

## 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 AXV (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 PETROICIDAE Australasian robins

Small to medium-sized and often brightly coloured passerines. Size ranges from Red-capped Robin *Petroica goodenovii* (length 11 cm, weight 8–9 g) and Garnet Robin *Eugerygone rubra* (length 10–11.5 cm) to Southern Scrub-robin *Drymodes brunneopygia* (length 19–22 cm, weight 31–37 g). The Petroicidae comprises 38–46 species in 11–17 genera (Wolters 1975–82; Sibley & Ahlquist 1990; Sibley & Monroe 1990; Peters; DAB); DAB recognizes 15 genera in the family, including *Eugerygone* of New Guinea, but excluding *Culicicapa* of Wallacea and se. Asia and *Amalocichla* of New Guinea. As circumscribed by DAB, family essentially confined to Aust.–New Guinea region, with only five species extending farther: Golden-bellied Flycatcher *Microeca hemixantha* endemic to Tanimbar Is in Wallacea, and four species of *Petroica* on islands of sw. Pacific Ocean, including three endemic to NZ, and Scarlet Robin *Petroica multicolor*, widespread, on Solomon Is, Vanuatu, Banks Is, Fiji, Samoa, Norfolk I. and Aust. (Sibley & Monroe 1990; Coates *et al.* 1997; DAB), though DAB splits Aust. and islands forms of Scarlet Robin. In HANZAB region, 23 species in eight genera; DAB tentatively divided the Petroicidae into three subfamilies; these and their component genera (combining arrangements of Christidis & Boles [1996] and DAB) are: EOPSALTRIINAE: *Poecilodryas* (3 species in genus, 1 in HANZAB region), *Heteromyias* (2, 1), *Plesiodyras* (1, 0), *Gennaeodryas* (1, 0), *Peneothello* (4, 0), *Tregellasia* (2, 2), *Eopsaltria* (5, 4) and *Melanodryas* (2, 2). DAB places *Heteromyias*, *Plesiodyras* and *Gennaeodryas* in *Poecilodryas*, and places Mangrove Robin *Eopsaltria pulverulenta* in monotypic *Peneoenanthe*.

PETROICINAE: *Monachella* (1, 0), *Microeca* (6, 3), *Eugerygone* (1, 0), *Petroica* (10, 8) and, probably, *Pachycephalopsis* (2, 0).

DRYMODINAE: Monogeneric *Drymodes* (2, 2).

The name Eopsaltriidae has been used for this family (e.g. Sibley & Ahlquist 1990; Peters) but Petroicidae has priority (Bock 1990; Christidis & Boles 1994). Formerly placed with Old World flycatchers (Muscicapidae), whistlers (Pachycephalidae) or monarch flycatchers (Dicuridae) (e.g. Schodde 1975) but evidence from DNA–DNA hybridization (Sibley & Ahlquist 1985, 1990) and protein allozyme (Christidis & Schodde 1991) studies confirm that they are not closely related to any of these and should be treated as a distinct family. *Drymodes* also formerly placed with turdine thrushes (Muscicapidae) (e.g. Mayr 1963; Diamond 1972; Storr 1973; Peters) or timaliine babblers (Sylviidae) (e.g. Mayr 1941; Rand & Gilliard 1967) but results of DNA–DNA hybridization studies show they are part of the Petroicidae (Sibley & Ahlquist 1980, 1982). Nearest relatives not certain; they are part of a particularly old and divergent lineage (DAB) and evidence from various molecular techniques is conflicting. Results of DNA–DNA hybridization studies suggest a relationship with the Corvoidea (Sibley & Ahlquist 1990) whereas results of protein allozyme studies suggest a relationship with the Meliphagoidea (Christidis & Schodde 1991).

Body shape rather rounded and stocky, with large and rounded head. Bill usually short, straight and varyingly broad, though typically not deep, and with prominent long rictal bristles at base of bill; maxilla notched. Wings usually rounded at tips, with ten primaries and, usually, nine primaries (including three tertials). Tail short to moderately long, with square tip; long in *Drymodes*; 12 rectrices. Tarsus usually moderately long to long, slender. Fossae at head of humerus, single and trabeculated (pachycephaloid in form). Horns of vomer articulated and dorsoventrally flattened, and protrude forward of apically inflated maxillo-palatine processes. Narial and orbital cavities openly aperturate. Temporal fossae much reduced, with short post-orbital and zygomatic processes and small, almost unwinged ectethmoid plate that tapers towards jugal bar without reaching it. Free lachrymals missing (Coates *et al.* 1997; DAB). The three subfamilies further characterized by the following features (after DAB). In the Eopsaltriinae, inter-orbital bar usually missing; vomerine horns are very large, oblong plates about the size of the maxillo-palatines, bilobed at tip and constricted at base; and temporal fossae larger than in the other two subfamilies. The Petroicinae retain fine inter-orbital bar; tiny, almost awl-shaped vomerine horns that are only a fraction of the size of the maxillo-palatines; and temporal fossae are small. The Drymodinae differ from the other two subfamilies in slender form; apparent lack of vomerine horns; and ossified inter-orbital bar.

In adult plumage, upperparts usually rather plain grey, brown or black, but underparts often brightly coloured. Sexes alike in most species but *Petroica* and *Eugerygone* sexually dimorphic in plumage, with brightly coloured males (pink to red on underbody) and plainer females. Most species have distinctive wing-markings, typically a large pale wing-bar across bases of primaries (see Fig. 1). Fine to broad pale or brownish streaking or spotting common in juvenile plumage. All species appear to undergo partial post-juvenile (first pre-basic) moult shortly after



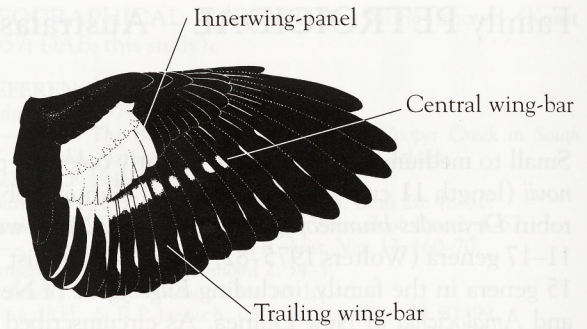
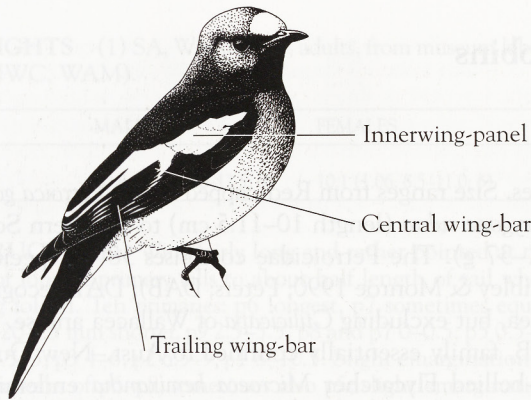


Figure 1(a). Pattern of folded wing of adult male Scarlet Robin (Source: Fig. 1, Rogers 1993)

Figure 1(b). Pattern of spread wing of adult male Scarlet Robin (Source: Fig. 1, Rogers 1993)

fledging to an adult-like first immature plumage. After attaining adult plumage, undergo a single complete post-breeding (pre-basic) moult annually, with no change in appearance. Primaries moult outwards.

