

Order PASSERIFORMES

The largest and most diverse order of birds, commonly called passerines or perching birds, and comprising some 5712 species in 45 families (based on Sibley & Monroe 1990; Sibley & Ahlquist 1990), and well over half the world's known bird species. In the HANZAB region, Passeriformes represented by some 382 species in 39 families. Tiny to large: smallest passerine is Pygmy Tit *Psaltria exilis* of Java, with a total length c. 8 cm; largest is Greenland Raven *Corvus corax principalis*, with a total length c. 64 cm and weighing up to 1.7 kg. Superb Lyrebird *Menura novaehollandiae* of e. Aust. probably second largest in Order, with a total length (in adult male) of c. 103 cm, including tail of c. 70 cm, and weight up to c. 1.1 kg. Cosmopolitan except Antarctica and some oceanic islands; and occupying all terrestrial habitats.

Overall, Passeriformes are characterized by (based on Raikow 1982; Sibley & Ahlquist 1990; and DAB [=Schodde & Mason 1999]): Palate aegithongnathous (except Conopophagidae [gnateaters]). Intestinal caeca rudimentary. Single left carotid artery (except paired in *Pseudocalyptomena* and possibly other broadbills [Eurylaimidae]). Aftershaft reduced or absent. Neck short, with 14 cervical vertebrae in most, but 15 in Eurylaimidae (broadbills); atlas perforated; metasternum usually two-notched (rarely four-notched). Bicep slip absent. Expansor secundariorum often present (Berger 1956; Raikow 1982; *contra* Beddard 1898; Ridgeway 1901). Pelvic muscles AXY (AX in *Dicrurus* [drongos]). Ambiens absent. Iliofemoralis externus usually absent, but present in some groups as 'developmental anomaly' (Raikow 1982). Tensor propatagialis brevis tendon present. Hypocleideum present (except Menuridae [lyrebirds]). Wings eutaxic. Usually ten primaries, but p10 often reduced or absent; 11 primaries in Menuridae (lyrebirds), most Eurylaimidae (broadbills), most Furnariidae (ovenbirds), and some Passeri (oscines [see below]). Usually nine secondaries (ten in Menuridae [lyrebirds]). Usually 12 rectrices, but from six (*Stipiturus* [Maluridae]) to 16 (Menuridae). Lesser primary and secondary coverts usually reduced or absent (Zeidler 1966; Morlion 1985; Winkler & Jenni 1996), but a few well-developed lesser primary coverts are present in Superb Lyrebird (Morlion 1985). Uropygial preen glands naked. No basipterygoid process. Nasal glands minute. Foot anisodactyl. Hallux incumbent, large and directed backwards; toes 2, 3 and 4 directed forward; digital formula 2-3-4-5. Deep plantar tendons usually of type VII (lacking vinculum), but often type I in Eurylaimidae (broadbills). Spermatozoa bundled with coiled head and large acrosome.

The DNA-DNA hybridization studies of Sibley & Ahlquist (1985a, 1990) revealed much about the relationships within the Passeriformes and resulted in fundamental changes to the higher level taxonomy of passerines, not least to the taxonomy of the Australo-Papuan oscine passerines. Importantly, these studies showed that many elements of the Australo-Papuan avifauna (e.g. the A'asian wrens [Maluridae], robins [Petroicidae], babblers [Pomatostomidae], and so on), represent an endemic radiation of forms that bear an external resemblance to Eurasian families. Many of the findings of DNA-DNA hybridization studies regarding the Australo-Papuan oscines have since been broadly corroborated by studies using protein allozymes (e.g. Christidis 1991; Christidis & Schodde 1991) and microcomplement fixation (e.g. Baverstock *et al.* 1991, 1992), though there are also many points that remain uncertain and many familial relationships within the Passeriformes are unresolved (Christidis & Boles 1994). (For discussion of historical taxonomic arrangements preceding results of DNA-DNA hybridization studies, see BWP, and Sibley & Ahlquist [1985a,b, 1990]).

The Passeriformes divide into two main groups:

SUBORDER TYRANNI (SUBOSCINES): The distribution of the suboscines is centred in the American and Afro-asian Tropics, with a massive radiation in South America (Sibley & Ahlquist 1990; DAB). Suboscines characterized by mesomyodian syrinx, with or without a single pair of intrinsic syringeal muscles (van Tyne & Berger 1976; Campbell & Lack 1985; DAB). Suborder sometimes named Oligomyodi (e.g. Sibley & Ahlquist 1985a,b), Deutero-Oscines (e.g. Morony *et al.* 1975; Voous 1977), or Clamatores (Campbell & Lack 1985). Poorly represented in the HANZAB region: only TYRANNIDAE (tyrant-flycatchers), with two species, both accidental to South Georgia; ACANTHISITTIDAE (NZ wrens), with four species (one extinct) in three genera, endemic to NZ; and PITTIDAE (pittas), with four species in one genus in HANZAB region (three breeding, one accidental). Tyranni formerly included the Menuridae and Atrichornithidae (e.g. Wetmore 1960; Storer 1971), though subsequently shown that these two families should be included in Passeri (e.g. Sibley 1974; Sibley & Ahlquist 1985, 1990).

SUBORDER PASSERI (OSCINES OR SONGBIRDS): Cosmopolitan in distribution. Within the HANZAB region there are 36 families of Passeri. The Australo-Papuan Passeri can be subdivided into several supra-familial groups, but those recognized differ between authors (for further information, see Sibley & Ahlquist 1985, 1990; DAB). Oscines are

characterized by acromyodian syrinx, with three or four pairs of intrinsic syringeal muscles (van Tyne & Berger 1976; Campbell & Lack 1985; Sibley & Ahlquist 1990; DAB).

Suborder Passeri comprises the major element of the Aust. and NZ passerine avifauna. The families recorded in the HANZAB region, and the representatives in the region, are (following Christidis & Boles [1994] for Aust., with additional species for wider region added as appropriate):

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- MENURIDAE (lyrebirds): two species in one genus; endemic to Aust.;
- ATRICHORNITHIDAE (scrub-birds): two species in one genus; endemic to Aust.;
- CLIMACTERIDAE (A'asian treecreepers): six species in two genera breeding in Aust.;
- MALURIDAE (Australopapuan fairy-wrens, emu-wrens and grasswrens): 22 breeding species in three genera in Aust.;
- MELIPHAGIDAE (honeyeaters and Aust. chats): 76 species in 26 genera in Aust. and NZ, all breeding;
- PARDALOTIDAE (pardalotes, scrubwrens, thornbills and allies): 51 species (one extinct) in 15 genera in HANZAB region, all breeding;
- PETROICIDAE (A'asian robins): 23 species in eight genera in HANZAB region, all breeding;
- ORTHONYCHIDAE (logrunners): two breeding species in one genus in Aust.;
- POMATOSTOMIDAE (A'asian babblers): four breeding species in single genus in Aust.;
- CINCLOSOMATIDAE (whipbirds, wedgebills, quail-thrushes and jewel-babblers): eight breeding species in two genera in Aust.;
- NEOSITTIDAE (sitellas): single species breeding in Aust.;
- PACHYCEPHALIDAE (whistlers, shrike-thrushes and allies): 17 species in seven genera in HANZAB region, all breeding;
- DICRURIDAE (monarchs, flycatchers, fantails and drongos): 19 species in seven genera in HANZAB region, all breeding;
- CAMPEPHAGIDAE (cuckoo-shrikes, trillers and minivets): eight species (one extinct) in two genera in HANZAB region, all breeding;
- ORIOLIDAE (Old World orioles and figbirds): three species in two genera in Aust., all breeding;
- ARTAMIDAE (woodswallows, butcherbirds and currawongs): 14 species in four genera in HANZAB region, all breeding;
- PARADISAEIDAE (birds of paradise): five breeding species in two genera in Aust.;
- CORVIDAE (crows and jays): six breeding species in single genus in Aust. and NZ, including one introduced to NZ;
- CORCORACIDAE (Aust. mudnesters): two species in two monospecific genera, endemic to Aust.;
- CALLAEIDAE (NZ wattlebirds): three species (one extinct) in three monospecific genera, endemic to NZ;
- LANIIDAE (shrikes): two species in HANZAB region, one accidental to Prince Edward Is, the other accidental to Christmas I.;
- PTILONORHYNCHIDAE (bowerbirds): ten species in seven genera in Aust. (nine species) and NZ (one species), all breeding; Piopio of NZ probably extinct (Heather & Robertson 1997);
- ALAUDIDAE (larks): two breeding species in HANZAB region (including one successfully introduced to Aust. and NZ);
- MOTACILLIDAE (wagtails and pipits): eight species in two genera in HANZAB region, only two breeding (one on South Georgia), the rest non-breeding visitors or accidentals;
- PRUNELLIDAE (accentors): one species successfully introduced to NZ;
- PASSERIDAE (Old World sparrows and A'asian finches): 22 species in nine genera (including four successful introductions) in HANZAB region, all breeding;
- FRINGILLIDAE (Old World finches): seven species in four genera in HANZAB region, all introduced except one naturally occurring vagrant to South Georgia;
- EMBERIZIDAE (buntings, cardinals, tanagers and allies): two successfully introduced species, occurring NZ and Lord Howe I.;
- NECTARINIIDAE (sunbirds and spiderhunters): single breeding species in Aust.;
- DICAEDIDAE (flowerpeckers): single breeding species in Aust.;
- HIRUNDINIDAE (swallows and martins): eight species in four genera in HANZAB region, including four breeding species in Aust. and NZ, one non-breeding visitor and three accidentals;
- PYCNONOTIDAE (bulbuls): one successfully introduced species in Aust.;
- SYLVIIDAE (Old World warblers): 13 species in eight genera in HANZAB region, including ten breeding species (one extinct) in Aust. and NZ, and three accidental to region;
- ZOSTEROPIDAE (white-eyes): seven species (one extinct) in single genus in HANZAB region, all breeding;
- MUSCICAPIDAE (Old World flycatchers, thrushes and chats): eight species in six genera in HANZAB region, including five breeding species (two introduced), and four accidentals (including one on Prince Edward Is);
- STURNIDAE (starlings and mynas): five species in four genera, four breeding in HANZAB region (including two species successfully introduced, and one species now extinct), and one accidental.
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The Aust. oscines fall into two distinct clusters, each with at least three major supra-familial lineages (DAB): One cluster is the Passerida, comprising the Muscicapoida (including true thrushes and allies), Sylvioidea (true warblers and babblers, and swallows, and others), and Passeroidea (including larks, pipits, sunbirds, flowerpeckers and all finches and their allies). The other cluster is the Corvida, which is centred on the Australo-Papuan region (though its origins are not certain) and which also comprises three main lineages: Menuroidea (lyrebirds, scrub-birds, treecreepers and bowerbirds), Meliphagoidea (A'asian wrens, pardalotes, acanthizid warblers, and honeyeaters), and Corvoidea (A'asian robins, logrunners, A'asian babblers, whipbirds and quail-thrushes, sitellas, whistlers, fantails and monarchs, birds of paradise, butcherbirds and woodswallows, cuckoo-shrikes, Old World orioles, crows and mudnesters).

Throughout this volume, arrangement of families follows that of Christidis & Boles (1994) except that the Meliphagidae precedes the Pardalotidae. This change was made to ensure the Meliphagidae were dealt with in a single volume, rather than split between volumes, and because the switch meant no change to the positioning of Meliphagidae relative to the Pardalotidae (including Acanthizidae), one another's closest relatives, and because there is little overriding evidence of the exact taxonomic positioning of all families within the Meliphagoidea; Sibley & Monroe (1990) also placed the Meliphagidae between the Maluridae and Pardalotidae. However, DAB points out that based on structure of humeral fossa, positioning of Meliphagidae between the Maluridae and Pardalotidae is not correct.

DAB, however, varies from the familial arrangement of Christidis & Boles (1994) in several ways. The main differences are: (1) recognition of Pardalotidae and Acanthizidae as separate families (combined in Pardalotidae in Christidis & Boles); (2) minor rearrangement of the sequence of the families Paradisaeidae–Artamidae–Campephagidae–Oriolidae between the Dicuridae and Corvidae (cf. Dicuridae–Campephagidae–Oriolidae–Artamidae–Paradisaeidae–Corvidae in Christidis & Boles); (3) and use of the more traditional muscicapoid (flycatcher) – sylvioid (warbler) – passeroid (finch) sequence of Sibley *et al.* (1988), Sibley & Ahlquist (1990) and Sibley & Monroe (1990) and much contemporary literature of n. hemisphere, with families in the sequence Muscicapidae–Sturnidae–Hirundinidae–Pycnonotidae–Zosteropidae–Sylviidae–Alaudidae–Dicaeidae–Nectariniidae–Passeridae–Motacillidae–Estrildidae–Fringillidae and noting recognition of the Estrildidae as a separate family (cf. the reversed sequence of Christidis & Boles, as given above, and which submerges the Estrildidae within the Passeridae). For discussion of the reasons for these changes, see DAB (and discussion under these families in future volumes of HANZAB).

Arrangement of genera and species within families also follows Christidis & Boles (1994), which was in turn largely based on Schodde (1975) unless there were specific reasons for change. Lastly, with few exceptions, which are discussed in individual species accounts, taxonomy of subspecies follows DAB.

Passerines are extremely diverse in body form and plumage, and vary greatly in rates of maturation. Some attain adult plumage within months or weeks of fledging; others can take up to 9 years to attain adult plumage (e.g. Superb Lyrebird). Degree of sexual dimorphism also varies greatly: some monomorphic, others vary in either size, plumage or both. Common pattern of annual moult is a single complete post-breeding (pre-basic) moult, but some groups (e.g. Maluridae) or species (e.g. Banded Honeyeater *Certhionyx pectoralis*) also undergo a partial pre-breeding (pre-alternate) moult annually. Moult of primaries usually outward. Secondaries moult from innermost and outermost toward s5. Moult of tail usually centrifugal (outward from centre). Young altricial, nidicolous and dependent on adults for food; usually hatch with sparse to very sparse covering of down, mainly on dorsum; Menuridae (lyrebirds) have heavy natal down. Juvenile plumage usually duller than adult, and in many sexually dimorphic species, often similar to that of adult female.

There are few common features of food, feeding behaviour, social organization and behaviour, voice or breeding in such a large and diverse group of birds.

Volant; extinct Stephens Island Wren *Traversia lyalli* probably the only flightless passerine (Millener 1988). Movements vary greatly: some species long-distance migrants (e.g. Barn Swallow *Hirundo rustica*, Nightingale *Luscinia megarhynchos* and many Old World warblers, such as *Acrocephalus* and *Locustella*, breed in temperate Palaearctic and migrate to Africa or Indian subcontinent [BWP]; Acadian Flycatcher *Empidonax virescens* breeds North America and migrates to South America [Ridgely & Tudor 1994]), others sedentary in small territories (e.g. Cactus Wren *Campylorhynchus brunneicapillus* of sw. USA and Mexico [Ricklefs 1975; Ehrlich *et al.* 1988]). In HANZAB region, movements also vary widely: e.g. Yellow-faced Honeyeater *Lichenostomus chrysops* regular annual migrant in parts of e. Aust.; Rifleman *Acanthisitta chloris* of NZ sedentary in small territories. In Aust., movements often poorly known and unstudied; many species often said to be nomadic, with such claims often based on no or very poor knowledge of actual movements and based only on apparently irregular occurrence in an area (see General Introduction [Movements] for fuller discussion of this point).

Arboreal or terrestrial or both; some strictly arboreal (e.g. Hirundinidae), others strictly terrestrial (e.g. Menuridae, Pittidae); most combine both arboreal and terrestrial foraging to varying degrees, but usually with one predominating. Feed on almost all known food, from plant material to vertebrate animals, but most show some specialization for certain food, such as feeding on nectar (Nectariniidae), seeds (Passeridae), fruit (Zosteropidae), small vertebrates (Artamidae) and, commonly, insects (e.g. Maluridae, Pardalotidae, Petroicidae and others). Mostly feed by gleaning

and probing, including probing flowers for nectar; and other substrates for invertebrates; also feed by sallying, including various sallying techniques (sally-hovering, sally-striking and sally-pouncing), each suited for one group of prey, particularly moving animals.

In passerines, parental care in both sexes is well developed. However, a few species are parasitic, e.g. cowbirds *Molothrus* (Campbell & Lack 1985). Young are dependent on parents for food. Young beg by gaping, typically exposing brightly coloured inside of mouth, often with contrasting pale or dark spots; in non-passerines, bright gape present only in hoopoes (Upupidae), mousebirds (Coliiformes) and cuckoos (Cuculiformes) (BWP). See Boles & Longmore (1985) for descriptions of colours and markings inside the mouths of some Aust. passerines.

Anting is a highly specialized behaviour: ants are held in the bill and applied to the plumage, usually to the underside of the wing-tip (direct or active anting, or ant-application), or ants are allowed access to the plumage (indirect or passive anting, or ant-exposure), or both, e.g. anting recorded in Regent Honeyeaters *Xanthomyza phrygia* in HANZAB region, with bird then seen eating ant. Thought to be unique to Passeriformes (e.g. Simmons 1966; Campbell & Lack 1985; BWP). Suggested this may be comfort behaviour related to maintenance of feathers, by perhaps reducing ectoparasite load, removing stale or excess lipids, or adding supplementary essential oils (Campbell & Lack 1985); some secretions of ants are antibiotic, inhibiting growth of both fungi and bacteria, and the secondary acquisition of these antibiotic secretions would be an important advantage of anting (Ehrlick et al. 1986).

Other behavioural characters include head-scratching indirectly (or over the wing) in most families, with the foot brought up above the lowered wing. Head oiled indirectly, as seen in most taxa, but passerines also oil head by head-scratching, in which bird oils the bill directly, then transfers the oil first to one foot by scratching the bill, and then to the head by scratching the head with foot. To oil the undersurface of the wings, use bill or bill and head together, extending one wing at a time sideways and forward, carpus uppermost, and often alternating rapidly from one wing to the other. The stretching of one wing as a comfort movement seems common to all birds, but in passerines it is often accompanied by sideways fanning of tail. After both wings are stretched, passerines often give a two-leg stretch as they straighten the tarsal joints and lift the body. Heat is dissipated by gaping and panting (not by gular-fluttering, so far as known) (Campbell & Lack 1985; BWP). Bathing widespread, mainly by standing in shallow water, but some groups jump into and out of water repeatedly, or flight- or plunge-bathe, while others bathe only or mainly in rain or among wet foliage; for further details of bathing, see Campbell & Lack (1985). Passerines do not flap wings in the manner of non-passerines to dry, but perform various shaking movements, as well as preening (Campbell & Lack 1985). Dusting confined to only a few groups, but sunning, both for gaining heat (sun-basking) and other purposes (sun-exposure), is widespread, and of two distinct types: (1) lateral posture, in which sunning bird squats or sits down, usually on ground, and leans to one side exposing the flank or the 'sun-wing', which has been lowered and partly unfolded, and the fanned tail, which has been brought round to the same side; and (2) spread-eagle posture, in which bird squats or lies flat with both wings open and tail fanned (details in Campbell & Lack 1985; Simmons 1986).

There is a high incidence of co-operative breeding in Aust. and NZ, and it is especially common and well-studied in the Maluridae but is more widely recorded, including within the Acanthisittidae, Meliphagidae, Petroicidae, Pomatostomidae and Corcoracidae (see Dow 1978, 1980; Brown 1987; Ford 1989; Rowley & Russell 1997).

In vocal abilities, species of Passeriformes are more accomplished than those of any other order, but songs may be simple or highly complex, and repertoires small or large. Mimicry of calls of other species is practised by many species; c. 15% of Australian passerine species have been reported to mimic (Marshall 1950). The Superb Lyrebird and the Tui *Prosthemadera novaeseelandiae* have been classed among the best seven of the world's songsters (Hartshorne 1973). Oscines, or songbirds, have specialized forebrain song nuclei, and, through auditory feedback, learn their songs from those of adults, in much the same way as human young learn their spoken language from adults. In contrast, the songs of suboscines are relatively simple (like the non-learned call-notes of songbirds), repertoires are small, geographical variation is minimal, and development of song appears to take place without any imitative or feedback process. Some oscine species use vocal learning to generate large song repertoires and may vary them geographically, even locally. Other oscine species forgo these possibilities and have song repertoires more like those of suboscines; how the learning process maintains stereotypy of song over the range of such species is a mystery (Kroodsma 1996).

Apart from the five families discussed hereunder, syringeal structure of passeriform species of our area is similar, there being four pairs of intrinsic muscles. Pittidae have no intrinsic muscles (Ames 1971); calls are mostly loud strong whistles (Pizzey 1980). Acanthisittidae also have no intrinsic muscles, but the presence of a well-developed drum (fusion of posterior tracheal elements) suggests they may have once been present; vocal repertoire is not great (Ames 1971). Menuridae and Atrichornithidae have similar syringeal structures, with three pairs of intrinsic muscles; songs are highly developed, and there can be much mimicry (Ames 1971). Climacteridae, with four pairs of intrinsic muscles, exhibit gross asymmetry of the extrinsic muscles, unusual directions of muscle fibre in the intrinsic muscles, and an exceptionally robust sternotracheal muscle (Ames 1987); calls are brisk, sharp and piping (Pizzey 1980).

