

## 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):

- 
- 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.
-

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 muscipoid (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 Muscipidae–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).

## REFERENCES

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

## Family ACANTHISITTIDAE New Zealand wrens

Very small passerines (7.5–10 cm in total length and weighing 5–20 g) with very short tails, short wings, long tarsi and rather straight and slender bills. Six species in four genera (Millener 1988; Sibley & Alquist 1990), all limited to NZ (including Stewart I. and some offshore islands). Rifleman *Acanthisitta chloris* and Rock Wren *Xenicus gilviventris* extant; Stephens Island Wren *Traversia lyalli* extinct; and Bush Wren *Xenicus longipes* almost certainly extinct. North Island Stout-legged Wren *Pachyplichas yaldwyni* and South Island Stout-legged Wren *P. jagmi* both extinct in late Holocene and known only from subfossil remains. Taxonomic history of family reviewed by Sibley *et al.* (1982) and Sibley & Ahlquist (1990). Studies of anatomy of syrinx (Forbes 1882; Pycraft 1905; Ames 1971), myology (Pycraft 1905; Raikow 1987), osteology (Pycraft 1906; Oliver 1945; Feduccia 1974, 1975; Millener 1988) and egg-white proteins (Sibley 1970) suggest New Zealand wrens form a distinct passerine lineage, but there is no consensus on their affinities with the oscines or suboscines. DNA–DNA hybridization studies (Sibley *et al.* 1982) suggest that the acanthisittids are members of an ancient passerine lineage and place them within the suborder Tyranni (suboscines), in keeping with previous authors (Wetmore 1930; Stresemann 1934; Mayr & Amadon 1951). Sibley *et al.* (1982) suggest that the acanthisittids may belong to a third suborder with no close living relatives; this notion is supported in previous studies (Wolters 1977; Peters).

Structure fairly homogeneous. Following summary based principally on studies of osteology (Millener 1988), myology (Raikow 1987) and general anatomy (Pycraft 1905; Sibley & Ahlquist 1990). Bill slightly decurved; posterior articulation with enlarged process, internal process having large pneumatic foramen. Rostrum medium length, triangular, pointed. External nares holorhinal (Millener 1988), considered schizorhinal in *Acanthisitta chloris* (Pycraft 1905). Cranium wide and depressed dorsoventrally; interorbital bridge constricted; ectethmoid plate inflated; post-orbital and squamosal processes minute; interorbital septum traversed by a single bony bar; maxillo-palatine process very long and slender in *Acanthisitta*. Sternum fenestrated; carina reduced, markedly so in *Traversia*; manubrial spine enlarged and bifid except in *Traversia*; anterior processes large and sharply triangular; posterior lateral processes widely divergent. Iliac crests firmly fused along midline in *Traversia* and *Pachyplichas* but not in *Acanthisitta* or *Xenicus*. Other osteological features summarized by Millener (1988). *M. flexor hallucis brevis* absent. *M. flexor hallucis longus* vestigial. *M. flexor perforatus digiti IV* resembles oscine type. Syrinx haplophone, lacking intrinsic muscles. Wings short with rounded tip. Ear opening in *Acanthisitta* composed of narrow horizontal slit giving access to chamber extending downward to opening of auditory meatus. Ten primaries; putative p11 in *Acanthisitta*; nine secondaries; eutaxic; s9 degenerate. Tail extremely short. Ten rectrices. Tarsus fairly long; scaling pycnaspidean; planta covered with moniliform scales. Soles covered with distinct papillae. Claws long and acute, particularly hallux. Outer and middle toes joined basally. Stephens Island Wren probably the only flightless passerine (Millener 1988).

Adult plumage rather dull, somewhat brighter in *Acanthisitta*. Degree of sexual dimorphism differs from species to species. Bare parts mostly black, grey, brown or flesh-coloured; iris usually brown or black. Post-breeding (pre-basic) moult of adults apparently complete. Moult of primaries apparently centrifugal. Little information on appearance of nestlings or juveniles; juvenile Rifleman similar to adults. First immature (first basic) plumage apparently resembles adult plumage. Attain adult plumage when c. 1 year old. Can first breed within first year, e.g. as young as 9 months in Rifleman (see accounts).

For following summary, see individual species accounts for fuller details and references.

Family restricted to NZ and surrounding islands. Rifleman mostly arboreal, Rock Wren and Bush Wren partly terrestrial and partly arboreal. Rifleman and Bush Wren found mainly in native forests, such as beech *Nothofagus* forest and podocarp–broadleaf forests. Rock Wren mainly restricted to alpine and subalpine zones, occurring on rocky slopes usually vegetated with low shrubland. Nothing is known on habitat of the extinct Stephens Island Wren.

Poor dispersers, especially across water (Blackburn 1968; Heather & Robertson 1997); the extinct Stephens Island Wren was apparently flightless. Rifleman sedentary, though may move altitudinally in some areas. Movements of Rock Wren and Bush Wren virtually unknown, but no evidence of any seasonal movements. Rock Wrens appear to remain in territories year-round (Heath 1986, 1989) and apparently either enter torpor or remain active under snow during winter (Child 1978).

Feed largely on insects, also spiders and occasionally fruit. Feed arboreally and on ground, but proportion of time spent feeding above ground differs between species, e.g. Rifleman spend more time feeding above ground than both Bush Wren and Rock Wren. Mainly feed by gleaning (all species), but occasionally probing (Bush Wren) or sallying

(Rock Wren). Young fed by both parents in Rock Wrens; by parents and helpers in co-operatively breeding Rifleman, usually on insects.

