

## Order PASSERIFORMES

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

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

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

The Passeriformes divide into two main groups:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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## Family DICRURIDAE fantails, drongos, monarch-flycatchers and boatbills

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



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

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

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*Monarcha melanopsis* **Black-faced Monarch**

COLOUR PLATE FACING PAGE 64

*Muscicapa melanopsis* Vieillot, 1818, *Nouv. Dict. Hist. Nat., Nouv. Éd., Paris* 21: 450 — New South Wales = region of Port Jackson, New South Wales.

This monarch was so named as an Old World equivalent to the American tyrant-flycatchers *Tyrannus* (Latin *monarcha*, a monarch). The substantive and specific names refer to the black face and chin of the adult (Greek μέλας, μέλανος, black, and όψις, appearance or face).

**OTHER ENGLISH NAMES** Black-faced, Carinated or Pearly-winged Flycatcher; Black-faced or Grey-winged Monarch-flycatcher.

**MONOTYPIC**

**FIELD IDENTIFICATION** Length 18 cm (16–19.5); wingspan 27 cm (25–29); weight 23 g. Distinctive, medium-sized Asian flycatcher with robust bill, rather long pointed wings, and moderately long tail with slightly rounded tip. Slightly larger and longer-billed than Spectacled Monarch *Monarcha trivirgatus*; similarly shaped, but tends slightly larger than Black-winged Monarch *M. frater*. Sexes alike; no seasonal variation. Adults mostly blue-grey above, with conspicuous black face (not extending to eye); and with blue-grey breast sharply demarcated from rich orange-rufous rest of underbody. Juvenile readily separable from adult by lack of black face, browner upperparts and upperwing, slightly paler underbody with orange-rufous tinge to breast, and blackish bill. Immature superficially similar to juvenile, lacking black face of adult and with retained juvenile plumage of wing and tail, but with adult-like upperbody and underbody. No geographical variation. **Adult** Forehead, forecrown, anterior lores, chin and throat, black, forming distinct black face. Rest of top of head and neck, uniform blue-grey, grading to pale silvery-grey on ear-coverts and lower sides of neck (and upper breast). Posterior lores, off-white, continuous with broad arc of off-white round lower front half of eye and diffuse ring of off-white encircling narrow black eye-ring (which is broadest above front upper quadrant of eye). Folded wing appears blue-grey with dark-brown tips to folded primaries, and small dark-brown patch at alula; in flight, upperwing mainly blue-grey, continuous with blue-grey of upperbody, and dark-brown primaries and secondaries, with blue-grey outer edges. Uppertail, bluish grey. Upper breast, pale blue-grey, continuous with bluish-grey of sides of neck and sharply demarcated from black chin and throat, and from rich orange-rufous rest of underbody; in some birds, black of chin and throat extends onto centre of breast. Underwing largely brownish grey with bluish-grey leading edge, rich orange-rufous innerwing-coverts, and pale-grey outerwing-coverts, scaled with white. Undertail, brownish grey. Bill, slate-blue with a small whitish tip. Iris, black-brown. Legs and feet, blue-grey. **Juvenile** Lack black face of adult. Forehead, pale orange-rufous, merging into greyish top of head, hindneck and sides of neck. All of lores and feathers below front of eye, cream, forming diffuse loreal spot. Ear-coverts, brownish grey with orange-rufous tinge. Malar area, chin and throat, greyish cream with orange-rufous tinge. Upperbody slightly browner than adult, dull bluish-grey with brownish tinge. Upperwing less blue-grey than adult; mainly dark brown with cinnamon fringes or edges to coverts and tertials, and cinnamon to light-brown outer edges to remiges (except outer two primaries). Uppertail slightly duller than in adult. Breast, pale grey with orange-rufous suffusion and less sharply demarcated from throat or from orange-rufous rest of underbody, which is also slightly paler than in adult. Underwing slightly more rufous than in adult. Bill, blackish with dull-yellow base to lower mandible. Gape, pale yellow. Rest of bare parts as adult. **Immature** Superficially similar to juvenile, lacking black face of adult and retaining some juvenile plumage of wing and tail. Top of head and neck, including forehead, dull bluish-grey, slightly paler than in adult. Sides of head and neck, including chin and throat, light grey, slightly paler than top of head. Small loreal spot (on posterior lores) and narrow arcs above and below eye, off-white. Upperbody, as adult. On upperwing, new adult-like blue-grey coverts show distinct moult-contrast with worn and brown retained juvenile secondary coverts and remiges. Uppertail as juvenile. Underbody much as adult but belly and flanks slightly paler. Underwing as juvenile. Bill, black with small yellowish base to lower mandible; gape, pale yellow, at least at first. Rest of bare parts as adult.

**Similar species** Adults distinctive and should not be confused with other flycatchers; for differences from superficially similar Spectacled and Black-winged Monarchs, see those texts.

Usually seen singly or in twos, which probably pairs, occasionally in small family groups or small parties when on passage; sometimes join mixed-species flocks. Migratory, occurring in e.-coastal Aust. from Sept. to Apr. More sedate and deliberate in movements than Spectacled Monarch. Capture most prey by sallying, either taking insects in air or snatching them from foliage or branches, and also forage by gleaning. Hop between branches in manner suggestive of a whistler. Male more lively and vocal when breeding, calling constantly, sometimes even from nest; loud *who-you* whistle as well as more complex variations of this and harsher grating notes commonly heard in rainforest and dense eucalypt forest in spring–summer (see Voice).

**HABITAT** Mainly in rainforests (Robertson 1948; Wheeler 1967b; Bravery 1970; Gill 1970; Morris 1975; Gibson 1977; Morris *et al.* 1981; Chafer *et al.* 1999; Johnson & Mighell 1999; ACT Atlas); also often in wet sclerophyll forests or in open sclerophyll forests near rainforest (Morris 1975; Gibson 1977; Morris *et al.* 1981; Chafer *et al.* 1999). Usually found in gullies in mountains or coastal hills (Robertson 1948; Cooper 1951; Gibson 1977; Boles & Longmore 1989; Storr 19; Vic. Atlas; ACT Atlas; NSW Bird Rep. 1973).