Extended tracheae are found in the genus *Manucodia* (Paradisaeidae), the calls of which are deep, loud or far-carrying (Frith 1994). In the only species occurring in our area, the Trumpet Manucode *M. keraudrenii*, the trachea forms a flat coil between the skin and the pectoral muscles, sometimes extending over the abdominal muscles as well,

and may be up to 828 mm in length, compared with body-length, from bill to pygostyle, of c. 150 mm (Ames 1971; Clench 1978).

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Family CAMPEPHAGIDAE cuckoo-shrikes, minivets and trillers

A fairly large and rather homogeneous family of sleek, small to medium-sized passerines with rather large heads, and long, tapered wings and tails. The family comprises 67–86 species in 6–9 genera, distributed from sub-Saharan Africa to the Indian subcontinent, much of e. and se. Asia, including Wallacea, to A'asia and islands of the sw. Pacific Ocean, with high species diversity in se. Asia and the Australo-Papuan region (Sibley & Monroe 1990; Monroe & Sibley 1993; Taylor 2005; Peters; DAB). As recognized here, the family comprises: the cuckoo-shrikes (genera *Coracina*, *Campephaga* and *Campochaera*), trillers (*Lalage*), minivets (*Pericrocotus*), and flycatcher-shrikes (*Hemipus*); the Ground Cuckoo-shrike *Coracina maxima* is sometimes placed in a monotypic genus *Pteropodocys*, and the two wattled cuckoo-shrikes from Africa are sometimes placed in *Campephaga* (as here) or in a separate genus *Lobotos*. In the HANZAB region, eight species in two genera (*Coracina*, *Lalage*); the Long-tailed Triller *Lalage leucopyga*, which once occurred on Norfolk I., is now extinct there, but remains extant on other islands in the sw. Pacific Ocean. Minivets are confined to Asia, and not recorded from the HANZAB region. Members of the Campephagidae are closely related to the Old World orioles as shown by DNA–DNA hybridization ($\Delta T_{50H} = 4.8$) studies (Sibley & Ahlquist 1985, 1990) and protein electrophoresis (Christidis & Schodde 1991). Accordingly, the Old World orioles *Oriolus* and figbirds *Sphecotheres* have been combined with the cuckoo-shrikes, trillers and minivets in one tribe, Oriolini, within the subfamily Corvinae of the expanded family Corvidae (Sibley *et al.* 1988; Sibley & Ahlquist 1990; Sibley & Monroe 1990; Monroe & Sibley 1993). However, we follow Christidis & Boles (1994) and DAB in placing the Old World orioles and figbirds in a separate family Oriolidae (see that family introduction for justification) within the corvoid lineage of songbirds (DAB).

Overall, length ranges from 13 cm (Samoan Triller *Lalage sharpei*) to 38 cm (Ground Cuckoo-shrike), and weights from 6–12 g (Small Minivet *Pericrocotus cinnamomeus*) up to 180 g (South Melanesian Cuckoo-shrike *Coracina caledonica*). Within HANZAB region, smallest is White-winged Triller *Lalage sueurii* (length c. 18 cm, weight c. 26 g) and largest is Ground Cuckoo-shrike (length 31–38 cm; weight 120–155 g). The family is characterized by (mainly from Beecher 1953 and DAB): wings rather long and pointed at tips; ten primaries, outermost well developed; and ten secondaries, including three tertials. Tail rather long and tapered, usually with gently rounded or rather square tips, but deeply forked in Ground Cuckoo-shrike; 12 rectrices. Bills rather short and broadly based, with small hook at tip and distinct notch near tip of upper tomium; nasal groove with several short bristles. Rictal bristles present. Tongue with quadrid tip and papillae which ventrally aligned in two ranks. Tarsi short with laminiplantar scaling; and feet rather small and weak in most species. However, Ground Cuckoo-shrike has rather long and robust legs and long toes. Osteological features include: single, well-developed and trabeculated (with cross-barred framework) humeral fossa, but almost completely doubled in *Pericrocotus* (Bock 1962); fully aperturate nasal cavity; vomers broad and bi-crested at tips; nasal bars narrow; tips of maxillo-palatines bulbous, with lateral grooves; palatine shelves broad, with well-developed interpalatine process; ectethmoid plate truncate, with broad slit-like foramen and free lachrymals below wing on latero-ventral face; large temporal fossae; lack heavy ossification to nasal cavity; and zygomatic processes often doubled.

Plumages dense and soft. Cuckoo-shrikes *Coracina* usually have fine powder-downs and reduced uropygial glands, and lack an apterium in the spinal feather-tract; cuckoo-shrikes and trillers have rather thin and fragile skin (DAB). Plumage varies from predominantly grey and white (cuckoo-shrikes), to pied or with varying brownish or buff tones (trillers) or brightly red and yellow (minivets). Some species are strongly sexually dimorphic (White-winged Triller, Cicadabird *Coracina tenuirostris*), but others are not (Ground Cuckoo-Shrike) or only slightly so (e.g. White-bellied Cuckoo-shrike *Coracina papuensis*). Females, immatures and juveniles of some species have duller and often distinctly barred plumage compared with adult males. Nestlings develop down within a few days of hatching; not known if any species hatch with natal down. Fledge in juvenile plumage. Post-juvenile (first pre-basic) moult partial, usually resulting in adult female-like first immature non-breeding (first basic) plumage (in cuckoo-shrikes and trillers). Acquire adult plumage in complete first immature post-breeding (second pre-basic) moult. Once adult plumage attained, most species undergo one complete post-breeding moult each year resulting in non-breeding (basic) plumage. A few species (e.g. White-winged Triller) undergo partial pre-breeding (pre-alternate) moult to a breeding plumage, this sometimes also occurring in first immatures; the Ashy Minivet *Pericrocotus divaricatus* undergoes two complete moults annually (Taylor 2005). Primaries moult outward, usually starting at p1. Moult of rectrices usually centrifugal; usually occurs at same time as moult of primaries. Moult of head and body usually begins before start of primary moult and finishes after end of primary moult.

Most species mainly or exclusively arboreal, often in upper levels or canopy of tall trees. In many species, flight strongly undulating and cuckoo-like (especially in larger cuckoo-shrikes), in which flapping to gain height alternates with glides on wings held stiffly downward or held to body. A characteristic habit of some of the larger

cuckoo-shrikes is shuffling or flicking of wings on alighting and when perched, and differences in such behaviour can be a useful field character (e.g. see White-bellied Cuckoo-shrike). All strictly diurnal, though in migratory forms some passage nocturnal (see discussion of Movements below).

Throughout range, predominantly birds of forested habitats, occupying a wide range of forests, including tropical and subtropical rainforest, dense montane forests, monsoon and swamp forests, bamboo forest, mangrove associations, deciduous forest, and pine *Pinus* forest; most species also use secondary forest, forest edges and the edges of clearings, and other modified forest habitats, though a few species apparently restricted to primary forest (e.g. New Caledonian Cuckoo-shrike *Coracina analis* and Hooded Cuckoo-shrike *C. longicauda*). Also use a range of other wooded habitats, such as many types of woodland, including savanna, evergreen thickets and orchards, and some species appear to prefer woodland or more lightly timbered habitats (e.g. White-breasted Cuckoo-shrike *Coracina pectoralis* of Africa occurs in acacia savanna and tall broadleaf woodland). Some species readily use modified habitats, such as overgrown plantations and parks. Many species are generalists, occurring in a wide range of habitats (e.g. White-bellied Cuckoo-shrike found in savanna, primary woodlands and forests, secondary and riparian forests and woodlands, mangroves and modified habitats including plantations, farmlands and suburban gardens). In HANZAB region, many species commonly in sclerophyll woodlands and forests dominated by eucalypts and acacias (e.g. White-winged Triller, Black-faced Cuckoo-shrike *Coracina novaehollandiae*, White-bellied Cuckoo-shrike and Ground Cuckoo-shrike). Other species commonly in more closed forests, such as rainforests and mangrove associations (e.g. Varied Triller *L. leucomela*, Barred Cuckoo-shrike *C. lineata* and Cicadabird). Black-faced Cuckoo-shrike a common species of cities, urban areas, rural towns and settlements. Throughout range, predominantly birds of lowlands and middle altitudes, though a few species primarily montane species (e.g. Hooded Cuckoo-shrike of montane New Guinea occasionally reaches 3700 m) (King *et al.* 1978; Mackworth-Praed & Grant 1980; Coates 1990; Sibley & Monroe 1990; Maclean 1993; Orn. Soc. Japan 2000; Robson 2002; Taylor 2005; see species accounts).

Patterns of movements in Aust. vary, with species variously considered resident (e.g. White-bellied Cuckoo-shrike), dispersive (Ground Cuckoo-shrike) or partly migratory (Black-faced Cuckoo-shrike, Cicadabird). Movements of migratory species complex and patterns include an inland slope-line pattern, in which birds move on SE–NW axis within e. Aust., regularly (Black-faced Cuckoo-shrike) or occasionally (White-winged Triller) reaching New Guinea. Several Aust. species also show irregular movements (e.g. Ground Cuckoo-shrike, White-winged Triller). Black-faced Cuckoo-shrikes migrate over broad front from Aust. to PNG across Coral Sea, arriving from early Apr. Subspecies *tenuirostris* of Cicadabird also migrates to New Guinea in the dry season, mostly by a direct N–S route, with local subspecies regarded as breeding residents (Coates 1990; Griffioen & Clarke 2002; Aust. Atlas 1; see species accounts). Extralimitally, mostly considered sedentary or resident. Extralimital populations of White-bellied Cuckoo-shrike, Cicadabird, Barred Cuckoo-shrike and Varied Triller are all sedentary; other A'asian species also described as sedentary (e.g. Boyer's Cuckoo-shrike *Coracina boyeri*). Asian species mostly described as resident (e.g. Bar-bellied Cuckoo-shrike *Coracina striata*, Pied Triller *Lalage nigra*, Fiery Minivet *Pericrocotus ignens*), but several of the minivets are migratory (e.g. Brown-rumped Minivet *Pericrocotus cantonensis* breeds in China and winters in se. Asia), or altitudinal migrants (e.g. Scarlet Minivet *P. flammeus*, descends to lower elevations after breeding in the Himalayas); a few species make seasonal movements (e.g. Black-headed Cuckoo-shrike *Coracina melanoptera*). Similarly, most species in Africa described as resident (e.g. White-breasted Cuckoo-shrike), though some make seasonal movements, including two that include migratory populations that move to equatorial Africa to breed (Red-shouldered Cuckoo-shrike *Campephaga phoenicea*) or after breeding (Black Cuckoo-shrike *Campephaga flava*). Some passage occurs at night, as evidenced by bird strikes at lighthouses in Aust. and attraction to lights in Africa, but diurnal passage also seen (Newman 1983; Grimes 1987; Coates 1990; Maclean 1993; Elgood 1994; Penry 1994; Cheke & Walsh 1996; Dean 2000; Robson 2000; Taylor 2005; see species accounts).

Mainly eat arthropods, predominantly insects, and fruit (especially wild figs *Ficus*), occasionally small vertebrates (including lizards and birds), seeds, buds, nectar or other vegetable matter, such as leaves. Some species primarily insectivorous (e.g. most cuckoo-shrikes, minivets *Pericrotus* and flycatcher-shrikes *Hemipus*), others primarily frugivorous (e.g. Varied and Black-browed *Lalage atrovirens* Trillers, and Barred, Boyer's, Black-headed Cuckoo-shrikes); many cuckoo-shrikes *Coracina* and trillers *Lalage* eat both insects and fruit. A few species recorded eating nectar (e.g. Cicadabird and White-bellied Cuckoo-shrike). Some species eat mostly caterpillars, e.g. Cicadabird and White-breasted, Grey *Coracina caesia* and Grauer's *C. graueri* Cuckoo-shrikes. One species, the Ground Cuckoo-shrike, once recorded eating a House Sparrow *Passer domesticus*. Mostly arboreal; tend to forage in small groups, mainly gleaning food from tree-trunks, branches and foliage in mid-levels to canopy of trees, and sally-striking from perches in trees; also capture prey by sally-pouncing, flutter-chasing and sally-hovering. Exceptionally, Ground Cuckoo-shrike forages mostly on or near ground, walking and running to glean food from ground or leaping into air for insects; some other species, such as wood-shrikes and some trillers, also occasionally forage on ground. White-bellied Minivet *Pericrocotus erythropygius* forages mainly in low shrubs, grasses and on ground (Coates 1990; Keith *et al.* 1992; Robson 2002; Taylor 2005; see species accounts).

Social organization and behaviour not well known. Group-size varies. Most species usually occur singly or in pairs, and in small family groups after breeding. Some species form small flocks, particularly in non-breeding season, e.g. Black-faced Cuckoo-shrike in flocks of up to 50+ in non-breeding season, and minivets considered generally gregarious in non-breeding season. Some species often encountered in small groups at any time of year, e.g. Ground Cuckoo-shrike and Hooded Cuckoo-shrike. Migratory forms also sometimes occur in flocks before departure, on passage and on arrival, e.g. Black-faced Cuckoo-shrikes observed in flocks of up to 170 or more. Many species regularly occur in mixed-species flocks when foraging, e.g. in Aust., Black-faced Cuckoo-shrikes forage with other cuckoo-shrikes and species such as Spangled Drongos *Dicrurus bracteatus*, Figbirds *Sphecotheres viridis* or Olive-backed Orioles *Oriolus sagittatus*. Most species are monogamous, at least socially, and most nest in discrete pairs; bonds probably maintained throughout year. Polygyny reported once in White-winged Triller. Ground Cuckoo-shrike sometimes breeds co-operatively, with up to three helpers at the nest, and co-operative breeding occurs occasionally in other species (e.g. Black-faced Cuckoo-shrike). Apparent plural breeding also reported in Ground Cuckoo-shrike. Parental care usually shared between sexes (see Breeding summary below). Fledgelings fed by both parents, for up to 2, or exceptionally 3, months. Immatures may remain in natal territories until start of next breeding season, when they may be driven away (e.g. Black-faced Cuckoo-shrike), though if second brood raised in a season, young of first brood may be driven off when second attempt begun (e.g. White-winged Triller). Age of first breeding not known, but probably c. 1 year old. Most species territorial and nest solitarily, but at least one species, White-winged Triller, often nests colonially; some resident species or populations are territorial throughout year. Details of roosting poorly known; appear usually to roost singly or in twos, but some have been recorded roosting communally (e.g. Barred Cuckoo-shrike). Social behaviour not well known in most species. Little known of maintenance behaviour. Allopreening not reported. Seen bathing in streams and pools, and Black-faced Cuckoo-shrikes seen bathing in rain and wet foliage; White-winged Trillers seen sun-bathing. Little information on displays of most species. Agonistic displays, fighting and chases known for some species during breeding season, many from anecdotal reports; but no observations of agonistic behaviour in non-breeding season. Sexual behaviour generally poorly known; aspects of courtship known in a few species, including courtship chases and pre-copulatory displays, and some minivets have conspicuous aerial courtship displays (Campbell & Lack 1985; Coates 1990; Keith *et al.* 1992; Taylor 2005; see species accounts).

Most species have loud and distinctive vocalizations, though birds tend to be rather quiet and often unobtrusive when foraging. Songs and calls typically simple, often loud and repeated whistles, trills, twitters, churrs, harsh buzzing, chatters or squawks, sometimes with nasal or metallic quality or resembling insect sounds. The cicadabirds are named for their loud songs reminiscent of the loud mechanical noises produced by cicadas (Homoptera: Cicadidae); Cicadabird can be heard from up to 800 m. In many species, calls apparently given largely or only by males. Several species have been heard to duet, e.g. Golden *Campochaera sloetii* and Boyer's Cuckoo-shrikes, and Black-bellied Cuckoo-shrike *Coracina montana* sings antiphonal duets; Black-browed Trillers *Lalage atrovirens* heard to counter-sing. Marked geographical variation in vocalizations noted within some species, but no detailed analyses (Coates 1990; Taylor 2005; see species accounts).

Usually nest solitarily (e.g. Cicadabird, Varied Triller), but co-operative breeding reported in Ground Cuckoo-shrike (and possibly occurs in others) and colonial nesting reported in White-winged Trillers). All build small, inconspicuous and usually shallow cup- or saucer-shaped nests; nest of Ground Cuckoo-shrike sometimes has tail hanging below nest. Nests usually made of twigs, roots, bark, grass, casuarina needles, vine tendrils, lichens and moss, sometimes with moss, lichen or bark attached to outside, probably as camouflage, and bound together and anchored to branch with spider web and, possibly in some, saliva; nests usually lined with fine twigs, rootlets, grass, moss, hair or wool or other fine material, though nests of some larger *Coracina* unlined. Occasionally build in old nests of other species (e.g. Ground Cuckoo-shrikes sometimes build in mud-nests of Magpie-larks *Grallina cyanoleuca*). Nests usually placed on fork or on top of horizontal branch, often towards end of branch. Nests usually placed quite high; though recorded nest heights in family range from c. 1 to 70 m, many nests placed at ≥ 4 m; some, such as Large Cuckoo-shrike *Coracina macei* and Grey-chinned *Pericrocotus solaris* and Long-tailed *P. ethologus* Minivets, rarely, if ever, nest below 10 m; one exception is White-bellied Minivet *P. erythropygus*, which nests at 1–2 m. White-winged Triller often nests close to other black-and-white birds, such as Magpie-larks or Willie Wagtails *Rhipidura leucophrys* or both. Nests either built by both sexes or, in some, female collects material and builds while accompanied by male, or both may collect material but only one build nest. Eggs typically oval to elongate oval but also rounded oval to pyriform; usually smooth and often glossy. Ground-colour varies substantially, from white, buff and pale greens and blues to green, olive, blue-green and blue. Eggs almost always spotted or blotched or both, and sometimes streaked or mottled, mostly with shades of brown, though some have underlying markings of shades of grey; markings sometimes form zone, or occasionally a ring, at large end; eggs of Ground Cuckoo-shrike can be unmarked. Clutch-size one to five, usually two or three; several species of *Coracina* and *Lalage* lay clutches of one (e.g. Varied Triller); minivets and woodshrikes lay largest clutches, of 3–5. In Aust., occasional reports of clutches of 5–6 probably laid by more than one female. In White-winged Triller, laying interval 48 h, occasionally shorter; in Black-faced Cuckoo-shrike, interval 24 h or more. Usually single-brooded, but double-brooding recorded in some

(e.g. White-winged Triller) and Black-faced Cuckoo-shrike can raise three broods in a season. In most species, incubation by both sexes, though in some (e.g. Purple-throated Cuckoo-shrike, Cicadabird, and several Minivets) only female incubates; probably begins when clutch complete, and hatching possibly synchronous. Incubation period ranges from 14 days to 27 days; 20–24 days in *Coracina* and *Campephaga*, 14–16 days in White-winged Triller. Young usually fed and brooded by both parents, who also dispose of faecal sacs; in some species, parental care by female alone, while in others only female broods but both parents feed young. Helpers attend nestlings in some species (e.g. Ground Cuckoo-shrike, Small Minivet *P. cinnamomeus*; see above). Fledging periods often long, up to 30 days; 22–29 days in *Campephaga* and *Coracina*, but short, usually 12–14 days, in White-winged Triller. Young remain with parents after fledging, and may be fed for up to 2, or exceptionally 3, months. Brood parasitism by cuckoos reported in Aust. but not known for African species (Ali & Ripley 1971; Coates 1990; Keith *et al.* 1992; Roberts 1992; Grimmett *et al.* 1999; Robson 2000; Taylor 2005; NRS; see species accounts).

Four species considered globally threatened: the Reunion Cuckoo-shrike *Coracina newtoni* considered endangered (because population small [60–160 pairs in 2000], and restricted island distribution); and the Mauritius Cuckoo-shrike *Coracina typica* of s. Mauritius, the White-winged Cuckoo-shrike *Coracina ostenta* of the Philippines, and the Western Wattled Cuckoo-shrike *Campephaga lobata* of w. Africa are considered vulnerable. The major threats are deforestation, timber harvesting, forests fires and habitat loss generally. A further nine species considered near threatened globally, seven of which are island forms (in Indonesia, Philippines, Solomon Is, and Samoa). None known to have become extinct since 1600, but three subspecies have disappeared (Taylor 2005). In HANZAB region, nominate subspecies of Long-tailed Triller *Lalage leucopygia* formerly restricted to Norfolk I. and last seen in 1942, though said to have been abundant in 1941; disappearance coincided with arrival of Black Rats on island, which most likely caused extinction, but also with construction of airport in centre of island and which involved clearing of large area of remnant native forest (Garnett & Crowley 2000; see species text). Two taxa endemic to Cebu, central Philippines, also extinct: subspecies *cebuensis* of Bar-bellied Cuckoo-shrike (thought to have become extinct by 1959), and subspecies *altera* of Blackish Cuckoo-shrike *Coracina coerulescens* also considered to be extinct, as a result of widespread deforestation on the island (Taylor 2005).