The following summary of biology and ecology based largely on HANZAB species accounts (q.v.), Rand & Gilliard (1967), Watling (1982), Coates (1990), Coates *et al.* (1997) and other references as cited.

Throughout family range, occupy most wooded habitats, from coasts to uplands, including alpine regions, and in all bioclimatic zones. In Aust., widely distributed in wet to dry sclerophyll forests and woodlands, usually dominated by eucalypts, including wet and dry forests through to arid and semi-arid woodlands and shrublands. In Aust. and New Guinea, many species in various rainforest associations and, in New Guinea, in lowland to montane forests. A few species inhabit mangroves (e.g. Mangrove Robin, Golden-bellied Flycatcher). NZ *Petroica* found in variety of native forests, mostly dominated by podocarps or beech *Nothofagus*, and coastal and subalpine shrubland. River Flycatcher *Monachella muelleriana* of New Guinea inhabits fast-flowing rocky streams. Many species use ecotone between wooded and open habitats, including agricultural and grazing land, with some species in such habitats more often in non-breeding season (e.g. Flame *Petroica phoenicea* and Scarlet Robins). Also use modified habitats, such as regrowth native forests following logging or fire, or plantations of introduced pines.

Most species resident or sedentary, though many undertake some local or dispersive movements. Populations of several species in se. Aust. migrate altitudinally, breeding at high altitudes and wintering in lowlands. Several Aust. species seasonally migratory or partly migratory, most notably several Aust. *Petroica*, which breed in SE, including Tas., in spring–summer, and migrate to winter in N, with movement generally aligned with e. Aust. coast (see Chan 2001; Griffioen & Clarke 2002; and species accounts). Some species (e.g. Flame Robin), show a high degree of site-fidelity, returning to same breeding areas and wintering grounds in subsequent years (Robinson 1990; see species accounts).

Primarily insectivorous, though several species occasionally also take seeds. Many species join mixed-species feeding flocks. Arboreal and terrestrial; many primarily arboreal, particularly *Microeca*, though most recorded at least occasionally foraging on ground; others largely or wholly terrestrial (e.g. scrub-robins *Drymodes*, some *Poecilodryas*, *Heteromyias*). Most foraging by perch-and-pounce method, perching on vantage point before catching prey by sally-striking or sally-pouncing onto ground, then returning to perch to eat prey; many species (particularly within Eopsaltriinae) commonly cling sideways to tree-trunks and other vertical surfaces, remaining stationary for long periods scanning for prey. *Microeca* flycatchers mostly sally-strike at aerial prey. Terrestrial species mainly glean prey from ground or low vegetation.

Social organization well known from detailed studies of several species, especially Flame Robin, New Zealand Robin *Petroica australis*, New Zealand Tomtit *P. macrocephala* and Hooded Robin *Melanodryas cucullata* though most species much less well known. Most occur in pairs or small family groups throughout year, though some form flocks in non-breeding season. Typically socially monogamous, with long-term bonds, though extra-pair copulation known in Hooded Robin. Co-operative breeding reported in *Melanodryas*, *Tregellasia* and *Eopsaltria*, with helpers assisting in feeding nestlings and defence of territory. Social behaviour quite well known for a few species, but poorly known in most (as social organization). During breeding season vigorously defend territory, especially area immediately round nest. Some sexual behaviour described, including song-flights in *Microeca*, and wing-flicking displays in Hooded Robin. Courtship feeding occurs in most genera studied. In HANZAB region, distraction displays reported in all genera, except *Microeca*.



In general, not noisy and not noted songsters. Vocalizations of most species pleasant but repetitious whistling, piping, squeaking, trilling or buzzing notes (Chisholm 1960; Rogers 1993; Pizzey & Knight 1997; Coates 1990; see species accounts). Songs apparently function in advertising and defending territories, in attracting a mate and maintenance of pair-bond; may also be used as contact call and in other circumstances (e.g. see Scarlet Robin).

Most nest as solitary pairs, but several species breed co-operatively (see above). Nests cup-shaped, often with pieces of bark, lichen or moss attached to outside, typically aligned vertically, so that nests well-camouflaged against branch or trunk. Most nests built in fork in tree or shrub, but some built in hollows, and scrub-robins nest on ground. Construction usually by female only. Eggs varyingly oval; usually creamy white, pale green or pale blue, often spotted or blotched with brown. Clutch-size usually 1–4, but clutches of up to six have been recorded in some species (e.g. New Zealand Tomtit). In most species, only female incubates, though both sexes observed incubating in scrub-robins. Incubating female usually fed by male. Incubation usually takes 14–20 days. Both parents, and any helpers present, usually feed nestlings and nestlings. Young of most species take 12–22 days to fledge.

Many species have been adversely affected by clearance, fragmentation and degradation of habitat. In Aust., Norfolk I. Scarlet Robin *Petroica multicolor multicolor* and Tiwi I. Hooded Robin *Melanodryas cucullata melvillensis* considered vulnerable (and six other taxa of Least Concern) (Garnett & Crowley 2000). Black Robin of NZ endangered.

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*Miro traversi* Buller, 1872, *Birds New Zealand*: 123 — Mangere Island, Chatham Islands.

Named for Henry H. Travers (1844–1928), New Zealand collector, explorer and naturalist, who discovered this robin on Mangere I. and sent specimens to Walter Buller.

**OTHER ENGLISH NAMES** Chatham Islands Robin.

**MONOTYPIC**

**FIELD IDENTIFICATION** Length c. 15 cm; wingspan not known; weight 24 g. Medium-sized, rather tubby A'asian robin. Slightly larger and bulkier than sympatric form of New Zealand Tomtit *Petroica macrocephala chathamensis*, with slightly longer tail, stouter bill and slightly longer and thicker legs. Sexes alike. No seasonal variation. Adult and juvenile dull black, though juvenile faintly streaked paler on head and body. Immature undescribed (but see Plumages). **Adult** Wholly dull black, glossier on undersides of remiges and rectrices; plumage becomes slightly browner with wear. Bill, black. Iris, dark brown. Legs and feet vary from black to dark grey, pink-brown, or pink with patchy blackish suffusion; soles, light grey, pink or bright yellow. **Juvenile** Very similar to adult, differing by: plumage of body has slightly softer, looser texture, and indistinct fine pale streaking, clearest on forehead, crown and underbody; bill, black, merging to cream on cutting edges and at tip and base, with obvious puffy cream gape; legs and feet, pink-brown with patchy blackish suffusion; soles, yellow.

