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):

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.;

DICAEIDAE (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.

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 Muscicapoidea (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 Dicruridae and Corvidae (cf. Dicruridae–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, taxomony 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 widepread, 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).

REFERENCES

Ames, P.L. 1971. *Bull. Yale Peabody Mus. Nat. Hist.* 37: 1–194.
—— 1987. *Emu* 87: 192–5.
Baverstock, P.R., *et al.* 1991. *Aust. J. Zool.* 39: 417–25.
——, *et al.* 1992. *Aust. J. Zool.* 40: 173–9.
Beddard, F.E. 1898. *The Structure and Classification of Birds*. Longmans, Green & Co., London.
Berger, A.J. 1956. *Am. Midl. and Nat.* 55: 326–33.
Boles, W.E., & N.W. Longmore. 1985. *S. Aust. Orn.* 29: 213–19.
Brown, J.L. 1987. *Helping and Communal Breeding in Birds*. Princeton Univ. Press, Princeton, New Jersey.
Campbell, B., & E. Lack. (Eds) 1985. *A Dictionary of Birds*. T. & A.D. Poyser, Calton, England.
Christidis, L. 1991. *Chromosomes Today* 10 (1990): 279–94.
——, & W.E. Boles. 1994. *RAOU Monogr.* 2. Melbourne.
——, & R. Schodde. 1991. *Ibis* 133: 277–85.
Clench, M.H. 1978. *Condor* 80: 423–30.
Dow, D.D. 1978. *Int. Orn. Cong. Proc.* 17: 875–81.
—— 1980. *Emu* 80: 121–40.
Ehrlich, P.R., *et al.* 1986. *Auk* 103: 835.
——, *et al.* 1988. *The Birder's Handbook: A Field Guide to the Natural History of North American Birds*. Simon & Schuster, New York.
Farner, D.S., *et al.* (Eds) 1971. *Avian Biology. 1*. Academic Press, New York.
Ford, H.A. 1989. *Ecology of Birds*. Surrey Beatty, Sydney.
Frith, C.B. 1994. *Condor* 96: 552–5.
Hartshorne, C. 1973. *Born to Sing*. Indiana Univ. Press, Bloomington, Indiana.
Heather, B.D., & H.A. Robertson. 1997. *The Field Guide to the Birds of New Zealand*. OUP, Auckland.
Kroodsma, D.E. 1996. Pp 3–19 **In**: Kroodsma & Miller 1996.
——, & E.H. Miller. (Eds) 1996. *Ecology and Evolution of Acoustic Communication in Birds*. Comstock, Ithaca, New York.
Marshall, A.J. 1950. *Emu* 50: 5–16.
Millener, P.R. 1988. *J. R. Soc. NZ.* 18: 383–406.
Morlion, M.L. 1985. *Rec. Aust. Mus.* 37: 143–56.
Morony, J.J., *et al.* 1975. *Reference List of the Birds of the World*. Am. Mus. Nat. Hist., New York.
Pizzey, G. 1980. *A Field Guide to the Birds of Australia*. Collins, Sydney.
Raikow, R.J. 1982. *Auk* 99: 431–45.
Ricklefs, R.E. 1975. *Condor* 77: 34–45.
Ridgely, R.S., & G. Tudor. 1994. *The Birds of South America. 2. The Suboscine Passerines*. OUP, Oxford.
Ridgeway, R. 1901. *Bull. US Natn. Mus.* 50(1): 1–715.
Rowley, I., & E. Russell. 1997. *Fairy-wrens and Grasswrens*. OUP, Oxford.
Schodde, R. 1975. *Interim List of Australian Songbirds: Passerines*. RAOU, Melbourne.
——, & I.J. Mason. 1999. *The Directory of Australian Birds: Passerines*. CSIRO Publ., Melbourne.
Sibley, C.G. 1974. *Emu* 74: 65–79.
——, & J.E. Ahlquist. 1985a. *Emu* 85: 1–14.
——, —— 1985b. *Int. Orn. Congr. Proc.* 18: 83–121.
——, —— 1990. *Phylogeny and Classification of Birds: A Study in Molecular Evolution*. Yale Univ. Press, New Haven.
——, & B.L. Monroe. 1990. *The Distribution and Taxonomy of Birds of the World*. Yale Univ. Press, New Haven.
——, *et al.* 1988. *Auk* 105: 409–23.
Simmons, K.E.L. 1966. *J. Zool., Lond.* 149: 145–63.
—— 1986. *The Sunning Behaviour of Birds*. Bristol Orn. Club, Bristol.
Storer, R.W. 1971. Pp 1–18 **In**: Farner *et al.* 1971.
van Tyne, J., & A.J. Berger. 1976. *Fundamentals of Ornithology*. John Wiley & Sons, New York.
Voous, K.H. 1977. *Ibis* 119: 223–250, 376–406.
Wetmore, A. 1960. *Smithson. Misc. Collection* 139.
Winkler, R., & L. Jenni. 1996. *Auk* 113: 968–9.
Zeidler, K. 1966. *J. für Orn.* 107: 113–53.

Family **HIRUNDINIDAE** swallows and martins

A fairly large family of familiar and morphologically similar small to medium-sized insectivorous passerines, adapted to aerial feeding, with distinctive slender bodies, short necks, long pointed wings, short broad bills, small weak feet and, often, deeply forked tails. The family comprises 83–89 species in 14–20 genera, and is cosmopolitan in distribution other than polar regions and many oceanic islands, occurring throughout Europe, most of Asia, including the Indian subcontinent, Africa, A'asia, islands of the sw. Pacific Ocean, and N., central and S. America (Turner & Rose 1989; Sibley & Monroe 1990; Monroe & Sibley 1993; Turner 2004; Sheldon *et al.* 2005). Nine, and possibly ten, species in four genera recorded in HANZAB region. Some early authors associated swifts (Apodidae) and swallows (see Sibley & Ahlquist [1990] and *HANZAB* 4 for discussion). Sharpe (1885) first termed the family Hirundinidae, and this has been maintained since. Opinion concerning nearest relatives varies. Sharpe (1885) thought Old World flycatchers (Muscicapidae) to be nearest relatives. Several authors (Stresemann 1927–34; Mayr & Amadon 1951; Bock 1962; Voous 1977; Peters) place swallows immediately after larks (Alaudidae) at the beginning of the oscine sequence. Berndt & Meise (1953) placed Hirundinidae between white-eyes (Zosteropidae) and waxwings (Bombycillidae). Beecher (1953) suggested affinities with Old World flycatchers and true thrushes (Muscicapidae) and starlings (Sturnidae) based on jaw musculature. Sibley (1970) suggested affinities with sylviid warblers (Sylviidae) and Muscicapidae based on electrophoresis of egg-white proteins. Wolters (1975–82) placed them after starlings at the end of the passerine sequence. DNA–DNA hybridization studies (Sibley & Ahlquist 1982, 1990) indicate swallows and martins are a distinctive group with no particularly close relatives. They are, however, part of the superfamily Sylvioidea, a major lineage of oscine passerines that includes the true warblers, Old World babblers, white-eyes, nuthatches, tits and bulbuls among others. Sibley & Ahlquist (1982) indicate that swallows and martins shared a common ancestor with sylviid warblers and Old World babblers, the divergence occurring *c.* 50 million years ago. More recent analyses based on nuclear DNA-sequences (Barker *et al.* 2004) supports Hirundinidae being part of the sylvioid lineage of songbirds.

The following two subfamilies are recognized by most authors (Turner & Rose 1989; Sibley & Monroe 1990; Monroe & Sibley 1993; Turner 2004; Sheldon *et al.* 2005): **PSEUDOCHELIDONINAE** (river-martins): Two species in single genus *Pseudochelidon*: African River-Martin *P. eurystomina* of Zaire; and White-eyed River-Martin *P. sirintarae* of Thailand; and **HIRUNDININAE** (typical swallows): Comprising 81–87 species in 13–19 genera, with cosmopolitan distribution. Nine species in four genera accepted for HANZAB region, seven of which, in two genera (*Hirundo*, *Delichon*), recorded in Aust. Pacific Swallow *Hirundo tahitica* possibly also occurs in Aust., but no formally accepted records of the species as yet (Christidis & Boles 1994; BARC). Red-rumped Swallow combined here with *Hirundo*, but often considered as *Cecropis*. Tree *H. nigricans* and Fairy *H. ariel* Martins also combined here with *Hirundo*, but often considered as *Petrochelidon* (see below for discussion).

Taxonomic relationships between genera within typical swallows (Hirundininae) were first clarified by Mayr & Bond (1943) who defined the following ten groups, based mainly on construction of nests and patterns of plumage (with number of species currently recognized following Turner [2004]): (1) **PHEDINA** (one species in w.-central Africa, and one in Madagascar and on Mascarene Is); (2) **SAND MARTINS** *Riparia* (five species, four with Afro-Asian distribution and one also in Americas); (3) **MUD-NESTING SWALLOWS**, comprising barn swallows *Hirundo* (14 species, cosmopolitan), crag martins *Ptyonoprogne* (three species, distributed in Africa and Eurasia), red-rumped swallows *Cecropsis* (seven species, distributed in Africa and Eurasia, one species reaching Australo-Papuan Region), cliff swallows *Petrochelidon* (11 species, distributed through much of Africa, the Americas, India, e. Lesser Sundas and Australo-Papuan region), and house martins *Delichon* (three species, with Afro-Asian distribution, one species reaching HANZAB region); (4) **WHITE-BACKED SWALLOW** *Cheramoeca leucosternus* (endemic to Aust.); (5) **GREY-RUMPED SWALLOW** *Pseudhirundo griseopyga* (endemic to Africa); (6) **AFRICAN SAW-WINGS** *Psalidoprocne* (five species, Africa); (7) **ROUGH-WINGED SWALLOWS** comprising *Stelgidopteryx* (two species in Americas), *Alopochelidon* (one species in S. America) and *Neochelidon* (one species in S. America); (8) **ATTICORA GROUP**, of the Americas, comprising *Notiochelidon* (four species in central and S. America, including Blue-and-white Swallow *N. cyanoleuca* which sometimes placed in monotypic genus *Pygochelidon*), *Haplochelidon* (one species, S. America) and *Atticora* (two species, S. America); (9) **TREE SWALLOWS** *Tachycineta* (nine species, the Americas); and (10) **AMERICAN MARTINS** *Progne* (nine species, the Americas). These genera and groupings are largely supported by molecular analyses, but the New World rough-winged swallows and Neotropical *atticora* group form a monophyletic cluster, with *Tachycineta* probably forming a sister-group to these (Sheldon *et al.* 2005). Several authors (Turner & Rose 1989; Sibley & Monroe 1990; Christidis & Boles 1994) do not recognize *Cecropis* or *Petrochelidon*, instead combining these with *Hirundo*; we follow their treatment here, but accept that the rigorous DNA-sequencing studies of Sheldon *et al.* (2005) provide empirical evidence for accepting *Cecropis* and *Petrochelidon*. Several other authors also accept latter two genera (Mayr & Bond 1953; Sheldon & Winkler 1993; Dickinson & Decker 2001; Turner 2004;

DAB). Basal relict lineages include White-backed Swallow, Grey-rumped Swallow and river martins, with disjunct distributions in Africa and Aust. (Sheldon *et al.* 2005).

Size varies from small (e.g. Fairy Martin: total length 11–12 cm, weight 9–14 g; and White-thighed Swallow *Neochelidon tibialis*: total length 12 cm, weight 10 g) to medium-sized (e.g. Purple Martin *Progne subis*: total length *c.* 19 cm, weight 48–64 g; and Mosque Swallow *Hirundo senegalensis*, total length *c.* 24 cm, weight 38–54 g). In HANZAB region, smallest is Fairy Martin and largest is migrant Barn Swallow *Hirundo rustica* (total length *c.* 18 cm, weight 16–24 g) or Red-rumped Swallow (total length 16–17 cm, weight *c.* 33 g). Species in the family share the following morphological characteristics (summarized from Beecher 1953; Bock 1962; Warner 1972; Moreno 1986; Turner & Rose 1989; Turner 2004; BWP; DAB): Body slender. Neck short. Wings long and pointed at tips. Ten primaries, with outermost (p10) vestigial; p9 often longest; two genera, *Stelgidopteryx* and *Psalidoprocne*, unique in having series of fine serrations (barbules) along outer edge of outer primaries. Nine secondaries, including three tertials. Tail varies from short and rather square or slightly notched at tip (e.g. cliff swallows, including Fairy and Tree Martins) to rather short with obvious fork or deep notch at tip (e.g. *Progne* and *Riparia* martins) or long and deeply forked, with elongated outermost rectrices (e.g. most *Hirundo* swallows); one species, White-eyed River Martin, is unique in having highly elongated central rectrices. Bill short, broad and flattened; tomia notched near tip. Nares usually operculate, but semi-operculate in house martins (*Delichon*) and red-rumped swallows (*Cecropis* [here considered *Hirundo*]), and non-operculate in cliff swallows; nostrils usually lateral slits, but sunken rounded apertures in cliff swallows (including Tree and Fairy Martins). Gape broad. Rictal bristles present, but usually vestigial. Loral feathering directed forward to act as lens shade for eyes; act under muscular control. Tongue broad, tapering to short, bifid tip. Legs and feet short; foot musculature rather weakly developed; front toes nearly united at base. Tarsus sharply ridged at rear (acutiplantar); tarsal scaling laminiplantar. Tarsi and toes usually naked, but partly or nearly fully feathered in some species (e.g. house martins). Claws rather strong. Jaw musculature distinctive, with enlarged protrators allowing bill to be opened widely. Syrinx unique among passerines, having complete bronchial rings (except in subfamily Pseudochelidoninae which have large syrinx with half bronchial rings and large internal membrane running length of bronchial tubes). Humerus short with single pneumatic fossa at head and vestigial second tricipital fossa. Maxillo-palatine processes pin-like. Double ectethmoid foramina. Aust. species have multiple orbital perforations at front of cranium. Temporal fossae narrow.

Following summarized from Turner & Rose (1989) and Turner (2004). Upperparts typically glossy, blackish, dark bluish or dark greenish, and underbody pale, often with dark streaking; some species (e.g. rough-winged swallows, crag martins) have much duller, brownish plumage, while others (e.g. some African saw-wings) have uniformly blackish plumage. Many species (e.g. red-rumped swallows, Tree and Fairy Martins) have contrasting colour to rump–uppertail-coverts or forehead or both. Many species have white markings, such as patches or spots, on rectrices. A few species (e.g. White-backed Swallow) have distinctive pattern to head and upperbody. Bare parts typically blackish or grey in adults. Sexes usually alike in plumage, but in some species (e.g. *Progne* martins) female duller; adult male *Hirundo* have longer, more deeply forked tails than adult females. Nestlings mostly naked at hatching, with a few patches of down; denser down develops after *c.* 1 week. Nestlings lack markings of mouth or tongue. Fledge in juvenile plumage, which is usually duller and less glossy than that of adults, and usually also have shorter, less deeply forked tails (particularly in *Hirundo*). Nestlings and juveniles of most species have swollen yellow gapes. Usually undergo a complete post-juvenile (first pre-basic) moult to adult (definitive basic) plumage, but a few species (e.g. Tree Swallow *Tachycineta bicolor*) acquire a distinct, brownish first immature (first basic) plumage in this moult. Adults usually undergo one complete post-breeding (pre-basic) moult annually, with no change in appearance; in migratory species (e.g. Barn Swallow), moult usually starts on wintering grounds, but sometimes (e.g. Collared Sand Martin *Riparia riparia*) starts on breeding grounds and is then suspended till arrival on wintering grounds. A few species (e.g. Asian House Martin *Delichon dasypus*) also undergo a partial pre-breeding (pre-alternate) moult, involving mainly feathers of head and body, and resulting in breeding plumage that usually appears little or no different from non-breeding plumage; sometimes pre-breeding and post-breeding moults overlap. Primaries moult outward, starting at p1; moult usually slow. Moult of secondaries inward; moult of tertials starts with central feather. Moult of tail centrifugal, usually starting during early stage of, or about halfway through, moult of primaries. Moult of body usually starts at about same time as moult of primaries.

Habitat usually includes open areas suitable for aerial foraging for insects. Generally found over open or sparsely wooded areas, and often near or over water (e.g. Pale Martin *Riparia diluta*), though sometimes inhabit open areas well away from water (e.g. Red-rumped Swallow in its wintering ranges in Africa and India). Often use open modified habitats, such as farmland (e.g. Grey-rumped Swallow), roadsides, airstrips and sewage ponds (e.g. Red-throated Swallow *Hirundo rufigula*). Also commonly over grassland, savanna and at edges of woodlands or forests (e.g. saw-wings *Psalidoprocne*). Often near settlement including residential areas, though densely built-up areas often avoided. Densely wooded habitats mostly avoided, but some species occur over forests (e.g. Pacific Swallow and Asian House Martin). Roost and nest in sand, dirt or gravel banks (e.g. Collared Sand Martin), crags, cliffs and caves, or artificial structures, such as culverts, bridges and buildings (e.g. Eurasian Crag Martin *Pytonoprogne rupestris*). Found from sea level to *c.* 4000 m asl. In Aust. and NZ, mostly over open habitats, including farmland,

airfields, grasslands, coastal areas, and wide range of wetlands; less often in or over mangroves and open woodland; some species associated with more heavily treed dry and wet eucalypt forests and rainforest, often at edges or clearings such as those created by logging (e.g. Tree Martin and Welcome Swallow *Hirundo neoxena*). Also common round settlements and cities (Heinzel *et al.* 1977; King *et al.* 1978; AOU 1998; Coates 1990; Keith *et al.* 1992; Ridgely & Tudor 1994; Orn. Soc. Japan 2000; Robson 2000, 2002; Turner 2004; BWP; see species accounts).

Many highly migratory. Extralimitally, range from sedentary or resident (e.g. Nepal House Martin *Delichon nipalensis*), predominantly resident with altitudinal movements (e.g. Eurasian Crag Martin, Black Saw-wing *Psalidoprocne pristoptera*), partly migratory (e.g. Blue-and-white Swallow) to total long-distance migrants (e.g. Barn Swallow). Several species more sedentary at lower latitudes, and migratory at higher latitudes (e.g. Red-breasted Swallow *Hirundo semirufa*, Lesser Striped Swallow *H. abyssinica*, Grey-breasted Martin *Progne chalybea*). This trend reflected across family as a whole, with tropical or subtropical breeding species more likely to be sedentary or resident (e.g. Congo Sand Martin *Riparia congica*) though many of these make local seasonal movements (e.g. Brazza's Martin *Phedina brazzae*), and most others, especially Holarctic breeding species, making at least some movement away from higher latitudes during winter (e.g. Collared Sand Martin and Northern House Martin *Delichon urbicum*). In HANZAB region, breeding species resident (White-backed Swallow) to partly migratory, with strong N–S pattern of movements (e.g. Tree Martin); Barn Swallow a regular non-breeding visitor to n. Aust. and vagrant elsewhere, mainly Sept.–Apr. (de Schauensee 1970, 1984; AOU 1998; Keith *et al.* 1992; Robson 2000; Griffioen & Clarke 2002; Turner 2004; BWP; see species accounts).

Aerial insectivores. Diet consists almost entirely of flying insects, but other invertebrates (e.g. spiders, small crustaceans) eaten occasionally, and a few species also take fruit or seeds in autumn–winter when insects scarce; other matter, such as gravel, shell fragments and pieces of fish bone, are also ingested. Most prey taken in flight by screening or sallying; usually involves pursuit of aerial prey, but items may also be snatched from surface of water or other substrates. When chasing aerial prey, use one of two general methods: (1) for agile prey, flight is rapid and involves much banking and turning; (2) for less manouvreable prey, which often occur in swarms, flight punctuated by gliding and fluttering. Also forage occasionally by sally-hovering; and sometimes seen hovering or fluttering in vegetation to flush insects. Despite preference for aerial feeding, food sometimes gleaned on ground or while perched, usually in adverse weather (when few insects in flight) or when non-aerial prey abundant. Foraging heights vary between species according to location of preferred prey items, but all species tend to feed at low levels in poor weather, when insects are scarce at higher altitudes (see above). Opportunistic; readily attend sites that attract insects or provide rich sources of prey (e.g. frequent fires, and associate with livestock or tractors ploughing fields to take advantage of flushed insects). Forage selectively: usually seek largest prey available, though all species take some smaller prey, and some (e.g. Northern House Martin, Red-throated Swallow *Hirundo rufigula*, Cliff Swallow *Hirundo pyrrhonota*) specialize on small prey; and generally avoid stinging insects. Many species forage singly or in pairs during breeding season; otherwise, forage in flocks that can be quite large at sites where food abundant. Drink regularly, by dipping bill into water while flying low over surface of creeks, lakes, rivers or the like (Keith *et al.* 1992; Turner 2004; BWP; see species accounts).