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Lalage sueurii **White-winged Triller**

COLOUR PLATE FACING PAGE 352

Turdus suerii (sic) Vieillot, 1818, *Nouv. Dict. Hist. Nat., Nouv. Éd., Paris* 20: 270 (as *suerii*) — Nouvelle Hollande = Timor.

The generic name is from Greek *λάλαγες*, a bird mentioned by Hesychius but not further identified. Species named for Charles Alexandre Lesueur (1778–1846), French draughtsman and zoologist who accompanied Captain Thomas Baudin's expedition to the South Seas in the *Géographe* 1800–04.

OTHER ENGLISH NAMES Jardine, Jardine's, White-shouldered or White-winged Caterpillar-eater or Triller; Australian White-winged Triller; Caterpillar-eater or Caterpillar-catcher; Peewee-lark or Peewit Lark; Triller.

POLYTYPIC Subspecies *tricolor* (Swainson, 1825), mainland Aust., Tiwi Is and islands of s. Torres Str.; also se. New Guinea and vagrant to NZ. Extralimitally, nominate *sueurii*, e. Java, Lesser Sundas, s. Sulawesi, and islands of Flores Sea.

FIELD IDENTIFICATION Length 18 cm (17–19.5); wingspan 30 cm (27–31.5); weight 26 g. Small, rather compact cuckoo-shrike, with fairly deep breast but slender belly; rather small head with flat crown and gently angled forehead; rather short, slender bill; long wings, with primaries projecting well past tips of tertials and uppertail-coverts to halfway along tail; and moderately long tail with rounded tip. In flight, wings broad and rounded at tips, and head appears small. Slightly smaller and less compact than Varied Triller *Lalage leucomela*, appearing more slender and with longer wings; similar in size to both Australasian Pipit *Anthus novaeseelandiae* and Rufous Songlark *Cincloramphus mathewsi* but more robust than both, with shorter tail and much shorter legs and, in flight, much broader wings. Sexes differ in adult and first immature plumages; alike at other ages. Marked seasonal variation in male, alternating between boldly pied breeding plumage (mainly spring–summer), and drab female-like non-breeding plumage (mainly autumn–winter); no seasonal variation in appearance of females. Adult male breeding mostly black above and white below, with large grey rump-patch and prominent white shoulder-patch, conspicuous when perched and in flight. Adult male non-breeding and adult female distinguishable: non-breeding male mostly brown above with faintly paler supercilium, slightly greyer rump-patch, and upperwing strongly patterned with buff and cream fringing (but retaining blackish ground-colour to primary coverts and remiges of male breeding); and whitish below with brownish tinge to breast and flanks; female differs by brownish ground-colour to primary coverts and remiges. Juvenile superficially like adult female but with whitish scales to upperbody and extensively streaked underparts. Immature non-breeding very like adult female but distinguishable, with good views, by some retained juvenile plumage of tail and upperwing. Immature male breeding varies: some very like adult male breeding but distinguished by extremely old retained juvenile remiges and primary coverts; some have scattered black feathering in otherwise female-like plumage; others indistinguishable from adult female. No geographical variation in Aust. **Adult male breeding** Strongly pied. Top half of head and neck, glossy black forming neat black cap, sharply demarcated from white chin, throat and whole underbody. Mantle and scapulars, glossy black (sometimes with a few pale scapulars intermixed); back, rump and uppertail-coverts, light grey finely scaled white, forming prominent pale patch contrasting with rest of upperparts; with wear, patch appears mottled grey and pale grey. Tail usually retained from non-breeding but much more worn than in that plumage: appears mostly black with white tip, broad on outer edge and narrowing inward till obsolete in centre; some birds replace central feathers, and new rectrices are black with neat and complete white fringes. Folded wing largely black with large bold white shoulder-patch across most of secondary coverts, and with prominent but narrow white fringes to outer greater secondary coverts and remiges (all retained from non-breeding plumage), usually most conspicuous on tertials and secondaries and very narrow or obsolete on primaries; some also show fine white fringes to primary coverts and alula (also retained from non-breeding plumage). Some birds replace one or more tertials or innermost secondary, which have very broad and conspicuous clean-white fringes compared with worn retained remiges (see Adult male non-breeding). In flight, shows large white triangular patch on leading edge of innerwing to otherwise black upperwing. Underparts wholly white, with pale-grey wash or faint light-grey barring on sides of breast and flanks. From below, folded tail, grey-black with broad white tip, as uppertail. Underwing appears mostly white, with black mottling on leading edge of outerwing and broad grey-black trailing edge and tip. Bill, iris, legs and feet, black. **Adult male non-breeding** Mostly brown, like adult female (see below); birds moulting into or out of breeding

plumage have scattered black feathers on top of head, mantle and scapulars. Top of head and neck, and mantle and scapulars, brown finely streaked black, most obviously on forehead and crown. Side of head marked with faint, diffuse brown supercilium (only slightly paler than top of head), bordered below by narrow dark-brown eye-stripe across lores to rear ear-coverts, and narrow, incomplete dull-white eye-ring, broken in front of and behind eye; ear-coverts, light brown streaked darker brown. Chin and throat, creamy white. Back, rump and uppertail-coverts, light grey with slight buff tinge. Uppertail much fresher than in breeding male, black with: buff fringes to central feathers; white tip, narrow in centre and broader outward; and fine white outer edge. When perched and in flight, lack large white shoulder-patch of adult breeding. Folded wing black with: broad white to pale-cinnamon fringes to most secondary coverts, and prominent narrow white fringes to outer greater secondary coverts (latter as in breeding plumage, but fresher), appearing in combination as bold pale streaks across coverts; broad white edges to primary coverts and alula; and broad buff fringes to remiges (which become narrower and fade to white with wear, as in breeding plumage, above). In flight, wing appears mostly black with broken shoulder-patch of black, buff and cinnamon. Breast and flanks, light buff-brown with light-grey barring on sides of breast and flanks, grading to uniform off-white on belly, vent and undertail-coverts. Undertail and underwing as male breeding. Bill, black with flesh-pink basal half to lower mandible; rest of bare parts as adult male breeding. **Adult female** Much like adult male non-breeding, from which differs by: Upperbody browner than non-breeding male: mantle, scapulars and back, light brown, and rump and uppertail-coverts, brownish grey to light brown, contrasting less with mantle, back and scapulars; and with diffuse light- and dark-brown barring to back and rump and dark-brown barring and light-grey scaling to uppertail-coverts. Tail patterned as male non-breeding but ground-colour dark brown (not black), and tip and margins pale pink-buff (not white). Ground-colour of wing brown (not black), but pale margins to feathers as in male non-breeding; in flight, upperwing appears less boldly patterned than that of non-breeding male. Underparts as non-breeding male though some have dark-brown streaks in centre of breast and upper belly (not seen in male). Undertail like non-breeding male but tip duller white with buff tinge. Underwing like adult male but with pale pink-buff tinge to coverts and bases of remiges; dark-brown (not black) mottling on leading edge of outerwing; and trailing edge and tip, light grey-brown. Upper mandible, black; lower mandible, pinkish brown with black tip. Rest of bare parts as adult male. **Juvenile** Superficially similar to adult female but with distinct scaly appearance; differences from adult female: Top of head and neck and upperbody, brown, with grey tinge to rump and uppertail-coverts and dark-brown mottling and off-white scalloping throughout. Rest of head and neck as adult female but chin and throat diffusely streaked dark brown. Tail much as adult female but feathers narrower and pointed; central feathers have distinct and complete black-brown submarginal stripe (indistinct or not present in adult female). Folded wing, dark brown, with: pink-buff edges and spots and off-white tips to secondary coverts; narrow pink-buff edges and white fringes at tips to greater primary coverts and alula (white fringes to tips of greater coverts not present in adult); and broad pink-buff edges and neat white spot at tips of tertials; rest of primary coverts and remiges as adult female. Breast, buff grading to off-white on rest of underbody, with bold dark-brown streaking to all but centre of belly. Underwing as adult female. Upper mandible, dark grey; lower mandible and gape, pinkish orange to brown, tipped dark grey. Rest as adult. **Immature non-breeding** Sexes indistinguishable. Much like adult female, differing mainly by appearance of retained juvenile plumage. Retain distinctive juvenile central feathers of tail (see above).

On upperwing: with wear, white tips to retained juvenile greater secondary coverts and remiges become less well defined and margins to feathers look more washed out, creamy buff; and retained juvenile greater primary coverts show diagnostic narrow white fringes to tips, even when rest of plumage very worn. Underparts as adult female but most of breast narrowly streaked dark brown. Bare parts as adult female. **Immature male breeding** Not known if all attain this plumage. Appears as varying mix of adult male breeding and immature non-breeding plumage, with varying extent of black-and-white plumage of body, from similar to adult female but with a few black feathers (though some possibly indistinguishable), to showing patchy black feathering on upperparts (which readily identified), to very similar to adult male breeding. Those similar to adult male breeding differ from male breeding by: On wing, have breeding-like black tertials with broad white fringes, and secondary coverts (not outer greater coverts) mostly white, forming white shoulder-patch much as in adult male breeding. New breeding plumage contrasts strongly with mostly brown rest of wing retained from immature non-breeding plumage, with contrast between new mostly white inner greater secondary coverts and old brown outer coverts very marked. Despite heavy wear, juvenile greater primary coverts still retain diagnostic white fringes at tips. In flight, shows white triangular shoulder-patch much as adult male breeding, contrasting with predominantly brown (not black) rest of wing. Also replace some of tail (usually central feathers) with new, mostly black feathers showing marked contrast with very worn and ragged brown juvenile feathers. **Immature female breeding** Not known, but probably indistinguishable from immature non-breeding.

Similar species For distinctions from **Varied Triller**, see that text. Pied plumage of adult breeding males distinctive, but in male breeding and brown plumages, some risk of confusion with superficially similar **Pied Honeyeater** *Certhionyx variegatus*. ALL PLUMAGES of Triller easily distinguished from all of Pied Honeyeater by: slightly larger size; much shorter and heavier bill in relation to head (bill proportionately much longer, and more slender and decurved in Pied); very different call, with Song of Triller a loud, sweet and resonant *ditch-ditch-ditch* ending with canary-like trill (main call of Pied a plaintive drawn-out piping *te-titee-tee-tee* or *titi-tee-tee*), but given in flight and while perched, and mainly during breeding season, in both species; and very different behaviour, actions and jizz: Triller often foraging on ground, as well as in trees and shrubs; and with strong, undulating flight with rapid wing-beats (cf. characteristic honeyeater actions and jizz of Pied, which rarely forages on ground and has fast and erratic flight; also perform aerobic Display Flights, with vertical ascents and descents and much singing). In poorer views in flight, all plumages of Triller could be confused with male or female and juvenile Pied Honeyeater, especially if bill not seen; in addition to above characters, **ADULT BREEDING MALE** Triller readily distinguished from male Pied Honeyeater by: larger grey rump-patch, covering back, rump and uppertail-coverts (rump-patch white in Pied, and smaller, covering lower rump and uppertail-coverts); larger and triangular white shoulder-patch (smaller and not triangular in Pied); wholly black base to tail with white tip to outer feathers (Pied has black tail with broad white edges at base, which meet white rump-patch, and centre of tail wholly black); and black top of head and neck sharply demarcated from white face, chin and throat (Pied has wholly black hood). **BROWN PLUMAGES** of Triller more difficult to distinguish from rather plain and brown adult female and juvenile Pied; in addition to above characters, best distinguished by pattern of tail: in Triller, tail, black (adult male non-breeding) to dark-brown (other brown plumages) with white to pale-buff to pink-buff tip, which broad on outer feathers (in Pied, tail brown without broad

white tip to outertail); further distinguished by: contrast between brown mantle, scapulars and greyer rump-patch (Pied similar but upperbody, brown to grey-brown with diffuse darker mottling and with contrasting paler mottled buff-pink rump and uppertail-coverts). Brown-plumaged White-winged Triller could also be confused with **Rufous Songlark** and **Australasian Pipit**; see those texts for details.

Often seen singly or in twos, probably pairs, and small, loose flocks, usually of up to 10; occasionally in larger flocks of up to 70 birds, usually during autumn-winter or on passage. Also often breed in small colonies. Partial migrant; largely leave S in winter, but recorded in N throughout year; appearance often sporadic: can be very regular in some areas, while in other areas can occur in large numbers one year and be absent the next. Often approachable. Male conspicuous in breeding season, in bold pied plumage and often singing while flying gracefully from tree to tree, gliding down with wings fully spread and cocked tail partly fanned; also sits upright and sings from perch. Female usually far less conspicuous, as plumage rather drab, rarely calls and does not display like male. Normal flight strong, swift and undulating, with rapid wingbeats. Active when foraging, taking insects aerially and flitting and hopping along branches through crowns of trees and shrubs searching for food and gleaning from foliage, branches and trunks; also often forage on ground and fallen logs, often in flocks, hopping with both feet. Noisy during breeding season, singing mainly in flight (see above, and Voice).

HABITAT Occupy a wide range of lightly timbered habitats with a sparse and open shrub layer and grassy ground-cover, particularly dry open eucalypt woodlands and forests (Hobbs 1961; McEvey 1965; Immelmann 1966; Gibson 1977; Forshaw & Muller 1978; Wyndham 1979; Bedggood 1980; Gibson 1986; Collins 1995; Goodfellow 2001; Storr 7, 16, 26, 27; see below); also often in sparsely wooded farmland, including edges with forest and woodland (Deignan 1964; Hall; Vic. Atlas). Rarely in dense forest (Frith 1969; see below). In arid and semi-arid zones, often attracted to flowering shrubs and trees, including grevilleas, e.g. Silver-leaf *Grevillea* *Grevillea refracta*, bloodwoods and eucalypts (Johnstone & Smith 1981; Johnstone *et al.* 1981; Storr 11, 16). Occur throughout mainland Aust., occupying all climatic zones (see Distribution). In n. Aust., occur in arid and semi-arid zones and sub-humid zone (Storr 11, 19), though mostly vacate sub-humid zone during wet season, at least in n. WA and n. NT (Storr 7, 11; H.A.F. Thompson & D.K. Goodfellow).

Mainly in dry open **EUCALYPT WOODLANDS**, including mallee woodlands (and shrublands; see below), usually with an open understorey of scattered small and large shrubs (including *Acacia* and *Grevillea*) and a ground-cover of grasses, including spinifex *Triodia* (Immelmann 1966; Pianka & Pianka 1970; Johnstone *et al.* 1977; Degabriele *et al.* 1979; Ford & Bell 1981; Jones 1981; Ford *et al.* 1985; Halse *et al.* 1985; Gibson 1986; Jones 1986; Woinarski *et al.* 1988, 1989; Woinarski & Tidemann 1991; Gosper 1992; Er & Tidemann 1996; Baxter & Paton 1998; Chafer *et al.* 1999; Storr 21); less often in dry open **EUCALYPT FORESTS** (Tarr 1963; Deignan 1964; Sedgwick 1968; Gibson 1977; Nichols & Nichols 1984; Woinarski *et al.* 1988, 1989; Gosper 1992; Chafer *et al.* 1999), though in inland often in woodlands and forests dominated by River Red Gums, and which often border watercourses (Jones 1952; Ford 1957; Immelmann 1966; Jones 1986; Storr 21) or other riparian *Eucalyptus* associations, including Coolibah (Gibson 1986; J. Reid). Also often in **ACACIA SHRUBLANDS AND WOODLANDS**, particularly in arid and semi-arid zones (where often along watercourses), such as tall woodlands of Mulga or Western Myall (Ford 1957; Pianka & Pianka 1970; Moriarty 1972; Brooker *et al.* 1979; Johnstone *et al.* 1979; Black & Badman 1986; Baxter & Paton 1998; Hall; Storr 21);

in all types of pindan, from open to dense, including burnt areas (Johnstone *et al.* 1981; Johnstone 1983; Collins 1995); and, in s. Qld, in remnant softwood scrub (Leach & Hines 1987). Commonly in a variety of other arid and semi-arid **SHRUBLANDS AND LOW WOODLANDS**: often in chenopod shrublands with scattered trees, and dominated by bluebush *Maireana*, saltbush *Atriplex* or other chenopods (McEvey & Middleton 1968; Brooker *et al.* 1979; Baxter & Paton 1998; Hall); and also often in woodlands dominated by cypress-pine *Callitris* or casuarinas or both (Hopkins 1948; Jones 1952; Hobbs 1961; Dawson *et al.* 1991; NSW Bird Rep. 1977). Also in: tall mallee shrubland with understorey of *Acacia*, *Eremophila* and spinifex (Black & Badman 1986); thickets of *Acacia*, *Grevillea* and *Melaleuca*; low woodland of Dragon Flower-tree *Sesbania formosa* (Start & Fuller 1983); and shrublands near salt lakes, watercourses and rocky outcrops, often foraging among *Eremophila macdonnellii* (Gibson & Cole 1988). Occasionally in **GRASSLANDS** with scattered trees (Deignan 1964; Immelmann 1966; Brooker *et al.* 1979; Congreve & Congreve 1985; Jones 1986; Gibson & Cole 1988; Baxter & Paton 1998; Goodfellow 2001; Hall), including grassland dominated by spinifex (Moriarty 1972; Fletcher 1980; Woinarski *et al.* 1989; Hall) or Barley Mitchell-grass *Astrelba pectinata* (Gibson & Cole 1988); in n. Simpson desert, NT, occur in grassland near salt lakes, watercourses and rocky outcrops (Gibson & Cole 1988); and in Kimberley Div., abundant in grasslands with scattered small trees, mostly *Bauhinia cunninghamii* and *Acacia bidwillii*, but not recorded in treeless grasslands (Immelmann 1966). Also occur in range of **RIPARIAN HABITATS** bordering swamps and watercourses (Immelmann 1966; Bravery 1970; McKean 1985; Sedgwick 1988; Verbeek *et al.* 1993; Johnson & Mighell 1999), including open *Melaleuca* woodland (Garnett & Bredl 1985); as well as riparian eucalypt woodlands and forests, and riparian grasslands and shrublands (see above). Sometimes in **MANGROVES** (Deignan 1964; Thompson 1978; H.A.F. Thompson & D.K. Goodfellow), particularly at edges (Goodfellow 2001). Occasionally in **WET SCLEROPHYLL FORESTS** (Bravery 1970; Gosper 1992); and in and at edges of **MONSOON RAINFORESTS** (Woinarski 1993; Hall). Rarely, recorded in **HEATHLAND** (Jordan 1987). Sometimes in **SUBURBAN PARKS AND GARDENS** (McPherson 1973; Recher 1975; Thompson 1978; Jones 1981) or lightly timbered **AGRICULTURAL LAND**, usually with scattered trees (Bravery 1970; Morris 1975; Halse *et al.* 1985; Sedgwick 1986; Leach & Hines 1987; Leach 1988; Possingham & Possingham 1997; Chafer *et al.* 1999). However, in study of eucalypt woodland varying affected by dieback near Armidale, n. NSW, recorded only in least disturbed of four sites surveyed, in largely unmodified woodland dominated by stringybarks, in which a few trees had been felled and there was occasional light grazing; and not recorded in sites in woodland that had been partly or largely cleared and variously grazed, with trees ranging from dead through various levels of defoliation to healthy (Ford & Bell 1981). Occasionally observed at edges of roads (Goodfellow 2001). Also recorded from orchard woodland (McEvey 1965); and in plantation of uniform, thinned stand of mature (46–52-year-old) pines *Pinus* (Debus 1983).

DISTRIBUTION AND POPULATION Widespread in Indonesia, from e. Java and Bali, N to Sulawesi and E to Lesser Sundas (White & Bruce 1986; Coates *et al.* 1997); recorded at a few scattered sites in New Guinea (Coates 1990). Widespread in Aust.

