

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 AX1 (AX in *Dicrurus* [drongos]). Ambians 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;
- ORIOOLIDAE (Old World orioles and figbirds): three species in two genera in Aust., all breeding;
- ARTAMIDAE (woodswallows, butcherbirds and currawongs): 14 species in four genera in HANZAB region, all breeding;
- PARADISAEIDAE (birds of paradise): five breeding species in two genera in Aust.;
- CORVIDAE (crows and jays): six breeding species in single genus in Aust. and NZ, including one introduced to NZ;
- CORCORACIDAE (Aust. mudnesters): two species in two monospecific genera, endemic to Aust.;
- CALLAEIDAE (NZ wattlebirds): three species (one extinct) in three monospecific genera, endemic to NZ;
- LANIIDAE (shrikes): two species in HANZAB region, one accidental to Prince Edward Is, the other accidental to Christmas I.;
- PTILONORHYNCHIDAE (bowerbirds): ten species in seven genera in Aust. (nine species) and NZ (one species), all breeding; Piopio of NZ probably extinct (Heather & Robertson 1997);
- ALAUDIDAE (larks): two breeding species in HANZAB region (including one successfully introduced to Aust. and NZ);
- MOTACILLIDAE (wagtails and pipits): eight species in two genera in HANZAB region, only two breeding (one on South Georgia), the rest non-breeding visitors or accidentals;
- PRUNELLIDAE (accentors): one species successfully introduced to NZ;
- PASSERIDAE (Old World sparrows and A'asian finches): 22 species in nine genera (including four successful introductions) in HANZAB region, all breeding;
- FRINGILLIDAE (Old World finches): seven species in four genera in HANZAB region, all introduced except one naturally occurring vagrant to South Georgia;
- EMBERIZIDAE (buntings, cardinals, tanagers and allies): two successfully introduced species, occurring NZ and Lord Howe I.;
- NECTARINIIDAE (sunbirds and spiderhunters): single breeding species in Aust.;
- DICAEIDAE (flowerpeckers): single breeding species in Aust.;
- HIRUNDINIDAE (swallows and martins): eight species in four genera in HANZAB region, including four breeding species in Aust. and NZ, one non-breeding visitor and three accidentals;
- PYCNONOTIDAE (bulbuls): one successfully introduced species in Aust.;
- SYLVIIDAE (Old World warblers): 13 species in eight genera in HANZAB region, including ten breeding species (one extinct) in Aust. and NZ, and three accidental to region;
- ZOSTEROPIDAE (white-eyes): seven species (one extinct) in single genus in HANZAB region, all breeding;
- MUSCICAPIDAE (Old World flycatchers, thrushes and chats): eight species in six genera in HANZAB region, including five breeding species (two introduced), and four accidentals (including one on Prince Edward Is);
- STURNIDAE (starlings and mynas): five species in four genera, four breeding in HANZAB region (including two species successfully introduced, and one species now extinct), and one accidental.
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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 (Kroodsmma 1996).

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

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

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

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Family MOTACILLIDAE pipits and wagtails

A fairly large and morphologically rather homogeneous family of small to medium-sized terrestrial insectivorous passerines with slim, elongated bodies, moderately long to very long tails, rather long and pointed wings, moderately long to long and slender legs, and often elongated hindclaw. The family comprises 54–65 species in five, or possibly six, genera, distributed through much of Eurasia, Africa, s., e. and se. Asia, including the Indian subcontinent, and A'asia and the Americas (Sibley & Monroe 1990; Monroe & Sibley 1993; Peters; BWP; DAB). The main groups are the pipits (*Anthus*; 34–45 species), wagtails (*Motacilla*; 10–11 species) and African longclaws (*Macronyx*; 7–8 species), as well as 2–3 other genera: monotypic *Tmetothylacus* (Golden Pipit *T. tenellus* of Africa) and *Dendronanthus* (Forest Wagtail *D. indicus* of e. Asia), and possibly *Hemimacronyx* (comprising two species, Yellow-breasted Pipit *H. chloris* and Sharpe's Longclaw *H. sharpei*, also African and often combined with *Anthus* or *Macronyx*). Within the HANZAB region, nine species have been recorded, in two genera, *Anthus* and *Motacilla*, though only two species known to breed, Australasian Pipit *Anthus novaeseelandiae* and South Georgia Pipit *A. antarcticus* (Sibley & Monroe 1990; Christidis & Boles 1994; DAB).

The taxonomic position of the Motacillidae has changed considerably over time. The following is not an exhaustive coverage of all changes, but summarizes some of the different treatments. Wallace (1874) combined motacillids with other nine-primaried oscines, including the Dicaeidae, Bombycillidae and Hirundinidae. Parker (1878) consider *Motacilla* to have cranial characteristics resembling those of *Sylvia*. Sharpe (1891) placed motacillids between the larks (Alaudidae) and wood-warblers (Parulidae), but noted that several species had two annual moults similar to some species of Old World warblers (Sylviidae). Hartert (1910) and Stresemann (1934) placed the family between the larks and creepers (Certhiidae). Mayr & Amadon (1951) placed them between typical thrushes (subfamily Turdinae) and accentors (Prunellidae). Studies of jaw musculature suggest similarities with *Cisticola* in the family Sylviidae (Beecher 1953). Bock (1962) considered the double humeral fossa to agree with that of weaverbirds (Ploceidae) and true finches (Fringillidae), hinting at more recent treatments based on DNA studies (see below). Early studies on egg-white proteins suggested affinities with Old World warblers (Sylviidae) or Old World flycatchers (Muscicapidae) (Sibley 1970). Sibley & Monroe (1990) considered motacillids as a subfamily, Motacillinae, within the Passeridae (nine-primaried oscines), based on DNA–DNA hybridization data (Sibley & Ahlquist 1981, 1990). This is largely supported by analysis of mitochondrial cytochrome-b sequences (Groth 1998; Voelker & Edwards 1998) and nuclear DNA-sequences (Ericson *et al.* 2000; Barker *et al.* 2001). Nonetheless, here we consider them as a full family. The genetic affinities between motacillid and other passeroid lineages are fairly low (ΔT_{50} 8.3; Sibley & Ahlquist [1990]) and, as such, the family Motacillidae has also been retained in recent works (Voelker 1999; Alström & Mild 2003; DAB). Some authors place pipits and wagtails in different subfamilies, Anthinae and Motacillinae respectively (Cooper 1985; Clancey 1990).

Smallest is Meadow Pipit *Anthus pratensis* (total length 13.5–14.5 cm, weight 19 g) to largest Cape Longclaw *Macronyx croceus* (total length 20–21 cm, weight 49 g). Within HANZAB region, smallest probably Pechora Pipit *Anthus gustavi* (length c. 14 cm, weight 17–26 g) and largest is probably White Wagtail *Motacilla alba* (length 18 cm, weight 19 g). The family has the following morphological characteristics (summarized from Moreno [1986], Alström & Mild [2003], BWP, and DAB): Wings rather long, and pointed at tips; ten primaries, p10 vestigial; nine secondaries, including three tertials; tertials very long, particularly outermost, which extends past tip of longest primary in most species. Tail moderately long to long (particularly in *Motacilla*); 12 rectrices; in many species tail often pumped or wagged up and down when perched or walking. Bill rather short, slender and pointed, with slight notch to upper tomium and operculate nostrils, which are not covered by feathers. Rictal bristles present. Tarsus acutipalantar, rather long and slender; scaling laminiplantar. Hindclaw elongated in many species, particularly *Anthus*. Syrinx has conventional passerine pessulus. Osteological characteristics common to family include: double humeral fossae; thin ectethmoids; flattened maxillo-palatine processes; and fully perforate nares. Palate described as similar to *Cisticola* (Sylviidae) with tongue trough-like and quadrifid at tip (Beecher 1953). Moreno (1986) provides illustrations and detailed biometrics of several species of *Motacilla* and *Anthus*.

Plumage varies. Most species show white wing-bars or wing-panels, and tertials usually have prominent pale fringes. In *Anthus*, plumages highly homogeneous, and sexes alike: prevailingly streaked, brownish in ground-colour, and with white edges to outertail. Smaller species of *Anthus* (e.g. Pechora Pipit) have equally spaced tertials (i.e. tip of middle tertial falls midway between tips of inner and outer tertial), while large species (e.g. Australasian Pipit) have unequal spacing between tertials (with distance between tips of outermost and middle tertials shorter than between tips of central and shortest tertials). In *Motacilla*, plumage varies greatly in coloration, but lacks red hues, comprising mainly a mixture of yellow, olive, black, white and grey; sexes differ, particularly in adult plumages. Spacing of tertials much as in large *Anthus*. Nestlings have rather dense covering of down. Fledged in juvenile

plumage. Most species undergo a partial post-juvenile (first pre-basic) moult, usually resulting in adult-like first immature non-breeding (first basic) plumage. Most species acquire adult plumage in a complete first immature post-breeding (second pre-basic) moult. Once adult plumage acquired, most species undergo two moults annually, a partial pre-breeding (pre-alternate) moult and a complete post-breeding (pre-basic) moult to adult breeding and non-breeding plumages respectively. Timing of moults varies between species, according to migration strategies. Primaries moult outward.

All predominantly birds of open or semi-open habitats, mainly natural and modified grasslands and low shrublands, including farmland, mountain and grassy steppes, tundra and meadows; and many species, especially wagtails, associated with wide range of wetlands, such as edges of watercourses and lakes, in and round swamps and marshes, and in wet meadows and damp to wet grasslands. Some species found mainly in stony and rocky habitats, such as steep, dry rocky or stony hills or mountain slopes (e.g. Blyth's Pipit *Anthus godlewskii*, Tawny Pipit *A. campestris*, Long-billed Pipit *A. similis*), and Rock Pipit *A. petrosus* breeds on rocky seacoasts and coastal islands. Some also inhabit forests and woodlands, including evergreen and deciduous forests (e.g. Forest Wagtail, Tree Pipit *A. trivialis*), and coniferous forests and birch woodlands (e.g. Olive-backed Pipit *A. hodgsoni*); Forest Wagtail also in tropical rain-forest in winter. Many species occur commonly in and round human settlements, or other open modified habitats, such as roads and airstrips. Migratory species often occupy wider range of habitats on passage and during non-breeding period. Occur from coasts and lowlands to high altitudes (e.g. Citrine Wagtail *Motacilla citreola* breeds between 3000 and 5000 m asl in Himalayas). In HANZAB region, Australasian Pipit found in range of open habitats with low or sparse vegetation or areas of bare ground with few or no trees, primarily grasslands, low shrublands, heaths and herbfields, and beaches and shorelines; also in open modified habitats, such as airstrips and clearings created by logging (AOU 1983; Sibley & Monroe 1990; Maclean 1993; Heather & Robertson 2000; Robson 2000; Griffioen & Clarke 2002; Alström & Mild 2003; Tyler 2004; BWP).

Many species migratory. Those breeding in temperate regions of n. hemisphere essentially migratory or partly migratory, over medium to long distances, while those breeding farther S tend to be short-distance migrants or resident; African and island species mainly resident or sedentary (e.g. Berthelot's Pipit *Anthus berthelotii*, African Pied Wagtail *Motacilla aguimp*); and s. American species probably largely resident or sedentary. Patterns of movements of several species vary across range, e.g. Meadow Pipit fully migratory in N and E of range, but resident in w. Europe. In HANZAB region, South Georgia Pipit sedentary on S. Georgia, and Australasian Pipit resident or sedentary (and probably largely sedentary) over most of range in Aust. and NZ, with some indication of local movements and flocking in non-breeding season, altitudinal movement in se. Aust. and NZ, and possible regular migration from Tas. to se. mainland Aust. Yellow Wagtail *M. flava* regular non-breeding migrant in small numbers from n. hemisphere, occurring austral spring–summer, though with a few records in austral winter. Remaining species in HANZAB region rare vagrants: all are long-distance migrants, breeding in n. hemisphere and migrating S for boreal winter, often with wintering grounds in s. and se. Asia and Indonesia; records in HANZAB region almost always in austral spring–summer (Sibley & Monroe 1990; Maclean 1993; Heather & Robertson 2000; Robson 2000; Griffioen & Clarke 2002; Alström & Mild 2003; Tyler 2004; BWP).

Omnivorous, taking insects and other invertebrates, and plant material, mainly seeds. Most species terrestrial, usually foraging on or from ground or from low vegetation, though a few species more arboreal (e.g. Forest Wagtail). Three main foraging methods: gleaning and probing, mainly from ground, low vegetation and also from surface of water (and sometimes just below); lunging, darting after animal prey on ground; and sally-striking (flycatching of BWP), where bird makes short flight or jumps from ground to catch flying prey; also occasionally sally-hover. Some species have been seen perching on twigs just above surface of water, and reaching down to take insect prey from water. Often hold large insects, such as locusts, beneath feet to dismember them by hammering with bill, or pound them on ground. Usually eat more invertebrates in summer, and more plant material in winter. Often forage in mixed-species feeding flocks, particularly with other Motacillidae and sometimes other passerines (Keith *et al.* 1992; Alström & Mild 2003; Tyler 2004; BWP).

Usually seen singly or in pairs during the breeding season. Many species gregarious outside the breeding season, often in small flocks, though some species occasionally congregate in many hundreds or thousands (e.g. Yellow Wagtail). Most species monogamous, but occasional polygamy (polygyny and polyandry) recorded in some species (e.g. Water Pipit *Anthus spinoletta*, Tawny Pipit and Rock Pipit). Co-operative breeding occasionally recorded in a small number of species, in which a single juvenile helped at nest (e.g. Madagascar Wagtail *Motacilla flaviventris*, Cape Wagtail *M. capensis*, Meadow Pipit). In most wagtails, both parents share incubation, but in many pipits only female incubates. Both parents feed nestlings and fledgelings and remove faecal sacs, and males often brood nestlings. All species establish breeding territories. Most species nest solitarily, but Citrine Wagtail sometimes nests in loose colonies. Some species defend territory not only from conspecifics but also from other species, e.g. White Wagtails will chase away Grey Wagtails *M. cinerea*. Some species roost communally in non-breeding season, with large roosts sometimes consisting of thousands of birds, e.g. >20,000 Yellow Wagtails. A conspicuous behaviour shown by most members of the family is the habit of wagging or pumping tail up and down, and whole rear-end in larger species; function of this not known, though there are many theories (see Tyler 2004). Scratch head indirectly.

When defending territories, often rather aggressive, and vigorously chase intruders; several species have been seen to attack their reflections. When pairing, most species perform a courtship display-flight, in which male flies into air and then, while descending, sings with vibrating raised wings and raised tail. Song-flights better developed in pipits than in wagtails. Some also perform greeting displays in which male approaches female on ground with outspread and quivering wings. When potential predator approaches nest, many species perform distraction displays by running or fluttering along ground while calling, sometimes dragging one wing along ground (Keith *et al.* 1992; Alström & Mild 2003; Tyler 2004; BWP).

Vocalizations vary greatly. Most calls are monosyllabic or disyllabic notes, sometimes repeated several times; and often call when taking off or when flushed. Songs of pipits and wagtails usually simple and rather monotonous, and often consist of repeated series of call-like notes, and sometimes include trills or buzzing notes; song usually uttered from an elevated perch or while in flight. Some species mimic (Alström & Mild 2003; Tyler 2004; see species accounts).

Usually nest solitarily, but some species nest in small groups (e.g. Australasian Pipit) or semi-colonially (e.g. Citrine Wagtail); polygamy and co-operative breeding occasionally recorded in a few species (see above). Nests typically built on ground, often in a hollow or depression, and usually among or close to vegetation (such as tussock of grass) or beneath a rock, but other sites also used, including trees and shrubs, crevices in cliffs and banks, artificial structures and (often in wagtails) nests of other species. Most species build a deep cup-shaped nest of dry grass, with moss, rootlets and leaves, but nests of Paddyfield Pipit *Anthus rufulus* can be partly domed, and those of Forest Wagtail (the only species that regularly nests in trees) are made of twigs, leaves, grass and rootlets, and bound together with moss and spider web. Males may assist in the collection of material or construction of the nest, but in most species, most or all building done by female. Nests may be used for several breeding attempts in a single season (particularly by Grey Wagtails, which often re-use nests in walls or under bridges). Eggs vary in shape from ovate to sub-elliptical. Eggs of most species white, buff or creamy, sometimes greyish or greenish, with dark-brown, reddish-brown or grey speckling, mottling, and streaking. Clutch-size 1–8 but usually 2–3 in tropics and 4–6 in temperate regions; clutch-size may also vary over breeding season. Occasional records of nests with exceptionally large numbers of eggs assumed to result from two females laying in same nest. Eggs laid on successive days. Incubation period 11–14 days, occasionally longer (e.g. up to 16 days in White Wagtail), and may decrease as breeding season progresses. In most wagtails, incubation by both sexes (though female often does more), but for the Forest Wagtail, Rosy-throated Longclaw *Macronyx ameliae* and several species of pipit (e.g. Long-billed, Tree, Water, Red-throated *A. cervinus* and Buff-bellied *A. rubescens* Pipits) claimed that eggs incubated by female only. Nestlings fed and brooded by both parents, but female usually does more than male and apparently only female broods at night. Both sexes attend to nest-sanitation. Fledging period typically 11–14 days, and in some species (e.g. White, Cape, Grey and Mountain *Motacilla clara* Wagtails, Grassveld's *A. cinnamomeus* and Rock Pipits, and Yellow-throated *M. croceus* and Rosy-throated Longclaws) may be up to 16–17 days or more, but nestlings of some species may fledge prematurely if disturbed. In most species, fledgelings attended by parents for 2 weeks or more, and sometimes for up to 8 weeks. Pairs usually rear two, or occasionally three, broods per season, though species at high latitudes or elevations are single-brooded, and some tropical species (e.g. African Pied and Cape Wagtails) can breed almost continuously throughout the year, and may rear up to six broods in a single season. When multiple broods attempted, laying occurs soon after previous brood fledges, and one parent (male in species in which only female incubates) attends to fledgelings while other attends nest. Main causes of nest-failure include inclement weather, heavy rain (which can flood nests), destruction of nests on ground by livestock, game or agricultural processes (e.g. ploughing, spraying), and predation by many different mammals, birds and reptiles. Nests also parasitized by cuckoos (Cuculidae) and cowbirds *Molothrus* (Icteridae) (Keith *et al.* 1992; Tyler 2004; BWP; and see species accounts).

Five species considered globally threatened: both Sokoke Pipit *Anthus sokokensis* of Kenya and Tanzania and Sharpe's Longclaw *Macronyx sharpei* of Kenya endangered, mainly through loss, degradation and fragmentation of habitat through clearing for cultivation, and logging and pole-cutting; and three species considered vulnerable: Yellow-breasted Pipit of s. Africa, Sprague's Pipit *A. spragueii* of N. and central America, and Ochre-breasted Pipit *A. nattereri* of S. America, all mainly through loss and degradation of habitat through cropping, grazing, burning and conversion to pasture and plantations. Four other species near threatened, including South Georgia Pipit of HANZAB region (Stattersfield & Capper 2000; see species account; BirdLife International Species Factsheets, available at <http://www.birdlife.org/datazone/species/index.html> [accessed Sept. 2005]).

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Anthus novaeseelandiae Australasian Pipit

COLOR PLATE FACING PAGE 1369

Alauda novae seelandiae Gmelin, 1789, *Syst. Nat.* 1(2): 799 — Queen Charlotte Sound, South Island, New Zealand.

The generic name is Latin *anthus*, a small bird that inhabited grasslands mentioned by Pliny. The specific name is a toponym, based on Latham's (1783; *Gen. Synop. Birds*, II, pt. 2, p. 284, pl. 51) 'New-Zealand Lark'.

OTHER ENGLISH NAMES Australian, Indian, New Zealand, Richard's, Southern or Western Pipit; Groundlark, Ground Lark or Australian Groundlark; Native Lark.

MAORI NAME: Pihoihoi.

POLYTYPIC Species and subspecies limits subject to much debate; here we treat A'asian populations as a distinct species, Australasian Pipit *Anthus novaeseelandiae* (cf. Christidis & Boles [1994]; see Geographical Variation). Nominate *novaeseelandiae*, NI and SI, NZ, including Stewart I. and offshore islands; possibly vagrant to Lord Howe I.; *chathamensis* Lorenz-Liburnau, 1902, Chatham Is; *aucklandicus* G.R. Gray, 1862, Auckland and Campbell Is; *steindachneri* Reischek, 1889, Antipodes Is; *bistriatus* (Swainson, 1837), Tas. and islands of Bass Str.; *bilbali* Mathews, 1912, Kangaroo I., s. Yorke Pen. and w. and s. Eyre Pen., SA, and sw. Aust., S of Irwin R. and mulga–eucalypt boundary W from about Pt Culver; *australis* Vieillot, 1818, all mainland Aust. except range of preceding subspecies, N to central Kimberley Div., WA, Victoria R. Drainage and Barkly Tableland, NT, and middle se. Gulf of Carpentaria Drainage and central C. York Pen. and region of Cooktown, Qld; *rogersi* Mathews, 1913, coastal n. Aust., from Joseph Bonaparte Gulf, E to nw. Cape York Pen., and on ne. coast of C. York Pen. between Portland Roads and C. Melville; and extralimitally, *exiguus* Greenway, 1935, central montane New Guinea.

FIELD IDENTIFICATION Length 16 cm (13–18); wingspan 26 cm (22–29); weight: 26 g for Aust. populations, 33 g for NZ populations. Medium-small and slender pipit, typically with rather upright stance, and with small rounded head and fairly long, straight and shallow bill (about two-thirds length of head); rather long wings, with, when folded, tips of tertials usually covering tips of primaries and extending slightly beyond tips of uppertail-coverts; long tail, which is usually held closed and appears narrow with slightly pointed tip but, when spread, edges flay out and tip either square or slightly forked; long legs, with feathered thighs; and very long hind-claw. Flight-silhouette long and elliptical, with large breast and long tail. Superficially similar to larks and roughly the same size, but differ in lankier, longer legged appearance with longer tail, which habitually quivered or pumped up and down. Similar in size and shape to Skylark *Alauda arvensis* (slightly smaller in Aust. populations, roughly the same size in NZ); much larger than Singing Bushlark *Mirafra javanica*, with longer and less compact and dumpy appearance. In all plumages, largely brown above and white below, boldly streaked above and on breast and flanks, and with complex head-pattern of stripes interspersed with patches of blacks,

browns, creams and whites; and with white edges to tail. Sexes alike. Much variation in appearance, both with wear and geographically, and with subspecies differing mainly in darkness of upperparts, extent and prominence of streaking above and below, darkness of supercilium, and overall size; subspecies fall into four broad groups: (1) **AUSTRALIS GROUP**, which varies much, but is generally not broadly streaked on upperparts, and only moderately streaked on breast and flanks; includes: (a) subspecies *australis* from most Aust. except far N and SW; (b) subspecies *bistriatus* from Tas., which larger than *australis* and only subtly different in plumages; (c) *bilbali* from Kangaroo I., Yorke and Eyre Pens, SA, and sw. Aust., with broader and blacker streaking on underparts than *australis*, bolder facial marking and colder, greyer ground-colour to upperparts; (2) **SUBSPECIES ROGERSI** of coastal n. Aust., which has much broader markings on upperparts, more striking facial pattern and stronger streaking on breast and flanks; (3) **NZ NOVAESEELANDIAE**, from main islands of NZ, which differs from Aust. subspecies by less boldly streaked upperparts, stronger blackish eye-stripe and broader but more diffuse streaking on breast and flanks; and (4) **NZ ISLAND GROUP** (*chathamensis* from Chatham Is, *aucklandicus* from Auckland

and Campbell Is, and *steindachneri* from Antipodes I.) that all differ from *novaezeelandiae* by longer bill, but with varying appearance, with some similar to nominate from main islands of NZ, while others very pale and washed-out (particularly from Chatham Is), and others strongly washed yellowish brown on upperparts and underparts (many birds from Auckland and Campbell Is). Juveniles similar to adults, but with scaly patterning to upperparts; also smaller than adults, with shorter tail, when recently fledged. Immatures differ only slightly (mainly by retained juvenile upperwing-coverts) and very difficult to distinguish from adult in field.

Adult AUSTRALIS GROUP: Pattern of head complex and varying. Some birds in spring and early summer show mixture of fresh and worn feathers on upperparts and upperwing; such birds have undergone a partial pre-breeding (pre-alternate) moult (see Moults) but there is no discernible difference in colour from non-breeding plumage (autumn–winter). Most of top of head and neck, light brown, sometimes with rufous or buff tinge, and heavily streaked dark brown to blackish brown; streaks vary from very narrow to moderately broad; upper hindneck slightly paler, forming indistinct half-collar. Distinct but narrow supercilium, extending from sides of forehead over eye to above rear-ear-coverts, usually cream or pale buff but pure white in some birds. Supercilium bordered below by dark eye-stripe that extends from upper lores to behind eye, sometimes curving down round rear edge of ear-coverts; eye-stripe indistinct in front of eye, and more obvious and darker behind eye. Narrow cream to white eye-ring merges with supercilium above eye, and is edged below by very narrow light-brown border. Sub-ocular area, cream, white or buff, forming broad arc below eye-ring; rest of ear-coverts, creamy or buff-brown, streaked or mottled dark brown. Narrow, sometimes broken, black moustachial stripe extends from gape to below ear-coverts; broad white, cream or buff submoustachial stripe extends from base of lower mandible to sides of neck, in some birds curving upward behind ear-coverts; and narrow, sometimes broken blackish-brown to black malar stripe extends from just behind lower mandible to sides of lower throat, often broadening posteriorly to form blackish-brown patch on lower sides of neck. Chin and throat, white to cream. Ground-colour of upperbody varies from brown to light brown, sometimes with rufous tinge, with well-defined dark-brown to blackish streaking, which becomes narrower and less distinct on rump and shortest uppertail-coverts; upperbody becomes more uniform dark brownish when worn. Tail mostly dark brown with white edges: (1) central rectrices (t1) mostly dark brown to blackish brown with narrow light-brown fringe; (2) next three pairs (t2–t4), blackish brown with very narrow cream or whitish outer edges, and, in some birds, narrow white tip to t4; (3) t5, white with blackish or dark-brown shaft and broad inner edge; and (4) t6, white, with broad blackish or dark-brown inner edge, sometimes with narrow, indistinct dark shaft-streak. Pattern of folded wing complex and varying, light brown, yellowish brown or cream, heavily marked with broad dark-brown to blackish-brown streaks and mottling; in detail: secondary coverts, dark brown in centres with usually broad light-brown, yellow-brown or off-white fringes, which, on some birds, align to form rather ill-defined pale median and greater wing-bars (centres to median secondary coverts come to acute point distally, visible only in close view [cf. juvenile, see below]); primary coverts and alula, dark brown, with narrow light-brown fringes to greater coverts and alula that grade whitish at tips; tertials, blackish with broad light-brown, yellowish-brown or off-white fringes (tip of central tertial extends well past tip of shortest and nearing tip of longest); secondaries and primaries, dark brown, with, when fresh, neat yellowish-brown, buff or cream outer edges that merge with narrow off-white fringes at tips. Underbody grades from buff or orange-buff on breast, rear-flanks and thighs, to cream or

off-white on belly, rest of flanks, vent and undertail-coverts; breast, and sometimes upper belly, rear-flanks and a few undertail-coverts, have narrow but distinct, blackish or dark-brown streaks (sometimes bolder and broader on upper breast). Undertail appears mostly white with blackish centre; rectrices patterned as uppertail, but lack fringes to central feathers, which are entirely blackish brown. Underwing-coverts mostly creamy, with narrow line of dark-brown flecking along leading edge of innerwing; and remiges mostly dark grey, forming broad dusky trailing edge. Bill mostly black, with tomia and basal lower mandible, flesh-pink. Iris, blackish brown; orbital ring, black. Legs and feet, flesh-pink to dull reddish-pink. **SUBSPECIES ROGERSI:** Much more boldly marked than *australis* group, but differences less obvious in worn plumage. Differs from *australis* group by: Most of top of head and neck and upperbody darker, with bolder dark-brown to black-brown streaking. Patterning of head much bolder with: eye-stripe slightly broader and darker; eye-ring, cream or buff, more strongly divided from sub-ocular region; moustachial stripe much broader, solid black and very well defined, further delineating broad white to cream submoustachial stripe which curves behind ear-coverts more consistently and broadly; and malar stripe broad, black and unbroken, extending along sides of throat and merging posteriorly with black patch on lower sides of neck. Uppertail tends to be darker, blackish brown, sometimes almost black. Folded wing, like upperbody, tends to be much darker. Streaking to underbody, darker, blackish; in some birds, streaking droplet-shaped. **NOMINATE NOVAESEELANDIAE:** Much like *australis* group but: (1) Streaking of top of head and upperbody slightly paler, dark-brown (less blackish), and more diffuse (dark-brown centres to feathers merge into light-brown or yellowish-brown edges), so that overall appear less well marked than *australis* group; and (2) facial pattern, while similar to that of *australis* group, differs by: better defined, white or cream supercilium; which further emphasized by stronger and better defined eye-stripe, particularly across lores (where stripe darker, blackish brown), and which continues and wraps broadly round rear ear-coverts in broad arc. **NZ ISLAND GROUP:** Like nominate *novaezeelandiae* but: all birds on Campbell and Auckland Is, and about half of those from Antipodes Is, have warmer yellowish-brown edges to feathers of top of head and upperparts; and all birds on Campbell I., and about half those on Antipodes Is, also have yellowish wash to most of underbody; otherwise as nominate. Chatham Is populations vary, with some birds like nominate (as above) or like nominate but differing by: (1) whitish edges or fringes to feathers of top of head, upperbody, upperwing-coverts and tertials; (2) whitish ear-coverts, chin and throat, mottled dark brown on ear-coverts; (3) broken dark malar and moustachial stripes (unbroken in nominate); and (4) purer white underbody with bold blackish streaking. **Juvenile** Very like adults, but darker on upperparts and with little known geographical variation. Forehead to crown mostly blackish brown with narrow light-brown streaks, all much darker than adult. Hindneck and sides of neck, light brown, mottled blackish, with ground-colour slightly warmer brown on upper hindneck, forming indistinct collar. Rest of facial patterning like adult. Upperbody mostly dark brown to blackish brown; when fresh, patterned with neat light-brown to buff fringes to feathers, giving scaly appearance; when worn, tips of fringes lost and reduced to narrow edges, making upperbody mostly dark brown to blackish brown with very narrow light-brown to buff streaking. Uppertail like adult but with neater buff, light-brown to rufous fringes to t1–t4; and central feathers (t1) narrower and more pointed at tips. Upperwing much like adult, but dark centres to greater and median secondary coverts rounded distally. Underparts like adult, but streaking on breast and flanks shorter, broader and slightly more diffuse. Rest of plumage and bare parts as in adult. **Immature** Very

difficult to identify from adult of respective subspecies and then only in very close view. Distinguished only by retained juvenile feathers, which include all or most median and greater secondary coverts, primary coverts, tertials and rectrices, which are more worn and often contrast with fresher, adult-like feathers replaced in post-juvenile moult. Replaced inner coverts may show moult-contrast with retained juvenile coverts, which have dark centres and which are rounded distally (cf. acute centres in replaced coverts). However, some adults in spring can show moult-contrast to secondary coverts (see Moults).

