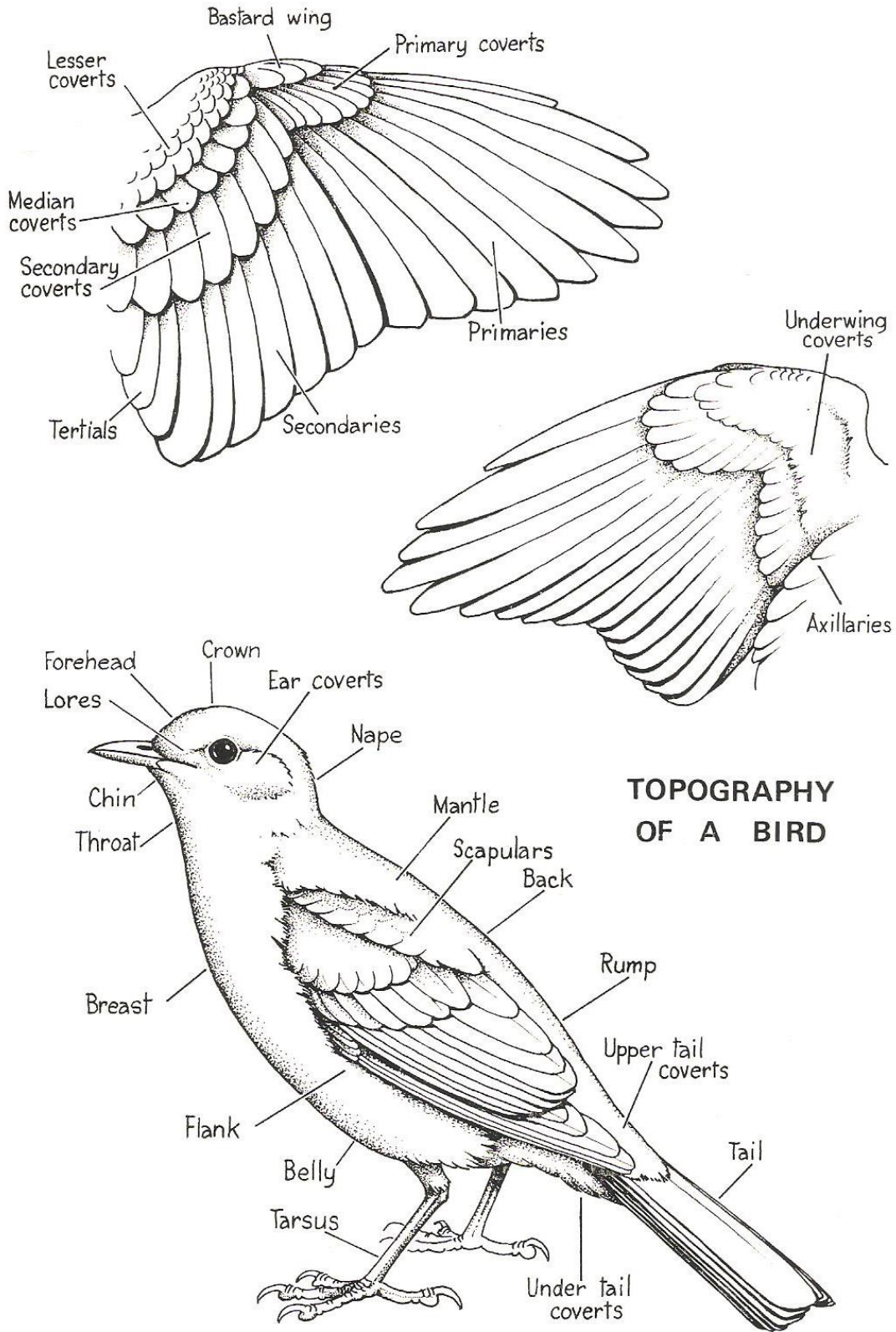
## 16. Glossary

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Behavioural enrichment	enhancement of the quality of captive animal care by identifying and providing the environmental stimuli necessary for optimal psychological and physiological wellbeing
Brooder	a device or structure for the rearing of young birds
Cloaca	vent; the opening to a bird's digestive, reproductive and urinary tracts
Cooperative breeding	a social breeding system whereby (subordinate) helpers provide care for offspring produced by a (dominant) breeding pair
Culmen	the upper ridge of a bird's bill
Hybrid	a bird that has two different species as parents
Incubation period	the interval from the laying of the last egg of a clutch to the hatching of the last egg
Interspecific	existing or occurring between different species
Intraspecific	produced, occurring, or existing between individuals of a single species
Life expectancy	the average number of years that a group of organisms, all born at the same time, might be expected to live
Longevity	life span; the period of time between birth and death; often given as a rough estimate based on the longest lived organism of a species known to date
Monogamy	a mating system of one male to one female; the most common avian mating system
Monophyletic	a monophyletic group is a group of organisms which forms a clade (i.e. consists of an ancestral species and all its descendants)
Morphometrics	measurements of the form of organisms
Nares	nostrils of a bird
Nestling period	the interval from the hatching of the last chick to the fledging of the last chick
Paraphyletic	a group of organisms is paraphyletic if it consists of all the descendants of the group's last common ancestor minus a small number of monophyletic subgroups
Pinioning	cut off the pinion of a wing to render a bird permanently flightless
Pulli	birds banded in the nest
Subspecies	a taxonomic category that ranks below species; often a geographically isolated race
Tarsus	part of the leg of a bird below the thigh

# 17. Appendix

## Appendix 1. Topography, colours and measurements (Disney & Lane 1974).



## Topography, Colours and Measurements

### Topography

The bird in the hand can only be accurately described if its topography is known and standard methods of measurement are used. This section sets out the terms used and the methods of measuring different parts of the bird.

A typical passerine bird is illustrated opposite with the different parts located and marked. Other terms which should be known are:-

- Rectrices* —Tail feathers, usually numbering 12.  