Aust. Widespread throughout mainland, though less so E and S of Great Divide (Aust. Atlas 1, 2). Occur on some offshore islands, but only single record in Torres Str. (Draffan *et al.* 1983); and absent from Kangaroo I., SA (Abbott 1974; Ford & Paton 1975). **Tas.** Recorded occasionally (Sharland

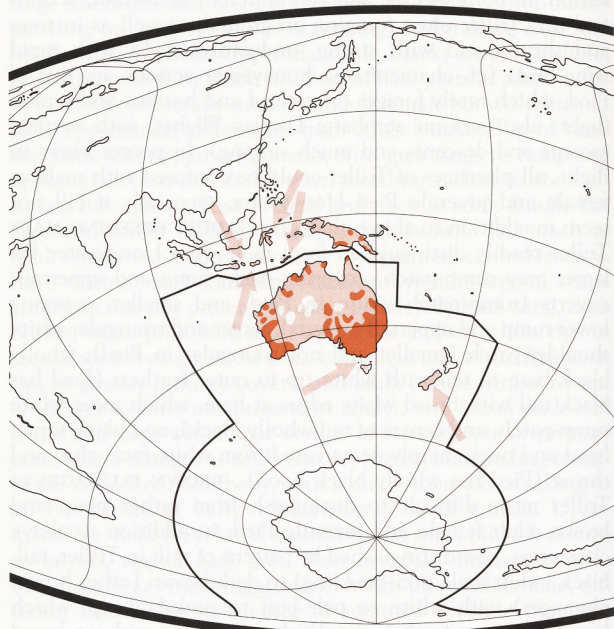
1958; Cooper 1970; Green 1977). Published records since late 1960s (singles unless stated): up to three adults and two young, Pardoe, near Devonport, 8 Oct. 1968–17 Jan. 1969 (Pinner & Bird 1970); Looorana, King I.: 11 Oct. 1968; two, 25 Feb. and 19 Mar. 1969; 15 Oct. 1970; and Boulder Pt, King I., 30 Nov. 1968 (Green & McGarvie 1971; McGarvie & Templeton 1974); single, Rocky C., 27 Nov. 1971 (Tas. Bird Rep. 2); Tinderbox, 29 Nov.–30 Dec. 1975 and 2 Mar.–15 May 1977 (Tas. Bird Rep. 5, 7); Blackmans Bay, Apr.–May 1976 (Tas. Bird Rep. 6); Moorina, 20 Jan. 1978 (Tas. Bird Rep. 8); and aboard M.V. *Soela* sailing across e. Bass Str., disembarking within sight of coast, 11 Sept. 1984 (Tas. Bird Rep. 14).

Lord Howe I. Vagrant. Single, 8–11 Nov. 2003 (McAllan *et al.* 2004).

NZ Vagrant. Single, Macandrew Bay, Otago Pen., SI, 26 Feb. to early Apr., 21 June 1969 (McPherson 1973).

Breeding Widespread but scattered. Very occasionally recorded in Qld N of 20°S, e.g. near Mt Carbine and Forest Home Stn, W of Georgetown (Aust. Atlas 2), though scattered in most regions farther S; scattered throughout Vic. and NSW; single record in Tas., 1968–69 (Pinner & Bird 1970); in SA, most records in regions S and E of Flinders Ras, with sparsely scattered records elsewhere; most WA records in area W of line from Esperance, N through Leonora, to Whim Ck, though also in Kimberley Div.; recorded at a few sites in Top End of NT, and a few round Alice Springs and area farther S (Aust. Atlas 1, 2; NRS).

Anomalies Influxes often recorded, usually in s. Aust. Since late 1960s, influxes include: **1968–69**: Many records in Tas. (see above), coinciding with influx into Vic. (Cooper 1970, 1972, 1975a) and n. Adelaide Plain, Murray–Mallee and Lower North Regions of SA (Mack 1970; Cox 1973; Taylor 1987). **1973**: Large numbers recorded inland NSW (NSW Bird Rep. 1973); and abundant in South-eastern Interior and Mid-eastern Interior Regions and Eucla Div., WA (Brooker *et al.* 1979; Storr 22, 26, 27). **1980**: Unusually common in South-eastern Interior Region, WA (Storr 26); and more than usual in Shoalhaven and Hawkesbury River Valleys, e. NSW (NSW Bird Rep. 1980). **1981**: Unusually common in North-west Plain Region of NSW (NSW Bird Rep. 1981). **1982**: Influx recorded in Mid-eastern Interior Region and Eucla Div., WA, coinciding with wet conditions

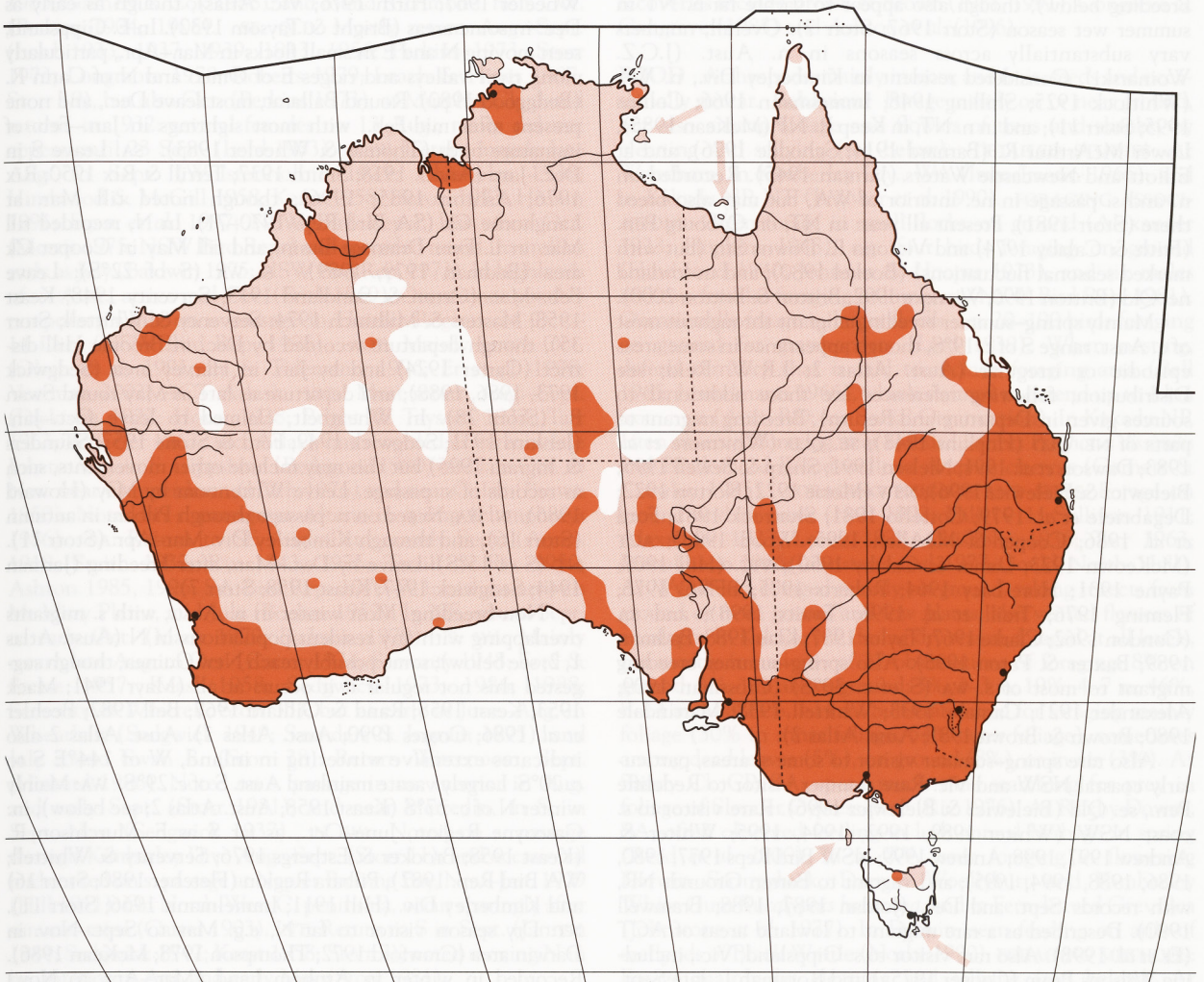


(Storr 22, 27); also more records than usual round Newcastle, NSW (NSW Bird Rep. 1982). 1984: Numerous in South-eastern Interior Region of WA (Storr 26). 1988: Influx recorded round Charters Towers and Georgetown, Qld, May–Aug. (Britton & Britton 2000; Qld Bird Rep. 1988). 1992: Small influx round Charters Towers, Qld (Britton & Britton 2000). 1994: Unusually high number of records in coastal NSW (NSW Bird Rep. 1994). 1995: More records than usual in Sydney and Illawarra Region of e. NSW, and also widespread in w. Hunter Region (NSW Bird Rep. 1995). 2000–01: Influx noticed round Geelong, Vic. (Hewish 2001, 2002).

Populations RECORDED DENSITIES: 0.04 and 0.01–0.18 birds/ha, near Armidale, NSW (Ford & Bell 1981; Ford *et al.* 1985); 0.14 breeding birds/ha, Cowra, NSW (Bourke 1949); 0–0.06 birds/ha, near Moyston, Vic. (Kennedy 2003); 0.32 birds/ha, Strzelecki Ck, SA (Mollenmans *et al.* 1984); 0.14 (0.02–0.73) birds/ha, Coongie Ls NP, SA (Reid 1999); 0.01 birds/ha, Nullarbor Plain, WA (Brooker *et al.* 1979); 0.003 birds/ha, L. Disappointment, WA (Davies *et al.* 1988); 0.08–0.16 birds/ha, Howards Pen., NT (Woinarski *et al.* 1988); 0.12 birds/ha, Berry Springs, NT (Franklin & Noske 1999); 1.0±1.7 birds/ha, Kakadu NP, NT (Woinarski *et al.* 1989); 0.02 birds/ha, S. Alligator R., NT (Keast 1985); 0.05 birds/ha, Yinberrie Hills, NT (Woinarski & Tidemann 1991).

THREATS AND HUMAN INTERACTIONS Very occasionally killed by cars (Brown *et al.* 1986).

MOVEMENTS Reasonably well known. Partial migrant, with episodic or irregular appearance at many sites. Some populations in n. Aust. resident or sedentary (Tarr 1963; see below). Migratory elsewhere, largely vacating mainland Aust. S of 29°S in autumn, and moving to n. Aust.; migratory populations return S in late winter to summer to breed in s. parts of range, and resident n. Aust. populations also breed spring–summer (Keast 1958; Frith 1969; Aust. Atlas 1, 2; Storr 19; see below; also see Breeding: Season); Aust. Atlas 2 shows return to S well under way in winter quarter (end of which 15 Aug.). Broad-scale analysis of bird atlas and count data in e. Aust. found strong evidence of inland slope-line movement, moving NNW from se. Aust. in winter (Griffioen & Clarke 2002); largely absent from e. coastal Aust. S of c. 19°S in autumn–winter, with wintering birds spread throughout w. Qld, N of c. 29°S and E to c. 145°E (Aust. Atlas 2). Occurrence can be sporadic and irregular, especially in central and n. Aust., with numbers returning to an area often varying greatly from year to year, and large influxes often recorded; such fluctuations often attributed to varying climatic or habitat conditions, especially availability of water, rainfall or drought or availability of food (Keast 1958; Immelmann 1966; Frith 1969; Cooper 1975a; Gosper 1986; Aust. Atlas 1; Storr 19; J.R.W. Reid; see Distribution, see below). Sometimes described as nomadic (Dickison 1927; Keast 1958; Storr 1967; Attiwill 1972; Storr 7, 19). **NATURE OF PASSAGE:** Poorly known; said usually to migrate in small flocks of up to 20 birds



(Anon. 1918; Gilbert 1935; Storr 16) and occasionally noted on passage in flocks of up to 60 birds (Storr 11, 21). However, also said that appear to arrive singly, paired or in small parties (Gilbert 1935), though may be referring to organization after arrival. Local populations may all leave simultaneously (Anon. 1907; Carlyle 1963). Sexes appear to travel separately on passage; in some areas, males appear to return to s. breeding areas before females: 2 weeks earlier in NSW (Purnell 1972); 7–10 days earlier in Vic. mallee (Anon. 1907); a few days to 1 week in e. SA (Rix 1976); elsewhere, females appear to arrive first: up to 6 weeks before males at Murphys Ck, se. Qld, in 1932 (Lord 1933; see Return); females also noted leaving after males (Anon. 1930; Hyem 1937). In Vic., juveniles appear to leave on n. migration about 2 weeks after adults (Tarr 1963; Thomas & Wheeler 1983); though also said that birds leave as soon as young independent and can fly strongly (see Bonds: Dispersal of young). Males said to be very restless on arrival in Vic. (Tarr 1963). Can cross large stretches of water, as shown by vagrant records in Tas. and NZ (see Distribution), though at least sometimes ship-assisted: adult female seen on ship crossing Bass Str. and leaving vessel within sight of Tas. (Tas. Bird Rep. 14). Noted on passage on islands of Gulf of Carpentaria and off e. coast (Storr 1973; Storr 19), including Capricorn Is, Great Barrier Reef (Cooper 1948).

Breeding Appear to be partly resident or sedentary in n. Aust. (Tarr 1963; Aust. Atlas 2), with influx of s. migrants augmenting local populations in autumn–winter (see Non-breeding below), though also appear to vacate far-n. NT in summer wet season (Storr 1967; Storr 7). Overall, numbers vary substantially across seasons in n. Aust. (J.C.Z. Woinarski). Considered resident in Kimberley Div., n. WA (Whitlock 1925; Shilling 1948; Immelmann 1966; Collins 1995; Storr 11); and in n. NT, in Keep R. NP (McKean 1985), Lower McArthur R. (Barnard 1914; Schodde 1976), and at Elliott and Newcastle Waters (Jarman 1945). Recorded on n. and s. passage in ne. interior of WA, but may also breed there (Storr 1981). Present all year: in NT, on Cobourg Pen. (Frith & Calaby 1974) and Victoria R. Downs Stn (but with marked seasonal fluctuations) (Boekel 1980); and in lowland ne. Qld (Britton 1990; Wieneke 1992; Britton & Britton 2000).

Mainly spring–summer breeding migrant throughout most of e. Aust. range S of c. 19°S, though appearance in some areas episodic or irregular (Aust. Atlas 2; J.R.W. Reid; see Distribution); following references are those additional to sources given in Departure and Return). Breeding migrant to parts of NE. QLD (Hopkins 1948); SE. QLD (Whitmore *et al.* 1983; Dawson *et al.* 1991; Nielsen 1991; Sharp & Sewell 1995; Bielewicz & Bielewicz 1996); NSW (Morse 1922; Norton 1922; Degabriele *et al.* 1979; Costello 1981; Sharrock 1981; Ford *et al.* 1986; Cooper & McAllan 1995; Wood 1998); ACT (McKeown 1923; Lamm & Calaby 1950); VIC. (Hill 1907; Payne 1931; Hore-Lacy 1964; Roberts 1975; BFNC 1976; Fleming 1976; Traill *et al.* 1996; Twaits 1998); and SA (Condon 1962; Clarke 1967; Taylor 1987; Klau 1988; Badman 1989; Baxter & Paton 1998). Also spring–summer breeding migrant to most of s. WA (S of c. 30°S) (Crossman 1909; Alexander 1921; Carnaby 1933; Whittell 1938; Martindale 1980; Brown & Brown 1981; Aust. Atlas 2).

Also rare spring–summer visitor to some s. areas, particularly coastal NSW and Vic. Rare summer visitor to Redcliffe Pen., se. Qld (Bielewicz & Bielewicz 1996). Rare visitor to s. coast NSW (Whiter 1989, 1992, 1994, 1995; Whiter & Andrew 1997, 1998; Andrew 1999; NSW Bird Reps 1977, 1980, 1986, 1988, 1994, 1995); and vagrant to Barren Grounds NR, with records Sept. and Dec. (Jordan 1987, 1988; Bramwell 1990). Described as a rare migrant to lowland areas of ACT (Er *et al.* 1998). Also rare visitor to s. Gippsland, Vic., including Wilsons Prom (Cooper 1975a) and Rotamah I., late Sept.

to early Jan. (Burbidge 1982, 1985; Anon. 1989, 1992; Dow & Dow 1989; Rolland & Rolland 1996); and rare summer migrant to Strathbogie Ras (Bedggood 1972). Vagrant to Tas. mainly in spring–summer, with published records since 1960s mostly Oct.–Mar. but once mid-Sept. and twice recorded as late as Apr.–May (see Distribution). Vagrant to Lord Howe I. in Nov.; and vagrant to NZ first recorded 26 Feb., and last seen 21 June (see Distribution).

Departure Migrate N from s. Aust., usually leaving Feb.–Apr., but departure recorded as early as Dec. and as late as Apr.–May (see below). CENTRAL-N. QLD: Leave Richmond by Apr. (Berney 1904, 1905). SE. QLD: Leave Dec. round Rockhampton (Longmore 1978) and Marburg district (Leach & Hines 1987); usually leave Murphys Ck late Jan. to early Feb. (Lord 1933, 1937, 1939, 1943, 1956). Also described as present in SE till May (Roberts 1979). NSW: Mainly leave Feb. (Wolstenholme 1929; Althofer 1934; Gilbert 1935; Chisholm 1938; Hindwood & McGill 1958; Keast 1958; Gibson 1977; Schmidt 1978; Morris *et al.* 1981; Hoskin 1991; Egan *et al.* 1997; NSW Bird Reps 1973, 1977, 1978, 1982, 1984), though departure recorded as early as Jan. (Anon. 1930; Hyem 1937; Morris 1975) and into Mar. (Heron 1973; NSW Bird Rep. 1988) and Apr. (Baldwin 1975; NSW Bird Rep. 1973). Possibly on n. passage in Hunter Region, 3 Feb.–20 Mar. (NSW Bird Rep. 1998). ACT: Most leave by Feb., as soon as young independent (ACT Atlas); leave Mt Mugga by Jan. (Olsen *et al.* 1991). VIC.: Most leave Jan.–Feb. (Ford 1909; Dickison 1927; Howe 1928; Brown 1950; Tarr 1963; Wheeler 1967; Hirth 1976; Vic. Atlas), though as early as Dec. in some areas (Bright & Taysom 1932). In E. Gippsland, seen moving N and E in small flocks in Mar.–Apr., particularly along river valleys and ridges E of Omeo and N of Cann R. (Bedggood 1980). Round Ballarat, most leave Dec., and none present after mid-Feb., with most sightings in Jan.–Feb. of immature birds (Thomas & Wheeler 1983). SA: Leave S in Dec.–Jan. (Anon. 1918; Smith 1937; Terrill & Rix 1950; Rix 1976; Ashton 1985, 1996), though noted till Mar. at Langhorne Ck (SA Bird Rep. 1970–71). In N, recorded till Mar. in L. Eyre Drainage Basin, and till May in Cooper Ck area (Badman 1979, 1989). s. WA (S of 22°S): Leave Feb.–Mar. (Orton & Sandland 1913; Serventy 1948; Keast 1958; Masters & Milhinch 1974; Serventy & Whittell; Storr 35), though departure recorded by Dec. in Broome Hill district (Carter 1924) and by Jan. in Harvey area (Sedgwick 1973, 1986, 1988); and departure as late as May round Swan R. (Storr 28). In Wheatbelt, claimed to leave Oct.–Jan. (Jenkins 1931; Sedgwick 1949; Ford & Stone 1957; Saunders & Ingram 1995) but this may include other movements, such as records of s. passage. Leave Wittenoorn by May (Howard 1986). n. WA: Noted on n. passage through Pilbara in autumn (Storr 16), and through Kimberley Div. Mar.–Apr. (Storr 11). NT (S of 15°S): Leave by Dec.–Mar., after breeding (Jarman 1944; Sedgwick 1947; Keast 1958; Storr 7).

Non-breeding Most winter in n. Aust., with s. migrants overlapping with any resident populations in N (Aust. Atlas 1, 2; see below); some possibly reach New Guinea, though suggested this not regular if it occurs at all (Mayr 1941; Mack 1953; Keast 1958; Rand & Gilliard 1967; Bell 1982; Beehler *et al.* 1986; Coates 1990; Aust. Atlas 1). Aust. Atlas 2 also indicates extensive wintering in inland, W of 144°E S to c. 20°S. Largely vacate mainland Aust. S of c. 29°S. WA: Mainly winter N of c. 27°S (Keast 1958; Aust. Atlas 2; see below), in: Gascoyne Region, June–Oct., as far S as E. Murchison R. (Keast 1958; Brooker & Estbergs 1976; Serventy & Whittell; WA Bird Rep. 1982), Pilbara Region (Fletcher 1980; Storr 16) and Kimberley Div. (Hill 1911; Immelmann 1966; Storr 11). NT: Dry season visitor to far N, e.g. May to Sept.–Nov. in Darwin area (Crawford 1972; Thompson 1978; McKean 1986). Recorded in winter in Arnhem Land (Mar.–Apr. to Nov.)

(Deignan 1964), Kakadu NP (Brooker *et al.* 1990), and Lower McArthur R. region (Schodde 1976). N. QLD (N of 19°S): Winter in N (Storr 1973; Storr 19), including: in central-N, on lowlands and islands of Gulf of Carpentaria (Storr 1973; Storr 19) and at Richmond (Berney 1904, 1905); on w. C. York Pen., Apr.–Aug. (MacGillivray 1918; Garnett & Bredl 1985); and on e. coast and associated islands (Storr 1973; Britton 1990; Britton & Britton 2000; Storr 19). In Atherton Shire, present late winter to spring or Dec. (Bourke & Austin 1947; Bravery 1970; Wieneke 1992).