Social organization studied for Rifleman and Rock Wren, but little is known of Bush Wren or Stephens Island Wren. Riflemen breed co-operatively, with helpers assisting primary pair with feeding of nestlings and fledgelings. Helpers at first brood of season usually unrelated males, while those at second brood usually juveniles of season. Sex-ratio of adults appears to favour males in some years, but over several years was not significantly different from unity. Males and females become paired at first opportunity after independence, and first breed within first year. Rock Wren does not show co-operative breeding. Both Rock Wren and Rifleman breed as monogamous pairs on all-purpose territories. Territories and pair-bonds are permanent and maintained year-round. Parents show a high level of co-operation when nesting; both build nest, incubate, feed young and defend territory and young. In Rifleman, male often accompanies female before hatching. Young of Rifleman are independent roughly 3–6 weeks after fledging. Young of Rock Wren able to provide 40% of their own food as soon as they fledge, and are independent within 2–3 weeks. Outside breeding season, Riflemen, Bush Wrens and Rock Wrens seen as pairs or small groups, probably families; single birds not often seen. Riflemen sometimes feed in flocks with other birds. When roosting, Riflemen may perch alongside one another, bodies touching; Rock Wrens roost in holes in rocks. Essentially, nothing known of Stephens Island Wren.

Displays not well known. Although territorial year-round, displays of actual territorial aggression, in Rifleman at least, weak. Bush Wrens and Rock Wrens bob when alighting from short flights. Said that bobbing by Rock Wren varies over range, being much slower and less frequent in Fiordland (Thomson 1964); confirmation needed. Bobbing, extension and vibrating of wings, and calling are features of display between male and female Rock Wrens when nest being built. In all three extant species, members of pairs call to each other to maintain contact. Courtship feeding occurs in Riflemen and Rock Wren, where male feeds female, but, in Rock Wren female sometimes also feeds male.

In Acanthisittidae, syrinx differs from that of typical passerines in having no intrinsic muscles, but the presence of a well-developed drum (formed by fusion of posterior tracheal elements) suggests that such muscles may once have existed (Ames 1971). Studies of syringeal structure reviewed in Sibley *et al.* (1982). All species usually heard before being seen. Vocal repertoire not large (Ames 1971), and calls simple in structure and very high-pitched (7–15 kHz). Antiphonal calling occurs.

Breeding of Rifleman well known, and breeding of Rock Wren reasonably well known; Bush Wren virtually unknown and Stephens Island Wren unknown. Summary below thus mainly refers to Rifleman and Rock Wren. Breeding seasonal, Aug.–Jan.; Rifleman can raise two broods in a season. Breed in simple pairs; Riflemen breed co-operatively. In Rifleman, males probably choose nest-site, which female accepts or rejects; in Rock Wren, female usually selects site. Nest-sites well hidden, usually low down; Rifleman in sheltered parts of open forest, in gullies or along watercourses beneath scrub, in hollows of tree-limbs and trunks, or among exposed tree-roots; Rock Wren in sheltered crevice or cavity, among rocks, on bluffs or rocky ledges of mountains, in earthen banks; often nest in similar sites to previous season. Nest built by both sexes. Rifleman has ovoid or dome-shaped nest with side entrance, though build cup-shaped nests in small sites; Rock Wren nests are spherical, oval or cigar-shaped, with small entrance in end or side of wall. Composed mostly of sticks, grass, rootlets and leaf skeletons, and occasionally moss, pine needles, leaves, bark and cobwebs; chamber usually lined with feathers. Eggs, 2–3 for Bush Wren; 3–5 for Rifleman; 1–5 for Rock Wren. Ovoid or oval, white or creamy white. Eggs laid at intervals of c. 24 h. Both sexes incubate, only female at night; full incubation begins only when clutch complete. Incubation period 18–22.5 days. Eggs usually hatch asynchronously, 1–3 days apart. Young altricial, nidicolous. At hatching, young naked and with eyes closed; may not develop natal down. Both sexes feed and brood young, though only female broods at night. Rock Wren fledge at c. 24 days, and independent after 2–4 weeks.

## REFERENCES

- Ames, F.L. 1971. *Bull. Peabody Mus. Nat. Hist.* 37: 1–194.  
 Barlow, B.A. (Ed.) 1986. *Flora and Fauna of Alpine Australasia*. CSIRO & Aust. Systematic Botany Soc., Melbourne.  
 Blackburn, A. 1968. *Notornis* 15: 51–65.  
 Child, P. 1978. *Notornis* 25: 71–83.  
 Feduccia, A. 1974. *Auk* 91: 427–29.  
 ——— 1975. *Wilson Bull.* 87: 418–20.  
 Forbes, W.A. 1882. *Proc. Zool. Soc. Lond.* 569–71.  
 Heath, S. 1986. Pp 277–88. In: Barlow 1986.  
 ——— 1989. Unpubl. MSc thesis, Univ. Otago, Dunedin.  
 Heather, B.D., & H.A. Robertson. 1997. *The Field Guide to the Birds of New Zealand*. OUP, Oxford.  
 Kuenthal, W., & T. Krumbach. 1934. *Handbook der Zoologie*. Walter de Gruyter, Berlin.  
 Mayr, E., & D. Amadon. 1951. *Am. Mus. Novit.* 1496.  
 Millener, P.R. 1988. *J. R. Soc. NZ* 18: 383–406.  
 Oliver, W.R.B. 1945. *Emu* 45: 55–77.  
 Pycraft, W.P. 1905. *Ibis* (8)5: 603–21.  
 Raikow, R.J. 1987. *Ornith. Monogr.* 41.  
 Sibley, C.G. 1970. *Bull. Peabody Mus. Nat. Hist.* 32: 1–131.  
 ———, & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds*. Yale Univ. Press, New Haven.  
 ———, *et al.* 1982. *Notornis* 29: 113–30.  
 Stresemann, E. 1934. *Aves*. Volume 7(2), pp 1–899. In: Kuenthal & Krumbach 1934.  
 Thomson, A.L. 1964. *A New Dictionary of Birds*. Thomas Nelson, London.  
 Wetmore, A. 1930. *Proc. US Nat. Mus.* 76: 1–8.  
 Wolters, H.E. 1977. *Die Vogelarten der Erde*. Paul Parey, Hamburg and Berlin.

