

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 PARDALOTIDAE pardalotes, scrubwrens, thornbills and allies

A highly diverse family of very small to medium-sized and largely drab-plumaged insectivorous passerines. The family comprises 67–71 species in 15–16 genera, with distribution centred in Aust. and New Guinea (48 and 19–21 species respectively, with six occurring both Aust. and New Guinea); only *Gerygone* occurs beyond Aust.–New Guinea, extending W to Wallacea (three species, two endemic) and se. Asia (one species, Goldenbellied *Gerygone* *G. sulphurea*), and E to NZ (two species) and sw. Pacific Ocean (one species, Fan-tailed *Gerygone* *G. flavolateralis*), on Solomon Is, New Caledonia, Loyalty Is and Vanuatu (Wolters 1975–82; Sibley & Ahlquist 1990; Sibley & Monroe 1990; Beehler & Finch 1985; Christidis & Boles 1994; Coates *et al.* 1997; NZCL; Peters; DAB). Fifty-one species in HANZAB region (49 in Aust. and its territories, and two in NZ), one of which extinct. The second-largest family of birds in Aust. (after the Meliphagidae). Combining various sources (Sibley & Ahlquist 1990; Christidis & Boles 1994; DAB) the Pardalotidae includes the following subfamilies and genera:

PARDALOTINAE: *Pardalotus* (pardalotes), endemic to Aust. (4 species in genus, 4 in HANZAB region);

DASYORNITHINAE: *Dasyornis* (bristlebirds) (2, 2), *Pycnoptilus* (Pilotbird *P. floccosus*) (1, 1), both endemic to Aust.;

ACANTHIZINAE: Consists of two tribes: **SERICORNITHINI**, which includes *Acanthornis* (Scrubtit *A. magnus*), endemic to Aust. (1, 1); *Origma* (Rockwarbler *O. solitaria*), endemic to Aust. (1, 1); *Hylacola* (heathwrens), endemic to Aust. (2, 2); *Calamanthus* (fieldwrens), endemic to Aust. (2, 2); *Chthonicola* (Speckled Warbler *C. sagittata*), endemic to Aust. (1, 1); *Pyrrholaemus* (Redthroat *P. brunneus*), endemic to Aust. (1, 1); *Crateroscelis* (mouse-warblers), endemic to New Guinea (3, 0); *Oreoscopus* (Fernwren *O. gutturalis*), endemic to Aust. (1, 1); and *Sericornis* (scrubwrens) (12, 6); and **ACANTHIZINI**, which includes *Smicromis* (Weebill *S. brevirostris*), endemic to Aust. (1, 1); *Gerygone* (gerygones, fairy-warblers or flyeaters) (19–20, 12 [see above]); *Acanthiza* (thornbills) (13, 12); and *Aphelocephala* (whitefaces), endemic to Aust. (3, 3).

The taxonomy of the group is complex and has been the subject of various reviews. Studies of DNA–DNA hybridization (Sibley & Ahlquist 1985, 1990) and protein allozymes (Christidis 1991; Christidis & Schodde 1991) show that the Pardalotidae are part of the Australo-papuan corvoid lineage. These studies also indicate they belong to the superfamily Meliphagoidea, which includes the honeyeaters and fairy-wrens. Early works include the species in a number of families, including the Old World sylviid warblers (Sylviidae), Old World babblers (Timaliidae) or with the Australo-papuan fairy-wrens in a subfamily Malurinae of the Old World flycatchers (Muscicapidae) (Sharpe 1883; Mayr & Amadon 1951; Beecher 1953; Wetmore 1960; Keast 1961). Further, *Pardalotus* has formerly been placed in the Dicaeidae (Sharpe 1885; Mayr & Amadon 1947), which it resembles only by convergence; it has also been placed in a separate family, the Pardalotidae (RAOU 1926; Schodde 1975; DAB). Here we follow most works (Sibley *et al.* 1988; Sibley & Ahlquist 1990; Sibley & Monroe 1990; Christidis & Boles 1994) by including *Pardalotus* with the Dasyornithinae and Acanthizinae in the Pardalotidae. However, DNA–DNA hybridization (Sibley & Ahlquist 1990) and mitochondrial-DNA sequence analysis (Cracraft *et al.* in DAB) suggest that *Pardalotus* is a divergent genus and support recognition as a separate family (in which case the remaining genera are placed in the Acanthizidae; DAB). The New Guinea genus *Amalocichla* may also be closely related to the Pardalotidae (Olson 1987; Sibley & Ahlquist 1990; DAB). Evolutionary relationships between genera discussed more fully in Christidis (1990, 1991), Christidis & Schodde (1991), and Sibley & Ahlquist (1985, 1990).

Species range in size from very small (Weebill *Smicromis brevirostris*: length c. 8.5 cm; weight c. 6 g) to medium-sized (e.g. Rufous Bristlebird *Dasyornis broadbenti*: length c. 26 cm; weight c. 75 g); most are small. Wings rather rounded in sedentary species, more pointed in species that undertake longer movements (e.g. Western *Gerygone* *Gerygone fusca*); ten primaries, the outermost (p10) vestigial in *Pardalotus*; nine secondaries, most with vestigial inner (tenth) secondary (I.J. Mason). Tail varies from very short (*Pardalotus*) to very long (*Dasyornis*); 12 rectrices. Bill rather short, fairly slender in most species, more robust and finch-like in others (e.g. *Pardalotus*, *Aphelocephala*), with terminal maxillary notch and semi-operculate nares. Tarsal scaling varies with genus, either laminipantar or holothecal. Osteological features vary considerably and a full discussion is outside the scope of this work, though some features are discussed here (after DAB). All species have twin furrows on either side of decurrent ventral tubercle at the head of the humerus. Cranial features, especially internal structure of palate, vary considerably between genera and best summarized in two main groupings: (1) Pardalotinae, with: well-ossified narial apertures; constricted

palates with attenuately subulate transpalatine processes; ossified and thickened hinges of the pterygoids with the medio-palatine processes; deeply bifid vomers with developed, round-tipped horns; temporal fossae nearly occluded by thickened zygomatic processes; nearly vestigial postorbital processes; undeveloped alae tympanicae; and two very deep twin furrows at head of humerus; and (2) Dasyornithinae and Acanthizinae, which differ from Pardalotinae in above characteristics, especially by: shallower furrows at head of humerus; club-shaped maxillo-palatines, overlying a truncated, flat and tongue-shaped vomer; and vomerine horns vestigial, except in *Acanthornis*. A detailed analysis of osteological characters for all genera is given in DAB.

Plumage of most species rather drab browns, greys or olives, except for some *Gerygone* and most *Pardalotus*, which have bright-red or bright-yellow pigmentation to parts of plumage. Markings vary considerably; some have distinct spotting or streaking on crown (most *Pardalotus*), ventral scalloping (*Dasyornis*) or streaking (e.g. *Calamanthus*, *Hylacola*, some *Sericornis* and *Acanthiza*) or distinct throat-patches (e.g. *Pyrrholaemus*, *Oreoscopus*). Many species have rather richly coloured uppertail-coverts contrasting with rather sombre rest of upperparts. Juveniles of most species similar to adults but typically duller and lacking distinct markings. Patterns of sexual dimorphism vary, with many species not plumage dimorphic, but others either obviously so (e.g. Spotted Pardalote *Pardalotus punctatus* and Fairy Gerygone *Gerygone palpebrosa*) or more subtly so (e.g. Speckled Warbler *Chthonicola sagittatus*, some *Sericornis*, *Hylacola* and *Calamanthus*). Naked at hatching or with sparse down. Post-juvenile (first pre-basic) moult usually partial, but complete or nearly so in some (e.g. *Gerygone*). In species undergoing partial post-juvenile moult, first immature (second basic) plumage resembles adult plumage. Adults undergo a complete post-breeding (pre-basic) moult each year, with no change in appearance. Primaries moult outward.

