

Order PASSERIFORMES

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

Overall, Passeriformes are characterized by (based on Raikow 1982; Sibley & Ahlquist 1990; and DAB [=Schodde & Mason 1999]): Palate aegithongnathous (except Conopophagidae [gnateaters]). Intestinal caeca rudimentary. Single left carotid artery (except paired in *Pseudocalyptomena* and possibly other broadbills [Eurylaimidae]). Aftershaft reduced or absent. Neck short, with 14 cervical vertebrae in most, but 15 in Eurylaimidae (broadbills); atlas perforated; metasternum usually two-notched (rarely four-notched). Bicep slip absent. Expansor secundariorum often present (Berger 1956; Raikow 1982; *contra* Beddard 1898; Ridgeway 1901). Pelvic muscles AX1 (AX in *Dicrurus* [drongos]). 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 Muscicapoidae (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 underside of the wings, use bill or bill and head together, extending one wing at a time sideways and forward, carpus uppermost, and often alternating rapidly from one wing to the other. The stretching of one wing as a comfort movement seems common to all birds, but in passerines it is often accompanied by sideways fanning of tail. After both wings are stretched, passerines often give a two-leg stretch as they straighten the tarsal joints and lift the body. Heat is dissipated by gaping and panting (not by gular-fluttering, so far as known) (Campbell & Lack 1985; BWP). Bathing widespread, mainly by standing in shallow water, but some groups jump into and out of water repeatedly, or flight- or plunge-bathe, while others bathe only or mainly in rain or among wet foliage; for further details of bathing, see Campbell & Lack (1985). Passerines do not flap wings in the manner of non-passerines to dry, but perform various shaking movements, as well as preening (Campbell & Lack 1985). Dusting confined to only a few groups, but sunning, both for gaining heat (sun-basking) and other purposes (sun-exposure), is widespread, and of two distinct types: (1) lateral posture, in which sunning bird squats or sits down, usually on ground, and leans to one side exposing the flank or the 'sun-wing', which has been lowered and partly unfolded, and the fanned tail, which has been brought round to the same side; and (2) spread-eagle posture, in which bird squats or lies flat with both wings open and tail fanned (details in Campbell & Lack 1985; Simmons 1986).

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

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

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

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

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

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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 tomia, 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 carduelis European Goldfinch

Fringilla carduelis Linnaeus, 1758, *Syst. Nat.* 10(1): 180 — Europa = Sweden.

Specific name directly from Latin *carduelis*, the Goldfinch, named with reference to a favourite food (*carduus*, a thistle).

OTHER ENGLISH NAMES Goldfinch or Eurasian or Eastern Goldfinch; Goldie, Thistle Finch; Diamondbird.

POLYTYPIC Subspecies *britannica* (Hartert, 1903), introduced and established throughout se. Aust., from round Brisbane, SW along Great Divide to Riverina, NSW, Murray–Mallee and SA gulfs and Kangaroo I., and S through Vic. to Tas., including islands in Bass Str.; also Norfolk I.; and NI, SI, Stewart, Chatham, Snares and Auckland Is, NZ (Niethammer 1971); indigenous to British Isles, w. Netherlands and nw. France, wintering in sw. Europe. Extraliminally, up to 13 subspecies from all Europe E through w. Russia and Asia Minor to Trans-Baikalia and w. Mongolia, w. Himalayas to s. Iran, Pakistan and Nepal.

FIELD IDENTIFICATION Length 12 cm; wingspan 21–26 cm; weight 14 (11–18) g. Introduced to HANZAB region. Small, distinctly marked finch with long, narrow, pointed wings, short, slender, deeply forked tail and slender, pointed bill. Much smaller than House Sparrow *Passer domesticus*; roughly similar size to Red-browed Finch *Neochmia temporalis*. Sexes differ slightly; adult females have slightly less red on face than males. Juveniles very different, having brown face instead of tricolour pattern; immatures separable from adults by retention of juvenile wing- and tail-feathers. Only subspecies *britannica* occurs in HANZAB region. Slight seasonal variation resulting from wear of plumage; birds in fresh plumage (late summer or autumn) have larger white spots on tips of remiges and rectrices than birds in worn plumage (spring to early summer). **Adult male** Front of face to just behind upper edge of eye, including forehead, forecrown, most of anterior malar area, chin and upper throat, deep, dark crimson, appearing almost blackish at some angles; together, form red facial patch which, with closer inspection, broken by black lores, eye-ring and narrow line of feathers bordering rear of lower mandible, on extreme anterior malar area. Sides of crown, ear-coverts, upper sides of neck and lower throat, white, sometimes with slight brownish tinge, forming broad whitish stripe through centre of face. Upper crown, nape, upper hindneck and central sides of neck, black, forming cap that extends across central sides of neck in crescent, forming third stripe through hind part of face. When fresh, lower hindneck, mantle, scapulars and back, rich rufous-brown to light brown; when worn, more greyish or grey-brown; lower hindneck also paler in worn plumage, light grey or whitish, forming indistinct short collar. Rump, grey-brown; uppertail-coverts mostly greyish white, forming pale band across coverts; longest coverts, black with broad white tips. Tail mostly black with broad white tips to all but outermost pair of feathers in fresh plumage; white tips become smaller in worn plumage; outermost three pairs of feathers have distinct white panels on basal inner webs, sometimes giving impression of white outer edge to tail. Upperwing black with broad bright-yellow stripe through centre, visible both when wings folded and when in flight. Folded wing mostly black, broken by broad yellow, sometimes orange-yellow, band through centre of primaries and bases of secondaries and tertials, encompassing all greater secondary coverts; innermost marginal coverts, brown, and often covered by scapulars; when fresh, tips of all remiges broadly white, forming series of broad white spots, largest on tertials; when worn, spots much reduced and sometimes worn off completely; rest of remiges, median secondary coverts and primary coverts, black. In flight, wings mostly black with broad yellow stripe through centre; inner leading edge of outerwing has small triangular brown patch; white spots on tips of remiges difficult to see. Lower sides of neck and upper breast, light brown, forming narrow and indistinct breast-band; second broader but incomplete band extends