**Similar species** None; the only all-black robin on Chatham Is.

Usually seen singly or in twos, occasionally in small groups of up to five. Tame and confiding. Active when foraging; feed mainly by pouncing onto prey on ground from low perch; also by brief bouts of hopping on ground or by making frequent short flights between low perches to snatch insects from bark of tree-trunks or branches, or from foliage; very occasionally sally for insects. Perch with rather upright stance; note rather longish legs and big head hunched into rather rotund body.

**HABITAT** Forest and scrub, mostly with closed canopy, on islands in Chatham Grp (Fleming 1939, 1950; Ellis 1975; Flack 1975a; Heather & Robertson 1997; Oliver). On Mangere I., mainly in closed forest dominated by Akeake *Olearia traversii*, with other scattered trees such as *Plagianthus*

*betulinus* and *Hymenanthera chathamica*; much of forest edge is vegetated with dense thickets of Pohuehue *Muehlenbeckia australis* (Dennison *et al.* 1984). On Little Mangere I., mostly inhabit closed forests, and occasionally in areas with scattered trees or on open ground (Flack 1974, 1975a; Butler & Merton 1992). Habitat on South East I. similar to that on Little Mangere I. (Butler & Merton 1992).

**DISTRIBUTION AND POPULATION** Based mainly on account in Butler & Merton (1992). Endemic to Chatham Is (Bell 1986; NZCL).

**Chatham Is** When first collected, in 1871, confined to Mangere and Little Mangere Is. May have occurred on Chatham and Pitt Is before 1871 (Fleming 1939), though no records in early literature, and not recorded on either island during visit in 1871 or subsequently. Apparently never recorded on South East I. till translocation of eggs and young there in 1981. Extirpated from Mangere I. by c. 1900, and then confined to Little Mangere I. Whole population transferred from Little Mangere I. to Mangere I. in 1976. Subsequently introduced to, and established on, South East I. in 1983 (Travers & Travers 1872; Fleming 1939; Flack 1971; Merton 1983b; Butler & Merton 1992; Nilsson *et al.* 1994; see Introductions, below).

**Introductions** Translocated from Little Mangere I. to Mangere and South East Is; also subsequently translocated from South East I. to Mangere I. (see below). **FROM LITTLE MANGERE I. TO MANGERE I.**: Five birds translocated in Sept. 1976; and two more in Mar. 1977. **FROM LITTLE MANGERE I. TO SOUTH EAST I.**: Eggs and nestlings first translocated, for cross-fostering by Chatham I. subspecies *chathamensis* of New Zealand Tomtit, in Nov. 1981; two adults translocated in Jan. 1983; another two in June 1983; and singles in Nov. 1983 and July 1984. **BETWEEN SOUTH EAST I. AND MANGERE I.**: Birds first moved from South East I. to Mangere I. in June 1985; various exchanges of adults, chicks and eggs made between





the two islands 1985–87 (Morris 1977; Anon. 1983; Merton 1983b; Butler & Merton 1992).

**Breeding** Currently on Mangere and South East Is; formerly on Little Mangere I. (Butler & Merton 1992).

**Snares Is** Not recorded. Two wholly black robins collected 1888 (Buller 1890; Butler & Merton 1992) referable to black subspecies *dannefaerdi* of New Zealand Tomtit (Fleming 1950).

**Status** Endangered (Bell 1986; Collar *et al.* 1994).

**Populations** Changes in population summarized in Table 1. To June 1976, total population as that of Little Mangere I.; from 1976–77 to early 1984, total population as that of Mangere I. For some figures given in Table 1, age or pair composition of totals known: On LITTLE MANGERE I.: In Jan. 1973, population included 15 adults (7–8 pairs); in Jan. 1974, six adult pairs, two juveniles and 3–4 nestlings; in Nov. 1974, 11 adults (including four breeding pairs) and 6–7 nestlings; in Jan. 1976, four breeding pairs, and three dependent young. On MANGERE I.: In Oct. 1977, population included three pairs; Feb. 1978 included two young; in Dec. 1979 included single productive pair; Sept. 1980 included two pairs; Dec. 1980 included two pairs, single adult, and three young (Butler & Merton 1992). Total population in Dec. 1987, consisted of 34 adults and 39 chicks (Butler & Merton 1992).

**THREATS AND HUMAN INTERACTIONS** Population declined on Little Mangere I. as a result of rapid degradation of forest habitats and poor regeneration of woody plants, caused partly by a prolonged drought in 1970s which subjected vegetation to salt damage, and was exacerbated by damage to regeneration by large numbers of breeding Sooty Shearwaters *Puffinus griseus* (Flack 1974, 1975a, 1976a; Mills & Williams 1978; Merton 1983b). Suggested that Star Keys may now have insufficient cover and leaf-litter (and thus depauperate invertebrate fauna in litter) to support viable population of Black Robins (Butler & Merton 1992). Extirpated from Mangere by introduced Cats by c. 1900 (Fleming 1939; Flack 1971; Butler & Merton 1992). Common Starlings *Sturnus vulgaris* kill chicks and incubating birds, tip eggs out of nests and destroy nests (Butler & Merton 1992).

**RECOVERY PROGRAM:** Major conservation program undertaken to save species from extinction. This included: (1) translocating birds from Little Mangere I. to Mangere I. (see above), where revegetation program had been initiated, and, later, to South East I.; (2) supplementary feeding; and (3)

**Table 1.** Estimates of population; figures are individual birds unless stated.

Date of	Total population	Little Mangere I.	Mangere I.	South East I.	Reference
1937		20–35 pairs			1
1961		(similar to 1937)			2
1968		15–25 pairs			2, 3
1972		26+			2
Jan. 1973		17–19			2, 4
Oct. 1973		16			2, 4
Jan. 1974		18			2
Nov. 1974		17–18			2
Jan. 1976		11			2
June 1976		8			2
Oct. 1977			7		2
Feb. 1978			7		2
Dec. 1979			5		2
Sept. 1980			5		2
Dec. 1980			8		2
Jan. 1981			9		2
Jan. 1982			12		2
Jan. 1983			11		2
Jan. 1984			8		2
Feb. 1984	30		19	11	2
Feb. 1985	38				2
Oct. 1985	28		4	24	2
Feb. 1986	35				2
Oct. 1986	28				2
Dec. 1986	57				2
Feb. 1987	47				2
Dec. 1987	73				2
Feb. 1988	58				2
Sept. 1988	48		12	36	2
Dec. 1988	100				2, 5
Early 1990s			20–25		2
Feb. 1990	116				2
Oct. 1990				92	2
Feb. 1991	127				2
Apr. 1992	120–128				2
Mar. 1993	103				6
1994	155				5
Feb. 1999	250				7

