

Order PASSERIFORMES

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

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

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

The Passeriformes divide into two main groups:

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

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

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

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

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- MENURIDAE (lyrebirds): two species in one genus; endemic to Aust.;
- ATRICHORNITHIDAE (scrub-birds): two species in one genus; endemic to Aust.;
- CLIMACTERIDAE (A'asian treecreepers): six species in two genera breeding in Aust.;
- MALURIDAE (Australopapuan fairy-wrens, emu-wrens and grasswrens): 22 breeding species in three genera in Aust.;
- MELIPHAGIDAE (honeyeaters and Aust. chats): 76 species in 26 genera in Aust. and NZ, all breeding;
- PARDALOTIDAE (pardalotes, scrubwrens, thornbills and allies): 51 species (one extinct) in 15 genera in HANZAB region, all breeding;
- PETROICIDAE (A'asian robins): 23 species in eight genera in HANZAB region, all breeding;
- ORTHONYCHIDAE (logrunners): two breeding species in one genus in Aust.;
- POMATOSTOMIDAE (A'asian babblers): four breeding species in single genus in Aust.;
- CINCLOSOMATIDAE (whipbirds, wedgebills, quail-thrushes and jewel-babblers): eight breeding species in two genera in Aust.;
- NEOSITTIDAE (sitellas): single species breeding in Aust.;
- PACHYCEPHALIDAE (whistlers, shrike-thrushes and allies): 17 species in seven genera in HANZAB region, all breeding;
- DICRURIDAE (monarchs, flycatchers, fantails and drongos): 19 species in seven genera in HANZAB region, all breeding;
- CAMPEPHAGIDAE (cuckoo-shrikes, trillers and minivets): eight species (one extinct) in two genera in HANZAB region, all breeding;
- 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.;
- DICAEDIDAE (flowerpeckers): single breeding species in Aust.;
- HIRUNDINIDAE (swallows and martins): eight species in four genera in HANZAB region, including four breeding species in Aust. and NZ, one non-breeding visitor and three accidentals;
- PYCNONOTIDAE (bulbuls): one successfully introduced species in Aust.;
- SYLVIIDAE (Old World warblers): 13 species in eight genera in HANZAB region, including ten breeding species (one extinct) in Aust. and NZ, and three accidental to region;
- ZOSTEROPIDAE (white-eyes): seven species (one extinct) in single genus in HANZAB region, all breeding;
- MUSCICAPIDAE (Old World flycatchers, thrushes and chats): eight species in six genera in HANZAB region, including five breeding species (two introduced), and four accidentals (including one on Prince Edward Is);
- STURNIDAE (starlings and mynas): five species in four genera, four breeding in HANZAB region (including two species successfully introduced, and one species now extinct), and one accidental.
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The Aust. oscines fall into two distinct clusters, each with at least three major supra-familial lineages (DAB): One cluster is the Passerida, comprising the Muscicapoida (including true thrushes and allies), Sylvioidea (true warblers and babblers, and swallows, and others), and Passeroidea (including larks, pipits, sunbirds, flowerpeckers and all finches and their allies). The other cluster is the Corvida, which is centred on the Australo-Papuan region (though its origins are not certain) and which also comprises three main lineages: Menuroidea (lyrebirds, scrub-birds, treecreepers and bowerbirds), Meliphagoidea (A'asian wrens, pardalotes, acanthizid warblers, and honeyeaters), and Corvoidea (A'asian robins, logrunners, A'asian babblers, whipbirds and quail-thrushes, sitellas, whistlers, fantails and monarchs, birds of paradise, butcherbirds and woodswallows, cuckoo-shrikes, Old World orioles, crows and mudnesters).

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

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

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

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

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

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

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

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

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

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

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

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

In vocal abilities, species of Passeriformes are more accomplished than those of any other order, but songs may be simple or highly complex, and repertoires small or large. Mimicry of calls of other species is practised by many species; c. 15% of Australian passerine species have been reported to mimic (Marshall 1950). The Superb Lyrebird and the Tui *Prothemadera 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 (Kroodma 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 FRINGILLIDAE Old World finches

A large and morphologically fairly diverse family of small to medium-small passerines, usually with short, robust and often conical bills. As defined here (see below), the family comprises c. 140 species in 20–21 genera, widely distributed through Eurasia, including Indian subcontinent, Philippines and Greater Sundas, Middle East, Africa (except Madagascar), islands of n. and e. Atlantic Ocean, and N., central and S. America. Do not occur naturally in the Lesser Sundas, Moluccas or A'asia, but some species introduced to Aust., NZ and islands of s. Pacific Ocean (Sibley & Monroe 1990; Monroe & Sibley 1993; Peters). In HANZAB region, four species in two genera (*Fringilla*, *Carduelis*), all introduced (Christidis & Boles 1994; NZCL); another seven species were unsuccessfully introduced to HANZAB region (see Table 1).

The taxonomy of the family is complex, and evolutionary relationships between various genera of nine-primaried oscines of Old World and New World have been the subject of much debate. Sibley & Ahlquist (1990) present a detailed discussion of taxonomic changes in the Fringillidae, which are summarized here. Sharpe (1888) divided the Fringillidae into three subfamilies, all of which have 'nine primaries, the first of which is fully developed and usually very long': Coccothraustinae (some cardueline finches, some tanagers, grosbeaks and various other species); Fringillinae (other cardueline finches, chaffinches, Old World sparrows); and Emberizinae (emberizids, including buntings and some tanagers); Sharpe considered the family closely allied to the Tanagridae (tanagers). Ridgeway (1901) largely followed Sharpe's (1888) treatment, but added a number of New World genera of tanagers that had previously (Sclater 1886) been placed in Tanagridae. Opinions vary concerning relationships between Old World finches (fringillids, carduelines) and emberizids (buntings, New World sparrows and allies). Several authors consider *Fringilla* and the cardueline finches closely related, based on similar cranial characteristics and jaw musculature (Beecher 1953), palate and bill structure (Ziswiler 1965), colour of plumage and markings (Harrison 1966), gut morphology (Ziswiler 1967), egg-white proteins (Sibley 1970), limb musculature (Raikow 1978) and tongue skeleto-musculature (Bock & Morony 1978). However, Tordoff (1954) considered *Fringilla* to be more closely related to emberizids than carduelines based on his examination of cranial features, and he combined them in the Fringillidae and placed cardueline finches in the family Ploceidae (including Old World sparrows, weaverbirds and estrildid finches). Some authors (Stresemann 1927–34; Cracraft 1981) consider the family Fringillidae to comprise two subfamilies, Fringillinae (*Fringilla*, cardueline finches, Hawaiian honeycreepers) and Emberizinae (buntings, tanagers and allies). Sibley & Ahlquist 1990 and Monroe & Sibley (1993) also included a monotypic family, Peucedraminae (see below) in Fringillidae. Others (Bock & Morony 1978; Christidis & Boles 1994; Peters; BWP; DAB) split them into two families, Fringillidae (Old World finches) and Emberizidae (see that introduction for further discussion on taxonomy), which we follow here.

Genetic studies have provided a greater insight into (and in some cases complicated) our understanding of evolutionary relationships between the nine-primaried oscine lineages. Marten & Johnson (1986) used allozyme electrophoresis to investigate relationships between various genera of cardueline finches. Their data provides strong support for recognition of separate Fringillidae (cardueline finches) and Emberizidae (emberizids, including New World sparrows) families. DNA–DNA hybridization distances suggest *Fringilla* and the cardueline finches represent a sister group to the New World nine-primaried oscines (Bledsoe 1988); see introduction to Emberizidae for further discussion on results of this and other studies. Other studies based on DNA–DNA hybridization distances (Sibley & Ahlquist 1990; Sibley & Monroe 1990; Monroe & Sibley 1993) examined evolutionary relationships, and the

Table 1. Unsuccessful introductions of Fringillidae to HANZAB region. Figures in parentheses indicate, where known, the number of birds released; where years (and numbers) within square brackets, birds not certainly known to have been released (e.g. imported but no indication of fate). All from Thomson (1922) and Long (1981), which see for some further details (and other sources).

	AUSTRALIA	NEW ZEALAND
Canary <i>Serinus canarius</i>	Vic., c. 1856–72 (18 birds)	[?]
European Siskin <i>Carduelis spinus</i>	[1860s]; Vic.: [1864 (40 birds)], 1866 (20), [1872 (20)]	1876 (2), 1879 (several birds)
Twite <i>Acanthis flavirostris</i>	–	1862 (2 birds), 1871 (38)
Linnett <i>Acanthis cannabina</i>	Vic.: [1856–58], 1860s (7–8 birds), 1865 (19); SA: c. 1879–80; NSW: 1880	1862–75 (50 birds)
Brambling <i>Fringilla montifringilla</i>	SA: c. 1879–80 (78 birds)	1868 (2 birds), 1871 (6), 1874 (3), 1877 (1)
Hawfinch <i>Coccothraustes coccothraustes</i>	[1860s]	–
Eurasian Bullfinch <i>Pyrrhula pyrrhula</i>	[c. 1860s]; Vic.: [1856 (?)]; SA: c. 1879–80 (14 birds)	<1870, 1875

data supports recognition of an expanded Fringillidae comprising the following three subfamilies: (1) Peucedraminae (one species; Olive Warbler *Peucedramus taeniatus*); (2) Fringillinae (169 species in 39 genera, in three tribes: Fringillini [*Fringilla* finches], Carduelini [cardueline finches] and Drepanidini [Hawaiian honeycreepers]); and (3) Emberizinae (823 species in 200 genera, and separable to five tribes: Emberizini [buntings, New World sparrows, towhees and allies], Parulini [wood-warblers], Thraupini [tanagers, seedeaters, tanager-finches and allies], Cardinalini [cardinals], and Icterini [troupials, grackles, meadowlarks and allies]). A number of recent studies of mitochondrial and nuclear DNA-sequences (Burns 1997; Klicka *et al.* 2000; Lovette & Bermingham 2002) indicate some of these subfamilies and tribes (e.g. Parulini) are not monophyletic, and many taxa of New World nine-primaried oscines have uncertain affinities. Here, we follow the combined works of Christidis & Boles (1994) and Peters and accept four families: Fringillidae, Emberizidae, Parulidae and Icteridae. Family Fringillidae, as defined here, comprises the following two subfamilies (excluding Hawaiian honeycreepers, which often placed in subfamily Drepanidinae [Christidis & Boles 1994]): FRINGILLINAE (CHAFFINCHES), with single genus *Fringilla*, comprising three species, one of which, Common Chaffinch *F. coelebs*, introduced to HANZAB region; and CARDUELINAE (CARDUELINE FINCHES, INCLUDING CANARIES, SEED-EATERS, ROSEFINCHES, GROSBEAKS), with c. 137 species in c. 20 genera; three species, in single genus *Carduelis*, successfully introduced to HANZAB region: European Greenfinch *C. chloris*, European Goldfinch *C. carduelis* and Common Redpoll *C. flammea*.

Size varies from small (e.g. Yellow-throated Seedeater *Serinus flavigula*: total length 10–11.5 cm; Lesser Goldfinch *Carduelis psaltria*: total length 11.5 cm; weight 9.5 g) to medium-small (e.g. Great Rosefinch *Carpodacus rubicilla*: total length 20–21 cm, weight 46 g). Little variation in HANZAB region: largest is Common Chaffinch (total length c. 14.5 cm, weight 17–25 g), and smallest Common Redpoll (total length c. 12 cm, weight 8–16 g). The following morphological and osteological characteristics are shared by the family (summarized mainly from Beecher 1953, BWP and DAB): Wings rather short to moderately long, with slightly rounded to slightly pointed tips. Nine well-developed primaries, with vestigial or very short outermost (p10); one species, Przewalski's Rosefinch *Urocynchramus pylzowi* (from w. China), has well-developed p10, and while usually placed in Fringillidae (Clement *et al.* 1993; Peters), Sibley & Monroe (1990) and Monroe & Sibley (1993) place it with the buntings and allies in the Emberizidae. Nine secondaries, including three tertials. Tail fairly short to moderately long, usually rather square with slight to moderate notch at tip; 12 rectrices. Bill usually rather short, robust and often conical; lack obvious notching to tomlia, but some species have faint notch or teeth at base of upper mandible; considerable variation in structure of bill between species (see BWP), but always designed for husking seeds in combination with action of blood-stiffened tongue and powerful jaw musculature; tips of upper and lower mandibles crossed in some species (e.g. *Loxia*). Nostrils oval, and partly or largely concealed by feathers. Rictal bristles present. See Ziswiler (1964, 1965, 1979) for discussion of bill anatomy and functional morphology. Legs and feet rather short to moderately long, slender; tarsus ridged at rear (acutiplantar); tarsal scaling laminiplantar. Musculature of jaw distinctive, with particularly massive medial slip of mandibular adductor *M. pseudotemporalis superficialis*. Single slot-like ectethmoid foramen. Lachrymal fused. Palatine processes unfused in *Fringilla* and lacking in cardueline finches (Bock 1960). Tongue cylindrical with horny sheath nearly meeting at dorsal mid-line. Preglossale and muscle *M. hg. anterior* absent (Bock & Morony 1978). Palate extensively ossified with short ridges between central and lateral ridges. Humerus with double pneumatic fossa (Bock 1962). Crop present in Carduelinae, but not in Fringillinae (Clement *et al.* 1993). Stomach and gizzard heavily muscled.

Following summarized from Clement *et al.* (1993) and BWP. Plumage varies greatly. *Fringilla* mostly have brown, blackish, greyish or bluish-grey upperparts, usually with contrasting pale wing-bars, and pinkish, buff, greyish or whitish underparts. Species of Carduelinae usually have brown, grey or olive upperparts, often with white, red or yellow rump, contrasting black or red cap or facial area, and white or yellow wing-bars or wing-panel; and reddish, whitish or yellowish underparts, often with dark streaking. Remiges and rectrices often fringed or tipped white, reddish or yellow. Juveniles usually lack bright coloration to head and body, and often have dark-brown streaking to underparts. Bill, blackish, greyish or yellowish. Only slight seasonal variation in plumage, typically through wear. Sexes usually differ, with males much brighter and more richly coloured than females, but alike or very similar in some species (e.g. European Goldfinch). Nestlings hatch with down, which is usually rather dense. Nestlings lack markings to mouth or tongue. Most species undergo a partial post-juvenile (first pre-basic) moult 1–2 months after fledging, usually not involving remiges or rectrices, to adult female-like first immature (first basic) plumage; some species (e.g. some *Carduelis* in s. part of range) undergo a complete or near complete post-juvenile moult, and acquire adult plumage or strongly adult-like first immature plumage. In most species, males do not acquire adult plumage till first immature post-breeding (second pre-basic) moult, when 1–2 years old. Adults undergo one complete post-breeding (pre-basic) moult annually; occasionally (e.g. in a few Evening Grosbeak *Hesperiphona vespertina*) some birds undergo a partial pre-breeding (pre-alternate) moult to breeding plumage that differs very little from non-breeding plumage. Primaries moult outward.

