

Order PASSERIFORMES

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

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

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

The Passeriformes divide into two main groups:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Family 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. Moults of tail centrifugal. Moults 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. Extralimitally, 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). Extralimital 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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Artamus personatus **Masked Woodswallow**

COLOUR PLATE FACING PAGE 385

Ocypterus personatus Gould, 1841, *Proc. Zool. Soc. Lond.* 1840: 149 — southern and western Australia = York, Western Australia.

Both substantive and specific names mirror the conspicuous facial mask of the male, from Latin *personatus*, masked (from *persona*, a mask).

OTHER ENGLISH NAMES Northern Woodswallow; Blue, Bush or Wood Martin; Bluebird, Blue Jay, Bluey, Cherry-bird, Skimmer, or Summerbird.

MONOTYPIC

FIELD IDENTIFICATION Length 19 cm (18–20); wingspan 32–34 cm; weight 37 g. Medium-sized, slim-bodied woodswallow with rather long, slender, gently decurved bill and rather long tail, gently cleft at tip when at rest and square-ended when spread in flight; wings long and pointed, tips reaching to about three-quarters of length of tail at rest. Very similar in size, shape and proportions to White-browed Woodswallow *Artamus superciliosus*. Sexes differ noticeably in adult and immature plumages, alike in juveniles. No seasonal variation. Adult male, dark blue-grey above with prominent narrow white tip to tail, and pale grey below, with contrasting whitish underwing, and with diagnostic black mask, bordered by prominent white line curving up behind ear-coverts from sides of breast. Adult female patterned like male but slightly duller and browner above, and duller grey-brown or pinkish-brown below, and with more subdued dark-grey mask bordered by light grey-brown. Juvenile very different from adult: much duller, with body mostly dark brown, boldly streaked and spotted whitish above and more diffusely streaked whitish below, with diagnostic dark-grey mask and contrasting blue-grey wings and tail, and with prominent white tips to coverts and remiges of upperwing and fine white tip to rectrices; tail also more deeply notched than in adult. Immatures very similar to respective sexes of adult but separable by retained white-spotted juvenile plumage on wing and tail. **Adult male** Top of head and neck, dark blue-grey, grading to grey-black on forehead, and sharply demarcated from diagnostic black mask (on lores, ear-coverts, chin and throat); mask bordered along lower edge by narrow white line that continues up sides of neck in prominent narrow white crescent behind ear-coverts. Upperparts, dark

blue-grey (slightly darker on mantle, back and scapulars) with prominent narrow white tip to tail; and thin white fringe round tips of remiges, obvious on tips of primaries on folded wing in fresh plumage and persisting even in worn plumage. Underbody, pale grey, grading to greyish white on undertail-coverts. Undertail, pale grey with prominent narrow 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 pale-grey underbody contrasting strongly with black mask and contrasting slightly with whitish underwing; white tip of tail prominent, especially when backlit. Bill, light blue-grey, with sharply demarcated black tip covering up to distal half or so (and extending basally as thin black line along tomlia). Gape, light grey or blue-grey, obvious against black face. Iris, dark brown. Legs and feet, grey to grey-black or black. **Adult female** Similar to male, differing by: Upperparts slightly duller, with forehead barely darker than crown and mantle, and back and scapulars washed brown. Lores, black, but ear-coverts paler, grey-black, grading to dark grey on malar area, chin and throat, combining to form paler, greyer, less clear-cut and less contrasting dark-greyish mask. Underbody duller and darker, light grey-brown, grading to slightly darker grey-brown or pinkish brown on upper breast, and merging to whitish on vent and undertail-coverts; grey-brown or pinkish brown of upper breast extends upward across anterior sides of neck to behind ear-coverts in pale crescent bordering rear-edge of mask. White tip of tail slightly narrower. **Juvenile** Very different from adult. Top of head, hindneck and sides of neck, dark brown with dense, fine white streaking. Chin, throat and malar area, dark grey with off-white streaking,

merging to uniform dark grey on ear-coverts, which, with slightly darker blackish lores, form dusky mask (echoing that of adult) prominent against browner and more boldly streaked rest of head and neck and paler breast. Upperbody mostly dark brown, grading to dark grey on uppertail-coverts, and with diffuse broad white or cream streaks (which tend buffier on scapulars and back). Uppertail, dark blue-grey, as adult, but with thin off-white sides, and with small off-white tip, which soon lost with wear. Upperwing, dark blue-grey, as adult, with: bold wedge-shaped off-white streaks on tips of smaller secondary coverts; narrower off-white or buff-white tips to greater secondary coverts, primary coverts, alula and tertials; and prominent narrow off-white fringe round tips of remiges, broader and more prominent than on adult and obvious on folded primaries. In flight, off-white tips of remiges form crisp narrow whitish trailing edge. Breast and fore-flanks, dark brown with diffuse broad off-white streaking; grade into cream belly, vent and rear-flanks, which faintly streaked brownish; and to off-white or pinkish buff on undertail-coverts. Undertail like uppertail but slightly paler grey. Underwing as adult but with crisp narrow whitish trailing edge, obvious when backlit. Bill, brownish, with prominent pale gape; iris, dark brown or greenish yellow; and legs and feet, slate grey. **Immature male** Very similar to adult male, from which distinguished, if not too worn, by retained juvenile plumage on wing and tail, most obviously: (1) fine white tips to alula, primary coverts and usually greater secondary coverts; (2) clearly broader and bolder whitish fringe round tips of folded primaries; (3) more deeply notched tip of tail, and narrow whitish tip (cf. more gently cleft or square-cut tail with much broader and more prominent white tip in adult); and (4) mask slightly duller grey-black, and less sharply demarcated from underparts. Immatures in worn plumage more difficult to separate from adults, as white tips of upperwing-coverts and tail then much reduced or lost through wear. Unless traces of white tips can be seen, such birds best separated by: much more worn and brownish appearance to folded primaries and more prominent white fringes round tips of same; and (if not already moulted) the more deeply notched tail. **Immature female** Very similar to adult female, differing by same characters as given for immature male.

Similar species White-browed Woodswallow: ADULT AND IMMATURE MALES: At rest, Masked readily separated by diagnostic white-bordered black mask and pale-grey underbody (White-browed darker generally, with prominent white supercilium and mostly dark red-brown underbody contrasting with dusky face and dark blue-grey breast). In flight, from below, note pale-grey underbody contrasting strongly with black mask, but otherwise appearing almost uniformly pale below with little contrast with whitish underwing and none with undertail (in White-browed, much darker red-brown underbody shows less contrast with dark head, neck and breast but contrasts much more strongly with whitish underwing and pale-grey undertail). **ADULT AND IMMATURE FEMALES:** Masked distinguished by diagnostic pale-bordered dusky-grey mask and light grey-brown or pinkish-brown underbody (White-browed have obvious greyish-white supercilium and noticeably darker dull red-brown or pinkish-brown underbody contrasting with dusky face and dark blue-grey breast). In flight from below, note paler light grey-brown or pinkish-brown underbody contrasting slightly with dusky-grey mask and whitish underwing (in White-browed, noticeably darker red-brown underbody gives much stronger contrast with whitish underwing). **JUVENILES** of the two species appear very similar, both when perched and in flight; Masked best distinguished in close view by diagnostic dusky mask (echoing that of adult) standing out against browner and more boldly streaked rest of head and neck and paler breast (lacking in White-browed, on which black lores are darkest part of head

and contrast more strongly with paler greyish ear-coverts than on Masked). For distinctions from **Black-faced Artamus cinereus** and **Dusky A. cyanopterus Woodswallows**, see those accounts. Adult **Black-faced Cuckoo-shrike** *Coracina novaehollandiae* bears superficial resemblance to adult male Masked Woodswallow but is much larger, with stouter black bill; no white border to black mask; and very different behaviour, flight action and calls (see that account).

General behaviour, actions, calls and habitat preferences very similar or identical to White-browed Woodswallow (q.v.) with which often mixes, sometimes in large flocks, with tendency for Masked to be more common in W of range and White-browed more common in E; like White-browed, often first detected by calls as they soar overhead.

HABITAT Mainly inhabit dry open sclerophyll woodlands and forests (including mallee associations), usually dominated by eucalypts or acacias; and in grasslands; less often in chenopod shrublands and farmland. Mostly in arid and semi-arid zones, less often in sub-humid zone, and occasionally in temperate zone (Keast 1958; McEvey 1965; Ford 1974; Close & Jaensch 1984; Brandle 1998; Hall; Storr 7, 11, 19; Vic. Atlas; G.A. Carpenter; see below). In se. Aust., mainly at low altitudes, though once recorded from subalpine woodland at 1200 m asl (ACT Atlas).

Primarily found in **DRY, OPEN WOODLANDS OR FORESTS**, often low and with dense or sparse understorey of shrubs or grass ground-cover. Mainly in **EUCALYPT WOODLANDS**, often riparian associations along watercourses or round wetlands, dominated by Coolibah, River Red Gum or Black Box or combinations of these (Jones 1952; Badman 1979; Gibson & Cole 1988; Er & Tidemann 1996; Traill *et al.* 1996; Possingham & Possingham 1997); in **DRY OPEN EUCALYPT FORESTS**, especially box-ironbark forests, dominated by various eucalypts such as Grey Box, White Box, Mugga and Red Stringybark (Morris 1975; Gibson 1977; Traill *et al.* 1996; ACT Atlas; C.L. Tzaros); and often in **MALLEE ASSOCIATIONS**, with either grass or shrubby understorey (Jones 1952; McEvey & Middleton 1968; Cox 1973; Possingham & Possingham 1997; Eckert 1989; Vic. Atlas). Very occasionally recorded in tall open eucalypt forest dominated by Flooded Gums at edge of rainforest (Griffin 1995). Also often in **ACACIA WOODLANDS OR WOODLANDS**, such as Mulga or myall woodlands (Moriarty 1972; Ford 1974; Wyndham 1978; Close & Jaensch 1984; Hall), e.g. woodland of Western Myall, with some Mulga, Belah and Sugarwood *Myoporum platycarpum*, and ground-cover of chenopods (Brooker *et al.* 1979). Also inhabit **MIXED WOODLANDS**, e.g. of stringybark eucalypts and banksia (Possingham & Possingham 1997); and woodlands of Belah and cypress-pine *Callitris* or Belah and Leafless Cherry *Exocarpos aphyllus* (Jones 1952; Hobbs 1986). Also often recorded (including breeding) in **GRASSLANDS** (Congreve & Congreve 1985; Jones 1986; Dymond 1988; Hall), including treeless flats, plains or dunefields vegetated with clumps of spinifex *Triodia* (Pianka & Pianka 1970; Gibson & Cole 1988). Less often in **CHENOPOD OR OTHER LOW SHRUBLANDS**, e.g. shrubland dominated by Pearl Bluebush *Maireana sedifolia*, usually <1 m tall, with scattered acacia trees (McEvey & Middleton 1968; Pianka & Pianka 1970; Brooker *et al.* 1979; Johnstone *et al.* 1979), and shrubland of Tangled Lignum *Muehlenbeckia florulenta*, Old Man Saltbush *Atriplex nummularia* and Bignonia Emu-bush *Eremophila bignoniiflora* on dunes in dry arid-zone swamp (Larkins 1992). Also occasionally occur in **FARMLAND**, including pasture and croplands (Bravery 1970; Morris 1975; Gibson 1977; Roberts 1979; Traill *et al.* 1996; Vic. Atlas). Very occasionally recorded in **OTHER HABITATS**, including among mangroves (Butler 1970); clearings in tropical rainforest (Bravery 1970); and on islands, recorded among clumps of paperbarks bordering grassland (McGarvie &

Templeton 1974) and in African Boxthorn shrubs (Paton 1973). Occasionally in dense mallee and heath after fires (G.A. Carpenter). Also recorded nesting in vineyards (Chandler 1944).