Similar species Superficially similar to **Singing Bushlark** and **Skylark**, though Pipit can often be instantly identified by its habit of pumping or flicking tail up and down, which Bushlark and Skylark do not do. For full distinctions from Singing Bushlark, see that account. Introduced **Skylark** is restricted to se. Aust. and NZ, and is similar in size to, or slightly larger than, Australasian Pipit and with similarly patterned plumage; Pipit readily distinguished from Skylark by: (1) **FACIAL PATTERN**: Pipit has very different pattern, with at least faint dark loreal stripe and, in NZ *novaeaeelandiae* and NZ island group, very strong blackish lores (Skylark lacks loreal stripe altogether, with lores mostly whitish, sometimes with diffuse dusky spot just in front of eye); narrow, sometimes broken, black or dark-brown moustachial stripe (moustachial stripe fairly obscure in Skylark); very broad and well-defined whitish to buff submoustachial stripe (very obscure in Skylark); and usually well-defined malar stripe, often ending in blotch on lower sides of neck (faint and almost obsolete in Skylark). (2) **WHITE ON WING AND TAIL**: In Pipit, outer two rectrices largely white and, while often difficult to see on perched bird in field, white edges to tail conspicuous in flight, especially when bird flying away when flushed or when tail spread when giving Subsong while perched (in Skylark, only outermost rectrix white and white edges to tail narrower); in flight, Pipit has only fine whitish trailing edge to entire wing, barely noticeable in field (Skylark immediately distinguished by distinct white trailing edge to wing, prominent on innerwing and inner primaries). (3) **FOLDED WING**: In Pipit, folded wing proportionately slightly shorter, with primaries typically not projecting beyond tertials (wings proportionately longer in Skylark, with much longer primary projection, tips of longest primaries extending 2–3 cm past tips of tertials); and tips of folded wing reach just past uppertail-coverts (in Skylark, wing-tips extend well past uppertail-coverts to halfway along tail). (4) **SIZE AND SHAPE WHEN PERCHED**: While similar in size, Pipit appears more compact and full bellied, with larger head in proportion to body and with more rounded profile to crown (with no crest), and, with respect to wings, proportionately longer tail and proportionately longer legs (in contrast, Skylark has triangular and quite pointed crest, which is diagnostic when erect, though, when held flat against crown, shape of head little different from Pipit, but crown is flatter and head appears smaller in proportion to longer body; longer and larger wings appear to cover most of undercarriage when perched; and shorter legs). (5) **STANCE**: Normal stance of Pipit generally more upright, with body held higher above ground on fairly straight or only gently bent legs, with body held at c. 45° and tip of tail almost touching ground (Skylark has shorter legs, which usually more strongly bent, giving more crouching, horizontal stance). Both species may adopt more upright stance when alert, but Pipit tends to adopt more extreme upright and straighter legged posture with upstretched neck. (6) **SHAPE IN FLIGHT**: Pipit has shorter and more rounded wing-tip and fairly straight-edged tail with rather square tip (Skylark has longer, broader and much more pointed wing-tip and edges of tail flayed out more in flight, and with deeper fork at tip). (7) **BILL** quite narrow and long, about two-thirds head-length (shorter in Skylark, about half head-length, and slightly

thicker). (8) **HABITS, SONG-FLIGHTS AND OTHER VOCALIZATIONS**: Pipit habitually pumps or flicks tail up and down when on ground, usually in quite stiff but shallow movements (never in Skylark), and also jerks tail up and down as it flies off (Skylark keeps tail level). Pipit has far less complex Song, consisting of a repeated series of pleasing, high-pitched, soft, warbling or trilling notes, usually variations of *swee*, *seeou* and *tsee*, rarely including any mimicry (see Voice), and given in both Level and Undulating Song-flights, as well as occasionally when perched; in Undulating Song-flights, usually sing during short ascents of undulation (Song of Skylark loud and continuous, with no breaks, and also with occasional mimicry; Skylark gradually makes its way into air on heavily quivering wings, sometimes singing, then hovers at highest point on quivering wings, sometimes for several minutes, and constantly singing; descend silently, either parachuting vertically with wings and tail spread or in circling sweep). Commonest call of Pipit (Excitement Call) a rasping drawn-out *zwee* or *tjsweep* or *tzwee*, often given in flight (see Voice), and when flushed, gives piercing single note *zeer* or *dreep* or chirping or chirruping notes (Skylark has rippling *chirrup* given in flight and in alarm when flushed). For differences from vagrant **Pechora Anthus gustavi** and **Red-throated A. cervinus Pipits**, see those accounts. Should not be confused with **songlarks Cincloramphus**, which lack bold streaking on underparts and white edges to tail, have proportionately longer tail and have very different vocalizations (see Voice sections of respective texts); in **Brown Songlark C. cruralis** male also much larger (though female similar in size, but still heavier) and much darker, and tail of both sexes longer and more graduated; and **Rufous Songlark C. mathewsi** has conspicuous rufous uppertail-coverts. Slight risk of confusion with superficially similar **Striated Calamanthus fuliginosus** and **Rufous C. campestris Fieldwrens**; for distinctions, see those texts (HANZAB 6).

Common bird of open habitats, often in modified habitats such as farmland. Usually seen singly, and less often in twos; sometimes in small parties or flocks, usually during autumn–winter, and comprising up to 20 birds, but occasionally up to 50 (rarely more). Usually cryptic and unobtrusive, but flocks can be conspicuous during non-breeding season or when congregating at food, water or when sheltering from heat. Can also become tame and allow close approach. Strongly terrestrial, and often seen perched on rocks, stumps, fences or posts, occasionally atop shrubs or small trees. Stance typically very upright (see Similar species above). Walk with somewhat swaggering or strutting gait, often lifting feet well above ground; run rapidly and directly across open ground, with loping stride and body held more horizontal than when walking or standing; run when chasing insect prey and when escaping observer, often stopping abruptly, bobbing tail up and down. Also hop and leap after prey. Often hide in or behind cover. Run away when approached by observer, but if approached too quickly, make short flight and then continue running rapidly away. When flushed, rise rapidly with flutter of wings. Flight-action varies, but usually strong, rapid and undulating, often covering some distance by direct route, with loping trajectory; drop straight into cover, not pausing to hover-and-drop or do so only very briefly. Display Song-flights distinctive; and Song fairly simply (see Similar species [above], Social Behaviour and Voice).

HABITAT Occupy wide range of open habitats with few or no trees and low or sparse, or sometimes no, vegetation; mainly native and modified grasslands, low shrublands, heaths and herbfields, and beaches and shorelines; also in open modified habitats, such as airstrips and clearings created by logging; commonly on bare ground. Less often in open forests and woodlands, usually in clearings or on roads and tracks, seldom in denser forests and woodlands (Loyn 1980, 1985); commonly

in pasture and other agricultural lands; seldom in parks, gardens and golf courses (McEvey 1949; St Paul 1975; Gibson 1977; Schulz & Kristensen 1994; Beauchamp 1995, 1998, in press; Collins 1995; Aust. Atlas 1; Storr 26, 27; see below). Grasslands and other habitats, often associated with wetlands, including floodplains, saline and freshwater lakes, swamps, lagoons, saltlakes, salt pans and clay pans, and sewage farms (Gosper 1981; Garnett & Bredl 1985; Gibson 1986; Ashton 1996; Coate *et al.* 1998; Chafer *et al.* 1999; Goodfellow 2005; Storr 11, 21, 27; see below), and often recorded foraging near water or on bare mud (Dove 1917; Roberts 1956; Beauchamp 1998; Beauchamp & Parrish 1999; CSN 4, 30, 39); also often found in dry, or drying, wetlands (Storr 11), e.g. at Wyperfeld NP, Vic., seen foraging on dry lake beds (Hanks 1930). In and around Darwin, widespread in all open habitats in dry season but confined to saline flats and areas of short grass during wet season (Crawford 1972). Widespread in Aust., NZ and on NZ subantarctic islands. In Aust., occur in all climatic zones, though more common on temperate slopes and plains, temperate highlands and semi-arid interior, and occur from sea-level to 2100 m asl (Paterson 1928; Jenkins 1968; Emison & Porter 1978; Gall & Longmore 1978; Osborne & Green 1992; Norment & Green 2004; Storr 28; Aust. Atlas 2; see Distribution and Population); in NZ, occur from sea-level to 1950 m asl (Sibson 1958; St Paul 1975; Warham & Bell 1979; Beauchamp 1995; CSN 9; see Distribution and Population). Populations have increased and range expanded with clearing of timbered habitats for agriculture. However, some populations have declined after initial increases, possibly as pasture improved or farming became more intensive or both. Further, some populations have declined or gone altogether after revegetation, establishment of vineyards, or after removal of vegetation (see Distribution and Population [Change in range, populations] for details).

Aust. Commonly in native and modified GRASSLANDS, both grazed and ungrazed (Terrill & Rix 1950; Bedgood 1972; Baldwin 1975; Beruldsen 1979; Dawson *et al.* 1991; Templeton 1992; Chafer *et al.* 1999; Ashton 2001; Tzaros 2005), typically sparse and short (Storr 11, 21, 26), including bare plains with very little grass (Jarman 1944), though sometimes in dense, low grasslands, such as dense kangaroo grass *Themeda*, 2–10 cm tall (and, rarely, to 45 cm tall) on coastal headlands (P.J. Higgins). In Simpson Desert, largely absent from densely vegetated sites and dune systems covered in Hard Spinifex *Triodia basedowii* (Gibson & Cole 1988). Commonly in a wide range of native grasslands, particularly on plains, flats or round wetlands (Cooper 1972, 1974; Paton 1972; Recher 1975; Gibson 1977; Reilly 1978; Wyndham 1978; Gosper 1981; Congreve & Congreve 1985; Garnett & Bredl 1985; McKean 1985; Gibson 1986; Gibson & Cole 1988; Aumann 1991; Osborne & Green 1992; Ashton *et al.* 1996; Baxter & Paton 1998; Goodfellow 2005; Storr 21, 26), including grasslands of spinifex *Triodia* (Fletcher 1980; Coate *et al.* 1998), spear-grass *Stipa* (Carpenter & Matthew 1997) and tussock grasslands (Osborne & Green 1992; Vic. Atlas; S.J. Cowling; A. Fisher), including of *Poa* (Smith 1977; Lane 1984); and including grazed native grasslands (Ford & Bell 1981). Also occupy a wide range of other modified grasslands, often with nearby shrubs and trees, such as shelter belts or roadside remnants, including farmland and other agricultural land, such as pasture, cultivation, crops and stubble (Storr 1947; Wheeler 1967; Bravery 1970; Heron 1973; Sedgwick 1973, 1984, 1986; Morris 1975; Recher 1975; Gibson 1977; Ratkowsky & Ratkowsky 1977; Cooper 1978; Emison & Porter 1978; Bedgood 1980; Abbott 1981; Conole 1981; Humphreys 1986; Jones 1986; Field & Field 1989; Chafer *et al.* 1999; Storr 35); playing fields and bowling greens (Morris 1975; Gibson 1977; Chafer *et al.* 1999; Storr 35); grassy parks and gardens (Fletcher 1904; Green & Mollison 1961), though

also said to avoid manicured lawns in temperate Aust. (R.H. Loyn). Analysis of detailed bird atlas data found Pipits most common in agricultural regions in sites surrounded by cereal cropping (Aust. Atlas 2). Also often in low SHRUBLANDS dominated by chenopods, including samphire, and on plains and flats (including gibber plains) (Cooper 1972; Cox & Pedler 1977; Brooker *et al.* 1979; Dymond 1988; Bellchambers & Carpenter 1990; Baxter & Paton 1998; Ashton 2001; Storr 11, 21, 26, 35), e.g. dry shrub steppe dominated by Black Bluebush *Maireana pyramidata* and Bladder Saltbush *Atriplex vesicaria* (Schodde 1956); considered very common on Nullarbor Plain, which largely dominated by chenopod shrubland with tussock grassland in places (Storr 26, 27). Also in acacia shrublands (Jarman 1944; Ellis 1948; Wyndham 1978; Brooker *et al.* 1979; Schrader 1981; Coate *et al.* 1998), e.g. shrubland 6–9 m tall dominated by Mulga and Broad-leaf Mulga *Acacia craspedocarpa* with an understorey of other acacias and ground-cover of spinifex *Triodia* (Pianka & Pianka 1970). Commonly in HERBLANDS AND HEATHS (Gibson 1977; Reilly 1978; Chafer *et al.* 1999; Storr 35), including low coastal heaths dominated by acacias, banksias, grevilleas, hakeas, tea-trees, casuarinas and *Epacris* (Morris 1975; McFarland 1988; Reilly 1991); and alpine heath and herbland, sometimes also with grasses such as *Poa* (Gall & Longmore 1978; Osborne & Green 1992; Norment & Green 2004), including when there is still snow-cover in early spring (Osborne & Green 1992); and sparse buttongrass plains (Schulz & Kristensen 1994; see following). Also occur on BARE OR STONY GROUND, e.g. bare ground at foot of stony hills (Storr 11, 21), in tussock grassland in semi-arid NT (A. Fisher), on rocky hills and bare stony or gravel rises (Gibson 1986; Gibson & Cole 1988) or bare clay pans (Gibson & Cole 1988). Also in recently burnt heathlands and shrublands (Gibson 1986; Storr 27). In Tas., occupy sparse buttongrass plains with large areas of bare ground and exposed rock (Schulz & Kristensen 1994). Often in COASTAL HABITATS such as on beaches, fore-dunes and flats behind fore-dunes (Sedgwick 1973, 1984; Bedgood 1980; Gosper 1983; Brooker 1989; Field & Field 1989; Ashton *et al.* 1996; Storr 21, 27, 35); e.g. in w. Tas. on shingle beaches, reef platforms and open dune vegetation (Morris 1975; Schulz & Kristensen 1994); and at Eyre Bird Observatory, mainly on beach above high-tide line, with smaller numbers on flats behind fore-dunes and on coastal dunes where plants starting to grow (Ashton *et al.* 1996). Occasionally in OPEN EUCALYPT WOODLAND AND FOREST with varying, but often sparse, understorey of low shrubs and ground-cover of grasses (Gall & Longmore 1978; Jones 1986; Osborne & Green 1992; Ashton *et al.* 1996; Possingham & Possingham 1997; Major *et al.* 2001; Davey 2002; Tzaros 2005; Storr 26, 27), e.g. subalpine Snow Gum woodland to 7 m tall with an understorey of shrubs to 60 cm tall and ground-cover of herbs and tussock grasses (Emison & Porter 1978); and mallee-grassland at edge of Nullarbor Plain (Ashton *et al.* 1996). Often at edges or in clearings in woodlands and forests (Terrill & Rix 1950; Clarke 1967; Loyn 1980), e.g. in Mountain Ash forests of Vic. found only in recently harvested areas (<3 years after harvesting) and in large open areas, such as on tracks (Loyn 1985) or large clear-felled areas (Vic. Atlas). Occasionally on remnant patches of hard snow in SNOWFIELDS in alpine areas (Paterson 1928; CSN 25, 33), though usually leave such areas when snow present (Osborne & Green 1992). In Canberra, occupy woodland remnants (Er & Tidemann 1996). Also occur in OTHER MODIFIED HABITATS that may be grassed, bare or nearly so, or paved, including round homesteads, mills and woolsheds (Sedgwick 1986; Storr 11, 21); airfields and airports (van Tets *et al.* 1969, 1977; Moeed 1975; Storr 11, 21, 35); and beside or on tracks and roads, including median strips (Cooper 1972, 1978; Sedgwick 1988; Ashton 1996; Bryant 1998; Cox 2001;

Goodfellow 2005; Storr 21, 27), where sometimes attracted to road-kill (Storr 35). Occasionally in young plantations of exotic pines: in 4-year-old plantations with dense understorey of shrubs, ferns, grasses and herbs, mostly <2 m tall (Friend 1982). Occupy overgrazed lands (Storr 11), though said that possibly less common in s. Top End of NT, possibly because of overgrazing (Goodfellow 2005).

NZ Range of habitats much as in Aust. Commonly in GRASSLANDS, including native tussock grasslands (Stidolph 1939; Dawson & Creswell 1949; St Paul 1975; Beauchamp 1995, 1998; Oliver; CSN 22) and alpine tussock grassland (Lambert 1970; St Paul 1975; Beauchamp 1995, 1998; Oliver; CSN 22), e.g. tall tussock grassland of Narrow-leaved Snow Tussock *Chionochloa rigida* and Red Tussock *C. rubra* on ridges and in gullies (Hamel 1972). Also commonly on farmland of modified grasslands and improved pastures, often with nearby shrubs and trees (Secker 1955; Skegg 1963; Cooper 1991; Beauchamp 1995, in press; CSN 22, 32, 37, 38); and less commonly in grassy urban areas, such as on playing fields, parks and gardens (Moncrieff 1929; Secker 1955; Sibson 1958; CSN 35). Commonly in COASTAL HABITATS (probably more so than in Aust.), including sand and gravel beaches, shell banks, rocks and rock platforms on foreshores, and coastal sand-dunes (Moncrieff 1928; Stidolph 1939; Buddle 1941; Skegg 1963, 1964; Warham & Bell 1979; Beauchamp 1995, in press; Oliver; CSN 22, 32, 35, 37, 38, 42; A.J. Beauchamp), e.g. in dense Kikuyu Grass *Pennisetum clandestinum* on bank over low coastal cliff (Beauchamp in press). Also often on dry RIVER BEDS and at rocky river and lake margins (Sibson 1958; St Paul 1975; Warham & Bell 1979; Beauchamp 1995, 1998, 2002; Oliver; CSN 22, 37, 42), e.g. on gravel flat beside river with low cushions of *Raoulia* with small weedy species and scattered tussocks of Hard Tussock *Festuca novaeseelandiae* (Hamel 1972). Also often in SHRUBLAND, sometimes dense such as Manuka *Leptospermum scoparium* shrubland, often with exposed rock (Dawson 1951; Secker 1951); and HEATHLAND, including pakihī heathland (Beauchamp 2002; CSN 32, 35); also inhabit FERNLAND including Bracken (Skegg 1964; Hamel 1972; Nilsson *et al.* 1994; Beauchamp 1995, 1998, 2002; Oliver; CSN 9). Occasionally in native FORESTS, along tracks or in clearings (St Paul 1975). Like Aust. populations, often found in a range of other MODIFIED HABITATS, including airfields (CSN 34); quarries, clay-capped dump sites, and marine sediment settlement ponds (A.J. Beauchamp); on gravel and dirt roads and tracks (Lindsay *et al.* 1959; Beauchamp 1995); on and beside major sealed roads (Beauchamp 1995; A.J. Beauchamp); and sometimes in young plantations of exotic pines (Beauchamp 1995; Stewart & Hyde 2004) and on tracks and firebreaks (Weeks 1949).

DISTRIBUTION AND POPULATION Widespread in Aust. and NZ and offshore islands (see below), and extraliminally, in New Guinea, from Highlands, round Laiagam, Wabag and Mendi, E to Markham R. and S to near Guari (Coates 1990). Origin of record on W. Papuan Is, not known but suggested to have come from Palaeartic (Mees 1965; Coates 1990), but confirmation needed.

Aust. Widespread, including many offshore islands, though generally scattered N of 16°S (n. Kimberley Div., Top End, C. York Pen.) and in Great Sandy, Gibson and Great Victoria Deserts (Aust. Atlas 1, 2).

NZ Widespread, though patchily distributed in some areas. Also widespread on many offshore islands (NZ Atlas; CSN).

Lord Howe I. Vagrant. Single, Nov. 1986 (R.H. Loyn, which probably record for 1975–90 mentioned in Hutton [1991] but not recorded in NSW Bird Repts and for which details could not be found by McAllan *et al.* [2004]); single, 16 Sept. 2003 (McAllan *et al.* 2004).

Norfolk I. Possible vagrant. Report of single, 13 Apr. 1983 (Moore 1999), though this and 'regular [unpublished] reports' 1983–85 considered unconfirmed (Hermes *et al.* 1986); single, 9 Dec. 1996 (Anon. 1997; Moore 1999).

Christmas I. Single report, 22 Oct. 1977 (Stokes *et al.* 1987) but with no details and no elimination of other likely species and thus considered unconfirmed here. Earlier report of Tawny Pipit *Anthus campestris* may have referred to Australasian Pipit. See Tawny Pipit account for discussion.

Kermadec Is Several historical records between 1880s and 1944 (Sorensen 1964). No recent confirmed records (Veitch *et al.* 2004). Recent but unconfirmed reports, possibly of this species, from Raoul I. on 21 Nov. 1964 (Edgar *et al.* 1965) and 11 Jan. 1967 (Merton 1970); and Macauley I. in 1988 (Tennyson & Taylor 1989).

Chatham Is Widespread on all islands (Fleming 1939; Freeman 1994; Beauchamp 1998).

Antipodes Is Widespread (Warham & Bell 1979).

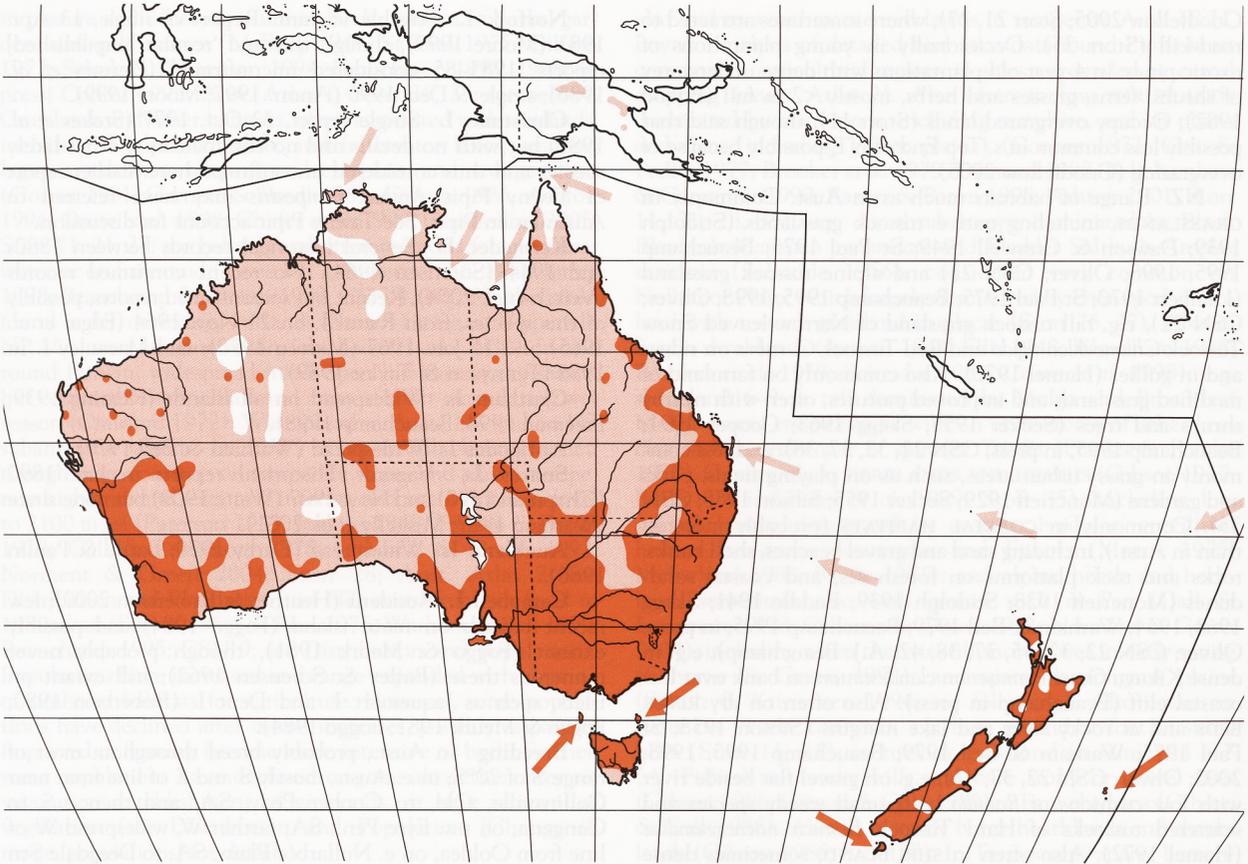
Snares Is Vagrant. Historical reports in Jan. 1890 (Chapman 1890) and Nov. 1907 (Waite 1909) but none since (Warham 1967; Miskelly *et al.* 2001).

Auckland Is Widespread (Darby 1970; Bartle & Paulin 1986).

Campbell I. Resident (Heather & Robertson 2000); few recent records on main island (Foggo 1984) and possibly extinct (Foggo & Meurk 1981), though probably never numerous there (Bailey & Sorensen 1962); still extant on islets, such as Jaquemart I. and Dent I. (Robertson 1980; Foggo & Meurk 1981; Foggo 1984).

Breeding In Aust., probably breed throughout most of range S of 20°S; in e. Aust., mostly S and E of line from near Collinsville, Qld, to Coober Pedy, SA, and thence S to Cungenana, on nw. Eyre Pen., SA; farther W, widespread W of line from Ooldea, on e. Nullarbor Plain, SA, to Deepdale Str and Barrow I. in Pilbara Region, WA; also at various sites in s. NT and nw. SA; and at a few scattered sites elsewhere. Few breeding records N of 20°S, e.g. in sw. Kimberley Div., at Sandfire Flat, Anna Plains and Roebuck Plains; near Edward R. on w. C. York Pen.; and at a few scattered sites between Cairns and Townsville, including Atherton Tableland, ne. Qld (Aust. Atlas 1, 2; NRS). Probably breed throughout range in NZ, as published records from scattered sites in most regions (CSN). Also breed on outlying islands: Chatham, Antipodes, Auckland and Campbell Is (NZCL).