Widespread, and occur in great diversity of habitats, from forest, woodland and open woodland to shrublands, savanna and grasslands, in all climatic zones and landforms, including open arid country, rocky ground and tundra. Many species (perhaps most) occupy mountainous regions, but recorded from sea coasts (e.g. White-throated

Canary *Serinus albogularis*) to >4000 m asl (e.g. Andean Siskin *Carduelis spinescens*). Eurasian and American species most commonly in woodlands and forests, often coniferous, as well as occupying forest edge, farmlands and other modified habitats. In Aust. and NZ, most commonly in modified habitats (Heinzel 1977; King *et al.* 1978; Mackworth-Praed & Grant 1980; Long 1981; AOU 1983, 1998; Sibley & Monroe 1990; Maclean 1993; Orn. Soc. Japan 2000; BWP; see species accounts).

In HANZAB region, mainly resident or sedentary, with some local movements between habitats (e.g. European Goldfinch, Common Redpoll), and possible local altitudinal migration (Common Chaffinch, and to a lesser extent, European Greenfinch). Readily cross large stretches of water (e.g. to outlying islands of NZ). Palearctic species generally mobile, with complex patterns of movements, ranging from sedentary (e.g. Desert Finch *Rhodospiza obsoleta*) to migratory (e.g. Scarlet Rosefinch *Carpodacus erythrinus*), with many species containing sedentary, resident and migratory populations (e.g. Serin *Serinus serinus*), and altitudinal migration common (e.g. Citril Finch *Serinus citrinella*); some species show erratic or dispersive movements, and some irruptive (especially crossbills, e.g. Common Crossbill *Loxia curvirostra*). African and s. Asian breeding species generally resident or sedentary (e.g. Dark-rumped Rosefinch *Cardopacus edwardsii*), though several species make local (e.g. White-throated Canary *Serinus albogularis*) or local altitudinal movements (e.g. Cape Canary *Serinus canicollis*). American species vary from partly migratory in N, with wintering range generally overlapping extensively with breeding range (e.g. Pine Siskin *Carduelis pinus*), to mainly resident in central and S. America (e.g. Yellow-bellied Siskin *Carduelis xanthogastra*) (AOU 1983, 1998; Grimmett *et al.* 1999; Robson 2000; Fry & Keith 2004; BWP).

Omnivorous, but feed mainly on seeds, supplemented with other plant materials, including fruit, flowers, nectar and buds; insects and other invertebrates, such as spiders, snails and worms, prominent in diets of Fringillinae, but such items taken only occasionally in Carduelinae. Terrestrial and arboreal. Forage mostly on ground and in herbs, shrubs or trees, taking items directly from seed-heads, flowers, foliage, cones and bark of branches and trunks. Forage mainly by gleaning; some species also jump from ground to take seeds from seed-heads, and some take insects by sallying. In contrast to Fringillinae, Carduelinae adept at hanging from vegetation to feed, and often use feet when foraging, e.g. to hold food items against perch, or to pin bent-over stems against ground to feed from seed-heads. Species of Fringillidae reported to engage in kleptoparasitism of Carduelinae. Bills adapted for extracting and husking seeds. Diet varies seasonally, with insects and other invertebrates taken mostly in breeding season; young of Fringillinae reared almost entirely on invertebrates, but young of Carduelinae fed mixture of seeds and invertebrates. Forage in flocks outside of breeding season; some species (especially bullfinches and grosbeaks) also forage in flocks during breeding season, though most species solitary and territorial at this time. Sometimes forage with other seed-eating species, including other Fringillidae (Fry & Keith 2004; BWP).

Most species gregarious outside the breeding season, foraging and roosting in flocks, with maximum size of flocks varying greatly between species, from, for example, small flocks of up to c. 12 birds (e.g. Papyrus Canary *Serinus koliensis*), to large flocks of up to several thousand (e.g. European Greenfinch). Many Carduelinae also gregarious during breeding season, at least while foraging or drinking, but most Fringillinae and some Carduelinae usually seen singly or in pairs during breeding season. Typically monogamous, with strong pair-bonds. In most species, pair-bonds usually last only for duration of breeding season, but sometimes same birds renew pair-bond in subsequent years. However, Pine Grosbeaks *Pinicola enucleator* and bullfinches *Pyrrhula* maintain pair-bonds throughout the year. Usually only female incubates (see below), but both sexes feed nestlings and fledgelings. Usually nest solitary, though many Carduelinae nest in loose colonies; typically territorial, at least in breeding season, with Fringillinae defending large territories, but colonial Carduelinae defending only small territories. Scratch head indirectly. All species are essentially non-contact birds, never allopreening and seldom recorded huddling. Defend territories by singing. Carduelinae species sing while perched and in song-flights, but Fringillinae sing only from perches. Male courtship-feeds female in Carduelinae, but not in Fringillinae (Fry & Keith 2004; BWP; DAB).

Utter large variety of often complex vocalizations that can include clear whistles, trills, warbling, chirps, rattles and squeaks, among others. Often highly vocal while flocking, with many of Carduelinae uttering twittering calls that are not given by Fringillinae. Song of Fringillinae usually short, loud, clear and highly stereotyped, but those of Carduelinae often quite protracted and varied (Fry & Keith 2004; BWP).

Monogamous, and mostly solitary, but some species loosely colonial. Most species usually build nest in horizontal or vertical forks, often among or screened by foliage, in shrubs and trees, but some exceptions, e.g. *Rhodopechys*, *Bucanetes* and *Pseudochloroptila*, nest on ground, in holes or crevices, or beneath boulders or vegetation such as tussocks; Papyrus Canary nests in Papyrus *Cyperus papyrus* heads; and Lemon-breasted Canary *Serinus citrinipectus* in fronds of Ilala Palm *Hyphaene natalensis*. Build cup-shaped nests which, in *Pinicola*, *Pyrrhula*, *Eophona*, *Coccothraustes* and *Hesperiphona*, consist of two distinct layers. Nests usually made of grass, rootlets, bark, fine twigs and plant stems, and sometimes moss, leaves or other plant fibres (e.g. Papyrus Canary builds nests entirely of Papyrus heads), bound together with silk (mostly spider web); and lined with soft material, such as plant down, hair, wool, feathers, rootlets and fine grass (unlined in Papyrus Canary); in some species, outside decorated with lichen, moss, cocoons or the like. Building by female only in Fringillinae and most Carduelinae; in Carduelinae, male usually attends female, and in some species may help with collection of material or construction of nest. Eggs vary

in shape, but usually subelliptical; and usually smooth and slightly glossy. Ground-colour typically pale, from various shades of white (e.g. pure or creamy white, bluish, greenish, or greyish white) to light shades of blue or green, or occasionally grey, brown, cream or buff. Eggs unmarked, or with sparse spots and sometimes blotches, streaks or lines of brown, black, purple, red or grey, often concentrated at broad end. Clutch-size usually two to 4–5, but up to eight, and only 1–2 in Blue Chaffinch *Fringilla teydea* and little known Papyrus Canary. Eggs usually laid on consecutive days. Incubation usually by female only, though claimed that male assists in a few species (e.g. Thick-billed Seedeater *Serinus albogularis*, African Citril *S. citrinelloides*). Incubating female fed by male in Carduelinae, only sometimes so in Fringillinae (e.g. Brambling). Incubation period usually 11–12 to 14–15 days, occasionally 1–2 days shorter or longer (e.g. as few as 9 days in European Goldfinch and Hawfinch; up to 17 days in Brimstone Canary *Serinus sulphuratus* and Cape Siskin *Pseudochloroptila totta*). Nestlings brooded by female; fed by both sexes in Fringillinae; in Carduelinae, fed by male during brooding period (male, at least in some species such as African Citril, passing food to female who in turn feeds young) and by both sexes thereafter. Fledging period typically 10–20 days, but can exceed 20 days in some species (e.g. up to 24 days in Yellow-fronted Canary and up to 28 days in Common Crossbill). Where known, fledgelings fed by both parents. Juveniles independent some 1–4 weeks after fledging (Fry & Keith 2004; BWP).

Twelve species considered globally threatened: Bonin Grosbeak *Chaunoproctus ferreorostris* of Bonin Is, Japan, extinct; São Tomé Grosbeak *Neospiza concolor* and Azores Bullfinch *Pyrrhula murina* critically endangered; and Hispaniolan Crossbill *Loxia megaplaga* (of Haiti and the Dominican Republic), Warsangli Linnet *Carduelis johannis* (n. Somalia), Red Siskin *Carduelis cucullata* (n. S. America) and Yellow-throated Seedeater *Serinus flavigula* (Ethiopia) endangered. A further five species are vulnerable: Syrian Serin *Serinus syriacus*, Salvadori's Serin *S. xantholaemus*, Ankober Serin *S. ankoberensis*, Yellow-faced Siskin *Carduelis yarrellii* and Saffron Siskin *C. siemiradzki*. Threatened species are concentrated in n. Africa and central and S. America, and associated islands; and major threats are from grazing, conversion of forest and native grassland to seeded pasture, and in some cases trapping for cagebird trade (e.g. Yellow-faced Siskin). Four species also considered near threatened (Stattersfield & Capper 2000; BirdLife International 2005).

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Carduelis chloris European Greenfinch

COLOUR PLATE FACING PAGE 1273

Loxia chloris Linnaeus, 1758, *Syst. Nat.* 10(1): 179 — Europa = Sweden.

Generic name derived from specific epithet for the European Goldfinch *C. carduelis*. In ancient Greece the Greenfinch was known as χλωρός because of its green colour (from χλωρός, green).

OTHER ENGLISH NAMES Greenfinch, Green Linnet, Greenie.

POLYTYPIC Source forms of Aust. populations probably either nominate *chloris* (occurring naturally across n. Europe E to w. Siberia), or *harrisoni* (Clancey, 1940) (from British Isles), or both of these subspecies with intergradation (DAB, p. 777). Now occur in coastal urban se. Aust. between Sydney and Adelaide, also Tas. and Bass Str. islands. Source forms of NZ populations unclear, but possibly subspecies *aurantiiventris* (Cabanis, 1851), introduced and established throughout NI, SI and Stewart I., NZ (Niethammer 1971), also Chatham and Norfolk Is, indigenous to s. Europe from s. France and central Spain to Croatia and w. Greece. Extraliminally, up to seven further subspecies throughout Europe and Mediterranean Sea S to n. Africa and Middle East, E through Russia and Asia Minor to n. Iran and sw. Asia including Turkmenistan, central Tadjikistan and Kyrgyzstan.

FIELD IDENTIFICATION Length 16 cm; wingspan 25 cm (23–27); weight 28 g. Introduced to HANZAB region. Thicket finch, with large conical bill, large head, short neck, rotund body, short, strongly forked tail and broad, rounded wings. Similar in size to House Sparrow *Passer domesticus*. Sexes separable, with females duller than males; juveniles separable, like adult females, but heavily streaked. Slight seasonal variation results from wear of plumage; fresh plumage slightly duller than worn plumage. **Adult male** Forehead and crown, olive green; face often appears concolorous with crown, but on closer inspection, faint yellowish supercilium and eye-ring; blackish or greyish lores, sometimes appearing as diffuse, slightly darker eye-stripe; frontal ear-coverts, yellowish olive; hind ear-coverts, olive-grey; malar area slightly darker, forming diffuse malar stripe; hindneck and sides of neck, olive-green, concolorous with top of head. Mantle, scapulars and upper back, olive-green, appearing bright in sunlight, grading to brighter yellowish-green on lower back and rump; uppertail-coverts, olive-grey; uppertail, black, narrowly fringed grey, and inner 2–3 pairs of rectrices have narrow grey edges, and outer three pairs have broad yellow outer edges which prominent on basal half of feathers. Folded wing rather complexly marked with: marginal and median secondary coverts, olive-green; inner greater secondary coverts and outer webs to tertials and secondaries, grey, combining to form mostly grey innerwing; narrow bright-yellow stripe at bend of wing formed by yellow outer primary coverts (except greater) and alula; blackish primaries with narrow grey fringes at tips and bright-yellow outer edges, edges combining to form prominent yellow panel on

outerwing which separated from yellow stripe at bend of wing by dark grey-brown greater primary coverts. In flight, innerwing mostly olive-green on leading edge, grey on trailing edge; outerwing has yellow stripe near bend of wing, diffuse yellow patch in centre formed by yellow outer edges to primaries and rather narrow blackish trailing edge. Chin and throat, yellowish olive, sometimes with brownish tinge; breast and sides of belly mostly olive-green, faintly streaked dull yellow, grading to pale yellow in centre of belly; vent and undertail-coverts, yellow; lower flanks, brownish grey. Undertail, pale yellow with broad black tips and narrow black centre. Underwing, broadly bright yellow on coverts, with broad dark-grey trailing edge formed by remiges. Overall, plumage generally paler and duller when fresh, due to greyish tips to feathers, which wear off to expose brighter bases shortly before breeding. Bill, pinkish grey or horn, with darker top to upper mandible, and small dark-grey tip. Eyes, blackish brown. Orbital ring, dark grey. Legs and feet, pinkish grey. **Adult female** Much as adult male, but duller. Forehead and crown, olive-brown, diffusely streaked brighter olive; supercilium, slightly paler yellow-olive; lores, dark olive-brown, contrasting less than in adult male; ear-coverts, olive-brown with yellow-olive streaking in centre, forming diffuse central patch; malar area, dark olive-brown, forming slightly more obvious malar stripe than in adult male. Hindneck and sides of neck, olive-brown, diffusely streaked brighter olive, concolorous with top of head. Mantle, scapulars and upper back, olive-brown, diffusely streaked brighter olive, grading to brighter olive on lower back and rump (duller than adult male); uppertail-coverts, olive-brown with yellowish-olive

fringes. Uppertail slightly greyer than in male, with narrower and paler yellow edges to outer rectrices, forming less obvious yellow edges to outer tail. Upperwing, much as adult male, but olive areas duller, olive-brown, and leading edge and edges to primaries, paler yellow; overall similar pattern in flight. Chin and throat, dull yellowish-olive, contrasting more with malar stripe than in adult male; breast, sides of belly and flanks, brownish olive, forming indistinct breast-band, grading to pale yellow in centre of belly; vent, white; undertail-coverts, pale yellow. Undertail mostly black with faint yellow edges to outer feathers. Underwing-coverts, olive-yellow, much duller than in male, with mottled brown leading edge to primary coverts; remiges as adult male; in flight, dull olive with broad dark trailing edge. Plumage barely changes with wear. Bare parts, as adult male, except bill lacks pinkish tones. **Juvenile** Dull, as female, but heavily streaked. Forehead and crown, olive-brown with broad, diffuse dark-brown streaking; supercilium, pale yellow with olive-brown streaking, but more clearly defined than in adult; lores, dark olive-brown; ear-coverts, olive-brown, faintly streaked pale yellow; malar stripe, olive-brown, only slightly darker than rest of face. Hindneck, olive-brown with broad, diffuse dark-brown streaking, concolourous with top of head. Rest of upperparts, from mantle to uppertail-coverts, olive-brown with broad, diffuse dark-brown streaking; ground-colour slightly yellower on lower back and uppertail-coverts. Uppertail, as adult female, but feathers much narrower and more pointed, with slightly deeper fork; juvenile males tend to have more extensive yellow edges to rectrices than juvenile females. Upperwing as adult female, but olive-brown areas duller, and fringes to greater secondary coverts, buff, forming narrow, indistinct wing-bar; secondaries more neatly and broadly fringed olive-grey; rest, including yellow wing-stripes, as adult female. Chin and throat, buff-olive, diffusely streaked brown; sides of breast, olive-brown, streaked straw-yellow, grading to straw-yellow with olive-brown streaking on centre of breast and flanks; centre of belly, pale yellow with diffuse streaking; vent and undertail-covert, pale yellow with faint buff tinge. Undertail, as adult female. Underwing, as adult female. Bare parts much as adults; bill, pale horn with dull flesh-pink base to lower mandible. **Immatures** Similar to respective sexes of adults, and difficult to distinguish (see Plumages, below, and BWP for detailed in-hand ageing and sexing); some retain juvenile wing and tail-feathers. Tail-feathers narrower and more pointed, and contrast with less pointed and broader replaced rectrices.

