

## Order PASSERIFORMES

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

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

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

The Passeriformes divide into two main groups:

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

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



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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

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



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

## 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 SYLVIIDAE Old World warblers, Old World babblers and allies

A very large and morphologically highly diverse family of very small to medium-sized passerines. The family, as defined here (see below), comprises c. 680 species in c. 119 genera, distributed throughout Africa, the Middle East, Eurasia, including the Indian subcontinent, Japan, Indonesia and the Philippines, Papuan Region, A'asia and islands of the w. Pacific Ocean; one species, Arctic Warbler *Phylloscopus borealis*, breeds in far nw. N. America and this and Dusky Warbler *P. fuscatus* occur as non-breeding vagrants to w. N. America (Sibley & Monroe 1990; Monroe & Sibley 1993; AOU 1998; Peters; DAB). The taxonomy of the family is highly complex and unsettled. Taxonomic history is discussed in detail in Sibley & Ahlquist (1990), and there are varying opinions concerning its composition. Sharpe (1879) was among the earliest workers to suggest affinities with true thrushes, and he included Old World warblers as a subfamily Sylviinae within the Turdidae. This was later followed by Hartert (1910), who placed Old World warblers, Old World flycatchers, monarch flycatchers, Old World babblers and true thrushes in one huge family, Muscicapidae. Later authors (Mayr & Amadon 1951; Mayr & Greenway 1956) included Hartert's groups, as well as some species and genera now known to be part of Australo-Papuan centred Meliphagoidea and Corvoidea superfamilies, into the family Muscicapidae. Beecher (1953) treated bulbuls, cisticolas, fairy-wrens, Old World flycatchers and Old World warblers as subfamilies or tribes in Sylviidae. Later, Old World babblers and laughing-thrushes were combined, along with true thrushes, Old World warblers and some Australo-Papuan corvid genera, in the family Muscicapidae, and the rest of the Old World warblers placed in the family Sylviidae (Peters: see introduction to Vol. 11 for discussion of that treatment). Molecular studies (see below) have now shown these various taxonomic arrangements to be largely incorrect from an evolutionary standpoint (this was pre-empted by Peters). Sibley (1970) found close affinities between Old World warblers and Old World babblers based on electrophoresis of egg-white proteins, but that they were not closely related to true thrushes and Old World flycatchers (see introduction to Family Muscicapidae in this volume for further discussion). Sibley & Monroe (1990) and Monroe & Sibley (1993) used DNA-DNA hybridization data (Sibley *et al.* 1988; Sibley & Ahlquist 1990) to split the Old World warblers (superfamily Sylvioidea) into three families: Regulidae (kinglets and goldcrests *Regulus*), from the Americas and Eurasia; Cisticolidae (cisticolas and African warblers); and Sylviidae, which includes the subfamilies listed below. Some authors include kinglets and goldcrests (*Regulus*) within the Sylviidae (Baker 1997; Peters).

Here, we follow the treatment of Sibley & Monroe (1990) and Monroe & Sibley (1993) except that we include the cisticolas as a subfamily within the Sylviidae (pending further revisions [see below]). The following subfamilies are recognized:

**ACROCEPHALINAE:** Comprising 223 species, in 36 genera; major genera include *Acrocephalus*, *Cettia*, *Bradypterus*, *Locustella*, *Hippolais*, *Eremomela*, *Phylloscopus*. Four species, in two genera (*Acrocephalus*, *Phylloscopus*), recorded in HANZAB region (see below).

**CISTICOLINAE** (cisticolas, prinias and allies): Comprising 120 species, in 17 genera. Two species of *Cisticola* recorded in HANZAB region (see below).

**MEGALURINAE** (grassbirds and allies): Comprising 22 species in ten genera, distributed in Africa, Asia, Papuan Region and A'asia. Seven species, in four genera (*Megalurus*, *Bowdleria*, *Eremiornis*, *Cincloramphus*), in HANZAB region (see below).

**GARRULACINAE** (laughing-thrushes and allies): Comprising 54 species, in two genera, distributed across s. and se. Asia. Not recorded HANZAB region.

**SYLVIINAE** (Old World babblers, *Sylvia* warblers and allies): Comprising 261 species, in 54 genera, falling into three distinct tribes: (1) Timaliini (Old World babblers, parrotbills and allies), with 236 species in 51 genera, distributed across Africa, Middle East and Asia, with no species in HANZAB region; (2) Chamaeini (Wrentit *Chamaea fasciata*), consisting of a single monotypic genus, occurring in w. USA and nw. Baja California; and (3) Sylviini (*Sylvia* warblers), with 24 species in one genus, occurring in Europe, Middle East, Africa and Asia, though with only one species in se. Asia (Lesser Whitethroat *S. curruca*, which vagrant in Thailand [Robson 2000]). No species recorded naturally in HANZAB region (but three species introduced unsuccessfully; see below).

Recent studies of mitochondrial DNA-sequences (Leisler *et al.* 1997; Helbig & Seibold 1999) and a combination of nuclear and mitochondrial DNA-sequences (Alström *et al.* In press) have shed further light on the evolutionary relationships between many of the taxa mentioned above. These studies all confirm the close relationship between *Acrocephalus*, *Chloropeta* and *Hippolais*; and Leisler *et al.* (1997) indicate that cisticolas lie between reed-warblers and *Phylloscopus* warblers (cf. Sibley & Ahlquist [1990] who place them outside the Old World warblers). The work of Alström *et al.* (In press) provides further insight into the phylogeny of the superfamily Sylvioidea and their data indicate the following: (1) a number of subfamilies, such as Acrocephalinae, Cisticolinae and Megalurinae, may be elevated to family status; (2) *Phylloscopus* is not monophyletic, and, along with *Seicercus*,



form the family Phylloscopidae; and (3) confirm the close relationship between Old World babblers, *Sylvia* warblers and laughing-thrushes, as well as white-eyes *Zosterops*, which together they place in the family Timaliidae. However, in this work we follow Christidis & Boles (1994) and DAB in maintaining *Acrocephalus*, *Cisticola*, *Megalurus* and *Phylloscopus* in Sylviidae, and white-eyes in Zosteropidae, but recognizing that this will almost certainly change.

Overall, 13 species, in seven genera, acceptably recorded within HANZAB region: two species of grassbirds *Megalurus* (Tawny *M. timoriensis* and Little *M. gramineus* Grassbirds); two species of fernbirds *Bowdleria* (Fernbird *B. punctata* and extinct Chatham Island Fernbird *B. rufescens*); monotypic *Eremiornis* (Spinifexbird *E. carteri*); two species of songlarks *Cincloramphus* (Rufous *C. mathewsi* and Brown *C. cruralis* Songlarks); two species of cisticolas *Cisticola* (Zitting *C. juncidis* and Golden-headed *C. exilis* Cisticolas); two species of reed-warblers *Acrocephalus* (Australian *A. australis* and Oriental *A. orientalis* Reed-Warblers, latter non-breeding migrant to Aust.); and two species of *Phylloscopus* (Arctic Warbler accidental to Aust., and Willow Warbler *P. trochilus* accidental to Prince Edward Is; see species accounts). In addition, Gray's Grasshopper Warbler *Locustella fasciolata* unacceptably reported for Aust. (see species account); and a further three species of Sylviinae (Sylvini) unsuccessfully introduced to Aust. and NZ: (1) RED-BILLED LEIOTHRIX *Leiothrix lutea*: Probably released in WA before 1912 but did not become established; (2) WHITETHROAT *Sylvia communis*: Two birds released Auckland, NI, in 1868 but not seen after release; attempted import in 1874 failed when birds died on passage to NZ; and (3) BLACKCAP *S. atricapilla*: Five birds released Auckland, NI, in 1872, but no further information (Thomson 1922; Long 1981).

The following discusses species in the subfamilies Acrocephalinae and Megalurinae, the tribe Sylviini within the subfamily Sylviinae and the Cisticolinae (see above). We do not discuss further laughing-thrushes and allies (subfamily Garrulacinae), and Old World babblers (tribe Timaliini) or Wrenit (tribe Chamaeini) in the Sylviinae; nor do we discuss further Regulidae, which some authors include in Sylviidae (see above). See Fry *et al.* (2000) for general discussion on Old World babblers, and Sibley & Ahlquist (1982) for discussion of Wrenit.

The family (excluding Garrulacinae, Old World Babblers, Wrenit and Regulidae) has the following characteristics (summarized largely from Baker [1997], Urban *et al.* [1997], BWP and DAB). Size varies from tiny (e.g. Tiny *Cisticola* *Cisticola nanus*: total length c. 9 cm, weight c. 5 g) or very small (e.g. Pallas's Leaf-Warbler *Phylloscopus proregulus*: total length 9 cm, weight c. 6 g), to medium-sized (e.g. Brown Songlark: total length 23 cm, weight 70 g [males]). Wings vary from short and rounded at tips in some (e.g. *Megalurus*, *Cisticola*) to rather long and pointed at tips (e.g. some *Phylloscopus*, *Sylvia*). Ten primaries; p10 usually rather short or very short. Nine secondaries, including three tertials. Tail varies from very short and slightly rounded at tip (e.g. *Tesia*, *Sylvietta*) to long with rather square tip (e.g. *Sylvia*, *Hippolais*) or very long and graduated at tip (e.g. *Megalurus*, *Locustella*, *Prinia*); most species have 12 rectrices, but some (e.g. *Tesia*, *Seicercus*, *Malcorus*, *Prinia*, *Abroscopus*) have only ten; number of rectrices can vary within genus and even species (e.g. Cinnamon Bracken-Warbler *Bradypterus cinnamomeus* which have 10 or 12). Some species (e.g. *Sylvietta*, Spinifexbird) have elongated tail-coverts. Bill usually rather short, straight and slender, but fairly long and more robust in some (e.g. *Acrocephalus*, *Hippolais*), rather long and more decurved in others (e.g. *Orthotomus*) or occasionally rather broad and slightly flattened (e.g. *Seicercus*); some even have small hook at tip of bill (e.g. longbills *Macrosphenus*). Bill said to lack tomial notch near tip of maxilla, but this present in some species (e.g. Brown Songlark). Nostrils rounded and operculate. Rictal and nasal bristles present; usually very short or vestigial, but more prominent in some species (e.g. *Acrocephalus*). Tongue slender with blade-like tip in some species (Beecher 1953); in some species (e.g. *Sylvia*, *Phylloscopus*) adapted for taking nectar or insects from flowers. Legs and feet usually rather short and weak, but longer and stronger in some (e.g. *Tesia*, *Locustella*, *Acrocephalus*). Some (e.g. *Acrocephalus*) have rather long hindtoe and hindclaw. Tarsal scaling laminiplantar in most species but said to be holothecal in some (BWP). Skull rather narrow. Ectethmoid plate usually truncate, but winged in cisticolas; species in the grassbird assemblage (Megalurinae) have thin ectethmoid plate. Ectethmoid foramen usually a single slit. Lachrymal fused. Tips to maxillo-palatine processes usually thickened and furrowed, but often differ in shape (e.g. clavate and flattened in grassbirds; subulate in cisticolas). Tip of vomer usually shortly acute (flat-tipped in cisticolas). Temporal fossae narrow and flanked by well-developed post-orbital and zygomatic processes. Humerus has two pneumatic fossae, but second fossa only weakly developed (Bock 1962).

Following plumage and moult characteristics shared by the family (summarized from Baker [1997], Urban *et al.* [1997], BWP and DAB). Colour and markings of plumage vary greatly; most species have rather dull and sombre plumage comprising brown, grey, olive, dull-green or yellow tones, but others, especially African and Asian genera (e.g. *Seicercus*, *Apalis*, *Abroscopus*, *Orthotomus*, *Sylvietta*), have brighter plumage, with rich yellows, greens and rufous; *Hyltiota* have dark-bluish or purplish upperparts. Markings also vary considerably; many (e.g. *Acrocephalus*, *Prinia*, *Cettia*, *Phylloscopus*, *Bradypterus*, *Megalurus*) have white or yellow supercilia; some also have other facial markings such as crown-stripes and dark eye-stripes (e.g. *Phylloscopus*, some *Acrocephalus*), blackish or rufous caps, facial masks or hoods (some *Apalis*, *Orthotomus*, *Eremomela*, *Bathmocercus*) or moustachial stripes (some *Sylvia*, *Phylloscopus*, *Apalis*). Some have distinct white tips or outer edges to tail (e.g. *Sylvia*, *Acrocephalus*, *Prinia*, *Cisticola*). Some species (e.g. *Megalurus*, *Cisticola*) have blackish streaking on head and body. Sexes usually similar, but some



(e.g. *Cisticola*, *Apalis*, *Sylvia*, *Hyltiota*) show obvious plumage-dimorphism. In adults, males tend to be slightly larger than females. Juveniles usually duller than adult, and unspotted. Nestlings usually naked, but some (e.g. *cisticolas*) develop fine, sparse down. Nestlings usually have 2–3 black spots on tongue; nestlings of songlarks also have black markings on tip of one or both mandibles, and nestling Brown Songlark also has much black on palate (Maclean & Vernon 1976). Fledge in juvenile plumage. Moulting strategies vary considerably, even within species. Most species undergo a partial post-juvenile (first pre-basic) moult to adult-like first immature (first basic) plumage, usually starting when 1–2 months old; this usually does not involve remiges, greater primary coverts or rectrices. Some (e.g. some *Acrocephalus*, *Sylvia* and *cisticolas*) undergo a complete or nearly complete post-juvenile moult; in some species (e.g. Zitting *Cisticola* in n. hemisphere), birds that hatch early undergo a complete post-juvenile moult to adult plumage, but late-hatched birds undergo a partial post-juvenile moult to first immature plumage. Moulting strategies often complex and vary considerably between species, and often related to migratory movements and date of hatching. Most species undergo a complete adult post-breeding (pre-basic) moult on or near breeding grounds each year, but some species, particularly long-distance migrants (e.g. some *Phylloscopus* and *Acrocephalus*), start complete post-breeding (pre-basic) moult on or near breeding grounds, then suspend moult for s. migration and finish moult on wintering grounds. Many species also undergo a partial pre-breeding (pre-alternate) moult, usually not involving remiges, greater primary coverts, alula and rectrices. A few species (e.g. Aquatic Warbler *Acrocephalus paludicola*) undergo only a partial post-breeding (pre-basic) moult, suspending moult of remiges during s. migration, and not finishing moult of remiges till complete pre-breeding (pre-alternate) moult on wintering grounds. Some species (e.g. some *Acrocephalus*, *Hippolais* and *Locustella*) undergo a partial post-breeding moult that includes outer primaries on breeding grounds, suspend moult for s. migration, then perform a complete pre-breeding (pre-alternate) moult in wintering grounds; these birds therefore moult outer primaries twice each year. Primaries moult outward, usually starting at p1, but sometimes starting with outer primaries in those species undergoing partial post-breeding moult; a few species (e.g. Savi's Warbler *Locustella luscinioides*) undergo outward and inward moult of primaries, starting at about p4. Secondaries usually moult inward, but sequence can vary individually; usually starting when moult of primaries about halfway through. Moult of tail centrifugal. Moult of tail and body usually start about same time as primaries.

Found in wide variety of habitats, but often in dense low vegetation, and many species closely associated with water in both aquatic and riparian associations, including swamps, marshlands, freshwater meadows and the like. Commonly in grasslands, sedgeland or rushlands, including pasture or cropland; also often in dense understorey of woodlands and forests, including riparian or gallery associations; and in more open habitats, such as sparse or arid shrublands. Some species strongly associated with open woodlands or forests, particularly where bordering open country or clearings (e.g. Rufous Songlark in Aust.) (de Schauensee 1984; Urban *et al.* 1997; Grimmett *et al.* 1999; Robson 2000; Shirihai *et al.* 2001; see species accounts).

Range from sedentary or resident to migratory, with proportion of migratory species increasing with increasing latitude. Most n. Eurasian breeding species migratory (e.g. *Hippolais* warblers), while African and s. Asian breeding species tend to be sedentary or resident with minor local or altitudinal movements (e.g. *Bradypterus* warblers, prinias). Reed-warblers *Acrocephalus* and grasshopper-warblers *Locustella* highly migratory, though some African breeding reed-warblers are resident (e.g. Lesser Swamp-Warbler *A. gracilirostris*), and Clamorous Reed-Warbler *A. stentoreus* is resident in e. Mediterranean, Indonesia and New Guinea, but partly migratory in central Asia and the Middle East; *Phylloscopus* and *Sylvia* warblers tend to be migratory (e.g. Pallas's Leaf-Warbler, Garden Warbler *S. borin*), or partly migratory (e.g. Chinese Leaf-Warbler *P. sichuanensis*, Sardinian Warbler *S. melanocephala*), with some altitudinal migrants (e.g. Smoky Warbler *P. fulgiventis*), and breeding residents in Africa (e.g. Laura's Woodland-Warbler *P. laurae*); tesian *Tesia* are local altitudinal migrants (e.g. Chestnut-headed *Tesia T. castaneocoronata*); and grassbirds *Megalurus* and *Graminicola*, *cisticolas Cisticola*, prinias *Prinia* and tailorbirds *Orthotomus* largely sedentary or resident (e.g. Golden-headed *Cisticola*, Graceful Warbler *P. gracilis*, Common Tailorbird *O. sutorius*), with a few species known to undertake local movements; Zitting *Cisticola*, especially juveniles, dispersive and occasionally irruptive in parts of range, and cross Mediterranean from Europe to n. Morocco. Interpretation of movement patterns of some species complicated by marked seasonal changes in conspicuousness (e.g. Little and Tawny Grassbirds) (de Schauensee 1984; Urban *et al.* 1997; Grimmett *et al.* 1999; Robson 2000; Shirihai *et al.* 2001; BWP; see species accounts).

Primarily insectivorous. Mainly take invertebrates, predominantly insects, though many species also eat small fruits and seeds, and some take nectar or other vegetable matter; some occasionally eat small vertebrates (e.g. small frogs, lizards, fish fry). Mainly arboreal, foraging in trees and shrubs, though many species also feed to varying degree on ground, and some also take food from surface of water or just below surface. Most prey gleaned from vegetation (usually foliage but also twigs and branches), usually while perching, or occasionally while hanging upside-down or hovering. Some species also take flying prey from air, usually by sally-striking, sometimes by leaping between branches or, rarely, by snatching prey while perched. Some probe flowers for nectar, insects or parts of flowers; and morphology of bill, tongue and oral cavity of some species adapted for this purpose. Usually search through vegetation by hopping or making short flights between branches, sometimes inspecting substrates slowly or



meticulously. When foraging on ground, walk, hop or run, and pause to glean or probe from ground or to glean from low vegetation, or sometimes leap to pounce on active prey. Usually forage solitarily during non-breeding season, though some may join mixed-species foraging flocks (Urban *et al.* 1997; BWP).

Most species typically seen singly or in pairs throughout year, but some more usually in small groups (e.g. eremomelas *Eremomela*). Some join mixed-species flocks in non-breeding season. Most species monogamous, but some polygynous. Co-operative breeding occurs in eremomelas *Eremomela*. In most species, incubation by female only. In many species, both parents feed nestlings and fledgelings, and helpers also feed young in co-operatively breeding species; in some species, only female feeds young. Most species nest solitarily and are territorial. Usually roost solitarily when not breeding. Social behaviour of most species not well known. Many species skulk within vegetation, making observation difficult, and vocalizations often the only indication of their presence (e.g. reed-warblers *Acrocephalus*, bush-warblers *Cettia* and *Bradypterus* and tailorbirds *Orthotomus*). Some species of open habitats more conspicuous (e.g. eremomelas *Eremomela* and crombecs *Sylvietta*). Most scratch head indirectly, but Eurasian Reed-Warbler *Acrocephalus scirpaceus* uses direct method. Usually bathe by standing in shallow water, but also bathe in wet foliage. Apparent dust-bathing reported in a few species. In many species, males perform aerial flight-displays, often accompanied by songs or noise of wings (Smythies 1981; Skutch 1987; Coates 1990; Urban *et al.* 1997; BWP).

Vocalizations vary greatly; for example, some produce insect-like buzzing (e.g. Zitting Cisticola), some almost mechanical sounds (e.g. River Warbler *Locustella fluviatilis*), and others produce sweet liquid notes (e.g. Marsh Warbler *Acrocephalus palustris*). Many species have well-developed songs that are often loud and far-carrying. Usually sing most often in breeding season, and song thought to be used both in mate attraction and territorial defence. Some species rather quiet in non-breeding season (Smythies 1981; Urban *et al.* 1997; BWP; see species accounts).