During breeding season, most species usually seen singly, in pairs, or in small flocks, but some gregarious when breeding (e.g. Collared Sand Martin *Riparia riparia*). When not breeding, most are gregarious, with some species occasionally gathering in large flocks of hundreds of thousands, especially near roosting sites (see below). Nearly all socially monogamous, but extra-pair copulation common. Some Tree Swallows occasionally polygynous. In most species, pair-bonds usually last only for duration of breeding season. Incubation by both sexes in some species, but only by female in others. Both sexes feed nestlings and fledgelings. Many species defend only nest and its immediate vicinity, but some species highly territorial and defend large all-purpose territories (e.g. Mangrove Swallow *Tachycineta albilinea*). Many nest solitarily, but some colonial. In colonial species, colonies vary greatly in size from just a few individuals, up to colonies of thousands (e.g. Cliff Swallow). Some colonial species build nests so close as to be in contact with those of neighbours (e.g. Streak-throated Swallow *Hirundo fluvicola*). Many species roost communally, but at start of breeding season, pair often roost at nest-site, and when nest active, female often roosts in nest. Flocks of some species perform spectacular aerial manoeuvres when flying to and from communal roosts, and sometimes large communal roosts consist of more than one species. Swallows and martins spend much time maintaining plumage. Often perch and preen after foraging in early morning and late evening, and often scratch both while perched and in flight. Scratch head indirectly. Usually bathe by skimming over water and briefly hitting surface to splash themselves, but occasionally wade into shallow water. Often also sunbathe. At start of breeding season, males usually choose a nest-site which they defend from other males. Threat displays often include calling and sometimes ruffling of feathers of head or vibrating of wings. Also lunge at or chase intruders, sometimes resulting in fights. Fights between males can be rather violent, with combatants beating each other with wings, pecking each other, pulling out feathers or grappling with feet. Once paired, both members of pair aggressively defend nest-site. In order to attract female, male usually sings in front of chosen nest-site, and in some species, male also performs visual displays, e.g. male Purple Martins fly up, circle over site and then dive back down and enter hollow. In some other species (e.g. Cliff Swallow), courtship behaviour almost lacking apart from singing, and the pair do little more

than tolerate each other at the nest-site. Pair-formation usually occurs at nest-site when female accepts a site that has been chosen and defended by a male. Copulation often occurs in or near nest, and is sometimes preceded by a short invitation display (Keith *et al.* 1992; Taylor 2004; BWP).

Song usually consists of a series of twittering or grating notes. Also utter variety of other calls, including alarm calls, contact calls, aggressive calls, submissive calls, copulation calls and begging calls. Often also produce non-vocal sounds, such as bill-snapping and fluttering or swishing sounds made by wings (Keith *et al.* 1992; Taylor 2004; BWP).

Socially monogamous, but extra-pair copulation common; rarely polygynous. Most species nest solitarily or in loose groups, but some are colonial, and colonies of some species (e.g. Cliff Swallow) may contain thousands of pairs (see above). SEASON: In temperate regions, breed mainly in late spring and summer, though season sometimes longer, e.g. Welcome Swallow recorded breeding throughout year in parts of Aust. Season shorter at higher latitudes (where laying may not begin till early summer), but can extend throughout year in tropics and subtropics; sometimes with peaks during rains. Breeding can also follow rains in arid regions. Breeding potential of some species may be limited by lack of mud for nests, particularly during extended dry periods or drought. SITE: Species that nest in pre-existing holes, or in burrows that they excavate themselves, use sites such as tree-hollows, termitaria, crevices in cliffs and caves, burrows in banks and cuttings, holes in artificial structures, and nest-boxes. Others build mud nests (see below), attached to trees, riverbanks, cliffs and caves, and a multitude of artificial structures, including bridges, culverts, wells, dams, mine shafts and exteriors and interiors of buildings. Use of unusual sites, generally artificial, is not uncommon in some species. Nests usually placed some distance above ground or often above water, and mud nests often built just beneath overhead cover. Nest-sites, especially mud nests, commonly re-used. Some species, such as Purple Martin, may usurp nests of other hirundines. NEST, MATERIALS: Nesting burrows comprise an entrance-tunnel, sometimes >1 m long, with an enlarged nest-chamber at the end. Mud nests vary in form, from open cups or half-cups to retort- or bottle-shaped structures with entrance spouts. Structure of mud nests often varies according to nest-site, e.g. nests of Welcome Swallow cup-shaped on horizontal surfaces, and usually half-cup if fixed to vertical surface or built in angle; when nesting in crevices, some species (e.g. South African Swallow *Hirundo spilodera*) simply add mud to reduce diameter of entrance to nest and to create tunnel. Most mud-nesting species build nests from pellets of pure mud, but some mix mud with grass, rootlets or other material. Both nesting burrows and mud nests have bowl-shaped lining, most commonly of grass, rootlets, leaves, twigs, hair and feathers. Nesting materials (including mud) sometimes stolen from nests of conspecifics. Both sexes build, which can take several days or several weeks. EGGS: Varyingly oval or subelliptical, usually smooth and somewhat glossy. Typically white and unmarked, though in some mud-nesting species, eggs spotted and blotched with reddish, brownish, grey or purple markings, usually concentrated at large end. Size of eggs does not vary substantially between smaller species (e.g. Blue-and-white Swallow, 17.2 × 12.5 mm, 1.4 g) and larger ones (e.g. Purple Martin, 24.3 × 17.4 mm, 4.1g). CLUTCH-SIZE: In tropics, usually two or three. In temperate regions, typical range 3–6, and in many species, clutch-size usually 4–5; clutches of 1–2 or 7–8 recorded occasionally, but may result from disruption of laying or egg-dumping. Clutch-size declines as breeding season progresses; and, in widely distributed species, tends to be smaller at lower latitudes. LAYING: Eggs laid early in morning, usually on successive days. Some species (e.g. Purple Martin, Cliff Swallow) engage in egg-dumping. Some species (e.g. Cliff Swallow) usually rear one brood per season, while others (e.g. Barn Swallow) often rear two, or sometimes three; multiple broods occur most commonly in lower latitudes. INCUBATION: By both sexes or, in some species, by female only. Begins with last or penultimate egg when by female only, and usually before penultimate egg when by both sexes. Incubation period in most species 14–18 days, but ranges from 10 to 21 days. YOUNG: Hatch over 1, 2 or sometimes 3 days. Nestlings usually fed by both parents, often almost equally; in cases of polygyny, one brood occasionally fed by female parent only. Helpers may also feed young in some species (e.g. Barn and Welcome Swallows). Nestlings usually brooded by both parents. Adults remove or swallow faecal sacs for *c.* 1 week after hatching. FLEDGING TO INDEPENDENCE: Fledging period usually 3–4 weeks. Fledging usually synchronous, with entire brood usually fledging on same day or within 24 h (and sometimes much less), but broods occasionally leave over >1 day. Young return to nest often during day, and roost in nest at night, for several days, and sometimes several weeks, after fledging. Both sexes feed fledgelings. Young dependent on adults for 1–4 weeks after fledging. SUCCESS: Causes of breeding failure include extreme or adverse weather, and depredation of nests by a variety of avian, reptilian, mammalian and even invertebrate predators. Nests also susceptible to infestation by a wide variety of blood-sucking and other parasites, which can reduce breeding success (Keith *et al.* 1992; Turner 2004; BWP; see species accounts).

Seven species considered globally threatened. White-eyed River Martin of Thailand, discovered only in 1968, is critically endangered, mainly as a result of loss and degradation of habitat at their unknown breeding sites and wintering grounds, exacerbated by hunting and trapping at roosting sites. Six other species considered vulnerable: Bahama Swallow *Tachycineta cyaneoviridis* (Bahamas), Golden Swallow *T. euchrysea* (Jamaica, Haiti, Dominican Republic), Galápagos Martin *Progne modesta* (Galápagos), Peruvian Martin *P. murphyi* (Peru, Chile), Blue Swallow *Hirundo atrocaerulea* (e. Africa), and White-tailed Swallow *H. megaensis* (Ethiopia) (Stattersfield & Capper 2000; BirdLife International Species Factsheets, available at http://www.birdlife.org/datazone/species/index.html [accessed Sept. 2005]).

REFERENCES

AOU. 1998. *Check-List of North American Birds*. Seventh edn. Am. Orn. Union, Washington, DC.

Barker, F.K., *et al.* 2005. *Proc. Natn. Acad. Sci., USA* 101(30): 11,040–45.

Beecher, W.J. 1953. *Auk* 70: 270–333.

Berndt, R., & W. Meise. (Eds) 1962. *Naturgesichte der Vögel. 2*. Franckh'sche Verlags., Stuttgart.

Bock, W.J. 1962. *Auk* 79: 425–43.

Christidis, L., & W.E. Boles. 1994, *RAOU Monogr.* 2.

Coates, B.J. 1990. *The Birds of Papua New Guinea*. Dove Publs, Alderley, Qld.

de Schauensee, R.M.1984. *The Birds of China*. OUP, Oxford.

del Hoyo, J., *et al.* (Eds) 2004. *Handbook of the Birds of the World. 9*. Lynx Edicions, Barcelona.

Dickinson, E.C., & R.W.R.J. Decker. 2001. *Zool. Verh., Leiden*. 335: 127–44.

Griffioen, P.A., & M.F. Clarke. 2002. *Emu* 102: 99–125.

Heinzel, H. 1977. *The Birds of Britain and Europe*. Collins, London.

Keith, S., *et al.* (Eds) 1992. *The Birds of Africa. 4*. Academic Press, London.

King, B.F., *et al.* 1978. *Birds of South-East Asia*. Collins, London.

Kükenthal, W., & T. Krumbach. (Eds) 1927–34. *Handbuch der Zoologie. Eine Naturgeschichte der Stäamme des Tierreiches*. Walter de Gruyter & Co., Berlin.

Mayr, E., & D. Amadon. 1951. *Am. Mus. Novit.* 1496: 1–42.

——, & J. Bond. 1943. *Ibis* 85: 334–41.

Monroe, B.L., Jr., & C.G. Sibley. 1993. *A World Checklist of Birds*. Yale Univ. Press, New Haven, CT.

Moreno, E. 1986. *Ardeola* 33: 69–129.

Orn. Soc. Japan. 2000. *Check-List of Japanese Birds*. Orn. Soc. Japan, Tokyo.

Ridgely, R.S., & G. Tudor. 1994. *The Birds of South America. 2*. OUP, Oxford.

Robson, C. 2000. *A Field Guide to the Birds of South-East Asia*. New Holland, London.

—— 2002. *Birds of Thailand*. New Holland, London.

Sharpe, R.B. 1885. *Catalogue of the Birds of the British Museum. 10. Fringilliformes (Part 1)*. Br. Mus. Nat. Hist., London.

Sheldon, F.H., & D.W. Winkler. 1993. *Auk* 110: 798–824.

——, *et al.* 2005. *Mol. Phylogenet. Evol.* 35: 254–70.

Sibley, C.G. 1970. *Bull. Yale Peabody Mus. Nat. Hist.* 32; 1–131.

——, & J.E. Ahlquist. 1982. *J. Yamashina Inst. Orn.* 14: 122–30.

——, —— 1990. *Phylogeny and Classification of Birds*. Yale Univ. Press, New Haven, CT.

——, & B.L. Monroe, Jr. 1990. *Distribution and Taxonomy of Birds of the World*. Yale Univ. Press, New Haven, CT.

Stattersfield, A.J., & D.R. Capper. (Eds) 2000. *Threatened Birds of the World*. Lynx Edicions, Barcelona, and BirdLife International, Cambridge, UK.

Stresemann, E. 1927–34. **In**: Kükenthal & Krumbach 1927–34.

Turner, A.K. 2004. *Family Hirundinidae (Swallows and Martins)*. Pp 602–40 **In**: del Hoyo *et al.* 2004.

Turner, A.T., & C. Rose. 1989. *A Handbook of the Swallows and Martins of the World*. Christopher Helm, London.

Voous, K.H. 1977. *Ibis* 119: 223–50.

Warner, R.W. 1972. *J. Zool., Lond.* 168: 381–93.

Wolters, H.E. 1975–82. *Die Vogelarten der Erde*. Paul Parey, Hamburg.

Hirundo nigricans **Tree Martin**

COLOUR PLATE FACING PAGES 1529, 1560

Hirundo nigricans Vieillot, 1817, *Nouv. Dict. Hist. Nat., Nouv. Éd., Paris* 14: 523 — Nouvelle-Hollande = Hobart, Tasmania.

The specific name refers to the blue-black crown and upperparts of this swallow (Latin *nigricans*, blackish).

OTHER ENGLISH NAMES Australian or Western Tree Martin; Tree Swallow.

POLYTYPIC Nominate *nigricans*, Tas. and islands in Bass Str., wintering N throughout e. Aust. to Arnhem Land and Tiwi Is, NT, C. York Pen. and islands in Torres Str., Qld, and New Guinea, Bismarck Arch. and Solomon Is, vagrant to NZ; *neglecta* (Mathews, 1912), throughout Aust. except central sandy deserts, breeding mainly S of 20°S, wintering mainly N of 30°S to New Guinea region; *timoriensis* (Sharpe, 1885), Lesser Sundas.

FIELD IDENTIFICATION Length 12 cm (10–13); wingspan *c.* 28 cm; weight *c.* 15 g. Medium-small swallow with large, rounded head, small, short bill with wide gape, short neck, stocky body, short tail that is slightly forked when closed but almost square when spread, and long wings, tips of which extend slightly beyond tip of tail. Slightly larger than Fairy Martin *Hirundo ariel*, but similar shape, though tail slightly more strongly forked. Wings proportionately shorter and broader than those of Welcome Swallow *H. neoxena*, but with pointed wing-tips. Two fairly similar subspecies (see Geographical Variation). Sexes similar. Juveniles moult to adult plumage. Juveniles mainly differ by duller, more brownish plumage without gloss, and slightly cleaner-looking and paler rump-patch. **Adult** Lower forehead, dull rufous with fine and indistinct blackish streaking, forming small frontal patch that becomes paler, dull buff or cream, with wear. Upper forehead, crown and nape, glossy blue-black, though gloss lost with wear. Lores, black, forming eye-patch; ear-coverts, smoky grey, contrasting slightly with top of head; sides of neck streaked or mottled buff or dull white. Hindneck, upper sides of neck, mantle, scapulars and back, glossy blue-black, gloss wears duller and lost if very worn; rump and all but longest uppertail-coverts, light grey, sometimes with cream or buff tinge, with narrow black streaking, forming strongly contrasting rump-patch; longest uppertail-coverts, brownish grey with rufous-cream or buff fringes, grading into pale rump-patch with little contrast. Uppertail, grey-black. Most of upperwing appears blackish; marginal and median secondary coverts, blackish with slight glossy blue tinge; greater secondary coverts and most outerwing, dark brown with narrow white strip along leading edge of outerwing. Remiges, black-brown with slight bluish gloss, becoming dark brown with wear; tertials further patterned with narrow but distinct off-white to cream fringes to tips when fresh, forming fine scalloping, and which lost with wear. Chin, throat and lower sides of neck, dirty cream, dull white or pale rufous, and usually with blackish streaking, but streaking indistinct on some, especially those with rufous tinge. Sides of breast, smoky grey; rest of breast, flanks and thighs, dull rufous, buff or cream, often with blackish streaking, but some, especially those with rufous tinge, have faint brownish streaking; breast and flank coloration grades paler and streaking dissipates into belly and vent, grading almost white in centre. Undertail-coverts, grey with dark streaking and diffuse, broad white fringes with cream tinge. Undertail, dark grey with narrow white inner edges to rectrices, visible only when perched. Underwing mostly grey with dirty buff and sometimes slight rufous tinge to coverts, with dark-grey mottling on leading edge of outerwing, forming broad dark trailing edge. Bill, black; iris, blackish brown; orbital ring, dark grey. Legs and feet, dark pinkish-grey. **Juvenile** Like adult but: Lower forehead, paler, cream or buff, with dark-brown streaking. Lores, paler, grey-black, more diffuse in front of eye, and merging more into smoky grey of ear-coverts. Top of head, neck, scapulars and back, dark brown (black in adult), and lack gloss. Rump and all but longest uppertail-coverts slightly paler than adult, with cream tinge and fainter dark streaking, appearing cleaner; longest uppertail-coverts, grey with neat grey-buff fringing. Uppertail, brownish grey. Upperwing paler than adult, dark brown (black in adult) with neat buff fringes to coverts (difficult to see unless perched); tertials broadly patterned with cinnamon-buff tips (lost with wear); secondaries and innermost primaries have narrow whitish-buff edging and fringing which only visible with close views. Chin and throat, dull white (no cream, buff or

rufous tinge) with faint or no streaking. Rest of underparts with weaker suffusion of colour than adult; sides of breast, smoky grey, as adult, but breast and flanks more lightly washed cream, buff or pale rufous, and streaking very faint; centre of breast and vent off-white, as adult; undertail-coverts, plain off-white with slight rufous, buff or cream wash, and narrow dark streaking. Undertail and underwing as adult.

Similar species Most similar to **Fairy Martin**, from which adults distinguished by: Top of head, glossy blue-black (rufous on Fairy Martin); rump-patch appears dirty, pale grey with distinct dark streaking, contrasting little with longest uppertail-coverts, giving impression of large patch (paler, whitish on Fairy Martin, sometimes with cream or buff tinge, but lacking greyish tones, and contrasting much with longest uppertail coverts, making patch appear smaller [note: sometimes not separable]); underbody heavily streaked and with strong rufous or buff tinge (Fairy Martin paler and cleaner-looking underneath); and tail slightly longer with slightly deeper fork (tail of Fairy Martin shorter and squarer, with shallower fork). Juveniles less readily distinguished from juvenile Fairy Martins, mainly by dark coloration of top of head (rufous in Fairy Martin); other characters are less reliable: rump-patch sometimes much paler than adult, but tends to have greyish wash (though Fairy Martin quite similar, rump-patch slightly paler, without greyish tones); and underparts tend to have greyish tones (Fairy Martin similar, often difficult to separate, but lack greyish tones to underbody). Distinguished from **Welcome Swallow** by: contrasting pale rump-patch (all upperparts dark glossy blue-black on Welcome Swallow); only lower forehead dull rufous (Welcome Swallow has large rufous forehead); pale, dirty-cream chin and throat (Welcome Swallow has large rufous throat-patch); tail short and either squarish or only slightly forked (Welcome Swallow usually has long tail-streamers, though these sometimes not present if undergoing moult); and silhouette in flight (Welcome Swallow is larger, more slender and longer winged). Juvenile Welcome Swallow more similar, with shallower fork in tail and less well-defined rufous forehead, and distinguished by: pale, dirty-cream chin and throat (juvenile Welcome Swallow has rufous throat-patch); streaked underparts (lacking on juvenile Welcome Swallow); tail short with blunt tips (tail of Welcome Swallow slightly longer with more pointed outer tail-feathers, forming slightly more acute and pointed fork). Distinguished from **Barn Swallow** *Hirundo rustica* by same characters mentioned for Welcome Swallow; in addition, often separated by: streaking only marking on underparts (Barn Swallow often has black breast-band). For differences from **Red-rumped Swallow** *H. daurica* and **Asian House Martin** *Delichon dasypus*, see those species.

Usually occur in flocks of up to 20–30, but sometimes in flocks comprising hundreds or thousands; sometimes also seen singly or in twos. Often mix with Fairy Martins or Welcome Swallows, and occasionally with other aerial species such as woodswallows or swifts. Sometimes breed colonially. Mostly forage in air, screening or sallying high above trees or low over water or grass. Flight similar to that of Fairy Martin, with more fluttering than Welcome Swallow; fly low to ground, buoyantly twisting and turning, fluttering and gliding among trees, and rapidly accelerating to chase insects; and fly high above trees with rapid, clipped wing-beats, wheeling and arcing. Fly directly into tree-hollows at great speed. Often perch with other swallows on overhead wires or fences, and occasionally gather on ground. Utter pleasant twittering Song and calls sometimes rendered as *drrrt-drrrt*.

HABITAT Occur in airspace above various habitats, ranging from open grassy areas or low shrublands, to woodlands and forests, especially near wetlands; also occur in built-up areas (see below). Occur from coasts to inland arid zones (Aust. Atlas 1, 2); and recorded from sea-level (e.g. Crawford 1972; Brothers 1979; Gosper 1983) to >1500 m asl (Fyfe 2003).