Similar species Some, especially juveniles and females, appear quite plain, and may briefly be confused with female **House Sparrow**; Greenfinch differs from by: mostly olive-brown upperparts with faint darker streaking (Sparrow more rufous-brown or richer brown with much bolder blackish streaking on mantle, scapulars and back); olive or olive-toned rump and uppertail-coverts (much browner in Sparrow); prominent yellow panel on folded outerwing (lacking in Sparrow); lacks pale wing-bar across tips of median secondary coverts (Sparrow has obvious pale median wing-bar); Greenfinch has faint yellowish supercilium (Sparrow has buff or whitish supercilium, prominent behind eye); Greenfinch has forked tail (only slightly notched in Sparrow); Greenfinch has yellow edge at base of outertail (lacking in Sparrow, which has narrow buff or light-brown fringes to rectrices). Readily distinguished from adult **European Goldfinch** *Carduelis carduelis* by larger, stockier body, stouter bill and olive-green head (Goldfinch boldly patterned red, white and black); juveniles of both species heavily streaked, but differ by: primaries dull olive-brown with pale-yellow leading edge (black with broad, contrasting bright-yellow wing-bar on Goldfinch). Unlikely to be confused with juvenile, immature male or female **Yellowhammer** *Emberiza citrinella* or **Cirl Bunting** *E. cirlus*, which similar size to Greenfinch, but lack yellow panel on

outerwing and yellow outer edges to base of tail, are clearly and densely streaked blackish on upperparts and underparts (juvenile Greenfinch has diffuse and sparser dark-brownish streaking), and have more complex facial markings including dark moustachial and rear eye-stripes (lacking in Greenfinch). Trilling call easily confused with that of Striated Pardalote *Pardalotus striatus*, and sometimes not separable, but unlike Striated Pardalote, usually finish trill with scolding note.

Usually occur in small flocks, but sometimes form much larger congregations in winter. Often forage with other seed-eating birds, especially finches and buntings. Roost communally. Forage mainly on ground, though also sometimes in vegetation. Sometimes approachable in settled areas, but often more nervous and easily flushed in countryside, flying to tree-top or top of shrub, where they sit prominently. Flight strong and undulating, with yellow on wings and tail obvious; when rising, long, broad, rounded wings beat heavily in strong bursts, before descending in heavy and jerky manner. Hop cautiously over ground. Perch in upright posture, but more horizontal when feeding on ground. Singing male holds head upward. Often call from perch, deep within thickets or high in trees, where heard well before bird seen. Flocks call in flight. Song given by males and females, and eight calls given extralimitally, of which five recorded in HANZAB region (see Voice).

HABITAT Mostly occur round exotic plants in modified habitats, such as parks and gardens in settled areas, farmland, orchards and pine plantations. Also often in coastal habitats, such as beaches, dunes and shrubland. Occasionally occur in forests, mainly in NZ. Recorded from coasts to ≥ 1000 m asl in Aust. (Tas. Bird. Rep. 4) and 1370 m asl in NZ (Challies 1966).

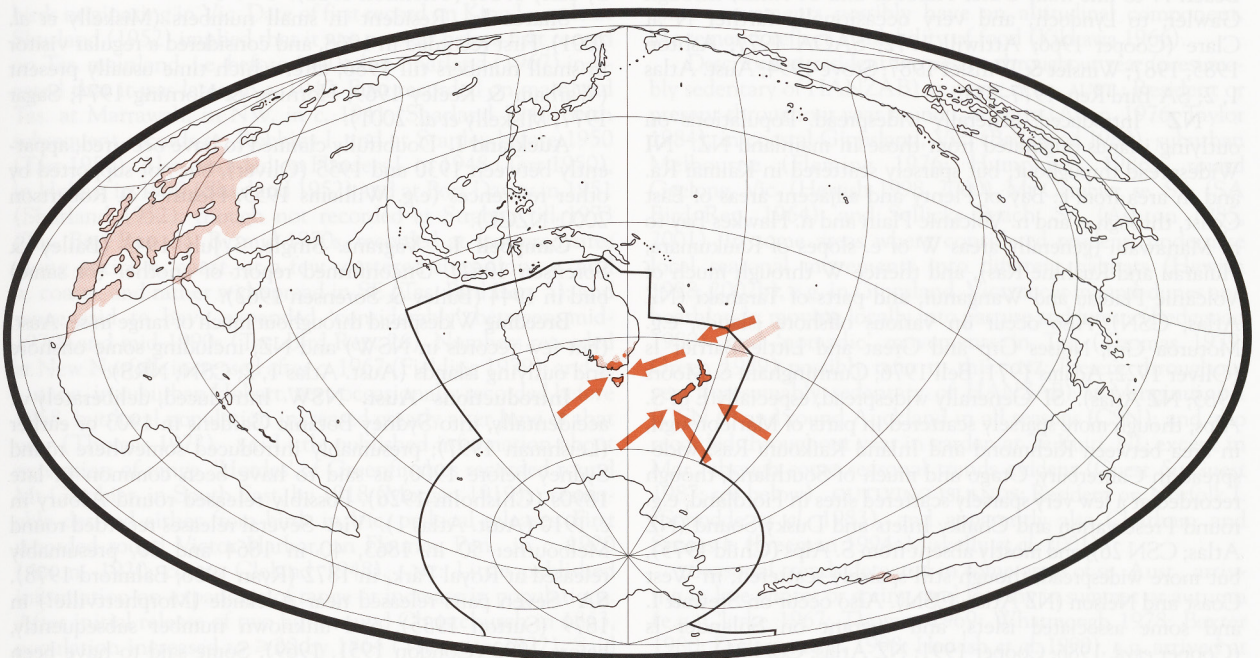
Usually occur in areas with exotic trees, especially cypress *Cupressus*, and also elm *Ulmus*, oak *Quercus* or pine *Pinus* (Bryant 1939; Stidolph 1948; Crockett 1954; Skegg 1963; Middleton 1969; Heron 1973; Falla *et al.* 1981; Morris *et al.* 1981; Schodde *et al.* 1983; Hermes 1985; Loyn 1985; Taylor & Davey 1985; Ashton 1996; Vic. Atlas; ACT Atlas), including plantations of pines (Morgan 1919; Ryder 1948; Gregory-Smith 1983; Owen & Sell 1985; CSN 2). Often recorded in parks and gardens in settled areas (Leach 1928; Taylor 1949; Black & Blomfield 1963; Thomas 1972; Harris 1980; Schodde *et al.* 1983; Hermes 1985; Guest & Guest 1987, 1993; Gill 1989; Day 1995; Brereton *et al.* 1996; Aust. Atlas 1; Vic. Atlas; CSN). Also occur in other open, grassy areas near settlement, such as golf courses (Dedman 1998; NSW Bird Reps 1992, 1994; G.D. Price), playing fields (CSN 41), cemeteries (Wakelin 1968; Ratkowsky 1993a,b) and airstrips (Moeed 1975; CSN 39). Also often inhabit farmland, especially in NZ, including pasture and crops, especially in areas infested with weeds (Hodgkins 1949; Blundell & McKenzie 1963; Moeed 1975; Innes *et al.* 1982; Sibson 1983; McLennan & MacMillan 1985; MacMillan 1985; Aust. Atlas 1; SA Bird Rep. 1977–81; CSN) or with hedges of African Boxthorn or Hawthorn *Crataegus monogyna* (Mellor 1925, 1926; Vic. Atlas); also orchards and market gardens (Sharland 1952; Jasper 1964; Fielding 1979; Baker 1980; Schodde *et al.* 1983; Hermes 1985; McLennan & MacMillan 1985; MacMillan 1985; Vic. Atlas; CSN 37). In coastal areas, sometimes recorded in saltmarsh (e.g. Sibson 1983; Hewish 2002a; CSN 41), on beaches, usually among pioneering plants, especially Sea Rocket *Cakile maritima* (Davis & Reid 1975; Loyn *et al.* 1986; Holdsworth 1998; Hewish 2002a,b; Aust. Atlas 1; CSN 35, 39), among Marram Grass *Ammophila arenaria* or Townsend's Cord-grass *Spartina townsendii* at margins of coastal lagoons (Sagar 1976; Owen & Sell 1985), or in sand-dunes, among Marram Grass, lupins *Lupinus* or coastal scrub (Cooper 1975; Ashton 1996; CSN 3, 4; J.M. Peter). Also occasionally recorded in shrubby coastal heathland (McGarvie & Templeton 1974; Preston 1983), or

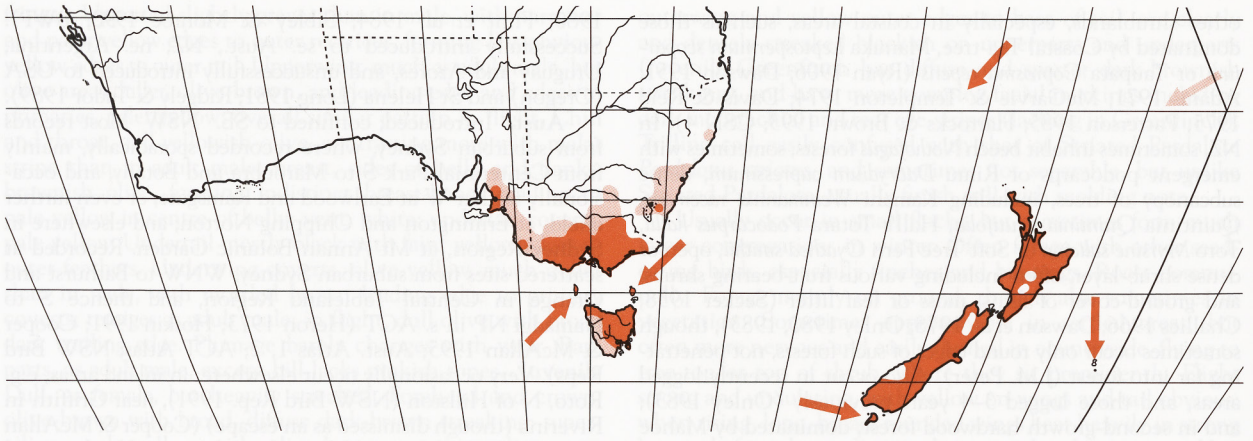
other shrublands, especially in coastal areas, such as those dominated by Coastal Tea-tree, Manuka *Leptospermum scoparium* or Taupata *Coprosma repens* (Ryan 1906; Dawson 1951; Adams 1971; McGarvie & Templeton 1974; Davis & Reid 1975; Patterson 1985; Harrocks & Brown 1993; CSN 4). In NZ, sometimes inhabit beech *Nothofagus* forests, sometimes with emergent podocarps or Rimu *Dacrydium cupressinum*, dense subcanopy of trees, including Kamahi *Weinmannia racemosa*, Quintinia *Quintinia acutifolia*, Hall's Totara *Podocarpus hallii*, Toro *Myrsine salicina* or Soft Tree Fern *Cyathea smithii*, open or dense shrub-layer, often including various fruit-bearing shrubs, and ground-cover of ferns, moss or leaf litter (Secker 1958; Challies 1966; Dawson *et al.* 1978; Onley 1980, 1983), though sometimes occur only round edges of such forests, not penetrating far into forest (J.M. Peter). Also occur in recently logged areas, and those logged 3–4 years previously (Onley 1983); and in second-growth hardwood forest, dominated by Mahoe *Meliclytus ramiflorus*, Kanuka *Kunzea ericoides* and Kootukutuku *Fuchsia excortica* (Freeman 1999). In Aust., seldom recorded in eucalypt woodland or forest (Aust. Atlas 1), e.g. on Mt Wellington, Tas., once recorded in wet sclerophyll forest dominated by Messmate (Ratkowsky & Ratkowsky 1977). On Norfolk I., seldom recorded in native forest (Schodde *et al.* 1983; *contra* McKean 1976). Occasionally recorded in grasslands, from coasts to alpine zones (Child 1975; Ashton 1996; Vic. Atlas). Near Arthurs Pass, SI, recorded in stunted alpine community comprising Mountain Flax *Phormium cookianum*, Turpentine Scrub *Dracophyllum longifolium*, Taramea *Aciphylla scott-thomsonii*, mountain daisies *Celmisia*, Great Mountain Buttercup *Ranunculus lyallii* and alpine cushion plants (J.M. Peter).

DISTRIBUTION AND POPULATION Widespread in Europe, except parts of n. and central Scandinavia and nw. Russia, and n. shores of Black and Caspian Seas. Farther W, occur on Madeira and Canary Is; farther S, occur in N. Africa, mainly in n. Morocco, Algeria and Tunisia, and at scattered sites between there and Egypt; and farther SE and E, occur in Middle East, from w. Syria S to Israel and E to nw. Saudi Arabia, w. and n. Iran and s. Turkmenistan, and SE of Aral Sea, in sw. and s. Kazakhstan, Uzbekistan, w. Kyrgyzstan and central Tadjhikistan (Stagg 1979; Silsby

1980; Flint *et al.* 1984; Sibley & Monroe 1990; BWP). Successfully introduced to se. Aust., NZ, ne. Argentina, Uruguay and Azores, and unsuccessfully introduced to USA (Oregon) and St Helena (Long 1981; Ridgely & Tudor 1989).