Most species solitary and monogamous, but some polygynous; most *Eremomela* breed co-operatively (see above). Most species nest close to ground (or surface of water) in dense, low vegetation (e.g. in tussocks of grass, clumps of reeds or sedges, or among brambles), or low down in shrubs or trees; *Phylloscopus* habitually nest on ground, or in holes or crevices. Structure of nests varies greatly; generally either cup-shaped or domed with side entrance, but sometimes partly domed (e.g. Moustached Warbler *Acrocephalus melanopogon*, Cricket Warbler *Spiloptila clamans*, Yellow-breasted Apalis *Apalis flavida*), purse or bag-shaped (e.g. *Schistolais*, *Sylvietta*, *Phyllolais*, some *Apalis* species), or occasionally pear or bottle-shaped (e.g. some cisticolas, White-tailed Warbler *Poliolais lopesi*). Nests typically made of grass, leaves and plant stems, and sometimes other material, such as plant down, moss, lichen, roots, bark or twigs; material sometimes bound together with spider web; and nests usually lined with fine grass, hair, feathers, plant down, rootlets or other fine fibres. Nests built by both sexes, or sometimes by female only; helpers may assist in *Eremomela*. Eggs varyingly oval to sub-elliptical; smooth; usually glossy, sometimes slightly glossy or lustreless. Ground-colour often pale, varying from white or shades of white (e.g. dull white, or pinkish, greenish, bluish or greyish white) to shades of buff, pink, green, blue or grey, or occasionally red, brown or olive. Eggs usually spotted or blotched with shades of brown, grey, red, black, green, mauve or purple; markings sometimes more concentrated at, or form ring or cap round large end. Eggs also occasionally unmarked. Clutch-size usually 2–4 in tropics and 3–4 to 5–6 in more temperate regions, but some variation. Eggs laid on consecutive days. Incubation by both sexes, though often mainly by female, or by female only; helpers may assist in *Eremomela*. Incubation period usually between 11–12 and 16–17 days in most species, but varies from <10 to >20 days. Nestlings usually fed and brooded by both sexes, though brooding often mainly by female and, in some species, brooding and occasionally feeding by female only; helpers may assist parents with feeding, and possibly brooding, in some species (e.g. eremomelas, Banded Prinia *Prinia bairdii*). Fledging period between 10–11 and 16–17 days in most species. In some species, young fledge before capable of flight. Fledgelings usually fed by both parents; brood-division can occur in some species, and fledgelings may also be fed by helpers in *Eremomela*. Young usually dependent on adults for 1–3 weeks after fledging, occasionally longer (up to 1 month or more). Many species rear 2–3 broods per season (Urban *et al.* 1997; BWP).

Within the components of this large family we discuss here, many species globally threatened. Two species extinct in wild, including Chatham Island Fernbird of HANZAB region (see species account); the other, Aldabra Warbler *Nesillas aldabrana*, was confined to the Seychelles and only discovered in 1967 (and last recorded in 1983). Three species considered critically endangered: Taita Apalis *Apalis fuscigularis* of Kenya, Long-billed Tailorbird *A. moreaui* of Tanzania and Mozambique, and Millerbird *Acrocephalus familiaris* of Hawaii. A further eleven species are endangered, and 26 considered vulnerable (Stattersfield & Capper 2000; BirdLife International Species Factsheets, available at <http://www.birdlife.org/datazone/species/index.html> [accessed Sept. 2005]).

#### REFERENCES

- Alström, P., *et al.* In press. *Mol. Phylogenetic. Evol.*  
 Baker, K. 1997. *Warblers of Europe, Asia and North Africa*. Christopher Helm, London.  
 Beecher, W.J. 1953. *Auk* 70: 270–333.  
 Bock, W.J. 1962. *Auk* 79: 425–43.  
 Christidis, L., & W.E. Boles. 1994. *RAOU Monogr.* 2.  
 Coates, B.J. 1990. *The Birds of Papua New Guinea*. 2. Dove Pubs, Alderley, Qld.  
 de Schauensee, R.M. 1984. *The Birds of China*. OUP, Oxford.



1600 Sylviidae

- Fry, C.H., et al. (Eds) 2000. *Birds of Africa*. 6. Academic Press, London.
- Grimmett, R., et al. 1999. *A Guide to the Birds of India, Pakistan, Nepal, Bangladesh, Bhutan, Sri Lanka and The Maldives*. Princeton Univ., Princeton, NJ.
- Hartert, E. 1910. *Die Vögel der Paläarktischen Fauna*. R. Friedlander, Berlin.
- Helbig, A.J., & I. Seibold. 1999. *Mol. Phylogenet. Evol.* 11: 246–60.
- Leisler, B., et al. 1997. *J. Orn., Lpz.* 138: 469–96.
- Long, J.L. 1981. *Introduced Birds of the World*. Reed, Sydney.
- Maclean, G.L., & C.J. Vernon. 1976. *Ostrich* 47: 95–8.
- Mayr, E., & D. Amadon. 1951. *Am. Mus. Novit.* 1496: 1–42.
- , & J.C. Greenway, Jr. 1956. *Breviora* 58: 1–11.
- Monroe, B.L., Jr., & C.G. Sibley. 1993. *A World Checklist of Birds*. Yale Univ. Press, New Haven, CT.
- Robson, C. 2000. *A Field Guide to the Birds of South East Asia*. New Holland, London.
- Sharpe, R.B. 1879. *Catalogue of the Birds in the British Museum*. 4. *Cichlomorphae (Part 1)*. Br. Mus. Nat. Hist., London.
- Shirihai, H., et al. 2001. *Sylvia Warblers*. Christopher Helm, London.
- Sibley, C.G. 1970. *Bull. Yale Peabody Mus. Nat. Hist.* 32: 1–131.
- , & J.E. Ahlquist. 1982. *Condor* 84: 40–4.
- , ——— 1990. *Phylogeny and Classification of Birds*. Yale Univ. Press, New Haven, CT.
- , & B.L. Monroe, Jr. 1990. *Distribution and Taxonomy of Birds of the World*. Yale Univ. Press, New Haven, CT.
- , et al. 1988. *Auk* 105: 409–23.
- Skutch, A.F. 1987. *Helpers at Birds' Nests*. Univ. Iowa Press, Iowa City, IA.
- Smythies, B.E. 1981. *The Birds of Borneo*. Third edn. Sabah Soc. and Malayan Nat. Soc., Kuala Lumpur.
- Stattersfield, A.J., & D.R. Capper. (Eds) 2000. *Threatened Birds of the World*. Lynx Edicions, Barcelona, and BirdLife International, Cambridge, UK.
- Thomson, G.M. 1922. *The Naturalisation of Animals and Plants in New Zealand*. Cambridge Univ. Press, Cambridge.
- Urban, E.K., et al. (Eds) 1997. *The Birds of Africa*. 5. Academic Press, London.



## *Bowdleria punctata* Fernbird

COLOUR PLATE FACING PAGE 1720

*Synallaxis punctata* Quoy & Gaimard, 1830, *Voy. Astrolabe, Zool.* 1: 255 — Tasman Bay, South Island, New Zealand.

The genus is named after Richard Bowdler Sharpe (1847–1909), English ornithologist at the British Museum (Natural History) 1872–1909 and author. This warbler is heavily streaked above and on the flanks (from Latin *punctatus*, spotted).

**OTHER ENGLISH NAMES** Codfish Island, North Island, Snares Island, South Island, Stewart Island or Tawny Fernbird; Swamp Sparrow or Swamp Thrush, Grassbird, Utick.

**MAORI NAME** Matata.

**POLYTYPIC** Nominate *punctata*, SI, NZ; *vealeae* Kemp, 1912, NI, NZ; *stewartiana* Oliver, 1930, Stewart I., NZ; *wilsoni* Stead, 1936, Codfish I., NZ; *caudata* (Buller, 1894), Snares Is, NZ.

**FIELD IDENTIFICATION** Length, c. 12 cm; wingspan unknown; weight 30 g. Only Old World warbler extant in NZ. Medium-small, thickset and skulking warbler with very long tail, fairly short, stout and slightly decurved bill which runs straight into forehead, and rather flat crown; rounded underbody, which very blunt and angular posteriorly; wings short, fall just short of tips of uppertail-coverts; tertials short, falling well short of tips of secondaries; tail very long, almost length of body (if not very worn), very narrow with very pointed tip when closed, tip spiky when spread; individual feathers become very worn and ragged-looking, giving quite tatty appearance to tail; at this time, barbs of feathers loose and give appearance of sticks or fern (hence common name); rather short but thick legs and long hindclaw. In flight (which seen infrequently), wings appear broad and rounded, legs often dangle down, and long tail trails loosely and drooping down.

Much larger and more thickset than Grey Warbler *Gerygone igata*, with much longer tail. Adults brownish above and paler below, with pale supercilium and dark eye-stripe, and in most subspecies, heavily streaked blackish-brown above and below; subspecies *caudata* of Snares Is has little streaking above. Sexes alike. No seasonal variation. Only juveniles of one subspecies known; these similar to adults but without rufous crown and with more diffuse streaking. Immature unknown. Marked geographical variation; five subspecies differing mainly in ground-colour and extent of streaking of upperparts and underparts, and strength of supercilium and eye-stripe; *caudata* of Snares Is quite different from other four subspecies, which all fairly similar. **NI, SI AND STEWART I.:** **Adult** Forehead uniform rufous, grading to rufous-brown, heavily streaked black-brown on crown, nape and hindneck, and to duller brown, strongly streaked blackish brown, on sides of neck. Dull pale-grey to



cream supercilium typically extends from just in front of eye to above ear-coverts, but in some extends narrowly from above lores, which appear dark grey-brown mottled white, and combines with diffuse blackish-brown line behind eyes and through upper ear-coverts to form diffuse dark eye-stripe. Cream eye-ring, broken in front of and behind eye by dark eye-stripe, merging with supercilium above eye, and forming pale arc below eye. Malar area and ear-coverts, dark brown to off-white, finely but boldly mottled black-brown. Upperbody strongly streaked, warm brown with slight rufous or yellowish tinge, broadly and heavily streaked black-brown. Uppertail, black-brown with yellowish-brown edges to feathers when fresh; with wear and abrasion, edges lost, ground-colour fades to dark brown and feathers become very ragged. Folded wing strongly streaked, as upperbody: appears warm brown or yellowish brown, heavily streaked black-brown; primaries and secondaries, dark brown, with very narrow buff-brown edges, appearing paler and plainer brown than tertiaries and coverts. Chin and throat, off-white to cream, mottled or finely streaked dark brown. Breast and belly, off-white to cream, grading to warm brown or yellowish brown on flanks, vent, undertail-coverts and, in some (especially on Stewart I.), sides of breast, and with bold black-brown streaking throughout except on lower belly and vent. Undertail, dark brown with light-brown edging to feathers. Underwing, buff with dark-brown mottling to primary coverts, and broad grey trailing edge across remiges, with buff edges of feathers. Bill varies: mostly blackish with pinkish-brown base to lower mandible, or mostly pinkish brown with blackish strip along ridge of upper mandible and tip. Iris, dark reddish-brown; orbital ring, grey. Legs and feet mostly dark grey with dull-pink rear tarsus and soles. **Juvenile** (Subspecies *vealeae* only; other subspecies unknown.) Very similar to adult, differing by: plumage softer and more loosely textured; top of head, hindneck and upperparts wholly brown, slightly richer on forehead (but lacking rufous colour) with slightly paler dark brown and less distinct streaking; coverts and tertiaries of folded wing tend to be paler and more yellowish brown; and mottling and streaking on chin, throat and underbody paler and more diffuse. At first (up to 2 weeks after fledging), gape, yellow; rest of bare parts undescribed and not known when adult coloration attained. Plumage, especially tail, less worn than adult at same time of year. **Immature** Undescribed. **CODFISH 1:** **Adult** Patterned much as adults from NI, SI and Stewart I., from which differs by: Streaking to top of head, neck, upperbody and folded wing much bolder and blacker, with deeper yellow-brown fringes to feathers of upperparts and upperwing; whitish supercilium clearer and slightly broader; lores and facial area more strongly mottled blackish with blackish eye-stripe broader and better defined; underbody deeper rufous-brown to yellowish brown throughout, with only centre of belly cream, and streaking to breast, most of belly and flanks bolder and broader. **Juvenile, Immature** Undescribed. **SNARES IS:** **Adult** Dullest subspecies; differences from adults on NI, SI, and Stewart I.: top of head, neck and upperbody, light brown with diffuse dark-brown streaking, which slightly stronger on upperbody than on top of head and neck, and very faint or absent on rump; uppertail uniformly light brown; folded wing appears mostly light brown, with only faint and diffuse dark-brown streaking, and with narrow light-brown edges to dark-brown tertiaries; and yellow-brown often extending from flanks to sides of breast and belly. **Juvenile, Immature** Undescribed.

**Similar species** None.

Usually occur singly or in pairs, and occasionally in small groups. Usually secretive and difficult to observe in dense vegetation, but sometimes inquisitive and may quickly peek at intruder from top or edge of vegetation before quickly disappearing back into undergrowth. Actively run up and down *Typha* leaves and fern stalks, taking short leaps, rather than

flying, between one piece of vegetation and another; use tail for support when climbing and foraging. Seldom leave dense cover, but when pressed, fly very low, just above vegetation, laboriously and for short distance (<50 m) with legs dangling and tail drooping. Forage within low vegetation and on ground; also known to explore petrel burrows for food. Run on ground like a mouse; sometimes work up tree-trunks like a treecreeper; when sifting through leaf-litter, turn leaves with strong legs and feet, not bill. Mainly detected by call, with most common call a low, sharp, mechanical double call *uu-tick* given by male, or in duet with female, male giving first syllable and female rapidly responding with second. Other calls rendered as *tchip* and *tcheong*, as well as a series of rapid clicks or chittering.

**HABITAT** Inhabit dense low vegetation (1–2 m tall) of reeds, ferns and shrubs, preferring associations with emergent shrubs or other vegetation to those of even height; and typically associated with freshwater and saline wetlands, including swamps, lagoons, river-flats, estuaries (including habitats inundated by high tides), bogs and poorly drained terraces and reverted peat swamps and peat domes (Best 1973, 1979b; Gray & Warburton 1974; Barlow 1983; Anderson & Ogden 2003; Oliver; CSN 19 Suppl., 38, 38; see below). Mainly recorded in dense shrubland, heathland and rushlands (often in seral succession) composed of varying combinations of shrubs, flax *Phormium*, ferns and reeds (sometimes loosely referred to as Pakihi heathland, shrubland or swamps), e.g. in lowlands, in pakihi swamps, an association of sedges and rushes, Pouched Coral Fern *Gleichenia dicarpa* and *Sphagnum* moss, and often stunted Manuka *Leptospermum scoparium*, growing on poorly to very poorly drained, partly cemented, podsolized soils of low to very low fertility. Also common in hillside and alpine shrublands and, less often, tussock grasslands with scattered shrubs and herbs (Moncrieff 1929; Hodgkins 1949; Weeks 1949; Gray & Warburton 1974; Best 1979b; Innes *et al.* 1982; Barlow 1983; Oliver; NZRD; CSN 19 Suppl.; see below). Uncommon in native forest on main islands, usually at edges (Best 1979b; see below) but more commonly inhabit forest on Codfish I. (Blackburn 1967; C.F.J. O'Donnell), and low Tree Daisy *Olearia lyallii* forest on Snares Is (C.M. Miskelly). On offshore islands, common in all habitats, including tussock grassland, shrubland and forest (Stead 1948; Blackburn 1967; Warham 1967; Best 1973; Miskelly *et al.* 2001; NZRD; CSN 24). Occasionally recorded in farmland (see below). Suggested that preference for habitats with emergent or uneven vegetation related to availability of elevated perches from which to advertise and defend territories (Best 1979b) or associated with nesting (Barlow 1983). On mainland NZ and offshore islands, occur from coasts to c. 1000 m asl, e.g. at L. Rotoaira, Turangi (Williams 1960; Gray & Warburton 1974; Wilson *et al.* 1988; Heather & Robertson 2000; CSN 19; see Distribution and Population), though confined to altitudes below c. 215 m asl in Fiordland (CSN 19 Suppl.); on Snares Is, occasionally forage in littoral zone (Best 1973).

**NI and SI** Mainly inhabit low, dense **SHRUBLAND, HEATHLAND** or **RUSHLAND** (commonly described as swamp, or simply as scrub, and including **PAKIHI** heathland), typically associated with freshwater and saline wetlands, comprising, and varying dominated by, combinations of reeds, rushes and sedges (such as *Juncus*, *Leptocarpus*, *Carex*, *Baumea* and *Typha*), flax *Phormium*, ferns (such as Bracken, Pouched Coral Fern, *Blechnum*, and tree-ferns *Cyathea*) and shrubs (commonly Manuka and *Coprosma*, but also Kamahi *Weinmannia racemosa*, *Cordyline*, *Muehlenbeckia*, *Pittosporum* and Broadleaf *Griselinia littoralis*) and sometimes *Sphagnum* moss or grasses (including *Poa* and *Danthonia*). Show strong preference for associations of uneven height with emergent shrubs or other vegetation, or with hummock form, than for those of even



height (McLean 1906; Stidolph 1925; Readman 1950; Penniket 1955; Roberts 1959; McKenzie & Sibson 1960, 1962; Best 1979b; Barlow 1983; Anderson & Ogden 2003; CSN; see above; also see descriptions of Kongahu Swamp and New R. Estuary, below); and seldom encountered at any distance into reed beds or shrubland of even height and lacking emergent shrubs or other vegetation (Best 1979b). In *KAITOKE WETLAND, GREAT BARRIER I., NI*, most abundant in: (1) open sedgeland dominated by *Baumea juncea*; and (2) sedge community dominated by umbrella ferns *Gleichenia dicarpa*; less often in (3) saltmarsh characterized by Marsh Ribbonwood *Plagianthus divaricatus* and *Oioi Leptocarpus similis*; and (4) permanent water with Cabbage Tree *Cordyline australis* and New Zealand Flax *Phormium tenax* over sedge; and occasionally in (5) permanent water with Raupo *Typha orientalis* and *Eleocharis sphacelata*; and (6) dry Manuka forest with an understorey of umbrella fern; seldom in (7) drained swamp bordering saltmarsh, comprising rank grasses with scattered Manuka (Anderson & Ogden 2003). In *KONGAHU SWAMP, W. NELSON, SI*, most abundant in: (1) dense reed beds of *Juncus*, 0.6–1.3 m tall, with scattered stunted Manuka, 1.2–2 m tall and 2–10 m apart, and ground-layer of dense Pouched Coral Fern and *Sphagnum*; and (2) shrubland comprising moderately to very dense stands of reeds *Juncus*, 0.6–1.4 m tall, shrubs (*Coprosma* and *Kamahi*), ferns (Bracken and *Blechnum*), flax *Phormium*, 1.3–2 m tall and c. 1.5 m apart, and sometimes ground-cover of *Sphagnum*; and seldom in (3) reed beds of even height, 0.6–1.3 m tall, with moderately to very dense reeds *Juncus*, and either dense ground-cover of Pouched Coral Fern and *Sphagnum*, or bare ground between reeds; or (4) logged forest with broken canopy of Kahikatea *Dacrydium dacrydioides*, Rimu *Dacrydium cupressinum* and *Kamahi* up to 15 m tall, with a dense understorey 2–3 m tall of *Toro Myrsine salicina*, *Kamahi*, Broadleaf, sapling Rimu and Kahikatea and tree-ferns, and a lower layer <1 m tall of *Coprosma* and hook-grass *Uncinia* (Best 1979b). At *NEW R. ESTUARY, NEAR INVERCARGILL, SI*, mainly recorded in similar habitat to that of preferred habitat at Kongahu Swamp (above). Mainly found in: (1) very dense reed beds of Jointed Rush *Leptocarpus similis*, 1.2–1.4 m tall, with emergent stunted shrubs of *Coprosma*, Marsh Ribbonwood *Plagianthus divaricatus*, *Muehlenbeckia complexa* and Manuka to 1.8 m tall; (2) dense shrubland 1.8–3.0 m tall, dominated by Manuka, with *Coprosma*, Marsh Ribbonwood, *Muehlenbeckia*, New Zealand Flax, *Pittosporum*, Broadleaf, and Lancewood *Pseudopanax crassifolius*, and some Jointed Rush; and (3) level and moderately dense reed beds of Jointed Rush, 0.5–1.3 m tall, with occasional stunted *Coprosma* and Marsh Ribbonwood, seldom rising above mud; less often in (4) shrubland of New Zealand Flax, *Cordyline*, Manuka and *Coprosma*, with some tussock grass *Poa* and Jointed Rush, 10–11 years after fires; and (5) native grassland with scattered clumps or plants of Marsh Ribbonwood, *Coprosma* and Jointed Rush (Barlow 1983). Also common at some sites in *HILLSIDE OR ALPINE SHRUBLAND*, often dominated by Manuka, but also dominated by or mixed with Bracken, *Dracophyllum*, *Cassinia* and introduced species such as Gorse *Ulex europaeus* (Stidolph 1948, 1949; Williams 1960; St Paul 1977; CSN 1, 19 Suppl., 22, 33, 37), e.g. in shrubland or low forest, to 2 m tall, on ridgetops at 1036 m asl, of Manuka, Bog Pine *Halocarpus bidwillii*, Yellow-Silver Pine *Lepidothamnus intermedius*, Celery-top Pine *Phyllocladus aspleniifolius* and stunted Mountain *Nothofagus solandri* and Silver *N. menziesii* Beech (Wilson *et al.* 1988). Also recorded in hillside *TUSSOCK GRASSLAND* or *TUSSOCK SHRUBLAND*, e.g. tussock grassland of Narrow-leaved Snow Tussock *Chionochloa rigida*, to 1 m, with scattered New Zealand Flax to 1.5 m, sometimes in clumps, and with sparsely scattered shrubs and herbs, including *Coprosma rugosa* and *C. propinqua*, daisy-bush *Olearia*, *Hebe*, Manuka to 2 m tall, *Aciphylla*, Gorse and *Cassinia*; or, in damper patches in same

area, in *Carex* with scattered New Zealand Flax to 2 m tall, and sparsely scattered *Coprosma* and *Hebe* (Gray & Warburton 1974). Uncommon in *NATIVE FORESTS*, usually occurring only at edges, though sometimes penetrate farther where disturbance, such as logging or windthrow, creates clearings and subsequent growth of suitable scrub (Best 1979b; CSN 5, 30, 43; also see Wilson *et al.* 1988); in kauri forests in Northland, mainly in dense *Gahnia* sedge on logging tracks, haulage sites and clearings (R. Parrish). Sometimes also in *PLANTATIONS OF EXOTIC PINES*, often in scrub at edges, or among young plantings (Weeks 1949; CSN 19 Suppl., 30, 32, 34, 42; Oliver), e.g. in ferns and Manuka growing at edges of dense plantations of *Ponderosa Pinus ponderosa* and Long-leaf *P. palustris* Pines (CSN 1). *MODIFIED HABITATS*: On *FARMLAND* and other modified habitats, including rough farmland, moving into improved pasture Jan.–July (CSN 33). Also inhabit thickets of Blackberry on edge of bush and marginal country paddocks (CSN 19 Suppl.), and Gorse where it has encroached into wetlands (C.F.J. O'Donnell). Also recorded in disturbed habitats, such as linear strips of stunted Manuka shrubland established on spoil at edges of bulldozed tracks and logging tramways (Best 1979b).

