

## 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 *Prothemadera 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 ARTAMIDAE woodswallows, butcherbirds, currawongs and Australian Magpie

A small but morphologically rather diverse family of medium-small to large passerines. The family comprises 24–25 species in six genera, distributed through s. and se. Asia to Wallacea, Aust., New Guinea and islands of sw. Pacific Ocean (Sibley & Monroe 1990; Monroe & Sibley 1993; Christidis & Boles 1994; DAB): (1) BUTCHERBIRDS *Cracticus*: six (seven in DAB) species, four (or five) in HANZAB region, confined to Aust. and New Guinea; (2) monotypic AUSTRALIAN MAGPIE *Gymnorhina tibicen*, in Aust. and Trans-Fly region of New Guinea, and introduced to NZ and Fiji; (3) CURRAWONGS *Strepera*: three species, endemic to Aust. (with outlying subspecies on Lord Howe I.); (4) WOODSWALLOWS *Artamus*: 11 species, six in HANZAB region, distributed from India to se. Asia, Wallacea, New Guinea, Aust. and sw. Pacific Ocean (with one species, White-breasted Woodswallow *A. leucorhynchus*, widespread from Andaman Is E to Philippines and Palau, and SE through Wallacea, New Guinea, Aust. and Vanuatu, New Caledonia and Fiji); (5) monotypic BORNEAN BRISTLEHEAD *Pityriasis gymnocephala* from Borneo; and (6) PELTOPS *Peltops*: two species, endemic to New Guinea. In HANZAB region, total of 14 (or 15 [DAB]) species in four genera. Most early authors place the butcherbirds, Australian Magpie and currawongs in the family Cracticidae, separate from the woodswallows, in the family Artamidae (Amadon 1951; Peters). However, most recent works (Sibley & Monroe 1990; Monroe & Sibley 1993; DAB) combine these genera on the basis of shared cranial features (Pycraft 1907; Leach 1914; McEvey 1976; see details below), DNA–DNA hybridization studies (Sibley & Ahlquist 1985, 1990) and protein electrophoresis (Christidis & Schodde 1991). Sibley & Monroe (1990) and Monroe & Sibley (1993) place all species in the tribe Artamini, within the subfamily Corvinae in the extended family Corvidae. The woodswallows are genetically similar to butcherbirds, Australian Magpie and currawongs, as shown by DNA–DNA hybridization ( $\Delta T_{50}H = 4.9$ ; Sibley & Ahlquist 1985), and accordingly we follow DAB in combining all species in the family Artamidae, part of the corvid lineage of passerines.

Size varies greatly, from medium-small (woodswallows) to medium-sized (butcherbirds, Bornean Bristlehead, peltops) and large (currawongs, Australian Magpie). In HANZAB region, Little Woodswallow *Artamus minor* smallest (length c. 14 cm, weight c. 17 g) and Grey Currawong *Strepera versicolor* largest (length c. 50 cm, weight c. 400 g). Wings fairly long and pointed in most species, but more rounded and shorter in butcherbirds, and rather long, broad and triangular in woodswallows; ten primaries, with p10 short in most species and vestigial in woodswallows. Most species have ten secondaries, but 11 in Australian Magpie. Tail varies from fairly short (*Gymnorhina*, *Artamus*, Bornean Bristlehead) to long (*Strepera*), medium length in rest; usually rather square or gently rounded at tips, though *Peltops* have fairly long, forked tail. Base of maxilla rounded and raised. Bill fairly long in most species, but rather short and rather conical in woodswallows. Bill, bluish white to pale grey basally with dark tip in adults of most species except *Strepera*, *Peltops* and Bornean Bristlehead, in which bills entirely black. Nares amphirhinal, fully exposed as bare slits. Tarsus varies from fairly short in most species to fairly long in *Gymnorhina*. Tarsal scaling laminiplantar; acrotarsium tends to be more weakly scaled in *Strepera*. Orbital and palate region of skull distinct. Shared osteological characteristics include (DAB): single pneumatic fossa in humerus; narrow palate with elongated palatines, constricted medial shelf and long pointed transpalatine processes; pterygoids fused to palatine shelf; orbital processes on quadrates thin and long; zygomatic processes distinctly bifurcate; palate heavily ossified with nasal floor and palatal aperture covered by fusion of maxillo-palatine processes and bony maxillary shelf; ectethmoids thin and narrowly winged; and lack cranial foramina above optical foramen. In addition, genera have the following diagnostic features: *Cracticus* has robust and sharply hooked bill for killing prey; *Gymnorhina* has straighter bill lacking distinct hook or maxillary notch and also has shallower temporal fossae and shorter post-orbital processes than butcherbirds; *Gymnorhina* and *Strepera* have bluntly bifurcate zygomatic process compared with *Cracticus* and *Artamus*, which are more acutely bifurcate; and *Artamus* rather short-toed, with flared jugal bars and, uniquely among passerines, diagnostic pectoral and lumbar powder-downs.

Adult plumages vary, from entirely black (in Black Butcherbird *Cracticus quoyi* [though see Plumages of that account for details]) to diagnostically pied (most butcherbirds, Australian Magpie, Pied *Strepera graculina* and Black S. *fuliginosa* Currawongs) or with more varying combinations of greys, browns, white and black (e.g. Grey Currawong *Strepera versicolor*, and woodswallows). Powder-down of woodswallows imparts distinctive bloom to plumage. Juveniles tend to be more mottled or barred than adults and, in woodswallows, juveniles have narrow whitish streaking to head and body. Sexes identical or very similar in most species, but Masked *Artamus personatus* and White-browed *A. superciliosus* Woodswallows show distinct dimorphism in plumage. Nestlings of at least some species hatch with sparse down. Post-juvenile (first pre-basic) moult partial, resulting in first immature (first basic) plumage, which in some species (such as woodswallows) is similar to adults, but in others (e.g. Grey Butcherbird *Cracticus torquatus*) differs considerably from adults. Most species acquire adult plumage in complete first immature post-breeding (second pre-basic) moult when c. 1 year old. However, some species do not acquire adult plumage till

>1 year old (e.g. Australian Magpie). Primaries moult outward, starting at p1. Moult of tail centrifugal. Moult of tail and body usually starts about same time as primaries.

In Aust., representatives of the family occupy a wide range of habitats, from coasts (including beaches) to alpine highlands, and in all climatic zones: arid, semi-arid, temperate, subtropical and tropical; Australian Magpie one of the most widespread species in Aust. Most butcherbirds, woodswallows and Australian Magpie commonly in open habitats, including open sclerophyll woodlands and forests, including savanna, typically dominated by eucalypts but also dominated by acacias, paperbarks, casuarinas or cypress-pines *Callitris*, or shrublands of acacias or chenopods, and in lightly timbered farming land; woodswallows also often in grasslands (e.g. with scattered shrubs or trees) shrublands, and over open water such as wetlands and floodplains. Currawongs typically in more heavily forested habitats, such as wet and dry sclerophyll forests dominated by eucalypts, and rainforests, but also occur in open woodlands and forests and timbered farming land (as above). Some Aust. species, such as Australian Magpie, Pied Currawong and Grey Butcherbird, common and familiar urban birds, occurring in cities, suburbs and rural and regional towns, in parks, gardens and schoolgrounds; also use a range of other modified habitats, such as airfields, ski facilities in alpine areas, and exotic pine plantations. Other species, such as Black Butcherbird, more commonly in denser habitats, such as rainforests, gallery forests and mangroves, as well as some sclerophyll forests and woodlands. Other habitats used include coastal heaths, alpine herblands and heathlands, and mangrove associations. Extralimittally, habitat of butcherbirds, woodswallows and Australian Magpie much as above, though additionally reported from swamp forest, monsoon forest, secondary forest growth, clearings in and edges of forests, grasslands, ricefields, teak plantations and coconut groves, mangroves, swamps and lakes; Ivory-backed Woodswallow moderately common in selectively logged lowland forest on Taliabu. On Sulawesi, White-breasted Woodswallow often forages round herds of cattle or buffalo grazing in open valleys. New Guinean *Peltops* occupy rainforest and swamp forest, commonly at forest edges, and in secondary growth of forest clearings; Bornean Bristlehead occupies lowland forest, including peat swamp forest, of Borneo (King *et al.* 1978; Smythies 1981; Watling 1983; van Marle & Voous 1988; Coates 1990; Sibley & Monroe 1990; Coates *et al.* 1997; Coates & Peckover 2001; Robson 2002).

Patterns of movements in HANZAB region highly diverse, with Aust. species ranging from sedentary to highly mobile and dispersive (e.g. White-browed Woodswallow). All Aust. butcherbirds, currawongs and Australian Magpie sedentary or resident, e.g. Australian Magpie sedentary and territorial throughout year, with territories often stable from year to year. However, currawongs appear to be partial altitudinal migrants from highlands of Tas. and se. mainland Aust. in winter. Woodswallows all show varying complex and often unpredictable patterns of movement: Black-faced Woodswallow *Artamus cinereus* considered predominantly sedentary, with dispersive characteristics; other Aust. *Artamus* tend to be migratory or undertake long-distance movements, including: general N–S movement, largely vacating n. coast of Aust. during the wet season (e.g. Little Woodswallow *A. minor*); inland movements on a SE–NW axis (White-breasted and Masked Woodswallows); inland big-circle pattern of movement, apparently moving S by a more inland route than on northward passage (White-browed Woodswallow); and migration out of Tas. in winter, in Y pattern of n. movement, along the e. coast of Aust. and through w. Vic. into SA (Dusky Woodswallow *A. cyanopterus*). Movements of some woodswallows, however, appear highly erratic, and birds may be absent from an area for several years, before abruptly arriving in large numbers, sometimes to breed, then leaving just as suddenly; such movements or occurrence may be influenced by drought or availability food or both (e.g. White-browed Woodswallow, Masked Woodswallow). Some species show geographical variation in patterns of movements, e.g. White-breasted Woodswallows generally considered resident or present throughout year in n. and ne. Aust., but migratory in much of e. Aust., though with broad overlap between breeding and non-breeding ranges, and with erratic or unclear patterns of occurrence in inland regions (Griffioen & Clarke 2002; see species accounts). Extralimittal taxa largely not well known; Australian Magpie resident in s. Trans-Fly region of New Guinea (Coates 1990); and White-breasted and other woodswallows described as resident in se. Asia, with Ashy Woodswallow, and no doubt others, locally dispersive or otherwise moving locally (White & Bruce 1986; van Marle & Voous 1988; Dickinson *et al.* 1991; Robson 2000).

All predominantly insectivorous, taking wide range of invertebrates, mainly insects; most species also take fruit and seeds occasionally and woodswallows have brush-tongue and often take nectar. Larger species (butcherbirds, currawongs and Australian Magpie) also take small vertebrates and some, such as Pied and Black Currawongs, and Australian Magpie, eat carrion. Woodswallows and *Peltops* predominantly aerial foragers, catching prey mostly by screening in continuous flight, but also by sally-striking; also glean prey from ground and vegetation (e.g. trunks, branches, foliage) and probe flowers for nectar. Butcherbirds and currawongs largely terrestrial and arboreal, foraging mainly on ground and in vegetation; butcherbirds usually solitary predators, foraging mainly by sallying, mostly sally-pouncing or sally-striking; currawongs glean and probe from ground, fallen logs and from standing vegetation. Australian Magpie gregarious, foraging mostly on ground, often round human habitation or activities, mainly by gleaning and probing, using bill to dig in or manipulate substrates. Bornean Bristlehead arboreal, gleaning prey from leaves, twigs and tree trunks, and occasionally foraging by sally-pouncing or sally-gleaning. Large prey items often manipulated before being eaten, though handling of prey less common in *Peltops*. Kleptoparasitism recorded for some species, such as White-browed and Dusky Woodswallows, Pied Currawong and Australian Magpie. Caching

recorded in butcherbirds (e.g. Grey Butcherbird), currawongs (e.g. Black Currawong) and Australian Magpie. Some, especially woodswallows and Australian Magpie, sometimes forage in large flocks, both of conspecifics and other Artamidae; currawongs can occur in large flocks in autumn–winter; butcherbirds generally forage singly or in twos; Bornean Bristlehead appear to forage in small flocks; and *Peltops* probably forage singly, in twos or small groups. All Artamidae regurgitate oblong pellets of hard, indigestible parts of food. In butcherbirds, currawongs and Australian Magpie, males have larger bills than females, suggesting possible sexual partitioning in foraging (Coates 1990; Coates *et al.* 1997; Colenutt 2002; DAB).

Social organization within the family quite diverse, with some species having quite complex social systems. However, many species, especially outside Aust., poorly known. Most species appear to breed in simple monogamous pairs, but Australian Magpie often lives in groups throughout year, sometimes leading to polygamous bonds, with both polygyny and polyandry recorded. Plural breeding occasionally recorded in Pied Butcherbird *Cracticus nigrogularis*. Gregariousness varies greatly. Butcherbirds and Lowland Peltops *Peltops blainvillii* usually seen in pairs or singly throughout the year; currawongs usually seen in pairs during breeding season, but often form flocks during non-breeding season; woodswallows often seen in flocks at any time of year, and several species breed in loose colonies. Bornean Bristlehead usually seen in small groups of 6–10 birds. Australian Magpies occur in groups throughout year, size of which varies greatly, with some complex geographical trends in group-size. Co-operative breeding widespread in several species, e.g. in Aust., recorded in White-breasted, Black-faced, Dusky and Little Woodswallows, Grey and Pied Butcherbirds, Australian Magpie, and possibly in Black Butcherbird. Division of parental care varies between species: often shared between sexes, and with helpers, in co-operatively breeding species (e.g. Dusky Woodswallow), but in some species, almost all parental care by female only (e.g. Australian Magpie); also see discussion of breeding below. Most species defend a territory, at least during breeding season. However, semi-colonial species such as White-browed Woodswallow defend only immediate area round nest. At least one species, Australian Magpie, defends a large all-purpose territory throughout the year, as apparently do Pied and Grey Butcherbirds. All woodswallows roost communally, often huddling together side by side on branches, or clustering together on a surface such as a tree-trunk. Social behaviour well known for some species, but poorly known for most. Some species show play behaviour, e.g. Black Currawong and Australian Magpie. Most species are vigilant in defence of nest and many attempt to drive off potential predators by swooping at them. Sexual behaviour generally poorly known, though aspects of courtship known in a few species (Coates 1990; Coates *et al.* 1997; Colenutt 2002; see species accounts).

Vocalizations of family quite varied. The butcherbirds, currawongs and Australian Magpie tend to have loud piping or ringing songs. Most woodswallow vocalizations tend to have a twittering or chattering quality (see species accounts). The most commonly uttered vocalizations from the two peltops are a series of rapidly repeated short, sharp notes, with that of the Lowland Peltops being likened to the sound made when winding a clock. The calls of the Bornean Bristlehead have been described as having a nasal and whining quality. Mimicry has been recorded in several woodswallows, butcherbirds, and the Australian Magpie, and possibly also in Pied Currawongs. Several species, such as Grey and Pied Butcherbirds, known to perform complex duets (Coates 1990; Colenutt 2002; see species accounts).