Often occur round wetlands, both permanent and ephemeral, freshwater and salt, natural and artificial, including watercourses, swamps, lakes, billabongs, coastal, subcoastal and inland lagoons, estuaries, sewage ponds, saltworks and dams (e.g. Clarke 1967; Beruldsen 1969; Rix 1970; Henley 1974; Morris 1975; Boekel 1976, 1980; Thompson 1978; Pierce 1980; Gosper 1981; Sharrocks 1981; Morrison & Morrison 1985; Smith & Chafer 1987; Henle 1989; Hewish *et al.* 1999; Baverstock & McCarthy 2000; Britton & Britton 2000; Ashton 2001; Hewish 2002a; Storr 7, 11, 16; CSN 41) with vegetation varying from grass, reeds, rushes and sedges or low shrubs to trees (see below). Often recorded in open grassy areas, such as dry or moist tussock grasslands of *Poa*, *Danthonia* or *Stipa*, sometimes with sparsely scattered trees (Ridpath & Moreau 1966; McEvey & Middleton 1968; Brandle 1998; Bryant 1998; Storr 7); or pasture, including irrigated areas, especially farmland with tree-lined creeks or roads (Sedgwick 1940, 1986a; Emison & Porter 1978; Morrison & Morrison 1985; Semmens 1993); or other grassy areas such as airstrips (Johnson & Hooper 1973), golf courses (Ratkowsky 1993b; Hewish 2002a) or grassy swamps with sparsely scattered eucalypts (Leach & Hines 1987); also in airspace above reeds, rushes and sedges (Serventy 1937b; Hobbs 1961; McEvey 1965; Bedggood 1972; Pierce 1980; van Delft 1984; Smith & Chaffer 1987; Ashton 2001). Often occur above shrublands, including low coastal saltmarsh dominated by *Sarcocornia*, heathlands, or chenopod shrublands dominated by saltbush *Atriplex*, *Rhagodia*, *Sclerolaena* or bluebush *Maireana* in arid and semi-arid areas, occasionally with scattered taller, emergent shrubs such as acacias or *Myoporum*; and low open shrubland, dominated by various acacias, sometimes mixed with other shrubs such as hopbush *Dodonaea* in semi-arid areas (McEvey & Middleton 1968; Johnstone 1983; McFarland 1988; Brandle 1998; Ashton 2001). Often recorded round thickets of trees, surrounded by open areas of grass or rushes (Smith & Chafer 1987; Bremner 1991), or in patches of trees in farmland (Loyn 1985c). In coastal areas, often occur in mixed shrubland–woodland, e.g. near Bega, se. NSW, occasionally occur in coastal associations of Coast Banksia and Southern Mahogany, with shrubby understorey (Smith 1984). Often recorded flying over open woodlands, such as low, open acacia woodlands in arid and semi-arid areas, dominated by Mulga, Dead Finish, Gidgee, Sandhill Wattle *Acacia ligulata*, or Brigalow, sometimes mixed with hopbush *Dodonaea* (Leach 1995; Brandle 1998); low banksia woodland with dense heath understorey (Halse *et al.* 1985); also various open eucalypt woodlands, such as River Red Gums, Coolibahs or Black Box, either open and grassy or with low shrubs, or with well-developed shrub-layer, associated with wetlands on plains (e.g. McEvey 1965; Badman 1981, 1989; Gibson 1986; Henle 1989; Newbey & Newbey 1989; Gates 1996; Brandle 1998; Loyn *et al.* 2002; Coate 2003); mallee woodland in semi-arid areas (Wilson 1912; McEvey & Middleton 1968; Possingham & Possingham 1997; Luck *et al.* 1999); York Gum, Wandoo or Powderbark *Eucalyptus accedens* woodland with sparse mid-storey or shrub-layer on plains in WA (McEvey & Middleton 1968; Nichols & Nichols 1984; Biddiscombe 1985; Halse *et al.* 1985); and Silver Box *E. pruinosa* or Darwin Stringybark in n. Aust. (Officer 1976; Sage 1994); and in foothills, Yellow Box–Blakely's Red Gum woodland (Er & Tidemann 1996, 2001; Er 1997; Er *et al.* 1998; McDonald 2001); sometimes also seen above mixed woodlands, with eucalypts such as River Red Gum, Yellow Gum or Yellow Box, mixed with casuarinas and cypress-pines (McEvey 1965; Clarke 1967; Rix 1976). Also occur above eucalypt forests, including: dry sclerophyll forests, sometimes in mixed associations, such as forest

of Moreton Bay Ash, River Red Gum, White Cypress-pine and Belah in s. Qld (Jones 1986); Spotted Gum associations either with ironbarks, bloodwoods and Forest Red Gum in ne. NSW, or with Yellow Stringybark *Eucalyptus muelleriana* and Woollybutt in se. NSW (Smith 1984; Gosper 1992); box–ironbark associations in Vic. (Traill *et al.* 1996); mixed eucalypt forests in Vic. Ranges, including in broad gullies dominated by Manna Gums and Narrow-leaved Peppermint, and stands containing Silvertop Ash or Narrow-leaved Peppermint (Friend 1982; Loyn 1985b); forests dominated by White Peppermint *Eucalyptus pulchella* and Manna Gum in Tas. (Ratkowsky & Ratkowsky 1977; Ratkowsky 1983), forests of Long-leaved Box and Yellow Gum in SA (Clarke 1967; Gepp & Fife 1975), Jarrah and Marri forests in sw. WA (Nichols & Nichols 1984), and forests of Darwin Stringybark and Darwin Woollybutt with small stands of cypress-pine *Callitris* and occasional acacias in n. Aust. (Haselgrove 1975). Less often recorded flying above wet sclerophyll forests, e.g. forests dominated by Tallow-wood, Blackbutt and Red Mahogany in ne. NSW (Gosper 1992); Mountain Ash in Vic. (Loyn 1985a); or Alpine Ash or Messmate in Tas. (Ratkowsky & Ratkowsky 1977; Ratkowsky 1983). Also very occasionally recorded above various rainforests, including semi-evergreen notophyll and semi-evergreen microphyll vine forests in tropical lowlands and subcoastal areas (Woinarski *et al.* 1989; Woinarski 1993); in subtropical areas, in low dry (monsoon) rainforest dominated by Lacebark, Deep Yellow-wood and White Cedar, with scattered emergents including Hoop Pine and Silky Oak *Grevillea robusta*, or tall closed subtropical rainforest with Black Booyong, Purple Cherry and Yellow Carabeen in upper canopy (Gosper 1992); or warm-temperate rainforest dominated by Lilly Pilly with Grey Myrtle, Yellow Sassafras and Sweet Pittosporum and Orange Thorn *Citriobatus pauciflorus* (Smith 1984, 1985). Occasionally occur in built-up areas, including city streets (Sharland 1943; Sedgwick 1944; Fielding 1977; Gibson 1977; Harris 1980); also rubbish tips (Loyn 1985c). In coastal areas, sometimes recorded round beaches, sand-dunes and cliffs, and occasionally mangroves (Butler 1970; Crawford 1972; Storr *et al.* 1975; Brothers 1979; Gosper 1983; Johnstone 1983).

In some forests in ranges, such as Mountain Ash forests in Vic., found mainly where suitable nest-sites are available in large hollow-bearing trees, especially where such trees grow in open situations, i.e. mature forest or recent logging coupes, but not in extensive areas of regrowth from severe fire or logging (R.H. Loyn).

DISTRIBUTION AND POPULATION Occur from Lesser Sundas and s. Moluccas, E through New Guinea to Solomon Is, and said to be vagrant to New Caledonia (Schmutz 1977; White & Bruce 1986; Coates 1990; Doughty *et al.* 1999; Dutson 2001); in HANZAB Region, widespread in Aust., and occasional visitor to NZ and various outlying islands.

Aust. Widespread. **Qld** Widespread (Aust. Atlas 1, 2; Storr 19), though recorded at few sites in lowlands associated with e. Gulf of Carpentaria, e.g. Mitchell and Edward Rs (Roff 1967; Garnett & Bredl 1985; Aust. Atlas 1, 2; Storr 19). Occur on islands in Torres Str. (Ingram 1976; Draffan *et al.* 1983; Ingram *et al.* 1986), including on Boigu, where first recorded in July 1996 (Lansley 1997); and occasionally recorded in n. Gulf of Carpentaria (Lavery 1964; Blake 1985). **NSW** Widespread (Morris *et al.* 1981; Gosper 1986; Cooper & McAllan 1995; Chafer *et al.* 1999; Aust Atlas 1, 2). **Vic.** Widespread, though sparsely scattered in highlands in n. Gippsland and s. North-East Regions, and in w. Mallee (Vic. Atlas). **Tas.** Widespread, especially in E, and more scattered in W (Thomas 1979; Aust. Atlas 1, 2; Tas. Bird Reps): w. records shown in Thomas (1979) are mostly clustered round Ls Pedder and Gordon, and from Strahan and Queenstown N to Pieman R., with records sparsely scattered elsewhere, though common in coastal and lowland areas of SW (Green & Mollison 1961; White 1985; R.H. Loyn). Also occur on islands in Bass Str., from Hunter Grp and King I. E to Furneaux Grp and N to Kent Grp (Green 1969; Green & McGarvie 1971; Brothers & Davis 1985; Garnett *et al.* 1991; Bryant & Holdsworth 1992; Aust. Atlas 1, 2). **SA** Wide-spread in most regions, though, in W, absent or very sparsely scattered in e. Great Victoria Desert, but occur in Musgrave Ras farther N, and on Nullarbor Plain farther S (Close & Jaensch 1984; Paton *et al.* 1994; Stove 1994; Carpenter & Matthew 1997; Aust. Atlas 1, 2; SA Bird Rep. 1977–81). **WA** Widespread (Saunders & Ingram 1995; Johnstone *et al.* 2000; Aust. Atlas 1, 2; Storr 11, 16, 21, 27, 28, 35) except in Gibson and Great Victoria Deserts, where recorded at a few sparsely scattered sites (Johnstone *et al.* 1979; Storr 1981; Aust. Atlas 1, 2; Storr 22, 26). **NT** Widespread, though sparsely scattered in Tanami and Simpson Deserts (Roberts 1980; Gibson 1986; Gibson & Cole 1988; Goodfellow 2001; Aust. Atlas 1, 2); claimed that widespread only in Top End (Storr 7).

NZ Vagrant; first recorded in 1851 (Oliver). Some early records possibly referred to Welcome Swallows (Edgar 1966); see Stidolph (1927), Barton (1947) and Oliver for details of some early records. All records of singles unless stated. **NI** Published records since 1960: *c.* 30–35, Karakatuwhero R., near Te Arara, 25 Apr. 1974, and *c.* 20 at same site on 13 July 1974 (Henley 1974); *c.* 20, Rangitukia, 9 Apr. 1975 (CSN 24); Tarawera R. estuary, Jan. 1977 (Edgar 1978) and nearby Matata, 25 Apr. 1977 (CSN 24); Miranda, 18 Feb. 1979 (CSN 26); Hamilton Sewage Ponds, Pukete, 20 Feb. 1992 (CSN 41; accepted by RBC [Sub. 92/04]); Raglan Harbour, 4 Dec. 1997 (CSN 47). **SI** Published records since 1960: two, Farewell Spit, 14 Jan. 1960 (Wright 1960); five, mouth of Waitaki R., mid-June 1972 and two at same site, mid-July 1972 (CSN 19 Suppl.); L. Waituna, Jan. 1973 (CSN 19 Suppl.), probably this species; Waipori, near L. Waihola, 1975 (CSN 22); L. Wainono, June 1976 (Pierce 1980; CSN 23); Punakaiki R. estuary, 5 June–3 July 1978 (CSN 25); Farewell Spit, 3 Oct. 1978 (Dennison & Robertson 1979; CSN 26); Vernon Lagoons, Apr. 1980 (NZCL); one or two, L. Holm, near Clarendon, 3 Dec. 1981–5 Mar. 1982, two at same site, 19–20 Dec. 1982, and three (possibly including two juveniles), 20 Jan.–14 May 1983 (Nevill 1984); Nelson Haven, 23 Nov. 1982 (CSN 31); Eglinton Valley, Fiordland NP, 3 Oct. 1983 (Morrison & Morrison 1985); up to 11, L. Holm, near Clarendon, 12 Jan.–2 Mar. 1984 (CSN 32) and single at same site, Mar. 1986 (CSN 34); Farewell Spit, Dec. 1990–Jan. 1992 (CSN 41); up to three, Clarendon, 13 Dec. 1996–17 Jan. 1997 (CSN 48). See Stidolph (1927), Phillips (1947) and Oliver for details of historical records.

Lord Howe I. Single, Jan. 1967; two, 26 Dec. 1968; single, Jan. 1971; single specimen, 18 Aug. 1978; unknown number, Apr. 2001 (McAllan *et al.* 2004).

Christmas I. Single, 2–3 Nov. 1993 (Carter 1994), though subsequently re-identified as Asian House Martin (M.J. Carter; q.v.).

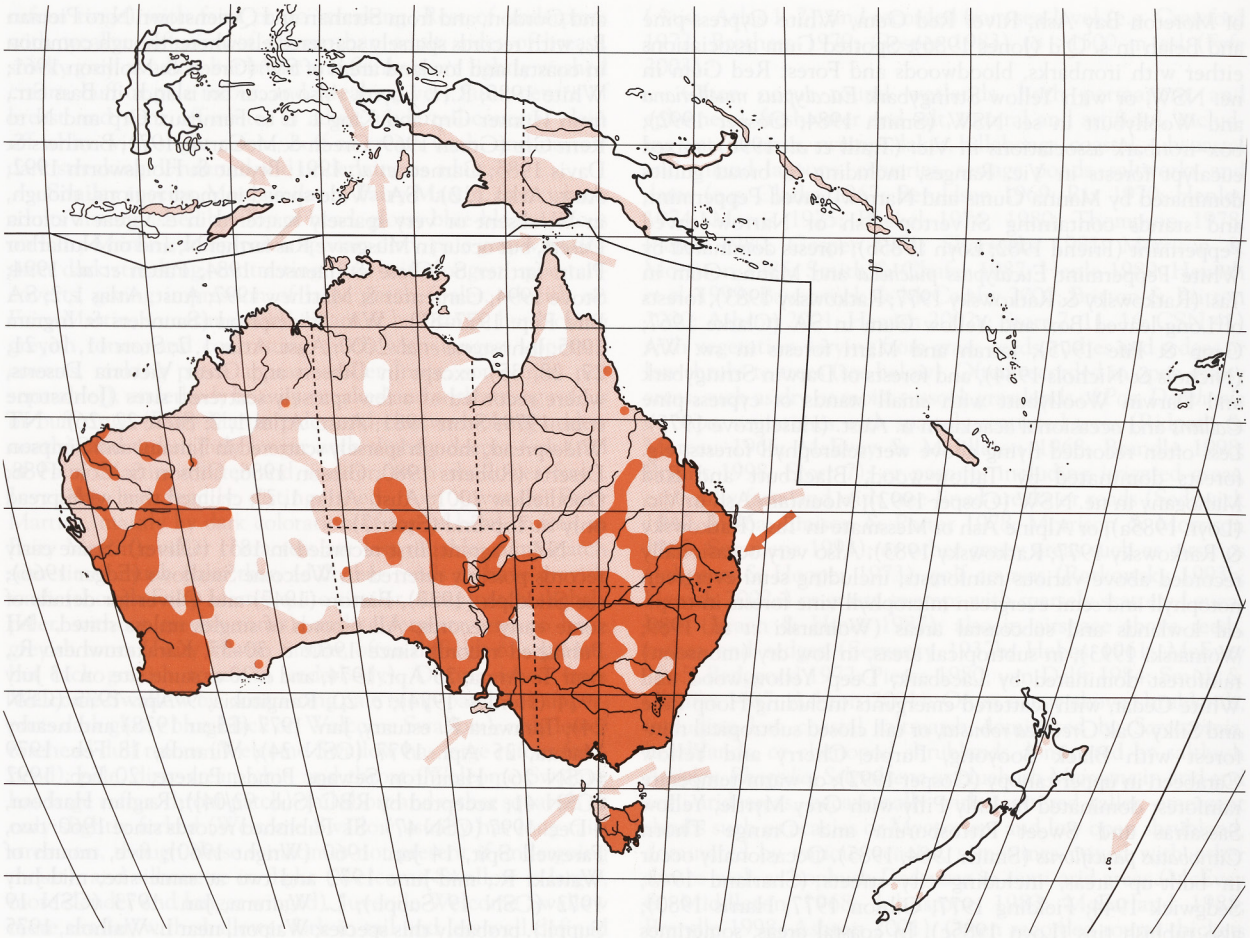
Kermadec Is Unconfirmed report of single, Raoul I., 14 Sept. 1966, with another exhausted bird captured at about that time (Merton 1970).

Snares Is Two, 18–20 Feb. 1969 (Warham & Keeley 1969); two, Aug.–Oct. 1982 (Miskelly *et al.* 2001); two, 4–12 Feb. 1984 (Miskelly *et al.* 2001).

Chatham Is Single, Te Whanga Lagoon, Chatham I., 22 Nov. 1988 (CSN 37).

Macquarie I. Unknown number, Sept. 1970 and Oct. 1974 (Green 1989).

Breeding In Aust., seldom recorded N of 20°S, e.g. at Kaban and near Townsville in ne. Qld, and Stretch Lagoon on



Canning Stock Route, WA (Gill 1970; Aust. Atlas 2; NRS). In e. Aust., mostly recorded S and E of line between Eungella, Qld, and Smoky Bay, SA; also widespread in parts of n. SA and s. NT, in area bounded by William Ck and Anna Ck Stns in SE, Lasseters Cave (150 km WNW of Yulara) in W and Alice Springs and Derwent R. (near Haast Bluff) in N; and widespread in WA, mainly W of 120°E; a few scattered records elsewhere, e.g. Serpentine Ls in e. Great Victoria Desert, near Moonera Tank on Hampton Tableland, and near Mt Ragged, N of C. Arid NP, in s. WA (Aust. Atlas 1, 2; NRS). No confirmed records in NZ; historical report of breeding at Oamaru in 1893 (Oliver), but this may have referred to Welcome Swallows (Heather & Robertson 2000).

Change in range, population Numbers round Roxby Downs, inland SA, increased since 1980s (Read 1999). On Rottnest I., WA, uncommon visitor in late 1950s and early 1960s, but huge numbers recorded by 1980s, and first breeding recorded in 1983 (Saunders & de Rebeira 1993; Storr 28). Speculated that numbers in Wheatbelt of s. WA may have declined after clearance of woodland (Saunders & Ingram 1995). Comparison of data in Aust. Atlas 1 (1977–81) and Aust. Atlas 2 (1998–2002) indicates that overall there was no change in reporting rates between the two periods; however, declines were recorded on C. York Pen., on and E of Great Divide in se. Qld and NSW, in Central-west Plain and Riverina Regions of NSW and throughout much of Vic. (Aust. Atlas 1, 2).

Populations RECORDED DENSITIES: 0–0.03 birds/ha, near Armidale, NSW (Ford *et al.* 1985); 0–4.29 birds/ha, near Moyston, Vic. (Kennedy 2003); 0.42–1.11 birds/ha, near Woodsdale, Tas. (Taylor *et al.* 1997); 0–0.50 birds/ha, Eyre Bird Observatory, WA (Davies 1982); 0.3 birds/ha, Jarrahdale, WA (Wykes 1985); 0.7 birds/ha, Margaret R., WA (Keast 1985); 0.32 birds/ha, Barrow I., WA (Sedgwick 1978); 0.2 birds/ha, S. Alligator R., NT (Keast 1985); 0.08–2.56 birds/ha, Howards Pen., NT (Woinarski *et al.* 1988).

THREATS AND HUMAN INTERACTIONS Suggested that populations in Wheatbelt of s. WA adversely affected by clearance of woodland (Saunders & Ingram 1995). Adversely affected by logging of hollow-bearing trees in mountain forests in Vic. and resultant change in structure of forest (Loyn 1985a, 1998). Occasionally killed by vehicles on roads (Mollison & Green 1962; Brown *et al.* 1986; J.M. Peter). Expansion of range of Common Starling *Sturnus vulgaris* in se. Aust. thought to have caused decline in local populations due to appropriation of nesting hollows (Batey 1907). Very occasionally attracted to lights of lighthouses (Hogan 1925).

MOVEMENTS Largely migratory in e. Aust., s. populations moving N to winter in n. Aust. and New Guinea, and returning in spring (Clarke *et al.* 1999; Bell 1967, 1968; Dutson 2001; Aust. Atlas 1), though some populations resident and some part-migratory, so that, in s. Aust., population of a few wintering birds augmented by visitors in spring, and in some parts of n. Aust., local populations swelled by birds on passage or visiting in winter (see below). Broad-scale analysis of bird atlas and count data from e. Aust. found strong evidence for seasonal N–S pattern of movement, moving N in autumn and S in spring, in 'Mid Line North' pattern (see Griffioen & Clarke 2002); much published data from e. and s. Aust., but little from n. Aust. Movements in WA and SA probably

similar, but less clear (see below). Regularly seen flying across Bass Str. (Sutton 1998).

Considered resident or recorded throughout year (probably sedentary of *HANZAB*) at many sites, e.g. at Innisfail, ne. Qld (Gill 1970); at Rockhampton (Longmore 1978) and various sites in se. Qld, both in coastal lowlands (Roberts & Ingram 1976; Durrant & Mac Rae 1994; Noyce 1997) and in hinterland (Lord 1943, 1956; Nielsen 1991; Templeton 1992); in NSW, in lower reaches of Richmond and Hunter Rs (Gosper 1981), Sydney (Hoskin 1991), sw. NSW (Hobbs 1961), round Cobar (Schmidt 1978) and Coonabarabran (NSW Bird Rep. 1978); in n. Vic., round Dookie and Mooroopna (Rowley 1961; Roberts 1975), and farther S in E. Gippsland (Bedggood 1970, 1980); in inland SA, in Cooper Ck Drainage Basin and n. Flinders Ras (McGilp 1930; Badman 1989); in n. and s. Mt Lofty Ras, SA (Ford & Paton 1976; Paton & Paton 1980, though see below); claimed that resident round Adelaide, with local movements (Morgan 1916a,b); at various sites in s. WA, at Eyre Bird Observatory (Ashton *et al.* 1996), L. Grace (Carnaby 1933), Northam (Jenkins 1931; Masters & Milhinch 1974) and on Swan Coastal Plain (Serventy 1937a; Sedgwick 1940; Heron 1970; Stranger 1993; Brooker 2001), and farther N in parts of Gascoyne and Pilbara Region (Storr 16, 21), including round Carnarvon (Brooker & Estbergs 1976; Johnstone *et al.* 2000), on Barrow I. (Sedgwick 1978), round Wittenoom (Howard 1986) and Broome (Collins 1995); and in NT, at Adelaide R. (Rhodes 1944) and on Groote Eylandt (Haselgrove 1975; *contra* Noske & Brennan 2002).