Mainly inhabit RAINFORESTS, including: tropical rainforests, such as dry monsoon rainforest, deciduous or semi-deciduous vine thickets and upland, simple and complex notophyll vine forest (Ford *et al.* 1980; Mills 1984; Johnstone 1991; Laurance *et al.* 1996; Frith & Frith 2005; Hall; Storr 19); subtropical rainforests, such as tall closed rainforest dominated by Black Booyong, Purple Cherry and Yellow Carabeen, with abundant lianes and epiphytes, and generally open below canopy, with plants such as Broad-leaved Palm-lily in understorey, and sparse ground-cover of broad-leaved herbs, such as Cunjevoi; or low dry monsoon rainforest dominated by Lacebark, Deep Yellow-wood and White Cedar, with scattered overstorey emergents, including Hoop Pine, vines in canopy, and understorey of thorny shrubs or, at edges of rainforest, dense Lantana (Howe *et al.* 1981; Gosper 1992); and low warm-temperate rainforest, such as gully rainforest dominated by Lilly Pilly often with scattered Grey Myrtle, Yellow Sassafras, Southern Sassafras, Water Gum or Sweet Pittosporum, and shrubby understorey (Smith 1984; Loyn 1985; Vic. Atlas); occasionally recorded in remnant cool-temperate rainforest dominated by Myrtle Beech, associated with Silver Wattle in gullies (Vic. Atlas). In gallery rainforest mixed with riparian species and colonizing species from adjacent disturbed areas (Johnson & Mighell 1999). Also occur in regrowth rainforest, e.g. on Atherton Tableland, in regrowth 20–30 years old that had been clear-felled and burned in 1960 and grazed by cattle till 1973, and dominated by Grey Bolleywood, Sarsaparilla *Alphitonia petriei*, Celerywood, Carabeen, Brown Salwood and Circle-fruit Salwood *Acacia cincinnata*, and, where tree cover remained sparse, an understorey of Lantana and Molasses Grass *Melinis minutiflora* (Laurance *et al.* 1996); said to occur often at edges of rainforest (Storr 19), but other references neither support nor contradict this. Also often occur in WET SCLEROPHYLL FORESTS, especially in gullies with dense shrubby and fern understorey, and sometimes with depauperate rainforest elements, e.g. forests dominated by Tallow-wood, Blackbutt, Flooded Gum, Red Mahogany, Mountain Grey Gum, Messmate, Brown Barrel, Shining Gum, River Peppermint and Gully Peppermint (Morris 1975; Gibson 1977; Morris *et al.* 1981; Smith 1984; Loyn 1985, 1993; Milledge & Recher 1985; Gosper 1992; Slater 1995; Vic. Atlas). Sometimes occur in dry sclerophyll forests and woodlands (Pyke 1985; Morris 1986; ACT Atlas), especially open forests near rainforests (Robertson 1948; Gill 1970) and in winter or on passage (Dawson *et al.* 1991; Storr 19); usually dominated by eucalypts such as Spotted Gum, Woollybutt,

Silvertop Ash, White Stringybark or Brown Stringybark, and often with patchy understorey (Smith 1984; Gosper 1992; Loyn 1993), including dry eucalypt forest regrowth (Smith 1984), but also in other dry sclerophyll communities, including those dominated by Brigalow (Leach & Hines 1987; Leach 1995), riparian paperbarks or casuarinas (Cooper 1951; Jones 1981; Wieneke 1988; Britton & Britton 2000; Storr 19), or mixed shrublands or forests dominated by Coast Banksia and Southern Mahogany (Smith 1984). Occasionally recorded among mangroves (Draffan *et al.* 1983; Storr 19). **MODIFIED HABITATS:** Sometimes occur in suburban parks and gardens (McGill 1943; Hopkins 1948; Morris 1986; ACT Atlas; NSW Bird Reps 1976, 1991).

**DISTRIBUTION AND POPULATION** Winter migrant to New Guinea, from Merauke and Trans-Fly Region, N to Star Mts and Hindenberg Ra.; and also round Finschhafen, and from Port Moresby E to Louisiade Arch. (Coates 1990). Widespread spring–summer migrant in e. Aust. Vagrant to Aru Is (Diamond & Bishop 1994); and to NZ (see below).

**Aust.** Widespread in E. **WA** Vagrant. Single specimen, 9 km ENE of Mt Brookes, 16 June 1987 (Johnstone 1991). **Qld** Widespread from islands in Torres Str. and C. York (Draffan *et al.* 1983; Beruldsen 1990), along coasts (occasionally including offshore islands) and e. slopes of Great Divide, S to NSW border (Aust. Atlas 1, 2; Storr 19; Qld Bird Reps). Occasionally recorded farther inland, e.g. Forty-Mile Scrub, 6–7 Apr. 1976 (Ford *et al.* 1980) and Eight-Mile Plain, 12 Oct. 1991 (Qld Bird Rep. 1991); single vagrant recorded in sw. Qld, at Windorah, 31 Mar. 1989 (Qld Bird Rep. 1989). **NSW, ACT** Widespread in E. Occur along coasts and e. slopes and tablelands of Great Divide, inland to Coutts Crossing, Armidale, Cedar Brush NR, Widden Valley, Wollemi NP, Wombeyan Caves and Canberra (Morris *et al.* 1981; Aust. Atlas 1, 2; ACT Atlas; NSW Bird Reps). Rarely recorded farther inland, e.g. Munghorn Gap NR, 14 Jan. 1995 (NSW Bird Rep. 1995), Maules Ck, 50 km SE of Narrabri, 6 Dec. 1994 (NSW Bird Rep. 1994), near Bathurst, 4 Apr. 1999 (Aust. Atlas 2) and Williwa Ck, near Portland, 16 Oct. 1999 (Aust. Atlas 2). **Vic.** Mostly confined to E. Gippsland, where wide-

spread S of 37°S, extending W to round Mitchell R. NP (Vic. Atlas). Vagrant farther W, with recent records sparsely scattered in Tarra–Bulga NP, Noojee, Powelltown, Mt Eliza, Kinglake, Aireys Inlet, Greytown and Echuca (Aust. Atlas 1, 2; Vic. Atlas; Vic. Bird Reps 1985, 1987), and several historical records in Dandenong Ras (Howe 1928; Burgess 1939; Wheeler 1942); single vagrant record in Western District, near Coleraine, Nov. 2000–13 Jan. 2001 (Aust. Atlas 2). **SA** Vagrant. Single (specimen), Goolwa, 3 Dec. 1998 (Eckert 2001); single, Sturt Gorge Recreation Park, Adelaide, 12 Mar. 2000 (Rogers 2001).

**NZ NI** Single, Stratford, Taranaki, 19 Apr. 1996 (Tennyson 1997).

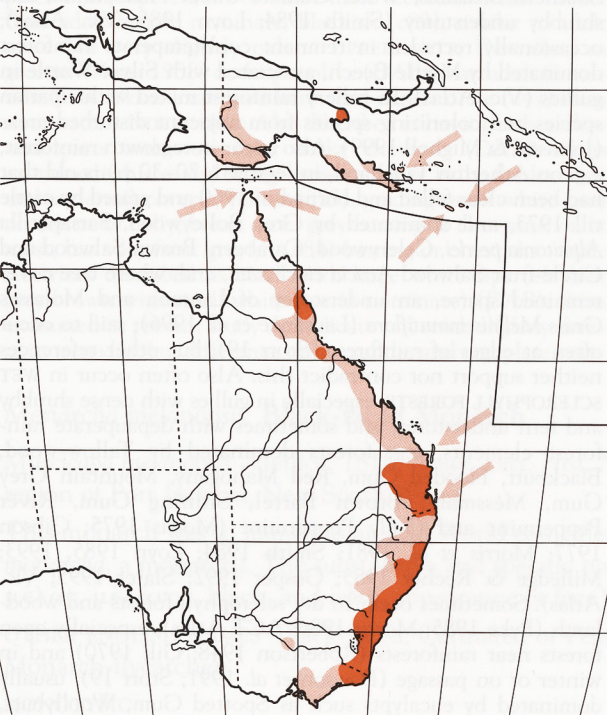
**Breeding** Recorded in Atherton Region (Wet Tropics), from Julatten S to Paluma Ra., and inland to Atherton Tableland (Bravery 1970; Gill 1970; Aust. Atlas 1, 2; NRS); also recorded at Eungella (Aust. Atlas 2). Farther S, widespread from 26°S in se. Qld to near Lakes Entrance, Vic. (Aust. Atlas 1, 2; NRS).

