

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 DICRURIDAE fantails, drongos, monarch-flycatchers and boatbills

A large and highly diverse family of small to medium-sized passerines, often with short and rounded wings and long tails. The family comprises 160–170 species in 21 genera, distributed from Africa, across much of s. Asia, including the Indian subcontinent, to e. and se. Asia, including Japan, the Philippines and Wallacea, to A'asia and islands of w. Pacific Ocean as far E as Hawaii (Sibley & Monroe 1990; Monroe & Sibley 1993; Peters; DAB). Within HANZAB region there are 19 species generally recognized, in seven genera (Sibley & Monroe 1990; Monroe & Sibley 1993; Christidis & Boles 1994), but up to 22 species recognized in DAB. The taxonomy of the family has been the subject of considerable confusion. Here we recognize the following four subfamilies within the family Dicruridae (largely following DAB):

RHIPIDURINAE (FANTAILS): Comprises a single genus *Rhipidura*, with 37–42 species; five species in HANZAB region according to most authors (Sibley & Monroe 1990; Monroe & Sibley 1993; Christidis & Boles 1994), but seven species according to DAB.

DICRURINAE (DRONGOS): Comprises two genera: monotypic *Chaetorhynchus*, endemic to New Guinea; and *Dicrurus*, with 19–23 species, one of which occurs in HANZAB region. Characters present in this subfamily but absent from the others include an extended maxillary plate in the roof of the palate, thickened nasal bars, a large temporal fossa to the muscle of the mandible, and a long, double zygomatic process (DAB).

MONARCHINAE (MONARCH FLYCATCHERS): Four genera in HANZAB region: *Monarcha*, with 26–31 species, four of which occur in HANZAB region according to most authors (Sibley & Monroe 1990; Monroe & Sibley 1993; Christidis & Boles 1994; DAB); *Arses*, with three species according to most authors (four according to DAB), two (or three according to DAB) of which occur in HANZAB region; *Myiagra*, with 15–18 species, five in HANZAB region according to most authors, but six species according to DAB; and *Grallina*, with two species, and one in HANZAB region (see below for discussion on taxonomic position of this genus). The subfamily contains a further 42–44 species, in 13 genera, extralimitally (Sibley & Monroe 1990; Monroe & Sibley 1993).

MACHAERIRHYNCHINAE (BOATBILLS): *Machaerirhynchus*, with two species, one in HANZAB region. These have a number of structural characteristics rather divergent from other subfamilies, including fully perforate nasal and orbital septa, a much narrowed palatine shelf with long, subulate trans-palatine processes with slightly swollen ends, and much reduced ectethmoid wings with vestigial lachrymals on the latero-ventral face (DAB).

Early studies placed the monarch flycatchers and fantails in the superfamily Muscicapidae, which includes Old World flycatchers and thrushes among other passerine groups (Mayr & Amadon 1951; Vaurie 1953; Wetmore 1960; Aust. CL 1926). Later studies on syringeal morphology (Ames 1975) and egg-white proteins (Sibley 1970, 1976) showed that Australo-Papuan flycatchers are not closely related to members of the Old World family Muscicapidae. Beecher (1953), in his studies of passerine cranial osteology and myology, was the first to group monarch flycatchers and drongos together, along with whistlers (Pachycephalidae) and vireos (Vireonidae), in the family Monarchidae (see DAB for further discussion). Wolters (1975–82) considered drongos as a sister family to the monarchs and fantails. Based largely on syringeal morphology, electrophoretic patterns of egg-white proteins and juvenile plumage, Boles (1979) proposed that the Australo-Papuan flycatchers, monarchs, fantails, robins, whistlers and shrike-thrushes form a monophyletic group, centred in Aust. and New Guinea, and were not related to muscicapine flycatchers.

DNA–DNA hybridization studies (Sibley & Ahlquist 1985, 1990) led to our current understanding of the taxonomic position of Australo-Papuan monarchs and flycatchers. These studies, along with those of Christidis & Schodde (1991), indicate they nevertheless form part of the corvid (not the muscicapoid) assemblage and are probably most closely related to the Aegithinidae (ioras) and Malaconotidae (bush-shrikes and allies), and within the HANZAB region to the Pachycephalidae (whistlers). DNA–DNA hybridization studies (Sibley & Ahlquist 1985) also suggest a relationship between Australo-Papuan flycatchers and their allies, and several genera of African flycatchers and monarchs, including *Erythrocerus*, *Elminia*, *Trochocercus*, *Terpsiphone*, *Clytorhynchus* and other genera. However, osteological data (Olson 1989) suggests at least some of these African genera are not monarchs.

The taxonomic position of the magpie-larks *Grallina* has been the subject of much debate. Amadon (1950) considered *Grallina* related to the other Aust. mud-nesters, the Apostlebird *Struthidea cimerea* and White-winged Cough *Corcorax melanorhamphos*, and placed them in a family Grallinidae. Beecher (1953) assigned *Grallina* to the Artamidae (butcherbirds and woodswallows). McEvey (1976) suggested *Grallina* was a linking group between the other mud-nesters and Artamidae. More recent osteological (Olson 1989) and DNA–DNA hybridization data (Sibley & Ahlquist 1985) indicate that *Grallina* is allied to the Australo-Papuan flycatchers. Based on DNA–DNA hybridization data, Sibley & Ahlquist (1985) combined the monarchs, fantails, magpie-larks and drongos as a subfamily Dicrurinae within an expanded family Corvidae. The latter authors combine *Grallina* with *Monarcha* ($\Delta T_{50}H$ 2.9) and African genera of monarchs, and they place these as a tribe Monarchini within the subfamily.

Their data also supports the inclusion of the drongos *Dicrurus* and *Chaetorhynchus* with the *Monarcha* and *Grallina* ($\Delta T_{50}H$ 5.0), and accordingly they consider drongos as a tribe Dicrurini. The fantails are a sister group to the other monarchines ($\Delta T_{50}H$ 6.1) and are considered as the tribe Rhipidurini. In the present study we follow Christidis & Boles (1994) and DAB in elevating the subfamily Dicrurinae to family status, and consider the tribes of Sibley & Ahlquist (1993) as subfamilies (as above).

Within the HANZAB region, the smallest is Mangrove Grey Fantail *Rhipidura phasiana* (length c. 14.5 cm, weight c. 7 g) and the largest is Magpie-lark *Grallina cyanoleuca* (length c. 28 cm, weight c. 85 g). The Dicruridae are characterized by (Olson 1989; DAB): Single humeral fossa that is of pachycephaloid form, except in drongos and magpie-larks, which have weakly developed ventral tubercle tuberosity and depression above it. Palate with extensive ossification of the internasal septum. In some *Myiagra* and in *Grallina* (magpie-larks), nares virtually imperforate (amphirhinal). Vomer simple and shortly bifid with cartilaginous extensions. Ectethmoid plate thin with narrowed wing and no lachrymals (except boatbills *Machaerirhynchus*). Maxillo-palatine processes dorsoventrally flat. Palatine shelf varyingly narrow with attenuate but usually round-tipped trans-palatine processes. In the Rhipidurinae (fantails) and Dicrurinae (drongos), the interorbital septum is extensively ossified. Bill typically broad (not *Grallina*), with shortly hooked tips and notched maxillary tomia. Usually have dense, well-developed rectal bristles. Ten primaries, with p10 moderately developed; nine (Rhipidurinae), nine plus a vestigial s10 (Dicrurinae, most species of Monarchinae) or ten (*Grallina*) secondaries (including tertials). Usually 12 rectrices, but Pygmy Drongo *Chaetorhynchus papuensis* has ten. Tarsal scaling laminiplantar.

Plumage of adults usually contrasting patterns of rich greys, russets, whites and glossy blacks, often with iridescent sheens (DAB). Many species sexually dimorphic in adult plumage. Juveniles often like dull versions of adults, often with pale or brownish fringes to upperwing-coverts. Post-juvenile (first pre-basic) moult usually occurs soon after fledging and is usually partial, resulting in adult-like first immature (first basic) plumage. Adults undergo a single complete post-breeding (pre-basic) moult annually. Primaries moult outward, usually starting at p1. Most species have rather long tails, and short, well-rounded wings. Fantails and some monarchs often fan or flirt tail while foraging (possibly as foraging manoeuvre); *Myiagra* flycatchers and boatbills *Machaerirhynchus* vibrate tails when perched; in drongos, tails commonly forked and twisted at tips. Feet usually rather weak.

Throughout range, predominantly birds of forested habitats, but with a few exceptions, such as Torrent-lark *Grallina bruijnii* which is found along small, rocky and swift-flowing montane forest streams of New Guinea; Fork-tailed Drongo *Dicrurus adsimilis* which inhabits mainly open country, including savanna; and Willie Wagtail *Rhipidura leucophrys* which is also often found in open country, including grasslands and forest clearings. Many species (e.g. many fantails and drongos) associate with forest edge and ecotones between forests and open habitats, or with watercourses, lakes or swamps and riparian vegetation (Sibley & Monroe 1990; Maclean 1993; Cheke & Walsh 1996; Coates *et al.* 1997). In HANZAB region, mainly associated with sclerophyll forests and woodlands, predominantly eucalypt or acacia associations, and rainforests; less often in shrublands or heath, regrowth forest, and mangrove associations; in HANZAB region, Mangrove Grey Fantail and Broad-billed Flycatcher *Myiagra ruficollis* mainly confined to mangrove associations. Some species commonly in modified habitats, e.g. Willie Wagtail and Magpie-lark both common and familiar urban birds and often also found in farmland, parklands and gardens, commonly nesting in close association with human habitation. Association with forested habitats in Aust. results in distribution largely confined to wetter forested N, E, SE and SW. However, Willie Wagtail found throughout the continent, and Magpie-lark found throughout except for arid deserts of SA-WA-NT; Grey Fantail also extends into arid inland WA-NT. Recorded from lowlands to mountains; occur from coastal lowlands to alpine uplands in Aust.; common to 1500 m asl in NZ; in New Guinea and Wallacea recorded to 3600–3900 m asl (e.g. Dimorphic Fantail *R. brachyrhyncha*, Friendly Fantail *R. albolimbata*). Clearing of forests has reduced suitable habitat for some species (Pied Monarch *Arses kaupii*, Restless Flycatcher *M. inquieta*, Rufous Fantail *R. rufifrons* and Satin Flycatcher *M. cyanoleuca*). In contrast, Magpie-lark and Willie Wagtail have benefited from clearing and agricultural development (Coates 1990; Sibley & Monroe 1990; Maclean 1993; Coates *et al.* 1997; Urban *et al.* 1997; Heather & Robertson 2000; Aust. Atlas 1, 2; DAB; see species accounts).

Most species are resident or sedentary, though some are migratory or partly migratory. In HANZAB region, many species (about half of those occurring) resident or sedentary, with some local movements or dispersion (e.g. Willie Wagtails, while largely sedentary, show some local movements to more open areas in winter). Remaining species partly or wholly migratory, with populations moving N for austral winter, mainly wintering in n. Aust., especially ne. Qld, and New Guinea, and returning to s. parts of range to breed (e.g. Leaden *Myiagra rubecula* and Satin Flycatchers, and Black-faced Monarch *Monarcha melanopsis*). However, patterns of movement can vary within some species, e.g. subspecies *allisteri* of Grey Fantail migrates from e. Aust. to WA and n. Aust., perhaps as far as New Guinea, and *preissi* moves from sw. WA, N and E in winter, while *keasti* of ne. Qld is resident or sedentary. A few species in e. Aust., particularly those occurring in se. highlands and tropical uplands, are partial altitudinal migrants, moving to lowlands, often near coasts, for autumn–winter; in NZ, Grey Fantail possibly also a partial altitudinal migrant. Readily cross water; in Aust., at least six (and probably eight) species regularly migrate across Torres Str., and Satin Flycatcher migrates across both Bass Str. and Torres Str. Extraliminally, drongos (Dicrurinae)

and boatbills (Machaerirhynchinae) generally resident or sedentary, except Crow-billed Drongo *D. annectans*, which winters in Greater Sundas after breeding in India and China, and Ashy Drongo *Dicrurus leucophaeus*, a resident and winter visitor to se. Asia, and altitudinal migrant to lowland India and Sri Lanka from Himalayan breeding grounds; several other show local movements. Fantails (Rhipidurinae) also largely sedentary or resident throughout se. Asia, Melanesia and Pacific region, but two species of Indian subcontinent show altitudinal movements. Monarch flycatchers (Monarchinae) mostly sedentary or resident, with a few migratory or partly migratory species, mainly *Terpsiphone* paradise-flycatchers extraliminally, e.g. Japanese Paradise-Flycatcher *T. atrocaudata* is migratory, breeding in Japan, Taiwan and extreme n. Philippines, and wintering in Sumatra, n. Borneo and Philippines; and African Paradise-Flycatcher *Terpsiphone viridis* partly migratory, with some populations moving towards Equator after breeding. For migratory species, birds usually occur singly or in pairs on passage, but some species observed in small flocks on passage, such as Rufous Fantail and Spangled Drongo (Britton 1980; Pratt *et al.* 1987; Coates 1990; Sibley & Monroe 1990; Maclean 1993; Coates *et al.* 1997; Robson 2000; see species accounts).

Mostly arboreal and aerial insectivores, and, with few exceptions, birds of middle and lower strata of forested habitats. However, *Grallina* predominantly ground foragers (Magpie-lark mainly in open, terrestrial habitats, and Torrent-lark in and along montane streams), and others also forage much on ground, such as Sooty Thicket-Fantail *Rhipidura threnothorax*. Mostly search for food from vantage perches, attacking by sally-striking in air or from foliage, branches or trunks of trees; some species sally-pounce to ground or sally-hover (e.g. Restless Flycatcher, Black-faced Monarch *Monarcha melanopsis*, fantails *Rhipidura* and paradise-flycatchers *Terpsiphone*), taking prey from foliage or flowers. Almost all species, especially monarchs and *Myiagra* flycatchers, also forage by flush-pursuit (though most Aust. literature does not distinguish between sallying and flush-pursuit). Some birds, especially fantails and *Elminia* flycatchers, intentionally use movements of tails and wings during foraging to flush prey (flush-pursuit) before chasing them. Some birds, such as paradise-flycatchers, follow other bird species along branches, gleaning prey that may be dislodged. In HANZAB region, two exceptions to typically flycatcher foraging: *Arses* commonly glean their food by spiralling up and round trunks of trees by foot (also typified, extraliminally, by *Erythrocerus* flycatchers, e.g. Chestnut-capped Flycatcher *E. mcallii*); and Magpie-lark, which forages primarily on ground (Coates 1990; Urban *et al.* 1997; Coates & Peckover 2001; see species accounts).

Social organization and behaviour poorly known for most species, but well known for a few in HANZAB region (Leaden Flycatcher, Grey Fantail, Willie Wagtail and Magpie-lark) and reasonably well known for some in Africa (e.g. African Paradise-Flycatcher). Usually solitary or in pairs, sometimes in small family groups. However, Grey Fantails and Willie Wagtails sometimes gather in loose congregations outside breeding season, and some species observed in small flocks on passage (see Movements summary above). Magpie-larks also sometimes form large flocks, of 100+, in winter. In most species, pair-bond monogamous and often long-term, pairs are territorial, and both sexes share parental care. At least two species in Africa, African Blue Flycatcher *Elminia longicauda* and Chestnut-capped Flycatcher, thought to be sometimes polygamous and have been recorded breeding co-operatively. In HANZAB region, co-operative breeding once recorded in Magpie-larks, and possibly once in Willie Wagtail. Most other species appear also to nest in simple pairs and share parental care between sexes; also appear to have distinctive, probably territorial, songs. Some species loosely colonial or at least show some clustering of nests (e.g. Satin Flycatcher, Spangled Drongo). Much aggression in defence of nest and young. Several species harass potential predators in fluttering, hovering flight, e.g. African Paradise-Flycatcher and Willie Wagtail. Often noisy (particularly drongos Dicrurinae) and conspicuous. Displays tend to be poorly known; and functions of several described displays are not known (such as some social displays in the monarch flycatchers, e.g. *Arses*). In HANZAB region, distraction displays recorded in Willie Wagtail, Rufous Fantail and Satin Flycatcher. In well-studied species, such as Willie Wagtail, young evicted from natal territory soon after independence, though young of migratory Rufous Fantail stay near natal territory until leaving on passage. Young of some species fully independent 4–7 weeks after fledging, but for most species period of dependence not known (Urban *et al.* 1997; DAB; see species accounts).

Dicrurids are noisy, particularly when breeding (DAB). Calls of the subfamily of monarch flycatchers (Monarchinae) are short and simple, the quality variously described as dry, grating, harsh, rasping, buzzing or scolding, with notes often rising in inflexion; the songs of *Myiagra* species have been described as a series of simple whistles, those of *Arses* species as slow rattled ringing trills, and those of *Monarcha* species as a musical jumble of loud mellow notes and fluting whistles; and *Grallina* (Magpie-lark and Torrent-lark) have loud and penetrating calls, often accompanied by conspicuous displays. Calls of the boatbills (Machaerirhynchinae) metallic or grating, and songs contain musical trills. Calls of fantails (Rhipidurinae) are simple chips, clucks and grating notes, and song is typically a weak, high-pitched but melodious phrase consisting of short clear whistles and climbing and tumbling series of shorter notes; a few species have louder and more forceful songs (e.g. Willie Wagtail). Within the drongos (Dicrurinae) vocalizations typically a mixture of harsh, scolding notes and pleasant musical whistles, and some species are good mimics (Campbell & Lack 1985; Beehler *et al.* 1986; see species accounts).

Breed solitarily. Seasonality varies geographically. In Aust. most species do not breed, or breed least often, in colder months (May–June) and a similar pattern, with birds breeding mostly in spring and summer, is followed in n. hemisphere. In tropical regions, birds may breed throughout year, e.g. in PNG, Willie Wagtail lays in all months,

while in Aust. eggs recorded only July–Feb. Usually nest in trees, shrubs or vines, on horizontal branches or in vertical or horizontal forks, though Frilled Monarch *Arses telescopthalmus* often builds between two parallel vertical hanging vines. Some species (e.g. Magpie-lark, Willie Wagtail, Grey Fantail) also build on and within assorted artificial structures. Usually show some evidence of site-fidelity, and some species show quite strong associations with other species, often others members of the family, e.g. Magpie-lark with Willie Wagtail. Build open nests: variously shallow, saucer, basket, basin or hammock-shaped in Yellow-breasted Boatbill *Machaerirhynchus flaviventer*, drongos *Dicrurus* and Frilled and Fantail *Monarcha axillaris* Monarchs, but cup-shaped in most other species; fantails often add tail to cup, making nest appear like a wine glass without a base. Nests usually made of plant material, sometimes with animal hair or spider web. In contrast, nests of Magpie-lark and Torrent-lark of New Guinea cup or bowl-shaped but often made of mud. Rarely, nests of Willie Wagtail also made of mud. Nests usually lined with soft or springy materials such as vine tendrils, hair, feathers, or soft plant material. Usually both sexes build, though on occasions workload may be shared unevenly, with female usually contributing more; in Yellow-breasted Boatbill, thought that males do all or most nest construction. Nest takes from <1 week to 6 weeks to build. Eggs vary in shape, but usually oval, elongate oval or swollen oval; also usually smooth and slightly lustrous. Ground-colour typically pale, from various shades of white (pure or creamy white, reddish, pinkish, yellowish, bluish or greenish white) to creamy brown or light buff, and, in Magpie-Lark, to rich buffy-red or reddish-buff; eggs of Ashy Drongos also quite dark. Eggs have various combinations of darker markings, sometimes mostly at, or forming a zone or band near, large end. Within the family, eggs of Grey and Mangrove Grey Fantails rather small (14–17 × 10–13 mm), ranging to large in Spangled Drongo and Magpie-lark (26–33 × 18–22); this range probably covers that of most extralimital species, though there is little data for many species (such as New Ireland Drongo *Dicrurus megarhynchus*). Clutch-size is one to four in most smaller species, but usually two or three in rest; apparently always two in Yellow-breasted Boatbill and Spectacled Monarch *Monarcha trivirgatus albiventris*; up to five in drongos (Ali & Ripley 1972a) and possibly six in Grey Fantail in NZ and Magpie-lark; Torrent-lark usually lays single egg, as does Silktail *Lamprolia victoriae* of Fiji. Laying interval usually c. 24 h, occasionally 48 h. Single- or multiple-brooded: in Aust., Willie Wagtails, Grey Fantails and Magpie-larks known to rear up to four or five broods in a season, Restless Flycatchers up to three, Satin and Leaden Flycatchers, Rufous and Northern Fantails two, and Yellow-breasted Boatbill, monarchs and Shining and Broad-billed Flycatchers only one. Both parents usually incubate, though sexes may not contribute equally, and in Spectacled Monarch, females incubate and are fed by males. Incubation period 12–19 days. Both parents feed nestlings; faecal sacs removed till late in nestling period; may perform distraction displays in defence of young. Both sexes also feed fledgelings, though broods sometimes divided; young usually fully independent 4–7 weeks after fledging. Fledging period usually 11–18 days in smaller species (fantails, flycatchers); 17–20 days in Spectacled Monarch; and 17–24 days in larger species (Spangled Drongo, Magpie-lark). In Aust., success varies: Willie Wagtail had most data in NRS (success data for 3091 eggs, in 1069 nests) and averaged 0.93 fledged young/nest; success in other species sometimes similar (e.g. Restless Flycatcher 0.97, Magpie-Lark 1.05), rarely higher (e.g. Spangled Drongo 1.25) and often substantially lower (e.g. Grey Fantail 0.46, Rufous Fantail 0.32, Leaden Flycatcher 0.24, Black-faced Monarch 0.10). Causes of failure include: extreme weather conditions, including heatwaves, drought, and cold, wet or windy weather; interference from people (some species desert nest readily); and cuckoos. Predators include Cats, rats *Rattus*, and other mammalian predators; rarely, lizards and snakes; and range of avian predators, including kookaburras *Dacelo*, crows and ravens *Corvus*, currawongs *Strepera* and butcherbirds *Cracticus* and various birds of prey (Ali & Ripley 1972a,b; Watling 1982; Coates 1990; Roberts 1992; see species accounts).

Some 21 species globally threatened, many of which are endemic island forms, e.g. Flores Monarch *Monarcha sacerdotum* confined to w. Flores, and White-tipped Monarch *M. everetti* restricted to island of Tanahjampea, between Sulawesi and Flores, in Wallacea (White & Bruce 1986; Coates *et al.* 1997); five considered critically endangered, including Caerulean Paradise-Flycatcher *Eutrichomyias rowleyi* of n. Sulawesi, and Black-chinned Monarch *Monarcha boanensis* of s. Moluccas; six species endangered, ten vulnerable and 18 near threatened (Stattersfield & Capper 2000). Most are threatened by degradation or fragmentation of habitat, both through deforestation for agriculture or logging, or by recurrent cyclonic activity, which has allowed spread of invasive weeds. Populations of some island species, e.g. Elepaio *Chasiempis sandwichensis* and Tahiti Monarch *Pomarea nigra*, are threatened by predation by Black Rats *Rattus rattus* (Stattersfield & Capper 2000). In HANZAB region, Lord Howe Island Grey Fantail *Rhipidura fuliginosa cervina* extinct, owing to predation by Black Rats, and Norfolk Island Fantail *R.f. pelzelni* considered vulnerable; five other taxa considered near threatened (Garnett & Crowley 2000).