The following summary of biology and ecology based largely on HANZAB species accounts (q.v.), Rand & Gilliard (1967), Coates (1990), Bregulla (1992), Coates *et al.* (1997) and other references as cited. As could be expected in such a large and diverse family, there are few common features, with considerable variation even within genera.

Over range, found in most vegetated habitats, with representatives throughout temperate, subtropical and tropical zones, semi-arid and arid zones, and from coasts to uplands, including alpine and subalpine regions. Use of strata within habitats varies greatly, even within genera, e.g. many scrubwrens *Sericornis* primarily terrestrial or inhabit dense understorey vegetation while others primarily arboreal in mid-storey or canopy. In Aust., pardalotes *Pardalotus* and thornbills *Acanthiza* predominantly inhabit sclerophyll forests, woodlands and shrublands, usually those dominated by eucalypts, but considerable variation, e.g. Yellow-rumped Thornbills *Acanthiza chrysorrhoa* often recorded in open habitats such as lightly wooded grasslands, Brown Thornbills *A. pusilla* mostly occur in dense shrubby vegetation, often in understorey of forests and woodlands, and Striated Thornbills *A. lineata* usually inhabit canopy of forests and woodlands. Over range, gerygones *Gerygone* occupy wide variety of habitats, from arid and semi-arid eucalypt woodlands (e.g. Western Gerygone) to rainforests (e.g. Brown Gerygone *G. mouki*) or mangroves (e.g. Mangrove Gerygone *G. levigaster*). Many species occupy dense understorey or dense low vegetation such as heathland, shrubland or grassland (including bristlebirds *Dasyornis*, scrubwrens *Sericornis*, heathwrens *Hylacola*, fieldwrens *Calamanthus*, mouse-warblers *Crateroscelis* and Fernwren *Oreoscopus guttaralis*). Whitefaces *Aphelocephala* usually occur in open habitats with low sparse vegetation, such as open chenopod or acacia shrublands. Many species commonly use modified habitats, including clearings, agricultural and pastoral land, parks and gardens; some species also use plantations of introduced pines or regrowth forests (e.g. White-browed Scrubwren).

Most species sedentary or resident, though many show some local or dispersive movements; most dispersive movements possibly by subadults. A few Aust. species partly migratory, with some populations making seasonal long-distance movements, e.g. s. populations of White-throated Gerygone *Gerygone olivacea* breed in se. Aust. in spring–summer and migrate to winter in N; and s. populations of Striated Pardalote *Pardalotus striatus* breed Tas. and se. Aust. and migrate N and inland for winter. Some altitudinal movements also recorded, e.g. Spotted Pardalote *Pardalotus punctatus* in se. Aust. (see Chan 2001; Griffioen & Clarke 2002; and species accounts). Little information on nature of passage in migratory species; White-throated Gerygone probably migrates in a succession of small parties, and, round Sydney at least, sexes appear to move separately; Tas. populations of Striated Pardalote cross Bass Str. on migration, and may migrate at night.

Mostly insectivorous; many also occasionally eat seeds, and whitefaces have short finch-like bills and hard-muscled stomachs that are adapted for collecting and digesting seeds, though also take insects. Pardalotes specialize in gleaning lerp—the protective carbohydrate coat of Aust. psyllids (Psyllidae)—using short, deep and blunt bill to glean lerp from foliage in crowns of trees. Occupy a wide range of foraging niches, varying from wholly or primarily arboreal (e.g. pardalotes, Weebill) to largely terrestrial (e.g. bristlebirds, whitefaces), with much

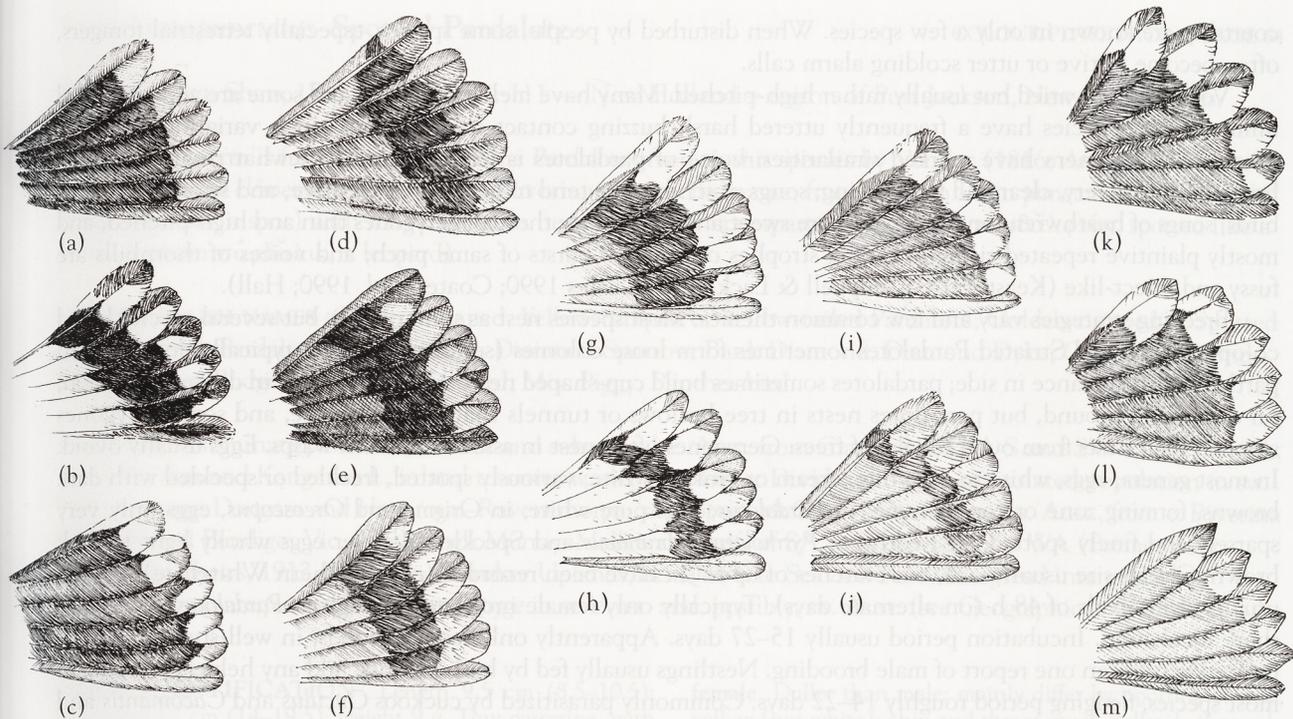


Figure 1. Undertail-patterns of *Gerygone*

- (a) Fairy Gerygone *G. palpebrosa*
 (b) White-throated Gerygone *G. olivaceous olivaceous*
 (c) White-throated Gerygone *G. olivaceous rogersi*
 (d) Green-backed Gerygone *G. chloronotus*
 (e) Large-billed Gerygone *G. magnirostris magnirostris*
 (f) Large-billed Gerygone *G. magnirostris cairnsensis*

- (g) Mangrove Gerygone *G. laevigaster laevigaster*
 (h) Western Gerygone *G. fusca fusca*
 (i) Western Gerygone *G. fusca mungi*
 (j) Dusky Gerygone *G. tenebrosa*
 (k) Brown Gerygone *G. mouki richmondii*
 (l) Grey Gerygone *G. igata*
 (m) Norfolk Island Gerygone *G. modesta*

variation in heights and strata used for foraging, e.g. from low dense vegetation, such as heathland, or dense understorey vegetation (e.g. heathwrens, fieldwrens, many scrubwrens) to canopy (e.g. pardalotes, gerygones); much variation within larger genera, e.g. most thornbills primarily arboreal (e.g. Striated Thornbill) but a few largely terrestrial (e.g. Slender-billed Thornbill *Acanthiza iredalei* and Yellow-rumped Thornbill). All forage by gleaning; also, but less often, by sallying, probing or hanging.