**Anomalies** Minor irruption recorded in Vic. in 1981, when recorded near Powelltown, Noojee and Aireys Inlet, all well W of usual range (Aust. Atlas 1; see above).

**Populations** **RECORDED DENSITIES:** 0.025 birds/ha, near Tallegalla, Qld (Leach & Watson 1994); 0.01 birds/ha, near Armidale, NSW (Ford *et al.* 1985); 0.2 birds/ha, at Moruya, NSW (Marchant 1979); 0.2–0.5 birds/ha, near Eden, NSW (Kavanagh *et al.* 1985); and 0.1–0.2 birds/ha, near Bombala, NSW (Recher & Holmes 1985).

**THREATS AND HUMAN INTERACTIONS** Occasionally collide with windows (Taplin 1991) and lighthouses (Makin 1961).

**MOVEMENTS** Reasonably well known. Strongly migratory, moving to and breeding e.-coastal Aust. from Sept. to Feb.–Apr., and wintering in New Guinea, Apr.–Aug. (Innes 1929; Gilbert 1935; Officer 1969; Coates 1990; Griffioen & Clarke 2002; Aust. Atlas 1; Storr 19). Few Aust. Atlas records in winter (Aust. Atlas 1; see Non-breeding below), which are possibly immatures (Hughes & Hughes 1980). Reporting rates in Atherton Region (Wet Tropics), during 1976–81, 19.2% in summer and 1.2% in winter (Aust. Atlas 1). Some may winter in parts of e. Qld and some may stay e. New Guinea in summer; such birds probably immatures (Officer 1969; but see below). Some migration may occur along coast, but most opt for a direct route north and later south (Griffioen & Clarke 2002). Timing of arrival varies: in NSW, arrival closely synchronized throughout state in some years (e.g. NSW Bird Rep. 1992) but much less so in other years (e.g. NSW Bird Rep. 1994). At Moruya, se. NSW, timing of departure probably depends on success or failure of breeding (Marchant 1992). **NATURE OF PASSAGE:** Seen singly on n. migration in NSW and se. Qld (Comrie-Smith 1932; Gilbert 1935); on n. and s. passage in Rockhampton, occur in singles and pairs (Longmore 1978); on s. migration in ne. Qld, seen singly at first, then later, timing not specified, in flocks of 8–10 (Campbell & Barnard 1917); on s. migration near Sydney, in group of at least three (McGill 1943). Round Maryborough, juveniles, assumed to be on passage, arrive regularly in late Mar. (Jones 1981). Movements occur during day (Aust. Atlas 1), in Sydney area observed at 09:15 (McGill 1943), and also migrate at night (Beruldsen 1990; L. Nielsen), supported by observations from lighthouses (Aust. Atlas 1), including on Pine Isl., Qld, mass mixed-species migration observed at midnight to 03:00 (Makin 1961). In NSW, birds on migration seen moving from tree to tree (Gilbert 1934, 1935). Occur on passage to and from New Guinea on islands in Torres Str., though lack of heavy passage there suggests that migration probably takes place on a broad front (Coates 1990).



Suggested that NZ record, on 19 Apr. 1996 (see Distribution), probably blown off course during n. migration (Tennyson 1997). Vagrants occurred in SA, an adult found dead at Goolwa on 3 Dec. 1998 (Eckert 2001) and an adult occurred near Sturt Gorge Recreation Park, near Adelaide, 12 Mar. 2000 (Rogers 2001).

**Breeding** Recorded spring–summer throughout e.-coastal Aust., including Qld (Nielsen 1964; Hopkins 1972; Durrant & MacRae 1994), NSW–ACT (Chisholm 1934; Kikkawa *et al.* 1965; Smith 1984; Smith & Chafer 1987; Ford & McFarland 1991; NSW Bird Rep. 1982) and Vic. (Wheeler 1967a; Loyn 1985; Vic. Atlas). However, apparently absent from far NE in Dec.–Mar., indicating present here only on passage (see Arrival, below). A few, possibly only young birds, may remain in e. New Guinea during summer (Rand & Gilliard 1967; Beehler *et al.* 1986; Coates 1990). Said to be present throughout year near Port Moresby (Anon. 1977), though few records; one juvenile recorded on 11 Dec. (Hicks 1989) and one immature recorded on 1 Feb. (Hicks 1990).

**Departure** Migrate N from Vic., NSW and Qld, usually leaving Feb.–Mar. but departure recorded as early as late Jan. and as late as Apr. (see below). **VIC.:** Leave Feb.–Mar. (Vic. Atlas). **NSW–ACT:** Appear usually to leave Feb.–Mar. and sometimes early Apr. (e.g. Innes 1929; Campbell 1938; Morris 1975; Holmes 1987; Hardy & Farrell 1990; Egan *et al.* 1997; NSW Bird Reps 1980, 1985, 1986, 1992, 1993, 1994, 1996; see below), though Morris *et al.* (1981) state that usually leave Mar.–Apr.; occasionally leave as early as Jan. (NSW Bird Reps; see below) and one report of departure in May (in Illawarra region; Gibson 1977). Dates of departure include: Nethercote, 27 Feb.–20 Mar. (NSW Bird Reps 1993, 1994, 1996); Bermagui, 11 Feb.–4 Apr. (NSW Bird Reps 1988, 1992, 1993); Moruya, 23 Jan.–13 Mar., 1976–84, 1989 (Marchant 1979, 1992; NSW Bird Reps 1976–84, 1989); Barren Grounds NR, late Feb. to 22 Mar. (Jordan 1987; Bramwell 1990; NSW Bird Rep. 1984), in 1988, last sighting early Dec. (Bramwell 1990); Sydney area, 9 Feb.–6 Apr. (Gilbert 1935; Hindwood & McGill 1958; Morris 1989; Hoskin 1991; Leishman 1994; NSW Bird Reps), once one seen as late as 31 May (NSW Bird Rep. 1980). Immatures sometimes recorded on passage in ACT (ACT Atlas). **QLD:** Departure recorded Feb.–May (Storr 1973; Aust. Atlas 1; Storr 19; see below) but noted on n. passage Jan.–Apr. (see below) and as late as May–June (Longmore 1978). Departure after Mar. confirmed by banding in Nanango since 1986 (Templeton 1992). In SE, departure recorded Mar.–Apr. (Morgan 1970; Roberts 1979; Leach & Hines 1987; Nielsen 1991; Templeton 1991, 1992); recorded on n. passage Jan.–Feb. (Dawson *et al.* 1991), Mar. (Jones 1981; Woodall 1999), Mar.–Apr. (Roberts & Ingram 1976), and Apr.–June (Longmore 1978). In NE, recorded leaving Paluma Ra., Apr. (Griffin 1974, 1995), Magnetic I., Feb.–Apr. (Wieneke 1988), Atherton Tableland, Feb. (Bravery 1970), and C. York (MacGillivray 1914; Storr 1973; Beruldsen 1990); and recorded on n. passage, Mar.–Apr. (Lavery & Hopkins 1963; Hopkins 1972; Wieneke 1992). **TORRES STR.:** Passage migrant across Torres Str. in small numbers (Draffan *et al.* 1983; Coates 1990).