DISTRIBUTION AND POPULATION Widespread in mainland Aust.; vagrants recorded Tas., Lord Howe and Norfolk Is and NZ.

Aust. Widespread on mainland, but apparently less so in coastal and near-coastal areas. **Qld** Generally absent from C. York Pen., S to c. 16°S, though vagrants recorded in e. Gulf of Carpentaria at Weipa, Surprise Ck and Kowanyama (Aust. Atlas 1, 2). Widespread in all areas S of 16°S, though more scattered and recorded only sporadically on and E of Great Divide, including Atherton Region (Wet Tropics) (Nielsen 1996; Aust. Atlas 1, 2; Storr 19). **NSW** Widespread inland of Great Divide; occur sporadically at scattered sites farther E, usually associated with eruptions from inland (Morris *et al.* 1981; Cooper & McAllan 1995; Chafer *et al.* 1999; Aust. Atlas 1, 2; NSW Bird Reps). **Vic.** Widespread N of Great Divide; more scattered and sporadic farther S, but still widespread (Vic. Atlas; Aust. Atlas 2). **Tas.** Vagrant, with most records on King I. On King I., several records at L. Martha Lavinia: two, 26 Nov. 1963; nine, 2–9 Feb. 1964 (though first date shown as Jan. in McGarvie [1965] and Tas. Bird Rep. 1); and unknown number (in mixed flock with White-browed Woodswallows) with at least six recorded breeding (see below), 17 or 18 Nov. 1972 till at least Mar. 1973 (McGarvie 1965; Green & McGarvie 1971; Good *et al.* 1973; Templeton & McGarvie 1973; McGarvie & Templeton 1974); also on King I., single, Egg Lagoon, 15 July 1970 (Good *et al.* 1973; Templeton & McGarvie 1973); and unknown number, early Apr. 1995 (Eades 1995). Elsewhere in Tas.: single, Scamander, Dec. 1977 (Cooper 1998); four, N of Gladstone, 23 Nov.–6 Dec. 1997 (Cooper 1998; Tas. Bird Rep. 26); at least three, C. Portland, 9 Jan. 1998 (Tas. Bird Reps 27, 28); and unknown number, Pipers R., 9–22 Jan. 2000 (Aust. Atlas 2). **SA** Widespread, though recorded sporadically at scattered sites in

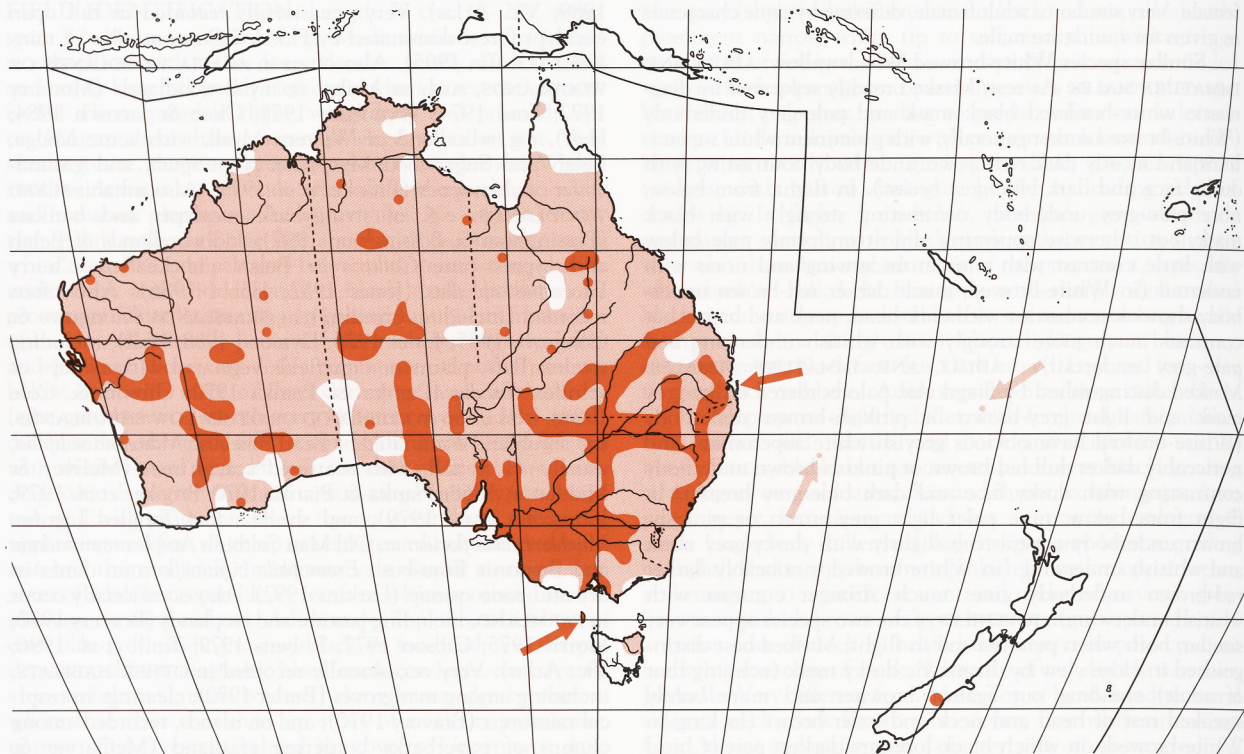
coastal and near-coastal areas, including vagrants on Kangaroo I., and occur sporadically in moister areas of Mt Lofty Ras and in SE (Mack 1970; Attiwill 1972; Cox 1973; Badman 1979; Close & Jaensch 1984; Stove 1994; Baxter & Berris 1995; Aust. Atlas 1, 2; G.A. Carpenter). **WA** Widespread in most regions (Johnstone *et al.* 1979; Storr 1981; Start & Fuller 1983; Serventy & Whittell; Storr 11, 16, 21, 22, 26, 27; Aust. Atlas 1, 2) but rarely or sporadically recorded at only scattered sites in some areas, such as s. coast, including extreme SW, and N through coastal areas from Swan Coastal Plain, W of Darling Scarp, N to Hamelin, and also in n. Kimberley Div., where occur at some places only during influxes (Ford 1954; Sedgwick 1962; Serventy 1973; Johnstone *et al.* 1977; Johnstone & Smith 1981; Daw 1983; Saunders & Ingram 1995; Rose 1996; Johnstone *et al.* 2000; Storr 11, 21, 28, 35; Aust. Atlas 1, 2). **NT** Widespread S of 14°S; only sporadic records at scattered sites in n. Top End, including Arnhem Land (Storr 7; Aust. Atlas 1, 2; H.A.F. Thompson & D.K. Goodfellow); and recorded on Sir Edward Pellew Grp (Schodde 1976), but not on Groote Eylandt or Tiwi Is (Noske & Brennan 2002; Aust. Atlas 1, 2).

NZ Vagrant. Two, Naseby Forest, Otago, SI, Jan. 1972–4 Aug. 1973 (Darby 1972; Child 1974, 1975).

Lord Howe I. Vagrant, with six groups of records (McAllan *et al.* 2004). Single, Aug. 1957 (McKean & Hindwood 1965); unknown number, Feb. 1967; three, 24 Dec. 1968; two, Jan. 1971, which had apparently been present for c. 3 years (i.e. since 1968 record); two, 10 Dec. 1994; two, 1 Mar. 1995; two, 8 Sept. 2000 (McAllan *et al.* 2004; NSW Bird Reps 1994, 1995).

Norfolk I. Not recorded before 1996, but recorded regularly in small numbers since: two, 8 July 1996 (Anon. 1996; Moore 1999); six, 17–20 July 1996 (Anon. 1996; Moore 1999); four, 31 May 1997 (Anon. 1997); up to five, early Aug. 1997 (Anon. 1997); between three and 12, 15–21 Feb. 1998 (Lester 1998); between seven and c. 15, 4 Mar. to 26 May 1998 (Anon. 1998a); c. 12, 21 Aug. 1999 (Anon. 1999).

Breeding Very occasionally recorded breeding N of 20°S,



e.g. in Top End, NT, on Bullita Stn, at site near Elliott and in n. Tanami Desert (Gibson 1986; Aust. Atlas 1; NRS); farther S, scattered throughout much of range, though most records in Murray–Darling Basin and in Goldfields Region of WA (Aust. Atlas 1, 2; NRS). Single record on King I., Tas., 1972–73 (Good *et al.* 1973; McGarvie & Templeton 1974; Tas. Bird Rep. 2). Once recorded in NZ, round Naseby Forest, Otago, SI, when two chicks reared, 1972–73 (Child 1974).

Populations RECORDED DENSITIES: 0.005–0.049 birds/ha, near L. Disappointment, WA (Davies *et al.* 1988).