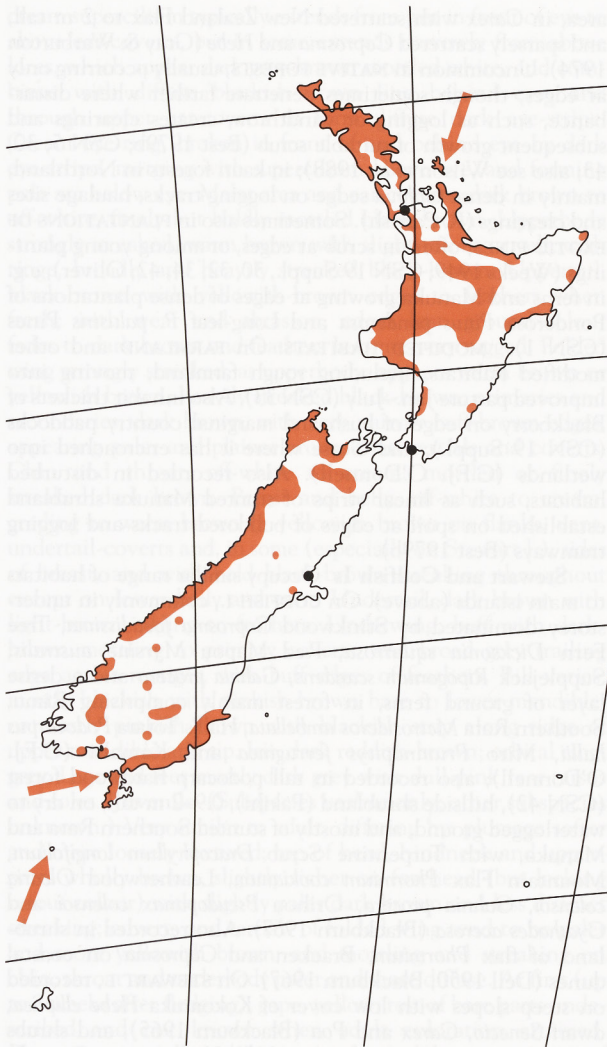
**Stewart and Codfish Is** Occupy similar range of habitats to main islands (above). On *CODFISH I.*, commonly in understorey dominated by Stinkwood *Coprosma foetidissima*, Tree Fern *Dicksonia squarrosa*, Red Mapou *Myrsine australis*, Supplejack *Ripogonum scandens*, *Gahnia procera* and a dense layer of ground ferns, in forest mainly comprising Rimu, Southern Rata *Metrosideros umbellata*, Hall's Totara *Podocarpus hallii*, Miro *Prumnopitys ferruginea* and *Kamahi* (C.F.J. O'Donnell); also recorded in tall podocarp hardwood forest (CSN 42), hillside shrubland (Pakihi), 0.9–2 m tall, on dry to waterlogged ground, and mostly of stunted Southern Rata and Manuka, with Turpentine Scrub *Dracophyllum longifolium*, Mountain Flax *Phormium cookianum*, Leatherwood *Olearia colensoi*, *Gahnia procera*, Orihou *Pseudopanax colensoi* and *Cyathodes acerosa* (Blackburn 1967). Also recorded in shrubland of flax *Phormium*, Bracken and *Coprosma* on coastal dunes (Dell 1950; Blackburn 1967). On *STEWART I.*, recorded on steep slopes with low cover of Kokomuka *Hebe elliptica*, dwarf *Senecio*, *Carex* and *Poa* (Blackburn 1965), and shrubs and sedges in wetlands (Anon. 1907). However, on Stage I., also said to be conspicuous due to lack of ground-cover (Blackburn 1965).

**Snares Is** Common in tussock grassland, e.g. a mixture of *Poa tennantiana* and Blue Shore-tussock *P. astonii* (Best 1973; Miskelly *et al.* 2001). Also common in *NATIVE FOREST*, e.g. forest dominated by Snares Tree-daisy *Olearia lyalli*, with scattered patches of Tree Daisy *Brachyglottis stewartiae*, and ground-cover of ferns (including Prickly Shield Fern *Polystichum vestitum*, Shore Spleenwort *Asplenium obtusatum* and *Blechnum durum*), and herbs Punui *Stilbocarpa robusta*, Antarctic Starwort *Callitriche antarctica* and *Crassula moschata* (Best 1973; Miskelly *et al.* 2001). Less often on steep hillsides in dense cover of *Poa* grass. Breeding territories in various habitats, e.g. mainly in open *Olearia* forest, also often in dense *Olearia* forest, including territories with dense mixed cover of *Hebe*, Sedge *Carex trifida*, *Poa* and *Stilbocarpa*, and occasionally in tussock grassland of *Poa tennantiana* and *P. astonii* with small patches of *Asplenium* ferns (Best 1973). Occasionally forage in penguin and sea-lion colonies, and in floating kelp in littoral zone (Best 1973; see Food).

**DISTRIBUTION AND POPULATION** Endemic to NZ.

**NI** Widespread in Northland, and recorded at more sparsely scattered sites farther S to coastal Manawatu and Hawkes Bay (NZ Atlas; CSN). Also occur on Great Barrier and Tiritiri Matangi Is, and formerly on Alderman Is (Bell 1976a; Parker 2002; Anderson & Ogden 2003; NZCL; CSN),





but 'not seen of recent years' on Great I. in Three Kings Grp, where recorded in 1887 (Oliver; NZCL; CSN 19 Suppl.). **NORTHLAND:** Widespread from C. Reinga and North C., S to line from Dargaville to Whangarei, and thence confined to coastal areas farther S to round Pouto (N. Kaipara Head) and Waipu. **AUCKLAND-S. AUCKLAND:** Mainly confined to coastal areas: on w. coast, occur at scattered sites from South Kaipara Head S to Awhitu Pen. in Manukau Harbour; and on e. coast, from Whangateau S to Waitemata Harbour. Also occur on n. Coromandel Pen., and, farther S, at scattered sites in Hunua Ras and s. Firth of Thames. Also recorded on Great Barrier I. **WAIKATO:** Occur at a few scattered sites in N, where recorded at Whangamarino Swamp, Torehape Peat Dome, L. Waahi, round Raglan Harbour, and in area from Hamilton W to Te Aroha, and S to Patuturu and Maungatautari. Farther S, recorded at coastal and near-coastal sites from Aotea Harbour S to Piopio, and thence inland to Pureora State Forest Park. Elsewhere, occur at various inland wetlands associated with Waikato R. Drainage Basin, e.g. Moanatuatua Swamp and L. Ngaroto. **BAY OF PLENTY:** Most widespread from Whitianga on Coromandel Pen. S to Tauranga Harbour, and thence at more scattered sites E to estuary of Waioueka R. Possible historical report from Mayor I. (Edwards 1955). **EAST COAST:** Few recent published records N of 38°30'S: recorded at Oponae, in middle reaches of Wioke R.; East C.; and Waihou Bay. Farther S, recorded more often round coast from near Muriwai S to Oraka Beach at base of Mahia Pen., and at

scattered coastal sites from there W to Wairoa, and from there, upstream along Waikaretaheke R., nearly to L. Waikare-moana. **VOLCANIC PLATEAU:** Widespread but scattered. Occur at a few sites round lakes in N, from round Ls Rotorua and Rotoiti S to Rotomahana and E to Mt Edgcumbe. Isolated records at L. Maraeti and Reporoa; and also recorded along middle and upper reaches of Rangitaiki R. and its tributaries upstream from Murupara. Widespread farther S, from w. and s. L. Taupo, especially round Turangi, S to Mt Ruapehu. **HAWKES BAY:** A few records at coastal and near-coastal sites in NE, from Mohaka SW to Tangoio and inland to L. Opuahi. Widespread farther inland, mainly in Kaweka Ra., extending S to n. Ruahine Ra. Single NZ Atlas record much farther S, at Waipatiki, near Porangahau. **WAIARAPA-WELLINGTON:** Recorded at L. Wairarapa and C. Palliser till 1940s (see Change in range, populations, below), but no recent records. **MANAWATU:** Occur at a few scattered coastal and near-coastal sites, from Santoft Forest S to L. Omanu (near Otaki), including Pukepuke Lagoon and Foxton. **WANGANUI:** A few records at scattered sites near border with Volcanic Plateau, round Waiouru and upper Moawhango. Also occur in coastal and near-coastal areas from L. Moumahaki and elsewhere round Waverley, SE to Wanganui R. Estuary; and inland, upstream along Wanganui R. **TARANAKI:** Scattered records from Awakino S to L. Rotokare. Many records round coastal and near-coastal N. Taranaki Bight, from mouth of Awakino R. to Okoki, near Ureti, but elsewhere, most records from farther inland, from round Whitianga, S through Whangamomona, to L. Rotokare, near Eltham, and recorded W to Egmont NP (Edgar 1971, 1978; McKenzie 1979; Innes *et al.* 1982; NZ Atlas; CSN). **SI** Widespread W of S. Alps, and occur at scattered sites elsewhere, especially in Southland and Otago. **NELSON:** Widespread, mostly in N. Occur in coastal areas from near Kahurangi Pt N to Farewell Spit, and thence S in coastal and near-coastal areas of margins of Golden Bay and w. Tasman Bay to Waimea Inlet; and also recorded inland, S to 41°S, round upper reaches of Aorere R., and farther S, also recorded at various inland sites, from round Tapawera S nearly to L. Rotoiti. **MARLBOROUGH:** Isolated populations in Wairau R. Drainage Basin, from St Arnaud Ra. and upper reaches of Waihopai R. downstream to Goulter R. **CANTERBURY:** Thought to have been extinct in lowlands since c. 1898 (see Change in range, populations, below), though reported from L. Ellesmere in Aug. 1977. However, occasionally recorded in S. Alps, e.g. L. Christabel, Goat Hut Pass in Arthurs Pass NP, and near headwaters of Selwyn R., E of L. Coleridge. **OTAGO:** Occur at scattered sites round Dunedin, and at scattered coastal and near-coastal sites from Ls Waipori and Waiholo and mouth of Taieri R. SW to various estuaries in se. Catlins State Forest Park, such as those of MacLennan, Fleming and Tautuku Rs. Also occasionally recorded at a few scattered sites farther inland, e.g. Waipori R. (near L. Mahinerangi) and Blue Mts; and very occasionally farther inland, in S. Alps, e.g. between Ls Hawea and Wanaka, and at Mt Allen, E of Queenstown. **SOUTHLAND:** Mainly recorded in coastal areas and valleys of e. Fiordland, from estuaries in s. Catlins State Forest Park W to Oreti R. (and the tributaries to its lower reaches), though mostly W of Matura R., and very occasionally farther W round L. George, Tuatapere, Eastern Bush and mouth of Waitutu R., and occasionally farther inland to Waikaia, Hokonui Hills, Taringatua Forest and Blackmount; and in Fiordland from L. Monowai, N along Waiau, Eglinton and Hollyford Valleys to Big Bay and upper reaches of Pyke R. Also occur on Ruapuke and Bird Is in Foveaux Str.; and on Stewart I., where separate subspecies *B.p. stewartiana* was first recorded in c. 1907, and on associated islets of Ulva, Jacky Lee, Big South Cape, Pohowaitai, Tamaitemioka, Solomon, Pukeawa, Big and Kundy Is. Separate subspecies *wilsoni* occurs on Codfish I., first recorded in 1935, and now established on



Putauhinu I. WEST COAST: Widespread W of S. Alps, though occasionally on w. slopes; occur from Awarua Pt NE to Heaphy Track; also occur on Open Bay Is, offshore from mouth of Okuru R. (Blackburn 1965, 1967; Stirling & Johns 1969; Gray & Warburton 1974; Elliot 1978; Dennison & Robertson 1979; Barlow 1983; Owen & Sell 1985; Harris 1987; Oliver; NZ Atlas; CSN; M. Wylie).

**Chatham Is** Extinct (see below).

**Snares Is** Ubiquitous on main island (Warham 1967), where most abundant passerine (Miskelly *et al.* 2001; CSN 24); also present on Broughton I., Rocky Isl. and Alert Stack (Miskelly *et al.* 2001), but absent from Western Chain (Sagar 1977; Miskelly 1984).

**Breeding** Throughout range. Few recent published records, but nevertheless recorded from Paua, Parengarenga Harbour, S to near Invercargill (Elliot 1978; Barlow & Moeed 1980; Barlow 1983; Harris 1987; Parker 2002; CSN 26), and also on offshore islands farther S, from Stewart I. and associated islets S to Snares Is.

**Introductions** Unknown number unsuccessfully translocated from Tongoio, Hawkes Bay, to Pautahanui in Wellington in 1984 (R. Parrish).

**Change in range, populations** Formerly more common and widespread than present ('one of our commonest birds') with populations having declined and range contracted and having become more sparsely scattered and localized owing to drainage of suitable habitat (Hutton & Drummond 1904; Turbott 1967; Best 1979b; McKenzie 1979; Pierce 1980; Oliver; see Habitat). On NI, occurred E to East C. and S to C. Palliser (Oliver); e.g. formerly widespread in Hunua Ra., but now confined to a few pockets of suitable habitat between Wharekawa and Kaiāua (McKenzie 1979); formerly widespread in Manawatu in 19th century (Turbott 1967), but single record in NZ Atlas, 1969–79, and few records in CSN, and even considered not to occur there now, after extensive burning (CSN 19 Suppl.) and recorded at C. Palliser in 1943 (CSN 1) and L. Wairarapa in 1949 (CSN 4), but not recently (NZ Atlas; CSN). Became extinct on Great I., Three Kings Is, 1887–1934, and on Alderman Is 1927–50 (Sladen & Falla 1927–28; Turbott 1948; Turbott & Buddle 1948; Fogarty & Douglas 1973). On SI, numbers in coastal areas of Nelson have declined in recent years with land development (Owen & Sell 1985); and, in lowlands of Canterbury, populations had declined noticeably by 1870 (Hutton & Drummond 1904), and said to have become extinct by c. 1898 (Oliver), e.g. extinct on Banks Pen. and round L. Wainono, where present in late 19th century (Dawson & Cresswell 1949; Pierce 1980; see above). Historically, range may have temporarily expanded in some areas, as regrowth and bracken replaced forests that were burnt or otherwise cleared (Guthrie-Smith 1910; Turbott 1967; Oliver; CSN 19 Suppl.). Extinct on Chatham Is since c. 1900 (Heather & Robertson 2000).

**Populations** Total population in Snares Grp, c. 1500 pairs (Miskelly *et al.* 2001). **RECORDED DENSITIES:** 2.4 birds/ha, Parahaki, Whangarei, NI (CSN 23); 1.89 birds/5-min count (0.12; 333 counts), Great Barrier I. (Anderson & Ogden 2003), and five recorded along c. 550-m transect (CSN 20); three birds/ha, Tiropahi, West Coast, SI (CSN 36); eight pairs/ha, North East I., Snares Grp (Miskelly *et al.* 2001).

**THREATS AND HUMAN INTERACTIONS** Many said to have been burnt in fires that settlers used to clear the land (Hutton & Drummond 1904; Oliver). Adversely affected by drainage of swamps and conversion of habitat into farmland (Best 1979b; McKenzie 1979; Oliver). On Stewart I., said to be colonizing inland flats as farmland reverts to shrubland (CSN 48). Preyed on by Cats (Fitzgerald & Veitch 1985), mustelids (which accounted for loss of eight nests of 31 monitored at Whangateau, NI) (Parker 2002) and Black Rats

(Guthrie-Smith 1914; Bell 1976b), and population of Fernbirds on Codfish I. increased after Rats extirpated (Kater 1999); ironically, Fernbirds sometimes poisoned by eating baits intended for control of Rats (Ranum *et al.* 1994). Said to have been hunted or attacked by Dogs (Oliver).

**MOVEMENTS** Sedentary and territorial, and no evidence of any long-distance movements. Usually remain in or near breeding territories throughout year, though territorial behaviour declines during autumn (Moncrieff 1929; Stead 1948; Best 1979b; Barlow 1983; Heather & Robertson 2000; CSN 38; see Social Organization and Behaviour). However, juveniles said to wander from natal territories after becoming independent, often moving through other territories (Barlow 1983; Heather & Robertson 2000), and have been recorded >20 km from nearest known breeding populations (Heather & Robertson 2000). Also some evidence of restricted local movements, with local expansion of range after breeding, from farmland and pakihi vegetation into, presumably nearby, pastureland and logged forest, Jan.–July, round Charleston, SI (CSN 33); and some movement indicated by expansions into areas where not seen previously or not seen for several years, e.g. Catlins and Port Whangarei (CSN 48; see Distribution [Change in range, populations]). Said to move from one isolated patch of habitat to another, with suggestion of travel at night (St Paul 1977). Flight weak, and seldom fly >50 m or so (McLean 1906; Stidolph 1949; St. Paul 1977; Heather & Robertson 2000; Oliver); near Invercargill, SI, longest recorded flight was 85 m (Barlow 1983). However, on Stewart I., described as 'strong flier', staying in air for 55–75 m (Oliver); and on Snares Is, said to fly more readily than main island subspecies, often flying >45 m, and once seen carrying nest-material over 90 m (Stead 1948; Oliver).

**Banding** Total of 337 banded 1950–96; no recoveries 1988–93, but no information on recoveries 1950–87 and 1994–96 (Cossee 1989, 1992, 1993, 1995, 1997, 1998a,b; Cossee & Wakelin 1991). Of nine banded as nestlings at Whangateau, NI, one resighted three times after fledging c. 800 m from natal territory, up to 59 days later. At Orewa, NI, 24 banded before translocation to Tiritiri Matangi I.; one escaped at Orewa, 26 June 2001, and recaptured 19 July 2002, c. 200 m away; since release on Tiritiri Matangi I., one recorded five times up to July 2002 (K.A. Parker). **LONGEVITY:** Oldest known birds, 6.5 years (Heather & Robertson 2000).