Breeding varies within family. Most species appear to nest in solitary pairs. However, several species, including some woodswallows and butcherbirds and Australian Magpie, also breed co-operatively (see discussion above); and Masked and White-browed Woodswallows sometimes nest in loose colonies, sometimes mixed with other species of woodswallow. Plural breeding recorded occasionally in Pied Butcherbirds; and Magpies occasionally polygamous (see above). Most species build nests in vertical or horizontal forks in branches or sometimes trunks of trees, though woodswallows use a wider variety of sites, including hollows; artificial sites are sometimes used by woodswallows (e.g. White-breasted, White-browed and Black-faced Woodswallows) and Australian Magpie. Butcherbirds, currawongs and peltops usually nest quite high, but woodswallow nests tend to be lower. Build rather insubstantial, untidy, and often shallow, open, cup- or bowl-shaped nests of sticks, twigs, rootlets, sometimes with other plant material such as strips of bark, casuarina needles or vine tendrils, and usually lined with finer and softer material, such as fine grass, rootlets, shredded bark, casuarina needles, wool, hair or fur, though in some species (e.g. White-breasted, White-browed and Dusky Woodswallows, and Black Butcherbird) nests are sometimes unlined; some species, such as Magpie and butcherbirds, occasionally include artificial materials, such as wire and string. In most species, nests built by both sexes; in some species, nests built only (e.g. Australian Magpie) or usually (e.g. Pied Currawong) by female. Eggs mostly varyingly oval, though some can be pyriform; usually smooth; usually glossy but varying. Ground-colour of eggs varies, but prominent tones are white (particularly in woodswallows), green, brown and grey, sometimes with shades of olive, blue, purple or red. Eggs usually marked with spots and blotches of varying shades of brown, grey, red or purple, and some also have underlying markings, usually of shades of grey. Most species lay eggs that, at least sometimes, have markings concentrated or forming zone at large end. Eggs occasionally unmarked. Clutch-size one to six, but usually 2–4; larger clutches recorded occasionally, but these probably laid by two or more females. Laying interval probably 24 h in most species, possibly longer (48 h) in Pied Butcherbird. Incubation by both sexes (e.g. in woodswallows and possibly Black Butcherbird), or by female only



(e.g. in Australian Magpie and probably most currawongs and butcherbirds); in co-operatively breeding species (e.g. Black-faced Woodswallow and Grey Butcherbird), helpers also assist with incubation. Incubation period, 11–17 days for woodswallows; roughly 19–23 days for butcherbirds, currawongs and Magpie. Young fed by both sexes; brooding by both sexes in woodswallows, by female only in butcherbirds (e.g. Grey Butcherbird) and currawongs (e.g. Pied Currawong), and usually by female only in Australian Magpie; in co-operatively breeding species, young can be brooded and fed by helpers. Fledging period 12–20 days in woodswallows, 21–33 days in butcherbirds, estimated 28–37 days in currawongs, and 30–34 days in Magpie. In Aust., parasitized by Pallid Cuckoo *Cuculus pallidus*, bronze-cuckoos *Chrysococcyx*, Common Koel *Eudynamis scolopacea* and Channel-billed Cuckoo *Scythrops novaehollandiae* (Coates 1990; Colenutt 2002; DAB; see species accounts).

No species currently listed as globally threatened by Stattersfield & Capper (2000); the Bornean Bristlehead is considered near threatened (Colenutt 2002). In Aust., *C. York Pen.* subspecies *normani* of Black-faced Woodswallow considered near threatened, with declines in population attributed to changes in fire regimes associated with pastoralism, resulting in loss of grasslands and increasing density of woodlands. The Torres Str subspecies of the Black Butcherbird *C.q. alecto* is considered near threatened; and the Black Currawong of King I. *S.f. colei* is vulnerable. Two subspecies of the Pied Currawong, *S.g. crissalis* of Lord Howe I. and *S.g. ashbyi* of w. Vic. are considered endangered and critically endangered respectively (Garnett & Crowley 2000).

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*Ocypterus superciliosus* Gould, 1837, *Synops. Birds Aust.* 1: pl.1, fig. 2 and text — interior of New South Wales = Hunter River, New South Wales.

Both specific and substantive names highlight the broad white supercilium of the male (Latin *superciliosus*, eye-browed).

OTHER ENGLISH NAMES White-eyebrowed Woodswallow; Bluey, Cherry-bird, Four-year-bird, Skimmer, Summerbird or Sky Summerbird.

MONOTYPIC

**FIELD IDENTIFICATION** Length 19 cm (18–20); wingspan 31–34 cm; weight 35 g. Medium-sized, colourful, rather slim-bodied woodswallow with long, slender, gently decurved bill and rather long tail, gently cleft at tip when at rest and square-ended when spread in flight; very similar in size, shape and proportions to Masked Woodswallow *Artamus personatus*, with tips of long wings reaching about two-thirds of way along tail when at rest. Sexes differ noticeably in adults but less so in immatures, and alike in juveniles. No seasonal variation. Adults male, dark grey on head, neck and upperparts and upper breast, with diffuse dark mask and prominent white supercilium and tip of tail; and mostly dark red-brown below, with contrasting whitish underwing. Adult female similar to male but slightly paler on head, neck, upperparts and breast, with contrasting black loreal stripe, duller and more diffuse pale supercilium, and paler red-brown underbody. Juvenile very different from adult: body much duller and browner, densely streaked and spotted whitish above and diffusely streaked whitish below, with prominent black loreal stripe and contrasting grey wings and tail marked with white tips to upperwing-coverts and remiges, and much finer white tip to tail, which also more deeply notched than in adult. Immature varies, with some similar to adult male and others to adult female, but separable by retained juvenile wing and, usually, tail. **Adult male** Head, neck and upper breast, dark grey, sharply demarcated from dark red-brown lower breast and rest of underbody (grading to slightly paler red-brown on longest undertail-coverts in some), and merging into diffusely darker grey-black forehead and mask (ear-coverts, malar area, chin and throat and loreal stripe); mask bordered above by bold, sharply defined white supercilium, starting above lores and broadening back over eye and ear-coverts. Mantle, back and scapulars, dark grey, grading to slightly paler grey on rest of upperparts and uppertail, with prominent narrow white tip to tail; and thin white fringes round tips of primaries, obvious on folded wing in fresh plumage and persisting even in worn plumage. Undertail, pale grey, with prominent white tip. Underwing mostly white, grading to dusky grey on tips of remiges, with narrow dark-grey border to leading edge of outerwing. In flight, from below, note dark underbody contrasting strongly with whitish underwing and pale-grey undertail but less so with dusky-grey head, neck and upper breast; white tip of tail prominent, especially when backlit; red-brown underbody can appear almost blackish in high-flying birds. Bill, light blue-grey, with sharply demarcated black tip covering up to distal half of bill. Gape, pale grey or blue-grey. Iris varies from

dark brown to orange-brown or orange-yellow. Legs and feet, grey-black or black. **Adult female** Similar to male; differing by: Head, neck and upper breast more uniform and slightly paler blue-grey, with prominent contrasting black loreal stripe but no dusky mask, and more diffuse and duller off-white supercilium, usually grading greyish towards rear; mantle, back and scapulars washed brownish; underbody duller red-brown to much paler, pinkish brown, merging to off-white (washed rufous brown or pinkish brown) on longest undertail-coverts and appearing less sharply demarcated from grey upper breast; and white tip of tail narrower (about half width that of male). **Juvenile** Very different from adult. Top of head and neck, dark brown with prominent dense fine off-white streaking, grading to brownish grey with more sparse and fainter off-white streaking on sides of neck; ear-coverts uniformly brownish grey, contrasting strongly with bold black loreal stripe, and standing out against boldly streaked top of head and neck and brown to brown-grey malar area, chin and throat, which also diffusely streaked off-white. Mantle and scapulars, dark brown, merging to greyer back, rump and uppertail-coverts and boldly and densely streaked off-white throughout (in some, streaking buff on lower mantle and scapulars). Uppertail, grey with thin white outer edges, and small off-white spots at tips of all rectrices, soon lost with wear; tail more deeply notched than in adult. Upperwing mostly grey with: small off-white or buff-white tips to tertials, secondary coverts, primary coverts and alula, those on secondary coverts showing as lines of pale spots on median and greater coverts; and prominent narrow off-white fringes round tips of remiges, broader and more prominent than on adult and obvious on folded primaries and persisting even in worn plumage. In flight, off-white tips of remiges form narrow crisp white trailing edge to wing. Breast and fore-flanks, brown or brown-grey with diffuse off-white streaking, merging to more uniform cream or cream-buff and more faintly and finely mottled brownish on rest of underbody; whitish streaking on chin, throat and breast noticeably bolder and more contrasting in some. Undertail as uppertail except slightly paler grey. Underwing as adult but with pale tips of rectrices forming narrow crisp whitish trailing edge, most obvious when backlit. Bill, brown with faint black tip; gape, cream, prominent; and iris, brownish yellow or olive-green. **Immature male** Plumage varies, with some resembling adult male and others more like adult female, but all retain juvenile remiges, alula, greater primary coverts and usually rectrices and greater secondary coverts. Best distinguished from adult (of either sex) by retained juvenile feathering, in particular: finely white-tipped

alula and greater upperwing-coverts; clearly broader and bolder white fringes round tips of folded primaries; and, in most or many, more deeply notched tail with fine white tips of rectrices often much reduced or absent from wear (cf. broader and more prominent white tip on adult). Immatures in worn plumage more difficult to separate from adults, as fine white tips of upperwing-coverts then much reduced or lost through wear; unless traces of white tips can be discerned, such birds best separated by: much browner appearance of worn folded primaries and more prominent white fringes round tips of same; and (if not already moulted) more deeply notched tail.

**Immature female** Very similar to adult female and separable by same characters as given for immature male.

**Similar species** Adults and immatures unlikely to be mistaken if seen well; combination of blue-grey upperparts, head, neck and breast, red-brown underbody and prominent pale supercilium diagnostic among woodswallows. Juveniles much more readily confused with other juvenile woodswallows, especially with **Masked Woodswallow**, which see for full distinctions; also see comments under **Black-faced Artamus cinereus**, **Dusky A. cyanopterus** and **Little A. minor Woodswallows**.

Gregarious and migratory, moving N in autumn and S in spring, but with some dispersive tendencies. Usually occur in pairs, small parties or, especially when on migration, large flocks (sometimes of thousands) in e. Aust., where often with less common Masked Woodswallows; in w. Aust., Masked dominate in mixed flocks and White-browed less abundant. Presence often first noted by calls of flocks flying overhead (sometimes at great height or even when not visible) or gathered at flowering eucalypts; often associate with honeyeaters and trillers *Lalage* at flowering eucalypts, and with Rainbow Bee-eater *Merops ornatus* when feeding on high-flying insects. Travelling and feeding flocks usually fly high; birds in feeding flocks flutter and wheel in all directions, uttering chirruping calls continuously to maintain contact, and catching and eating insects on the wing. Forage mainly in air but flocks also occasionally forage on ground and in flowering trees and shrubs, where often hang acrobatically upside-down while rifling among blossoms. Flocks assemble at dusk in foliage of trees and shrubs to roost, and occasionally cluster against one another on trunk or in hollow of tree. Commonest calls include: musical chirruping *chap, chap* or *chp, chap* (Contact Call); sweet miner-like notes; harsh, strident scolding or chatter; and soft twittering Song that includes some mimicry (see Voice).

**HABITAT** Mainly inhabit open eucalypt woodlands and, less often, forests, often riparian associations; other open woodlands, especially inland; and grasslands with sparsely scattered shrubs and few or no trees, including farmland and other agricultural lands. Less often in shrublands, particularly inland, and built-up areas. However, travelling flocks can obviously occur over wide range of habitats. Mostly in semi-arid and arid zones, less often in tropics, subtropics and temperate zone (Keast 1958; Hore-Lacy 1964; McEvey 1965; Parker 1969; Baldwin 1975; Longmore 1978; Hall; Aust. Atlas 1, 2; Storr 19; see below). Often near or over water (Jones 1986; Traill *et al.* 1996).

Mainly occur over and in **OPEN EUCALYPT WOODLANDS**, usually with ground-cover of grasses and, often, varying but open understorey of shrubs (Bedgood 1972; Rix 1976; Ford & Bell 1981; Ford *et al.* 1986; Jones 1986; Er & Tidemann 1996; Possingham & Possingham 1997; Er *et al.* 1998), and, less often, in **OPEN EUCALYPT FORESTS**, with similar ground-cover and understorey (Hore-Lacy 1964; Gibson 1977; Smith 1984; Jones 1986; Traill *et al.* 1996). Often in riparian eucalypt woodlands and forests of River Red Gum and Yellow Box, particularly inland (Jones 1952; Wyndham 1978; Traill *et al.* 1996); in mallee woodlands (and probably other shrublands)

(Jones 1952; Carpenter & Matthew 1986; Possingham & Possingham 1997; Vic. Atlas; C.L. Tzaros); and in box-ironbark forests (Vic. Atlas), such as forests of Grey Box, White Box, Mugga Ironbark and Red Stringybark (Traill *et al.* 1996). During irruption in se. NSW, recorded in woodland of Manna Gum, Snow Gum and Black Sallee; and forest of Narrow-leaved Peppermint and Mountain Gum (Recher & Schulz 1983). Vagrants recorded in Flooded Gum forest in ne. Qld (Griffin 1995). Also recorded in **OTHER OPEN WOODLANDS**, also usually with ground-cover of grasses, including: mixed woodlands with eucalypts co-dominant with banksias (Possingham & Possingham 1997), or acacias (Parker 1969); low open woodlands or thickets of Belah or cypress-pine *Callitris* (Jones 1952; Tarr 1981; McAllan 1986), sometimes with other trees, such as Bullock Bush *Alectryon oleifolium* (McAllan 1986). Often recorded in **GRASSLANDS**, often with scattered trees, such as eucalypts or cypress-pines (Ford 1974; Rix 1976; Longmore 1978; Congreve 1982; Congreve & Congreve 1985; Jones 1986), or sometimes with sparsely scattered shrubs and few or no trees (McEvey 1965; Parker 1969). Occasionally in tall **ACACIA SHRUBLAND** with low shrubby or open understorey and ground-cover of grasses, especially in semi-arid and arid areas; mainly dominated by Mulga but also occasionally by other acacias, such as Horse Mulga *Acacia ramulosa*, Ironwood *A. estrophiolata*, Dead Finish, River Cooba *A. stenophylla* or Colony Wattle *A. murrayana*, sometimes in association with other shrubs, such as Whitewood *Atalaya hemiglauca* or emu-bush *Eremophila* (Ford 1974; Wyndham 1978; Badman 1979; Gibson & Cole 1988; Cody 1994). Sometimes also occur in other shrublands, e.g. mixed open shrubland of *Cassia*, hop-bush *Dodonaea* and emu-bush (Wyndham 1978; Gibson 1986). **MODIFIED HABITATS**: Sometimes in or over farmland, including pasture and cropland, orchards and vineyards, and small remnant patches of native vegetation on farmland, e.g. large flocks foraging at flowers of citrus trees (McEvey 1965; Lowe & Lowe 1972; Templeton & McGarvie 1973; Morris 1975; Gibson 1977; Roberts 1979; Traill *et al.* 1996; Vic. Atlas; see Food); pine plantations (Debus 1983; Recher & Schulz 1983); and gardens and parks in rural towns and round homesteads (McEvey 1965; Lashmar 1972; Traill *et al.* 1996). Once in a new housing development in outer suburban Melbourne (Mason 1985).

In study of eucalypt woodland varying affected by dieback near Armidale, NSW, found only in least disturbed of four sites surveyed, consisting of largely unmodified woodland dominated by stringybarks, in which a few trees had been felled and there was occasional light grazing, and few dead or severely defoliated trees (Ford & Bell 1981).

**DISTRIBUTION AND POPULATION** Widespread in mainland e. Aust., more sparsely in N and very sparsely in WA. Occasional visitor to Tas., and vagrant to NZ, Lord Howe and Norfolk Is (see below).

