Order PASSERIFORMES

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

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

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

The Passeriformes divide into two main groups:

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

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

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

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

MENURIDAE (lyrebirds): two species in one genus; endemic to Aust.;

ATRICHORNITHIDAE (scrub-birds): two species in one genus; endemic to Aust.;

CLIMACTERIDAE (A'asian treecreepers): six species in two genera breeding in Aust.;

MALURIDAE (Australopapuan fairy-wrens, emu-wrens and grasswrens): 22 breeding species in three genera in Aust.;

MELIPHAGIDAE (honeyeaters and Aust. chats): 76 species in 26 genera in Aust. and NZ, all breeding;

PARDALOTIDAE (pardalotes, scrubwrens, thornbills and allies): 51 species (one extinct) in 15 genera in HANZAB region, all breeding;

PETROICIDAE (A'asian robins): 23 species in eight genera in HANZAB region, all breeding;

ORTHONYCHIDAE (logrunners): two breeding species in one genus in Aust.;

POMATOSTOMIDAE (A'asian babblers): four breeding species in single genus in Aust.;

CINCLOSOMATIDAE (whipbirds, wedgebills, quail-thrushes and jewel-babblers): eight breeding species in two genera in Aust.;

NEOSITTIDAE (sitellas): single species breeding in Aust.;

PACHYCEPHALIDAE (whistlers, shrike-thrushes and allies): 17 species in seven genera in HANZAB region, all breeding;

DICRURIDAE (monarchs, flycatchers, fantails and drongos): 19 species in seven genera in HANZAB region, all breeding;

CAMPEPHAGIDAE (cuckoo-shrikes, trillers and minivets): eight species (one extinct) in two genera in HANZAB region, all breeding;

ORIOLIDAE (Old World orioles and figbirds): three species in two genera in Aust., all breeding;

ARTAMIDAE (woodswallows, butcherbirds and currawongs): 14 species in four genera in HANZAB region, all breeding;

PARADISAEIDAE (birds of paradise): five breeding species in two genera in Aust.;

CORVIDAE (crows and jays): six breeding species in single genus in Aust. and NZ, including one introduced to NZ;

CORCORACIDAE (Aust. mudnesters): two species in two monospecific genera, endemic to Aust.;

CALLAEIDAE (NZ wattlebirds): three species (one extinct) in three monospecific genera, endemic to NZ;

LANIIDAE (shrikes): two species in HANZAB region, one accidental to Prince Edward Is, the other accidental to Christmas I.;

PTILONORHYNCHIDAE (bowerbirds): ten species in seven genera in Aust. (nine species) and NZ (one species), all breeding; Piopio of NZ probably extinct (Heather & Robertson 1997);

ALAUDIDAE (larks): two breeding species in HANZAB region (including one successfully introduced to Aust. and NZ);

MOTACILLIDAE (wagtails and pipits): eight species in two genera in HANZAB region, only two breeding (one on South Georgia), the rest non-breeding visitors or accidentals;

PRUNELLIDAE (accentors): one species successfully introduced to NZ;

PASSERIDAE (Old World sparrows and A'asian finches): 22 species in nine genera (including four successful introductions) in HANZAB region, all breeding;

FRINGILLIDAE (Old World finches): seven species in four genera in HANZAB region, all introduced except one naturally occurring vagrant to South Georgia;

EMBERIZIDAE (buntings, cardinals, tanagers and allies): two successfully introduced species, occurring NZ and Lord Howe I.;

NECTARINIIDAE (sunbirds and spiderhunters): single breeding species in Aust.;

DICAEIDAE (flowerpeckers): single breeding species in Aust.;

HIRUNDINIDAE (swallows and martins): eight species in four genera in HANZAB region, including four breeding species in Aust. and NZ, one non-breeding visitor and three accidentals;

PYCNONOTIDAE (bulbuls): one successfully introduced species in Aust.;

SYLVIIDAE (Old World warblers): 13 species in eight genera in HANZAB region, including ten breeding species (one extinct) in Aust. and NZ, and three accidental to region;

ZOSTEROPIDAE (white-eyes): seven species (one extinct) in single genus in HANZAB region, all breeding;

MUSCICAPIDAE (Old World flycatchers, thrushes and chats): eight species in six genera in HANZAB region, including five breeding species (two introduced), and four accidentals (including one on Prince Edward Is);

STURNIDAE (starlings and mynas): five species in four genera, four breeding in HANZAB region (including two species successfully introduced, and one species now extinct), and one accidental.