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Rhipidura leucophrys Willie Wagtail

CLOUR PLATE FACING PAGE 97

Turdus leucophrys Latham, 1802 (1801), *Index Orn., Suppl.* 2: 45 — Nova Hollandia = region of Port Jackson, New South Wales.

The familiar and fearless Willie Wagtail has a distinct white eyebrow (Greek λεύκοφρυς, white-browed).

OTHER ENGLISH NAMES Black-and-white Fantail or Flycatcher; Pied or White-browed Fantail; Fantail Flycatcher; Australian Nightingale; Frogbird, Morning Bird, Shepherd's Companion, Willy or Water Wagtail.

POLYTYPIC Nominate *leucophrys*, mainland Aust. S of c. 20°S, including Fraser I. off se. Qld and Kangaroo I. off SA; *picata* Gould, 1848, n. Aust. N of c. 20°S, from sw. Kimberley Div., WA, E to C. York Pen., Qld, including Tiwi Is and Groote Eylandt; *melaleuca* (Quoy & Gaimard, 1830), n. Torres Str. islands, and Moluccas, New Guinea, Bismarck Arch. and Solomon Is.

FIELD IDENTIFICATION Length 20 cm (18–21.5); wingspan 29 cm (25–31.5); weight 18 g. One of the most common and widespread Aust. birds. Familiar, active and conspicuous pied flycatcher, with rather short pointed bill, medium-long wings with slightly rounded tips, and long tail with rounded

tip that is often held cocked and fanned, or partly so, and characteristically wagged from side to side. Very similar in size to Restless Flycatcher *Myiagra inquieta* of se. and e. Aust. (nominate *inquieta*) but slightly smaller and more robust, with obviously shorter bill; much larger than Restless Flycatcher of n. Aust. (subspecies *nana*) with obviously shorter bill; much larger than Satin Flycatcher *Myiagra cyanoleuca*, with longer tail with more rounded tip, and typically more horizontal posture; also much larger than Grey Fantail *Rhipidura fuliginosa*. Sexes alike. Adult has black head, neck and upperparts, marked with fine white supercilium, dark-brown remiges, and white underbody sharply demarcated from black chin and throat. No seasonal variation. Juveniles similar to adults but much duller and browner, with blackish-brown head, neck and upperparts, scalloped with buff-brown. Immatures separable at close range by retained juvenile plumage. Three subspecies, known to vary only in size. **Adult** Head, neck and upperbody, black, with: slight gloss to upperbody in good light; fine white supercilium,

Plate 6

(P. Slater)

Magpie-lark *Grallina cyanoleuca* (page 134)

NOMINATE CYANOLEUCA: 1 Adult male; 2 Adult female;
3 Juvenile; 4 Immature male; 5 Adult male; 6 Adult male

Spangled Drongo *Dicrurus bracteatus* (page 249)

SUBSPECIES CARBONARIUS: 7 Adult

NOMINATE BRACTEATUS: 8 Adult; 9 Juvenile; 10 Immature;
11 Adult

prominence of which varies; and varying fine white flecking to malar area, chin and throat, usually combining to form fine, often broken, white malar stripe and white speckling across chin and throat, though flecking and stripe can be obsolete or almost so. Uppertail, black-brown. On folded wing: coverts largely black, with slight gloss in good light; primary coverts and primaries and secondaries, dark brown. Black of chin, throat and upper breast sharply demarcated from white rest of underbody. Undertail, blackish. Underwing-coverts mostly blackish, with white tips to primary coverts, and remiges, grey; underwing appears mostly black with broad greyish trailing edge and tip, and patch of black and white mottling near bend of wing. Bill and gape, black. Iris, dark brown. Legs and feet, black. **Juvenile** Head, neck, entire upperparts and upper breast, duller and browner than in adult, blackish brown, with little or no gloss above, and marked with: longer but buff-brown supercilium, extending to sides of nape; off-white to buff flecking to chin and throat (but no malar markings); and buff-brown scalloping to top of head, upperbody and upper breast, boldest on scapulars, rump and uppertail-coverts. Folded wing, dark brown with broad and distinct buff-brown tips or fringes at tips to all coverts and tertials; and cream fringes at tips of secondaries and primaries. White of underbody tinged cream, and undertail-coverts tipped buff. Feathers of upperparts, chin, throat and breast softer and more loosely textured than in adult. Bill, dull black or brownish black. Gape changes from buff-cream to pale yellow and grey with age (see Bare Parts). Legs and feet as adult or slightly browner. **First immature** Very similar to adult but often distinguishable at close range by retained juvenile plumage of wing, which is contrastingly paler and more worn than new adult-like plumage. Retain all juvenile greater primary coverts, one or more outer greater secondary coverts and most or all remiges and rectrices. Best distinguished by retained outer greater secondary coverts, which are contrastingly paler than new adult-like coverts, and with buff-brown tips. Bare parts as adult, though gape also described as grey.

Similar species None, and should not be mistaken. Only likely to be confused with superficially similar pied flycatchers. At all ages, Willy Wagtail immediately distinguished from **Restless Flycatcher** by black head and neck, including all of chin, throat and upper breast, sharply demarcated from white rest of underbody (in adult and immature Restless, whole underbody, including chin and throat, white; in juvenile Restless, chin and throat, white with weak buff wash); further distinguished by varying white supercilium on otherwise black head and neck (Restless lacks supercilium) and by much sweeter and more musical call, or repeated short chattering notes (common call of Restless is a harsh, rasping, scissors grinder sound). Adult also readily distinguished from superficially similar adult male **Satin Flycatcher** by: much larger size; longer tail, with rounded tip when folded and characteristic fan-shape when spread, and lack of erectile crest (in Satin, tail much shorter, with square tip, and has small erectile crest); duller and less glossy black plumage, with varying white supercilium, broken white malar stripe, and white flecking to chin and throat (in Satin, head, neck and upperbody strongly glossy blue-black, with contrasting black lores but no white markings); when perched, typically more horizontal posture, with long tail often held cocked and fanned or partly so, and characteristically wagged from side to side (in Satin, posture typically more upright, with distinctive habit of quivering tail up and down when perched; though, on alighting, sometimes wag tail rapidly from side to side); Willie Wagtail also usually forages on or close to ground, typically in open habitats (Satin strictly arboreal, usually high in trees, and mainly in eucalypt forests, particularly wet sclerophyll forest); calls are also very different, as above (Satin has characteristic strong, repeated upslurred piping, whistling *choo-ee*, *choo-ee* or *wu-chee*, *wu-chee* and

associated clear, high-pitched *weir-to-weir-to-weir*, or *thurp*, *pewit pewit pewit*).

Usually seen singly or in pairs; less often in small groups and occasionally in small flocks; and also sometimes in mixed-species feeding flocks. Widespread and familiar to most Australians, birdwatchers or not; often tame, and common in urban and rural areas and round human habitation, where often in close contact with people, including feeding closely round or in buildings, and nesting on verandas, fences and gateposts. Active and rarely still; when perched, continuously fan and partly cock tail and wave it from side to side. When foraging, flit restlessly about, or perch on vantage points, darting after prey which is taken aerially, on ground, or from foliage, branches or trunks of trees; sometimes flush prey by movements of wings or sideways movement of tail; also forage for flying insects disturbed by grazing animals, often using backs of animals as moving perches. Fly with rather deep flapping wingbeats, often combined with short dropping glides when making short flights between perches, often making final glide to perch and wagging tail on alighting; when flying longer distances, at height, flapping more regular and continuous, with jerky, dipping trajectory. Pugnacious at times, especially when defending territories, nests or young; and chasing and fighting between Wagtails can occur throughout year. Will attack intruding conspecifics and predators, even birds much larger themselves, including Laughing Kookaburras *Dacelo novaeguineae*, Australian Magpies *Gymnorhina tibicen* and Wedge-tailed Eagles *Aquila audax*, usually by flying at and round head of threat in figure of eight while scolding with chattering call. Width of white supercilium varies with levels of aggressiveness or excitement. Strong, sweet musical call can be heard, constantly, by day and by night when they are breeding.

HABITAT Occupy a wide range of open habitats, including grasslands, dry open woodlands and forests and edges of clearings in woodlands and forests; commonly in urban and rural areas, including gardens, parklands and golf-courses (Rix 1943; Jones 1952; Masters & Milhinch 1974; Ford & Paton 1975; Morris 1975; Harrison 1976; Gibson 1977; Longmore 1978; Jones 1986; Morris 1986; Gibson & Cole 1988; Saunders & Ingram 1995; Luck *et al.* 1999; Hall; Aust. Atlas 1). Usually absent from closed forests (Terrill & Rix 1950; Heron 1973; Masters & Milhinch 1974; Leach & Hines 1987), such as wet sclerophyll forests and rainforests (Loyn 1985; Gosper 1992; Vic. Atlas). In all habitats, often associated with riparian communities round watercourses and other wetlands (Clarke 1967; Storr *et al.* 1975; Longmore 1978; Halse *et al.* 1985; Traill *et al.* 1996), including riparian woodlands and forests dominated by eucalypts (e.g. River Red Gum, Black Box) or combinations of *Eucalyptus*, *Pandanus*, *Melaleuca*, casuarinas, *Lophostemon* and *Terminalia* and others (Gell 1977; Halse *et al.* 1985; Tidemann & Wilson 1992; Chan 1995; Traill *et al.* 1996; Woinarski *et al.* 2000); also riparian grasslands, sedgeland, and shrublands (Crawford 1972; Jones 1986; McFarland 1988). In Top End of NT, recorded mainly in riverine habitats and less often in adjacent non-riverine vegetation (Woinarski *et al.* 1989; Woinarski *et al.* 2000); and in arid and semi-arid zones, usually recorded near water (Ford & Sedgwick 1967; McEvey & Middleton 1968; Pianka & Pianka 1970; Wilson 1974; Wyndham 1978; Brooker *et al.* 1979; Brandle 1988; Storr 19). However, in study on New England Tableland, n. NSW, along a habitat gradient from riverine woodland through ecotone zone to eucalypt woodland, most commonly recorded in eucalypt woodland (Major *et al.* 2001). Also often occur in habitats that have undergone some form of disturbance, such as fire, cyclone damage or clearance (Nicholls & Nicholls 1984; Halse *et al.* 1985; McFarland 1988; Woinarski *et al.* 1988; Saunders & Ingram 1995).

Often in modified GRASSLANDS, with scattered trees, bordered by trees, including wind-breaks and shelterbelts (Vic. Atlas), or with trees nearby, such as in gullies or along creek-lines (Emison & Porter 1978; Bedgood 1980; Cameron 1985; Leach 1988); often in farmland (Sedgwick 1968; Templeton 1992), especially pastures, and sometimes cropland, with associated trees or shrubs (McEvey 1965; McEvey & Middleton 1968; Baxter 1981; Nichols & Nichols 1984; Cameron 1985; Traill *et al.* 1996; Possingham & Possingham 1997; J.M. Peter); often about grazing stock (Gibson 1977; Jones 1981; Saunders & Ingram 1995; Aust. Atlas 1; Storr 19); and in roadside verges in central wheatbelt of WA, using remnant vegetation for roosting and nesting and paddocks for feeding (Lynch & Saunders 1991; Saunders & de Rebeira 1991). Commonly round human habitation (Terrill & Rix 1950; Saunders & Ingram 1995) such as farmyards (McEvey 1965); common and widespread in towns and suburban habitats, especially in parks, gardens and golf courses (e.g. Gannon 1932; Sedgwick 1968; Morris 1975, 1986; Recher 1975; Harrison 1976; Paton 1976; Gibson 1977; Price 1977; Jones 1981, 1983; Mason 1985; Catterall *et al.* 1989; Green *et al.* 1989; Jackson & Elgar 1993; Woodall 1995; Bielewicz & Bielewicz 1996; Vic. Atlas). In suburban Brisbane, mostly recorded in well-established gardens, with lawns and little or no remnant vegetation (Sewell & Catterall 1998). Often nest in or near human habitation or activities, such as on verandas, gateposts and fences, and machinery (see Food, and Breeding [Site]). Also reported from natural grasslands (Longmore 1978; Draffan *et al.* 1983), e.g. tall tussock grassland bordering wetlands (Jones 1986) or dry tussock grassland adjacent to chenopod shrubland (McEvey & Middleton 1968); in varying grazed grasslands, such as lightly grazed grasslands dominated by Hairy Panic *Panicum effusum* and Kangaroo Grass *Themeda australis*, and more heavily grazed areas dominated by hair-grass *Aira*, Red-legged Grass *Bothriochloa macra* and Windmill Grass *Chloris truncata* (Davey 2002). Also often in dry open EUCALYPT WOODLANDS, usually with ground-cover of grasses or sedges, including spinifex *Triodia*, and sometimes sparse understorey of shrubs (Ford 1957; Abbott 1976; Gell 1977; Degabriele *et al.* 1979; Ford & Bell 1981; Chesterfield *et al.* 1984; Halse *et al.* 1985; Loyn 1985; Ford *et al.* 1986; Gibson & Cole 1988; Leach 1988; Woinarski *et al.* 1988; Woinarski & Tidemann 1991; Tidemann & Wilson 1992; Chan 1995; Er & Tidemann 1996; Possingham & Possingham 1997; Recher & Davis 1998; Davey 2002; Vic. Atlas), and including open mallee woodland or shrubland, generally with open understorey of spinifex and sometimes low, scattered shrubs, such as acacias or emu-bush *Eremophila* (Jones 1952; Ford & Sedgwick 1967; McEvey & Middleton 1968; Pianka & Pianka 1970; Gell 1977; Hunt 1979; Johnstone *et al.* 1979; Congreve & Congreve 1985; Black & Badman 1986; Matthew & Carpenter 1990; Possingham & Possingham 1997). Less often in DRY OPEN EUCALYPT FOREST, usually with grassy ground-cover and, sometimes, sparse understorey of shrubs (Ford & Stone 1957; Deignan 1964; Kikkawa *et al.* 1965; McEvey 1965; Clarke 1967; Crawford 1972, 1979; Recher 1975; Gell 1977; Nichols & Nichols 1984; Ford *et al.* 1985; Jones 1986; Leach 1988; Woinarski *et al.* 1988, 1989; Gosper 1992; Traill *et al.* 1996). Commonly in forest and woodland associations dominated by River Red Gums and Black Box, typically riparian associations round watercourses or other wetlands; examples of other dominant eucalypts of forests and woodlands include: in e. and se. Aust., Grey Box, Red Box *Eucalyptus polyanthemus*, Mugga, Yellow Box, Yellow Gum, Pink Gum, Spotted Gum and Blakely's Red Gum; in sw. Aust., Salmon Gum, Wandoo, Powderbark *E. accedens* and York Gum; in n. Aust., Darwin Stringybark and Darwin Woollybutt; and in central Aust., Marble Gum *E. gongylocarpa* and riparian eucalypts such as River Red Gum and Coolibah; and in mallee

associations, Red Mallee, Yorrell, Giant Mallee, Victoria Desert Mallee *Eucalyptus concinna* and Kopi Mallee *E. striatocalyx* (references as above). Often also in dry OPEN SCLEROPHYLL WOODLANDS OR FORESTS dominated by species other than eucalypts, or in mixed associations of eucalypts and other sclerophyllous species. Often in acacia woodlands, especially Mulga woodland, often with open understorey of spinifex and low shrubs (Deignan 1964; Ford & Sedgwick 1967; Pianka & Pianka 1970; Matheson 1976; Wyndham 1978; Johnstone *et al.* 1979; Black & Badman 1986; Matthew & Carpenter 1990; Recher & Davis 1997); also in myall woodland dominated by Weeping Myall or Western Myall with open or continuous understorey of shrubs such as chenopods (Ford & Sedgwick 1967; Brooker *et al.* 1979); and in softwood scrub dominated by Brigalow (Leach & Recher 1993; Leach & Watson 1994; Leach 1995). Also in open woodlands or forests dominated by casuarinas (Jones 1952; Gell 1977; Halse *et al.* 1985; Chan 1995), such as coastal low, open woodland 5–10 m dominated by Black Sheoak (Roberts & Ingram 1976); cypress-pines *Callitris* (Jones 1952; Gell 1977); paperbarks (Abbott 1976; Baxter 1981; Garnett & Bredl 1985; Halse *et al.* 1985), such as low open paperbark woodland to 5 m tall dominated by Yellow-barked Paperbark *Melaleuca nervosa* and Liniment Tree (Woinarski *et al.* 1988); or banksias (Halse *et al.* 1985; Possingham & Possingham 1997), such as coastal low forest 5–15 m tall dominated by Coast Banksia and Southern Mahogany with an understorey of shrubs (Smith 1984, 1985); or forests and woodlands dominated by combinations of these, such as, in Top End of NT, riverine habitats comprising combinations of screw-palms *Pandanus*, eucalypts (especially River Red Gum and Coolibah), paperbarks (such as Broad-leaved Tea-tree *Melaleuca viridiflora*, Cajuput, Weeping Paperbark and Silver-leaved Paperbark *M. argentea*), River Sheoak, Milky Box *Lophostemon lactifluus* and Northern Swamp Box *L. grandiflorus*, bamboo *Bambusa* and rainforest trees and shrubs such as Leichhardt Tree and figs *Ficus*, or low open woodland or forest dominated by Screw-Palm *Pandanus spiralis* and Fern-leaved Grevillea *Grevillea pteridifolia* (Crawford 1972, 1979; Woinarski *et al.* 1988, 2000). Sometimes occur at ecotone between open areas and woodlands or forests, or between different types of woodland or shrubland (Rix 1943; Possingham & Possingham 1997; Luck *et al.* 1999). Very occasionally in tall, open WET SCLEROPHYLL FOREST (Gosper 1992); or RAIN-FORESTS, such as monsoon or vine forest (Crawford 1972; Howe *et al.* 1981; Leach & Recher 1993). Sometimes recorded in SHRUBLANDS, such as samphire and saltbush shrublands (Matheson 1976); or low banksia woodland, which usually has a dense shrub layer <1 m tall (Halse *et al.* 1985). Also in Lignum bordering wetlands (Jones 1986). Occasionally in HEATHLAND, more often in semi-arid areas than near coast (Ford & Stone 1957; Recher 1975; Gell 1977; Halse *et al.* 1985; McFarland 1988; Possingham & Possingham 1997), e.g. on Marchagee Track, WA, found in disturbed areas of scrub-heath consisting of a diverse plant community with an open overstorey, growing to 2 m, and a closed lower layer 1 m tall (Halse *et al.* 1985). Often on beaches, often among beachcast seaweed or other tidal wrack, or exposed wave-cut platforms (Hindwood 1942; Longmore 1978; Draffan *et al.* 1983; Gosper 1983; Ashton & Ashton 2000; J.M. Peter); in coastal Sawtell, n. NSW, regularly on beaches, usually in or close to low grassy foredunes, or perched in shrubs or small trees immediately behind foredunes (P.J. Higgins). Sometimes also in mangrove habitats (Roberts & Ingram 1976; Smith *et al.* 1978; Gosper 1981; Draffan *et al.* 1983; Storr 19). Occasionally occur in exotic pine plantations (Friend 1982; Debus 1983).

DISTRIBUTION AND POPULATION Widespread from Moluccas, E through whole of New Guinea, to Solomon Is

(White & Bruce 1986; Blaber 1990; Coates 1990; Webb 1992), and widespread on mainland Aust.

Aust. Widespread throughout mainland except n. C. York Pen. (Aust. Atlas 1) and recorded on only three islands in Torres Str.: Boigu, Dauan and Saibai Is (Druffan *et al.* 1983).

Tas. Occasional visitor, mostly in N; breeding recorded once (see below). Sometimes occur on islands in Bass Str., e.g. King I., Trefoil I. (Hunter Grp), Furneaux Grp and Deal I. (Green 1969; Green & McGarvie 1971; McGarvie & Templeton 1974; Gray *et al.* 1987; Aust. Atlas 1; Tas. Bird Reps. 10, 14, 17). Published records on mainland since 1980 (all singles unless stated): Burnie, 8 May–5 Aug. 1980 (Tas. Bird Rep. 10); Anthony Beach, near Smithton, 24 Sept. 1980 (Tas. Bird Rep. 10); four, Circular Head, 25 Sept. 1981 (Tas. Bird Rep. 11); Andover, 15 June 1982 (Tas. Bird Rep. 12); C. Portland, 21 Apr. 1985 (Tas. Bird Rep. 15); Rostrevor Lagoon, 7 May 1986 (Tas. Bird Rep. 16); Boat Harbour, 10 July 1986 (Tas. Bird Rep. 16); 18 km W of Campbell Town, May 1987 (Green 1989; Tas. Bird Rep. 17); Table C., 9 Oct. 1993 (Tas. Bird Rep. 23); Woolnorth, 11 Apr. 1999 (J.R. Starks).

Lord Howe I. Vagrants recorded Oct. 1980 and 4 Sept.–6 Oct. 2000 (McAllan *et al.* 2004). Historical report of two birds, said to have been collected, in c. 1924 (Le Souëf 1924), considered doubtful (Hindwood 1940); and unconfirmed report from late 1960s (McAllan *et al.* 2004).

Chatham Is Vagrant, Mangere I., 27 Oct. 1999 (Gummer 2002); accepted by NZRBC (Medway 2001).

Breeding Probably throughout range. Most records from e. Aust., E and S of line joining Cairns, Qld, and Streaky Bay, SA; in central Aust.; and in WA, W of line joining sites near Esperance and Gregory Ra. Scattered records elsewhere (Aust. Atlas 1; NRS). Single record in Tas., at Cataract Gorge, Launceston, Dec. 1978 (Tas. Bird Rep. 8).