REFERENCES: 1 Fleming (1939); 2 Butler & Merton (1992); 3 CSN 19 (Suppl.); 4 Flack (1974); 5 Collar *et al.* 1994; 6 Nilsson *et al.* 1994; 7 D.V. Merton.

mist-netting and removal of other species of insectivorous birds, such as Dunnocks *Prunella modularis*, Common Blackbirds *Turdus merula*, Starlings, Silvereyes *Zosterops lateralis* and Chatham Island Warblers *Gerygone albofrontata*, all of which were considered potential competitors or predators, from Mangere I. Further, in Sept. 1980, first clutches were removed from Black Robin nests for cross-fostering, initially by Chatham Island Warblers and later, and more successfully, New Zealand Tomtits, thus encouraging re-nesting and increased production of eggs (see Breeding). One female Black Robin that was raised by New Zealand Tomtits was mal-imprinted, and subsequently paired with a New Zealand Tomtit and produced a hybrid chick, which was destroyed. Intense management of population stopped in 1990, though population still monitored closely (Bell 1974; Flack 1976a; Butler & Merton 1992; Nilsson *et al.* 1994).



**MOVEMENTS** Sedentary, and territorial throughout year; present throughout year on Mangere and South East Is, Chatham Grp (Flack 1974, 1977; Merton 1983b, 1990; Munn 1984; Butler & Merton 1992; also see Social Organization).

**Banding** Of 21 banded, 1950–74, 14 recoveries (66.7%) (Robertson 1975); 466 birds banded 1950–96 (Cossee 1989, 1991, 1993, 1995, 1997, 1998a,b; Cossee & Wakelin 1991).

**FOOD** Invertebrates, mainly insects. **Behaviour** Terrestrial and arboreal: forage on ground and in low vegetation (Fleming 1950; Butler & Merton 1992; McLean *et al.* 1994; Heather & Robertson 1997). **DETAILED STUDIES:** Single study of foraging on South East I., Chatham Grp, 29 Mar. to 7 Apr. 1992 (McLean *et al.* 1994). Search for prey by perch-hunting, mostly from low elevated perches; and catch prey by sallying, mostly sally-pouncing onto prey on ground; also forage by gleaning while hopping on ground, or inspecting freshly dug soil for prey; occasionally sally for flying insects or flutter-chase prey after flushing them (Fleming 1950; Butler & Merton 1992; McLean *et al.* 1994; Heather & Robertson 1997). On Little Mangere I., formerly occupied small area of coastal forest and scrub, where fed on ground, sometimes in fresh soil of collapsed petrel burrows (Fleming 1950). Also said to hunt by making short flights between low perches, then briefly hopping on ground; or by taking prey from bark; leaf-litter not usually scratched or turned over when foraging; and prey occasionally captured from surfaces of leaves on plants (NZRD). On South East I., foraged mostly on ground; of 60 observations of foraging: 80% on ground; 5% above ground, at 0.1–10% height of canopy (height of canopy not stated); 9% at 10–20% height of canopy; and 6% at >20% height of canopy. Of these observations, mostly collected food from leaf-litter on ground (77%); less often from bare ground (3%), bark on small and large branches (12%), foliage (5%) and in air (3%). May use different perches while foraging on certain substrates; most commonly used perches were large branches and trunks of trees (50%), ground (32%), or small branches (18%) (McLean *et al.* 1994). On South East I., attacked prey mainly by sallying; of 60 observations of foraging: 57% by sally-pouncing, 3% sally-striking on vegetation, 35% gleaning (which included scratching among leaf-litter, probing and turning over leaves) and 5% flutter-chasing. When searching for prey, Robins moved between perches at mean rate of  $5.7 \pm 3.27$  moves/min, covering distance of  $1.9 \pm 2.47$  m in  $19.3 \pm 16.43$  s (McLean *et al.* 1994). Also on South East I., seen to feed on nocturnal wetas on forest floor at twilight (Anon. 1983). Compared with New Zealand Tomtits from South East I., foraging Black Robins on Little Mangere I. tended to fly shorter distances than Tomtits; obtained most food by gleaning rather than sallying; and foraged mostly from soil or tree branches rather than from all levels of forest; Robins foraged within forest, whereas Tomtits would use open, and even treeless, areas as well as forest (Butler & Merton 1992). Attracted to and accompany people within territories, to take prey disturbed by human activity; sometimes accept mealworms *Tenebrio molitor* from people's hands, and sometimes take them to feed mate or young (Butler & Merton 1992). On South East I., birds spent 83.5–85.3% of time foraging (n=10 birds; 100 10-s periods of obs.), and birds from which blood samples taken spent a similar amount of time foraging (Ardern *et al.* 1994).

No detailed studies. **INSECTS**<sup>2</sup>: Coleoptera<sup>2</sup>; Orthoptera: Anastomatidae and Rhophadoridae<sup>1,2</sup>. Also take

mealworms (larvae of *Tenebrio molitor* and *Galleria mellonella*) when artificially fed<sup>2</sup>. Also reported to take spiders; Diptera; Aphididae (Hemiptera) and Lepidopteran larv.<sup>3</sup>

**REFERENCES:** <sup>1</sup> Anon. 1983; <sup>2</sup> Butler & Merton 1992; <sup>3</sup> Heather & Robertson 1997.

**SOCIAL ORGANIZATION** Well known. Some information from detailed studies conducted as part of recovery program on islands of Chatham Grp since 1971–72 and recorded in Butler & Merton (1992). Occur singly or in twos, which are usually pairs, or sometimes in small groups of up to five (Fleming 1939; Butler & Merton 1992).