The Aust. oscines fall into two distinct clusters, each with at least three major supra-familial lineages (DAB): One cluster is the Passerida, comprising the Muscicapoidea (including true thrushes and allies), Sylvioidea (true warblers and babblers, and swallows, and others), and Passeroidea (including larks, pipits, sunbirds, flowerpeckers and all finches and their allies). The other cluster is the Corvida, which is centred on the Australo-Papuan region (though its origins are not certain) and which also comprises three main lineages: Menuroidea (lyrebirds, scrub-birds, treecreepers and bowerbirds), Meliphagoidea (A'asian wrens, pardalotes, acanthizid warblers, and honeyeaters), and Corvoidea (A'asian robins, logrunners, A'asian babblers, whipbirds and quail-thrushes, sitellas, whistlers, fantails and monarchs, birds of paradise, butcherbirds and woodswallows, cuckoo-shrikes, Old World orioles, crows and mudnesters).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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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 haploophone, 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.

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Traversia lyalli **Stephens Island Wren**

Traversia lyalli Rothschild, 1894, *Bull. Br. Orn. Club* 4: 10 — Stephens Island, Cook Strait, New Zealand.

The genus is named for Henry H. Travers (1844–1928), a New Zealand collector, explorer, and naturalist, who sent specimens of this Wren to Lord Rothschild. The species was named for David Lyall (1849–1911), assistant lighthouse-keeper on Stephens Island, who discovered the species and sent several specimens, which had been caught and brought back to the lighthouse by a Cat, to Travers.

OTHER ENGLISH NAMES Stephen Island or Stephens Wren; Stephens Island Flightless Wren.

MONOTYPIC

EXTINCT Based on contribution by R.A. Galbreath. Endemic to NZ but extinct since shortly after its discovery in 1894, and virtually unknown. First recorded Stephens I., Cook Str. (not Stewart I. as reported in Sibley & Monroe [1990]), when a Cat began to catch and bring in birds. One of the lighthouse-keepers, David Lyall, recognized the Wren as unusual, and saved the corpses. All the specimens preserved (fewer than 20, 13 of which now traceable) were evidently obtained in

this way, mainly during winter 1894. Careful searches by H.H. Travers in Feb. 1895 and subsequently did not locate any more Wrens (Millener 1989; Oliver; NZCL; R.A. Galbreath). Population on Stephens I. was a relict of a much more widespread species: subfossil records show that the species was formerly found in NI and SI, with records from King Country in NI, and from nw. Nelson S to Fiordland in SI (Millener 1989; NZCL).

Often said to have become extinct through predation by the single lighthouse-keeper's Cat (Hutton & Drummond 1904; Moncrieff 1938; Halliday 1978; Fuller 1987; Gill & Martinson 1991; Oliver), perhaps combined with collecting for museum specimens (Millener 1989; NZCL). However, general predation by feral Cats more likely, as Cats were already multiplying on the island, and some other vulnerable species were declining (Buller 1905; Medway 1972); and there is no evidence of formal collecting having occurred. Decline possibly also linked with modification of habitat by clearance and stock (R.A. Galbreath).

Two sightings of live birds reported by Lyall are the basis of the few published observations: that the Wren was seen among rocks, was crepuscular or nocturnal, and did not fly, but ran 'like a mouse and very fast' (Buller 1895, 1905; Rothschild 1895). Flightlessness also indicated by reduced wings, loose plumage and almost acarinate sternum (Millener 1989). Suggested that 'probably ground feeders taking, largely, leaf-litter invertebrates' (Millener & Worthy 1991). No information on movements, food, social organization, social behaviour, voice or breeding.

PLUMAGES Prepared by J.S. Matthew. Nothing known about life history and moult cycles. Sexes alike. Plumage description based on two skins, labelled as adult male and adult female (CM).