**Aust. Qld** Vagrant to C. York Pen., with two recent Aust. Atlas records at Weipa (Aust. Atlas 2), and only occasionally recorded elsewhere N of 17°S, e.g. Dunbar and round Cairns (Wheeler 1967; Storr 19; Aust. Atlas 2). Widespread but scattered between 17°S and 21°S, on w. slopes of Great Divide and plains farther W; and widespread W of Great Divide farther S. More scattered on tablelands and e. slopes of Great Divide and in near-coastal and coastal areas (Aust. Atlas 1, 2; Storr 19). **NSW** Widespread on inland slopes of Great Divide and plains farther W; more sparsely scattered E of Great Divide (Morris *et al.* 1981; Cooper & McAllan 1995; Aust. Atlas 1, 2; NSW Bird Reps). **Vic.** Widespread on inland slopes of Great Divide and farther N; more sparsely scattered S of Great Divide (Aust. Atlas 1, 2; Vic. Atlas). **Tas.** First recorded at C. Wickham, King I., 9 Apr. 1905 (Anon. 1905; Le Souéf 1906); recorded regularly on King I.

between 1958 and 1980s, including 100–200 birds at L. Martha Lavinia on 17 Nov. 1972 (McGarvie 1965; Templeton & McGarvie 1973; McGarvie & Templeton 1974; Cooper 1998; Tas. Bird Reps 2, 13); another published record in Apr. 1995 (Eades 1995). Apparently only recorded on Flinders I. during irruptions: two, Memana, 24 Apr. 1973 (Tas. Bird Rep. 3), though also said to have been present in Mar. of that year (Cooper 1998). Occasional visitor to Tas. mainland: first recorded, at Penguin, 5 Oct. 1972, as portent to great irruption, and stayed there till at least 13 Dec. 1972 (Good *et al.* 1973; Tas. Bird Rep. 2; see Anomalies, below); 20+, C. Portland, 5 Mar. 1973 (Good *et al.* 1973; Tas. Bird Rep. 3); single, Sedgy Ck, near Smithton, 5 Mar. 1973 (Good *et al.* 1973; Tas. Bird Rep. 3); six, C. Lodi, 6 Mar. 1978 (Tas. Bird Rep. 8); 12, Anthony Beach, near Stanley, Nov.–Dec. 1982 (Tas. Bird Rep. 12); c. 30, near Gladstone, 22 Nov.–7 Dec. 1997 (Cooper 1998); several, C. Portland, Jan. 1998 (Tas. Bird Reps 27, 28). **SA** Widespread in most areas W to 133°E, though only sporadically in moist areas of Mt Lofty Rgs and in South East, and very sparsely scattered or absent from areas N of L. Eyre and in s. Simpson Desert (Mack 1970; Joseph & Black 1983; Badman 1989; Stove 1994; Aust. Atlas 1, 2; G.A. Carpenter). Also recorded at a few scattered sites farther W, e.g. in Yalata Aboriginal Reserve and e. Great Victoria Desert (Close & Jaensch 1984; Black & Badman 1986; Aust. Atlas 1, 2). Single record on Kangaroo I., 26 Oct. 1971 (Lashmar 1972). **WA** Sporadically recorded at sparsely scattered sites, mainly in interior. In Kimberley Div., recorded in area from Broome N to Stewart R. and S to Edgar Ra.; also recorded at Landrigan Ck; and in Ord R. Drainage Basin (Ford 1987; Anon. 1999a; Coate *et al.* 2001; Storr 11; Aust. Atlas 2). Sparsely scattered records in Great Sandy, Gibson and Great Victoria Deserts and on Nullarbor Plain, from Mt Brophy Spring S to Shell Ls and Forrest Ls (Carnaby 1965; Brooker *et al.* 1979; Coate *et al.* 1998; Serventy & Whittell; Aust. Atlas 1, 2), and occasionally farther S at Eyre Bird Observatory (Congreve 1982; Congreve & Congreve 1985; Anon. 1987). Very occasionally occur in South-eastern Interior Region, with records at sites between Linden and

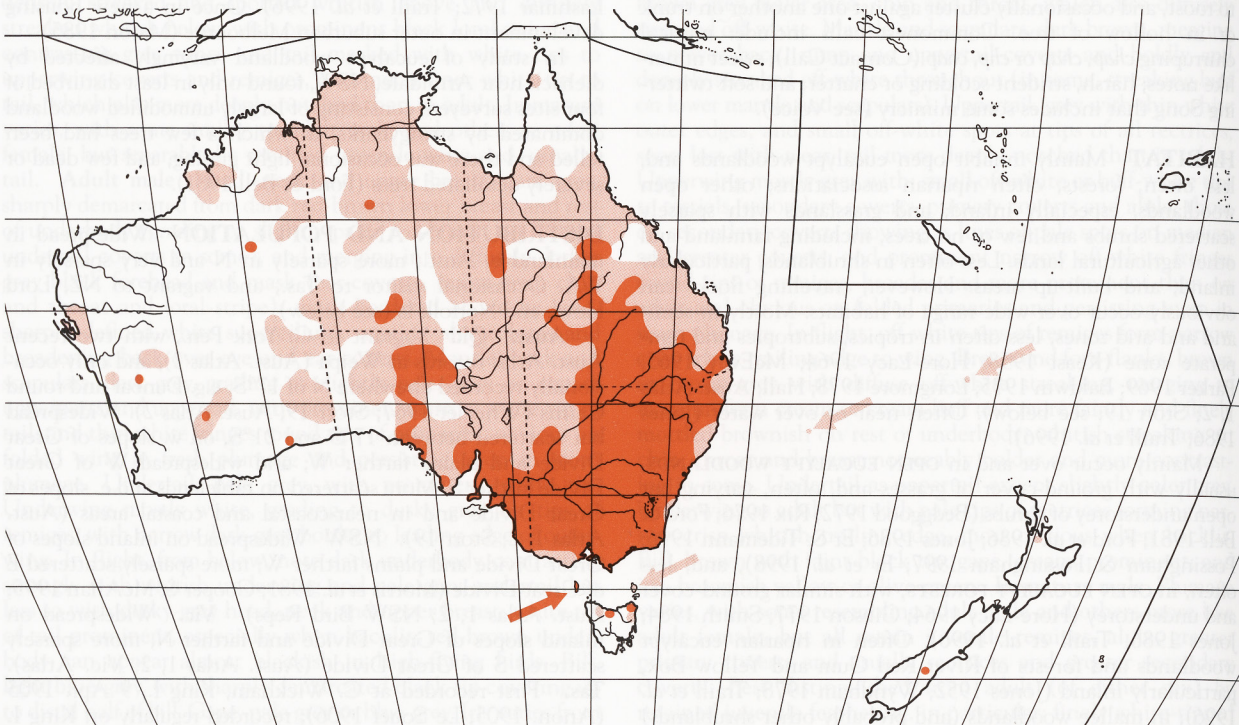
Kellerberrin; and also very occasionally recorded in South-West Div., e.g. in Whicher Ra., Glen Avon and East Yuna (Aust. Atlas 1, 2; Storr 35). Scattered records in Gascoyne, Pilbara and Mid-eastern Interior Regions, from Woodleigh and Callagiddy Stns, E to near Wanjarri and Calvert Hills (Brooker & Estbergs 1976; Johnstone *et al.* 2000; Serventy & Whittell; Aust. Atlas 1, 2; Storr 22). Also recorded much farther N near Wallal Downs, Eighty Mile Beach (Aust. Atlas 1). **NT** Recorded at a few scattered sites in Top End, S to 14°S, e.g. round Darwin and at sites in drainage basins of E. Alligator and S. Alligator Rgs, such as Cannon Hill, El Sharana and UDP Falls, near w. edge of Arnhem Land (Crawford 1972; Aust. Atlas 1, 2; H.A.F. Thompson & D.K. Goodfellow). Farther S, more widespread but still scattered S to 19–20°S, from Kneebone Stn (N of Keep R. NP), Inverway Ck (SE of Waterloo Stn) and n. Tanami Desert, E to lower reaches of Roper and McArthur Rgs, Borrooloola and Barkly Tableland. Scattered records farther S, in area between 126°E and Qld border. A few records in Simpson Desert, but more widespread from Alice Springs S to SA border, and W to Petermann and Deane Rgs and Sandy Blight Junction (Parker 1969; Rix 1970; Tucker 1970; Bristowe *et al.* 1971; Wilson 1974; Gibson 1986; Gibson & Cole 1988; Aust. Atlas 1, 2).

**NZ** Vagrant. **NI** Single, Miranda, 21 Sept. 1991 (Guest 1992). **SI** Up to four, Naseby SF, Otago, 9 Dec. 1971–30 July 1973 (Darby 1972; Child 1974, 1975). Unconfirmed report from Alexandra, c. 1972 (Darby 1972).

**Lord Howe I.** Vagrant. Ten, 20 May 1993; and two, 10 Dec. 1994 (McAllan *et al.* 2004; NSW Bird Rep. 1994).

**Norfolk I.** Vagrant. Single unless stated: 20 July 1996 (Moore 1999); 1 Aug. 1997 (Moore 1999); 15 Feb. 1998 (Anon. 1998); and c. 12, 21 Aug. 1999 (Anon. 1999b). Said to have been present since c. 1994 (Anon. 1997) but no published reports till 1996.

**Breeding** In mainland Aust., sporadically recorded at scattered sites E and S of Great Divide; widespread from inland slopes of Great Divide W to line joining Hughenden, central Qld, and Cockaleechie, s. Eyre Pen., SA. Farther W in SA, scattered records in area from Anna Ck Stn and Billa



Kalina Stn, W to line joining Marla and Coppudurba Hill, near Ceduna (Aust. Atlas 1, 2; NRS). A few breeding records at sparsely scattered sites in WA, e.g. Eyre Bird Observatory, Goongarrie NP, near Kalgoorlie, Thundellara Stn and L. Tobin (Congreve & Congreve 1985; Serenty & Whittell; Storr 21, 26; Aust. Atlas 2) or in NT, e.g. Green Swamp Well, Stuart Bore and Wilba Dam (Aust. Atlas 1; NRS). Also recorded in s. Barkly Tableland (Aust. Atlas 1; NRS). Occasional records in Tas., usually during irruptions: >20 nests, L. Martha Lavinia, King I., Nov.–Dec. 1972 (Good *et al.* 1973; Templeton & McGarvie 1973; Tas. Bird Rep. 2; NRS); nest with two young, near Penguin, Dec. 1972 (Good *et al.* 1973; Tas. Bird Rep. 2); Anthony Beach, near Stanley, Nov.–Dec. 1982 (Tas. Bird Rep. 12); two nests, near Gladstone, Nov. 1997 (Cooper 1998); and two nests, C. Portland, Jan. 1998 (Tas. Bird Rep. 28). In NZ, possibly bred near Naseby, SI, as dependent young recorded in 1973 (Child 1974).

**Anomalies** Often subject to irruptions, especially in coastal areas, probably influenced by conditions inland (Chisholm 1946a; Brown 1950; Keast 1950, 1958; Morris 1975; Leishman 1994; Paton *et al.* 1994). Influxes since early 1970s include: **1970:** Present in much larger numbers than usual in Sunset Country, nw. Vic. (Cooper 1972) and in Murray–Mallee Region of SA (SA Bird Rep. 1970–71). This coincided with influx round Darwin (Crawford 1972). **1972–73:** Large numbers recorded on King I., including 100–200 birds on 10 Nov. (Templeton & McGarvie 1973), and also recorded on Flinders I. and at various sites in n. coastal Tas., as well as several breeding records in Tas. (see above); coincided with record on Wilsons Prom., s. Vic. (Cooper 1975a) and influx into se. Qld (Ingram 1972; Dawson & Perkins 1973; Roberts & Ingram 1976), e. NSW (Heron 1973b; Egan *et al.* 1997; NSW Bird Rep. 1972), n. Vic. (Roberts 1975) and parts of SA (Eckert 1973; SA Bird Rep. 1972–73); and with much breeding activity in se. Aust. (NRS). These all roughly coincided with records near Carnarvon, WA (Brooker & Estbergs 1976) and in NZ (see above). **1977:** Large numbers round Cobar in winter preceded influx into ne. and e. NSW, from New England Tableland S to Illawarra Region, Oct.–Dec. (Schmidt 1978; NSW Bird Rep. 1977); influx also recorded in E. Gippsland, Vic. (Bedgood 1980). **1979:** First record in Gawler Ras, SA, where widespread in Oct. (Joseph & Black 1983). **1980:** Unusually widespread in parts of e. NSW, ACT, Vic. and s. SA in spring (Burbidge 1982; Lenz 1982; Debus 1983; Recher & Schulz 1983; Ashton 1985; Ford *et al.* 1985; Marchant 1992; Wood 1994; Egan *et al.* 1997; ACT Atlas; NSW Bird Reps 1980, 1981; Vic. Bird Rep. 1981). Vagrants also recorded in WA at Eyre Bird Observatory (Congreve & Congreve 1985), at sites in South-eastern and Mid-eastern Interior Regions of WA (Storr 22, 26) and at Woodleigh Stn, E of Shark Bay (Johnstone *et al.* 2000; Storr 21). **1982:** Large influx recorded in coastal and near-coastal NSW, from Northern Rivers S to South Coast (Larkins 1983; Ford *et al.* 1985; Marchant 1992; Wood 1994; Egan *et al.* 1997; NSW Bird Rep. 1982); in Vic., Sept.–Dec., with many records of large numbers in S, and widespread records in s. Vic. from Lower Glenelg NP E to Rotamah I., including suburban Melbourne (Burbidge 1985; Mason 1985; Vic. Bird Rep. 1982); and records in s. SA (Ashton 1985), coinciding with breeding record in n. Tas. (Tas. Bird Rep. 12) and roughly coinciding with vagrants at Paluma and on Magnetic I., ne. Qld, June–July (Wieneke 1988; Griffin 1995). **1984:** More s. records than usual in Vic. and SA, and larger than usual numbers in sw. NSW and n. Vic., Oct.–Dec. (Paton *et al.* 1994; Stove 1994; NSW Bird Rep. 1984; Vic. Bird Rep. 1984), coinciding with records at Moruya, se. NSW (Marchant 1992) and Rotamah I., Vic. (Anon. 1989). **1986:** Small influx recorded round Charters Towers, ne. Qld, in Mar. (Qld Bird Rep. 1986). **1991:** Large influx recorded in coastal and near-coastal NSW (Wood 1994; NSW Bird Rep. 1991),

coinciding with record in Redcliffe, se. Qld (Noyce 1997). This also coincided with record on NI of NZ (Guest 1992). **1994:** Large influx into Darling Downs, se. Qld (Eades 1994); e. NSW, from Northern Rivers S to South Coast, Oct. (Ley 1995; Whiter 1995; NSW Bird Rep. 1994); and s. Vic. (Eades 1994; Dedman 1995); all coinciding with occurrence on ne. Eyre Pen. (Cox 2001) and record on Lord Howe I. (NSW Bird Rep. 1994), and possible occurrence on Norfolk I. (Anon. 1997). **2003:** Huge numbers reported W of Charleville, Qld, in Aug. (H.A. Ford). Other, more localized influxes or congregations sometimes associated with hatching of plague locusts or infestations of caterpillars (e.g. Barnard 1905; McGilp 1935; Bravery 1970; Loyn 1980; Wood 1994; Lord 2001; NSW Bird Reps).

**Populations RECORDED DENSITIES:** 0.25 birds/ha, near Armidale, NSW (Ford & Bell 1981); 1.4 birds/ha, near Eden, NSW (Kavanagh *et al.* 1985).

**THREATS AND HUMAN INTERACTIONS** Occasionally struck by vehicles (Vestjens 1973), and one, that had been ill, by a cart (D'Ombra 1934). Formerly sometimes considered a pest round beehives (Leach 1928) but also often welcomed as a destroyer of insect pests in farmland (Austin 1907).