*Motacilla longipes* Gmelin, 1789, *Syst. Nat.*, ed. 1(2): 979 — Nova Seelandia = Dusky Sound, New Zealand.

The generic name is derived from the Greek ξενικός, foreign, strange (ξενός, stranger, foreigner), and alludes to the distinctive yet peculiar features of these small birds. The description of this largely terrestrial wren was based on Latham's (1783; *Gen. Synop. Birds*) 'Long-legged Warbler' (Latin *longipes*, long-footed).

**OTHER ENGLISH NAMES** North Island, South Island or Stewart Island Bush Wren; Green Wren; Tom Thumb Bird.

**POLYTYPIC** Considered extinct throughout range. Nominate *longipes*, SI of NZ; *stokesii*, G.R. Gray, 1862, NI of NZ; *variabilis*, Stead, 1936, Stewart I. (probably) and outlying sw. islands (NZCL).

**EXTINCT**

**FIELD IDENTIFICATION** Length 9–10 cm; wingspan unknown; weight 15–17 g. Small terrestrial NZ wren, now extinct. Very similar in size, shape and proportions to Rock Wren *Xenicus gilviventris*. Much individual variation, but no seasonal variation; sexes apparently similar (but see Plumages). Adults generally dark green to dark olive above and on lower underbody, merging to duller olive on ear-coverts and dark brown on cap, with varying white supercilium (except duller *variabilis*) bordered with black and merging to yellow at rear, and diagnostic dark-grey throat and breast. Juvenile poorly known; apparently much as adult but with fine white streaking and pale markings on upperparts. Some poorly known geographical variation; three subspecies that differ mainly in colour of upperparts, breast and flanks (in adult plumage).

**Adult SUBSPECIES LONGIPES:** Plumage varies, from birds with rather dull and uniform brownish upperparts to brighter birds with greener upperparts that contrast more strongly with brownish cap. Top of head, dark brown to olive-brown. Brownish cap underscored by bold narrow white supercilium broadening over and behind eye and merging to yellow above rear ear-coverts. Supercilium bordered above by narrow black line, and below by

black eye-stripe that continues in thin line below eye, highlighting prominent thin white arc round bottom of eye. Olive-brown hindneck and sides of neck grade to brighter olive on ear-coverts. Saddle and rump, dark olive to dark green, always showing some contrast with browner top of head (most marked in those with green saddle), and grading to olive or green on uppertail-coverts; uppertail, olive. Folded wing, dark olive to dark green, as saddle, with: (1) prominent contrasting black carpal patch, with clear narrow whitish leading edge (sometimes hidden by feathers of flanks); (2) brighter yellow-olive edges to remiges, forming slightly paler panel in folded wing, strongest on secondaries; and (3) contrasting dark-brown inner webs to tertials. Chin and throat, off-white, merging to dark brownish grey on breast, belly and foreflanks; vent and undertail-coverts, olive, with diffuse brighter olive or yellow-olive blaze along rear-flanks, sometimes concealed by folded wing. Underwing: most of coverts, pale yellow, contrasting with brownish-grey greater coverts and remiges. Bill, black or brownish black. Iris, brownish black. Legs and feet, pale brown or pale pinkish brown. **SUBSPECIES VARIABILIS:** Apparently much variation, but little information (see Plumages). Brightest birds appear simi-

lar to dullest *longipes*, with only slight contrast between olive-brown saddle and top of head, and brownish-grey flanks have duller olive tinge. In dullest birds entire upperparts are uniform dark brown with, at most, only a faint olive tinge, and pale supercilium is absent. **SUBSPECIES STOKESII:** Poorly known. Said to be similar to *longipes* but sides of neck and breast, shining slate-blue, with greenish tinge in certain lights; and with bright-yellow blaze on rear-flanks. **Juvenile** Little known. A confirmed juvenile *variabilis* similar to brighter adults but with some fine white streaking on hindneck and sides of neck. Subspecies *longipes* tentatively aged as juveniles similar to duller adults but with fine pale streaking on top of head and neck, and fine pale streaking and mottling on saddle and secondary coverts of upperwing; and much paler buff chin, throat, breast, belly and flanks. No other information (see Plumages).

**Similar species** Considered extinct; surviving populations likely to be found only in remote forested parts of SI or on Stewart I. On SI, could be confused with similar **Rock Wren**, but Bush Wren distinguished in all plumages by: (1) whitish chin and throat and much darker brownish-grey breast and belly (cf. paler grey-brown, yellow-brown or whitish underbody in Rock Wren, which only rarely shows such contrasting whitish chin and throat); (2) marked contrast between brown crown and greenish saddle (in bright individuals only, cf. hardly or not apparent in Rock Wren); (3) pale leading edge to black carpal patch (usually obvious on Bush Wren but rarely so on Rock Wren); (4) bolder black borders to supercilium giving more contrasting pattern of head (in bright individuals only); and (5) no pale tips to tertials (cf. obvious pale tips to outer webs of tertials in Rock Wren). In distant or fleeting views, beware confusion with **Rifleman** *Acanthisitta chloris*; Bush Wren easily distinguished by: (1) being clearly bigger and bulkier, with heavier and gently decurved bill (cf. fine and diagnostically upturned in Rifleman) and much longer legs and toes; (2) dark brownish-grey breast and belly, and olive lower underbody (adult Rifleman has all-white underbody, and juvenile has a well-streaked foreneck and breast); (3) green or duller olive or brownish saddle, usually showing some contrast with brown cap (adult male Rifleman has concolorous green cap and saddle, while in adult female and, often, in juvenile, these tracts boldly streaked darker); (4) bolder and darker facial pattern, with black lores and borders to yellow-ended white supercilium, more prominent narrow white arc below eye, and wholly olive ear-coverts (adult Rifleman has all-white supercilium, and mostly white lores, lower face, chin and throat, giving characteristically open-faced expression; juvenile has well-streaked face, chin and throat); (5) pattern of tertials differs in much the same ways as described for Bush and Rock Wrens (see above); (6) no diffuse pale bar across bases of remiges, obvious both at rest and in flight in Rifleman; (7) olive (not blackish and narrowly white-tipped) tail; (8) paler brown or pink-brown legs and feet (can be similar in Rifleman, but are often more yellow-brown or darker, blackish with contrasting yellowish feet); and (9) different foraging behaviour (Rifleman spends much time foraging on trunks of trees). Insufficient information to provide definitive differences in calls or habitats.