Considered a partial migrant in many areas; although recorded throughout year, local populations fluctuate seasonally, with numbers generally lowest in winter in s. Aust., e.g. round Cobar, w. NSW (Schmidt 1978), e. NSW, including Hunter and Illawarra Regions (Morris 1975; Gibson 1977), in ACT (Veerman 2003; ACT Atlas), n. Vic., such as Caniambo (Bedggood 1973; Vic. Atlas), on Mt Mary Plains and Kangaroo I., SA (Boehm 1957; Baxter 1989), and at Eyre Bird Observatory, s. WA (Ashton *et al.* 1996). Farther N, in se. Qld, round Carnarvon, WA, and at Adelaide R., NT, resident populations are expanded by influx of birds in winter, presumably from farther S (Rhodes 1944; Vernon 1968; Brooker & Estbergs 1976; Johnstone *et al.* 2000); and at Broome, WA, though recorded in all months, numbers swelled in Mar. by birds on passage (Collins 1995). Fluctuations vary much, however, e.g. in lower reaches of Hunter R., NSW, and E. Gippsland, Vic., decline is sharp, and few remain over winter (Bedggood 1970, 1980; Gosper 1981), but in sw. NSW, though numbers lower in winter, decline is slight (Hobbs 1961). After winter, local populations augmented by birds moving into the area, e.g. in s. WA, numbers round Eyre Bird Observatory increase in Aug. or Sept. (Ashton *et al.* 1996), and at L. Grace, numbers increase in spring (Carnaby 1933).

Departure NSW: Depart SE Feb. to late Apr. (Whiter 1993, 1994, 1995; Whiter & Andrew 1998; Andrew 1999); and Southern Tableland early Apr., though some remain till May in mild years (Frith 1969; see also ACT). Farther N, leave Illawarra Region in Mar. (Gibson 1977), St Marys, near Penrith, in Sydney Region, in Feb. (Gilbert 1935); and Hunter Region mid-Mar. to mid-Apr. (Morris 1975; NSW Bird Reps). In Northern Rivers Region, depart Casino, May (Campbell 1938). W of Great Divide, depart Barellan, in Riverina, late Apr. (Campbell 1938); and recorded Gulargambone, Central-west Plain Region, till late May (NSW Bird Rep. 1978). ACT: Most leave Feb.–Mar., though a few depart Jan., and a few remain till mid-Apr. or even May (Lamm & Calaby 1950; Anon. 1974; Lenz 1982; Taylor 1983; Taylor *et al.* 1986, 1987; Veerman *et al.* 1988, 1989; Anon. 1998, 1999a,b; ACT Atlas). VIC: Depart Feb.–Mar. (Vic. Atlas); departure said to be less protracted than that of Welcome Swallows (Semmens 1993). In Gippsland, leave Merrimans Ck, near Rosedale, in Mar. (Ingle 1910), and Rotamah I., late Mar. to Apr., though occasionally early May (Burbidge 1985; Anon. 1989; Hall & Hall 1990; Edwards & Shadbolt 1992; Rolland & Rolland 1996). Farther W, leave Tooradin in early Feb. (Campbell 1932), and ranges E of Melbourne in early Apr. (Campbell 1938; Loyn 1985a). Depart Geelong district late Mar. to Apr. (Hewish 2002a,b), Ballarat district late Apr. (Thomas & Wheeler 1983) and Terang mid-May (Campbell 1938). Farther W, recorded on n. passage near Ararat, mid-Dec. to mid-Mar. (Semmens 1993). In NE, depart Mar.–early Apr., though some remain till May in mild years (Frith 1969; Bedggood 1972). TAS: Mostly leave Mar.–Apr. (Green 1989; Aust. Atlas 1). Depart Hobart Feb.–Mar. (Thomas 1972; Fielding 1977), and Bruny I. by early Apr. (Tas. Bird Rep. 25); Antill Ponds, in s. Midlands, mid-Jan. to early Mar. (Mollison & Green 1962); Great Western Tiers and Lakes District, early to mid-Apr. (Fletcher 1909b; Tas. Bird Rep. 9); and farther N, mostly depart Devonport late Mar., and sometimes early Apr. (Dove 1919, 1925, 1927, 1937). Recorded on passage over Swan I. and C. Portland, in NE, late Jan. to early Feb. (Thomas 1968; Patterson 1985), Furneaux Grp late Feb. to early Mar. (Cashion 1958; Mollison 1960) and Deal I. in mid-Mar. (Garnett *et al.* 1991); and on King I., Feb.–Apr. (Thomas 1969; Green & McGarvie 1971). SA: Leave Mannum, in Murray–Mallee Region, in Mar. (Cox 1973); said to leave Adelaide in Jan., with a few remaining till autumn (Whatmough 1978); and in n. Mt Lofty Ras, depart Sandy Ck CP in May and Para Wirra NP mid- to late June (Clarke 1967; Rix 1976). WA: In SW, depart Porongurup Ra. in Jan. (Abbott 1981) or Mar. (Abbott 1995); Kojonup in Jan., though some leave later (Campbell 1938); and remain at Woodenbillup, near Bunbury, and on Rottnest I. till late Apr. (Campbell 1938; Storr 1965). Sometimes observed on n. passage, e.g. autumn and winter in Swan R. district and Harvey, described as 'long, drawn-out' (Serventy 1948; Sedgwick 1988); mid-Feb. to late May in Eucla Div. (Storr 27); and Mar.–May in South-East Interior (Storr 26); also recorded on passage in parts of Gascoyne and Pilbara Regions (Storr 16, 21).

Non-breeding Seldom breed N of 20°S (see Distribution and Population). N. AUST. *WA*: Winter visitor to parts of Gascoyne Region and Pilbara Div. (augmenting local populations; Storr 16, 21; see above) and Mid-East Interior, e.g. Jiggalong, May–Aug. (Lindgren 1960; Storr 22). Also autumn–winter visitor to Kimberley Div., mainly coastal areas, late Mar. to late Oct. (Johnstone *et al.* 1977, 1981; Johnstone & Smith 1981; Johnstone 1983; Storr 11). *NT*: Present Top End mainly late Mar.–Apr. to Sept.–Nov. (Schodde 1976; Storr 7), e.g. Victoria R. Downs, Apr.–July (Boekel 1980), Darwin May–Aug., with odd birds in some summers (Crawford 1972; Thompson 1978), Gove Pen., May–Oct. (Boekel 1976), and Groote Eylandt, Jan.–Aug. (Noske & Brennan 2002). *QLD*: In North-East Region, winter visitor to islands in Torres Str. (Draffan *et al.* 1983; Aust. Atlas 1) and Atherton Tableland, late Dec. to early Sept. (Bravery 1970); farther W, visit Charters Towers, Apr.–Sept. (Britton & Britton 2000) and Mt. Isa, May–July (Horton 1975). S. AUST.: Sometimes suggested that birds move inland for winter, e.g. mostly recorded Brindana Gorge, n. Flinders Ras, June–Oct. (Hornsby 1997), and winter records, sometimes of large numbers in inland NSW, e.g. Coonabarabran and Cobar (NSW Bird Reps 1978, 1981, 1982, 1992).

Return NSW: Mostly return Aug., sometimes Sept. (see below). Arrive Casino, in Northern Rivers Region, Aug. (Campbell 1938). Farther S, in Hunter Region, return Wyong and Tuggerah, early Aug. to mid-Sept. (NSW Bird Reps 1990, 1993, 1994), and in Sydney Region, Aug.–Sept, e.g. 11 Aug. at Surry Hills (NSW Bird Rep. 2002), Bouddi NP 7–28 Aug.

(NSW Bird Rep. 1989, 1995) and St Marys, near Penrith, Sept. (Gilbert 1935). In SE, mostly arrive mid-Aug. to late Sept. (Whiter 1993, 1994, 1995; Whiter & Andrew 1998; Andrew 1999), e.g. arrive Nethercote, 7–27 Aug. (NSW Bird Reps 1995, 1996, 1997), though once 30 June (NSW Bird Rep. 2000); but said to return to Araluen in Oct. (Gregory-Smith 1991). Said to arrive Southern Tableland Region in second week of Aug. (Frith 1969). ACT: Return July–Sept., mainly Aug. or early Sept. (Lamm & Calaby 1950; Anon. 1969, 1974; Wilson 1970; Marchant 1973; Lenz 1981; Taylor *et al.* 1986, 1987; Veerman *et al.* 1988, 1989; Er & Tidemann 1996; Anon. 1998, 1999a,b; ACT Atlas). VIC: In Gippsland, mostly return Rotamah I. and Merrimans Ck, near Rosedale, in Aug.–Sept. (Ingle 1910; Burbidge 1985; Hall & Hall 1990; Edwards & Shadbolt 1992; Rolland & Rolland 1996), though very occasionally in late July (Anon. 1989); and Toolangi, in ranges E of Melbourne, in Oct. (Loyn 1985a). Mostly arrive Geelong district Aug.–Sept. (Belcher 1914; Hewish 1998, 2002a,b; Vic. Bird Rep. 1986); and Ballarat mid-Aug. (Thomas & Wheeler 1983). Farther W, recorded on s. passage near Ararat, mid-Aug. to mid-Nov. (Semmens 1993). In NE, arrive Aug. (Campbell 1902; Frith 1969), though said not to arrive in Strathbogie Ra. till Oct. (Bedggood 1972). TAS: Mostly return late Aug. or early Sept. to Oct. (Sharland 1958; Green 1989; Aust. Atlas 1; Tas. Bird Reps 7, 22, 25), e.g. in SE, especially round Hobart, though some arrive late Aug. (Thomas 1966), mostly late Sept. to early Oct. (Thomas 1966, 1972; Fielding 1977); and in Midlands and Lake Country, such as Cleveland and Oatlands, late Aug. to early Sept. (Fletcher 1909a; Thomas 1969; Tas. Bird Rep. 8). Occasionally return earlier, e.g. on n. coast, arrived Boat Harbour mid-July (Fletcher 1918) and Bruny I., 8 Aug. (Tas. Bird Rep. 22); or later, e.g. Devonport, mid-Oct., though possibly returned earlier to surrounding countryside (Dove 1922). Arrive King I. early to mid-Sept. (Thomas 1969). SA: In Mt Lofty Ras, return to Para Wirra NP early Aug. (Clarke 1967), and mid-Sept. in Sandy Ck CP (Rix 1976). Arrive Adelaide and Mannum in July (Cox 1973; Whatmough 1978). WA: In SW, return to Kojonup in mid-Aug., and Woodenbillup, near Bunbury, and Porongurup Ra. in Sept. (Campbell 1938; Abbott 1981, 1995); arrive on Rottnest I. mid-Nov. (Storr 1965). Sometimes recorded on s. passage, e.g. in spring and summer in Swan R. district and Harvey (Serventy 1948; Sedgwick 1988); July–Sept., South-East Interior (Storr 26); and early July to early Nov., Eucla Div. (Storr 27), where thousands seen flying E at Eyre Bird Observatory and Eucla, 22–23 Aug. 1982 (Congreve & Congreve 1985).

In NZ, where occasional visitor, though recorded in most months, most records Dec.–Apr., when birds usually present in breeding areas or on n. passage (see Distribution and Population, above).

Aberrant movements N. passage noted at Wilsons Prom., s. Vic., in Nov. and June (Cooper 1975); and flocks seen on s. passage near Perth in late May (Cohn 1926).

Regular local movements In late Jan. and early Feb., large numbers, e.g. c. 15,000, fly from mainland to Rottnest I. to roost (Bremner 1991).

Nature of passage Gather in large flocks before departure (e.g. Norton 1922; Chisholm 1934; Campbell 1938; Clarke 1967; Bedggood 1973; Rix 1976; Nielsen 1991; Templeton 1992; Vic. Atlas; Storr 27). Migrate in flocks, usually of 25–50, but occasionally up to 100, and, in n. Aust., sometimes 1000+ (Gilbert 1935; Mollison 1960; Semmens 1993; Collins 1995; Storr 26). Flocks move in spherical manner, birds weaving within group, flying around one another 'like bees in a swarm'; fly in tight flocks, but less compact than flocks of migrating Fairy Martins (Gilbert 1935; Semmens 1993). Near Ararat, Vic., flight-paths usually follow tree-lined creeks or roads between mountain ranges (Semmens 1993). Over land, recorded moving low, just above height of trees, often pausing to forage (Gilbert 1935; Semmens 1993); over sea, fly low into headwind (Mollison 1960), but sometimes at greater elevations, e.g. c. 70–80 m and climbing, drifting with e. wind (Thomas 1968); suggested that migrating birds may travel at high altitudes (Aust. Atlas 1). At C. York, seen migrating with Fairy Martins and Welcome Swallows (Beruldsen 1990; ACT Atlas); and at Eyre Bird Observatory, s. WA, seen moving with Masked Woodswallows *Artamus personatus* and Crimson Chats *Epthianura tricolor* (Dymond 1988).

Banding Of 5282 banded in Aust., 1953–June 2003, 49 recoveries (0.9%), of 40 birds. Of these recoveries, 48 (98.0%) were <10 km from banding place, and one (2.0%) >100 km (ABBBS). Long-distance recovery: Eyre Bird Observatory, WA, to near Monkey Mia, WA (1417 km, 297°, 6 months^{D}, Nov., +1) (ABBBS). LONGEVITY: Adult banded at Partridge I., Tas., 13 October 1989, recaptured >1 year 5 months later (ABBBS).

FOOD Insects, including ants, beetles, bugs, flies and wasps.
Behaviour Forage mainly by screening or sallying for insects at height of canopy or higher, or low over open areas, often with Welcome Swallows; very occasionally glean prey (Mollison & Green 1962; Ford *et al.* 1986; Recher & Davis 1998). DETAILED STUDIES: Near Armidale, ne. NSW, 1981–82 and 1984 (Ford *et al.* 1986); at Dryandra, WA, Aug. 1995 (Recher & Davis 1998). FORAGING ASSOCIATIONS: Forage mostly in flocks, often comprising 30–60 birds (Jarman 1944; Storr 1947; Simpson 1964; Henley 1974; Semmens 1993; North; Vic. Bird Rep. 1987; Tas. Bird Rep. 7), but congregations of hundreds recorded occasionally (Mollison & Green 1962; Squire 1984; Semmens 1993); sometimes forage singly (CSN 41) or in twos (Dove 1909; McKean 1985; Templeton 1991; Tas. Bird Rep. 22). Often forage with Welcome Swallows (Kendall 1901; Mellor 1924b,c; Cleland 1943; Mollison & Green 1962; Simpson 1964; Sedgwick 1973; Semmens 1993; Fulton 2002; CSN 24) and Fairy Martins (Longmore 1978; J.M. Peter); sometimes with Barn Swallows (A. Boyle) and, once, Red-rumped Swallows (Squire 1984). Sometimes attracted to swarms of insects, where forage with various other species; for details of composition of one such mixed-species feeding flock, see Ashby (1932). FORAGING HEIGHTS: Forage at heights varying from just above surface of water, ground or grass to well above trees (Campbell & Barnard 1917; Dove 1917; Mellor 1924b; Cooper 1972; Henley 1974; Bremner 1991; Templeton 1991; Sage 1994; Baverstock & McCarthy 2000), e.g. 18–25 m above ground (Dove 1902), or up to 60 m (Simpson 1964); seldom forage on ground (see below). Near Armidale, ne. NSW, foraged mostly at level of canopy or above, sometimes >30 m above ground; of 162 observations of foraging, 75.0% 15+ m above ground, 12.2% 10–14 m, 9.6% 1–2 m, and 3.2% on ground. At Dryandra, WA, foraged in and above canopy; mean foraging height 17.9±2.9 m, with all foraging >5 m above ground. At Weddin Mt., NSW, mostly >15 m above ground (Turner 1992); and at heights of >10 m in eucalypt woodland in ACT (Er 1997). Foraging height sometimes influenced by weather, e.g. fed at higher levels in still, humid conditions, and at lower levels in windy weather (Mollison & Green 1962). FORAGING SITES: Usually forage in air (e.g. Dove 1902, 1917; Campbell 1905; Chaffer 1932; Mollison & Green 1962; Simpson 1964; Thomas 1966; Cooper 1972; Henley 1974; Wilson 1975; Arnold *et al.* 1987; Brooker *et al.* 1990; Templeton 1991; Turner 1992; Er 1997; Hall; CSN 24) and seldom from ground or other substrates (see below). Near Armidale, NSW, of 162 observations of foraging, 157 (97%) were in air and five (3%) on bare ground. At Dryandra, WA, of 110 observations of foraging, all prey taken in air. When foraging aerially, often use airspace above canopy of trees or skim low over grass or water (see Foraging heights). Seen 'feeding on swarming flies on

sand' (Whiter 1991); and occasionally take insects from surface of water (CSN 24). Sometimes forage in canopy of trees (Er 1997); once, *c.* 15 fed at eucalypt flowers (Tas. Bird Rep. 7), presumably taking insects attracted to blossom. In NZ, said to forage in canopy of trees, such as eucalypts and ratas *Metrosideros* (NZRD). At Bakers Hill, WA, foraging habitats varied with season: in autumn, fed mostly over open farmland; in spring, mainly in and round clumps of trees (Arnold *et al.* 1987). Birds migrating in w. Vic. foraged in sheltered areas, usually on lee side of paddocks and forest edges (Semmens 1993). Also forage over sea (Aust. Atlas 1). FORAGING METHODS: Forage almost entirely by screening and sallying; seldom by gleaning (e.g. Dove 1902, 1909; Campbell 1905; Campbell & Barnard 1917; Fletcher 1924; Mellor 1924b; Chaffer 1932; Hyem 1936; Whitlock 1939; Storr 1947; Mollison & Green 1962; Simpson 1964; Thomas 1966; Cooper 1972; Henley 1974; Harris 1980; McKean 1985; Brown *et al.* 1986; Prendergast 1990; CSN 24, 41; Tas. Bird Reps 22, 24; see below). Near Armidale, NSW, from 162 foraging observations, 97% were by sallying (refers to screening of *HANZAB*) and 3% by gleaning. At Dryandra, WA, in 110 observations of foraging, foraged only by sallying (presumably screening of *HANZAB*). Once recorded foraging on swarms of insects by suddenly launching from trees, then screening for up to 30 min, usually drifting with wind, before returning to trees (Rix 1976). Sometimes glean insects from surface of water while in flight (CSN 24). DRINKING: Sometimes drink in flight, skimming over water (Blyth 1997).

No detailed studies. **Animals** INSECTS[1,2,7,9,10,12,14,15,20,21,22,24,25,26]: Coleoptera[16,18,25]: Anthicidae[19]; Carabidae[19]: *Homeodytes scutellaris*[19,27]; Chrysomelidae[17,27]: *Paropsis*[13]; *Tomyris*[25]; Coccinellidae[17]: *Coccinella transversalis*[19,27]; Curculionidae[18,19,25]; Elateridae[13]; Hydrophilidae: *Berosus australiae*[19,27]; Staphylinidae[25]; Diptera[3,5,6,11,16,17]: ads[18]; gnats[4,5,6]; Culicidae[4]; Syrphidae[18,27]; Hemiptera[18,25]: Aphididae[27]; Cicadellidae[17]: Jassinae[17]; Corixidae[19]; Cydnidae[27]; Lygaeidae[25]; Pentatomidae[17,18,19,27]; Reduviidae[27]; Hymenoptera[16]: wasps[18]; Formicidae[19]: alates[8,17,18]; *Iridomyrmex*; *Pheidole* alates[23]; Ichneumonidae[27]; Odonata: Zygoptera[19,27]. SPIDERS[25].

REFERENCES: [1] Campbell 1905; [2] Dove 1909; [3] Littler 1910b; Mellor [4] 1924a, [5] 1924b, [6] 1924c; Ashby [7] 1929, [8] 1932; [9] Chaffer 1932; [10] Hyem 1936; [11] Warham 1961; [12] Mollison & Green 1962; [13] Green 1966; [14] Thomas 1966; [15] Cooper 1972; [16] Matthiessen 1973; [17] Frith & Calaby 1974; [18] van Tets *et al.* 1977; [19] Vestjens 1977; [20] Harris 1980; [21] Wooller & Calver 1981; [22] McKean 1985; [23] Lepschi 1993; [24] North; [25] Lea & Gray; [26] Hall; [27] FAB.

Young Fed by both parents (see Breeding).

SOCIAL ORGANIZATION Gregarious (Bourke & Austin 1947; North), but sometimes seen singly or in twos, presumably pairs (Fletcher 1904; Dove 1909; Lavery 1964; Thomas & Wall 1972; Storr 22, 35). In non-breeding season, occur in flocks of up to 20–30, or larger ones of hundreds (e.g. Campbell 1932; Clark 1975; Schodde 1976; Johnstone *et al.* 1977; Johnstone & Smith 1981; Johnstone 1983; Baxter 1989; Paton & Pedler 1999; Storr 11, 21), and occasionally in much larger congregations, e.g. flocks of >1000 (Hobbs 1961; Masters & Milhinch 1974; Storr 28, 35; SA Bird Rep. 1967–68). Also gregarious during breeding season, usually in small flocks (Austin 1907; Dove 1908; Chandler 1913; Dove 1916; Chaffer 1932; Morris 1975; Storr 28; see below). Often form larger flocks before departure from breeding areas; and migrate in small to large flocks, though very occasionally singly (see Movements). Often form mixed-species flocks with Welcome Swallows and Fairy Martins (e.g. Norton 1922; Chisholm 1929, 1934, 1938; Mellor 1931; Cleland 1942; Watson 1955; Mollison 1962; Mollison & Green 1962; Wheeler 1967; Fleming 1976; Passmore 1982; Ashton 1985; Gibson 1986; Baxter 1989; Semmens 1993), especially when foraging (see Food), and sometimes Dusky Woodswallows *Artamus cyanopterus*, White-throated Needletails *Hirundapus caudacutus* and Barn Swallows (Mollison 1962; Klapste 1977).