Change in range, populations Populations in AUST. have possibly declined, as reporting rates between 1977–81 and 1998–2002 were significantly lower over most of range, declining overall by 44% (Aust. Atlas 2). This especially marked where revegetation has taken place, e.g. Peel I., se. Qld, and Sydney Harbour NP, NSW, where populations have declined or gone altogether (Morris 1986; Woodall 1999a). At Sellicks Beach, SA, local population declined when road widened and vegetation removed (Ashton 1996, 2001); and round Red Cliffs, nw. Vic., numbers declined after establishment of vineyards (Chandler 1944). Population on Le Fevre Pen., SA, declined between 1972 and 1985 (Winslet & Winslet 1987). Conversely, populations have increased and range has expanded in some areas where forest and other natural vegetation cleared for agriculture, resulting in expanded areas of pasture or crops, e.g. Stanthorpe, Qld; Kangaroo I., Mt Mary Plain and Penong, SA; and Break O'Day Valley, Tas. (Fletcher 1904; Batey 1907a,b; Campbell 1910; Carter 1924; Whitlock 1939; Rix 1943; Bourke & Austin 1947; Terrill & Rix 1950; Boehm 1957b; McEvey & Middleton 1968; Napier 1969; Passmore 1982; Baxter 1989; see Habitat). Round Bickley, on Swan R. Plain, s. WA, population increased after 1918 with expansion of grazing farmland, but this occurred for only 1–2 years before numbers declined and, by late 1940s, rarely seen (Serventy 1948). Population on King I., Tas., said



to have increased in early 1970s (McGarvie & Templeton 1974). In NZ, many populations increased and range expanded between 1880s and 1920s as native vegetation cleared and converted to pasture (Guthrie-Smith 1910; Turbott 1967; McKenzie 1979; Beauchamp 1995, 1998; Oliver), but some populations have subsequently declined since 1940s or 1950s, possibly as pasture improved and farming has become more intensive (Turbott 1967; Stidolph 1974; Lovegrove 1980; Beauchamp 1995, 1998; Oliver) or as marginal farmland or shrubland converted to pine plantations (A.J. Beauchamp). Vegetational change probably precipitated disappearance from Noises Is (where not recorded since 1934; though rats also possibly involved) (Cunningham & Moors 1985) and Poor Knights Is (McCallum 1981; Cunningham & Moors 1985), and decline in Gollans Valley (Beauchamp 1995) and on Cavalli Is (Millener 1980; Cunningham & Moors 1985). Said to have gone from round Masterton between 1943 and 1972 (Stidolph 1977), and numbers said to have declined round Dunedin (CSN 19 Suppl.). No such decline recorded on Chatham Is (CSN 23).

Populations RECORDED DENSITIES: AUST.: 0.02–0.2 birds/ha, Cooloola NP, Qld (McFarland 1988); 0.22 birds/ha, near Armidale, NSW (Ford & Bell 1981); 0.2 birds/ha, near Eden, NSW (Kavanagh *et al.* 1985); 0.13–1.25 birds/ha, Kosciuszko NP, NSW (Davey 2002); 0.15 birds/ha, near Woodsdale, Tas. (Taylor *et al.* 1997); c. 0.2 birds/ha, Mt Mary Plain, SA (Boehm 1957b); 0.01–0.03 birds/ha, Nullarbor Plain, WA (Brooker *et al.* 1979); 0.006–0.01 birds/ha, L. Disappointment, WA (Davies *et al.* 1988); 0.02 birds/ha, Barrow I., WA (Sedgwick 1978). NZ: At five sites round Whangarei: (1) Ormiston Heights, 3.3–16.7 birds/km, along 0.9-km transect (n=21 counts); (2) Ormiston Rd, 0–4.7 birds/km, along 2.1-km transect (n=17 counts); (3) Port Whangarei, 0–0.8 birds/km, along 3.6-km transect (n=9

counts); (4) Portland wetlands, 0–2.7 birds/km, along 1.1-km transect (n=17 counts); and (5) Portland Quarry, 2.5–4.6 birds/km, along 2.8-km transect (n=4 counts) (A.J. Beauchamp); 0.04 birds/5-min count (0.18; 333 counts), Kaitoke Wetland, Great Barrier I. (Anderson & Ogden 2003); 0.01–0.025 birds/ha, various sites in Wellington (Beauchamp 1995); 4.9 birds/ha, Kaimanawa Ra. (Ann. Loc. Rep. 8); 0.16–6.22 birds/km along transects of 0.5–10.6 km in Wellington (Beauchamp 1995); along transect of c. 16 km at Westhaven, 3.9 birds/km (Beauchamp 1995); along 1.6-km transect at Moumoukai, 29.6 birds/km (CSN 19 Suppl.); and along 8.8-km transect at Awarua, 5.8 birds/km (CSN 32). CHATHAM IS: 0.07 and 0.19 birds/ha, Chatham I. (Beauchamp 1998; CSN 37).

THREATS AND HUMAN INTERACTIONS While generally thought to have benefited from clearing of timbered habitats and conversion to open grassy habitats, and historically numerous on fernland and rough or reverting farmland, has declined in these areas when they became farmed more intensively. Suggested that habitat degradation is a principal problem for population viability, and that it increases the intensity of predation (A.J. Beauchamp). In some areas, numbers have declined with widening of roads, increased traffic and removal of roadside vegetation (Stidolph 1974; Ashton 1996, 2001; see Change in range, populations [above]). Occasionally killed by Cats (St Paul 1975; Foggo 1984; Dowling *et al.* 1994); said to be depredated by Foxes (Stephen 1909). Populations on Campbell I. said to have been extirpated, or nearly so, by rats by mid-1800s, and now largely confined to offshore islets (Foggo 1984; Miskelly 2000), but population now recovering after removal of Brown Rats (Thompson *et al.* 2005). In NZ, also possibly adversely affected by introduction and spread of Australian Magpies *Gymnorhina tibicen*

(Stidolph 1974) and other 'imported vermin' (Oliver), such as Brown Rats, mustelids, Hedgehogs *Erinaceus europaeus* and Common Mynas *Acridotheres tristis* (Wilkinson & Wilkinson 1952; St Paul 1975). Stock said to trample nests and eggs often (Dickison 1930). Sometimes killed by vehicles on roads (Vestjens 1973; Stidolph 1974). Very occasionally killed by vandals (Hanks 1955, 1957); and some illegally poisoned by eating grain treated with organophosphorous pesticide and intended for cockatoos in Aust. (du Guesclin *et al.* 1983), and also occasionally poisoned in NZ (Oliver). Once sold in Sydney market in cages (Anon. 1932). Very occasionally strike lantern of lighthouses (Anon. 1913; Ford 1916). In NZ, formerly captured by Maori, using noose at end of long stick (Turbott 1967). Sometimes considered pest of gardens, snipping off small sprouting vegetables (Green & Mollison 1961), though also eat seeds of weeds (Miller 1938) and caterpillars and crickets during plagues (Stephen 1907; Slaney 1922). Sometimes forage round human activity, taking invertebrates and other prey disturbed or exposed; once fed on crumbs at picnic table, and very occasionally approach houses for food (see Food).

MOVEMENTS Considered resident or sedentary, and probably largely sedentary, over most of range in Aust. and NZ, but with some indication of local movements and flocking in non-breeding season, altitudinal movement in se. Aust. and NZ, and possible regular migration from Tas. to se. mainland Aust. However, apparent seasonal changes in abundance in some areas of se. Aust. attributed to changes in behaviour (Vic. Atlas; ACT Atlas); and in Wellington, NZ, conspicuousness, and thus numbers recorded, varies with weather (Beauchamp 1995; see Social Behaviour). Sedentary on Chatham, and NZ subantarctic islands (Antipodes, Auckland and Campbell), with no indication of other than local movements. Able to cross large stretches of water, as indicated by vagrancy on remote oceanic islands (e.g. Lord Howe and Norfolk Is; see Distribution, and below). Also seen making shorter crossings, e.g. observed flying between mainland and offshore islands in NI, NZ (see below), and between Five Is and the mainland, near Wollongong, NSW (Keast 1943).

Aust. Resident or sedentary, and probably largely sedentary, over most of mainland Aust. (Storr 19; see below). However, some seasonal altitudinal migration from high country of se. mainland Aust. and poorly known partial migration in n. Tas., leaving many areas in autumn–winter and returning spring, and with some passage across Bass Str. (see below). Broad-scale analysis of bird atlas and count data in e. Aust. found strong evidence of local movements only (Griffioen 2001; Griffioen & Clarke 2002). However, earlier analysis of similar data suggested general increase in abundance in se. Aust. (Tas., Vic. and s. NSW) in summer; and, although few data from WA, a winter increase in n. WA (Clarke *et al.* 1999). In se. mainland Aust., reporting rates S of 35° vary little: 34.9% in summer, 29.3% in winter (Aust. Atlas 1). Seasonal declines in parts of se. Aust. and NZ attributed in part to changes in behaviour (see below). Widespread reports of flocking in many parts of range, usually in autumn–winter non-breeding period in s. Aust. (McEvey 1952; Bedggood 1970, 1980; Tas. Bird Rep. 26; see Social Organization) with such birds probably undertaking some local movements. However, in se. Aust., such flocks sometimes appear to be altitudinal migrants (ACT Atlas; see below). Round Broome, n. WA, congregate in flocks of 10–20 at end of wet season, where grass is seeding (Collins 1995).

Widely described as **SEDENTARY** or **RESIDENT** (latter probably often referring to sedentary of HANZAB), or said to be present throughout year, at sites throughout range. In QLD, described as sedentary (Storr 19), or resident, in NE (Bravery 1970; Gill 1970; Britton & Britton 2000), at Idalia NP (Sharp

& Sewell 1995), near Duaringa (Barnard 1925), and in SE (Agnew 1921; Lord 1956; Roberts & Ingram 1976; Longmore 1978; McFarland 1988; Bielewicz & Bielewicz 1996; Woodall 1999b). Resident or sedentary in NSW (Morris *et al.* 1981) except at high altitudes of Southern Tablelands. Resident or sedentary in Cobar district in NW (Schmidt 1978); and in Hunter (Morris 1975 [but see Other movements, below]), Sydney (Morris 1986; Leishman 1994; NSW Bird Rep. 1990), Illawarra (Gibson 1977; Smith & Chafer 1987; Chafer *et al.* 1999), South Coast (Whiter 1989, 1991; Gregory-Smith 1991) and Riverina regions (Hobbs 1961). Recorded all months at Barren Grounds NR, in Illawarra, but only occasionally May–July (Jordan 1984). Migrant or partial migrant in Southern Tablelands (see below). Partial resident and partial altitudinal migrant in ACT (Er & Tidemann 1996; ACT Atlas): resident round Canberra and elsewhere in lowlands (Anon. 1969, 1974, 1990b; Taylor 1984, 1987b; Holland 1985; Taylor & Davey 1985; Er & Tidemann 1996; ACT Atlas) with apparent influx, possibly from highlands, in May–June (Taylor 1983; Veerman 2003), though also said that more frequently recorded in spring–summer, possibly reflecting behavioural change (ACT Atlas). Summer migrant or partial migrant at higher altitudes (see below). In VIC., considered resident in NE (Cheney 1915; Bedggood 1972, 1973); and in Gippsland (Bedggood 1970, 1980), including Wilsons Prom. (Cooper 1975), though at Rotamah I. Bird Observatory, more frequently observed late winter to spring (Anon. 1989, 1990a); and considered sedentary round Geelong (Belcher 1914; Pescott 1983). At Nareen, in SW, one pair defended territory over 2 years (McEvey 1949, 1952; see Social Organization). Although considered resident at Laverton, w. suburban Melbourne, most often observed in autumn (Watson 1955) and described as late spring to summer visitor at nearby Altona (Humphreys 1986). However, show some increases in abundance at lowland or coastal sites, in autumn–winter (see Migration, below). In SA, resident in Roxby Downs area (Read *et al.* 2000), near Kimba (Leiblich 1971) and at Sellicks Beach (Ashton 1985); and present throughout year at Willunga (Syman 1946) and Cook, 1979–88 (breeding in 1983) (Klau 1988). Described as summer visitor at Parra Wirra NP (Clarke 1967). Considered resident in n. and s. WA: round Eyre Bird Observatory (breeding when rainfall good) but with some, probably local, movements at times (Congreve & Congreve 1985; Dymond 1988; Ashton *et al.* 1996; see Other movements below); in South-West Division, including Wheatbelt and on Rottneet I. (Alexander 1921; Storr 1965; Heron 1970; Saunders & Ingram 1995); on North I., Houtman Abrolhos (Storr 1966); round Leinster, in central W (Moriarty 1972); and at Wittenoom (Howard 1986). Round North-West C., persist even during droughts (apparently breeding after rain) (Carter 1903a). Round Broome, numbers appear stable, with slight increase in wet season (Collins 1995) and locally common in arid zone of Kimberley Div., though described as largely winter visitor to semi-arid zone of Kimberley Div., arriving Apr. (Storr 11). In NT, resident in and round Darwin, though with shift in habitat use between seasons (Crawford 1972; see Habitat); and probably resident in Keep River NP (McKean 1985). Described as nomadic in Lower McArthur R. region, and possibly more widespread during drier years (Schodde 1976), though nature and extent of these movements not known.

Migration Some seasonal movements apparent in se. mainland Aust. and Tas., with partial migration from high country, and complete winter departure from snow-bound habitats. In NSW, considered summer breeding migrant in alpine and subalpine Thredbo Valley, Sept.–Mar. (Gall & Longmore 1978), and present in Snowy Mts only during snow-free months (Osborne & Green 1992). In Snowy Mts, date of

first observation above winter snowline (1500 m asl; 28 Aug.–29 Sept. for 12 years, 1979–2003, with median date 18 Sept.) was closely related to date of last snow-cover at Spencers Ck (1830 m asl); birds wintered in areas close to breeding grounds in Snowy Mts, so may be able to move upslope opportunistically and arrive in alpine zone earlier in years with early snow-melt (Normant & Green 2004). In ACT, while largely resident (see above), summer migrant in highest parts of range and partial migrant below this, with apparent winter influx at lower altitudes. At high altitudes (>1200 m asl), arrive late Sept. and leave as early as late Jan.; at intermediate altitudes (1000–1200 m), arrive earlier, in Aug.–Sept., and leave later, in Feb.–Mar., and occasionally winter; present throughout year below 1000 m, but recorded more frequently in spring–summer (possibly reflecting changes in behaviour) (ACT Atlas). Loose flocks of possible migrants appear in Lower Naas Valley in winter (ACT Atlas). W of Black Mt, 1964–68, considered irregular summer resident, with none recorded July to mid-Oct. 1967 and late Apr. to late Oct. 1968 (Marchant 1973). In and round Canberra, fewest recorded Jan.–Mar., with increase in records May–June (Taylor 1983; Veerman 2003). Described as partial migrant in lowland woodland remnants (Er & Tidemann 1996). In VIC., though largely resident or sedentary, show some increases in abundance in lowland or coastal sites, in autumn–winter (e.g. Thomas 1968; Reilly 1981; Anon. 1989, 1990a), which could be result of altitudinal migration from high country, as described for Southern Tablelands of NSW–ACT, or passage of birds from Tas. (see below). In Alps, large numbers arrive Sept., as snow melts, and leave in autumn; also considered a summer visitor to forest clearings at intermediate elevations (Loyn 1980, 1985). Recorded at Somers only during Aug.–Sept., with one visible record of passage (Thomas 1968). Often struck lighthouse at C. Otway (Ford 1916); and one seen flying in from the sea at Jan Juc, 28 Mar. 1996 (Hewish 1997). On Wilsons Prom., in 1988, Pipits recorded mid-Mar. to mid-Apr. and 1 May (Garnett *et al.* 1991), corresponding with possible passage across Bass Str. from Tas. (see below). Possibly seasonal in Maryborough district, based on claim that earliest record was 22 Aug. (Chisholm 1910), but confirmation needed. Partly migratory in TAS. but extent of movements not clear. Recorded throughout year, though reporting rates suggest that some leave in winter: reporting rate 26.5% in summer, and 10% in winter (Aust. Atlas 1, 2). Reports from n. Tas. indicate seasonal movement away from area in autumn–winter, and return in spring–summer. Observations at Devonport over many years found that most left area in Mar.–Apr. and returned Aug.–Oct., with odd individuals wintering (Dove 1905, 1909, 1910, 1912, 1916b, 1918, 1919, 1922, 1924, 1925, 1926, 1927, 1928a,b,c, 1929, 1930, 1932a,b, 1934a,b, 1937a,b, 1939a,b). Little information from e. or s. Tas. Round Boat Harbour, common early spring to late autumn, leaving with onset of cold weather (Fletcher 1918). At Stirling, 1901 and 1902, arrived late Aug., and left about first week of Apr. (Dean 1903). Round Port Davey, mostly observed in summer (Green & Mollison 1961). Said to become more common on beaches in winter (Aust. Atlas 1). Sighting of small flock at Launceston in June 1902 described as unusual for that time of year (Littler 1903). Also left Wilmot district in frosty winters (Fletcher 1908). Movements after departure from n. Tas. not known, though some indication of movement in or across Bass Str., possibly to Vic. (see above). At Looorana, King I., seen in groups of 10–20 during autumn–winter 1972 (Tas. Bird Rep. 2). In Furneaux Grp, one struck lighthouse on Goose I., 6 Oct. 1912 (Anon. 1913). In Kent Grp, 15–25 Mar. 1988, 3–8 present in one area of Deal I. throughout period, and 40+ seen 17 Mar. but not subsequently (including observations on Erith I.) and these thought to have left Kent Grp; and birds recorded Wilsons Prom. Mar.–May (Garnett *et al.* 1991; see

Vic., above). However, presence on Black Pyramid, W of Albatross I. in Hunter Grp, suggested to be movement from Tas. or King I. and not passage across Bass Str. (Green & McDonald 1963).

Other movements Various sporadic movements reported, extent of which not known and possibly largely local, or result of opportunistic use of favourable conditions. In QLD, absent from Richmond district from summer 1903–04 to May 1904 then present till July 1904, and said to have an undescribed migratory movement (Berney 1904), and later described as a winter visitor, only occasionally observed in summer (Berney 1905). In Cooloola NP, consistently recorded in surveys over 10 years after fire, with most seen in summer (McFarland 1988). In NSW, arrived in numbers in Northern Rivers Region after good spring rains in 1943 (Sharland 1944); and though considered sedentary in Hunter Region (see above), claimed to show regular movement ('migratory behaviour') on Kooragang I. (Morris 1975) without further details. In VIC., though considered resident in NE, described as migratory, without further details, round Dartmouth Dam (Thomas & Gilmore 1976). Birds used a burnt area of foreshore in suburban Melbourne during winter, 1980–81; and single birds appeared on coast June–Oct. (Reilly 1981). In TAS., said to leave districts where common for years, not returning for many months, with movement influenced by growth of grass in wet seasons (Sharland 1958). In WA, though resident round Eyre Bird Observatory, some, probably local, movements occur: birds visit the coast in summer, and flocks of over 50 seen on Hampton Tableland in winter 1989, and large movements observed in coastal mallee early Dec. 1989 (Congreve & Congreve 1985; Dymond 1988; Ashton *et al.* 1996). Rare vagrant to some islands of Houtman Abrolhos (Storr 1966; Storr 24).

NZ No evidence of long-distance movement. Resident, and probably largely sedentary, throughout, though with some seasonal local movements. However, exhibit some apparent altitudinal migration, especially in SI, with increased frequency of observation in coastal areas during autumn–winter and occurrence at high altitudes in spring–summer. Some pairs remain on territories throughout year, and breed year after year in same place, while others form loose flocks in autumn–winter (Moncrieff 1929; Heather & Robertson 2000; CSN; see Social Organization; also see below). In Wellington, conspicuousness, and thus numbers recorded, varies with weather; and some fluctuations in numbers may also reflect variation in breeding success rather than movements (Beauchamp 1995; see Social Behaviour). **INTER-ISLAND MOVEMENTS:** Some movement noted between NI and offshore islands: seen flying between Hen and Chickens Is and mainland (Skegg 1964), and between Little Barrier I. and mainland (Turbott 1947); two also seen flying from Kapiti I. to mainland, and several seen flying N from Kapiti (Wilkinson 1927).

For NI and SI, variously described as resident or seasonal, with no strong geographical patterns. NI: At six sites monitored for 6–12 months near Whangarei, n. NI, present at breeding sites throughout year, with flocking late summer to winter, and local movements over wider area from late summer; at coastal sites, seasonal winter flocking was dependent on suitable habitat (A.J. Beauchamp). Resident at Port Whangarei district and w. Northland, Toatoa Valley, Opotiki, L. Otamangakau (Beauchamp & Parrish 1999; A.J. Beauchamp). Mainly seen in autumn at Miranda (CSN 26). In Bay of Plenty, considered winter visitor, in small numbers, to coast (CSN 26, 35), but some present throughout year at Papamoa, with influx Apr.–May (CSN 47); and also considered resident at Te Mahoe (Quinn 1971). In Volcanic Plateau–East Coast, little change in numbers at Tihoi and Arataki, 1944–46, and Minginui, 1946–61 (St Paul 1975). In inland Manawatu, most often observed during autumn (CSN 19). In Wellington

region, seen throughout year (Secker 1955; Beauchamp 1995) though, earlier, described as a visitor to Ngaio (Moncrieff 1929); appear to move locally from mid-summer (Secker 1955); and some movement to lowland sites round Wellington in late autumn, with some habitats used only during winter (Beauchamp 1995). **SI:** In 1987–88, most coastal records in autumn–winter (CSN 36). At Nelson, appear irregularly during autumn in high country above city (Moncrieff 1929). In Canterbury, common on braided river beds in N in autumn (CSN 42); and late summer to winter visitor at Wainono Lagoon (CSN 19, 24) and L. Ellesmere (CSN 19). However, present year-round at Hororata (Moncrieff 1929). In Otago, appear to be absent from areas with mean annual rainfall <767 mm/year during breeding season (Hamel 1972). In sw. Southland, only observed at Puysegur Pt, Dec.–Jan. (Stuart-Sutherland 1922); probably move from tussock areas, including those above timber line, into lower country in winter in Fiordland (CSN 19). Elsewhere in West Coast, breed in high country round Charleston, then disperse to beaches and farmland in winter (CSN 32); and reported as winter visitor to Hokitika, first appearing early June (CSN 31).

Chatham Is Sedentary (though usually described as resident) and territorial (Nilsson *et al.* 1994; Beauchamp 2002). **NZ Subantarctic islands** Apparently sedentary (though described as resident in some literature) with no indication of any movements, on **Antipodes** (Warham & Bell 1979), **Auckland** (Darby 1970; Bartle & Paulin 1986) and **Campbell Is** (Robertson 1980; Foggo & Meurk 1981; Foggo 1984; Heather & Robertson 2000).

Island vagrants Origin of reported vagrants on various islands of HANZAB region (see Distribution and Population) not known; those reported Lord Howe, Norfolk, Kermadec and Snares Is possibly originated NZ; reports from Christmas I. could have originated Aust. or Asia.

Banding Of 1075 banded in Aust., 1953–June 2003, 19 recoveries (1.8%), of 17 birds, all <10 km from banding site (ABBBS). **LONGEVITY:** Adult banded near Sutherland, NSW, 1 Feb. 1972, recaptured at banding place over 6 years 11 months later (ABBBS). Of 49 banded in NZ, 1950–88, one recovery (no details) (Cossee 1989, 1992, 1993, 1995, 1997, 1998a,b; Cossee & Wakelin 1991).

FOOD Wide variety of invertebrates, including insects, earthworms, spiders, crustaceans, millipedes and snails; and seeds, particularly of clover, grasses and thistles. **Behaviour** Mostly forage on ground, taking food from ground and low vegetation, usually by gleaning and lunging; occasionally sally for aerial insects (see below). **DETAILED STUDIES:** At Christchurch International Airport, NZ (Moeed 1975); round Wellington, NZ, Apr. 1988–Apr. 1989 (Beauchamp 1995); on Chatham I., Apr.–May 1997 (Beauchamp 1995, 1998 [latter includes re-analysis of data from 1995 paper]); and at Huiarua Stn, NI, Dec. 1973–Apr. 1976 (Garrick 1981). **FORAGING ASSOCIATIONS:** Usually forage solitarily (e.g. Dove 1913, 1917; Roberts 1956; Secker 1959; Jaensch 1985; Bremner 2000; Aust. Atlas 1; CSN) but also forage in twos, probably pairs (Edgar 1949; McEvey 1949; St Paul 1975; Beauchamp 1995; CSN 4, 5) or flocks of 3–50+ (Dove 1913; McEvey 1952; Secker 1955; Boehm 1957b; Turbott 1967; Jenkins 1968; CSN 9, 29, 30, 34; C.J. Norment). At least some breeding pairs defend territories in which foraging takes place (see Social Organization). Sometimes forage with or near *OTHER SPECIES*, but generally appear not to be foraging in association. In Tas., observed foraging in freshly ploughed paddock, in which Flame Robins *Petroica phoenicea* and White-fronted Chats *Epthianura albifrons* also foraged (Dove 1913); at Mandurah, WA, 20 Pipits foraged for kelp-fly maggots (Coelopidae) among seaweed at mouth of estuary with Red-capped Plovers *Charadrius ruficapillus*, Silver Gulls *Larus*

novaeollandiae and Willie Wagtails *Rhipidura leucophrys* (Jenkins 1968); on Chatham I., observed foraging with Skylarks (Beauchamp 1998); and on Antipodes Is, associate with Antipodes Island *Cyanoramphus unicolor* and Red-crowned *C. novaeseelandiae* Parakeets round penguin colonies, taking abundant insects feeding on penguin waste and carcasses (Oliver; NZRD). Sometimes forage round *HUMAN ACTIVITY*, taking invertebrates and other prey disturbed or exposed by such activity (Edgar 1949; van Tets *et al.* 1969, 1977; CSN 30, 38). At Minginui, NI, birds followed machinery dragging logs during forestry operations, alighting on logs to search for food when hauling stopped; also followed workers, taking grubs from split posts and rotten logs, one bird calling loudly till a log was chopped open for it (St Paul 1975; CSN 4, 5); two birds frequented a sawmill, running along logs to feed on insects and grubs that were dislodged when logs were rolled off trucks (CSN 4). In NSW, birds followed cultivators to feed on insect larvae exposed in freshly turned soil (Gubanyi 1910). In NZ, formerly often foraged round dairies, taking ticks from cattle or floors of dairy (Oliver; NZRD), though dairies now much cleaner and ticks no longer taken (A.J. Beauchamp). Along Hastings–Napier Railway line, NI, in 19th century, claimed that flocks of up to 100 Pipits often followed train over distances of 3–5 km (Guthrie-Smith 1910; Turbott 1967). Once, a bird waited for and ate crumbs from a picnic table (CSN 38); and another fed on grubs removed from a vegetable patch and thrown onto lawn (CSN 30); very occasionally approach houses for food (A.J. Beauchamp). Often forage in modified habitats (see Foraging sites below; also see Habitat). **FORAGING HEIGHTS AND SITES:** Mainly forage on ground, but also in grass, on logs and among rocks on ground (Anon. 1915; Barrett 1916; Dove 1917; McEvey 1949; Secker 1959; Ford & Bell 1981; Osborne & Green 1992; Turner 1992; Er 1997; Heather & Robertson 2000; Beauchamp in press; Oliver; C.J. Norment); occasionally take insects from air (Anon. 1915; Sutton 1927c; Roberts 1956; St Paul 1975; Beauchamp 1995; Heather & Robertson 2000; Oliver). **FORAGING HABITAT:** Forage in a wide variety of open habitats, often associated with water (Dove 1917; Hanks 1930; Miller 1938; McEvey 1949; Roberts 1956; Warham & Bell 1979; Beauchamp 1998; Beauchamp & Parrish 1999; CSN 4, 30, 39; see Habitat); primarily natural and modified grasslands and low herblands, heathlands or shrublands, including crops, paddocks and pasture (Dove 1913; Anon. 1915; Barrett 1916; Miller 1938; Secker 1959; Roberts & Ingram 1976; Beauchamp 1995, 1998; Bremner 2000); also commonly on beaches and shorelines (Secker 1959; Jenkins 1968; Warham & Bell 1979; Beauchamp 1995, 1998; Heather & Robertson 2000; Oliver; CSN 9, 24), foraging among beachcast seaweed, and on sand and rocks in intertidal zone (Jenkins 1968; Beauchamp 1995, 1998; Oliver; Storr 28; CSN 8). In Snowy Mts, se. NSW, of 296 foraging observations: 22.6% on snow; 34.5% in alpine herbfield dominated by *Poa* and *Celmisia*; 31.8% in short heath c. 30 cm tall; 7.4% in tall alpine herbfield; 3% round margins of ponds and streams; and 0.7% on rocks (C.J. Norment). On Antipodes Is, forage round penguin colonies (Warham & Bell 1979; Beauchamp 1995; Oliver); and on Chatham I., among Bracken (Beauchamp 1998). In alpine areas, sometimes seen foraging for immobilised insects on remnant patches of snow (Paterson 1928; Green & Pickering 2002; CSN 25, 33), and on ground within 20–30 cm of edge of snow (C.J. Norment). Commonly forage round human activity (see Foraging associations), in wide range of grassed, bare or paved habitats, including: roads and tracks (Secker 1959; St Paul 1975; Roberts & Ingram 1976; Beauchamp 1995, 1998; Beauchamp & Parrish 1999), and round camps and picnic grounds (Barrett 1916; Mack 1992; CSN 38); and on mown grass at airfields and airports (Moeed 1975), occasionally feeding on insects and other invertebrates