Aust. Introduced; confined to SE. **NSW** Most records from suburban Sydney, where recorded sporadically, mainly from Centennial Park S to Maroubra and Botany, and occasionally farther W at Earlwood and Ramsgate, or even farther afield, at Ermington and Chipping Norton; and elsewhere in Sydney Region, at Mt Annan Botanic Garden. Recorded at scattered sites from suburban Sydney, WNW to Bathurst and Orange in Central Tableland Region, and thence S to Namadgi NP in s. ACT (Heron 1973; Hoskin 1991; Cooper & McAllan 1995; Aust. Atlas 1, 2; ACT Atlas; NSW Bird Reps). Very occasionally occur elsewhere: in inland areas, e.g. Roto, N of Hillston (NSW Bird Rep. 1991), near Griffith in Riverina (though dismissed as an escape) (Cooper & McAllan 1995; NSW Bird Rep. 1986), and site between Howlong and Jindera in s. South-west Slope Region (Cooper & McAllan 1995); and in coastal areas, e.g. at Kempsey in Northern Rivers Region (Aust. Atlas 2), and S. Moruya Head, S. Coast (Whiter 1991). **Vic.** Widespread, mostly S of Great Divide. In E. Gippsland, isolated record at Mallacoota, but more widespread on coastal and subcoastal plain farther W, between Bemm R. and Stratford; widespread in all areas S of 38°S, from Gippsland W to Western District, and extending farther N to n. slopes of Great Divide in North Central District. Elsewhere, recorded at sparsely scattered sites on plains in n. Western District, s. and se. Wimmera and s. Northern Country, from Dergholm E to Mansfield, and N to line from Horsham, through St Arnaud, Inglewood, Bendigo and Heathcote, to Yarrck. Occasionally recorded at a few scattered sites along Murray R., between Cobram and Wodonga (Aust. Atlas 1, 2; Vic. Atlas; Vic. Bird Reps). **Tas.** Widespread along n. coast and in SE. Widespread in coastal areas of NW and N, from Temma N to Woolnorth, and thence E to Port Sorell; farther E, occur at more scattered sites along coast to Great Musselroe Bay, but also occur much farther inland, S to line joining Mayberry, Epping Forest and Fingal. Recorded at a few sparsely scattered sites along e. coast. Widespread in SE, mainly centred on Hobart, with records S to S. Bruny I., NW to Ouse, N to Bothwell and Oatlands, and E to Tasman Pen. Very occasionally





recorded in SW, at Port Davey and Swainson I.; and occasionally recorded on w. coast, mainly between Birthday Bay and Granville Harbour, and farther inland at Queenstown (Thomas 1979; White 1985; Schulz & Kristensen 1994; Aust. Atlas 1, 2; Tas. Bird Reps). Single record in Central Plateau, at Liawenee, 1 Oct. 1981 (Tas. Bird Rep. 11). Also occur on islands in Bass Str., including Hunter Grp, King I., and Furneaux and Kent Grps (Green 1969; Green & McGarvie 1971; McGarvie & Templeton 1974; Pinner & Bird 1974; Gray *et al.* 1987; Garnett *et al.* 1991; Holdsworth 1998; Aust. Atlas 1, 2; Tas. Bird Rep. 11). **SA** Occur at many sites in South East Region, mainly N to line from Mt Gambier, through Hatherleigh, to Beachport, with occasional records farther N round Naracoorte and Kingston SE, and very occasionally farther N in Upper South East, along The Coorong at Salt Ck and at Comet Bore. Recorded at a few scattered sites in s. Murray-Mallee Region, e.g. Lameroo, Tailem Bend, Monarto and near Langhorne Ck. Occur on e. and n. Fleurieu Pen., mainly between Goolwa and Victor Harbor, and Sellicks Beach, but only very occasionally recorded farther W on Fleurieu Pen., e.g. near Tunkalilla Beach, on s. coast. More widespread in s. Mt Lofty Ras, and extending W onto Adelaide Plain, from Angaston and Eden Valley W to e. coast of Gulf St Vincent, and from line between Strathalbyn and Sellicks Beach N to line from Outer Harbour and St Kilda, through Gawler, to Lyndoch, and very occasionally farther N at Clare (Cooper 1966; Attiwill 1972; SAOA 1977; Ashton 1985, 1987; Winslet & Winslet 1987; Stove 1994; Aust. Atlas 1, 2; SA Bird Rep. 1977–81).

NZ Introduced; generally widespread. Populations on outlying islands originated from those in mainland NZ. **NI** Widespread throughout, but sparsely scattered in Kaimai Ra. and in area from e. Bay of Plenty and adjacent areas of East Coast, through e. and n. Volcanic Plain and n. Hawkes Bay to n. Manawatu (generally areas W of e. slopes of Raukumara, Huiarau and Ruahine Ras), and thence W through much of Volcanic Plateau and Wanganui, and parts of Taranaki (NZ Atlas, CSN). Also occur on various offshore islands, e.g. Moturoa Grp, Noises Grp and Great and Little Barrier Is (Oliver 1922; Adams 1971; Bell 1976; Cunningham & Moors 1985; NZ Atlas). **SI** Generally widespread, especially E of S. Alps, though more sparsely scattered in parts of Marlborough, in area between Richmond and Inland Kaikoura Ras; widespread in Canterbury, Otago and much of Southland, though recorded at a few very sparsely scattered sites in Fiordland, e.g. round Preservation and Chalky Inlets and Dusky Sound (NZ Atlas; CSN 26), and mostly absent from S. Alps (Child 1975), but more widespread, though still sparsely scattered, in West Coast and Nelson (NZ Atlas; CSN). Also occur on Stewart I. and some associated islets, and vagrant on Solander Is (Cooper *et al.* 1986; Cooper 1991; NZ Atlas; CSN 21).

Norfolk I. Widespread on main island (Schodde *et al.* 1983) and recorded in small flocks on Phillip I. (Hermes *et al.* 1986; Moore 1999; Clarke & Stephenson 2002). First appeared in 1930s, and established by 1939 (recorded as 'linnets') (Williams 1953; Schodde *et al.* 1983); probably originated from NZ (Williams 1953; Schodde *et al.* 1983).

Lord Howe I. Vagrant. Four, 20 May 1980 (Fraser 2004); single, 5 June 1983 (Fraser 2004); 18, June–4 July 1983 (Fraser 2004).

Kermadec Is Vagrant, with most records from Raoul I.: three specimens collected, c. 23 June 1910 (Veitch *et al.* 2004), but not recorded again till 1964 (Edgar *et al.* 1965). Since then, unknown number recorded in 1972 (Veitch *et al.* 2004); part of an old wing found in Mar. 1973 (Merton & Veitch 1986) and up to three birds recorded 21 May–7 June 1973 (Merton & Veitch 1986); specimen collected 11 May 1983 (Veitch *et al.* 2004); singles, 26 Apr. and mid-July 1994 (Veitch *et al.* 2004). Also recorded on Macauley I., 13 Nov. 1980 (Veitch *et al.* 2004) and two on L'Esperance Rock, 14 Sept. 1988 (Veitch *et al.* 2004).

Chatham Is Present in small numbers, mainly on Chatham I., but also recorded on Pitt and South East Is, and skeletal material recovered on Murumurus (Freeman 1994; CSN 28). Probably first occurred early in 20th century; present by early 1920s (Thomson 1922).

Snares Is Resident in small numbers (Miskelly *et al.* 2001). First recorded in 1968, and considered a regular visitor in small numbers till 1986, after which time usually present (Warham & Keeley 1969; Horning & Horning 1974; Sagar 1977; Miskelly *et al.* 2001).

Auckland I. Doubtfully claimed to have occurred, apparently between 1930 and 1955 (Oliver), but not supported by other references (e.g. Williams 1953; Heather & Robertson 2000; NZCL).

Campbell I. Vagrant. Single, 3 July 1943 (Bailey & Sorensen 1962). Unconfirmed report of another (or same) bird in 1944 (Bailey & Sorensen 1962).

Breeding Widespread throughout much of range in se. Aust. (but few records in NSW) and NZ, including some offshore and outlying islands (Aust. Atlas 1, 2; CSN; NRS).

Introductions Aust. NSW Introduced, deliberately or accidentally, into Sydney Botanic Gardens in 1903 or earlier (Leishman 1997); presumably introduced somewhere round Sydney before 1900, as said to have been common in late 1890s (Chisholm 1926). Possibly released round Albury in c. 1910 (Aust. Atlas 1). **Vic.** Several releases recorded round Melbourne: 50 in 1863, 40 in 1864 and 20, presumably released at Royal Park, in 1872 (Ryan 2006; Balmford 1978). **SA** Seven pairs released near Adelaide (Morphettville?) in 1879 (Sutton 1935), and unknown number subsequently, before 1900 (Condon 1951, 1969). Some said to have been

accidentally released when fire damaged a bird-fancier's shop in Adelaide (date unknown): a window was broken and the cages containing the birds fell out and opened (Anon. 1917). **NZ** Records of introductions by acclimatization societies summarized from Thomson (1922). **NI** Several released round Auckland in 1865, 18 in 1867, and 37 in 1868. **SI** Five released in Nelson in 1862, but not recorded further. A pair released round Christchurch in 1863, and unknown number in 1866. In Otago, eight released in 1868.

Change in range, populations **NSW, ACT:** Said to have been common in parts of Sydney in 1890s (Chisholm 1926, 1933), and common in Sydney Botanic Gardens by 1913 (Leishman 1997); present at Narrabeen in 1910 (Cleland 1911); and said to have been common at Bathurst by mid-1920s (Alexander 1925; Chisholm 1926), though another source indicated that, while present at that time, the species was not plentiful (Bourke 1957). Claimed to have been recorded round Albury in c. 1910 (Long 1981; Aust. Atlas 1), and certainly common there by late 1940s (Tarr 1950; McEvey 1965). Populations in parts of Sydney said to have declined, or even disappeared, by mid-1920s (Chisholm 1926), but persisted in Botanic Gardens till c. 1977 (Leishman 1997), and small numbers persist in some suburbs (see above). First recorded in Canberra in 1961 (Lamm *et al.* 1963). **VIC.:** After releases round Melbourne in 1860s and 1870s (see above), said to have become 'established near the metropolis and ... round Port Phillip' by early 1900s, though expansion of range was slower than that of Common Starling *Sturnus vulgaris* or House Sparrow (Ryan 1906): e.g. established in Shire of Box Hill, c. 15 km E of Melbourne, by 1890s (Hall 1899); in part of this area (now City of Whitehorse), formerly annual visitor to Bennettswood, 1989–98, but not recorded since (J.M. Peter). Populations in suburban Melbourne said to have increased in 1930s and 1940s (Bryant 1939; Tarr 1950). Formerly common round Melbourne Zoo, but now seldom recorded (Dunn 1989). Range expanded W to reach 'Turkeith', between Winchelsea and Colac in Western District, in c. 1909 (Brown 1950; *contra* Aust. Atlas 1), present round Maryborough since c. 1910 (Chisholm 1950) and St Arnaud by late 1920s (Leach 1928). **TAS.:** Not introduced to Tas. (Sharland 1967; Long 1981), so colonization was natural; thought to cross Bass Str. (Garnett *et al.* 1991; Sutton 1998; Tas. Bird Rep. 25; see Movements), implying that colonization of Tas. was by birds originating in Vic. Date of first record on King I. unclear: Sharland (1952) implied that it was present before first record on Tas. mainland, i.e. before 1940s, but Sharland (1967) indicated that it was later, in c. 1947. First recorded on mainland Tas. at Marrawah, in NW, in c. 1941 (Sharland 1946) with subsequent records on Robbins I. and at Stanley before 1950 (Tarr 1950). Also recorded on Flinders I. in 1948 (Tarr 1950), in Hobart in 1950 (Sharland 1952) and at Port Davey in 1951 (Sharland 1952), though not recorded at Strahan till 1973 (Tas. Bird Rep. 3). By mid-1970s, recorded at scattered sites along entire n. coast, at a few scattered sites along e. and w. coasts, and rather widespread in SE (Tas. Bird Rep. 5); and range said to have expanded 'considerably' between mid-1970s and mid-1990s (Tas. Bird Rep. 26). Numbers recorded at New Norfolk increased after c. 1967 (Fielding 1979); and at Lutana, in suburban Hobart, very occasionally recorded before 1968, but local population increased greatly after June of that year (Thomas 1972). **SA:** Little published information about expansion of range. 'Hordes' of Greenfinches recorded round Mt Gambier, in South East, by 1918 (Morgan 1919); presumably derived either from birds in Vic. or local releases. First recorded round Victor Harbor, on Fleurieu Pen., in c. 1920 (Anon. 1920; *contra* Cleland 1948). **NZ:** Little published information on expansion of range or increase in populations. After initial release of two birds round Christchurch in 1863, population increased to ≥ 20 by 1864 (Thomson 1922). Said

to have become 'thoroughly acclimatized' round Auckland by 1868 (Thomson 1922), and present on Little Barrier I. by 1880s (Angehr 1984). Abundant in all settled areas by early 1920s (Thomson 1922), though numbers in Southland said to have declined between early 1890s and 1918 (Thomson 1922). Recorded on Chatham Is by early 1920s (Thomson 1922). Numbers round Masterton have declined since 1940s: recorded on total of 62 days, May 1942–Apr. 1943, but only on ten, May 1971–Apr. 1972 (Stidolph 1977).

Populations **NUMBERS RECORDED IN 5-MINUTE COUNTS:** 0.29 birds/count, Auckland Domain (Gill 1989); 0.01 birds/count, Kennedys Bush Scenic Reserve, near Christchurch (Freeman 1999); 0.06 birds/count, Fletcher Ck, near Reefton (Dawson *et al.* 1978); 0.08 birds/count, Reefton Saddle, near Reefton (Dawson *et al.* 1978); 0.03 birds/count, Te Wharau, near Reefton (Dawson *et al.* 1978); 0.002 birds/count, Rahu Saddle, near Reefton (Dawson *et al.* 1978); 0.07–0.1 birds/count, near Karamea (Onley 1983).

THREATS AND HUMAN INTERACTIONS Said to be a pest in gardens and ripening crops (see Food: Pest status). Formerly killed extensively in NZ by orchardists (Moncrieff 1931); Little Owls *Athene noctua* said to have been introduced to NZ to combat this and other small birds in fruit-growing districts (Thomson 1922). Occasionally killed by Cats (Dowling *et al.* 1994); nest contents eaten by rats and mustelids (McLennan & MacMillan 1985) and, in NZ, introduced Common Brushtail Possums *Trichosurus vulpecula* (Brown *et al.* 1993). Occasionally killed on roads, especially in areas where grain spilt (CSN 23). Sometimes collide with windows (ABBBS 2000).

MOVEMENTS Probably resident or sedentary in HANZAB region. Broad-scale analysis of bird atlas and count data in Aust. found suggestive evidence of no movements (Griffioen & Clarke 2002). However, occur seasonally in many areas, suggesting local movement (see below). Readily cross water: said to have colonized Tas. from Vic. (see Distribution and Population), and suggested that some regularly cross at least part of Bass Str. (Garnett *et al.* 1991; see below); and birds originating from NZ mainland have reached various outlying islands unaided (see Distribution and Population). Possibly some regular N–S movements in SI of NZ (see below); and some movements possibly have an altitudinal component. Movements reflect availability of food (Kikkawa 1966).