**MOVEMENTS** Migratory, with some dispersive characteristics. General trend of s. movement in spring to breed in s. and se. Aust., and n. movement to tropics in autumn (Keast 1958). Reporting rates in Aust. Atlas 1 much higher in summer in se. Aust. (6.9%, 25.6% and 7.1% in three regions) than in winter (0.3%, 3.3% and 1.5% respectively). Broad-scale analysis of bird count and atlas data in e. Aust. found strong evidence for inland circle pattern of movement, with n. migration apparently closer to e. coast and s. return farther inland (Griffioen & Clarke 2002; cf. claim of coastal and near-coastal s. migration in e. NSW [Gilbert 1934]; see Return below). However, movements and occurrence complex, irregular and unpredictable with regard to year and place (Keast 1958; Wood 1994; see below), making generalized interpretation difficult; extent, timing and location of arrival in se. and s. Aust. varies greatly, in part depending on environmental conditions (Keast 1958). Flocks sometimes appear in response to local abundance of food, such as flowering plants (Boekel 1980; Storr 19; see Food) or infestations of insects (Edwards 1920; D'Ombra 1934; Tarr 1964; NSW Bird Rep. 1984); such flocks may breed in an area while others move on (Edwards 1925; D'Ombra 1934). Penetrate farther into s. and se. coastal regions during inland drought (e.g. Keast 1958; Recher & Schulz 1983; Wood 1994; NSW Bird Reps), e.g. irruptions recorded round Sydney nine times between 1929 and 1950, each coinciding with low rainfall in inland NSW (Keast 1958); for details of irruptions recorded since 1970, see Distribution. Described as 'the most spectacular and accomplished true nomad' in arid Aust. (Rowley 1975), and movements in central Aust. possibly truly dispersive, but are seldom reported and poorly understood. Possible that population size fluctuates greatly in response to availability of food, and that this fluctuation obscures strongly migratory patterns (Wood 1994). **NATURE OF PASSAGE:** Often fly at high altitudes, possibly reducing reliability and frequency of reports. Move during day, flying in large compact flocks, often with Masked Woodswallows, at great heights (Gilbert 1934, 1935; NSW Bird Rep. 1982). Proportions of White-browed and Masked Woodswallows in mixed-species flocks varies geographically (see Masked Woodswallow: Social Organization). Suggested that small groups leave flock and settle as they pass suitable nesting sites (Gilbert 1935; NSW Bird Rep. 1982). Capable of travelling large distances over sea, as evidenced by vagrancy in NZ and on Lord Howe and Norfolk Is (see Distribution).

Migration irregular, and generalized discussion accordingly difficult, with much variation from year to year, or region to region, e.g. occasionally winter in some locations, absent from others for years, and possibly resident throughout year at some sites (e.g. Inverell, n. NSW, 1962–73, from almost daily observations; Baldwin 1975) despite sightings from surrounding areas being intermittent. Difficult to draw conclusions about movements round some locations, e.g. described as sporadic round Mt Isa, where seen in flocks July–Apr. (Horton 1975).

**Departure** Summer visitor to se. Aust., usually leaving Jan.–Apr., but mostly Mar. (see below). Departure often more gradual and less noticeable than arrival (D'Ombain 1934; Costello 1981), though birds may also leave *en masse* (Gilbert 1934), sometimes after flocking (Gilbert 1935). Flocks or individuals occasionally winter in breeding areas (see Non-breeding), including sites below where departure discussed. SA: Usually leave S in late Jan. or early Feb. (Glover 1952; Ashton 1985; Taylor 1987; H.J. Eckert), though recorded leaving in Dec. (Cox 1973) and Apr. (Glover 1952). In N, leave L. Frome district roughly Feb.–Mar. (McGillp 1923). TAS.: Said not normally present in Tas. after Feb., though scattered records all months (Templeton & McGarvie 1973; see below, and Distribution); usually leave King I. in autumn (McGarvie 1965). VIC.: Most records of departure in Mar.–Apr., at sites throughout State (Anon. 1907, 1930; Bedggood 1970; Vic. Atlas; see below); at Cobden, central Vic., 1896–1901, departure between 13 Mar. and 30 Apr. (Graham 1903). Departure also recorded Feb.–Mar., in N (Bedggood 1973), and W (Anon. 1930); and occasionally departure reported as early as Dec. or Jan., e.g. near Colac (Brown 1950) and Maryborough in central Vic. in 1908 (Chisholm 1909a). Rarely, aberrant departure recorded: at Bendigo, birds wintered in 1952, nested in Aug. but left in Sept., deserting nests (Ryan 1953). NSW: In W, usually leave Mar.–Apr. (Chisholm 1938; Schmidt 1978; Morris *et al.* 1981; NSW Bird Reps 1982, 1997, 1999), though sometimes later, e.g. mostly leave SW by Apr. (Hobbs 1961) but left Dareton 13 May in 1984 (NSW Bird Rep. 1985); at Mungindi, gradual departure extended into winter (Costello 1981); and thousands seen on n. passage over Ivanhoe, 11 May (NSW Bird Rep. 1975). May leave earlier when conditions unfavourable, e.g. left Pulletop in Nov. after failing to breed during drought (NSW Bird Rep. 1994). In E (including ACT), occurrence irregular, and the few available records of departure mostly in Jan. (Gilbert 1935; Wilson 1976; Anon. 1990; Calaby 2000), though recorded round Orange till Apr. (NSW Bird Rep. 1980). QLD: Few records. Left Murphys Ck, in SE, early Jan. in 1938, though small groups continued to visit until Apr. (Lord 1939). Left Bundaberg in Mar. (Anon. 1930). Absent from Milparinka district after Apr. 1974 (Wynndham 1978), and from Mt Isa before Apr. (Horton 1975).

**Non-breeding** Most winter and non-breeding records from n. and inland Aust. (Aust. Atlas 2; see below). In N. AUST., occasional winter (dry season) visitor to Kimberley Div., WA, May–Aug. (Storr 11); Top End, May–June (Crawford 1972; Schodde 1976; Boekel 1980; H.A.F. Thomson & D.K. Goodfellow); and very occasionally in ne. Qld, June–Aug., e.g. Atherton (Bravery 1970) and Paluma Ra. (Griffin 1995). Most winter records in INLAND AUST., e.g. in Gascoyne Region of WA, records of small numbers, July–Oct., though breeding once recorded in Oct. (Johnstone *et al.* 2000; Storr 21); and very occasionally recorded in Mid-eastern Interior Region of WA, May, Aug. (Storr 22), with records of w. and nw. movement in E. Murchison district in early Aug. (Whitlock 1910). At Mt Isa, nw. Qld, recorded from July, persisting over summer till Apr. (Horton 1975); and mainly occur at Richmond, Qld, in winter, with most leaving by mid-spring, but a few remaining over summer (Berney 1905). Recorded in Upper Western Region of NSW,

May–Aug. (Morris *et al.* 1981); and Feb.–May in middle reaches of Cooper Ck, ne. SA (Badman 1989). s. AUST.: Flocks and individuals occasionally winter in s. breeding areas. In NSW, noted wintering near Roto in large flocks in 1987 (NSW Bird Rep. 1987); and round Cobar, occasional records of wintering individuals (Schmidt 1978); and during drought, recorded in large flocks near Nowra, se. NSW, 11 Apr.–22 Sept. 1991 (NSW Bird Rep. 1991). Records on King I. in every month (McGarvie 1965). In Vic., recorded in winter in mid-N during drought year (Lowe & Lowe 1972), and wintering noted at Bendigo in 1952 (Ryan 1953) and at Maryborough (Thomas & Wheeler 1983).

**Return** Dates of departure from non-breeding areas not well documented; in general, arrive in spring. Typically arrive in s. breeding areas suddenly and in large numbers and begin nesting immediately (see Social Behaviour, Breeding); also said that travelling flocks break up and descend if conditions suitable for breeding or keep moving if not (NSW Bird Rep. 1982). Often arrive in s. areas on days with hot northerly winds (Wheeler 1947; McGarvie 1965; Thomas & Wheeler 1983; Dedman 1995; SA Bird Reps 1963, 1965), though sometimes first seen flying N into wind, despite having arrived from N (Wheeler 1947; Austin 1972; Thomas & Wheeler 1983). QLD: Appear to leave Atherton and Paluma Ra., in NE, after winter (Bravery 1970; Griffin 1995); and Richmond, by mid-spring (Berney 1905). Uncommon and irregular in SE, not occurring every year, but when present usually arriving Sept.–Oct. (e.g. Anon. 1930; Lord 1933, 1939, 1943, 1956). NSW: Arrive in spring, mainly Sept.–Oct. (Morris *et al.* 1981). Irregular ON AND E OF GREAT DIVIDE, INCLUDING ACT, not occurring every year and often transitory; most arrivals Sept.–Oct. (Edwards 1920, 1925; D'Ombain 1934; Gilbert 1935; Whiter 1995; Gosper & Holmes 2002), though sometimes first seen Nov. (Recher & Schulz 1983); round Orange, usually arrive Sept. (Heron 1973a); and in ACT, mainly arrive in Oct. (Chapman & Purchase 1969; Clarke & Lenz 1978; Anon. 1990; Allan 2001), though as early as 8 Sept. (Jones 1929) and as late as mid-Nov. (Jones 1929; Calaby 2000). Gilbert (1934) postulated two routes of migration for birds moving S to Sydney, but these appear at odds with detailed analysis of atlas and count data (Griffioen & Clarke 2002) and general occurrence of birds in NSW. W OF GREAT DIVIDE: Usually arrive Sept.–Oct. in N and S (Chenery *et al.* 1920; Chisholm 1938; Schmidt 1978; Costello 1981; Wood 1994; NSW Bird Reps 1982, 1985, 1997, 1998), though arrival often earlier, in late Aug., during drought years (Wood 1994; NSW Bird Reps 1977, 1981, 1982). VIC.: Usually arrive in spring (e.g. Anon. 1930; Vic. Atlas), mostly Sept.–Oct. (see below). From records across State, 1896–99, mean date of arrival 21 Oct. and median date 12 Oct. (n=14 years). N OF GREAT DIVIDE: Usually arrive late Sept. to late Oct. or Nov. (Chisholm 1909a; Sullivan 1911; Chandler 1913; Leach 1928; Anon. 1930; Bright & Taysom 1932; Ryan 1953; Tarr 1964; Lowe & Lowe 1972; Bedggood 1973; Vic. Bird Reps 1981, 1984, 1985), though, at Mystic Park, in central N, occasionally as early as Aug. (Lowe & Lowe 1972) and near Castlemaine, as late as Dec. (Leach 1928). Single record at Wilsons Prom., early Nov. 1972, coincident with drought (Cooper 1975b). ON AND S OF GREAT DIVIDE: Usually arrive late Sept. to Nov. or Dec. Round Geelong, usually arrive late Sept. to early Oct. (Dedman 1995) but between 1994 and 2001, first records 7–22 Oct. (n=7) with mean date of arrival 17 Oct. (Dedman 1995; Hewish 1996, 1997, 1998, 1999, 2000, 2002). At Ballarat, arrive Oct.–Nov. (Thomas & Wheeler 1983). In Western District, arrive near Colac, in late Nov. to Dec. (Brown 1950); at Cobden, 1896–1901, arrived 9 Oct. to 20 Dec. (n=5) with mean date of arrival 19 Nov., and median 14 Nov. (Graham 1903); and at Portland, arrived late Oct. or Nov. (Learmonth 1953; Austin 1972). TAS.:

While scattered records in all months, arrivals tend to be in Nov. (McGarvie 1965; Templeton & McGarvie 1973). SA: Occasional visitor to N in spring–summer; arrive L. Frome area in early summer (McGilp 1923); recorded middle Cooper Ck area Feb.–May (Badman 1989); and observed round Roxby Downs in spring (Read *et al.* 2000). In S, arrive Murray–Mallee in Sept. and early Oct. (Glover 1952; Boehm 1957; Cox 1973; SA Bird Rep. 1963, 1965; H.J. Eckert); and on Adelaide Plain, arrive Sellicks Beach Oct.–Nov. (Ashton 1985) and at Port Wakefield in early Oct. (Taylor 1987). WA: Arrive in s. regions in small numbers in spring; recorded at various sites in South-East Interior Region, Sept.–Nov. (Storr 26), and arrived at Eyre Bird Observatory, Sept. (Congreve 1982; Congreve & Congreve 1985); arrive in South West Div., Sept. (Storr 35).

No clear pattern to timing of vagrant occurrence in NZ and Lord Howe and Norfolk Is. Records on Lord Howe I. in May and Dec.; and on Norfolk I., July–Aug., but once Feb. Vagrants to NZ recorded Sept. and up to four noted Dec. 1971 and present till July 1973 (see Distribution).

**Breeding** Throughout se. Aust., with scattered records farther N. Usually present in S Sept.–Oct. through to autumn, with most birds having left by Apr., though leave some areas much earlier, in Jan., or occasionally later, in May (see Departure above). Dispersion after arrival described as circumscribed, confined to small forest patches (Gilbert 1935).

**Banding** Of 180 banded in Aust., 1953–June 2003, two recoveries (1.1%), of two birds, both <10 km from banding site and within 1 month of banding (ABBBS). No other information.

**FOOD** Invertebrates, mainly insects; also nectar and occasionally fruit. **Behaviour** Some aspects well known. Usually forage in air, mostly above or among trees and shrubs; also occasionally on ground and among flowers in trees and shrubs (see below). **DETAILED STUDY:** In Imbota NR, near Armidale, ne. NSW; 1981–82, and 1984 (Ford *et al.* 1986). **FORAGING ASSOCIATIONS:** Usually forage in small to large flocks, ranging from 3–20 birds, to one or more hundreds and sometimes 1000 or more (Cameron 1932; Bravery 1970; Ingram 1972; Lowe & Lowe 1972; Rix 1976; Larkins 1983; Hobbs 1986; Eckert 1989, 1997; Coate *et al.* 1998; D.I. Rogers; see Social Organization); very occasionally forage singly (J.M. Peter). Large flocks often congregate round food sources, such as flowering trees or swarms of insects (Berney 1903; Cleland 1919; McGilp 1935; Parker 1969; Lowe & Lowe 1972; Dawson & Perkins 1973; Mack 1973; Larkins 1983; Eckert 1989; NSW Bird Reps 1984, 1999; Vic. Bird Reps 1984, 1985; H.J. Eckert). Often form mixed-species feeding flocks with Masked Woodswallows (e.g. Chisholm 1909b, 1971; White 1918; Cleland 1919; Barrett 1920; MacGillivray 1929; Elliott 1938; Ingram 1972; Mack 1973; Rix 1976; Schrader 1981; Hobbs 1986; Eckert 1989; Larkins 1992; Coate *et al.* 1998; Hall; Vic. Atlas; D.I. Rogers; H.J. Eckert) and Dusky Woodswallows (Lowe & Lowe 1972; Dabb 1999). Also sometimes forage on flowering plants with Rainbow Bee-eaters; honeyeaters, including Yellow-throated Miners *Manorina flavigula*, Noisy Friarbirds *Philemon corniculatus*, and Brown *Lichmera indistincta*, White-cheeked *Phylidonyris nigra* and Blue-faced *Entomyzox cyanotis* Honeyeaters; and trillers, including White-winged Triller *Lalage sueurii* (Hall 1902; Ingram 1972; Pizzey 1980; Larkins 1983; Pizzey & Knight 1997). **FORAGING SITES, HEIGHTS:** Mostly forage in air (Cameron 1932; Rix 1943, 1976; Ford & Bell 1981; Recher & Schulz 1983; Ford *et al.* 1986; Hobbs 1986; Eckert 1997; Dabb 1999; Vic. Atlas); also forage in flowering trees and shrubs (Chisholm 1909b; Ingram 1972; Parker 1977; Larkins 1983, 1992; Ford *et al.* 1986; Coate *et al.* 1998; Vic. Atlas), and occasionally in fruiting shrubs (Lowe & Lowe 1972; Hobbs 1986; Eckert 1989); and occa-

sionally forage on ground (Bravery 1970; Recher & Schulz 1983; Ford *et al.* 1986; Dabb 1996, 1999; Eckert 1997; Hall; Vic. Atlas; H.J. Eckert; D.I. Rogers), including on flowering prostrate plants (Sargent 1928; Mack 1973; Parker 1977) and in stubble (D.I. Rogers). In Bondi SF, se. NSW, insects taken mostly in air or snatched from vegetation, occasionally from ground; foraged mostly in open paddocks and along edges of roads, rather than among trees at edge of forest or above canopy (Recher & Schulz 1983). In Imbota NR, mostly foraged in upper levels, mainly above 15 m; of 51 observations of foraging: 1.9% on ground; none between ground and 5 m; 5.9%, 6–9 m; 17.3%, 10–14 m; and 75.0% >15 m above ground; mostly foraged in air (74.5%), occasionally among flowers of Blakely's Red Gum (23.5%) and very occasionally on bare ground (2.0%). **FORAGING METHODS:** Forage mostly by screening (Ford *et al.* 1986), though many reports of foraging in literature identified as undefined hawking (e.g. Cameron 1932; Rix 1976; Ford & Bell 1981; Recher & Schulz 1983). Also forage by sally-striking from vegetation; sally-pouncing from low perch, such as a fence or a low bush, onto prey on ground (D'Ombrain 1934; Good *et al.* 1973; Recher & Schulz 1983), sometimes without landing (Barrett 1920); and sally-striking prey in air (H.A. Ford). Seen to swoop from tree and catch cicadas in both feet in mid-air, then fly to ground and break cicada in two (D'Ombrain 1934; North). Also probe flowers for nectar (Ingram 1972; Mack 1973; Parker 1977; Larkins 1983; Ford *et al.* 1986) and pluck (glean) fruit (Lowe & Lowe 1972; Hobbs 1986; Eckert 1989). In Imbota NR, of 51 observations of foraging: 74.5% by screening, 23.5% by probing and 2.0% by gleaning. When foraging in flowering trees or shrubs, sometimes acrobatically hang sideways or upside-down (Chisholm 1909b; Ingram 1972). Once seen killing small lizard, but neither ate it nor fed it to young (Eckert 1997). Feed on insects fleeing fires (Rhodes 1944). Steal food from other birds: recorded snatching grub from bill of Southern Whiteface *Aphelocephala leucopsis* (Hindwood 1968), and from adult Black-faced Cuckoo-shrike *Coracina novaehollandiae* attempting to feed young bird (Chisholm 1969). **HANDLING OF FOOD:** After catching cicadas, broke them in two by repeatedly jabbing thorax region of cicada with bill, before feeding it to nestling (D'Ombrain 1934). **ADAPTATIONS:** Brush-like tongue and rather curved bill used for feeding on nectar (Berney 1905; McKean 1969; H.A. Ford).