Anomalies Influxes probably influenced by conditions in inland Aust. (e.g. Cooper 1938; Badman 1989; Storr 7; NSW Bird Reps) and often coincide with irruptions of White-browed Woodswallows (e.g. NSW Bird Reps 1982, 1984; Vic. Bird Rep. 1982; also see White-browed account), but an irruption of latter species does not invariably indicate presence of Masked, e.g. a few Masked recorded in e. NSW in 1991 (NSW Bird Rep. 1991) during major influx of White-browed Woodswallows (Wood 1994). Influxes and other anomalous occurrences since 1970 include: **1970** Said to be common round Darwin (Crawford 1972), coinciding with influx into Lower North and Murray–Mallee regions of SA (SA Bird Rep. 1970–71). **1972** Breeding records on King I., Tas., and in NZ (see above) coincided with large numbers recorded in se. Qld (Dawson & Perkins 1973; Roberts 1979), and small influxes round Sydney (NSW Bird Rep. 1972), n. Vic. (Roberts 1975), Swan Coastal Plain and elsewhere in South-West Div. of WA (Serventy 1973; Serventy & Whittell; Storr 28, 35), and in Top End (H.A.F. Thompson & D.K. Goodfellow). **1973** Influx recorded in Mid-eastern Interior Region and Eucla Div. of WA (Brooker *et al.* 1979; Johnstone *et al.* 1979; Storr 22, 27). **1980–81** Small influx recorded in Swan Coastal Plain, sw. WA (Storr 28). **1982** Record of vagrants at Paluma, ne. Qld, in June–July (Griffin 1995) preceded influx into coastal and near-coastal NSW, Oct.–Nov. (Wood & Simcock 1993; NSW Bird Rep. 1982) and large number of records in s. Vic., Sept.–Dec. (Vic. Bird Rep. 1982) and in South-West Div., Eucla Div. (including record of several thousand at Esperance) and Mid-eastern Interior Region of WA, extending NW to Wittenoom (Daw 1983; Howard 1986; Storr 22, 27, 35; WA Bird Rep. 1982). **1984–85** Major influx into Lower Western Region of NSW (NSW Bird Rep. 1984) coincided with influx in s. Mt Lofty Ras and Adelaide Plain in SA (as well as records on Fleurieu and Eyre Pens) (Paton *et al.* 1994; Stove 1994; Ashton 1996; Cox 2001) and Eucla Div., s. WA (Dymond 1988; Storr 27), and several records in Top End (Fisher & Fisher 1985; H.A.F. Thompson & D.K. Goodfellow). **1990** Influx recorded in n. and central Wheatbelt of s. WA (Saunders & Ingram 1995). **1994** Many coastal and near-coastal records in NSW, from Casino S to Pambula, including first record in Eurobodalla Shire and first records in Hunter Valley since 1968 (Morris 1975; Eades 1994; Ley 1995; Whiter 1995; Egan *et al.* 1997; Chafer *et al.* 1999; NSW Bird Rep. 1994); also recorded in large numbers on Darling Downs in se. Qld, and in s. Vic. (Eades 1994; Dedman 1995) and se. SA (Possingham & Possingham 1997), coinciding with records of vagrants on Kangaroo I., SA (Baxter & Berris 1995) and Lord Howe I. (see above). Other, more localized influxes or congregations sometimes associated with hatching of locusts or grasshoppers (e.g. Barnard 1905; White 1918; McGilp 1935; Lord 1939, 1956; Storr 27; NSW Bird Rep. 1999).

THREATS AND HUMAN INTERACTIONS Sometimes welcomed as a destroyer of insect pests in farmland (Austin 1907).

MOVEMENTS Migratory, with dispersive elements. Movements complicated and irregular, but most obvious trend is s. movement to breeding range in spring and n. movements

in autumn (Keast 1958; Storr 19; Aust. Atlas 1, 2). Broad-scale analysis of bird atlas and count data from e. Aust. found strong evidence for slope-line pattern of movement, with nw. movement to non-breeding areas, and se. return movement to breeding areas in se. Aust. (Griffioen & Clarke 2002). Reporting rates S of 26°S higher in summer (2.9%) than in winter (1.4%) (Aust. Atlas 1) with widespread but scattered records in s. Aust. in winter (see Non-breeding below). Sometimes regarded as dispersive, erratic or nomadic in n. Aust. (see Non-breeding below). Timing and extent of some movements influenced by rainfall (e.g. Badman 1989) with penetration to n. Aust. or coasts, and irruptions into Tas. more likely during droughts (Chisholm 1909a; Storr 7, 19; NSW Bird Rep. 1994), and availability of food, such as nectar (Sedgwick 1947; Ryan 1953; Boekel 1980; Storr 7, 19) or grasshoppers (Lord 1939, 1956; Storr 27; G.A. Carpenter). Appearance at Wooroloo, near Perth, in 1949 attributed to low-pressure gradient caused by a cyclone (Robinson 1949). Typically arrive suddenly and in large numbers, often in mixed flocks with White-browed Woodswallows, but may also occur in small or large single-species flocks. Often, large flocks arrive in an area and begin breeding immediately (Carnaby 1933; Gilbert 1935; see below, and Social Organization). In s. Aust., first returns in spring often coincide with first hot days with northerly winds (Wheeler 1947; Boehm 1957; Daw 1983; Pescott 1996; see below). **NATURE OF PASSAGE:** Migrate, and undertake other movements, in flocks (Gilbert 1935; see Social Organization). Such movements sometimes involve thousands of birds, e.g. passage of c. 10,000 birds seen during one day at Eyre Bird Observatory, 7 Oct. 1984 (Dymond 1988) and of thousands at Esperance, 23 Oct. 1982 (Daw 1983). Said to move by day. Flocks fly in close formation, arriving at destination in compact flocks during day (Gilbert 1934, 1935). Suggested that sometimes small groups leave larger flock and settle as they pass suitable breeding habitat (Gilbert 1935). In s. Aust., arrival often coincides with strong n. winds (see below), but flocks occasionally seen flying into such winds (Ford 1908; Wheeler 1947; Austin 1972; Dedman 1995); and in one season at Melbourne, Vic., said to leave with first s. winds at time of departure (Wheeler 1947). Often fly at high altitudes (Austin 1972; Serventy 1973). Capable of travelling large distances over sea, as evidenced by vagrancy in NZ and on Lord Howe and Norfolk Is (see Distribution).

Departure Poorly known, possibly because migrate at high altitude (Austin 1972; Serventy 1973). In general, leave s. Aust. in autumn, though some leave earlier, in late summer, while others present throughout year (see Non-breeding). However, timing of departure varies much from year to year (see below). Birds from se. Aust. probably move NW (Griffioen & Clarke 2002). **QLD:** At Murphys Ck, occur erratically, and often not at all; sometimes leave within days or weeks of first arrival in spring; in one year, left Jan. (Lord 1939, 1943, 1956). Present at Mt Isa till Apr. (Horton 1975). **NSW:** Widespread till Apr., though recorded throughout year in some regions and some years (Morris *et al.* 1981); generally scarce round Mungindi after Jan. (Costello 1981); recorded leaving Sydney Region, 21 Jan. (Gilbert 1935); and usually leave Hunter Region by Feb. (Morris 1975). Departure from SW may be as early as Oct. if not breeding (Sullivan 1911), or as late as Apr. if breeding occurs (Chisholm 1938; Hobbs 1961; Schmidt 1978); in 1998, left Roto, 10 Apr. (NSW Bird Rep. 1998). **VIC.:** Seldom recorded after Apr. (Vic. Atlas). Left Maryborough area suddenly, 16 Jan. 1909 (Chisholm 1909a); in one year, left mallee in two groups, in early Mar. and 18 Apr. (Anon. 1907). At Cobden, over 3 years, mean date of departure 7 Apr. (median 8 Apr.), ranging from 13 Mar. to 30 Apr. (Graham 1903). **SA:** Leave Port Wakefield area in Jan.–Feb. (Taylor 1987), and L. Frome area in Feb.–Mar. (McGilp 1923). At Sandy Ck CP, near Lyndoch, most left by

late Nov. 1963, after breeding (Rix 1976). WA: Leave sites in S in Jan., after breeding (Carter 1924; Ford & Stone 1957). However, become scarce or absent from SE Interior Div. after breeding Sept.–Nov. (Storr 26); and a large flock left Leonora in late Oct. after 2-month stay, though without evidence of breeding (Sedgwick 1952). Group of c. 20 birds left Wittenoom by mid-Jan. after breeding (Howard 1986).

Non-breeding Non-breeding range generally considered to be N of 20°S (though breeding occasionally recorded N of 20°S; see Distribution, Breeding [Season]). Within n.-Aust. range, often described as dispersive, erratic or nomadic (e.g. Storr 1981; Johnstone 1983; Nielsen 1996; Wieneke 2000; Goodfellow 2001; Storr 7). Some may stay in s. Aust. throughout year, depending on conditions. N. AUST.: WA: Dry-season visitor to, or passage migrant through, Kimberley Div., with most records Apr.–Oct. (Collins 1995; Storr 11; see Breeding below), e.g. while usually seen in Broome in small numbers, thousands passing over W to E June–July 1994 (Collins 1995) and May 1998 (Anon. 1998b), and hundreds moving S to N in May 2000 (Anon. 2000). Recorded in Great Sandy Desert, Mar.–Aug. (Start & Fuller 1983); and in Barlee Ra. in winter (Robinson 1933). NT: Mainly winter (dry season) visitor to Top End, with most records Apr.–Aug. (H.A.F. Thompson & D.K. Goodfellow), e.g. recorded Darwin 23 May–20 June 1970 (Crawford 1972), Larrimah, 24 July to late Aug. 1944 (Sedgwick 1947) and Victoria River Downs Stn, May–July (Boekel 1980). Seen flying N in Simpson Desert in late Apr. (Wilson 1974). QLD: Little published information, possibly reflecting irregular occurrence. Most widespread N of 20°S in winter and spring (Aust. Atlas 2); recorded round Innisfail (17°32'S) in May, June and Oct. (Gill 1970); at Richmond (20°44'S), usually occur Mar.–Sept. but, rarely, stay and breed through summer (Berney 1905); and at Mt Isa (20°44'S), where breeding also recorded in wet season, occur July–Apr. (Horton 1975). Rare visitor in small flocks to Atherton Shire, Sept.–Oct. (Bravery 1970). s. AUST.: Scattered records of wintering across s. Aust. (Aust. Atlas 1, 2; as follows). SE. QLD: Described as local on Peel I., near Brisbane, congregating in Mar. and in small companies in winter (Agnew 1921). NSW: Recorded throughout year in some regions and some years (Morris *et al.* 1981), e.g. present till winter at Armidale, 1920 (Norton 1922). VIC.: Wintered round Bendigo in 1952, leaving in Sept. (Ryan 1953). s. WA: Occasionally seen all year on nw. Nullarbor Plain (Brooker *et al.* 1979; Storr 27).