**FOOD** Invertebrates, mainly insects; occasionally seeds and fruit. **Behaviour** Difficult to study because birds secretive and cryptically plumaged, and preferred habitats usually densely vegetated. Opportunistic, taking wide range of food, and using various foraging methods, which enables them to exploit wide variety of habitats. Insects gleaned mostly from ground but also from vegetation (Stead 1948; Sansom 1949; Warham 1967; Best 1973, 1975, 1979a; Falla *et al.* 1981; Heather & Robertson 2000; Oliver). **DETAILED STUDIES:** Of diet and foraging ecology on North East I., Snares Grp, Nov. 1970–Mar. 1971 and Dec. 1971–Mar. 1972 (Best 1973, 1979a); and diet of nestlings near Invercargill, SI (Barlow & Moeed 1980). **FORAGING ASSOCIATIONS:** On North East I., usually foraged singly, though members of territorial pair or adult and young sometimes foraged together. Elsewhere, sometimes forage with New Zealand Tomtit *Petroica macrocephala*, Tomtit taking insects disturbed by Fernbird (Wilson 1959). **FORAGING HEIGHTS, SITES:** Mostly forage in places where much accumulated organic matter, or other sites where arthropods found, investigating large variety of potential food sites (Best 1973, 1979a). Forage mostly on ground, among leaf-litter, on beaches, in crevices, under stones, or among bones in skua *Stercorarius* middens and sometimes among root systems of partly fallen *Olearia* trees; or low in vegetation, including reeds, sedges and



rushes, ferns (such as bracken), in grass tussocks *Poa*, among herbs (e.g. *Crassula moschata*, Antarctic Starwort *Callitriche antarctica*, chickweed *Stellaria media* and *S. decipiens*) and in shrubs (including Manuka *Leptospermum scoparium*, and outer foliage of *Hebe*) (Moncrieff 1929; Stead 1948; Sanson 1949; Breen 1956; Warham 1967; Best 1973, 1975, 1979a; Falla *et al.* 1981; Moon & Lockley 1982; Heather & Robertson 2000; Oliver); in forest, also forage on bark and among branches and foliage of trees (Stead 1948; Best 1973, 1979a; Falla *et al.* 1981; Oliver; also see Foraging methods, below). Regularly forage in penguin *Eudyptes* colonies, both on shoreline and farther inland (Stead 1948; Best 1973, 1979a; Falla *et al.* 1981; Oliver) and in petrel burrows (Best 1973, 1979a). Other marine sites where foraging observed include: beaches, tidal rock platforms and crevices, lichen-encrusted granite of supralittoral zone, narrow rock ledges in cliffs bordering beaches, rafts of floating Bull Kelp *Durvillea antarctica*, and other detritus (Best 1973, 1979a). Often forage for flies on resting or dead New Zealand Fur-seals *Arctocephalus forsteri* and New Zealand Sea-lions *Phocarctos hookeri*, and their faeces (Stead 1948; Best 1973, 1979a; Heather & Robertson 2000; Oliver). **FORAGING METHODS:** From North East I. (Best 1973, 1979a) unless stated. **SEARCH:** Search pattern cursory till attention attracted by prey. Seldom catch food on wing, though often drop onto prey dislodged from overhanging sites (Best 1975). Often forage on floor of forest covered by dead *Olearia* leaves, grasping edge of leaf with foot and lifting it; uncovered area quickly checked for food, and underlying material probed and pecked to disturb any prey (Wilson 1959; Best 1973, 1975, 1979a; Oliver). Leaf then released if nothing found. Many leaves examined in this way in quick succession, using first one foot and then the other. When prey detected, leaves, twigs and other debris flicked or thrown aside with strokes of one or both legs. Clods of peat, small stones and other debris pushed away or raked over with feet, with bird often clearing path down to bare peat, or tunnelling completely under leaves. When no leaf-litter on forest floor, spend much time foraging among root systems of *Olearia* trees and searching petrel burrows; most visits to petrel burrows last 15–30 s, but occasionally up to several min. Also forage in penguin colonies, which contain large numbers of blowflies *Xenocalliphora eudypti*, especially late Nov. to Feb., when many dead chicks and fragments of squid present for maggots to live in, though Fernbirds prefer adult blowflies. Bird stands in one place and reaches up, snapping at flies within range, or gleans flies from ground. Leaf-litter and twigs in penguin nests examined for arthropods in similar manner to that used in leaf-litter on forest floor; and also turn over sticks, stones and plant fragments in streams draining from penguin colonies. Sometimes eat food spilt by penguins while chicks being fed. When searching for food in low shrubs, strut about (see Foraging postures, below), or search for prey flying just above foliage or resting on top of plants; ground-cover vegetation investigated in similar manner to dead leaves on forest floor. Search through skirts of dead foliage drooped across bases of grass tussocks, flicking or pushing skirt aside with feet, possibly to flush insects. Crowns of tussocks also examined, concentrating on bases of leaves where foliage packed most tightly. Use several methods to reach undersides of substrates: (1) Sometimes hang upside-down on undersurface of limbs of trees, but cannot move about in this position; (2) stand on side of small branches to pick at that side, and usually able to climb back on top of branch after search completed; (3) overhangs near ground, or <10 cm or so above other branches, examined by reaching up fully on tiptoes and rocking from side to side; and (4) bird sometimes jumps up to dislodge peat thrown into bark by burrowing shearwaters *Puffinus*; leaps sometimes repeated several times, but bird usually flies up and hangs upside-down by executing sudden backflip and grasping substrate with feet;

while upside down, tail is pressed firmly against trunk (Best 1973, 1979a; C.M. Miskelly). While performing this intricate manoeuvre, one bird tore off loose bark with one foot, flapping its wings to maintain balance. **ATTACK:** In *Olearia*–*Senecio* forest, glean and probe for arthropods, from crevices and under loose pieces of bark on trunk and branches, and sometimes round exposed root systems. When foraging on *Hebe* shrubs, glean insects from outer foliage, where insects tend to cluster. When moving on trunks and branches, mainly adopt Stooped Posture (see Foraging postures, below); steep parts of trees traversed either by pointing feet in line of travel, or side-stepping. When foraging on granite of supralittoral zone, probe and glean small beetles and mites from lichen and around quartz veins and tension cracks in surface. When foraging on tidal rock platforms or on floating Bull Kelp, grasp smaller algal fronds and lift them with feet, gleaning any insects uncovered. Where Kelp washed up in littoral zone, reach up for flies buzzing above rotten Kelp, or glean larvae from among it. Often take blowflies attracted to resting fur-seals and sea-lions, either by reaching up when flies flying around or gleaning from body surfaces, especially from muzzle, jowls and snout; also glean blowflies from seal faeces (Wilson 1959; Best 1973, 1979a). **FORAGING POSTURES:** From North East I. (Best 1973, 1979a) unless stated. Adopt four different postures when actively foraging, in all cases with plumage of body sleeked. (1) **STRUT** (Fig. 1): Bird adopts upright stance with neck extended and bill slightly below horizontal, and axis of body at 50–60°, legs fully extended, and each foot carefully raised in goose-stepping manner as bird walks. As leg moved forward, body and head jerked forward; when leg put down, body and head jerked backwards again, resulting in an upright, jerky walk. Most noticeable when bird moves about on tips of branches, when moving about on sea-lions, and in penguin colonies. (2) **SLINK** (Fig. 2): Bird crouches so that body, bill and tail horizontal, with bill pointing directly at prey, and bird appearing to fix gaze on one item only. Legs moved in same fashion as Strut but faster, birds usually running or walking rapidly. Used when prey sighted, and nearing striking distance. When bird changes posture from Strut to Slink, often pause and walk on the spot for a few steps, apparently to get footing right and to judge number of steps to prey. (3) **STOOP:** A posture intermediate between Strut and Slink, with body inclined at 30–40°, head held forward of body axis, with bill lowered at 5°, giving stooped appearance; tend to move in partly crouched attitude and at walking pace, with legs moving in manner described above for Strut and Slink. (4) **LUNGE** (Fig. 3): Sometimes birds that are either Slinking, Strutting or Stooping suddenly stop and lunge forward; the body is thrust forward and tilted down head first, and tail and wings flick up to help bird maintain balance and regain upright posture. At furthest extent of Lunge, a loud snap can be heard as mandibles of bill suddenly close; used for capturing prey. **SELECTION OF FOOD:** On North East I., c. 75% of food comprised beetles (especially weevils) and wetas (Orthoptera). In penguin colonies and areas occupied by seals, main source of food was flies. When on mat plants (*Stellaria*, *Crassula* and *Callitriche*) and in *Poa* meadows, ate wide variety of small arthropods such as aphids, small spiders, harvestmen, crane-flies, caterpillars, pseudoscorpions and amphipods. **HANDLING OF FOOD:** Small items swallowed alive. Larger and tougher prey, such as large beetles and weevils, bashed on ground or against rocks or trees till dead, though usually swallowed whole once appendages removed. However, while appendages usually torn off, they are often eaten. Most prey usually eaten within 30 s of capture, though once knocked a large weta on ground for several minutes after it was caught; bird finally pinned weta to ground with its foot, and tore pieces off with bill and swallowed them. Items usually eaten before searching for more. **ADAPTATIONS:** Have acute eyesight; on North





Figure 1 Strut (after Best 1979a)



Figure 2 Slink (after Best 1979a)

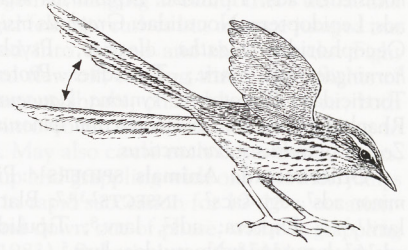


Figure 3 Lunge (after Best 1979a)

East I., often running 3–5 m to capture stationary flies, and observe and catch moths camouflaged against cryptic background (Best 1973, 1979a).

**Detailed studies** On NORTH EAST I., SNARES GRP (items in adult crop castings, gut contents of dead nestlings, and observations of prey caught by juveniles and adults combined; Best 1973, 1979a): **Animals** CRUSTACEANS: Unident. amphipods; Talitridae: *Orchestria aucklandica*. SPIDERS: Unident.; Araneae: Dictynidae: *Oramia rubrioides*. OPILIONES: Unident. harvestmen. MITES, TICKS: Unident. INSECTS: Coleoptera: Anthribidae: *Cacephatus aucklandicus*; Carabidae: *Mecodema alternans hudsoni*; Chrysomelidae: unident. elytra; Colydiidae: *Pristoderai*; Curculionidae: *Exeiratus laqueorum*; *Gromilus laqueorum*; *Pentathrum spadiceum*; *Phrynixus laqueorum*; *Oclandius vestitus*; Staphylinidae: unident.; Diptera: Calliphoridae: *Pollenia*; *Xenocalliphora eudypiti*; Chloropidae: *Oscinosoma huttoni*; Coelopidae: *Chaetocoelopa littoralis*; *Coelopa debilis*; *Protocoelopa philpotti*; Empididae: Chelipoda; Hilarempis; Helemyzidae: *Allophylopsis laquei*; *Heloclusia antipoda*; Muscidae: *Fannia fuliginosa*; *Limnophora*; Mycetophilidae: *Zygomayia trifasciata*; Psychodidae: unident.; Sciomyzidae: *Polytocus costata*; Stratiomyidae: *Bereis*; Syrphidae: *Helophilus hochstetteri*; *Syrphus novaezelandiae*; Tipulidae: *Leptortarsus*; *Limonia arthuriana*; Hemiptera: Aphididae: *Myzus ornatus*; *Brachycaudus helichrysi*; Psyllidae; Hymenoptera: Braconidae: *Aphidius matricariae*; Lepidoptera: Noctuidae: *Graphania insignis pagaia*; Oecophoridae: *Izatha oleariae*; Orthoptera: Rhaphidophoridae: *Insulanopteron spinosum*; Stenopelmatidae: *Zealandrosandrus subantarcticus*; Psychidae: *Gryptothea homingae*; Tineidae: *Proterodesma byrsopola*; Tortricidae: *Planotortrix syntona laqueorum*.

**Other records** **Plants** Unident. seeds<sup>6</sup>. MONOCOTYLEDONS: Poaceae: *Poa shoots*<sup>3</sup>, sds<sup>6</sup>. DICOTYLEDONS: Malvaceae: *Plagianthus divaricatus* fru.<sup>12</sup>. **Animals** MOLLUSCS: Gastropods<sup>1</sup>. CRUSTACEANS: Amphipods<sup>7</sup>. SPIDERS<sup>11</sup>: Pisauridae: *Dolomedes minor* ads<sup>12</sup>, egg-sacs<sup>12</sup>. INSECTS<sup>1,2,4,6,8,9,10,12</sup>: larv.<sup>6,13</sup>; Blattodea<sup>12</sup>; Coleoptera: ads<sup>11</sup>, larv.<sup>5,11</sup>; Cerambycidae: *Prionoplus reticularis*<sup>3</sup>; Diptera: ads<sup>4,11,12,13</sup>, larv.<sup>3,11,12</sup>; Lepidoptera: ads<sup>11,12</sup>, larv.<sup>3,11,12</sup>; Orthoptera<sup>12</sup>. REPTILES: Scincidae: *Cyclodina aenea*<sup>14</sup>.

REFERENCES: <sup>1</sup> McLean 1906; <sup>2</sup> Stead 1948; <sup>3</sup> Breen 1956; <sup>4</sup> Wilson 1959; <sup>5</sup> Blackburn 1965; <sup>6</sup> Turbott 1967; <sup>7</sup> Warham 1967; <sup>8</sup> Best 1975; <sup>9</sup> Moon & Lockley 1982; <sup>10</sup> Harris 1987; <sup>11</sup> Heather & Robertson 2000; <sup>12</sup> Parker 2002; <sup>13</sup> Oliver; <sup>14</sup> R. Parrish.

**Young** Nestlings fed by both parents (see Breeding). Size of food fed to nestlings increases with age of nestling. On North East I., nestlings <8 days old fed small, soft-bodied prey, such as flies, moths, spiders, and a wide range of insect larvae. Once nestlings attained full weight, by c. 12–16 days old, fed large prey such as wetas and marine amphipods, often gleaned from beachcast kelp. Wetas and amphipods too large for even the largest nestlings to swallow are torn into smaller pieces by adults before being fed to young (Best 1973, 1979a). Some prey, especially moths and crane-flies, caught and fed to nestlings in

early morning and late evening, when they are most active; other prey, such as spiders, flies, larvae and wetas, brought to nestlings throughout day. Even though wetas nocturnal, thousands of them spend day in petrel burrows, where readily accessible as prey. In one nest, mean number of feeding visits per hour by each parent increased gradually from c. 2 visits/h at hatching, to 5 visits/h at 5 days and c. 8 visits/h at 14 days. For nestlings up to 19 days old, peak in rate of feeding at 05:00–06:00, a trough between 15:00–16:00, and a second peak late in evening (Best 1973, 1979a). Young usually fed at intervals of 4–5 min, though some intervals between feeds up to 20 min (Moon 1967); at Whangateau, NI, 9.4 feeding visits/h (n=12) (Parker 2002); at Golden Bay, SI, ten feeding visits/h (n=1) (Elliot 1978); at Lake Waipori, SI, 11.5 feeding visits/h (n=4) (Harris 1987). Adults seen collecting maggots from dead seal and taking them to nestling at frequent intervals (Stead 1948; Oliver).

**Detailed studies** At LAKE WAIPORI, SI (Items observed being fed to nestlings; Harris 1987): **Animals** ANNELIDS: Oligochaetes: Lumbricidae. CRUSTACEANS: Talitridae: *Orchestia*. SPIDERS: Agelenidae: *Cambridge secunda*; Araneidae: *Araneus pustulosa*; Clubionidae: *Clubiona*; *Miturga*; Dictynidae: *Ixeuticus martius*; *Neorami*; Lycosidae: *Lycosa schauslandii*; Orsolobidae: *Ascuta*; *Steatoda*; *Tekella*; Pisauridae: *Dolomedes minor*; Salticidae: *Trite*; Tetragnathidae: *Tetragnatha*; Theridiidae; Thomisidae: *Diaea*; *Sidymella*. INSECTS: Coleoptera: Carabidae; Diptera: Bibionidae: *Dilophus nigrostigma* ads; Chironomidae: ads; Culicidae: ads; Empididae: ads; Mycetophilidae: ads; Stratiomyidae: ads, larv.; Therevidae: ads; Tipulidae: *Holorusia fulva* ads, larv.; Hemiptera: Cicadidae; Coccidae; Lepidoptera: Geometridae: larv.; Noctuidae: *Agrotis ipsilon* larv.; *Persectania aversa*; *Tmetolophota* larv.; Nymphalidae: *Argyrophenga antipodum* ads, larv.; Pyralidae: *Eudonia* larv.; *Orocrambus* ads; Odonata: Coenagrionidae: *Xanthocnemis zealandica*; Lestidae: *Austrollestes colenonis*.

Near INVERCARGILL, SI (199 items from stomachs of three nestlings; Barlow & Moeed 1980): **Plants** Unident. seeds 3.0% freq. **Animals** CRUSTACEANS: Amphipods 1.0. SPIDERS: Araneida: Lycosidae 39.5; Thomisidae: *Diaea* 7.5; Theridiidae 14.0. OPILIONES 1.0. MITES, TICKS: Acarina 1.5. INSECTS: Blattodea: Blattidae: *Celatoblatta notialis* 1.0; Coleoptera: ads 2.5, larv. 0.5; Diptera: Calliphoridae: ads 1.0; Stratiomyidae: *Odonomyia* ads 0.5; Tipulidae: ads 0.5; Hemiptera: Aphrophoridae: *Carystoterpa fingens* 2.5; Nabidae 5.5; Lepidoptera: ads 1.5, larv. 11.5; Noctuidae larv. 2.5; Nymphalidae: *Argyrophenga antipodum* larv. 3.0.

On NORTH EAST I. (Items observed being fed to nestlings; Best 1973): **Animals** CRUSTACEANS: Amphipods: Unident.; *Orchestria aucklandica*. SPIDERS: Araneae: Dictynidae: *Oramia rubrioides*. OPILIONES: Unident. harvestmen. INSECTS: Coleoptera: Tenebrionidae: *Pseudhelops quadricollis* larv.; Diptera: Calliphoridae: *Calliphora* ads; *C. huttoni* ads, larv.; Coelopidae: *Chaetocoelopa littoralis* ads, larv.; *Coelopa debilis* ads, larv.; Heleomyzidae: *Allophylopsis laquei* ads; Muscidae: *Fannia fuliginosa* ads; *Limnophora* ads; Syrphidae: *Helophilus*



hochstetteri ads; Tipulidae: *Leptotarsus* ads; *Limonia arthuriana* ads; Lepidoptera: Noctuidae: *Graphnia insignis pagaia* ads, larv.; Oecophoridae: *Izatha oleariae*; Psychidae: *Gryptotheca horningae* ads, larv.; Tineidae: *Proterodesma byrsopola*; Tortricidae: *Planotorrix syntona laquaicum* ads; Orthoptera: Rhaphidophoridae: *Insulanopteron spinosum*; Stenopelmatidae: *Zealandosandrus subantarcticus*.

**Other records** **Animals** SPIDERS<sup>3,4</sup>: Pisauridae: *Dolomedes minor* ads<sup>7</sup>, egg-sacs<sup>7</sup>. INSECTS<sup>2,3,4,7</sup>: Blattodea<sup>7</sup>; Coleoptera: larv.<sup>1,3,4,6</sup>; Diptera: ads<sup>7</sup>, larv.<sup>8</sup>; Tipulidae<sup>6,7</sup>; Lepidoptera: ads<sup>2,6,7</sup>, larv.<sup>1,3,6,7,8</sup>; Noctuidae: larv.<sup>5</sup>.

REFERENCES: <sup>1</sup> Guthrie-Smith 1914; <sup>2</sup> Potter 1949; <sup>3</sup> Soper 1965; <sup>4</sup> Moon 1967; <sup>5</sup> Warham 1967; <sup>6</sup> Falla *et al.* 1981; <sup>7</sup> Parker 2002; <sup>8</sup> Oliver.

**Intake** On North East I., took largest arthropods present (e.g. beetles and marine amphipods >20 mm long), as well as mites and small beetles <1 mm long. Once, during 14-min observation in supralittoral zone, one bird made 19.7 successful strikes/min (Best 1973, 1979a). At Goulard Downs, SI, observed eating caterpillar and Huhu Grub *Prionoplus reticularis*, both c. 2 cm long (Breen 1956). Near Invercargill, SI, food fed to nestlings ranged in size from c. 1 mm (mites) to c. 2 cm (caterpillars) (Barlow & Moeed 1980).

**SOCIAL ORGANIZATION** Not well known. Breeding biology and territories studied on North East I., Snares Grp, over two breeding seasons, Nov. 1970–Mar. 1971 and Dec. 1971–Mar. 1972 (Best 1973); at Golden Bay, SI, Dec. 1977–Feb. 1978 (Elliot 1978); at New R. Estuary, near Invercargill, SI, June 1978–July 1980 (Barlow 1983); L. Waipori, SI, Dec. 1979–Nov. 1983 (Harris 1987), and at Whangateau R. Estuary, NI, Nov. 2000–Feb. 2001 and Dec. 2001–Mar. 2002 (Parker 2002). Usually seen singly or in pairs (Ryder 1948; CSN), occasionally in small groups (Phillips & Lindsay 1948). Mostly stay in pairs or small groups throughout year, many pairs staying within or near their breeding territories (Best 1973; Harris 1987; Heather & Robertson 2000; Parker 2002; see below). On North East I., only territory-holding birds known to breed (Best 1973).

**Bonds** Monogamous; thought to pair for life, with territories held for extended periods. On Snares Is, most males maintained same territory with same mate over two breeding seasons (Best 1973; see below). **Parental care** Both sexes incubate and feed nestlings and fledgelings, though broods often appear to be split after fledging (see Breeding). **DISPERSAL OF YOUNG:** Juveniles wander from natal territories after becoming independent, often moving about nearby territories, though on North East I., independent juveniles said usually to frequent home-range that includes natal territory (Best 1973; Heather & Robertson 2000). However, juveniles also recorded >20 km away from nearest breeding birds (see Movements). Near Invercargill, large territory defended by one pair was the area most visited by fledged juveniles from local population, with territory-holders ineffective in their attempts to evict juveniles (Barlow 1983).

**Breeding dispersion** Two nests on Codfish I. were c. 40 m apart (Blackburn 1967). On North East I., two nests were c. 18 m apart; and another two, separated by a small penguin colony, c. 12 m apart (Stead 1948). Also on North East I., c. 8 pairs/ha, based on nests found (Miskelly *et al.* 2001). At Whangateau, NI, 18 nesting territories recorded along 1.8 km of suitable habitat (Parker 2002). **Territories** Territorial during breeding season and remain within territory, though defence apparently reduced, throughout year (Best 1979b; Barlow 1983; Harris 1987; Heather & Robertson 2000; Parker 2002; see Social Behaviour). Near Invercargill, strongly territorial during pre-breeding and breeding seasons, Aug.–Feb.