Social organization diverse, and varies even within genera. Most species typically occur singly or in pairs; some species occasionally form small flocks and most thornbills and whitefaces do so regularly; pardalotes may form flocks in non-breeding season. Many species join, or form nucleus, of mixed-species feeding flocks with variety of other small to medium-sized insectivorous birds. Most species monogamous, at least socially; in well-studied White-browed Scrubwren, subordinate males have sired young despite mate-guarding by primary male. Most species apparently breed in simple pairs. However, co-operative breeding usual for some species of thornbills and whitefaces (e.g. Striated, Yellow-rumped and Buff-rumped Thornbills *Acanthiza reguloides*) and has been reported occasionally in other species (e.g. Striated Pardalote, some scrubwrens, Speckled Warbler, Weebill). Usually nest solitarily; territorial at least in breeding season, with many species proclaiming territory with loud or distinctive songs. Striated Pardalote sometimes nests semi-colonially, defending only area immediately round nest. In at least one species, Striated Thornbill, larger area defended in non-breeding season by several pairs or groups, which form a clan; in others, such as Eastern Bristlebird *Dasyornis brachypterus*, home-ranges overlap but core-areas defended. Some species stop defending territory outside breeding season (e.g. Grey Warbler *Gerygone igata*). Social behaviour less well known than social organization in most species. There is a paucity of information on displays of most species. Distraction displays recorded in several genera (e.g. *Hylacola*, *Calamanthus*, *Sericornis*) and mobbing behaviour recorded in some well-studied species (e.g. White-browed Scrubwren). Agonistic displays, fighting and chases known for some species, many from anecdotal reports. Sexual behaviour is generally poorly known, and aspects of

courtship are known in only a few species. When disturbed by people, some species, especially terrestrial foragers, often become furtive or utter scolding alarm calls.

Vocalizations varied but usually rather high-pitched. Many have melodious songs and some are accomplished mimics; many species have a frequently uttered harsh buzzing contact call. Though much variation, voice of species within genera have marked similarities: voice of pardalotes is insistent and somewhat ringing; that of bristlebirds is silvery, clear and far-carrying; songs of scrubwrens tend to be highly repetitive, and strong for size of birds; songs of heathwrens and fieldwrens are sweet and melodious; those of gerygones thin and high-pitched, and mostly plaintive repeated rising or falling strophes or staccato bursts of same pitch; and voices of thornbills are fussy and insect-like (Keast 1978; Campbell & Lack 1985; Coates 1990; Coates *et al.* 1990; Hall).

Breeding strategies vary and few common themes. Most species nest as solitary pairs but several species breed co-operatively, and Striated Pardalotes sometimes form loose colonies (see above). Nests typically domed, with partly hooded entrance in side; pardalotes sometimes build cup-shaped nests. Most nests built in dense vegetation, on or close to ground, but pardalotes nests in tree-hollows or tunnels that they excavate, and some gerygones suspend their nests from outer foliage of trees. Gerygones often nest in association with wasps. Eggs usually ovoid. In most genera, eggs, white to off-white, cream or pinkish white, variously spotted, freckled or speckled with dark browns, forming zone or cap in some; in *Pardalotus*, eggs pure white; in *Origma* and *Oreoscopus*, eggs only very sparsely and finely spotted; in Redthroat *Pyrrholaemus brunneus* and Speckled Warbler eggs wholly light to dark brown. Clutch-size usually 2–4, but clutches of up to six have been recorded (e.g. Southern Whiteface). Laying usually at intervals of 48 h (on alternate days). Typically only female incubates, though in *Pardalotus* both sexes share incubation. Incubation period usually 15–27 days. Apparently only female broods; in well-studied White-browed Scrubwren one report of male brooding. Nestlings usually fed by both parents, and any helpers present. In most species, fledging period roughly 14–22 days. Commonly parasitized by cuckoos *Cuculus* and *Cacomantis* and bronze-cuckoos *Chrysococcyx*, with bronze-cuckoos particularly associated with gerygones *Gerygone* and thornbills *Acanthiza* (HANZAB 4).

One species, Lord Howe Gerygone *G. insularis*, and w. subspecies of Rufous Bristlebird *Dasyornis broadbenti litoralis* extinct. In HANZAB region, another 24 taxa, of 16 species, considered threatened, with three species critically endangered (n. subspecies of Eastern Bristlebird *Dasyornis brachypterus monoides*, King I. subspecies of Scrubtit *Acanthornis magnus greenianus*, and King I. subspecies of Brown Thornbill *Acanthiza pusilla archibaldi*), three endangered (Forty-spotted Pardalote *Pardalotus quardagintus*, s. subspecies of Eastern Bristlebird *D.b. brachypterus*, and Mt Lofty Ras subspecies of Chestnut-rumped Heathwren *Hylacola pyrrhopygia parkeri*), seven vulnerable, seven near threatened, and four of least concern. Extralimitally, Biak Gerygone *Gerygone hypoxantha* also endangered. In Aust., many species have been or continue to be adversely affected by clearance and fragmentation of natural vegetation; continued degradation of habitat through overgrazing is a threat to some species (e.g. Redthroat). Changes to fire regimes and wildfires also considered to be major threat to survival of some species, notably bristlebirds *Dasyornis* (Collar *et al.* 1994; Garnett & Crowley 2000).

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Gerygone albofrontata Chatham Island Warbler

COLOUR PLATE FACING PAGE 288

Gerygone? albofrontata G.R. Gray, 1844, In Richardson & J.E. Gray, *Zool. Voyage 'Erebus' & 'Terror'*, 1 (Birds): 5, pl. 4, fig. 2 — Chatham Islands.

The specific name refers to the white forehead of this warbler, from the Latin *albus*, white, and Modern Latin *frontatus*, fronted, browed (from Latin *frons*, the forehead).

OTHER ENGLISH NAMES Woodpecker.

MONOTYPIC

FIELD IDENTIFICATION Length 12 cm; wingspan c. 18 cm; weight: male 11 g, female 9.5 g. Distinctive large and long-billed gerygone endemic to Chatham Is. Adults olive-brown above and whitish below, with pale supercilium and face, and dark eye-stripe; tail with dark subterminal band and white spots near tips; and red iris. In adults, sexes differ slightly in size and more noticeably in plumage, with males slightly larger and bulkier, and with whiter supercilium, face and underbody. No seasonal variation known. Juvenile separa-

ble: similar to adult female, but with less distinct and yellowish supercilium, some with yellowish tinge to chin, throat and eye-ring, darker, less reddish iris and paler bill, legs and feet. Not known if immature separable from adult. **Adult male** Top of head, hindneck and sides of neck, olive-brown. Lower face, chin, throat and prominent long pale supercilium, white, set off by narrow olive-brown eye-stripe; supercilia taper behind eyes and extend forward to join across lower forehead, forming distinctive prominent white forehead. In

close view, note narrow broken white eye-ring, usually eclipsed by white of face. Rest of upperbody, olive-brown, grading to warmer brown on uppertail-coverts. Uppertail, grey-brown, with diffuse broad blackish subterminal band, and large white spots on inner webs near tips of all except central pair of rectrices; white spots usually concealed when bird perched with tail folded, but conspicuous in flight when tail fanned. Folded wing, olive-brown, with contrasting darker blackish alula, greater primary coverts and centres to tertials, and fine yellow-brown edges to remiges. Underbody mostly white, with pale olive-yellow wash to flanks, thighs and vent; undertail-coverts, cream. Undertail, greyish black with broad white tip formed by large white spots on inner webs of outer rectrices. Bill, black, often with paler grey base to lower mandible. Iris, dark red. Legs and feet, greyish brown or dark grey. **Adult female** Similar to male, differing by: Forehead, olive-brown as crown, with little or no whitish feathering at base of bill. Supercilium, face and underbody duller, off-white or greyish white, with varying cream or pale-yellow wash. **Juvenile** Poorly known. Sexes alike. Very similar to adult female, at least some differing by: Supercilium, less distinct, washed yellow in some; face, chin, throat and underbody washed yellow in some; lack narrow olive-brown eye-stripe, instead having small dark patch directly in front of eye; broken pale eye-ring slightly more prominent below eye, washed pale yellow (not white) in some. Bill, dark brown with more prominent and paler pinkish (not grey) base. Iris darker, dark brown (not red). Legs and feet paler, dull pink (not grey-brown).