Described as resident or present throughout year (presumably sedentary of HANZAB) at many sites. **AUST.:** Resident or present throughout year round Canberra (Anon. 1976; Taylor 1984), in coastal Gippsland, Vic. (Bedggood 1980), suburban Melbourne (Fleming 1976; Humphreys 1986), round Geelong, Vic. (Hewish 1998, 2000), Mt Gambier, se. SA (SA Bird Rep. 1964), and Sellicks Beach, SA (Ashton 1985, 2001). In some areas where considered resident, undertake local seasonal movements into different habitats (Hewish 1998, 2002b), e.g. in Gippsland, Vic., occur in sand-dunes and heathlands, moving locally into pasture and forests (Bedggood 1980), and 'nomadic' movements in Tas. (Thomas 1979; Green 1989) possibly refer to this. **NZ:** Present throughout year (presumably sedentary of HANZAB) at Minginui, NI (CSN 6) and round Auckland in all seasons (CSN); and also recorded throughout year in garden at Te Kuiti, NI, except in Mar., though some seasonal trends evident (Guest & Guest 1987; see below). **OUTLYING ISLANDS:** Resident on Norfolk I. (Schodde *et al.* 1983), and apparently also Chatham and Snares Is (Freeman 1994; Miskelly *et al.* 2001).

Seasonal trends detected in some areas of se. Aust., arriving in late winter or spring, and leaving in summer or autumn (e.g. Clarke 1967; Thomas 1969; Whatmough 1978; Baxter 1980; Dedman *et al.* 1998; Hewish *et al.* 1999), e.g. arrived at

'Turkeith', near Colac, w. Vic., in early Aug. and left in summer (Brown 1950), arrived at Cobden, w. Vic., early Sept. and left Feb.–Apr. (Thomas 1969), arrived at Kindred, near Devonport, n. Tas., early Sept. and left Feb.–Apr. (Thomas 1969), and arrived at Bulleen and Glen Waverley, suburban Melbourne, in Nov. and left Feb.–Apr. (Thomas 1969). Mean dates of arrival at Bacchus Marsh, Vic., 1997–2003, 15 Sept. (25 Aug.–2 Oct.) (Hewish 1998, 1999, 2000, 2002a,b, 2003, 2004). Mean dates of arrival at Bennettswood, e. suburban Melbourne, 1989–98, 11 Sept. (18 July–20 Nov.); and mean date of departure 18 Feb. (11 Dec.–5 Apr.) (J.M. Peter). At Bannockburn, Vic., six stock, 1982–99, of which, five were 23 Nov.–4 Jan. (Baverstock & McCarthy 2000). Some birds apparently cross Bass Str., or at least part of it, with strong seasonal trends: recorded, apparently on passage, on Kent Grp, in Mar. (Garnett *et al.* 1991), and apparently seen crossing Bass Str. from Wilsons Prom., s. Vic. (Sutton 1998); thought to have colonized Tas. from Vic. (see Distribution: Change in range, populations).

Some seasonal occurrence also evident in NZ, especially in SI, where birds apparently on passage observed occasionally (see below), but no evidence of regular migration (Heather & Robertson 2000). However, form flocks in winter, which undertake 'considerable local movement' (Heather & Robertson 2000). NI: Described as winter visitor round Auckland (Moncrieff 1929), though this may reflect conspicuousness at time of formation of large congregations (e.g. Blundell & McKenzie 1963), as recorded in all seasons (CSN). Though recorded throughout year in garden at Te Kuiti, NI, except in Mar., occur most regularly, and reporting rates greatest, Sept.–Feb. (Guest & Guest 1987). Recorded round Clevedon, Aug.–Feb., and suggested that birds moved locally to coast in autumn–winter (CSN 1, 3). Winter records 'in valley' at Minginui (CSN 3) possibly reflect altitudinal movements. SI: Occasionally recorded on n. passage on e. and w. coasts in Apr. and May (CSN 35, 37; see Nature of passage, below); regarded as common near Reefton, W. Coast, in late winter and Feb., possibly reflecting either movement or conspicuousness (Dawson *et al.* 1978). In Paparoa Ra., near Punakaiki, recorded in large numbers in autumn and winter (Onley 1980).

Nature of passage In NZ, occasionally recorded on passage, e.g. large numbers seen on n. passage at Millerton and C. Foulwind, on w. coast, early in morning in Apr.–June (CSN 35); and similarly, birds on n. passage recorded passing at rate of 20 birds/h at Christchurch, mid-Apr. (CSN 37).

Banding Of 958 banded in Aust., 1953–June 2003, 13 recoveries (1.4%), of 13 birds. All recoveries <10 km from banding place (ABBBS). Of 8492 banded in NZ 1950–1996, 28 recoveries 1988–93; no information on recoveries at other times (Cossee 1989, 1992, 1993, 1995, 1997, 1998a,b; Cossee & Wakelin 1991). One banded at Upper Hutt, NI, said to have been recovered in Christchurch (Heather & Robertson 2000). Juvenile female banded at Christchurch, Feb., killed by Cat at Blenheim, July of same year, 253 km NNE (P.M. Sagar). **LONGEVITY:** Adult banded at Riverside, Tas., 27 December 1962, was recaptured at banding place over 6 years 7 months after banding (ABBBS). Said that oldest Greenfinch recorded in NZ was over 7.5 years old (Heather & Robertson 2000).

FOOD Mainly seeds; sometimes also fruit, buds and insects.

Behaviour Largely granivorous, taking most food from ground, but also occasionally forage in upper levels of vegetation, and sally for insects (Jackson 1958; East 1967; Green 1984; Gill 1989; Green 1995; CSN 22). Often occur in mixed-species foraging flocks (see below). **DETAILED STUDIES:** Near Hastings, NI, Mar. 1977–June 1978 (MacMillan 1981); Christchurch International Airport, Mar. 1968–Feb. 1969 (Moeed 1975); Christchurch Botanic Gardens, winter 1967

(East 1967); Windbag Valley, SI, Oct. 1983–Dec. 1985 (O'Donnell & Dilks 1994). **FORAGING ASSOCIATIONS:** Usually forage in flocks (Owen & Sell 1985; Gill 1989; CSN 35, 41), but also singly and in twos (Jackson 1958; Warham & Keeley 1969; Flux & Thompson 1988; CSN 19 Suppl., 24, 31, 45). Flocks can be small groups of as few as three birds (Edgar 1961; Child 1975; Holdsworth 1998; CSN); medium-sized (15–50 birds) (Tas. Bird Rep. 5; CSN), e.g. 20 feeding on sunflower seed-heads, Hamilton, NZ NI, Jan.–Feb. (CSN 32); or large (Davis & Reid 1975; CSN 4, 9, 19 Suppl., 41), e.g. >100 feeding on shoreline, King I., Apr.–May (McGarvie & Templeton 1974); and congregations of >1000 birds occasionally recorded (CSN 32, 34, 37), e.g. >2000 feeding on seeding turnips, Wairarapa, NZ NI, May (CSN 39). Once, >10,000 said to have fed at linseed-processing plant in Dunedin, SI (NZRD). Congregate on ripe crops after breeding season (Gillespie 1982a). Large feeding flocks said to occur in winter (NZRD). Regularly occur in mixed-species feeding flocks with other finches and small passerines at abundant food sources (Heather & Robertson 2000; CSN 37). Usually form mixed-species flocks with European Goldfinches (Blundell & McKenzie 1963; Moeed 1975; Loyn *et al.* 1986; CSN 21, 38; J.M. Peter) or House Sparrows (Black & Blomfield 1963; Blundell & McKenzie 1963; Moeed 1975; Peter 2000; CSN 21, 23, 38); also forage with Common Chaffinches *Fringilla coelebs* (Black & Blomfield 1963; Blundell & McKenzie 1963; East 1967; Sibson 1983; CSN 31), Yellowhammers (Blundell & McKenzie 1963; Sibson 1983; CSN 37), Common Redpolls *Carduelis flammea* (Blundell & McKenzie 1963), Red-browed Finches *Aegintha temporalis* (Fleming 1976), Spotted Turtle-Dove *Streptopelia chinensis* (Hewish 2002a; J.M. Peter), Crimson Rosellas *Platycercus elegans* (CSN 31) and Silvereyes *Zosterops lateralis* (Lewis 1961; Blundell & McKenzie 1963). Near Wellington, NZ, Greenfinches fed on seeds of crab apples *Malus 'gorgeous'* that had been pecked open by Common Blackbirds *Turdus merula* (McDonnell 1962). **FORAGING HEIGHTS AND SITES:** Forage mostly on ground (Black & Blomfield 1963; East 1967; Garnett *et al.* 1991; Green 1995; CSN 31, 34, 35, 39). In e. suburban Melbourne, of 76 observations of foraging: 72 (94.7%) were on ground, two (2.6%) in exotic plants and two (2.6%) on other substrates (Green 1984). In Christchurch Botanic Gardens, c. 95% (estimated from diagram) of food taken from ground, including lawns, leaf-litter, bare soil and paths. At Windbag Valley, of 79 observations of foraging, c. 31% in emergent foliage, c. 30% on top of canopy, c. 20% in canopy, c. 10% in upper understorey and c. 8% on ground (estimated from diagram). At same location, of 79 observations of foraging, 88.0% on canopy plants, 0.1% on shrub hardwoods, 11.7% on other plants (including mosses, ferns and lichens), 6.5% on ground and 5.1% in air (see O'Donnell & Dilks 1994 for plant species and sites used when feeding on invertebrates only). Seeds also taken from seed-heads (Beauchamp & Parrish 1999; CSN 19 Suppl., 20, 24, 32, 41). In Canola crop near Oamaru, SI, foraged in standing crop by perching above ground on stems of plants, and fed from ground among stubble (Gillespie 1982b). Also often forage in trees and other vegetation, taking seeds and fruit directly from shrubs and trees (Ryder 1948; Sutherland & Pettersson 1959; Edgar 1961; Lewis 1961; McDonnell 1962; East 1967; Gill 1989; Peter 2000; CSN 26, 41). In Auckland City Domain, fed in canopy and subcanopy of fruiting trees (Gill 1989); elsewhere, take seeds in crown of Golden Elm tree *Ulmus hollandica* (J.M. Peter). Very occasionally feed aerially (CSN 22). **FORAGING METHODS:** Forage mostly by gleaning. At Windbag Valley, foraged almost entirely by gleaning (n=79 observations of foraging). When feeding in Canola crop near Oamaru, SI, flocks moved steadily across paddock, with birds regularly moving from rear of flock to the front; gleaned (plucked) seeds from seed-pods in standing crop by perching

on and hanging from bent stems, and gleaned seeds from ground among stubble (Gillespie 1982b). Fruit and seeds are gleaned from shrubs, sometimes by systematically working down from top of shrub (Sutherland & Petterson 1959; Lewis 1961). To get at seeds, fruit crushed, torn apart or flesh removed (McDonnell 1962; CSN 1); damaged fruit often left attached to plant (McDonnell 1962). At Waingaro, NI, one jumped up, grabbed thistle seed-heads, then ate seeds on ground (CSN 19 Suppl.). Once seen probing lawn, presumably for grass stems (CSN 21). Very occasionally sally after flying insects (CSN 22); once recorded swooping down to snatch bees as they left hive (Jackson 1958). Once, insects gleaned from radiator of parked car (Flux & Thompson 1988). **FOOD-HANDLING:** For details of rates of removing husks from seeds in captivity, see Gillespie (1982a). When eating bees, grasped round thorax, then crushed before being swallowed (Jackson 1958). **FEEDING TIMES:** Foraging observed 05:30–09:00 (Tarr 1950; Jackson 1958; Edgar 1961). In Canola crops near Oamaru, SI, began feeding at c. 07:00, and fed for most of day; fed mostly on Canola seeds early in morning and late in afternoon, but in middle of day, also ate weed seeds and plant material in nearby paddocks (Gillespie 1982b). **SEASONAL VARIATION:** In Western Hutt Hills, NI, foraged on weed seeds in late summer and autumn, and on grain and crumbs in winter (Gibb 2000). Near Hastings, NI, fed mainly on *Amaranthus* and Maize in autumn and winter; Polygonaceae also eaten in winter; *Stellaria media* and *Erodium* eaten in spring; and berries of African Boxthorn, and Caprifoliaceae and *Raphanus sativus* eaten in summer; a few insects, mostly beetles, taken during Aug.–Feb. (MacMillan 1981). At Windbag Valley, fed on seeds in winter and early spring, and on invertebrates in summer. Often eat seeds of Scotch Thistle *Onopordum acanthum* and Monterey Pine in summer, Manuwatu, NI (NZRD). *Cotoneaster* shrubs raided Apr.–June (Lewis 1961; McDonnell 1962). At Papakura, fallen Tamarillo *Cyphomandra betacea* seed provided a food source over winter, with birds also seeking out dried Passionfruit *Passiflora edulis* pods (CSN 1973). Birds also frequent gardens in winter, attracted by readily available fruit and seeds (CSN 36, 37). **FOOD SELECTION:** In Christchurch Botanic Gardens, fed mostly on fallen seeds of European Ash *Fraxinus excelsior*, with seeds of Stone Pine *Pinus pinea* and Sycamore *Acer pseudoplatanus* also favoured. Round Tauranga, NI, preferred partly ripe seeds of milkweed *Euphorbia*, with pine seeds also important (Hodgkins 1949). In W. Hutt Hills, NI, seeds of Mouse-ear Chickweed *Cerastium glomeratum* favoured in summer and autumn (Gibb 2000). Birds feeding on Canola crops near Oamaru, SI, took seed mainly from ripe, brown pods, though occasionally from yellow or green pods (Gillespie 1982b); sometimes Canola seeds preferred over grass seeds (Gillespie 1982a). Insects eaten regularly, but comprise small proportion of diet (Heather & Robertson 2000). **FEEDING ADAPTATIONS:** Short, powerful bill used to remove husks from seeds and prise fruit open (Falla *et al.* 1981; Green 1995). **PEST STATUS:** Said to be a pest in gardens and ripening crops (Anon. 1917; Thomson 1922; Oliver), especially in orchards, attacking apricots when fruit is forming, flowering cherries and ripening Plums and Peaches (Thomson 1922; Oliver); though seen eating Apples in orchard, only fed on fruit that was already damaged (Baker 1980). Formerly considered highly destructive (Oliver); now thought to have minor impact (Heather & Robertson 2000). Near Oamaru, SI, main cause of bird damage to ripening Canola crops (Gillespie 1982b). May also assist in spread of weeds by dropping seeds (Cleland). **DRINKING:** In Aust., very occasionally drink from bird baths (Simpson 2003).