**Detailed studies** NEAR ARMIDALE, NSW (observations; qualitative estimate of importance: +++ major food, ++ often eaten, + occasionally eaten; Ford 1985): **Plants** Nectar\*. **Animals** SPIDERS<sup>+</sup>. **INSECTS:** Diptera<sup>+</sup>; Coleoptera<sup>+++</sup>: Scarabaeidae<sup>+</sup>; Hemiptera<sup>+</sup>; Hymenoptera: Formicidae<sup>++</sup>; others<sup>+</sup>.

**Other records** **Plants** Nectar<sup>1,3,7,33</sup>. **GYMNOSPERMS:** Cupressaceae: *Callitris* sap<sup>12</sup>. **MONOCOTYLEDONS:** Xanthorrhoeaceae: *Xanthorrhoea* nectar<sup>30,32</sup>. **DICOTYLEDONS:** Caesalpiniaceae: *Bauhinia* nectar<sup>2</sup>; Chenopodiaceae: *Enchylaena tomentosa* fru.<sup>42</sup>; *Rhagodia candolleana* fru.<sup>42</sup>; Fabaceae: *Brachysema* nectar<sup>30</sup>; *Clianthus formosus* nectar<sup>35</sup>; *Leptosema daviesioides* nectar<sup>16</sup>; Loranthaceae: *Amyema miquelii* nectar<sup>36</sup>; Myoporaceae: *Eremophila maculata* nectar<sup>17</sup>; Myrtaceae: *Eucalyptus* nectar<sup>9,10,17,39,56</sup>; *E. grandis* nectar<sup>45</sup>; *E. ochrophloia* nectar<sup>17</sup>; *E. terminalis* nectar<sup>29</sup>; Pittosporaceae: *Pittosporum phylliraoides* fru.<sup>33</sup>; Proteaceae: *Grevillea* nectar<sup>5</sup>; *G. robusta* nectar<sup>8,9,40,53</sup>; *G. wickhamii* fl.<sup>46</sup>; Rutaceae: *Citrus* nectar<sup>33</sup>; Santalaceae: *Exocarpos aphyllus* fru.<sup>41</sup>. **Animals** **MOLLUSCS:** Snails<sup>56</sup>. **SPIDERS**<sup>50,52</sup>. **INSECTS**<sup>19,24,38</sup>: Coleoptera<sup>2,23,37,49,50</sup>: Buprestidae<sup>52</sup>; Carabidae<sup>50</sup>; Chrysomelidae: *Edusella*<sup>50</sup>; *Tomyris*<sup>50</sup>; Curculionidae<sup>37,52</sup>; Hydrophilidae: *Cercyon*<sup>50</sup>; Scarabaeidae<sup>14,50,52</sup>: *Anoplognathus*<sup>44</sup>; *Aphodius*<sup>50</sup>; *Liparetrus*<sup>50</sup>; Hemiptera<sup>50,52</sup>: Cicadidae<sup>48</sup>; *Psaltoda*<sup>50</sup>; Pentatomidae<sup>50,52</sup>; Psyllidae<sup>50</sup>; Scutelleridae<sup>50</sup>; Hymenoptera: wasps<sup>37,52</sup>; *Apis mellifera*<sup>15,52</sup>; Formicidae<sup>2,23,27,37,43,49,52</sup>; *Camponotus*<sup>28</sup>; *Iridomyrmex*<sup>50</sup>; *I. detectus*<sup>13</sup>; *Pheidole*<sup>52</sup>;

Lepidoptera: larv.<sup>6,31,49</sup>, ads<sup>47,49</sup>; *Agrostis infusa*<sup>19</sup>; Orthoptera: grasshoppers<sup>4,6,11,15,18,20,21,22,23,26,34,51,54,55</sup>; Acrididae<sup>37,52</sup>; *Austroicetes*<sup>44</sup>; *Chortoicetes terminifera*<sup>25,57</sup>; *Phaulacridium vittatum*<sup>44</sup>; *Praxibulus*<sup>44</sup>; Gryllidae<sup>37</sup>; Tettigoniidae<sup>37</sup>.

REFERENCES: <sup>1</sup> Hall 1902; Berney <sup>2</sup> 1903, <sup>3</sup> 1905; Barnard <sup>4</sup> 1905, <sup>5</sup> 1914; <sup>6</sup> Austin 1907; <sup>7</sup> Hall & Rogers 1908; Chisholm <sup>8</sup> 1909b, <sup>9</sup> 1911; <sup>10</sup> Chandler 1913; <sup>11</sup> White 1918; <sup>12</sup> Cleland 1919; <sup>13</sup> Barrett 1920; <sup>14</sup> Edwards 1925; <sup>15</sup> Leach 1928; <sup>16</sup> Sargent 1928; <sup>17</sup> MacGillivray 1929; <sup>18</sup> Morgan 1932; <sup>19</sup> D'Ombain 1934; <sup>20</sup> McGilp 1935; <sup>21</sup> Elliott 1938; Lord <sup>22</sup> 1939, <sup>23</sup> 1956; <sup>24</sup> Rix 1943; <sup>25</sup> Basse 1948; <sup>26</sup> Boehm 1957; <sup>27</sup> Tarr 1964; <sup>28</sup> Bedgood 1965; Parker <sup>29</sup> 1969, <sup>30</sup> 1977; <sup>31</sup> Bravery 1970; <sup>32</sup> Ingram 1972; <sup>33</sup> Lowe & Lowe 1972; <sup>34</sup> Good *et al.* 1973; <sup>35</sup> Mack 1973; <sup>36</sup> Paton & Ford 1977; <sup>37</sup> Vestjens 1977; <sup>38</sup> Ford & Bell 1981; <sup>39</sup> Schrader 1981; <sup>40</sup> Larkins 1983; <sup>41</sup> Hobbs 1986; <sup>42</sup> Eckert 1989; <sup>43</sup> Brandwood 1992; <sup>44</sup> Lepschi 1993; <sup>45</sup> Griffin 1995; <sup>46</sup> Coate *et al.* 1998; <sup>47</sup> Dabb 1999; <sup>48</sup> North; <sup>49</sup> Cleland; <sup>50</sup> Lea & Gray; <sup>51</sup> Hall; <sup>52</sup> FAB; NSW Bird Reps <sup>53</sup> 1982, <sup>54</sup> 1983, <sup>55</sup> 1994; <sup>56</sup> H.A. Ford; <sup>57</sup> H.J. Eckert.

**Young** Nestlings and fledgelings fed by both parents (see Breeding, Social Behaviour).

No detailed studies. CENTIPEDES<sup>8</sup>. INSECTS<sup>6</sup>: Coleoptera<sup>2,5</sup>; Diptera<sup>1</sup>; Hemiptera: Cicadidae<sup>5,6</sup>; Lepidoptera: ads<sup>1,3,5</sup>; Orthoptera: grasshoppers<sup>1,4,6,7</sup>; Acrididae: locusts<sup>8</sup>. REPTILES: lizards<sup>8</sup>.

REFERENCES: <sup>1</sup> Barrett 1916a; <sup>2</sup> Lawrence 1923; <sup>3</sup> Gwynne 1932; <sup>4</sup> Leach 1928; <sup>5</sup> D'Ombain 1934; <sup>6</sup> Recher & Schulz 1983; <sup>7</sup> Campbell; <sup>8</sup> NRS.

**SOCIAL ORGANIZATION** Not well known; no detailed studies though some observations from two breeding colonies in Bondi SE, near Bombala, se. NSW, during one season (Recher & Schulz 1983). Gregarious (see below), and only very occasionally seen singly (Cooper 1972; J.M. Peter). Mainly occur in small flocks of up to 20 throughout year (e.g. Cooper 1972; Bedgood 1973; Morris 1975; Gibson 1977; Hatch 1977; Marchant 1992; Templeton 1992), or in larger flocks of up to 500 (e.g. Lansell 1933; Attiwill 1972; Morris 1975; Gibson 1977; Marchant 1992; Birt 2002; NSW Bird Reps); occasionally form very large flocks of up to 2000, usually when on migration (e.g. Austin 1907; Condon 1962; Dawson & Perkins 1973; Heron 1973b; Cooper 1975a,b; Henle 1989; NSW Bird Reps 1975, 1982). Large flocks often congregate at source of food, such as flowering trees or swarms of insects (see Food). Often occur in mixed-species flocks, especially with Masked Woodswallows (e.g. McGilp 1921; Condon 1962; Rix 1970; Cox 1973, 2001; Morris 1975; Baxter & Paton 1998; Cooper 1998; North; Mathews; NSW Bird Rep. 1999; also see that text), and often when on passage (e.g. Leach 1928; Terrill & Rix 1950; Schrader 1981; Allan 2001; NSW Bird Rep. 1975; SA Bird Rep. 1963); relative proportions of the two in mixed flocks varies geographically: in e. Aust., White-browed generally predominate, and Masked predominate in more arid and inland areas and in WA (see Masked Woodswallow account for details). Sometimes also associate with White-breasted *Artamus leucorhynchus* (Lendon 1966; Britton 1992), Black-faced (Chisholm 1929; Whitmore *et al.* 1983) and Dusky Woodswallows (Officer 1958; Tarr 1964; Baldwin 1975; Bedgood 1979; Dabb 1999; Gould; see Food). Sometimes forage with other species, particularly honeyeaters (see Food).

**Bonds** Monogamous; nest in pairs (e.g. Lawrence 1923; Gwynne 1932; Recher & Schulz 1983; NRS). Not recorded breeding co-operatively (e.g. Dow 1980; Clarke 1995). However, in colony of c. 15 nests near Canberra, some groups of three or four birds noted, but not clear whether they attended nests (Dabb 1999). **Parental care** Both sexes brood and feed nestlings and feed fledgelings (Lawrence 1923; Gwynne 1932;

Tarr 1981; Cooper 1998; NRS). In captivity, male said to contribute more to feeding nestlings (Brook 1908). **DISPERSAL OF YOUNG:** After fledging, young may remain on ground near nest for 2–3 days, and in area round nest for up to 2 weeks, after which appear to join adults in departure from nesting area. Fledgelings seen in flocks with adults, and being fed in these flocks, suggesting that young birds depend on parents for some weeks after fledging and join migratory flocks while still dependent (Recher & Schulz 1983; Dabb 1999; North; ACT Atlas; NRS).

**Breeding dispersion** Usually nest in loose colonies of up to c. 50 nests (Lawrence & Littlejohns 1917; Costello 1981; Recher & Schulz 1983; Shields & Recher 1984; Dabb 1999; Vic. Atlas; ACT Atlas; NRS); also sometimes nest solitary (NRS), though frequency of solitary versus colonial nesting not known. In Bondi SE, two colonies of 38 and 17 nests in a study site of 10 ha, these c. 200 m apart; another colony of 44 nests was 2 km away (Recher & Schulz 1983; Recher & Holmes 1985). In Canberra, one colony of 15 nests in area of c. 50 ha (Dabb 1999). Elsewhere, seven active nests found within radius of 70 m; and distance between nests within a group, 31–55 m (NRS [n=4]). **ASSOCIATIONS WITH OTHER WOODSWALLOWS:** Sometimes nest in mixed colonies with other woodswallows, or a few nests of one or another species noted in larger colonies of the other; most often reported with Masked Woodswallows (Barnard 1925; Barnard 1944; Carnaby 1965; Austin 1972; North; Mathews; Aust. Atlas 1; Vic. Atlas; NRS) and, less often, Dusky Woodswallows (Recher & Schulz 1983; Dabb 1999; NRS) or Black-faced Woodswallows (NRS). On Carriewerloo Stn, near Port Augusta, SA, colonies of White-browed and Masked Woodswallows found in same patches of Mulga, though each species nested in distinct clusters (Brandon 1951). One colony contained nesting Masked, White-browed and Black-faced Woodswallows (NRS). Recorded nesting 4.5 and 19 m from active nests of White-breasted Woodswallow (NRS). **Territories** Within colonies, defend area round nest from conspecifics as well as other species (Lawrence & Littlejohns 1917; Gwynne 1932; Dabb 1999). No other information.

**Roosting** Often gather in large numbers at dusk, before roosting at night, clustering on trunks of trees or inside hollows of burnt-out trees (Lord 1956; Bourke 1972), or on outer dead branches of trees (H.A. Ford). Diurnal clustering also recorded, sometimes as early as 10:30, usually in overcast or windy weather, with cluster occupying sheltered part of tree (Bourke 1972; Hobbs 1972). Sizes of clusters range from 20 to hundreds, though sometimes made up of several discrete groups; and some include other species, especially Black-faced and Masked Woodswallows (Bourke 1972; Hobbs 1972; NRS). Birds in diurnal cluster on burnt-out trunk of large eucalypt near Cowra, NSW, were quite restless: cluster broke up and re-formed five times in 60 min; each time, birds flew around calling loudly for a few minutes. Site also used for nocturnal roosting for at least 6 nights before birds left on migration; used again in following year. Two other nearby sites also used during day: beneath overhang on burnt-out log, and in angle between tree-trunk and large horizontal branch of an ironbark eucalypt; and latter also used at least once at night (Bourke 1972). Near Ivanhoe, w. NSW, large mixed-species flock with Black-faced and Masked Woodswallows sheltered from wind in Belah tree; small groups clung below each fork in tree on lee side of trunk; each group comprised 4–5 birds of various species clinging closely to one another at different angles; composition of each group changed constantly as new birds arrived, forcing others out (Hobbs 1972). Near Atherton, about 100 roosted in Lantana thicket (Bravery 1970).