Return In e. Aust., move generally SE in spring (Griffioen & Clarke 2002). Timing and destination possibly determined by conditions inland. Often return to s. areas with first hot spring day with northerly winds (e.g. Belcher 1914; Wheeler 1947; Boehm 1957; Cox 1973; Daw 1983; Pescott 1996; SA Bird Rep. 1965), and often with White-browed Woodswallows (see above, Social Organization). QLD: Present Mt Isa from July (Horton 1975). Return to S in Sept.–Oct. (e.g. Barnard 1925; Lord 1939, 1943, 1956); at Windorah, in SW, earliest records Oct. (Wyndham 1978). NSW: Mainly spring–summer visitor (Heron 1973; Leishman 1994). Arrive, or recorded, at sites E of Great Divide in Oct.–Nov., though only sporadically in SE (D'Ombra 1934; Gilbert 1935; Morris 1975; Jordan 1987, 1988; Chafer *et al.* 1999; NSW Bird Rep. 1972). Arrive Northern Tablelands in Oct. (Norton 1922; Elliott 1938; NSW Bird Rep. 1985). Observed on s. passage at Kinchega NP, in central W, in Sept. (Henle 1989). In SW, mostly arrive Sept. (Chenery & Morgan 1920; Chisholm 1938; Hobbs 1961; NSW Bird Reps 1987, 1998) but occasionally in Aug. (NSW Bird Rep. 1984) or as late as Nov. (Sullivan 1911; NSW Bird Rep. 1987). 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. VIC.: Mainly spring–summer visitor

(e.g. Bedggood 1972; Dedman 1995; Vic. Atlas), usually arriving Sept.–Oct., but as early as Aug. and as late as Dec.: usually arrive Sept.–Oct. in NW (Sullivan 1911; Chandler 1913) and in central Vic. (Ford 1908); at Mystic Park, mid-Murray Valley, usually arrived 5–11 Sept., though did not appear till Oct. one year (Lowe & Lowe 1972); at Castlemaine, usually arrived Nov., but arrival ranged from Sept. to late Dec. (Leach 1928); and at L. Cooper, near Rochester, arrival late Aug. (Bright & Taysom 1932). In NE, arrived Wangaratta in Nov. (Cheney 1915). Usually arrive Oct. in S: round Geelong, over 5 years, 1994–2001, first records 7–24 Oct. (Dedman 1995; Hewish 1996, 1998, 2000, 2002); and at Cobden, over six years, 1896–1901, mean date of arrival 13 Nov. (median 10 Nov.), ranging from 9 Oct. to 20 Dec. (Graham 1903). TAS.: Occasional summer visitor (see Distribution); three records of arrival in Nov., earliest on 17–18 Nov. (McGarvie 1965; Templeton & McGarvie 1973; McGarvie & Templeton 1974; Cooper 1998). SA: Irregular spring–summer visitor (Terrill & Rix 1950; Boehm 1957; Clarke 1967; Badman 1989), usually arriving Sept.–Oct., sometimes Nov.: in NE (e.g. McGilp 1923; Badman 1989); in Murray–Mallee (Boehm 1957; Cox 1973; SA Bird Rep. 1965; H.J. Eckert); in SE (Harvey 1931, 1933; Attiwill 1972; H.J. Eckert); and in Mt Lofty Ras (Rix 1976). Elsewhere, arrived Port Wakefield in Oct. (Taylor 1987); and at Ceduna, in SW, in mid-Sept. (Sullivan 1928). Vagrant records from Kangaroo I. in Sept.–Oct. (Baxter 1989). WA: Generally spring–summer visitor to S, with arrivals, or passage, in Oct.–Nov. (e.g. Carter 1924; Carnaby 1933; Ford & Stone 1957; Serventy 1973; Daw 1983; Rose 1996). However, in Eucla and South-eastern Interior Regions, recorded in most months but with general increase in numbers in Sept. to Nov. or early Dec. (Storr 26, 27), and considered irregular spring–summer visitor to Eyre Bird Observatory (Congreve & Congreve 1985; Dymond 1988); and on nw. Nullarbor Plain, said to occur mostly July–Nov., though occasionally seen throughout year (Brooker *et al.* 1979). NT: No published information.

Breeding Usually breed spring–summer, S of c. 20°S and mainly S of 30°S (see Distribution, Breeding). s. AUST.: Largely present in se. Aust. from Sept.–Oct. to Mar.–Apr., though with much annual variation (see Departure, Arrival above). Patterns of movements at this time depend on whether birds nest or not. In any area may breed in some years, but return and not breed in others (e.g. Sedgwick 1952; Learmonth 1953; Keast 1958), or flocks may move through without stopping (e.g. Ford & Stone 1957; Heron 1973), or a few birds may stop to breed while most of flock continues moving (e.g. Whitlock 1910). On arrival, will often begin breeding immediately (Carnaby 1933; Gilbert 1935), and movements probably largely local (e.g. Gilbert 1935) till departure. Often leave soon after breeding finished (e.g. Carter 1924; Rix 1976; Howard 1986). MID-WA: In Gascoyne Region, common in wet years, breeding July–Sept. (Storr 21); and in Barlee Ra., occasionally breed in large numbers, though rarely seen Nov.–Jan. (Robinson 1933), though bred at Wittenoom Dec. 1982 (Howard 1986). N. AUST.: Only occasionally recorded in n. Aust. during s. spring–summer (i.e. in wet season), mainly non-breeding records, e.g. Atherton, ne. Qld (Bravery 1970), Keep R. NP, NT (McKean 1985), and, once, at Broome, WA, in Jan. (Collins 1995). However, occasionally recorded breeding in N in wet season, e.g. at Mt Isa (Horton 1975) and Richmond district (Berney 1905) (both at 20°44'S).

No clear pattern to vagrant occurrence in Tas., NZ and Lord Howe and Norfolk Is. Described as uncommon migrant across Bass Str. (Green 1977), but such movements rare and highly irregular, with most records Nov.–Apr. and single record in July (see Distribution). Records Lord Howe I. mainly Aug.–Mar., though two birds apparently resident for 3 years;

records on Norfolk I. more widely spread, mid-Feb. to May, July and Aug.; two vagrants to NZ first recorded Jan., and remained till Aug. of following year (see Distribution).

Banding Of 201 banded in Aust., 1953 to June 2003, two recoveries (1.0%) of two birds, both <10 km from banding site (ABBBS). **LONGEVITY:** Adult banded at Newcastle, NSW, 17 Dec. 1988, recaptured at banding place 2 years after banding (ABBBS).

FOOD Invertebrates, mainly insects, and nectar, occasionally fruit; observation of taking sap (see below). **Behaviour** Poorly known. Mostly forage in air, above or between vegetation, but also often forage for nectar in flowering trees and shrubs and occasionally on ground or among foliage (Barrett 1920; MacGillivray 1929; Rix 1943, 1976; Frith 1969; Lowe & Lowe 1972; Sharland 1972; Parker 1977; Hobbs 1986; Eckert 1989; Larkins 1992; Baxter & Paton 1998; Hall; Aust. Atlas 1; Vic. Atlas; D.I. Rogers). **FORAGING ASSOCIATIONS:** Usually forage in flocks, of varying sizes: from small flocks of 10–50 birds (Rix 1976; Baxter & Paton 1998) to much larger flocks of hundreds (Cleland 1919; Gilbert 1935; Elliott 1938; Hobbs 1986); also recorded in flocks of thousands, and occasionally singly or in twos (see Social Organization), though these not specifically noted as foraging. Sometimes congregate at source of abundant food, such as flowering trees or swarms of insects (Whitlock 1910; Barnard 1914; White 1918; Barrett 1920; Elliott 1938; Sedgwick 1947; Rix 1970; Hobbs 1986; Larkins 1992; Storr 16; Aust. Atlas 1; Vic. Bird Rep. 1984; H.J. Eckert). Often forage in mixed-species flocks with White-browed Woodswallows (Hall 1902; Berney 1903a, 1905; Austin 1907; Hall & Rogers 1908; Chisholm 1909b; Chandler 1913; Barnard 1914; White 1918; Cleland 1919; Barrett 1920; MacGillivray 1929; Elliott 1938; Rix 1976; Schrader 1981; Hobbs 1986; Eckert 1989; Larkins 1992). Occasionally forage with other species: once with Yellow-throated Miner *Manorina flavigula* (Hall 1902); and seen foraging with White-browed Woodswallows and Pied *Certhionyx variegatus* and Black *C. niger* Honeyeaters (Schrader 1981). **FORAGING METHODS:** Usually forage in air, mainly by screening or sallying. Most reports describe method of foraging as hawking in air, which could refer to either screening or sally-striking prey in air or both (Rix 1943, 1976; Hobbs 1986; Baxter & Paton 1998; Aust. Atlas 1; Vic. Atlas); relative importance of these two methods not known, and study needed. Also often forage for nectar in flowering trees or understorey shrubs, including eucalypts, *Eremophila*, *Grevillea* and *Hakea* (Lowe & Lowe 1972; Sharland 1972; Boekel 1980; Start & Fuller 1983; Eckert 1989; Larkins 1992; Aust. Atlas 1; Vic. Atlas; see records of food below); seen to probe flowers of grevilleas for nectar, hanging head-down from thin branches (Chisholm 1909b); and birds in flock seen inserting bills deep into flowers of Bignonia Emu-bush *Eremophila bignoniiflora*, flock advancing by repeatedly settling on plants then flying on (Larkins 1992). Sometimes also forage on ground (Hall; Vic. Atlas; D.I. Rogers; H.J. Eckert); and seen foraging in stubble (D.I. Rogers). Sometimes sally-pounce onto ground to catch prey, usually without landing (Barrett 1920). Noted that birds foraged high over trees on calm days, but on windy day fed on fruits in native Leafless Cherry *Exocarpos aphyllus* (Hobbs 1986). **ADAPTATIONS:** Have brush-like tongues for feeding on nectar (Hall 1902; Berney 1905; Chisholm 1909b).