Also winter in small numbers across s. Aust., with records in all months for most or all regions (Aust. Atlas 1, 2), including: SW. QLD (Aust. Atlas 2); SE. QLD, e.g. at Murphys Ck (Lord 1933, 1937, 1939, 1943, 1956); NSW (Morse 1922; Morris *et al.* 1981; NSW Bird Reps 1973, 1977, 1978); VIC. (Vic. Atlas); SA, e.g. in Cooper Ck Drainage, recorded all months except June and July (Badman 1989); at Gascoyne Junction (WA Bird Rep. 1982); and in far-s. NT, where can be found throughout winter, but not known if they comprise resident local breeding populations or non-breeding migrants from farther S replacing locally breeding populations (Storr 1967). Present throughout year at Victoria R. Downs Stn, but with marked seasonal fluctuations (Boekel 1980).

Return Widely distributed throughout mainland Aust. in spring–summer, though with records concentrated in se. Aust. and n. WA and NT in summer (Aust. Atlas 2); return S mainly Aug.–Sept. NE. QLD: Noted as summer visitor to some parts, including Townsville (Hopkins 1948; Lavery & Hopkins 1963; Garnett & Cox 1988); and round Richmond, from Oct. (Berney 1904, 1905). SE. QLD: Mostly return Aug.–Sept. (Lord 1933, 1937, 1939, 1943, 1956; Perkins 1973; Storr 1973; Longmore 1978; Roberts 1979; Leach & Hines 1987; Storr 19), but also Oct. (Perkins 1973); at Murphys Ck, dated returns in 1932: several females on 13 Aug., males did not appear until 23 Sept. (Lord 1933). NSW: Return mainly late Aug. to Sept. (Wolstenholme 1929; Chisholm 1938; Hindwood & McGill 1958; Keast 1958; Heron 1973; Hoskin 1991; Egan *et al.* 1997; NSW Bird Reps), less often Oct. (Morris 1975; NSW Bird Reps) and recorded round Inverell as early as July (Baldwin 1975; NSW Bird Rep. 1973). In highlands of se. Aust., arrive mid-Oct. (Frith 1969). Occurrence possibly temporary while on s. passage in Hunter Region, 24 Oct.–14 Dec. (NSW Bird Rep. 1998). ACT: Mainly arrive Oct. (Olsen *et al.* 1991; Er & Tidemann 1996; Er *et al.* 1998; Veerman 2002; ACT Atlas). VIC.: Most return Aug.–Sept. (Dickison 1927; Howe 1928; Bright & Taysom 1932; Tarr 1963; Wheeler 1967; Vic. Atlas), but recorded as early as late July to Aug. in E. Gippsland (Bedgood 1980) and late Oct. to Nov. near Camperdown (Hirth 1976) and near Colac (Brown 1950). Noted on s. passage at Altona in spring (Humphreys 1986). SA: Return to SE Aug.–Oct., mainly Sept. (Anon. 1918; Smith 1937; Rix 1943, 1976; Terrill & Rix 1950; Ashton 1985, 1996; SA Bird Rep. 1970–71); earliest arrivals Mt Mary Plains, mid-July (Boehm 1957). In NE, return Sept. to early Oct. (Mack 1970; Badman 1979). s. WA: Mainly return late Aug. to Oct. (Carter 1924; Serventy 1948; Ford & Stone 1957; Keast 1958; Sedgwick 1973, 1986, 1988; Serventy & Whittell; Storr 35), but as early as June–Aug. in Wheatbelt (Sedgwick 1949; Saunders & Ingram 1995), and July round Swan R. (Storr 28). Return Wittenoom, Sept. (Howard 1986). Noted on s. passage in ne. interior in Aug. and early Sept. (Storr 1981); and near Merredin, in S, in Sept.–Nov. (Sedgwick 1937). N. WA: Noted on s. passage through Kimberley Div., Aug.–Sept. (Storr 11); and occasional birds noted on s. passage at Napier Broome Bay, Nov.–Jan. 1909 (Hill 1911). On North-West C. peninsula, occur sparingly after summer rains (Carter 1903). NT: Return to S in Sept. (Jarman 1944; Sedgwick 1947; Keast 1958; Storr 7); noted moving N in ne. interior in Apr. and early May (Storr 1981).

Occurrence often sporadic and irregular, especially in central and n. Aust., with numbers often varying greatly from year to year, even being absent in some years; influxes of greater than usual numbers also often recorded (Jenkins 1931; Whittell 1938; Terrill & Rix 1950; Lord 1956; Boehm 1957; Keast 1958; McEvey 1965; Immelmann 1966; Attiwill 1972; Heron 1973; Cooper 1975a; Thomas & Wheeler 1983; Gosper 1986; Taylor 1987; Aust. Atlas 1; Storr 19; see Distribution). Such fluctuations in occurrence often attributed to seasonal climatic conditions, particularly drought and recent rainfall, and their impact on availability of water and food (Chenery & Morgan 1920; Keast 1958; Hobbs 1961; Immelmann 1966; Wheeler 1967; Mack 1970; Cooper 1975a,b; BFNC 1976; Sharrock 1981; Badman 1989), e.g. often reported to be more abundant during years of greater rainfall (Brown 1950; Brooker *et al.* 1979; Howard 1983; Klau 1988; Badman 1989; Storr 21, 22, 26, 27); in Qld, numbers said to vary greatly with condition of ground herbage and resultant abundance of insects (Storr 1973; Storr 19); and recorded Richmond R. district, ne. NSW (Gosper 1986) and Portland district, sw. Vic. (Officer 1958) during times of inland drought. In parts of arid savanna habitats of Kimberley Div. said to move irregularly depending on distribution of surface water (Immelmann 1966), but confirmation needed.

Banding Of 1194 banded in Aust. and New Guinea, 1953–Aug. 2001, 20 recoveries (1.7%). Of 14 recoveries, of 12 birds, July 1984–Aug. 2001: all <10 km from banding site (ABBBS). Other published studies of <20 captures and no recoveries include Brown & Brown (1981, 1991), Congreve & Congreve (1985) and Ashton *et al.* (1996).

FOOD Arthropods, mainly insects; and fruit, seeds and occasionally nectar. **Behaviour** Forage mainly on or near ground, but also among foliage and flowers of trees and shrubs; by gleaning and sallying (see below). **DETAILED STUDIES:** At Wyndham, in Kimberley Div., WA (Immelmann 1966); and in Kakadu NP, NT (Brooker *et al.* 1990). **FORAGING ASSOCIATIONS:** Often forage in small flocks, on ground (Alexander 1923; Hopkins 1948), e.g. four birds foraging on ground (Hindwood 1940; Johnson & Hooper 1973), and six males and two females foraging in low grass (NSW Bird Rep. 1981). Occasionally forage in larger flocks, e.g. 20–100 birds foraging on ground for grasshoppers (Lord 1939). When nesting, defend territory that is said to include foraging area (Bell 1965; Immelmann 1966), which claimed to extend up to 1 km from nest (Aust. RD; see Social Organization). In Kakadu NP, often observed foraging near Hooded Parrots *Psephotus dissimilis* and Black-faced Woodswallows *Artamus cinereus* (Garnett & Crowley 1995). **FORAGING HEIGHTS AND SITES:** Forage on ground and in trees (Hall 1902; Hill 1911; Sullivan 1911; Alexander 1923; Leach 1928; Chisholm 1938; Tarr 1963; Immelmann 1966; Johnstone *et al.* 1977; Gould; North; Hall). At Wyndham, foraged mainly on ground, taking insects from ground or from grasses and low plants; also visited flowers of eucalypts. In Kakadu NP, during dry season, foraged at all levels, but mostly in canopy; of 37 observations of foraging: 8% on ground; 3%, 1 m above ground; 3%, 2–3 m; 19%, 4–7 m; 46%, 8–14 m; and 22%, >14 m. Substrates used for foraging mainly foliage (30% in inner foliage, 54% outer foliage), sometimes among dead leaves (5%), on ground (8%), or in air (3%). At Sandy Ck CP, SA, spent much time searching for prey in foliage of Slender Cypress-pine (Rix 1976). At Roxby Downs, SA, often observed feeding in lush annual herbage in spring (Read *et al.* 2000). In n. WA, seen foraging in flowering Darwin Stringybark, Darwin Woollybutt and Kimberley White Gum *Eucalyptus houseana*, and in Fern-leaved Grevillea (Johnstone *et al.* 1977). In Darwin, seen feeding on arils of seedpods of Black Wattle (Noske 1990). **FORAGING METHODS:** Forage mainly by gleaning and sallying (see below). At

Wyndham, foraged by gleaning medium-sized insects from bare ground, grasses and shrubs; sallying for flying insects, especially flying ants and, after showers of rain, flying termites; hovering close to ground to sally-pounce on insects on ground; and visiting flowers of eucalypts, either to feed on nectar or on insects at flowers. Elsewhere, also seen to sally for flying insects from ground and to glean insects from flowers of shrubs (Hall 1902); and to fly over grass and sally-pounce to ground (Edwards 1925). In Kakadu NP, foraged mostly by gleaning (55%) and by flutter-chase (39%) and only occasionally by sallying (6%), including sally-strikes in air and on vegetation. In Imbota NR, NSW, foraged mostly by sally-striking from leaves of trees (n=42 obs.; Ford *et al.* 1986). At Wyndham, said not to specialize, taking great variety of food (see below). However, towards end of wet season specialized almost entirely on two species of grasshoppers. Swallow insects whole after bashing against ground or twigs (Immelmann 1966). **DRINKING:** Seen drinking at a water trough (Paton & Paton 1980).

No detailed studies. **Plants** Seeds^{12,14,22,39,40,41}, fruit^{11,12,22,39}, nectar^{1,4,18,28,35,36}, flowers²³, vegetable matter^{39,40}. **DICOTYLEDONS:** Caesalpiniaceae: *Bauhinia cunninghamii* nectar³⁴; Chenopodiaceae: *Enchylaena tomentosa* fru.^{11,41}; Epacridaceae: *Leucopogon* sds³⁸; Moraceae: *Ficus* fru.³; Mimosaceae: *Acacia auriculiformis* arils³³; Myrtaceae: *Callistemon* nectar¹⁹; *Eucalyptus houseana* nectar²⁶; *E. miniata* nectar²⁶; *E. tetradonta* nectar²⁶; Proteaceae: *Grevillea eriostachya* nectar³⁴; *G. magnifica* nectar³⁴; *G. petrophiloides* nectar^{26,32,34}; *G. robusta* nectar²⁹; Rosaceae: *Prunus* fru.³¹; Santalaceae: *Exocarpos aphyllus* fru.^{11,39}. **Animals** SPIDERS^{22,25,39,41}. **INSECTS**^{2,3,4,5,8,9,10,11,14,15,17,19,21,37,38,39,40}: Blatodea⁴¹; Coleoptera^{3,8,22,39,40}: Chrysomelidae^{15,40,41}: *Edusa*³⁹; *Paropsis*³⁹; Curculionidae^{6,27}: *Polyphrades*⁶; *Titinia*³⁹; Scarabeidae^{24,38,39,41}; Diptera^{2,40,41}: Tabanidae⁴¹; Hemiptera^{22,27,39}: Cicadellidae²⁷; Cicadidae: *Melampsaltra*³⁹; Lygaeidae⁴¹: *Nysius vinitor*³⁹; Miridae³⁹; Pentatomidae^{27,41}: *Oeschalia schellenbergi*³⁷; Psyllidae: lerp⁶; Hymenoptera: wasps²⁴; Apidae^{39,40}; Formicidae⁶: *Iridomyrmex*⁴¹; *I. detectus*²²; Ichneumonidae⁴¹; Isoptera⁶: Mastotermitidae: *Mastotermes darwiniensis*²²; Lepidoptera: larv.^{5,8,11,13,20,22,24,30,39,40,41}, ads^{15,25,38,41}; Noctuidae: *Spodoptera litura*²²; Tortricidae⁷; Orthoptera: grasshoppers^{16,18,22,39,40}; Acrididae⁴¹: *Gastrimargus musicus*²²; *Nomadacris guttulosa*²²; Gryllidae⁴¹; Tettigoniidae^{27,41}; Mantodea⁴¹; Phasmatodea²².

REFERENCES: ¹ Hall 1902; Mathews ² 1909a, ³ 1909b; ⁴ Hill 1911; ⁵ Sullivan 1911; ⁶ Lea 1914; ⁷ Cheney 1915; ⁸ White 1917; ⁹ Anon. 1918; ¹⁰ Caldwell 1918; ¹¹ Morgan *et al.* 1926; ¹² Morgan 1930; ¹³ Gannon 1932; ¹⁴ Mules 1932; ¹⁵ McKeown 1934; ¹⁶ Chisholm 1938; ¹⁷ Rix 1938; Lord ¹⁸ 1939, ¹⁹ 1956; ²⁰ Sedgwick 1949; ²¹ Tarr 1963; ²² Immelmann 1966; ²³ Macdonald & Colston 1966; ²⁴ Jenkins 1968; ²⁵ Green & McGarvie 1971; ²⁶ Johnstone *et al.* 1977; ²⁷ Vestjens 1977; ²⁸ Ford *et al.* 1979; ²⁹ Larkins 1983; ³⁰ Saunders & de Rebeira 1983; ³¹ Hobbs 1986; ³² Hopper & Burbidge 1986; ³³ Noske 1990; ³⁴ Brown *et al.* 1997; ³⁵ Franklin 1999; ³⁶ Franklin & Noske 1999; ³⁷ North; ³⁸ Cleland; ³⁹ Lea & Gray; ⁴⁰ Hall; ⁴¹ FAB.

Young Fed by both parents (Bell 1965; Immelmann 1966; Ashton 1987). At Wyndham, older young fed larger prey. Young fed on adult and larval insects, including cicadas, a moth and grasshoppers (Immelmann 1966; Sedgwick 1973; Rix 1976; McKean 1985).

SOCIAL ORGANIZATION Not well known but some details from observations of colonial nesting, including: at Wyndham, Kimberley Div., n. WA, Oct. 1959–Apr. 1960 (Immelmann 1966), at Morawa, s. WA, 1949–51 (Rogers 1951; White 1952), and at Macleod, Vic., Nov.–Dec. 1961 (Bell 1965). Often occur singly or in twos, probably pairs (e.g. Thomas 1947; Cooper 1972; Johnstone *et al.* 1977; Longmore 1978; Passmore 1982; Halse *et al.* 1985; Nielsen 1991; North;

NSW Bird Reps), and small flocks of 3–10, occasionally of up to 20 birds (e.g. Deignan 1964; Immelmann 1966; Morris 1975; Gibson 1977; Johnstone *et al.* 1977; Smith *et al.* 1978; Coate *et al.* 1998). Also regularly in larger flocks of up to 100, usually during autumn–winter non-breeding season (e.g. Schodde 1976; Fletcher 1980; Britton 1990; Aumann 1991; Britton & Britton 2000; NSW Bird Rep. 1996; see Food) or on passage (Storr *et al.* 1975; Schmidt 1978; Bedgood 1980; Johnstone & Smith 1981; Johnstone 1983), particularly when foraging (see Food). Some winter flocks contain mostly juveniles and immatures (Smith *et al.* 1978; Johnstone *et al.* 1981; Britton 1997). **ASSOCIATIONS WITH OTHER SPECIES:** Flocks often associate with other species (Britton 1997), including Crimson Chats *Epthianura tricolor* (Johnstone *et al.* 1981), Magpie-larks *Grallina cyanoleuca* (Garnett & Bredl 1985), Black-faced Cuckoo-shrikes *Coracina novaehollandiae* (Britton 1997), and Masked *Artamus personatus* (Johnstone *et al.* 1981) and Black-faced Woodswallows (Boekel 1980).

Bonds Usually monogamous and nest in simple pairs (e.g. Rogers 1951; Bell 1965; Immelmann 1966; Bond 1968; Brown & Brown 1981; NRS). Polygyny recorded once: a male and two females occupied a territory, with females using separate nests and fledging two young each; male assisted at each nest and at no time was another male seen (Lord 1956). Suggested pair-bond maintained throughout year in resident populations, but maintained only during breeding season in migratory populations; at Wyndham, pairs stay close together before and after breeding season (Immelmann 1966). Suggested pair-bond strongest when building nest to shortly before eggs laid, weakens during incubation and early nestling period, and weakest shortly before and after young fledge; pair-bond again closer towards beginning of second brood (Immelmann 1966; see Breeding: Incubation, Young). However, elsewhere, pair-bond appears strong throughout incubation and nestling period, with bird on nest being fed by partner (Le Souéf & Macpherson 1920; Austin 1923; Tarr 1963). Where migratory, males and females appear to travel separately (see Movements: Nature of passage). Males normally pair and breed when in breeding plumage (Immelmann 1966; Bravery 1970; Garnett & Cox 1988). Some evidence of mate guarding during nest-construction (see Sexual behaviour). After young hatch, males reduce contribution to care of young (see below); no evidence for suggestion male might be seeking second mate at this time (Brown & Brown 1981). **Parental care** Both parents brood and feed nestlings and remove faecal sacs, though contributions of males and females vary (see Breeding: Young). Male rarely participates in care of fledgelings (Immelmann 1966). **DISPERSAL OF YOUNG:** Young stay near nest for 1–2 weeks after fledging and fed by female alone (Immelmann 1966; NRS). Departure of juveniles from natal territories appears to vary. At Wyndham, where breeding pairs apparently resident, juveniles driven from natal territory by adult male as second nesting attempt begun, though no comment made on behaviour with second broods of fledgelings (Immelmann 1966; see Social Behaviour: Relations within family group). However, where migratory, said to leave for non-breeding range with parents as soon as they can fly strongly (Anon. 1907; Smith 1937; Carlyle 1963; North; ACT Atlas), though also said to leave c. 2 weeks after adults (Tarr 1963), and in se. Aust., some recorded after all adults have left (North).

Breeding dispersion Often nest colonially, with up to seven nests in one tree or 15 pairs in same clump of trees (Austin 1918; McGill 1923, 1932; Souter 1927; Hyem 1930; Lord 1933; Smith 1937; Robinson 1939; McGill 1942; Rix 1943; Rogers 1951; Carlyle 1963; Bond 1968; Frith 1969; Brooker & Estbergs 1976; ACT Atlas; NSW Bird Rep. 1977; NRS); and said to be few records of solitary nesting (Tarr 1963; Immelmann 1966). However, of 523 records in NRS,

23 were of colonies, comprising minimum 58 nests (number of nests not specified in three such records), appearing to indicate that solitary nesting more usual, though also possible that records of solitary nesting failed to notice other nests in colonies. Confirmation of frequency of colonial nesting needed. Within groups, dispersion of nests ranges from all in same tree to spread over radius of 150 m (NRS); at Morawa, s. WA, distance between nests in two separate groups of six, 7.3–18.9 m and 22.9–51.2 m (White 1952); at Uluru NP, s. NT, three pairs nested within 400 m of each other (J.R.W. Reid); and at Macleod, Vic., four pairs nested within radius of c. 15 m (Bell 1965). Said that colonial nesting occurs more often in inland Aust. (Immelmann 1966). Often nest close to other species, particularly other black-and-white birds, such as Magpie-larks and Willie Wagtails *Rhipidura leucophrys* (see Breeding). **Territories** Strongly territorial, at least during breeding season. Territories may be maintained year-round near permanent water where populations resident but probably break down elsewhere (Immelmann 1966). No information on extent of territories. When nesting colonially, each pair maintains territory, including a foraging area from which nesting materials also collected (Dickison 1927; Rogers 1951; Carlyle 1963; Bell 1965), though extent of such territories not described. One pair remained in and round same group of trees, and never seen to venture further than 40 m from it for whole of breeding season (Carlyle 1963).

Roosting No information.