**SOCIAL BEHAVIOUR** Not well known; no detailed studies, though some observations from two breeding colonies in



Bondi SF, near Bombala, se. NSW, during one season (Recher & Schulz 1983). Can be difficult to observe, as described as shy and wary, and often fly at great heights (Lawrence 1923; Gould; see Movements). When followed to roost, sensitive to close approach by observer, birds dispersing before observations possible (Chapman 2000). **Flock behaviour** Twittering Contact Call used often when flying in flocks, either feeding or on passage (Berney 1903, 1905; De Warren 1929; Wheeler 1947; Watson 1955; Tarr 1964; Austin 1972; Lowe & Lowe 1972; Dawson *et al.* 1991; Wood 1994; Campbell; Hall; see Voice). On arrival after passage, one flock of c. 200 perched in a dead tree and stayed there for rest of day; next morning they dispersed across hillside, screening or sallying for insects with much noisy calling (Gilbert 1935). In early morning, large foraging flock (with Masked Woodswallows) flew noisily into air every 30 min or so, gradually circling higher, separating as they ascended; eventually descended, returning to trees (Cleland 1919); another flock, also with Masked Woodswallows, observed performing active flights about low shrubs (Chisholm 1910). Noted forming flocks with Masked Woodswallows on approach of storms (Chisholm 1910; Boehm 1957), but other observations suggest that the two species can form flocks at any time (see above, Food). **Maintenance behaviour** Said to perform much allopreening (Frith 1969).

**Agonistic behaviour** Little information on intraspecific agonistic interactions. Pairs said to guard area round nest from intruders (Gwynne 1932); and nesting birds sometimes squabble with other individuals (Dabb 1999). Nesting pair occasionally chases another for some distance if they land near nest-site (Lawrence & Littlejohns 1917). **Alarm, Mobbing** No details of mobbing. Utter harsh call in alarm or when mobbing potential predators (Jurisevic & Sanderson 1994; see Voice). Seen mobbing a vagrant Spangled Drongo *Dicrurus bracteatus* with Black-faced Woodswallows and White-winged Trillers (Ford 1996). In colony of 38 nests, of which 18 successful, birds actively mobbed and pursued potential predators, such as Laughing Kookaburras *Dacelo novaeguineae*, Brown Goshawks *Accipiter fasciatus* and Pied Currawongs *Strepera graculina*, that approached colony; in smaller colony of 17 nests, all of which failed, individual pairs tried to defend nests from Pied Currawongs, but no mobbing observed (Recher & Schulz 1983). When apparently alarmed, parent flew backward and forward over nest, calling constantly; another pair flew to tree adjacent to nest, called noisily, and wagged tails vigorously from side to side (Mathews). **Interactions with other species** Seen to chase White-winged Triller feeding in same tree (Larkins 1983), though also join with this species to mob others (see Alarm). Very occasionally recorded stealing food from other species (see Food). When nesting, aggressive to other species that approach nest or fledgelings (North; NRS). At one colony in Canberra, sometimes squabbled with Dusky Woodswallows that nested nearby (Dabb 1999). One pair built nest 50 cm from an already completed White-plumed Honeyeater *Lichenostomus penicillatus* nest on same branch, and both pairs behaved aggressively towards one another (NRS). Once, all adults from colony of seven pairs rose simultaneously to chase a young Pallid Cuckoo *Cuculus pallidus* that had perched nearby (NRS); and a small mixed flock (with Dusky Woodswallows) joined other species to chase Black Falcon *Falco subniger* from their territory (Bedgood 1979).

**Sexual behaviour** Typically arrive in s. breeding areas suddenly and in large numbers and begin nesting immediately once a location chosen (Barnard 1925; Leach 1928; Wolstenholme 1929; D'Ombra 1934; Good *et al.* 1973; Recher & Schulz 1983; see Movements, Breeding). Suggested possibly pair in flight (Gilbert 1935), though bonds may simply be maintained in non-breeding flocks. **Allopreening** When flushed from nest, a brooding female flew to nearby tree, and

male landed beside and preened her (Tarr 1981). **Copulation** Copulation occurs near or at nest while building (NRS). **PRE-COPULATORY DISPLAY:** Female solicits copulation when perched, by lowering and spreading tail, then wagging it from side to side, though males sometimes also display in this way (Recher & Schulz 1983). However, following observed near nest of a pair, which had been destroyed: female flew from ground to a low branch near nest and male soon flew to her and copulated, with no other display noted. Female then flew off but soon reappeared, landing close to male on branch where he was perched; male hopped over female, then she hopped over him and flew away briefly, but soon returned and the two perched together for a short time, then sat apart and preened. Both then flew to ground and foraged; male then left and foraged in air, leaving female to forage on ground till she hopped onto a small stick near ground. Male returned to higher perch, c. 5 m away; soon after, female extended her wings slightly upward and slightly forward, and male immediately flew to her, alighted on her back and copulated briefly, then flew away, leaving female on branch. The birds re-nested 30 m away (Eckert 1997).

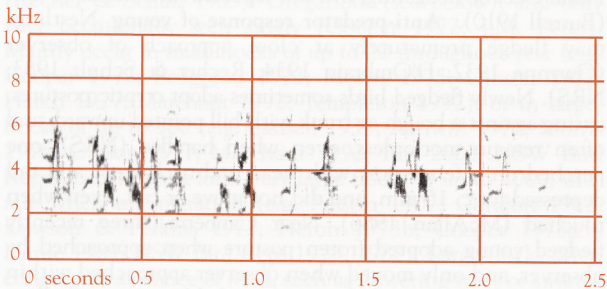
**Relations within family group** During very hot weather, brooding bird seen crouched, with bill agape, over two nestlings, shading them with outstretched wings (D'Ombra 1934). When two nestlings fledged prematurely on close approach of observer, adult male flew down, grasped one young in his claws and flew with it to a nearby tree, depositing it on a branch, then repeated this with second young, this time taking it to another tree (D'Ombra 1934). Fledgelings often barely able to fly after leaving nest, and may be accompanied closely by parents (NRS). Recently fledged young seen moving up a tree-trunk then gliding away from nest-tree; both parents appeared to be enticing fledgeling away from nest (NRS). A sitting female seen to leave nest and feed a begging Pallid Cuckoo fledgeling; this was repeated six times in 40 min (Burrell 1910). **Anti-predator response of young** Nestlings may fledge prematurely at close approach of observer (Gwynne 1932; D'Ombra 1934; Recher & Schulz 1983; NRS). Newly fledged birds sometimes adopt cryptic postures, sitting against a bough or trunk with bill pointed upward, and often remain motionless, even when handled (NRS); one perched on a fence post with head and neck erect and tail depressed for c. 15 min, and did not move or call, even when touched (McAllan 1986). Near Canberra, three recently fledged young adopted frozen posture when approached by observer, and only moved when observer approached within c. 20 m, after apparently being persuaded by insistent calling by parents to flutter and hop across open ground to another location (Dabb 1999). **Parental anti-predator strategies** Female on nest sat nearly motionless, with bill pointing upward in a cryptic pose (NRS). Incubating or brooding bird may sit tight, not leaving till observer within 2 m, and returning as soon as observer moves away (NRS). Parents also noisily drive off intruders from near nest or fledgelings (see Agonistic behaviour), including people near nest (Jackson 1908; Morgan 1930; Crompton 1946; McAllan 1986; NRS). Once struck observer at nest (NRS).

**VOICE** Not well known. Sonagram of Alarm Chatter in Jurisevic & Sanderson (1994). Noisy, especially in breeding season (Frith 1969; North; Aust. RD). Contact Call and Alarm Chatter both said to be uttered often when in pairs or flocks (Aust. RD). Call strongly in flight (De Warren 1929; Watson 1955; Bourke 1972), and attention may be drawn by calls when birds barely visible (North; Mathews; Aust. RD) or completely out of sight (Lowe & Lowe 1972; Wood 1994). Sound of a flock of thousands settling in an orchard described as a noisy chattering (Lowe & Lowe 1972), and that of large flocks rising as 'a great noise' (Cleland 1919) and a 'grey chirping mass'

(Mathews). Sonagram A shows Contact Calls from a large feeding flock. Contact Call said to be similar to, but distinct from, those of Dusky Woodswallow (Frith 1969) and to be diagnostic (Lowe & Lowe 1972). Called loudly when cluster disbanded (Bourke 1972). Occur in mixed flocks with Masked Woodswallow, whose Contact Calls are very similar (Austin 1972; Dawson *et al.* 1991; North; Aust. RD; see also account for that species). MIMICRY: Said to mimic a wide range of, but undescribed, species (Frith 1969), and heard to mimic Pallid Cuckoo and Brown Treecreeper *Climacteris picumnus* (Chisholm 1937, 1946b); mimicry by males said to be 'quite good' (Hyem 1937).

**Adult SONG:** A pleasant little song, interspersed with mimicry (Chisholm 1937). **CONTACT CALL:** High-pitched whistle, twitter, chatter, chirp or chirrup, described as *chip chip*; *chap chap*; *chyep*; or *chp*, *chap*. Various considered loud, plaintive, descending, musical or sweet and clear; and given singly or repeated, and in flight and while perched (Berney 1905; Wheeler 1947; Frith 1969; Lowe & Lowe 1972; Pizzey & Knight 1998; Campbell; North; Mathews; Hall; Aust. RD). Said to be like chirp of House Sparrow *Passer domesticus* (Lowe & Lowe 1972; Mathews; J.M. Peter). **ALARM CHATTER:** Harsh, strident chatter, covering a broad frequency range; uttered in alarm or aggression, or when mobbing potential predator (Frith 1969; Jurisevic & Sanderson 1994; Mathews; Aust. RD). **ALARM CALL:** Said to give *whamp* in alarm, similar to that of Masked Woodswallow (Campbell; also see that text). **Other calls** Sweet notes, like those of a miner *Manorina* (Pizzey 1980). Repeated *tut-tut-tut* (Campbell). A high, querulous short call when disturbed (Hall).

**Young** A very young fledgeling, found on fence post, was silent when approached and when touched, but uttered low cheeps when grass seeds attached to its feathers were removed (McAllan 1986).



A R. Buckingham; Warrumbungle NP, NSW, Sept. 1985; P94

**BREEDING** Reasonably well known. Detailed studies of two colonies studied in Bondi SF, near Bombala, se. NSW (Recher & Schulz 1983); and notes from 15 years' observation in NSW, mostly round Gosford on central coast (D'Ombra 1934); 1154 records in NRS to June 2003. Often arrive in an area *en masse*, and begin breeding immediately, occupying virtually any suitable site (e.g. Barnard 1925; Leach 1928; Wolstenholme 1929; D'Ombra 1934; Good *et al.* 1973; Recher & Schulz 1983; see below). Usually nest in loose colonies (see Social Organization: Breeding dispersion). However, frequency of solitary breeding not known. Sometimes nest in groups with Masked and Black-faced Woodswallows (see Social Organization, and below); and possibly occasionally hybridize with Masked Woodswallow (see Plumages).

**Season** Throughout range, clutches recorded July–Jan., though only July records in NT (see below); of 839 clutches in NRS: eight (1%) in July, none in Aug., 22 (3%) in Sept., 197 (23%) in Oct., 381 (45%) in Nov., 194 (23%) in Dec., and 37 (4%) in Jan. (NRS). Nestlings, Aug. to early Feb., though

only Aug. nestlings from NT (see below); of 589 nestling records in NRS: four (0.7%) in Aug., three (0.5%) in Sept., 57 (9.7%) in Oct., 303 (51.4%) in Nov., 158 (26.8%) in Dec. and 64 (10.9%) in Jan. QLD: Eggs, Aug.–Jan. (McGill 1944b; Lavery *et al.* 1968; Campbell; NRS [n=11]). Nestlings, Sept.–Oct. (NRS [n=5 records]). Overall, breeding (including eggs and nestlings, above) recorded Aug.–Jan. (Templeton 1992; Storr 19; Aust. Atlas 1, 2); single record of feeding young between 1 Mar. and 31 May (Aust. Atlas 1). NSW–ACT: Eggs, Aug.–Jan. (Gwynne 1932; D'Ombra 1934; Morris *et al.* 1981; Recher & Schulz 1983; North; ACT Atlas); of 404 clutches in NRS, early Sept. to late Jan., most (83.2%) mid-Oct. to mid-Dec. Nestlings, early Oct. to early Feb. (D'Ombra 1934; Recher & Schulz 1983; ACT Atlas; NRS [n=270]). Overall, breeding (including eggs and nestlings, above) recorded Aug.–Feb. (Aust. Atlas 1, 2). VIC.: Eggs, late Aug. to late Jan. (Ryan 1953; Campbell; NRS); of 346 clutches in NRS, late Sept. to late Jan., most (86.1%) late Oct. to early Dec. Nestlings, mid-Oct. to late Jan. (NRS [n=256]). Overall, breeding (including eggs and nestlings, above) recorded Aug.–Feb. (Cheney 1915; Bedgood 1972; Aust. Atlas 1, 2; Vic. Atlas). TAS.: Eggs, Nov. (NRS [n=3]) and Jan. (Tas. Bird Rep. 28); nestlings and fledgelings, Dec. (Good *et al.* 1973); a juvenile seen begging for food Nov.–Dec. (Tas. Bird Rep. 12). On King I., eggs, early Nov. to mid-Dec.; nestlings, Dec.; fledgelings, Dec. and Jan. (Templeton & McGarvie 1973). SA: Eggs, Sept. to Jan. (Brandon 1951; Attiwill 1972; Rix 1976; Ashton 1987; SA Bird Rep. 1963; NRS); of 64 clutches in NRS, late Sept. to mid-Jan., most (70.3%) late Oct. to mid-Dec. Nestlings, late Sept. to late Jan. (Rix 1976; NRS [n=53]). Overall, breeding (including eggs and nestlings, above) recorded Aug.–Feb. (Brandon 1951; Aust. Atlas 1, 2; SA Bird Rep. 1963, 1972–73). WA: Eggs, mid-Sept. and Nov. (Carnaby 1965; NRS [n=2]); nestlings, Nov. (NRS [n=1]). Overall, breeding (including eggs and nestlings, above) recorded Sept.–Nov. (Aust. Atlas 1; Storr 21, 26, 27). NT: Eggs, July (n=8) and Sept. (n=1); nestlings, Aug. (NRS [n=4]); and single records of unspecified breeding in Sept. (Aust. Atlas 1) and Nov. (Aust. Atlas 2).