Formerly seen singly, in pairs or small parties. General habits and behaviour little known. Foraged on ground, among leaf-litter, mosses and so on, and also among foliage of trees and shrubs and, less often, on trunks, branches and twigs of same. Moved swiftly and furtively while foraging, with characteristic hopping or bobbing movement; and made short purposeful flights between branches of trees and shrubs.

**HABITAT** Very few and often anecdotal records. Possibly more widely distributed in past (except possibly in alpine zone) (Falla *et al.* 1981; D.J. Onley). Later records mostly from dense, remote forests at high altitudes (Turbott 1967; Falla *et al.* 1981; Oliver), such as subalpine beech *Nothofagus* and Rimu *Dacrydium cupressinum* forests, or mixed beech forests (Stidolph 1926; Dunckley & Todd 1949; Williams 1962; Turbott 1967; Creswell 1968; St Paul 1977; Oliver; CSN). In Fiordland, also occupied lower-altitude beech and podocarp forests (Oliver). No further information.

**DISTRIBUTION AND POPULATION** Extinct. Formerly endemic to NZ.

**NI** Last recorded in 1955 (St Paul 1977). Few scattered records, though widespread subfossil remains (NZCL). Single specimen from Taupo (Fischer 1981). Several records around L. Waikaremoana, including at L. Waikareiti, Huiarau Ra. and Aniwanui Valley (Edgar 1949; St Paul 1977); unconfirmed reports also at Mt Egmont and upper reaches of Waitotara R. (Oliver). Several records from Makuri Gorge in Manawatu S to Rimutaka Ra. and Days Bay (Stidolph 1922, 1926; Oliver). **SI** Last recorded in 1968 (Creswell 1968). Formerly widespread. Scattered records in Nelson and Marlborough, from Tasman Ras S to Moss Pass and L. Rotorua (Moncrieff 1925, 1929; Creswell 1968; Oliver). Most records in Westland and w. Southland, from w. Paparoa Ra. S to Dusky Sound, Chalky Inlet and Hump Ridge (Dunckley & Todd 1949; Penniket 1955; Medway 1976; Oliver; CSN). Said to have been seen in Otago (Oliver); and once reported near Woodbury on Waihi R. in s. Canterbury (Graham 1948), though also suggested this may have been misidentified Rifleman (A. Crossland; R. Neilson; D.J. Onley). **Stewart I.** Few anecdotal reports from Stewart I. (Buller 1905; Dawson 1951; Tiley 1951); but recorded more often on satellite islands; last recorded, on Kaimohu I., in 1972 (Stead 1936; Blackburn 1965; Oliver; see Introductions below).

**Breeding** Probably bred throughout range.

**Introductions** Before 1965, six birds transferred from Big South Cape I., off Stewart I., to nearby Kaimohu I. Two were seen there in 1967 and again in 1972, but none located in 1977 (Blackburn 1965; Secker 1966; Mills & Williams 1979).

**Change in range, populations** Population declined rapidly after introduction of predatory mammals (Collar *et al.* 1994). In s. parts of NI, last recorded at Days Bay near Wellington in 1918 (Stidolph 1922, 1926) and extinct in Wairarapa by 1930s (Stidolph 1939). Farther N, records around L. Waikaremoana persisted till mid-1950s, with last record of single bird on 17 Nov. 1955 in Aniwanui Valley (Edgar 1949; St Paul 1977). On SI, though formerly widespread, populations said to have declined after c. 1880 (Buller 1905; Williams 1962; Mills & Williams 1979), and by 1950s thought to be extinct in W. Paparoa Ra. (Penniket 1955) and rarely recorded elsewhere. Observed at Milford Sound, Mar. 1965 (NZCL). Last recorded on 17 Jan. 1968, when two birds seen at Moss Pass in Nelson Ls NP (Creswell 1968). Formerly common on Stewart I. and nearby islets in 1930s (Stead 1936). Last recorded on Stewart I. in Jan. 1950 (Tiley 1951) with unconfirmed report in early 1951 (Dawson 1951). Still common on Big South Cape I. in Apr. 1961, and recorded again in Aug. 1964, but could not be located in Feb. 1965 (Blackburn 1965). Introduced population on nearby Kaimohu I. last recorded in 1972 (see above).

**Status** Extinct.

**THREATS AND HUMAN INTERACTIONS** Population declined rapidly after introduction of predatory mammals

(Collar *et al.* 1994). Extinction on Stewart I. and associated islands coincided with introduction of Black Rats *Rattus rattus* in 1962 or 1963 (Blackburn 1968; Mills & Williams 1979); Wrens last recorded there in 1964 (Blackburn 1965). Possibly also adversely affected by clearance of native forest for agriculture (Moncrieff 1938).

**MOVEMENTS** No information. Possibly incapable of moving between islands; thought that channel between Codfish and Big South Cape Is, only c. 3 km wide, might have been barrier to colonization of Codfish I. (Blackburn 1968). Record of one bird in poor weather in winter at c. 1000 m asl (Edgar 1949) suggests no seasonal movement from high altitudes or in adverse conditions, at least in some birds. Said to be weak fliers (Oliver).