SOCIAL BEHAVIOUR Some aspects well known but no detailed studies; some information from observations of breeding behaviour of colony at Morawa, s. WA, 1949–51 (Rogers 1951) and at Wyndham, Kimberley Div., n. WA, Oct. 1959–Apr. 1960 (Immelmann 1966). Males may breed in non-breeding plumage, at least in n. NT (Goodfellow 2001; cf. Immelmann 1966), though possible that such birds immature males in female-like breeding plumage (see Field Identification, Plumages for description). However, birds can be difficult to observe as they often nest, and will forage, high in crowns of trees (Leach 1928; Bryant 1934; Brown & Brown 1981; Biddiscombe 1985) and plumage cryptic (Collins 1995). Females described as quiet and inconspicuous; breeding males can be conspicuous and noisy, especially on return to breeding grounds after migration, when searching for mate and establishing territory, as they sing noisily, often in flight (McGilp 1944; Rogers 1951; Tarr 1963; Bell 1965; Bedggood 1980; Thomas & Wheeler 1983; Gould; Mathews; North; NRS). Often approachable (Goodfellow 2001). **Displays** **SINGING AND SONG-FLIGHTS:** Male sings noisily, both from perches (including highest in territory) and in frequent, loud and conspicuous Song-flights, to advertise ownership of territory and to attract females (Lord 1956; Carlyle 1963; Tarr 1963; Immelmann 1966; Nielsen 1991; Serventy & Whittell; NRS), including when close to or even on nest (Wolstenholme 1929; Tarr 1963; North). At Wyndham, mostly sang in Song-flights and perched Song given only rarely, usually from rather concealed position within dense foliage or twigs of tree or shrub or from grass stem close to ground (Immelmann 1966); for timing of singing after return to breeding areas, see Voice. **SONG-FLIGHTS:** Sing while flying from tree to tree, or while ascending high into air and gliding down with wings and tail spread; Song-flights usually start silently, Song beginning before high point of flight and sometimes continuing after alighting. Song-flights given most often during nest-building and early stages of incubation period and, if re-nesting, about time first brood fledges; frequency declines during rest of incubation and through nestling period, when male spends much time attending nest and young (Immelmann 1966). **Maintenance behaviour** Sunbathe by lying with body on horizontal branch with tail directed towards sun, wings and tail

fully spread and plumage of head and dorsum slightly raised, exposing plumage and skin of dorsum to sun (Immelmann 1966). A female also seen sunning itself on ground, with feathers fluffed up (Thomas 1980). Both male and female preen while on nest (NRS). One seen to perch and stay stationary for c. 10 min (Panetta 1980). Scratch heads indirectly (Immelmann 1966).

Agonistic behaviour Strongly territorial when breeding, and male advertises territory by conspicuous noisy singing and Song-flights (Lord 1956; Carlyle 1963; Tarr 1963; Immelmann 1966; Nielsen 1991; Serventy & Whittell; NRS); see above for full description (also see Voice for timing of singing after return to breeding areas). **Threat** Intruders into territory attacked and chased by territory-owners. **PURSUIT-FLIGHTS:** Intruders chased by territory-owner, sometimes several hundred metres beyond territorial boundary; territorial males (but apparently not females) give aggressive Disyllabic Call in flight (Carlyle 1963; Immelmann 1966). Males attack intruding males and females, though sometimes ignore females other than mate; female may drive off other females (Dickison 1927; Rogers 1951; Carlyle 1963; Bell 1965). Territorial defence most intense during nest-building and early stages of incubation period and, if re-nesting, about time first brood fledges (Immelmann 1966). Once, during early breeding season, group of three males and two females seen in noisy aggressive conflict, thought to be over either territory or mates; 2 weeks later, two pairs found in this area with no sign of third male (Rix 1976). **Fighting** During most of incubation period and nestling period, male spends much time attending nest and young and time spent in territorial Song-flights reduced greatly, resulting in more frequent territorial incursions by intruders. Most confrontations during this time end in Pursuit Flights and escalate to physical fights (Immelmann 1966). Once, when a second female arrived during construction of nest by a pair, the two females fought for c. 15 min, chasing each other from tree to tree and sometimes dropping to ground locked together and wrestling; birds sometimes rested briefly and panted with mouths agape. Male took no part in confrontation but followed females wherever they went. Intruding female then flew off and building continued (Chaffer & Wolstenholme 1923). **Alarm** Seen to mob vagrant Spangled Drongo *Dicurus bracteatus* with woodswallows *Artamus* (Ford 1996). Give Hiss in alarm when intruders near nest (see Voice); also attack other species of birds and people at or near nests, though not birds of prey (see Parental anti-predator strategies below).

Sexual behaviour **Advertising** During early breeding season, loud singing and Song-flights (see above for full description; also see Voice) used to attract females (Carlyle 1963; Tarr 1963; Nielsen 1991; NRS). **COURTSHIP CHASES:** Early in breeding season, male seen chasing female through trees while singing constantly and with buoyant and floating flight (Gould; Hall; Mathews). Male seen chasing female for 4–5 days before start of building of nest (NRS). **SELECTION OF NEST-SITE:** Both male and female look for nesting site, either separately or together. When suitable site found, bird settles there and mate approaches immediately and hops closely round partner before taking its place when finder moves off. Pair usually starts building at this site within 2–4 days (Leach 1928; Immelmann 1966). Both sexes build (see Breeding). **NEST DISPLAY:** At Middlesex Field Study Centre, near Manjimup, WA, males seen to turn round and round on chosen nest-site, with wings half open and tail spread, while singing. When female comes to site, he hops to a twig above her, fully spreads and vibrates wings as he sings softly. One bird then flies away and returns with nesting material (Brown & Brown 1981). Similarly, when female at nest during construction, male seen to perch c. 10 cm above her with wings and tail spread or slightly depressed, and at Nambucca Heads, NSW,

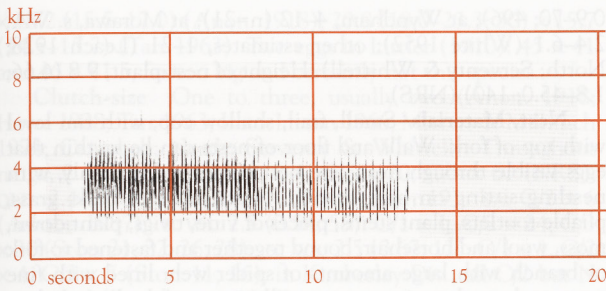
rapidly but silently open and close bill (NRS) or, at Wyndham, utter soft high-pitched calls (Immelmann 1966). During construction of nest, male and female also seen perched together but facing opposite directions; male fluffed plumage, vibrated body, and moved head from side to side (NRS). **MATE-GUARDING:** Some evidence of mate-guarding during building of nest. At Wyndham, male and female usually arrived at nest together with material, female going straight to nest to work material in while male performed Nest Display above her; when finished, female would fly off and male would add his material. Sometimes male did not bring material but just accompanied female and flew off with her as soon as she had finished adding material; male occasionally came to nest alone (Immelmann 1966). At nest near Sydney, male and female always together when gathering material and when arranging it at nest; male also seen to stroke female's back with his bill sometimes (Chaffer & Wolstenholme 1923). **Pair-bond maintenance** Joint territorial activities and Song and Song-flights may function to maintain pair-bond (Immelmann 1966). Members of pairs also stay close together for much of the time, especially during building (Chaffer & Wolstenholme 1923; Immelmann 1966). **Copulation** Observed several times during construction of nest (NRS). Twice, male seen to nod head vigorously at nest-site before copulation took place; during 30 min after copulation, male repeatedly returned to nest between bouts of singing (NRS). **Courtship feeding** Both male and female feed the other on nest (Le Souëf & Macpherson 1920; Austin 1923; Tarr 1963; NRS; *contra* Immelmann 1966).

Relations within family group Both parents incubate, brood, shade and feed nestlings, and remove faecal sacs; males usually brood more than female while female seems to feed young more than male, though contribution of each sex to brooding and feeding of nestlings appears to vary (see Breeding: Young). However, male stops attending young by time they are c. 8 days old (Immelmann 1966; NRS; see Breeding: Young). Change-over at nest may occur quickly, with relieving bird alighting on branch beside nest, before other flies off (Rix 1943); or be indirect, with sitting bird leaving nest when partner appears nearby or even before partner approaches, leaving eggs uncovered for several minutes (Immelmann 1966). At one nest, when female incubating, male seen not to allow her to leave nest for very long before he chased her back with loud growling call (NRS). However, during brooding period at one nest, male seen to act aggressively towards female: each time she came to nest, he would drive her away; if she happened to be on nest, he would alight beside nest with his bill open and, uttering a scolding note, chase her away for distances up to 100 m; sometimes she managed to beat him back to nest, only to be driven away again (Tarr 1963). Young nestlings beg with loud calls but when c. 1 week old are almost completely silent when being fed; when begging, young quiver wings vigorously (Immelmann 1966). Nestlings often preen and flap wings when near fledging (NRS). Fledgelings stay together (Immelmann 1966; NRS). At Wyndham, if parents re-nesting, male begins to chase fledgelings as soon as second nest started, and young gradually leave natal territory (Immelmann 1966); and near Larrimah, NT, male seen to behave aggressively towards fledgeling still being fed by female (Sedgwick 1947). For details of dispersal of young, see Social Organization. **Anti-predator response of young** On approach of observer, nestlings sit motionless; older nestlings may fledge (NRS). **Parental anti-predator strategies** Females will sit tight on nests, even allowing themselves to be touched by observer (Chisholm 1911; Mellor 1927; Leach 1928; Rogers 1951; Sedgwick 1952; Carlyle 1963; NRS); or will fly and sit close by while nest is being examined (Chisholm 1911). Utter hissing calls from nest when observer approaches (Buchanan 1987), and swoop at intruders, with tails fanned and feathers

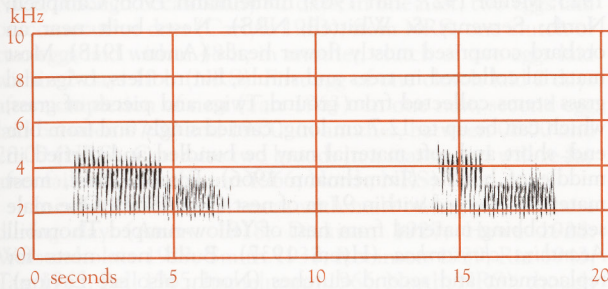
fluffed out (Rogers 1951). Seen to fly rapidly towards observer, veering away when within a few metres, often snapping bills (Austin 1923; NRS). Both parents attack intruders, including other Trillers (White 1914; Austin 1918; Crompton 1936; McGill 1942; Sedgwick 1947; Rogers 1951; Carlyle 1963; Frith 1969; Gould; NRS; see Agonistic behaviour) and larger birds, such as wattlebirds *Anthochaera*, Black-faced Cuckoo-shrikes and Australian Magpies *Gymnorhina tibicen*, but ignore smaller birds, such as Willie Wagtails (Crompton 1936; Rogers 1951; Bell 1965). However, when bird of prey observed in sky, adults leave nest immediately and quickly hop into lower, denser foliage of tree (Immelmann 1966).

VOICE Well known, from study near Wyndham, WA (Immelmann 1966). Noisy when breeding (Mathews), and on return to breeding sites, with males starting to sing immediately on return (McGilp 1944; Tarr 1963; Rix 1976; Bedggood 1980; see Movements for timing of return); females may also call noisily (Rix 1976). Song given most often during breeding season, but occasional phrases of Song heard at other times and in non-breeding plumage (Sedgwick 1952; Immelmann 1966). One male observed on return from migration in mid-Oct.: at first he looked about and flew from limb to limb then, after c. 3 h, began to vocalize; by late afternoon, by which time a female had arrived, he was singing almost continuously (Carlyle 1963). However, in sw. WA, thought to be silent or to sing in a listless manner for 1–2 weeks (Robinson 1949); and one male sang for 5–6 days before female seen (NRS); and at Derby, WA, birds did not call or gave only a few notes of Song in late Aug. to early Sept. but in late Nov.–Dec. gave full Song and performed many Song-flights (Mathews). During breeding season Song-flights performed often; during nestling period, male usually indulges in a series of flights, which may last for several minutes immediately after change-over. However, during incubation period there is little time for such flights because he spends much time incubating. When nestlings only 2 days old, Song-flights become more frequent, and from the eighth day after hatching the male no longer cares for young, and spends most of his time in Song-flights near territorial boundaries (Immelmann 1966). One male became silent once he began incubation, even though a number of other birds were in area and males were chasing each other noisily (Carlyle 1963). Males appear to be much more vocal than females (Lord 1956; Mathews; see above). Individuals may differ: one male was regarded as a poor singer, uttering only first few notes of Song (Carlyle 1963). **SIMILAR SPECIES:** Song like that of Jacky Winter *Microeca leucophaea*, but louder and deeper (Wolstenholme 1929; North; see HANZAB 6). **NON-VOCAL SOUNDS:** Snap bill when flying at intruder (Austin 1923).

Adult SONG: Song of male is a quick series of calls sounding like *ditch-ditch-ditch* and ending with a canary-like trill (Immelmann 1966). Also described as: *chur...chur...churr...churr...churr...churr* ending in a trill (Goodfellow 2001); even and prolonged canary-like trill, broken only by distinct modulation or change of key about halfway through, rhythm continuing unchanged (Wolstenholme 1929); very sweet, resonant *che'uu, che'uu, che'uu* or a repetitive trill *teu-teu-teu*, followed by a *stii-stii-stii* (Hall); and as loud, pretty, sweet, agreeable, pleasant, rich whistling, melodious and canary-like, and rather liquid and descending (Tarr 1963; McPherson 1973; Gould; North; Mathews). Song of male said to be more melodious than that of female (Gilbert 1928). Sonagram A shows one Song of a male, sonagram B two Songs of a female. Given in flight, in noisy Song-flights; also given while perched (Immelmann 1966; Goodfellow 2001; Mathews; see Social Behaviour). When flying from tree to tree, may glide for short distances with wings outstretched and motionless, singing all the time (Wolstenholme 1929).



A F.W. van Gessel; Wilcannia, NSW, Sept. 1988; P49



B D.A. Stewart; Davenport Downs Stn, Qld, June 1988; P49

Song can be given by male when chasing female (Gould; Hall); and by male when sitting on nest (Tarr 1963); seen to fly to nest uttering full Song (Bell 1965). Mainly functions to advertise territory (Immelmann 1966), but also used in courtship (see Social Behaviour). Song duels occur between neighbouring males (Robinson 1949). **DISYLLABIC CALL:** Disyllabic *tret-tret*; given by male in Pursuit-flights; not heard from female (Immelmann 1966). **HISS:** Given when observer c. 15 m from nest (Buchanan 1987), and when swooping at intruder (Rogers 1951). **Other calls** Series of very high-pitched soft calls, uttered by male during construction of nest when female present (Immelmann 1966). Low piping note, thought to be preface to Song (Hall). Single peep (Hall). Scolding notes given by male to drive female away from nest when observer present (Tarr 1963). Growling from male, apparently to drive female back to incubation (NRS).

Young Begging call develops rapidly and audible to 15 m on second day; reach maximum amplitude at 3–4 days, after which loudness decreases; when c. 1 week old almost completely silent when being fed (Immelmann 1966). Call of young described as peevish, husky squeak (Lord 1956). After fledging, beg with vigorous trembling of wings, but rarely utter calls (Immelmann 1966). May sing in juvenile plumage (Immelmann 1966).

BREEDING Fairly well known. Much information from observations of breeding of c. 20 pairs at Wyndham, Kimberley Div., WA (Immelmann 1966); and 523 records in NRS to Sept. 2003. Usually monogamous; single record of polygyny (see Social Organization: Bonds). Many records of colonial nesting, with up to seven nests in one tree or 15 pairs in same clump of trees, and claimed that few records of solitary nesting

(see Social Organization: Breeding dispersion). However, true frequency of such not known; of 523 records in NRS, 23 were of colonies (containing minimum of 58 nests; see below), which appears to indicate that solitary nesting more usual, though also possible that records of solitary nesting failed to notice other nests in colonies. Of the 23 colonies: 11 × two nests, 5 × three nests, 2 × four nests, 1 × six nests and 1 × seven nests; number of nests in three not stated (NRS).

Season Throughout range, eggs recorded June–Mar. (Lavery *et al.* 1968; NRS; see below); of 266 clutches in NRS, most (79.7%) Oct.–Dec.; see Table 1 for monthly breakdown. Nestlings recorded July–Apr. (Carter 1903; Slater 1959; NRS; see below); of 293 broods in NRS, most (94.5%) Oct.–Jan.: one (0.3%) in Aug., five (1.7%) in Sept., 36 (12.3%) in Oct., 101 (34.5%) in Nov., 89 (30.4%) in Dec., 51 (17.4%) in Jan., eight (2.7%) in Feb., none in Mar., and two (0.7%) in Apr. Otherwise, fledgelings and unspecified breeding recorded all months, but mostly Aug.–Mar. (Aust. Atlas 2; NRS; see below). Records from NRS and Aust. Atlas 2 (and Storr 19) suggest breeding occurs earlier in s. Aust. than n. Aust., and earlier in w. Aust. than e. Aust., but very few data from n. Aust. (see Table 1). **N. QLD** (N of 23°28'S): Eggs, Oct.–Mar. (Lavery *et al.* 1968; NRS [n=2 clutches]). Nestlings, Jan.–Feb. (NRS [n=4 broods]). **s. QLD:** Eggs, Sept.–Jan. (Carlyle 1963; Whitmore *et al.* 1983; NRS); of nine clutches in NRS: four (44.4%) in Oct., three (33.3%) in Dec. and two (22.2%) in Jan. Nestlings, Oct.–Jan. (Carlyle 1963; Whitmore *et al.* 1983; NRS [n=9 broods]). **NSW–ACT:** Eggs, early Sept. to Feb. (Morris *et al.* 1981; North; NRS); of 150 clutches in NRS, most (82.7%) mid-Oct. to mid-Dec.: 11 (7.3%) in Sept., 37 (24.7%) in Oct., 67 (44.7%) in Nov., 29 (22.0%) in Dec., and six (4.0%) in Jan. Nestlings, late Sept. to early Feb. (Mendel 1972; ACT Atlas; NSW Bird Rep. 1980; NRS [n=156 broods]). Otherwise, fledgelings or unspecified breeding, Aug.–Feb. (ACT Atlas; Aust. Atlas 2; NRS). **VIC.:** Eggs, mid-Oct. to mid-Dec. (Ingle 1910; Tarr 1963; Bell 1965; NRS); of 17 clutches in NRS: two (11.8%) in Oct., eight (47.1%) in Nov. and seven (41.2%) in Dec. Nestlings, early Nov. to late Jan. (Bell 1965; NRS [n=41 broods]). Said to breed Oct.–Feb. (Vic. Atlas; Aust. Atlas 2; NRS). **SA:** Eggs, late Aug. and early Oct. to late Dec. (Souter 1927; Smith 1937; Ey 1946; Attiwill 1972; NRS); of 42 clutches in NRS, most (64.3%) early Oct. to early Nov.: one (2.4%) in Aug., one (2.4%) in Sept., 21 (50%) in Oct., 14 (33.3%) in Nov., and five (11.9%) in Dec. Nestlings, mid-Oct. to mid-Jan. (Souter 1927; Smith 1937; NRS [n=40 broods]). Otherwise, fledgelings or unspecified breeding, July–Jan. (McGilp 1923; Sutton 1927; Boehm 1957; Aust. Atlas 2; SA Bird Rep. 1977–81; NRS). **s. WA** (S of 23°S): Eggs, late June to mid-Dec. (Sedgwick 1952, 1955; White 1952; NRS); of 33 clutches in NRS, most (84.8%) Aug.–Nov.: one (3%) in June, one (3%) in July, nine (27.3%) in Aug., seven (21.2%) in Sept., six (18.2%) in Oct., six (18.2%) in Nov., two (6.1%) in Dec., and one (3%) in Jan. Nestlings, Aug.–Jan. and May (Sedgwick 1952; White 1952; Aust. Atlas 2; NRS [n=36 broods]). Otherwise, fledgelings or unspecified breeding, June to mid-Jan. (White 1952; Masters & Milhinch 1974; Davies 1979; Napier 1991; Storr 21, 22, 26, 28; NRS). **N. WA** (N of 23°S): Eggs, Aug.–Mar. (Slater 1959; Immelmann 1966; Howard 1986; Campbell; NRS [n=2 clutches]). Nestlings, July–Aug., Feb. and Apr. (Carter 1903;

Table 1. Monthly distribution of clutches from NRS data to Sept. 2003; for breakdown for individual states, see text. Figures in brackets are percentages of total records.

	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	N
N. AUST.	–	2 (13.3)	3 (20.0)	6 (40.0)	–	–	1 (6.7)	–	3 (20)	–	–	–	15
S. AUST.	1 (0.4)	1 (0.4)	10 (4.0)	19 (7.6)	70 (28.0)	95 (37.8)	46 (18.3)	9 (3.6)	–	–	–	–	251
TOTAL	1 (0.4)	3 (1.1)	13 (4.9)	25 (9.4)	70 (26.3)	95 (35.7)	47 (17.7)	9 (3.4)	3 (1.1)	–	–	–	266

Slater 1959; Howard 1986; North; NRS [n=3 broods]). Otherwise, breed Aug.–Apr. and June (Storr 11, 16; Aust. Atlas 2). Immelmann (1966) considers extension of breeding into dry season (July–Aug.) in Kimberley Div. a result of unseasonal rains and temporal abundance of food (grasshoppers) for young. NT: Eggs, July–Sept., Jan. and Feb. (Boekel 1980; McKean 1986; NRS); of 11 clutches in NRS: two (18.2%) in July, three (27.3%) in Aug., five (45.5%) in Sept., and one (9.1%) in Feb. Nestlings, Sept. and Feb. (Boekel 1980; McKean 1986; NRS [n=4 broods]). Otherwise said to breed late Aug. and Oct.–Mar. (Jarman 1944, 1945; Boekel 1980; Goodfellow 2001; Storr 7; Aust. Atlas 2).