**Non-breeding** Winter in s. and e. New Guinea, where recorded Mar. to Oct.–Nov. (Mayr 1941; Rand & Gilliard 1967; Storr 1973; Bell 1982a,b,d, 1983, 1984a,b; Coates 1990; Diamond & Bishop 1994; Storr 19; Aust. Atlas 1). Small numbers recorded during winter (15 June–15 Aug.) throughout Aust. range (Aust. Atlas 2). Claimed to be resident in Qld (Officer 1969), in upland rainforests in ne. Qld (Wieneke 1992). Claimed, without substantiation, that some winter in coastal lowlands of ne. Qld, between Rockhampton and Bloomfield R. (Storr 1973; Storr 19), and said to be resident round Innisfail (Gill 1970). However, little evidence for this, with very few records in winter since 1990 (L. Nielsen), and the

few winter records there are possibly of migratory stragglers (Nielsen 1996) or non-migrating immatures (Hughes & Hughes 1980). In SE, immatures present June–Aug. at Widgee, near Gympie (Hughes & Hughes 1980), and observed at Logan Reserve, 7–9 July, 1989 (Britton 1990).

**Arrival** Return to e. Aust. in early spring, moving S in Sept.–Nov. (Storr 1973; Aust. Atlas 1; Storr 19); recorded throughout e.-coastal Aust. from Sept. (see below). However, not recorded n. C. York Pen., Dec.–Mar., which suggests that birds have moved farther S by Dec. (G.R. Beruldsen). **QLD:** In NE, recorded on s. passage, Sept.–Oct. (Lavery & Hopkins 1963; Hopkins 1972; Wieneke 1992), including at Claudie R., Oct. (Storr 1973) and Magnetic I., Aug.–Oct. (Wieneke 1988); arrive Atherton Tableland, Sept. (Bravery 1970) and Paluma Ra., Sept.–Oct. (Griffin 1974, 1995). In SE, earliest arrival Aug. (Roberts 1979) but arrival or s. passage widely recorded Sept.–Oct. (Perkins 1973; Roberts & Ingram 1976; Longmore 1978; Dawson *et al.* 1991; Nielsen 1991; Templeton 1991, 1992; Woodall 1999); confirmed arrival in Oct. in Nanango by banding since 1986 (Templeton 1992), round Brisbane, arrival reported 17 Sept.–15 Oct. (Vernon 1968; Morgan 1970; Perkins 1973; Slater 1995; Bielewicz & Bielewicz 1996), and at Marburg, earliest arrival 23 Sept. (Leach & Hines 1987). **NSW, ACT:** Arrive Sept. in both N and S, and less often in Oct., though more often arrive Oct. in S (Innes 1929; Hyem 1936; Campbell 1938; Morris 1975; Gibson 1977; Morris *et al.* 1981; Holmes 1987; Hardy & Farrell 1990; Egan *et al.* 1997; ACT Atlas; NSW Bird Reps 1980, 1984, 1986, 1988; see below); once arrived Moruya, se. NSW, in mid-Nov. (see below). Dated arrivals in NE mainly mid- to late Sept., e.g. at various sites, arrivals 12–26 Sept. (NSW Bird Reps 1984, 1985, 1986, 1988, 1995, 1996) but also recorded Oct., e.g. over two years arrived Iluka, 16 Sept. and 5 Oct. (NSW Bird Reps 1978, 1980), and over two years at Nambucca Heads, arrived 15 Sept. and 11 Oct. (NSW Bird Reps 1985, 1992). Dated arrivals in central and s. NSW mainly late Sept. to mid-Oct. but as late as end Oct. (Campbell 1938; NSW Bird Reps 1984, 1986, 1992, 1993), e.g. near Newcastle, 18–26 Sept. (NSW Bird Reps 1982, 1984, 1995); Ourimbah, 24 Sept.–21 Oct. (NSW Bird Reps 1990, 1992, 1995); Sydney area, 16 Sept.–31 Oct. (Gilbert 1935; Hindwood & McGill 1958; Morris 1989; Hoskin 1991; Leishman 1994; NSW Bird Reps); Barren Grounds NR, 22 Sept.–15 Oct., 1982–89 (Jordan 1984, 1987, 1988; Bramwell 1990; NSW Bird Reps 1983, 1984); at Moruya, arrival rather consistent, 26 Sept.–13 Oct., though once as late as 18 Nov. (Marchant 1979, 1992; NSW Bird Reps); Bermagui, 20 Sept.–5 Oct. (NSW Bird Reps 1989, 1990, 1992); and Nethercote 1–10 Oct. (NSW Bird Reps 1993, 1994, 1996, 2000). **VIC.:** Arrive Sept. (Vic. Atlas).

**Banding** Of 888 banded in Aust., 1953 to Aug. 2001, 52 recoveries (5.9%). Of 28 recoveries, of 23 birds, July 1984–Aug. 2001, all <10 km from banding site (ABBBS). At Barren Grounds NR, NSW, 1982–88, 13 banded, and one retrapped twice (Jordan 1988). **LONGEVITY:** Adult banded at Barren Grounds NR, NSW, Oct. 1982, retrapped at banding place 5 years later (Jordan 1984, 1987, 1988).

**FOOD** Arthropods, mainly insects. **Behaviour** Mostly arboreal; forage at all heights, from canopy of trees to near, and occasionally on, ground. Forage mainly by sallying and less so by gleaning, taking prey in air or from foliage and branches of trees and shrubs (though at Widgee, Qld, not seen foraging aerially). Mostly forage in rainforest (MacGillivray 1914; Ashby 1924; Innes 1929; Cooper 1951; Storr 1953; Hughes & Hughes 1980; Recher *et al.* 1985; Laurance *et al.* 1996; North; see below; also see Habitat), though once seen foraging in dense tea-tree thickets (Hall). **FORAGING ASSOCIATIONS:** Once seen foraging with White-eared *Monarcha leucotis* and Spectacled Monarchs (Makin 1961). In PNG, occasionally in

mixed-species feeding flocks, but never more than one Monarch per flock ( $n=14$  flocks); when feeding in such flocks, foraged at slightly higher levels than when feeding alone (Bell 1983). **FORAGING HEIGHT, SITES:** At Widgee, se. Qld, foraged mostly 1.5–6 m above ground, mainly along branches, moving short distances before probing crevices; birds would also move to higher branches then descend rapidly to lower ones; not seen foraging on ground, on tree-trunks or among foliage (Hughes & Hughes 1980). Near Bombala, se. NSW, mean height of foraging 6.3 m (4.7; 283 obs. foraging): 1% on ground; 43% in shrubs, 0.2–4 m above ground; 44% in sub-canopy, 4–10 m; and 12% in canopy, >10 m. Of these observations, foraging substrates were: foliage (65%); bark of trees (13%), including on loose bark (1%), bark on branches (10%) and bark on trunks (2%); on ground (1%); and in air (21%). **FORAGING METHODS:** Near Bombala, se. NSW, of 283 observations of foraging, foraged mainly by sallying (92%), including sally-striking on vegetation (68%), sally-striking in air (21%) and sally-hovering (3%), with rest of foraging by gleaning (8%) (Recher & Holmes 1985; Recher *et al.* 1985). Prey held against branch and dismembered before being eaten (Hyem 1936).