from lower sides of breast in broken V, failing to meet on upper belly; flanks, rich brown or rufous brown, lower flanks sometimes with greyish tinge; rest of underparts, including mid-breast, belly, vent and undertail-coverts, white, often with slight brownish tinge. Undertail, white with broad black tip, narrow black sides and narrow black stripe through centre. Underwing mostly white with narrowly mottled black-and-white leading edge to outerwing; buff-white bases to remiges, broadest on secondaries, forming broad pale bar with broad dark brownish-grey trailing edge; all slightly broken by yellow outer webs of remiges which, though inconspicuous, show through as yellowish suffusion. Bill, pale pinkish-white to greyish white with dark-grey tip. Iris, black-brown; orbital ring, dark grey. Legs, reddish brown. **Adult female** Similar to adult male; separable with good views, when both sexes seen together. Red on face tends slightly duller and extends only to forehead, not behind eye, and confined to chin (in male reaches forecrown, behind eye and upper throat). **Juvenile** Much like adult, mainly differing by brownish head instead of bold tricolour pattern. Top and sides of head and neck, light grey-brown, diffusely streaked rich dark-brown; patch on lower hindneck sometimes paler, almost whitish. Mantle, scapulars and back, grey-brown, streaked dark brown; rump and uppertail-coverts, buff-brown, mottled darker brown; longest uppertail-coverts, dark brown with broad buff tips. Tail as adult, mostly black with white panels, but differs by neat, narrow buff fringes to all feathers, and central 2–3 pairs of feathers marked with broad buff subterminal bars; tips lost with wear, and subterminal bars become broad buff tips; feathers narrower and more pointed than in adult. Upperwing mostly as adult, but differs by: (1) tips to remiges, buff-white or rich buff, broader than in adult and forming large rosethorn-shaped tips on tertials; (2) yellow on remiges as adult, but greater secondary coverts, black with broad orange-buff tipping (not all yellow as in adult); and (3) innermost marginal secondary coverts, brown, streaked blackish brown (not plain brown as in adult). Chin and throat, dull white, with light-brown suffusion. Breast and flanks, dirty pale-grey with diffuse brown streaking; belly, vent and undertail-coverts, white with dirty-buff tinge. Undertail as adult, but with narrow buff tip. Underwing as adult, except mainly off-white coverts tinged buff, lack black-and-white mottling on leading edge to outerwing, and tips to remiges narrowly pale buff. Bill more greyish, with yellowish or pinkish tinge, and broader black tip; rest of bare parts as adult. **Immatures** Similar to adults of respective sexes; distinguished only by presence of some retained juvenile feathers on wing and tail; these differ from adult by having buff tips to remiges and rectrices, but with wear, tips become paler, but usually still buff on tips of tertials and tail-feathers. Tail-feathers also narrower and more pointed than in adult. On some birds, replaced tail-feathers and tertials may contrast sharply with retained

browner and buff-tipped feathers. Eventually, tips of feathers much reduced, with pale spots lost; these birds impossible to age in field.

Similar species Adults unmistakable, with distinctive red, white and black pattern on head and diagnostic bright-yellow wing-bar on otherwise black wings. Juveniles, though heavily streaked, also distinguished from superficially similar, heavily streaked juveniles of all other finches and buntings by bright-yellow wing-bars. Even at a distance, bouncy undulating flight and yellow wing-stripe diagnostic. Tinkling call may be briefly confused with that of Yellow-rumped Thornbill *Acanthiza chrysorrhoa*, but less bubbly or metallic, and less varied and musical.