Detailed studies Near HASTINGS, NI (% frequency of occurrence in stomachs and crops of 158 birds, and months in which recorded, where known; MacMillan 1981): **Plants**

(Seeds unless stated.) Plant matter 17.1, Dec.–Apr., June and Aug. **MONOCOTYLEDONS:** Agavaceae: *Cordyline australis* 0.6, Mar.; Poaceae: grass embryo 0.6, Feb.–Mar.; *Lolium* 1.3, Mar.; *Panicum* 0.6, Feb.; *Poa annua* 7.6, Aug.–Sept.; *Setaria viridis* 3.8, Mar.–July; *Zea mays* 29.1, Apr.–Sept. **DICOTYLEDONS:** Amaranthaceae: *Amaranthus* (*A. deflexus* and *A. powellii*) 37.3, Feb.–Sept.; Asteraceae: unident. 1.3, Dec.; *Cotula australis* 1.3, Mar., Sept.; *Lactuca virosa* 1.3, Jan.; Boraginaceae: *Echium vulgare* 4.4, Feb.–Mar., Dec.; Brassicaceae: *Brassica* 2.5, Apr., Oct.; *Lepidium ruderales* 0.6, Dec.; *Raphanus sativus* 17.7, Mar.–May; *Sisymbrium* 1.3, Feb., July; Caprifoliaceae: unident. 13.9, Dec.–Mar., May; Caryophyllaceae: *Silene gallica* 0.6, Dec.; *Stellaria media* 24.1, July–Nov.; Chenopodiaceae: *Chenopodium album* 5.1, Feb., Apr.–June; Fabaceae: *Pisum sativum* 1.9, Jan., Dec.; *Trifolium* (*T. glomeratum* and *T. repens*) 8.9, Nov.–Apr.; Geraniaceae: *Erodium* 19.0, Feb., July, Oct.–Dec.; Malvaceae: *Malva parviflora* 0.6, Dec.; Polygonaceae: *Persicaria maculosa* 5.7, Apr.–June, Dec.; *Polygonum* unident. 16.5, Mar.–July; *P. aviculare* 1.9, May, July; *Rumex* 0.6, Dec.; Scrophulariaceae: *Hebe* 29.1, Jan.–Dec; Solanaceae: *Lycium ferocissimum* fru. 15.2, Jan.–July, Nov. **Animals** **COLLEMBOLA** 1.9, Aug.–Sept. and Nov. **INSECTS** (Ads unless stated): Coleoptera: unident. 1.9, Jan., Aug.–Sept., larv. 1.3, Sept.–Oct.; Curculionidae: unident. 0.6, Aug.; *Graphognathus leucoloma* 1.9, Feb., Aug.–Sept.; *Listroderes delaigui* 1.9, Jan., Dec.; Elateridae: *Agrypnus variabilis* 0.6, Nov.; Diptera: Chironomidae 7.6, Jan.–Feb., Aug.–Dec.; Sarcophagidae: *Hybopygia varia* 0.6, Sept.; Hemiptera: Aphididae 0.6, Sept.; Odonata: *Xanthocnemis zealandica* 1.9.

At CHRISTCHURCH INTERNATIONAL AIRPORT, SI (crop contents of six birds collected Mar. 1968–Feb. 1969; Moeed 1975): **Plants** (All seeds.) **MONOCOTYLEDONS:** Poaceae: *Anthoxanthum odoratum* 1.34% no., 16.67% freq.; *Avena* 6.15, 50; *Lolium* 35.56, 66.67; *Triticum* 16.31; 66.67; *Vulpia* 5.08; 16.67. **DICOTYLEDONS:** Caryophyllaceae: *Stellaria media* 11.50, 16.67; Chenopodiaceae: *Chenopodium album* 13.90, 50.0; Papilionaceae: *Cytisus* 1.34, 33.33; *Trifolium* 5.35, 16.67; *Ulex* 1.34; 33.33; *Vicia* 0.80, 16.67; Polygonaceae: *Polygonum* 0.80, 16.67. **Animals** Lepidoptera: larv 0.53, 16.67). **Other matter** Grit –, 100.

Other records—Aust. Plants (Seeds unless stated.) Seeds^{1,13}; water weed^{2,9,10,11}. **DICOTYLEDONS:** Asteraceae:² *Cynara cardunculus*⁶; Brassicaceae: *Cakile*⁷; *C. maritima*^{4,8,11}; Epacridaceae: *Leucopogon* fru.³; Rosaceae: *Rosa* fru.¹⁴; Solanaceae: *Lycium ferocissimum* fru.^{6,10,12}; Ulmaceae: *Ulmus hollandica*¹⁵.

REFERENCES: ¹ Cleland 1911; ² Bryant 1939; ³ Wheeler 1967; ⁴ Davis & Reid 1975; ⁵ Ross 1981; ⁶ Ashton 1985; ⁷ Loyn *et al.* 1986; ⁸ Holdsworth 1998; Hewish ⁹ 1999, ¹⁰ 2002a, ¹¹ 2002b; ¹² Peter 2000; ¹³ Cleland; ¹⁴ Tas. Bird Rep. 5; ¹⁵ J.M. Peter.

Other records—NZ Plants (Seeds unless stated.) Seeds^{19,23,35}, fruit^{22,23}, leaves²³, flowers²³, plant material¹⁴, wild turnip²⁴. **FILICOPHYTES:** Dryopteridaceae: *Leptocarpacea similis*⁴⁶. **GYMNOSPERMS:** Cupressaceae: *Chamaecyparis lawsoniana*^{33,38,43}; Pinaceae: *Pinus*^{2,22,23,42}; *P. pinea*¹⁰; *P. radiata*¹; *Tsuga heterophylla*¹⁰; Podocarpaceae: *Dacrydium dactyloides* fru.²²; *Dacrydium cupressinum*¹⁸; Taxaceae: *Taxus baccata*³⁵. **MONOCOTYLEDONS:** Agavaceae: *Phormium*^{33,37,46}; Cyperaceae: *Desmoschoenus spiralis*⁴⁶; Poaceae^{14,30,32}; *Poa annua*^{11,36}; *Spartina townsendii*¹⁶; *Zea mays*^{22,36}. **DICOTYLEDONS:** Aceraceae: *Acer pseudoplatanus*¹⁰; Actinidiaceae: *Actinidia chinensis*^{44,47}; Amaranthaceae: *Amaranthus*³²; *A. retroflexus*^{9,22}; Asteraceae^{12,19,22}: *Helianthus annua*^{22,32,39,41,42,44,46}; *Onopordum acanthium*²⁴; *Taraxacum officinale*^{14,30}; Betulaceae: *Alnus glutinosa*¹⁰; Bignoniaceae: *Tecomaria capensis* fl.⁴⁶; Boraginaceae: *Echium vulgare*³²; Brassicaceae: *Brassica*²²; *B. napus*^{14,22}; *B. rapa*^{27,45}; *Cakile maritima*^{41,45}; *Cardamine*³⁴; *C. hirsuta*³³; *Raphanus sativus*²²;

*Sisymbrium officinale*⁴⁰; Cannabaceae: *Humulus lupulus*²²; Caprifoliaceae²⁴; Caryophyllaceae: *Cerastium glomeratum*²¹; *Stellaria media*^{14,22,27,33,48}; Chenopodiaceae: *Beta vulgaris*³⁹; *Sarcocornia quinqueflora*¹⁵; Convolvulaceae: *Calystegia soldanella*³⁹; Cucurbitaceae: *Cucurbita*^{32,42}; Euphorbiaceae: *Euphorbia*^{2,23}; *E. helioscopia*²⁵; *E. peplus*²⁵; Fabaceae: *Pisum sativum*²²; Fagaceae: *Nothofagus*⁴; Geraniaceae: *Erodium cicutarium*²²; Linaceae: *Linum usitatissimum*²²; Myrtaceae: *Lawsonia*³²; Oleaceae: *Fraxinus excelsior*¹⁰; *Ligustrum lucidum* fru.²⁰; Passifloraceae: *Passiflora* fru.³³; Polygonaceae: *Muehlenbeckia* fru.⁴⁵; *Polygonum*¹⁴; Rosaceae: *Cotoneaster* fru.^{6,7,32,42,46}; *C. microphyllus*⁸; *C. serotinus*⁸; *Cydonia vulgaris*⁸; *Malus* 'Gorgeous' (crab apple)⁸; *M. purpurea* fru.¹⁰; *M. sylvestris* fru.¹³, fru. buds²², sds^{25,42,44}; *Prunus armeniaca* fru. buds²²; *P. persica* fru. buds²²; *Pyracantha* fru.³¹; *Pyrus communis*^{42,44}; *Rosa* fru.²⁴; Saxifragaceae: *Ribes nigrum*²⁹; Solanaceae: *Cyphomandra betacea*³³; *Lycium ferocissimum* fru.^{14,22,36,41,44}, sds²⁴; Thymelaeaceae: *Daphne* fru.^{26,28}; *D. mezereum*⁵; Violaceae: *Viola*³². **Animals** Unident. invertebrates¹⁸. **INSECTS**^{13,14,17,32,34}; larv.²³; Coleoptera²²; Diptera²²; Hymenoptera²²: Apoidea³; Symphyta: larv.²⁴; Lepidoptera¹⁷. **Other matter** Bran³⁸; crumbs²¹; honey cake³⁸; suet³⁸.

REFERENCES: ¹ Ryder 1948; ² Hodgkins 1949; ³ Jackson 1958; ⁴ Secker 1958; ⁵ Sutherland & Pettersson 1959; ⁶ Edgar 1961; ⁷ Lewis 1961; ⁸ McDonnell 1962; ⁹ Blundell & McKenzie 1963; ¹⁰ East 1967; ¹¹ Warham & Keeley 1969; ¹² Child 1975; ¹³ Baker 1980; ¹⁴ Gillespie 1982b; ¹⁵ Sibson 1983; ¹⁶ Owen & Sell 1985; ¹⁷ Flux & Thompson 1988; ¹⁸ O'Donnell & Dilks 1994; ¹⁹ Beauchamp & Parrish 1999; ²⁰ Gill 1989; ²¹ Gibb 2000; ²² Heather & Robertson 2000; ²³ Oliver; ²⁴ NZRD; CSN ²⁵ 1, 26 3, 27 4, 28 5, 29 6, 30 9, 31 19, 32 19 Suppl., 33 20, 34 22, 35 23, 36 24, 37 29, 38 31, 39 32, 40 33, 41 35, 42 36, 43 37, 44 38, 45 39, 46 41, 47 43, 48 45.

Young Fed by both parents (see Breeding). At one nest, 9-day-old nestlings fed every 30 min (NZRD). Fed on insects, including larvae, and seeds (Baker 1980; Oliver). Near Hastings, NI, diet consisted mainly of seeds with testa removed; few insects recorded, though proportion of insects in diet possibly underestimated (MacMillan 1981). Fledgelings chase parents to be fed for a few weeks (Green 1995). Near Oamaru, SI, juveniles ate significantly more green, unripe Canola seeds than adults (Gillespie 1982b).

Detailed studies Near HASTINGS, NI (% frequency of food items in 49 crop samples from 32 nestlings; MacMillan 1981):

Plants (Seeds unless stated) Leaf fragments 8.2, unident. plant material 14.3. **MONOCOTYLEDONS:** Poaceae: *Glyceria* 2.0. **DICOTYLEDONS:** Boraginaceae: *Echium vulgare* 4.1; Brassicaceae: *Brassica* 14.3; Caprifoliaceae: unident. 10.2; Caryophyllaceae: *Stellaria media* 4.1; Fabaceae: *Trifolium* 2.0; Geraniaceae: *Erodium* 12.28; Plantaginaceae: *Plantago major* 2.0. **Animals** **SPIDERS:** Unident. ad. 2.0. **INSECTS:** Unident. 2.0; Coleoptera: Curculionidae: unident. ads 4.1; Hymenoptera: Tenthredinidae: *Priophorus morio* larv. 4.1.

Intake For intake under laboratory conditions, see Gillespie (1982a).

SOCIAL ORGANIZATION Well known extraliminally (see BWP), but poorly known in HANZAB region. Occur singly, in twos or small flocks at any time of year; in non-breeding season (Mar.–Sept.), often form large flocks of several hundred, or occasionally thousands (Mellor 1926; Moncrieff 1929; Watson 1955; McGarvie & Templeton 1974; Rix 1976; Aust. Atlas 1; CSN 19, 32, 34, 38, 39). Often form mixed-species flocks with European Goldfinches, and sometimes with House Sparrows, Common Chaffinches, Common Redpolls, Yellowhammers and Common Starlings (Mellor 1926; Black & Blomfield 1963; Loyn *et al.* 1986; Hewish 2002; CSN 19, 21, 37, 38, 41; see also Food).

Bonds No information from HANZAB region. Extraliminally, mainly monogamous, but polygyny also occurs (BWP).

Breeding dispersion Mostly solitary (NRS). Often several pairs nest in loose colony, with nests a few metres apart (Heather & Robertson 2000; Aust. Atlas 1). Extraliminally, breed either solitary or in 'neighbourhood groups' of 4–6 pairs (BWP).

Roosting At Miranda, NI, c. 280 roosted in large communal roost in mangroves in Oct.; arrived at roost-site between 18:24 and c. 19:40. Most arrived at roost singly, in twos or small groups, apart from two flocks of 14 and 30. Some birds in larger flocks did not land, presumably continuing on to other roost-sites (Keeley 2002). At same site, 19 months later, did not use same roost-site, but another nearby was used by c. 2300 birds; arrived between 16:10 and c. 17:15, last arriving 9 min before sunset; left roost between c. 7:00 and c. 7:40 on following morning (Keeley 2004). In Auckland, occasionally roosted in row of trees (Counsilman 1974).

SOCIAL BEHAVIOUR Well known extraliminally (see BWP), but poorly known in HANZAB region.

Agonistic behaviour **Alarm** Took to trees and gave Alarm Call when New Zealand Falcon *Falco novaeseelandiae* flew overhead (Porter & Dawson 1968). **Interspecific aggression** Once, small flock mobbed Nankeen Kestrel *Falco cenchroides* (Edgar & Grant 1969); and pair once seen, with two White-plumed Honeyeaters *Lichenostomus penicillatus*, chasing Fan-tailed Cuckoo *Cacomantis flabelliformis* (Wade 1936). Often interfere with nests of European Goldfinches (Middleton 1970).

Sexual behaviour No information from HANZAB region. Extraliminally, when forming pair-bonds, male chases female and performs Sleeked Wings-raised Display, often adopts Fluffed Posture and occasionally performs Butterfly Flight. Courtship Feeding often also occurs with male feeding female, although often the two merely lean towards each other in display described as Bill-flirting. Female solicits copulation by uttering soliciting call and crouching beside male with wings lowered and lightly shivered (see BWP for details).

Relations within family group **Anti-predator responses of young** Near Hastings, NI, young sometimes fledged prematurely when nest checked (MacMillan 1985). **Parental anti-predator strategies** No information from HANZAB region. Extraliminally, incubating bird sits tightly, sometimes able to be touched without flushing; at same time, other member of pair may dive at person, or perform distraction displays (BWP).