**Extraliminally** For data on heights, sites and methods of foraging in PNG, see Bell (1982c, 1983), Rand & Gilliard (1967) and Coates (1990).

No detailed studies. **SPIDERS**<sup>7</sup>: Salticidae<sup>7</sup>. **INSECTS**<sup>1,3,5,8</sup>: Coleoptera<sup>6</sup>: Alleculidae<sup>7</sup>; Buprestidae: *Melobasis*<sup>7</sup>; Cerambycidae<sup>7</sup>; Chrysomelidae: *Tomyris*<sup>7</sup>; Cleridae<sup>2</sup>; Curculionidae<sup>6</sup>; Scarabaeidae: *Diphucephala*<sup>7</sup>; Diptera<sup>2</sup>: Calliphoridae: *Calliphora*<sup>7</sup>; Hemiptera<sup>7</sup>: Cicadellidae<sup>7</sup>; Cicadidae<sup>2</sup>: *Cystosoma saundersii*<sup>4</sup>; Psyllidae: lerp<sup>7</sup>; Hymenoptera: wasps<sup>2,6</sup>, sawflies<sup>7</sup>; Apidae<sup>7</sup>; Lepidoptera: larv.<sup>7</sup>, ad. moth<sup>5</sup>; Odonata<sup>7</sup>; Orthoptera<sup>1</sup>.

**REFERENCES:** <sup>1</sup> MacGillivray 1914; <sup>2</sup> Jarvis 1929; <sup>3</sup> Cooper 1951; <sup>4</sup> McKenzie 1968; <sup>5</sup> North; <sup>6</sup> Cleland; <sup>7</sup> Lea & Gray; <sup>8</sup> Hall.

**Young** Fed mainly insects, especially flies (Innes 1929).

**SOCIAL ORGANIZATION** Very poorly known. Usually seen singly or in twos, probably pairs (e.g. Wigan *et al.* 1938; Morris 1975; Gibson 1977; Longmore 1978; Drake 1979; Leach 1995; Kikkawa 1997; North), sometimes in small family groups, with up to two young (Campbell; NSW Bird Rep. 1997). On passage, seen singly or in small flocks of up to ten (see Movements). Once seen foraging with White-eared and Spectacled Monarchs (see Food). In non-breeding areas in New Guinea, usually occur singly (e.g. Watson *et al.* 1962; Bell 1983; Coates 1990), though immatures seen in twos during Nov.–Dec. (Coates 1990); also join mixed-species associations (Bell 1983).

**Bonds** Nest in simple pairs (Marchant 1986). In New Guinea, suggested that pair-bond breaks down in non-breeding season, as usually seen singly in winter (Bell 1983).

**Breeding dispersion** No information. Said, without supporting evidence, to be territorial (Boles). No details.

**Roosting** No information.

**SOCIAL BEHAVIOUR** Very poorly known. Frequently observed bathing in creek (North).

**Agonistic behaviour** Male said to advertise territory while female incubates (Marchant 1986). No other information regarding intraspecific interactions. **INTERSPECIFIC INTERACTIONS:** Once observed chasing a Green Catbird *Ailuroedus crassirostris* and, in turn, being chased by another Green Catbird (Nubling 1921). Attracted to commotion caused by mobbing of Rufous Owl *Ninox rufa* (Banfield 1906).

**Sexual behaviour** Possible mate-guarding: off-duty parent often stays near nest (G.R. Beruldsen) and male often sings

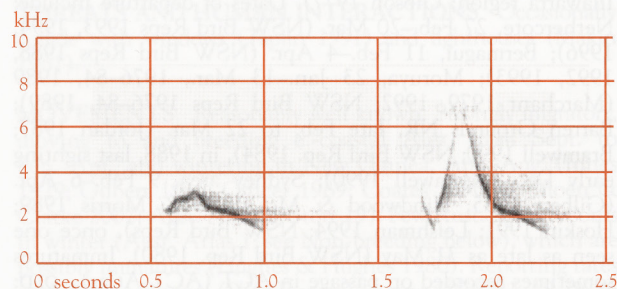
near nest while female incubates (North; G.R. Beruldsen). Male said to feed female at nest (Chisholm 1919). No other information.

**Relations within family group** Reportedly sit tight on nest, bird allowing itself to be touched by observer (Innes 1929; Hyem 1936; Chisholm 1971), *contra* claim that desert nest after it is touched (O'Grady & Lindsey 1979). Once, incubating female pecked at person (Chisholm 1971). If startled while brooding, point bill almost vertically (Innes 1929).

**VOICE** Poorly known. Call much (Storr 1953) but said never heard calling in winter (North). Song apparently given only by male, who often sings near nest while female incubates, or when he is on nest incubating; female mostly silent during breeding season, though possibly makes occasional Quick call (Marchant 1986; Campbell; North). One call resembles that of White-eared Monarch (q.v.).

**Adult SONG:** Loud, rich, clear whistled *why-yew witch-yew* (sonagram A), each note uttered slowly and distinctly; repeated several times (Officer 1967; Gould; North); variations include utterance of only part of the phrase (Officer 1967, 1969). Also described as a loud unvaried *which-is-you? we-you* (Storr 1953); and as *give us a chew, whack, give us a chew*; often repeated without the *whack*, which is, however, usually introduced eventually (Jackson 1907, 1914; Campbell). **QUICK:** A short scraping *quick*, thought to be given by female (Marchant 1986). **Other calls** Chattering and grinding notes (Officer 1969); *turry-tully* or *kirry-killy* (Storr 1953).

**Young** No information.



A R. Buckingham; Norrinbee North, Vic., Dec. 1982; P50

**BREEDING** Moderately well known; 51 records in NRS to Dec. 2003; some information from Moruya, se. NSW (Marchant 1981, 1986, 1992). Breed solitarily (North).

**Season** Eggs recorded Oct.–Feb. (see below) with fresh eggs mostly Nov. to mid-Jan. (North). Breeding otherwise recorded Oct.–Mar. (Campbell; Vic. Atlas; NRS). **QLD:** Eggs, Oct. to mid-Jan. (Campbell; NRS [ $n=6$ ]). In NE, laying Nov.–Jan. (Lavery *et al.* 1968; Storr 19). In SE, breeding recorded Oct.–Jan. (Templeton 1991; Storr 19; Aust. Atlas 2). **NSW:** Eggs, Oct.–Feb. (Morris *et al.* 1981; Campbell; North; NRS); of 21 clutches in NRS, ten (47.6%) in Nov., nine (42.9%) in Dec., one (4.8%) in Jan. and one (4.8%) in Feb.; nestlings, Nov.–Feb. (NRS). At Moruya, laying started 1–12 Dec. (4 nests), and, for single nests, c. 1 Nov. and on 12 and 27 Nov. (Marchant 1981, 1992). Breeding otherwise recorded Oct.–Feb. (Innes 1929; Gibson 1977), though Aust. Atlas (2) mentions breeding in Mar. and Apr. but without any details. **VIC.:** Few data. One nest with young, late Jan. (NRS); breeding recorded Oct.–Jan. and Mar. (Vic. Atlas; Aust. Atlas 2).