attracted by runway lighting (van Tets *et al.* 1969, 1977); see Habitat for further details. **FORAGING METHODS:** **SEARCH:** When foraging in flocks, birds scatter in different directions over a foraging site, but depart as a flock if disturbed (Turbott 1967; CSN 9). At Nareen, Vic., one was observed turning lichen on rocks in search of invertebrates (McEvey 1949). **ATTACK:** Attack mainly by gleaning (Anon. 1915; Dove 1917; Paterson 1928; Oliver; Aust. Atlas 1; CSN 25); less often by sallying (Anon. 1915; Sutton 1927c; Roberts 1956; St Paul 1975; Beauchamp 1995; Oliver) and lunging (Fletcher 1904; Barrett 1916; Jaensch 1985; Baxter 1989; CSN 39); and occasionally by leaping (St Paul 1975; Beauchamp 1995). In Snowy Mts, NSW, pursue insects by lunging across tops of shrubs in heath; sometimes paused to glean insects from foliage, and sally-hover or sally-strike insects from air (C.J. Norment). Occasionally remove shoots of sprouting vegetables (Green & Mollison 1961). On Antipodes Is, one seen taking food dropped by an Erect-crested Penguin *Eudyptes sclateri* as it fed its chick (Warham & Bell 1979). Rarely, birds accustomed to people take food thrown to them (Edgar 1949). On Chatham I. and round Wellington, foraging behaviour consisted of standing search and walking search, dashing (lunging) and dash-flying (running followed by a short jump or flight), leaping, and eating and ingesting prey; foraging behaviour in different habitats round Wellington summarized in Table 1, and behaviour in different habitats on Chatham I. and round Wellington in Table 2. Dashing was prevalent on smooth surfaces (beach, pasture) on Chatham I. and round Wellington, while hopping was more common on rough terrain incorporating ferns and rocks. Dash-flying was recorded wherever flying insects were present. Round Wellington, foraging activities accounted for 72.8–93.9% of total activity budget. On Chatham I., foraging behaviour differed significantly between open pasture and fernland, and between open pasture and beaches: birds on beaches walked less and dashed more than in open pastures (moved [walked and flew] 10.3 m/min [17.61; 10] on open pasture, 23.1 m/min [87.93; 14] on beaches); and spent more time eating and ingesting prey and less time hopping and dash-flying than on open pasture. Compared with fernland, birds on open pasture spent more time feeding (handling food), standing searching, and dashing after prey, whereas birds on fernland hopped, dash-flew and walked more than birds on open pasture. Behaviour differed significantly between Chatham I. and Wellington, both on beaches and on pasture (see Table 2), suggesting that foraging methods tailored to habitat. Dashing for flies more common on beaches on Chatham I. because beaches were more open with more even distribution of seaweed, compared with rocky beaches with patchy seaweed at Wellington. When foraging on pasture, birds on Chatham I. were on level ground

and spent more time moving across ground, compared with hillier pasture in Wellington, where birds able to stand more and survey sites from elevated ground. **FOOD-HANDLING:** Unable to handle whole grubs of Huhu beetle *Prionoplus reticularis*, but will pick off pieces if grubs are broken for them (CSN 5). Collect multiple items before returning to feed still-dependent fledgelings (A.J. Beauchamp). **SEASONAL VARIATION:** On Huiarua Stn, NI, only significant seasonal variation in frequency of occurrence of prey was for Diptera, which present in 93% of gizzards in Oct.–Dec. and 29% in Apr.–June; seeds appeared more prevalent (and conversely, invertebrates less common) in diet in Jan.–June than in other months (see Garrick 1981 for further details). **FORAGING TIMES:** While said to forage mostly in afternoon and evening (Dove 1913; McEvey 1949, 1952; Secker 1955), also feed in morning (Fletcher 1904; McEvey 1952). In Snowy Mts, NSW, highest rates of foraging on snow in morning (06:00–08:00) and evening (16:00–19:00) (C.J. Norment). **INTERSPECIFIC COMPARISONS:** In open pasture on Chatham I., foraging behaviour significantly different from that of Skylarks: Pipits more mobile while foraging, moving mean 10.3 m/min (17.61; 10) compared with 1.06 m/min (2.41; 5) for Skylarks, but spent less time foraging than Skylarks. Pipits also used all available habitats, but Skylarks mainly foraged on closely grazed grass and round seeding *Bromus* on dry slopes (Beauchamp 1998). On Huiarua Stn, NI, Pipit and Skylark took similar range of food items, Pipits eating 75% of invertebrate families and 73% of seeds taken by Skylarks; Skylarks ate 57% of identified invertebrate families and 80% of identified seeds taken by Pipits. Pipits took significantly more invertebrates than Skylarks: only 14% of Skylark gizzards contained $\geq 75\%$ invertebrates by volume, compared with 91% of Pipit gizzards (trend apparent throughout year). Food competition between the two species considered unlikely given differences in occurrence and volume of seeds and invertebrate matter in diets (see Garrick 1981 for further details). Moeed (1975) also has data on diet of both Pipit and Skylark (see Detailed studies, below, and Skylark account). **PEST STATUS:** Known to damage germinating vegetables (Green & Mollison 1961; Aust. Atlas 1), and eat some beneficial insects (Lea & Gray). Conversely, also considered useful as they eat destructive insects, especially insect larvae, and seeds of weeds growing among crops (Miller 1938; Lea & Gray; Oliver). **DRINKING:** Seen to drink in flocks during hot weather in summer; 25 seen drinking from a water dish during extreme heat (Boehm 1937, 1957b).

Detailed studies At HUIARUA STN, NI (frequency occurrence of items in 57 gizzards; totals for plant families and arthropod orders, and insect larvae and pupae, include all items within those categories; Garrick 1981): **Plants** (All seeds.) Unident. seeds 10.5% freq. **MONOCOTYLEDONS:**

Table 1. Foraging as % of total activity budget in major habitat types round Wellington (from Beauchamp 1995).

Activity	Beach cliff	Coastal road	Gravel pasture	Rough
Standing search	18.9	8.9	15.2	17.6
Walking search	26.4	28.4	43.3	49.4
Dashing	19.0	1.3	5.3	3.4
Hopping/Jumping	2.8	1.8	<0.1	<0.1
Feeding	26.8	38.7	9.0	20.3
Other	6.0	20.2	26.1	8.1
Number of birds observed	10	7	11	16
Number of obs. periods	11	7	11	23
Number of 5-s obs. units	462	380	598	1294

Plate 39

(N. Day)

Common Redpoll *Carduelis flammea* (page 1345)

SUBSPECIES CABERET: 1 Adult male (fresh plumage); 2 Adult male (worn plumage); 3 Adult female; 4 Juvenile; 5 Immature male; 6 Adult male

Yellowhammer *Emberiza citrinella* (page 1449)

SUBSPECIES CALIGINOSA: 7 Adult male (fresh plumage); 8 Adult male (worn plumage); 9 Adult female; 10 Juvenile; 11 Immature male; 12 Adult male

Cirl Bunting *Emberiza cirlus* (page 1457)

13 Adult male (fresh plumage); 14 Adult male (worn plumage); 15 Adult female; 16 Juvenile; 17 Adult male

Table 2. Foraging as % of total activity budget on Chatham I. and round Wellington (from Beauchamp 1998).

Activity	CHATHAM I.			WELLINGTON	
	Fern and rough pasture	Open pasture	Beach	Open pasture	Beach
Standing search	11.9	13.7	16.3	20.1	7.2
Walking search	50.5	43.8	38.0	44.6	51.7
Dashing	3.0	5.7	7.6	1.3	3.4
Hopping	8.6	3.9	<0.1	—	1.7
Dash-flying	3.0	1.7	<0.1	—	—
Feeding	17.1	23.4	32.8	27.1	34.3
Other	4.8	7.6	2.4	4.4	3.4
Minimum number of birds	4	8	8	5	5
Number of 5-s units	572	984	846	159	172

Cyperaceae 8.8: *Carex* 8.8; Poaceae 24.6: *Anthoxanthum odoratum* 17.5; *Cynosurus cristatus* 5.3; *Setaria* 3.5. DICOTYLEDONS: Asteraceae 25.0: *Cirsium arvense* 1.8; *C. vulgare* 21.1; *Taraxacum officinale* 1.8; Brassicaceae 3.5: *Sinapis nigra* 3.5; Caryophyllaceae 1.8: *Stellaria media* 1.8; Fabaceae 33.3: *Trifolium dubium* 19.3; *T. repens* 15.8; *T. pratense* 8.8; Lamiaceae 5.3: *Prunella vulgaris* 5.3; Plantaginaceae 22.8: *Plantago* 1.8; *P. lanceolata* 21.1; Polygonaceae 5.3: *Polygonum aviculare* 5.3; *Rumex acetosella* 1.8; Ranunculaceae 1.8: *Ranunculus repens* 1.8; Rubiaceae 1.8. **Animals** Unident. invertebrates 35.1. MOLLUSCS: Gastropods: Mesogastropods: Hydrobiidae: *Potamopyrgus antipodarum* 1.8. CRUSTACEANS: Isopods 1.8. SPIDERS: Araneae: Dictynidae 5.3; Epeiridae 1.8; Lycosidae 1.8; Salticidae 3.5. INSECTS: Larv. 38.6, pupae 21.1; Coleoptera: ads 77.2, unident. larv. 3.5; Carabidae: Cidelineae: ads 10.5; Chrysomelidae: *Eucolaspis* ads 3.5; *E. sculptus* ads 1.8; Coccinellidae: *Coccinella undecimpunctata* ads 21.0; Curculionidae: ads 5.3; Elateridae: larv. 3.5; *Lacon variabilis* ads 1.8; Scarabaeidae: unident. ads 1.8; *Aphodius granarius* ads 3.5; Melolonthinae: unident. ads 1.8; *Pyronota* ads 3.5; Diptera: ads 63.1, unident. larv. 5.3; Nematocera: unident. ads 7.0; Tipulidae: ads 35.1, larv. 3.5; Brachycera: Cyclorrhapha: ads 31.6; Hemiptera: ads 12.3; Cydnidae: ads 1.8; Nabidae: ads 1.8; Saldidae: *Saldula* ads 1.8; Tibicinidae: *Amphisalta* ads 3.5; Hymenoptera: ads 66.7; Apocrita: unident. ads 42.1; Formicidae: ads 35.1; Lepidoptera: ads 14.0, unident. larv. 10.5; Coleophoridae: *Coleophora* pupae 21.1; Noctuidae: larv. 5.3; Orthoptera: ads 17.5; Gryllidae: *Pteronemobius bigelowi* ads 14.0; Acrididae: *Phaulacridium marginale* ads 3.5; Phthiraptera: Mallophaga: ads 1.8.

At CHRISTCHURCH INTERNATIONAL AIRPORT, NZ (433 food items from gizzards of five birds; Moeed 1975): **Plants** (All seeds.) MONOCOTYLEDONS: Poaceae: *Poa* 11.55% no. DICOTYLEDONS: Caryophyllaceae: *Stellaria media* 30.02; Fabaceae: *Trifolium* 18.48; Geraniaceae: *Erodium* 13.16; Oxalidaceae: *Oxalis* 1.62; Polygonaceae: *Polygonum* 0.46.

Plate 40

(P. Marsack)

Australasian Pipit *Anthus novaeseelandiae* (page 1359)
 SUBSPECIES ROGERSI: 1 Adult
 SUBSPECIES AUSTRALIS: 2 Adult (fresh plumage); 3 Adult (worn plumage); 4 Juvenile; 5 Immature; 6, 7 Adult
 SUBSPECIES BISTRATUS: 8 Adult
 SUBSPECIES BILBALI: 9 Adult
 NOMINATE NOVAESEELANDIAE: 10 Adult
 SUBSPECIES AUCKLANDICUS: 11 Adult (Campbell Is)
 SUBSPECIES CHATHAMENSIS: 12 Adult

South Georgia Pipit *Anthus antarcticus* (page 1389)
 13 Adult

Animals INSECTS: Coleoptera: Carabidae 2.31; Coccinellidae: *Coccinella undecimpunctata* 0.23; Curculionidae 10.16; Scarabaeidae: *Costelytra zealandica* 0.46; Diptera 6.93; Hemiptera: Lygaeidae: *Nysius* 2.31; Lepidoptera: Coleophoridae: *Coleophora* larv. 0.69; Pyralidae: *Crambus* larv. 0.46. SPIDERS: Lycosidae 0.69; Opiliones: Phalangiidae: *Phalangium opilio* 0.46.

Other records—Aust. Plants Seeds^{11,14,15,22,23,24,25,26,27,28,29,31}, vegetable sprouts^{16,29}, fruit and berries²⁶, vegetable matter²⁷. MONOCOTYLEDONS: Poaceae: sds^{4,5,26,31}; *Triticum aestivum* sds^{14,27}. DICOTYLEDONS: Boraginaceae: *Echium lycopsis* sds²⁸; Polygonaceae: *Polygonum aviculare* sds²⁶; *Polygonum lapathifolium* sds²⁶; Portulacaceae²⁷: *Portulaca oleracea* sds³¹. **Animals** CRUSTACEANS: Decapods: crabs^{12,29}. SPIDERS^{4,14,19,23,26,27,31}. DIPLOPODS^{13,14,27}. INSECTS^{4,5,6,7,9,10,15,19,22,23,24,25,26,27,28,29,31}: pupae³; larv.^{3,5}; Blattodea: Blattidae¹⁹; Coleoptera^{1,4,17,20,23,26,27,28}; Carabidae^{4,26,31}; Chrysomelidae^{26,31}; *Cadmus*³¹; *Paropsis*³¹; Coccinellidae¹³: *Coccinella*^{4,26}; Curculionidae^{17,18,19,26,31}: *Hyphaeria*^{14,27}; *Mandalotus*²⁷; *M. wedgensis*²⁷; *Polyphrades*³¹; *Prosalyeus*³¹; *Titimia*³¹; Dermestidae: larv.²⁷, ads²⁷; Elateridae: larv.^{26,31}, ads³¹; Noctuidae: larv.²⁶; Scarabaeidae³¹: Aphodiinae³¹; Tenebrionidae: *Adelium*^{14,27}; Dermaptera^{19,31}; Diptera^{17,27}: pupae²⁷; Calliphoridae²⁷: *Calliphora*^{14,27}; Coelopidae³⁰; Muscidae: *Musca domestica*²⁷; Hemiptera^{11,20,26,27,31}; Cicadidae¹¹; Lygaeidae^{13,27}; Miridae^{27,31}; Pentatomidae^{18,19,31}; Reduviidae¹³; Hymenoptera^{20,27}; Formicidae^{4,13,14,17,26,27,31}: *Camponotus*^{13,14,27,31}; *Iridomyrmex*^{13,14,19,27,31}; *I. purpureus*³¹; *Pheidole*^{13,14,27,31}; Ichneumonidae^{14,27}; Lepidoptera: larv.^{5,6,14,19,23,26,27,28,31}, ads^{5,14,27}; Noctuidae: ads²⁷; *Agrotis infusa* larv.⁸; Orthoptera^{14,17,20,23,26,27,28,31}: Acrididae^{17,18,19,21,31}; Gryllidae^{2,31}; Tetrigidae: *Paratettix argillaceus*¹⁷; Tettigoniidae²¹. **Other matter** Grit^{2,27,28}, sand^{14,27}, pebbles^{14,27}.

REFERENCES: ¹ Berney 1907; ² Stephen 1907; ³ Gubanyi 1910; ⁴ Cleland 1911; Anon. ⁵ 1915, ⁶ 1926; ⁷ Barrett 1916; ⁸ Slaney 1922; ⁹ Sutton 1927c; ¹⁰ Paterson 1928; ¹¹ Jarvis 1929; ¹² Mayo 1931; ¹³ McKeown 1936; ¹⁴ Lea 1938; ¹⁵ Miller 1938; ¹⁶ Green & Mollison 1961; ¹⁷ Green 1966; van Tets et al. ¹⁸ 1969, ¹⁹ 1977; ²⁰ Matthiessen 1973; ²¹ Vestjens 1977; ²² Saunders & de Rebeira 1991; ²³ Rose 1999; ²⁴ Gould; ²⁵ North; ²⁶ Cleland; ²⁷ Lea & Gray; ²⁸ Hall; ²⁹ Aust. Atlas 1; ³⁰ Storr 28; ³¹ FAB.

Other records—NZ Plants Seeds^{2,5,8,9,10,11}, fruit and berries⁶. MONOCOTYLEDONS: Poaceae: sds^{5,10}. DICOTYLEDONS: Chenopodiaceae: *Chenopodium* sds¹⁷; Fabaceae: probably *Trifolium* sds¹⁰; Rubiaceae: *Nertera depressa* fru.⁷. **Animals** MOLLUSCS: Gastropods: snails¹². ANNELIDS: Oligochaetes: earthworms^{2,11}. CRUSTACEANS^{6,11}: Amphipods: sandhoppers¹⁰. TICKS¹²: Ixodidae: *Haemaphysalis longicornis*¹¹. SPIDERS^{10,11}. INSECTS^{2,4,5,6,8,11,13}: pupae¹⁰; larv.^{2,4,10,11,13,14}; Coleoptera¹⁰; Cerambycidae: *Prionopus reticularis* larv.^{4,14}; Scarabaeidae: probably *Costelytra zealandica* larv.^{10,16}; *Odontria* larv.¹¹; Diptera^{4,10}; Chironomidae⁹; Coelopidae: larv.³; Hemiptera¹⁰;

Cicadidae^{15,16}; Hymenoptera¹⁰; Lepidoptera: ads^{6,10}; Herialidae: larv.¹⁹; Orthoptera: Gryllidae¹⁰. REPTILES: Lizards²⁰. **Other matter** Breadcrumbs^{1,18}.

REFERENCES: ¹ Edgar 1949; ² Turbott 1967; ³ Jenkins 1968; ⁴ St Paul 1975; ⁵ Child 1978; ⁶ Warham & Bell 1979; ⁷ Pierce 1980; ⁸ Falla *et al.* 1981; ⁹ Beauchamp & Parrish 1999; ¹⁰ Heather & Robertson 2000; ¹¹ Oliver; ¹² NZRD; CSN ¹³ 4, ¹⁴ 5, ¹⁵ 29, ¹⁶ 30, ¹⁷ 34, ¹⁸ 38, ¹⁹ 41, ²⁰ 48.

Young Nestlings and fledgelings fed by both parents for c. 3 weeks (Oliver; see Breeding). On Limestone I., NI, adults fed nestlings seven times in 30 min; at another nest near Mangawhai, adults fed nestlings less often, 4–6 times/h; and in Whitikau Valley, fledgelings seen still being fed by parents 2–3 times/h, each time with multiple items (Beauchamp in press; A.J. Beauchamp). At a nest in WA, young fed 12 times between 09:45 and 11:45 (Serventy 1958). Claimed that nestlings may be fed throughout night, regardless of weather (Littler 1904) but confirmation needed.

No detailed studies—**Aust. Animals** CRUSTACEANS: Decapods: Crabs¹. INSECTS: Larv.²; Lepidoptera: larv.². (REFERENCES: ¹ Mayo 1931; ² NRS.)

No detailed studies—**NZ Animals** INSECTS: Ads^{2,3}; Diptera: Flies^{1,4}; Tipulidae: crane-fly ads^{1,4}; Lepidoptera: Crambidae *Crambus flexuosellus* ads^{1,4}; Lycaenidae: *Zizina otis* ads^{1,4}. (REFERENCES: ¹ Beauchamp in press; ² Oliver; ³ CSN 30; ⁴ A.J. Beauchamp.)

Intake In Snowy Mts, NSW, foraging rates on snow (34 pecks/min) higher than off snow (9 pecks/min) (C.J. Norment).

SOCIAL ORGANIZATION Not well known. Detailed studies: on Chatham I., Apr.–May 1997 (Beauchamp 1998) and Nov. 1999 (Beauchamp 2002), including details on dispersion and territories; in Kosciuszko NP, Snowy Mts, NSW, 1979–2003, with intensive observations Oct. 2000–May 2001 (Norment & Green 2004); and at Nareen, sw. Vic., July–Dec. 1948 (McEvey 1949) and July–Nov. 1949 (McEvey 1952), of dispersion and territories. Usually solitary, less often in twos, probably pairs (e.g. Rix 1970; Longmore 1978; Badman 1979; Storr 1981; Halse *et al.* 1985; McFarland 1988; Nielsen 1991; Baxter & Berris 1995; Beauchamp 1998, 2002; Storr 21, 24; CSN 49; see Food). Occasionally in small parties or flocks, usually during autumn and winter (e.g. Wilkinson 1924; McEvey 1952; Heron 1970, 1973; Morris 1975; Gibson 1977; Bedgood 1980; Gosper 1981; Storr 1981; Aumann 1991; Beauchamp 1998, 2002; Johnstone *et al.* 2000; Storr 16, 22), of 3–12 birds (e.g. Littler 1904; Saunders & de Rebeira 1993; North; Storr 26, 27, 28, 35); and, rarely, in larger groups of up to 20 (Longmore 1973; Templeton 1992; Baxter & Paton 1998; see Food) or up to 50 or more (Schulz & Kristensen 1994; see Food); flocks of up to 100 claimed in Qld (Storr 19). In Snowy Mts, all foraged in flocks during Sept. and early Oct., but by early Nov. many had dispersed into territories; formed post-breeding flocks from late Feb., and were seen in flocks during Mar., before leaving area (Norment & Green 2004). At Mt Mary, SA, occasionally congregate in paddocks, probably attracted by food; and flocks drink at dams during hot summer weather (Boehm 1957b). On Chatham I., in Nov., groups and pairs remained separate; average size of groups 3.2 birds (0.4; 5) and thought to be predominantly males (Beauchamp 2002). Sometimes associate with other species when foraging (see Food).

Bonds Monogamous (e.g. Elliott 1932; McEvey 1949, 1952; Norment & Green 2004; NRS), though one probably incidence of polygyny in Snowy Mts: two unbanded females simultaneously incubated eggs in nests <9 m apart with no observed agonistic interactions between them, and no more

than three birds were seen at once within territory (Norment & Green 2004). May form pair-bonds at a young age: once, two birds in juvenile plumage appeared to form bond. Pairs may form while associating in parties in non-breeding season (Secker 1955). Some evidence of mate-guarding by males (see Sexual behaviour). **Parental care** Both adults feed nestlings and fledgelings (see Breeding).

Breeding dispersion Usually nest solitarily (e.g. McEvey 1949, 1952; Serventy 1958; NRS) but sometimes nest in small groups (Littler 1910; see below). Once, 2 weeks after several territorial pairs observed, all were found nesting within a few metres of each other. In ne. NSW, three nests found within c. 18 m of a fourth (Gannon 1953). In NSW, four nests within area of c. 65 m², a fifth c. 22 m away from nearest of those, a sixth c. 4 m from this, and a seventh c. 35 m from the sixth nest, all seven nests being active. Nearby, another two active nests c. 4 m apart (Bourke 1948). In Snowy Mts, mean minimum distance between known, simultaneously active, neighbouring nests was 78.3 m (20.4; 52–150; 24). All known nests that were <50 m from another appeared to be replacement or second nests of a single pair, and, once, polygynous nesting (Norment & Green 2004; see also Bonds). Near Wollongong, NSW, one nest 50 m from an active nest and another nest 250 m further away (NRS). Two nests, one containing one egg and the other two nestlings, c. 15 cm apart (Haines 1968). In e. NSW, 13 species of bird, including Pipits, nested in an area of <0.8 ha, and few nests were found in surrounding area searched (Gannon 1953). **Territories** At Nareen, territories of one pair in two consecutive breeding seasons estimated to be 9.04 ha and 8.91 ha; breeding and associated behaviours confined to an area of c. 4.45 ha within territories in both years, with rest appearing to be used for foraging. On Chatham Is, in Nov., for six pairs, minimum range 2.9–6.3 ha (Beauchamp 2002); and during Apr.–May, one pair defended area of c. 2.5 ha against other Pipits (Beauchamp 1998). In Snowy Mts, many had established territories by early Nov.; by repeatedly flushing some paired males (at least 20 times each), territory size estimated at 0.34 ha (0.07; 0.28–0.45; 6). From distribution of known nests and observations of territorial birds within 35-ha plot, territorial density estimated at 1.06 pairs/ha (n=37 pairs) (Norment & Green 2004). One nesting pair near Dumbleyung, sw. WA, gathered food within an area of 5.9 ha (Serventy 1958). On Chatham Is, all home-ranges contained high vantage sites, which appear to be an important feature of a territory (Beauchamp 2002). Territoriality may change in season: several pairs defending territories were found nesting within a few metres of each other 2 weeks later (Gannon 1953).

Roosting On Chatham Is., those that foraged on beach during day departed at dusk (Beauchamp 1998). No other information.

SOCIAL BEHAVIOUR Some aspects well known. Studies of agonistic and sexual behaviour, including mate-guarding and displays, on Chatham Is, Apr.–May 1997 (Beauchamp 1998) and Nov. 1999 (Beauchamp 2002); of sexual behaviour at Wellington, 1951–54 (Secker 1955); and of behaviour of parents and nestlings at nest (Serventy 1958). Usually cryptic and unobtrusive (Ford & Stone 1957; Green 1995), but occasionally conspicuous when in scattered flocks during non-breeding season or when congregating at food or water or when sheltering from heat in trees (Ford & Stone 1957; CSN 19; North; see below). Can also become tame and approachable (Stidolph 1923; Wilkinson 1927; Wilkinson 1957). Round Wellington, cool winds reduced numbers seen on exposed hilltops; and numbers lower on shaded s. faces of cliffs and on beaches in winter (Beauchamp 1995). Once, a flock of 26 seen circling and milling above a turnip field, calling steadily (CSN 19). **Display** Perform variety of Song-flight

displays (see below). Often give Subsong throughout year with white lateral tail-feathers spread out, without an apparent sexual or territorial function (Secker 1955). Once, in Snowy Mts, NSW, one landed on shrub c. 5 m from another Pipit, and then approached second bird by hopping across tops of low shrubs while fluttering wings and uttering Chirping Call; first bird stopped when c. 50 cm from second, and both then chirped with rapidly fluttered wings for c. 1 min and then first bird chased second (C.J. Norment). **Maintenance behaviour** On very hot days seen to gather in hundreds under shade of trees (Ford & Stone 1957), and flock to dams to drink (Boehm 1957b). Seen to dust-bathe on dirt roads, and to preen and sun themselves on tall rock outcrops and fence-posts (Beauchamp 1995).

Agonistic behaviour Aggressive towards conspecifics during breeding season (see below). Song sometimes appears to be used as territorial advertisement (e.g. Secker 1955), but appears to have sexual function when given in Undulating Song-flight (see Sexual Behaviour). When used as territorial advertisement, song uttered in rather LEVEL SONG-FLIGHT, sometimes with wings rapidly quivering; sometimes uttered while flying rapidly in straight line, sometimes over c. 180 m, and sometimes while circling c. 8 m above ground (Secker 1955). Song also uttered while perched (see Voice), possibly as agonistic behaviour but confirmation needed. Twice, two seen singing while flying towards and away from each other (Dove 1936; Secker 1955). Sometimes such singing in flight ended in a chase (Secker 1955; CSN 19 Suppl.). Respond to playback of Song by quickly approaching source (C.J. Norment). **Chases, Fights** Territorial males will chase and fight with intruders, and members of pairs seen to drive off intruding birds (McEvey 1949; Beauchamp 2002). In Snowy Mts, NSW, first territorial chases were noted on 11 Oct. (Norment & Green 2004); chases sometimes involved three or four birds of unknown sex (C.J. Norment). Once, two males flew to within 1 m of each other and perched; both then repeatedly fluttered vertically into air to height of c. 0.5 m, each time returning to perch, then one chased the other for c. 50 m (C.J. Norment). On Chatham Is, paired males chased and fought intruding males. When call of solo male played back within home-range of a pair, male responded as if to drive off solo bird, whereas paired females did not respond. In longest chase between a paired male and a challenging solo male, males flew within 50 cm of each other over hundreds of metres, both within and outside the known home-range of the pair. The paired male called as he passed over female. In this chase males locked bills and feet in air and descended four times to fight on ground. After the chase the males and female called (Beauchamp 2002). Sometimes attack reflection in mirror or window (CSN 41, 47). **Alarm** Call in alarm or distress (see Voice), e.g. when chased by harrier *Circus* (Fletcher 1909) or Australian Magpie (McClymont 1908). When escaping from Magpies, usually fly up in spirals or make rapid sideways movements. Once, one alighting on ground was attacked by Magpie, but then ignored by it (Secker 1955). Run away when approached by observer, but if approach too quick, make short flight and then run rapidly away (Cooper 1978).