**Bonds** Territorial throughout year (Fleming 1939; Morris 1977; Butler & Merton 1992). Usually pair for life once bond established, though switching mates not unusual in 1- and 2-year-old birds early in first breeding season (Butler & Merton 1992; Merton 1992). **SEX-RATIO:** In 1991–92, after a decade of intensive management, sex-ratio on Mangere I., 1:1 in post-breeding season (n=26 adults); on South East I., in post-breeding season, sex-ratio slightly male-biased, 55:47 (n=102 adults). During breeding season (Oct.), sex-ratio 1:1 or nearly so on each island (Butler & Merton 1992). Before management, in 1973, population on Little Mangere I. slightly male-biased, with six pairs and four unpaired males (Flack 1975b). **Divorce** Paired females sometimes abandon mate and pair with new male; paired males rarely switch mates (Bell 1978; Butler & Merton 1992; Merton 1992). Upon transfer of two pairs and an unpaired male from Little Mangere I. to Mangere I., in Sept. 1976, pairs split up: unpaired male was released first, and immediately claimed territory and paired with female, who divorced her mate from Little Mangere I.; the other female then paired with divorced male, leaving second divorced male unpaired (Morris 1977). During May–June 1976, female associated with two males in different territories on same day, appearing to be paired to both (Butler & Merton 1992). Usually take 2 years to reach sexual maturity and begin breeding (Merton 1983a), though both sexes known to breed successfully in first year, usually when an older bird dies, leaving a territory unoccupied (Butler & Merton 1992). **Parental care** Only female incubates and broods (see Breeding). Both sexes feed nestlings and remove faecal sacs; both sexes also feed fledgelings, though broods sometimes divided and some parents less attentive than others, which can result in one parent doing most or all feeding of young (Butler & Merton 1992; Nilsson *et al.* 1994; see Relations within family group, and Breeding). For discussion of behaviour of adults in response to manipulation of breeding as part of recovery program, see Breeding. **PERIOD OF DEPENDENCE:** Juveniles dependent for 3–6 weeks (Bell 1978; Nilsson *et al.* 1994), or 40–65 days (Butler & Merton 1992) after fledging. Period c. 4 weeks for young cross-fostered by New Zealand Tomtits (Butler & Merton 1992).

**Breeding dispersion, Territories** Territorial throughout year, especially during breeding season when male patrols by singing from prominent perches (Fleming 1939; Morris 1977; Butler & Merton 1992; Heather & Robertson 1997). Territory boundaries break down to some extent in late summer (Butler & Merton 1992). On Mangere and South East Is, mean size of territories was just under 1 ha after 10 years of intensive management (Butler & Merton 1992). On Little Mangere I. in 1973, ten territories defended, by six pairs and four unpaired males, in c. 9 ha (Flack 1975b); or c. 20 birds in 4 ha (Mills & Williams 1979). One female occupied territory



of 0.68 ha, but shifted to occupy territory of 2.03 ha in 1974–75 (Butler & Merton 1992). In 1973, most birds remained on same territories as in 1972, though a female that was paired in 1972 joined a new male on his territory (Butler & Merton 1992). With decline of population on Little Mangere I., 1972–76, occupied territories expanded to include parts of neighbouring territories that were no longer defended (Butler & Merton 1992). Most successful territories were those with mixture of scrub, forest and open areas; territories in areas of closed forest or with little woody vegetation had low or zero nesting success (Butler & Merton 1992). Dominance hierarchy exists among young fledgelings, with subordinate birds chased away by dominant parents, siblings or neighbouring territory-holders; hierarchy once noted to change in 1 week (Butler & Merton 1992).

**Roosting** At night. Fledgelings recorded roosting above ground in vegetation (Butler & Merton 1992).

**SOCIAL BEHAVIOUR** Not well known. Some information from detailed studies conducted as part of recovery program on islands of Chatham Grp since 1971–72 and recorded in Butler & Merton (1992), on which account based unless otherwise stated. Time-budgets of behaviours of birds from which blood taken for DNA finger-printing, compared with unsampled controls, studied on South East I. (Ardern *et al.* 1994). Sometimes tame (Morris 1977; Merton 1981b; Butler & Merton 1992). Alert and active. Become wary of mist-nets after repeated trapping. Contact Calls given at fairly regular intervals, especially when foraging alone (Hay 1975; Heather & Robertson 1997; see Voice). **MAINTENANCE BEHAVIOUR:** Often sit and preen after feeding (Butler & Merton 1992). Reported sunning, before laying, and in Jan., when not busy nesting or raising young (Morris 1981; Anon. 1983; Butler & Merton 1992); also reported dust-bathing (Butler & Merton 1992). On South East I., birds spent 1.4–2.1% of time bill-wiping and preening (n=10 birds; 100 10-s periods of obs.); slightly, but not significantly, higher in bled birds. Birds spent 1.8–2.7% of time resting (n=10; 100 10-s periods of obs.); slightly, but not significantly, higher in bled birds (Ardern *et al.* 1994).

**Agonistic behaviour** Male said to advertise ownership of territory during breeding season by singing from prominent perches along boundary (Heather & Robertson 1997). After breeding (Jan.–Apr.), Down-scale Call given by both sexes; thought to have territorial function, possibly replacing Song of male at that time of year (Hay 1975; see Voice). In disputes, raise feathers of head (Butler & Merton 1992). Males will CHASE rivals (Bell 1978). Bill-clapping can be given in aggressive circumstances, with Aggressive Calls during chases (Butler & Merton 1992; see Voice). On Little Mangere I., two males that remained after removal of all five other Robins, expanded their territories and vigorously contested new territorial boundaries; during disputes, the two would fly into air together, pecking each other repeatedly, like fighting male Chaffinches *Fringilla coelebs*. Bouts of singing between these two males became more protracted (Morris 1977). Another dispute between two males over territorial boundary ended with one standing over and pecking the other furiously while the second was on ground in cavity; both flew off after approach by observer, and then hopped side by side along apparent territorial boundary, chirping and displaying at one another, while their mates looked on and twittered loudly from inside their territories. **INTERSPECIFIC INTER-ACTIONS:** Female flew at and chased an intruding immature

female New Zealand Tomtit. Historically, aggressive towards Bellbirds *Anthornis melanocephala* on Mangere I. **Alarm** Once male seen giving alarm call in response to nearby Swamp Harrier *Circus approximans*, and on another occasion, parents with fledgeling gave alarm calls in response to human intruders.

**Sexual behaviour** **Courtship** Perform courtship flights high in trees with male following closely behind or beside female, and subsequently attempting to mount her; male can also perform an excited 'dance' round female, which may also lead to copulation. Courtship feeding of female by male begins Sept.; and male continues to feed female through incubation, calling female off nest to be fed. Male sometimes alternates between feeding his mate and chasing her. Rarely, female chases mate. **COPULATION:** Female appears to solicit copulation by display.

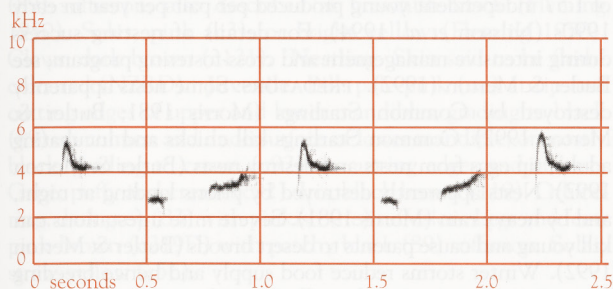
**Relations within family group** Only female broods nestlings (see Breeding); stop brooding young at night from 12–14 days after hatching. After young fledge, broods sometimes divided. In some pairs, either male or female is inattentive, leaving mate to do most or all of providing for fledgelings. Brood produce cacophony of chirping and squawking in response to arrival of parents at nest with food. When food in short supply, young sometimes pursue parents for food (Butler & Merton 1992). **Anti-predator responses of young** Fledgelings usually spend first 1–2 days on ground; then climb into vegetation. Fledgelings will hide in petrel burrows if chased (Butler & Merton 1992). **Parental anti-predator strategies** Use alarm calls and distraction displays to divert attention from fledgelings (Butler & Merton 1992).