**FOOD** Insectivorous; took insects and their larvae, and spiders. **Behaviour** Little known. Fed on ground and arboreally (Turbott 1967; Oliver). No information on size of feeding flocks (but see Social Organization). Took food by gleaning from branches and foliage of trees and shrubs, or by probing into crevices and searching bark or mosses and lichens that grow on stems and branches of trees (Turbott 1967; CSN 19); on ground, fed among leaf-litter, mosses and lichens growing on forest floor and understorey vegetation (Oliver).

Diet virtually unknown. **INSECTS:** Adults and larvae, mostly beetles (Coleoptera) (Turbott 1967; Falla *et al.* 1981; Oliver); also food scraps picked up round camps (Oliver). Young said to have been fed insects, including flies (Diptera), adult moths (Lepidoptera), and some spiders (Pholcidae) (NZRD) but source of this not known.

**SOCIAL ORGANIZATION AND BEHAVIOUR** Almost nothing known. Usually seen singly or in pairs but sometimes in small groups of 2–4 birds (Buller 1888; Turbott 1967; Oliver). Both parents incubated and fed young (Falla *et al.* 1981; Oliver). Would vigorously bob whole body, often on landing (Falla *et al.* 1981); also bobbed head (Oliver). When alarmed or excited gave loud cheeps (Oliver). Pairs continually called to each other with a subdued trill (= Rasp) (Buller 1888). Graham (1948) described some behaviour, though there are some doubts about his identification; nevertheless, he reported a flock of at least 12 birds feeding along branches of withy willows, moving swiftly along branches and making short flights between them; he also described them as active and elusive, and that, when approached, gave seep note (= Cheep) before moving away. No other information.

**VOICE** Very little known. No known recordings. Responded to imitation of calls (Potts 1873).

**Adult RASP:** Conversational notes were a faint rasping sound (Guthrie-Smith 1925); also described as subdued trill; given by both sexes, continually calling to each other (Buller 1888). **CHEEP:** Sharp *cheep*, not as shrill as that of Brown Creeper *Mohoua novaeseelandiae*, yet more powerful than that of Rifleman (Potts 1873). Also described as loud *cheep*, given when alarmed or excited (Guthrie-Smith 1925). When approached, said to give *seep*, *seep*, before moving away (Graham 1948). **FLIGHT CALL:** Said to have uttered a rapid succession of merging *cheeps* in flight (NZRD) but no primary information.

**Young** No information.

**BREEDING** Almost nothing known. Account based on information in Oliver and Wilson (1959), from SI, and Solomon I., SW of Stewart I.

**Season** In SI, one nest apparently ready for eggs, late Dec. (Oliver); eggs, Nov. (CM); Long I., Fiordland, eggs, Nov. and Dec. (CM). On Solomon I., eggs, Nov. and mid-Dec. (Oliver; CM).

**Site** Usually placed among upturned roots of fallen tree, but also in cavity in side of tree and in forked trunk of tree (Mathews 1930; Turbott 1967; Oliver). In SI, one nest found beneath moss-covered roots of alpine ribbonwood tree. Three nests on Solomon I.: one halfway down side of Rata log covered with creeping *Polypodium*; one in petrel's burrow, with passage to Wren's nest passing upwards into roots of fern clump; another in centre of half-dead Tupare *Olearia colensoi*; all nests damp and after each shower of rain, birds would carry in dry feathers and carry out wet ones (Oliver). One nest in hollow log had entrance underneath log (Wilson 1959).

**Nest, Materials** In SI, one nest, pouch-shaped, with opening well hidden, near top; composed almost entirely of fern rootlets; entrance neatly and strongly formed with extra entwinements of same material; lined with feathers. Nests built in holes or cavities generally cup-shaped, open at top; nests built in fork of tree slightly hooded (Turbott 1967). On Solomon I., nest a spherical structure composed of fern leaves and rootlets, and lined with feathers.

**Eggs** Ovoid; white. **MEASUREMENTS:** Nominate *longipes*: 17.4 (0.93; 16.1–18.7; 6) × 12.7 (0.96; 11.4–14) (Oliver; CM); subspecies *variabilis*: Long I., Fiordland: 21.1 (0.44; 20.4–21.7; 6) × 15.6 (0.26; 15.3–15.9) (CM); Solomon I., off Stewart I.: 21 × 15.4, 21 × 15.5, 21.4 × 15.5 (Oliver; CM). **Clutch-size** Two (Oliver); also given as 2–3 (Falla *et al.* 1981) or said to be occasionally three (NZRD) but source of claims of three not known and confirmation needed. **Laying** No information. **Incubation** Both sexes incubate. **INCUBATION PERIOD:** No information. **Young** Both sexes feed young. No other information. **Fledging to independence, Success** No information.

**PLUMAGES** Prepared by J.S. Mathew. No information on young. Assumed to fledge in juvenile plumage, then undergo post-juvenile (first pre-basic) moult; not known if post-juvenile moult partial or complete, and thus sequence of plumages to adult not certainly known. After attaining adult plumage, probably undergo complete post-breeding (pre-basic) moult each cycle, producing successive adult plumages, apparently with no change in appearance. Sexes apparently alike. Nominate *longipes* described below, based on examination of skins of three adult males, two adult females, two unsexed adults, and one putative juvenile (CM, NMNZ). Plumage account lacks adequate detail because there are few reliably sexed skins and information on museum labels is not reliable.