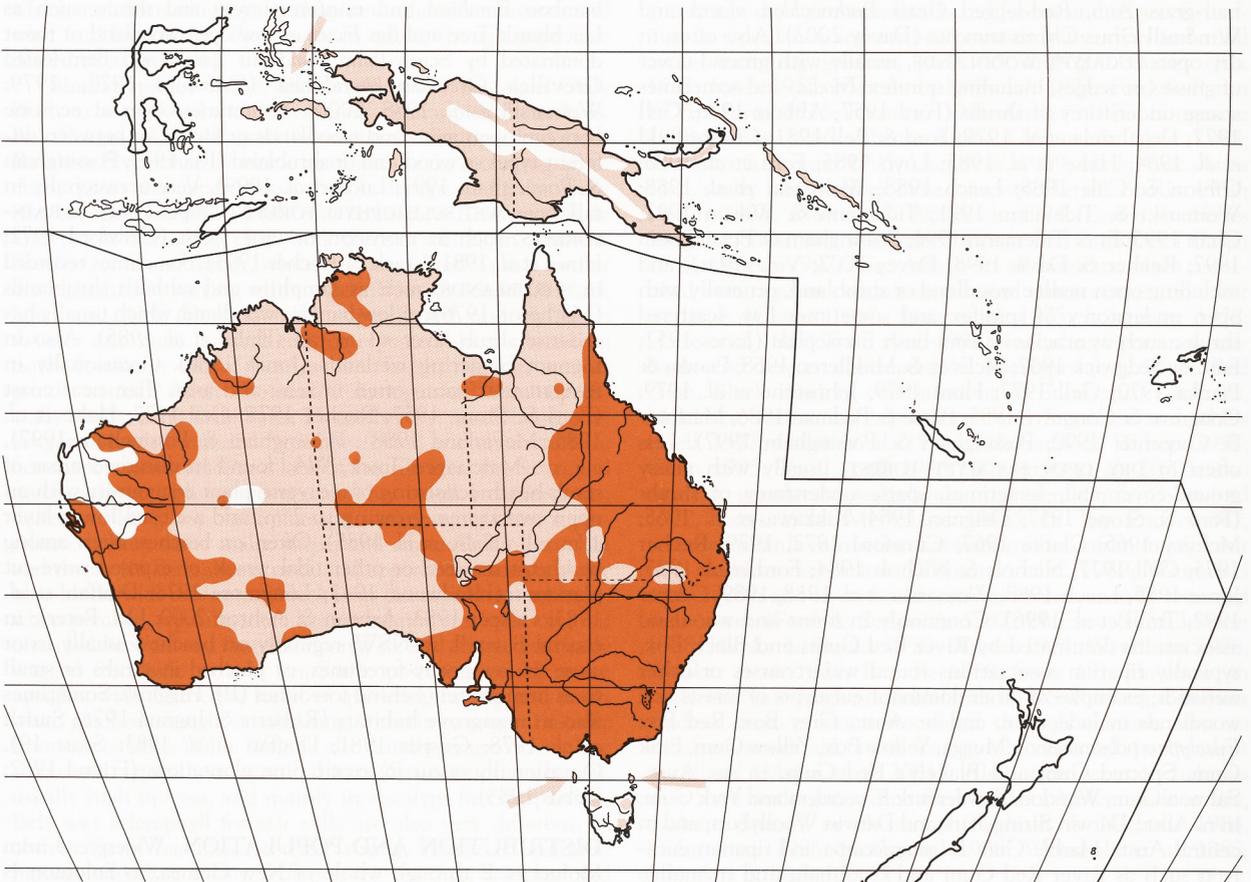
Introductions Unsuccessfully introduced to Hawaii in c. 1923, when 50 pairs imported (Anon. 1923a; Long 1981); some said to have persisted till 1937 (Long 1981).

Change in range, populations Populations in Aldinga Scrub CP, SA, declined after 1987 (Ashton 1996); and round Rutherglen, Vic., possibly declined in 1960s (McEvey 1965); said to be less common in Stirling Ra., WA, in 1960s than in early 1900s (Sedgwick 1964). Range expanded in Wheatbelt of s. WA after clearance of vegetation for agriculture (Saunders & Ingram 1995).

Populations RECORDED DENSITIES: At Corinda, Qld, 0.48 birds/ha (Walters 1985); Archerfield Airport, near Brisbane, c. 0.015 birds/ha (Woodall 1999b); near Armidale, NSW, 0.02–0.25 and 0.06–0.15 birds/ha (Ford & Bell 1981; Ford *et al.* 1985); Hawkesbury R., NSW, 0.2 birds/ha (Keast 1985a); Beverly Hills, Sydney, 1.33 breeding birds/ha (McFarland 1984); Cowra, NSW, 0.14–0.28 breeding birds/ha (Bourke 1949); near Canberra, 0.02 birds/ha (Bell 1980); Jamieson, Vic., 0.31 birds/ha (Aust. Atlas 1); Kangaroo L., Vic., 0.98 breeding birds/ha (Lowe 1959); Nullarbor Plain, WA, up to 0.4 birds/ha (Brooker *et al.* 1979); Margaret R., WA, 0.2 birds/ha (Keast 1985a); Wellard, WA, 0.13 birds/ha (Plumb 1948); L. Disappointment, WA, 0.006 birds/ha (Davies *et al.* 1988); S. Alligator R., NT, 0.9 birds/ha (Keast 1985a); Kakadu NP, NT, 0.4 birds/ha (Woinarski *et al.* 1989); Howards Pen., NT, 0.08–0.64 birds/ha (Woinarski *et al.* 1988; see Habitat for details); Yinberrie Hills, NT, mean of 0.29 birds/ha (Woinarski & Tidemann 1991).

Status Population in Torres Str. near threatened (Garnett & Crowley 2000).

THREATS AND HUMAN INTERACTIONS Has benefited from clearance of native vegetation and resultant



agricultural development as foraging opportunities have increased (Aust. Atlas 1; see Habitat, Food). Often killed by Cats (e.g. Anon. 1914; Ashby 1921; Chandler 1944; Boughtwood 1948b; Dowling *et al.* 1994). Sometimes struck by cars (Vestjens 1973; Brown *et al.* 1986; Lepschi 1992). Said to have been despised by Aborigines in Musgrave Ras as reputed to enter camps to hear what is said and then carry tales to other camps (McGilp 1935); also regarded as a liar and a tell-tale in Top End, and possibly elsewhere (Goodfellow 2001).

MOVEMENTS Probably largely sedentary throughout range, though mainly described as resident in literature (Morris *et al.* 1981; Storr 7, 19; see below); appear to defend territories throughout year (see Social Organization) and no evidence of large-scale seasonal movement (Griffioen & Clarke 2002; Aust. Atlas 1; Vic. Atlas). However, seasonal occurrence or changes in abundance reported in many areas, usually at same locations or within regions where considered sedentary or resident by other sources (see below); extent of such movements, if any, not clear but probably mostly local movements, particularly dispersal after breeding or seasonal shifts between habitats; further study needed. Broad-scale analysis of bird atlas and count data found strong evidence of local movements only (Griffioen & Clarke 2002). Altitudinal migration reported in high country of se. Aust. and locally in ne. NSW. Non-breeding occurrence on islands of Bass Str., Tas., single record in Chatham Is, NZ, and doubtful record for Lord Howe I. (see Distribution) indicate long-distance movement over broad stretches of ocean possible; also recorded as visitor or irregularly on many inshore islands round Aust. mainland (e.g. Heatwole 1968; see Distribution). Probably vagrant to Tas. mainland and Bass Str. Is (see below). Said to occur singly when on passage (Thomas 1968; Storr 16, 22) or in small parties (Storr 16, 22, 24, 28).

Widely described as resident or, less often, present throughout year, in regions throughout mainland Aust. However, seasonal or irregular occurrences, or changes in numbers, reported in many areas where populations also described as resident; often reported as autumn–winter visitor, in many areas of Qld, Tas., SA, WA and NT. Extent of movements involved in these fluctuations not known; at least some movements or changes in abundance are local movements, mainly to open habitats for autumn–winter, after breeding (see below). Only local or altitudinal movements reported for NSW and Vic. (see below). Occasionally described as nomadic, usually in non-breeding season (Hindwood & McGill 1958; Brooker & Estbergs 1976; Gibson 1977; Hoskin 1991), probably referring to local movements. Given wide overlap in somewhat contradictory statements for regions and states, and that there is no evidence of any large-scale seasonal movements (see above), information dealt with state by state.

Qld Described as generally resident (Storr 19): in NE (Bravery 1970; Gill 1970; Wieneke 1992), round Rockhampton in central-E (Longmore 1978), and in SE (Vernon 1968; Roberts & Ingram 1976; Leach & Hines 1987; Dawson *et al.* 1991; Durrant & MacRae 1994; Bielewicz & Bielewicz 1996); and W of Great Divide, at Meandarra (Whitmore *et al.* 1983). Present throughout year at Julia Ck (Bell 1971), Mt Isa (Horton 1975), Richmond (Berney 1905), Idalia NP (Sharp & Sewell 1995), and in parts of SE (Lord 1956a; Nielsen 1991). **MOVEMENTS:** Said to be autumn–winter visitor to parts of N and SE, moving N in Apr.–May, and S in late Aug. and Sept. (Storr 1973; Storr 19), though no evidence of any regular large-scale movements evident in detailed analyses of bird atlas and count data (as above); recorded during autumn–winter (within months Mar.–Sept. when stated) in Gulf Country, parts of C. York Pen., and in Atherton Region (Wet Tropics) (Jones 1983; Garnett & Cox 1988; Wieneke 1988, 1992; Griffin 1995; Britton 1997; Britton & Britton 2000; Storr 19; Qld Bird Rep. 1986), and in SE (Templeton 1992;

Woodall 1995, 1999b); on Peel I., mainly present Mar.–Aug. (Agnew 1913, 1921; Woodall 1999a). Resident population in Richmond district was augmented by a large influx Apr.–May 1904 (Berney 1905). Some movements considered local movements: round Mackay, breed in surrounding hills and move to coast in winter (Alexander 1926); and recorded moving into open habitats, including farmland, round Jandowae, in autumn–winter, leaving in Aug.–Sept. (Nielsen 1964). **NSW** Considered resident throughout (Morris *et al.* 1981), on and E of Great Divide from Qld to Vic., including Greater Sydney Region (Kikkawa *et al.* 1965; Gibson 1977; Winterbottom 1981; McFarland 1984; Morris 1986, 1989; Holmes 1987; Smith & Chafer 1987; Hoskin 1991; Leishman 1994; Egan *et al.* 1997), and W of Great Divide, including SW (Chenery & Morgan 1920; Althofer 1934; Chisholm 1938; Hobbs 1961; Schmidt 1978; Costello 1981; Henle 1989). Present throughout year round Richmond and Hunter Rs (Gosper 1981), near Bega (Smith 1984) and in Riverina (Gubanyi 1910). Recorded moving locally into open areas in autumn–winter in ne. NSW, round Richmond R. and Five Day Ck Valley (Gosper 1981; Cameron 1985), and round Hunter R., NSW (Gosper 1981). Further, considered mainly a summer visitor to Inverell (Baldwin 1975) and Comboyne Plateau (Chisholm 1934). **Vic.** Resident in Gippsland (Bedgood 1980; Burbidge 1985; Anon. 1989, 1992; Dow & Dow 1989; Hall & Hall 1990; Rolland & Rolland 1996a,b), North-East (McEvey 1965; Traill *et al.* 1996), Central (Campbell 1937; Hore-Lacy 1964; Thomas 1968; Mitchell & Mitchell 1975; Fleming 1976; Price 1977; Thomas & Wheeler 1983; Humphreys 1986; Dunn 1989; Hewish 1998; Twaits 1998a,b), Northern Country (Rowley 1961; Bedgood 1973; Roberts 1975; BFNC 1976) and Western Districts (Brown 1950b; Hirth 1976). Round Ballarat, local movements recorded spring and summer (Thomas & Wheeler 1983). **Tas.** Little information, but probably vagrant to n. Tas. mainland and Bass Str. Is. Dated records since 1980 all Apr.–Oct., and mainly of singles (see Distribution). Described as rarely crossing Bass Str. to Tas. (Sharland 1958). Described as accidental to Tas. mainland, and suggested that the few records are of storm-blown or ship-assisted individuals (Green 1989). Concentration of records Apr.–Sept suggests this species may be very rare autumn–spring visitor to Bass Str. Is and n. Tas. (McGarvie & Templeton 1974; Gray *et al.* 1987; Aust. Atlas 2; Tas Bird Reps 2, 10, 14, 17; see Distribution). **SA** Resident in SE (Symon 1946; Mack 1961; Clarke 1967; Cox 1973; Ford & Paton 1976; Paton 1976; Rix 1976; Whatmough 1978; Baxter 1980; D.C. Paton & J.B. Paton 1980; Saunders 1983; Ashton 1985, 1987, 1996), including Kangaroo I. (Baxter & Berris 1995), and Cortlinye Water Reserve, n. Eyre Pen. (Leiblich 1971), Roxby Downs in N (Read *et al.* 2000) and Davenport Ra. (Gee *et al.* 1996). Also said to be present throughout year in s. and w. L. Eyre Drainage Basin (Badman 1979), in NW (Close & Jaensch 1984) and on Le Fevre Pen., Adelaide (Winslet & Winslet 1987). Winter influxes recorded in L. Eyre Drainage Basin in NE (Reese 1924, 1928a,b; Badman 1989) and round Mannum, Murray–Mallee Region (Cox 1973). **WA** Resident in nearly all regions, in Eucla Div. (Congreve & Congreve 1985; Dymond 1988; Ashton *et al.* 1996; Storr 27); South-West Div., including many locations in Wheatbelt and Swan Coastal Plain (Hill 1904; Alexander 1921; Sedgwick 1940, 1988a; Serventy 1948; Robinson 1951; Watson 1959; Abbott 1980; Brown & Brown 1981, 1987; Saunders & de Rebeira 1991; Mawson & Massam 1995; Saunders & Ingram 1995; Storr 28, 35); Pilbara Region (Lindgren 1961; Howard 1986); Kimberley Div. (Hill 1911; Slater 1959; Johnstone & Smith 1981; Johnstone 1983; Collins 1995; Storr 11); North-East Interior (Storr 1981); and Mid-Eastern Interior Region (Moriarty 1972; Storr 22). Present throughout year on Nullarbor Plain (Brooker *et al.* 1979), on Culeenup and

Jeegarnyeejip Is (Serventy 1970) and near Marchagee, in Wheatbelt N of Perth (Halse *et al.* 1985). **MOVEMENTS:** Resident populations augmented by autumn–winter visitors (within months Apr.–Oct. when stated) or passage migrants in nearly all regions: in Eucla Div. (Storr 27); South-West Division including Swan Coastal Plain (Storr 28, 35); Gascoyne Region (Storr 21); Pilbara Region (Carter 1903; Johnstone 1983; Storr 16); Kimberley Div., especially sw. coastal plains (Johnstone & Smith 1981; Storr 11); North-East Interior Region (Storr 1981); and in Mid-Eastern Interior (Storr 22). Conversely, in South-East Interior, more common in spring and summer than at other times (Storr 26). Also recorded on passage at Houtman Abrolhos, May and Aug. (Storr 24); and at Bickley, on Swan Coastal Plain, said to occur only in autumn and spring (Serventy 1948). NT Partly resident (Storr 7), e.g. resident in parts of Top End, including Keep R. NP (McKean 1985), Darwin area (Crawford 1972, 1979), and Lower McArthur R. (Schodde 1976). However, also described as largely winter (dry season) visitor to n. NT, Apr.–July (Storr 7) or numbers higher in dry season (Woinarski *et al.* 2000), including at Port Keats, Cobourg Pen., Darwin and Mt Bundeley (Ashby 1906; Frith & Calaby 1974; H.A.F. Thompson & D.K. Goodfellow); also said to vacate coastal areas of Top End in wet season (Storr 1967). Round Darwin, also said to leave open forest in wet season (Crawford 1979).

Some apparent altitudinal movements noted. In Five Day Ck Valley, ne. NSW, move to lower altitudes in winter (Cameron 1985). In ACT, summer visitor at altitudes >800 m asl, moving from higher elevations towards lower altitudes in Apr.–May, and returning in Aug.–Sept.; seen on passage in lowlands in autumn and spring (Lamm & Calaby 1950; ACT Atlas). Also recorded on passage in Thredbo Valley, s. NSW, in Aug.–Sept. and Jan.–Apr. (Gall & Longmore 1978). Extraliminally, considered resident in parts of PNG (Mackay 1970; Bell 1982; Murray 1988), though may leave some areas in dry season (Beehler *et al.* 1986); considered breeding visitor to some areas in e. Highlands (Diamond 1972) and rare visitor to some areas (Bell 1984; Mack & Wright 1996).

Banding Of 6248 banded in Aust., New Guinea and sw. Pacific, 1953–2001, 584 recoveries (9.3%). Of 360 recoveries, of 273 birds, July 1984–Aug. 2001: 358 (99.4%) <10 km from banding site; and two (0.6%), 10–49 km (ABBBS). **LONGEVITY:** Adult banded near Sutherlands, SA, 17 Oct. 1964, retrapped at banding place over 9 years 4 months later (ABBBS 1974). **BANDING STUDIES:** At Humewood–Beulah Forest, near Campbelltown, NSW, 1973–93, eight banded, with no recaptures (Leishman 1994). At Rotamah I. Bird Observatory, Vic., 1980–96, five banded, none retrapped; none captured since 1984 (Burbidge 1982, 1985). At Middlesex Field Study Centre, near Manjimup, WA, 1972–91, 256 banded, with 32 retraps (12.5%); oldest retrap, adult male banded 31 May 1984, retrapped at banding place over 5 years 7 months later (Brown & Brown 1991). At Smiths Brook, near Manjimup, WA, 1977–80, 14 banded, with six retrapped (42.9%) (Brown & Brown 1981). At Durokoppin, near Kellerberrin, WA, 50 banded and five retrapped (10.0%), including one retrapped 7 km from banding site; longest survival, 36 months (Saunders & de Rebeira 1991).

FOOD Invertebrates, mainly insects; single record of seeds.

Behaviour Mainly terrestrial, but sometimes arboreal. Flit restlessly or perch on vantage points, darting after prey which is taken aerially, on ground, or from foliage, branches or trunks of trees; prey sometimes flushed by movement of wings or sideways movement of tail (Anon. 1914; Gannon 1932; Rix 1943; Boehm 1962; Goodwin 1967; Gregory 1967; Harrison 1976; Cameron 1985; Ford *et al.* 1986; Brooker *et al.* 1990; Jackson & Elgar 1993; Er 1997; Recher & Davis 1997, 1998; Rose

1999; North; Hall; Aust. Atlas 1). **DETAILED STUDIES:** In Five Day Ck Valley, New England Tableland, n. NSW (Cameron 1985); in Imbota NR, near Armidale, n. NSW, 1981–82 and 1984 (Ford *et al.* 1986); in three large parks in suburban Melbourne, May–Sept. 1994 (Webb-Pullman & Elgar 1998) and Jan.–Mar. 1992 (Jackson & Elgar 1993); at Dryandra, WA, 6–15 Aug. 1995 (Recher & Davis 1998); in Kakadu NP, NT (Brooker *et al.* 1990); and on Hamilton Downs Stn, NT (Recher & Davis 1997). **FORAGING ASSOCIATIONS:** Mostly forage singly or in twos; occasionally in family parties or small loose parties or flocks of up to 12, and, exceptionally, up to 40 birds in autumn–winter non-breeding season (e.g. Baldwin 1975; Longmore 1978; Donohoe 1985; Templeton 1992; Hall; Aust. Atlas 1; Storr 22, 26, 28; see Social Organization), e.g. 11 birds seen foraging in low hedge infested with leafhoppers (Glover 1967), 21 birds feeding in loose flock among grazing cattle (NSW Bird Rep. 1980), and 37 birds seen in area of c. 50 m diameter, some feeding on insects abundant on lawn (Gregory 1967). Where resident, maintain all-purpose territories throughout year, with defence most intense during breeding season but with almost exclusive use as feeding area for rest of year (McFarland 1984; Goodey & Lill 1993; see Social Organization). **INTERACTIONS WITH OTHER SPECIES:** Often feed in association with large mammals, especially farm animals, such as Cattle, Horses and Sheep; often hover round them or use them as a vantage perch from which to sally for prey disturbed by them (e.g. McIlwraith 1901; Milligan 1902, 1905; A.S. Le Souëf 1904; Anon. 1914; Bryant 1919; Chisholm 1927; Cameron 1932; Chisholm 1936, 1940; Hyem 1936; Boehm 1948; Boughtwood 1948a; Lord 1956a; Wheeler 1959; Immelmann 1960; Jenkins & Ford 1960; Wheeler 1963; Bravery 1970; Harrison 1976; Gibson 1977; Boekel 1980; Jones 1981; Cameron 1985; Brown & Brown 1989; Goodfellow 2001; Campbell; North; Hall; Serventy & Whittell). Also similarly associate with other large animals, such as kangaroos, Emus *Dromaius novaehollandiae* and, sometimes, people (Boughtwood 1948a; Goodfellow 2001; Hall); once observed riding on back of Short-beaked Echidna *Tachyglossus aculeatus* and foraging round it (J.M. Peter). Often observed feeding on ectoparasites from skin of Cattle and occasionally Pigs, and very occasionally recorded doing so on sleeping Lions *Panthera leo* in zoo (McIlwraith 1901; Le Souëf 1917; Le Souëf 1920; Lord 1956a; Bravery 1970; Bedgood 2000). Once recorded foraging in association with flock of White-winged Choughs *Corcorax melanorhamphos*, catching insects disturbed by them (McCulloch 1968). **MIXED-SPECIES FEEDING FLOCKS:** Sometimes in mixed-species feeding flocks of small passerines (Goodwin 1967; Sedgwick 1988b; Britton 1997; Hall), though in some areas or habitats not recorded in such flocks, e.g. in study near Armidale (Cameron 1985). Near Charters Towers, n. Qld, present in 87% of 127 mixed-species feeding flocks (mean flock-size 32.8 birds, comprising mean 8.3 species), May–July, with mean of 2.7 Wagtails/flock (1–7); such feeding flocks dominated by Striated Pardalotes *Pardalotus striatus*, Rufous Whistlers *Pachycephala rufiventris*, Weebills *Smicromis brevirostris* and Yellow-rumped Thornbills *Acanthiza chrysorrhoa*, and often contained other small insectivorous species. In s. Qld, present in ten of 16 mixed-species feeding flocks (mean flock 16.2 birds, 5.6 species), June–July, with mean of 1.2 Wagtails/flock (1–2); flocks comprised combinations of at least 14 other small insectivorous species, mainly Red-capped Robins *Petroica goodenovii*, Rufous Whistlers and Black-faced Woodswallows *Artamus cinereus* (Britton 1997). In sw. WA, recorded in 10% of 73 flocks 1939–53, which usually dominated by thornbills, and attracted many (2–13) other small insectivorous species (Sedgwick 1949b, 1956). At Bolgart, WA, often in mixed-species feeding flocks in winter; flocks often comprise Yellow-rumped, Chestnut-rumped *Acanthiza*

uropygialis and Brown A. *pusilla* Thornbills, Weebills, Grey Fantails, Singing *Lichenostomus virescens* and Brown *Lichmera indistincta* Honeyeaters, and occasionally Scarlet Robins *Petroica multicolor* and Varied Sittellas *Daphoenositta chrysoptera* (Erickson 1951). **FORAGING HEIGHTS:** Forage mostly on or close to ground (Cameron 1985; Ford *et al.* 1986; Brooker *et al.* 1990), but seen to sally up to c. 75 m above ground to catch an insect (Boehm 1962). In Five Day Ck Valley, (n=1230 obs. foraging in Oct.–Mar., and 693 in Apr.–Sept.; figures approximate, estimated from graph), mostly foraged below 3 m; in Oct.–Mar., 26% of perches from which foraging initiated were on ground; in Apr.–Sept., proportion of perches on ground increased to 42% (and between July and Sept., 90% of foraging observations were within 10 cm of ground). In Oct.–Mar., 80% within 3 m of ground, in Apr.–Sept., 86%; 9% and 5% at 3.1–6 m; 4% and 4% at 6.1–9 m; 2% and 1% at 9.1–12 m; <1% and 1% at 12.1–15 m; 2% and 1% at 15.1–18 m; and 2% and 1% >18.1 m. At Imbota NR, of 192 observations of foraging: 22.8% on ground; 50.8%, 1–2 m above ground; 13.0%, 3–5 m; 10.9%, 6–9 m; 2.1%, 10–14 m; and 0.5%, >15 m. At Dryandra, of 71 observations of foraging: 77% on ground; 19%, 0.2–1 m above ground; 4%, 1.1–5 m; and none seen feeding >5 m. In open forest and woodland in Kakadu NP, foraged at similar levels in both dry (Aug.–Nov.) and wet (Jan.–Apr.) seasons; of 75 observations of foraging in dry and wet seasons combined (see paper for each separately): 25.3% on ground; 20% up to 1 m above ground; 21.3%, 2–3 m; 18.7%, 4–7 m; 9.3%, 8–14 m; and 5.3%, >14 m; of 15 observations in monsoon forest during dry season only: 33% on ground; 53%, 1 m above ground; 7%, 2–3 m; and 7%, 4–7 m. On Hamilton Downs Stn, mean height of foraging 0.2 m (0.9; 44 obs. foraging). **FORAGING SITES:** Forage mostly in air, though also on ground; usually stay near perch, such as a tree, shrub or fence post, from which can sally for prey (Anon. 1914; Gannon 1932; Harrison 1976; Rose 1999; Hall). In Five Day Ck Valley, mostly foraged round trees and shrubs, and most perches used when foraging were exposed distal branches >5 mm in diameter; in winter, rarely perched in trees, but often perched on logs, fences, rocks, sticks on ground or on ground. Of 234 observations of foraging Oct.–Mar., and 66 in Apr.–Sept. (excluding foraging on ground; see Foraging Heights): in Oct.–Mar, 27% in outer foliage and in Apr.–Sept., 20% in outer foliage, 35% and 42% in distal branches, 18% and 14% in proximal branches; and 21% and 24% on trunks of trees. Birds also foraged along creek banks and in grassy clearings, but rarely among bracken. Also in Five Day Ck Valley, used variety of perches from which to launch sallies for prey; of 1215 perches used throughout year: 6% among sclerophyllous foliage, e.g. of eucalypts and acacias; 11% among mesophyllous foliage, mostly understorey plants; 3% among needle-like foliage, such as that of casuarinas; 10% in dead plants; 8% in tall shrubs; 4% in low shrubs; 16% on logs, stumps or fences; and 42% on fallen sticks, rocks, cow-pats or ground. In Imbota NR, of 192 observations of foraging: 64.2% in air, 21.9% on ground (including 3.2% on bare ground, 0.5% among leaf-litter, and 18.2% among grass), 7.5% among foliage, 5.4% from branches, and 1.1% from trunks of trees. In Imbota, of 192 observations of foraging, prey taken from: air, bare ground or litter (68.3%); among grass (18.3%) and from eucalypts, including Broad-leaved Stringybark (7.5%), Blakely's Red Gum (1.6%), and Manna Gum (1.1%); and from bipinnate acacias (3.2%), mostly Fern-leaf Wattle *Acacia filicifolia*. At Dryandra, (n=18 foraging obs.), foraged on ground (44%), in air (39%), and among foliage (17%). In open forest and woodland in Kakadu NP, foraging substrates similar in both dry (Aug.–Nov.) and wet (Jan.–Apr.) seasons; of 75 observations of foraging in dry and wet seasons combined (see paper for each separately): 49.3% in air, 22.7% on ground, 17.3% among foliage, 9.3% from trunks of trees, and