*Remiges* —A collective term for the primaries and secondaries.  
*Greater wing coverts* —Another name for secondary coverts.  
*Outer* —Furthest from body.  
*Inner* —Nearest to body.  
*Bill* —Upper and lower mandible.  
*Culmen* —The central ridge of the upper mandible.  
*Leg* —Correctly consists of the tibia and tarsus, although often applied to the scaly tarsus alone.  
*Iris* —The coloured part of the eye which surrounds the dark pupil.  
*Eye ring* —The scaly ring of skin around the eye.

### Colours

The colours of the soft parts (i.e. bill, legs, bare skin around eyes and eye rings) are sometimes a valuable guide to ageing and sexing. They should be determined in good light, preferably sunlight. In adults the colour of the soft parts may change in the breeding season and then back again after breeding.

Plumage colours should also be determined in good light, taking care that no coloured surface nearby is reflected on to the plumage. Very bright sunlight may alter the colours, especially if they are iridescent.

### Measurements

Measurements of the wings, total length, wing span, tail, bill, and tarsus are used to separate similar species, geographical races and the sexes, and also in the ageing of birds.

The following methods of measurement, unless otherwise stated, have been used to obtain the data given in the text.

The first four measurements described below should not be taken if the relevant feathers are in moult.

### Total Length

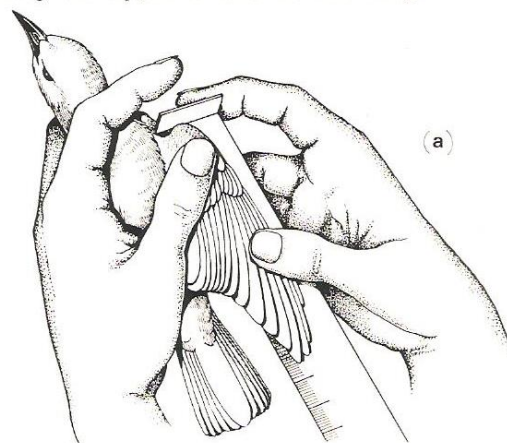
Place the bird on its back along a ruler, hold by the legs with one hand, and fix the tail with thumb. Grip the head or bill with the other hand and stretch the bird very gently. Let the bird's crown rest against the ruler so that the bill is roughly parallel with the ruler. Now loosen grip slightly to let the bird lie in its own natural and relaxed position. Read the measurement from tip of bill to tip of tail.

### Wing

The method given here is that which gives the maximum measurement with the flattened and straightened wing. If possible, a stopped ruler should be used to make this measurement (Fig. a).

1. Slide the ruler under the closed wing until the carpal joint rests against the stop.
2. Straighten the bastard wing until it is as nearly as possible in line with the longest primary.
3. Press the wing flat.
4. Straighten and extend the longest primary to its maximum length by stroking thumb of free hand along shafts of the primaries, from base to tip, pressing firmly against the ruler all the time.
5. Check that the bend of the wing is still touching the stop and read measurement.