**Adult** (Definitive basic). **HEAD AND NECK:** Forehead, crown and nape, vary from dark brown (121, 119A) to olive-brown (c29) or brown (28). Hindneck varies from olive-brown (c29) to dark olive (c48), grading browner towards nape. Sides of neck, dark olive (c48) with yellow-olive (c52) patch in centre, becoming brownish grey (80) towards throat. Supercilium, white, grading to yellow (c55) posteriorly; prominent and sharply demarcated, extends from above lores to near nape. Narrow line of feathers above supercilium, black-brown (119), forming narrow black-brown lateral crown-stripe. Lores, black-brown (119). Eye-ring, white above and below eye, black-brown (119) in front of and behind eye; shows as prominent white crescent below eye. Feathers extending narrowly behind and below eye, black-brown (119), combining with lores to form diffuse black-brown eye-stripe. Ear-coverts, dull yellowish brown (c24) or olive (51). Chin, cream (92). Malar area and throat, light brownish grey (c80). A few short black (89)

pinnate rectal bristles protrude from lower lores, each bristle ending in at least three tips. **UPPERPARTS:** Mantle, back, scapulars and rump, vary from dark-green (260) to dark-olive (c48) with olive-brown (29) on parts of mantle and upper back; feathers, brown (28) with dark-green (260) or dark-olive (c48) fringes. Uppertail-coverts, olive (50) or light green (59). All feathers of upperparts have concealed dark-grey (83) bases. **UNDERPARTS:** Breast and belly, rich brownish grey (c79 c80), appearing almost glossy in some lights. Flanks, bright olive (c50), grading to brownish grey (c79, c80) anteriorly. Feathers of thighs, brownish grey (c79) or light grey-brown (119C) with olive (51) fringes. Axillaries, pale yellow (157). Undertail-coverts, olive (c50). All feathers of underparts have concealed dark-grey (83) bases. **UPPERTAIL:** Rectrices, brown (28) or grey-olive (c43) with olive (51) fringes. Shafts of rectrices, dark red-brown (221A). **UNDERTAIL:** Brownish grey (c79) with olive (51) fringes to rectrices; shafts, off-white (ne). **UPPERWING:** Marginal and median secondary coverts, brown (28) or dark brown (121) with bright-olive (150, 50) or dark-green (260) fringes, which appear bluish green (c65) when viewed at some angles. Greater secondary coverts, brown (28) with bright-olive (50, 150) fringes on outer webs and at tip. Marginal primary coverts, pale yellow (157) with dark-brown (121) inner edges. Median primary coverts, dark brown (121) with olive (50, 150) fringes. Alula and greater primary coverts, dark brown (121); some have olive (c51) edge to outer webs. Primaries, dark brown (121) with olive (c51) edge to outer webs, and off-white (ne) inner edge, which does not extend as far distally on outer primaries as on inner primaries. Secondaries and tertials similar to primaries, but tertials and innermost secondaries have bright-olive (c150) or dark-green (c260) edge to outer webs. Shafts of remiges, reddish brown (221B) or dark red-brown (221A). Outer webs of remiges combine to form olive (150, 50) panel on folded wing, barely contrasting with upperparts and rest of wing. **UNDERWING:** All marginal and median coverts and greater secondary coverts, pale yellow (157) or yellow (c55) with partly exposed dark-grey (83) bases; marginal coverts combine with marginal primary coverts of upperwing to form prominent pale-yellow (157) or yellow (55) stripe on leading edge at carpal joint. Greater primary coverts, brownish grey (c79) with very narrow pale-yellow (157) fringes. Remiges, brownish grey (c79); markings similar to uppersurface, but outer webs duller. Shafts of remiges, off-white (ne). Outer webs of remiges usually concealed on normally spread wing.

**Nestling** No information.

**Juvenile** Very little known. The following based on single skin (AV2620) labelled juvenile (CM) with obvious plumage differences from other skins examined. Specimen tentatively aged as juvenile based on similarities with another specimen of not fully grown juvenile *variabilis* (see Geographical Variation). However, specimen rather faded and perhaps discolored, so description below should be used with caution. Differences from adult: **HEAD AND NECK:** Crown, nape and hindneck, dark brown (121A) with fine white striations; feathers, dark brown (121A) with white shafts. Lores, light brown (c39). Chin and throat, pale buff (c124). **UPPERPARTS:** Mantle, back, scapulars and rump, brown (c123); some scapulars and feathers of mantle, cream (92) towards tip and have white shafts. **UNDERPARTS:** Breast, belly and flanks, pale buff (c124). **UPPERWING:** All secondary coverts, cream (92) near tips with white shafts. Remiges similar to adult, but edged brown (c123) on outer webs.

Slater (1888) described a skin he considered an adult female *longipes* (BMNH). This bird, however, thought to be an

immature by Ogilvie-Grant (1905), by which he probably meant a juvenile. Slater's description is of umber-brown upperparts tinged yellowish green; purplish-brown crown; delicate vinous-brown throat, breast and sides of neck; and dull lemon-yellow flanks; the published description does not mention white shafts to feathers of upperparts.

**First immature** (First basic). No information. If present (as distinct from first adult plumage), probably very similar to adult.

**BARE PARTS** Based on published descriptions; the few published photos (e.g. NZRD) are of a mounted skin and so not used. **Adult** Bill, black (Creswell 1968) or brownish black (Oliver). Orbital ring, not known. Iris, brownish black (Slater 1888; Oliver); also described as dark (Creswell 1968). Legs and feet, pale brown (Slater 1888; Oliver) or slaty black (Creswell 1968). **Juvenile** Virtually no information. Subspecies *stokesii* had black bill and pale-yellow legs and toes (Oliver). **First immature** No information, if such a plumage exists.

**MOULTS** Based on examination of skins of five adult *longipes*, and ten adult and one juvenile *variabilis* (AM, CM, NMNZ). **Adult post-breeding** (Probably second or third and subsequent pre-basic). Poorly known. Probably complete. Timing not known; probably after breeding (see that section): of 15 adults, two in Dec. and one in Feb. had all new primaries; remaining 12, collected between Oct. and May, had worn primaries. None had active moult of primaries. Moult of body starts before start of moult of primaries. **Post-juvenile** (First pre-basic). Nothing known. **First immature post-breeding** (Second pre-basic). If a first immature plumage exists, nothing is known of post-breeding moult to adult plumage.