**VOICE** Quite well known from study on Little Mangere I. (Hay 1975), which includes sonagrams, and from which unreferenced statements taken. Apparently little or no overlap in seasonal use of Song and Down-scale Call. Down-scale Call uttered commonly, by both sexes, Jan.–Apr.; Song, given by males only, commonly from June to mid-Dec.; Song given often in breeding season but not heard in autumn (Hay 1975; NZRD). Can sing long after dark (Butler & Merton 1992). Male said to sing while female builds nest, incubates and broods (NZRD). Females do not sing full Song, but sometimes sing brief phrases of Song when feeding young (Heather & Robertson 1997). Once, a female was unusually quiet the day before eggs laid (Butler & Merton 1992). Counter-calling occurs between birds in neighbouring territories. On South East I., birds uttered vocalizations in 19.2–22.6% of 10-s periods (n=10 birds; 100 periods); vocalized in slightly but not significantly, more periods in birds from which blood samples taken (n=10) (Ardern *et al.* 1994). **INDIVIDUAL VARIATION:** Down-scale Call has some individuality. Compared with New Zealand Robin *Petroica australis*, Song not nearly so full in tone or so varied in composition, and is less complex (Fleming 1950; NZRD). **RESPONSE TO PLAYBACK:** Playback of Song elicited a typical aggressive search response in Nov. and Jan., and which was also accompanied by counter-singing in Nov. **NON-VOCAL SOUNDS:** Bill-clapping (= Bill-clicks of Hay [1975]), in which mandibles rapidly clapped together, given in aggressive circumstances (Butler & Merton 1992), e.g. with Aggressive Calls during chases.

**Adult SONG:** A simple series of pure notes (sonagram A), drawn from an individual repertoire of 5–13 notes. Described as beautiful (NZRD) and crystal clear (Butler & Merton 1992). Total repertoire of population on Little Mangere I. in 1973 and 1974 was 48 notes. In Nov., unpaired males sang



often, paired males less often and mostly when carrying food to nestlings or mate. Song of one unmated male was simpler than those of mated males. However, when all but two birds were removed from Little Mangere I., Songs of the two remaining males became noticeably richer and more protracted (Butler & Merton 1992). **SUBSONG** also uttered.



A M. Aitcheson; Little Mangere I., Chatham Is; P107

**CONTACT CALL:** A high-pitched single note, given at fairly regular intervals, especially when foraging alone (Hay 1975; Heather & Robertson 1997). When food was given by an observer, Contact Call was often uttered 2–3 times in quick succession, attracting other birds; also given by a female carrying food to a juvenile. **AGGRESSIVE CALLS:** Various calls uttered in aggressive situations, most commonly consisting of *chuck* notes. At the outset of encounters, louder and harsher notes usually given, while *chuck* notes, particularly in staccato form, are given during chases, sometimes accompanied by bill-clicks. Flute-like notes occasionally heard when one bird was not clearly dominant over another. One report states that alarm calls, not further described, were given apparently to divert attention from fledgelings and in response to predators, and that chirping by two males hopping along a disputed territorial boundary was accompanied by twittering from their mates, who were looking on (Butler & Merton 1992). Another observer reported loud calls during boundary disputes (Flack 1976b). **DOWN-SCALE CALL:** A series of notes, successively lower in pitch. Mostly uttered just before departure to a new foraging area. Appears to have a territorial function when Song is not given. **Other calls** Undescribed submissive calls associated with begging posture; and calls given when patrolling territorial boundary (Hay 1975, which gives sonagrams of both). Chirping and squawking apparently from parents feeding young (Butler & Merton 1992; see Young).

**Young** When parents brought food to nestlings in nest-box, 'chirping and squawking' given by parents and young (Butler & Merton 1992). After fledging, begging calls change in structure with age.

**BREEDING** Fairly well known. Much information from detailed studies conducted as part of recovery program on islands of Chatham Grp since 1971–72 (Robson 1975; Bell 1978; Morris 1981; Anon. 1983; Merton 1990; Butler & Merton 1992; Nilsson *et al.* 1994). Breed in simple pairs, which usually maintained for life; defend territories throughout year; sometimes breed when 1 year old, but most start when 2 years old (see Social Organization). One instance of hybridization between a female Robin and a male New Zealand Tomtit (Butler & Merton 1992). **MANIPULATION OF BREEDING AND CROSS-FOSTERING:** A major objective of the recovery program was to boost breeding productivity to

quickly restore population to a viable level. This was achieved by a combination of cross-fostering, improving nest security and translocation of Robins to more secure habitats on neighbouring predator-free islands. Cross-fostering involved placing eggs and young in the nests of Chatham Island Warblers and New Zealand Toms for them to hatch and raise, and the fostering of eggs and young from less productive Robin pairs to more successful ones (Merton 1983a, 1990; Butler & Merton 1992). For further details, see Butler & Merton (1992).

**Season** Season is short. Eggs laid mostly Oct.–Nov. Usually raise only one brood per season, but also said that experienced pairs may raise several broods in a season; and intensive management can also be used to induce laying of up to four clutches, and to extend laying period to Jan. (see Laying below). Laying of first clutches, early Oct. to mid-Nov.; second clutches, late Oct. to late Nov.; third and fourth clutches, late Nov. to early Jan. (Morris 1981; Butler & Merton 1992); rarely, last clutches, early Feb. (Nilsson *et al.* 1994). Hatching of first broods, late Oct. to late Nov.; second broods, late Nov. to late Dec.; third and fourth broods, early Dec. to late Jan. (Morris 1981; Butler & Merton 1992).

**Site** Usually in narrow-entranced cavities in hollow limb or trunk of tree, such as Akeake *Olearia traversi*; in rotten stumps; and among tangled vines, such as *Muehlenbeckia*; sometimes nest on ground among rocks; once in disused nest of Common Blackbird (Bell 1978; Morris 1981; Butler & Merton 1992; Nilsson *et al.* 1994; Heather & Robertson 1997). One pair built in same site in three consecutive seasons; another pair used same site for a second clutch (Butler & Merton 1992). **MEASUREMENTS:** Nests usually  $\leq 10$  m above ground (Nilsson *et al.* 1994). **MANIPULATION OF BREEDING:** Readily and successfully use nest-boxes (Butler & Merton 1992). Tolerant of human interference at nests, including relocation of nests to more sheltered sites within c. 2 m of original position, rebuilding or substituting nests by researchers, and fitting of plastic mesh guards to front of nest-boxes to exclude entry of Common Starlings (Merton 1983b, 1990; Reed & Merton 1991; Butler & Merton 1992; Arden *et al.* 1994).