Site In fork of branch of tree or, less often, a shrub; usually in a horizontal fork, and towards uppermost part of tree and at end of limb; occasionally on bare limb (Anon. 1918; McGilp 1923; Rix 1943; Carlyle 1963; Tarr 1963; Campbell; North; Serventy & Whittell). Of 21 nests in Kimberley Div., 18 in horizontal fork, and three in near-vertical fork (Immelmann 1966); at North West C., WA, usually built in bunch of leafy twigs (Carter 1903). Usually nest in eucalypts (White 1952; Masters & Milhinch 1974; Bedgood 1980; North; SA Bird Rep. 1968–69; NRS). Of 422 records in NRS: 280 (66.35%) in eucalypts; 48 (11.37%) in casuarinas; 33 (7.82%) in acacias; ten (2.37%) in willows; nine (2.13%) in each of *Callitris* and *Angophora*; seven (1.66%) in *Banksia*; five (1.18%) in *Melaleuca*; four (0.95%) in each of *Tamarix* and *Eremophila*; three (0.71%) in each of *Ficus*, *Geijera* and pepper tree; and two (0.47%) in each of *Atalaya* and *Flindersia*. Of 21 nests at Wyndham: 19 were in eucalypts and two in *Lysiphillum*. In inland, nests often in shrubs, such as hop bush or *Eremophila* (North). In addition to plants above, also recorded in Turpentine, *Pinus*, Hoop Pine and Apples (Chisholm 1911; Wolstenholme 1929; Hyem 1930; Smith 1937; McKean 1985; Leach & Hines 1987; North; NSW Bird Rep. 1977; J.R.W. Reid). Once attempted to nest in mangroves (Thompson 1978). Many records of nesting in groups but frequency of colonial nesting not fully known (see above, and Social Organization: Breeding dispersion). Both sexes select site (Leach 1928; Immelmann 1966; see Social Behaviour). Build replacement or second nests near site of first (Immelmann 1966; NRS). **ASSOCIATIONS WITH OTHER SPECIES:** Nesting associations: Tree Martin *Hirundo nigricans* (Rogers 1951), honeyeaters (Rogers 1951; Immelmann 1966), Crimson and White-fronted Chat (White 1952), thornbills *Acanthiza* (Rogers 1951; Kurtz 1981), Jacky Winter (Attiwill 1946; White 1952), Rufous Whistler *Pachycephala rufiventris* (Sloane 1932), Black-faced Cuckoo-shrike (Rogers 1951; White 1952; Bell 1965), White-browed Woodswallow *Artamus superciliosus* (Sloane 1932; Attiwill 1946), Black-faced Woodswallow (White 1952), Dusky Woodswallow *A. cyanopterus* (Hyem 1930; Brown & Brown 1981), Zebra Finch (Rogers 1951; White 1952). Often nest close to other species, particularly other black-and-white birds such as Magpie-larks and Willie Wagtails (e.g. McGilp 1921, 1932; Hyem 1930; Sloane 1932; Attiwill 1946; Rogers 1951; White 1952; Bell 1965; Immelmann 1966; Mack 1967, 1970; North; NRS). Recorded nesting in same tree as: Silver-crowned Friarbird *Philemon argenticeps*, Rufous-throated Honeyeater *Conopophila rufogularis*, Magpie-lark, Willie Wagtail, Dusky Woodswallow, Long-tailed Finch *Poephila acuticauda* and Diamond Firetail *Stagonopleura guttata* (Hyem 1930; Immelmann 1966; North; NRS). In Kimberly Div., one nest in same tree as nests of Magpie-larks, Rufous-throated Honeyeaters and Long-tailed Finches; another nest in same tree as Silver-crowned Friarbird and Rufous-throated Honeyeater (Immelmann 1966). Also recorded nesting near other species, including Little Eagle *Hieraetus morphnoides*, White-winged Chough *Corcorax melanorhamphos* and Apostle-bird *Struthidea cinerea* (Mack 1967; NRS). **MEASUREMENTS (m):** Height of nest, 5.6 (4.83;

0.9–70; 496); at Wyndham, 4–12 (n=21); at Morawa, s. WA, 2.4–6.1 (White 1952); other estimates, 1–21 (Leach 1928; North; Serventy & Whittell). Height of nest-plant, 9.8 (6.66; 1.8–45.0; 140) (NRS).

Nest, Materials Small, frail, shallow cup, with rim level with top of fork. Walls and floor of nests can be so thin that eggs visible through nest; one nest comprised rim only, with nestling sitting on bare branch. Nests made of bark, grass, pliable rootlets, plant stems, pieces of vine, twigs, plant down, moss, wool and horsehair, bound together and fastened to fork or branch with large amounts of spider web; lined with fine grass and rootlets; in some, small pieces of bark or lichen attached to outside (Anon. 1918; Kersey 1919; McGilp 1921, 1923; Mellor 1927; Tarr 1963; Immelmann 1966; Campbell; North; Serventy & Whittell; NRS). Nests built near an orchard comprised mostly flower heads (Anon. 1918). Most material collected in trees and shrubs, but rootlets, twigs and grass stems collected from ground; twigs and pieces of grass, which can be up to 12.7 cm long, carried singly and from one end; short and soft material may be bundled and carried in middle of bundle (Immelmann 1966). For one nest, most material collected within 91 m of nest (Tarr 1963). One male seen robbing material from nest of Yellow-rumped Thornbill *Acanthiza chrysorrhoa* (Hyem 1937). Build new nests for replacement and second clutches (North; also see Laying). Will use material from deserted nests to build new nest (Dickinson 1927). **CONSTRUCTION:** Building starts within 2–4 days of selection of site (Immelmann 1966). Both sexes build, though most work done by male (e.g. Chisholm 1911; Wolstenholme 1929; Smith 1937; Carlyle 1963; Bell 1965; Immelmann 1966; Ashton 1987; NRS); at Wyndham, roughly 60–70% done by male. However, some sources say only male builds (e.g. Anon. 1918; McGilp 1923; Campbell; North). Building usually begins with bird sitting in fork and wiping spider web onto it (Carlyle 1963; Tarr 1963); and plant material also woven round fork while bird sitting in fork (Chisholm 1911). At Wyndham, both sexes usually arrived at nest with material together; female worked material into nest first, then male; in between joint visits, male often brought material to nest alone (Immelmann 1966). At one nest, male brought material to nest and female worked it into nest (Tarr 1963). Material fixed in place with trembling movements of bill; whole nest fastened with spider web, applied by wiping movements of bill. Most building occurs during early and late part of day. Building takes 2–5 days; once over 8 days (Tarr 1963; Immelmann 1966; North). At one apparently complete nest, birds continued to add material till laying of first egg (Carlyle 1963). Some material added to nest during first few days of incubation; and spider web regularly smeared over wall of nest during incubation. Nest becomes compressed, and may be trampled to a tiny platform during nestling period (Immelmann 1966). **MEASUREMENTS (cm):** External diameter of two nests, 7.6, 6.4; external depth, 5.1, 3.2; internal diameter, 5.1, 5.1; internal depth, 2.5, 1.9 (Campbell; North); other measures, c. 7, –, 5.1, 1.3–1.6 (McGilp 1923). Internal diameter, 5.7–6.4; internal depth, 1.3–2.2 (Tarr 1963 [n=10]). Nests on horizontal forks usually larger than those in upright forks (North).

Eggs Oval to round oval; close-grained, slightly lustrous or glossy. Ground-colour varies from light green to dull warm-green or rich bluish-green (Campbell; North), uniformly blotched or marked with short, irregular streaks of reddish or chestnut-brown, sometimes almost obscuring ground-colour, occasionally confined almost entirely to large end, forming a zone (North); or heavily blotched with dark brown or reddish brown and dull slate, especially about large end, where markings are confluent; markings often nearly cover shell (Campbell). **MEASUREMENTS:** 20.9 (0.79; 19.8–22.1; 8) × 16.5 (0.27; 16.0–16.8; 7) (Campbell; North); 21.8 (20.5–23.0; 20)

× 16.2 (15.5–17.0) (Anon. 1918); 20.8 (18.0–23.3; 30) × 15.7 (14.5–15.7) (Tarr 1963). Two eggs in Littler (1910): 45 × 41 and 46 × 41.5, far too big and certainly not this species.

Clutch-size One to three, usually two (Anon. 1918; Howe 1928; Tarr 1963; Immelmann 1966; Masters & Milhinch 1974; Campbell; North; Serventy & Whittell). Throughout range, 2.4 (0.55; 134): C/1 × 4, C/2 × 70, C/3 × 60 (NRS). QLD: 2.4 (0.52; 8): C/2 × 5, C/3 × 3 (Storr 19). SA: C/2 × 6 (Ashton 1987). s. WA: 2.5 (0.54; 55): C/1 × 1, C/2 × 24, C/3 × 30 (Storr 21, 22, 26, 28). N. WA: 2.5 (0.67; 12): C/1 × 1, C/2 × 4, C/3 × 7 (Storr 11, 16); in Kimberley Div., all C/2 but N not stated (Immelmann 1966).

Laying Usually laid at intervals of 2 days (Tarr 1963; NRS), though occasionally <2 days; in one nest, two eggs laid on consecutive days (Carlyle 1963); from NRS, one clutch of two eggs laid within 48 h; in another, clutch of two eggs laid within 2 days 10 h (NRS). First egg of one clutch laid 2 days after completion of nest (Tarr 1963). In one nest, second egg laid between 07:00 and 19:00; in another, between 08:00 and 20:00 (NRS). Can raise two broods in a season and will re-lay after failure (Immelmann 1966; North; NRS).

Incubation By both sexes, with male taking greater share during day (Anon. 1918; Dickison 1927; Howe 1928; Wolstenholme 1929; Smith 1937; Robinson 1939; Rix 1943; Tarr 1963; Bell 1965; Immelmann 1966; North; NRS), though at some nests female does most (Austin 1923; Carlyle 1963). Female incubates at night (Anon. 1918; North). At Macleod, Vic. (930 min obs. of four nests), males incubated for 58.3% of time (46.7–66.3; 4); mean length of stints of incubation for members of each pair 12.5–15 min; of eight stints >30 min, six by male (Bell 1965). At Wyndham, male did 60–70% of incubation; stints lasted 10–15 min, with longest stint by male >35 min and by female 25 min (Immelmann 1966). Incubation usually begins with laying of second egg (Immelmann 1966; NRS); adults sometimes sit for lengthy periods after first egg laid but mostly sit on rim of nest to shade egg (Immelmann 1966). For one C/2, male started incubating on day after first egg laid (NRS). At Wyndham, change-over indirect, with pair seldom meeting at nest, so eggs sometimes left uncovered for several minutes. When temperature reached c. 38 °C, birds did not incubate but sat on rim of nest and shaded eggs with wings partly outstretched. Hatching usually occurred on same day. At Wyndham, sitting bird not fed on nest. However, elsewhere said that male sometimes fed by female while on nest, or vice versa (Le Souéf & Macpherson 1920; Austin 1923). Eggs usually hatch within 24 h (NRS). **INCUBATION PERIOD:** 14 days (Immelmann 1966); from laying of second egg, 14 days (n=2 eggs) (Tarr 1963); from laying to hatching: first egg, 16 days (n=1 egg), second egg, 14 days (n=1) (NRS).

Young Altricial, nidicolous. Blind and naked at hatching (NRS); eyes open at 6–7 days (Immelmann 1966); develop down (NRS) but not known when. **Parental care** Both sexes brood (e.g. Rogers 1951; Carlyle 1963; Tarr 1963; Brown & Brown 1981; Ashton 1987; Serventy & Whittell; NRS) and feed nestlings (McGilp 1923; Rogers 1951; Carlyle 1963; Bell 1965; Immelmann 1966; Brown & Brown 1981; Ashton 1987; NRS); contribution by each sex may differ, but no clear patterns in comments in literature (see Anon. 1918; Dickison 1927; Sutton 1927; Sedgwick 1947, 1973; Carlyle 1963; Bell 1965; Immelmann 1966; Brown & Brown 1981; Howard 1986; Campbell; NRS); further study needed. At one nest (142 min obs.), male brooded for five periods totalling 77 min, and female for six periods totalling 41 min and young not brooded for rest; at another nest (60 min obs.), male brooded for three periods totalling 48 min, and female not seen; food brought to each nest when birds arrived to brood (Bell 1965). During 4 h observation at one nest, female made 90% of feeding visits to young (Howard 1986). At Wyndham, young brooded by each parent alternately and roughly equally for

first 3 days, with stints of brooding much as during incubation; from Day 4, adults sometimes come to nest only to feed young and leave after doing so, without brooding, though sometimes brood for short period (maximum 6 min for male, 8 min for female) but do not wait for return of partner before leaving, so that young left uncovered; on Day 7, young covered only occasionally; on Day 8, male stops attending nestlings and female alone forages for and feeds young, though she no longer broods but will shade nestlings if needed. At Wyndham, young not brooded when air temperature exceeds c. 38 °C, but shaded by adult who stands on rim of nest with outstretched wings (Immelmann 1966). Both sexes remove faecal sacs, though female may do more (Rogers 1951; Immelmann 1966; NRS): sacs swallowed by parents for first week; after Day 8, only female removes sacs, carrying them away and dropping them at least 30 m from nest (Immelmann 1966).

Fledging to independence **FLEDGING PERIOD:** 12 days (Immelmann 1966); 14 days for two young (Tarr 1963). Report of 19 days for two young (NRS) seems unusually long. Fledgelings stay near nest for 1–2 weeks and are fed by female alone. Young beg silently but with quivering wings. Departure of juveniles from natal territories appears to vary: at Wyndham, where breeding pairs apparently resident, juveniles driven from natal territory by adult male as second nesting attempt begun (Sutton 1927; Immelmann 1966; Sedgwick 1973; see Social Behaviour: Relations within family group).

Success Where clutch-size and outcome known, of 163 eggs in 69 nests, 80 (49.1%) hatched, and 45 (27.6%) young fledged, equal to 0.65 young fledged/nest; where clutch-size and hatching success known, of 259 eggs, in 110 nests, 173 (66.8%) hatched. Of five nests in Darling Downs, se. Qld, two failed at egg-stage, one failed with large young and two fledged successfully (Carlyle 1963). In strong winds, nestlings can be blown from nests (Immelmann 1966; NRS) and nests blown down (Bell 1965). **CUCKOOS:** Parasitized by Pallid *Cuculus pallidus*, Brush *Cacomantis variolosus* and Fan-tailed *C. flabelliformis* Cuckoos and Shining Bronze-Cuckoo *Chrysococcyx lucidus* (Brooker & Brooker 1989; HANZAB 4; also see NSW Bird Rep. 1994).

PLUMAGES Prepared by F.J.G. Copley and J.S. Matthew. Fledge in juvenile plumage. Undergo a partial post-juvenile (first pre-basic) moult to first immature non-breeding (first basic) plumage, which similar to adult female plumage. At least some birds then undergo partial first immature pre-breeding (first pre-alternate) moult to a varying first immature breeding (first alternate) plumage. Acquire adult plumage in complete first immature post-breeding (second pre-basic) moult. Thereafter, a partial pre-breeding (pre-alternate) moult in winter-spring, and complete post-breeding (pre-basic) moult in late summer–autumn, produces successive breeding (alternate) and non-breeding (basic) plumages respectively, which differ in adult males but alike in adult females. Sexes differ in first immature breeding and adult plumages. Plumage descriptions based on examination of skins of 55 adult males, 15 adult females, eight first immature males, six first immature females and five juveniles (some starting post-juvenile moult) (ANWC, HLW, MV, SAM).

Adult male breeding (Definitive alternate). Distinctly pied. All or most adult males in this plumage from mid- to late spring through to late summer. **HEAD AND NECK:** Forehead, crown, nape, hindneck, upper sides of neck, lores, upper half of eye-ring and upper ear-coverts, glossy black (89), combining to form distinct glossy black cap with faint greenish-blue (ne) sheen in good light. Lower sides of neck, lower ear-coverts, malar area, lower half of eye-ring, chin and throat, white; sharply demarcated from black cap. **UPPERPARTS:** Mantle and scapulars, glossy black (89) with faint greenish-blue (ne) sheen in good light; some birds have narrow pale-grey (86)

fringe to tips of scapulars. Back, rump and uppertail-coverts, light grey (pale 85) with white fringes to uppertail-coverts and feathers of rump; and some have black (89) subterminal band or uneven shaft-streak to one or more longest uppertail-coverts. Back usually concealed by black scapulars. **UNDERPARTS:** Breast, belly, vent, undertail-coverts and axillaries, white; some have faint light-grey (c85) barring on sides of upper breast and flanks, formed by narrow light-grey (c85) subterminal barring to proportion of feathers. Thighs, white, or grey (84) with broad white fringes to feathers; some birds have blackish (c89) shaft-streak to some feathers. All feathers of underparts have concealed dark-grey (83) bases. **UPPERTAIL:** Most, or all, rectrices retained from non-breeding plumage (see below). Some replace t1, which contrasts with more worn t2–t6; replaced t1, black with distinct white fringe when fresh, which reduced with wear. **UNDERTAIL:** As uppertail (and male non-breeding; see below). **UPPERWING:** Most median and marginal secondary coverts, white; at least some birds retain a few outer median and marginal coverts from non-breeding plumage (see below), which are worn and blackish with buff (124) or off-white (ne) fringes, and contrast obviously with fresher white coverts. Inner 3–5 greater secondary coverts, white with varying black (89) shaft-streak in centre, narrow or reduced to shaft on some coverts, much broader on others, so that feather black (89) with broad white fringe. Remaining (outer) greater secondary coverts retained from non-breeding plumage (see below), black with buff (c124) or narrow off-white (ne) fringes, and contrast with fresh inner coverts. Marginal and median primary coverts, black with white outer edges or fringes. Greater primary coverts and alula retained from non-breeding plumage (see below). Remiges usually retained from non-breeding plumage (see below); retained remiges more worn than in non-breeding and with narrower white fringes, which often lost on primaries. Some birds replace one or more tertials, or innermost secondary, or both, which are black (89) with broad white fringe to outer webs and tips. **UNDERWING:** Coverts, white, with blackish (89) bases to marginal and median primary coverts, which often exposed on outer coverts to form patchy blackish markings on leading edge near bend of wing. Remiges retained from non-breeding (see below).

Adult male non-breeding (Definitive basic). All or most adult males in this plumage from autumn to late winter or early spring. Very different from adult male breeding, with much of body like adult female but remiges and tail as adult male breeding. Following is description of full non-breeding plumage. Birds moulting to or from breeding plumage have varying amount of glossy black feathering on top of head and upperparts. Adult males partway through post-breeding moult have patchy black-and-brown plumage of body, but have little or no black feathering on body once this moult finished (by about May). **HEAD AND NECK:** Forehead, crown, nape, hindneck and upper sides of neck, light brown (239, 26) to brown (c119B) with fine dark-brown (121) shaft-streaks to feathers of forehead and crown; some have richer cinnamon-brown (39) tinge to top of head. Narrow off-white (ne) forehead-supercilium merges with more diffuse cinnamon-brown (39) hind-supercilium, bordered below by narrow dark eye-stripe from lores to rear ear-coverts, dark brown (121) or grey-black (82) on lores, dark brown (121A) behind eye, on uppermost ear-coverts. Eye-ring, white, narrowly broken in front of and behind eye by dark brown (121). Rest of ear-coverts, pale buff (c124) or cream (92); some coverts grey-black (c82), bases partly exposed forming indistinct dark markings on coverts. Lower sides of neck, pale buff (c124) with faint, greyish (c84) barring. Malar area, chin and throat, off-white (ne), tinged pale buff (c124) in some. **UPPERPARTS:** Mantle and scapulars, light brown (26, 239) to brown (c119B) with faint, fine dark-brown (121) shaft-streaks to feathers; some birds also have

richer cinnamon-brown (c39) tinge. Back, rump and uppertail-coverts, light grey (c85) with cream (c54) to off-white (ne) fringes at tips of feathers. **UNDERPARTS:** Breast and flanks, buff (124) to cream-buff (123D), usually faintly barred brownish grey (c79), particularly on sides of upper breast and flanks. Belly, vent and undertail-coverts, white, with buff (124) to cream-buff (123D) wash to belly in some. Thighs as adult male breeding. **UPPERTAIL:** T1, black (89) with buff (c124) fringe when fresh and which becomes narrower and paler, off-white (ne) with wear. T2–t6, black (89) with narrow white fringe at tip of t2; white tips to t3–t6 narrow on t3 and progressively broader outward (c. 8 mm long on t6) and merge with narrow white outer edge on t6. **UNDERTAIL:** As uppertail. White tips to outer rectrices prominent. **UPPERWING:** Marginal and median secondary coverts, black-brown (119) with broad fringe that varies from buff (124) to orange-buff (118), cinnamon-brown (39) or white, and which produce rather complex pattern of colouring to those coverts. Greater secondary coverts, black (89) or black-brown (119) with buff (124) to orange-buff (118) fringes that often grade to white towards base of outer webs; in some birds, fringes mostly white. Marginal and median primary coverts, black (89) with white tips. Greater primary coverts, black (89) with concealed white inner edges and fine white outer edges when fresh. Feathers of alula, black (89) with very narrow off-white (ne) fringe to outer webs and tips when fresh. Tertials, black (89) with broad buff (124) fringe to outer webs and tips, usually grading to white towards base of outer webs; some feathers have entirely white fringes. Secondaries, black (89) with fairly broad white fringe to outer webs and broad white inner edges. Primaries, blackish brown (119) with off-white (ne) to cream (54) fringe at tips when fresh, and broad, sharply demarcated white inner edges on basal half. **UNDERWING:** Coverts as adult male breeding. Remiges, grey-black (82) with prominent white inner edges, much broader basally. When spread, white coverts and inner edges to remiges contrast with broad blackish trailing edge.