(Barlow 1983); and near Buller R., territories defended Aug.–Feb. but territorial defence waned after breeding, when pairs occupied home-ranges that included some or all of breeding territory (Best 1979b). In strip of vegetation bordering New R. Estuary, mean area of territories 1430 m<sup>2</sup> (530–2870; 17 territories measured in each of two seasons) with annual means of 1490 m<sup>2</sup> and 1375 m<sup>2</sup>; in territory at end of strip, not bordered by other pairs, home-range estimated to be c. 12,000 m<sup>2</sup>. Apparently more aggressive birds held largest territories; and territorial incursions by neighbouring adults occurred occasionally. Of 69 sightings of banded adults, 56 were within territorial boundaries, 11 were within 20 m of boundary, one 40 m outside boundary, and one 65 m. Juveniles were often found outside territories from mid-Nov., roaming through territories of other birds, where tolerated if moving through but sometimes chased off (Barlow 1983; also see Habitat, Movements). Mean territory sizes of other studies: Snares Is 2560 m<sup>2</sup> (n=27 territories) (Best 1973); Golden Bay 8110 m<sup>2</sup> (n=6) (Elliot 1978); L. Waipori 13,500 m<sup>2</sup> (n=14) (Harris 1987); and Whangateau R. Estuary 5865 m<sup>2</sup> (n=15) (Parker 2002). Territories on North East I. defended less vigorously by Feb., when juveniles and adults observed wandering between territories. However, territorial adults not observed moving >300 m from territories during winter 1972 (Best 1973).

**Roosting** On North East I., breeding pairs roost at nest-site; non-breeding birds roost in sheltered sites, with dense vegetation pushed aside to form small nest-sized roosting hollows. Young and parents roost together at end of first day after fledging, usually in nest, but sometimes in cover nearby. Before roosting, family group more vocal than usual from 20–30 min before dark till 10–15 min after dark; adult calls apparently function as contact notes (Best 1973). Occasionally loaf in mane of sleeping New Zealand Sea Lion *Phocarctos hookeri* for short periods during day (C.M. Miskelly).

**SOCIAL BEHAVIOUR** Reasonably well known. Detailed studies of breeding biology and territorial, sexual and foraging behaviour on Snares Is, over two breeding seasons, Nov. 1970–Mar. 1971 and Dec. 1971–Mar. 1972, using individually colour-banded birds (Best 1973); and of territorial behaviour on New R. Estuary, near Invercargill, SI, June 1978–July 1980 (Barlow 1983), L. Waipori, SI, Dec. 1979–1983 (Harris 1987) and Whangateau R. Estuary, NI, Nov. 2000–Mar. 2002 (Parker 2002). Observation difficult, because birds secretive, cryptically plumaged, and tend to remain in dense cover. Seldom fly and may remain stationary in presence of observer. Approach nest cautiously and under cover (Hodgkins 1949; Potter 1949; Best 1973, 1979b; Elliot 1978; Barlow 1983; Harris 1987; Parker 2002). However, more easily observed in some areas on Stewart I. where little ground-cover, and where also described as 'tame and confiding' (Blackburn 1965).

**Maintenance behaviour** Pair seen taking turns at bathing in shrub-covered pool, then hopping into shrub to preen themselves before foraging (Breen 1956). Non-breeding birds described as spending more time bathing and loafing than breeding pairs. Within 1–2 days of fledging, young often loaf in sunny places away from nest and near cover, sunning or dust-bathing, or pecking randomly at nearby objects; parents also frequent these areas when not foraging (Best 1973).

**Agonistic behaviour** Aggression between mates observed near nests, with Threat Display (see below) and calling observed between mates during change-over at nest; mates also observed attacking each other, and fighting briefly (for 3 s) before disengaging and facing away from each other in Threat Display. Earliest aggression seen in young was from fledgeling c. 57 days old (Best 1973). **Territorial advertising and defence** Territories strongly defended during pre-breeding and breeding seasons, and occupied but less strongly defended during non-breeding (see Social Organization). However, on



North East I., while pattern of territoriality similar, most vicious fighting occurred Apr., and suggested that territorial boundaries may be re-established in autumn before subsequent breeding season (Best 1973). Near Buller R. and on Snares Is, overt aggression between territory-holding neighbours frequent before breeding season, but declined once boundaries established. Territorial boundaries established and maintained mainly by **TERRITORIAL ADVERTISING CALLS (TAC)**, given regularly from elevated perches by males, sometimes in bouts lasting >30 min, and which often stimulated response, with similar calls, from neighbouring males. On North East I., males gave TAC from prominent perches, tilting head skyward and, after each call, hunching head slightly into shoulders and pointing bill and head downward. Female of pair sometimes responded to TAC of males in duet for first few minutes (Best 1973, 1979b; see Voice). In Duetting during territorial disputes, timing may fall out of phase when disputes intense, and both females begin to respond to calls of each male; when this occurs females give Submissive Display rather than usual Threat Display (see below). Juveniles practising TAC in a territory quickly evicted by territory-owner (Barlow 1983; Parker 2002). **Threat** Often utter **CHITTERING** (see Voice) in threat; usually uttered with head raised and neck extended, bill rapidly opening and closing, and with feathers of throat vibrating. Performed by both sexes, at varying intensity. Given at moderate intensity when roving juvenile passed through a territory; if juvenile moving through, moderate Chittering usually the only reaction from territory-owner, but when juvenile loafing in a territory, or responded with Chittering of its own, Chittering of territory-owner might intensify into a chase (see below). Given at high intensity during territorial disputes, interspersed with occasional Tchup Calls; high-intensity Chittering observed in all territorial disputes during pre-breeding and breeding season but only moderate intensity Displays given between neighbours during non-breeding period (Barlow 1983). At low and moderate intensity, also appears to function in alarm (see below); also once given in interspecific interaction, and sometimes in non-agonistic circumstances (see below; see Voice [Chittering]). **THREAT DISPLAY** (= Territorial Defence Display of Best [1973]): Aggressor faces opponent with breast prominent, wings spread slightly and lowered, and quivering rapidly, and legs straight; most of plumage sleeked, but feathers of nape often raised; aggressor rapidly advances and retreats, or quickly moves sideways, with short, stiff-legged movements, and intruder may adopt Submissive Display (see Submission, below) in response; aggressor advances till the other retreats, after which aggressor turns away and both birds move off in different directions. Utter Aggressive Calls (see Voice) while displaying. Intensity of display varies, with movements more rapid, calling more frequent and feathers of nape more erect in high-intensity displays (Best 1973; Barlow 1983). **CHASES**: On North East I., in Nov., most disputes ended with intruder retreating after calls from territory-owner (probably Chittering Calls), but disputes occasionally escalated into wing-fluttering and chasing (described as chivvying) (Stead 1948). At Whangateau R. Estuary, chasing ceased when territory boundary reached (Parker 2002). Near Invercargill, territory-owner followed closely behind intruder, stopping when intruder moved off and then preened or foraged. Independent juveniles moving about between territories (from Nov.) sometimes challenged and chased off by adults, though tolerated at times (once to within 1 m of a nest) if moving through (Barlow 1983; see below). **Fighting** Typically, two birds lunge at each other, feathers of nape and breast prominent, leaping up and pecking at each other's breasts for 1–2 s, before defeated bird moves off, the victor remaining to forage or preen. Aerial combat also observed: two birds hurtled from rushes facing each other with feet

apparently locked together, lunging at each other's throat and breast, rolled over and fell into rushes but at once jumped out separately and locked into second and third attacks. Fight ended when one bird flew off, making three short flights of 3–4 m between emergent shrubs, chased by the other; both birds then dropped into cover with one bird re-emerging to forage c. 2 min later. May also circle each other during fights, sometimes jumping up and grappling with one another; jumps sometimes repeated in rapid succession for 10–15 s; occasionally birds jump up and down out of phase, without grappling (Best 1973; Barlow 1983). **SUBMISSION SUBMISSIVE DISPLAY**: Performed by all birds except males in their territories; often given in response to Threat Display (which it may match in intensity). At first, submissive bird crouches in frozen, horizontal posture, with closed tail held rigidly above body, and with wings drooping and primaries spread, before beginning synchronous wing- and tail-flicking: tail rapidly flicked down when wings opened, then, as wings snapped against body, tail raised at slower rate. Sometimes accompanied by Escape Calls. When searching for escape route, in addition to wing- and tail-flicking, displaying bird stands fully upright with neck extended, leaning from side to side, then crouches low and looks under branches. Displaying birds sometimes stand still but more often move about in short, jerky hops, then may stop suddenly and give one or more jerk-jumps, jumping on the spot, facing one way then another. Submissive Display also seen in immatures when they meet other immatures or adults (Best 1973; Barlow 1983). Suggested that females may also use Pre-copulatory Display (see below) as submissive posture when a strange male intrudes on their territory (Best 1973). **Alarm** Give several different calls when alarmed (see Voice). Low-intensity Chittering given when people approach nest; and moderate-intensity Chittering given when bird surprised by a person within territory. Moderate-intensity Chittering also given by independent young at any time, including in response to people, other Fernbirds and sometimes other birds, such as Common Redpolls *Carduelis flammea*, Silvereyes *Zosterops lateralis* (Barlow 1983) or Weka *Gallirallus australis*, and mammals such as Stoats *Mustela erminea* (Parker 2002). Utter Distress Calls when handled. Others often approach upon hearing Distress Calls, and appear to respond with mobbing behaviour if predator present (Best 1973). When submissive individual about to flee conspecific, give flight-intention movements (Best 1973). **Interspecific interactions** Once, following playback of a tape of calls of Spotless Crake *Porzana tabuensis*, members of a pair appeared and began Duetting, with bodies vibrating as they called (probably Chittering Calls). When a Spotless Crake also responded to playback, one Fernbird raised itself and appeared to duet with Crake, with Fernbirds responding to *pit* calls of Crake with U-tick Calls; the two parties alternated calls for some time, with *pit* calls of Crake sometimes coinciding with *tick* part of U-tick Call (Skinner 1979). Aggressive interaction with Spotless Crake also observed after playback of Fernbird calls; one Fernbird, responding to playback, directed territorial display at Crake, raising its crown-feathers, Chittering, and quivering its wings while holding them out, from c. 1 m away, for 1–2 min Crake followed Fernbird and lunged at it several times (Parker 2004).

**Sexual behaviour** Possible **COURTSHIP DISPLAY** observed on North East I., in Nov., but method of sexing not known: male spread and fluttered wings while calling with clear single bell-like notes (probably U-tick Calls) and tapping left foot in time with calls; female moved to and fro on a grass tussock, giving a trilling call. Male sometimes stood erect, throwing head back as he called, while at other times he crouched. Display continued for 3–4 min, ending with male descending into cover, followed by female (Stead 1948). **DUETS**: Antiphonal duets thought to function in maintenance of



pair-bond (Best 1979b); and antiphonal U-tick Call possibly also functions as Contact Call between members of a pair; members of a pair uttering U-tick Call seen to move closer together, calling as they did (Watt 1947, 1949; Cunningham 1949; Potter 1949; Jenkins 1978; Best 1979b); see Voice for further details. Pairs also said to communicate by puffing up throat and uttering throaty, muffled purring sound (Breen 1956). On North East I, Duets between members of pair heard much during construction of nest, and low-intensity Chittering heard when birds placing nesting material (Best 1973). **Copulation PRE-COPULATORY DISPLAY:** Observed twice on North East I. Once, female hopped onto branch and adopted crouched horizontal posture, flapping wings slowly, tail held rigidly upward at 50–55°; male then landed beside her, performed same display and then mounted for 2–3 s, fluttering wings, but not apparently attempting copulation. In second observation, female adopted posture and calls similar to low-intensity Threat Display; male landed beside her, gave matching display for a moment, then mounted for 2–3 s, before dismounting and preening; female continued to call and display for 30 s. Suggested that females may also use Pre-copulatory Display as submissive posture when a strange male intrudes on their territory (Best 1973).

**Relations within family group** (Summarized from Best [1973] unless stated.) **INCUBATION:** During incubation, bird usually sits motionless, sometimes sleeping with bill tucked under wing, but with periods spent yawning, preening feathers of breast and carrying out nest-maintenance. A bird approaching nest during incubation sometimes ruffles its feathers. Sitting bird may leave nest as soon as it hears calls of its mate, sit up alert till its mate arrives at nest, or sometimes be reluctant to move, when partner will approach nest several times in rapid succession before sitting bird leaves. Duetting and Chittering common during change-overs, which usually last 5–8 s (Best 1973; Barlow 1983; also see Agonistic behaviour). Relieving bird carries out stereotyped sequence of stooping, ruffling feathers of belly, shifting eggs and settling. Bird leaving nest often pauses briefly nearby to yawn, stretch, preen or scratch before beginning foraging. If an egg broken during incubation or hatching, adults Duet and Chitter much (Best 1973). **NESTLINGS:** On North East I., adults only observed bringing one prey item at a time to nestlings. With large items, if nestling has difficulty swallowing it, adult may remove and attempt to re-feed it to young several times, then attempt to shove it down throat of another nestling; if unsuccessful, adult either eats item itself or holds it down with a foot, tears off pieces and feeds them to nestlings. Once, nestlings were asleep when adult arrived with food, and were woken with Tchup Call from adult; nestlings immediately begged, at first facing away from adult and then moving to direct begging to adult before being fed. At another visit, nestlings apparently satiated and female with food came to and left nest 12 times in 3 min, Chittering softly and prodding nestlings with her bill, but failing to elicit begging response, and eventually ate food herself. Another time, nestlings begged strongly and male turned from one gape to another for 8 s before feeding one nestling. Adults remove faecal sacs after most feeds; and often rearrange nest material, increasingly so as nestlings grow, in bouts of up to 5 min (Best 1973). **BEGGING OF NESTLINGS:** Begging directed at visual stimuli when nestlings 8 days old. Slight wing-quivering during begging occurs from Day 10. From Day 13, chicks stand up, stretch their necks out fully towards approaching parent, and quiver wings rapidly during high-intensity begging; lunge vigorously towards incoming adult by Day 14 (see Best 1973 for more details). **FLEDGELINGS:** Young seen to fledge after being displaced from nest by activities of adult rearranging nest material. On finding nest empty after young fledged, a returning adult gave low-intensity Chittering, to which young responded with Tsip Calls. At first, fledgelings spend long

periods standing still, giving Tsip Calls, sometimes scrambling about in vegetation for 10–15 min; roost with parents on first night. In days after fledging, young spend progressively more time away from cover, encouraged by parents, who often land near them and call them from cover to be fed. When begging, fledgeling crouches low with head hunched into shoulders, directing its begging upward with wings half extended and rapidly quivering up and down, and uttering Begging Call. Fledgelings often then follow adult for a short distance when foraging; by third day out of nest, foraging sorties typically last 20–25 min, and are usually initiated by adults but occasionally by young, which may rouse parent by pecking at its tail or jumping on its back as it sunbathes or sleeps. Younger fledgelings catch arthropods without eating them, and probably do not recognize them as food. Awareness of prey as food develops from c. 20 days after fledging. Usually broods appear to be split, with each parent tending one young. Some parents regularly lead offspring into neighbouring territories. Young venture farther as they grow; by end of second week, investigate large objects such as people, seals and penguins, and often stray into neighbouring territories and return unguided. One chick observed to overturn its sibling when picking it up by the foot, apparently unaware the foot was attached to anything. Juveniles described as indifferent to presence of parents by 57 days old. No evidence of parents urging young to leave natal territories (Best 1973; also see Breeding). **ANTI-PREDATOR RESPONSES OF YOUNG:** Nestlings at 10–11 days old cower and freeze in nest in absence of parents, pulling head and legs against body so that appear quite flat (Best 1973). **PARENTAL ANTI-PREDATOR STRATEGIES:** Parents give Alarm Calls, including uneven bursts of Chittering, when offspring approached by observer or otherwise threatened (McLean 1906; Best 1973; see Voice).

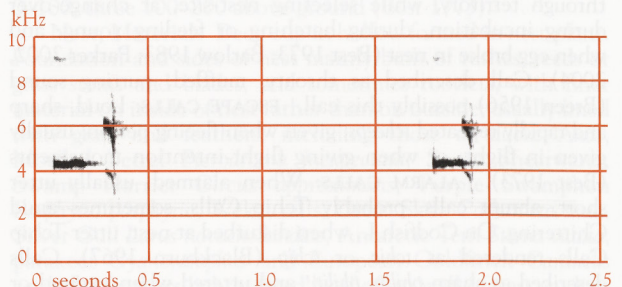
**VOICE** Reasonably well known. Detailed study of breeding biology and behaviour on North East I., Snares Grp, over two breeding seasons, in Nov. 1970–Mar. 1971 and Dec. 1971–Mar. 1972 (Best 1973), and terminology mainly follows this study. Usually heard before being seen (Scarlet 1967; Heather & Robertson 2000). Utter variety of brief and subtly varied calls (Best 1973) that are difficult to render (McLean 1906). Said not to possess a song (McLean 1906; Best 1973). Calls vary from <0.1 s to 0.5 s duration and are often repeated several times in a few seconds, with long calls typically clear and bell-like, and short calls usually harsher (Best 1973). Calls variously described as richly musical (Barlow 1983), monotonous (McLean 1906), a metallic twang (Sansom 1949), or feeble, squeaking note (Stidolph 1939). Often described as calling from conspicuous perches on shrubs, grass stems or tussocks (e.g. Stidolph 1939, 1949; Roberts 1959), but near Invercargill, SI, and at Whangateau, NI, seldom used elevated perches as calling posts (Barlow 1983; Parker 2002). Near Karamea, SI, territorial calls given from conspicuous perches, whereas calls given from within dense vegetation were subdued, and used almost exclusively to maintain contact between members of pair or family-group (Best 1979b). The most vocal birds are territorial males, and non-territorial birds tend to remain silent (Best 1973). Any disturbance increases vocal activity (Best 1973). **ANNUAL PATTERN:** Territorial Advertising Calls (TAC) uttered most often in Oct.–Mar. (Cunningham 1949; Stidolph 1949; Best 1973; Barlow 1983), but can also be heard in winter and early spring (Hodgkins 1949; Harris 1987; Heather & Robertson 2000; Parker 2002). Near Invercargill, SI, frequency and intensity of Chittering increased after May (Barlow 1983). **DIURNAL PATTERN:** Frequency of calling tends to be fairly constant throughout day, with increased levels of vocal activity in early morning and at dusk (Buller 1888; Turbott 1967; Best 1979b). Near Karamea, SI, TAC can be heard throughout day, but most



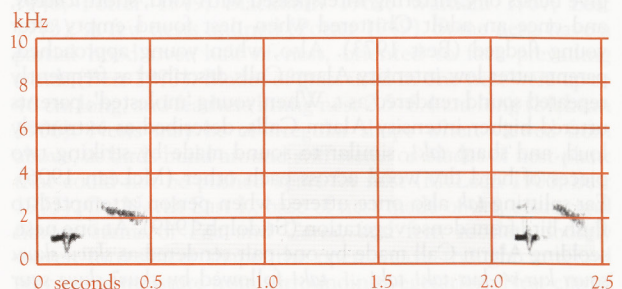
often 06:00–08:00 and 18:00–20:00; sometimes call for >30 min (Best 1979b). On Codfish I., one began to call at 05:30 and called for 20 min (Blackburn 1968). **EFFECT OF ENVIRONMENT:** On calm days, loud calls (e.g. TAC) audible over >70 m if uttered above level of vegetation; audible over c. 40 m in open forest; and over  $\leq$ 20 m in dense undergrowth. Wind noise markedly reduces carrying distance of calls. Rate of calling much higher in areas of dense vegetation than in areas of more open habitat (Best 1973). Call less often when windy, but often increase calling activity after rain (Parker 2002). At unknown location, Tee-oo Call was uttered at intervals of 3–4 s on hot summer days (McLean 1906). **SEXUAL DIFFERENCES:** Males utter wider variety of calls than females, and only males give TAC (Best 1973; see below). **DUETTING:** Duets consists of two calls uttered as if by a single bird; male gives first call and another bird, usually female partner, responds immediately with second call (Buller 1888; Watt 1947, 1949; Cunningham 1949; Sansom 1949; Turbott 1967; Best 1973; Jenkins 1978; Heather & Robertson 2000; Oliver). First call uttered by male either TAC or Contact Call (see below), and can consist of 1–6 notes (Jenkins 1978). Responding bird invariably gives a single stereotypical note (Jenkins 1978), corresponding to Tchip type of Contact Call (Best 1973; see below). U-tick Call is well-known example of antiphonal duet (see below). Gap between first and second call of duet sometimes as short as 0.8 s (Jenkins 1978). Female often responds to each call of male during first few minutes of bout of TAC, but later responds infrequently; males often continue to call long after female stops answering (Best 1973). Duetting occurs regularly between adults of established pairs; very occasionally occurs between adults and their fledgelings (Best 1973). Sometimes more than one bird gives second call in response to first call of a single bird (Jenkins 1978). Thought to function in maintenance of pair-bond (Best 1973; Jenkins 1978). Duetting heard throughout year, but given more often when breeding (Best 1973). When breeding, often duet while building nest and during incubation change-over (Best 1973). In any one area, first call invariably differs from one bird to the next, and each caller has repertoire of up to four different versions of first call. There is some tendency towards regional dialects in second call, but not in first call (Jenkins 1978). **COUNTER-SINGING:** Prolonged performance of TAC often appeared to induce neighbouring males to respond, usually with similar calls (Turbott 1967; Best 1979b; Barlow 1983; see Social Behaviour). **RESPONSE TO PLAYBACK AND IMITATION:** Border disputes sometimes initiated by playing recordings of calls (Best 1973; Parker 2002). Birds often excited by and attracted to imitation of TAC and other notes (Buller 1888; McLean 1906; Turbott 1967). Respond most emphatically to own calls or those of neighbours, but quickly become habituated to playback (Parker 2002). Once responded to playback of taped calls of Spotted Crane (Skinner 1979; see Social Behaviour: Agonistic behaviour). **NON-VOCAL SOUNDS:** Rapidly beating wings made a whirring sound rather like a sparrow, but quite distinct (Roberts 1959).