Bonds No information.

Parental Care Both sexes feed young and clean nests (see Breeding).

Breeding Dispersion Nest colonially, with several nests often close together in same tree, but nests scattered if suitable nest-sites are not concentrated (e.g. Chandler 1913; Morgan 1916a; Parsons 1928; Chaffer 1932; Hyem 1936; Sharland 1943; Loyn 1985a; Campbell; North; NRS). Up to 30 pairs may nest in same tree (Slater 1962); and, near Lorne, Vic., ⩾50 pairs recorded nesting in cave (Pescott 1978). Two pairs nested on side of verandah, *c.* 30 cm apart (Bell 1979). Sometimes gregarious when building nests (see Breeding).

Roosting Usually roost in protected or hidden sites such as tree-hollows, sometimes with 5–6 birds roosting in same hollow (Mellor 1930; McGilp 1935, 1944), or reed beds or corn crops, where hundreds or thousands may roost together in summer and autumn (Hyem 1936; Serventy 1937b; van Delft 1984; Aust. Atlas 1; Storr 35). When approaching roost-sites at sunset, flocks move as one, rising into air then plummeting into vegetation at top speed, or circling vegetation area several times before descending, twittering continuously (Hyem 1936; Serventy 1937b; Bremner 1991; Serventy & Whittell). On Rottnest I., WA, *c.* 15,000 roosted in clump of eucalypts *c.* 6 m^2: arrived at roost from 17:15 in three groups of *c.* 4000, and others of *c.* 400. At 05:00 next morning, faint calling gradually became louder, then quieter, followed by silence for a few seconds; then group of *c.* 4000 left roost at 05:10; second group, also *c.* 4000, left at 05:13, after 3 min of calling followed by a few seconds of quiet; seven further groups of *c.* 600 left by 05:20 (Bremner 1991). During breeding season, both parents roost in nest-hollow (McGilp 1930). LOAFING: Perch close together on branches, between sallying for insects (Rix 1976). Many seen loafing in tightly packed group on dry sandy river bed in warm weather, either resting or cooling off; flew when alarmed, but soon returned (D'Ombrain 1903). Recorded loafing throughout day, on overhead wires, fences or roofs (Norton 1922; Cleland 1942; Baxter 1989; Bremner 1991; Templeton 1992).

SOCIAL BEHAVIOUR Poorly known; no major studies or descriptions of displays, and few published observations of behaviour. FLOCK BEHAVIOUR: Observed congregating on finely crushed dolerite gravel and patches of charcoal near Ross, Tas., Dec. 1960. Flocks of *c.* 200 gathered in evening, 15:00–17:00, leaving *c.* 15 min after sunset, appearing to 'follow the leader', as birds on ground or hovering just above it attracted others. Birds picked up small particles, and repeatedly mandibulated (but did not swallow) larger white objects, e.g. pebbles or pieces of china, also picked up short straws which would be carried aloft before being dropped. Attempted copulation and soliciting for food also observed within flock (Mollison & Green 1962). Flocks also observed landing on area of burnt rubbish (Simpson 1964). Flocks on migration called as they flew (Beruldsen 1990). Attracted by distress call of bird in hand (Mollison & Green 1962).

Agonistic Behaviour Possible piracy of nesting material: once, when many Martins collecting leaves (presumably nesting material) in their bills and carrying them to trees, one bird flew from ground with a piece of leaf in its bill, and was chased by three others, two of which ceased chasing after *c.* 30 m, but third bird persisted, and after *c.* 50 m, bird dropped leaf, which was snatched by pursuer in its bill before it reached the ground, and then taken to trees (Stokes 1981). INTERSPECIFIC

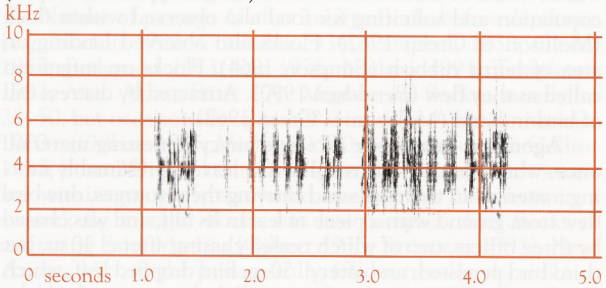
INTERACTIONS: Sometimes drive Welcome Swallows from their nests, then breed in them (Dove 1908; Mellor 1930; see Breeding).

Sexual Behaviour Possible mating ritual described: group landed at same place on ground each morning, forming a circle with one, thought to be female, in the middle; every few minutes, one from circle, thought to be male, ran in and quickly jumped onto presumed female, then all flew towards nearby nest-hollow. Whether same female was involved on each occasion not known (Hardacre 1987). COURTSHIP FEEDING: During breeding, one adult often feeds other near nest-entrance (McGilp 1930). COPULATION: Copulate in flight, sometimes tumbling to ground (Hastwell 1985); also recorded copulating on ground (Mollison & Green 1962).

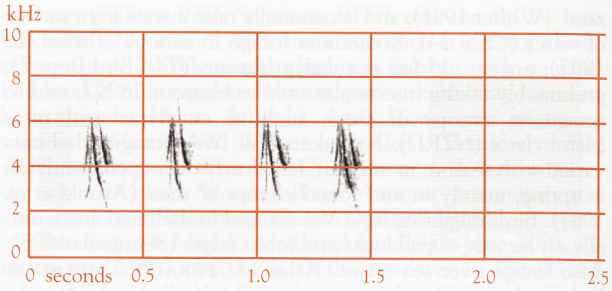
Relations within family group Nestlings heard to beg when adult enters nest (NRS). After fledging, fledgelings seen to sit close together on branch (NRS). At one nest, fledgelings seen to fly to nest-hollow and enter and leave nest on several occasions after fledging (NRS). **Anti-predator responses of young** At several nests, young flew from nest when disturbed by observer (NRS). **Parental anti-predator strategies** No information.

VOICE Poorly known. Often twitter constantly (e.g. Serventy 1937b; Mollison & Green 1962; Serventy & Whittell; see below) while in flight (Hyem 1936; Mollison & Green 1962; Frith 1969) or when perched (Chaffer 1932). Calls described as quiet and not distinctive (Frith 1969). DIURNAL PATTERN: In evening, flock twitters continuously when approaching roost-site (Hyem 1936), and after landing at roost-site (Serventy 1937b; Serventy & Whittell). Combined twittering from large flock of roosting birds can produce 'terrific din', described as 'almost overpowering' (Serventy 1937b; Serventy & Whittell). Sound of roosting birds said to change to chirping as birds settle (Hyem 1936), and birds quieten at dusk (Serventy 1937b; Serventy & Whittell). When departing roost in morning, combined twittering gradually increases in volume, then flock becomes quiet a few seconds before leaving roost (Bremner 1991; see Social Organization: Roosting). NON-VOCAL SOUNDS: When large flock circles, noise from wings can produce rushing sound like wind in tree-tops (Hyem 1936).

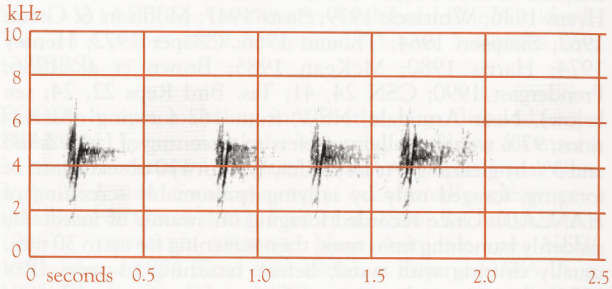
Adult SONG: Described as pleasant, pretty or delightful, quiet twittering (Chaffer 1932; Pizzey 1980; Aust. RD). See sonagram **A**. Musical, scratchy, squeaky chatter rendered as *chwip-chip-chzeit-chwip* (Morcombe 2000), possibly also refers to Song. **Other calls** A slightly metallic *tzweit* (Morcombe 2000), clear *tweeet* (Aust. RD), and dry little *drrrt drrrt* (Pizzey 1980) probably all describe same call (the four calls shown in Sonagram **B** probably this call). Throaty chirping or chatter given when settling to roost and when departing roost (Hyem 1936; Bremner 1991). Flock gave *chip* call in flight and when taking off (Rix 1976). Sonagram **C** shows three examples of short, high-pitched *chip*, possibly this call (A.M. Dunn). Some uttered undescribed distress call while being handled (Mollison & Green 1962).



A R. Buckingham; Wyperfeld NP, Vic., Nov. 1981; P48



B R. Buckingham; Wyperfeld NP, Vic., Nov. 1981; P48



C R. Buckingham; Nannup, WA, Sept. 1987; P48

Young Nestlings heard to utter begging calls (NRS), but not described. No further information.

BREEDING Well known, but no detailed studies; 216 records in NRS to June 2004. Nest solitarily or in loose colonies (see Social Organization: Breeding dispersion). In areas where resident (see Movements), often visit nest-site throughout year (e.g. Morgan 1914a).

Season AUST.: Eggs mostly recorded Aug.–Jan., and once in May (Carnaby 1954; NRS). Of 34 clutches in NRS: two (5.9%) in Aug., eight (23.5%) in Sept., ten (29.4%) in Oct., 11 (32.4%) in Nov., two (5.9%) in Dec. and one (2.9%) in Jan. Breeding initiated by rainfall in arid regions (McGilp 1930; Beruldsen 1980; Serventy & Whittell). Note that Martins visit hollows that do not contain nests, sometimes for roosting (Morgan 1916a; Mellor 1930; Robinson 1933). QLD:

Plate 45 (K. Franklin)

White-backed Swallow *Cheramoeca leucosternus* (page 1499)
1, 2 Adult

Barn Swallow *Hirundo rustica* (page 1508)
SUBSPECIES *GUTTURALIS*: **3, 4** Adult male

Welcome Swallow *Hirundo neoxena* (page 1517)
NOMINATE *NEOXENA*: **5, 6** Adult male

Red-rumped Swallow *Hirundo daurica* (page 1549)
SUBSPECIES *JAPONICA*: **7, 8** Adult male

Tree Martin *Hirundo nigricans* (page 1553)
9, 10 Adult

Fairy Martin *Hirundo ariel* (page 1568)
11, 12 Adult

Asian House Martin *Delichon dasypus* (page 1583)
NOMINATE *DASYPUS*: **13, 14** Adult

Eggs, Oct. (Mayo 1932). Of eight records of nestlings in NRS: six (75.0%) in Sept., one (12.5%) in Oct. and one (12.5%) in Dec. Unspecified breeding, including fledgelings, Feb., Apr.–May and July–Dec. (Agnew 1921; Chenery 1921; Gill 1970; Bielewicz & Bielewicz 1996; Storr 19; Aust. Atlas 1, 2; Qld Bird Rep. 1987; NRS [n=2]). Of 45 records of unspecified breeding in Aust. Atlas 1, 2: three (6.7%) in July, four (8.9%) in Aug., 16 (35.6%) in Sept., nine (20.0%) in Oct., seven (15.6%) in Nov., one (2.2%) in Dec., one (2.2%) in Feb., two (4.4%) in Apr. and two (4.4%) in May. NSW: Eggs, Aug.–Jan. (MacGillivray 1910; Sharland 1943; Wyndham 1978; Morris *et al.* 1981; NRS). Of seven clutches in NRS: one (14.3%) in Sept., two (28.6%) in Oct., three (42.9%) in Nov. and one (14.3%) in Dec. Nestlings, mid-Sept. (North); of 34 records of nestlings in NRS: ten (29.4%) in Sept., seven (20.6%) in Oct., eight (23.5%) in Nov., seven (20.6%) in Dec., one (2.9%) in Jan. and one (2.9%) in Apr. Unspecified breeding, including fledgelings, July–Feb. and Apr. (Bettington 1927; Chaffer 1932; Hindwood & McGill 1951; Hobbs 1961; Heron 1973; Baldwin 1975; Gibson 1977; Costello 1981; Gosper 1981; Henle 1989; Aust. Atlas 1, 2; NSW Bird Rep. 2000; NRS [n=4]). Of 152 records of unspecified breeding in Aust. Atlas 1, 2: 19 (12.5%) in Aug., 33 (21.7%) in Sept., 35 (23.0%) in Oct., 25 (16.4%) in Nov., 27 (17.8%) in Dec., 11 (7.2%) in Jan., one (0.7%) in Feb. and one (0.7%) in Apr. VIC.: Eggs, Jan. (NRS [n=1]). Of 15 records of nestlings in NRS: six (40.0%) in Sept., three (20.0%) in Oct., four (26.7%) in Nov. and two (13.3%) in Dec. Unspecified breeding, including fledgelings, Aug.–Feb. (Bedggood 1973; Pescott 1978; Aust. Atlas 1, 2; NRS [n=4]). Of 123 records of unspecified breeding in Aust. Atlas 1, 2: five (4.1%) in Aug., 18 (14.6%) in Sept., 28 (22.8%) in Oct., 44 (35.8%) in Nov., 12 (9.8%) in Dec., 13 (10.6%) in Jan. and three (2.4%) in Feb. TAS.: Eggs, Nov.–Dec. (NRS [n=2]). Nestlings, Oct.–Nov. and Jan. (North; NRS); of seven records of nestlings in NRS: one (14.3%) in Oct., one (14.3%) in Nov. and five (71.4%) in Jan. Unspecified breeding, including fledgelings, Sept.–Mar. (Littler 1910a; Dove 1916; McGilp 1924; Hodges 1960; Mollison & Green 1962; Tas. Bird Rep. 21). Of 76 records of unspecified breeding in Aust. Atlas 1, 2: three (3.9%) in Sept., five (6.6%) in Oct., four (5.3%) in Nov., 19 (25.0%) in Dec., 12 (15.8%) in Jan., 17 (22.4%) in Feb. and 16 (21.1%) in Mar. SA: Eggs, Aug.–Dec. (Sutton 1929; Brummitt 1934; Campbell; North; NRS). At Naracoorte, 1941–71, earliest eggs, 26 Aug., and latest 30 Oct. (Attiwill 1972). Of 23 clutches in NRS: two (8.7%) in Aug., six (26.1%) in Sept., eight (34.8%) in Oct. and seven (30.4%) in Nov. Nestlings, July–Jan. (Sutton 1930; NRS); of 35 records of nestlings in NRS: one (2.9%) in July, three (8.6%) in Aug., eight (22.9%) in Sept., 11 (31.4%) in Oct., seven (20.0%) in Nov., four (11.4%) in Dec. and one (2.9%) in Jan. Unspecified breeding, including fledgelings, Aug.–June (Morgan 1914b; McGilp 1923; Sutton 1928; Hanks 1930; McGilp 1930; Schodde & Glover 1955; Clarke 1967; Rix 1976; Badman 1979; Ashton 1987; Baxter & Paton 1998; North; Aust. Atlas 1, 2; SA Bird Rep. 1977–81; NRS [n=5]). Of 160 records of unspecified breeding in Aust. Atlas 1, 2: 17 (10.6%) in Aug., 43 (26.9%) in Sept., 51 (31.9%) in Oct., 22 (13.8%) in Nov., 14 (8.8%) in Dec., four (2.5%) in Feb., one (0.6%) in Mar., three (1.9%) in Apr., one (0.6%) in May and four (2.5%) in June. WA: S. WA: Eggs, May and Aug.–Oct. (Carter 1924; Carnaby 1954; Serventy & Whittell; NRS [n=1]); nestlings, June and Aug.–Jan. (Reid 1951; Brooker 2001; NRS); of 17 records of nestlings in NRS: one (5.8%) in June, four (23.5%) in Sept., six (35.3%) in Oct., two (11.8%) in Nov., three (17.6%) in Dec. and one (5.8%) in Jan. Unspecified breeding, including fledgelings, late Mar. to Dec. (Jenkins 1931; Carnaby 1933; Robinson 1934, 1955; Ford & Stone 1957; Heron 1970; Masters & Milhinch 1974; Brooker 2001; Serventy & Whittell; Storr 21, 22, 26, 27, 28; NRS [n=3]). Of 301 records of unspecified breeding in Aust. Atlas 1, 2: one (0.3%) in July, 26 (8.6%) in Aug., 77 (25.6%) in Sept., 96 (31.9%) in Oct., 60 (19.9%) in Nov., 25 (8.3%) in Dec., 14 (4.7%) in Jan., one (0.3%) in Feb. and one (0.3%) in May. N. WA: Eggs, early Aug. (Carter 1903); nestlings, Aug. (Howard 1986; NRS [n=1]). Unspecified breeding Apr.–Sept. (Robinson 1955; Storr 16). Of 11 records of unspecified breeding in Aust. Atlas 1, 2: three (27.3%) in July, five (45.5%) in Aug., two (18.2%) in Sept. and one (9.1%) in Jan. NT: No information on eggs. Nestlings, Sept. (Aust. Atlas 1) and Mar. (Roberts 1980). Unspecified breeding Mar.–Apr. and July–Sept. (Aust. Atlas 1). Of nine records of breeding in Aust. Atlas 1, 2: one in July (11.1%), three (33.3%) in Aug., two (22.2%) in Sept., two (22.2%) in Mar. and one (11.1%) in Apr. NZ: No confirmed records.

Site Usually in hollow spout or knothole in dead branch, or occasionally in living branch or dead part of live branch; branches usually horizontal and often high up (e.g. Fletcher 1904; Agnew 1913; White 1917; McGilp 1930; Chaffer 1932; Cooper 1972; Beruldsen 1980; Campbell; North; NRS). Occasionally also in holes in trunks of live or dead trees or stumps (Dove 1902; Mellor 1930; Favaloro 1931; Sharland 1943; NRS), and less often in cracks and fissures in trees (Bridgewater 1932; Mollison & Green 1962; NRS). Sometimes nest in burrows, caves or crevices in cliffs or banks (White 1914; Morgan 1919; Pescott 1978; Beruldsen 1980; Baxter 1989; Campbell; North; Tas. Bird Rep. 21; NRS), though banks apparently not favoured (McGilp 1930). In one colony, nests built into complex of pits, holes and ledges in overhang of cliff (Pescott 1978). Often nest in artificial sites (Marshall 1935), though said to only use such sites if preferred natural sites unavailable (Mellor 1930). Nests in buildings recorded in holes and gaps in bricks or stonework, in ventilators, on ledges beneath verandas, roofs or eaves, or on walls (Crompton 1915; Morse 1922; Mellor 1930; Rix 1942; Sharland 1943; White 1952; Bell 1979; Beruldsen 1980; Winslet & Winslet 1987; North; Serventy & Whittell; NRS). Sometimes use nest-boxes (Sharland 1943; Goodfellow 2001; NRS). Occasionally nest in recesses beneath bridges and culverts (Sharland 1943; Masters & Milhinch 1974; Pescott 1978; SA Bird Rep. 1967–68); less often on piers and jetties

---

Plate 46 (K. Franklin)

Australian Reed-Warbler *Acrocephalus australis* (page 1605)
NOMINATE *AUSTRALIS*: **1** Adult (fresh plumage); **2** Adult (worn plumage); **3** Juvenile; **4** Adult
SUBSPECIES *GOULDI*: **5** Adult

Oriental Reed-Warbler *Acrocephalus orientalis* (page 1623)
6 Adult

Zitting Cisticola *Cisticola juncidis* (page 1700)
SUBSPECIES *LEANYERI*: **7** Adult male breeding; **8** Adult female breeding; **9** Juvenile; **10** Adult male breeding; **11** Adult female breeding
SUBSPECIES *LAVERYI*: **12** Adult male breeding

Golden-headed Cisticola *Cisticola exilis* (page 1712)
SUBSPECIES *ALEXANDRAE*: **13** Adult male breeding; **14** Adult male non-breeding
SUBSPECIES *DIMINUTA*: **15** Adult male breeding
NOMINATE *EXILIS*: **16** Adult male breeding; **17** Adult male non-breeding; **18** Adult female breeding; **19** Juvenile; **20** Adult male breeding; **21** Adult male non-breeding

(Hodges 1960; Bielewicz & Bielewicz 1996; NRS); three nests, among beams supporting pier decking, were 2.4 m above high-tide level (Hodges 1960). Sometimes nest on moored boats, e.g. in canvas sail covers or inside aluminium boom (Mayo 1932; Harris 1980; NRS). Nests also recorded on portable generator (Howard 1986; NRS); and in tubular lamp-posts (Singor 1995; Storr 28). At one site, nested in suspended bamboo and hollow logs, old tins, a hanging watering-can and an old funnel nailed to wall (Mellor 1930; North). Sometimes nest in hollows or holes previously used by other species, including Budgerigar *Melopsittacus undulatus*, Laughing Kookaburras *Dacelo* and Striated Pardalote *Pardalotus striatus* (NRS). NEST-PLANT: Appear to nest mostly in eucalypts (Campbell 1909; White 1917; Sutton 1922; McGilp 1930; Bright & Taysom 1932; Heron 1970; Cooper 1972; Badman 1979; Abbott 1981), though probably nest in any hollow tree (Orton & Sandland 1922). Of 107 records of nest-plant in NRS, all were in eucalypts; of 64 identified to species level: 11 (17.2%) in River Red Gum, eight (12.5%) in Coolibah, six (9.4%) in Mountain Gum, six (9.4%) in Black Box, six (9.4%) in Wandoo, five (7.8%) in Southern Mahogany, four (6.3%) in Karri, three (4.7%) in Yorrell, three (4.7%) in Swamp Gum *Eucalyptus ovata*, three (4.7%) in Yellow Gum, two (3.1%) in Jarrah, and singles (1.6%) in Blakely's Red Gum, Sugar Gum *E. cladocalyx*, Round-leaved Blue Gum *E. deanei*, Brittle Gum *E. mannifera*, Snow Gum, Manna Gum and Grey Box. At Gooseberry Hill, WA, of 11 nests, nine (81.8%) were in Wandoo and two (18.2%) in Marri. Unknown number of nests were also discovered nearby in Flooded Gums *E. rudis* (Brooker 2001). Nests also recorded in White Gum *E. alba*, Mountain Grey Gum, Salmon Gum and Forest Red Gum (Carter 1903; Lawson 1905; Sedgwick 1951; Hastwell 1985; Leach & Hines 1987). After vacating one hollow, one pair probably occupied another 1 m away (NRS). Some nest-sites used in consecutive years (Sharland 1943; Lord 1956; NRS), though unclear if by same pair (Dove 1902; Masters & Milhinch 1974), or for multiple attempts within same season (NRS). Often nest near or in same tree (sometimes in same branch) as various other hollow-nesting species, especially Common Starling and parrots such as Red-rumped Parrots *Psephotus haematonotus*, Galah *Eolophus roseicapillus*, Little Corella *C. sanguinea*, Budgerigar, Brown Treecreeper *Climacteris picumnus* and Striated Pardalote; also nest near raptors, Magpie-lark *Grallina cyanoleuca*, Willie Wagtail *Rhipidura leucophrys*, Scarlet Robin *Petroica multicolor*, White-winged Triller *Lalage sueurii*, Zebra Finch *Taeniopygia guttata* and House Sparrow *Passer domesticus* (Sutton 1922, 1927; Sedgwick 1951; Gates 1996; North; NRS); one nest was 5 m from nest of Dollarbird *Eurystomus orientalis*, and another was within Bell Miner *Manorina melanophrys* colony (NRS). Two hollows contained eggs of both Tree Martin and Budgerigar; one was apparently used simultaneously by both species (NRS), while other occupied by Budgerigar, with Martin eggs pushed aside (Lane 1956). MEASUREMENTS (m): Height of nest, 6.6 (5.99; 0.3–30.0; 177) (NRS); 0.9–4.6 (Cooper 1972); 4.6–13.7 (Sutton 1928); 3.7–21.3 (Chaffer 1932); seldom <6.1 (North); usually up to 30, sometimes more (Beruldsen 1980). One pair entered hollow *c.* 60 above ground (Le Souëf 1921).