**Site** Nest in almost any suitable site round area occupied by colony. Usually low; either concealed or exposed; in fork of branch or trunk, in cleft or behind piece of bark on side of trunk, in hollow of limb, stump or trunk, in fork of fallen limb, in dense foliage of prickly shrub or sapling, on vines or creepers (including grape vines), among epicormic regrowth on saplings after fire, or on top of foliage of branches of Norfolk Island Pine. Also in old nests of Eastern Yellow Robin *Eopsaltria australis*, White-browed Babbler *Pomatostomus superciliosus*, Magpie-lark *Grallina cyanoleuca*, Black-faced and Dusky Woodswallows, and Zebra Finch *Taeniopygia guttata*. Also in artificial sites, such as fence post or rail, on crossbar of stockyard, building scaffolding, upright of bridge, post supporting a vine, in hollow on top of post or telegraph pole, and in top of coil of wire netting (Cheney 1915; Barrett 1916a,b; Wolstenholme 1929; Gwynne 1932; D'Ombra 1934; Sharland & Hindwood 1941; Ryan 1953; Boehm 1957; Rix 1976; Tarr 1981; Campbell; North; SA Bird Rep. 1968–69; NRS). Once c. 50 cm down in a crack, c. 5 cm wide, in upper surface of rock (Reid 1973). Nest in a wide variety of native and introduced trees and shrubs, mostly in native plants such as eucalypts, casuarinas, banksias and tea-trees, but also other plants including native *Araucaria* and introduced pines *Pinus*, rose *Rosa* bushes, grape vines and *Citrus* trees (Barrett 1916a; Gwynne 1932; D'Ombra 1934; Recher & Schulz 1983; North; SA Bird Rep. 1963; and see below). Of sample of 100 records of nest-plant in NRS: 57 (57.0%) in *Eucalyptus* (mostly mallees [n=34]); 12 (12.0%) in *Casuarina* (mostly Belah [n=11]); ten (10.0%) in *Callitris*; three (3.0%) in each of *Acacia* and *Lycium*; two (2.0%) in each of *Angophora*, *Banksia*,

Briar and *Vitis vinifera*; and one (1.0%) in each of *Cotoneaster*, *Dodonaea*, *Eremophila*, *Hakea*, *Kochia*, *Melaleuca* and an unidentified pine. In Bondi SF, all 57 nests were in eucalypts: 43.1% in Snow Gum, 27.6% in Narrow-leaved Peppermint, 17.2% in Manna Gum and 12.1% in Black Sallee (percentages quoted from original reference; do not equate to whole numbers). On King I., of 13 nests: five (38.5%) in Silver Banksia, four (30.8%) in Prickly Tea-tree, three (23.1%) in Coastal Tea-tree and one (7.7%) in Manna Gum (Templeton & McGarvie 1973). In Bondi SF, of 38 nests in one colony in eucalypt woodland: 21 (55.3%) were in fork of trunk, 14 (36.8%) behind loose bark on trunk, and three (7.9%) in cavity where trunk of tree had broken off; of 17 nests in second colony in eucalypt forest regenerating after fire: ten (58.8%) were in dense epicormic growth, and seven (41.2%) in cavities of broken-off trunks or limbs. In one paddock in Vic., preferred prickly acacias, usually close to a dead eucalypt, which appeared to be used as lookout perches by adults (Lawrence & Littlejohns 1917). One pair took over a partly built nest of Rufous Whistler *Pachycephala rufiventris* (Bridges 1992). Occasionally return to old sites for subsequent nesting attempts; one pair built on remnants of an old nest (NRS). **DISPERSION:** For dispersion of colonies and nests within colonies, see Social Organization (Breeding dispersion). **ASSOCIATIONS WITH OTHER SPECIES:** Sometimes nests in mixed colonies with other woodswallows, or a few nests of one or another species noted in larger colonies of the other; usually associated with Masked but also sometimes with Dusky and Black-faced Woodswallows; and both Masked (often) and Dusky have been reported nesting in same tree as White-browed (Robinson 1933; McGill 1944b; Brandon 1951; Carnaby 1965; Austin 1972; Lowe & Lowe 1972; Costello 1981; Recher & Schulz 1983; Dabb 1999; North; Mathews; Aust. Atlas 1; Vic. Atlas; NRS; see Social Organization: Breeding dispersion); see Masked Woodswallow for further details. Other species recorded nesting within colonies include: Brown Falcon *Falco berigora*, Striated Pardalote *Pardalotus striatus*, Yellow-rumped Thornbill *Acanthiza chrysorrhoa*, White-browed and Chestnut-crowned Pomatostomus *ruficeps* Babbler, Gilbert's Whistler *Pachycephala inornata*, Willie Wagtail *Rhipidura leucophrys*, Black-faced Cuckoo-shrike, White-winged Triller and Zebra Finch (NRS). As well as Masked and Dusky Woodswallows (as above), other species recorded nesting in same tree include: Willie Wagtail, White-winged Triller and House Sparrow (Dabb 1999; North; NRS); and one nest was built 50 cm from an already completed White-plumed Honeyeater nest on same branch (NRS). Recorded nesting near variety of other species, not necessarily associated with colonies, such as Restless Flycatcher *Myiagra inquieta*, Magpie-lark, Fuscous Honeyeater *Lichenostomus fuscus* (within 2 m), Crested Pigeon *Ocyphaps lophotes* (within 5 m), and Olive-backed Oriole *Oriolus sagittatus* (within 10 m) (NRS). **MEASUREMENTS (m):** Height of nest, 2.7 (1.89; 0.3–16.0; 1104) (NRS); in Bondi SF, 7.8 (5.28; 57); in pine plantation, 1.5 (0.9–3.0; 44) (Recher & Schulz 1983); in high country of se. NSW–ne. Vic., 3.0 (n=25) (Frith 1969); on King I., 1.0–3.0 (n=13) (Templeton & McGarvie 1973); 0.6–6.1 (D'Ombra 1934). Height of nest-plant, 5.5 (2.98; 0.9–20.0; 560) (NRS); in Bondi SF, 11.2 (6.04; 57).

**Nest, Materials** Nest a loose, shallow cup or platform; made of twigs, rootlets, grass or plant stems; and usually lined with fine rootlets, grass, plant stems or green flowering stems, but sometimes unlined; one lined entirely with green clover leaves (Wolstenholme 1929; D'Ombra 1934; Frith 1969; Campbell; North; NRS). Nests said to be scanty, semi-transparent and well ventilated (Frith 1969). One nest had outer frame of twigs 8–12 cm long, and inner frame and lining of grass stalks 10–18 cm long (NRS). Often begin building immediately on arrival at breeding area (Leach 1928;

Wolstenholme 1929; see above). Both sexes build (Recher & Schulz 1983; NRS), but most by male (D'Ombra 1934). Construction takes 2–3 days (D'Ombra 1934; Recher & Schulz 1983). **MEASUREMENTS (cm):** External diameter, 9.5–10.8; external depth, 5.1; internal diameter, 7.0; internal depth, 2.5 (no N) (Campbell).

**Eggs** Oval, or stout, rounded or elongate oval, or pyriform; close-grained, smooth and glossy (Campbell; North). Ground-colour whitish brown, buff-white, light greenish-grey or bluish, usually mottled, spotted and blotched with pale amber or slate, with a few underlying markings of slaty grey, mainly round large end; some entirely white and unmarked, while others have markings sparsely scattered over entire surface (Gould; Campbell; North; NRS). Eggs almost identical to those of Masked Woodswallow (McGill 1944b). **MEASUREMENTS:** 22.8 (0.7; 21.6–23.6; 8) × 17.3 (0.33; 17.0–17.8) (Campbell; North). **WEIGHT:** Just before hatching, 3.5–4.5 (n=5) (Recher & Schulz 1983).

**Clutch-size** Usually two to three, sometimes one or four (Wolstenholme 1929; D'Ombra 1934; Carnaby 1965; McEvey 1965; Frith 1969; Campbell; North). From NRS: **THROUGHOUT RANGE**, 2.13 (0.473; 465): C/1 × 25, C/2 × 353, C/3 × 87; **QLD**, C/2 × 1; **NSW**, 2.23 (0.52; 241): C/1 × 11, C/2 × 164, C/3 × 66; **VIC.**, 2.02 (0.39; 191): C/1 × 13, C/2 × 162, C/3 × 16; **TAS.**, C/2 × 1; **SA**, 2.14 (0.44; 29): C/1 × 1, C/2 × 23, C/3 × 5; **WA**, C/2 × 2. In Bondi SF, **NSW**, 2.3 (0.4; 16): C/1 × 1, C/2 × 10, C/3 × 5 (Recher & Schulz 1983). For small published samples, see Storr 19 (Qld), 26 (WA).

**Laying** Appears synchronous within colony (Barrett 1916a). Begins immediately (NRS) or soon (Recher & Schulz 1983) after completion of nest; one pair laid first egg 3 days after selection of site (McGill 1944a). Eggs usually laid in morning (Frith 1969; NRS); individual eggs laid between 07:00 and 11:55 (n=3 eggs), between 09:15 and 14:55 (n=1), and between 13:30 and 08:05 next day (n=1) (NRS). Eggs usually laid on consecutive days, though last egg occasionally laid after a delay; D'Ombra (1934) stated that first and second eggs laid on consecutive days but third egg, if laid, is usually several days after second. For one C/2, first egg laid by 07:00 on one day, with second egg laid after 10:00 next day and before 14:00 on third day; for another nest, third egg laid at least 4 days after second (NRS). In one nest where first egg fell through lining into base of loosely built nest, second egg not laid till 4 days after first (NRS).

**Incubation** By both sexes (Brook 1908; Frith 1969; Recher & Schulz 1983; North; NRS), roughly equally during day (D'Ombra 1934), though with female appearing to do slightly more: of 831 observations of incubating bird throughout range, 503 (60.5%) were of female and 328 (39.5%) male (NRS); in Bondi SF, of 112 observations of incubating bird, female on nest on 64 (57.1%) occasions, male 48 (42.9%) occasions, though difference not significant. Not known which sex incubates at night; said to be usually male (D'Ombra 1934) or female (Frith 1969). Adults sit from laying of first egg, but proper incubation probably starts with second egg, because in clutches of two, both eggs hatch within 24 h of one another; and in clutches of three (where last egg usually laid several days after second), last egg usually hatches later than other two (D'Ombra 1934; Recher & Schulz 1983; NRS). Nests in one colony appeared to be deserted after adults left breeding area for 1–2 days but adults returned and resumed incubating (NRS). Eggs probably hatch in morning: one at 09:40, another between 07:10 and 07:30, and another between 11:00 and 18:00 (NRS). **INCUBATION PERIOD:** From completion of clutch, 13.1 days (1.80; 11–16; 13) (NRS); within 14 days (Gwynne 1932); 16 days (Frith 1969).

**Young** Altricial, nidicolous. Hatch with eyes closed and covering of down (Cheney 1915; NRS); eyes start to open at c. 5 days (NRS). **Growth MEAN WEIGHT** (figures approximate,

estimated from growth-curve of two nestlings): At hatching, c. 4.0; at 2 days, c. 7.5; 4 days, c. 15.5; 6 days, c. 21.0; 8 days, c. 25.5; and 10 days, c. 27.0. For other nestlings at 13–15 days, 28–32. In one brood of two 4-day-old nestlings, one weighed 8.5 g more than the other, but both gained weight at same rate and fledged together. For two broods of three nearly fledged young, difference in weight between lightest and heaviest nestlings, 1.5 and 3.5 g (Recher & Schulz 1983). **Parental care** Both parents brood and feed young (Brook 1908; Gwynne 1932; D'Ombra 1934; Tarr 1981; NRS; see Food). In captivity, young fed by both parents, though male did most (Brook 1908). At one nest, female sheltered young on a hot day, quivering wings, possibly to fan young (Barrett 1916a). Adults remove faecal sacs (Brook 1908).

**Fledging to independence** **FLEDGING PERIOD:** 14.1 days (1.07; 13–16; 7) (NRS); in high country of se. NSW–ne. Vic., said to be 15 days, and to be shorter inland (Frith 1969); in captivity, 14 days (Brook 1908). Two young fledged between 09:00 and 15:00; one fledged by 12:00 on one day, and second between 06:30 and 11:35 next day (NRS). Nestlings >10 days old liable to leave nest if handled (Recher & Schulz 1983). For reaction of adult to premature fledging, see Social Behaviour (Relations within family group). After fledging, remain on ground near nest for 2–3 days, and said to be unable to fly, or fly only weakly; able to fly short distances at 18–20 days (Recher & Schulz 1983; NRS). Fledgelings attended by both parents (Good *et al.* 1973; Tarr 1981; NRS). Weight of fledgelings 16–18 days old, 28–32 g (no N) (Recher & Schulz 1983).

**Success** Where clutch-size, hatching and fledging success known: from 856 eggs, in 421 nests, 259 (30.3%) hatched and 92 (10.8%) young fledged, equal to 0.22 fledged young per nest; from 1355 eggs, in 657 nests, 701 (51.7%) hatched; of 644 nests where outcome known, 220 nests (34.2%) fledged at least one young and 424 known to have failed (NRS). In Bondi SF, all 17 nests in one colony failed as a result of predation by Pied Currawong (see below); of 33 accessible nests in another colony, nine (27.3%) failed before hatching, and six (18.2%) failed before young fledged; five (15.2%) fledged one young and 13 (39.4%) fledged two young (Recher & Schulz 1983). Nests deserted after severe windstorm (D'Ombra 1934). Liable to desert clutch if nest close to frequent disturbance (North). Birds with active nests will desert clutches when rest of colony leaves breeding area (Ryan 1953; Sharland 1972; NRS). **PREDATORS OF YOUNG:** Predators can cause failure of entire colonies: in Bondi SF, a Pied Currawong worked through colony taking all eggs (Recher & Schulz 1983); and near Bendigo, Vic., Australian Ravens *Corvus coronoides* arrived in a large colony and robbed all nests of eggs or young (Ryan 1963). In a colony of six nests located round a nest of Chestnut-crowned Babbler with young, all Wood swallow nests failed after nestlings taken by unknown predator (NRS). One C/3 destroyed by an Apostlebird *Struthidea cinerea*, which drove adult away from nest then pecked a hole in each egg (Bourke 1941); one nest torn apart and eggs broken by two young Australian Magpies *Gymnorhina tibicen* (NRS); and nestlings taken by Laughing Kookaburras (North) and Australian Magpies (NRS). In Bondi SF, other probable predators included Common Brushtail Possum *Trichosurus vulpecula*, Cats and Foxes (Recher & Schulz 1983). One brood of live nestlings was heavily infested with maggots (NRS). **CUCKOOS:** Parasitised by Horsfield's Bronze-Cuckoo *Chrysococcyx basalus* (Brooker & Brooker 1989; HANZAB 4).

**PLUMAGES** Prepared by J.S. Matthew. Covered with grey down at hatching. Fledge in juvenile plumage; then undergo a partial post-juvenile (first pre-basic) moult to adult-like first immature (first basic) plumage. Probably attain adult plumage in complete first immature post-breeding (second pre-basic)

moult. Thereafter, a complete post-breeding (pre-basic) moult each cycle produces successive adult (basic) plumages with no change in appearance. Sexes differ. Plumage description based on examination of skins of nine adult males, seven adult females, two first immature males, three first immature females and three juveniles (HLW, MV, SAM), and photos (R.P. Allen) of first immature males and females.

**Adult male** (Definitive basic). **HEAD AND NECK:** Forehead, crown, nape and neck, dark grey (dark 83), usually blackish (c89) at sides of lower forehead. Eye-ring, black (89) or grey-black (82). Lores, ear-coverts, malar area, chin and throat, grey-black (82), slightly darker (blackish c89) on lores; and all darker than top of head and neck, forming diffuse grey-black mask. Prominent and sharply demarcated white supercilium extends from sides of lower forehead towards hindneck, broader behind eye. Several short, fine black (89) bristles on interramal area, above gape and sides of lower forehead. **UPPERPARTS:** Mantle, scapulars and back, dark grey (dark 83), usually slightly paler than top of head. Rump and uppertail-coverts, grey (dark 84), slightly paler than rest of upperparts. All feathers of upperparts have concealed pale-grey (86) bases. **UNDERPARTS:** Uppermost breast, dark grey (c83), usually slightly paler than throat and fairly sharply demarcated from dark red-brown (132, 221A) or red-brown (221B) of most of rest of underbody; longest undertail-coverts, pale red-brown (c35) in some. Feathers of thighs, light grey (c85). Axillaries, white. All feathers of underparts have concealed grey (c87) bases. **UPPERTAIL:** Rectrices, grey (c84) with: narrow pale-grey (c86) or light grey-brown (119D) fringe to outer web of t1, usually grading to white at tip; broad white tips (7–12 mm along shaft) to t2–t5, merging with narrow white fringes to inner webs; and narrow white outer edge and broad white tip to inner web (5–10 mm along shaft) of t6, tip barely extending to outer web. Shafts, dark red-brown (c221A). **UNDERTAIL:** Rectrices, pale grey (c86), contrasting with dark underbody, and with pale markings as uppertail; tips to outer rectrices clearly visible. Shafts, brown (219B). **UPPERWING:** All coverts and feathers of alula, grey (c84) with: narrow off-white (ne) fringe at tips of feathers of alula and greater primary coverts; and concealed light grey-brown (c119D) inner edges to greater primary coverts. Tertiaries, grey (c84), usually with diffuse dark-brownish (c119A) inner edges. Secondaries and primaries, grey (c84), grading to dark brownish (c119A) near tips, with narrow off-white (ne) fringe at tips when fresh, and fairly broad pale-grey (c86) or off-white (ne) inner edges; fringe at tips of outermost primaries very narrow or absent. Shafts of remiges, black-brown (19). **UNDERWING:** All secondary coverts and median and greater primary coverts, white. Marginal primary coverts, white with dark-grey (c83) outer webs or outer edges, which combine to form narrow dark-grey leading edge to outerwing. Remiges: inner webs, pale grey (c86) grading darker (grey 84) towards tips; outer webs, grey (c84) or dark grey (83); and with pale markings as upperwing. Shafts of remiges, brown (219B). Underwing appears mostly whitish, grading to grey towards tips of remiges, and with narrow dark-grey leading edge to outerwing.