No detailed studies. **Plants** (Following nectar [including feeding at flowers] unless stated.) Nectar^{1,4,7,33,34}, fruit⁴⁵, pollen⁵¹. **GYMNOSPERMS:** Cupressaceae: *Callitris* sap¹⁹. **DICOTYLEDONS:** Caesalpiniaceae: *Bauhinia*^{2,44}; Chenopodiaceae: *Enchylaena tomentosa* fru.⁴¹; *Rhagodia candolleana* fru.⁴¹; Fabaceae: *Brachysema*³⁶; *Erythrina*³⁰; *Leptosema daviesio-ides*^{10,20}; Loranthaceae: *Amyema miquelii*³⁷; Myoporaceae: *Eremophila bignoniiflora*⁴²; *E. duttonii*⁴²; *E. maculata*²¹; *E. mitchelli*⁴⁵;

Myrtaceae: *Eucalyptus*^{11,15,21,28,30,32,38}, pollen³⁹; *E. grandis*⁴³; *E. miniata*³²; *E. ochrophloia*²¹; *E. terminalis*³⁹; Proteaceae: *Grevillea*^{12,44}; *G. robusta*^{8,9}; Rutaceae: *Citrus*³³; Santalaceae: *Exocarpos aphyllus* fru.⁴⁰; *Santalum* fru.⁴⁵; Solanaceae: *Lycium* fru.⁴⁵. **Animals** **INSECTS**^{31,34,39,49}: Cole-optera^{3,17,47,48,49,51}; Carabidae⁵¹: *Stenolophus*⁴⁸; Curculionidae^{48,51}; Diptera: larv.⁴⁸; Hemiptera^{39,51}: Cicadidae⁵¹; Pentatomidae^{48,51}; Psyllidae¹⁴; Scutelleridae⁴⁸; Hymenoptera: wasp⁴⁸; Apidae¹³; Formicidae^{18,48}; *Camponotus*⁴⁸; *Iridomyrmex detectus*^{18,48}; *Pheidole*^{14,46,48,51}; *Rhytidoponera metallica*^{14,48}; Ichneumonidae⁴⁹; Isoptera¹⁴; Lepidoptera: larv.^{6,14,48}, ads⁴⁸; Orthoptera: grasshoppers^{5,6,16,22,23,25,26}, 29,49; Acrididae⁵¹: *Chortoicetes terminifera*^{27,52}. **Other matter** Bread^{24,35}.

REFERENCES: ¹ Hall 1902; Berney ² 1903a, ³ 1903b, ⁴ 1905; ⁵ Barnard 1905; ⁶ Austin 1907; ⁷ Hall & Rogers 1908; Chisholm ⁸ 1909b, ⁹ 1971; ¹⁰ Whitlock 1910; ¹¹ Chandler 1913; ¹² Barnard 1914; ¹³ Beuhne 1914; ¹⁴ Lea 1917; ¹⁵ Mathews 1918; ¹⁶ White 1918; ¹⁷ Morgan 1919; ¹⁸ Barrett 1920; ¹⁹ Cleland 1919; ²⁰ Sargant 1928; ²¹ MacGillivray 1929; ²² McGilp 1935; ²³ Elliott 1938; Lord ²⁴ 1939; ²⁵ 1956; ²⁶ Basse 1948; ²⁷ Sedgwick 1947; ²⁸ Boehm 1957; ²⁹ Liddy 1962; ³⁰ Tarr 1964; ³¹ Rix 1970; ³² Lowe & Lowe 1972; ³³ Sharland 1972; ³⁴ Parker 1977; ³⁵ Paton & Ford 1977; ³⁶ Schrader 1981; ³⁷ Start & Fuller 1983; ³⁸ Hobbs 1986; ³⁹ Eckert 1989; ⁴⁰ Larkins 1992; ⁴¹ Griffin 1995; ⁴² Brown *et al.* 1997; ⁴³ Baxter & Paton 1998; ⁴⁴ Rose 1999; ⁴⁵ Gould; ⁴⁶ Lea & Gray; ⁴⁷ Hall; ⁴⁸ Aust. Atlas 1; ⁴⁹ FAB; ⁵⁰ H.J. Eckert.

Young Both parents feed nestlings and fledgelings, though contribution of sexes may vary (see Social Behaviour, Breeding). In NZ, one brood of fledgelings appeared to be fed blowflies (Child 1974).

SOCIAL ORGANIZATION Not well known, and no studies. Highly gregarious; usually in flocks of up to 100 birds throughout year (Johnstone 1983; Start & Fuller 1983; Baxter & Paton 1998; Hall; Storr 11, 21, 22, 35) and sometimes in larger flocks of up to 500 (Johnstone *et al.* 1981; Storr 11, 28, 35) or 2000 birds (Storr 1981; Storr 16, 21, 22, 26, 35); on migration or other movements, occur in very large flocks, of up to 5000 (e.g. MacGillivray 1914; Gilbert 1934; Ford & Stone 1957; Johnstone *et al.* 1977; Daw 1983; Dymond 1988; North; Mathews; Storr 27; NSW Bird Rep. 1987). Sometimes congregate at sources of food, such as flowering trees or swarms of insects (Whitlock 1910; Barnard 1914; White 1918; Barrett 1920; Sedgwick 1947; Rix 1970; Hobbs 1986; Storr 16; Vic. Bird Rep. 1984). Sometimes occur singly or in twos (Hall; Storr 21, 22, 26, 27) or small flocks of up to ten (Bravery 1970; Storr 1981; Templeton 1992; Storr 11, 21, 22, 27). Often occur in mixed flocks with White-browed Woodswallows, including when on migration (e.g. Austin 1907; Chenery & Morgan 1920; MacGillivray 1924; Gilbert 1935; Chisholm 1938; Mack 1970; Morris 1975; Hobbs 1986; Hoskin 1991; Leishman 1994; Britton & Britton 2000; Cox 2001; Campbell; North). In e. Aust., White-browed Woodswallows usually predominate in mixed-species flocks, in proportions varying from 2:1 to 10:1 (e.g. Gilbert 1935; Elliott 1938; Wheeler 1947; Watson 1955; Officer 1958; Tarr 1964; Carpenter & Matthew 1986; Jones 1986; Eckert 1997; Britton & Britton 2000; Chapman 2000; Storr 19), but in arid and inland areas and in parts of WA, including Kimberley Div., mixed flocks occasionally dominated by Masked Woodswallows, in a ratio of c. 10:1 (e.g. Tarr 1964; Bonnin 1965; Brooker *et al.* 1979; Ford 1987; Larkins 1992; Baxter & Paton 1998; Coate *et al.* 1998, 2001; Serventy & Whittell; Storr 7, 11, 26). Sometimes also associate with Fork-tailed Swifts *Apus pacificus* (Sedgwick 1948), Pied Honeyeaters (Whitlock 1910; Schrader 1981), Crimson Chats *Epthianura tricolor* (Whitlock 1910, 1924) and Black-faced (Campbell;

Hall) and Dusky Woodswallows (Gannon 1953; Officer 1958; Tarr 1964; Hall; NSW Bird Rep. 1991; SA Bird Rep. 1970–71). Once, a small group seen to leave large migrating flock and settle; while suggested they had seen a suitable breeding area (Gilbert 1935), no evidence for such.

Bonds Nest in simple pairs and appear to be monogamous (D'Ombra 1934; NRS). May be paired in migratory flocks before reaching breeding grounds (see Social Behaviour). **Parental care** Both parents brood and feed nestlings and feed fledgelings, though contribution of sexes may vary (see Social Behaviour, Breeding). Period of dependence not known; fledgelings observed with adults for at least 12 days (NRS). One banded young seen in flock c. 2 km from natal site at least 23 days after fledging (NRS). Local populations may leave breeding areas as soon as fledgelings can fly strongly (Mathews; also see Success).

Breeding dispersion Often nest in colonies (Terrill & Rix 1950; North; Aust. Atlas 1; Vic. Atlas; NRS), and often in colonies with White-browed Woodswallows (Carnaby 1965; Austin 1972; North; Aust. Atlas 1; Vic. Atlas; NRS), though in mixed colony at Carrierloo Stn, near Port Augusta, SA, each nested in discrete clusters (Brandon 1951). Colonies consist of up to 16 nests, sometimes more, often with several nests in one tree (Austin 1972; NRS); in one colony on Yorke Pen., SA, eight nests within diameter of c. 45 m (Souter 1942). Also sometimes nest solitarily (NRS), though frequency of solitary versus colonial nesting not known. **Territories** Considered territorial and adults once defended territory round nest for up to 12 days after young fledged (NRS). No other information.

Roosting Said to cluster at night (Frith 1969), though few records of nocturnal roosting. Occasionally cluster during day, usually during windy and inclement weather, sheltering in lee of tree-trunk or branch, with groups of other species of woodswallows, especially White-browed and occasionally Black-faced; sites used for clustering sometimes also used as nocturnal roosts (Bourke 1972; Hobbs 1972). Groups of clustering woodswallows sometimes as small as four birds (including two Masked) and sometimes >100 birds (with unknown proportion of Masked) (Bourke 1972; Hobbs 1972). In Otago, NZ, roosting family group huddled very tightly together on wires or branches, especially on cool days; also said to roost high in Ponderosa Pine *Pinus ponderosa* during day (Child 1974).

SOCIAL BEHAVIOUR Not well known, and no studies. Often easily observed when perched atop trees and shrubs (Hall), but sensitive to close approach by observer when roosting, often dispersing before observations can be made (Chapman 2000). **Flock behaviour** Noisy, with flocks (including mixed flocks) often heard calling, especially in flight (e.g. Mathews 1918; Elliott 1938; Watson 1955; Lindgren 1961; Tarr 1964; Austin 1972; Serventy 1973; Child 1974; Johnstone *et al.* 1981; Daw 1983; Dawson *et al.* 1991; Larkins 1992; Mathews). In Central Otago, NZ, on arrival with White-browed Woodswallows in non-breeding season, for c. 1 h there was much calling, chattering and general excitement between the two species (Child 1974). While claimed that form flocks with White-browed Woodswallows on approach of storms (Chisholm 1910; Boehm 1957), general observations of flocks (see Social Organization) indicate that the two species can form flocks at any time. **Maintenance behaviour** Nestlings pant when hot (NRS). In cold or windy conditions, sometimes cluster or huddle together, often in sheltered position (Bourke 1972; Hobbs 1972; Child 1974; see Roosting).