**MEASUREMENTS** (1–2) Adults, skins, sexed using labels (CM, NMNZ). (1) Nominate *longipes*, SI; (2) Subspecies *variabilis*, Big South Cape I.

		MALES	FEMALES	
WING	(1)	56.2 (1.10; 55–57; 5)	56.0 (1.41; 54–57; 4)	ns
	(2)	51.4 (1.40; 49–53; 7)	55.0 (0.00; 55; 4)	**
TAIL	(1)	27.0 (1.58; 25–29; 5)	22, 25, 26	
	(2)	22.4 (2.51; 20–26; 5)	23.5 (2.08; 21–26; 4)	ns
BILL S	(1)	15.8 (0.98; 14.1–16.4; 5)	15.0, 15.9, 16.5	
	(2)	15.3 (0.89; 13.4–16.1; 7)	15.5 (0.83; 14.9–16.7; 4)	ns
TARSUS	(1)	25.3 (0.87; 24.3–26.0; 6)	24.7, 25.4, 26.6	
	(2)	23.4 (0.51; 22.5–24.0; 7)	24.6 (0.90; 24.1–25.9; 4)	*

Unsexed: (3–5) Adult, skins (CM, NMNZ): (3) Nominate *longipes*, SI; (4) Subspecies *variabilis*, Big South Cape I.; (5) Locations not known. (6–7) Age not given, skins (Stead 1936): (6) Nominate *longipes*; (7) Subspecies *variabilis*. (8–9) Subspecies *stokesii*, NI, skins (BMNH, data in Oliver): (8) Adults; (9) Juvenile.

		UNSEXED	
WING	(3)	55.6 (2.97; 51–59; 5)	
	(4)	54.2 (2.14; 51–56; 6)	
	(5)	54.3 (3.06; 48–57; 10)	
	(6)	56.5 (52–59; 9)	
	(7)	54.0 (52–56; 12)	
	(8)	53.3	
	(9)	57	
	TAIL	(3)	24.2 (2.59; 21–27; 5)
		(5)	24.1 (1.57; 22–26; 7)

BILL S	(3)	16.2 (0.57; 15.4–16.7; 4)
	(4)	14.5 (0.97; 13.1–15.8; 6)
	(5)	15.7 (0.85; 14.5–17.3; 10)
	(9)	16
TARSUS	(3)	26.0 (0.41; 25.6–26.5; 5)
	(4)	23.4 (0.75; 22.8–24.6; 6)
	(5)	25.0 (0.66; 24.2–26.3; 7)

**WEIGHTS** Subspecies *variabilis*, Big South Cape I., from museum labels (NMNZ): adult male, 15; adult female, 17.

**STRUCTURE** Wing short; tip of longest primary of folded wing reaches to about half length of tail. Ten primaries; p6 longest (sometimes p5 or p7 equal longest), p10 9.0–14.0 mm shorter, p9 3.0–6.5, p8 1.0–3.5, p7 0–2.0, p5 0–1.0, p4 1.0–3.5, p3 2.0–5.0, p2 2.5–6.0, p1 3.0–7.0. Slight emargination of outer web of p5–p8, sometimes also p9; slight emargination of inner web of p6–p10 or p7–p10. Nine secondaries, including three tertials; tip of longest tertial does not reach p1 on folded wing. Tail very short, slightly rounded at tip; ten rectrices; t1 longest, t2–t4 about same length as t1, t5 c. 2 mm shorter than t1. Bill short, about same length as head or slightly shorter; upper mandible slightly downcurved; lower mandible fairly straight; gonys inclined slightly upward. Tip of upper mandible slightly overhangs tip of lower mandible. Nostrils occupy about half length of exposed culmen. Tarsus very long; scaling: non-bi-laminate, single large scale with very indistinct notches on anterior surface with no division between anterior and posterior surface. Middle front toe longest, 19.4 mm (0.93; 18.7–20.5; 5) including claw; inner front toe 75–85% length of middle front; outer front toe 70–80%; hindtoe 80–90%. Claw of hindtoe slightly shorter than toe, c. 8 mm long.

**AGEING** Little known. Juvenile similar to adult (see description above, and Geographical Variation below), but possibly distinguished by browner upperparts, and white shafts and pale centres near tips of some feathers of hindneck, mantle and sides of neck. None of the published descriptions or illustrations of juveniles mention white shafts to feathers of hindneck and upperparts (Ogilvie-Grant 1905; Oliver), but these may simply have been overlooked and possibly form a distinguishing feature of juveniles.

**SEXING** Comparison of five female and seven male *longipes*, and seven male and two female *variabilis* showed no consistent difference in plumage between sexes (this study). Further, published information (Ogilvie-Grant 1905; Oliver) suggests no difference between males and females. Adult female *variabilis* apparently have longer Wing and Tarsus than adult males (this study) but samples small. (For discussion of description of so-called female *longipes* in Sclater [1888], see description of juvenile plumage.)

**GEOGRAPHICAL VARIATION** Poorly understood. Three subspecies recognized (Heather & Robertson 1997; Oliver; NZCL). Within nominate *longipes*, there is slight variation in tone of upperparts, forehead, crown and nape (see Plumages, above); one unsexed skin (CM) from Southland, s. SI, resembles *variabilis* (this study). Not known if variation in tone of upperparts and head in *longipes* is related to sex or age, or is individual variation.