Nest, Materials Eggs sometimes laid directly onto rotten wood of hollow (Dove 1902; North), or onto bed of eucalypt leaves, sometimes with dry grass, straw or feathers, and very occasionally twigs, rootlets or pine needles, with slight depression for eggs; seaweed or pieces of dry sponge sometimes used in coastal areas (Carter 1903; Dove 1916; McGilp 1930; Mellor 1930; Chaffer 1932; Sharland 1943; Hodges 1960; Mollison & Green 1962; Beruldsen 1980; Ambrose 1981; Serventy & Whittell; Campbell; North; NRS); once laid eggs onto layer of dry mud (NRS). Also said to build nests of mud (Lang 1927; Serventy & Whittell; NRS), sometimes mixed with straw or grass (Mayo 1932; North; NRS). Mud is sometimes plastered round entrance of large spouts (usually lower part) or other opening, such as hole in caves, to reduce diameter of entrance (Wilson 1912; Morse 1922; McGilp 1930; Sharland 1943; Boehm 1957; Napier 1969; Cooper 1972; Pescott 1978; Beruldsen 1980; Ambrose 1981; North; NRS), possibly to exclude competitors (Mellor 1930; Campbell). Nests in colonies can have a common entrance (Dove 1916; Morgan 1916a; Pescott 1978); single nests can also have two entrances; in one, birds entered one hole and left via another (NRS). Sometimes use nests of Welcome Swallow or Fairy Martin (Dove 1908; Mellor 1930; Griffiths & Holyoak 1993; Hicks & Hicks 2000; NSW Bird Rep. 2000; Campbell; North; NRS). Materials collected by both birds of pair; though several birds may collect material together, each collects for its own nest (NRS). Leaves and other materials collected from ground (McGill & Lane 1955; Stokes 1981; Brown *et al.* 1986; NRS), several being examined and discarded before being taken to nest one at a time, though many dropped in transit (McGill & Lane 1955; Boehm 1957; NRS). Incorporate leaves of up to *c.* 5 cm long into nests (Chaffer 1932; NRS); and others added strips of seaweed 7.6–10.2 cm long (Dove 1916). Mud gathered from edge of water (NRS), and one group gathered mud from 'chimneys' of land crabs (Hastwell 1985). Possible piracy of nesting material (see Social Behaviour: Agonistic behaviour). At one nest, birds brought material twice in 15 min; at another, three visits in 10 min (NRS). Build from 08:30–15:00 (NRS); both birds of pair sometimes take material into hollow simultaneously (Chaffer 1932). Claimed that more than one pair may help build single nest (Chaffer 1932; North); at one site, groups collected nesting material, then returned to nest at same time, but not all birds carried material (Chaffer 1932). Nests of Welcome Swallows are re-lined with leaves before laid eggs (Dove 1908; Campbell; North); at one site, mud was also added, leaving only a narrow gap at entrance (Mellor 1930). MEASUREMENTS (cm): Depth of hollow, 29 (0.12; 10–50; 7) (Dove 1916; Sutton 1929; NRS); 15–46 (North). One nest in beam of pier was accessed by 20 cm passage which opened out into nest-cavity (Hodges 1960). Diameter of hollow or spout, 9.0 (1.87; 7.0–10.0; 5) (NRS); diameter of entrance of hollow or spout partly blocked with mud, 3.2–5.0 (McGilp 1930; Beruldsen 1980). Diameter of hole in side of branch or tree-trunk, 3.8 (0.84; 3.0–5.0; 5) (NRS). One nest on rafter comprised 6 cm layer of dry mud with depression in centre (NRS).

Eggs Stout oval to oval, some pointed at one end; smooth, close-grained, and extremely delicate for size; glossy, slightly lustrous or lustreless (McGilp 1930; Beruldsen 1980; Campbell; North). Usually white or pearly white (Dove 1902; Beruldsen 1980; Campbell; Serventy & Whittell), but some pinkish white or faint creamy-buff (North); marked with spots and blotches, usually of dull purplish-red, pale reddish, reddish brown, pale rufous or rufous, sometimes of faint pale mauve, lavender or faint purplish red, and sometimes concentrated round large end (Dove 1902; Littler 1910a; McGilp 1930; Robinson 1934; Beruldsen 1980; Campbell; North; Serventy & Whittell), and vary from sparse and minute spotting to heavily blotched (Littler 1910a; McGilp 1930; Robinson 1934; Campbell). Some creamy-buff eggs had 'fleecy' markings of slightly darker shade of ground-colour (North). In one clutch of four, three heavily marked rich chestnut, and fourth normal colour (Littler 1910a). In nest where three clutches laid (first two were stolen), markings on eggs of first clutch differed from those of subsequent ones (Serventy & Whittell). Some similarly marked to eggs of Welcome Swallow (Campbell; q.v.), though said to be rounder than those of Swallow (Dove 1908). MEASUREMENTS: 18.5 (1.33; 17.0–20.0; 15) × 13.3 (0.54; 12.5–14.0) (Campbell; North; Littler

1910a); 17.0–20.0 × 13.0–14.0 (Serventy & Whittell); mean 18.0 × 13.0 (Frith 1969); *c.* 18.0 × 13.0 (Beruldsen 1980).

Clutch-size Usually two or three (Carnaby 1933); three (Dove 1902; Carter 1924; Storr 19); three or four (Robinson 1934; Mollison & Green 1962; Masters & Milhinch 1974); four (Mellor 1930; Serventy & Whittell); four or five (Ey 1944; North); three to five (McGilp 1930; Campbell); up to five (Stone 1912); three to five, usually four (Beruldsen 1980). From NRS: 3.8 (0.41; 6): C/3 × 1, C/4 × 5. In WA, 3.3 (0.55; 20): C/2 × 1, C/3 × 13, C/4 × 6 (Storr 16, 21, 22, 26, 28).

Laying One, and sometimes two or more clutches laid per season (McGilp 1923; Fletcher 1924; Beruldsen 1980; Campbell; North). At one nest, eggs stolen on 25 Aug. and on 8 Sept., and third clutch found on 10 Oct. (Serventy & Whittell). At another nest, young capable of leaving on 3 Oct.; nest active again on 17 Oct. (NRS). A third nest had young capable of leaving on 12 Nov.; adult sitting in hollow again on 5 Dec. (NRS).

Incubation Not known if both sexes incubate (McGilp 1930), but two adults sometimes occur together in nests with eggs (NRS). At one nest, incubation appeared to begin from first egg (NRS). Sit tightly (Mellor 1930). Eggshells removed from nest, apparently dropped onto ground below (Fletcher 1924; Sutton 1933). Incubating bird fed by partner at entrance to hollow, sometimes leaving nest due to distance of nest from entrance (McGilp 1930).

Young Altricial, nidicolous. Hatch blind; either naked or with some down on back. In one nest, down on back by 3 days; pin-feathers at 2–5 days; and fully feathered by 16–19 days. In another nest, contour-feathers begun to erupt at 12–15 days (NRS). Both parents feed nestlings (McGilp 1923, 1930; North; NRS), and sometimes up to four birds (NRS). Probably fed by regurgitation (Winslet & Winslet 1987). Both parents remove faecal sacs from nest after feeding young, dropping them *c.* 9–12 m from nest (North; NRS), but at one nest, dropped 2–3 m away (NRS).

Fledging to independence Fledgelings return to nest-hollows; one brood which returned was barely able to fly (NRS). No other information.

Success At one nest, three eggs laid, all of which hatched, but no young fledged. At three nests where clutch-size and number hatched known, but fledging outcome unknown: of 12 eggs, all hatched; of 26 nests where outcome known, 21 (80.8%) successfully fledged at least one young, and five (19.2%) failed (NRS). CAUSES OF FAILURE: Compete with House Sparrows and Common Starlings for nest-sites, and nesting hollows often usurped by them (Mellor 1930; Favaloro 1942; Sharland 1943; Napier 1969; Campbell; North; Tas. Bird Rep. 21). Two nests failed after storms: eggs were spilled and broken at one (Mayo 1932); other was deserted (NRS). Fledgelings sometimes taken by Laughing Kookaburras, which may have major effect on success at some sites (Pescott 1978). One nest contained a headless adult Martin and a Brown Tree Snake *Boiga irregularis* (Nielsen 1966); another nest contained a dead adult, and eggs had been taken (NRS). Claimed that process of opening hollow usually destroyed nest (Hood 1935).

PLUMAGES Prepared by J.S. Matthew. Hatch naked, or possibly with some down on upperbody. Fledge in juvenile plumage. Complete post-juvenile moult to adult (first basic) plumage. Thereafter, complete post-breeding (pre-basic) moult each cycle produces successive non-breeding (basic) plumages. Sexes similar. Three subspecies, two in HANZAB region (but see Geographical Variation); plumages described below based on examination of skins of 20 adults and nine juveniles collected from mainland Aust. from Oct.–Jan. (HLW, MV).

Adult (Definitive basic). HEAD AND NECK: Lower forehead, rufous-brown (c38, 36) with fine black-brown (119) streaking formed by black-brown shaft-streaks to feathers; forms distinct rufous frontal patch. Upper forehead, crown, nape and hindneck, glossy blue-black (glossy 90), some birds with a few rufous-brown (c38, 36) patches or streaks on upper forehead. Sides of neck, cream (c92) or light brown (223D) with dark-brown (121) mottling or streaking. Rufous-brown (c38, 36) extends from sides of lower forehead as narrow fore-supercilium which terminates above front edge of eye. Lores, feathers below eye and ear-coverts, dark brown (121), usually darker (black-brown [119]) on posterior lores; feathers combine to form rather broad mask, black-brown (119) in front of eye, dark brown (121) behind eye. Malar area, chin and throat, off-white (ne) or cream (c54), variably tinged buff (c124), especially on chin, with fine dark-brown (121) streaks formed by dark shaft-streaks. A few very short black (89) bristles arise from sides of lower forehead. UPPERPARTS: Mantle, scapulars and back, glossy blue-black (glossy 90); all feathers with broad concealed white band across centres and concealed grey (87) bases. Feathers of rump and most uppertail-coverts, light grey-brown (119C) or light brown (239, 223D) with broad white tips and dark-brown (121) shafts, and usually with orange-buff (118) edges; feathers combine to form prominent broad greyish-white (ne) or brownish-white (ne) band across rear upperbody, indistinctly streaked dark brown (c121) and variably tinged orange-buff (118); longest uppertail-coverts, brown (c28) with off-white (ne) or buff (124) fringes. UNDERPARTS: Breast, off-white (ne), variably tinged buff (124) or pale orange-buff (pale 118), grading to grey-brown (91) on sides of upper breast, and with fine dark-brown (121) streaking over entire breast formed by narrow dark-brown shaft-streaks to feathers. Flanks, orange-buff (c118) or off-white (ne) with orange-buff (c118) tinge, and finely streaked dark brown (121). Belly and vent, white or off-white (ne) with fine dark-brown (121) streaking at sides of belly. Undertail-coverts vary from off-white (ne) to orange-buff (c118) with narrow dark-brown (121) shaft-streaks. Thighs, off-white (ne) with partly visible brown (28) bases. Axillaries, light brownish-grey (c80), grading to orange-buff (118) at edges. UPPERTAIL: Rectrices, dark brown (c121) with faint dark-blue (c70) gloss in certain lights, and concealed off-white (ne) inner edges which grade broader basally; in a few birds, inner edge to t6 broadens near tip to form concealed diffuse off-white (ne) patch. UNDERTAIL: Rectrices, slightly paler (brown [c28]); inner edges as uppertail and visible on outer rectrices. UPPERWING: All marginal and median secondary coverts, black-brown (119) with glossy blue-black (glossy 90) fringes at tips; outer few marginal coverts have cream (54) tips. Greater secondary coverts, dark brown (121) or blackish brown (c119) with faint glossy blue-black (glossy 90) tinge to outer webs and very narrow off-white (ne) fringes at tips when fresh; inner 2–3 coverts have pale-greyish (c86) inner webs and narrow light-brown (39) or buff (c124) fringes at tips, but these coverts usually concealed by overlying scapulars. Marginal and median primary coverts, dark brown (121) with off-white (ne) or buff-white (ne) tips or fringes at tips; marginal coverts combine to form narrow dark-brown and whitish mottled strip along leading edge of wing. Alula and greater primary coverts, dark brown (121) or black-brown (119) with narrow off-white (ne) fringes at tips and concealed light grey-brown (119D) inner edges to primary coverts. Tertials, dark brown (121) with fairly prominent white fringes at tips when fresh, lost with wear, leaving small notch at tip of feather. Primaries and secondaries, dark brown (121) with concealed light brownish-grey (c80) inner edges and narrow off-white (ne) fringes at tips or near tips of outer webs when fresh. Shafts of remiges, dark red-brown (221A), white at bases of outer two primaries. UNDERWING: All marginal coverts, dark brown (121) at bases with broad buff (124) tips which are narrowly broken in centre by dark-brown (121) shaft-streaks. All median coverts and

greater secondary coverts, light brownish-grey (c80) with buff (124) or orange-buff (119) edges and narrow dark-brown (121) shaft-streaks. Greater primary coverts, brownish grey (c79) with narrow buff (124) fringes at tips. Remiges, brownish grey (c79) with fringes as upperwing; shafts, off-white (ne).

Nestlings No information on down-colour.

Juvenile Differs from adult by: HEAD AND NECK: Lower forehead, light brown (223D) or cream-brown (ne) with fine dark-brown (121) mottling or streaking formed by shaft-streaks to feathers; forms paler and less distinct frontal patch than adult. Upper forehead, crown, nape and hindneck, dark brown (121) or blackish brown (c19) with indistinct glossy blue-black (glossy 90) tinge formed by tips to feathers; hindneck has patchy off-white (ne) or buff-white (ne) mottling formed by diffuse band across centres of feathers. Sides of neck, off-white (ne) or cream (54) with scattered dark-brown (121) mottling. Narrow fore-supercilium slightly paler (light brown [223D, 39]) than in adult. Mask, dark brown (121), more diffuse and paler in front of eye than adult. Malar area, chin and throat, off-white (ne) with indistinct fine dark-brown (219A) streaking formed by narrow shaft-streaks to feathers. UPPERPARTS: Mantle, scapulars and back, black-brown (20) with rather indistinct blue-black (c90) gloss; most scapulars and feathers of back with very narrow buff (124) fringes at tips when fresh, forming fine scalloping which lost with wear. Rump and uppertail-coverts have slightly less distinct orange-buff (118) tinge. UNDERPARTS: Breast and flanks tend paler, off-white (ne), usually with only faint buff (c124) tinge, and with less prominent dark-brown (121) streaking than in adult. TAIL: As adult but lacks dark-blue gloss to rectrices. UPPERWING: All marginal and median coverts, dark brown (121) with light-brown (39) or buff (124) tips or fringes at tips. Greater secondary coverts and alula, dark brown (121) with narrow buff (124) or buff-white (ne) fringes at tips when fresh. Greater primary coverts and alula, as adult, but primary coverts with narrow indistinct light grey-brown (119D) fringes at tips when fresh. Tertials, dark brown (121) with broad cream (54) or buff-white (ne) fringes at tips, fringes much broader than in adult. Primaries and secondaries, as adult, but have slightly broader and more distinct off-white (ne) fringes at tips. UNDERWING: As adult.

First immature (First basic). Not known if this plumage exists and more information on extent of post-juvenile moult required. Comments by Rogers *et al.* (1986) implied at least some birds do not replace primaries in post-juvenile moult, resulting in adult-like first immature plumage; their description of 'sub-adult' is consistent with bird partway through post-juvenile moult, or alternatively, first immature with some juvenile body-feathers and remiges retained. However, examination of skins (this study) reveals none is identifiable as first immature (with adult-like plumage but with retained juvenile primaries). It is possible that worn juvenile remiges are indistinguishable from those of adults, and therefore first immatures would be difficult to identify.

BARE PARTS Based on photos (Watts 1999; unpubl.: R.P. Allen; M.J. Carter; G.S. Chapman; C.H. Sandbrink; and standard sources), birds captured in Vic. (Rogers *et al.* 1986), data on museum labels (MV) and other sources as cited. **Adult** Bill, black (89). Gape, black (89); also grey-black (Rogers *et al.* 1986). Mouth described as white, yellow, yellow-orange, pink or mottled grey (Hall); these descriptions possibly include juveniles. Orbital ring, dark grey (83) or grey-black (82). Iris, dark red-brown (221A); also dark brown, blackish brown, and olive-grey in one bird (Hall). Legs and feet, dark grey (c83) with faint pink (c3) tinge; also brown or black (Hall). Soles, pale pinkish (c5). **Nestlings** Photos (Strahan) of well-developed nestlings show: Bill and orbital ring, dark greyish (c83). Gape, pale yellow (c157), slightly swollen.

Juvenile Bill, black (89); also brownish black (MV). Iris, dark brown (22). Legs and feet described as flesh-coloured (MV). Rogers *et al.* (1986) described soles of 'immature' as pink, and gape as yellow fading with age; these descriptions probably refer to juveniles judging by description of plumage; photo of bird partway through post-juvenile moult (C.H. Sandbrink) shows dark-grey (83) gape, suggesting gape-colour changes fairly rapidly in juveniles.

MOULTS Based on examination of skins of 29 adults and eight juveniles (subspecies combined) (HLW, MV, SAM), and other information as cited. **Adult post-breeding** (Second or third and subsequent pre-basic). Complete. Primaries moult outward. Only two skins with active moult of primaries: one from Qld in Mar. with PMS 38, and one from WA in July with PMS 39. In Vic., moult of primaries occurs Jan.–Mar. (Rogers *et al.* 1986). In skins, one of two in May, three of four in June, one in July and one of seven in Sept. had all primaries new; rest from May, June and Sept., three in Aug., and all 12 from Oct.–Dec., had all primaries worn. None of four from Pilbara Region, WA, in July, had active moult (Mees 1961). Birds from sw. WA in Mar., Kimberley Div. in May, and se. SA in Jan., had active moult, or just finished moult, of primaries and rectrices (Hall). Bird collected on Cobourg Pen., NT, in July, had no active moult (Frith & Calaby 1974). Little other information on moult. One skin from Qld in Mar. with active moult of tail, t1–t3 new and t4–t6 growing, and with slight moult on crown. **Post-juvenile** (First pre-basic). Probably complete. Two from Qld in Mar. with active moult of primaries (PMS 26, 38); one from Vic., in Mar., with active moult of primaries (PMS 35). In Vic., Rogers *et al.* (1986) did not record post-juvenile moult of primaries in any of 17 captured in Jan., or nine in Mar., but recorded moult of primaries in four of seven 'sub-adults' in Vic. in Jan.; suggested that these were either first-year birds resulting from early brood and acquiring adult plumage in complete post-juvenile moult, or second-year birds acquiring adult plumage in complete first immature post-breeding (second pre-basic) moult. The lack of active moult of primaries in Mar. is difficult to explain; these birds may have been from late brood and had not yet started moult of primaries, or were first immatures which had undergone partial post-juvenile moult which did not include primaries. Skins (this study) undergoing post-juvenile moult had active moult of primaries, rectrices and body, and were acquiring plumage identical to that of adults. Also, there were no skins identifiable as first immatures (with any retained juvenile plumage), suggesting that adult plumage is acquired in post-juvenile moult.