1.3% from dead branches; of 15 observations in monsoon forest during dry season only: 40% in air, 33% on ground, 7% from tree-trunks, 7% from branches, 7% from vines, and 7% in shrubs. On Hamilton Downs Stn (n=44 obs. foraging), foraged on ground (82%) and in air (18%). On Culeenup I., WA, of 26 obs. foraging: 55% in air, 35% on ground and 10% from trunks and branches of saplings (Keast 1975). In Kakadu NP, when feeding in Screw-Palms *Pandanus spiralis*, foraged among green foliage or dead leaves and from trunk (Verbeek *et al.* 1993). Seen to sally for flying insects above surface of water, or insects floating on surface of water; once recorded diving, head first, to collect floating prey (Carter 1924); or also feed on flying insects along channels (Bailey 1934). Once seen sallying for flying insects above lagoon, where it rested on floating leaves of water lilies between sallies (Storr 1953). Observed feeding on insects flying round street lights in evening (Favaloro 1931a), and, at side of road, collecting insects disturbed by passing cars (Rix 1945). Said to pick spiders from walls of buildings (Aust. RD). **FORAGING METHODS:** Search for prey from vantage-perches or ground, then attack by sallying or flush-pursuit, or leaping. However, in most detailed studies and general observations, flush-pursuit not distinguished as a separate method, being combined within other methods, such as sallying or gleaning (e.g. Ford *et al.* 1986; Recher & Davis 1997, 1998) or being treated as a search method (Cameron 1985; Brooker *et al.* 1990), while recognizing flush-pursuit as a separate foraging method, combined flutter-chase within it. **Search** Watch for prey from vantage-perch, returning to same perch after attack, or move actively, searching for prey and pursuing it (Cameron 1985; Recher & Davis 1997; North). Further, wing-flashing (opening and closing of wings) and wagging of tail while bird stands still thought to disturb and flush prey (Goodwin 1967; Jackson & Elgar 1993). In suburban Melbourne, rates of tail-wagging and running were significantly higher when on ground than on a perch; also, when foraging in sunshine, wagged tail at less than half the rate of birds foraging in shade or in overcast weather, probably reflecting ease with which prey could be flushed on sunny days (Jackson & Elgar 1993). In Five Day Ck Valley, used two methods of searching: (1) Remain on vantage-perch while surveying surroundings for prey, often wagging tail; and (2) search for prey while continuously moving. Most prey detected by first method, from low vantage-perches such as rocks, logs and dried cow-pats and, less often, from trees or shrubs; sometimes perched almost motionless for up to 15 min and rate of change of perch was low (4–5 perches/min; cf. Grey and Rufous *Rhipidura rufifrons* Fantails; see those texts). After locating prey, sometimes fly strongly 10–15 m in straight line to catch single insect, though pursuit-flights from vantage-perches often include diagonal loops, dives, steep ascending cones and horizontal sweeps over water or grass. When foraging by second method, continuous movement, mostly searched on ground, birds covering ≥ 20 m in zigzagging series of runs, hops and low sweeps, often flashing wings and fanning tail while foraging. **Attack** Forage mostly by sallying and flush-pursuit, and occasionally by gleaning (see below and note comments above re Foraging methods). Also attack by leaping (labelled snapping by authors), catching prey in air while remaining on ground (Webb-Pullman & Elgar 1998). In Five Day Ck Valley, foraged by gleaning and sallying, proportions of which varied seasonally (see Table 1): for most of year (Oct.–June), most prey caught by sallying, with c. 15% of observations by gleaning during Oct.–Mar. increasing to c. 25% during Apr.–June; in July–Sept., most prey (72%) caught by gleaning. However, data from Five Day Ck Valley on attack and search behaviour (Cameron 1985) include what HANZAB defines as flush-pursuit, and this not represented. In Imbota NR (n=192 obs. foraging), foraged mainly by sallying (80.3% of obs.) (including 62.5% by sally-striking in air, 16.2% by

sally-striking on vegetation and 1.6% by sally-pouncing onto ground) and with rest by gleaning (19.8%). At Dryandra, of 17 observations of foraging: 55% by gleaning; and 45% by sallying (including 39% sally-striking in air, 3% sally-striking on vegetation and 3% sally-pouncing onto ground); flush-pursuit probably included within these categories. In Kakadu NP, of 89 foraging observations: 62% by sallying (including 22% sally-striking on foliage, 37% sally-striking in air and 3% sally-hovering); 34% by flush-pursuit (including some flutter-chasing); 2% by gleaning; and 1% by probing. On Hamilton Downs Stn (n=100 obs. foraging), foraged by gleaning (82%) and by sallying into air (18%). Once observed clinging to bark on trunk of River Red Gum, pecking bark as it ascended tree (J.M. Peter). **KLEPTOPARASITISM:** When in mixed-species feeding flocks, often steal food from smaller species, such as thornbills (Goodwin 1967; Hall). Once attempted to steal moth from female Hooded Robin *Melanodryas cucullata* (Sullivan 1993). In PNG, once seen stealing insect from Sacred Kingfisher *Todiramphus sanctus* (Clapp 1982). **RATES OF FORAGING:** Seasonal rates of foraging (attack) in Five Day Ck Valley were: Oct.–Dec., 2.0 captures/min (1.6; 0.1–6; 60); Jan.–Mar., 1.8 (1.5; 0.1–9; 72); Apr.–June, 1.5 (1.0; 0.1–4; 28); and July–Sept., 2.2 (1.8; 0.1–8; 12); mean rate of capture when foraging in association with Cattle was 2.13 insects/min. **FOOD HANDLING:** Hold down large prey with feet; pull off wings, then tear out edible material with bill, before eating (Hyem 1936; Terrill 1944; Immelmann 1960). When feeding on butterflies, held body and bashed it against bare ground or concrete till its wings fell off and then ate body (Woodall 2001). Once, immature bird captured large dragonfly (63.5 mm long), bashed it against dead branch till its wings fell off, then swallowed it whole over c. 5 min (Rix 1976). In suburban Perth, handling time of grasshopper prey increased with prey size/age: for male grasshoppers, from 0.4 s (n=1) for first instar nymphs to 15.3 s (11.00; 6) for fifth instar nymph, and 122.2 s (55.00; 4) for adults (seventh instar); and for females from 0.44 s (0.04; 5) for first instar nymph to 103.7 s (34.03; 3) for sixth instar nymph and not observed taking adult (seventh instar) females (Maxwell & Calver 1998). **TIMES OF FORAGING:**

Foraging behaviour during day in suburban Melbourne summarized in Table 2; there were significant differences in rates of use of all behaviours other than gleaning during day. Rate of tail-wagging higher in early morning and late afternoon than middle of day, while rate of wing-flashing highest from mid-morning to mid-afternoon. Rate of snapping (= leaping) highest from mid-morning to mid-afternoon; and rate of flush-pursuit increased during morning and fluctuated slightly for rest of day (Webb-Pullman & Elgar 1998). **DRINKING:** In arid and semi-arid areas, observed drinking from bores (Davies 1972), a water-trough (D.C. Paton & P.A. Paton 1980) and a puddle (Sedgwick 1971).

Detailed studies At L. COWAL, NSW (eight stomachs; Vestjens 1977): **Plants** MONOCOTYLEDONS: Poaceae sds 12.5% freq. **Animals** INSECTS: Coleoptera: Carabidae 50; Dytiscidae 50; Scarabaeidae 12.5; Curculionidae 37.5; Diptera 37.5; Hemiptera 12.5; Corixidae 12.5; Hymenoptera: Formicidae 12.5; Orthoptera: grasshoppers 12.5.

In FIVE DAY CK VALLEY, N. NSW (309 items from 18 stomachs; Cameron 1985): **SPIDERS** 2% no. **INSECTS:** Coleoptera 14; Diptera (including Muscidae, Tabanidae) 18; Ephemeroptera 1; Hemiptera 4; Hymenoptera: wasps, bees, ants 44; Lepidoptera: ads, larv. 5; Odonata: dragonflies, damselflies 2; Orthoptera: grasshoppers, crickets 10.

At MURDOCH UNIVERSITY, PERTH (629 items from c. 403 droppings Dec. 1992 and Jan. and Mar. 1993; Adriano & Calver 1995): **SPIDERS** 9.2% no. **INSECTS:** Unident. 20.7; Coleoptera 15.9; Diptera 12.1; Hemiptera 6.8; Hymenoptera: wasps 18.0; Formicidae 16.4; Odonata: dragonflies 0.9. Scales of Lepidoptera were present in every sample but numbers could not be quantified.

Other records **Animals** ANNELIDS: Oligochaetes⁴⁰. **TICKS**^{1,7,22,27,33,40}. **SPIDERS**^{29,44}. **INSECTS**^{3,5,9,12,32,40,41,42,43}: Blattodea: cockroaches⁴⁴; Coleoptera^{4,9,28,29,40,41,42,43}; Carabidae: *Notonomus*⁴⁴; Chrysomelidae⁴⁴; Coccinellidae: *Rhyzobius*⁴²; Curculionidae⁴⁴; Hesteridae⁴⁴; Scarabaeidae⁴⁴; *Onthophagus granulatus*³³; Staphylinidae³⁶; Tenebrionidae: *Tenebrio* larv.²⁰; Diptera: larv.⁸, ads^{10,40,41,44}; Asilidae⁴¹; Calliphoridae²⁹; *Calliphora stygia*³⁶; Coelopidae²⁶; Culicidae^{10,44}; *Aedes notoscripta*¹⁶; Dolichopodidae²⁹; Muscidae^{29,33,36}; *Australophyra rostrata*³⁶; *Musca domestica*³⁶; Oestridae: larv.²; Syrphidae: *Syrphus viridoceps*⁴⁴; Tabanidae³³; Hemiptera⁴²; Berytidae⁴⁴; Cicadidae⁴⁴; Pentatomidae⁴⁴; Psyllidae: *Cardiaspina albixtura*²⁴; Hymenoptera: wasps^{29,42,44}; Formicidae^{11,25,30,41,43,44}; *Camponotus*⁴⁴; *Iridomyrmex*⁴⁴; *I. purpureus*⁴⁴; Ichneumonidae⁴⁴; Lepidoptera^{9,14,19,23,25,40,42}; Hesperidae: *Cephrenes augiades*³⁵; Lycaenidae³⁴; *Zizina labradus*³⁶; Noctuidae: *Helicoverpa armigera*¹³; Nymphalidae: *Heteronympha merope*^{18,34,36,37}; *Hypolimnas bolina*³⁹; *Melanitis leda*³⁹; *Vanessa itea*³⁶; *V. kershawi*¹⁸; Pieridae: *Belenois java teutonia*²⁹; Odonata: dragonflies^{15,30,31}; Orthoptera: crickets⁴; Acrididae: *Acrida conica* nymph³⁸; *Chortoicetes terminifera*²¹; Phthiraptera: Haematopinidae: *Haematopinus suis*⁶. **FISH:** Cyprinidae: goldfish *Cyprinus*^{8,17}. **Other matter** Breadcrumbs⁴⁰; pieces of biscuit⁸.

Table 1. Seasonal use (% of total observations) of foraging methods in Five Day Ck Valley (Cameron 1985). Sally-strike includes strikes in air and on hard substrates. Some figures approximate, estimated from graphs. N= number of foraging observations.

	SEASON			
	Oct.–Dec.	Jan.–Mar.	Apr.–June	July–Sept.
SALLYING	c. 85	c. 83	c. 75	28
Sally-hover	c. 15	c. 15	c. 13	2
Sally-strike	70	c. 68	c. 62	26
GLEANING	c. 15	c. 17	c. 25	72
N	185	340	161	99

Table 2. Foraging behaviours during five periods of day. Figures are mean number of observations of that behaviour per min (\pm SE); N= number of foraging observations (Webb-Pullman & Elgar 1998).

Foraging behaviour	Time of day				
	Early morning	Mid-morning	Midday	Mid-afternoon	Late afternoon
Tail-wags	16.4 \pm 1.2	10.1 \pm 0.9	10.4 \pm 0.9	9.0 \pm 0.8	16.0 \pm 1.1
Wing-flashes	0.5 \pm 0.2	5.5 \pm 0.6	5.3 \pm 0.6	5.8 \pm 0.6	1.9 \pm 0.4
Cleans	12.5 \pm 0.9	12.5 \pm 1.2	9.2 \pm 0.9	13.0 \pm 1.3	12.8 \pm 1.1
Snaps	0.1 \pm 0.1	1.0 \pm 0.1	1.2 \pm 0.2	1.2 \pm 0.1	0.5 \pm 0.1
Flush-pursuits	0.5 \pm 0.1	2.5 \pm 0.3	2.1 \pm 0.2	2.5 \pm 0.2	2.1 \pm 0.2
N	97	118	97	102	107

REFERENCES: ¹ McIlwraith 1901; ² Milligan 1905; ³ Mathews 1909a; ⁴ Mathews 1909b; ⁵ White 1917; ⁶ Le Souëf 1920; ⁷ Alexander 1926; ⁸ Sutton 1926a; Favaloro ⁹ 1931a; ¹⁰ 1931b; ¹¹ Ashby 1932; ¹² Gannon 1932; ¹³ Chisholm 1934; ¹⁴ Hyem 1936; Cleland ¹⁵ 1937, ¹⁶ 1943; ¹⁷ Anon. 1938; ¹⁸ Simmonds 1943; ¹⁹ Terrill 1944; ²⁰ Haggard 1945; ²¹ Basse & Condon 1948; Lord ²² 1956a; ²³ 1956b; ²⁴ Clark 1964; ²⁵ Bedgood 1965; ²⁶ Jenkins 1968; ²⁷ Bravery 1970; ²⁸ Matthiessen 1973; Rose ²⁹ 1973, ³⁰ 1999; ³¹ Rix 1976; ³² Boekel 1980; ³³ Cameron 1985; ³⁴ Faithfull 1988; ³⁵ Hutchinson 1988; ³⁶ Lepshi 1993; ³⁷ Braby 1994; ³⁸ Maxwell & Calver 1998; ³⁹ Woodall 2001; ⁴⁰ North; ⁴¹ Cleland; ⁴² Lea & Gray; ⁴³ Hall; ⁴⁴ FAB.

For foraging behaviour and food for PNG, see Bulmer (1966), Clapp (1982) and detailed study by Dyrzc & Flinks (1995).

Young Fed by both parents, though broods sometimes divided and, sometimes, when one parent re-nesting, other parent feeds young of first brood; feeding of young declines about 2 weeks after fledging (see Social Organization, Breeding). Usually fed for 12 days after fledging; thereafter, young able to feed themselves, though still fed by parents till 17 days after leaving nest; young not observed being fed after Day 17 (Roberts 1942; Grant 1966; Quinn 1966; McFarland 1984). At Becroft, NSW, parents made 21 visits in 44 min (Roberts 1942). At Werribee, no significant difference in rates of feeding by adult males and females: male made 8.1 feeding visits/h to nestlings early in nestling period and 13.7 visits/h late in period; females made 7.8 visits/h early in nestling period and 11.97 late in period. Fledgelings also fed often, with up to 7.2 feeds/h/young by male and 10.0 by female (Goodey & Lill 1993; see Breeding for further details). In suburban Perth, single unsexed bird collected grasshopper *Acrida conica* nymphs and carried them c. 4 m to feed young; when prey collected >4 m from young, prey eaten rather than taken back to young. This bird also accepted grasshoppers from observer (prey had been weighed, sexed and measured beforehand) with larger prey carried to young, while smaller prey eaten on spot. Before feeding them to young, adults killed or stunned grasshoppers by beating them (Maxwell & Calver 1998).

No detailed studies of diet of young in Aust. Recorded being fed: SPIDERS². INSECTS: Lepidoptera¹; Odonata: damselflies²; Orthoptera: Acrididae: *Acrida conica*³. (REFERENCES: ¹ Roberts 1942; ² Vestjens 1977; ³ Maxwell & Calver 1998.)

For feeding and food of young in PNG, see Dyrzc (1994) and Dyrzc & Flinks (1995).

Intake At Perth, WA, mean length of insect prey 3.9 mm (<1–16.4; 449 items) (Adriano & Calver 1995). From published summary from sites in ne. NSW, sw. WA and PNG, length of prey ranged from 1 to \geq 30 mm, and dry weight from 0.03 to 226.13 mg. In suburban Perth, WA, estimated energy return from feeding on grasshoppers *Acrida conica* ranged from 21.37 kJ/min (9.11; 3) when feeding on male second instar nymphs to 1.09 kJ/min (0.64; 4) from adult males, and from 12.68 kJ/min (6.84; 9) for female third instar nymphs to 2.36 kJ/min (0.78; 3) for female sixth instar nymphs (Maxwell & Calver 1998). In PNG, adults consumed smaller prey (1–15 mm long) than that offered to nestlings (1–30+ mm long) (Dyrzc & Flinks 1995).

SOCIAL ORGANIZATION Well known, with detailed studies of: breeding in e. and s. Aust. (Marchant 1974); foraging ecology and habitat preferences in Five Day Creek Valley, n. NSW (Cameron 1985); breeding and behaviour of two pairs over 2 years in Sydney (McFarland 1984); parental care over four breeding seasons at Western Treatment Plant, Werribee, Vic. (Goodey & Lill 1993); and observations of colour-marked breeding pairs near Manjimup, sw. WA (Brown & Brown 1987). Mainly occur singly or in twos, which usually considered pairs (e.g. Jarman 1945; Storr 1965; Cooper 1974;

Morris 1975; Gibson 1977; Longmore 1978; Gosper 1981; Cameron 1985; Halse *et al.* 1985; Walters 1985; Woodall 1986; Bellchambers & Carpenter 1990; Aumann 1991; Schulz 1991; Carpenter & Mathew 1997; Hornsby 1997; Hall; see Movements). Also recorded in small family groups (Gibson 1977) or occasionally in small parties of up to 12 (Donohoe 1985; Hall; Storr 22, 26, 28; see Food) or, exceptionally, up to 40 or so birds; larger groups more often reported outside breeding season, in autumn and winter (Glover 1967; Baldwin 1975; Longmore 1978; Gosper 1981; Preston 1983; Templeton 1992; Collins 1995; Storr 35; Qld Bird Rep. 1986; NSW Bird Reps 1978, 1980, 1993, 1994; Vic. Bird Rep. 1984; SA Bird Rep. 1966–67; see Food). Occur in mixed-species feeding flocks (see Food). In Top End of NT, possibly have feeding association with Jacky Winters *Microeca fascians* (Rix 1970) and Hooded Parrots *Psephotus dissimilis* (Garnett & Crowley 1995).

Bonds Monogamous (Goodey & Lill 1993), in apparently stable pairs (Cameron 1985). Nearly all reports of nesting refer to pairs (e.g. Ashby 1933; Lowe 1959; Rix 1976; McFarland 1984; Ashton 1987; Brown & Brown 1987, 1989; NRS; see Breeding). However, one record of apparent cooperative breeding, with a nest with young attended by three birds (Cooper 1972). **Parental care** Both parents feed, brood and shelter nestlings, remove faecal sacs and feed fledgelings; broods at least sometimes divided (e.g. Anon. 1914; Mellor 1921b; Roberts 1942; Grant 1966; Quinn 1966; Marchant 1974; McFarland 1984; Goodey & Lill 1993; NRS; see Breeding; Young, Fledging to independence). **Dependence of young on adults** Feeding of young usually declines towards end of second week after young fledge, and parents begin to attack and drive young from natal territory some time after they forage independently, though timing of start of attacks and departure from territories appears to vary (Anon. 1914; Serventy & Whittell; see below). In Sydney, young not normally fed beyond 17 days after fledging, with feeding progressively reduced from 12 days; young sometimes attacked by parents from 19 days after fledging but, when breeding uninterrupted, remained in natal territory for at least 26 days; when breeding uninterrupted, mean duration from laying of first egg to last observation of juveniles in natal territory, 58.3 days (9.6; 6), compared with duration of 86.5 days (7.8; 2) when new nest lost while fledgelings still being cared for (McFarland 1984; also see Breeding: Fledging to independence). At Werribee, parents cared for fledgelings for c. 2 weeks and, rarely, for up to 3 weeks, though after 2 weeks parents tended to avoid or attack juveniles that begged for food (Goodey & Lill 1993). In Adelaide, fledgelings remained in natal territory for at least 24 days after fledging (Mellor 1924). However, young can remain in natal territory and be fed for longer, e.g. one brood still fed 1 month after fledging (Sanders 1938); occasionally, juveniles still in natal territory when subsequent brood being fed (Lord 1953); and once, an adult seen feeding fledgelings from one brood >42 days after fledging, while other adult of pair fed fledgelings of subsequent brood (Baldwin 1974).