**Nest, Materials** Neat open cup; made of twigs, bark, dry leaves and moss, held together with spider web and thickly lined with moss and feathers (Butler & Merton 1992). Usually build 2–3 nests, and can start up to five, though only one is finished and used (Butler & Merton 1992). Built by female only; only female collects material (Morris 1981; Nilsson *et al.* 1994). One female seen collecting dry leaves from beneath rock overhangs and jumping up to pluck strands of dried moss from underside of boulders in the bush (Morris 1981). Will repair damaged nests (Butler & Merton 1992). At start of breeding cycle, collection of material appears casual, with females often carrying material a few metres before dropping it; building activity gradually increases, and material starts reaching nest-site; one female, 2 days after starting nest, made seven visits to nest in 10 min (Butler & Merton 1992). One pair started building new nest 4 days after clutch taken; another pair completed a replacement nest 4 days after previous nest was removed (Butler & Merton 1992).

**Eggs** Ovoid; creamy-white with purplish-brown spots and blotches (Heather & Robertson 1997). **MEASUREMENTS:**  $22 \times 17$  (Heather & Robertson 1997).

**Clutch-size** One to three, mostly two (Merton 1981a, 1983b; Nilsson *et al.* 1994); 2.1 (0.58; 1–3; 70); C/1  $\times$  9, C/2  $\times$  46, C/3  $\times$  15 (Butler & Merton 1992).



**Laying** Eggs laid at intervals of 24 h; second egg of one clutch laid 2 days after first; eggs usually laid in morning; second egg of one clutch laid in afternoon (Butler & Merton 1992). Usually lay 8–12 days after finishing nest, though in bad weather laying sometimes delayed for up to 1 month (Anon. 1983; Butler & Merton 1992). Usually single-brooded, though may lay second clutch if first unsuccessful (Morris 1981; Merton 1983a,b; Butler & Merton 1992; Nilsson *et al.* 1994). However, also said that experienced pairs may raise several broods in a season (Nilsson *et al.* 1994); and can be induced to produce up to four clutches in a season by removal of clutches to induce re-laying (Merton 1983b; Butler & Merton 1992; Nilsson *et al.* 1994). Replacement clutches laid within 10 days of removal of first clutch (Morris 1981). Occasionally, eggs have been found laid on rim of nest and have remained there for up to 8 days without being turned or incubated (Butler & Merton 1992).

**Incubation** By female only (Morris 1981; Butler & Merton 1992; Nilsson *et al.* 1994). During incubation, female sometimes shelters nest from rain by spreading wings (Butler & Merton 1992). Female leaves nest periodically to forage and be fed by male (Butler & Merton 1992). **MANIPULATION OF BREEDING:** Can be induced to incubate for almost twice normal incubation period by replacing eggs with fostered clutches, including eggs of other small passerines, which they would accept, or artificial eggs (Merton 1983b, 1990; Reed & Merton 1991). **INCUBATION PERIOD:** Usually 18 days, once 19 days (Butler & Merton 1992); c. 18 days (Bell 1978); also said to be 17–19 days (Heather & Robertson 1997). One female incubated an infertile clutch for 33 days (Butler & Merton 1992).

**Young** Brooded by female only (Butler & Merton 1992; Nilsson *et al.* 1994; Heather & Robertson 1997). Nestlings fed by both adults (Butler & Merton 1992; Nilsson *et al.* 1994). Parents remove faeces (Reed & Merton 1991; Butler & Merton 1992), though also said young do not produce faecal sacs but void faeces over side of nest (Morris 1981). **MANIPULATION OF BREEDING:** Will readily accept nestlings hatched by other pairs and nestlings of other small passerines; incubating females will feed and brood young if their eggs are removed and young are placed in their nest (Merton 1981a; Merton 1990; Butler & Merton 1992). **Growth** Weight at fledging, 22–26 g (Butler & Merton 1992). No other information.

**Fledging to independence** **FLEDGING PERIOD:** At least 21 days (Bell 1978); 20–23 days (Heather & Robertson 1997); usually 23 days, but occasionally less, including 20 days × 1, 21 days × 1, and 22 days × 2 (Butler & Merton 1992). Severe mite infestations can cause young to fledge early (Butler & Merton 1992). Young fed by both parents for at least 4 weeks after fledging (Butler & Merton 1992; Nilsson *et al.* 1994). At first, fledgelings stay close to nest. Division of brood can occur; and sometimes either male or female is inattentive, leaving mate to do most or all of providing for fledgelings (Butler & Merton 1992). Remain with parent for up to 6 weeks (Bell 1978); independent of parents within 3–6 weeks (Nilsson *et al.* 1994) or 40–65 days (Butler & Merton 1992) of fledging. Young cross-fostered and raised to fledging by New Zealand Tomtits dependent for c. 4 weeks (Butler & Merton 1992).

**Success** Can raise three young to independence, but usually raise only one or two (Nilsson *et al.* 1994). During seasons of active management, including cross-fostering multi-brooding, an average of one independent young was raised for every two eggs laid; when intensive management was scaled

down, one independent young was raised for every three eggs laid (Butler & Merton 1992). Experienced pairs sometimes raise several broods per season; and broods raised early in season have higher rates of survival than those raised later (Nilsson *et al.* 1994). After intensive management stopped in 1989, breeding productivity reasonably constant, with a mean of 1.57 independent young produced per pair per year in early 1990s (Nilsson *et al.* 1994). For details of nesting success during intensive management and cross-fostering program, see Butler & Merton (1992). **PREDATORS:** Some nests apparently destroyed by Common Starlings (Morris 1981; Butler & Merton 1992). Common Starlings kill chicks and incubating adults, tip eggs from nests and destroy nests (Butler & Merton 1992). Nests apparently destroyed by prions landing at night, and by heavy rain (Morris 1981). Severe mite infestations can kill young and cause parents to desert broods (Butler & Merton 1992). Winter storms reduce food supply and hence breeding success; avian pox can also affect population (Anon. 1986; Butler & Merton 1992); petrels crash onto nests at night, killing young (Munn 1984; also Butler & Merton 1992).

**PLUMAGES** Prepared by A.M. Dunn. Fledge in juvenile plumage. Early plumages not well understood. Extent and timing of post-juvenile (first pre-basic) moult not known, but probably begins shortly after fledging, and subsequent plumage adult or very similar to adult. After attaining adult plumage, a complete post-breeding (pre-basic) moult each cycle produces successive adult plumages without change in appearance. Sexes similar. No subspecies. Descriptions based on examination of skins of 18 adults and six juveniles (AIM, NMNZ).