**SUBSPECIES VARIABILIS:** Very similar to *longipes*, but with shorter Wing, Tarsus ( $P < 0.01$ , sexes combined), Tail and Bill S ( $P < 0.05$ , sexes combined). Plumage description based on skins

of eight adults (including holotype) and one juvenile (AM, CM) and published information (Stead 1936; Oliver). Differences from nominate *longipes*: **Adult HEAD AND NECK:** Hindneck, brownish (c28). Supercilium, off-white (ne), more diffuse above lores compared with nominate *longipes*. **UPPERPARTS:** Mantle, scapulars and back, brownish (c28, 33) on mantle, grading to olive-brown (c29) on back and scapulars; some have dark-olive (c48) tinge to mantle, back and scapulars. Rump and uppertail-coverts, dark olive (c47). **UNDERPARTS:** Flanks, brownish grey (c79) with dull-olive (51) tinge. **UPPERWING:** All marginal and median coverts, outer webs of greater secondary coverts, and outer edges of remiges, dull olive (c51). **UNDERWING:** All marginal coverts, very pale yellow (c157) or off-white (ne), combining with marginal upperwing-coverts to form off-white (ne) leading edge at carpal joint. **Juvenile** One skin of a not fully grown juvenile (CM) very similar to adult, but some feathers of hindneck and sides of neck have white shafts.

Stead (1936) stated that colour of upperparts varied within *variabilis*, independently of age or sex. All gradations between description above and greenest *longipes* were seen on islands SW of Stewart I., and birds of various colours formed pairs (Stead 1936).

**SUBSPECIES STOKESII:** Very poorly known. Only three skins known (NZCL) and none examined here. Adult *stokesii* described as having shining slate-blue sides of neck and chest tinged, in certain lights, with greenish; and a patch of pure yellow feathers on otherwise yellowish green flanks (Ogilvie-Grant 1905). Description of skin of adult Rock Wren *X. gilviventris* in Sclater (1888) is actually of an immature (i.e. probably juvenile) Bush Wren *X.l. stokesii* (Ogilvie-Grant 1905); originally this juvenile was described as being purplish brown above, tinged with olive on the lower part of back, and purplish white beneath, shining in certain lights, and with the sides and abdomen olivaceous (Gray 1862); illustrations of *stokesii* in Ogilvie-Grant 1905 indicate upperparts and underparts of juvenile browner than adult, and that adult *stokesii* have darker bluish-grey underparts and richer yellow posterior part of supercilium than adult *longipes*.

## REFERENCES

- Blackburn, A. 1965. *Notornis* 12: 191–207.  
 — 1968. *Notornis* 15: 51–65.  
 Buller, W.L. 1888. *A History of the Birds of New Zealand*. Second edn. Author, London.  
 — 1905. *Supplement to History of the Birds of New Zealand*. Author, London.  
 Collar, N.J., et al. 1994. *Birds to Watch*. 2. Birdlife Conserv. Ser. 4. Birdlife Int., Cambridge.  
 Creswell, R.A. 1968. *Notornis* 15: 125.  
 Dawson, E.W. 1951. *Notornis* 4: 146–9.  
 Dunckley, J.V., & C.M. Todd. 1949. *NZ Bird Notes* 3: 163–4.  
 Edgar, A.T. 1949. *NZ Bird Notes* 3: 170–4.  
 Falla, R.A., et al. 1981. *The New Guide to the Birds of New Zealand*. Rev. edn. Collins, Auckland.  
 Fischer, C.T. 1981. *Bull. Br. Orn. Club* 101: 276–85.  
 Graham, D.H. 1948. *NZ Bird Notes* 2: 178–80.  
 Gray, G.R. 1862. *Ibis* 1862: 219.  
 Guthrie-Smith, H. 1925. *Bird Life on Island and Shore*. Blackwood, Edinburgh.  
 Heather, B., & H. Robertson. 1997. *The Field Guide to Birds of New Zealand*. OUP, Oxford.  
 Mathews, G.M. 1930. *Emu* 29: 278–87.  
 Medway, D.G. 1976. *Notornis* 23: 44–60.  
 Mills, J.A., & G.R. Williams. 1979. Pp 147–68 In: Tyler 1979.  
 Moncrieff, P. 1925. *Emu* 25: 21–7.  
 — 1929. *Emu* 28: 215–25.  
 — 1938. *Emu* 37: 207–34.  
 Ogilvie-Grant, W.R. 1905. *Ibis* (8)5: 543–602.  
 Penniket, J.G. 1955. *Notornis* 6: 171–5.  
 Potts, T.H. 1873. *Trans. NZ Inst.* 5: 171–205.

- Sclater, P.L. 1888. *Catalogue of the Birds in the British Museum*. 14. Passeriformes. Br. Mus., Lond.
- Secker, H.L. 1966. *Emu* 66: 152-3.
- St Paul, R. 1977. *Notornis* 24: 65-74.
- Stead, E.F. 1936. *Trans. Roy. Soc. NZ* 66: 313.
- Stidolph, R.H.D. 1922. *Emu* 21: 290-4.
- 1926. *Emu* 25: 204-7.
- 1939. *Emu* 38: 344-55.
- Tiley, I. 1951. *Notornis* 4: 149-50.
- Turbott, E.G. (Ed.) 1967. *Buller's Birds of New Zealand*. Whitcombe & Tombs, Christchurch.
- Tyler, M.J. (Ed.) 1979. *The Status of Endangered Australasian Wildlife*. Roy. Zool. Soc. S. Aust., Adelaide.
- Williams, G.R. 1962. *Notornis* 10: 15-32.
- Wilson, R.A. 1959. *Bird Islands of New Zealand*. Whitcombe & Tombs, Christchurch.
- Sponsor: Birding Aus**



Volume 5, Plate 1

Rifleman *Acanthisitta chloris* (page 60)

NOMINATE *CHLORIS*: 1 Adult male; 2 Adult female; 3 Juvenile male, heavily streaked individual; 4 Juvenile male, lightly streaked individual; 5 Juvenile female; 6 Adult male

Bush Wren *Xenicus longipes* (page 76)

NOMINATE *LONGIPES*: 7 Adult, bright individual; 8 Adult, dull individual  
 SUBSPECIES *VARIABILIS*: 9 Age uncertain

Rock Wren *Xenicus gilviventris* (page 81)

10 Adult male, typical individual; 11 Adult male, green morph; 12 Adult female