Breeding dispersion Nest solitarily, in simple pairs (Robinson 1947b; McFarland 1984; Cameron 1985; Woodall 1986; Goodey & Lill 1993; Serventy & Whittell; also see Breeding) within territories defended throughout year (see below). Same or nearby nesting sites often used in successive seasons, though not known if same pairs, or one member of pair, involved (see Breeding: Site). At Manjimup, sw. WA, most territories arranged along creeks and roads; territories have been occupied for at least 15 years, though individual members of pairs not recorded for more than 3 years in succession; when one bird disappeared, it was replaced (Brown & Brown 1987, 1989). At Werribee, territories arranged serially along shelter belts, extending up to 100 m into open paddocks (Goodey & Lill 1993). In 1984, 17 nests found in 15 ha at

Aldinga Scrub CP, SA (Ashton 1987). In three suburbs of Canberra, estimated one territory in 197 ha, one territory in 75 ha and none in 36 ha (Lenz 1990). **TERRITORIES** Maintain all-purpose territories throughout year, but most intensely defended during breeding season, Sept.–Jan. (Robinson 1947b; McFarland 1984; Cameron 1985; Sedgwick 1988a; Goodey & Lill 1993; Dyrce 1994); both sexes defend territory against conspecifics (Goodey & Lill 1993). **SIZE OF TERRITORIES, HOME-RANGE:** In Five Day Creek Valley, mean size 3.3 ha (n=4) (Cameron 1985). At Werribee, territories 1–2 ha (Goodey & Lill 1993). Round Wellard, sw. WA, territories 2 ha, though for several weeks before nesting birds mostly confined activity to area of c. 0.8 ha (Plumb 1948). One nesting pair (location not stated) occupied area of c. 0.8 ha (Quinn 1966). In Sydney, home-range estimated at 2 ha (McFarland 1984). **DOMINANCE HIERARCHIES:** In pairs in captivity, male dominant over female (Ives 1975).

Roosting At night. Once, roosted with several species of passerines in dense Scarlet Bottlebrush *Callistemon macropunctatus* (Clarke 1967). Round Jandowae, se. Qld, roosted in sorghum crop (Nielsen 1964). During breeding season, non-incubating bird roosted in trees close to nest (Sutton 1931; McGill 1934). Parents of one brood roosted in a shrub within a few metres of their recently fledged young (Carter 1924). One brood of fledgelings roosted near their nest, on rafters inside building, for several nights (Haines 1945).

SOCIAL BEHAVIOUR Quite well known, with several detailed studies (as Social Organization). Readily observed, as common and widespread, often found associated with human habitation or activity in both urban and rural areas (see Habitat, Distribution, Food), and tame in some circumstances, particularly near human habitation or settlements, including when nesting (e.g. Anon. 1914; Norton 1922; North; see Breeding); also sing or call throughout year, though sing little in winter; and sing at night, especially during breeding season and on moonlit nights; also respond to squeaking and playback of vocalizations (see Voice). However, while readily observed, difficult to capture for individual marking (Rogers *et al.* 1986; Brown & Brown 1987). **MAINTENANCE BEHAVIOUR:** Perch higher in trees during maintenance behaviour and singing than when foraging (Cameron 1985). During extreme heat (shade temperature of 46 °C) one bird sought refuge in macro-litter at base of clump of Moonah *Melaleuca lanceolata* (Ashwell 1980); also recorded occupying wombat burrow when shade temperature was 47 °C, though possibly regularly forage at entrances to such sites (Attwood 1982). **BATHING:** Recorded bathing in water trough (D.C. Paton & P.A. Paton 1980).

Agonistic behaviour Pugnacious at times, especially when defending nest and young (e.g. Anon. 1914; Wolstenholme 1929; Tindale 1930; Roberts 1942; Walter 1946; Immelmann 1960). Strongly territorial throughout year, but territories defended most intensely during breeding season, Sept.–Jan. (see Social Organization); both sexes defend territory against conspecifics (Goodey & Lill 1993; see below). Song used to advertise territory and during defence of territory, and heard throughout year; both sexes sing (McFarland 1984; see Voice). Both aggression and submission between conspecifics often displayed by expansion or reduction of white supercilium (Ives 1975; McFarland 1984; Brown & Brown 1989; and see below). **Threat, Chases** Chasing and Diving Display occur throughout year (McFarland 1984). Chases occur whenever one bird intrudes into territory of another, and when adults expel juveniles from natal territory (McFarland 1984). **DIVING DISPLAY:** Performed between neighbouring pairs at boundaries of territories, without physical contact, and involves only one member of each pair at a time. Both birds expand white supercilia and utter Song and

Rattle while one bird flies in loop, up to ten times, over opponent; after one finishes loops, roles often reversed, and display performed repeatedly (Immelmann 1960; McFarland 1984; Brown & Brown 1989). Previously suggested to have been courtship display (Immelmann 1960). Will attack own reflection throughout year (Barnard 1902, 1903). **Fighting** One record of a fight to the death between two adults: both fluttered at one another, including spiralling up to 2 m above ground; when on ground, larger bird stood on top of smaller one and pecked at it several times; after a few more short flights near one another, birds again went to ground; smaller bird sometimes lay sideways on sand, as did, once or twice, the larger bird, without pecking; soon after, smaller bird found dead with one eye closed but otherwise no apparent signs of injury; death possibly caused by exhaustion, as conflict was observed for only 5–7 min but had started earlier (Ashton & Ashton 2000). Fighting also occurs between adults if their young stray into neighbouring territories (Mellor 1924), and once, female fought with another female that male partner attempted to court (Harvey & Harvey 1919). **Alarm** Utter Rattle and Harsh Call when alarmed, such as when being handled after capture (see Voice). Once, a bird close to a hunting snake stayed motionless, till snake shot by observer (Hynes 1946). **Appeasement** Reduce or conceal white supercilium to show submission. In aggressive encounters between members of pair in captivity, female showed submission, and maintained subordinate status, by keeping supercilium smaller than that of male (Ives 1975). **SUBMISSIVE POSTURE OF FLEDGLINGS:** Crouch low with supercilium hidden and flank exposed; posture adopted during attacks by parents, or when begging (McFarland 1984). **Interactions with other species** Both sexes strongly defend nest, eggs and young from potential and actual threats, and vociferous in defence; interspecific aggression virtually confined to breeding season and near nest (McFarland 1984; Cameron 1985; Goodey & Lill 1993; Campbell). Attack people, Cats, Dogs, and any bird, regardless of size, near nest, including cuckoos, Laughing Kookaburras, Australian Magpies, Black-faced Cuckoo-shrikes *Coracina novaehollandiae*, Red Wattlebirds *Anthochaera carunculata*, and raptors as large as Wedge-tailed Eagle, though also aggressive to smaller and harmless species, such as Silvereyes *Zosterops lateralis* and Grey Fantails. Members of pair attack birds together or singly by swooping and arcing over threat, while pecking at them (e.g. Dove 1908; Anon. 1914; Mellor 1922; Whitlock 1924; Sharland 1929; Wolstenholme 1929; Tindale 1930; Bridgewater 1931; McGill 1942; Roberts 1942; Walter 1946; Bourke 1958; Ellis 1958; Wheeler 1959; Quinn 1966; Cooper 1971; Arthur 1973; Olsen *et al.* 1979; McFarland 1984; Buchanan 1987; Tarburton 1991; Robinson 1993; Gosper 1997; Fitri & Ford 1998; Serventy & Whittell; NRS). However, in study in Sydney, no aggressive interactions between Wagtails and Magpie-larks *Grallina cyanoleuca* observed despite latter being present throughout year (McFarland 1984). Once seen to alight on back of Laughing Kookaburra and pull at feathers of its head (Quinn 1966). When much fluttering and calling in attack on Australian Raven *Corvus coronoides* did not provoke a reaction, Wagtail landed on back of Raven and pecked vigorously at its neck; Raven called loud *aah*, and Wagtail leapt off (Buchanan 1987). While harassing a Whistling Kite *Haliastur sphenurus*, Wagtail perched on wing of soaring Kite and fluttered and called above it when Kite flapped (Buchanan 1992); and when harassing a Brown Goshawk *Accipiter fasciatus*, perched on back of Goshawk, which ignored Wagtail (Chandler 1939). Once mobbed dead Southern Boobook *Ninox novaeseelandiae* on roadside (Clancy 1980); and once attacked mounted specimen of Australian Raven or Pied Currawong *Strepera graculina* (Geering 1998). Once joined with White-plumed Honeyeaters *Lichenostomus penicillatus* to mob young

Pallid Cuckoo *Cuculus pallidus* (Anon. 1918); once, on Boigu I., mobbed Gurney's Eagle *Aquila gurneyi* together with at least four other species (Garnett 1987); and once, joined with pair of Magpie-larks to mob Dog and both joined by pair of Restless Flycatchers to mob cuckoo (Roberts 1942). Displace Grey Fantails from perches (Cameron 1985); and once attempted to displace incubating Grey Fantail from nest by grasping its tail; the two birds and Fantail's mate descended to ground in a tangle (Elliott 1933). Occasionally steal, or attempt to steal, food from other birds (see Food).

Sexual behaviour Singing probably functions, in part, in courtship (see Voice). **COURTSHIP DISPLAY:** Possible Courtship Displays described by Hough (1969) and McFarland (1984). Pair would settle on a horizontal branch, 10–15 cm apart; the assumed male, with supercilia barely visible, bobbed towards female while she crouched side-on to him, with supercilia expanded. Male jumped towards and round female, uttering Song and Rattle calls, while female only moved to stay 10–15 cm from male. Display ended with male chasing female away or pair resuming feeding (McFarland 1984). In similar display, assumed male sometimes swung beneath branch when performing display and, unlike above description, expanded supercilia, which were turned towards female; and only Rattle calls used (Hough 1969). Seen only in 2 months before, and in first 3 months of, breeding season; and, of nine observations of display, not seen to lead to copulation. Suggested that if not a courtship display, may function to strengthen bond, or to stimulate breeding response in female (McFarland 1984). Once, during construction of nest, one member of pair, which had carried large amount of material to nest, chased away its mate when it carried a smaller amount (Ashton 1987).

Relations within family group Both parents feed and brood nestlings, including shading them during day, and remove faecal sacs; contribution of sexes roughly equal but contributions of each vary over nestling period (see Breeding: Young). Adults seen to spread wings over nest in attempt to protect young from rising floodwaters (D. Le Souëf 1904, 1915). Parents utter Rattle to stimulate nestlings to feed (Roberts 1942). When nearly fledged, nestlings stand at edge of nest and on each other (Ashby 1932) and exercise wings (Roberts 1942). Both sexes feed and care for fledgelings, but contribution of sexes apparently varies; in one study, female spent more time than male caring for fledgeling (Goodey & Lill 1993; see Breeding: Fledging to independence). Newly fledged young often remain close to nest (Courtney & Marchant 1971); ≤ 6 days after fledging, seen flying from limb to limb in nest-tree (Plumb 1948). **Anti-predator responses of young** Brood stays together in dense shrubs and birds rarely fly for first 1–3 days after fledging, emerging from cover only to be fed (Carter 1924; Goodey & Lill 1993). Fledgelings give Alarm Calls when handled (Brown & Brown 1987). **Parental anti-predator strategies** Highly aggressive and vociferous in defence of nest, eggs, and young (see Agonistic behaviour: Interactions with other species). During incubation, sit tightly (Hyem 1932; McGilp 1934; Baldwin 1974); and sometimes tolerate disturbance to nest; one bird resumed sitting after nest-tree was felled and nest replaced near original position (Chenery 1933). Give noisy churr when guarding fledgelings (Baldwin 1974). In response to Alarm Calls of young being handled, male parent flew in rapidly (Brown & Brown 1987). **DISTRACTION DISPLAYS:** Feign injury or perform Rodent-run distraction displays when eggs, nestlings or fledgelings threatened (e.g. Cleland 1951; see below). If on nest, sitting bird will flush from nest and often drop to ground. May feign injury while running or fluttering along ground (Anon. 1914; Tindale 1930), positioning itself so that observer between bird and nest (Leach & Lloyd 1993). Once, in nestling period, bird flitted close to observer then flew away (Baldwin 1974). **RODENT-RUN:** When intruder approached nest, assumed female

dropped to ground and fluffed up feathers of breast and belly, so that legs almost completely obscured; she then waddled round under nest before moving away, occasionally hopping and jumping onto tree-trunks. When intruder was >40 m away, female returned to nest. If male near nest when intruder appeared, he dived and called loudly while female performed Rodent-run display. Seen after hatching of first clutch of season, in nestling and early fledging periods, but thereafter performed as soon as eggs present in nests in subsequent attempts (McFarland 1984). Near another nest, assumed female performed Rodent-run till nestlings handled, when bird flew at observer (Roberts 1942).

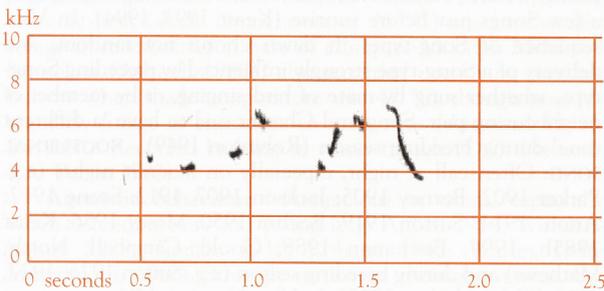
VOICE Well known from study near Melbourne and near Shepparton in Vic. (Walker 1979), which includes sonagrams, and on which this account based unless otherwise stated; sonagram of Rattle also in Jurisevic & Sanderson (1994). Vocalizations from PNG given in musical notation by Mosey (1956), and graphically by Diamond (1972). Song is attractive, and, like many less musical songs with consonantal sharpness, lends itself to a rendering in words as 'sweet pretty creature' (Hartshorne 1953). Audible to >200 m (Walker 1979). **ANNUAL AND DIURNAL PATTERN:** In Vic., sing less in winter. In June and July, the few Songs uttered usually formed part of dawn chorus; and a solitary bird occupying a territory sang far fewer Songs than a neighbouring pair. In Aug., number of Songs per day increased markedly, and solitary bird concentrated its Song early in morning, while another neighbouring pair sang at lower rate but throughout day. In Sept., number of songs increased further: solitary bird continued to sing most at dawn, while neighbouring pair, with nestlings, sang most near dawn, with a further substantial contribution at night. Nocturnal Song (see below) becomes important from start of incubation. Incidence of Chatter does not vary greatly with season, while Whit is most commonly used round dawn and dusk, but is not restricted to those times. Willie Wagtail is a major contributor to dawn chorus on S. Alligator R., NT, in late Sept. and early Oct. (Keast 1985b), and at Ebenezer, NSW, from late winter to early summer, at maximum rate of 16 Songs/min, with sound production occupying 20–27 s/min. However, in late Sept. and Nov., when young present, contributed little to dawn chorus, singing only a few Songs just before sunrise (Keast 1993, 1994). In Vic., sequence of Song-types in dawn chorus not random, and delivery of a Song-type strongly influenced by preceding Song-type, whether sung by mate of bird singing, or by member of neighbouring pair. Song and Chatter said to have 'a different tone' during breeding season (Robinson 1949). **NOCTURNAL SONG:** Often call at night, especially on moonlit nights (e.g. Parker 1902; Berney 1905; Jackson 1907, 1912; Stone 1912; Anon. 1914; Sutton 1919; Boehm 1950; Mosey 1956; Keast 1985b, 1994; Buchanan 1988; Gould; Campbell; North; Mathews) and during breeding season (e.g. Sutton 1925, 1927, 1928; Wolstenholme 1929). In Vic., Nocturnal Song common throughout breeding season, from Aug. on, regardless of weather or phase of moon. Once started, Song often continues, as single Song draws response from all birds within hearing, stimulating further Song. A possible function is maintenance of territory at a time when there is no conflict with parental duties, when there is little competition from other sounds, and when sounds carry farthest. Most nocturnal vocalizations come from bird roosting away from nest, usually in another tree and well away from nest-site. **COUNTER-SINGING:** In PNG, counter-singing said to be common, often with second bird repeating each Song phrase or the latter part of each phrase (Coates 1990). **INDIVIDUAL DIFFERENCES AND REGIONAL VARIATION:** In Vic., Song-types vary over geographical range. Neighbouring pairs often share one or two Song-types and occasionally all Song-types; more often, beginnings or endings

of Song-types of one pair are found as beginnings or endings of different Song-types of neighbouring pairs. In a small isolated population, all birds shared a similar repertoire. Chatter varies little over geographical range. In PNG, voice slightly different from that of birds in Aust. (Watson *et al.* 1962), and Song rather jerky in comparison (Mosey 1956). Analysis of a few Songs from PNG suggests they have a different rhythm and extend to lower maximum frequencies than Songs of birds in Aust. (this study). **RESPONSE TO PLAYBACK:** In Vic., response to playback is similar, regardless of whether Song-types played back were recorded in territory, in territory of a neighbour or in a distant geographic region. In June and July, respond by approaching source of replay, but seldom by singing. In Aug. and Sept., sing in response to Song played within territory or a neighbouring territory (Walker 1979). Respond to squeaking by approaching observer (Sutton 1926b). **NON-VOCAL SOUNDS:** Snap bill when catching prey (North).

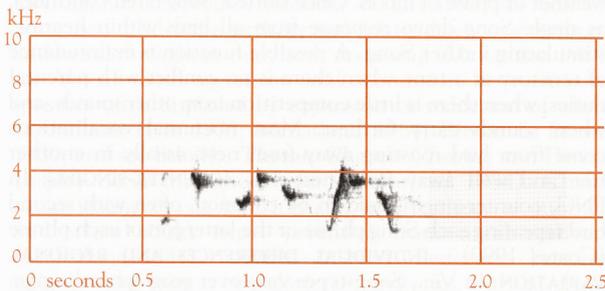
Adult SONG: Song described as not unpleasant, but monotonous (Anon. 1914), and in PNG, as sweet yet militant (Coates 1990). Rendered as *sweet pretty creature* (Parker 1902; Jackson 1907; Anon. 1914; North), *pretty little creature* (McFarland 1984), and *sweet pretty little cree-a-ture* (Leach 1928; Mathews). Both sexes sing; members of pair share similar repertoire of Songs, usually slightly different from those of surrounding pairs, of 2–5 (usually three or four) simple Song-types. Each Song-type contains no trills or repeated parts, and consists of same notes given in same pattern, with very little variation in duration when uttered by an individual or its mate. Occasionally a bird deletes some notes, usually by not completing Song. When several pairs share one Song-type, mean duration of that Song-type varies between pairs, but not known if sufficient for recognition of individual or pair. Most Song-types end with note that descends in frequency, but sometimes Song-types have final note that increases in frequency. Sonagram **A** shows a nocturnal Song, and sonagram **B** another Song. Part of one Song-type often forms part of another; e.g. end of Song-types identical but with quite different beginnings. When Song-types compared, similar phrases occurred more often at end than at beginning, suggesting that final phrase varies less than notes leading up to it. When 2–10 examples of each of 59 different Song-types (number of

different individuals in sample for each Song-type not stated) from throughout Aust. were measured, standard deviation <5% of mean duration in all but one Song-type, in which it was c. 10%. Mean duration for all Song-types was 1055 ± 235 ms; mean number of notes per Song 9.7 (2.3; 5–19); range of fundamental frequency 1.0–6.2 kHz, with most energy at 2.0–4.0 kHz, and little energy in harmonics. Songs usually given while perched, and very occasionally from ground or in flight (Walker 1979); also given during Diving and Courtship Displays (Hough 1969; McFarland 1984). A Song is sometimes preceded by one or more soft notes, sounding like individual notes in Secondary Song, and audible to 10–20 m. **SECONDARY SONG:** A soft rambling Song that lasts for several seconds. Similar notes occur in different parts of Secondary Song, but no set sequence. Range of fundamental frequency lower (1.5–4 kHz) than that of Song and, in contrast to Song, harmonics prominent. Heard throughout year, most often in breeding season. Apparently an important communicatory signal between members of pair, especially when direct interaction, e.g. at change-over at nest (though this often takes place in silence). Often used in aggressive situations, e.g. when conspecific is intruding, or when driving away potential predator. Often given in flight. Sometimes associated with Rattle or Whit (Walker 1979). **RATTLE (= Chatter)** (sonagram C): A disyllabic rattle (Hough 1969, McFarland 1984; Gould; Campbell; North) or chatter (Anon. 1914, Roberts 1942; Robinson 1949; Walker 1969; Jurisevic & Sanderson 1994). Uttered in many situations, when perched and in flight, e.g. during Diving and Courtship Displays (Hough 1969; Walker 1979; McFarland 1984) and in alarm (Anon. 1914; McFarland 1984; Jurisevic & Sanderson 1994; Mathews). Sometimes given at end of Song bout or to punctuate sequence of Secondary Song. Also given while foraging, when mobbing potential predator, or when driving intruder from near nest (Walker 1979). Appeared to act as a stimulus to well-fed nestlings when they seemed indifferent to food (Roberts 1942). Chattering of Brown & Brown (1989) probably this call. **WHIT:** A short note (0.03–0.10s). Given most often in flight, though also given just before taking off or after alighting, and appears to signal flight or intention to fly. Three or four may be given in succession. Occasionally punctuate a sequence of Secondary Song, and often associated with Rattle. **HARSH CALL:** Similar to Begging Call of nestling, and given when severely stressed, e.g. when handled (Walker 1979). **Other calls** Begging Calls given occasionally during pair interactions, but only from nesting pairs, when uttered by one bird while crouching below other (Walker 1979). Noisy churring when guarding fledgeling (Baldwin 1974).