**Adult** (Definitive basic). **HEAD AND NECK, UPPERPARTS, UNDERPARTS:** Black-brown (119) with concealed grey-black (82) bases to feathers, and concealed light-brown (c223D) shafts to basal halves of feathers. **TAIL, WING:** Black-brown (119).

**Nestling** Said to have dark-grey down (NZRD).

**Juvenile** Similar to adult but with fine pale streaking and slightly fluffier appearance. **HEAD AND NECK:** Feathers of forehead, crown, nape and hindneck, black-brown (119) with light-brown (c223D) shafts extending to tips, and with faint, fine dark-brown (c121A) fringe to tips. Feathers of ear-coverts, chin and throat, black-brown (119) with slightly paler grey-brown (c91) shafts, giving finely streaked appearance. Lores and sides of neck, as adult. All feathers have softer and looser texture than those of adult, giving slightly fluffier appearance. **UPPERPARTS:** Mantle, back and scapulars, black-brown (119) with light-brown (c223D) shafts extending to tips of feathers, and with faint, fine dark-brown (c121A) fringe to tips of feathers. Feathers of rump and uppertail-coverts, black-brown (119) with faint, fine dark-brown (c121A) fringe to tips. **UNDERPARTS:** Breast and belly, black-brown (119) with light-brown (c223D) shafts extending to tips of feathers, and with faint, fine dark-brown (c121A) fringe to tips of feathers. Feathers of flanks, vent and undertail-coverts, black-brown (119) with faint, fine dark-brown (c121A) fringe to tips. All feathers have softer and looser texture than those of adult, giving slightly fluffier appearance. **WING, TAIL:** As adult.

**First immature** (First basic). None identified from museum specimens. Some possibly separable from adult based on wear of primaries, since these probably retained from juvenile, and would be older than those of adult at same time of year. However, confirmation of these characters needed.



**BARE PARTS** Based on photos (Munn 1984; Merton 1990; Butler & Merton 1992; Bryant 1995; Edwards 1997; NZRD; unpubl.: B. Chudleigh). Sexes similar. **Adult** Bill, black (89). Iris, dark brown (121). Orbital ring, black (89). Legs and feet, dark grey (83), black (89), dark brown (c219A), pink-brown (221D), or pink (c3) with patchy black (89) suffusion; also described as brownish black (Fleming 1950). Soles, pink (c3); or bright yellow (Fleming 1950). Claws, dark brown (c121). **Nestling** Skin said to be flesh-coloured (NZRD). **Juvenile** Bill: pale pink (ne) at tip and cutting edges of upper and lower mandibles, grading to black (89) on culmen and undersurface of lower mandible; or mostly black, grading to cream (c92) on cutting edges and at base. Gape, puffy and cream (c92). Iris, black brown (119). Orbital ring, dark grey (83) with pinkish (ne) suffusion. Legs and feet, pink-brown (c219D) with patchy black (89) suffusion. Soles, straw-yellow (c56).

**MOULTS** Poorly known. Based on examination of 11 adult and three juvenile skins (AIM; NMNZ) and published information as cited. **Adult post-breeding** (Pre-basic). Few data. Probably complete; primaries outward. One in Jan. was moulting tail (Fleming 1950). None of museum specimens examined was moulting; all collected Aug.–Nov. **Post-juvenile** (First pre-basic). Few data. None recorded with active moult. Extent not known; possibly partial as in other robins. Timing uncertain but probably begins within a few months of fledging, as in other robins. Skins recorded in full juvenile plumage in Jan. (n=2) and Mar. (n=1).

**MEASUREMENTS** Chatham Is: (1–2) Skins (AIM, NMNZ): (1) Adults; (2) Juveniles. (3) Adults, skins (Fleming 1950).

		MALES	FEMALES	
WING	(1)	83.6 (1.95; 81–86; 10)	81.7 (1.67; 80–84; 8)	*
	(2)	77, 80, 80	79, 82	
	(3)	82.6 (1.87; 81–86; 11)	81.4 (79–85; 10)	ns
TAIL	(1)	64.5 (2.76; 61–70; 10)	62.9 (2.03; 60–66; 8)	ns
	(2)	60, 61, 62	57, 59	
	(3)	63.7 (1.97; 61–68; 11)	64 (62–66; 10)	ns
BILL S	(1)	17.7 (0.33; 17.3–18.3; 8)	17.2 (0.42; 16.9–18.2; 8)	*
	(2)	16.1, 16.2, 17.2	17.0	
TARSUS	(1)	29.9 (1.11; 28.3–31.6; 10)	30.2 (0.99; 28.5–31.2; 8)	ns
	(2)	28.9, 29.1, 31.6	29.7, 31.7	
	(3)	31.5 (0.74; 30–32; 11)	31.2 (30–33; 10)	ns

**WEIGHTS** Few data. Unsexed adults, 23.5 g (20.0–25.5; 10) (Ardern *et al.* 1994). From museum labels: one juvenile male 16.5 g; one juvenile female 15.5 g; and one unsexed juvenile 18.5 g (NMNZ).

**STRUCTURE** Wing moderately long and broad, with rounded tip. Ten primaries: p6 longest; p7 usually equal, and p5 often equal; p10 29–35 mm shorter, p9 12–15, p8 3–6, p7 0–1, p5 0–1, p4 2–5, p3 6–9, p2 10–12, p1 12–15. P5–p8 slightly emarginated on outer webs; no emarginations to inner webs. Nine secondaries, including three tertials; tips of longest tertials do not reach tips of secondaries on folded wing. Tail moderately long with square or slightly rounded tip; 12 rectrices. Bill straight and rather slender; about half length of head. Tarsus long and slender; scaling holothecal.

Tibia fully feathered. Middle toe with claw, 21.8 (0.54; 21.0–22.6; 6). Outer toe 74–83% of middle, inner toe 58–75%, hindtoe 82–90%.

**GEOGRAPHICAL VARIATION** None.

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**Sponsors:** The McConnell Family, RJ McGlashan, PC McLauchlan





Volume 6, Plate 18

Scarlet Robin *Petroica multicolor* (page 604)  
 NOMINATE MULTICOLOR: 1 Adult male; 2 Adult female

New Zealand Tomtit *Petroica macrocephala* (page 629)  
 NOMINATE MACROCEPHALA: 3 Adult male; 4 Adult female; 5 Juvenile male; 6 Juvenile female; 7 Adult male  
 SUBSPECIES TOITOI: 8 Adult male  
 SUBSPECIES MARRINERI: 9 Adult female  
 SUBSPECIES DANNEFAERDI: 10 Adult; 11 Juvenile

New Zealand Robin *Petroica australis* (page 706)  
 NOMINATE AUSTRALIS: 12 Adult male; 13 Adult female; 14 Juvenile; 15 Adult male  
 SUBSPECIES LONGIPES: 16 Adult male; 17 Adult female

Black Robin *Petroica traversi* (page 725)  
 18 Adult