Agonistic behaviour No information on intraspecific aggression. **Interactions with other species** In Central Otago, adults feeding on bread at feeding table were aggressive towards House Sparrows *Passer domesticus*, Common Black-

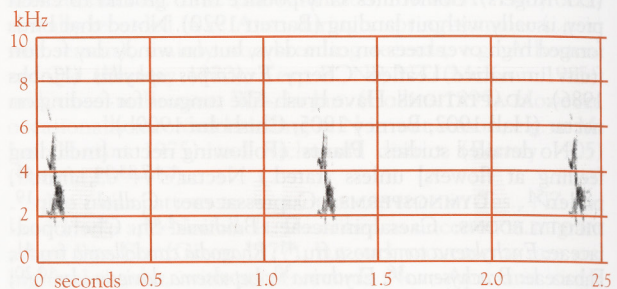
birds *Turdus merula* and Song Thrushes *T. philomelos* that were also attracted to the bread; tolerated Sparrows after a few weeks (Child 1974). When nesting, aggressive to other species that approach nest (see Relations within family group).

Sexual behaviour **Courtship** **COURTSHIP OR PRE-COPULATION DISPLAY:** Once, when migratory flock stopped to rest, a perched female exaggeratedly moved tail from side to side in an arc of >180° and, after 2–3 min, also began to flick wings rapidly, three to five flicks at a time, interspersed with quiet periods. After several bouts of wing-flicking, a male alighted gently on her back and copulated briefly. During copulation, another Woodswallow dived at male, who was dislodged or flew off; the female also then flew, and both were lost from sight (Eckert 1997). In a similar display, male once seen extending wings and fanning tail from side to side when near female (Howard 1986). **Courtship feeding** Once, in large migratory flock in late Oct., a male seen to feed an insect to a female by flying above her, then twisting down towards her (Tarr 1964). **Pair-bond maintenance** Members of pair sit close beside one another, calling quietly and preening each other's necks (D'Ombra 1934).

Relations within family group Though both parents brood and feed nestlings, contributions may differ; both feed fledgelings (see Breeding). In nw. Vic., birds seen to abandon active nests when local breeding flock suddenly left (NRS). **Anti-predator response of young** Nestlings may leave nest when closely approached by observer, even when barely able to fly (NRS). **Parental anti-predator strategies** Incubating adult usually flies from nest when observer approaches, returning as soon as observer moves away; may perch near nest, fanning tail and flicking wings (NRS). Parents aggressive towards observers and other birds, such as Australian Magpie *Gymnorhina tibicen*, near nest or fledgelings, swooping at, and once striking, observer (Hopkins 1948; Mathews; NRS).

VOICE Poorly known. Calls described as chirrups, chattering and chittering (Child 1974; see below). Voice very similar to that of White-browed Woodswallow (q.v.), though Alarm Call of Masked said to be coarser and deeper (Campbell). Flocks comprising the two species call constantly, especially in flight, and also when alighting or feeding on nectar, with calls variously described as chirping, cheeping, chattering and twittering (Berney 1903a; Elliott 1938; Tarr 1964; Austin 1972; Serventy 1973; Johnstone *et al.* 1981; Dawson *et al.* 1991; Larkins 1992; Campbell; Mathews); and calls of high-flying flocks may draw attention (Lindgren 1961). **MIMICRY:** Said to mimic but no details (Aust. RD). **NON-VOCAL SOUNDS:** Snap bill when swooping at observer near nest (Mathews).

Adult CONTACT CALLS: Said to be high, descending chirrup in contact (Aust. RD); three such calls probably shown in sonagram A. In addition, a loud, penetrating *chyet*, often in flight (Slater 1974), a chirp resembling that of House Sparrow (Gould), and a single note uttered in flight (Mathews 1918), all possibly describe contact calls. **SONG:** Said to be soft



A R. Buckingham; Alice Springs, NT, July 1988; P94

twittering, with mimicry (Aust. RD). **ALARM CALLS:** Whamp note in alarm (Campbell); also loud calls when swooping observer near nest (Mathews). **Other calls** Sweet calls, like those of a miner *Manorina* (Pizzey 1980). Members of pairs occasionally utter very quiet twittering when pressed against each other and allopreening (D'Ombraïn 1934).

Young No information.

BREEDING Not well known and no studies; 248 records in NRS to Oct. 2002. Often begin nesting almost immediately on arrival in area (see Movements). Nest either solitary or colonially, though relative frequency of each not known; also often in mixed colonies with White-browed Woodswallows (Robinson 1933; McGill 1944; Carnaby 1965; Austin 1972; North; Vic. Atlas; NRS; see Social Organization). Possibly hybridize with White-browed, but rarely (see White-browed Woodswallow: Plumages).

Season Breeding recorded July–Mar. (see below). Eggs, July–Jan. and Mar., but mainly Sept.–Dec. (see below); of 182 clutches in NRS: one (0.5%) in July, 16 (8.8%) in Aug., 57 (31.3%) in Sept., 30 (16.5%) in Oct., 50 (27.5%) in Nov., 25 (13.7%) in Dec., one (0.5%) in Jan., and two (1.1%) in Mar. Nestlings, July–Jan. (see below); of 100 records in NRS: one (1.0%) in July, eight (8.0%) in Aug., 14 (14.0%) in Sept., 25 (25.0%) in Oct., 32 (32.0%) in Nov., 18 (18.0%) in Dec. and two (2.0%) in Jan. Little variation in season across range, though appear to breed slightly earlier in n. and inland Aust., though rarely breed N of 20°S (see below; also see Distribution, Movements). Also reported to breed after rain (Lord 1956), e.g. near L. Brown, WA, many birds on eggs Nov., 68 days after storms flooded area (Brooker *et al.* 1979). **S. Aust.** s. QLD: Breed Aug.–Mar. (Aust. Atlas 1, 2; and below). Eggs, Oct. and Nov. (Aust. Atlas 1; NRS [n=3 records]). NSW, ACT: Breed Aug.–Feb. (Aust. Atlas 2; and below). Eggs, Aug.–Jan. (D'Ombraïn 1934; Costello 1981; Morris *et al.* 1981; North); of 40 records in NRS: 16 (40%) in Sept., three (7.5%) in Oct., eight (20%) in Nov., and 13 (32.5%) in Dec. Nestlings, Sept.–Jan. (D'Ombraïn 1934; NRS [n=26 records]). VIC.: Breed Oct.–Feb. (Vic. Atlas; Aust. Atlas 2; and below). Eggs, Oct.–Jan. (Chisholm 1910; Campbell; Aust. Atlas 1; NRS); of 17 records in NRS: two (11.8%) in Oct., nine (52.9%) in Nov., five (29.4%) in Dec. and one (5.9%) in Jan. Nestlings, Nov.–Dec. (NRS [n=10 records]). TAS.: Breeding recorded only once, on King I., with eggs and young, Dec. (McGarvie & Templeton 1974). SA: Breed Sept.–Jan. (Aust. Atlas 2; and below). Eggs, mostly Sept.–Dec., occasionally Jan. (Brandon 1951; Boehm 1957; Attiwill 1972; Rix 1976; SA Bird Rep. 1963; NRS); of 55 records in NRS: 12 (21.8%) in Sept., 23 (41.8%) in Oct., 17 (30.9%) in Nov., and three (5.5%) in Dec. Nestlings, Oct.–Dec. (Rix 1976; NRS [n=33 records]). s. WA: Breed July–Dec. (Storr 21, 22, 26, 27, 35; Aust. Atlas 2; and below). Eggs, Aug.–Dec. (Carter 1924; Robinson 1934; Brooker *et al.* 1979; North; NRS); of 42 records in NRS: seven (16.7%) in Aug., 20 (47.6%) in Sept., one (2.4%) in Oct., and 14 (33.3%) in Nov. Nestlings, Aug.–Nov. (Carter 1924; NRS [n=18 records]). s. NT: Breeding recorded July–Sept., Nov., Jan. and Mar. (Storr 7; Aust. Atlas 1, 2; and below). Eggs, July–Sept. and Nov. (Aust. Atlas 1; NRS); of 17 clutches in NRS: one (5.9%) in July, nine (52.9%) in Aug. and seven (41.2%) in Sept. Nestlings, July–Sept. (NRS [n=12 records]). **N. Aust.** n. WA: Eggs, Aug.–Dec. and Mar. (Davies 1979; NRS [n=5 records]); in Pilbara Region, breed Mar., July–Oct., Dec. and possibly Jan. (Storr 16); otherwise, breeding recorded Aug. and Feb. (Aust. Atlas 2). N. NT: Breeding and eggs recorded Sept. and Dec. (Aust. Atlas 1; NRS [n=3 clutches]). N. QLD: Eggs, Sept., Dec. and Jan. (Berney 1905; MacGillivray 1924; Lavery *et al.* 1968). Nestlings, Jan. (NRS [n=1 record]); breed Mt Isa in wet season (Horton 1975).

Site Mostly in fork of branch or trunk of live or dead shrub or tree, or in end of hollow limb, spout, stump or trunk of tree; less often in hollow post, behind piece of peeling bark or in old nest of another species, such as pigeon, Grey Shrike-thrush *Colluricincla harmonica*, Australian Magpie, on top of old nest of Zebra Finch *Taeniopygia guttata*, and in old mud nest, probably of Apostlebird *Struthidea cinerea* (Cheney 1915; Carter 1924; Robinson 1933; D'Ombraïn 1934; Roberts 1955; Lord 1956; McGarvie & Templeton 1974; Rix 1976; Gibson 1986; Campbell; North; NRS; see below). Of 167 records in NRS: 88 (52.7%) were in fork of tree or shrub; 47 (28.1%) in hollow spout, stump or notch in trunk; 16 (9.6%) between peeling bark and trunk; five (3.0%) in old nest of another species; four (2.4%) in mistletoe; and rest (4.2%) in various other sites. Of 163 sites: 56 (34.4%) were in acacias (mostly Mulga); 53 (32.5%) were in eucalypts, mostly mallees; ten (6.1%) were in Belah; five (3.1%) in creeper growing over a tree or shrub; four (2.5%) in *Callitris*; and four (2.5%) in rose-wood *Heterodendrum*; rest in various other trees or shrubs (NRS). **ASSOCIATIONS WITH OTHER SPECIES:** Often in mixed colonies with White-browed Woodswallows (Robinson 1933; McGill 1944; Carnaby 1965; Austin 1972; Lowe & Lowe 1972; North; Mathews; Aust. Atlas 1; Vic. Atlas; NRS); one colony contained Masked, White-browed and Black-faced Woodswallows (NRS). Often nest in same tree as White-browed Woodswallow (McGill 1944). However, in mixed colonies, species said to nest at different levels: with Masked usually nesting higher than White-browed (Cheney 1915) or lower (D'Ombraïn (1934); and on Carrierloo Stn, SA, colonies of Masked and White-browed Woodswallows found in same patches of Mulga but each species nested in discrete clusters (Brandon 1951). Sometimes nest close to other species (NRS), e.g. nests of Magpie-lark *Grallina cyanoleuca*, Willie Wagtail *Rhipidura leucophrys* and White-winged Triller *Lalage suevii* all in same shrub as (within 4 m of) Woodswallow nest (NRS). **MEASUREMENTS** (m): Height of nest, 2.1 (1.27; 0.25–12.2; 235) (NRS); in Barlee Ra., s. WA, 0.9–3.0 (Robinson 1933); round Gosford, NSW, 1.2–1.5 (D'Ombraïn 1934). Height of nest-plant, 4.2 (2.38; 1.2–12; 82) (NRS).