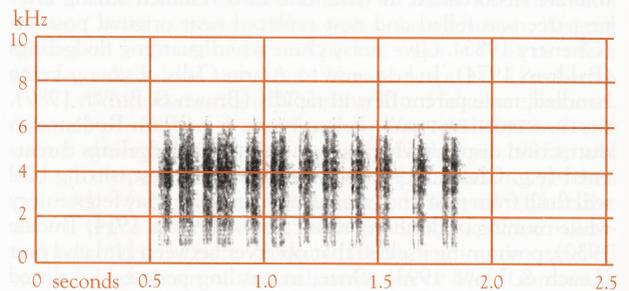
Young Within 24 h of hatching, nestlings give a soft reedy call, which becomes louder and harsher with age; by 5–6 days, call audible up to 10 m. Newly fledged young call loudly if left alone. Begging Call most often heard from dependent juveniles. In addition to Begging Call, birds collected from nests in the wild 3–11 days after hatching, and reared in captivity, including some deafened and some raised in sound-proof boxes,



A J. Courtney; Glen Innes, NSW, Sept. 1983; P50



B R. Buckingham; Warrumbungle NP, NSW, Sept. 1983; P50



C R. Buckingham; Balmoral, Vic., Mar. 1978; P50

uttered Rattle, Wheat Call, Complex Wheat Call (possibly a precursor of Song), and Pip Call (probably a precursor of Whit). Rattle was given by all captive birds during first 30 days, including those deafened and those in isolation, and was indistinguishable from Rattle of wild adults; apparently fully developed at its first delivery, and independent of learning. One bird tutored with eight wild Song-types began to sing, but failed to sing true Song of adult, though it was well over 1 year old, suggesting that environmental stimuli such as pair-formation and territorial defence needed to produce stable adult Song. For further discussion of development of calls of young in captivity, see Walker (1979). Young give distress calls while being handled (Brown & Brown 1987).

BREEDING Very well known, from several detailed studies: of NRS records in e. and s. Aust. by Marchant (1974), which supersedes earlier analysis by Courtney & Marchant (1971); of parental care at Western Treatment Plant, Werribee, Vic., over four breeding seasons (Goodey & Lill 1993); of two breeding pairs over 2 years in Sydney (McFarland 1984); of ten nests in Five Day Ck Valley, n. NSW (Cameron 1985). A total of 3560 records in NRS to Dec. 2003 analysed below. Also, detailed description of newly hatched nestlings (Gill 1982). Nest solitarily, in simple pairs (see Social Organization). Have bred in captivity (Rix 1954). Contributions by breeding male and female roughly equal at most stages of breeding cycle (Goodey & Lill 1993; see below).

Season Subspecies discussed separately below. Given the abundant data on clutches (and nestlings) for nominate *leucophrys*, mainly from NRS, only timing of these is given, and records of unspecified breeding largely not considered beyond records outside range of eggs and nestlings; all records for *picata* are discussed. Throughout Aust. range, eggs and nestlings recorded July to late Feb. (see below). Using NRS data to Dec. 2003: nominate *leucophrys* (n=1869 clutches), eggs recorded late July to mid-Feb., with most (86.9%) mid-Sept. to mid-Dec.; see Table 3 for monthly breakdown. Nestlings, early Aug. to late Feb. (n=1808 broods) with most (86.6%) early Oct. to early Jan. Subspecies *picata*: Eggs, early Sept. to mid-Nov. and mid-Feb. (n=12 clutches); nestlings, late Sept. to late Oct., mid-Dec. and early to late Feb. (n=9 broods); fledgelings, Oct. (n=1), Dec. (n=2) and Mar. (n=2). From earlier analysis of NRS data (n=345 clutches), estimated start of clutches from mid-Aug. to late Jan., with 78% started between late Sept. and early Dec.; no seasonal differences apparent between different latitude or geographical areas, though season thought to start c. 10 days later at altitudes >500 m asl (Marchant 1974).

NOMINATE LEUCOPHRYS: QLD S OF 20°S: Eggs, Aug.–Feb. (Ford 1904; Lord 1953; NRS); of 89 clutches in NRS, most (76.4%) Sept.–Nov. (see Table 3). At Murphys Ck, one pair laid four clutches between 2 Sept. and 4 Jan. (Lord 1953). Nestlings, early Sept. to late Feb. (n=93 broods) with most (84.9%) Oct.–Jan. (NRS). Fledgelings, early Sept. to mid-Feb. (NRS [n=58]). Otherwise, unspecified breeding recorded Aug.–Mar., May and June, but mostly Sept.–Jan. (Aust. Atlas 1, 2). **NSW–ACT:** Eggs, mid-Aug. to early Feb. (Morris *et al.* 1981; McFarland 1984; North; ACT Atlas; NRS); of 829 clutches in NRS, most (92.5%) Sept.–Dec. (see Table 3). Nestlings, early Sept. to early Feb. (ACT Atlas; NRS); of 758 broods in NRS, most (93.8%) Oct.–Jan. In Five Day Ck Valley, eggs or nestlings mid-Oct. to early Jan., with fledgelings till late Jan. In Sydney, of eight nests by two pairs, first clutches laid early Sept., with eggs recorded through to Jan. (McFarland 1984). In far SW, nestlings sometimes as early as Aug. (Chenery & Morgan 1920). Otherwise, breeding recorded July–May (Aust. Atlas 1, 2); occasional records of breeding June–July (Chaffer 1929; Lord 1953). **VIC.:** Eggs, early Aug. to mid-Jan. (Stevens 1998; North; NRS); of 388

clutches in NRS, most (95.1%) Sept.–Dec. (see Table 3). Nestlings, mid-Aug. to early Feb. (Bolton & Hall 1982; Stevens 1998; NRS); of 403 records in NRS, most (87.3%) mid-Oct. to early Jan. Unspecified breeding recorded Aug.–Mar. and May (Vic. Atlas; Aust. Atlas 2); of 907 records of unspecified breeding in Vic. Atlas and Aust. Atlas 2, 97.0% Sept.–Jan. with rest Aug. (5), Feb. (19), Mar. (3) and May (1). **TAS.:** Single breeding record, in Dec. (Tas. Bird Rep. 8; see Distribution). **SA:** Eggs, Aug.–Jan. (Souter 1928; Sutton 1930; Brummitt 1934; Condon & Rix 1936; Gray 1938; Attiwill 1956, 1972; Paton 1975; Close *et al.* 1982; Bransbury 1984). Of 304 clutches in NRS, most (95.7%) Sept.–Dec. (see Table 3). Nestlings, late Aug. to early Feb. (n=289 broods), most (92.7%) late Sept. to late Dec. (NRS). In Aldinga Scrub CP, estimated start of clutches between 1 Sept. and 21 Dec., with most in Oct. (Ashton 1987). One pair laid first clutch in first week Oct. and young fledged by 31 Oct.; laid second clutch first week in Nov. and young fledged by 30 Nov.; and laid third clutch by second week of Dec. and young fledged by 7 Jan.; by 10 Feb. all but one juvenile had left natal territory (Quinn 1966). Young sometimes fledge as late as Feb. (Laffer 1914; Attiwill 1946); and unspecified breeding said to occur till Mar. (Whatmough 1978). **WA S OF 20°S:** Eggs, Aug.–Jan., with first clutches laid about third week of Aug., second clutch in early to mid-Oct., third about early Nov., and fourth, if laid, in late Dec., with fledgelings recorded till late Jan. (Carter 1924; Plumb 1948; Sedgwick 1949a; Ford & Stone 1957; Serventy 1958; Heron 1970; Serventy & Whittell; Storr 27; NRS). Of 253 clutches in NRS, most (92.1%) Sept.–Dec. (see Table 3). Nestlings, early Aug. to late Feb. (n=261 broods), most (80.5%) early Oct. to late Dec. (NRS). At Wittenoom, eggs recorded Sept. and Dec., nestlings Oct. and Feb., and fledgelings Feb. (Howard 1986). Breeding otherwise recorded Aug.–Feb., mainly Sept.–Dec. (Brooker *et al.* 1979; Davies 1979; Storr 16, 21, 22, 26, 27, 35; Aust. Atlas 1, 2), but also as early as Mar. and June near Perth, July and, very occasionally, May in Gascoyne Region (Aust. Atlas 1, 2; Storr 21), and, in South-West Div., very occasionally in Apr., after passage of tropical cyclone (Storr 35). **NT S OF 20°S:** Little information. Eggs, July–Oct. (White 1924 [n=1]; NRS [n=5]); see Table 3. Otherwise, breeding recorded July–Sept. (Hitchcock & Jarman 1944; Storr 7), Sept.–Apr. (Aust. Atlas 1, 2), and Feb.–May (Jarman 1944). **SUBSPECIES PICATA:** Few data. Only 13 clutches N of 20°S in NRS, all Sept.–Nov. and Feb. (see Table 3). Nestlings recorded late Sept. to late Feb. (NRS [n=9 broods]). Otherwise said to breed Sept.–Feb. (see below). **WA:** In Kimberley Div., breed Sept.–Feb. (Storr 11; Aust. Atlas 1, 2), though fledgelings also recorded Mar. (NRS). Two clutches in NRS, in mid-Feb. Two records of nestlings, Feb., plus one record of fledgelings in Mar. (NRS). Otherwise, breeding recorded Sept.–Jan. (Aust. Atlas 2). **NT:** In Top End, eggs June–Oct. (Frith & Davies 1961; H.A.F. Thompson & D.K. Goodfellow; NRS [two Sept., one Oct.]). Nestlings, Sept.–Oct. (H.A.F. Thompson & D.K. Goodfellow; NRS). Otherwise said to breed Sept.–Feb., plus one record in July (Deignan 1964; Storr 7; Aust. Atlas 1, 2; H.A.F. Thompson & D.K. Goodfellow). **QLD:** Between Cooktown and Bowen, estimated start of clutches, Aug.–Feb. (Lavery *et al.* 1968); clutches recorded Sept. (n=3), Oct. (2) and Nov. (2) (NRS; see Table 3). Nestlings, Oct. (1), Dec. (1) and Feb. (2); fledgelings, Oct. (1) and Dec. (2) (NRS). Otherwise said to breed Aug.–May (White 1946; Bravery 1970; Gill 1970; Horton 1975; Storr 19; Aust. Atlas 1, 2); claimed that breed Sept.–Dec. near watering points, and Jan.–Apr. elsewhere (Horton 1975; Storr 19).

Site Usually in trees or shrubs, mostly live but sometimes dead, and on and within artificial structures, often near human settlements or activity (Wolstenholme 1922; Anon. 1923b, 1982; Pearse 1931; Sutton 1931; Morgan 1932; Roberts 1940; Lord 1953; Binns 1954; Gill 1982; Tarburton

Table 3. Monthly distribution of clutches from NRS data to Dec. 1999, as a percentage of total records.

	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	N	
<i>SUBSPECIES PICATA</i> (WA, NT and Qld N of 20° combined)										
	–	–	38.46	23.08	15.38	–	–	23.08	13	
<i>NOMINATE LEUCOPHRYS</i>										
Qld S of 20°	–	2.30	31.03	24.14	20.69	13.79	6.90	1.15	87	
NSW	–	1.33	16.89	29.55	29.07	17.01	6.03	0.12	829	
Vic.	–	0.52	11.86	40.72	27.58	14.95	4.38	–	388	
SA	–	2.63	17.76	37.83	25.99	14.14	1.64	–	304	
WA S of 20°	0.40	2.77	18.58	30.43	24.90	18.18	4.74	–	253	
NT S of 20°	40.0	20.0	40.0	–	–	–	–	–	5	
All <i>leucophrys</i>	0.16	1.66	16.93	33.02	27.22	16.08	4.82	0.11	1866	
Throughout range	0.16	1.65	17.08	32.94	27.14	15.97	4.79	0.27	1879	
Mean clutch size	C/3 × 1	2.83	3.01	3.02	3.13	3.04	2.97	2.75		
(S.D.; Range; N)	–	(0.51; 2–4; 18)	(0.58; 1–5; 172)	(0.55; 1–4; 329)	(0.6; 1–5; 291)	(0.5; 1–4; 145)	(0.36; 2–4; 63)	(1.26; 1–4; 4)		

1991; Saunders & Ingram 1995; North; NRS; see below); of 3185 sites in NRS, 2720 (85.4%) in live plants, 236 (7.41%) in dead plants, and 229 (7.19%) in or on artificial structures. (A fuller breakdown of nest-sites from NRS given below.) **NESTS IN PLANTS:** Nest in wide variety of native and exotic trees and shrubs, both evergreen or deciduous (e.g. Jackson 1912; Harvey & Harvey 1919; Anon. 1923b; Sutton 1927, 1928, 1931; McGilp 1928, 1934; Wolstenholme 1929; Pearse 1931; McGill 1942; Lowe 1959; Wheeler 1966; Baldwin 1974; Gill 1982; Angus 1993; Leach & Lloyd 1993; NRS; and references below). Most often in eucalypts, of many species (e.g. Jackson 1912; Anon. 1919; Sutton 1928; Wolstenholme 1929; Morgan 1932; Brummitt 1934; Boughtwood 1948b; Sedgwick 1949a; Sefton 1956; Quinn 1966; Heron 1970; Baldwin 1974; McFarland 1984; Cameron 1985; Ashton 1987; Stevens 1998; North; NRS); also often recorded in various acacias (Sharland 1929; Gray 1938; Anon. 1947; Brown 1950a; Watson 1955; Paton 1975; Chinner 1977; Stevens 1998; North), casuarinas (Sedgwick 1949a; Serventy 1958), paperbarks (Serventy 1958; Heron 1970; Hunt 1979), tea-trees (Condon & Rix 1936; McFarland 1984; Stevens 1998), banksias (Plumb 1948; Hunt 1979), mangroves (Hindwood 1935), and exotic plants, including willows *Salix* (Grant 1966; North), Peppercorn *Schinus molle* trees (Anon. 1921; Boughtwood 1948b; NRS), pines *Pinus* (Stevens 1998; NRS), ivy *Hedera* (Pearse 1929, 1931; Cheney 1933), and fruit trees and vines, including Almond, Apple, Mulberry, Olive, Orange, Lemon, Plum, Pear and Grape-vines (Harvey & Harvey 1919; McGilp 1928; Sutton 1928, 1931; Wolstenholme 1929; Pearse 1931; Lowe 1959; Wheeler 1966; NRS). **ARTIFICIAL AND UNUSUAL SITES:** Nest on wide variety of artificial structures, including beams or rafters in buildings, machinery, fences, including posts or wires, electrical wiring, cables or ropes, swinging floodgate, windmill, metal frame of bedstead, on edge of pot plant hanging under a carport, and a flat plank protruding over water (Carter 1924; Wolstenholme 1929; Bridgewater 1931; Carnaby 1933; Roberts 1940, 1945; Boughtwood 1948b; Lord 1953; Sefton 1956; Wheeler 1959; Chisholm 1962; Masters & Milhinch 1974; Larkins 1980; Bolton & Hall 1982; Baxter & Paton 1998; Gould; Campbell; North; NRS; A.M. Dunn; and see below). Sometimes close to human activity, such as on rail of sheep dip that was in use (Hyem 1932; Haines 1945); on shower (Pearse 1929, 1931); on overhead wire of electric railway (Roberts 1944); on top of electric light pole (Hitchcock 1936). Also sometimes placed on geological features, such as against wall of cliff (Tindale 1930) or on protruding roots down disused mine (Chisholm 1962; Rogan 1966); once, on treeless island, beneath limestone overhang

(Serventy & White 1943); once on ground (Rogan 1966). **ANALYSIS OF SITES IN NRS:** From subset of NRS data (n=495 nests): 31.1% were in EUCALYPTS (including mallee eucalypts); 18.6% in OTHER NATIVE TREES OR SHRUBS, including casuarinas (4.24%), acacias (3.64%), paperbarks (2.02%), and with small numbers in many other plants, including *Leptospermum*, *Angophora*, *Araucaria*, *Banksia*, *Callistemon*, *Callitris*, *Eremophila*, and mangroves; 18.6% were in EXOTIC SPECIES, including pines *Pinus* (4.44%), willows *Salix* (3.84%), and with small numbers in wide variety of others, including fruit trees and vines, Camphor Laurel *Cinnamomum camphora*, briar *Rubus*, elm *Ulmus* and hawthorn *Crataegus*; 24.6% on DEAD BRANCHES, FALLEN TREES OR BOUGHS (species of tree not noted); and 6.06% in buildings or other ARTIFICIAL SITES OR STRUCTURES; a further three nests were in roots of fallen trees; and two in disused nests of Magpie-lark (Marchant 1974). Analysis of 180 records in NRS (this study) found similar proportions in these categories. **SITE OF NEST WITHIN NEST-PLANT:** Often build on dead wood (Marchant 1974; Campbell), sometimes on dead limb with living branch above (e.g. Brown 1950a; Gould). Nest usually placed on horizontal fork or branch (McGilp 1934; Plumb 1948; Grant 1966; Anon. 1982; Gould; Campbell; Serventy & Whittell); less often on sloping or drooping limb (Jackson 1912; Stevens 1998). Usually sheltered by foliage (Le Souëf 1903; Masters & Milhinch 1974). One situated among clusters of pine cones (Watson 1955), another on flap of bark (NRS). From subset of NRS records (n=292 nests): 94.9% on horizontal surfaces and 5.1% on sloping or vertical ones (Marchant 1974). From another subset of NRS data (descriptions of 400 natural sites), 353 (88.3%) on horizontal branch or fork (including 64 identified as fork), 24 (6.0%) on sloping branch or fork, 14 (3.5%) on fallen branch or tree, and seven (1.75%) in vertical branch or fork (NRS). Said that often near or on branch overhanging water (Carter 1924; Chisholm 1924; Sedgwick 1949a; Horton 1975; Bedgood 1980; Gould; Campbell; NRS). However, from subset of NRS data (n=565 nests), 37 (6.55%) built above water and another 48 (8.50%) near water (Marchant 1974); similarly, of 3560 records in NRS, 229 (6.43%) described as being over water (NRS). Sometimes build in disused nests of other species, including those of Magpie-larks (Roberts 1955; Chisholm 1962; Marchant 1974; North; NRS) and Welcome Swallows *Hirundo neoxena* (Newell 1929; Roberts 1955; Mack 1970). **FIDELITY TO SITE:** Sometimes re-use same nest in same season, adding to nest with each attempt (e.g. Carter 1924; McGilp 1926; Bridgewater 1931; Ashby 1933; Souter 1942; Lord 1953; Grant 1966; Quinn 1966; Marchant 1974; McFarland 1984;

Cameron 1985; Ashton 1987; Campbell; NRS), or build new nest on same branch or in same tree (e.g. Anon. 1921, 1923b; Miller 1938; Plumb 1948; Lord 1953; Grant 1966; Marchant 1974; McFarland 1984; Ashton 1987; Campbell; NRS). Often use same nesting site in successive seasons (Mellor 1921a, 1923; Marchant 1974; Ashby 1987), though not known if same pairs or one member of same pair involved. Same territories also occupied long-term (see Social Organization: Breeding dispersion). Over 8 years at Cobbora, NSW, a pair always nested within 100 m of house (Mathews). At least once, nest built in same spot despite failure in previous year (Boughtwood 1948b). Once built on top of nest of previous year that had become inverted (Sefton 1956); said to build each year in same garden (North) or vine (Chenery 1933). Twice reported building two nests simultaneously (once 1.2 m apart), though only one used (Roberts 1945; Brown 1950a). Once, pair said to have built 18 nests in a continuous row of identical 'pigeon holes', each 12.7 × 38.1 × 10.2 cm, and c. 1.8 m above ground, beneath floor of house; finally laid in one of them, but clutch abandoned; nests in centre were complete, while those towards each edge were progressively less complete; in following season, same pair built single nest (Roberts 1940). Once, four nests built on top of one another in same season (Bridgewater 1931). Once, nest built on top of another which contained dead Willie Wagtail on eggs (Anon. 1927). Recorded nesting in same tree as other Wagtails (Morgan 1932). ASSOCIATIONS WITH OTHER SPECIES: Often nest near or in same tree as Magpie-lark (Harvey & Harvey 1919; McGilp 1923; Chisholm 1924; Morgan 1928, 1930; Sutton 1928; Chaffer 1929; Wolsten-holme 1929; Ashby 1933; Hindwood 1935; Hood 1935; Hyem 1937; Robinson 1947a,b; Plumb 1948; Anon. 1949; Brown 1950a; Chisholm 1962; Mendel 1972; Moriarty 1972; McFarland 1984; Ashton 1987; Campbell; North; NRS); of three nests situated near Magpie-lark nests near Sydney, in all three cases Magpie-larks had nested first (McFarland 1984); this association possibly for mutual protection (Roberts 1942; Kemp 1943), or Willie Wagtail possibly gains disproportionate benefit in driving away potential predators from nest-site (Roberts 1942); association said not to occur in NT (Barnard 1914). Of 31 nests in NRS indicating some association with Magpie-lark: 20 were of nesting in same tree, six in adjacent tree and five nearby; where distance recorded, one 1–2 m away from that of Magpie-lark, nine were 2–5 m away, four were 5–10 m away and one was >10 m away. Once, pair of Willie Wagtails moved 400 m to nest within 4 m of Magpie-larks after failure of previous nest (Marchant 1974). Also recorded nesting in same tree as White-faced Heron *Egretta novaehollandiae*, Black-shouldered Kite *Elanus notatus*, Whistling Kite, Little Eagle *Hieraetus morphnoides*, Brown Falcon *Falco berigora*, Australian Hobby *F. longipennis*, Nankeen Kestrel *F. cenchroides*, White-plumed Honeyeater, Yellow-rumped Thornbill, Jacky Winter, Varied Sittella, Leaden *Myiagra rubecula* and Restless Flycatchers, Grey Fantail, Black-faced and Ground *Coracina maxima* Cuckoo-shrikes, White-winged Triller *Lalage sueurii*, White-breasted *Artamus leucorhynchus* and Dusky *A. cyanopterus* Woodswallows, and Diamond Firetail *Stagonopleura guttata* (Sutton 1928; Hyem 1930; McGill 1942; Anon. 1946; Robinson 1947b; Brown 1950a; Mendel 1972; Ashton 1987; Angus 1993; Campbell; NRS). However, suggested that apart from nesting in same tree as raptors, these records possibly fortuitous (Marchant 1974). MEASUREMENTS (m): HEIGHT OF NESTS: From NRS, nominate *leucophrys*: 3.11 (2.65; 0.25–30; 3051): 11.08% within 1 m of ground; 37.62%, 1–2 m above ground; 23.01%, 2–3; 8.85%, 3–4; 5.77%, 4–5; 11.40%, 5–10; 2.13%, 10–20; and 0.13% (four), >20 above ground. Subspecies *picata*: 2.65 (1.43; 0.6–7.1; 25) (NRS). Most nests (71.7%) within 3 m of ground, with no indication of bimodal distribution (see Marchant [1974] below). HEIGHTS OF NEST

WITHIN NEST-PLANTS: Of 2057 records in NRS, in classes of 10% of height of nest-plant from lowest 10% to highest 10%, most (66%) were in lower half of nest-plant, but very few in lowest 10%: 81 (3.9%), 263 (12.8%), 281 (13.7%), 362 (17.6%), 372 (18.1%), 199 (9.7%), 167 (8.1%), 150 (7.3%), 96 (4.7%), 86 (4.2%); see Marchant (1974: Fig. [1]) for similar analysis. From earlier analysis of NRS data (565 records), height of nests between <1 and >15, with mean height c. 3 m, and height possibly bimodally distributed, especially if sites in exotic trees were excluded, since lowest branches of tall native trees tend to be >7 m above ground, while native shrubs provide sites up to c. 5 m above ground; suggested nests usually placed >c. 15% height of nest-plant below top of vegetation (Marchant 1974). Eight nests near Sydney were all on horizontal branches 2.5–4 m above ground (McFarland 1984). Mean height of nest from records in literature 2.7 (2.13; 1.2–9.1; 30) (Jackson 1912; Sutton 1927; Sutton 1927, 1928, 1931, 1933; Parsons 1928; Tindale 1930; McGilp 1934; Gray 1938; Anon. 1947; Boughtwood 1948b; Plumb 1948; Watson 1955; Serventy 1958; Grant 1966; Quinn 1966; Baldwin 1974; Gill 1982; Angus 1993; Leach & Lloyd 1993; Stevens 1998). In Five Day Ck Valley, mean height c. 7, though this was highly biased by two of the three highest nests, which were 4.5, 22 and 25 respectively (Cameron 1985). HEIGHT OF NEST-PLANT: 8.39 (6.7; 0.5–100.0; 2065) (NRS).