MEASUREMENTS NOMINATE *NIGRICANS*: (1) Tas., skins, adults (ANWC, MV, SAM): Tail-fork measured as length between tips of t1 and t6 on closed tail.

		MALES	FEMALES	
WING	(1)	107.3 (2.22; 105–109; 5)	106.0 (1.22; 104–107; 5)	ns
TAIL	(1)	55.0 (5.66; 51–63; 4)	53.2 (3.27; 51–59; 5)	ns
TAIL-FORK	(1)	5.9	–	
BILL S	(1)	10.8 (0.51; 10.2–11.3; 4)	11.0 (0.48; 10.4–11.6; 5)	ns
TARSUS	(1)	10.7, 11.0, 11.9	–	

SUBSPECIES *NEGLECTA*: (2–4) Qld, NSW, Vic., SA and WA, skins (HLW, MV, SAM): (2–3) Collected throughout year and possibly includes some migrant nominate from Tas.: (2) Adults; (3) Juveniles. (4) Collected during breeding season only (Sept.–Mar).

		MALES	FEMALES	
WING	(2)	104.2 (2.55; 99–110; 13)	105.3 (5.52; 91–114; 12)	ns
	(3)	101.2 (3.63; 96–106; 5)	96. 99	

	(4)	103.7 (2.08; 99–106; 10)	104.3 (5.65; 91–109; 9)	ns
TAIL	(2)	49.9 (3.65; 42–55; 12)	51.7 (4.04; 44–57; 12)	ns
	(3)	45.7 (2.82; 41–49; 5)	45, 46	
	(4)	49.1 (3.04; 42–55; 9)	51.1 (4.47; 44–57; 9)	ns
TAIL-FORK	(2)	7.9 (1.09; 5.7–8.9; 8)	7.3 (0.80; 6.1–8.4; 8)	ns
	(3)	6.6	–	
	(4)	7.6 (1.14; 5.7–8.6; 5)	7.2 (0.84; 6.1–8.4; 7)	ns
BILL S	(2)	10.3 (1.18; 8.2–11.8; 12)	10.7 (0.74; 9.4–12.4; 11)	ns
	(3)	9.7 (1.11; 8.5–11.3; 5)	8.2, 8.9	
	(4)	10.3 (1.31; 8.2–11.8; 9)	10.5 (0.54; 9.4–11.1; 9)	ns
TARSUS	(2)	10.6 (0.97; 9.4–12.1; 12)	10.6 (1.10; 9.2–13.5; 11)	ns
	(3)	11.2 (1.43; 9.3–12.7; 5)	11.5, 11.6	
	(4)	10.6 (1.04; 9.4–12.1; 10)	10.7 (1.21; 9.2–13.5; 9)	ns

SUBSPECIES UNKNOWN: (5) Vic., live birds, ages combined (Rogers *et al.* 1986).

	UNSEXED
WING	(5) (97–111; 57)
TAIL	(5) (43–53; 54)
THL	(5) (25.1–28.0; 37)

WEIGHTS SUBSPECIES *NEGLECTA*: (1) NSW, Vic., SA and WA, adults, from museum labels (MV) and Hall.

	MALES	FEMALES	
(1)	15.1 (1.06; 13.0–16.5; 7)	18.3 (4.57; 14.8–25.0; 4)	ns

An unsexed juvenile (MV) from Vic. weighed 16.0 g.

SUBSPECIES UNKNOWN: (2) Vic., live birds, ages combined (Rogers *et al.* 1986).

	UNSEXED
(2)	(13.8–19.3; 57)

STRUCTURE Wing long and pointed at tip. Ten primaries: p9 longest; p10 vestigial, p8 0.5–2 mm shorter than p9, p7 7–10, p6 14–18, p5 23–26, p4 31–39, p3 37–41, p2 43–48, p1 50–55. Primaries not emarginated. Nine secondaries including three tertials; tip of longest tertial falls short of tip of secondaries on folded wing; secondaries with distinct notch in centre of tips. Tail quite short with slight but obvious fork (see Measurements); 12 rectrices; t6 longest; t1 5–9 mm shorter than t6 (see Measurements), t5 *c.* 2, t4 *c.* 4, t3 *c.* 6, t2 *c.* 8. Bill short and flattened, wide at base, pointed at tip. Tarsus short and rather slender, compressed laterally; scaling laminiplantar, plantar surface ridged. Tibia fully feathered. Middle toe with claw 13.8 (0.49; 13.3–14.7; 6); outer toe 65–80% of middle, inner 68–78%, hindtoe 63–78%.

GEOGRAPHICAL VARIATION Most authors recognize two subspecies in Aust., but views differ concerning limits of range. Extralimitally, one further subspecies, *timoriensis*, said to be resident on Timor and possibly Flores (Sharpe 1885; White & Bruce 1986; Peters), but little information available on this subspecies; said that those from Timor have wing-length <100 mm and dark streaks on throat (this consistent with juvenile from Aust. [this study]); skin (BMNH) from Flores probably mislabelled (White & Bruce 1986); said to be occasional non-breeding visitor to that island (Schmutz 1977). Most recent study (DAB) recognized following two subspecies in Aust.: nominate *nigricans*, which breeds in Tas., including King I. and Furneaux Grp, with proportion of population wintering across mainland e. Aust., N to n. Qld, New Guinea and its offshore islands, Bismarck Arch. and Solomon Is; and subspecies *neglecta*, breeding across much of mainland Aust., with a proportion of population also wintering as far N as New Guinea region. Some authors consider subspecies to have differentiated between e. and w. Aust.: nominate *nigricans* breeding in e. Aust., from Qld (except far N), NSW, Vic., Tas. and e. SA; and subspecies *neglecta* breeding in w. and n. Aust. (Mees 1961; Frith & Calaby 1974; Peters). Mees (1961) found that skins from WA have shorter wing-length (100–103; n=5; sexes combined) than those from NSW and Adelaide (104–111; n=8), but he found no difference in plumage coloration between e. and w. Aust. birds. Frith & Calaby (1974) gave following wing-lengths for skins from Cobourg Pen., n. NT: 100–103 for males (n=5); 96–103 for females (n=7); these measurements consistent with those given by Mees (1961) for WA birds. However, DAB found no difference in size of WA birds (Wing 101–107; n=39; sexes combined) compared with those from e. Aust. (Wing 100–107; n=113), and consequently did not accept subspecific division of breeding populations from mainland Aust. This also supported by data in Hall. Skins from Tas. are larger (Wing 105–111; n=9) and have more russet lower forehead, rump and underparts than those collected from mainland e. Aust. during breeding season; consequently Tas. birds considered to differ subspecifically from mainland breeding populations (DAB). Present study indicates adults (sexes combined) from Tas. have longer Wing and Tail ($P<0.05$) than adults from mainland (from Sept.–Mar.).

REFERENCES

Abbott, I. 1981. *Emu* 81: 91–6.
—— 1995. *West Aust. Nat.* 20: 125–32.
Agnew, N.V.I. 1913. *Emu* 13: 93–7.
—— 1921. *Emu* 21: 131–7.
Ambrose, G.J. 1981. Unpubl. BSc(Hons.) thesis, LaTrobe Univ., Melbourne.
Andrew, E. 1999. *Nature in Eurobodalla* 13: 6–46.
Anon. 1969. *Canberra Bird Notes* 1(3): 2–16.
—— 1974. *Canberra Bird Notes* 2(12): 2–24.
—— 1988. *West Aust. Bird Notes* 45: 2–3.
—— 1989. *RAOU Rep.* 63: 10–28.
—— 1998. *Canberra Bird Notes* 23 Suppl.: 1–96.
—— 1999a. *Canberra Bird Notes* 24(2): 49–143.
—— 1999b. *Canberra Bird Notes* 24(4): 193–248.
Arnold, G.W., *et al.* 1987. *Aust. Wildl. Res.* 14: 331–41.
Ashby, E. 1929. *S. Aust. Orn.* 10: 6–14.
—— 1932. *S. Aust. Orn.* 11: 165–6.
Ashton, C.B. 1985. *S. Aust. Orn.* 29: 169–79.
—— 1987. *Aust. Bird Watcher* 12: 73–82.
—— 2001. *S. Aust. Orn.* 33: 145–55.
Ashton, I., *et al.* 1996. *RAOU Rep.* 97: 24–76.
Attiwill, A.R. 1972. *S. Aust. Orn.* 26: 59–64.
Austin, T.B. 1907. *Emu* 7: 28–32.
Badman, F.J. 1979. *S. Aust. Orn.* 28: 57–81.
—— 1981. *S. Aust. Orn.* 28: 141–53.
—— 1989. *The Birds of Middle and Lower Cooper Creek in South Australia.* Nature Conserv. Soc. S. Aust., Adelaide.
Baldwin, M. 1975. *Emu* 75: 113–20.
Barton, I.E. 1947. *NZ Bird Notes* 2: 131.
Batey, I. 1907. *Emu* 7: 1–17.
Baverstock, G., & G. McCarthy. 2000. *Geelong Bird Rep.* 1999: 63–90.
Baxter, C.I. 1989. *An Annotated List of the Birds of Kangaroo Island.* S. Aust. Natl Pks Wildl. Serv., Kingscote, Kangaroo I., SA.
——, & P.A. Paton. 1998. *S. Aust. Orn.* 33: 1–15.
Bedggood, G.W. 1970. *Aust. Bird Watcher* 3: 252–65.
—— 1972. *Aust. Bird Watcher* 4: 116–28.
—— 1973. *Aust. Bird Watcher* 5: 12–22.
—— 1980. *Aust. Bird Watcher* 8: 147–62.
Belcher, C.F. 1914. *The Birds of the District of Geelong, Australia.* Griffiths, Geelong, Vic.
Bell, H.L. 1967. *Emu* 67: 57–79.
—— 1968. *Emu* 68: 5.
—— 1979. *Aust. Bird Watcher* 8: 102.
Beruldsen, G.R. 1969. *Aust. Bird Watcher* 3: 201–8.
—— 1980. *A Field Guide to Nests and Eggs of Australian Birds.* Rigby, Sydney.
—— 1990. *Aust. Bird Watcher* 13: 209–17.
Bettington, B.C.J. 1927. *Emu* 26: 188–92.
Biddiscombe, E.F. 1985. *West. Aust. Nat.* 16: 32–9.
Bielewicz, J., & F. Bielewicz. 1996. *Sunbird* 26: 81–120.
Blake, T. 1985. *Aust. Bird Watcher* 11: 65.

Blyth, J. 1997. *West Aust. Bird Notes* 81: 7.
Boehm, E.F. 1957. *Emu* 57: 311–24.
Boekel, C. 1976. *Aust. Bird Watcher* 6: 231–45.
—— 1980. *Aust. Bird Watcher* 8: 171–93.
Bourke, P.A., & A.F. Austin. 1947. *Emu* 47: 87–116.
Brandle, R. 1998. (Ed.) *A Biological Survey of the Stony Deserts, South Australia, 1994–1997*. Heritage & Biodiversity Section, Dept Env. Heritage & Aboriginal Affairs, Adelaide.
Bravery, J.A. 1970. *Emu* 70: 49–63.
Bremner, M.H. 1991. *West Aust. Bird Notes* 58: 7.
Bridgewater, A.E. 1932. *Emu* 31: 280–5.
Bright, J., & A.R. Taysom. 1932. *Emu* 32: 42–8.
Britton, P.L., & H.A. Britton. 2000. *Sunbird* 30: 61–88.
Brooker, M.G. 2001. *West. Aust. Nat.* 23: 62–106.
——, & A.J. Estbergs. 1976. *West Aust. Nat.* 13: 160–70.
——, *et al.* 1990. *Emu* 90: 215–30.
Brothers, N.P. 1979. *Emu* 79: 89–91.
——, & G. Davis. 1985. *Tas. Bird Rep.* 14: 3–9.
Brown, R.J., *et al.* 1986. *Corella* 10: 118–22.
Brummitt, D.W. 1934. *S. Aust. Orn.* 12: 172–6.
Bryant, S.L. 1998. *Tas. Bird Rep.* 27: 13–16.
——, & M.C. Holdsworth. 1992. *Tas. Bird Rep.* 21: 31–2.
Burbidge, A.H. 1985. *RAOU Rep.* 16: 23–55.
Butler, W.H. 1970. *West. Aust. Nat.* 11: 149–60.
Campbell, A.G. 1902. *Emu* 2: 9–18.
—— 1905. *Emu* 5: 7–12.
—— 1909. *Emu* 9: 22–3.
—— 1932. *Emu* 31: 311.
—— 1938. *Emu* 38: 317–22.
Campbell, A.J., & H.G. Barnard. 1917. *Emu* 17: 2–38.
Carnaby, I.C. 1933. *Emu* 33: 103–9.
—— 1954. *West. Aust. Nat.* 4: 149–56.
Carpenter, G.A., & J.S. Matthew. 1997. *S. Aust. Orn.* 32: 134–40.
Carter, M.J. 1994. *Wingspan* 13: 18–21.
Carter, T. 1903. *Emu* 3: 89–96.
—— 1924. *Emu* 23: 223–35.
Cashion, T. 1958. *Emu* 58: 327–32.
Chafer, C.J., *et al.* 1999. *A Handbook of Birds Found in the Illawarra, Shoalhaven and Adjacent Tablelands*. Illawarra Bird Obs. Club, Wollongong, NSW.
Chaffer, N. 1932. *Emu* 31: 302–4.
Chandler, L.G. 1913. *Emu* 13: 33–45.
Chenery, A. 1921. *S. Aust. Orn.* 6: 37–40.
Chisholm, E.C. 1929. *Emu* 29: 143–51.
—— 1934. *Emu* 34: 8–23.
Chisholm, E.C. 1938. *Emu* 37: 301–13.
Clark, G. 1975. *Canberra Bird Notes* 3(3): 2–10.
Clarke, G. 1967. *S. Aust. Orn.* 24: 119–34.
Clarke, M.F., *et al.* 1999. *Wingspan* 9 (Suppl): 1–16.
Cleland, J.B. 1942. *S. Aust. Orn.* 16: 31–3.
—— 1943. *S. Aust. Orn.* 16: 56.
Close, D.H., & R.P. Jaensch. 1984. *S. Aust. Orn.* 29: 81–99.
Coate, K.H. 2003. *West. Aust. Nat.* 24: 25–36.
Coates, B.J. 1990. *The Birds of Papua New Guinea. 2*. Dove Publs, Alderley, Qld.
Cohn, M. 1926. *Emu* 25: 282–6.
Collins, P. 1995. *The Birds of Broome*. Broome Bird Observatory, Broome, WA.
Congreve, P., & D.P. Congreve. 1985. *RAOU Rep.* 9: 20–38.
Cooper, R.M., & I.A.W. McAllan. 1995. *The Birds of Western New South Wales: A Preliminary Atlas*. NSW Bird Atlassers, Albury, NSW.
Cooper, R.P. 1972. *Aust. Bird Watcher* 4: 171–81.
—— 1975. *Aust. Bird Watcher* 6: 47–60.
Costello, J. 1981. *Aust. Bird Watcher* 9: 55–67.
Cox, J.B. 1973. *S. Aust. Orn.* 26: 103–14.
Crawford, D.N. 1972. *Emu* 72: 131–48.
Crompton, R. 1915. *S. Aust. Orn.* 2: 36–43.
D'Ombrain, E.A. 1903. *Emu* 3: 69.
Davies, S.J.J.F. 1982. *RAOU Rep.* 3: 43–9.
Dennison, M.D., & H.A. Robertson. 1979. *Notornis* 26: 204–7.
Doughty, C., *et al.* 1999. *Birds of the Solomons, Vanuatu and New Caledonia*. Christopher Helm, London.
Dove, H.S. 1902. *Emu* 2: 19–22.
—— 1908. *Emu* 8: 38–9.
—— 1909. *Emu* 9: 37–9.
—— 1916. *Emu* 15: 234–43.
—— 1917. *Emu* 17: 45–7.
—— 1919. *Emu* 19: 53–5.
—— 1922. *Emu* 21: 306–8.
—— 1925. *Emu* 25: 43–4.
—— 1927. *Emu* 27: 47.
—— 1937. *Emu* 37: 61–2.
Draffan, R.D.W., *et al.* 1983. *Emu* 83: 207–34.
Durrant, B., & I. MacRae. (Eds) 1994. *Birds of Bribie Island, Pumicestone Passage and Environs*. Bribie I. Env. Prot. Assoc., Bribie I., Qld.
Dutson, G. 2001. *Emu* 101: 237–48.
Dymond, N. 1988. *RAOU Rep.* 38: 13–63.
Edgar, A.T. 1966. *Notornis* 13: 27–60.
—— 1978. *Notornis* 25: 279–90.
Edwards, R., & K. Shadbolt. 1992. *RAOU Rep.* 86: 18–35.
Emison, W.B., & J.W. Porter. 1978. *Emu* 78: 126–36.
Er, K.B.H. 1997. *Corella* 21: 101–11.
——, & C.R. Tidemann. 1996. *Corella* 20: 117–28.
——, —— 2001. *Canberra Bird Notes* 26(2): 33–42.
——, *et al.* 1998. *Aust. Bird Watcher* 17: 370–82.
Ey, A.E. 1944. *S. Aust. Orn.* 17: 32–7.
Favaloro, N.J. 1931. *Emu* 31: 48–59.
—— 1942. *Emu* 41: 268–76.
Fielding, P. 1977. *Tasm. Nat.* 48: 2–3.
Fleming, A.M. 1976. *Aust. Bird Watcher* 6: 151–60.
Fletcher, J.A. 1904. *Emu* 4: 14–17.
—— 1909a. *Emu* 8: 218.
—— 1909b. *Emu* 9: 95.
—— 1918. *Emu* 18: 96–101.
—— 1924. *Emu* 24: 107–17.
Ford, H.A., & D.C. Paton. 1976. *S. Aust. Orn.* 27: 88–95.
——, *et al.* 1985. *Corella* 9: 97–107.
——, *et al.* 1986. *Emu* 86: 168–79.
Ford, J.R., & P.S. Stone. 1957. *Emu* 57: 9–21.
Friend, G.R. 1982. *Emu* 82: 80–91.
Frith, H.J. (Ed.) 1969. *Birds in the Australian High Country*. Reed, Sydney.
——, & J.H. Calaby. 1974. *Tech. Pap. Div. Wildl. Res. CSIRO, Aust.* 28.
Fulton, G.R. 2002. *Corella* 26: 1–12.
Fyfe, M. 2003. *Canberra Bird Notes* 28(1): 17–20.
Garnett, S.T., & R. Bredl. 1985. *Sunbird* 15: 25–40.
——, *et al.* 1991. *Corella* 15: 1–7.
Gates, J.A. 1996. *S. Aust. Orn.* 32: 65–75.
Gepp, B.C., & A.J. Fife. 1975. *S. Aust. Orn.* 27: 12–17.
Gibson, D.B., & J.R. Cole. 1988. *Tech. Rep. Cons. Comm. North. Terr.* 40.
Gibson, D.F. 1986. *Tech. Rep. Cons. Comm. North. Terr.* 30.
Gibson, J.D. 1977. *Aust. Birds* 11: 41–74.
Gilbert, P.A. 1935. *Emu* 35: 17–27.
Gill, H.B. 1970. *Emu* 70: 105–16.
Goodfellow, D.L. 2001. *Birds of Australia's Top End*. Scrubfowl Press, Darwin.
Gosper, D.G. 1981. *Corella* 5: 1–18.
—— 1983. *Corella* 7: 7–13.
—— 1986. *Corella* 10: 1–16.
—— 1992. *Corella* 16: 78–88.
Green, R.H. 1966. *Emu* 66: 105–10.
—— 1969. *Rec. Queen Vict. Mus.* 34: 1–32.
—— 1989. *Birds of Tasmania*. Potoroo Publs, Launceston, Tas.
——, & A.M. McGarvie. 1971. *Rec. Q. Vict. Mus.* 40: 1–42.
Green, R.H., & B.C. Mollison. 1961. *Emu* 61: 223–36.
Gregory-Smith, R. 1991. *Canberra Bird Notes* 16(4): 65–74.
Griffioen, P.A., & M.F. Clarke. 2002. *Emu* 102: 99–125.
Griffiths, G.A. & D.T. Holyoak. 1993. *Aust. Bird Watcher* 15: 93.
Hall, G., & C. Hall. 1990. *RAOU Rep.* 73: 12–44.
Halse, S.A., *et al.* 1985. *West. Aust. Nat.* 16: 57–69.
Hanks, E.S. 1930. *Emu* 29: 246–51.
Hardacre, K. 1987. *Canberra Bird Notes* 12(3): 106–7.
Harris, J.G.K. 1980. *Tasm. Nat.* 60: 1–6.
Haselgrove, P. 1975. *Sunbird* 6: 32–41.
Hastwell, K. 1985. *Aust. Bird Watcher* 11: 64.
Heather, B.D., & H.A. Robertson. 2000. *The Field Guide to the Birds of New Zealand*. Viking, Auckland.
Henle, K. 1989. *Aust. Birds* 22: 53–68.
Henley, J.C. 1974. *Notornis* 21: 266–7.
Heron, S.J. 1970. *Emu* 70: 155–8.
—— 1973. *Emu* 73: 1–8.