Similar species None: the only gerygone present on Chatham Is.

Seen singly, in pairs or family parties; juveniles occasionally form small parties of up to 15 birds. Rather tame. Foraging behaviour atypical of genus: forage mainly in understorey or on ground and, less often, in canopy, by gleaning invertebrates from foliage and twigs, probing crevices in trunks and branches of trees and shrubs, and also by searching among leaf-litter on ground; seldom forage by hover-gleaning from foliage as other gerygones commonly do. Song rather weak trill of several notes (see Voice).

HABITAT Dense forest and shrubland on islands, in all areas from coasts to plateaux (Archey & Lindsay 1924; Lindsay *et al.* 1959).

Following description of habitats, inhabited during breeding season, on three islands of Chatham Grp, based on Dennison *et al.* (1984) unless otherwise stated. On **CHATHAM I.**, occur in: (1) dense hardwood forest in steep valleys, with canopy 6–12 m tall, mainly comprising Chatham Island Karamu *Coprosma chathamica*, Hoho *Pseudopanax chathamica*, *Hymenanchera chathamica* and *Dracophyllum arboreum*, with Supplejack *Rhipogonum scandens* and numerous tree-ferns *Cyathea* in dense understorey; and (2) more open *Dracophyllum arboreum* forest on drier slopes and ridges, with open understorey and ground layer. On **SOUTH EAST I.**, occur in three main habitats: (1) patches of coastal *Olearia traversii*-*Ngāio Myoporum laetum*-*Hymenanchera chathamica* forest, often with dense thickets of Pohuehue *Muehlenbeckia australis* at margins; (2) continuous *Olearia traversii*-*Hymenanchera chathamica*-Chatham Island Karamu-Chatham Island Ribbonwood *Plagianthus betulinus* forest, 7–10 m tall, with open understorey and ground layer resulting from intensive burrowing by petrels, and margins often vegetated with dense thickets of Pohuehue; and (3) previously cleared and grazed

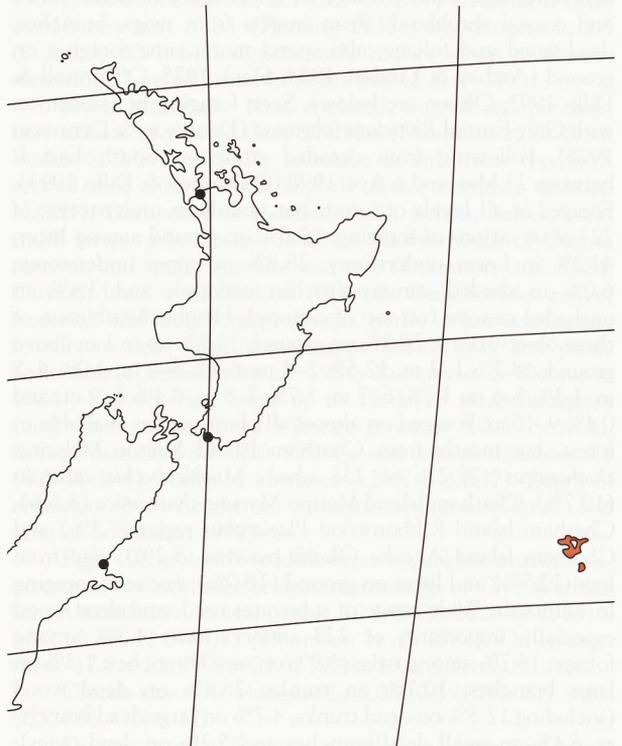
farmland, now mainly vegetated with Bracken *Pteridium esculentum* and Pohuehue. Said to occur in all habitats, and not to have a preference for any particular type (D.J. Onley), though Dennison *et al.* (1984) stated that Warblers prefer dense thickets of Pohuehue at edge of forests. On **MANGERE I.**, observed in 4.2-ha remnant patch of coastal *Olearia traversii* forest, with Chatham Island Ribbonwood and *Hymenanchera chathamica* subdominant, and dense thickets of Pohuehue at margin. On **LITTLE MANGERE I.**, inhabit dense shrubland and low open forest (Flack 1975). Probably occur in similar habitats during non-breeding season.

On Chatham I., recorded at highest density in density in *Dracophyllum* forest on slopes and ridges (c. 0.3 pairs/ha), and at lower density in pure broadleaf forest (Dennison *et al.* 1984).

DISTRIBUTION AND POPULATION Endemic to Chatham Is. Recorded on all islands in group: **CHATHAM I.**, where virtually absent from N, but regularly recorded in S, especially round Tuku Reserve in SW; **HOURUAKOPARA I.**; **PITT I.**; **SOUTH EAST I.**; **MANGERE I.**; **LITTLE MANGERE I.**; and **STAR KEYS** (Robertson & Dennison 1984; CSN; NZCL).

Breeding Probably throughout range (Dennison *et al.* 1984).

Change in range, populations Formerly common over most of Chatham and Pitt Is (O'Donnell & Dilks 1993). 'Only moderately abundant' on n. Chatham I. in 1920s (Archey & Lindsay 1924) and less abundant in N than in S in 1937 (Fleming 1939); not seen in n. half of island during expedition in 1957 (Lindsay *et al.* 1959); and now very rare or absent from n. Chatham I. (Robertson & Dennison 1984; NZCL; CSN). Only recorded in small numbers on Pitt I. now (Freeman 1994). However, still abundant on South East and Mangere Is (Dennison *et al.* 1984; O'Donnell & Dilks 1993; CSN 36, 38).



Populations RECORDED DENSITIES: On s. Chatham I., up to 0.3 pairs/ha; on South East I., at least 10.4 pairs/ha in 1979 and 8.2 pairs/ha in 1981; and on Mangere I., 9.3 pairs/ha in 1980 and 10.5 pairs/ha in 1981 (Dennison *et al.* 1984). Total of 434 birds recorded in 12,500 ha (0.035 birds/ha) on s. Chatham I., summer 1988–89 (CSN 37); about five birds recorded on Star Keys, Feb. 1988 (CSN 37).

Status 'One of the most common birds' on South East I. (Nilsson *et al.* 1994), though, because range is so restricted, potentially susceptible to change in ecology of islands (D.J. Onley). Said to have been 'on the borderland' of extinction in early 1900s (Buller 1905).

THREATS AND HUMAN INTERACTIONS Possibly adversely affected by changes to habitat caused by grazing by stock (D.J. Onley). May be killed by introduced Cats and rats on Chatham and Pitt Is (Dennison *et al.* 1984). Nests and eggs were manipulated in early part of conservation program to conserve Black Robin *Petroica traversi* (Dennison *et al.* 1984; Butler & Merton 1992).

MOVEMENTS Sedentary, but very poorly known. No current records of movement between islands in group; nature of local movements, if any, not known. Study of colour-banded birds on Chatham I. (42 adults and 33 juveniles banded), South East I. (five adults and six juveniles) and Mangere I. (four adults and four juveniles) recorded no movements, but no observations were made during non-breeding season (Dennison *et al.* 1984; Robertson & Dennison 1984; also see Social Organization).