Nest, Materials Nest round and cup-shaped (North; NRS); felt-like (NRS). Usually made of shreds of bark and grass, sometimes with twigs, roots, feathers, animal hair or twine and bound together, and thickly coated, with spider web; very occasionally, nests made of mud, and, once, one made entirely from tufts of white fibres from cotton plants. Neatly lined with grass, fibrous roots or other fibres, and hair of Horse or Cattle or occasionally Cats or Rabbits, and feathers (Le Souëf 1903; Sutton 1927; Bridgewater 1931; McGilp 1934; Deignan 1964; Anon. 1982; Bolton & Hall 1982; Goodey & Lill 1993; Gould; Campbell; North; Serventy & Whittell; NRS [see below]); also said that lining not required, as interior of nest already soft (Campbell). Occasionally incorporate other materials, such as newspaper, into nest (Lord 1953; NRS [see below]). From a subset of NRS records (158 nests), commonly reported materials were: spider web (95.57%); grass, especially fine dry grass (70.89%); bark (20.25%); plant down (12.03%); wool (11.39%); rootlets (10.13%); hair, including of Horse (9.49%); feathers (9.49%); fibres, from plants, hessian sack or rope (9.49%); and unspecified plant material (6.33%). In addition, three nests were made of mud, two contained fur (e.g. Dog fur), two contained plastic, and singles contained cocoons or egg-sacs, twigs, leaves, cotton thread and string. Materials used in lining of ten nests were: hair (n=7), including of Cattle; wool (2); and fur (1). From another subset of NRS data (565 nests): lining of 97 nests contained hair of Cattle or Horse, 88 wool, 38 feathers (e.g. Galah *Eolophus roseicapillus*, White-winged Chough or Australian Ringneck *Barnardius zonarius*), seven plant down, six threads of string, cotton or burlap, three fluff from a house, two Rabbit fur, and single records of bits of dead leaves and nylon fishing line (Marchant 1974). RE-USE OF MATERIALS: Sometimes reuse materials from earlier nests in new nests (D'Ombrain 1905; Anon. 1919, 1923b; Roberts 1940; Boughtwood 1948b; Marchant 1974; Ashton 1987; Campbell; NRS), and occasionally dismantle old nests to build new ones (Marchant 1974). CONSTRUCTION OF NESTS: Both sexes collect material and build nest (McGilp 1934; Roberts 1945; Anon. 1982; McFarland 1984; NRS), though with second and subsequent attempts, thought that one adult initiated new attempt while other member of pair mainly cared for fledglings of previous brood (Grant 1966; NRS; see below). Materials gathered from near nest (McGilp 1934); and hair or fur sometimes plucked from backs of animals (Wheeler 1959; North; NRS). At

Werrabee, early in nest-building ($n=18.5$ h of obs. at four nests), males made 12.1 visits/h, and females 14.0; late in nest-building period ($n=29$ h obs. at seven nests), males made 6.6 visits/h, and females 7.4; no significant differences between sexes in rates of building both early and late in building cycle, and visits rarely overlapped, except when copulation occurred (Goodey & Lill 1993). Once, one member of pair built new nest while other tended nestlings from previous brood (Grant 1966); repairs made to nests are at least sometimes by female only (McFarland 1984), and at one nest, during 30 min of observation, both birds brought material but only one, thought to have been female, added material to nest (McGilp 1934). Foundation of nest formed by twisting spider web under and across both sides of fork; then fine rootlets and strips of soft bark twisted round fork till cup is formed, with bird sitting in nest and shaping it with breast; then a layer of web added, which binds materials together and helps camouflage nest (McGilp 1934; Grant 1966; McFarland 1984; Campbell). Alternatively, circle of spider web placed onto surface of branch, forming hollow saddle, and within this, platform of fine grass, hair and strips of bark built up; web and lining added by bird sitting on platform and acting as mould, round which materials were arranged; web was smeared round circumference of nest (McFarland 1984). At one nest, bird sat in nest and pulled material up round itself; at another, bird shaped lining with circular movement and pressure of breast (NRS). Material often added to nest or nest repaired after laying or hatching, adults wiping sides of nest with bill as they sit (Marchant 1974; Ashton 1987; NRS), e.g. at one nest with C/4, male brought spider web, and female added it to external wall of nest and pulled it up to rim (McGilp 1934). **CONSTRUCTION TIME:** Varies. Near Sydney, nests completed in 5–7 days ($n=8$) (McFarland 1984); in SA, nests completed in 6–17 days (no N) (Ashton 1987). Once, only 6 days between start of building and laying of first egg (NRS). However, construction sometimes much longer: once more than 1 month (Anon. 1923b); once, >25 days in wet weather (NRS). Once, building and pre-incubation period, ≥ 10 days (Sedgwick 1958). Sometimes begin building new nest before previous brood has fledged; once, new nest half built when previous brood fledged (Grant 1966). In Sydney, if a nest destroyed, building of new nest did not start for 18–28 days if fledgelings present, but started within 1–2 days without fledgelings. **MEASUREMENTS (cm):** External diameter, 7.0; external depth, 4.4; internal diameter, 5.7; internal depth, 3.8 (Campbell; Serventy & Whittell); and average nest said to measure (respectively as above): 7.6; 6.4; 5.7; 3.2 (North). Internal depth once 1.9 (Marchant 1974).

Eggs Oval to elongate oval (Campbell; North), sometimes pointed at small end (North), or prominently rounded at one end (Campbell); one set of three from SA swollen oval (White 1924). Close-grained, smooth and slightly lustrous (North). Ground-colour varies, from pure white to pale creamy-brown, pale cream, yellowish white, pale yellowish, cream-buff, dull greenish-white or greyish; marked with spots, blotches or cloudy markings of dark yellowish-brown, amber, olive, purplish brown, purplish grey, dull inky-grey, ashy grey, bluish black, slate, blackish brown, chestnut-brown, chestnut-red, light rufous or lilac, usually in well-defined zone of confluent markings at larger end, sometimes round centre or sometimes uniformly distributed over shell; some have underlying bluish-black or pale bluish-grey spots or blotches (Le Souëf 1903; White 1924; Gould; Campbell; North). One set had a few small underlying bluish-grey spots on large end and a dark creamy-brown cap on small end (North). Some have been recorded with only a large coalesced patch of underlying inky-grey markings on one side of shell (North). As incubation proceeds, eggs said to acquire brownish tinge (Serventy & Whittell). **MEASUREMENTS:** *SUBSPECIES PICATA*, n. Aust.: 18.0

(1.35; 16–19.8; 8) \times 14.1 (0.56; 13.5–14.7; 8) (Le Souëf 1903; Campbell; North). From elsewhere in Aust. (probably all nominate *leucophrys*), 20.1 (1.18; 17.5–21.3; 17) \times 15.1 (0.55; 14.2–16; 17) (White 1924; Campbell; North). In WA, said to average 18–20 mm \times 14–15 (Serventy & Whittell). **COMPOSITION:** Of egg weighing 2.29 g, yolk comprised 25.0% of total mass (Lill & Fell 1990).

Clutch-size Usually 3–4, occasionally two and rarely one (McGilp 1923; Marchant 1974; Campbell; Saunders & Ingram 1995; Serventy & Whittell; NRS; see below); twice, five (NRS). From NRS: *NOMINATE LEUCOPHRYS*: mean clutch-size 3.05 (0.56; 1–5; 1020 clutches): C/1 \times 13, C/2 \times 99, C/3 \times 742, C/4 \times 167, C/5 \times 2; mean size by month: July, C/3 \times 1; Aug., 2.83 (0.51; 2–4; 18); Sept., 3.01 (0.58; 1–5; 172); Oct., 3.02 (0.55; 1–4; 329); Nov., 3.14 (0.6; 1–5; 290); Dec., 3.04 (0.5; 1–4; 145); Jan., 2.97 (0.36; 2–4; 63); and Feb., 2.0 (1–3; 2); *SUBSPECIES PICATA*: C/2 \times 1, C/3 \times 1, C/4 \times 1 (NRS). From earlier analysis of NRS (to 1972), mean 3.10 (0.52; 2–4; 173): C/2 \times 15, C/3 \times 125, C/4 \times 33. Clutch-size significantly smaller at elevations below 500 m asl (3.03; $n=113$ clutches) than above (3.25; $n=60$ clutches). When divided into broad geographical categories, clutch-size greatest on Great Divide (3.2; $n=94$ clutches) and smaller within 100 km of coast (3.0; $n=46$ clutches) and inland (2.9; $n=33$ clutches). No significant differences in clutch-size between years or seasons, or at different latitudes, though clutch-size tended to differ seasonally, with second clutches, laid in Nov., largest: from 166 nests in NRS, before Oct., mean clutch-size 3.05 ($n=22$); in Oct., 3.16 ($n=64$); in Nov., 3.21 ($n=44$) and after Nov., 2.97 ($n=36$) (Marchant 1974). In Vic., 3.2 ($n=42$) (Lill & Fell 1990); at Werrabee, 3.15 (0.545; 2–4; 95): C/2 \times 8, C/3 \times 65, C/4 \times 22 (Goodey & Lill 1993). In Aldinga Scrub CP, SA: 3.09 (0.34; 2–4; 64): C/2 \times 1, C/3 \times 56, C/4 \times 7; in season after drought broke, 50% of clutches were C/4, but no C/4 recorded in following year (Ashton 1987). In Sydney, C/2 \times 2, C/3 \times 6, C/4 \times 1 (McFarland 1984); and in Five Day Ck Valley, mean 3.0 ($n=5$) (Cameron 1985). Other records include: in Qld, C/2 \times 9, C/3 \times 22, C/4 \times 9 (Storr 19); near Cowra, NSW, C/2 \times 1, C/3 \times 4 (Bourke 1948); and, in WA: on Swan Coastal Plain: C/2 \times 5, C/3 \times 26, C/4 \times 1 (Storr 28); in Eucla Div.: C/2 \times 3, C/3 \times 1 (Storr 27); in South-Eastern Interior, C/2 \times 2, C/3 \times 1 (Storr 26); in Mid-Eastern Interior, C/3 \times 8 (Storr 22); in Gascoyne Region, C/2 \times 6, C/3 \times 15 (Storr 21); in Pilbara Region, C/2 \times 3, C/3 \times 7, C/4 \times 1 (Storr 16); in Kimberley Div., C/3 \times 9 (Storr 11).

Laying Usually at intervals of 24 h or so (Lord 1953; Sedgwick 1958; Marchant 1974; McFarland 1984; Goodey & Lill 1993; Campbell; Serventy & Whittell; NRS) but sometimes longer (NRS; see below); three times, first and second egg laid 2 days apart, but only 1 day between laying of second and third eggs (Anon. 1921, 1923b; Mellor 1924); and several other records of intervals of 48 h (Marchant 1974). Eggs laid in early morning (Goodey & Lill 1993), usually between 05:00 and 09:00 (Marchant 1974); one clutch of three eggs laid on three consecutive days, each c. 35 min after dawn (NRS). Usually raise two or three broods per season, mostly three (Anon. 1923b, 1982; Chaffer 1929; Lord 1953; Lowe 1959; Quinn 1966; Marchant 1974; Campbell; North; NRS); very occasionally rear four broods (Anon. 1945; Grant 1966; Serventy & Whittell). Of 51 occasions in which pairs had successive clutches in same nest or territory, intervals between success or failure of one nest and start of next were: when using same nest, 10.7 days (3–19; 19) after success of previous attempt (excluding outliers of 26 and 28 days), and 12, 14 and 28 days after failure; when using different nest, 12.4 days (7–25; 11) after success, (excluding outliers 31 and 43 days) and 8 days (4–16; 12) after failure (excluding outliers 29 and 31 days); apparent frequency of re-use of same nest for later broods possibly as high as 50%, though this result potentially

biased (Marchant 1974). Observed incubating within 9–18 days ($n=5$ instances) of fledging of previous brood (Mellor 1924; Grant 1966; Quinn 1966), and once, within 3 weeks (Anon. 1921); sometimes start building new nest while still feeding young from earlier brood, and sometimes lay eggs while still feeding fledgelings from earlier brood (Grant 1966; McFarland 1984; NRS); in Sydney, second clutch hatched about 4 days after first brood expelled from territory (McFarland 1984; see Social Organization). Once, began laying next clutch 24 days after fledging of previous brood (Ashton 1987). Will re-lay persistently after loss of eggs, up to eight times in a season (Lord 1956a; Campbell). At Werribee, mean interval between failure of nest and start of new clutch 10.6 days (9.4; 22) (Goodey & Lill 1993); in Aldinga Scrub CP, interval between loss of nestlings and start of new clutch 6–7 days ($n=2$ nests) (Ashton 1987). Once, nest rebuilt within 1 week and eggs laid within 10 days of loss of previous clutch; once, new egg laid 4–5 days after another egg was abandoned (NRS). Once, pair built six nests in same season, with eggs lost in at least one nest, and only final attempt successful (Stevens 1998). When nesting near Magpie-larks, often lay after or at about same time as Magpie-larks; of 17 nests near nests of Magpie-lark, on nine occasions, Wagtails laid 25.2 days (11.25; 5–36; 9) after Magpie-larks and in another five cases Magpie-larks started first, but interval was not known; two nests started about same time, and for one, outcome not known (Marchant 1974).

Incubation Said probably to begin on laying of final egg of clutch (Marchant 1974; see Young below); or on day after first egg laid (Serventy & Whittell), which usually coincides with laying of second egg (Sedgwick 1958). Once, incubation began after laying of first egg (Anon. 1923b). By both sexes (Ford 1904; Harvey & Harvey 1919; Anon. 1921; McGilp 1934; NRS), sometimes such that incubation virtually continuous (Anon. 1923b). When brood overlaps with subsequent clutch, one member of pair (probably female) incubates while other tends fledgelings (Ashby 1933; Lord 1953; Grant 1966), and once, one bird spent much greater proportion of time incubating than its mate (NRS). At Werribee, mean length of stints of incubation by male significantly shorter (by 1–1.5 min, or 11–13%) than those by female; early in incubation period ($n=73.2$ h obs. of ten breeding attempts by six pairs), of time spent incubating, female sat for 53.4% of time, in 201 stints of mean length of 11.8 min, while male contributed 46.6% of time, in 181 bouts of mean length of 10.2 min; late in incubation period ($n=55.8$ h obs.), female sat for 52.9% of time, in 170 stints of mean length of 10.1 min, while male sat for 47.1% of incubation time, in 167 bouts of mean length of 9.0 min. Mean duration of all recesses during incubation, 0.4 min; constancy of early incubation, 94.6%, late incubation, 95.5%. Recesses in attendance were significantly longer (1.7 min) when they involved a chase of a potential predator (Goodey & Lill 1993). At one nest, mean length of seven incubation shifts was 15.1 min (Roberts 1942). Male does not usually feed female (Roberts 1942; Goodey & Lill 1993), though at one nest male seen to feed female on nest twice (McGilp 1934). Highly aggressive and vociferous in defence of nest with eggs; and sit tightly during incubation. Perform distraction displays when nest threatened (see Social Behaviour: Interactions with other species, and Relations within family group). However, incubating birds made little attempt to draw observer away from nest when flushed from nest at night, and instead landed on ground near nest-tree (McGilp 1934). **INCUBATION PERIOD:** Usually c. 14 days, with five best determinations between 13 days 18 h \pm 6 h and 14 days 16 h \pm 8 h, and range of another seven determinations from 12 days 14 h to 16 days 15 h \pm 15 h (Marchant 1974). At Werribee, mean period 14.1 days (0.8; 13–15; 16) (Goodey & Lill 1993). Other estimates 12–16 days (Grant 1966; Anon.

1982; Bolton & Hall 1982; Campbell; Serventy & Whittell; NRS; and below); 13.8 days (0.92; 12–15; 10) (Mellor 1921a, 1924; Anon. 1923b; Lord 1953; Hobbs 1971). Once, presumably infertile eggs were incubated for 4 weeks before being abandoned (NRS).

Young Altricial, nidicolous. Broods of three hatch over 1–1.5 days, with little difference in weight within broods (10–20%) (Goodey & Lill 1993); Often all hatch on same day, indicating that genuine incubation begins when clutch complete (Lord 1953; Marchant 1974; NRS); three records of time between hatching of first and last egg in clutch of 22.25, 24, 28.25 h, and six other records of 34–44 h, but exact interval not recorded, and not all eggs in three other clutches hatched in 22–24 h (Marchant 1974). See Plumages, Bare Parts for description of nestlings. **PARENTAL CARE:** Both parents feed and brood nestlings, including shading them during day, and remove faecal sacs (Anon. 1914; Roberts 1942; Larkins 1980; Goodey & Lill 1993; NRS; see below). However, once, brooding of three broods done entirely by a melanistic adult of a breeding pair (Baldwin 1974). **BROODING:** Both sexes brood nestlings roughly equally, though contribution of sexes varies over nestling period (Goodey & Lill 1993). Early in nestling period, proportion of time spent brooding by females (58%) significantly greater than that spent by males (42%); late in nestling period, brooding by female significantly less (32.5%) than that by male (67.5%); as overall time spent brooding decreased by two-thirds between early and late stages of nestling period, contributions by both sexes approximately equal overall, and feeding rates by males and females not significantly different: of eight attempts by five pairs, early in nestling period (56.4 h obs.), female contributed 58.0% of time spent brooding in 420 stints of mean length of 3.8 min, and made 7.78 feeding visits/h, while male contributed 42.0% of time spent brooding in 386 stints of mean length of 3.1 min; later in nestling period ($n=47.0$ h obs.), male contributed 67.5% of time spent brooding in 143 stints of mean length of 3.0 min, and made 13.73 feeding visits/h, while female contributed 32.5% of brooding time in 103 stints of mean length of 3.5 min, and made 11.97 feeding visits/h (Goodey & Lill 1993). **NEST HYGIENE:** Both parents inspect nestlings often and remove faecal sacs, sometimes while hovering near rim of nest (Anon. 1914; Roberts 1942). Faecal sacs removed 2–3 times/h throughout nestling period; in early part of nestling period, 50.4% of faecal sacs produced were swallowed, whereas significantly fewer eaten later in period (only 1.1%), with rest removed; rates of removal and distance from nest that faecal sacs dropped did not differ significantly between sexes, though distance of removal decreased during late nestling period: of eight breeding attempts by five pairs, early in nestling period (51.5 h obs.), male removed faecal sacs 85 times (17.6% of visits) at rate of 1.7/h, with mean removal distance of 7.5 m, while female removed faecal sacs 69 times (15.0% of visits) at rate of 1.4/h, with mean removal distance of 7.6 m; late in nestling period (47.0 h obs.), male removed faecal sacs 90 times (13.4% of visits) at rate of 2.1/h, with mean removal distance of 5.9 m, while female removed them 112 times (20.1% of visits) at rate of 2.6/h, with mean removal distance of 6.3 m (Goodey & Lill 1993). **DEFENCE OF YOUNG:** Perform distraction display or attack intruders near nest (see Social Behaviour). Once, two dead and one weak nestling were removed from nest, leaving one healthy young (Leach & Lloyd 1993). Once, adults fed nestlings that had fallen from nest and been placed in a basket (Stevens 1998). At one nest, young fed and brooded by a New Holland Honeyeater *Phylidonyris novaehollandiae* but parents drove it away almost immediately (Paton & Paton 1994). **GROWTH** For two nestlings, weight and length of tarsus on day of hatching: 2.7 g and 8.5 mm, and 2.9 g and 8.0 mm; at 4 days old: 9.3 g and 16.3, and 9.7 g and 16.0 mm (Gill 1982).

Fledging to independence FLEDGING PERIOD: Usually c. 14 days (see below). Mean 14.01 days ($n=12$; excluding outlier of 16 days 3 h \pm 20 h) with four best determinations between 13 days 4 h \pm 5 h and 15 days 9 h \pm 11 h, and another eight between 12 days 8 h to 15 days 9 h (Marchant 1974). At Werribee, mean time from completion of hatching to fledging 14.3 days (1.58; 12–17; 10) (Goodey & Lill 1993). Combined incubation and fledging periods (where neither could be determined in isolation) c. 29.25 days ($n=6$) (Marchant 1974). Otherwise, fledging period 11–17 days (Anon. 1921; Mellor 1921b, 1924; Carter 1924; Ashby 1933; Lord 1953; Grant 1966; Hobbs 1971; Serventy & Whittell; NRS; see below); very occasionally said to have been probably 10 or 11 days (Tindale 1930) or probably 11 or 12 days (Bolton & Hall 1982); and once, in bad weather, 19 days (Anon. 1923b). All members of brood usually fledge within a few hours (Goodey & Lill 1993); once, brood of three all fledged within 1 h (NRS). Fledgelings stay together in dense cover near nest for first 24–48 h, but after 2–3 days range up to 20 m from nest-site and 10 m from each other, sometimes emerging from dense cover to be fed (Goodey & Lill 1993). **PARENTAL CARE:** Young fed and cared for by both parents (Mellor 1921b), though, at least sometimes, brood divided between parents (Sutton 1928; Goodey & Lill 1993; see below). Feeding of young usually declines towards end of second week after fledging, and parents begin to attack and drive young from natal territory some time after they forage independently and usually before next brood hatches, though timing of start of attacks and departure from territories appears to vary (McFarland 1984; Goodey & Lill 1993; Serventy & Whittell; see Social Organization: Bonds). At Werribee, brood-division may have occurred: six fledgelings were fed mainly by one parent or other (four by female and two by male) with mean proportion of feeding by dominant parent 91.5%; another fledgeling fed roughly equally by female (54%) and male (46%). Overall, contribution by male to feeding 33.6%; male said to invest more time in building new nest for subsequent brood. When one fledgeling present ($n=13.3$ h obs.), fed by male at rate of 3.5 visits/h, and by female at 9.2 visits/h; when three fledgelings present ($n=1.8$ h obs.), parents made many more visits, feeding young at rates of 7.2 visits/h/fledgeling (by male) and 10 visits/h/fledgeling (by female); overall, mean number of visits varied from 2.9 to 29.9/h, and 0–11.5% of visits did not involve feeding (Goodey & Lill 1993). In Sydney, when breeding uninterrupted, mean duration from laying of first egg to last observation of juveniles in natal territory 58.3 days (9.6; 6), compared with duration of 86.5 days (7.8; 2) when new nest lost while fledgelings still being cared for (McFarland 1984). Once, Wagtail young fledged 5 min before those of Magpie-lark nesting nearby (Chaffer 1929).