VOICE Well known extraliminally (see BWP, and references therein), but little published information from HANZAB region, mostly from NZ; sonagrams in BWP. Extraliminally, in W. Palaearctic, repertoire of adults consists of male and female Song and eight calls (BWP). Song is most often reported vocalization in HANZAB region (see below). Sometimes sing from conspicuous perch, such as top of tree (Sutton 1923; Pizzey 1980; Falla *et al.* 1981), but also occasionally call from perch hidden among foliage, betraying presence of bird (Moncrieff 1929). **SEASONAL PATTERN:** In NZ: most reports of first Song of season occur in late Aug. or Sept. (CSN), but occasionally in late July or early Aug. (CSN 33, 36, 48) or in Oct. (CSN 5). Sing till at least early Feb. ([Rep. Bull. OSNZ 3; CSN 6), but also heard singing at other times, e.g. Apr. (CSN 1, 37) and male once heard singing on 3 May, till joined by mate, then both flew away (CSN 41). Near Reefton, SI, change in detectability in late winter and again in Feb. possibly due to conspicuousness of singing birds (or movements into and out of area) (Dawson *et al.* 1978). In SA, first heard in June and July (Ashby 1921; Sutton 1922c). **DIURNAL PATTERN:** Vocalize at almost any time during daylight (J.M. Peter); in Adelaide, heard calling at 13:20 (Sutton 1923). In list of species

participating in dawn chorus near Te Teko, NI, on 27 Oct., first heard at 06:14 (8 min before sunrise) (Taylor 1975). **MIMICRY:** Extralimitally, mimicry said to be regularly included in Song (BWP), but not recorded in HANZAB region.

Adult SONG OF MALE: Most often reported vocalization in HANZAB region. Harsh, drawn-out or monotonous buzzing, whirring or jeering wheeze, rendered as *birrzz*, *zeep*, *che-e-e-se* or *dzwee* (Mellor 1925, 1926; McKenzie 1950; Pizzev 1980; Falla *et al.* 1981; Heather & Robertson 2000; CSN; Aust. RD). Churring *scwerr* notes, sometimes given in flight (CSN 1, 22), possibly refer to this. Extralimitally, wheeze often preceded by groups of tremolos, varying subtly in pitch and timbre (BWP); though these not reported in HANZAB region, they occur on recordings, e.g. sonagram A shows alternating tremolos and wheezes. A few aspects of Song have been compared with other sounds: whirring sounds said to be grasshopper-like (Pizzev 1980) or to 'remind one much of the quick unwinding of a small but powerful watch-spring' (Mellor 1925); and *dzwee* said to be reminiscent of call of Long-tailed Cuckoo *Eudynamis taitensis* (Heather & Robertson 2000). **SONG OF FEMALE:** Seldom given; less intense version of Song of Male (BWP). Not recorded in HANZAB region. **CONTACT CALL:** Pleasant, rapid twittering *chichichichichit* (sonagram B), sometimes followed by *teu-teu-teu-teu*; sometimes given as isolated units, *teu* or variations thereof (Pizzev 1980; Falla *et al.* 1981; Heather & Robertson 2000; Aust. RD). Twittering said to be canary-like (Pizzev 1980). Yammering call (CSN 47) possibly describes the twittering aspect of this call. **THREAT CALL:** Sharp rattle, rendered as a coarse *tsk tsk tsk* or rattling *tsrr* (BWP). In HANZAB region, described as clicking or rattling sounds, apparently much like part of Song of Yellowhammer (Taylor 1978). **SWEET CALL:** High-pitched whistle, rendered as a rising *tsooet* or *sweee* (Pizzev 1980; Heather & Robertson 2000; CSN 35); 'sweet note' given from cover of foliage (Moncrieff 1929) probably this call. Given in alarm, when aerial predator detected (BWP). **ALARM CALL:** Not described in HANZAB region; given when flushed by New Zealand Falcon (Porter & Dawson 1968), though possibly refers to Sweet Call. **OTHER CALLS:** Hard, flat trill mentioned by Pizzev (1980). Other calls reported extralimitally: Soliciting

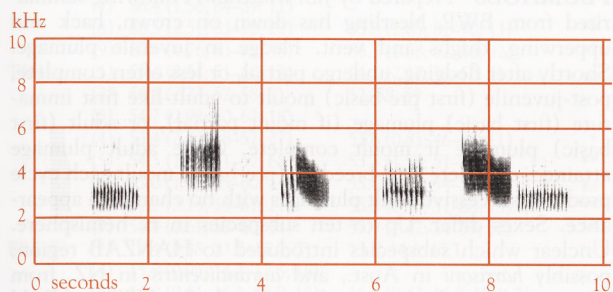
Call, Begging Call, Excitement Call and others of unknown function, rendered as *dzweeo* and *joooooe* (BWP).

Young Extralimitally, nestlings give prolonged sibilant trill or shrill whirring squeak, *smrrrr* (BWP). In HANZAB region, fledgelings said to call persistently (Falla *et al.* 1981), uttering 'clanging chirp' when following adults (Rep. Bull. OSNZ 3). Extralimitally, fledgelings give shrill insistent *cheeu* as Contact Call, and older fledgelings also utter liquid *si-si-si-si* (BWP).

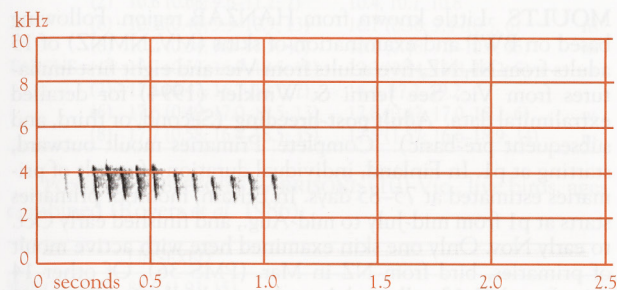
BREEDING Well known extralimitally (BWP); in HANZAB region, reasonably well known in NZ, where detailed study near Hastings, NI, covering three consecutive breeding seasons (MacMillan 1985) and 158 records in NRS to c. 1985 (summarized in MacMillan 1985); less well known in Aust., where 27 records NRS and no detailed studies.

Season AUSTRALIA: Of 19 clutches in NRS, recorded Oct.–Feb.: one (5.3%) in Oct., seven (36.8%) in Nov., eight (42.1%) in Dec., two (10.5%) in Jan. and one (5.3%) in Feb. Sometimes lay two clutches in a season (Frith 1969). **NSW:** Eggs, Sept.–Mar. (Morris *et al.* 1981). Unspecified breeding, including fledgelings, in Sept.–Jan. (Frith 1969; Anon. 1971; Aust. Atlas 2). **VIC.:** Eggs, Oct.–Jan. (NRS [n=9 clutches]); nestlings, Oct.–Jan. (Aust. Atlas 1; NRS). Unspecified breeding, including fledgelings, Sept.–Mar. and July (Frith 1969; Talmage 1988; Aust. Atlas 1, 2; Vic. Atlas; Vic. Bird Rep. 1987; NRS). **TAS:** Eggs, Nov.–Feb. (NRS [n=10 clutches]). Nestlings, Dec.–Jan. (NRS). Unspecified breeding, including fledgelings, Oct.–Feb. (Aust. Atlas 1, 2; NRS). **SA:** Unspecified breeding, including fledgelings, Oct. and Dec.–Feb. (Sutton 1922a,b; Ashton 1987; Aust. Atlas 1, 2; NRS). **NZ:** Eggs mostly mid-Oct. to early Feb. (Heather & Robertson 2000). Of 55 clutches in NRS: seven (12.7%) in Oct., 20 (36.4%) in Nov., 17 (30.9%) in Dec. and 11 (20.0%) in Jan. (MacMillan 1985; NRS). Unspecified breeding Sept.–Mar. (Falla *et al.* 1981; Oliver). Two clutches usually laid per season, with first clutch usually in late Oct. on NI and late Nov. on SI, and second clutch usually in early Jan. on NI, and mid-Jan. on SI (Falla *et al.* 1981; Heather & Robertson 2000; Oliver). From NRS, earliest clutch recorded in early Oct. on NI, and on SI, earliest clutch recorded in mid-Oct. (MacMillan 1985). **NI:** Eggs, Oct.–Mar. (MacMillan 1985; CSN 41). In Hawkes Bay, earliest eggs 16 Oct. and latest 5 Feb. (MacMillan 1985): of 55 clutches, 15 (27.3%) in Oct., 19 (34.5%) Nov., ten (18.2%) Dec., ten (18.2%) Jan. and one (1.8%) Feb. (MacMillan 1985). Nestlings, Mar. (CSN 1, 5). Fledgelings, Jan.–Feb. (CSN 1, 5). **SI:** Few published records. Eggs, late Sept. and Jan. (CSN 1, 2); nestlings, Jan. (CSN 1). Unspecified breeding, including fledgelings, Sept. and Jan.–Mar. (CSN 1, 2, 5, 33).

Site Usually in fork in outer branches of tree, shrub or hedge; seldom in centre or close to main stem; sometimes hidden by foliage (Frith 1969; MacMillan 1985; Talmage 1988; Heather & Robertson 2000; Oliver; NRS). Often placed in tall trees, such as conifers, especially pines *Pinus*, oaks *Quercus*, plane *Plantanus* or cypress *Cupressus*, and, often in fruit trees; and occasionally in other trees, including banksias, Brush Box *Lophostemon confertus* or hawthorn *Crataegus*. Also often in shrubs such as tea-tree *Leptospermum*, bearded heath *Leucopogon*, Matagouri *Discaria toumatou*, Tauhinu *Cassinia leptophylla*, African Boxthorn or Gorse *Ulex europaeus*; and occasionally among vines in tree-tops and once in Blackberry (Anon. 1917; Sharland 1946; McGilp 1956; Jasper 1964; Talmage 1988; Leishman 1997; Heather & Robertson 2000; CSN 1, 2; NRS). Of 183 nests throughout NZ: 21% were in conifers, 18% in Gorse, 14% in Manuka and Kanuka, 8% in Matagouri, 7% in fruit trees, 7% in thorny hedges (mainly hawthorn), 1% in African Boxthorn, and 24% in other trees and shrubs (MacMillan 1985; NRS). Of 104 nests near Hastings, NI: 39% in Holm Oak *Quercus ilex*, 20% in African



A F.W. van Gessel; Deloraine, Tas., Dec. 1988; P94



B W.V. Ward; Nelson, SI, Nov. 1969; P107

Boxthorn, 14% in Silverberry *Elaeagnus pungens*, 13% in fruit trees, 7% in conifers, 4% in roses *Rosa*, and 3% other trees or shrubs (MacMillan 1985). Sometimes nest in same site in successive years (CSN 31; NRS). At Hawkes Bay, NI, recorded nesting in same shrub as European Goldfinches, Silvereyes, Common Blackbirds and Song Thrushes *Turdus philomelos* (McLennan & MacMillan 1985). **MEASUREMENTS** (m): **AUST.**: Height of nest, 2.9 (1.21; 1.2–6.0; 20) (NRS); 2.9 (Talmage 1988). Depth below top of vegetation, 1.5 (2.19; 0.2–9.1; 15) (NRS). **NZ**: Height of nest, 2.6 (0.9–10.7; 187) (MacMillan 1985; NRS); 2.5 (1–11) (Heather & Robertson 2000); usually <6 (Falla *et al.* 1981); near Hastings, NI, 2.5 (0.9–9.1; 101) (MacMillan 1985); and elsewhere, 1.8 (CSN 1, 2). Height of nest-plant: 12 (Talmage 1988).

Nest, Materials Untidy, cup-shaped nest; usually made of twigs or grass (one had strips of bark), often mixed with rootlets, moss or wool, and sometimes with hair; lined with feathers, fine grass, bark, rootlets, plant down, wool or hair (Frith 1969; Beruldsen 1980; Heather & Robertson 2000; Oliver; NRS). One nest at Albert Park, Vic., had nest-cup comprising feathers and cigarette filter-tips placed on tightly woven foundation of rootlets, grass and plant fibre; at least two insect cases (cocoon-like fibres) also incorporated into cup. Some of the filter-tips had been unravelled, and the 'felt' used to line nest. The feathers, generally white or off-white, were mostly from Silver Gulls *Larus novaehollandiae*, mean of 37 mm long ($n=145$) with two >70 mm long (Talmage 1988). Building takes *c.* 5 days (NRS). **MEASUREMENTS**: No published records of dimensions in HANZAB region. **WEIGHT** (g): Nest-cup (described above) 11; comprised filter-tips, 5.5, grass, 5, and feathers 0.5 (Talmage 1988).

Eggs No information on shape in HANZAB region, but extraliminally, sub-elliptical, smooth and slightly glossy (BWP). Various white, dirty white, pale blue, bluish white, pale greenish-blue, greenish or bluish pink; spotted and blotched reddish, reddish brown, light brown, dark brown or pale violet (Frith 1969; Beruldsen 1980; Falla *et al.* 1981; Heather & Robertson 2000; Oliver). On some, markings concentrated at large end (Oliver), but scattered on others (Heather & Robertson 2000). **MEASUREMENTS**: 21.5 × 14.8, 22.8 × 13.8 (Oliver); 21 × 15 (Frith 1969); 22 × 14.5 (Heather & Robertson 2000).

Clutch-size Usually five; three to six (Heather & Robertson 2000), or four to six (Frith 1969; Falla *et al.* 1981; Oliver). **AUST.**: 4.8 (0.41; 4–5): C/4 × 1, C/5 × 5 (NRS). **NZ**: 4.56 (0.66; 3–6): C/3 × 3, C/4 × 20, C/5 × 30, C/6 × 2 (MacMillan 1985; NRS); 4.55 (0.50; 4–5; 18) (Niethammer 1970). Near Hastings, NI, 4.6 (0.59; 3–6): C/3 × 2, C/4 × 19, C/5 × 33, C/6 × 1 (MacMillan 1985). Of 30–40 nests examined at Bedes, central Otago, SI, one nest contained seven eggs, four nests had five, and remainder had six (CSN 1). In NZ, clutch-size varies throughout breeding season; of 55 clutches, mean clutch-size: Oct. 4.43 ($n=7$ clutches), Nov. 4.45 (20), Dec. 5.00 (17), and Jan. 4.18 (11) (NRS); near Hastings, of 55 clutches: Oct. 4.73 (15), Nov. 4.57 (19), Dec. 4.40 (10), Jan. 4.70 (10), and Feb. 4.00 (1) (MacMillan 1985; NRS).

Laying Eggs laid on consecutive days (CSN 1).

Incubation By female only (Frith 1969; Heather & Robertson 2000). Begins after final egg laid (CSN 1). Extraliminally, though usually starts with last egg, may start earlier (BWP). Incubating bird fed by male (Heather & Robertson 2000). **INCUBATION PERIOD**: 13.1 days (1.27; 11–15; 9) (MacMillan 1985); 13 (11–15) days (Heather & Robertson 2000); 13–14 days (Frith 1969; Falla *et al.* 1981). Claimed that all eggs in clutch hatch on same day (MacMillan 1985), but at one nest, an egg hatched on day before other eggs in clutch (NRS).

Young Nidicolous. No details on state at hatching; some nestlings of unknown age covered in down, with eyes closed.

Eyes opened at 3–5 days in one nest; and by 7–8 days in another. At one nest, pin-feathers visible by 6–7 days, and had erupted by 8–9 days; by 9–10 days, feathers growing on back, wings and tail; by 10–11 days, feathers growing on head and prominent on wing, and bill had begun to turn yellow (NRS). Fed by both parents, by regurgitation (Frith 1969; Heather & Robertson 2000; NRS).