**Site** Usually in densely foliated or vine-covered tree, sapling or shrub (Innes 1929; Marchant 1992; NRS); usually sheltered or partly concealed by foliage (North), but sometimes conspicuous (Campbell); often beside creek or in gully (Innes 1929; Smith 1984; Marchant 1992; North); in upright or vertical fork, less often on horizontal branch among lateral

twigs or shoots (Innes 1929; Marchant 1992; Campbell; North; NRS; G.R. Beruldsen). Of seven nests at Ourimbah, NSW, six were in and round upright forks and one was on a horizontal branch (North); of eight nests in NRS, four were in upright forks and four in horizontal forks. Said to be often near tops of nest-plant (Campbell; North), though this not supported by NRS, where said nests can be near top of nest-plant or on a low branch (see Measurements). Of 32 records in NRS: five (15.6%) were in *Olearia*, and five in vines on shrubs or small trees (including four on *Acacias*); four (12.5%) in Lilly Pilly and in Yellow Sassafras; three (9.4%) in *Acacia* (e.g. Blackwood) and in Coachwood *Ceratopetalum apetalum*; two (6.3%) in *Notelaea* and *Pittosporum*; and one (3.1%) in each of Grey Myrtle, *Callicoma* and Turpentine (NRS). Also once recorded in Hoop Pine (NSW Bird Rep. 1980); and once on leaning branch of Coachwood growing through frond of Bangalow Palm; others recorded in sassafras and Maiden's Blush *Sloanea australis* (North). Usually securely built into a three-pronged upright fork (Innes 1929; Campbell; North; G.R. Beruldsen); less often on a horizontal fork, or on horizontal branches with several thin leafy lateral twigs or shoots (North; NRS). MEASUREMENTS (m): Height of nest above ground: 4.3 (2.27; 1.3–10; 46) (NRS); 1.5–10.7 (Chisholm 1919; Innes 1929; Campbell; North). Height of nest-plant, 10.0 (8.82; 2.5–35; 12) (NRS). For 12 nests, difference between height of nest and height of nest-plant, 5.8 (7.03; 0.9–25) (NRS).

**Nest, Materials** Shape varies with site. In upright forks, nest usually inverted cone or pear-shape, with cup-like cavity at top, and with base tapering more or less to a point, depending on thickness of fork (Innes 1929; North); less often, when placed on thin horizontal fork, nest cup-shaped (Campbell; North). At Moruya, completed nests described as looking like an egg in an egg-cup with its top cut off (Marchant 1986). Camouflaged (Chisholm 1919). Usually made of casuarina needles, thickly coated with bright-green moss (North) and bound together with spider web (Innes 1929), or made entirely of hair-like mosses (Campbell); sometimes lined with fine hair-like or wiry rootlets (possibly refers to horsehair fungus) (Innes 1929; Campbell; North; G.R. Beruldsen). Of 36 nests in NRS for which materials described: 29 (80.6%) contained moss, including epiphytic moss; four (11.1%) lichen; three (8.3%) fine black fibres from ferns; three (8.3%) plant material or twigs, or were decorated with green fern fronds; and single records (2.8%) contained feathers, fibres, vines, rootlets, bark or grass. Of these nests, seven (19.4%) were lined with roots or rootlets, five (13.9%) with twigs, one (2.8%) with feathers, and another with plant fibres (NRS). At Moruya, none of c. 10 nests had moss on external walls. Three nests, each observed being built, began as a small cup of green moss, inside which a taller cup of casuarina needles and twigs was constructed (Marchant 1986). Building by female only (Marchant 1986; NRS) or, probably less often, by both birds (NRS). Once, at well-advanced nest, intervals between visits were up to 30 s; one bird took material to nest three times in 15 min while other manipulated sticks but did not add them to nest; at another nest, both birds lined nest (NRS). MEASUREMENTS (cm): Average nests said to measure: (external diameter, 7.6, 10.2; external depth, 10.2–12.7, 8.9; internal diameter, 5.1, 6.4; internal depth, 5.1, 3.8 (Campbell; North [respectively]). For one nest in upright fork (measurements as preceding): 8.9, 11.4, 6.4, 3.8; and for one on horizontal fork: 8.9, 7.6, 5.7, 3.8 (North).

**Eggs** Oval, elongate oval or pyriform; some compressed at small end, others pointed at both ends. Close-grained and smooth; lustreless or glossy (Campbell; North). Pure white to faint reddish white, with minute bright-red, pinkish-red or purple spots, especially round large end, though others uniformly marked all over, almost obscuring ground-colour; spots

sometimes mingled with a few underlying dull-red or purplish-grey spots (Innes 1929; Hyem 1936; Campbell; North); one set had only fine pink spots (Hyem 1936; Campbell). From set of two at Ourimbah, NSW, one was pure white with broad band of confluent rich-red spots on large end and other was faint reddish-white, minutely dusted purplish red all over, with markings more densely distributed on one side, and a broad, confluent rich purplish-red patch at large end (North). MEASUREMENTS: 23.6 (0.93; 21.8–25.1; 10) × 17.0 (0.44; 16.3–17.5) (Campbell; North).

**Clutch-size** Two or three (Hyem 1936; Campbell; North; Storr 19; NRS; G.R. Beruldsen). From NRS, 2.33 (0.49; 2–3; 12); C/2 × 8; C/3 × 4. In se. Qld, C/2 × 2, C/3 × 2 (Storr 19).

**Laying** Twice, interval between laying of first and second eggs was >40 h; in one of these clutches, interval between second and third eggs was <35 h (Marchant 1986); in one nest, both eggs of a 2-egg clutch laid within 49 h (NRS). Second egg of one clutch laid between 17:30 and 06:15 next day (NRS).

**Incubation** By both sexes (Innes 1929; Chisholm 1971; Marchant 1986). Incubating bird sits tight (see Social Behaviour). Incubate more or less continuously on cold days (NRS). At Moruya, at one nest with C/3, during 3.5 h of observation on first 3 days of incubation, female sat for 118 min (55%) and male for 79 min (35%) with nest unattended for c. 20 min (10%); change-overs were rapid and usually occurred when other bird within 10 m of nest; nest usually remained unattended for <2 min at a time, except on third day when female apparently reluctant to replace male, and nest unoccupied for several minutes. During pre-incubation period (before final egg laid), female sat briefly three times (for 11, 4 and 6 min) and male once (for 2–3 min), during 225 min of observation from 05:35 to 11:45 (Marchant 1986). At another nest, sexes shared incubation spells of c. 20 min duration (Innes 1929). INCUBATION PERIOD: Once, ≥13 days; once, young seen c. 15 days after eggs first observed (NRS).

**Young** Altricial, nidicolous. One nestling 1–2 days old covered in fine down; another nestling of unknown age naked except for a bit of dark down; another had eyes closed and was covered with down, and with pin-feathers on wings (NRS). Both sexes brood and feed nestlings; at one nest, change-overs occurred at c. 20-min intervals (Chisholm 1919; Innes 1929; NRS).

**Fledging to independence** FLEDGING PERIOD: Once, ≥7 days; once, >6 days but <21 days, and incubation period plus fledging period possibly 23 days (NRS). Both sexes feed fledgelings (NRS), once for at least 4 days after fledging.