Success Where number of eggs and outcome known, of 3091 eggs, in 1069 nests, 1659 (53.67%) hatched and 998 (32.29%) young fledged, equal to 0.93 fledged young per nest; from 4340 eggs in 1482 nests, 2734 (63.0%) hatched; of 2094 nests where outcome known, 947 (45.2%) fledged at least one young, another 277 (13.2%) contained young that were capable of leaving nest when last seen, and 870 (41.5%) failed (NRS). From subset of NRS data, where outcome known, of 339 nests, 220 (64%) fledged at least one young and 119 failed; total breeding success was 58% (from 520 eggs, 421 hatched and 297 fledged); breeding success apparently higher (63%) in broods produced after 30 Nov. than in earlier ones (56%), and C/3 was most successful clutch-size in producing fledgelings (60%), though differences not statistically significant (Marchant 1974). In Sydney, of 26 eggs laid by two pairs over two seasons in eight nests, 22 (88%) hatched, and 18 (69%) young fledged; 14 (52%) survived to independence; survival to independence did not appear to be enhanced in two cases of an extended period of parental supervision (McFarland

1984). Near Cowra, NSW, one pair hatched and fledged 12 young from 14 eggs in five nests (Bourke 1948); at Laverton, Vic., one pair raised 13 young from four broods in one season (Grant 1966). In Five Day Ck Valley, 30% of nests deserted, but success rate where eggs laid was 67%, though only two free-flying young observed from eight pairs over two seasons (Cameron 1985). In Aldinga Scrub CP, SA, of 69 nests, 43 were successful and 26 failed (Ashton 1987). Once, a pair lost eight of nine clutches in one season but three young fledged on final attempt (Lord 1956a). At Werribee, many nests abandoned or destroyed before laying; after laying, clutches were either wholly depredated or all eggs hatched, but individual nestlings often lost, especially from large broods (Goodey & Lill 1993). **CAUSES OF FAILURE:** Many eggs or young taken by predators. Nestlings sometimes killed by Cats (Mellor 1926; Boughtwood 1948b), and eggs and young taken by Pied *Cracticus nigrogularis* and Black C. *quoyi* Butcherbirds (Marchant 1974; Tarburton 1991; NRS), Spangled Drongos *Dicrurus bracteatus* (NRS) and Pied Currawongs (NRS). Near Murphys Ck, se. Qld, many nests destroyed by Australian Magpies and, once, a nearly completed nest was pulled down by Grey-crowned Babblers *Pomatostomus temporalis* (Lord 1953). Nests with eggs sometimes thought to be interfered with by rats *Rattus* (Lord 1953). Because nests readily accessible, often interfered with by people, with nests removed or eggs stolen by children (e.g. Anon. 1919; Chenery 1933; Roberts 1945; Marchant 1974; NRS), though nests sometimes rebuilt after interference (Anon. 1919), or replacement or repositioned nest sometimes accepted by parents (Chenery 1933; Stevens 1998). Once nest was destroyed, possibly by birds themselves, after it was examined (Pearse 1931). Nests sometimes deserted for no apparent reason (Marchant 1974). Nests often destroyed or contents lost after bad weather, especially, rain, wind and cold, and associated floods sometimes destroy nests or nest-trees (Le Souëf 1915; Hyem 1936; Roberts 1942; Gannon 1945; Baldwin 1974; Marchant 1974; Ashton 1987; Angus 1993; NRS), and once, drowned adult (Le Souëf 1915). Sometimes nest relocated after storms or floods (Anon. 1923b). **CUCKOOS:** Parasitized by Pallid, Fan-tailed *Cacomantis flabelliformis* and Brush C. *variolosus* Cuckoos, and Horsfield's *Chrysococcyx basalis* and Shining C. *lucidus* Bronze-Cuckoos (Brooker & Brooker 1989; HANZAB 4). Once, a fledgeling Pallid Cuckoo was hatched and raised by White-plumed Honeyeaters; 10 days after leaving nest, fledgeling Cuckoo threw 4-week-old Wagtail nestlings out of nearby nest, killing them, and Cuckoo was then immediately fed by adult Wagtails (Hughes & Hughes 1997). Cuckoos also said to intercept food intended for incubating bird (Sharland 1929). Once, suggested that nestlings died from starvation after food supply intercepted by juvenile Pallid Cuckoo (Ashton 1987); another Pallid Cuckoo fledgeling removed two Wagtail nestlings from a nest and was then fed by adult Wagtails (Francis 1944). Once, Willie Wagtails seen removing side of nest that contained egg of Pallid Cuckoo (Marshall 1932). Parasitism by Pallid Cuckoo often unsuccessful, possibly because eggs do not mimic those of Wagtail (Marchant 1974). Once, Rufous-throated Honeyeater *Conopophila rufogularis* stole material from nest, though not specified if nest was active or if any impact on success (Hill 1913). One nest that had been colonized by small ants was pulled apart (Lord 1953).

PLUMAGES Prepared by F.J.G. Copley. Fledge in juvenile plumage. Undergo a partial post-juvenile (first pre-basic) moult to adult-like first immature (first basic) plumage, soon after fledging. Acquire adult plumage in complete first immature post-breeding (second pre-basic) moult, probably when c. 1 year old. Thereafter, a complete post-breeding (pre-basic) moult each cycle produces successive adult (basic) plumages with no known change in appearance. Sexes alike. Three

subspecies, two in Aust.; nominate *leucophrys* from Aust. S of 20°S described below, based on examination of skins of ten adult males, five adult females, six immatures and seven juveniles (HLW, MV).

Adult (Definitive basic). **HEAD AND NECK:** All of head, black, except for: very narrow white partial supercilium extending from above front edge of eye to c. 5 mm behind eye; white tips to feathers on lower malar area, forming narrow white malar stripe or broken line of small white spots along lower malar area; and, in most, white fringes to tips of feathers of chin and, in some, throat, forming white flecking on chin and throat. Extent and prominence of white markings varies individually; some have no malar stripe or flecking on chin and throat. Several fine black rictal bristles, to c. 1 cm long. **UPPERPARTS:** Wholly black, with glossy sheen in good light, dullest on uppertail-coverts. Feathers of upperparts, black-brown (119) with broad black fringes and concealed grey (84) bases. **UNDERPARTS:** Upper breast and sides of breast, black, sharply demarcated from white of lower breast, belly, vent and undertail-coverts. Flanks mostly white, grading to grey-black (82) on upper flanks. Thighs, dark brown (219) with white tips to feathers. Axillaries, grey-black (82). All feathers have concealed grey-black (82) bases. **UPPERTAIL:** Black-brown (20). **UNDERTAIL:** Blackish brown (dark 121). **UPPERWING:** Marginal and median secondary coverts, black-brown (119) with black fringes and with glossy sheen in good light; in some, outer few coverts have narrow white tips. Greater secondary coverts, dark brown (121) or black-brown (119). Marginal and median primary coverts, black-brown (119) with white tips to outermost coverts. Greater primary coverts, dark brown (119A, 219A) on outer webs, pale greyish (c86) on inner webs, and slightly paler than other wing-coverts. Alula and tertials, black-brown (20). Secondaries and primaries, dark brown (c121) with lighter brown (c223B) shafts; slightly paler than tertials and most wing-coverts. **UNDERWING:** Secondary coverts, dark brown (c121) with black-brown (119) edges, and, in some, white tips to most coverts. Marginal and median primary coverts, black-brown (119) with broad white tips. Greater primary coverts, brownish grey (c79) with white tips. Remiges, brownish grey (c79) with light-brown (223D) shafts.

Nestling On day of hatching have light-brown natal down, dense on crown, dorsal and ventral areas, and sparse or none on legs and outer wing. Eight well-developed down patches, the major dorsal patches (coronal, occipital, secondary, humeral, dorsal, and femoral) and major ventral patches (pectoral and latero-abdominal); and five less developed down patches, the minor dorsal patches (ocular, primary, crural and caudal) and minor ventral patch (jugular) (Gill 1982). Another brood described as naked except for scraggly down on crown and back (NRS).

Juvenile Feathers of upperparts and chin, throat and breast softer and more loosely textured than in adult. Further differs from adult by: **HEAD AND NECK:** Slightly paler and duller, black-brown (c119), and lacking glossy sheen. Feathers of crown, nape and hindneck also have faint cinnamon-brown (c39) fringes at tips when fresh, giving faintly scalloped appearance. Supercilium longer than in adult, extending to sides of nape; off-white (ne) or buff (c124) grading to cinnamon-brown (39) to rear. Feathers of chin and throat have off-white (ne) or buff (c124) flecks or bars. Lack white malar stripe or markings on malar area. **UPPERPARTS:** Blackish brown (c119) with cinnamon-brown (c39) or buff (c124) fringes at tips of feathers, forming brown to buff scalloping, very fine on mantle and shortest scapulars, and broader on longest scapulars, rump and uppertail-coverts. Have only faint glossy sheen in good light. **UNDERPARTS:** Upper breast and sides of breast, blackish brown (c119) or dark brown (c121) with faint buff (c124) fringes to feathers, forming paler scalloping. Axillaries and

upper flanks, black-brown (c119). Thighs, dark brown (121) with white tips. Rest of underparts, white with cream (54) tinge; uppertail-coverts grade to buff (124) at tips. **TAIL:** As adult but rectrices slightly narrower and slightly more acute at tip, particularly on outer rectrices. **UPPERWING:** All secondary coverts, and marginal and median primary coverts, dark brown (121) with distinct cinnamon-brown (39) tips. Greater primary coverts, alula and tertials similar to adult but with narrow cinnamon-brown (39) fringe at tips when fresh. Secondaries and primaries similar to adult but with cream (c92) fringe at tips when fresh, narrower on primaries. **UNDERWING:** Similar to adult but marginal and median primary coverts slightly paler at bases, dark brown (c121).

First immature (First basic). Very similar to adult but retain all juvenile greater primary coverts, all or most primaries, secondaries and rectrices, and one or more outer greater secondary coverts; some also retain one or more tertials; retained juvenile feathers of wing contrastingly paler and more worn than new adult-like plumage; retained juvenile secondary coverts also have distinct cinnamon-brown (c39) tips, and show moult-contrast with new adult-like coverts.

Aberrant plumages Albinism recorded in this species (Lepschi 1990). One bird recorded in Perth with entire plumage white, and with black irides and very pale brown legs, feet and bill (Milligan 1905). Le Souéf (1905) recorded a pure white nestling in a brood of two in Perth, the other nestling with typical (black and white) plumage. Three birds with all plumage pure white collected in NSW, all apparently progeny of same parents which had typical plumage (White 1914). Whitlock (1947) recorded a bird in WA with head, hindneck, mantle and uppertail-coverts, cream, and the rest of plumage of typical colour. Part albino with white 'saddle' across back recorded in Sydney (Haines 1967). Part albino recorded at Werribee, Vic. (Vic. Bird Rep 1987). Russell (1987) recorded the following from Vic. in Jan.–Apr. 1985: one at Moriac, with 'almost white' plumage; one at North Geelong with sandy-coloured plumage; and an albino at Werribee. Melanism also recorded in this species. Lepschi (1990) found 15 published records of melanistic birds. Hill (1907) recorded a bird with plumage entirely black in Ararat area, Vic. Melanistic birds also recorded in SA (SA Bird Reps 1969–70, 1976, 1977–81).

BARE PARTS Based on photos (A.G. Wells [in SWANS 12(1): 18]; unpubl.: G.S. Chapman; P.R. Marsack; and standard sources), and other information as cited. **Adult** Bill and gape, black (89). Palate described as grey (Rogers *et al.* 1986). Iris, dark brown (121). Orbital ring, black (89). Legs and feet, black (89). **Nestling** Based on museum skins and description of brood of two on day of hatching (Gill 1982). Skin, pink (c3); or very dark red-black, paler on underside (Gill 1982). Bill, dark grey (c83) with pale-yellow (157) base to tomia; or dark grey with black tip (Gill 1982). Gape, pale yellow (157), swollen; rictal flanges, pale yellow-white (Gill 1982). Palate and tongue, orange ([c17]; Gill 1982). Egg-tooth, pale, small and inconspicuous (Gill 1982). Iris, dark brown (121). Feet, pale grey (86). Claws, grey, darkening to black with age (Gill 1982). **Juvenile** Differences from adult: Bill similar to adult (photos, this study), but also described as brownish black (HLW). Gape said to change from buff-cream to pale yellow with age (Rogers *et al.* 1986). Legs and feet similar to adult (photos, this study) but also described as brownish black (HLW). Fledgelings <1 week out of nest had: bill, dark; gape, creamy yellow; legs, bone colour; 14 days later these birds had dark-grey legs (NRS). **First immature** As adult (photos, this study), though gape also described as grey (Rogers *et al.* 1986).

MOULTS Based on examination of skins of 71 adults, 20 first immatures and ten juveniles (AM, ANWC, HLW, MV;

subspecies combined). Timing of moult apparently similar between subspecies and these combined below. **Adult post-breeding** (Pre-basic). Complete; primaries outward. Moult of primaries starts Dec.–Feb. and finishes Mar. or Apr.; from skins, active moult of primaries recorded: Jan. (3 of 4; PMS 17, 14, 14); Feb. (4 of 4; PMS 7, 20, 21, 23); Mar. (3 of 6; PMS 23, 31, 42); and Apr. (1 of 5; PMS 41); none of 61 between May and Dec. had moult of primaries. Timing of moult of tail much as primaries but one (of 5 skins) started Nov. (just started moult of tail). Moult of body also mainly Jan.–Apr. (9 of 19 skins); timing much as moult of primaries and tail, but with some earlier records in Aug. (1 of 8, with slight moult), Sept. (2 of 18) and Nov. (1 of 6); none between May and July had moult of body. Moult also recorded in ne. NSW in Apr. and sw. WA in Feb. and Mar. (Hall). In PNG, timing apparently similar to Aust. populations, mostly from Dec. to Apr., though moult recorded every month (Mayr 1931). **Post-juvenile** (First pre-basic). Few data. Partial; involving all feathers of body and all marginal and median coverts, varying number of, or no, tertials, and most or inner few greater secondary coverts; some also replace 1–2 inner secondaries. Usually do not moult primaries (Rogers *et al.* 1986; present study), but one skin, in Feb., had active moult of primaries ($S^{4N}13^{1O4}$); same skin also moulting inner rectrices (growing t1 and t2 on both sides of tail). A first immature skin, in Apr., had retained juvenile t2–t6, but replaced t1 nearly fully grown. Active moult of body recorded Jan.–May (5 of 8). **First immature post-breeding** (Second pre-basic). Few data. Timing and extent probably much as adult post-breeding. Active moult of primaries recorded Mar. (2 of 3; PMS 30, 38); both of these also with heavy moult of body and active moult of tail. None of 27 first immature skins from May–Nov. had active moult of any feather-tracts.

MEASUREMENTS NOMINATE LEUCOPHRYS: (1–2) Aust. S of 20°S (Qld, NSW, Vic., SA, WA, NT), skins (AM, ANWC, HLW, MV, SAM): (1) Adults, (2) Juveniles and first immatures.

	MALES		FEMALES		
WING	(1)	99.9 (3.30; 92.0–105.5; 29)	95.6 (2.80; 90.0–100.5; 20)	**	
	(2)	95.7 (3.72; 89.0–101.5; 13)	94.3 (4.92; 81.0–101.0; 17)	ns	
TAIL	(1)	105.1 (4.07; 89.0–112.0; 29)	103.2 (3.25; 98.0–109.0; 20)	*	
	(2)	101.5 (4.13; 94.0–109.0; 13)	99.6 (10.32; 65.0–109.5; 17)	ns	
BILL S	(1)	17.5 (0.83; 15.7–18.8; 25)	17.3 (0.77; 15.7–18.5; 19)	ns	
	(2)	17.2 (0.93; 16.1–19.0; 12)	17.3 (1.09; 14.7–18.9; 16)	ns	
TARSUS	(1)	23.4 (1.30; 21.4–25.6; 28)	22.8 (1.76; 18.0–25.8; 19)	ns	
	(2)	24.4 (1.11; 21.4–25.7; 13)	23.4 (1.46; 21.3–26.3; 17)	*	

NOMINATE LEUCOPHRYS: (3) Vic., unsexed adults, live (Rogers *et al.* 1986). (4) NSW, Vic. and WA, adults, skins (Keast 1958).

	UNSEXED	
WING	(3)	100.3 (3.94; 28)
	(4)	98 (92–104; 37)
TAIL	(3)	106.8 (4.84; 12)
	(4)	98 (94–106; 37)
THL	(3)	35.5 (0.76; 27)

SUBSPECIES PICATA: Aust. N of 20°S (WA, NT and Qld): (5–6) Skins (ANWC, MV, HLW, AM, SAM): (5) Adults; (6) Juveniles and first immatures. (7) Adults, skins (Keast 1958).

	MALES		FEMALES		
WING	(5)	95.1 (2.95; 89.0–99.0; 16)	91.1 (1.70; 89.0–93.0; 8)	**	
	(6)	95.0 (2.45; 92.0–100.0; 7)	88.1 (2.62; 85.0–91.0; 7)	**	
	(7)	94 (90–98; 20)	–		
TAIL	(5)	100.4 (3.27; 94.0–105.0; 16)	99.3 (2.91; 93.5–102.0; 8)	ns	
	(6)	100.9 (4.22; 95.0–107.5; 7)	95.6 (6.20; 83.0–101.0; 7)	*	

	(7)	96 (91–100; 20)	–		
BILL S	(5)	17.7 (0.80; 16.1–19.1; 16)	17.2 (0.71; 16.4–18.6; 7)	ns	
	(6)	17.7 (0.76; 16.4–18.3; 5)	16.9 (0.25; 16.5–17.3; 7)	*	
TARSUS	(5)	23.1 (1.09; 21.0–24.6; 15)	23.5 (1.25; 21.9–25.3; 8)	ns	
	(6)	23.2 (1.41; 21.6–25.3; 7)	22.0 (1.06; 21.2–24.2; 7)	*	

SUBSPECIES MELALEUCA: (8–9) New Guinea, skins (AM): (8) Adults; (9) Juveniles and first immatures. (10) Merauke, PNG, adults, skins (Mees 1982). (11) PNG, adults, skins (Diamond 1972). (12) PNG, adults, skins (Mayr & Rand 1937).

	MALES		FEMALES	
WING	(8)	102.0, 99.0	94.0, 101.0	
	(9)	–	96.5	
	(10)	–	97	
	(11)	101	95, 95, 98	
	(12)	105, 105	–	
TAIL	(8)	106.5, 100.0	102.5, 105.5	
	(9)	–	101.0	
	(10)	–	96	
	(11)	100, 108, 108	95, 104	
BILL S	(8)	21.1, 20.9	19.0, 20.6	
	(9)	–	19.1	
	(10)	–	20	
TARSUS	(8)	24.6, 23.5	22.0, 24.3	
	(9)	–	23.8	
	(10)	–	24	

WEIGHTS NOMINATE LEUCOPHRYS: (1–2) Aust., S of 20°S, from museum labels (AM, ANWC, MV, SAM): (1) Adults; (2) Immatures and juveniles. (3) SA, adults (Hall). **SUBSPECIES PICATA:** (4–5) N. Aust., N of 20°S, from museum labels (AM, ANWC, MV, SAM): (4) Adults; (5) Juveniles. (6) N. WA, adult (Hall 1974). **SUBSPECIES MELALEUCA:** (7) New Guinea, adults, from museum labels (AM), Diamond (1972) and Mees (1982).

	MALES		FEMALES		
(1)	19.6 (4.38; 14.5–25.5; 9)	21.3 (2.53; 19.5–25.0; 4)	ns		
(2)	18.0 (2.30; 13.0–21.0; 10)	17.5, 19.2, 20.0			
(3)	19.3	18.3			
(4)	16.7 (1.90; 14.3–20.5; 11)	15.9 (1.38; 13.5–17.4; 6)	ns		
(5)	16.3 (0.82; 15.0–17.0; 6)	16.7 (1.45; 14.5–18.5; 5)	ns		
(6)	19.4	–			
(7)	25.5, 27.0	25.1 (2.95; 23.0–29.5; 4)			

NOMINATE LEUCOPHRYS: Rogers *et al.* (1996) recorded weight of unsexed adults as 17.4–23.9 (n=28).

STRUCTURE Wing fairly long and slightly rounded at tip. Ten primaries: p7 longest (p6 =); p10 40–47 mm shorter, p9 8–16, p8 1–3, p6 0–1, p5 1–4, p4 6–11, p3 11–16, p2 14–21, p1 17–23. Slight emargination to outer webs of p5–p8 and inner webs of p6–p10. Nine secondaries, including three tertials; tips of longest tertials fall short of tips of secondaries on folded wing. Tail long, rounded at tip when folded, characteristically fan-shaped when spread; 12 rectrices; t6 c. 9 mm shorter than t1. Bill rather short, about half length of head, fairly slender; small hook to tip of upper mandible, overhanging lower; slight notch near tip of upper mandible. Tarsus fairly long, compressed laterally; scaling laminiplantar. Tibia fully feathered. Middle toe longest, length with claw 15.8 (1.26; 14.2–17.5; 6); outer toe 72–80% of middle, inner 59–74%, hindtoe 78–88%.

GEOGRAPHICAL VARIATION Three subspecies that apparently vary only in size: nominate *leucophrys* in s. and central mainland Aust. S of c. 20°S; *picata* in n. Aust. N of c. 20°S, and *melaleuca* on n. Torres Str. islands, and in Moluccas, New Guinea, Bismarck Arch., and Solomon Is. No known variation in plumage between subspecies (Keast 1958; DAB).

Two subspecies on mainland Aust. (Keast 1958; DAB; *contra* Mees 1961; Hall). There is an abrupt step in length of wing at 18–22°S, with wing shorter N of these latitudes (DAB); present study confirms that adults N of 18°S (subspecies *picata*) have shorter Wing and Tail ($P < 0.01$; sexes analysed separately) compared with those S of 22°S (nominata), but measurements overlap considerably between subspecies. Nominata *leucophrys* and *picata* intergrade in a broad, sparsely populated zone round eucalypt-acacia line, at c. 20°S, from Great Sandy Desert, WA, through central NT (including Barkly Tableland) to s. Gulf of Carpentaria Drainage and humid ne. Qld (DAB). More data needed on subspeciation on mainland Aust.

Subspecies *melaleuca* much larger, with broader and longer bill, and longer stouter rectal bristles than mainland Aust. populations (DAB); Mees (1982) also states *melaleuca* from s. New Guinea has large bill.

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PETER SLATER

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Shining Flycatcher *Myiagra alecto* (page 114)

SUBSPECIES MELVILLENSIS: 1 Adult male; 2 Adult female

SUBSPECIES WARDELLI: 3 Adult male; 4 Adult female; 5 First immature

Restless Flycatcher *Myiagra inquieta* (page 121)

SUBSPECIES NANA: 6 Adult male; 7 Adult female

NOMINATE INQUIETA: 8 Adult male; 9 Adult female; 10 Juvenile; 11 Immature male; 12 Adult male

Willie Wagtail *Rhipidura leucophrys* (page 225)

NOMINATE LEUCOPHRYS: 13 Adult; 14 Juvenile; 15 Immature; 16 Adult