Sexual behaviour Solitary birds advertise by giving Common Advertising Call, sometimes while holding large invertebrate, such as cicada, butterfly or large fly, in bill (Beauchamp 2002; A.J. Beauchamp; see also Voice). **Courtship displays** Perform UNDULATING SONG-FLIGHT high in air, repeatedly swinging up with rapid wing-beats or on quivering wings and with tail raised, then dipping down and singing from lowest point of each arc with volume reaching maximum at top of each peak (Anon. 1915; McEvey 1949; Secker 1955; Nielsen 1991; Goodfellow 2005). Singing in flight not always part of Undulating Song-flight (see Agonistic

behaviour). In Aust., Undulating Song-flights usually performed in spring (McEvey 1949; Nielsen 1991); Song-flights also seen Mar.–Apr. after heavy rains (Masters & Milhinch 1974), but not known whether these sexual or agonistic. Possible **PAIR-FORMATION**: Once, three of a flock of ten made harsh chattering calls then flew from the group and perched in line on separate fence-posts; one crouched, spread and fluttered wings, then flew downhill with fluttering wings before gliding and alighting, and was followed by second bird. These two birds appeared to have formed pair-bond, as they later chased away another that came near them (Secker 1955). On Chatham Is, unpaired birds (thought to be mainly males) formed groups at start of breeding season. On three occasions, a lone bird (probably female) approached group and crouched; one bird from group (probably male) then circled lone bird for 45–90 s with rapidly fluttering wings, and with tail fanned and raised at angle of 60°, until crouching bird flew off with bird from group in pursuit; no calls given (see Pre-copulatory Display below). On two other occasions, lone birds briefly joined group but no displays observed and these birds subsequently moved away (Beauchamp 2002). **PAIR-BOND MAINTENANCE**: Female sometimes fed by male during incubation (NZRD). **MATE-GUARDING**: On Chatham Is, males appeared to perform female-guarding behaviour; males perched on top of ferns near foraging female, and followed female, flying low over her, from perch to perch (Beauchamp 2002). Similar behaviour also observed in Kosciuszko NP (C.J. Norment), and at Whangarei, NI (A.J. Beauchamp). **PRE-COPULATORY DISPLAY**: Female raises tail almost vertically, raises bill at angle of c. 75° from horizontal, and rapidly quivers lowered wings, held slightly away from body, while uttering *cheeps* (C.J. Norment). Male responds by running towards female with bill held horizontal, tail spread and lowered, and wings held in similar position to those of female. When within c. 10 cm of female, male then circles displaying female, either by running or by ‘bouncing’ round female in short flights. Once seen to be followed by copulation. In Kosciuszko NP, NSW, frequently observed Nov., usually at time of nest-building or laying. On two occasions, two males approached displaying female, but chase ensued and no copulation occurred (C.J. Norment).

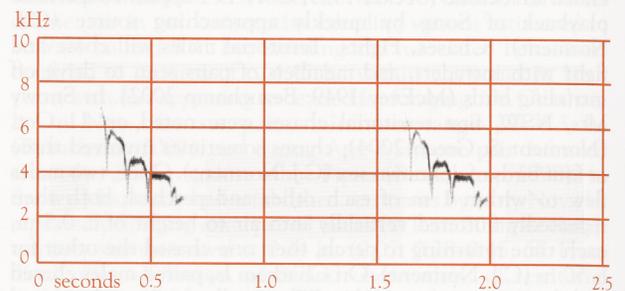
Relations within family group Nestlings and fledglings fed by both adults (see Food [Young], Breeding). Nestlings did not react till parents c. 1 m from nest; they then gaped bills, showing bright-orange mouth (Serventy 1958). Parents wary and elusive near nest (ACT Atlas); land 5–10 m from nest and approach on foot, usually after a delay (Turbott 1967; Falla *et al.* 1981; Heather & Robertson 2000). When approaching nest, never go straight to nest but proceed gradually in a series of steps, stopping at each one to check for danger before continuing. When close to nest, approach quickly, feed nestlings, run 1 m or so away, and then take off and fly considerable distance before alighting (Elliott 1932; NRS). Parents silent while approaching and leaving nest (Beauchamp in press). In presence of observer, may abandon going to nest (NRS) or change approach (Serventy 1958). **Anti-predator response of young** Nestlings cryptically plumaged and usually squat flat in nest (NRS). Seen to leave nest when approached, possibly prematurely (NRS). **Parental anti-predator strategies** Sitting bird may sneak away from nest at approach of observer or other potential danger (Le Souéf 1902; NRS). Birds also noted to sit tightly, allowing close approach (NRS); one bird remained at nest to defend nestlings against an egret *Ardea*, but was killed by the egret; its mate continued care of nestlings, though attempt ultimately failed (Harvey & Harvey 1919). Once, while observer at nest with three nestlings, parent flew above nest calling (Beauchamp in press; see also Voice). **DISTRACTION DISPLAYS**: Performed often when sitting bird flushed from nest in attempt to lead intruder away from nest, usually not taking

flight till well away from nest. Displays include feigning injury (Hood 1935; Boehm 1946; Green 1995; Oliver; NRS), usually fluttering along ground away from nest feigning a broken wing, e.g. with one wing extended and slightly lowered or with both wings extended and raised (usually with one held higher than other) (Anon. 1915; McEvey 1952; NRS). While displaying, often spread and lower tail, and utter series of raspy squawks (C.J. Norment). May also give a rodent-run display, holding wings tight against body, head lowered and tail dragging (Serventy 1958; Johnstone 1983). Sometimes feign juvenility (Boehm 1946). Occasionally call when flushed (North; NRS); and one flushed from nest stood c. 3 m from nest and called in distraction with no other behaviour (NRS). One displaying bird never >12 m from nest, moving in a circle round nest (NRS); and another led observer c. 70 m from nest, along ground, before it flew back to nest (Serventy 1958). At one nest discovered before laying, parent first gave distraction display after laying second egg; sat tight and did not display after third egg laid, and next day, initially sat tight, but gave display after approached to within 2 m (Serventy 1958).

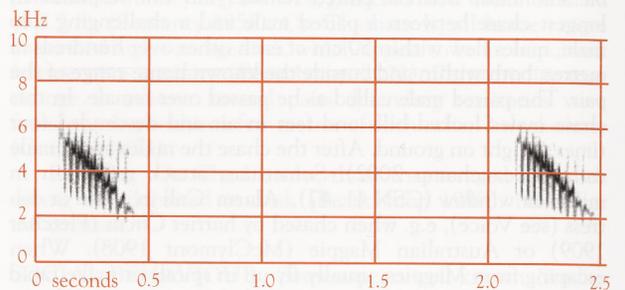
VOICE Not well known. Sonagrams from both Aust. and NZ in Alström & Mild (2003). In Aust., usually sing while flying in Undulating Song-flight (Dove 1910, 1936; Anon. 1915; Chisholm 1932, 1946; Sharland 1944; McEvey 1952; Serventy & Whittell), singing during ascent, and appearing to reach maximum volume at top of each peak (Dove 1916a; McEvey 1949; Campbell; North; see also Social Behaviour: Sexual Behaviour); can rise to considerable height (Anon. 1915). In Aust., also recorded singing while perched, e.g. on fence-post or from dead branches at top of tree (Anon. 1915; Chisholm 1932, 1946; Boehm 1957a). In NZ, recorded singing in flight, or while perched on rocks, stumps or, once, from fern frond (Secker 1955; St Paul 1975; Oliver); in flight, given with wings rapidly quivering (Secker 1955). Sometimes sing late at night; within 3 h of midnight (Boehm 1950); and in Tas., calls (possibly referring to Song) heard at night during breeding season (Littler 1904). See Social Behaviour for further details of Song-flights. **ANNUAL PATTERN:** In Aust., appear to sing only in breeding season (e.g. Littler 1904; Serventy & Whittell), and then said to sing only for a few weeks (Anon. 1915). At Nareen, sw. Vic., one seen in Song-flight in Aug., and another in Oct. (McEvey 1949). In NZ, Song heard intermittently from late July to early Jan. (Sibson 1949; Secker 1955), and Subsong heard occasionally throughout year (Secker 1955). On Antipodes Is, Song recorded Nov. (Alström & Mild 2003). On Chatham Is, calling and Song heard Nov. (Beauchamp 2002). **MIMICRY:** In Aust., described as minor mimic (Chisholm 1965). Heard to mimic calls of Black-fronted Dotterel *Elseyornis melanops* (Contact Call), Red-rumped Parrot *Psephotus haematonotus* (including flock of birds), Brown Treecreeper *Climacteris picumnus*, Yellow-rumped Thornbill *Acanthiza chrysorrhoa*, Willie Wagtail (Song), White-browed Woodswallow *Artamus superciliosus*, Australian Magpie and Zebra Finch *Taeniopygia guttata* (Bourke 1943). Also reported to mimic raven *Corvus*, plover and Skylark (Chisholm 1932, 1946). Mimicry not noted in NZ. **REGIONAL VARIATION:** Based on differences in descriptions between different locations, there appears to be extensive variation across range, but trends in variation have not been described; see descriptions of individual vocalizations from different areas below.

Adult SONG: Song variously described as spirited, beautiful and blithesome (Chisholm 1932, 1946; Campbell). In AUST., described as pleasing, high-pitched, soft, trilling warble (Anon. 1915; McEvey 1949; Aust. RD), or whistling (Sharland 1944). In Tas., also described as short, sibilant *sss-siou* (Dove 1910, 1916a,b). Sonagram A shows two repetitions of a phrase that was repeated in Song during Song-flight,

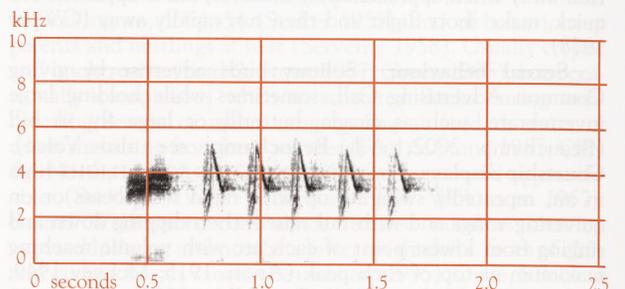
and sonagram B shows two repetitions of a phrase from long sequence. In NZ, usually utter repeated Song-phrase that sounds like *txree-tzit-it-it* (= Challenge Song) and which consists of drawn-out slur, *txree*, followed by three short notes (Secker 1955); see sonagram C. Song described as noise of cork in wet bottle, and uttered by two after a chase (CSN 19 Suppl.), probably same Song. Song also described as trilling *tsaw-tser weet-tsir* (NZRD). Once, in Oct., male sang different Song in undulating flight when female nearby, not as loud as usual Song, and rendered *tchwee-tchwee-tchwee-tchwee* (Secker 1955). Possibly utter different phrases depending on whether context is sexual or agonistic (Secker 1955; see Social Behaviour for contexts). Trill or *tzju-weet* uttered while sitting on rocks or stumps and occasionally during flight, especially while descending to ground (Oliver; NZRD), also probably Song. On CHATHAM IS: *tjwee-tjit-it-it* once given after chasing another Pipit (Beauchamp 2002) probably Song; *tzju eoot* uttered by bird (probably male) while flying in high-speed passes over probable female possibly also Song; first syllable given on descent and latter on ascent of flight (Beauchamp 2002). On ANTIPODES IS, two-note repetitive *tcher-ti tcher-ti tcher-ti* probably Song (A.M. Dunn; see sonagram D). On AUCKLAND IS, descending trill *tzeeuw* probably Song (A.M. Dunn; two trills shown in sonagram E). **SUBSONG:** Low, warbling Subsong; in NZ, given occasionally throughout year (Secker 1955). A soft semi-trill reported in Aust.



A F.W. van Gessel; Widden Valley, NSW, Apr. 1981; P48



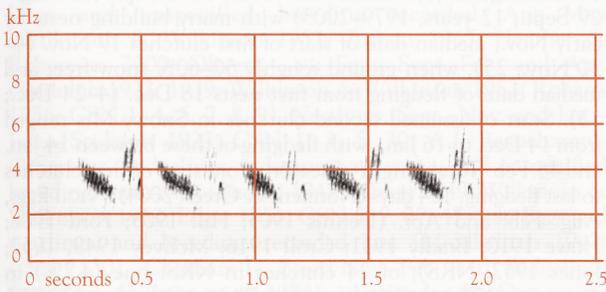
B F.W. van Gessel; Widden Valley, NSW, Oct. 1988; P48



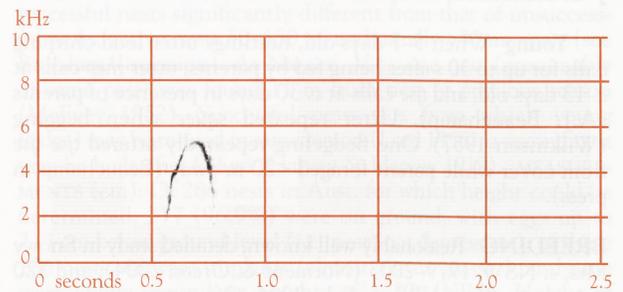
C W.V. Ward; Nelson Lakes NP, SI, Dec. 1965; P106

(McEvey 1952) possibly Subsong. **COMMON ADVERTISING CALL:** In NZ, call rendered as *tzweep* or *tcherweet* and heard throughout year from lone birds or from two together (Secker 1955). On CHATHAM IS, rendered as *tjwee*. In loose groups, thought to be comprised mainly of single males, 60–100% of birds gave call on average every 3.5 s (1.4; 69 5-s obs. of six birds); call given from the ground, fence-posts or in the air; also given with large insects in bill. Lone adults will be driven away by male if give call within home-range of pair (Beauchamp 2002). On AUCKLAND IS, rendered as *twee* (A.M. Dunn; see sonagram F). Three different calls recorded in WA, in mid-July, rendered as *cheep*, *chep* and *chirt* (Alström & Mild 2003 [with sonagrams]), possibly same or similar calls. **EXCITEMENT CALL** (= General Excitement Note of Secker 1955): In AUST., rendered as rasping, drawn-out *zwee* (Pizzey 1980) or thin *tswee* (Aust. RD). Throaty *zhwee...we* with last syllable swallowed (Goodfellow 2005) probably this call. In NZ, rendered as harsh, piercing *tzree* (Secker 1955), rasping, drawn-out *tuee* (NZRD) or *tjsweep* or *tzwee* (A.J. Beauchamp). Described as commonest call, and heard throughout year, though often subdued in winter; given in presence of conspecifics, Australian Magpies, Skylarks and people, and heard from birds flying across built-up areas (Secker 1955). High-pitched *scree* (NZRD) probably same call, as is *zee* uttered after running along ground (Stidolph 1923). On ANTIPODES IS, rendered as high-pitched, clear *tsweet* (A.M. Dunn; see

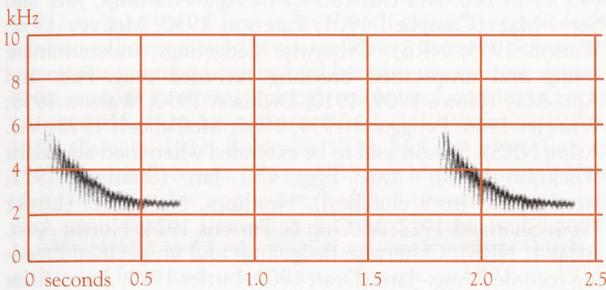
sonagram G). **CHIRPING CALLS:** One or several types of call with similar sound. In AUST., variously described as sustained pleasant chirping, plaintive trilling chirp (McEvey 1949), animated chirp (McEvey 1952), short chirrup often repeated twice (Anon. 1915) or sparrow-like *chirrup* (Aust. RD). Given while perched on rock or branch (McEvey 1952), or upon leaving ground when disturbed (Anon. 1915). In NZ, similar or same calls described as very sharp chirp (St Paul 1975), or *tirr-eep*, *cheet* or *peeet* (NZRD). On ANTIPODES IS, one call rendered as a shrill *tzweep* possibly this call (A.M. Dunn; see sonagram H). On AUCKLAND IS, one call rendered as a shrill *tzerrp* possibly same call (A.M. Dunn; see sonagram I). **ALARM CALL:** In NZ, one possible alarm call rendered *zeer* (Alström & Mild 2003). On CHATHAM IS, four possible alarm calls recorded in mid-Jan. rendered as *dreeep*, *durree*, *zeerp* and *zreeu* (Alström & Mild 2003). **DISTRESS CALL:** In AUST., one uttered shrill cry while being chased by Australian Magpie (McClymont 1908), and another gave cries of distress while being chased by harrier *Circus* (Fletcher 1909). Female utters raspy squawks while performing Distraction Display (C.J. Norment; see Social Behaviour). **Other calls** In AUST., brisk splintered *pith* said to be usual call (Pizzey 1980). Female utters *cheeps* while performing Precopulatory Display (C.J. Norment; see Social Behaviour: Sexual Behaviour). In NZ, repeatedly utter high-pitched and slurred *pi-pit* in spring from prominent perch (Oliver; NZRD). Harsh, subdued twitter, rendered as



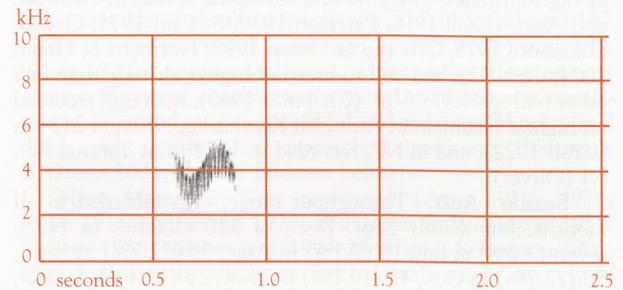
D E. Samuelson; Antipodes Is, Dec. 1978; P106



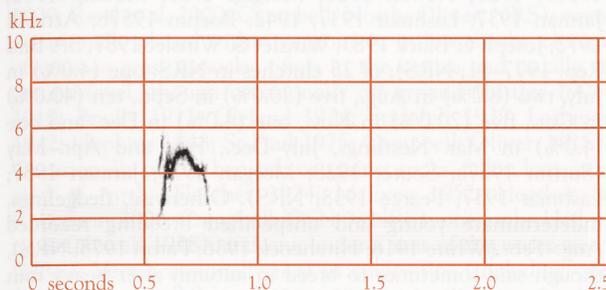
G E. Samuelson; Antipodes Is, Dec. 1978; P106



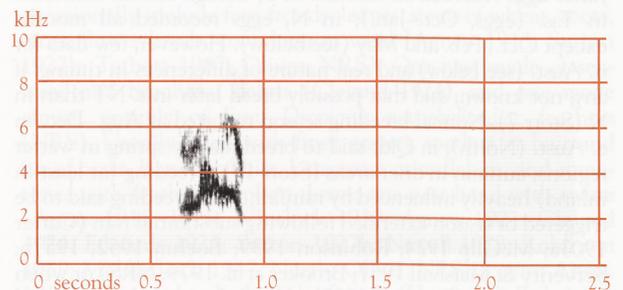
E R. Buckingham; Adams I., Auckland Is, Nov. 1989; P106



H E. Samuelson; Antipodes Is, Dec. 1978; P106

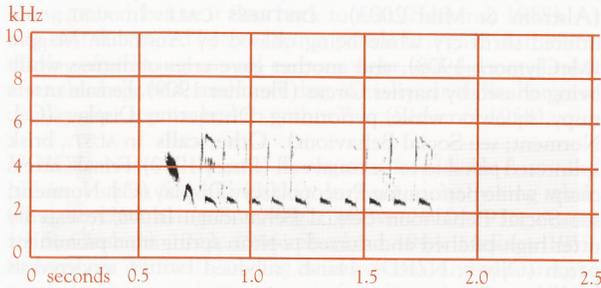


F R. Buckingham; Adams I., Auckland Is, Nov. 1989; P106



I R. Buckingham; Adams I., Auckland Is, Nov. 1989; P106

tchack-tchack-tchack-tchack, heard throughout year when pair approached by third bird; thought to express sexual excitement. Feeble twittering heard throughout year when several running about on ground together thought to express threat from one to another (Secker 1955). Soft double-note *dri-ink* or *dr-p* given when returning to nest to incubate or brood, or while waiting to return (Wilkinson 1957). Once, at Wellington, three of party of ten started to make harsh chattering cries; thought to have occurred before pairing. Uttered *chee-cheeing* call when chasing each other (CSN 19). Once while observer at nest with three nestlings, parent flew above nest uttering *tjws it ittit* calls (Beauchamp in press). On *ANTIPODES IS*, one call rendered as high-pitched *tchp pi-pi-pi-pi-pi* (A.M. Dunn; see sonagram J).



J E. Samuelson; Antipodes Is, Dec. 1978; P106

Young When 5–7 days old, nestlings utter loud chirping calls for up to 30 s after being fed by parents; utter *zhep* calls at c. 13 days old, and *tjse* calls at c. 30 days in presence of parents (A.J. Beauchamp). Utter repeated *squee* when begging (Wilkinson 1957). One fledgeling repeatedly uttered *tjse tjse* from cover while parent foraged <20 m away (Beauchamp in press).

BREEDING Reasonably well known; detailed study in Snowy Mts, s. NSW, 1979–2003 (Norment & Green 2004); and 320 records in Aust. NRS to Feb. 2004. Often raise two, sometimes more, broods in a season (see Laying). Regularly breed at high altitudes, in alpine and subalpine zones, in both NZ and Aust. (Croll 1916; Paterson 1930; St Paul 1975; Gall & Longmore 1978; Osborne & Green 1992; Norment & Green 2004; CSN 32), and said to breed at higher altitude than any other bird species in Aust. (Chapman 1969), with eggs recorded on highest mountain in Aust., Mt Kosciuszko, NSW, at 2134 m (Croll 1922); and in NZ, recorded at 1372 m in Tararua Ra., NI (Oliver).

Season Aust. Throughout range, eggs recorded in all months, but mainly Sept.–Dec.; of 220 clutches in NRS: seven (3.2%) in July, 16 (7.3%) in Aug., 50 (22.7%) in Sept., 50 (22.7%) in Oct., 42 (19.1%) in Nov., 25 (11.4%) in Dec., 12 (5.5%) in Jan., five (2.3%) in Feb., five (2.3%) in Mar., four (1.8%) in Apr., two (0.9%) in May, and two (0.9%) in June. Eggs recorded all months in S, though season restricted in Tas. (eggs, Oct.–Jan.); in N, eggs recorded all months except Oct., Feb. and May (see below). However, few data for n. Aust. (see below) and real nature of differences in timing, if any, not known; said that possibly breed later in s. NT than in N (Storr 7). Normal breeding season reported as Aug.–Dec. in e. Aust. (North); in Qld, said to breed mainly spring in wetter regions, autumn in drier areas (Storr 19). Breeding (at least in inland) heavily influenced by rainfall, with breeding said to be triggered or season extended following substantial rain (Carter 1903a; McGilp 1924; Robinson 1939; Boehm 1952, 1957b; Serventy & Marshall 1957; Brooker *et al.* 1979; NRS) or when food abundant (Dickison 1930), though latter probably related to former. Said that few birds breed during very dry seasons,

and those that do tend to have smaller than average clutches; during good periods, season can be extended, and unusually large clutches may be produced (McGilp 1924). In Snowy Mts, breeding affected by patterns of snow-melt and abundance of insects. N. QLD: Eggs (including estimated starts of clutches) Aug.–Mar. (Hopkins 1948; Storr 1953; Lavery *et al.* 1968; Lavery 1986; NRS [n=5 clutches]); nestlings Aug. (NRS). Otherwise, unspecified breeding recorded Sept.–Jan. (Bravery 1970). s. QLD: Eggs, July–Dec. (Lord 1956; Wheeler 1959, 1973; NRS [n=9]). Nestlings, Aug.–Nov. (Lord 1956; NRS). Otherwise, fledgelings, indeterminate young and unspecified breeding recorded July–Jan. and Apr. (Agnew 1921; Mayo 1931; Lord 1956; Wheeler 1959; McFarland 1988; Bielewicz & Bielewicz 1996; NRS). NSW–ACT: Eggs, Aug.–Apr. (Croll 1922; Elliott 1932; Haines 1968; Morris *et al.* 1981; COG 1990, 1992, 1996, 1999; North; NRS); of 101 clutches in NRS: four (4.0%) in Aug., 17 (26.7%) in Sept., 23 (22.8%) in Oct., 21 (20.8%) in Nov., 13 (12.9%) in Dec., eight (7.9%) in Jan., three (3.0%) in Feb., one (1.0%) in Mar. and one (1.0%) in Apr. Nestlings, Aug.–Apr. (Elliott 1932; Haines 1968; Taylor *et al.* 1987; Veerman *et al.* 1988; North; NRS). Otherwise, fledgelings, indeterminate young and unspecified breeding recorded Aug.–Apr. (Bourke 1948; Hindwood & McGill 1951; McGill & Lane 1955; Hobbs 1961; Heron 1973; Anon. 1974; Baldwin 1975; Morris 1975; Maclean 1976; Gosper 1981; Morris *et al.* 1981; Taylor 1987a; Taylor *et al.* 1987; COG 1996; North; NRS). In Snowy Mts (where migratory), median date of arrival 18 Sept. (28 Aug.–29 Sept.; 12 years, 1979–2003) with many building nests by early Nov.; median date of start of first clutches 19 Nov. (4–30 Nov.; 25), when ground roughly 50–60% snow-free; and median date of fledging from first nests 18 Dec. (4–24 Dec.; 13). Start of assumed second clutches in Snowy Mts ranged from 14 Dec. to 16 Jan., with fledging of these between 14 Jan. and 15 Feb. Total length of season, from start of first clutches to last fledging, 104 days (Norment & Green 2004). VIC.: Eggs, Aug.–Feb. and Apr. (Dennis 1903; Hill 1903; Ford 1908; Howe 1910; Bradly 1911; Croll 1916; McEvey 1949, 1952; Jones 1952; NRS); of 24 clutches in NRS: one (4.2%) in Aug., six (25%) in Sept., four (16.7%) in Oct., five (20.8%) in Nov., three (12.5%) in Dec., two (8.3%) in Jan., one (4.2%) in Feb. and two (8.3%) in Apr. Nestlings, July and Sept.–Mar. (Campbell 1901; Paterson 1930; McEvey 1952; Watson 1955; NRS). Otherwise fledgelings, indeterminate young and unspecified breeding recorded Aug.–Feb. and Apr.–May (Howe 1909, 1910; Dickison 1930; Watson 1955; Wheeler 1966; Bedgood 1973, 1980; McCulloch 1973; Vic. Atlas; NRS). Season said to be extended when food abundant (Dickison 1930). TAS.: Eggs, Oct.–Jan. (Sharland 1922; North; NRS [n=9 clutches]). Nestlings, Nov.–Dec. (Littler 1904; Sharland 1922; McGilp & Parsons 1924; North; Aust. Atlas 1; NRS). Otherwise fledgelings and unspecified breeding recorded Aug.–Jan. (Dean 1903; Littler 1910; Aust. Atlas 1). SA: Eggs, June–Jan. and Mar.–Apr. (Anon. 1915, 1926, 1927; McGilp 1920; Cleland 1924; Souter 1927, 1928; Sutton 1927b, 1928; Newell 1928; Morgan 1930; McGilp 1932; Jarman 1937; Lashmar 1937, 1942; Boehm 1957b; Attiwill 1972; Joseph & Black 1983; Winslet & Winslet 1987; SA Bird Rep. 1977–81; NRS); of 25 clutches in NRS: one (4.0%) in July, two (8.0%) in Aug., five (20.0%) in Sept., ten (40.0%) in Oct., five (20.0%) in Nov., one (4.0%) in Dec. and one (4.0%) in Mar. Nestlings, July–Dec., Feb. and Apr.–May (Sutton 1927a; Souter 1928; Morgan 1930; Jarman 1937; Lashmar 1937; Pearce 1938; NRS). Otherwise, fledgelings, indeterminate young and unspecified breeding recorded Aug.–Feb. (White 1916; Hitchcock 1936; Paton 1975; NRS), though said sometimes to breed in autumn after heavy rain after drought (Boehm 1952, 1957b). s. WA: Eggs, Apr.–Jan. (Milligan 1902; Carter 1903b, 1924; White 1921; Whitlock

1937; Sedgwick 1955, 1974; Serventy & Marshall 1957; Serventy 1958; Lindgren 1961; Masters & Milhinch 1974; NRS); of 36 clutches in NRS: two (5.6%) in May, two (5.6%) in June, five (13.9%) in July, six (16.7%) in Aug., ten (27.8%) in Sept., five (13.9%) in Oct., five (13.9%) in Nov. and one (2.8%) in Jan. Nestlings, July–Dec. and Apr.–May (Serventy & Marshall 1957; Serventy 1958; Lindgren 1961; Masters & Milhinch 1974; NRS). Otherwise, fledgelings, indeterminate young and unspecified breeding recorded all months (Whitlock 1921; Carter 1924; Carnaby 1933, 1954; Whittell 1933; Robinson 1939, 1955; Ford & Stone 1957; Serventy & Marshall 1957; Masters & Milhinch 1974; Tarburton 1974; Wells & Wells 1974; Brooker & Estbergs 1976; Brooker *et al.* 1979; Storr 21, 22, 26, 27, 28; NRS). Periods of heavy rain can trigger breeding and extend season (Robinson 1939; Serventy & Marshall 1957; Brooker *et al.* 1979). N. WA: Poorly known. Eggs recorded during a stay on Barrow I. in July–Aug. (Whitlock 1919); and recorded elsewhere in Feb. (NRS [n=1]); near Pt Cloates, laying apparently occurred after rain-fall (Carter 1903a). Otherwise, unspecified breeding recorded Feb.–Sept. (Storr 16; NRS). NT: Eggs, June–Aug. and Mar.–Apr. (White 1924; Whitlock 1924; Crawford 1972; Aust. Atlas 1; NRS [n=3 clutches]). Nestlings, May, July and Sept. (NRS). Otherwise, fledgelings and unspecified breeding recorded Mar.–Sept. and Dec.–Apr. (White 1924; Goodfellow 2005; Storr 7; Aust. Atlas 1; NRS).