Nest, Materials Shallow, cup-shaped nest. Foundation made of twigs and grass, and occasionally rootlets, with an upper layer of grass or plant stems; and then lined with dry rootlets and dry or green grass (Carter 1924; Campbell; North; NRS). Both sexes build, and at one nest, both collected material, though male mostly passed material to female to incorporate into structure, though he placed material on nest if female absent (NRS). **MEASUREMENTS** (cm): External diameter, 11.4; external depth, 7.6–8.9; internal diameter, 6.4; internal depth, 3.8 (no N) (Campbell; North). Diameter of one nest, c. 3.7 (Carter 1924).

Eggs Indistinguishable from those of White-browed Woodswallow (Campbell; North). Oval, thick oval or sharply pointed at one end; close-grained; smooth, glossy or nearly lustreless. Ground-colour greyish white, green or light greenish-grey, clouded and blotched with varying shades of brown and dull grey, sometimes intermingled with a few underlying grey spots; markings mostly at large end, forming a cap or zone (Chisholm 1910; Campbell; North). **MEASUREMENTS:** 21.7 (0.75; 20.3–22.4; 8) × 16.9 (0.23; 16.5–17.3) (Campbell; North); eggs of three clutches, 23–24 × 16–17 (Boehm 1957); in WA: 20.2 (19.4–22.8; 17) × 16.7 (15.6–18.1) (Serventy & Whittell). One egg of C/2 only c. 5 mm long, though other of normal size (NRS).

Clutch-size One to four, most often two, and only occasionally one or four (MacGillivray 1924; Robinson 1934; Campbell; North; NRS). From NRS: 2.2 (0.56; 56); C/1 × 3, C/2 × 39, C/3 × 13, C/4 × 1, excluding a clutch of seven, which almost certainly a result of two or more females laying in same nest. In Qld, C/2 × 2 (Storr 19). In WA, 2.16 (0.50;

104): C/1 × 5, C/2 × 78, C/3 × 20, C/4 × 1 (Storr 16, 21, 22, 26, 27, 35).

Laying Begins immediately after completion of nest (NRS). Eggs laid daily, in morning, or at intervals a little over 1 day (NRS); in one nest, second egg laid between 07:35 and 09:50 on same day (NRS). Can raise two broods in a season (Serventy & Whittell).

Incubation By both sexes, but probably mostly female (D'Ombra 1934; NRS). Begins with laying of first egg (NRS). Hatching not synchronous; in one nest, last egg of C/3 hatched c. 3 days after first two (D'Ombra 1934); and in nest with C/2, one had hatched by 11:00 on one day and second had still not hatched by 17:00 on same day; in another nest, two eggs hatched between 09:15 of one day and 12:00 next day (NRS). **INCUBATION PERIOD:** 12 days (Serventy & Whittell); two eggs in one nest hatched a maximum of 11 days after clutch complete (NRS).

Young Hatch blind and with a little natal down; at 2 days old, nestlings downy but eyes still closed; feathers in pin appear at 2–6 days, visible first on wings; eyes open at 7–9 days; body covered in emerging feathers at c. 9 days; and feathering well developed by 12 days old. Young appear to retain some down at fledging (NRS). Both sexes brood and feed nestlings (NRS), though contributions may differ. Once, male attended nestlings far more often than female (NRS); at another nest, male rarely attended nestlings (though he had previously shared incubation), as female chased him away when he approached nest, but once male seen to feed nestlings before being chased away (D'Ombra 1934).

Fledging to independence **FLEDGING PERIOD:** 12 days × 1 brood, 13 days × 1 brood; two broods fledged at 15 or 16 days old, and two others at 17 or 18 days old (NRS); 12 days (Serventy & Whittell). Fledgelings fed by both adults (Child 1974). Newly fledged young fly only weakly (NRS). Fledgelings remain with adults for at least 12 days (see Social Organization).

Success Where clutch-size and outcome known: from 58 eggs, in 25 nests, 22 (37.9%) hatched and 13 (22.4%) young fledged, equal to 0.6 fledged young per nest; from 91 eggs in 39 nests, 54 (59.3%) hatched (NRS). Outcomes of nests not easily recorded as young can leave area almost immediately after fledging; of 45 nests where outcome known, 35 (77.8%) failed and ten (22.2%) were successful; in another 18 nests, young capable of leaving nest when last seen, but outcome not confirmed (NRS). Said that adults will sometimes abandon nests and eggs when flocks leave area (NRS). **CUCKOOS:** Parasitized by Pallid Cuckoo *Cuculus pallidus* and Shining Bronze-Cuckoo *Chrysococcyx lucidus* (Storr 35; Brooker & Brooker 1989; HANZAB 4).

PLUMAGES Prepared by J.S. Matthew. Young hatch with very little down (NRS). Fledge in juvenile plumage, then undergo a partial post-juvenile (first pre-basic) moult to adult-like first immature (first basic) plumage. Acquire adult plumage in complete first immature post-breeding (second pre-basic) moult, probably when c. 1 year old. Thereafter, a complete post-breeding (pre-basic) moult each cycle produces successive adult (basic) plumages with no change in appearance. Sexes differ. Plumage description based on examination of skins of ten adult males, ten adult females, seven first immature males, three first immature females, two juvenile males and three juvenile females (HLW, MV, SAM).

Adult male (Definitive basic). **HEAD AND NECK:** Forehead, grey-black (c82) or dark grey (c83), usually black (c83) on lower sides of forehead. Crown, nape and neck, bluish grey (dark 87) or grey (c84), grading to white or greyish white (ne) on anterior sides of neck. Lores, eye-ring, ear-coverts, malar area, chin and throat, black (89), combining with sides of lower forehead to form diagnostic black mask. Feathers of

lower throat, and posterior and upper ear-coverts tipped white, combining with pale anterior sides of neck to form whitish band curving behind black mask. Several short, fine black (89) bristles on sides of lower forehead, interramal area and above gape. **UPPERPARTS:** Dark bluish-grey (dark 87) or grey (dark 84), grading slightly paler (same colour number) on rump and uppertail-coverts; some have faint dark-brown (119A) scalloping on rump and lower back, formed by narrow dark-brown (119A) subterminal band to feathers; all feathers have concealed pale-grey (c86) bases. **UNDERPARTS:** Breast, belly and flanks, pale greyish (c86) or whitish grey (ne); breast separated from black mask by indistinct narrow whitish (ne) band; some have grey (84) patches at sides of upper breast. Undertail-coverts and vent, off-white (ne) or greyish white (ne); posterior coverts rather long. Feathers of thighs, light grey (c85) or off-white (ne). Axillaries, white. All feathers of underparts have concealed grey (c87) bases. **UPPERTAIL:** Rectrices, grey (c84); with white fringe at tip of t1 when fresh; and broad (10–12 mm on inner web) and fairly sharply demarcated white tips to t2–t5, which are slightly narrower on outer webs and merge with narrow white fringes to inner webs; and white tip and narrow white outer edge to t6, tip very narrow on outer web. Shafts, dark red-brown (221A), becoming white at tips. **UNDERTAIL:** Patterned as uppertail but ground-colour pale grey (c86) and white tips less sharply demarcated. **UPPERWING:** All coverts and feathers of alula, bluish grey (c87); feathers of alula have narrow off-white (ne) fringe at tips and inner webs; greater primary coverts have narrow off-white (ne) fringe at tips, dark-brown (121) outer edges and concealed off-white (ne) inner edges. Tertiaries, bluish grey (c87), grading to white at bases and dark brownish (c119A) near tips of inner webs, with dark-brown (121, 119A) edges to distal half of inner webs. Secondaries and primaries, bluish grey (c87), usually grading to dark brown (c119A) towards tip, with narrow off-white (ne) fringes at tips and diffuse off-white (ne) inner edges. Shafts of remiges, blackish brown (c19). **UNDERWING:** Coverts, white except for proximal row of marginal primary coverts, which dark grey (83). Remiges: inner webs, pale grey (86) grading darker (greyish c84) at tips; outer webs, dark grey (c83) but concealed; and pale markings similar to upperwing. Shafts of remiges, brown (223A, 121B). Overall appearance, whitish, greyer on remiges, with narrow dark-grey leading edge to outerwing.

Adult female (Definitive basic). Differs from adult male by: **HEAD AND NECK:** Forehead, dark grey (c83), grading to dark brownish (c119A) at sides of lower forehead. Crown, nape, and neck, dark grey (c83), slightly paler and less bluish than adult male, grading to light grey-brown (119D) on anterior sides of neck. Lores, feathers below eye and eye-ring, greyish black (c82). Ear-coverts mostly dark grey (c83) or greyish black (c82). Malar area, chin and throat, dark grey (c83) or grey (c84); combine with lores and ear-coverts to form dark-grey (c83) or grey (c84) mask, distinctly paler than in adult male. Posterior and upper ear-coverts have light grey-brown tips (119D) that combine with pale anterior sides of neck to form narrow light grey-brown (119D) band behind mask. **UPPERPARTS:** Similar to adult male, but with faint brownish (c28) tinge to mantle, scapulars and upper back; upperparts tend less bluish than adult male. **UNDERPARTS:** Breast, belly and flanks, light greyish-brown (c119D), some with pinkish-brown (c219C) tinge; breast less sharply demarcated from mask than in adult male. Undertail-coverts, white or off-white (ne) with brown (28) shafts to longest coverts in some birds. **TAIL:** Similar to adult male but white tips to t2–t6 narrower (4–10 mm on inner webs). **UPPERWING:** Wing-coverts tend to be slightly paler than in adult male.

Nestling Photo (R. Drummond) shows nestling with sparse light grey-brown (c119D) down on top of head and upperparts.