Fledging to independence All young of brood usually fledge on same day (MacMillan 1985). In one nest, young fledged either late in evening or early in morning (CSN 1). **FLEDGING PERIOD**: 16 (13–17) days (Heather & Robertson 2000); 13–15 days (Frith 1969); 13–16 days (Falla *et al.* 1981); 13–17 days (MacMillan 1985).

Success At one nest, of five eggs laid, all hatched but none fledged. At two nests where clutch-size and number hatched known, but outcome unknown, all nine eggs laid hatched. Of 12 nests where outcome known, five (41.7%) successfully fledged at least one young, and seven (58.3%) failed (NRS). Near Hastings, NI, in 55 completed clutches, where clutch-size, number hatched and outcome known: of 253 eggs, 123 (48.6%) hatched, 81 (32.0%) fledged; equivalent to 1.47 fledgelings per clutch; 31 (56.4%) clutches fledged young. Many nests fail due to predation (NRS). Of 297 eggs laid near Hastings, NI, 119 (40.1%) were taken by predators and 55 (18.5%) lost to other causes. Of the 123 young that hatched, 38 (30.9%) were taken by predators and four (3.3%) were lost to other causes (MacMillan 1985). Eggs eaten by Black Rats (McLennan & MacMillan 1985), and nestlings and young by Swamp Harriers *Circus approximans* and New Zealand Falcons (Fitzgerald 1965), and probably also by mustelids (McLennan & MacMillan 1985). One nest was found with a pierced egg (McGilp 1926), at another, sitting bird was killed and eaten on nest; and at another, nestlings decapitated (NRS). A few nests are abandoned (Wilkinson & Wilkinson 1952; NRS); at an orchard in Hawkes Bay, NI, nests were apparently deserted when trees sprayed because nests disturbed (McLennan & MacMillan 1985). **CUCKOOS**: Parasitized by Pallid *Cuculus pallidus* and Long-tailed *Eudynamis taitensis* Cuckoos and Horsfield's Bronze-Cuckoo *Cuculus basalis* (Stead 1936; McGilp 1956; Campbell).

PLUMAGES Prepared by J.S. Matthew. Following summarized from BWP. Nestling has down on crown, back and upperwing, thighs and vent. Fledge in juvenile plumage. Shortly after fledging, undergo partial, or less often complete, post-juvenile (first pre-basic) moult to adult-like first immature (first basic) plumage (if moult partial), or adult (first basic) plumage if moult complete. Once adult plumage attained, complete post-breeding (pre-basic) moult each cycle produces successive adult plumages with no change in appearance. Sexes differ. Up to ten subspecies in n. hemisphere. Unclear which subspecies introduced to HANZAB region; possibly *harrisoni* in Aust., and *aurantiventris* in NZ, from whence colonized various outlying islands. See BWP and Field Identification for descriptions of plumages and bare parts.

MOULTS Little known from HANZAB region. Following based on BWP and examination of skins (MV, NMNZ) of 15 adults from NI, NZ, five adults from Vic. and eight first immatures from Vic. See Jenni & Winkler (1994) for detailed extralimital data. **Adult post-breeding** (Second, or third, and subsequent pre-basic). Complete. Primaries moult outward, starting at p1. In Finland, individual duration of moult of primaries estimated at 75–85 days. In Britain, moult of primaries starts at p1 from mid-July to mid-Aug., and finished early Oct. to early Nov. Only one skin examined here with active moult of primaries, bird from NZ in Mar. (PMS 36). Of other 14 skins from NZ: 12 collected Aug.–Jan. with all primaries worn, less so in Aug.; one collected June and one in July with all

primaries very slightly worn. Five birds collected in Vic. Aug.–Jan. had all primaries worn, less so in Aug. This limited data suggests moult occurs in summer to autumn in HANZAB region, but more data needed to ascertain precise timing. Moult of secondaries starts at s1 when moult of primaries about halfway through (when p5–p7 being replaced). **Post-juvenile** (First pre-basic). Usually partial; complete in a few birds in S of range in n. hemisphere, especially birds hatched early in season (Jenni & Winkler 1994). In n. hemisphere, extent of post-juvenile moult varies individually and geographically; much variation in moult of remiges, greater secondary coverts, alula and rectrices; some birds undergo eccentric partial moult of primaries, and a few undergo complete moult of primaries (Jenni & Winkler 1994). Little known of timing and extent in HANZAB region. One juvenile from Vic. in mid-Dec. not yet started moult. First immatures collected in Vic. had all juvenile primaries and secondaries, greater primary coverts, most greater secondary coverts, and usually all or most juvenile rectrices retained; four of eight of these immatures had replaced t1 or t2, or both, in post-juvenile moult; one bird had replaced all juvenile rectrices and tertials in post-juvenile moult. **First immature post-breeding** (Second pre-basic). No information from HANZAB region. Extent and timing possibly similar to adult post-breeding.

MEASUREMENTS SUBSPECIES *HARRISONI* (BRITISH ISLES AND POSSIBLY AUST.) AND POSSIBLY SUBSPECIES *AURANTII-VENTRIS* (NZ): (1–2) Vic., skins (MV): (1) Adults; (2) First immatures. (3) NI, NZ, adult male skins (NMNZ). (4–5) Skins, including some from sample (3) (Niethammer 1971); (4) NZ; (5) British Isles. (6) England and Scotland, skins, ages not specified (BWP). SUBSPECIES *AURANTII-VENTRIS*: (7) France, adults, skins (BWP). NOMINATE *CHLORIS*: (8–9) Netherlands, skins (BWP): (8) Adults; (9) First immatures.

	MALES	FEMALES	
WING	(1) 85.8 (2.34; 81–88; 12)	83.6 (0.89; 83–85; 5)	ns
	(2) 85.4 (1.51; 83–87; 7)	81, 82, 83	
	(3) 86.3 (1.87; 83–91; 18)	–	
	(4) 86.4 (1.73; 83–90; 27)	83.5 (1.12; 82–85; 13)	**
	(5) 86.5 (1.73; 83–90; 69)	84.7 (1.69; 81–88; 38)	**
	(6) 87.5 (1.79; 84–91; 13)	84.4 (0.99; 83–86; 8)	**
	(7) 86.4 (1.56; 84–89; 11)	–	
	(8) 88.3 (2.51; 83–92; 22)	85.8 (2.65; 81–90; 13)	**
	(9) 87.4 (1.76; 83–91; 35)	85.3 (1.68; 82–88; 32)	**
TAIL	(1) 55.4 (2.54; 51–60; 12)	54.2 (2.17; 51–56; 5)	ns
	(2) 56.4 (2.23; 52–58; 7)	52, 58, 59	
	(3) 54.2 (2.92; 50–62; 18)	–	
	(4) 53.4 (2.40; 48–57; 27)	51.6 (0.81; 46–53; 11)	*
	(5) 54.5 (1.85; 51–57; 68)	53.3 (1.54; 51–56; 38)	**
	(6) 57.0 (1.73; 55–60; 13)	55.6 (1.19; 54–57; 5)	ns
	(8) 57.2 (2.15; 53–61; 21)	55.6 (2.85; 51–60; 13)	**
	(9) 56.9 (1.61; 53–60; 34)	55.9 (1.42; 54–59; 32)	**
	BILL S	(1) 14.4 (0.48; 13.7–15.0; 7)	13.6, 14.6, 15.1
(3) 15.5 (0.95; 14.3–17.6; 18)		–	
(6) 16.9 (0.61; 16.1–18.0; 13)		16.6 (0.43; 16.0–17.1; 7)	ns
BILL N	(8) 16.7 (0.61; 15.5–17.5; 24)	16.6 (0.78; 15.2–17.5; 17)	ns
	(1) 11.0 (0.36; 10.3–11.6; 12)	10.6 (0.31; 10.3–11.0; 50)	ns
	(2) 10.6 (0.68; 9.6–11.2; 7)	10.4, 10.7, 10.8	
TARSUS	(6) 10.3 (0.46; 9.5–10.9; 13)	10.1 (0.38; 9.4–10.5; 6)	ns
	(8) 10.2 (0.54; 9.0–11.5; 40)	10.1 (0.48; 9.3–10.9; 35)	ns
	(1) 17.7 (0.52; 16.9–18.5; 12)	17.3 (0.54; 16.8–18.2; 5)	ns
	(2) 17.4 (0.47; 16.7–18.1; 7)	16.4, 17.2, 19.2	
	(6) 17.6 (0.49; 17.0–18.5; 13)	17.8 (0.47; 17.0–18.2; 6)	ns
(8) 17.7 (0.58; 16.4–18.5; 35)	17.5 (1.57; 16.6–18.9; 34)	ns	

POSSIBLY SUBSPECIES *HARRISONI*: (10) Vic., live birds, ages combined (Rogers *et al.* 1986).

	UNSEXED
WING	(10) 88.6 (1.93; 15)
THL	(10) 30.8 (1.22; 15)

WEIGHTS SUBSPECIES *HARRISONI* (BRITISH ISLES AND PROBABLY AUST.) AND POSSIBLY *AURANTII-VENTRIS* (NZ): (1) Vic., adults, from museum labels (MV). (2) NI, NZ, adult males, from museum labels (NMNZ). (3) NZ (Niethammer 1971).

	MALES	FEMALES
(1)	27.4 (2.02; 24.4–29.0; 4)	28
(2)	23.4 (2.70; 18–28; 15)	–
(3)	26.8 (24.5–31; 17)	26.1 (23–28; 7)

POSSIBLY SUBSPECIES *HARRISONI*: Rogers *et al.* (1986) gave weight-range of birds captured in Vic. (ages combined) as 20.2–26.0 (n=28).

SUBSPECIES *HARRISONI*: BWP gave mean weight of birds from Wales as 26.7 (25.5–28.4; 7); and exhausted birds in s. England have mean weight 19.3 (16.2–22; 7). NOMINATE *CHLORIS*: BWP gave mean weight of birds from Norway as 29.6 (26.5–34.4; 14); and mean weight of adult males from Sussex, England: summer 27.2 (24.8–30.4; 147); winter 28.5 (25.7–35.6; 147). See BWP for details on seasonal variation in weight in Netherlands.

STRUCTURE See BWP for details. BWP states that *aurantiiventris* (Tunisian birds) are slightly deeper and wider at base of bill than nominate (Sweden) and *harrisoni* (British Isles).

AGEING See BWP, Svensson (1992) and Jenni & Winkler (1994) for details. Juveniles distinguished from adults by plumage and slight differences in bare parts (see Field Identification). First immatures difficult to distinguish from respective sexes of adults. Most immatures retain all or most juvenile remiges and rectrices; juvenile rectrices narrower and more pointed at tips than those of adults (see Svensson 1992). First immature often shows obvious moult-contrast between retained (often outer few) juvenile and replaced adult-like greater secondary coverts; retained juvenile coverts have pale-buff tips and are shorter than less worn adult-like coverts, which tipped greyish and longer; first immature also often show moult-contrast within tertials, retained juvenile tertials more worn but with paler brownish fringes than greyish-fringed and less worn adult-like tertials replaced in post-juvenile moult (Jenni & Winkler 1994).

SEXING See BWP and Svensson (1992) for details. Adults and first immatures obviously plumage-dimorphic (see Field Identification for details). Only females develop brood-patch (Rogers *et al.* 1986; Svensson 1992). Juveniles show slight plumage-dimorphism; following differences summarized from BWP (which see for more details): (1) most obvious difference is tail coloration, juvenile males with basal two-thirds of rectrices yellow (much as adult male), and juvenile females with yellow confined to fringe along outer webs or rectrices and seldom reaching shaft of rectrices (cf. male in which yellow always reaches shafts on outer rectrices); (2) juvenile males tend to have strong yellow tinge to sides of neck (cf. very weak yellow tinge in juvenile females); and (3) outer web of feathers of alula extensively yellow in juvenile males (cf. yellow confined to fringe on outer webs in juvenile females).

GEOGRAPHICAL VARIATION In n. hemisphere considered either marked (BWP) or slight and clinal (Svensson 1992). Up to ten subspecies recognized (BWP), but Peters recognizes only four: nominate *chloris* from British Isles, w. and n. Europe E to nw. Ukraine and Urals; *aurantiiventris* from s. Europe including islands of Mediterranean (excluding Malta), n. Africa and Asia Minor; *chlorotica* from Middle East; and *turkestanica* from sw. Asia E to Kyrgyzstan and central Tadjikistan. Geographical variation mainly involves: size;

bill-structure, especially bill-depth and bill-width; tone and richness of green on upperparts, chin and throat; intensity of yellow on underparts, base of tail and fringes to wing-coverts. Geographical variation in colour of plumage difficult to assess, as it relates to age, sex and degree of wear (see BWP for details). Subspecies *harrisoni*, occurring naturally over most of British Isles, very similar to nominate *chloris* from central and n. Europe (and possibly n. Scotland), and possibly not different enough to warrant separation (BWP). Both have olive-green mantle and scapulars with distinct brown tinge, even when worn (cf. other subspecies from Europe and sw. Asia which lack brown tinge); subspecies *harrisoni* said to have less yellowish forehead and rump than nominate *chloris*, and more uniform olive-green underparts with darker grey-brown flanks (BWP). Meinertzhagen (1947) stated that *harrisoni* has slightly darker upperparts and darker underparts than nominate from Sweden, and considered it a valid subspecies; he suggested that populations in sw. Scotland are *harrisoni*, those from e. Scotland, England (except Cornwall) and Ireland are mixture of nominate and *harrisoni*, and those from Scandinavia are nominate, some of these wintering in Britain. Variation within Great Britain possibly clinal (Vaurie 1956), but this questioned by Niethammer & Wolters (1969).

Introduced populations in Aust. thought to be either subspecies *harrisoni* or nominate *chloris*, based on extensively olive-citrine upperparts and uniform rich-citrine underparts of adult male skins from Vic. and SA (n=16; DAB). DAB also stated that adult males from Aust. have rich-yellow forehead (cf. green in nominate and *harrisoni*; BWP); suggested that this due to genetic drift in Aust. populations. Subspecies *aurantiiventris* occurs naturally in s. Europe and n. Africa; said to have brighter green upperparts and brighter yellow underparts than nominate (Svensson 1992; BWP). Niethammer (1971) found adult male skins from NZ resemble *aurantiiventris* in colour of plumage, especially yellow of underparts. However, origins and taxonomic affinities of NZ populations are uncertain (NZCL). DAB stated that one adult male skin from Norfolk I. matches *aurantiiventris* in plumage. Adult males from NZ have slightly longer Bill S ($P < 0.05$) and Tarsus ($P < 0.05$) than adult males from Aust. (this study).

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Volume 7 (Part B), Plate 38

Common Chaffinch *Fringilla coelebs* (page 1305)

1 Adult male (fresh plumage); 2 Adult male (worn plumage); 3 Adult female; 4 Adult male

European Greenfinch *Carduelis chloris* (page 1315)

5 Adult male (fresh plumage); 6 Adult male (worn plumage); 7 Adult female; 8 Juvenile male; 9 Immature male; 10 Adult male; 11 Adult female

European Goldfinch *Carduelis carduelis* (page 1328)

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