**Success** Where number of eggs and outcome known, of 23 eggs in ten nests, two (8.7%) hatched and one (4.4%) fledged, equivalent to 0.1 fledged young per nest; from 37 eggs in 16 nests, 15 (40.5%) hatched; where outcome known, of 15 nests, four nests fledged at least one young and 11 failed (NRS). At Moruya, all of at least three, and probably c. 10, nests failed (Marchant 1986). CUCKOOS: Parasitized by Brush Cuckoo *Cacomantis variolosus* (Brooker & Brooker 1989; HANZAB 4).

**PLUMAGES** Prepared by F.J.G. Copley. Fledge in juvenile plumage. Then undergo a partial post-juvenile (first pre-basic) moult to first immature (first basic) plumage. Attain adult plumage in complete first immature post-breeding (second pre-basic) moult, probably when c. 1 year old. Thereafter, a complete post-breeding (pre-basic) moult each cycle produces successive adult (basic) plumages, with no change in appearance. Sexes similar. No subspecies. Descriptions based on examination of skins of 51 adult males, 19 adult females, 11 immatures and two juveniles.

**Adult** (Definitive basic). HEAD AND NECK: Hindcrown, nape, hindneck and upper sides of neck, bluish grey (87) to dark blue-grey (78), grading to light grey (c85) on lower sides



of neck and ear-coverts. Forehead, forecrown, anterior lores, malar area, chin and throat, black (89), combining to form distinct black face. Narrow black (89) eye-ring, slightly more prominent above fore-quadrant of eye; black eye-ring encircled by off-white (ne) to pale-grey (c86) feathering which forms fairly distinct and broad arc in front of and below front half of eye, a small diffuse patch just behind eye, and a narrow ring round rest of eye. Several rather long (up to 12 mm) black (89) rictal bristles arise from lower lores and above gape. **UPPERPARTS:** Wholly bluish grey (c87). All feathers have concealed paler grey (c86) bases. **UNDERPARTS:** Most of breast, light bluish-grey (pale 87), sharply demarcated from black (89) throat; in some, black feathering extends from throat to centre of upper breast, and, rarely, some diffuse blackish (c89) mottling extends to centre of breast. Lower breast, belly, flanks, vent and undertail-coverts, orange-rufous (ne), fairly sharply demarcated from black of rest of breast. Thighs, dark brown (121) with orange-rufous (ne) or off-white (ne) tips to feathers. Axillaries, orange-rufous (ne). All feathers have concealed dark-grey (83) bases. **UPPERTAIL:** T1, bluish grey (c87). T2–t5, bluish grey (c87) on outer webs, dark brownish (c119A) on inner webs. T6, dark brownish (c119A). Shafts, dark red-brown (c221A). **UNDERTAIL:** Brownish grey (c79) with white shafts to rectrices. **UPPERWING:** Marginal and median secondary coverts, bluish grey (c87) grading to brown (28) at bases. Greater secondary coverts, bluish grey (c87) on outer webs, brownish grey (c79) on inner webs. Marginal and median primary coverts, dark brown (121) with blue-grey (c87) tips. Greater primary coverts, bluish grey (c87) on outer webs, dark brown (121) on inner webs. Feathers of alula, dark brown (c121) with diffuse bluish-grey (c87) fringes which are less distinct on longest feather. Tertials, bluish grey (c87) with narrow dark-brown (121) inner edges near tips separated from concealed off-white (ne) inner edges near bases; inner web of s7 mostly dark brown (121). Secondaries and primaries, dark brown (121) with diffuse off-white (ne) inner edges, and narrow bluish-grey (c87) outer edges to secondaries and p1–p8; inner and outer edges extend from base of feather and end progressively closer to base (thus becoming shorter) towards outer primaries. Shafts of remiges, dark red-brown (221A). **UNDERWING:** Marginal coverts, black-brown (119) with bluish grey (c87) or off-white (ne) tips or fringes. Median and greater secondary coverts, orange-rufous (ne). Median primary coverts, light grey (85) with broad off-white (ne) fringes that grade to orange-rufous (ne) at extreme margins of coverts. Greater primary coverts, light grey (c85) with narrow off-white (ne) fringes. Remiges, brownish grey (c79) with off-white (ne) inner edges; shafts, off-white (ne) or light brownish (c223D).

**Nestling** From photos, down on crown sparse, brownish grey (c79) (standard sources) or grey-black (82) (unpubl.: L.N. Robinson).

**Juvenile** Differs from adult by: **HEAD AND NECK:** Forehead, pale orange-rufous (ne), merging into greyish (c84) crown, nape, hindneck and sides of neck, and with brown (c119B) tips to feathers of crown which form indistinct fine brown (c119B) mottling. Lores and feathers below front half of eye, cream (92), forming large loreal spot. Eye-ring, dark greyish (c83). Ear-coverts, brownish grey (c79) with diffuse orange-buff (118) tips. Malar area, chin and throat, greyish cream (ne) with diffuse orange-buff (118) tips to feathers. **UPPERPARTS:** Slightly browner than in adult, bluish grey (c87) with brownish-grey (c79) tinge; feathers also softer and more loosely textured than in adult. **UNDERPARTS:** Similar to adult but breast tinged orange-rufous (ne) and less sharply demarcated from chin and throat and from orange-rufous (ne) rest of underbody, which is also slightly paler than in adult. **TAIL:** Similar to adult, but t1 and outer webs of t2–t5 much duller bluish-grey (c87); rectrices also slightly narrower and more acute at tips. **UPPERWING:** Coverts and alula, brownish (c28)

with narrow cinnamon-brown (c39) fringes. Tertials, brownish (c28) with narrow cinnamon-brown (c39) fringes. Secondaries, dark brown (121) with narrow cinnamon-brown (c39) outer edges. Primaries, dark brown (c121) with narrow light-greyish (c85) or light-brownish (c223D) outer edges to p1–p8. Inner edges to all remiges as adult. **UNDERWING:** Similar to adult but all marginal coverts brownish grey (c79) or light bluish-grey (c87) with orange-rufous (ne) tips, and median primary coverts with broader orange-rufous (ne) fringes than in adult.

**First immature** (First basic). Superficially similar to juvenile, lacking black face of adult; and retain all juvenile rectrices, remiges, greater primary coverts, alula and outer 3–6 greater secondary coverts. **HEAD AND NECK:** Top of head, including forehead, and hindneck, rather uniform dull bluish-grey (c87). Anterior lores, ear-coverts, sides of neck, malar area, chin and throat, light greyish (c85), slightly paler than top of head; some have faint orange-rufous (ne) tinge to throat and ear-coverts. Posterior lores and feathers extending below front half of eye, off-white (ne), forming small whitish loreal spot. Eye-ring, dark grey (c83) or dark brown (c119A), bordered above and below by narrow off-white (ne) arcs. **UPPERPARTS:** Similar to adult, but slightly duller bluish-grey (dull 87). **UNDERPARTS:** Similar to juvenile. **TAIL:** As juvenile. **UPPERWING:** New marginal, median and inner greater secondary coverts, as adult and show distinct moult-contrast with brownish and worn retained juvenile coverts. Remiges as juvenile. **UNDERWING:** As juvenile.