Usually occur in flocks, often threes, occasionally in twos, and very occasionally singly. Seldom associate with other finches in breeding season, but at other times may form large flocks, sometimes with other finches or occasionally other small birds such as Yellow-rumped Thornbills and White-fronted Chats *Epthianura albifrons*; in such mixed-species flocks, usually remain in discrete groups. Forage on ground, in low vegetation, especially thistles, and occasionally in trees; very occasionally take insects. Sometimes readily approachable, but wary and easily frightened at other times; flocks often flush with little disturbance. When flushed, flight flitting and rapid, rising quickly, then descending onto nearby perch. At other times flight buoyant and undulating, with burst of wingbeats followed by glide, and then sharp descent with wings held next to body, before being repeated. Hop over ground; horizontal stance when feeding on ground; perch upright. In HANZAB region, both males and females give Song, and recorded giving Subsong and at least four calls (See Voice).

HABITAT Usually inhabit open or cleared areas, often infested with weeds, especially thistles, including in farmland, grassland, 'wasteland' in built-up areas, roadsides, tracks and clearings in forest (e.g. Cunningham & Wodzicki 1948; Graham 1948; Brown 1950; Blundell & McKenzie 1963; Chapman 1969; Brothers 1979; Baxter 1980, 1989; Loyn 1980, 1985; Lenz 1981; Wright & Wright 1990; Garnett *et al.* 1991; Rowe 1991; Holdsworth 1997; Beauchamp & Parrish 1999). Also often occur among exotic trees and shrubs in parks and gardens, plantations and orchards (see below). Occasionally also on beaches and associated coastal habitats, including heathlands and shrublands; grasslands and button grass plains; and woodlands and forests (see below). Occur from coasts to alpine zone, up to 1555 m asl in Aust. (Chapman 1969) and 1600 m asl in NZ (CSN 48).

Often inhabit open farmland, including rough or improved pasture and crops, occasionally with a few remnant trees (e.g. Moncrieff 1929; Brown 1950; Ridpath & Moreau 1966; Green 1969; Bedggood 1970; Moeed 1975; Pierce 1980; Ashton 1985; Loyn 1985; Wright & Wright 1990; Traill *et al.* 1996; Holdsworth 1997; Bourne 2002; CSN 2, 33); and orchards and vineyards (Leach 1928; Hindwood 1931; Bourke 1957; Frith 1957; McEvey 1965; Fielding 1979; Baker 1980). Often associated with pine *Pinus* trees, whether in plantations of various ages (Moncrieff 1929; McEvey 1965; Pawsey 1966; Stevens 1975; Loyn 1980; Friend 1982; Debus 1983; Traill 1985), in shelter belts (Hindwood 1931; J.M. Peter) or odd trees planted round buildings or towns (Stidolph 1948; Chapman 1969; Baxter 1989). In towns and other built-up areas, also occur in parks and gardens, especially in areas with exotic vegetation and grassy areas (e.g. Morgan 1914; Napier 1969; Anon. 1976; BFNC 1976; Harris 1980; Morris *et al.* 1981; Sharrocks 1981; Mason 1985; Guest & Guest 1987, 1993; Gill 1989; Lenz 1990; Day 1995; Moverley 1997; Gibb 2000; CSN 20; ACT Bird Rep. 1995–96). Also occur in other grassy habitats in settled areas, such as playing fields, golf courses, airfields and cemeteries (Moeed 1975; Fleming 1976;