**Adult male** Classification of calls based on that of Best (1973). **TERRITORIAL ADVERTISING CALLS (TAC):** Usually long, moderately loud to loud calls, often given continuously for >30 min. Uttered only by territorial males, but often answered by female partner in duets (see above); and most often uttered by males of pairs without young (Best 1973). Probably same as Organ Call of Barlow (1983), which described as single note sometimes repeated in slow sequence of 8–10 calls; one exceptionally long sequence lasted c. 7 min. On Snares Is, calls appear to differ between individuals, and males respond more vigorously to calls of strangers than to familiar calls (Best 1973). On Snares Is, these calls could be grouped into three types, based on sound of call (i.e. U-tick, Tee-oo and Tcherp Calls), and these or similar sounds have

been recorded at other locations (e.g. Best 1973). **U-TICK CALLS:** Often considered usual call (e.g. Buller 1888; McLean 1906; St Paul 1977; Oliver), and has been recorded in many different populations. Can be given by male alone (Best 1973; Heather & Robertson 2000), but usually uttered as antiphonal duet, with U given by male, and female giving tick (Jenkins 1978; see also Duetting). Various described as sharp, melancholy, metallic or bell-like double call, and usually rendered as *u-tick* or similar (Buller 1888; Moncrieff 1924; Watt 1947, 1949; Cunningham 1949; Potter 1949; Roberts 1959; Turbott 1967; St Paul 1977; Falla *et al.* 1981; Heather & Robertson 2000; Oliver); and usually uttered at medium speed and moderate to loud volume (Best 1973). See Sonagrams A and B for calls that probably correspond to U-tick duets: each sonagram shows two duets from a longer sequence, and in each, response time in second duet is faster than in first (time between duets in Sonagram A has been reduced by 1.0 s). On Snares Is, variations include *dtew-tchick*, *whu-dtick* and *whuddit* (Best 1973). Call also rendered as sharp *tū-ʻt*, uttered at intervals of 6–7 s (McLean 1906), probably this call. U-tick Call possibly functions in pair-bond maintenance and as Contact Call between members of a pair. **TEE-OO CALLS:** Uttered only by territorial males, with varied volume and length. On Snares Is, variations include *tee-touw*, *blee-touw*, *ee-ouw*, *thwee-ouw* or *tou-ee*; sometimes only first part of call given (Best 1973). Call described as slightly plaintive, ringing *tū-ūlt*, and sounding similar to distant ring of an anvil (McLean 1906), probably variation of same call (Best 1973). **TCHERP CALLS:** Call of moderate volume and medium length with constant pitch, sounding like *tcherp*, and given while foraging. Several variants by territorial males are loud and long; uttered as *tcherp* or *tchep* with pitch initially constant, but rising sharply in latter half of call, or uttered as *tchorp* with pitch initially constant, but descending in latter half of call giving a slur (Best 1973). Sonagram C probably shows two Tcherp Calls; the time between the calls has been reduced by 1.5 s. **OTHER TERRITORIAL ADVERTISING CALLS:** Very occasionally utter melodic warble of about six rather metallic notes (Falla *et al.* 1981; Heather & Robertson 2000). One call described as loud, almost bell-like note, once rendered as *toick!* (Potter 1949; Stidolph 1949).



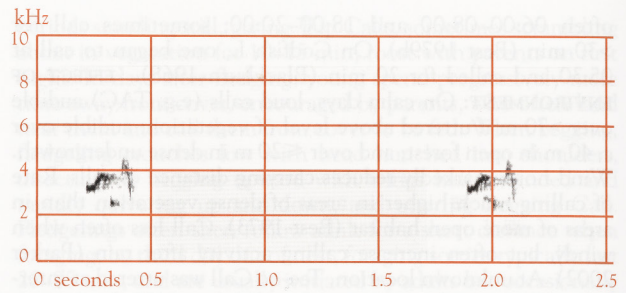
A B. Lay; Big South Cape I., off Stewart I., March 1984; P106



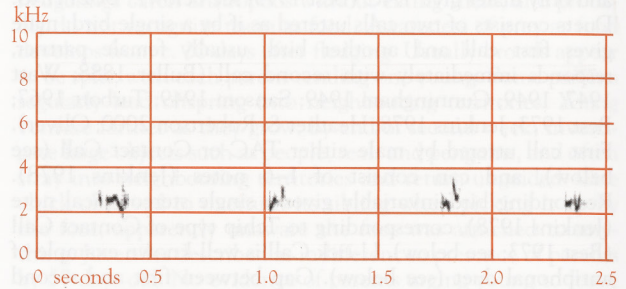
B C.M. Miskelly; Snares Is, Feb. 1986; P106



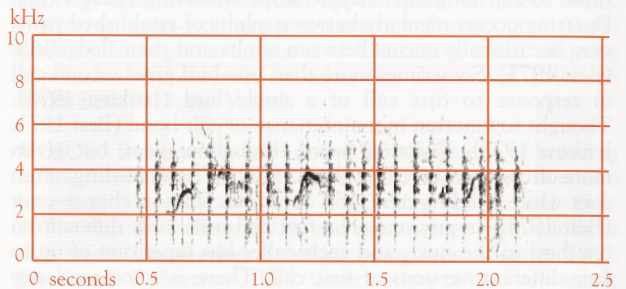
The following calls possibly describe duets: loud penetrating *sto-pit* (Stidolph 1949); *tropip* (Hunt 1949); plaintive ringing *tū-wē-lt!* (McLean 1906); and call consisting of two very musical notes of upward cadence, with timbre like that of Bellbird *Anthornis melanura* (Blackburn 1967). **CONTACT CALLS:** While foraging, sometimes utter calls of soft to moderate volume and of medium duration, usually including calls of TAC types and Tchup Calls (Best 1973). When separated from partner, male usually gives loud, long, distinct and clear-cut calls, mainly of Tcherp, Too-ee and Tching types (Best 1973). **TCHIP CALLS:** Typically abrupt short calls, varying from soft to loud, and similar to Tcherp Calls, but shorter. Only given by males, with variations rendered as *blut*, *bluck*, or *took*. When nestlings asleep, adult of either sex sometimes gave Tchup Call to induce begging. Other variations uttered by males rendered as *tchic*, *tchap*, *toup*, and *tchop* (Best 1973). The four calls shown in Sonagram D are probably variants of the Tchup call; the spacing between the four calls is artificial. Call rendered as *tu-it* (McLean 1906) probably corresponds to combined male-female duet of this call (Best 1973). **TCHING CALLS:** Very distinct, clear, metallic sound uttered as *tching* with slightly rising pitch in latter half of call. Uttered only by males at loud volume and long duration. Another form uttered as *tcheong* with pitch initially rising then levelling out or falling in latter half of call (Blackburn 1967; Best 1973). **AGGRESSIVE CALLS** (= Territorial Defence Calls of Best 1973): Consists of Chittering interspersed with loud, short Tcherp, Tchup, U-tick, and Too-ee type calls (Best 1973; Jenkins 1978; Barlow 1983). Usually uttered during Threat Display, and given at increased rates with increased intensity of Display. Sometimes give low-intensity version during change-over at nest, and pair once uttered low-intensity version before copulation (Best 1973). Fighting often occurs when uttered at high intensity, but seldom when uttered at low intensity (Best 1973; see Social Behaviour). **CHITTERING** (= Clapping of Barlow 1983): A series of rapid clicks (Best 1973; Jenkins 1978; Heather & Robertson 2000); see Sonagram E (in which it was not possible to remove some background calls). While Chittering, bill rapidly opened and closed (Barlow 1983). Uttered in variety of situations, most often during territorial boundary disputes and when alarmed, but also when juvenile moved through territory, while selecting nest-site, at change-over during incubation, during hatching or feeding young, and when egg broke in nest (Best 1973; Barlow 1983; Parker 2002, 2004). Call described as throaty, muffled, purring sound (Breen 1956) possibly this call. **ESCAPE CALLS:** Loud, sharp and rapidly repeated *tcheeps*; given when fleeing person; usually given in flight, or when giving flight-intention movements (Best 1973). **ALARM CALLS:** When alarmed, usually utter short, abrupt calls, probably Tchup Calls, sometimes amid Chittering. On Codfish I., when disturbed at nest, utter Tchup Calls rendered as *tchic* or *tchip* (Blackburn 1967). Calls described as sharp *philip*, *philip!* and uttered when excited or alarmed (Buller 1888; Turbott 1967) probably type of Tchup Call. On Snares Is, when eggs or young threatened, parents give bursts of Chittering interspersed with loud, short *tcheeps*, and once an adult Chittered when nest found empty after young fledged (Best 1973). Also, when young approached, parents utter low-intensity Alarm Calls described as frequently repeated sound rendered as *t*. When young 'molested', parents uttered higher intensity Alarm Calls, described as extremely loud, and sharp *tak!*, similar to sound made by striking two pieces of hard dry wood across each other (McLean 1906). Ear-splitting *tak* also once uttered when person attempted to flush bird from dense vegetation (Stidolph 1949). At one nest, scolding Alarm Call made by one pair rendered as *skwū skwu squur kw-r-r-kur tak! tak! ... tak!* followed by *skwū skwe squur tak! squur-r tak! tak!*; these uttered by both sexes (McLean 1906). One once uttered *piup* when approached, which



C L.B. McPherson; Codfish I., off Stewart I., Nov. 1989; P106



D L.B. McPherson; Raypehu Swamp, King Country, NI, Jan. 1988; P106



E F. de Hamel; L. Waiholā, Otago, SI, Aug. 1975; P106

possibly Alarm Call (Hunt 1949). Alarm Calls sometimes given during Submissive Displays (Best 1973). **DISTRESS CALLS** (= Scream Calls of Best 1973): Screaming call given when handled or captured, and appears to elicit mobbing response if given in presence of predator (Best 1973). **Other calls** Very occasionally utter sharp, clear, *pit* call (Breen 1956). Sometimes when moving through dense vegetation, one bird of pair utters *plik* and the other *choot* (Falla *et al.* 1981). When adult returned to feed fledgeling but fledgeling absent, adult called *ding* softly (Best 1973). Other descriptions of calls include: *kip* heard from both birds of pair (Hunt 1949); single soft *click* (Falla *et al.* 1981); and feeble 2-3-s note like rubbing fingernail along comb or winding a watch, and only audible at close range (Stidolph 1949).

**Adult female CONTACT CALLS:** While foraging, sometimes utter calls of soft to moderate volume and medium duration, usually including calls of Tcherp or Tchup type (Best 1973). **TCHERP CALLS:** Like those uttered by adult male while foraging (Best 1973). **TCHIP CALLS:** During duets, females utter *tchep*, *teort*, *tep*, or *tet* in response to TAC of male (Best 1973). Sometimes given as *tick* part of U-Tick call in answer to male as part of duet; female never utters first part of U-Tick (Potter 1949; Best 1973). Second call of duet (see Duetting) said to be always given as antiphonal response and never on its own (Jenkins 1978), though said to sometimes utter *tick* without preceding call of male (Stidolph 1949; St Paul 1977). As in



adult male, sometimes give *tchip* call to induce begging in young nestlings (Best 1973). Other variations uttered by females at other times include *tchic*, *tchap*, *toup*, and *tchop* (Best 1973). **AGGRESSIVE CALLS:** Consist of Chittering interspersed with loud, short *Tchip* Calls; mainly used in territorial defence (Best 1973). Once, pair uttered low-intensity version of call before copulation, and given again by female for 30 s after copulation (Best 1973). **CHITTERING:** As that of adult male. **ESCAPE CALLS:** As those of adult male (Best 1973). **ALARM CALLS:** As those of adult male (Best 1973). **DISTRESS CALLS:** As that of adult male. Once uttered by adult female while fighting with adult male during a border dispute (Best 1973). **Other calls** Once heard to utter trill during possible courtship display (Stead 1948; see Social Behaviour: Sexual Behaviour).

**Young BEGGING CALLS:** Fledgelings utter a soft, harsh *uurr* (Best 1973). Faint whispering given by 3–4-day-old nestlings (Potter 1949), possibly begging. **CONTACT CALLS** (= Pleasure Calls of Best 1973): Soft calls uttered by fledgelings and rendered as *tsip*, *tsap* and *tschip*; thought to be used to maintain contact with parents, and uttered less often as fledgelings get older (Best 1973). **TSIP CALL:** Nestlings first give *Tsip* Calls at 17 days old, and often also given by fledgelings. At 21 days old, fledgelings often give *Tsip* Calls for >30 min, at rate of up to 40 calls/min. Fledgelings responded to Chittering of adults with *Tsip* Calls (Best 1973). **TCHIP CALLS:** From 31 days old, fledgelings respond to adult calls with typical adult-female duet response of *tschep*, *teart* or *tchip*, as well as typical fledgeling *Tsip* (Best 1973). Other variations uttered by young at other times include *tchic*, *tchap*, *toup*, and *tchop* (Best 1973). **TCHERP CALLS:** Similar to those uttered by adult male while foraging (Best 1973). **CHITTERING:** Given by independent juveniles at any time in response to people, other Fernbirds, and sometimes other species (Barlow 1983). **DEVELOPMENT OF TAC:** On Snares Is, three 46-day-old fledgelings heard uttering *thiroo*, a long call with falling cadence; also gave *thoo*, a long call with rising cadence; and *theoo*, similar to Tee-oo Call of adult male, but slurred together. Gave typical Tee-oo Calls by 54 days old (Best 1973). Near Invercargill, SI, after Nov., fledged young practised these calls, which did not have tonal purity of adults and often 'choked' and 'crackled' (Barlow 1983). **DISTRESS CALLS:** From c. 17 days old, nestlings or fledgelings utter screaming call when handled, similar to that of adult male (Best 1973). Calls uttered when young handled and rendered as *squū* and *squrr* (McLean 1906), probably same call. Also when handled, young very occasionally give faint *t* (McLean 1906). **ESCAPE CALLS:** As those of adult male (Best 1973). **Other calls** Once, very gentle *tiitiiti* heard, possibly given by young (Hunt 1949).

**BREEDING** Subspecies *vealeae* well known from study at Whangateau, NI, Nov. 2000–Feb. 2001 and Dec. 2001–Mar. 2002 (Parker 2002). Nominative *punctata* well known from detailed study at Golden Bay, SI, Dec. 1977–Feb. 1978 (Elliot 1978); and at L. Waipori, SI, Dec. 1979–Nov. 1983 (Harris 1987). Subspecies *caudata* of Snares Is well known from detailed study of breeding biology on North East I. over two breeding seasons, Nov. 1970–Mar. 1971 and Dec. 1971–Mar. 1972 (Best 1973); other subspecies little known, though some information from small study of *wilsoni* on Codfish I. in Dec. 1966 (Blackburn 1967). Multi-brooded; sometimes raising three broods in a season (see Laying).

**Season** Throughout range, eggs, Aug.–Feb.; and nestlings, Nov.–Mar. NI (subspecies *vealeae*): Eggs, Nov.–Feb.; nestlings, Nov.–Feb. (McLean 1906; Parker 2002; CSN 3). SI (nominative): Eggs, Sept.–Feb. (Barlow & Moeed 1980; Harris 1987; Oliver; CSN 8, 45); nestlings, Oct.–Feb. (Barlow & Moeed 1980; Harris 1987; Oliver). Unspecified breeding, including fledgelings, Sept.–Mar. (Barlow 1983; Harris 1987; CSN 26). **STEWART I. (stewartiana):** Eggs, late Aug. to Jan. (Guthrie-

Smith 1914; Heather & Robertson 2000). No other information. **CODFISH I. (wilsoni):** Eggs, late Aug. to Jan. (Blackburn 1967; Heather & Robertson 2000). No further information. **SNARES IS (caudata):** Eggs, early Nov. to late Feb. (Warham 1967; Best 1973; Heather & Robertson 2000; Miskelly *et al.* 2001; CSN 24); over two seasons, first clutches laid early Nov. to mid-Jan.; replacement clutches, mid-Dec. to early Feb.; second clutches early Jan. to mid-Feb. (Best 1973, which see for further details and variation between seasons). Nestlings, mid-Nov. to mid-Mar. (Stead 1948; Best 1973). Unspecified breeding, including fledgelings, Oct.–Mar. (Stead 1948; Best 1973; Miskelly *et al.* 2001).

**Site** Well concealed and well protected from wind and rain. All subspecies usually nest low in centre of grass tussock or dense clump of rushes, reeds or ferns; occasionally in shrub or hollow log; do not nest in crowns of ferns (McLean 1906; Stead 1948; Potter 1949; Weeks 1949; Blackburn 1967; Miskelly *et al.* 2001; Oliver). Once nested in pine tree (CSN 45). Sometimes a slightly enlarged passage through rush or grass stems leads from nest to wetland through which sitting bird leaves nest (McLean 1906; CSN 6). Of 50 nests on North East I., 17 (34%) were among fronds of Shore Spleenwort *Asplenium obtusatum*, 11 (22%) in tussocks of *Poa tenmantiana*, nine (18%) in sedge *Carex*, six (12%) in tussocks of Blue Shore-tussock *Poa astonii*, four (8%) among fronds of Prickly Shield Fern *Polystichum vestitum*, two (4%) in hollow *Olearia* trunks and one (2%) among fronds of fern *Blechnum durum*. *Asplenium* and *Polystichum* ferns often grow in dense thickets with closely packed stems that provide strong foundations and protection from damage, such as by Sooty Shearwaters *Puffinus griseus* landing in evening; nests placed on a *Poa*-tussock slope used as launching and landing site by Shearwaters were built at least 20 cm down into tussock (Best 1973). Near Invercargill, SI, usually nest in rushes within 3–4 m of a shrub (Barlow 1983). On Codfish I., pair nested in *Gahnia* in sheltered area (Blackburn 1967). Several records of two nests 12–40 m apart (see Social Organization: Breeding dispersion). **MEASUREMENTS (cm):** Height of nest: 30–120 (n=3) (Guthrie-Smith 1914; Potter 1949; Blackburn 1967); 15–75 (Heather & Robertson 2000); one nest 1.8 m in pine tree (CSN 45). On North East I., 33 (4.25; 0–200; 50): 47 nests 0–100, three 100–200 above ground (Best 1973).

**Nest, Materials** Deep cup in hollow formed in nest-plant. Foundation and sides of nest mainly built of rushes, reeds or grass stems and blades, and sometimes rootlets, with finer material on inside of nest rather than on outside; usually lined with grass and feathers, including those of ducks *Anas*, Mottled Petrel *Pterodroma inexpectata*, Sooty Shearwater, Swamp Harrier *Circus approximans*, Purple Swamphen *Porphyrio porphyrio*, Weka, rails, Great Skua *Catharacta skua*, Silver Gull *Larus novaehollandiae*, Antarctic Tern *Sterna vittata*, parakeet *Cyanoramphus* and European Goldfinch *Carduelis carduelis*; feathers lightly fixed by shaft to wall of nest, curling over from rim to hide contents of nest; one nest contained a few tufts of wool (McLean 1906; Guthrie-Smith 1914; Stead 1948; Potter 1949; Blackburn 1967; Warham 1967; Best 1973). A few nests unlined (Potter 1949). Some nests have a partial hood over half of nest, oriented to face prevailing winds (Best 1973). Blades of grass used in one nest were up to 46 cm long, and feathers lining nest 2.5–6.4 cm long (McLean 1906). Nests may be of irregular shape when viewed from above, as birds build around stiff stems or blades of nest-plant that could not be pushed apart for nest (McLean 1906; Best 1973). On North East I., base of nest made of dry, coarse and fibrous stems of *Poa* and *Carex*, and fern rootlets, loosely woven into saucer shape, the open weave thought to retard seepage of moisture from surrounding vegetation. Nest-cup of stems of Blue Shore-tussock then built on base but not woven into it, with curved bottom of cup laid down by interweaving



grass strands placed at right angles; strands often >30 cm long and brought to nest one or two at a time; walls of cup then built up using stems of Blue Shore-tussock arranged latitudinally and interlaced to form rigid, closely packed structure. Feathers and more stems of Blue Shore-tussock then added to bottom of nest, the feathers only lightly fixed to nest by their shafts; in some nests, material mostly comprised feathers of Great Skua 8–10 cm long and neatly arranged so that they pressed against walls of nest and were not fixed; most nests contained 30–40 feathers, but sometimes only 5–10, usually from Sooty Shearwater. During building, adult stands on edge of nest and pushes one end of Blue Shore-tussock stem into framework with its bill; bird then sits and shuffles round, pushing strand into walls with bill and breast; displaced strands and loose ends tucked back into nest (Best 1973, which see for details of variation in construction of nest according to site and material). Stems of nest-plant very occasionally incorporated into material of nest; nest can usually be lifted out of tussock (McLean 1906). **CONSTRUCTION:** Both sexes build (McLean 1906; Best 1973). One pair made 29 visits to nest with material in 31 min (CSN 26). During 2-h observation of another pair, most visits to nest 20–60 s, but three times spent 2–3 min incorporating material; intervals between visits usually 2 min (20–540 s; no N) (Best 1973). On Snares Is, material can be carried >90 m to nest (Stead 1948; Oliver), and sometimes >150 m (Best 1973). On Snares Is, building can start within 2 days of selection of nest-site; nests usually completed within 3 days if not interrupted by rain, but up to 20 days during bad weather. Building activity greatest in fine weather after a long period of rain; becomes sporadic after long periods of fine weather, occurring mostly 05:00–09:00 and 17:00–20:00; building continued on dull days during dry weather but infrequent or non-existent on dull days between rain periods; at one nest, building stopped when squall passed over and did not resume for hours (Best 1973). One pair continued to add a few feathers to nest during incubation (Guthrie-Smith 1914). Both adults carry out maintenance of nest during incubation and nestling periods, rearranging displaced lining or tucking projecting stems back in nest, sometimes removing stems, then weaving them back in. Soiled material is removed and sometimes fresh material is gathered while foraging (Best 1973). Build new nest for subsequent clutches; one pair began building a few days after young from previous nest fledged (Stead 1948). **MEASUREMENTS (cm):** On North East I.: internal diameter 6.9 (0.54; 4.0–9.0; 30); internal depth 6.6 (1.01; 4.0–9.0; 30); and thickness of nest-wall 2.6 (0.73; 1.0–4.0; 30) (Best 1973). For average nest: external diameter 11.4; external depth 11.4; internal diameter 5.8; internal depth 6.4 (McLean 1906); for unknown number of nests: internal diameter 5.5; internal depth 6.5; and thickness of nest-wall 1–3 (Stead 1948).