The wings of larger birds may be measured by stretching a steel tape from the front of the carpal joint to the tip of the longest primary, along the upper surface of the wing.

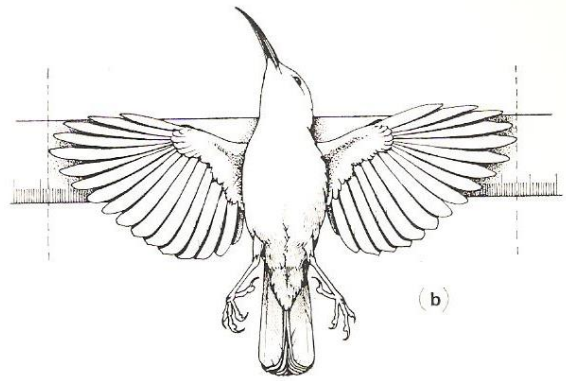


## Wing Span

Although not yet widely adopted by banders, this is a very useful measurement for ageing and sexing some species (Fig. b).

1. Lay the bird on its back across a ruler or tape.
2. Hold out the wings by the carpal joints and bring the primaries parallel to the ruler.
3. Stretch out the wings to their maximum in this position and read measurement.

Done properly this method does not harm the bird, as individual birds have been repeatedly measured in this way.



## Tail

Use either calipers or a ruler with the scale starting at one end (Fig. h).

1. With calipers, place one end underneath the undertail coverts, against the root of the tail, and the other against the tip of the longest tail feather. Record length.
2. With ruler, slide end under the undertail coverts until it reaches root of tail. Measure length of the longest tail feather.

## Bill

Preferably use slide calipers with pointed tips for this measurement.

1. In small birds measure bill from tip to where it joins the skull. The latter point is often hidden by bristles or feathers (Fig. d).
2. In owls and birds of prey measure from tip to cere (Fig. c).
3. In waders and long-billed birds measure from tip to feathering at base (Fig. e).
4. State the method used.

## Bill Width

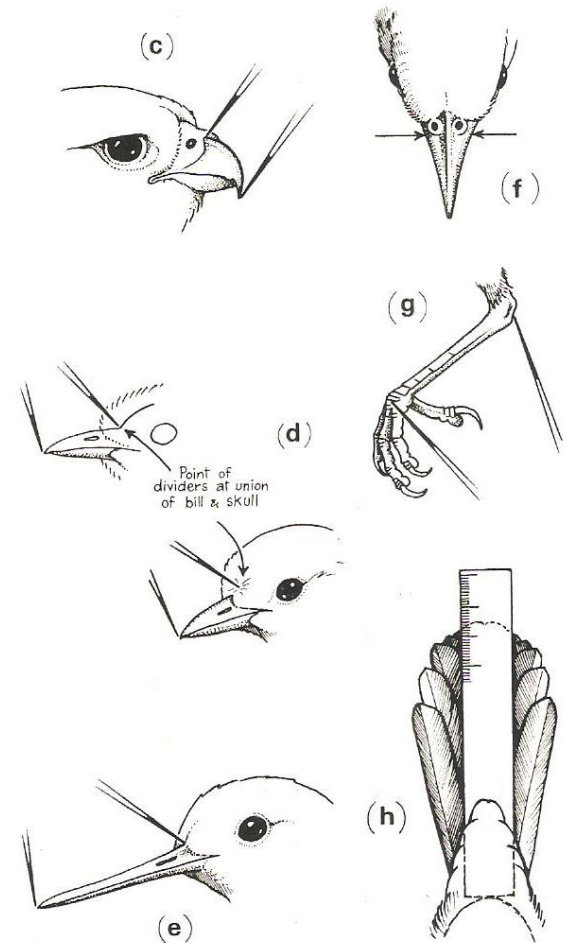
Measure with calipers just in front of nostrils (Fig. f).

## Tarsus

It is the length of the tarso-metatarsal bone that is measured. Using calipers or dividers, place one point in the notch on the back of the intertarsal joint and the other on the lowest edge of first complete scale before the toes separate. Measure distance between points (Fig. g).

## Claws

Using dividers, measure the chord on top of the claw from the tip to the edge of the skin. Do not measure if the tip is broken.



Drawings by W. T. Cooper