Adult female non-breeding (Definitive basic). Plumage of head, neck and body similar to adult male non-breeding, but wings and tail very different. Description based on six skins collected May–July. **HEAD AND NECK:** As adult male non-breeding. **UPPERPARTS:** Mantle, scapulars and back, light brown (c26, c239) to brown (c119B) with fine, indistinct dark-brown (121) shaft-streaks to feathers; some also have richer cinnamon-brown (c39) tinge to these tracts. Rump and most uppertail-coverts, brownish grey (c80) to light brown (c223D, c26) with 1–2 diffuse dark-grey (c83) subterminal bands and narrow light-buff (123D) or cream (54) tips; longest uppertail-coverts tinged richer cinnamon-brown (c39) and have clear grey-black (82) subterminal band. Rump and uppertail-coverts contrast less with rest of upperparts than in adult male non-breeding. **UNDERPARTS:** Similar to adult male non-breeding but some have fine dark-brown (121) streaks on centre of upper breast (adult male non-breeding not known to show this). Feathers of thighs, cinnamon-brown (39) or buff (124) with diffuse dark-grey (83) barring. **UPPERTAIL:** T1, brown (119B, 28) or dark brown (119A) with narrow buff (124) or cream (c92) fringe, often with indistinct narrow dark-brown (121) submargin. T2 and t3, dark brown (119A) with very narrow cream-buff (123D) fringe to outer webs, slightly broader at tips. T4–t6 similar to adult male non-breeding but paler, dark brown (c119A), and with fringes and tips usually tinged pale buff (c124) or pinkish buff (121D); t6, pale buff (c124) or buff-white (ne) on distal half of outer web, forming much broader pale outer edge to tail. **UNDERTAIL:** As uppertail. **UPPERWING:** Overall appears browner than adult male non-breeding. Secondary coverts similar to adult male non-breeding but paler, dark brown (c119A, 121). Marginal and median primary coverts, dark brown (119A) with buff

(124) tips to most and white tips to outermost coverts. Greater primary coverts and feathers of alula, dark brown (121) with narrow cinnamon-brown (c39) fringes at tips and outer webs. Tertiaries, dark brown (121) with fringes similar to adult male non-breeding but less often pure white. Secondaries, dark brown (121) with broad buff (124) to orange-buff (118) fringe to outer webs and tips, usually grading to paler off-white (ne) at tips; and with pinkish-buff (c131D) to buff-white (ne) inner edges. Primaries, dark brown (121) on outer webs, paler brown (c28) on inner webs, with narrow cinnamon-brown (39) or buff (124) fringe to outer webs, grading to off-white (ne) or cream (54) round tips; fringes reduced or lost at tips with wear; inner edges, pinkish buff (c121D) or buff-white (ne). **UNDERWING:** Broadly similar to adult male non-breeding. Coverts, white tinged pale buff (123D) or pinkish buff (121D) and with dark-brown (121) or dark-grey (83) bases to marginal and median primary coverts, which often exposed on outer coverts; format similar but paler markings on leading edge near bend of wing. Remiges paler than in adult male (breeding and non-breeding), brownish grey (c79) with prominent pinkish-buff (121D) inner edges.

Adult female breeding Body-plumage indistinguishable from adult female non-breeding, though, as in adult males, it appears that adult females also undergo a partial pre-breeding moult. Nine birds collected Oct.–Jan. have mostly worn remiges with reduced fringes. Of these birds: four have fresh innermost rectrices (t1); five (including two with fresh t1) have one or more fresh inner greater secondary coverts, or inner median secondary coverts, or both; and one has fresh inner secondary. Replaced feathers contrast clearly with worn feathers from non-breeding plumage.

Nestlings Photos (standard sources) show grey (c84) natal down on head and throat; and said to have down on upperparts, underparts, thighs and upperwing (Brooker & Brooker 1987).

Juvenile Superficially similar to adult female, but with distinctive scaly appearance. Feathers of rump and undertail-coverts softer and more loosely textured than in adult. **HEAD AND NECK:** Forehead, crown, nape and hindneck, light brown (c26) with distinctive dark-brown (121) mottling and off-white (ne) scalloping; feathers, light brown (26) with dark-brown (121) subterminal spot and off-white (ne) fringe at tips. Lower sides of neck, buff (124) with diffuse dark-brown (121) mottling or streaking. Rest of head similar to adult female and adult male non-breeding, but chin and throat, white with diffuse dark-brown (119A) streaking. **UPPERPARTS:** Mantle, back and scapulars, brown (119B) with scattered dark-brown (121) mottling and diffuse off-white (ne) scalloping; patterning of feathers similar to those of top of head. Rump and uppertail-coverts similar to adult female. **UNDERPARTS:** Upper breast, buff (c124), grading to off-white (ne) on rest of underbody; and with dark-brown (19A) shaft-streaks to feathers of breast, flanks and undertail-coverts, forming fairly bold dark-brown (119A) streaking. **TAIL:** Rectrices narrower and more pointed at tips, particularly outer rectrices, than in adult. Rectrices patterned much as adult female, but t1 usually has more prominent dark-brown (121) submargin; and pale tip to t6 tends to be longer (11–21 mm on inner web) than in adult (9–16 mm). **UPPERWING:** Marginal and median secondary coverts, dark brown (121) with off-white (ne) tips, and buff (124) or pinkish-buff (121D) edges that often broaden distally to form subterminal spot on both webs. Greater secondary coverts, dark brown (121) with off-white (ne) tips, and buff (124) to pinkish-buff (121D) outer edges that often broaden distally to form subterminal spot on outer webs. Median and marginal primary coverts as adult female. Greater primary coverts and alula, dark brown (121) with cinnamon-brown (39) fringes grading to off-white (ne) at tips; fringes broader on greater primary coverts. Tertiaries, dark brown (121) with

buff (124) to cinnamon-brown (c39) fringes that become white at tips where they form small white terminal spot. Secondaries and primaries as adult female. **UNDERWING:** As adult female.

First immature non-breeding (First basic). Very similar to adult female non-breeding but primaries appear much more worn. Most of breast has rather narrow dark-brown (121) streaking (confined to centre of breast in adult female) with brownish-grey (c79) barring on extreme sides of breast and flanks. Retain juvenile: all or most rectrices; all except inner few greater secondary coverts; alula and greater primary coverts; and all or nearly all remiges. Some replace one or more juvenile tertiaries; and some replace juvenile t1. Characteristic white fringes to tips of juvenile greater primary coverts very useful for distinguishing first immatures (Mayr 1940; this study). Mayr (1940) states that first immatures have pointed alula, but examination of skins (this study) reveals no consistent difference in shape of alula between different plumages.

First immature male breeding (First alternate). Not known whether all first immatures undergo pre-breeding (pre-alternate) moult to this plumage but at least some do. First immature males (identified by retained juvenile greater primary coverts) collected July–Nov. (n=5) vary in appearance, but all have rather worn primaries (fresher in first immature non-breeding). One of these (collected Nov.) has plumage of body much as adult male breeding, but retains all juvenile rectrices except t1, and all juvenile primaries, secondaries, greater primary coverts, alula and some greater secondary coverts; this bird has upperwing mostly brown (cf. blackish in adult) except for one or two adult male-like tertiaries (black with white fringes). The other four skins (collected July–Oct.) had active moult of body and varying, patchy black feathering on upperparts and top of head. See Moults for more information.

First immature female breeding (First alternate). At least some first immature females probably acquire this plumage but probably not distinguishable from first immature female non-breeding; feathers of body and possibly one or more tertiaries, or central rectrices, or both, would be less worn than those feathers retained from non-breeding plumage.

BARE PARTS Based on photos (Rowland 1995; Layton 1999; unpubl.: G.S. Chapman, R. Drummond, C.H. Sandbrink; standard sources), museum labels (ANWC, MV), and other information as cited. **Adult male breeding** Following descriptions apply to most birds from mid-spring to late summer. Bill and gape, black. Orbital ring, black. Iris, black-brown (c19); also described as dark brown (Hall). Legs and feet, dark grey (83) or grey-black (82). **Adult male non-breeding** Following descriptions apply to most birds from autumn to late winter. Bill, black with salmon (c106) or flesh-coloured (c5) basal half to lower mandible and gape; also described as black, dark grey-brown or dark brown, with grey, buff-yellow or yellow base to lower mandible (ANWC; Hall). Rest as adult male breeding. **Adult female** Bill, grey-black (82) with pinkish-brown (221D) basal half to lower mandible and gape; also described as brown on upper mandible and tip of lower mandible and pale orange on rest of lower mandible (Rogers *et al.* 1986); black or brown, with yellow base to lower mandible (Hall). Photos of adult female at nest (G.S. Chapman) show bill entirely grey-black (c82), suggesting colour may change seasonally. Rest as adult male breeding and non-breeding. **Nestling** Bill, light grey (85) with yellow (c55) tomlia. Gape, yellow (c55) or orange-buff (c118). Palate, orange (c16). Iris and legs and feet as adult (male and female). **Juvenile** Bill similar to adult female: dark grey (83) on upper mandible and tip of lower mandible, with pink (108D) tomlia and rest of lower mandible and gape; also described as dusky or brown on upper mandible and tip of lower mandible, and yellow or

Table 2. Plumage condition of adult males (skins) by month.

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
N. AUST. N OF 20°S												
Breeding plumage	1	0	0	0	0	0	1	0	1	2	4	0
Non-breeding plumage	0	0	0	0	5	1	2	3	1	0	0	0
Total	1	0	0	0	5	1	3	3	2	2	4	0
S. AUST. S OF 25°S												
Breeding plumage	3	1	0	0	0	0	0	2	8	18	15	2
Non-breeding plumage	0	0	0	2	0	2	2	7	3	0	0	0
Total	3	1	0	2	0	2	2	9	11	18	15	2

buff-yellow on rest of lower mandible (ANWC, MV). Gape, orange (MV). Rest as adult (male and female). **First immature non-breeding** Very similar to adult female. Bill: upper mandible described as brown; lower mandible described as brown or pink-orange with brown tip; by spring or summer, when c. 1 year old, males have black upper mandible (Rogers *et al.* 1986). Gape described as grey in spring and summer (Rogers *et al.* 1986), these probably c. 1 year old. **First immature male breeding** Probably very similar to adult male breeding. Bill of one described as black with spot of yellow at base of lower mandible (MV).

MOULTS Based on examination of skins of 97 adults, 23 first immatures and five juveniles (ANWC, HLW, MV, SAM, SAW), and other information as cited. Patterns of moult complex and little known of geographical variation in timing and extent of moult, if any. Difficult to determine when post-breeding moult of body ends and pre-breeding moult begins, but those starting pre-breeding moult, with emerging black body-feathers, collected in July at earliest (see Adult pre-breeding). **Adult post-breeding** (Third and subsequent pre-basic). Complete. Primaries outward. Few data, but appears to occur summer–autumn in n. and s. Aust. (see below). Moult recorded Dec.–Jan. (Rogers *et al.* 1986) or Jan.–Feb., sometimes as late as Apr. (Mayr 1940). From skins, active moult of primaries recorded: Jan. (1 of 5; PMS 19), Mar. (2 of 2; PMS 20, 44) and May (1 of 7; PMS 21); one in n. WA moulting in Aug. (1 of 12; PMS 35). In n. WA, males in post-breeding moult in early May; and in sw. Qld, males in fresh non-breeding plumage in June (Hall). Unusual record of a male from Pt Torment, n. WA, undergoing post-breeding moult in Feb., but acquiring plumage very similar to breeding plumage (Mayr 1940). Suggested that populations in n. Aust. start moult c. 1 month later than s. populations (Mayr 1940). Timing of moult of tail probably much as primaries or earlier; those with active moult of tail appeared to start at t1. Timing of moult of body also much as primaries but starts earlier and not finished till after finish of moult of primaries. Table 2 shows proportion of adult male skins in breeding and non-breeding plumage over year. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial; involves all or most feathers of body, some secondary coverts, and, in some, innermost rectrices (Mayr 1940; this study). Some birds replace one or more tertials or innermost secondary or both. Table 2 shows proportion of adult male skins in breeding and non-breeding plumage over year. Moult starts July or earlier (Hall); Aug.–Nov. (Mayr 1940). Table 2 shows breeding plumage acquired as early as July (one of four from C. York Pen.), but usually not till Sept.–Oct., with all birds collected Nov.–Feb. in breeding plumage. A male collected in Port Moresby, PNG, in full breeding plumage in Aug., at a time when nearly all Aust. birds are in non-breeding plumage; some birds possibly resident in Port Moresby region (Mayr 1940). **Post-juvenile** (First pre-basic). Partial; replace all, or most, feathers of body, some secondary coverts, and probably all marginal and median primary coverts; some replace one or more tertials or inner rectrices

(t1), or both. Acquire female-like, first immature non-breeding plumage. Post-juvenile moult recorded Jan.–Apr. (Mayr 1940; Hall; skins [this study]). Deignan (1964) collected eight first immatures (presumably finished post-juvenile moult) in Arnhem Land, NT, from early May to mid-July; one of these a male with adult male-like rectrices and some adult male-like primaries and secondaries, which suggests post-juvenile moult can sometimes include primaries and secondaries. **First immature pre-breeding** (First pre-alternate). Little known. Partial; involves varying amount of plumage of body and secondary coverts; some birds replace some rectrices or tertials or both. At least some, possibly all, birds undergo this moult; males acquire first immature breeding plumage, which varies in appearance from similar to adult female (but with retained juvenile greater primary coverts, primaries and secondaries, and with a few black feathers on body) to those with body and most marginal and median secondary coverts much as adult male breeding. Recorded July–Nov. (Mayr 1940; skins [this study]). One male from C. York Pen. probably undergoing this moult in June (Hall). **First immature post-breeding** (Second pre-basic). Extent uncertain, but probably complete. Probably acquire adult non-breeding plumage in this moult. Said to usually occur Jan.–Feb., sometimes as late as Apr. (Mayr 1940).

MEASUREMENTS (1–2) Mainland Aust., skins (ANWC, MV, HLW, SAM, SAW): (1) Adults; (2) Juveniles and first immatures. (3) Mainland Aust., adults, skins (Keast 1958).

		MALES	FEMALES	
WING	(1)	101.6 (2.73; 92.0–108.0; 88)	99.1 (3.05; 94.0–105.5; 18)	**
	(2)	97.4 (2.66; 92.5–103.0; 30)	97.8 (2.48; 93.5–105.0; 44)	ns
	(3)	101 (98–104; 18)	–	
TAIL	(1)	76.1 (3.94; 66.0–87.0; 88)	72.7 (4.26; 63.0–80.5; 18)	**
	(2)	74.5 (3.73; 69.0–87.0; 27)	73.4 (4.21; 66.5–90.5; 44)	ns
	(3)	72 (68–75; 18)	–	
BILL S	(1)	19.0 (0.82; 17.0–22.1; 83)	19.3 (1.01; 17.1–21.0; 18)	ns
	(2)	18.9 (1.35; 15.2–21.0; 28)	19.0 (1.11; 16.2–21.0; 41)	ns
BILL F	(3)	11.2 (10.8–11.4; 18)	–	
TARSUS	(1)	19.1 (1.29; 16.4–21.9; 88)	19.0 (1.73; 16.0–22.9; 18)	ns
	(2)	18.4 (1.16; 16.9–20.8; 29)	18.5 (1.08; 16.2–20.4; 44)	ns

(4–5) Vic., unsexed, live (Rogers *et al.* 1986): (4) Adults and subadults (probably first immatures); (5) Immatures (possibly includes juveniles).

		UNSEXED
WING	(4)	100.2 (2.54; 16)
	(5)	98.4 (2.67; 8)
TAIL	(4)	76.1 (2.22; 16)
	(5)	75.1 (1.21; 7)
THL	(4)	38.4 (0.55; 16)
	(5)	36.7 (0.69; 6)

WEIGHTS (1–2) Aust., skins, from museum labels (ANWC, MV, SAM): (1) Adults; (2) Juveniles and immatures. (3) Location unknown, live adults (ABBBS).

	MALES	FEMALES	
(1)	24.4 (1.48; 21.2–27.5; 14)	26.1 (3.85; 20.7–31.5; 7)	ns
(2)	23.4 (2.66; 20.0–29.0; 10)	22.3 (4.36; 13.0–27.0; 8)	ns
(3)	25.9 (1.6; 24–28; 5)	26.2 (3.3; 22–35; 13)	ns

Vic., live, unsexed: Adults and subadults (probably first immatures), 24.8–27.5 (n=16); immatures (possibly includes juveniles), 22.5–26.9 (n=6) (Rogers *et al.* 1986).

STRUCTURE Wing fairly long and broad, and slightly pointed at tip; tip of longest primary reaches to about half length of tail when wing folded. Ten primaries: p7 and p8 longest; p10 42–53 mm shorter than p7, p9 1–4, p6 1–4, p5 9–12, p4 15–19, p3 21–24, p2 25–28, p1 27–33. Slight emargination to outer webs of p7 and p8, and inner webs of p7–p10. Ten secondaries, including three tertials; s10 minute (I.J. Mason); tip of longest tertial falls between p1 and p3 on folded wing. Tail fairly long with slightly rounded tip when folded; 12 rectrices; longest one or more of t2–t5, these usually varying by ≤ 2 –3 mm; t1 usually c. 2 mm shorter than t2, and usually 4–8 mm shorter than t6. Bill fairly short and rather slender; upper mandible slightly decurved. Tarsus short with slight lateral compression; scaling laminipilar. Tibia fully feathered. Middle toe with claw 18.3 mm (0.54; 17.7–19.0; 6); outer toe 71–77% length of middle, inner 63–73%, hindtoe 71–78%.

AGEING Juvenile distinguished by plumage (q.v.). Some first immatures, particularly those in non-breeding plumage, difficult to distinguish from adult female non-breeding (see Plumages). First immature male breeding superficially similar to adult male breeding, but retain most juvenile feathers of wing and tail, so that upperwing and outertail mostly brownish (pied in adult male; see Plumages). First immature female breeding probably difficult to distinguish from adult female breeding. First immatures of both sexes (breeding and non-breeding plumages) distinguished from adult female by retained juvenile greater primary coverts which have distinct whitish fringes to tips (cf. adult female, in which tips have very indistinct cinnamon fringes).

SEXING Adults readily sexed on plumage (q.v.). First immature non-breeding and juvenile plumages probably not sexable. Males also have slightly longer Wing and Tail (see Measurements).

GEOGRAPHICAL VARIATION Here we combine Aust. and New Guinean populations with those in Lesser Sundas (nominated *sueurii*) following Mayr & Ripley (1941), Keast (1958), Christidis & Boles (1994) and Peters. Some authors (White & Bruce 1986; Sibley & Monroe 1990; DAB), however, separate Aust. and New Guinean populations as specifically distinct from populations in the Lesser Sundas (*L. tricolor* and *L. sueurii* respectively). Aust. and New Guinea populations differ from *sueurii* of Lesser Sundas by: no white supercilium in adult male (adult male of Lesser Sundas has narrow white supercilium); more pointed wing; alternating breeding and non-breeding plumages, so that plumage dimorphism varies seasonally (in Lesser Sundas, plumage strongly dimorphic all year); and, in breeding plumage, adult males have pure-white marginal and median upperwing-coverts (variably streaked black in Lesser Sundas). Mayr (1940) states that males in non-breeding plumage in n. Aust. have more black plumage to body than males in non-breeding plumage in s. Aust.; basis for this not understood but samples possibly include birds partway through pre-breeding or post-breeding moult (and therefore not in full non-breeding plumage).

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Volume 7 (Part A), Plate 9

White-winged Triller *Lalage sueurii* (page 325)

1 Adult male breeding; 2 Adult male non-breeding; 3 Adult female; 4 Juvenile; 5 Immature non-breeding; 6 Immature male breeding; 7, 8 Adult male breeding

Varied Triller *Lalage leucomela* (page 344)

SUBSPECIES RUFIVENTRIS: 9 Adult male; 10 Adult female; 11 Juvenile

SUBSPECIES YORKI: 12 Adult male; 13 Adult female

NOMINATE LEUCOMELA: 14 Adult male; 15 Adult female; 16 Juvenile moulting to immature