Hewish, M. 1998. *Geelong Bird Rep.* 1997: 3–41.
—— 2002a. *Geelong Bird Rep.* 2000: 3–61.
—— 2002b. *Geelong Bird Rep.* 2001: 3–65.
——, *et al.* 1999. *Geelong Bird Rep.* 1998: 57–84.
Hicks, R.K., & A.M. Hicks. 2000 *Geelong Bird Rep.* 1999: 53–62.
Hindwood, K.A., & A.R. McGill. 1951. *Emu* 50: 217–38.
Hingston, A. 1994. *Tas. Bird Rep.* 23: 5–23.
Hobbs, J.N. 1961. *Emu* 61: 21–55.
Hodges, M. 1960. *Emu* 60: 118.
Hogan, J. 1925. *Emu* 24: 266–75.
Hood, J.B. 1935. *S. Aust. Orn.* 13: 107–19.
Hornsby, P. 1997. *S. Aust. Orn.* 32: 118–27.
Horton, W. 1975. *Sunbird* 6: 49–69.
Hoskin, E.S. 1991. *The Birds of Sydney.* Surrey Beatty, Sydney.
Howard, M. 1986. *Aust. Bird Watcher* 11: 247–57.
Hyem, E.L. 1936. *Emu* 36: 109–27.
Ingle, A.P. 1910. *Emu* 10: 121–7.
Ingram, G.J. 1976. *Sunbird* 7: 67–76.
——, *et al.* 1986. *Sunbird* 16: 12–24.
Jarman, H.E.A. 1944. *S. Aust. Orn.* 17: 22–4.
Jenkins, C.F.H. 1931. *Emu* 31: 30–5.
Johnson, H.R., & N. Hooper. 1973. *Aust. Bird Watcher* 5: 80–95.
Johnstone, R.E. 1983. *Wildl. Res. Bull. West. Aust.* 11: 54–96.
——, & L.A. Smith. 1981. Pp 171–214 **In**: West. Aust. Mus. 1981.
——, *et al.* 1977. *Wildl. Res. Bull. West. Aust.* 6: 87–96.
——, *et al.* 1979. *Wildl. Res. Bull. West. Aust.* 8: 22–30.
——, *et al.* 1981. *Wildl. Res. Bull. West. Aust.* 10: 46–53.
——, *et al.* 2000. *Rec. West. Aust. Mus. Suppl.* 61: 371–448.
Jones, D.N. 1986. *Sunbird* 16: 1–11.
Keast, A. 1985. Pp 97–116 **In**: Keast *et al.* 1985.
——, *et al.* (Eds) 1985. *Birds of Eucalypt Forests and Woodlands.* Surrey Beatty, Sydney.
Kendall, H. 1901. *Emu* 1: 19–23.
Kennedy, S.J. 2003. *Corella* 27: 33–44.
Klapste, J. 1977. *Aust. Bird Watcher* 7: 65–6.
Lamm, D.W., & J.H. Calaby. 1950. *Emu* 50: 114–22.
Lane, S.G. 1956. *Emu* 56: 99.
Lang, C.L. 1927. *Emu* 27: 110–16.
Lansley, P.S. 1997. *Aust. Birding* 3(2): 24.
Lavery, H.J. 1964. *Emu* 63: 307–9.
Lawson, F. 1905. *Emu* 4: 132–7.
Le Souëf, A.S. 1921. *Emu* 20: 140–4.
Leach, G.J. 1995. *Corella* 19: 118–26.
——, & H.B. Hines. 1987. *Sunbird* 17: 65–95.
Lenz, M. 1981. *Canberra Bird Notes* 6(1): 3–42.
—— 1982. *Canberra Bird Notes* 7(1): 2–33.
Lepschi, B.J. 1993. *Emu* 93: 195–9.
Lindgren, E. 1960. *Emu* 60: 115–17.
Littler, F.M. 1910a. *Birds of Tasmania.* Author, Launceston, Tas.
—— 1910b. *Emu* 9: 141–8.
Longmore, N.W. 1978. *Sunbird* 9: 25–53.
Lord, E.A.R. 1943. *Emu* 43: 18–23.
—— 1956. *Emu* 56: 100–28.
Loyn, R.H. 1985a. *Emu* 85: 213–30.
—— 1985b. Pp 33–36 **In**: Keast *et al.* 1985.
—— 1985c. Pp 291–99 **In**: Keast *et al.* 1985.
—— 1998. *Pacifc Conserv. Biol.* 4: 111–21.
——, *et al.* 2002. *Victorian Nat.* 119: 114–32.
Luck, G.W., *et al.* 1999. *Emu* 99: 157–69.
MacGillivray, W. 1910. *Emu* 10: 16–34.
Marchant, S. 1973. *Canberra Bird Notes* 2(5): 2–16.
Marshall, A.J. 1935. *Emu* 34: 189–96.
Masters, J.R., & A.L. Milhinch. 1974. *Emu* 74: 228–43.
Matthiessen, J.N. 1973. *Emu* 73: 191–3.
Mayo, L.M. 1932. *Emu* 31: 304.
McAllan, I.A.W., *et al.* 2004. *Aust. Field Orn.* 21 (Suppl.).
McDonald, D. 2001. *Canberra Bird Notes* 26(3): 65–76.
McEvey, A.R. 1965. *Emu* 65: 1–56.
——, & W.G. Middleton. 1968. *Emu* 68: 161–212.
McFarland, D.C. 1988. *Emu* 88: 249–57.
McGill, A.R., & S.G. Lane. 1955. *Emu* 55: 49–71.
McGilp, J.N. 1923. *Emu* 22: 274–87.
—— 1924. *Emu* 23: 197–205.
—— 1930. *S. Aust. Orn.* 10: 200–4.
—— 1935. *Emu* 34: 163–76.
—— 1944. *S. Aust. Orn.* 17: 1–8.
McKean, J.L. 1985. *Aust. Bird Watcher* 11: 114–30.
Mees, G.F. 1961. *J. Proc. R. Soc. West. Aust.* 44: 97–143.
Mellor, J.W. 1924a. *S. Aust. Orn.* 7: 164–5.
—— 1924b. *S. Aust. Orn.* 7: 232–3.
—— 1924c. *S. Aust. Orn.* 7: 234–5.
—— 1930. *S. Aust. Orn.* 10: 204–8.
—— 1931. *S. Aust. Orn.* 11: 104–6.
Merton, D.V. 1970. *Notornis* 17: 147–99.
Miskelly, C.M., *et al.* 2001. *Notornis* 48: 1–40.
Mollison, B.C. 1960. *Emu* 60: 55–6.
—— 1962. *Emu* 62: 112–14.
——, & R.H. Green. 1962. *Emu* 61: 277–80.
Morcombe, M. 2000. *Field Guide to Australian Birds.* Steve Parish Publs, Brisbane.
Morgan, A.M. 1914a. *S. Aust. Orn.* 1(3): 13–14.
—— 1914b. *S. Aust. Orn.* 1(4): 11–21.
—— 1916a. *S. Aust. Orn.* 2: 116–21.
—— 1916b. *S. Aust. Orn.* 2: 168.
Morgan, A.M. 1919. *S. Aust. Orn.* 4: 7–20.
Morris, A.K. 1975. *Aust. Birds* 9: 37–76.
——, *et al.* 1981. *Handlist of Birds in New South Wales.* NSW Field Orn. Club, Sydney.
Morrison, K., & J.V. Morrison. 1985. *Notornis* 32: 244.
Morse, F.C. 1922. *Emu* 22: 24–36.
Napier, J.R. 1969. *Aust. Bird Watcher* 3: 179–92.
Nevill, A. 1984. *Notornis* 31: 173–5.
Newbey, K.R., & B.J. Newbey. 1989. *West. Aust. Nat.* 18: 13–20.
Nichols, O.G., & F.M. Nichols. 1984. *West. Aust. Nat.* 15: 179–89.
Nielsen, L. 1966. *Emu* 65: 314.
—— 1991. *Birds of Lamington National Park and Environs.* Author, Canungra, Qld.
Norton, S.P.W. 1922. *Emu* 22: 39–44.
Noske, R.A., & G.P. Brennan. 2002. *The Birds of Groote Eylandt.* North. Terr. Univ. Press, Darwin.
Noyce, J.E. (Ed.) 1997. *A Bird Watchers Guide to Redcliffe, Pine Rivers and Caboolture.* Wildl. Preserv. Soc. Caboolture Shire, Brisbane.
Officer, H.R. 1976. *Aust. Bird Watcher* 6: 223–8.
Orton, C.L.E., & T. Sandland. 1922. *Emu* 22: 134–7.
Parsons, F.E. 1928. *S. Aust. Orn.* 9: 191–206.
Passmore, M.D. 1982. *Aust. Bird Watcher* 9: 227–37.
Paton, D.C., & J.B. Paton. 1980. *S. Aust. Orn.* 28: 120–6.
——, *et al.* 1994. *S. Aust. Orn.* 31: 161–94.
Paton, P.A., & J.A. Pedler. 1999. *S. Aust. Orn.* 33: 33–46.
Patterson, R.M. 1985. *Tas. Bird Rep.* 14: 14–16.
Pescott, T. 1978. *Aust. Bird Watcher* 7: 273–6.
Phillips, W.J. 1947. *Emu* 47: 116.
Pierce, R.J. 1980. *Notornis* 27: 21–44.
Pizzey, G. 1980. *A Field Guide to the Birds of Australia.* Collins, Sydney.
Possingham, M.L., & H.P. Possingham. 1997. *S. Aust. Orn.* 32: 145–60.
Prendergast, H.D.V. 1990. *Canberra Bird Notes* 15: 35.
Ratkowsky, A.V. 1983. *Tas. Bird Rep.* 12: 15–21.
—— 1993a. *Tasm. Nat.* 113: 7–8.
—— 1993b. *Tas. Bird Rep.* 22: 15–22.
——, & D.A. Ratkowsky. 1977. *Emu* 77: 19–22.
Read, J.L. 1999. *Aust. Bird Watcher* 18: 59–67.
Recher, H.F., & W.E. Davis. 1998. *Aust. J. Ecol.* 23: 514–27.
Reid, D. 1951. *West. Aust. Nat.*3: 68–71.
Rhodes, L.J. 1944. *Emu* 44: 87–93.
Ridpath, M.G., & R.E. Moreau. 1966. *Ibis* 108: 348–93.
Rix, C.E. 1942. *S. Aust. Orn.* 16: 44.
—— 1970. *S. Aust. Orn.* 25: 147–90.
—— 1976. *Aust. Bird Watcher* 6: 255–88.
Roberts, G.J. 1980. *S. Aust. Orn.* 28: 99–102.
——, & G.J. Ingram. 1976. *Sunbird* 7: 1–20.
Roberts, R.G. 1975. *Aust. Bird Watcher* 6: 61–8.
Robinson, A.H. 1933. *Emu* 33: 95–6.
—— 1934. *Emu* 34: 75.
—— 1955. *West. Aust. Nat.* 4: 187–92.
Roff, C. 1967. *Emu* 66: 273–8.
Rogers, K.G., *et al.* 1986. *Bander's Aid: A Guide to Ageing and Sexing Bush Birds.* A. Rogers. St Andrews, Vic.
Rolland, J., & T. Rolland. 1996. *RAOU Rep.* 110: 13–29.
Rowley, I.C.R. 1961. *Emu* 61: 7–17.
Sage, B. 1994. *Aust. Bird Watcher* 15: 260–4.
Saunders, D.A., & C.P. de Rebeira. 1993. *The Birds of Rottnest Island.* Authors, Perth.
——, & J.A. Ingram. 1995. *Birds of Southwestern Australia.* Surrey Beatty, Sydney.

Schmidt, B.L. 1978. *Aust. Birds* 12: 61–86.
Schmutz, E. 1977. *Die Vögel der Manggarai (Flores)*. Ruteng, Flores. Author.
Schodde, R. 1976. *A Survey of the Fauna of the Lower McArthur River Region, Northern Territory*. CSIRO Div. Wildl. Res. for Mimets Dev't, Canberra.
——, & B. Glover. 1955. *S. Aust. Orn.* 21: 65–72.
Sedgwick, E.H. 1940. *Emu* 40: 237–45.
—— 1944. *Emu* 43: 229–33.
—— 1951. *Emu* 50: 207.
—— 1973. *West Aust. Nat.* 12: 147–55.
—— 1978. *West. Aust. Nat.* 14: 85–108.
—— 1986a. *Aust. Bird Watcher* 11: 146–9.
—— 1988. *Aust. Bird Watcher* 12: 222–32.
Semmens, A.K. 1993. *Aust. Bird Watcher* 15: 108–15.
Serventy, D.L. 1937a. *Emu* 37: 90–4.
—— 1937b. *Emu* 37: 158.
—— 1948. *Emu* 47: 241–86.
Sharland, M.S.R. 1943. *Emu* 43: 126–30.
—— 1958. *Tasmanian Birds*. Angus & Robertson, Sydney.
Sharpe, R.B. 1885. *Catalogue of the Birds in the British Museum. 10. Fringilliformes (Part 1)*. Br. Mus. Nat. Hist., London.
Sharrocks, R.E. 1981. *Aust. Bird Watcher* 9: 110–23.
Simpson, K.G. 1964. *Emu* 63: 334.
Singor, M. 1995. *West. Aust. Bird Notes* 76: 10.
Slater, P. 1962. *West. Aust. Nat.* 8: 124–6.
Smith, L.E., & C.J. Chafer. 1987. *Aust. Birds* 21: 1–18.
Smith, P. 1984. *Emu* 84: 200–10.
—— 1985. Pp 259–71 **In**: Keast *et al.* 1985.
Squire, J. 1984. *Aust. Bird Watcher* 10: 251–4.
Stidolph, R.H.D. 1927. *Emu* 26: 212–19.
Stokes, T. 1981. *Aust. Birds* 16: 36.
Stone, A.C. 1912. *Emu* 12: 112–22.
Storr, G.M. 1947. *S. Aust. Orn.* 18: 31–7.
—— 1965. *Emu* 64: 172–80.
—— 1981. *Rec. West. Aust. Mus.* 9: 65–99.
——, *et al.* 1975. *Wildl. Res. Bull. West. Aust.* 3: 75–83.
Stove, K. (Ed.) 1994. *S. Aust. Orn.* 31: 195–265.
Stranger, R.H. 1993. *West Aust. Nat.* 19: 257–64.
Sutton, J. 1922. *S. Aust. Orn.* 6: 182–3.
—— 1927. *S. Aust. Orn.* 9: 35–44.
—— 1928. *S. Aust. Orn.* 9: 173–83.
—— 1929. *S. Aust. Orn.* 10: 22–45.
—— 1930. *S. Aust. Orn.* 10: 186–94.
—— 1933. *S. Aust. Orn.* 12: 5–18.
Sutton, P. 1998. *Tas. Bird Rep.* 26: 24–8.
Taylor, I. 1983. *Canberra Bird Notes* 8(1): 5–52.
——, *et al.* 1986. *Canberra Bird Notes* 11(2): 26–88.
——, *et al.* 1987. *Canberra Bird Notes* 12(2): 30–83.
Taylor, R., *et al.* 1997. *Emu* 97: 220–30.
Templeton, M.T. 1991. *Sunbird* 21: 19–25.
—— 1992. *Sunbird* 22: 87–110.
Thomas, D.G. 1966. *Emu* 66: 33–8.
—— 1968. *Emu* 68: 42–84.
—— 1969. *Emu* 68: 249–71.
—— 1972. *Tas. Nat.* 31: 5–8.
—— 1979. *Tasmanian Bird Atlas*. Univ. Tas., Hobart.
——, & L.E. Wall. 1972. *Tas. Nat.* 29: 6–8.
Thomas, R., & J. Wheeler. 1983. *Birds of the Ballarat Region*. Author (Thomas), Linton, Vic.
Thompson, H.A.F. 1978. *North. Terr. Nat.* 1: 5–10.
Traill, B.J., *et al.* 1996. *Aust. Bird Watcher* 16: 309–26.
Turner, R.J. 1992. *Corella* 16: 65–74.
van Delft, R. 1984. *West. Aust. Bird Notes* 31: 4.
van Tets, G.F., *et al.* 1977. *Guide to the Recognition and Reduction of Aerodrome Bird Hazards*. Aust. Govt Publ. Serv., Canberra.
Veerman, P.A. 2003. *Canberra Birds: A Report on the First 21 Years of the Garden Bird Survey*. Author, Canberra.
——, *et al.* 1988. *Canberra Bird Notes* 13(3): 54–102.
——, *et al.* 1989. *Canberra Bird Notes* 14(3): 37–88.
Vernon, D.P. 1968. *Birds of Brisbane and Environs*. Qld Mus., Brisbane.
Vestjens, W.J.M. 1977. *Tech. Memo. Div. Wildl. Res. CSIRO, Aust.* 12.
Warham, J. 1961. *Emu* 61: 77–93.
——, & B.R. Keely. 1969. *Notornis* 16: 221–4.
Watson, I.M. 1955. *Emu* 55: 224–48.
Watts, D. 1999. *Field Guide to Tasmanian Birds*. New Holland, Sydney.
West. Aust. Mus. 1981. *Biological Survey of Mitchell Plateau and Admiralty Gulf, Western Australia*. West. Aust. Mus., Perth.
Whatmough, R.J. 1978. *S. Aust. Orn.* 28: 1–15.
Wheeler, W.R. 1967. *Aust. Bird Watcher* 3: 55–76.
White, C.M.N., & M.D. Bruce. 1986. *BOU Checklist* 7.
White, G. 1985. *Birds and Other Vertebrates of South West Tasmania*. Author, Sydney.
White, S.A. 1914. *Emu* 13: 122–9.
—— 1917. *Trans. R. Soc. S. Aust.* 41: 441–65.
White, S.R. 1952. *West. Aust. Nat.* 3: 103–6.
Whiter, J. (Ed.) 1991. *Nature in Eurobodalla* 5: 5–41.
—— (Ed.) 1993. *Nature in Eurobodalla* 7: 5–48.
—— (Ed.) 1994. *Nature in Eurobodalla* 8: 5–47.
—— (Ed.) 1995. *Nature in Eurobodalla* 9: 5–50.
——, & E. Andrew. (Eds) 1998. *Nature in Eurobodalla* 12: 5–54.
Whitlock, F.L. 1939. *Emu* 39: 47–56.
Wilson, F.E. 1912. *Emu* 12: 30–9.
Wilson, S.J. 1970. *Canberra Bird Notes* 1(7): 2–18.
—— 1975. *Canberra Bird Notes* 3(1): 12–13.
Winslet, J., & B. Winslet. 1987. *S. Aust. Orn.* 30: 103–10.
Woinarski, J.C.Z. 1993. *Emu* 93: 100–20.
——, *et al.* 1988. *Aust. Wildl. Res.* 15: 171–96.
——, *et al.* 1989. *Emu* 89: 223–31.
Wooller, R.D., & M.C. Calver. 1981. *Emu* 81: 48–50.
Wright, A. 1960. *Notornis* 8: 260–1.
Wykes, B.J. 1985. The Jarrah Forest Avifauna and its Re-establishment after Bauxite Mining. *West. Aust. Inst. Tech. School Biol. Bull.* 11.
Wyndham, E. 1978. *Emu* 78: 179–87.

Sponsor: JL Wettenhall

Volume 7 (Part B), Plate 44

White-backed Swallow *Cheramoeca leucosternus* (page 1499)
1 Adult; **2** Juvenile

Barn Swallow *Hirundo rustica* (page 1508)
SUBSPECIES *GUTTURALIS:* **3** Adult male; **4** Juvenile

Welcome Swallow *Hirundo neoxena* (page 1517)
NOMINATE *NEOXENA:* **5** Adult male (fresh plumage); **6** Adult male (worn plumage); **7** Juvenile

Red-rumped Swallow *Hirundo daurica* (page 1549)
SUBSPECIES *JAPONICA:* **8** Adult male; **9** Juvenile

Tree Martin *Hirundo nigricans* (page 1553)
10 Adult; **11** Juvenile

Fairy Martin *Hirundo ariel* (page 1568)
12 Adult; **13** Juvenile

Asian House Martin *Delichon dasypus* (page 1583)
NOMINATE *DASYPUS:* **14** Adult

Volume 7 (Part B), Plate 45

White-backed Swallow *Cheramoeca leucosternus* (page 1499)
1, 2 Adult

Barn Swallow *Hirundo rustica* (page 1508)
SUBSPECIES *GUTTURALIS:* **3, 4** Adult male

Welcome Swallow *Hirundo neoxena* (page 1517)
NOMINATE *NEOXENA:* **5, 6** Adult male

Red-rumped Swallow *Hirundo daurica* (page 1549)
SUBSPECIES *JAPONICA:* **7, 8** Adult male

Tree Martin *Hirundo nigricans* (page 1553)
9, 10 Adult

Fairy Martin *Hirundo ariel* (page 1568)
11, 12 Adult

Asian House Martin *Delichon dasypus* (page 1583)
NOMINATE *DASYPUS:* **13, 14** Adult