Juvenile Sexes alike. Differs from adult male by: **HEAD AND NECK:** Forehead, crown, nape and neck, dark brown (121) with bold white streaking; feathers, dark brown (121) with white shaft-streaks or rosethorn-shaped tips; lower sides of neck have finer off-white (ne) or buff (c124) streaking or flecking. Lores, feathers below eye and eye-ring, greyish black (c82), darker than rest of face; and ear-coverts, dark brownish-grey (ne) with narrow off-white (ne) tips to some coverts; these combine to form rather diffuse dark facial mask which is smaller, paler and less prominent than in adult. Malar area, chin and throat, dark brownish-grey (ne) with diffuse off-white (ne) streaking or flecking. **UPPERPARTS:** Mantle, scapulars, back and rump, dark brown (121) with bold white or cream (c92) streaking, which tends to buff (124) or light brown (39) on back and scapulars; feathers, dark brown (121) with broad white or cream (92) shaft-streaks or rosethorn-shaped tips, tending to buff (124) or light-brown (c39) on some scapulars and feathers of back. Uppertail-coverts, grey (84) with small buff (124), cream (92) or white rosethorn-shaped tips. **UNDERPARTS:** Breast, sides of belly and flanks, dark brown (119A) with bold but diffuse off-white (ne) mottling or streaking, with buff (124) tinge to rear-flanks; feathers, off-white (ne) with broad dark-brown (119A) edges and partly exposed grey (c87) bases. Centre of belly off-white (ne). Undertail-coverts, off-white (ne) or pinkish buff (c121D), some with dark-brown (c119A) edges. **TAIL:** Tail has slightly deeper fork when folded compared with adult. Rectrices narrower and more acute at tip than in adult. Rectrices, dark bluish-grey (c87) with: small off-white (ne) rosethorn-shaped tips which lost with wear; narrow white inner edges to t2–t6; and narrow white fringe to outer web of t6. **UPPERWING:** Marginal secondary coverts, dark brown (119A, 121) with off-white (ne) shaft-streak, broader at tips. Median and greater secondary coverts, bluish grey (dark 87), grading to dark brown (119A) near tips, and with small buff (c124) rosethorn-shaped tips. Marginal and median primary coverts, white with dark-brown (119A) edges. Feathers of alula and greater primary coverts, bluish grey (dark 87) with small pale-buff (c124) rosethorn-shaped tips that become reduced with wear. Tertiaries, dark bluish-grey (c87) with off-white (ne) or pale-buff (c124) tips or fringe at tips. Secondaries and primaries similar to adult but more rounded at tips and with broader off-white (ne) or cream (c92) fringe at tips, which becomes narrower with wear. **UNDERWING:** As adult but fringes to tips of primaries and secondaries combine to form narrow off-white (ne) trailing edge when wing spread.

First immature male (First basic). Most are very similar to adult male, but differ by: retain all juvenile remiges; retain all or most juvenile rectrices; some retain all juvenile greater secondary coverts; and some have paler, greyish-black (c82), mask. One examined had fine whitish flecking on scapulars, but not known if these retained juvenile scapulars. One skin (SAM) resembles adult female but has retained juvenile feathering as above; another skin (SAM) superficially similar to adult female but with darker, grey-black (c82) mask which extends over most of throat and ear-coverts. Birds with all juvenile rectrices retained have deeper fork to tip of tail when folded.

First immature female (First basic). Very similar to adult female; one in Mar. starting second pre-basic moult (PMS 23) with juvenile t1 replaced and juvenile t2–t6 not yet replaced, otherwise similar to adult.

BARE PARTS Based on photos (Chapman 2000; unpubl. Anon.; R. Drummond; L. Robinson; C.H. Sandbrink; and standard sources), museum labels (HLW, MV) and other information as cited. **Adult** Bill, bluish grey (pale 87) or pale blue (168D) with black (89) distal third or half, and narrow black (89) line extending towards base on tomia; also described as milky blue (Mees 1961), or blue-white with black tip (Aust.

RD). Gape, bluish grey (pale 87) or light grey (c85). Palate described as whitish, black or greyish pink (Hall). Orbital ring, grey (84) or light grey (c85). Iris, dark brown (c121); also described as brown (Etchécopar & Hüe 1977; Hall; MV) or dark hazel (HLW). Legs and feet, grey (c84) or grey-black (82); also described as olive-grey or black (Hall). **Nestling** Bill, dark greyish (c83) with pale-yellow (c157) or cream (c92) basal half of tomia. Gape, pale yellow (c157) or cream (c92), swollen. Palate, yellow-orange (c18). Iris, dark (ne). Bare skin of body, pinkish (c4); bare skin around eye, greyish black (c82). **Juvenile** Poorly known. Bill described as brown in one, bluish horn in another (HLW). No information on colour of gape; probably pale yellowish or flesh-coloured as in juvenile White-browed Woodswallow (q.v.). Palate of immature (possibly referring to juvenile) described as yellower than adult (Hall). Iris described as greenish yellow or dark brown (HLW). Legs described as slate-grey (HLW). **First immature** Poorly known but apparently similar to adult (HLW).

MOULTS Based on examination of skins of 45 adults, ten first immatures and five juveniles (HLW, MV, SAM), and other information as cited. **Adult post-breeding** (Third and subsequent pre-basic). Complete. Primaries outward, starting at p1. One in Jan. with primary moult-formula of N²O⁸, and which had possibly suspended moult. Active moult of primaries recorded in three of three in Mar. from Ooldea, w. SA (PMS 6, 9, 20); all of 32 recorded June–Dec. (from throughout much of range) with worn primaries; two of five in May with all primaries new. Adults from Mt Anderson, WA, in May with active moult, but feather-tracts not specified (Hall). One from w. Pilbara, WA, in early Aug. with fresh plumage (Mees 1961). Combined results suggest that moult of primaries occurs in late summer and autumn; reporting rates in s. Aust. lower in winter (see Movements) and moult possibly precedes post-breeding migration to n. Aust. Those above with active moult of primaries had not yet started moult of secondaries or tertiaries; one adult-like bird (no date) with p7, innermost secondary and outer two tertiaries new, and rest of remiges worn; this possibly suspended moult or with partial moult of remiges. Timing of moult of tail and wing-coverts much as primaries, but one in Nov. replacing t1 before start of moult of primaries. Moult of tail centrifugal. Moult of body starts before moult of primaries. **Post-juvenile** (First pre-basic). Little known. Partial. Involves all or most feathers of body, and marginal and median secondary coverts; some replace greater secondary coverts. Recorded June–Nov., but more data on timing and extent needed. One first immature in June with all juvenile rectrices retained except t5 on one side of tail. **First immature post-breeding** (Second pre-basic). Little known. One adult-like bird in SA undergoing complete moult in Mar. (PMS 23); this identified as second pre-basic moult by worn juvenile rectrices and very worn outer primaries.

MEASUREMENTS (1–3) Mainland Aust., skins (HLW, MV, SAM): (1) Adults; (2) First immatures; (3) Juveniles.

	MALES	FEMALES	
WING	(1) 123.3 (3.44; 115–128; 26)	118.6 (4.75; 104–126; 21)	**
	(2) 119.1 (3.53; 115–125; 7)	111, 117, 118	
	(3) 117	115, 119, 119	
TAIL	(1) 78.2 (4.65; 70–88; 26)	75.7 (3.41; 70–86; 21)	*
	(2) 75.4 (2.99; 70–79; 7)	66, 74, 75	
	(3) 80	70, 71, 75	
BILL S	(1) 23.2 (0.88; 21.5–25.3; 26)	21.5 (0.99; 19.6–23.1; 20)	**
	(2) 22.8 (1.76; 19.7–25.0; 7)	19.9, 22.5, 23.5	
	(3) 21.0	20.4 (1.34; 19.1–22.0; 4)	
BILL D	(1) 7.2 (0.32; 6.6–7.9; 17)	7.2 (0.50; 6.6–8.2; 8)	ns
BILL W	(1) 7.1 (0.40; 6.7–8.4; 17)	7.4 (0.56; 6.7–8.4; 8)	ns
TARSUS	(1) 19.9 (0.96; 18.0–21.4; 26)	19.5 (0.86; 18.2–21.0; 21)	ns
	(2) 19.8 (0.60; 18.9–20.7; 7)	20.3, 20.8, 22.7	
	(3) 19.7, 20.3	19.8 (0.91; 18.7–20.9; 4)	

WEIGHTS (1) Mainland Aust., adults, from museum labels (ANWC) and Hall.

	MALES	FEMALES	
(1)	36.1 (2.94; 31.5–39.5; 12)	33.2 (4.18; 25.5–41.0; 13)	ns

Live adults (possibly also including first immatures): males 37.8 (2.31; 33.0–42.0; 26); females 36.3 (2.32; 33.0–41.0; 21) (ABBBBS).

STRUCTURE Powder-down present on breast and lower back. Wing long, fairly broad and pointed at tip; tip of longest primary falls to about three-quarters length of tail on folded wing. Ten primaries; p10 very short; p9 usually longest, sometimes p8; p10 75–82 mm shorter than p9, p8 0–3, p7 6–10, p6 15–19, p5 23–28, p4 29–37, p3 34–45, p2 40–52, p1 46–57. No emargination to remiges. Ten secondaries, including three tertials; tip of longest tertial falls short of tip of p1 or between tips of p1 and p2 on folded wing. Tail fairly long; rather square at tip when spread, slightly forked at tip when folded; juvenile has deeper fork; 12 rectrices; juvenile rectrices narrower and more acute at tip than on adult; longest rectrix varies, but usually one or more of t4–t6, these varying no more than 2 mm; t3 usually 1–5 mm shorter than longest, t2 2–6, t1 1–10. Bill about same length as head, fairly slender; upper mandible slightly decurved; lower mandible curved slightly upward near tip; slight notch in upper tomium near tip. Nares amphirhinal. Tarsus fairly short, compressed laterally; scaling laminiplantar. Tibia fully feathered. Middle front toe longest, mean length, including claw, 21.4 mm (1.68; 19.9–23.6; 4); outer front toe 70–75% length of middle, inner toe 65–75%, hindtoe 70–75%. Hindclaw c. 6 mm long.

AGEING Juvenile distinguished by plumage and bare parts (q.v.). First immature similar to adult but retain juvenile remiges and greater primary coverts, and all or most juvenile rectrices; some retain all juvenile greater secondary coverts, and some first immature males distinguished by paler mask than adult male, though darker than adult female.

SEXING Adults and first immatures differ in plumage (q.v.); adults also differ in size, with males larger than females. Juveniles do not differ in plumage.

GEOGRAPHICAL VARIATION None (Keast 1958; Echécopar & Hüe 1977; Hall; Peters; 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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