NZ Eggs recorded Sept.–Feb. and Apr.; and nestlings, Sept., Nov. and Jan.–Feb. (Turbott 1967). Otherwise, fledgelings and unspecified breeding recorded Aug.–May (Wilkinson & Wilkinson 1952; Turbott 1967; Heather & Robertson 2000; Oliver). NI: Eggs, Sept.–Feb. and Apr. (Stidolph 1923, 1939; Wilkinson & Wilkinson 1952; Roberts 1956; CSN 1, 4, 5, 7, 8, 9). Nestlings, Sept.–Nov. and Jan.–Feb. (Stidolph 1923; CSN 1, 3, 5, 30; A.J. Beauchamp). Otherwise, fledgelings, indeterminate young and unspecified breeding Sept.–May (Buddle 1941; Sibson 1949; Wilkinson & Wilkinson 1952; Edgar 1971; CSN 5, 7, 37, 47). ST: Eggs and nestlings, and breeding, recorded Jan. (Middleditch 1947; CSN 7, 30). **Chatham Is** Breed Nov.–Feb., with fledgelings from Dec. (Nilsson *et al.* 1994). **Antipodes Is** One young observed in Feb. (Warham & Bell 1979).

Site Usually on ground, in a depression (*contra* St Paul 1975) so that rim of nest is level with ground (eggs at least sometimes below ground-level; see Measurements); depression sometimes scratched out by bird but also use existing depressions, such as hoofprints, plough marks and cavities in rocks (Anon. 1915, 1926; Dove 1916a; Whitlock 1919; Sutton 1927b, 1928; Carnaby 1933; Robinson 1939; McGilp 1944; Turbott 1967; Campbell; North; Oliver; NRS; see Measurements). Nest often at base of low vegetation, usually a tussock of grass, but also small shrubs (including Chenopodiaceae and lignum *Muehlenbeckia*) and herbs (including weeds such as thistles), rushes and ferns and, once, at base of grape vine (Anon. 1915; Dove 1916a; Agnew 1921; White 1921; Sharland 1922; Benn 1938; Robinson 1939; Stidolph 1939; Wilkinson & Wilkinson 1952; Turbott 1967; Falla *et al.* 1981; Heather & Robertson 2000; Read *et al.* 2000; Campbell; North; Oliver; NRS); nests occasionally placed within vegetation, in low shrubs, clumps of grass or grass tussocks, often in the centre and usually at ground-level, though occasionally off ground (Littler 1904, 1910; Bradley 1911; Cleland 1924; Stidolph 1939; Lashmar 1942; Hopkins 1948; St Paul 1975; Campbell; Oliver; NRS). Occasionally placed beneath or against rocks, fallen logs, or a clod of earth (Fletcher 1924; McEvey 1952; Heather & Robertson 2000; Campbell; CSN 3; NRS); one embedded in moss (Newell 1928); and one under a mat of dry water-weed (NRS). Very occasionally nest in empty tins (including one 11.4 cm long × 8.9 cm diameter, with opening narrowed to 5.1 cm by protruding grass), and one nested in base of a broken

bottle (Anon. 1915; Campbell; North). Nests usually well concealed by overhanging vegetation or projecting rock (White 1921; Chisholm 1927; Leach 1928; Benn 1938; Robinson 1939; Hopkins 1948; Wilkinson & Wilkinson 1952; Nilsson *et al.* 1994; Heather & Robertson 2000; North; Oliver; NRS); at some nests, surrounding vegetation can form a hood or an entrance-tunnel 15.2–22.9 cm long (Wilkinson & Wilkinson 1952; Roberts 1956; Masters & Milhinch 1974; Falla *et al.* 1981; NRS). Of 41 nests in Snowy Mts, 39 (95%) were beneath small shrubs, ≤30 cm tall (see Measurements), including *Grevillea*, *Richea*, *Kunzea*, *Phebalium*, *Prostanthera*, *Leucopogon* and *Epacris*; and two (5%) were below ground in turf dominated by *Poa*; of six other nests, outside main study area, four were beneath low shrubs (*Richea*, *Phebalium*, *Empodisma*), one beneath *Chionochloa* tussock and one against a rock with cover of grass *Poa*. Nest placed on level ground, cliffs, hillsides and banks. Commonly associated with water, sometimes close to water-level (e.g. one 15 cm above water) or high-tide mark; one on high, sandy ground on a river bed. Also nest often close to, or occasionally on, roads, though frequency of latter may reflect ease of observation of such nests (Lawson 1905; Bradley 1911; Whitlock 1919; Stidolph 1923, 1939; Sutton 1927a; Hood 1935; Roberts 1956; St Paul 1975; Heather & Robertson 2000; North; Oliver; CSN 7, 20, 25; NRS; see Habitat for further details). In Snowy Mts, orientation of entrances to nests not random, with most facing 100–200° away from direction of prevailing cold fronts that bring unseasonable snow and cold; and mean orientation of successful nests significantly different from that of unsuccessful nests; active nests 50–150 m, and usually >50 m, apart (see Breeding dispersion). At Nareen, Vic., one nest (presumably of same pair) was found 11 m from nest of previous season (McEvey 1952). Successful nests (i.e. from which young fledge) may be re-used in same season (Lord 1956); a second nest may be built after failure (Harvey & Harvey 1919). **MEASUREMENTS** (cm): Of 286 nests in Aust. for which height could be determined, 277 (96.9%) were on ground, with eggs up to 2–3 cm below ground level (i.e. nest in a depression); of these 286 nests, 48 were in plants (almost always grasses), and nine were above ground, at heights of 3–20 (NRS). Height of vegetation above nests 22.1 (15.00; 1–100; 100) (NRS). In Snowy Mts, mean height of shrubs over nest and mean distance to edge of shrubs respectively: 20.7 (4.8; 20) and 152 (165; 20) for successful nests, and 18.8 (5.8; 17) and 79.5 (91.6; 17) for unsuccessful nests, with neither affecting nest success. However, shrub-cover within 1 m of nest was significantly different between successful and unsuccessful nests, and shrub-cover within 10 m approached significance (Norment & Green 2004; also see Success, below).

Nest, Materials Nest cup-shaped (Anon. 1915, 1926; Dove 1916a; Sharland 1922; Wilkinson & Wilkinson 1952; Roberts 1956; Nilsson *et al.* 1994; Heather & Robertson 2000; Campbell; North; NRS; see Site). Usually made entirely of grass (Le Souëf 1902; Littler 1904; Anon. 1915; Whitlock 1919; Agnew 1921; Stidolph 1923; Wilkinson & Wilkinson 1952; Heather & Robertson 2000; Campbell; North), but occasionally include fern fronds, leaves, stems of wheat, roots, moss, flower-heads, cow dung or wool (Agnew 1913; Sutton 1927b; Turbott 1967; Oliver; NRS). One nest made of seaweed and beachcast debris (Cleland 1924), and one made almost entirely of Emu *Dromaius novaehollandiae* feathers (NRS). Usually lined with finer grasses, rootlets or hair and fur of cows, horses, rabbits, kangaroos or wallabies, and sometimes with feathers or plant down; one nest lined with twine (Anon. 1915, 1926; Whitlock 1919; Agnew 1921; Cleland 1924; Edwards 1925; Sutton 1927b; Newell 1928; Robinson 1939; Middleditch 1947; North; Oliver; NRS) (*contra* Anon. 1915). Nest said to be built by female (Heather & Robertson 2000). **MEASUREMENTS** (cm): External diameter 12.0 (n=1);

external depth 6.5 (n=1); internal diameter 6.9 (0.65; 6.0–7.5; 5); internal depth 4.9 (0.87; 4.0–6.3; 5) (NRS). At Whangarei, NI, external diameter 12, 13; external depth 12, 13 (A.J. Beauchamp). For unknown number, internal diameter 5.1–7.0, and internal depth 3.8–7.6 (Anon. 1915; Stidolph 1923; Frith 1969; Campbell; North). At one nest material surrounding nest-cup was up to 25 wide (NRS).

Eggs In Aust., described as oval to elongate oval; fine and close-grained; smooth and somewhat glossy (Littler 1910; Campbell; North; NRS), though also said to be without gloss (White 1921). In NZ, described as broadly ovoid to narrow elliptical (Oliver). In both Aust. and NZ, ground-colour varies from pale cream to cream, dirty white or greyish white; occasionally with faint blue-green tinge. Usually marked all over with spots and blotches of light to dark brown, greyish brown, brownish black, grey or dark grey, and some also have underlying markings of mauve or faint purple. In some, markings so dense they obscure ground-colour; in others, markings concentrated at large end, forming well-defined zone (Hutton & Drummond 1904; Littler 1910; Agnew 1913; Anon. 1915; Stidolph 1923, 1939; Mathews 1930; McEvey 1949; Wilkinson & Wilkinson 1952; Frith 1969; Heather & Robertson 2000; Campbell; North; Oliver), though also said markings sometimes concentrated at small end (Campbell). Few apparent geographical trends, but few data; eggs of subspecies *bistriatus* (Tas. and Bass Str. islands) said to be larger than those of Aust. mainland subspecies (Campbell). However, size of eggs said to also vary significantly within subspecies, with eggs of subspecies *australis* from central and w. Aust. smaller than specimens from e. Aust.; shape said also to vary, with eggs of w. populations more pyriform than those from e. Aust. (White 1921, 1924; Robinson 1939). Further study needed. **MEASUREMENTS:** AUST.: 22.3 (1.07; 19.8–24.1; 31) × 16.3 (0.39; 15.5–17.0; 29) (Littler 1910; White 1921, 1924; Serventy 1958; Campbell; North; NRS); said to be 23 × 17 (Frith 1969); in Snowy Mts, 23.2 (0.91; 91 from 32 clutches) × 16.9 (0.48; 91) (C.J. Norment); in SA, 22.0 (21.0–23.5; 10) × 16.4 (16.0–17.5) (Anon. 1915). NZ: 24.2 (1.44; 23.0–26.0; 5) × 17.3 (0.84; 16.0–18.0) (Oliver); 23 (21–25) × 17 (16–18) (Mathews 1930; Heather & Robertson 2000); claim of length 17.8 (Hutton & Drummond 1904) too short. **WEIGHT:** In Snowy Mts, 3.34 (0.31; 91 eggs from 32 clutches), equal to 11.5% of adult female weight; mean weight of clutch, equal to 33.1% of adult female weight. **VOLUME:** In Snowy Mts, 3375 mm³ (232; 91 eggs from 32 clutches).

Clutch-size Two to four, occasionally five, and usually 2–3 (see below). Possibly varies geographically in Aust. (C.J. Norment; *pace* Courtney & Marchant 1971); preliminary analysis of clutches from NRS and Norment & Green (2004) indicates slight trend towards smaller clutch-sizes in N (C.J. Norment); and during good seasons in arid Aust., claimed that clutches can be large, e.g. at Moolawatana, SA, clutches usually four and sometimes five after rainfall (McGilp 1924). While few data for NZ or subantarctic islands, appears similar to Aust. (see below). **AUST.:** Two to four, usually two or three, with modal size in Snowy Mts of three (Carter 1903a; Stone 1912; Agnew 1913, 1921; Morgan 1914; Anon. 1915; Fletcher 1918; McGilp 1923; Newell 1927; Carnaby 1933; Robinson 1939; Howe & Burgess 1942; Bourke 1948; Courtney & Marchant 1971; Norment & Green 2004; Campbell; North); occasionally five (McGilp 1924; North; *contra* Stone 1912; see below). Claim that usually four, occasionally three or five (Frith 1969) not supported by other sources (above) and apparently incorrect. Throughout Aust., 2.8 (0.48; 71): C/2 × 15, C/3 × 53, C/4 × 3 (NRS); in Snowy Mts, 2.91 (0.34; 57): C/2 × 6, C/3 × 50, C/4 × 1 (Norment & Green 2004); Qld, 2.83 (0.58; 12): C/2 × 3, C/3 × 8, C/4 × 1 (Storr 19); WA, 2.85 (0.53; 40): C/2 × 9, C/3 × 28, C/4 × 3 (Storr 16, 21, 22, 26, 27, 28). **NZ:** Two to five, usually three or four (Mathews 1930;

Wilkinson & Wilkinson 1952; Falla *et al.* 1981; Heather & Robertson 2000; Oliver). Northland, C/3 × 4 (A.J. Beauchamp). **CHATHAM IS:** Usually two (Nilsson *et al.* 1994).

Laying Eggs laid on consecutive days (Lord 1956; Serventy 1958; Norment & Green 2004; CSN 5; NRS); in Snowy Mts, one female skipped a day in laying of C/3. At one nest, laying began 4 days after completion of nest (Lord 1956). Often double-brooded, and, in Aust., sometimes raise more than two broods in a season (Anon. 1915; Lord 1956; Norment & Green 2004; Campbell) and NZ (Turbott 1967; Heather & Robertson 2000; Oliver); at one nest, young fledged 19 Sept. and adult incubating second clutch at same nest on 3 Oct., an interval of ≤14 days (Lord 1956). In Snowy Mts, estimated that at least 46% of females double-brooded. Also re-lay after failure (Harvey & Harvey 1919; Norment & Green 2004; NRS), e.g. in Snowy Mts, one nest with three nestlings 6 days old depredated on 14 Dec., and female built new nest 26 m from first and had clutch of three by 20 Dec., which, given laying interval of 1 day, meant second clutch initiated by 18 Dec., 4 days after loss of first; this second nest depredated on 28 Dec., and a third nest, 18 m from the first and also with C/3, found 11 Jan., but depredated by 30 Jan.

Incubation At one nest in Aust., incubation began after second egg of a clutch of three was laid (Serventy 1958); at another nest, all eggs hatched on same day (Lord 1956), suggesting incubation began with completion of clutch. Suggested that female may be fed by male during incubation (NZRD). Adults commonly perform distraction displays if eggs threatened (see Social Behaviour: Relations within family group). No other information. **INCUBATION PERIOD:** AUST.: In Snowy Mts (laying of last egg to hatching of last egg), 13.9 days (0.63; 13–14.5; 4). For one clutch, in which all eggs hatched on same day, period from laying of last egg to hatching, 14 days (from first to hatching 17 days) (Lord 1956). NZ: 14–15 days (Falla *et al.* 1981; Heather & Robertson 2000; Oliver).

Young Semi-altricial, nidicolous. Hatch blind with down on head, back and wings and probably elsewhere (Wilkinson & Wilkinson 1952; Norment & Green 2004; NRS), though two records in NRS claim young naked. Eyes open at 4–7 days old (NRS); usually at 4 days in Snowy Mts. **Growth** Approximate stages of feather development (from Norment & Green [2004], and NRS): Feathers in pin (including primaries and secondaries), emerge from skin by Days 3–4; feathers start to break from sheaths by Days 5–7 or, in Snowy Mts, Days 8 (6 of 7 broods) or Day 9 (1 brood); in Snowy Mts, well feathered on dorsal and ventral surfaces by Day 10, and almost fully feathered by Days 11–12. Tail about half length of that of adult at fledging (NRS). **MEASUREMENTS:** Asymptotic length of tarsus 27.3 mm (1.65; 14) (Norment & Green 2004). **WEIGHT:** Asymptotic mass 28.8 g (0.79; 13). **Parental care** Nestlings fed by both parents, about equally (Elliott 1932; Wilkinson & Wilkinson 1952; Falla *et al.* 1981; Heather & Robertson 2000; Oliver; NRS). At one nest adults gathered food within radius of >137 m of nest (Serventy 1958); and at another, carried food hundreds of metres (Wheeler 1959). For rates of feeding, see Food (Young). Adults commonly perform Distraction Displays if nestlings threatened (see Social Behaviour: Relations within family group). Adults remove faecal sacs and drop them away from nest (NRS).

Fledging to independence **FLEDGELING PERIOD:** In Aust., 12–15 days (Lord 1956; NRS); in Snowy Mts, 13.6 days (0.61; 12–14; 19) with combined incubation and fledging periods, 27.5 days. In NZ, 14–16 days (Wilkinson 1957; Falla *et al.* 1981; Heather & Robertson 2000; Oliver). After c. 2 weeks, nestlings sometimes crawl out into grass to receive food, then quickly return to nest (Wilkinson & Wilkinson 1952). Newly fledged young either unable to fly or can fly only short distances (Wilkinson & Wilkinson 1952; NRS). In Snowy Mts, young of first and second broods fledged when abundance

of arthropods near maximum levels. Fledgelings fed by both parents, till c. 3 weeks old (Oliver).

Success Where clutch-size, number hatched and outcome known: of 91 eggs, in 32 nests, 26 (28.6%) hatched, and 13 (14.3%) young, from five (15.6%) nests, fledged; equal to 0.41 fledgelings per nest, or 2.60 per successful nest. Of 155 eggs, in 55 nests, 90 (58%) hatched. Where outcome known, of 104 nests, 41 (39%) successfully fledged at least one young, and 63 (61%) failed. In addition to above data, there were 13 nests in which young were ready to leave or capable of leaving when last observed (NRS). In Snowy Mts, where outcome known, of 106 eggs, in 37 nests, 53 (50%) young fledged; equal to 1.43 young per nest; of 37 nests, 20 (54.1%) fledged at least one young, and 17 failed (see below; also see Site, above). From literature, where clutch-size, number hatched and outcome known: of 22 eggs, in eight nests, 16 (72.7%) hatched, and 13 (59.1%) young, from five (62.5%) nests, fledged; equal to 1.63 fledgelings per nest, or mean of 2.6 per successful nest (Lord 1956; Bourke 1958). Where outcome known, of nine nests, three (33.3%) successfully fledged at least one young (Harvey & Harvey 1919; Sharland 1922; McEvey 1949; Lord 1956; Clayton 1970; Rose 2001; CSN 7). Over four breeding seasons at Whangarei, NI, successfully raised 0.42–1.0 fledgelings/pair/season (n=20 pairs) (A.J. Beauchamp). **CAUSES OF FAILURE:** Many nests fail as a result of predation (Norment & Green 2004; NRS; see below). In Snowy Mts, predation major cause of failure; of 17 nests that failed, 12 (70.6%) were depredated, four (23.5%) were abandoned, and incubating female killed at one; at three of these nests (one with eggs, two with nestlings), failure caused by ants *Iridomyrmex*, and Little Ravens *Corvus mellori* may have been responsible for some losses. Elsewhere, eggs have been found in gizzards of Square-tailed Kites *Lophoictinia isura* (Carter 1913; Le Souëf 1918); and corvids, including Australian Ravens *Corvus coronoides*, take eggs and nestlings (Boehm 1948; Bourke 1948); Australian Magpies take young birds (Stidolph 1974); and Swamp Harriers *Circus approximans*, Black Falcons *Falco subniger*, New Zealand Falcon *F. novaeseelandiae* and Nankeen Kestrels *F. cenchroides* and Common Mynas take nestlings or fledgelings (Wilkinson & Wilkinson 1952; St Paul 1975; Czechura & Debus 1985; Rose 2001; Stewart & Hyde 2004; NRS). Nests possibly depredated by Wekas *Gallirallus australis* (Guthrie-Smith 1914; Wilkinson & Wilkinson 1952); and Laughing Kookaburra *Dacelo novaeguineae* thought to have taken nestlings at one nest (Elliott 1932). One nest failed when an egret killed female parent as she defended young (Harvey & Harvey 1919). Lizards, including monitors *Varanus*, sometimes take nestlings or sitting birds (Edwards 1921; Bourke 1948); and a tiger snake *Notechis* once recorded within centimetres of an incubating bird (Campbell). In Aust. in the early 1900s, many failures attributed to Foxes and domestic Cats (Stephen 1909; Chisholm 1938); in NZ, nests robbed by Brown Rats (Wilkinson & Wilkinson 1952) and eggs or nestlings taken by Black Rats, Cats, Hedgehogs *Erinaceus europaeus* and Stoats *Mustela erminea* (St Paul 1975). Many nests trampled by stock (Dickison 1930; NRS). Many nests apparently fail following desertion; and clutches said often to contain addled or infertile eggs (NRS). Other causes of failure including flooding and destruction by lawnmowers and ploughs (Whitlock 1921; Bourke 1948; NRS). **CUCKOOS:** Parasitized by Pallid Cuckoo *Cuculus pallidus* and, possibly, Horsfield's Bronze-Cuckoo *Chrysococcyx basalis* (Brooker & Brooker 1989; Rose 1997; HANZAB 4). Once, a cuckoo seen placing an egg into a nest and then removing one of Pipit's eggs, which it then sucked dry (Chisholm 1927).

PLUMAGES Prepared by J.S. Matthew. Have dense covering of down within c. 2 days of hatching. Fledge in juvenile plumage. Undergo a partial post-juvenile (first pre-basic)

moult to adult-like first immature (first basic) plumage, probably starting when <3 months old. Some birds may undergo a partial first immature pre-breeding (first pre-alternate) moult, but no evidence for this in HANZAB region. Probably attain adult plumage in a complete first immature post-breeding (second pre-basic) moult, when c. 1 year old or slightly earlier. Thereafter, a complete post-breeding (pre-basic) moult each cycle produces successive adult non-breeding (basic) plumages. Evidence suggests at least some adults undergo a partial moult in winter–early spring, which probably pre-breeding (pre-alternate) moult and results in adult breeding (alternate) plumage that is very similar to non-breeding plumage (see description below; also see Moults). Sexes alike. Eight subspecies recognized in HANZAB region, four in Aust.; subspecies *australis* described below based on examination of skins of 52 adults, five probable first immatures and six juveniles, all collected from mainland se. Aust. (ANWC, HLW, MV).

Adult non-breeding (Definitive basic). **HEAD AND NECK:** Pattern complex. Forehead, crown and nape coarsely streaked or mottled blackish brown (c119) with finer light-brown (c26, 123A) or yellowish-brown (123B) streaking; feathers, blackish brown (c119) in centre with broad light-brown (c26, 123A) or yellowish-brown (123B) edges, which reduced or lost with wear so top of head becomes more uniform blackish brown. Hindneck and sides of neck, buff (c124) with diffuse dark-brown (121) streaking; and heavy dark-brown (121) mottling on lower sides of neck; upper hindneck slightly paler buff (pale 124) than rest of neck, forming indistinct pale partial collar. Fairly broad and diffuse creamy-buff (c123D), buff-yellow (53) or off-white (ne) supercilium extends from sides of lower forehead, over eye to above rear ear-coverts. Lores, off-white (ne) with partly exposed black-brown (119) bases to feathers. Eye-ring, cream-buff (c123D), buff-yellow (53), cream (92) or off-white (ne), broken narrowly by dark eye-stripe (see below); upper edge of eye-ring merges with similarly coloured supercilium. Feathers below lower edge of eye-ring, cream (54) or off-white (ne), forming narrow pale sub-ocular arc, which is usually separated from similarly coloured eye-ring by very narrow dark-brown (121) or light-brown (ne) line. Most ear-coverts, cream (54) or buff-yellow (c53) with broad and diffuse dark-brownish (c121) tips; combine to form creamy-buff (ne) ear-patch with bold dark-brown (c121) mottling. Upper ear-coverts mostly dark brown (121), combining to form narrow dark-brown (121) stripe behind eye and bordering lower edge of supercilium; in some birds, this combines with dark bases to feathers of lores to form continuous dark eye-stripe that varies in prominence with angle of view, usually indistinct in front of eye, more distinct behind eye. Narrow and uneven, sometimes broken, blackish-brown (119) moustachial stripe starts just behind gape and extends to just below anterior ear-coverts. Narrow but distinct black-brown (119) malar stripe extends down sides of throat, broadening posteriorly, and merges with dark-brown (121) mottling on lower sides of neck, where it forms a fairly large dark-brown (121) patch. Prominent off-white (ne) or cream (92) sub-moustachial stripe extends below ear-coverts, and in some birds, as arc around rear edge of ear-coverts; submoustachial stripe bordered above and below by narrow blackish-brown moustachial and malar stripes respectively. Chin and throat, off-white (ne) or cream (pale 92). Several fine black (89) rictal bristles protrude from lower lores. **UPPERPARTS:** Most of upperparts coarsely streaked and mottled black-brown (119) and more finely streaked light brown (26, 123A) or yellowish brown (123B), with black-brown mottling or streaking less prominent on rump and shortest upperpart-coverts. Feathers, black-brown (119) in centre with light-brown (26, 123A) or yellowish-brown (123B) edges; edges become paler and reduced with wear so that upperparts become more uniform

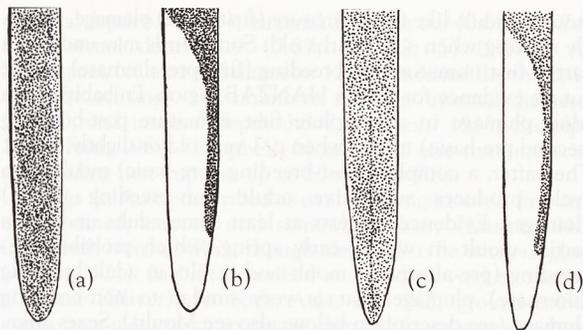


Figure 1 Inner rectrix (t1) of (a) Adult and (c) Juvenile; outer rectrix (t6) of (b) Adult and (d) Juvenile

blackish brown (c119). All feathers have concealed grey (87) bases. **UNDERPARTS:** Breast, buff (124), or off-white (ne) grading to buff (124) in centre, with distinctive dark-brown (121) streaking that varies in prominence and patterning between individuals: some birds have rather fine streaks, particularly on lower breast; other birds have rather coarse streaking on upper breast grading to finer streaking on lower breast. Rest of underparts, creamy white (ne) or off-white (ne), usually grading creamier (c54) on vent and undertail-coverts and to buff (c124) on rear-flanks and thighs; most birds have fine dark-brown (121) streaking on upper belly and rear-flanks, and some have dark-brown (121) shaft-streaks to a few undertail-coverts. All feathers have concealed grey (87) bases. **UPPER-TAIL:** T1–t4, black-brown (119), becoming paler, dark brown (121) with wear, and with: light-brown (39) fringe to t1, which becomes paler cream (54) and reduced with wear; and narrow cream (c54) outer edges to t2–t4 when fresh, outer edge tending whiter on t4; in some birds, t4 has narrow white tip when fresh. T5 and t6, white with mostly concealed dark-brown (121) inner edges, which grade broader basally; t5, and rarely t6, has dark-brown (121) shaft or narrow shaft-streak not quite extending to tip. Outer two rectrices show as narrow white edges to tail, most obvious when tail spread. See Figure 1. **UNDERTAIL:** As uppertail; when folded appears mostly white with narrow dark-brown (121) stripe down centre. **UPPER-WING:** All secondary coverts, dark brown (121) in centre, with narrow, darker, black-brown (c119) shaft-streaks, and broad fringes that vary between individuals from light brown (39) to yellow-brown (123B, 123C) or off-white (ne), and which become paler and narrower with wear; fringes grade to off-white (ne) towards tips and on inner webs of greater coverts; in some birds, fringes to median and greater coverts align to form pair of rather diffuse light-brown, yellow-brown or off-white wing-bars; and dark centres to median secondary coverts come to a rather acute point distally (see Fig. 2). Marginal and median primary coverts, dark brown (121) grading to light brown (39) at tips; outermost coverts, off-white (ne) with narrow light-brown (39) or yellow-brown (123B) fringes that grade to off-white (ne) round tips. Tertiaries, blackish brown (c119) with fairly broad, light-brown (c39) to off-white (ne) fringes, which are reduced or lost with wear. Secondaries, dark brown (121) with yellow-brown (123C) outer edges that merge with narrow off-white (ne) fringes at tips, and with concealed off-white (ne) inner edges; outer edges become paler and narrower with wear. Inner primaries similar to secondaries; rest (p5–p9) as secondaries, but with narrow off-white (ne) fringes to tips and outer webs, which grade to cream (54) or buff (c124) at bases of outer webs, reduced with wear; outer edges to primaries and secondaries combine to form rather diffuse yellowish-brown or cream panel on outwing. Shafts of remiges, dark red-brown (221A). **UNDERWING:** Most coverts, creamy buff (123D) or

cream (c54); and dark-brown (121) shaft-streaks to most marginal primary coverts. Greater primary coverts, light greyish (c85) with narrow buff (124) fringes. Remiges patterned as upperwing but ground-colour brownish grey (c79); and shafts, light grey-brown (c27) or brown (219B); outer webs concealed and off-white (ne) inner edges visible when wing spread.