Banding Of 74 banded, 1950–96, no recoveries (Cossee 1989, 1991, 1993, 1995, 1997, 1998a,b; Cossee & Wakelin 1991).

FOOD Insectivorous. **Behaviour** Little known. Arboreal and terrestrial; mainly forage in understorey of dense forest and coastal shrubland; glean insects from twigs, branches, dead wood and foliage; also spend much time foraging on ground (Archey & Lindsay 1924; Flack 1975; O'Donnell & Dilks 1993; Oliver; see below). Seen foraging in association with Grey Fantail *Rhipidura fuliginosa* (Dennison & Dennison 1978). Following from detailed study on South East I. between 23 Mar. and 6 Apr. 1990 (O'Donnell & Dilks 1993). Foraged at all levels of forest, but mainly in understorey; of 223 observations of foraging: 20.6% on ground among litter; 41.2% in lower understorey; 28.8% in upper understorey; 6.0% in shaded canopy (within canopy); and 3.4% in unshaded canopy (on top of canopy). Height distribution of these observations: 20.2% on ground; 33.5% up to 1 m above ground; 18.7% 1–2 m; 12.5% 2–3 m; 6.4% 3–4 m; 3.0% 4–5 m; 1.3% 5–6 m; 1.7% 6–7 m; 1.7% 7–8 m; 0.4% 8–9 m; and 0.4% 9–10 m. Foraged on almost all plant species available in forest, but mostly from Chatham Island Mahoe *Melycitus chathamicus* (22.2% of 233 obs.), *Muehlenbeckia australis* (10.7%), Chatham Island Matipo *Myrsine chathamica* (8.6%), Chatham Island Ribbonwood *Plagianthus regius* (7.3%) and Chatham Island Akeake *Olearia traversii* (5.2%); also from logs (12.5%) and litter on ground (18.0%); not seen foraging in saltmarsh. Wide range of substrates used, and dead wood especially important; of 223 observations: 4.3% among foliage; 16.7% among twigs; 6.9% on small branches; 1.3% on large branches; 10.7% on trunks; 28.8% on dead wood (including 12.5% on dead trunks, 4.7% on large dead branches, 6.4% on small dead branches and 5.2% on dead twigs);

11.6% in vines; 1.7% in air; 16.7% among litter; and 1.3% on bare ground.

No detailed studies. Unconfirmed reports of feeding on flies, beetles, bugs, cicadas, moths, caterpillars and spiders (Heather & Robertson 1997; NZRD).

Young Nestlings and fledgelings fed insects by both parents (Dennison *et al.* 1984; also see Social Behaviour, Breeding).

SOCIAL ORGANIZATION Reasonably well known. Studied over five seasons on three islands in Chatham Grp, using colour-banded birds (see Movements): nesting studied most intensively on Mangere I., and most observations after fledging were from South East I. (Dennison *et al.* 1984). For comparison of social organization with that of Grey Warbler *Gerygone igata*, see Dennison *et al.* (1984). During breeding season, seen in pairs or families (see Parental care below). By Dec., family groups of first brood disband, and adults become busy with second brood (NZRD). Towards end of breeding season, flocks of up to 15 juveniles form in gaps between breeding territories, and may form flocks in non-breeding season, but nothing is known of social system in autumn and winter; adults sometimes occur in flocks of juveniles, but not seen to feed any of them (Dennison *et al.* 1984; NZRD). Otherwise, seen feeding in small family groups (Fleming 1939) and in association with Grey Fantail (Dennison & Dennison 1978).

Bonds Monogamous. At least some 1-year-old birds do not breed or hold territories in breeding season. No records of other birds helping at nests or in family parties (Dennison *et al.* 1984). **Parental care** Only female incubates and broods young, but usually both feed nestlings and fledgelings (Dennison *et al.* 1984; Robertson & Dennison 1984), though at three nests with well-grown chicks, only one adult was present (Dennison *et al.* 1984). Fledgelings stay near nest for c. 2 days, even though able to fly rather well. Siblings said to stay in tight group, and are shepherded and fed by parents for several weeks after leaving nest (NZRD). Sometimes fledgelings of brood are divided between parents, though these groups sometimes coalesce (Dennison *et al.* 1984). One fledgeling still fed by parents 24 days after leaving nest. Seen in family parties comprising parents and 3–4 young from Nov. to late Jan. (Fleming 1939); on South East I., recorded in family parties from late Nov. to early Dec. (Dennison *et al.* 1984).

Breeding dispersion Nest solitary (Dennison *et al.* 1984). During breeding season, strongly territorial (NZRD). Both members of pairs defend breeding territory from all other Warblers, other than their own dependent young. Non-territorial 1-year-olds often trespass onto territories and induce chases. On South East I., some pairs defended same territories for at least three breeding seasons. On Mangere I., in 1980, birds were occupying territories in mid-Sept., but did not start building nests till late Sept. Both sexes involved in defence of territories. On South East I., 28 territories recorded in area of 2.7 ha in 1979 (10.4 pairs/ha), and 22 territories in 1981 (8.3 pairs/ha); on Mangere I., 39 territories in area of 4.2 ha in 1980 (9.3 pairs/ha), and 44 territories in 1981 (10.5 pairs/ha); on Chatham I., territories recorded at density of c. 0.3 pairs/ha in forest dominated by *Dracophyllum*, but lower in areas of pure broadleaf forest (Dennison *et al.* 1984).

Roosting No information.

SOCIAL BEHAVIOUR Some information from study by Dennison *et al.* (1984). Said to be quite tame (Oliver).

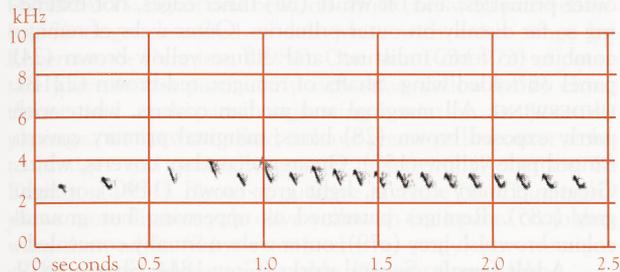
Agonistic behaviour Singing possibly has territorial function; only males sing (see Voice). Boundary disputes mainly involve males, and consist of long chases interspersed with bouts of loud singing, and no physical contact; females occasionally join chases (Dennison *et al.* 1984). In one chase between two birds in early Feb., birds landed on vertical tree-trunk, with attacking bird landing above and almost touching lower bird, so that it hung facing lower bird, and it displayed expanded white supercilia; lower bird faced downward and away from upper bird, with wings held half-open and supercilia not displayed; birds held positions <1 min, then both flew away (Flack 1975). Said to chase intruders with fast direct flights (NZRD). **Alarm** No information.

Sexual behaviour Male usually accompanies female as she collects material for nest and builds, and often sings while doing so. No other information.

Relations within family groups Behaviour of parents when feeding young said to be same as that of Grey Warbler (Fleming 1939). Chatham Island Warblers used for fostering of eggs and young of endangered Black Robin, as Warblers tolerant of disturbance at nest, and accept eggs and nestlings of other small insectivorous passerines at virtually any stage of incubation (Merton 1983). **Anti-predator responses of young, Parental anti-predator strategies** No information.

VOICE Not well known. One vocalization given in musical notation in Archey & Lindsay (1924). Only males utter Song (Robertson & Dennison 1984). Fairly quiet outside breeding season, with only brief snatches of Song (Archey & Lindsay 1924; NZRD). Females and independent juveniles have only a weak subsong (Robertson & Dennison 1984; NZRD). Song very different to that of Grey Warbler or Brown *Gerygone mouki* or Mangrove *G. levigaster* Gerygones (Robertson & Dennison 1984).