**Eggs** Subspecies given separately but not known to what extent, if at all, differences reflect differences between observers. *NI* (subspecies *vealeae*): Long oval; dull white to faintly creamy white, closely dotted all over with violet, and with overlying larger and more thinly distributed blotches of purple-brown; dots denser on large end (McLean 1906). Also described as pinkish, spotted all over with light brown and purplish, but markings concentrated at large end (Oliver). *SI* (nominate *punctata*): Oval; white, spotted reddish brown (Oliver). *STEWART I.* (subspecies *stewartiana*): Pale pinkish, dotted all over with reddish brown, concentrated in band round large end (Guthrie-Smith 1914; Oliver). *CODFISH I.* (subspecies *wilsoni*): Broadly elliptical; pinkish, with light mauve-brown spots all over but more heavily marked at large end (Blackburn 1967). *SNARES IS* (subspecies *caudata*): Oval. Pigmentation becomes paler with successive eggs of clutch, with differences between first, second and third eggs consistent and pronounced. Ground-colour pale mauve-pink, heavily flecked

with mauve-brown to purple-brown dots, concentrated in band round large end; dots on some eggs up to nearly 1 mm in diameter; second clutches similarly marked but dots paler; third clutches have very pale purple-brown dots almost evenly distributed over shell (Best 1973). Also described as white or pale mauve-pink; with first laid egg heavily spotted all over with red and mauve; and last laid paler with few or no spots and with indistinct mauve blotches (Stead 1948). **MEASUREMENTS:** *VEALEAE:* Mean of a C/4, 22.4 × 14.7; of another C/4, 20.3 × 14.7; an average egg, 20.1 × 14.7 (McLean 1906). Two eggs quoted by Oliver (18 × 14, 18 × 14.5) seem unusually small and outside range of all other measurements for all subspecies. *NOMINATE:* 20.5 × 15 (Heather & Robertson 2000). *WILSONI:* 21.3 (0.80; 20.4–22.5; 9) × 16.5 (0.19; 16.2–16.9) (Blackburn 1967); 22.5 × 15.5 (Heather & Robertson 2000). *STEWARTIANA:* 21.8 × 15.8, 22.6 × 15.4, 24.0 × 15.8 (Oliver); 22.5 × 15.5 (Heather & Robertson 2000). *CAUDATA:* 22.9 (0.68; 20.7–24.2; 73) × 16.7 (0.48; 15.8–17.9) (Best 1973); 23.4 (1.15; 21.5–24.5; 6) × 16.4 (0.38; 16.0–17.0) (Stead 1948). **WEIGHT:** *VEALEAE:* At c. 9 days incubation, 2.25 (no N); at <9 days incubation, 2.27 (no N) (McLean 1906).

**Clutch-size** One to five, usually two or three (McLean 1906; Blackburn 1967; Heather & Robertson 2000; Oliver; see below). Few quantitative data. *NOMINATE:* 3.7 (1–5; 46) (Harris 1987). *VEALEAE:* 2.8 (2–4; 18) (Parker 2002). **CAUDATA:** 2.42 (0.56; 31); C/1 × 1, C/2 × 16, C/3 × 14; mean size of clutches in Nov., 2.25 (n=4); Dec., 2.43 (n=14); Jan., 2.5 (n=10); Feb., 2.33 (n=3) (Best 1973). Also said to be usually C/2, occasionally C/1 (5%) or C/3 (10%) (N not known; Stead 1948); 2 × C/3 (Warham 1967).

**Laying** Eggs laid on consecutive days, probably in morning (McLean 1906; see below). On Snares Is, laid on consecutive days in ten clutches; first and second eggs laid 2 days apart in one clutch; and two eggs laid 3 days apart in another clutch. However, latter two clutches were not incubated. In one clutch, first egg laid just before 18:30 and second egg before 09:40 next day. For 20 eggs on North East I., 15 (75%) were laid before 10:00, ten (50%) before 09:00 and four (20%) after 12:00; latest between 17:00 and 18:30 (Best 1973). In one nest, laying began 2 days after completion of nest (McLean 1906). Multi-brooded, sometimes raising three broods in a season; will re-lay after failure (Stead 1948; Best 1973; Harris 1987; Parker 2002). Replacement clutches laid 19.7 days (11.86; 5–43; 7) after desertion of first clutch; second clutches laid 37–43 days (n=3) after first brood fledged (Best 1973).

**Incubation** Since eggs thought to hatch in order laid (Best 1973; see below), probably begins when first egg laid. Both sexes incubate (Stead 1948) about equally (Best 1973). One instance of both sexes on nest at same time, when eggs were hatching (Guthrie-Smith 1914). Sitting bird often leaves nest as soon as calls of relieving bird heard, or sits alert till mate arrives; sometimes relieving bird moves to and from nest several times before sitting bird leaves; changeover usually takes 5–8 s, occasionally >20 s, seldom only 1–2 s (Best 1973). During rain, sitting bird sits tightly, with wings spread against sides of nest so that rain runs off to grass lining, and does not vacate nest till relieving bird is beside it; on fine days, often sit with dorsal feathers fluffed up and leaves nest more readily, before mate appears (Best 1973). On North East I., mean length of stints of incubation, for females, 14 min 37 s (10 min 45.9 s; 6 s – 35 min 4 s; 31); for males, 15 min 52 s (8 min 31.4 s; 2 min – 33 min 5 s; 28). At Whangateau, mean length of stints of incubation 22 min (1–42; 11). At Golden Bay, mean length of stints of incubation 16 min (10–20). Eggs hatch asynchronously, in order laid; length of hatching period (±3 h): for C/2, 12.8 h (7.08; 6–22; 6); for C/3, 13.3 h (6.39; 6–23; 6) (Best 1973). One brood of four hatched overnight



(McLean 1906). Eggshells removed and discarded 10–20 m from nest after nestling has fully emerged; fracturing of eggshell occurs latitudinally round broadest part of egg (Best 1973). **INCUBATION PERIOD:** From completion of clutch, 14.5 days ( $n=1 \times C/4$ ) (McLean 1906); on main islands, 12–15 days, mostly 13 (Heather & Robertson 2000) though seems shorter than other studies. On Snares Is, from laying to hatching of last egg, 16.1 days (0.64; 15.4–17.5; 7) (Best 1973); 15–19, mostly 16 days (Heather & Robertson 2000). Five clutches were attended for 21.6 days (13.4; 0–36) before being deserted (Best 1973).

**Young** Altricial, nidicolous. Blind and naked at hatching (McLean 1906; Best 1973; Harris 1987; K.A. Parker). **DEVELOPMENT:** At c. 12 h after hatching, feather-tracts are visible as diffuse areas of very fine pores through which hair-like filaments project minutely above skin. At 1 day old (Day 2), three begging spots appear on tongue, and dark red-brown zone on back marks position of feather-tracts. At 2 days old, eye-slits start to form; areas of feather-tracts on back, wing, head and abdomen appear as grey waxy patches. At 3 days old, pins of feathers start to emerge through waxy skin of feather-tracts. At 4 days old, splits start to form along eye-slits; and feathers start to emerge from pins on wings and back. From 5 to 7 days old, eye-slits advance and feathers continue to grow till, by 8 days old, eyes are fully open, primary feathers are 7–9.5 mm long, feathers of abdomen and back 4–5 mm long, and tail 2–3 mm long. At 11 days old, primary feathers 14–17.5 mm long, feathers of abdomen and back, 7–8.5, and tail 4–5.5 mm long. At 14 days, largely feathered except for small area on belly. At 17 days, fully feathered (Best 1973). Claimed that eyes fully open, and feather-pins start to emerge through skin on back, on Day 3; and at 15 days old, tail-feathers c. 19 mm long (McLean 1906). For extra details on development of young, see Harris (1987). **Growth** Approximate figures, from growth-curves for one brood (Best 1973): **WEIGHT** (g): At 4 days old 11–12, 6 days 18–19, 8 days 23–26, 10 days 26–29, 12 days 29–30, 16 days 32–34, 20 days 32–33. **TARSUS** (mm): 4 days 12.5, 6 days 15.5, 8 days 19.5, 10 days 20.5–21, 12 days 22.5–23.5, 16 days 23–23.5, 20 days 23.5–24. **BILL** (mm): 4 days 8, 8 days 9–9.5, 12 days 10, 16 days 11.5–12, 20 days 12. **WING** (mm): 4 days 12–14, 6 days 19.5–20, 8 days 23–26, 11 days 33–36, 13 days 40–43, 16 days 47–49, 19 days 51–53. **TAIL** (mm): 4 days 2, 8 days 4, 12 days 10–11, 16 days 19.5–21, 19 days 26–29. Tarsus-length of nestlings near fledging age, 93–>100% mean adult length; bill-length of nestlings 20–21 days, 78–90% mean adult length; wing-length of nestlings 20 days old, 77–89% mean adult length; length of rectrices of nestlings, 20 days old, 22–49% mean adult length (Best 1973). **Parental care** Both sexes brood (Warham 1967; Best 1973; Harris 1987; Parker 2002). In one nest on Snares Is, during first 4 days after hatching, adults each spent c. 30 min/h on nest, though female spent slightly longer than male; after 4 days, both spent progressively less time on nest (Best 1973). For other nests, mean period of adult attendance varied with size of brood; in nest with B/1 from 3 to 7 days old, adults attended nest for  $\geq 50$  min/h; in nest with B/2 from 3 to 8 days old, 22–58 min/h; in nest with B/3 from 5 to 8 days old, >30 min/h (Best 1973). Both sexes feed nestlings (Potter 1949; Best 1973; Harris 1987; Parker 2002; Oliver). One male brought food to a nestling within 10 min of its hatching (Guthrie-Smith 1914); sometimes parents give Tchup Call to induce begging in young nestlings (Best 1973). Both parents remove faecal sacs, dropping them up to 25 m from nest. Nestlings usually defecate a few seconds after being fed (Potter 1949; Best 1973) and often move to deposit faecal sacs on edge of nest. Parents usually pause after feeding nestlings to collect faecal sac, and may even prod cloaca of nestling if faecal sac is not produced; also remove any sacs deposited between feeds, when parents absent. If faecal sac broken, parent

may make several trips to carry faeces away, and will also remove soiled nest-material. Wipe both sides bill after disposing of faecal sacs. Nest sanitation apparently declines during last few days of nestling period. Some nests become infested with ectoparasites; one nest contained 1698 flea larvae; and another, 129 adult fleas (Best 1973); and at Whangateau, six nests contained mean of 34 (0–115) adult and 36 (0–139) protonymph Starling Mites *Ornithonyssus bursa*.

**Fledging to independence** **FLEDGING PERIOD:** On mainland, c. 15 days (McLean 1906); 15–17 days, mostly 17 (Heather & Robertson 2000); at Whangateau, 17 ( $n=1$  nest) or 18 ( $n=1$  nest) days; at L. Waipori, 15 days ( $n=4$  nests) to 18 days ( $n=1$ ); on Snares Is, 20–21 days (Best 1973). Nestlings usually fledge within 24 h of each other, but occasionally 28 h (Best 1973). One brood of two fledged when parents started rearranging nest-material after feeding visits (Best 1973). Adults and fledgelings often roost in nest at night; fledgelings follow parents and continue to be fed, parents often taking one fledgeling each, though in broods of three, male tended two young and female one; fledgelings begin feeding for themselves c. 20 days after leaving nest, and probably independent by 35–40 days old (Best 1973). Growth of tail of fledgelings: at 8 days after fledging (29 days old), 30–35 mm ( $n=6$ ); 14 days, c. 60 ( $n=11$ ); 25 days, 70–75 ( $n=3$ ); reach adult tail-length 55 days after fledging (Best 1973, which see for further details of growth of fledgelings).

**Success** On Snares Is, from 79 eggs, in 33 clutches ( $C/2 \times 18$ ,  $C/3 \times 14$ ), 42 (53.9%) hatched and 25 (32.1%) young fledged; of 37 eggs that failed to hatch, 20 infertile, nine broken during incubation, and eight deserted; of 17 nestlings that failed to fledge, six (three broods) were mutilated, possibly by parents, three (one brood) died after nest collapsed, one nestling died from cold, one died of a ruptured gut (within 2 h of hatching), and six failed for unknown reasons. Most (76.5%) nestlings died first 10 days after hatching; one fledgeling died before independence and was found as a flattened corpse, having probably been rolled on by a New Zealand Sea-lion (Best 1973). For details of egg and nestling mortality with respect to laying sequence and clutch-size, see Best (1973). Success highest for clutches laid in Nov. and lowest in Dec.: success in Nov. 71% ( $n=7$  eggs); Dec. 21% ( $n=28$ ); Jan. 43% ( $n=28$ ); and Feb. 33% ( $n=9$ ) (Best 1973). Success of first clutches, 28.6% ( $n=56$  eggs in 23 clutches); of second clutches, 75% ( $n=4$  eggs, 2 clutches); replacement clutches, 44% ( $n=56$  eggs, 23 clutches). Remains of eggs found in two nests; recently hatched young disappeared from one nest (Stead 1948). At Whangateau, of 21 nests, ten (47.6%) successfully fledged at least one young, five (23.8%) were preyed on by mammalian predators during incubation, three (14.3%) were preyed on by mammalian predators during nestling period, two (9.5%) were flooded by spring tides and one (4.8%) was abandoned when eggs failed to hatch. At L. Waipori, of 46 clutches, 16 (34.8%) were taken by predators (terrestrial [ $n=6$ ] and aerial [ $n=10$ ]) and 11 (23.9%) failed to hatch. Of 143 nestlings hatched, 50 (35.0%) taken by predators (terrestrial [ $n=13$ ] and aerial [ $n=37$ ]), ten (7.0%) died when deserted, six (4.2%) disappeared and six (4.2%) died when nests flooded. A clutch of three blown out of nest-tree (CSN 45). Two broods of three taken by predators (Guthrie-Smith 1914; Barlow & Moeed 1980). There are no potential nest-predators on Snares Is (C.M. Miskelly).

**PLUMAGES** Prepared by J.S. Matthew. Hatch naked (McLean 1906; Oliver). Fledge in juvenile plumage. Extent of post-juvenile (first pre-basic) moult not known; as no skins could be identified as first immatures it is probable that at least all feathers of head and body are replaced in post-juvenile moult. Once adult plumage attained, probably undergo a complete post-breeding (pre-basic) moult each cycle



producing successive adult (basic) plumages with no change in appearance. N nominate *punctata* described below, based on skins of eight adult males and four adult females (AM, CM, NMNZ).

**Adult** (Definitive basic). Sexes alike. **HEAD AND NECK:** Forehead, rufous-brown (136), indistinctly streaked black-brown (19) on upper forehead. Crown, nape and hindneck, warm brown (37, 121C) or pale rufous-brown (c38) with bold black-brown (19) streaking formed by broad shaft-streaks to feathers. Sides of neck and most ear-coverts, brown (c123) with scattered dark-brown (121) mottling formed by tips to feathers. Narrow cream (54) hind-supercilium extends from above front upper quadrant of eye to above ear-coverts. Loes, buff (c124) or cream (54) with bold dark-brown (121) flecking. Uppermost ear-coverts, dark brown (121), combining with loes to form narrow dark eye-stripe. Eye-ring, cream (54), broken narrowly by dark brown (121) in front of and behind eye; upper edge merges with supercilium and below eye forms obvious pale arc. Malar area, dark brown (121) or off-white (ne) with bold dark-brown (121) mottling. Chin and throat, off-white (ne) or creamy (c54) with dark-brown (121) mottling or short streaking formed by narrow tips or rosethorns to feathers. **UPPERPARTS:** Entirely warm brown (121C) or dull yellowish-brown (c123B) with bold black-brown (19) streaking; feathers, black-brown (19) with broad brown (123, 121C) or yellowish-brown (c123B) edges and concealed grey (87) bases. **UNDERPARTS:** Breast and belly, cream (c54) grading to yellow-brown (123B, 123C) on flanks, lower belly, thighs, vent and undertail-coverts, and with bold black-brown (19) streaking to all except lower belly, vent and thighs; streaking tends to be bolder on flanks. **UPPERTAIL:** Rectrices, black-brown (19) with warm-brown (121C) outer edges, and dark red-brown (221A) shafts (see Structure for further details). **UNDERTAIL:** Patterned as uppertail but ground-colour paler, dark-brown (c121), and shafts, dark brown (219A). **UPPERWING:** All coverts, alula and tertials, dark brown (219) or blackish brown (c20) with light-brown (123A) or warm-brown (121C) fringes. Primaries and secondaries, dark brown (121), slightly paler than tertials, with concealed cream (c92) inner edges and narrow light-brown (123A) outer edges, palest (light brown [223D]) on outer 3–4 primaries. Shafts of remiges, red-brown (35). **UNDERWING:** Secondary coverts, buff (124) with concealed brownish-grey (c79) bases. Marginal and median primary coverts, cream (92) or buff (124) with partly visible dark-brown (121) bases. Greater primary coverts, light greyish (c85) with narrow buff (124) fringes. Remiges, brownish grey (c79) with diffuse creamy (c92) inner edges to primaries and secondaries; shafts, off-white (ne).

**Nestlings** Photos of nestlings (Moon 1992) do not indicate any down present. Lack of nestling down confirmed by other observers (Harris 1987; K.A. Parker).

**Juvenile** No information on nominate *punctata*, but juvenile skins of subspecies *vealeae* (adults of which identical in appearance to nominate [see Geographical Variation]) described here (from two skins [CM, NMNZ]). Very similar to adult, differing by: (1) feathers of body softer and more loosely textured; (2) forehead, brown (c123), only slightly deeper than crown and lacking rufous tones; (3) crown, nape, hind-neck and upperparts, drabber brown (c123) with slightly paler dark-brown (121) or blackish-brown (c119) and more diffuse streaking; (4) mottling or streaking on chin, throat and underparts, slightly paler dark brown (121) and more diffuse than in adult; and (5) fringes to secondary coverts and tertials of upperwing tend to be paler, yellowish brown (c123C) or brownish (pale 123).

**First immature** (First basic). No information. Not certain if this plumage exists as extent of post-juvenile moult unknown (see Moults).

**BARE PARTS** Based on photos (Moon 1979, 1992; *Forest & Bird* 283: p. 38; *Forest & Bird* 295: cover; and standard sources), museum labels (AM) and other sources as cited. **Adult** Bill, dark grey (83) with dull-pinkish (c5) tomia and base to lower mandible; or pinkish brown (219C) with dark-grey (83) culmen. Gape, greyish (c84). Iris, dark brown (ne); also black (AM). Orbital ring, grey (87). Legs and feet, greyish (c84), pinkish brown (221D) or pinkish (c3). **Nestlings** Bill, yellowish grey (ne) with pale-yellow (c157) tomia. Gape, pale yellow (157), swollen. Palate, orange-yellow (18). Pair of large black (89) spots at base of tongue and one small black (89) spot at tip of tongue (Boles 1985). Iris, dark (ne). **Juvenile** Little known. Said to lose yellow coloration to gape by c. 2 weeks after fledging (NZRD) but source of this not known.