Adult breeding (Definitive alternate). At least some birds undergo a partial moult in winter and early spring (see Moults). This moult involves some feathers of body, particularly upperparts, and sometimes one or more of following: a few, usually inner, greater and median secondary coverts; one or more tertiaries; and one or more rectrices. Wing-coverts, tertiaries and feathers of upperparts replaced in this moult are fresher, with broad and prominent yellow-brown edges, and contrast with more worn feathers of non-breeding plumage, which have reduced yellow-brown edges. Other authors (Hall 1961; Alström & Mild 2003) have described a similar partial moult in Richard's Pipit *A. richardi* from n. hemisphere (see Moults). Whether this should be considered a pre-alternate moult (resulting in alternate plumage) or another moult (such as pre-supplemental) is debatable, but Alström & Mild (2003) consider it pre-breeding (pre-alternate) moult.

Nestling Hatch with sparse cover of down, though also said to hatch naked; confirmation needed (see Breeding: Young). Photo (G.S. Chapman) shows 2-day-old nestling with dense covering of greyish-white (ne) down on top of head, upperparts, upperwing and thighs. By 10 days old, nestling has well-developed cover of juvenile feathering on upperparts and underparts (Norment & Green 2004).

Juvenile Superficially similar to adult, from which differs by: **HEAD AND NECK:** Forehead, crown and nape, black-brown (19) with coarse buff (124) streaking and finer buff (124) scalloping, formed by broad edges and narrow fringes at tips of feathers respectively. Hindneck and sides of neck, buff (124) with bold dark-brown (121) or blackish-brown (c119) mottling. **UPPERPARTS:** Entirely black-brown (19) with distinctive buff (124) or yellow-brown (123B) scalloping, formed by fine fringes to feathers; fringes to longest uppertail-coverts richer light-brown (c39) than on rest of upperparts. **UNDERPARTS:** Similar to adult, but streaks tend to be shorter and slightly bolder dark-brown (121), and streaking tends to cover entire flanks (cf. rear-flanks in adult). **TAIL:** Rectrices, particularly t1, tend to be slightly narrower than in adult; t1 has slightly broader light-brown (39) fringe than in adult, but this difference reduced with wear (see Fig. 1). **WING:** Very similar to adult. On skins examined here, dark centres to median secondary coverts less acute distally, and slightly more clearly demarcated from pale fringes than in adult (see Fig. 2); also, shaft-streaks to median and greater secondary coverts not contrastingly darker than centres of coverts; these differences very subtle and probably only noticeable with very close views or in hand. Greater primary coverts and feathers of alula as adult but fringes slightly broader.

First immature non-breeding (First basic). Very similar to adult breeding, and some probably indistinguishable. However, some distinguished from adults by contrast between retained juvenile feathers and new and less-worn adult-like feathers which replaced in post-juvenile moult, but such moult-contrast only evident in autumn to early winter, and probably not noticeable by late winter to spring. Also, pre-breeding moult in adults produces plumage showing wear-contrasts which are very similar to those of first immature. Skins examined in present study retained the following juvenile feathers: (1) all or most rectrices, which tend to be slightly narrower and more pointed at tips than those of adult; some birds replace t1 (on both sides, or one side only); (2) all or most greater and median secondary upperwing-coverts; one skin (ANWC 37167) shows obvious moult-contrast in

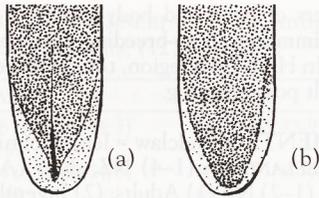


Figure 2 Median secondary covert of (a) Adult and (b) Juvenile

secondary coverts: inner two greater secondary coverts and most median secondary coverts replaced in post-juvenile moult and are fresh and with similar appearance to those of adult; rest of greater secondary coverts and outer two median secondary coverts are retained juvenile (see above); (3) all greater primary coverts and alula; (4) all or most tertials; one skin had replaced innermost tertial in post-juvenile moult, this feather contrasting with more worn retained juvenile tertials; and (5) all primaries and secondaries, which more worn than those of adult at same time of year. For more information see Moults and Ageing.

First immature breeding (First alternate). No information from HANZAB region. If such a plumage exists it probably closely resembles adult breeding, but with similar extent of retained juvenile feathering as for first immature non-breeding. Alström & Mild (2003) state that in *A. richardi*, 'first-year' birds (presumably same as first immatures in HANZAB terminology) undergo partial pre-breeding moult, similar in extent and timing to adult pre-breeding moult (see Moults), which results in 'first summer' plumage (presumably same as first immature breeding plumage in HANZAB terminology).

Aberrant plumages One skin (HLW) has wholly white plumage, but no data on bare parts; not known if this is albino or leucistic bird.

BARE PARTS Based on examination of photos (Andrew & Eades 1994; Watts 1999; Thompson *et al.* 2005; unpubl.: R.P. Allen; G.S. Chapman; J.S. Matthew; C.H. Sandbrink; D. Watts; also standard sources), museum labels (ANWC, HLW, MV) and other sources as cited. Subspecies (HANZAB region only) combined unless stated. **Adult** Bill: upper mandible, grey (84), grey-black (82) or dark brownish (ne) with pinkish (c3) or yellowish (c55) tomium; lower mandible, pinkish (c3), pinkish brown (219D), creamy (c92) or yellowish (c55) with grey (c84) tip. Gape, pinkish (c3), creamy (c92) or yellowish (c55). Palate and mouth, yellowish (c55); also described as orange, fleshy (MV) or pinkish (Hall). Orbital ring, dark grey (83). Iris, dark brown (c219); or blackish brown (MV) or hazel (HLW). Legs and feet, salmon (c6) or pinkish brown (221D, 219C), tending pinkish grey (ne) or brownish (c119B) on feet; also described as brown (Rogers *et al.* 1990). Soles, pinkish (c3); or dirty yellow (Rogers *et al.* 1990). Claws, blackish (c89). **Nestling** Two-day-old nestling has: bill, pinkish (c3) with yellow (55) tomia; gape, pale yellow (157), swollen; bare skin of body, dirty pink (c4); legs and feet, orange-pink (ne). Mouth (palate) described as yellow-orange (Boles & Longmore 1985). **Juvenile** Similar to adult once fully grown, but one recently fledged and partly grown bird has bill, pale grey with yellow edges; and feet, pale yellow (ANWC). In *A. richardi*, bare parts also said to be similar to those of adult (BWP). **First immature** Museum labels (ANWC, MV) indicate bare parts similar to those of adult.

MOULTS Based on examination of skins of: 62 adults, four probable first immature and three juvenile *australis*; 12 adult and two juvenile *bilbali*; 16 adult and five probable first immature *bistriatus*; 11 adult, two probable first immature and one

juvenile *rogersi*; 34 adult and two juvenile nominate *novaeseelandiae*; nine adult *aucklandicus*; five adult and seven juvenile *chathamensis*; and eight adult *steindachneri* (AIM, AM, ANWC, CM, HLW, MV, NMNZ, QVM), and other information as cited. Some comments made on closely related Richard's Pipit *A. richardi*. **Adult post-breeding** (Third and subsequent pre-basic). Complete. Primaries moult outward, starting at p1. Extralimitally, in migratory *A. richardi*, sequence of replacement of primaries often complex, with up to five feathers growing at once, scattered through tract (Stresemann & Stresemann 1968; BWP). No evidence for such unconventional moult in Australasian Pipit (this study). In skins from s. and central Aust. (subspecies *australis*, *bilbali* and *bistriatus*), active moult of primaries recorded: Oct. (1 of 11; PMS 19), Nov. (1 of 10; PMS 14), Dec. (2 of 5; PMS 33, 35), Jan. (2 of 4; PMS 29, 42), Feb. (2 of 2; PMS 33, 41), Mar. (4 of 5; PMS 36.3 [11.32; 20–44]), Apr. (1 of 8; PMS 36), and May (1 of 10; PMS 12); rest from Mar.–May (17 of 23) and 3 of 14 from June–July had all primaries new; rest from June–July (11 of 14), Oct.–Nov. (19 of 21), and all 27 from Aug.–Sept. had all primaries worn. Little information on timing of moult of primaries in tropical and humid n. Aust. (subspecies *rogersi*); from skins, active moult of primaries recorded: Oct. (1 of 3; PMS 24) and Nov. (1 of 1; PMS 23); all six from Apr.–Aug., and other two from Oct., had all primaries worn; only one in Jan., with all primaries new. Deignan (1964) recorded adult female from Darwin, NT, with fresh plumage in mid-Apr. Following recorded by Hall: in sw. and central-e. WA, birds collected in July in worn plumage, and birds collected from central WA in Aug. starting moult (tracts not specified); all five from sw. Qld in May–June in full moult (presumably including primaries); birds from NSW in Mar. in fresh plumage or starting moult (tracts not specified). In skins from NZ (subspecies combined), active moult of primaries recorded from: Jan. (3 of 5; PMS 14, 22, 22) and Feb. (4 of 4; PMS 21 [14.07; 12–42]). Skins from NZ with all primaries new recorded: Mar. (3 of 4), Apr. (5 of 5), May (4 of 4), June (1 of 2) and July (14 of 17); remaining skins from Jan. (2), Mar. (1), June (2), July (3) and all from Aug.–Dec. (15, ten from Nov.–Dec.) had all primaries worn. These data suggest timing of moult of primaries is slightly later in NZ than in s. and central Aust. In migratory *A. richardi*, starts with p1 in mid-July to mid-Aug. (Hall 1961; BWP); timing and sequence of moult of primaries complex and not fully understood (Svensson 1992; Alström & Mild 2003; BWP). Briefly, there are three main strategies of post-breeding moult in these migratory populations: (1) moult is finished on breeding grounds, by about late Sept.; (2) some birds replace most of plumage on breeding grounds but suspend moult before migration and resume it on wintering grounds; and (3) some birds replace only plumage of head and body, and a few secondary coverts and tertials, on breeding grounds, and resume moult on wintering grounds. These complex moult-strategies probably not relevant to HANZAB region as only known migration here is altitudinal in highlands of se. Aust. and possibly in Tas. (see Movements). In HANZAB region, secondaries moult inward; starting when moult of primaries about half completed. Moult of tail, centrifugal; usually starts during early stage of moult of primaries, but can start before start of moult of primaries. Moult of body starts before start of moult of primaries, and not finished till after finish of moult of primaries. **Adult pre-breeding** (Second and subsequent pre-alternate). Little known. Only scant evidence to suggest this moult occurs in HANZAB region (see below). Hall (1961) and Alström & Mild (2003) discuss pre-breeding moult in *A. richardi* from n. hemisphere: this is a partial moult occurring in a number of *Anthus*, the extent varying considerably between individuals. Hall (1961) found that in n. hemisphere, percentage of birds with pre-breeding moult (she termed it 'haphazard' winter moult) involving any feather-tracts varies

monthly, with moult recorded in: Oct. (8 of 23 skins), Nov. (19 of 33), Dec. (28 of 39), Jan. (17 of 44), Feb. (16 of 39), Mar. (27 of 31), Apr. (26 of 29), and May (16 of 30); no data for June–Sept. In *A. richardi*, pre-breeding moult said to occur Jan.–Apr. (Alström & Mild 2003) or Mar.–Apr. (BWP); involves most feathers of head and body, none to all marginal and median coverts, usually a few inner greater secondary coverts, none to all tertials, and central pair of rectrices (t1); some birds also replace other rectrices, inner secondaries, carpal coverts and alula. Extent and timing of pre-breeding moult in HANZAB region not understood, and difficult to distinguish this moult with certainty from post-breeding moult; also difficult to distinguish adults that may have undertaken pre-breeding moult from first immatures that undertook a partial post-juvenile moult (see below). Several skins collected in winter from s. and central Aust. had active moult of body (this study); of 21 collected June–Aug., four in Aug. had active moult of body. Of 30 adult skins from s. and central Aust. (with no retained juvenile feathers) collected in early spring, at least five showed wear-contrast on upperparts, some feathers worn and mostly blackish brown, others fresh with distinct pale edges. Some of these birds also have wear-contrast in upperwing, e.g. one collected from L. Frome, e. SA, in Sept., had p1–p5, all secondaries and inner two greater secondary coverts new, but p6–p9, tertials and rest of upperwing-coverts worn. These limited data suggest at least some birds undergo a partial moult that is not concordant with timing of post-breeding moult; these birds possibly undertook a partial pre-breeding moult as described for *A. richardi* in n. hemisphere. **Post-juvenile** (First pre-basic). Partial. In Aust., active moult recorded from following skins: (1) two from Vic., in Dec. and Feb.; these birds were moulting feathers of body, and the latter replacing median secondary coverts of upperwing; (2) one *bilbali* from sw. WA in late Nov., and one from Reevesby I., SA, in Dec., starting moult of body; and (3) one *rogersi*, from n. WA in Aug., with active moult of body and replacing t1. None of four from Vic., Tas. and WA, collected Oct.–Nov., had started post-juvenile moult. In NZ: two collected in Dec. had not yet started moult; two of seven from Jan. and two of six in Feb. had started moult of body. First immatures from s. and central Aust. (n=9; subspecies combined), collected in autumn and winter, retained following juvenile plumage: all juvenile remiges (six skins); all juvenile primaries and secondaries, but one or two tertials replaced (n=3); all juvenile rectrices (n=4); juvenile t2–t6, but t1 replaced (n=5); some, possibly all, retain one or more juvenile greater and median secondary upperwing-coverts, but most birds apparently replace one or more inner secondary coverts. In *A. richardi* partial post-juvenile moult occurs from early Aug. to late Sept. (Dement'ev & Gladkov 1954; BWP), sometimes as early as July (Svensson 1992); moult often suspended or slowed during migration, and resumed on wintering grounds in Nov.–Feb. (BWP). In *A. richardi*, moult involves all, or most, feathers of head and body, all or most marginal coverts, some or all median coverts, 0–3 inner greater secondary coverts, 0–1 tertials, and sometimes t1; a few birds do not replace any secondary coverts (Alström & Mild 2003; BWP). In first immatures, feathers of upperwing and tail replaced in post-juvenile moult-contrast with slightly more worn retained juvenile feathers; Alström & Mild (2003) illustrate this for *A. richardi* (Figs 36–39). **First immature pre-breeding** (First pre-alternate). No information from HANZAB region. Probably very difficult to distinguish from end of post-juvenile moult or first pre-basic moult, and may even overlap with these, but data needed. First immatures (see Ageing for separation from adults) with active moult recorded from about July to Sept. likely to be undergoing this moult. In *A. richardi*, occurs Mar.–May; extent similar to adult pre-breeding, but sometimes not as extensive or involving only a small propor-

tion of feathers of head and body (Alström & Mild 2003; BWP). **First immature post-breeding** (First pre-basic). Very little known. In HANZAB region, timing and extent probably similar to adult post-breeding.

MEASUREMENTS Hindclaw = length of hindclaw. **NOMINATE NOVAESEELANDIAE**: (1–4) NZ, skins (AIM, AM, CM, MV, NMNZ): (1–2) NI; (1) Adults; (2) Juvenile. (3–4) SI: (3) Adults; (4) Juveniles.

		MALES	FEMALES	
WING	(1)	89.3 (3.52; 82–95; 12)	86.2 (4.32; 77–90; 10)	ns
	(2)	–	87	
	(3)	93.8 (2.51; 90–100; 17)	90.9 (2.47; 88–96; 11)	**
	(4)	93	89, 91	
TAIL	(1)	71.5 (2.81; 65–75; 12)	68.7 (3.40; 63–74; 10)	*
	(2)	–	73	
	(3)	73.6 (3.12; 70–81; 17)	71.5 (2.77; 66–76; 11)	ns
	(4)	74	71, 72	
BILL S	(1)	16.8 (0.95; 15.5–18.2; 10)	16.3 (1.16; 14.2–17.3; 8)	ns
	(2)	–	15.7	
	(3)	16.1 (1.23; 13.9–18.6; 17)	15.8 (0.92; 14.4–17.2; 11)	ns
	(4)	14.4	17.5	
TARSUS	(1)	24.8 (0.95; 22.9–26.4; 11)	24.3 (1.47; 21.6–26.1; 8)	ns
	(2)	–	24.3	
	(3)	24.8 (1.51; 21.5–27.0; 17)	24.5 (0.61; 23.3–25.3; 11)	ns
	(4)	24.6	23.3, 23.5	
HIND C	(1)	11.3 (0.83; 9.8–12.5; 9)	11.4 (0.92; 10.4–12.7; 7)	ns
	(3)	10.9 (0.97; 9.5–12.7; 16)	11.2 (0.94; 9.7–12.5; 11)	ns

NOMINATE NOVAESEELANDIAE: (5–6) NI, adults (possibly including some first immatures), sexes combined: (5) Live birds and skins combined (Foggo *et al.* 1997); (6) Skins (NMNZ), probably including some from above (Foggo 1984).

		UNSEXED
WING	(5)	93.6 (4.20; 47)
	(6)	93.9 (34)
TAIL	(5)	74.8 (3.70; 47)
	(6)	74.6 (34)
BILL F	(5)	12.2 (0.80; 47)
	(6)	12.6 (34)
TARSUS	(5)	26.0 (2.00; 47)
	(6)	26.4 (34)

SUBSPECIES AUCKLANDICUS: (7–8) Auckland and Campbell Is, skins (CM, NMNZ): (7) Adults; (8) Juveniles.

		MALES	FEMALES	
WING	(7)	91.7 (1.25; 90–94; 10)	89.3 (2.14; 85–92; 7)	*
	(8)	90, 94	–	
TAIL	(7)	71.3 (3.57; 66–75; 9)	67.9 (3.24; 64–72; 7)	ns
	(8)	70, 71	–	
BILL S	(7)	20.2 (1.08; 19.0–21.7; 9)	20.0 (1.03; 18.8–21.5; 7)	ns
	(8)	19.9, 19.9	–	
TARSUS	(7)	26.4 (1.13; 24.5–27.6; 9)	24.9 (1.88; 21.2–26.5; 7)	ns
	(8)	24.9, 26.9	–	
HIND C	(7)	11.3 (1.06; 10.1–13.1; 9)	12.9 (0.76; 11.4–13.8; 7)	**

SUBSPECIES AUCKLANDICUS: (9–10) Auckland and Campbell Is, adults (possibly including some first immatures), sexes combined: (9) Live birds and skins combined (Foggo *et al.* 1997); (10) Skins (NMNZ), possibly including some from above (Foggo 1984).

		UNSEXED
WING	(9)	92.0 (0.60; 24)
	(10)	91.9 (13)
TAIL	(9)	72.1 (4.50; 24)
	(10)	70.5 (13)
BILL F	(9)	15.9 (0.60; 24)
	(10)	16.1 (13)
TARSUS	(9)	26.7 (1.30; 24)
	(10)	26.4 (13)

SUBSPECIES STEINDACHNERI: (11–12) Antipodes Is, skins (CM, NMNZ): (11) Adults; (12) Juveniles.

	MALES	FEMALES	
WING (11)	89.6 (3.58; 86–94; 5)	86.0 (3.03; 82–91; 6)	ns
(12)	85, 87	85, 87	
TAIL (11)	69.6 (3.36; 66–74; 5)	66.5 (4.23; 60–72; 6)	ns
(12)	65, 69	65, 69	
BILL S (11)	18.2 (1.15; 17.0–19.9; 5)	18.0 (0.21; 17.8–18.3; 5)	ns
(12)	15.5, 16.3	16.3, 16.6	
TARSUS (11)	25.2 (1.47; 22.9–27.0; 5)	24.7 (0.91; 23.5–25.6; 6)	ns
(12)	22.8, 26.5	24.5, 24.6	
HIND C (11)	11.3 (0.53; 10.7–11.7; 4)	11.4 (1.16; 9.8–12.4; 4)	ns

SUBSPECIES STEINDACHNERI: (13–14) Antipodes Is, adults (possibly including some first immatures), sexes combined: (13) Live birds and skins combined (Foggo *et al.* 1997); (14) Skins (NMNZ), probably including some from above (Foggo 1984).

	UNSEXED
WING (13)	87.4 (2.80; 8)
(14)	88.3 (7)
TAIL (13)	69.6 (3.40; 8)
(14)	69.0 (7)
BILL F (13)	14.2 (0.70; 8)
(14)	14.7 (7)
TARSUS (13)	25.5 (1.40; 8)
(14)	26.1 (7)

SUBSPECIES CHATHAMENSIS: (15–16) Chatham Is, skins (CM, NMNZ): (15) Adults; (16) Juveniles.

	MALES	FEMALES
WING (15)	87.3 (2.66; 83–90; 6)	82, 86, 90
(16)	82, 91, 91	87.6 (4.51; 84–93; 5)
TAIL (15)	68.6 (4.28; 61–71; 5)	60, 68, 69
(16)	72, 73, 79	70.8 (3.56; 66–76; 5)
BILL S (15)	18.2 (1.17; 16.5–19.4; 5)	16.3, 16.9, 18.6
(16)	14.1, 16.9, 19.9	17.2 (0.93; 16.3–18.4; 4)
TARSUS (15)	24.2 (1.08; 23.2–25.8; 5)	24.1, 24.5, 24.6
(16)	24.2, 24.8, 25.7	24.5 (0.80; 23.6–25.7; 5)
HIND C (15)	9.8 (0.60; 9.0–10.4; 4)	9.3, 9.7, 10.3

SUBSPECIES CHATHAMENSIS: (17–18) Chatham Is, adults (possibly including some first immatures), sexes combined: (17) Live birds and skins combined (Foggo *et al.* 1997); (18) Skins (NMNZ), probably including some from above (Foggo 1984).

	UNSEXED
WING (17)	89.6 (3.50; 9)
(18)	91.0 (7)
TAIL (17)	69.4 (3.10; 9)
(18)	70.2 (7)
BILL F (17)	13.7 (1.20; 9)
(18)	13.9 (7)
TARSUS (17)	26.8 (2.30; 9)
(18)	26.0 (7)

SUBSPECIES AUSTRALIS: (19–21) Qld (except range of *rogersi*), NSW, Vic., SA and WA (except SW), skins (ANWC, HLW, MV): (19) Adults; (20) First immatures; (21) Juveniles.

	MALES	FEMALES	
WING (19)	86.1 (2.52; 81–91; 34)	81.5 (2.74; 72–87; 31)	**
(20)	80, 84	80, 80, 84	
(21)	85	76, 80	
TAIL (19)	63.8 (3.07; 57–72; 35)	61.2 (2.31; 58–69; 31)	**
(20)	60, 60	60, 61, 65	
(21)	65	57, 60	
BILL S (19)	16.1 (0.92; 14.3–18.2; 34)	16.1 (0.66; 14.5–17.4; 30)	ns

(20)	15.5, 15.9	14.5, 15.4, 16.3	
(21)	15.4	12.9, 14.8	
TARSUS (19)	24.8 (1.05; 22.1–26.6; 35)	24.3 (1.00; 22.2–26.6; 30)	ns
(20)	24.8, 25.0	22.8, 23.8, 24.7	
(21)	22.8	23.9, 24.4	
HIND C (19)	9.8 (1.64; 7.5–14.4; 18)	10.5 (1.05; 8.1–12.4; 17)	ns

SUBSPECIES AUSTRALIS: (22) Townsville, Qld, live, adults, unsexed (Rogers *et al.* 1990).

	UNSEXED
WING (22)	79.0 (3.67; 75–84; 6)
TAIL (22)	58.7 (2.34; 57–62; 6)
THL (22)	35.2 (0.37; 34.8–35.5; 6)
TARSUS (22)	25.6 (1.24; 24.3–26.5; 6)

SUBSPECIES BISTRATUS: (23–24) Tas. and islands of Bass Str. (excluding Kent and Hogan Grps), skins (ANWC, QVM, SAM): (23) Adults; (24) First immatures.

	MALES	FEMALES	
WING (23)	88.2 (2.55; 85–93; 12)	82.6 (2.13; 80–87; 9)	**
(24)	86, 87	81	
TAIL (23)	66.2 (3.10; 61–70; 12)	62.1 (2.90; 57–65; 8)	*
(24)	62, 65	63	
BILL S (23)	16.6 (1.23; 14.9–18.4; 12)	16.3 (0.68; 15.0–16.9; 9)	ns
(24)	16.7, 17.7	16.9	
TARSUS (23)	26.1 (0.88; 25.1–27.5; 12)	25.2 (0.49; 24.9–26.0; 9)	*
(24)	25.8, 27.1	25.6	
HIND C (23)	11.7 (0.76; 10.1–12.5; 8)	12.4 (0.91; 11.0–13.9; 9)	ns

One unsexed adult *bistratus* captured on Flinders I. had: Wing 91; Tail 64; THL 36.9 (Rogers *et al.* 1990).

SUBSPECIES BILBALI: (25–26) Kangaroo I. and Yorke and Eyre Pens, SA, and sw. WA, skins (AM, ANWC, HLW, MV, SAM): (25) Adults; (26) Juvenile.

	MALES	FEMALES	
WING (25)	87.3 (2.16; 84–90; 6)	84.3 (1.97; 81–86; 6)	*
(26)	–	81	
TAIL (25)	62.0 (1.79; 60–65; 6)	60.7 (1.37; 58–62; 6)	ns
(26)	–	62	
BILL S (25)	16.0 (0.79; 14.8–17.0; 5)	15.9 (0.75; 14.8–17.0; 6)	ns
(26)	–	15.7	
TARSUS (25)	24.1 (0.79; 22.9–24.9; 6)	25.1 (0.99; 24.0–26.5; 4)	ns
(26)	–	22.5	
HIND C (25)	9.3 (1.03; 8.0–10.6; 5)	10.3 (1.20; 8.7–11.5; 4)	ns

SUBSPECIES ROGERSI: (27) N. NT (including Melville I.) and Gulf of Carpentaria and C. York Pen., Qld, adults, skins (AM, ANWC, SAM).

	MALES	FEMALES	
WING (27)	80.0 (2.97; 75–84; 11)	75.5 (2.38; 73–78; 4)	*
TAIL (27)	60.4 (1.80; 58–63; 11)	56.0 (3.16; 52–59; 4)	**
BILL S (27)	16.6 (0.77; 15.4–17.8; 11)	15.3 (0.47; 14.8–15.9; 4)	**
TARSUS (27)	25.7 (1.15; 23.5–27.3; 11)	24.7 (0.83; 23.7–25.4; 4)	ns
HIND C (27)	12.2 (1.58; 10.4–14.1; 5)	10.0, 10.4	

SUBSPECIES EXIGUUS: New Guinea: One adult male skin has following measurements (taken by R. Schodde & I.J. Mason): Wing 83; Tail 55; Tarsus 26.3.