Adult Plumage of body has loose shaggy appearance. HEAD AND NECK: Forehead, crown, nape and hindneck, dark brown (119A) with distinct short yellowish-brown (c123B) streaking or mottling that grades to buff (124) on anterior forehead; feathers, dark brown (119A) with yellow-brown (c123B) tips and off-white (ne) shafts. Sides of neck, dark brown (119A) with bold yellowish-brown (123C) or buff (124) mottling. Lores, buff (124) anteriorly, becoming brownish (c28) to rear. Eye-ring, cream (c54). Supercilium indistinct, yellowish brown (c123B), extending to just behind eye. Ear-coverts, dark brown (c119A) with buff (124) tips and off-white (ne) shaft-streaks. Malar area, chin, throat and foreneck, deep buff-yellow (c53) with narrow dark-brown (119A) fringes and concealed dark-grey (83) bases to feathers. Several short buff (124) feathers protrude from lower lores, each feather ending in black (89) bifurcate bristle. UPPERPARTS: Mantle, back, scapulars, rump and uppertail-coverts, dark brown (119A) with bold buff (124) mottling; feathers, dark brown (119A) grading to buff (124) in centre near tip, with off-white (ne) shafts and narrow dark-brown (119A) fringes at tips. All feathers of upperparts have concealed dark-grey (83) bases. UNDERPARTS: Breast, belly and flanks, buff-yellow (53) with dark-brown (119A) scalloping or mottling; feathers, dark brown (119A) with broad buff-yellow (53) fringes. Feathers of thighs, light brown (26). Axillaries, light grey-brown (119C). All feathers of underparts have concealed dark-grey (83) bases. TAIL: Upper surface of rectrices, dark brown (119A) with light-brown (39) fringe. Shaft, brown (928), becoming off-white (ne) basally. Under surface similar to upper. UPPERWING: Marginal secondary coverts, all median and greater coverts, and feathers of alula, brown (28) grading to buff-yellow (53) in centre near tip. Marginal primary coverts mainly pale yellow (c157). Remiges, brown (28), becoming light brown (c26) at tips and at edges of outer webs. Shaft of remiges, light cinnamon-brown (25). UNDERWING: All marginal coverts, buff-yellow (53) or pale yellow (c157), grading to brown (28) towards base. All median and greater coverts, dark brownish grey (c79) with off-white fringes. Remiges, dark brownish grey (c79), becoming light brown (28) at tip and at edge of outer web.

BARE PARTS Little known. Adult said to have dark brown bill, with paler lower mandible; and pale-brown feet (Oliver, compiled from Buller 1895).

MOULTS Nothing known.

MEASUREMENTS (1) Stephen I., single adult male and female skins (CM), sexed using labels, which may not be accurate (R.A. Galbreath).

		MALE	FEMALE
WING	(1)	50	47
TAIL	(1)	18	–
BILL	(1)	19.0	18.7
TARSUS	(1)	20.5	20.3

STRUCTURE Wing fairly short; on folded wing, tip of longest primary about level with tip of tail. Ten primaries; p6 and p7 longest, p10 13–16.5 mm shorter, p9 c. 7, p8 3.5–4.5, p5 0–0.5, p4 0–0.5, p3 0.5–1.0, p1 and p2 c. 1 mm. Slight emargination to outer web of p6 and p7. Nine secondaries, including three tertials; tip of longest tertial does not reach tip of p1 on folded wing. Tail very short, slightly rounded at tip; apparently ten rectrices; t1–t5 similar length. Bill moderately long, slightly shorter than length of head; upper mandible slightly downcurved; lower mandible fairly straight, inclined slightly upward at gonys; tip of upper mandible slightly overhangs tip of lower. Nostrils occupy about one-third of length of exposed culmen. Tarsus long; scaling, non-bilaminate, single large scale with indistinct notches along anterior surface, no division between posterior and anterior surface. Middle toe longest, 18.5–19.7 mm (including claw); inner and outer front toes 80–85% length of middle front; hindtoe almost as long as middle front toe.

AGEING, SEXING Nothing known.

GEOGRAPHICAL VARIATION None known.

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Sponsor: 'Patch'