Adult SONG: Rapid phrase of 4–5 notes, with second note much higher than first, and remaining notes descending in pitch; repeated several times, sometimes monotonously (NZRD). Faint trill of four notes, with pitch descending from first to second notes, maintained from second to third, then descending again from third to fourth (Archey & Lindsay 1924), probably also describes Song. Possibly has territorial function (NZRD). Male often sings as female collects material and works on nest; boundary disputes, mainly by males, consist of long chases interspersed with bouts of Song (Dennison *et al.* 1984). Sonagram A shows a longer Song.



A M. Aitcheson; Mangere I., Chatham Is; P106

Other calls Three rather weak notes, repeated several times with intervening breaks (Falla *et al.* 1979).

Young No information.

BREEDING Reasonably well known. Detailed study over five seasons, 1977–81, on Chatham, South East and Mangere

Is (Dennison *et al.* 1984), on which account based unless otherwise stated. Nest solitarily. Have been used as host for eggs and chicks of Black Robins in attempt to save Robins from extinction (see Merton 1981a; Dennison *et al.* 1984).

Season Short, but varies from year to year (Dennison *et al.* 1984). On Chatham I., nestlings, early Dec.; fledgelings, mid-Dec.; breeding in Nov. and family parties of parents and young, Nov.–Jan. (Fleming 1939). On South East I., nestlings, mid-Dec. (Fleming 1939). On Mangere I., laying 3 Oct. to 21 Nov. in 1980, but c. 13 Sept. to 6 Dec. in 1981, and though re-nesting was artificially induced on Mangere I. in both years, nest with eggs were found in Dec. on both other islands, suggesting that natural replacements also occurred (Dennison *et al.* 1984). Breed Sept.–Jan., with most clutches laid Oct. to early Feb. (NZRD). Independent juveniles seen Jan. and Feb. (Flack 1975).

Site On Chatham I., nests high and in open, and hanging freely; on other, predator-free, islands, nests closer to ground in dense vegetation, with most having lateral and basal connections, so not hanging freely. On Chatham I., nests recorded hanging from terminal branches of *Dracophyllum arboreum* (n=3), in tangle of vine hanging from lofty limb, in the open (n=2) and from trunk of *Ponga Cyathea dealbata* (n=1) (Fleming 1939; Dennison *et al.* 1984); on South East I., in Pohuehue *Muehlenbeckia australis* (n=8), sapling of *Hymenanthera chathamica* (n=5), *Olearia traversii* (n=2), Ngaio (n=1) and Chatham Island Karamu (n=1); and on Mangere I., in *Olearia traversii* (n=65), Pohuehue (n=39), *Hymenanthera chathamica* (n=3) and Chatham Island Ribbonwood (n=2). Also described as nesting in tangled vines *Muehlenbeckia* (Fleming 1939). Some pairs defended same territories for at least three breeding seasons, suggesting a level of site-fidelity (see Social Organization). **MEASUREMENTS** (m): Height above ground: on Chatham I., 6 (1.5–10.0; 4) (Dennison *et al.* 1984); two nests c. 6.1–9.1 (Fleming 1939); on South East I., 2.1 (0.5–8.0; 17) (Dennison *et al.* 1984); one nest c. 2.1 (Fleming 1939); on Mangere I., 2.5 (0.2–6.0; 109), and significantly higher when in *Olearia traversii* (2.7; n=65) than in Pohuehue (2.1; n=39).

Nest, Materials Nest enclosed, domed and pendant, very similar to that of Grey Warbler (Dennison *et al.* 1984; Butler & Merton 1992); entrance at side near top, with arched roof that projects slightly above entrance (Oliver; NZRD). Composed of rootlets, moss, lichen, leaves, bark, small twigs, grass stems, feathers, flower-heads of *Olearia traversii*, and spider egg-sacs and web (Dennison *et al.* 1984; Oliver); lined with feathers (Oliver). Only females collect material and build nest, though males often accompany females to nest; once, a male appeared to work at a partly built nest (Dennison *et al.* 1984; Robertson & Dennison 1984). Construction takes up to 13 days. **MEASUREMENTS** (cm): External depth 14.3 (range given as 8.0–10.5; n=4), frontal diameter 8.3 (7.0–9.5; 4), and lateral diameter 9.1 (8.0–10.5; 4); width of entrance 3.2 (2.5–3.8; 7). Depth of entrance, 2–6; height of entrance above nest-bowl, 2–6 (Butler & Merton 1992).

Eggs White with reddish-brown speckles, usually concentrated towards large end; similar to eggs of Grey Warbler. **MEASUREMENTS:** On Mangere I., 18.1 (0.62; 17.2–19.2; 25) × 13.0 (0.38; 12.0–13.7) (Dennison *et al.* 1984). Other measures: 17.5 × 13, 18.5 × 13.5, 19.4 × 13.6 (Oliver).

Clutch-size On Mangere I., 3.08 (0.59; 79); C/2 × 11, C/3 × 51, C/4 × 17.

Laying Interval between completion of nest and laying

of first egg, 6.0 days (1–12; 25), 6.4 days (n=21) for first nests, and 4.0 days (n=4) for replacement nests. Laying interval was 2 days. Single-brooded, though pairs can re-nest if first brood fails (Dennison *et al.* 1984), *contra* NZRD, which claims probably rear two broods.

Incubation By female only (Dennison *et al.* 1984; Robertson & Dennison 1984); begins after laying of final egg, though unsettled during first day or two where female can be absent from nest for prolonged periods (Butler & Merton 1992). Do not recognize own eggs; will incubate plastic eggs and eggs of Silvereye *Zosterops lateralis* and Black Robin when exchanged for their own eggs; will successfully incubate Silvereye and Black Robin eggs to hatching (Butler & Merton 1992). **INCUBATION PERIOD:** 19.5 days (1.3; 17–21; 13). On Mangere I., one female incubated for 20 days a clutch of three plastic eggs that had been exchanged for her own clutch (Butler & Merton 1992).

Young Altricial, nidicolous. At hatching, young naked except for down on upperparts; when 1 week old, feathers emerge from sheaths, and down mostly gone by 10 days old. Only female broods (Robertson & Dennison 1984). Brooding periods generally short, averaging 9 min (n=10 periods); proportion of time spent brooding: 3-day-old nestlings, 48% (n=58 min of observation); 10-day-old nestlings, 49% (n=51); and 12-day-old nestlings, 55% (n=69). Nestlings usually fed by both parents (see Social Organization). Parents remove faecal sacs (Butler & Merton 1992). Do not recognize own nestlings; will feed and brood nestlings of Dunnock *Prunella modularis* and Black Robin placed in their nests (Butler & Merton 1992). When Black Robins cross-fostered, Chatham Island Warblers reared them successfully to 8 days old, but not to fledging (Merton 1981a).

Fledging to independence **FLEDGING PERIOD:** 20.0 days (1.5; 19–23; 7). Fledgelings usually fed by both parents, though sometimes brood split between parents; once, fledgling still being fed 24 days after fledging (see Social Organization).

Success Apparently high, with most pairs on South East I. having fledged young with them, and those family parties consisting of one (n=1), two (n=10), three (n=18) or four (n=2) fledgelings. **CUCKOOS:** Parasitized by Shining Bronze-Cuckoo *Chrysococcyx lucidus*, but rate of parasitism by cuckoos very low (Dennison *et al.* 1984; Oliver; HANZAB 4).

PLUMAGES Prepared by J.S. Matthew. Young naked at hatching except for down on upperparts. Fledge in juvenile plumage. Not known if post-juvenile (first pre-basic) moult partial or complete. Post-juvenile moult results in first immature (first basic) plumage which resembles adult but with distinctly yellow underparts. Said to 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 apparent change in appearance. Sexes differ. Plumage description based on examination of skins of nine adult males, two adult females and three juveniles, including one undergoing post-juvenile moult (CM; NMNZ), and other sources as cited.