WEIGHTS (All from museum labels, except samples 8–9 and 13–14, which include data from Hall.) **NOMINATE NOVAESEELANDIAE:** (1–2) SI, NZ (NMNZ): (1) Adults; (2) Juvenile. **SUBSPECIES AUCLANDICUS:** (3–4) Auckland and Campbell Is (NMNZ): (3) Adults; (4) Juvenile. **SUBSPECIES STEINDACHNERI:** (5) Antipodes Is, adults (NMNZ). **SUBSPECIES CHATHAMENSIS:** (6–7) Chatham Is (NMNZ): (6) Adults; (7) Juveniles. **SUBSPECIES AUSTRALIS:** (8–9) Qld (except

range of *rogersi*, NSW, Vic., SA and WA (except range of *bilbali*) (ANWC, MV); data in Burke Museum [Univ. Washington], and Hall): (8) Adults; (9) Juvenile. **SUBSPECIES BISTRATUS:** (10–11) Tas. and islands of Bass Str. (excluding Kent and Hogan Grps) (ANWC, QVM): (10) Adults; (11) Juveniles. **SUBSPECIES BILBALI:** (12) Kangaroo I., Yorke and Eyre Pens, SA, and sw. WA, adults (ANWC, MV). **SUBSPECIES ROGERSI:** (13–14) N. NT, Gulf of Carpentaria and C. York Pen., Qld (including Melville I.) (AM, ANWC and Hall): (13) Adults; (14) Juveniles.

	MALES	FEMALES	
(1)	33.2 (3.06; 28.3–39; 12)	32.3 (1.92; 30–35; 9)	ns
(2)	–	29.5	
(3)	35.5 (1.31; 34–36.9; 5)	37.6 (1.42; 36.5–39.6; 4)	ns
(4)	37.3	–	
(5)	26.4	22.9, 34.5	
(6)	31.5, 32.0, 33.2	29, 37	
(7)	31.2	30, 30	
(8)	26.4 (2.52; 20–30; 18)	25.2 (3.41; 20–33; 21)	ns
(9)	–	23	
(10)	29.7 (0.91; 28.5–30.5; 5)	29.2 (2.27; 26.5–33.0; 6)	
(11)	24.5, 32.0	–	
(12)	25.3 (1.50; 23–26; 4)	26, 30, 31	
(13)	23.5 (1.26; 22–25.1; 5)	22.7 (1.39; 21–25; 9)	ns
(14)	–	23	

Mean weight of adult *australis* captured in Qld, 22.4 (1.09; 21.5–23.5; 6) (Rogers *et al.* 1990). An adult *bistriatus* captured on Flinders I. weighed 27.3 (Rogers *et al.* 1990).

STRUCTURE Refers to subspecies *australis* unless stated. Wing fairly long and rather pointed at tip; tip of longest primary falls just over one-third length of tail when wing folded. Ten primaries; p10 vestigial; p7 or p8 longest, occasionally also p6 or p9, these varying no more than 2 mm; p9 0–1 mm shorter than longest, p6 0–2, p5 6–9, p4 11–16, p3 16–19, p2 18–23, p1 20–26. DAB stated that in A'asian populations, distance between tips of p4 and p5 greater than distance between tips of p5 and p6 on folded wing (cf. Afro-Asian populations where reverse). However, examination of skins of 27 adults from Aust. (this study) reveals considerable variation in relative lengths of p4, p5 and p6: in 15 skins, p4–p5 \geq p5–p6; and in 12 skins p5–p6 $>$ p4–p5; distance between p5–p6 also apparently differs between sexes (see Sexing). Wing-tip formed by tips of p7–p9, sometimes also p6. Adult nominate from NZ (n=10) have same wing-structure as Aust. populations. Migratory *A. richardi* from n. hemisphere have slightly more pointed wing with following primary formula: p8 longest; p7 and p9 0–1 mm shorter than p8, p10 60–67, p6 1–4, p5 8–14, p4 15–20, p3 18–22, p2 no data, p1 23–29 (Alström & Mild 2003; BWP). Slight emargination to outer webs of p6–p8, occasionally also p5 (see also Hall 1961); slight emargination to inner webs of p6–p9. In *A. richardi*, p5 never emarginated on outer web (Hall 1961; BWP). Ten secondaries, including three tertials; tip of longest tertial falls between tips of p5 and p6 (\leq 4 mm shorter than wing-tip) or extends slightly (to 2 mm) past tip of longest primary on folded wing. Distance between outer (s7) and central tertial (s8) 10–14 mm, greater than between central (s8) and inner tertial (s9), which 4–8 mm; this characteristic of large pipits (Alström & Mild 2003). Tail fairly long, slightly rounded or rather square at tip when folded; 12 rectrices; t3–t5 longest, t1 1–4 mm shorter than t3–t5, t2 0–2, t6 0–3. Bill fairly short and slender, slightly shorter than length of head; upper mandible slightly decurved at tip; lower mandible inclined slightly upward at gonys; slight notch near tip of upper tomium. Nostrils operculate. Tarsus fairly long, compressed laterally; scaling laminiplantar. Tibia fully feathered. Middle front toe including claw, 20.7 mm (0.88; 19.7–22.2; 6); inner and outer front toes with claw

65–75% length of middle; hindtoe with claw 85–105%; DAB states that hindclaw up to 1.5 \times length of hindtoe in A'asian populations (cf. Afro-Asian populations where hindclaw about same length as hindtoe). Hindclaw rather long and slender, slightly decurved; see Measurements for length of hindclaw.

SEXING No differences in plumage. Adult males have longer average Wing and Tail but considerable overlap between sexes (see Measurements). Some evidence (this study) also suggests adult males (at least in *australis*) have greater difference between length of p5–p6 than in adult females (P<0.01). Length between tips of p5–p6: adult male *australis*, 7.8 (1.07; 6.0–9.5; 13); adult females, 6.0 (0.94; 4.5–6.9; 7). More data needed to confirm any differences between sexes in primary formula. Hindclaw tends to be longer in adult females than adult males, and significantly so (P<0.01) for subspecies *aucklandicus*.

AGEING JUVENILE readily distinguished by plumage (q.v.). **FIRST IMMATURES** difficult to distinguish from adults, particularly once plumage worn by late winter or early spring, and probably only feasible from autumn to early winter. Separating first immatures from adults requires careful examination (in hand) of colour and pattern of upperwing-coverts, shape of central rectrices and degree of wear of primaries. Following plumage criteria, particularly in combination, indicative of first immature plumage in s. and central Aust.: (1) Some birds retain all juvenile rectrices, t1 tending slightly narrower and more pointed than in adult. However, some birds may replace t1 in post-juvenile moult and therefore do not differ from adult in tail. (2) Most birds, possibly all, retain varying number of secondary coverts of upperwing; these difficult to distinguish from adult coverts, but juvenile secondary coverts have slightly more rounded dark centres to feathers (cf. more rosethorn-shaped centre with contrasting darker shaft in adults); colour of fringes does not differ between retained juvenile and replaced coverts (cf. Alström & Mild [2003], who state that in *A. richardi* the juvenile coverts have whiter fringes at tips compared with those of adult); in autumn to early winter, retained juvenile coverts contrast with adult-like coverts (usually inner few) replaced in post-juvenile moult. (3) Retain all juvenile greater primary coverts and longest feather of alula; these have slightly broader and whiter fringe at tip compared with adult. (4) Retain all juvenile primaries and secondaries, which are slightly worn by Apr.–May (cf. adult, which has fresh remiges in autumn). Ageing criteria for subspecies *rogersi* not understood, as timing of moult not well known. Probably not possible to distinguish immatures from adults by spring, as combination of wear and partial pre-breeding moult (which can involve wing-coverts and central rectrices) results in identical plumage for both age-classes.

RECOGNITION For separation from other species of pipits recorded in HANZAB region see Field Identification. Two Asian species (or subspecies-groups), *A. rufulus* and *A. richardi*, are very similar to *A. novaeseelandiae* (see Geographical Variation for taxonomy). *A. richardi* is migratory and some individuals could potentially winter as far S as HANZAB region (see DAB for discussion of unidentified species from Christmas I.). DAB states both of these Asian species differ structurally from *A. novaeseelandiae* by: (1) hindclaw shorter than hindtoe (in *novaeseelandiae* hindclaw up to 1.5 \times length of hindtoe); and (2) more pointed wing, with distance between tips of p4–p5 less than distance between p5–p6 (cf. blunter wing in *novaeseelandiae* in which p4–p5 greater than p5–p6). However, present study reveals considerable variation in relative lengths of these primaries (see Structure). Migratory Asian *A. richardi* are slightly blunter-winged than

Aust. and NZ populations (which are probably not migratory); see Structure and other authors (Hall 1961; Keith *et al.* 1992; Alström & Mild 2003; BWP) for primary formulae in n. hemisphere populations. Plumage and measurements of *A. rufulus* and *A. richardi* summarized in Table 3. Length of hindclaw and extent of white on outer two rectrices (t5 and t6) may be useful for separation of *A. novaeseelandiae* and *A. richardi*. In *A. novaeseelandiae*, Hindclaw ranges from 7.5–14.4 (NZ and Aust., subspecies combined); in *A. richardi*, Hindclaw ranges from 11.2–22.0. In *A. novaeseelandiae*, outer two rectrices mostly white with concealed dark-brown bases merging with dark-brown inner edges, which extend distally up to halfway along inner web on t6, or farther towards tip on t5 (though usually not as far distally in NZ birds); in some birds, t5 or t6, or both, have dark-brown shaft or narrow dark-brown shaft-streak, not extending to tip of feather. In *A. richardi*, t5 and t6 similar to *A. novaeseelandiae*, but in some birds t5 has extensively dark-brown outer web (Svensson 1992; Alström & Mild 2003; this study; see Fig. 3). Also, timing of moult differs in *A. richardi*, with complete moult occurring July–Sept. (cf. Oct.–May in *novaeeseelandiae*; see Moults); any *A. richardi* wintering in HANZAB region (in austral spring–summer) are therefore unlikely to have active primary moult.

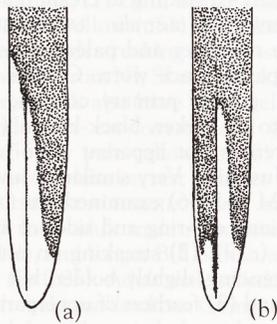


Figure 3 Rectrix (t5) of (a) *A. australis* and (b) *A. richardi* (some birds)

Table 3. Summary of measurements of adult *A. novaeseelandiae* (Aust. subspecies, sexes combined) and two Asian species, *A. richardi* (subspecies combined) and *A. rufulus*. (Summarized from Hall [1961]; Svensson [1992]; Alström & Mild [2003].) Values for p5 refer to distance (in mm) tip falls short of tip of longest primary.

	<i>A. novaeseelandiae</i>	<i>A. richardi</i>	<i>A. rufulus</i>
WING	72–93	84–104	73–86
TAIL	52–72	58–82	51–67
BILL S	14.3–18.4	16.3–21	15.0–18.4
TARSUS	22.1–27.5	28.0–32.7	21.4–27.9
HINDCLAW	7.5–14.4	11.2–22.0	10.0–18.2
p5	6–9	8–14	7–11

GEOGRAPHICAL VARIATION Complex, and species and subspecies limits within the *A. novaeseelandiae* species-complex (distributed through A'asia, Asia and Africa) unsettled and subject to much debate. Here we consider A'asian populations as a separate species, Australasian Pipit *A. novaeseelandiae* (as per forthcoming revision of Christidis & Boles [1994]; L. Christidis & W.E. Boles); this view differs from that of Christidis & Boles (1994) and others (Vaurie 1959; Hall 1961; White & Bruce 1986; Keith *et al.* 1992; BWP; Peters) who recognized only one species, Richard's Pipit *A. richardi*. The species-complex apparently consists of several allopatric species: Australasian Pipit *A. novaeseelandiae* from New Guinea, Aust., NZ and its offshore islands (see below);

African (or Grassveld) Pipit *A. cinnamomeus* from s. and e. Africa with an outlying population in Cameroon; Richard's Pipit *A. richardi* from e. Asia, breeding from central and s. Siberia, Mongolia, n. and e. China, Taiwan and Korea, and wintering from India to s. China and se. Asia, and occasionally as far W as s. Europe, Middle East and nw. Africa; and Paddyfield Pipit *A. rufulus* in s. Asia from Pakistan, India, Sri Lanka, sw. and se. China, and se. Asia as far E as Philippines, Greater and Lesser Sundas (Sibley & Monroe 1990; Voelker 1999; Alström & Mild 2003). These species differ mainly in length of hindclaw, primary formula and markings of tail (see Structure, Recognition). Mitochondrial-DNA sequence-analysis supports recognition of these four species, and also indicates that these are part of a large Afro–Asian–Aust. clade, with *A. richardi* and *A. rufulus* closely related sister species (Voelker 1999). Voelker (1999) also suggests that *A. novaeseelandiae* is closely related to the Woodland Pipit *A. nyassae* from central Africa, but this finding has been questioned on morphological, vocal, distributional and ecological grounds (Alström & Mild 2003). However, Alström & Mild do accept the close relationship between *A. rufulus* and *A. richardi*. African populations have been further split into four species: African Pipit *A. cinnamomeus*, Mountain Pipit *A. hoeschi*, Cameroon Pipit *A. cameroonensis*, and Jackson's Pipit *A. latis-triatus* (Prigogine 1981; Clancey 1984, 1985, 1990; Sibley & Monroe 1990). Relationships between the various species once combined as *A. novaeseelandiae* is discussed in detail by Alström & Mild (2003). For distinguishing *A. novaeseelandiae* from *A. richardi* and *A. rufulus*, see Recognition (above), and other published studies (Hall 1961; Alström & Mild 2003; DAB).

Within Australasian Pipit *A. novaeseelandiae*, following subspecies recognized (Alström & Mild 2003; Peters; DAB): nominate *novaeeseelandiae* from NI and SI of NZ; *chathamensis* from Chatham Is; *steindachneri* from Antipodes Is; *aucklandicus* from Auckland and Campbell Is; *australis* from most of mainland Aust.; *bistriatus* from Tas. and islands of Bass Str.; *bilbali* from Kangaroo I., and Yorke and Eyre Pens, SA, and sw. WA (intergrading with *australis* where ranges abut); *rogersi* from coastal and subcoastal n. Aust., from ne. Kimberley Div., WA, E to C. York Pen., Qld; and *exiguus* from central New Guinea, which said to have deeper blackish markings than Aust. birds, but this based on one skin from New Guinea (DAB). Within HANZAB region, there is debate concerning relationships between various taxa. Some authors (Glutz von Blotzheim & Bauer 1985; Foggo *et al.* 1997; DAB) separate populations from NZ and its offshore islands as a full species, New Zealand Pipit *A. novaeseelandiae*, distinct from Australian Pipit *A. australis*, but there are no published genetic analyses to corroborate this. Populations from main islands of NZ and its offshore islands usually treated as separate subspecies (see below). Foggo *et al.* (1997) found appreciable differences between populations on NI of NZ and the offshore islands of Chatham, Auckland, Antipodes and Campbell Is, based on analysis of proteins (23 allozyme loci) and morphometrics; their allozyme data suggest populations on main islands (NI, SI) and offshore islands are different species, but indicate that the different offshore island populations are closely related and probably not taxonomically distinct from each other.

SUBSPECIES AUSTRALIS: Little obvious geographical variation within *australis* (n=74 skins; this study), which largely supported by DAB. There is slight clinal variation in overall tone of plumage: skins from central Aust. (n=7) tend to have slightly paler plumage compared with those from coastal or subcoastal areas (n=41). DAB states that, in accordance with Gloger's Rule, populations have progressively paler plumage from coastal e. Aust. W through inland regions to mid-w. WA, and streaking of breast is also clinally paler from E to W (DAB). Mees (1961), however, noted one particularly rufous

skin from w. Pilbara. Also, in accordance with Bergmann's Rule, birds are progressively smaller from S to N (DAB), though Mees (1961) found no consistent geographical variation in size across WA, based on examination of 63 skins (WAM). Effects of wear and varying extent of pre-breeding moult probably account for much variation in appearance of plumage within this and other subspecies (see Plumages above).

SUBSPECIES BISTRATUS: Very similar to *australis*, and most birds probably not separable. Compared with adult *australis*, adult *bistriatus* have longer Wing, Tail and Bill S ($P < 0.05$, males only), Tarsus ($P < 0.01$ males; $P < 0.05$ females) and Hindclaw ($P < 0.01$, both sexes, analysed separately), and weigh more ($P < 0.01$ males, $P < 0.05$ females). Examination of skins (ANWC, QVM) of 16 adults and three juveniles from Tas. (including four from Flinders I. and one from King I.) indicates the following plumage differences from se. Aust. adult *australis*: (1) in fresh plumage, feathers of top of head and upperparts have slightly richer yellowish-brown (c123B) edges and slightly darker, black-brown (c119) centres than *australis*, but no differences once plumage worn (by late spring); and (2) dark-brown (121) streaking on breast tends to be slightly bolder, but considerable overlap. No noticeable difference between juveniles of *australis* and *bistriatus*.

Identity of population from Kent Grp, Bass Str., not known with certainty, but one skin (ANWC) closely resembles mainland *australis*.

SUBSPECIES BILBALI: Similar to *australis*, but adult female *bilbali* have slightly longer Wing ($P < 0.05$) than adult female *australis* (not significant for males). Plumage description based on examination of skins of ten adults and one juvenile (AM, ANWC, HLW, MV, SAM), all collected from sw. WA, from Apr.–Nov. Differences from *australis*: **Adult non-breeding** **UPPERPARTS:** Very similar to *australis* and comparison complicated by effects of wear and varying extent of pre-alternate moult of body. In fresh plumage, centres to feathers of mantle, back and scapulars slightly darker, black-brown (c119), than *australis*; overall, upperparts tend to be slightly darker than *australis*. **UNDERPARTS:** Streaking on breast tends darker, black-brown (119) or dark brown (dark 121) and bolder, some birds heavily mottled rather than streaked; individual streaks on upper breast tend to be broader than in *australis*; and streaking on upper belly and flanks tends to be slightly bolder than *australis*. Ground-colour of breast tends to be slightly paler and less buff, whitish buff (ne) than *australis*. **Juvenile** As juvenile *australis* except for feathers of upperparts, which paler brown (c28) on one skin examined. DAB states that populations on Kangaroo I., and Yorke and Eyre Pens, SA, are *bilbali*, but provide no other details. Following adult skins (AM, ANWC, HLW, MV) resemble *bilbali* from sw. WA (R. Schodde & I.J. Mason; also this study): four from Kangaroo I.: two from Reevesby I., s. Spencer Gulf, SA; four from s. Yorke Pen.; and one from s. Eyre Pen. DAB suggests that *bilbali* and *australis* intergrade across fairly narrow zone of inland sw. and s.-central Aust., but specimens needed to confirm this.

SUBSPECIES ROGERSI: Generally similar to *australis*, but differing from that more than other subspecies. Adult *rogersi* have shorter Wing ($P < 0.01$, sexes separate) and Tail ($P < 0.01$ males, $P < 0.05$ females) than adult *australis*. Adult male *rogersi* also have longer Tarsus ($P < 0.05$) and Hindclaw ($P < 0.01$) than adult male *australis*. Adult *rogersi* have proportionately longer ratio of Tarsus:Wing ($P < 0.01$, sexes separate) than adult *australis*; this supported by DAB. Plumage description based on examination of skins of 12 adults and one juvenile (AM, ANWC, MV). Differences from *australis*: **Adult** Rather different from adult *australis*. **HEAD AND NECK:** More boldly patterned. Feathers of top of head, from crown to hindneck, and most of sides of neck, mostly black-brown (119) with narrow yellow-brown (123C) edges; overall, top of head and

sides of neck darker than in *australis*, even in worn plumage. Eye-stripe slightly broader and more prominent. Moustachial stripe darker, blackish (c89), and tends to be more sharply defined from pale submoustachial stripe than in *australis*. Feathers below eye-ring form similar pale sub-ocular arc to *australis*, but more clearly separated from lower edge of eye-ring by narrow dark-brown (121) line of feathers. Malar stripe, broader, unbroken and darker, black (c89), merging with more extensive dark mottling on lower sides of neck to form more prominent blackish (c89) patch. **UPPERPARTS:** Overall, darker, even in worn plumage, with less distinct pale edges to feathers. Feathers of upperparts mostly blackish (c89) or black-brown (dark 119) with narrow pale yellow-brown (123B) fringes that grade to light brown (c223D) round tips; feather-centres form bolder blackish (c89) streaking or mottling than in *australis*. **UNDERPARTS:** Rather different from *australis*. Breast, belly and flanks, off-white (ne) or white, with bold dark-brown (121) teardrop-shaped streaks to all except centre of belly, streaks broadest and boldest on sides of breast and becoming narrower and more elongated on flanks and sides of belly (in *australis* streaking finer and extending only just to flanks and not belly). **TAIL:** Ground-colour to t1–t4, darker, blackish (c89) or black-brown (dark 119); fringe to t1 tends narrower and slightly paler buff (c124), grading to cream (c92) or off-white (ne) distally. Otherwise as *australis*. **UPPERWING:** Fringes to tertials tend to be narrower and paler, off-white (ne), but differences not apparent once worn. Centres to tertials, all secondary coverts, greater primary coverts, primaries and secondaries, tend to be darker, black-brown (c119) than in *australis*, but differences not apparent once worn. **UNDERWING:** As adult. **Juvenile** Very similar to juvenile *australis*, but single skin (AM 053556) examined has following differences: (1) supercilium, eye-ring and sides of lower forehead, richer light-brown (c39); (2) streaking on underparts as for juvenile *australis*, tending slightly bolder, but little different from adult *rogersi*; and (3) feathers of upperparts have slightly paler centres.

No information on intergradation between *rogersi* and *australis*, if any. As the species is continuously distributed across n. Aust. (Aust. Atlas 2), it is possible that the two subspecies intergrade across high latitudes of WA, NT and Qld, but no skins with intergradient plumage noted in present study or in DAB. One adult skin (MV) from Stewart R., C. York Pen., Qld, generally resembles *rogersi*, but has upperparts and pattern of head closer to *australis*; this region may be within zone of intergradation between the two subspecies, but more data needed, particularly from central C. York Pen., and round Katherine, NT.

NOMINATE NOVAESEELANDIAE: Very similar to subspecies *australis*. Adult nominate (SI and NI skins analysed separately) have longer Wing, Tail ($P < 0.01$, sexes analysed separately) and Hindclaw ($P < 0.05$; not significant for SI females) than adult *australis*. Plumage descriptions based on examination of skins (AM, AIM, CM, NMNZ) of 22 adults from NI, 28 adults from SI and four juveniles (one from NI). No difference between plumage of adults from NI or SI (this study). Adults from SI have longer Wing ($P < 0.01$; sexes separate) than adults from NI. **Adult** Differences from adult *australis* non-breeding: **HEAD AND NECK, UPPERPARTS:** Feathers of top of head, hindneck and upperparts, blackish brown (119) or dark brown (121) with dull-brown (c123) or light-brownish (c123A) edges, which contrast less with dark feather-centres (cf. *australis* with paler edges contrasting strongly with dark centres); overall, top of head and upperparts appear more uniform, less obviously streaked, than in *australis*. Lores and upper earcoverts, darker, black-brown (119); combine to form distinct narrow blackish (c89) eye-stripe (cf. less prominent eye-stripe in *australis*). Malar and moustachial stripes, dark brown (c121), slightly paler and less prominent than in *australis*.

UNDERPARTS: Dark streaks on underparts tend to be slightly broader and more diffuse. **TAIL:** As *australis* but dark-brown inner edges to t5 and t6 usually not extending as far distally. However, some birds have identical tail markings to *australis*.

Juvenile As juvenile *australis*.

SUBSPECIES AUCKLANDICUS: Very similar to nominate; adult *aucklandicus* have longer Bill S ($P < 0.01$); both sexes analysed separately) than adults from NI or SI; adult male *aucklandicus* have longer Wing ($P < 0.05$) than adult males from NI, and longer Tarsus ($P < 0.01$) than adult males from NI or SI. Adult female *aucklandicus* have longer Hindclaw than adult females from NI or SI. Plumage descriptions based on examination of skins of 14 adults from Auckland Is, six adults from Campbell I. and two juveniles from Auckland Is (CM, NMNZ) and photo of adult from Campbell I. (Thompson *et al.* 2005).

Differences from nominate *novaeseelandiae*: **AUCKLAND IS: Adult** Very similar to adult nominate, but feathers on top of head and upperparts have warmer light-brown (c123A) or yellow-brown (c123, c24) edges (similar to *australis*). **Juvenile** As juvenile nominate. **CAMPBELL IS: Adult** (1) Edges to feathers on top of head and upperparts, yellow-brown (c24), similar to birds from Auckland Is, and much richer yellowish-brown than nominate; (2) chin, throat and underparts, straw-yellow (c56) or buff-yellow (c53) with dark-brown streaking as for nominate, though streaking on breast and flanks said to be finer than in birds from NI, SI and Auckland Is (Thompson *et al.* 2005); some birds also have straw-yellow (c56) tinge to supercilium and most ear-coverts; and (3) rectrices have straw-yellow (c56) or pale-yellow (c157) outer edges, contrasting clearly with white on rest of outer webs of t5 and t6.

SUBSPECIES STEINDACHNERI: Adult males have shorter Wing ($P < 0.01$) than adult male nominate from SI (but not different from NI), and longer Bill S than adult males from SI ($P < 0.01$) or NI ($P < 0.05$). Adult male *steindachneri* have shorter Bill S than adult male *aucklandicus*. Compared with adult male *chathamensis*, adult male *steindachneri* have similar measurements, except for longer Hindclaw ($P < 0.01$). Plumage description based on examination of skins of 11 adults and four juveniles (CM, NMNZ). Differ from nominate by: **Adult** Rather varying in appearance: some identical to adult *aucklandicus* from Campbell Is, others identical to nominate. **Juvenile** As juvenile nominate.

SUBSPECIES CHATHAMENSIS: Probably the most distinctive subspecies in NZ region. Adult male have longer Bill S ($P < 0.05$) and shorter Hindclaw ($P < 0.01$) than adult male nominate from NI or SI. Plumage description based on examination of skins of nine adults and nine juveniles (CM, NMNZ). **Adult** Some very similar in appearance to nominate, but most birds (six of nine examined) differ from nominate by: **HEAD AND NECK:** Feathers on top of head, from forehead to hindneck, dark brown (121) with off-white (ne) edges, which broader and more prominent on feathers of hindneck. Supercilium, white, broader and more prominent than in nominate (or *australis*). Ear-coverts, white or off-white (ne) with faint dark-brown mottling formed by narrow dark-brown (121) tips. Sides of neck, malar area, chin and throat, white or off-white (ne), faintly tinged pale yellow (c157) on lower sides of neck, and with dark-brown (121) or blackish (c89) streaking on sides of throat and lower sides of neck. Malar and moustachial stripes, dark brown (121) and broken (cf. continuous in nominate). Dark eye-stripe stands out clearly against extensively whitish sides of head and neck. **UPPERPARTS:** Feathers of mantle and most scapulars edged white or off-white (ne), as hindneck. **UNDERPARTS:** Mostly white with bold dark-brown (121) or blackish (c89) streaking on breast and flanks; some birds have buff-yellow (c53) or pale-yellow (c157) wash to upper breast. **UPPERWING:** Fringes to median and greater secondary coverts and tertials tend to be purer

white or off-white (ne), particularly at tips. **Juvenile** Similar to juvenile nominate, but with: (1) purer white edges to feathers on top of head and hindneck; (2) supercilium, whiter and more prominent; and (3) ground-colour of chin, throat and underparts, purer white.

Single unidentified pipit seen on Iles Crozet, 2 Dec. 1982 (Stahl *et al.* 1984), could potentially have been African Pipit *A. cinnamomeus*.

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Volume 7 (Part B), Plate 40

Australasian Pipit *Anthus novaeseelandiae* (page 1359)

SUBSPECIES ROGERSI: 1 Adult

SUBSPECIES AUSTRALIS: 2 Adult (fresh plumage); 3 Adult (worn plumage); 4 Juvenile; 5 Immature; 6, 7 Adult

SUBSPECIES BISTRATUS: 8 Adult

SUBSPECIES BILBALI: 9 Adult

NOMINATE NOVAESEELANDIAE: 10 Adult

SUBSPECIES AUCKLANDICUS: 11 Adult (Campbell Is)

SUBSPECIES CHATHAMENSIS: 12 Adult

South Georgia Pipit *Anthus antarcticus* (page 1389)

13 Adult

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