**BARE PARTS** Based on photos (Morcombe 1971; unpubl.: L.N. Robinson; and standard sources) and other sources as cited. **Adult** Bill, light blue (66) grading to pale blue (168D) or cream (92) on edges of mandible and at tip. Iris, black-brown (20). Orbital ring, black-grey (c83). Legs and feet, blue-grey (c78). **Nestling** Skin of crown and occipital area, blue-grey (c78); skin of chin, throat and body, pink-salmon (c6), darkening with growth to pink (c3), darker dorsally than ventrally; skin of wing, blue-grey (78), grading to lighter pale-grey (c86) distally. Bill, dark grey (c83). Gape swollen, cream (92) or pale yellow (c157). Inside of mouth, orange-rufous (c132D), grading to orange-yellow (c18) at sides. Iris, black-brown (20). **Juvenile** Little known. Mees (1982) describes bill as blackish. **First immature** Based on photos of one live bird captured in Canberra in May (Boles), for which colour numbers given, and descriptions of one collected in n. WA in June (Johnstone 1991) and one collected in NSW in Apr. (Hall). Bill, blackish (c89) with indistinct dull-yellowish (ne) base to lower mandible; described as black with orange-yellow base to lower mandible (Johnstone 1991). Gape, pale yellowish (c157); described as yellow (Hall). Inside of mouth, orange (Johnstone 1991). Orbital ring, blue-grey (c78). Iris, black-brown (20); described as dark brown (Johnstone 1991; Hall). Legs, blue-grey (c88).

**MOULTS** Based on examination of skins of 65 adults, 11 first immatures and two juveniles (AM, ANWC, HLW, MV, SAM). **Adult post-breeding** (Pre-basic). Little known. Probably complete (Mayr & Rand 1937; this study). Little data on timing of moult for Aust.; of 65 Aust. skins (collected Aug.–Apr.), only two with active moult: one from Sept. with slight moult of underparts; and one from Feb. with moderate moult of underparts. In PNG, none of nine males (collected Mar.–Oct.) with active moult; of these, three in Mar. and Apr. with worn plumage, and six from May–Oct. with fresh plumage; in females, active moult recorded in two of four in Apr. (no other details given), and one of one in June (with moult of wing); two of two in May with fresh plumage (Mayr & Rand 1937). In s. PNG, a female collected in full moult in June (Mees 1982). Combined results suggest peak of moult occurs from about

Apr.–June, on wintering grounds in New Guinea, but more data needed. **Post-juvenile** (First pre-basic). Little known. Apparently partial but few data. Involves feathers of body, marginal and median coverts and inner greater secondary coverts. All 11 immatures retained all juvenile remiges and rectrices; not known if any replace all, or any, rectrices or remiges. Two juveniles collected in NSW in Jan. starting moult of body. **First immature post-breeding** (Second pre-basic). Little known. Complete; attain adult plumage in this moult (Mayr & Rand 1937). In n. NSW, one male starting moult to adult plumage in Apr. (Hall), but no further information given.

**MEASUREMENTS** (1–2) Skins (AM, ANWC, HLW, MV, SAM, WAM): (1) E. Aust., adults; (2) NSW and Qld, juveniles and immatures. (3) E. Aust., adult skins (Keast 1958). (4–5) PNG, skins (Mayr & Rand 1937): (4) Adults; (5) Immatures.

	MALES	FEMALES	
WING	(1) 91.5 (2.80; 85.5–98.5; 51)	88.0 (2.85; 82.5–93.0; 20)	**
	(2) 87.4 (2.10; 84.5–89.5; 4)	86.5 (1.73; 84.5–89.0; 8)	ns
	(3) 91.5 (4.17; 85–97; 12)	–	
	(4) 90.2 (3.23; 83–94; 9)	87, 89	
	(5) 79, 87	83	
TAIL	(1) 75.9 (2.88; 69.0–81.5; 50)	74.3 (4.99; 68.0–89.5; 20)	*
	(2) 74.8 (1.85; 73.5–77.5; 4)	72.3 (2.28; 69.0–75.5; 8)	*
BILL S	(1) 22.0 (0.65; 20.8–23.8; 47)	21.1 (0.82; 19.7–22.4; 19)	**
	(2) 21.4, 22.7, 22.9	21.3 (0.68; 20.8–22.8; 7)	
TARSUS	(1) 16.6 (1.10; 14.3–19.2; 50)	16.9 (0.84; 16.0–19.1; 20)	ns
	(2) 16.4 (0.71; 15.9–17.4; 4)	17.1 (0.78; 16.1–18.2; 8)	ns

One first immature male from WA had: Wing 89, Tail 71, and Bill S 23.0 (Johnstone 1991).

**WEIGHTS** (1–2) NSW and Qld, from museum labels (AM, ANWC, MV): (1) Adults; (2) Juveniles and first immatures.

	MALES	FEMALES	
(1)	22.8 (1.98; 19.0–27.0; 21)	22.3 (1.60; 20.5–25.0; 6)	ns
(2)	23.0, 29.0	21.0, 22.0, 23.0	

One juvenile male from s. PNG weighed 25 g (Mees 1982).

**STRUCTURE** Wing fairly long, slightly pointed. Ten primaries: p7 longest (p6, p8 =); p10 39–46 mm shorter, p9 13–15, p8 0–2, p6 0–1, p5 2–6, p4 7–14, p3 10–18, p2 14–20, p1 16–23. P5–p8 slightly emarginated on outer webs; p7–p8, sometimes also p6 and p9, slightly emarginated on inner webs. Nine secondaries, including three tertials; tips of longest tertials fall short of tips of secondaries on folded wing. Tail rather long, with slightly rounded tip when closed; 12 rectrices; rectrices slightly acute at tips, and more acute in juvenile than in adult. In fresh plumage, t1 longest; t2–t6 only slightly shorter, with t6 mean of 2.2 mm (0.98; 1–4; 6) shorter than t1. Bill robust, about same length as head; upper mandible slightly down-curved with tip overhanging tip of lower mandible, forming small hook. Tarsus short and slender, slightly laterally compressed; scaling laminiplantar. Tibia fully feathered. Middle toe with claw 14.5 (1.26; 12.6–16.1; 6); outer toe 69–97% of middle, inner 72–90%, hindtoe 75–98%.

**GEOGRAPHICAL VARIATION** Slight, and no subspecies currently recognized. Keast (1958) and Storr (1973) distinguished populations in n. Aust. as a separate subspecies *pallidus*. Most other authors (e.g. Mees 1982; Peters; DAB) do not recognize any subspecies. Slight clinal increase in length of wing from N to S in Aust., but no significant difference in adult male wing-length when comparing n. and s. breeding populations (DAB). Suggestion that n. populations have

narrower bill, paler sides of head and smaller area of black on forehead (Storr 1973) not supported by observations of skins in present study.

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Volume 7 (Part A), Plate 1

Black-faced Monarch *Monarcha melanopsis* (page 42)  
 1 Adult male; 2 Juvenile; 3 Immature; 4 Adult male

Black-winged Monarch *Monarcha frater* (page 50)  
 SUBSPECIES CANESCENS: 5 Adult male; 6 Adult female

Spectacled Monarch *Monarcha trivirgatus* (page 54)  
 SUBSPECIES ALBIVENTRIS: 7 Adult  
 SUBSPECIES MELANORRHOA: 8 Adult female; 9 Juvenile  
 SUBSPECIES GOULDII: 10 Adult; 11 Immature; 12 Adult