Adult male (Definitive basic). **HEAD AND NECK:** Lower forehead, white, grading to olive-brown (29) on upper forehead. Crown, nape and hindneck, olive-brown (29) with faint yellowish-brown (c24) suffusion. Sides of neck, olive-brown (29), grading to white towards throat. Lores, dark brown (121), grading to white anteriorly. Narrow strip of

feathers behind eye, dark brown (121); combine with posterior lores to form narrow dark-brown (121) eye-stripe, merging with grey-brown (91) upper ear-coverts. Eye-ring, whitish or cream (c54), broken by dark brown (121) in front of and behind eye; in some, lower edge of eye-ring forms indistinct and narrow white sub-orbital arc. Feathers from lower forehead, broadly above eye, to above ear-coverts, white, combining to form broad and distinct white supercilium. Upper ear-coverts, grey-brown (c91); lower ear-coverts, narrow area of feathers below eye, malar area, chin and throat, white, some with faint pale-yellow (157) tinge to lower ear-coverts; combine to form predominantly white face. Several short and fine black (89) bristles protrude from base of forehead, above gape and interramal area. **UPPERPARTS:** Mantle, scapulars, back and rump, olive-brown (c29) with faint yellow-brown (c24) tinge; feathers, olive-brown (c29), grading to yellow-brown (c24) at edges. Anterior uppertail-coverts, brownish (c123); posterior uppertail-coverts, dull yellow-brown (c123B); uppertail-coverts contrastingly warmer brown than rest of upperparts. All feathers of upperparts have concealed grey (87) bases. **UNDERPARTS:** Breast and belly, white, with cream (c54) or pale-yellow (157) tinge to belly. Flanks, dull yellow-olive (c52), or light greyish-brown (c45) with pale-yellow (157) tinge. Undertail-coverts, cream (92). Axillaries, white, grading to pale yellow (157) at tips. Feathers of thighs, brown (28) with straw-yellow (56) tips. All feathers of underparts have concealed dark-grey (83) bases. **UPPERTAIL:** Rectrices, grey-brown (91), grading to yellow-brown (123B) at base of outer webs; with: broad (c. 15 mm) black-brown (119) subterminal band to t1–t5 (confined to inner web on t2); white or cream (c92) patch near tips of inner webs of t2–t6, which indistinct on t2 and progressively larger and extending to outer web on outer rectrices; narrow straw-yellow (56) outer edge to t1–t5; and narrow white outer edge to t6. Shafts, light brown (239). **UNDERTAIL:** Patterned as uppertail, but markings not so bold. **UPPERWING:** All marginal and median coverts, dark brown (121) with yellowish-brown (c24) fringes; outermost marginal and median primary coverts have white outer webs. All greater coverts, dark brown (121) with yellow-brown (24) fringes to outer webs and tips; greater primary coverts appear darker because fringes narrower. Feathers of alula, dark brown (121) with narrow yellow-brown (24) fringes. Remiges, dark brown (121) with: yellow-brown (24) outer edges that extend round tip on tertials and are paler and grade to off-white (ne) distally on outer primaries; and off-white (ne) inner edges, not extending so far distally on outer primaries. Outer webs of remiges combine to form indistinct and diffuse yellow-brown (24) panel on folded wing. Shafts of remiges, red-brown (221B). **UNDERWING:** All marginal and median coverts, white with partly exposed brown (28) bases; marginal primary coverts fringed pale yellow (157). Greater secondary coverts, white. Greater primary coverts, light grey-brown (119C) or light grey (c85). Remiges patterned as upperwing but ground-colour brownish grey (c79); outer webs normally concealed.

Adult female Several works (Grey 1844; Sharpe 1879; Buller 1872; Hutton 1872; Meise 1931; Chambers 1989; Oliver) suggest that the species is sexually monomorphic, but this contradicted by more recent studies (Robertson & Dennison 1984; Heather & Robertson 1997). Very similar to adult male, but differ by: **HEAD AND NECK:** Forehead, olive-brown (c29) with very narrow and indistinct band of white feathers across lowermost forehead. Lores similar to male, but tinged buff (124) anteriorly in some. Supercilium, malar area,

chin and throat, white or cream (54) with buff (124) or straw-yellow (c56) suffusion in some; straw-yellow usually more prominent on chin and throat. Photo (Chambers 1989) shows putative adult female with: supercilium, lower ear-coverts and narrow area of feathers below eye, straw-yellow (c56); malar area, chin and throat, pale yellow (c157); and eye-ring, white, broken by dark brown in front of and behind eye, forming fairly distinct white arcs above and below eye. Robertson & Dennison (1984) stated that females have yellow tinge to face, most prominent on throat. In all pairs observed in three study areas, one adult had white face and throat and the other had yellow throat; only yellow-throated bird seen to incubate and brood (Robertson & Dennison 1984). **UNDERPARTS:** Robertson & Dennison (1984) stated that females have grey-white underparts, tinged yellow; these authors made no mention of yellow-olive on flanks in either sex. According to Meise (1931), the intensity of yellow on underparts varies individually. Of two female skins examined (this study), one had straw-yellow (c56) suffusion to belly and one had cream (c54) suffusion on breast. Photo (Chambers 1989) of putative adult female shows bird with rather diffuse and short greyish streaks on sides of breast and indistinct greyish-brown wash on sides of upper breast; this not seen on skins examined and not mentioned in literature cited above; possibly only visible under certain light conditions (D.J. Onley).

Nestling At hatching, have white dorsal down (Robertson & Dennison 1984). At 1 week old, feathers emerge from sheaths; fully feathered by 2 weeks old.

Juvenile Little information; more data needed to corroborate findings below. Plumage description based on skins (see above), illustration in Cemmick & Veitch (1985) and photos (B. Chudleigh; A. Palliser). Very similar to adult female, differing by: **HEAD AND NECK:** Top of head said to be olive-grey (Robertson & Dennison 1984), but examination of single skin reveals no consistent difference from adult female. Supercilium less distinct, straw-yellow (c56); described as obscure and white by Robertson & Dennison (1984). Eye-ring, pale yellow (c157) or off-white (ne), broken by dark brown (c121) in front of and behind eye. Lower ear-coverts, feathers below eye, malar area, chin and throat, apparently vary from off-white (ne) to straw-yellow (c57) or pale yellow (c157). **UPPERPARTS:** Said to be olive-grey (Robertson & Dennison 1984; Heather & Robertson 1997), but examination of single skin (this study) revealed no consistent difference from adults. **UNDERPARTS:** Breast and belly, off-white (ne) with pale-yellow (c157) tinge; described as dull white with cream tinge by Robertson & Dennison (1984). One skin (CM 973) of putative juvenile has particularly rich straw-yellow (c57) chin, throat and underparts, suggesting variation in juvenile plumage. **UPPERWING:** Said to have green-yellow outer webs to remiges and generally greener upperwing (Robertson & Dennison 1984). Photo of putative juvenile (B. Chudleigh) shows more distinct pale olive-yellowish (ne) panel on folded wing than adult. Skins examined (this study) have remiges slightly worn and not appreciably different from adult.

First immature (First basic). No skins definitely identified in this study. Robertson & Dennison (1984) state that 1-year-old birds retain distinctly more yellow on throat and abdomen than adult females, and this probably refers to first immature. Not known if first immatures retain juvenile remiges or rectrices, or both. Three skins sexed as female (two undated, one in Sept.) resemble adult female, but have more distinct pale-yellow (c157) tinge to chin, throat, eye-ring

above and below eye, breast and belly, and worn remiges; these possibly first immatures.