**Adult female** (Definitive basic). Differs from adult male by: **HEAD AND NECK:** Lack dark facial mask. Top of head and neck tend to be paler, bluish grey (c87), becoming darker grey (c83) on lower sides of forehead. Lores, black (89), forming black loreal stripe that contrasts with rest of face. Supercilium, off-white (ne), narrower and less sharply demarcated than in adult male, and usually grading to pale grey (c86) and becoming more diffuse posteriorly. Ear-coverts, malar area, chin and throat, dark grey (c83) or grey (c84), paler than in adult male and not forming dark facial mask. **UPPERPARTS:** As adult male but with fairly distinct greyish-brown (ne) wash to mantle, scapulars and back. **UNDERPARTS:** Uppermost breast, grey (ne), paler than in adult male, grading into varying, russet-brown

(c34) to pale rufous-brown (c139, c340) or pinkish brown (c219C), lower breast, and most of rest of underbody; posterior undertail-coverts, off-white (ne) or light grey (c85) with pale rufous-brown (c139, c340) wash of varying intensity. Thighs and axillaries as adult male. **TAIL:** As adult male except tips to t2–t6, narrower (c. 5 mm along shaft), off-white (ne) and less sharply demarcated. **WING:** As adult male.

**Nestling** Photos (L.N. Robinson) show nestlings with dense cover of light-grey (c85) down on head and body.

**Juvenile** Differs from adult by: **HEAD AND NECK:** Forehead, crown, nape and hindneck, dark brown (121) with distinct white or off-white (ne) streaking; feathers, dark brown (121) with white or off-white (ne) rosethorn-shaped tips or shaft-streaks near tips. Sides of neck, brown (28) or brownish grey (c79) with fine scattered white or off-white (ne) streaks. Lores and eye-ring, blackish (c89), forming distinct blackish loreal stripe that contrasts with rest of face; eye-ring slightly paler (dark grey c83) behind eye. Ear-coverts, brownish grey (c79). Malar area, chin and throat, brown (c28) with dense short off-white (ne) streaking formed by shaft-streaks to feathers. **UPPERPARTS:** Mantle and most scapulars, dark brown (121), grading to slightly greyer, dark brownish-grey (c79) back, rump and uppertail-coverts, with dense white or off-white (ne) streaking throughout, though in some birds streaking buff (c124) or buff-white (ne); feathers, dark brown (121) with white, off-white (ne) or buff-white (ne) shaft-streaks near tips or rosethorn-shaped tips; some scapulars, dark grey (83) with small buff (124) or cream (c92) rosethorn-shaped tips. Feathers of upperparts softer and more loosely textured than adult. **UNDERPARTS:** Breast, sides of belly and anterior flanks, brown (28) with scattered and diffuse off-white (ne) streaks; rear-flanks, centre of belly and vent, cream (c92) or brownish cream (ne) with diffuse brown (28) mottling. Undertail-coverts, pale grey (c86) with small cream (92) or cream-buff (c123D) subterminal spot; some have indistinct grey (84) barring to posterior coverts. **TAIL:** More deeply forked than in adult, particularly when tail folded; and rectrices narrower and more acute at tips than in adult. Rectrices largely grey (84) above and pale grey (c86) below, grading to brownish (c28) near tips of t2–t6; with small white rosethorn-shaped tips when fresh (and which lost with wear), and with narrow white outer edge to t6. **UPPERWING:** Marginal and median secondary coverts, dark brown (121), grading to grey (c84) at bases, with white rosethorn-shaped tips. Greater secondary coverts, grey (84), grading to dark brown (121) near tips, and with white rosethorn-shaped tips. Tips to median and greater secondary coverts combine to form two lines of white spots across folded wing. Marginal and median primary coverts, dark brown (121) or dark greyish (c83) with small white tips. Greater primary coverts, grey (84) with white rosethorn-shaped tips. Feathers of alula, grey (84) with narrow white fringe at tips and concealed light grey-brown (119D) inner edges. Tertiaries similar to adult but with distinct buffish-white (ne) tips when fresh, reduced with wear. Secondaries and primaries similar to adult, but with broader whitish (ne) fringe at tips, reduced with wear. **UNDERWING:** As adult, but broader whitish (ne) fringes to tips of primaries and secondaries, combining to form narrow whitish trailing edge when wing spread.

**First immature male** (First basic). Plumage varies. One skin examined similar to adult female, but with darker grey (c83) chin and throat; and all juvenile rectrices, remiges, greater primary coverts and feathers of alula retained. Another skin superficially similar to adult female, but with: same retained juvenile feathering as previous skin but all juvenile greater secondary coverts also retained; whitish (ne) supercilium, rather like that of adult male; and darker greyish-black (c82) facial region (lores, malar area, chin, throat and ear-coverts) than adult female. Two captured in NSW in Oct. (R.P. Allen) resembled adult male, but with all juvenile

greater coverts, rectrices and alula retained. Hall stated that immature male (with partly pneumatized skull) resembles adult female.

**First immature female** (First basic). Very similar to adult female; two skins examined have all juvenile remiges, greater coverts, rectrices and feathers of alula retained; other skin with chin and throat paler (same colour number) than adult female, and with all juvenile remiges, greater coverts, feathers of alula, some outer scapulars and a few longest undertail-coverts (with cream subterminal spots) retained, and all juvenile rectrices replaced. Photo of probable first immature female (R.P. Allen) indicates plumage similar to adult female, but with all juvenile greater coverts and alula retained.

**Hybrid White-browed A. superciliosus × Masked A. personatus** Evidence for hybridization equivocal. Early report (Anon. 1909) described an unusual male collected while building nest with adult female *A. superciliosus*; while specimen possibly lost (and not examined in present study), details from published description include: upperparts as *A. superciliosus*; forehead, lores, cheeks, ear-coverts and throat, black; underparts, ashy grey with slight vinous wash; and undertail-coverts, pale ashy grey; supercilium, as *A. superciliosus*, but not extending as far posteriorly. McGill (1944a,b) mentioned sighting of a putative hybrid male in nw. NSW, with description not unlike skin mentioned above. However, these descriptions not inconsistent with that of first immature male *A. superciliosus* (this study; see above). More tangible evidence for hybridization is provided by McGill (1944b) who described a mixed-species pair (male *A. superciliosus*, female *A. personatus*) with a nest and eggs; unfortunately this pair was collected before eggs were allowed to hatch. Barnard (1944) also noted mating between the two species on Dawson R., Qld. Boehm (1974) provided details of probable hybrid captured at Sutherlands, SA: a male resembling *A. superciliosus* but lacking white supercilium and having black mask similar to *A. personatus*. Tarr (1981) also described a female *A. superciliosus* and male resembling *A. personatus* (but lacking white lower margin to black facial patch and with indistinct whitish supercilium) feeding nestlings.

**BARE PARTS** Based on examinations of photos (Chapman 2000; unpubl.: R.P. Allen; R. Drummond; L.N. Robinson; C.H. Sandbrink; D. Watts; and standard sources), museum labels (HLW, MV, SAM) and other sources as cited. **Adult** Bill, pale blue (c168D) or light bluish-grey (c88, pale 87), sometimes paler (off-white) on lower mandible, with black (89) or grey-black (82) distal third or distal half and usually continuing further towards base as thin black line on tomia; also described as bluish white with black tip (HLW). Gape, pale grey (c86) or bluish grey (c88); also described as blue (Rogers *et al.* 1986); shows as narrow pale stripe contrasting with dark plumage of face. Palate described as greyish pink (Hall). Orbital ring, light grey (c85) or grey (84). Iris varies from dark brown (ne) to orange-yellow (18); also described as orange-brown (Rogers *et al.* 1986) or brown (Hall; HLW, MV); basis of variation not known. Legs and feet, grey-black (c82) or dark brownish-grey (c79); also described as black (Hall; HLW). **Nestling** Bill, brownish grey (c80) with cream (c54) or pale-yellow (c157) tomia. Gape, cream (c54) or pale yellow (c157), slightly swollen. Palate, orange-yellow (c18). Iris, dark (ne). Bare skin, pink (c3). **Juvenile** Little known. Differs from adult by: Bill described as brown (HLW) or brown with faint black tip (Rogers *et al.* 1986); also flesh-coloured (SAM). Gape described as cream (Rogers *et al.* 1986) or yellow (SAM). Palate described as yellow (Rogers *et al.* 1986) or dull orange-yellow (SAM). Iris described as brownish yellow (HLW), dull brown (SAM) or olive-green (Rogers *et al.* 1986). **First immature** Similar to adult (HLW, MV). Photos (R.P. Allen) show iris of first immature males varies from dark brown

(ne) to orange (c17); and gape from cream (c54) to pale greyish (c86). One immature male said to have: iris, golden yellow; palate, yellower than adult; and legs, greyish horn (Hall).

**MOULTS** Based on examination of skins of 45 adults, five first immatures and three juveniles (HLW, MV, SAM), and other information as cited. **Adult post-breeding** (Third and subsequent pre-basic). Complete. Primaries outward. Active moult of primaries recorded from two in sw. Qld in Jan. (PMS 18, 22), one in NSW in Feb. (PMS 23) and one in Vic. in May (PMS 48); moult of primaries said to start in Nov. in Vic. (Rogers *et al.* 1986) but all 19 skins collected Nov.–Dec. had not yet started moult of primaries; all 15 June–Oct. had worn or slightly worn primaries. Five captured at Dubbo, NSW, in late Nov. 1958 showed no moult, and others collected there in early Mar. 1959 had finished moult (Keast 1968). Combined data suggest that moult of primaries occurs Nov.–May, sometimes not starting till midsummer. One with PMS 23 had not yet started moult of secondaries but was starting moult of tertials at s9; one with PMS 48 had finished moult of secondaries and tertials. Little known of timing of moult of tail, wing-coverts and body, but one with PMS 23 starting moult of tail (at t1) and greater secondary coverts, and with much moult of body. Slight moult of body recorded in May in Qld (Hall). **Post-juvenile** (First pre-basic). Little known. Partial. Involves all feathers of body, marginal and median secondary coverts, and varying number of rectrices; some birds replace a few inner greater secondary coverts. Two first immatures had all juvenile remiges, greater primary coverts and alula retained, and all juvenile rectrices replaced; three first immatures (Apr.–Nov.) had all juvenile remiges, greater primary coverts and alula retained, but replaced rectrices; one of latter birds had all juvenile greater secondary coverts retained. One partly grown juvenile in Jan., starting moult of marginal secondary coverts before start of moult of body; another similar juvenile, in early Nov., not yet started moult. **First immature post-breeding** (Second pre-basic). No information. Extent and timing probably similar to adult post-breeding, but data needed.

**MEASUREMENTS** (1–3) Qld, NSW and Vic., skins (HLW, MV, SAM): (1) Adults; (2) First immatures; (3) Juveniles. (4) Vic., live adults, sexed by plumage (Rogers *et al.* 1986).

	MALES	FEMALES	
WING	(1) 124.1 (3.44; 116–132; 24)	120.5 (3.56; 116–126; 15)	**
	(2) 119, 125	112, 119, 120	
	(3) –	116	
	(4) (127–131; 4)	122, 124	
TAIL	(1) 75.3 (4.20; 68–83; 24)	74.4 (4.07; 70–86; 15)	ns
	(2) 70, 74	69, 70, 73	
	(3) –	71	
THL	(4) (43.6–44.3; 4)	42.5, 44.4	
BILL S	(1) 22.5 (1.16; 20.4–25.1; 23)	22.0 (1.37; 19.8–24.1; 15)	ns
	(2) 21.6, 23.5	21.2, 21.3, 21.4	
	(3) –	22.2	
BILL D	(1) 7.2 (0.35; 6.6–7.8; 16)	7.0 (0.48; 6.2–7.9; 10)	ns
BILL W	(1) 7.2 (0.32; 6.6–7.7; 16)	7.0 (0.47; 6.4–7.9; 10)	ns
TARSUS	(1) 19.9 (1.04; 18.1–21.4; 24)	19.7 (0.81; 18.2–20.5; 15)	ns
	(2) 20.4, 22.9	18.4, 18.7, 20.0	
	(3) –	18.6	

**WEIGHTS** (1) Vic., adults and first immatures, from museum labels (MV, SAM) and data in Hall. (2) Locations not given, live adults, basis for sexing not known (ABBBS). (3) Live adults, sexed by plumage (Rogers *et al.* 1986).

	MALES	FEMALES	
(1)	30.5, 36.0, 41.1	30.0, 31.5	
(2)	35.4 (0.70; 34.5–36.2; 4)	36.5 (2.81; 33.5–40.0; 5)	ns
(3)	(36.2–39.3; 4)	34.4, 36.5	

**STRUCTURE** Powder-downs present on breast and lower back. Wing long and rather pointed at tip, rather broad; on folded wing, tip of longest primary falls to about two-thirds length of tail. Ten primaries; p10 very short; p9 usually longest, though p8 sometimes equal or up to 1 mm longer than p9; p10 72–84 mm shorter than p9; p8 usually 1–3 shorter, but sometimes equal or longer (as above), p7 6–12, p6 13–22, p5 22–30, p4 29–38, p3 35–45, p2 40–50, p1 46–56. No emargination to primaries. Ten secondaries, including three tertials; tip of longest tertial reaches about same length or slightly shorter than p1 on folded wing. Tail rather long, slightly forked or rather square at tip when folded in adults, more deeply forked in juveniles; 12 rectrices; one or more of t4–t6 longest, varying  $\leq 1$  mm, t2 and t3 usually 1–5 mm shorter than longest, t1 3–7; rectrices of juvenile narrower and more acute at tip than in adult. Bill rather slender compared with all other Aust. woodswallows except Masked; about same length as head; upper mandible slightly decurved; lower mandible inclined slightly upward near tip; slight notch in upper tomium near tip. Nares amphirhinal. Tarsus fairly short, compressed laterally; scaling laminiplantar. Tibia fully feathered. Middle toe longest, mean length including claw 21.2 mm (0.84; 20.1–22.2; 5); inner and outer toes 65–75% length of middle, hindtoe 75–80%. Hindclaw c. 6 mm long, strongly recurved.

**AGEING** Juveniles readily distinguished by plumage and bare parts (q.v.). First immatures differ by retained juvenile primaries and secondaries (primaries have broader white fringes at tips than adults), greater primary coverts (which have distinct white rosethorns at tips) and often all juvenile rectrices (which are narrower and more acute at tips than in adults). Some, possibly most, first immatures retain varying number of juvenile greater secondary coverts, these having small whitish rosethorns at tips and contrasting with uniformly grey inner coverts replaced in post-juvenile moult. First immature males vary in plumage of head and body: some similar to adult female, others with darker facial area than adult female, and some rather similar to adult male.

**SEXING** Adults differ in plumage (q.v.) and size, with males larger than females. Juveniles apparently do not differ in plumage, but more data on reliably sexed juveniles needed. First immatures can be difficult to sex, but some males have darker facial area than first immature or adult females, and some birds have rich reddish-brown underparts similar to those of adult male.

**GEOGRAPHICAL VARIATION** None apparent in this or other studies (Keast 1958; Etchécopar & Hùe 1977; Peters; Hall; DAB).

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**Volume 7 (Part A), Plate 12**

White-breasted Woodswallow *Artamus leucorhynchus* (page 399)  
 SUBSPECIES *LEUCOPYGIALIS*: 1 Adult; 2 Juvenile; 3 Immature; 4, 5 Adult; 6 Juvenile

Masked Woodswallow *Artamus personatus* (page 412)  
 7 Adult male; 8 Adult female; 9 Juvenile; 10 Immature; 11 Adult male; 12 Juvenile

White-browed Woodswallow *Artamus superciliosus* (page 424)  
 13 Adult male (dark iris); 14 Adult male (yellow iris); 15 Adult female; 16 Juvenile; 17 Immature male; 18 Adult male; 19 Adult female; 20 Juvenile

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