**MOULTS** Based on examination of skins of 47 adults and two juveniles (AIM, AM, CM, NMNZ); subspecies combined. **Adult post-breeding** (Probably third and subsequent pre-basic). Complete. Primaries outward, usually starting at p1, but one bird starting at p4. Up to three primaries grow at once. From skins, active moult of primaries recorded: Dec. (1 of 3; PMS 6; nominate [SI]); Feb. (4 of 6; mean PMS 8.5 [5.74; 2–16]); and Apr. (1 of 7; PMS 48; *vealeae* [NI]); rest from Apr. (n=6), four of five in May, three of ten in June and one of four in July had all primaries new; all seven from Aug.–Nov., all five in Jan., and rest from Dec., Feb. and May–July had all primaries worn, less so in those from May–July. NZRD stated that *caudata* from Snares Is undergo post-breeding moult for 5–6 weeks in late Feb. and early Mar. These limited results indicate moult of primaries starts from early to late summer, and finishes mid- to late autumn. Insufficient data to assess geographical variation, if any, in timing of moult. No information on moult of secondaries, but one bird starting moult of tertials before start of moult of primaries or secondaries. One bird starting moult of greater secondary coverts of upperwing before start of moult of primaries, in Oct. Moult of tail centrifugal; starts at t1 during early stages of, or before start of, moult of primaries. Moult of body starts before start of moult of primaries and still active on crown after finish of moult of primaries; recorded as early as Oct. and as late as May. **Post-juvenile** (First pre-basic). Almost no information. Not known if complete or partial; two adult-like skins collected in Apr.–May with worn primaries and rectrices (at time when adults have these feathers fresh) suggest these are retained juvenile feathers. Two juveniles from NI, both in Oct., had not yet started moult of any tract. By 5 weeks after fledging, juveniles said to have crown becoming chestnut colour (NZRD); this may refer to start of post-juvenile moult. **First immature post-breeding** (Second pre-basic). No information.

**MEASUREMENTS** SUBSPECIES *VEALEAE*, NI: (1–2) Skins (AIM, CM, NMNZ): (1) Adults; (2) Juveniles.

	MALES	FEMALES	
WING	(1) 58.3 (3.57; 51–64; 16) (2) 55	57.0 (2.65; 54–61; 5) 54	ns
TAIL	(1) 88.7 (10.47; 70–106; 15) (2) 46	89.8 (6.80; 82–100; 5) 62	ns
BILL S	(1) 15.3 (0.99; 13.6–17.5; 16) (2) 14.6	15.1 (0.35; 14.5–15.3; 5) 12.4	ns
TARSUS	(1) 20.7 (1.44; 17.2–22.8; 16) (2) 22.1	21.0 (0.74; 20.1–21.8; 5) 20.5	ns

SUBSPECIES *VEALEAE*, NI: (3) Live birds, unsexed (Parker 2002).

	UNSEXED
WING	(3) 55.0 (3.56; 26)
TAIL	(3) 92.3 (10.20; 26)
BILL F	(3) 12.0 (1.07; 26)



**NOMINATE PUNCTATA**, SI: (4) Adults, skins (AIM, CM, NMNZ). (5) Live birds, ages not specified (K.A. Parker).

	MALES	FEMALES	
WING	(4) 61.1 (2.23; 56–63; 8)	60.8 (2.50; 58–64; 4)	ns
	(5) 61.9 (2.73; 10)	58.4 (0.93; 7)	**
TAIL	(4) 76.3 (5.74; 69–83; 4)	87.3 (12.63; 77–104; 4)	ns
	(5) 89.4 (3.21; 10)	81.1 (3.21; 7)	**
BILL S	(4) 16.2 (1.24; 15.1–18.4; 8)	15.7 (0.66; 15.0–16.5; 4)	ns
BILL F	(5) 12.4 (0.39; 10)	11.3 (0.43; 7)	**
TARSUS	(4) 22.2 (1.21; 19.7–23.5; 8)	21.5 (0.41; 21.0–21.9; 4)	ns
	(5) 24.1 (1.39; 10)	23.6 (1.05; 7)	

**SUBSPECIES STEWARTIANA**, Stewart I. and associated islets immediately to SW: (6) Adults, skins (AIM, AM, CM, NMNZ).

	MALES	FEMALES	
WING	(6) 61.8 (2.75; 59–65; 4)	62.0 (2.39; 58–65; 8)	ns
TAIL	(6) 84, 87, 93	87.6 (5.18; 78–94; 8)	
BILL S	(6) 15.4, 16.0, 16.1	16.2 (0.65; 15.4–17.3; 8)	
TARSUS	(6) 23.0 (1.11; 22.1–24.5; 4)	21.8 (0.94; 20.1–23.2; 8)	ns

**SUBSPECIES WILSONI**, Codfish I.: (7) Adults, skins (AM, CM, NMNZ).

	MALES	FEMALES	
WING	(7) 63.3 (0.50; 63–64; 4)	–	
TAIL	(7) 90.8 (7.37; 82–100; 4)	–	
BILL S	(7) 17.0 (0.75; 16.4–18.1; 4)	–	
TARSUS	(7) 23.2 (0.65; 22.4–23.9; 4)	–	

**SUBSPECIES CAUDATA**, Snares Is: (8) Adults, skins (AIM, AM, CM, NMNZ).

	MALES	FEMALES	
WING	(8) 70.1 (2.98; 64–73; 9)	69.9 (3.21; 62–73; 10)	ns
TAIL	(8) 84.4 (7.31; 75–92; 8)	84.3 (5.32; 77–92; 9)	ns
BILL S	(8) 18.6 (0.78; 17.3–19.9; 9)	18.1 (1.26; 15.6–20.3; 10)	ns
TARSUS	(8) 23.7 (1.12; 21.5–25.1; 9)	23.2 (0.78; 22.3–24.3; 10)	ns

Unsexed adult *caudata* captured Snares Is: Wing 68.5 (3.00; 65–72; 6); Bill F 14.8 (0.70; 13.8–15.8; 6); Tarsus 22.6 (2.20; 19.1–25.7; 6) (Miskelly *et al.* 2001).

**WEIGHTS** **NOMINATE PUNCTATA**, SI: (1) Adults, from museum labels (NMNZ). (2) Live birds, ages not specified (K.A. Parker).

	MALES	FEMALES	
(1)	23.8 (0.96; 23.0–24.8; 4)	–	
(2)	26.4 (2.09; 10)	24.0 (2.17; 7)	*

Harris (1987) gave mean weight of unsexed nominate *punctata*, 25.3 g (n=18). One adult male *wilsoni* from Codfish I. 26.8 (NMNZ). Unsexed adult *caudata*, captured Snares Is: 36.6 (4.30; 30.5–40.4; 6) (Miskelly *et al.* 2001). Best (1973) gave mean weight of unsexed *caudata* 33.9 (n=36). Parker (2002) gave mean weight of unsexed *vealeae* 18 (1.58; 26).

**STRUCTURE** Wing rather short, rounded at tip; tip of longest primary falls less than one-quarter length of tail when wing folded; wing tip falls shorter than tips of uppertail-coverts. Ten primaries: p6 longest (p7 and p5 often =); p10 17–21 mm shorter, p9 7–9, p8 1–2, p7 0–1, p5 0–1, p4 0.5–1, p3 2–4, p2 3–6, p1 4–7. Very slight emargination to outer webs of p5–p8 and inner webs of p6–p10. Ten secondaries, including three tertials; tips of longest tertials fall short of tips of secondaries on folded wing. Tail long and graduated, venation sparse as barbs only partly connected by interlocking barbules;

ten rectrices; shafts extend slightly beyond venation to give rather spiny appearance; t1 longest, t5 38–45 mm shorter than t1. Bill fairly short, just less than half length of head; upper mandible slightly decurved; slight notch near tip of upper tomium. Tarsus fairly long, compressed laterally; scaling laminiplantar. Tibia fully feathered. Middle toe with claw, 17.3 (1.19; 15.8–18.5; 5); outer toe and inner toes 80–90% of middle, hindtoe c. 90%.

**GEOGRAPHICAL VARIATION** Five subspecies recognized by most authors (e.g. Heather & Robertson 2000; NZCL; NZRD; Oliver; Peters): nominate *punctata* from SI; subspecies *vealeae* from NI; subspecies *stewartiana* from Stewart I. and associated islets (except Codfish I.); subspecies *wilsoni* from Codfish I.; and subspecies *caudata* from Snares Is. Falla *et al.* (1981) suggested that populations from NI and SI insufficiently different to warrant recognition of subspecies *vealeae*, and consequently combined both populations under nominate *punctata*. Some authors considered extinct Chatham Island Fernbird *B. rufescens* (q.v.) as a subspecies of *B. punctata* (Falla *et al.* 1981; NZRD; Peters), but here we follow more recent work (Olson 1990; NZCL) and consider *rufescens* as a full species. For discussion on taxonomic affinities of *Bowdleria*, see family introduction to Sylviidae.

**SUBSPECIES VEALEAE**: Examination of skins of 20 adults from NI and 14 adults from SI (AIM, CM, NMNZ) indicates colour, tone and markings of plumage do not differ. Adults from NI have slightly shorter Wing and Tarsus ( $P < 0.05$ ; sexes combined) than adult males from SI, but not known if variation in size is clinal or abrupt. Validity of subspecies *vealeae* must therefore be questioned (see also Falla *et al.* [1981], and above). See Plumages, above, for description of juvenile *vealeae*.

**SUBSPECIES STEWARTIANA**: Very similar to birds from NI and SI. Adults do not differ on measurements from nominate *punctata*; adult *stewartiana* have longer Wing, Tarsus ( $P < 0.01$ ) and Bill S ( $P < 0.05$ ) than adult *vealeae* (sexes combined). Following slight differences from nominate based on examination of skins of 12 adults from Stewart I. and associated islets to SW, mostly from Kundy I. (AM, CM, NMNZ): (1) edges to feathers of crown, nape, hindneck and upperparts tend to be richer yellowish brown (c123B), but this only apparent when series of skins compared; this also largely supported by literature (Oliver); (2) dark streaking on upperparts tends to be less bold, but much overlap with nominate; and (3) entire flanks richer yellow-brown (rich 123B) than nominate, with colour often extending to sides of breast (usually not extending to sides of breast in nominate).

Because *stewartiana* significantly larger than nominate and show some, albeit slight, differences in plumage, suggested that this subspecies may be valid, but DNA sequence-analysis needed to confirm this. Stead (1936) stated that some birds on Stewart I. and associated islets lack dark markings on throat or have only faint dark spotting, describing these as subspecies *insularis*, but no specimens of these examined in present study. It is possible that these birds lacking obvious dark throat markings were juveniles (see description, above).

**SUBSPECIES WILSONI**: Only four skins (AM, CM, NMNZ) examined in present study, all collected Codfish I. Adult *wilsoni* have longer Tarsus ( $P < 0.05$ ) than adult nominate; and adult *wilsoni* have longer Bill S ( $P < 0.05$ ) than adult *stewartiana*, but more data needed to confirm this. Examination of these four skins indicates following differences from nominate: (1) facial area, including lores, most of malar area, ear-coverts, eye-ring, chin and throat, and lower sides of neck, boldly mottled blackish (c89) or black-brown (119), mottling formed by broad tips to feathers (cf. same areas in nominate lack mottling or with finer dark-brown mottling); (2) streaking on top of head and upperparts much bolder and darker, blackish



(c89), and yellow-brown edges to feathers narrower than in nominate; (3) entire breast, flanks and most of belly, boldly streaked black-brown (119), formed by broad shaft-streaks to feathers; (4) all upperwing-coverts, tertials and alula, black-brown (119) with slightly deeper brown (223B) fringes; and (5) primaries and secondaries have deeper brown (223B) outer edges. Though sample examined here very small, differences from nominate and *stewartiana* suggest that *wilsoni* is a valid subspecies.

**SUBSPECIES CAUDATA:** Differs more from nominate than any other subspecies; also the largest subspecies (see Measurements). Adult *caudata* have longer Wing, Bill S and Tarsus ( $P < 0.01$ ; sexes combined) than nominate and *stewartiana*. Description based on examination of skins of 19 adults (AIM, AM, CM, NMNZ); differences from nominate: **Adult HEAD AND NECK, UPPERPARTS:** Top of head, deep yellowish-brown (dark 123B), grading to reddish brown (c34) on forehead, with much less prominent and more diffuse dark-brown (119A, 121) streaking on crown, nape, hindneck and upperparts, and streaking obsolete or very faint on rump and uppertail-coverts. **UNDERPARTS:** Yellow-brown (123B) often extends from flanks to sides of breast and belly. **TAIL:** T1–t6 rather uniform yellowish brown (deep 123B) with dark red-brown (221A) shafts (cf. nominate which have extensive black-brown centres to rectrices). **UPPERWING:** Secondary coverts and tertials slightly paler, dark brown (c121) with deeper yellow-brown (deep 123B) fringes which are less sharply defined than in nominate.

#### REFERENCES

- Anderson, S.H., & J. Ogden. 2003. *Notornis* 50: 201–9.
- Anon. 1907. *Emu* 7: 108–9.
- Barlow, M. 1983. *Notornis* 30: 199–216.
- , & A. Moeed. 1980. *Notornis* 27: 68.
- Bell, B.D. 1976a. *Notornis* 23: 310–19.
- 1976b. *Ecology and Control of Rodents in NZ Nature Reserves*. Dept Lands Surv., Wellington.
- Best, H.A. 1973. Unpubl. MSc thesis, Univ. Canterbury, Christchurch.
- 1975. *Wildl.* — *A Rev.* 6: 32–7.
- 1979a. *NZ J. Zool.* 6: 481–8.
- 1979b. *Notornis* 26: 279–87.
- Blackburn, A. 1965. *Notornis* 12: 191–207.
- 1967. *Notornis* 14: 62–6.
- 1968. *Notornis* 15: 51–65.
- Boles, W.E. 1985. *Notornis* 32: 41.
- Breen, M.J. 1956. *Notornis* 7: 61.
- Buller, W.L. 1888. *A History of the Birds of New Zealand*. Author, London.
- Cossee, R.O. 1989. *NZ Dept Conserv. Sci. & Res. Ser.* 19.
- 1992. *NZ Dept Conserv. Sci. & Res. Ser.* 49.
- 1993. *NZ Dept Conserv. Sci. & Res. Ser.* 59.
- 1995. *NZ Dept Conserv. Sci. & Res. Ser.* 87.
- 1997. *NZ Dept Conserv. Sci. & Res. Ser.* 64.
- 1998a. *NZ Dept Conserv. Sci. & Res. Ser.* 72.
- 1998b. *NZ Dept Conserv. Sci. & Res. Ser.* 93.
- , & M. Wakelin. 1991. *NZ Dept Conserv. Sci. & Res. Ser.* 33.
- Cunningham, J.M. 1949. *Notornis* 3: 131.
- Dawson, E., & I.D.R. Cresswell. 1949. *NZ Bird Notes* 3: 141–6.
- Dell, R.K. 1950. *Notornis* 3: 231–5.
- Dennison, M.D., & H.A. Robertson. 1979. *Notornis* 26: 204–7.
- Edgar, A.T. 1971. *Notornis* 18: 118–30.
- 1978. *Notornis* 25: 279–90.
- Edwards, J.S. 1955. *Notornis* 6: 118–19.
- Elliot, G.P. 1978. Unpubl. BSc(Hons) thesis, Univ. Canterbury, Christchurch.
- Falla, R.A., et al. 1981. *The New Guide to the Birds of New Zealand*. Second edn. Collins, Auckland.
- Fitzgerald, B.M., & C.R. Veitch. 1985. *NZ J. Ecol.* 12: 319–30.
- Fogarty, S.M., & M.E. Douglas. 1973. *Tane* 19: 31–9.
- Gray, R.S., & B. Warburton. 1974. *Notornis* 21: 82–3.
- Guthrie-Smith, H. 1910. *Birds of the Water, Wood and Waste*. Whitcombe & Tombs, Wellington.
- 1914. *Mutton Birds and Other Birds*. Whitcombe & Tombs, Christchurch.
- Harris, W. 1987. Unpubl. PhD thesis, Univ. Otago, Dunedin.
- Heather, B.D., & H.A. Robertson. 2000. *The Field Guide to Birds of New Zealand*. OUP, Oxford.
- Hodgkins, M. 1949. *NZ Bird Notes* 3: 116–25.
- Hunt, W.F.I. 1949. *NZ Bird Notes* 3: 131.
- Hutton, F.W., & J. Drummond. 1904. *Animals of New Zealand*. Whitcombe & Tombs, Christchurch.
- Innes, J.G., et al. 1982. *Notornis* 29: 93–9.
- Jenkins, P.F. 1978. *Notornis* 25: 245.
- Kater, C.G. 1999. Unpubl. Dip. WLM thesis, Univ. Otago, Dunedin.
- McKenzie, H.R. 1979. *Notornis* 26: 105–19.
- 1980. *Notornis* 27: 1–6.
- , & R.B. Sibson. 1960. *Notornis* 9: 99–100.
- , — 1962. *Notornis* 10: 128–30.
- McLean, J.C. 1906. *Emu* 6: 1–7.
- Miskelly, C.M. 1984. *Notornis* 31: 209–23.
- , et al. 2001. *Notornis* 48: 1–40.
- Moncrieff, P. 1924. *Emu* 24: 61–7.
- 1929. *Emu* 28: 215–25.
- Moon, G.J.H. 1967. *Refocus on New Zealand Birds*. Reed, Wellington.
- 1979. *The Birds Around Us*. Heinemann, Auckland.
- 1992. *The Reed Field Guide to New Zealand Birds*. Reed, Auckland.
- , & R. Lockley. 1982. *New Zealand's Birds*. Heinemann, Auckland.
- Olson, S.L. 1990. *Notornis* 37: 161–71.
- Owen, K.L., & M.G. Sell. 1985. *Notornis* 32: 271–309.
- Parker, K.A. 2002. Unpubl. MSc thesis, Univ. Auckland, Auckland.
- 2004. *Notornis* 51: 241.
- Penniket, J.G. 1955. *Notornis* 6: 171–5.
- Phillips, W.J., & C.J. Lindsay. 1948. *Notornis* 3: 43–50.
- Pierce, R.J. 1980. *Notornis* 27: 21–44.
- Potter, S.D. 1949. *NZ Bird Notes* 3: 162–3.
- Ranum, A., et al. 1994. Unpubl. Rep., Dept Conserv., Invercargill.
- Readman, V.M. 1950. *Notornis* 4: 32–3.
- Roberts, M.R. 1959. *Notornis* 8: 122–3.
- Ryder, H.R. 1948. *NZ Bird Notes* 3: 20–2.
- Sagar, P.M. 1977. *Notornis* 24: 178–83.
- Sansom, O. 1949. *NZ Bird Notes* 3: 133.
- Scarlet, R.J. 1967. *Notornis* 14: 31–3.
- Skinner, J.F. 1979. *Notornis* 26: 22.
- Sladen, B., & R.A. Falla. 1927–28. *NZ J. Sci. Tech.* 9: 193–205, 282–90.
- Soper, M.F. 1965. *More New Zealand Bird Portraits*. Whitcombe & Tombs, Christchurch.
- St Paul, R. 1977. *Notornis* 24: 65–74.
- Stead, E.F. 1936. *Trans. R. Soc. NZ* 66: 312–13.
- 1948. *NZ Bird Notes* 3: 70–80.
- Stidolph, R.H.D. 1925. *Emu* 24: 278–80.
- 1939. *Emu* 38: 344–55.
- 1948. *NZ Bird Notes* 3: 64–7.
- 1949. *NZ Bird Notes* 3: 131–2.
- Stirling, I., & P.M. Johns. 1969. *Notornis* 16: 121–5.
- Turbott, E.G. 1948. *Rec. Auckl. Inst. Mus.* 3: 253–72.
- (Ed.) 1967. *Buller's Birds of New Zealand*. Whitcombe & Tombs, Christchurch.
- , & G.A. Buddle. 1948. *Rec. Auckl. Inst. Mus.* 3: 319–36.
- Warham, J. 1967. *Notornis* 14: 122–39.
- Watt, A.H. 1947. *NZ Bird Notes* 2: 115–20.
- 1949. *NZ Bird Notes* 3: 131.
- Weeks, M.F. 1949. *NZ Bird Notes* 3: 83–4.
- Williams, G.R. 1960. *Notornis* 8: 236–43.
- Wilson, P.R., et al. 1988. *Notornis* 35: 217–43.
- Wilson, R.A. 1959. *Bird Islands of New Zealand*. Whitcombe & Tombs, Christchurch.





Volume 7 (Part B), Plate 47

Arctic Warbler *Phylloscopus borealis* (page 1601)  
 NOMINATE BOREALIS: 1 Adult

Tawny Grassbird *Megalurus timoriensis* (page 1629)  
 SUBSPECIES ALISTERI: 2 Adult; 3 Juvenile; 4 Adult

Little Grassbird *Megalurus gramineus* (page 1638)  
 SUBSPECIES GOULBURNI: 5 Adult; 6 Juvenile; 7 Adult  
 SUBSPECIES THOMASI: 8 Adult

Fernbird *Bowdleria punctata* (page 1649)  
 NOMINATE PUNCTATA: 9 Adult; 10 Juvenile  
 SUBSPECIES WILSONI: 11 Adult  
 SUBSPECIES CAUDATA: 12 Adult

Spinifexbird *Eremiornis carteri* (page 1667)  
 13 Adult; 14 Juvenile; 15 Adult