BARE PARTS Based on photos (Chambers 1989; Butler & Merton 1992; unpubl.: B. Chudleigh, A. Palliser; and standard sources), information from museum labels (CM; NMNZ), and other sources as cited. **Adult** Bill, black or grey-black (82), usually with pale-grey (c86) or light-grey (85) basal half to tomia and lower mandible, or both mandibles, and, in some, narrow pale-grey (c86) tip; also described as brownish black (NMNZ). Gape, light grey (c85). Orbital ring, black; also described as brown (NMNZ). Iris, dark red (c108); also described as red (Robertson & Dennison 1984), red, vermilion, black with brown outer ring or light reddish-brown (CM). Legs and feet, dark grey (c83) or dark pinkish-brown (c221C) with feet darker than tarsus in some; also described as blackish brown (NZRD), brown or dark brown (NMNZ). **Nestling** Bill, brownish grey (c80) with pale-yellow (157) tomia. Gape, pale yellow (157). Palate, orange-yellow (c18). No information on colour of iris. **Juvenile** Differences from adult: Bill, brownish grey (c80) with pale-pink (c5) nasal groove and base to tomia and lower mandible; also described as dusky brown with dull-pink base (Robertson & Dennison 1984). Gape, pale pink (c5), slightly swollen. Iris described as dark brown (NMNZ) or brown (Robertson & Dennison 1984; NZRD). Legs and feet described as dull pink, paler than in adult (Robertson & Dennison 1984; NZRD).

MOULTS Based on examination of skins of 15 adults, three juveniles, including one undergoing post-juvenile moult (CM; NMNZ), and other sources as cited. **Adult post-breeding** (Third and subsequent pre-basic). Little information. Complete. Said to occur Jan.–Feb. (NZRD) or Jan.–Mar. (Heather & Robertson 1997). Active moult of primaries recorded from two skins; one in Dec. replacing inner three primaries, and one in Jan. replacing p6–p8. Of two in late Feb., both had all primaries and secondaries new and were finishing moult of tertials and body. Of two in Mar., both had all primaries new, one of which finishing moult of secondaries and with active moult of body, but had not yet started moult of tertials. No moult of primaries in eight collected May–Sept.; five of these (in Aug. and Sept.) had worn primaries. Moult of tail recorded from one in late Feb.; this bird had t2–t6 new and t1 almost fully grown; timing probably much as primaries. No information on timing of moult of wing-coverts but probably much as primaries. **Post-juvenile** (First pre-basic). Little known. One in late Feb. with active moult of body but not remiges or rectrices. Said that juveniles moult into adult plumage Nov.–Jan. (Heather & Robertson 1997), but also that adult plumage not acquired till second winter or till 1 year old (Robertson & Dennison 1984; NZRD). No information on extent of post-juvenile moult; three skins (NMNZ), one with date (Sept.), resemble juvenile in body-plumage but have worn remiges; these possibly first immatures with retained juvenile remiges. **First immature post-breeding** (Second pre-basic). Little known. Said to moult from immature to adult plumage in this moult, when 1 year old (Robertson & Dennison 1984; NZRD), *contra* Heather & Robertson (1997).

MEASUREMENTS Chatham Is: (1–2) Skins (CM; NMNZ): (1) Adults and putative first immatures; (2) Juveniles. (3) Skins, adult males (Keast & Recher 1997). (4) Live adults, sexed by plumage (Robertson & Dennison 1984).

		MALES	FEMALES	
WING	(1)	65.2 (1.01; 63–67; 11)	58.4 (2.30; 55–61; 5)	**
	(2)	61, 62	58	
	(3)	65.2 (2.10; 8)	–	
	(4)	63.6 (1.64; 60–67; 40)	59.8 (1.78; 57–62; 11)	**
TAIL	(1)	54.7 (2.24; 51–58; 11)	49.8 (1.92; 47–52; 5)	**
	(2)	49, 53	46	
	(3)	52.6 (3.60; 8)	–	
	(4)	52.2 (1.92; 48–56; 38)	49.3 (2.71; 45–53; 10)	**
BILL S	(1)	16.2 (0.65; 15.1–17.3; 11)	15.3 (1.45; 13.7–16.4; 5)	ns
	(3)	15.2 (0.40; 8)	–	
CULMEN	(4)	12.5 (0.71; 11.0–14.1; 40)	11.2 (1.00; 9.7–12.8; 11)	**
BILL W	(4)	3.8 (0.26; 3.2–4.3; 40)	3.5 (0.35; 3.0–4.0; 11)	**
BILL D	(4)	3.4 (0.23; 3.0–3.9; 40)	3.2 (0.34; 2.8–3.9; 11)	*
TARSUS	(1)	23.2 (0.49; 22.1–24.1; 11)	21.9 (1.18; 20.3–23.6; 5)	**
	(2)	23.3	–	
	(3)	22.4 (0.60; 8)	–	
	(4)	23.3 (0.78; 21.2–24.7; 40)	21.6 (0.98; 20.0–23.3; 11)	**

WEIGHTS Chatham Is: (1) Adults, from museum labels (NMNZ). (2) Live adults, sexed by plumage (Robertson & Dennison 1997).

	MALES	FEMALES
(1)	10.0, 10.1, 10.9	7.8, 8.6
(2)	11.1 (0.87; 9.8–13.8; 39)	9.5 (1.02; 8.3–11.5; 11)

Keast & Recher (1997) give mean weight of adult males as 11.8 g.

STRUCTURE Wing fairly long, much longer than in other gerygones (Keast & Recher 1997); tip of longest primary reaches about halfway along tail when folded. Ten primaries: p6 longest; p10 24–32 mm shorter than p6, p9 8–14, p8 2–3.5, p7 0.5–1.5, p5 0–1, p4 2–4, p3 5–7, p2 7–9.5, p1 9–12. Slight emargination to outer webs of p5–p7, sometimes also p8; slight emargination to inner webs of p7–p10. Nine secondaries, including three tertials; tip of longest tertial does not reach tip of p1 on folded wing. Tail fairly long, longer than in other gerygones (Keast & Recher 1997); slightly pointed at tip when folded; 12 rectrices; t1 longest; t2 0–1 mm shorter than t1, t3 0–3, t4 0–4, t5 2–6, t6 5–9. Bill fairly long, longer than in other gerygones (Keast & Recher 1997); about three-quarters length of head; laterally compressed on distal half; upper mandible slightly decurved; gonys inclined slightly upward. Tarsus fairly long, much longer than in other gerygones (Keast & Recher 1997), compressed laterally; scaling holothecal. Tibia fully feathered. Middle toe longest, mean length including claw 15.4 mm (1.00; 14.0–16.8; 5); inner and outer toes 70–85%; hindtoe 85–95% length of middle; hindtoe and claw much longer than in other gerygones (Keast & Recher 1997).

AGEING Poorly understood. Juvenile apparently distinguished by plumage and bare parts (q.v.), but more data needed to assess plumage variation in this age class. First immatures said to be distinguishable by plumage, having more prominent yellow on throat and belly than adult female

(Robertson & Dennison 1984). Data needed on first immatures, especially regarding variation in colour of underparts and extent to which juvenile feathers retained.

SEXING Differ in plumage (q.v.) and size, with adult males larger than adult females. Only females develop brood-patch (Heather & Robertson 1997).

GEOGRAPHICAL VARIATION None known. According to cladistic analysis based on morphological characters (Ford 1986), Chatham Island Warbler *G. albofrontata* is a highly differentiated member of Grey Warbler *G. igata*-Brown Gerygone *G. mouki* group. The marked plumage and morphometric divergence of *G. albofrontata* is consistent with it being a derived species that has evolved rapidly after colonization by a small founder population (Ford 1986).

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Volume 6, Plate 11

Grey Warbler *Gerygone igata* (page 319)
1 Adult; 2 Juvenile; 3 Adult

Chatham Island Warbler *Gerygone albofrontata* (page 334)
4 Adult male; 5 Adult female; 6 Putative juvenile (yellow variant); 7 Juvenile (pale variant)

Norfolk Island Gerygone *Gerygone modesta* (page 341)
8 Adult; 9 Juvenile