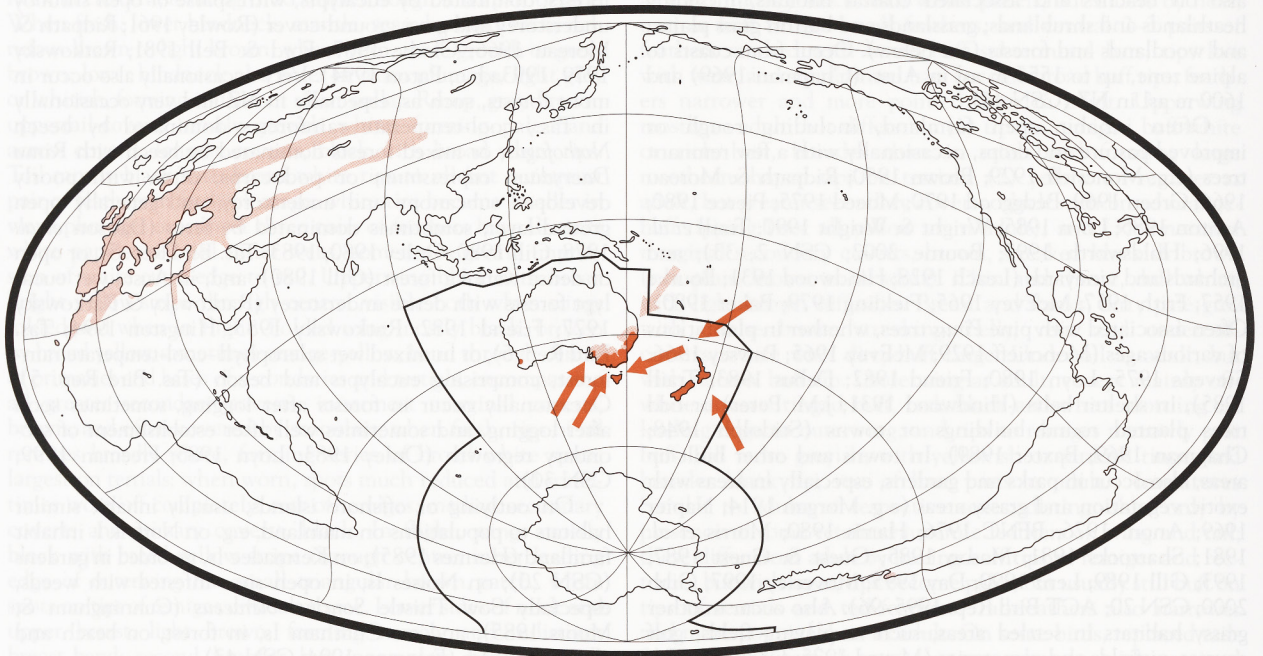
Ratkowsky 1993a,b,c; Baverstock & McCarthy 2000). Often occur in tussock grassland, dominated by *Poa*, wallaby grass *Danthonia* or spear grass *Stipa*, with a few sparsely scattered trees (Ridpath & Moreau 1966; Clarke 1967; McEvey & Middleton 1968; Rowe 1973; Cooper 1974; Child 1975; Gregory-Smith 1987; Bryant 1999; Hewish *et al.* 1999; Ashton 2001); and sometimes in grassland infested with thistles (see above). In upper reaches of Molonglo R., NSW, absent from tussock grassland, but occurred in adjacent areas of improved pasture (Bourne 2002). In Tas., occasionally recorded on button-grass plains (Tas. Bird Rep. 6), and, in alpine areas, in moorlands above treeline (Ratkowsky 1983; Tas. Bird Rep. 5). Occasionally recorded on beaches, e.g. among low pioneering plants, such as Sea Rocket *Cakile maritima* (Loyn *et al.* 1986; Holdsworth 1997), among grasses or in low saltmarsh vegetation at margins of coastal lagoons and other near-coastal wetlands (Sagar 1976; Owen & Sell 1985; Loyn *et al.* 1986; Hewish 1998, 2002; Hewish *et al.* 1999; CSN 37), on sand dunes (Bedggood 1980) or on bare sand of beach (CSN 19 Suppl., 20). Very occasionally recorded in mangroves (Hindwood 1935; CSN 31); or in shrubby heathland, especially after fires have opened structure of vegetation and stimulated release of seeds (Ridpath & Moreau 1966; Cooper 1974; Hewish 1998; Bryant 1999); and round edges of dense shrublands (Bedggood 1970; Ashton 1985, 2001; Bryant 1999; Vic. Atlas; Tas. Bird Rep. 5), such as, in coastal areas, that comprising casuarinas, Coastal Wattle, Silver Banksia and eucalypts (Duckworth 2002), in near-coastal areas, comprising mixed Manuka *Leptospermum scoparium* and Kanuka *Kunzea ericoides* shrublands (McKinlay 2000), or in upland areas, comprising Manuka (Challies 1962). Occasionally recorded in open eucalypt woodlands with open understorey, sometimes opened up by fire, or at their edges (McEvey 1965; McEvey & Middleton 1968; Gregory-Smith 1987; Paton 1994; Hingston & Black 1998; Baverstock & McCarthy 2000); such habitats include mallee woodlands (Schodde & Glover 1955; Possingham & Possingham 1997), and in snow among Tasmanian Snow Gums *Eucalyptus coccifera* (Tas. Bird Rep. 7, 9). Occasionally recorded in forests, usually round edges, along roads or in clearings (Wilkinson 1924; Weeks 1949; Mollison 1974; Loyn 1980; Clout & Gaze 1984a; Traill *et al.* 1996; Tas. Bird Rep. 5; CSN 30, 31); mostly in open dry sclerophyll forests, dominated by eucalypts, with sparse or open shrubby understorey and grass ground-cover (Rowley 1961; Ridpath & Moreau 1966; Clarke 1967; Ford & Bell 1981; Ratkowsky 1979, 1993a,b,c; Paton 1994). Very occasionally also occur in moist forests, such as, especially in NZ and very occasionally in Tas., cool-temperate rainforests dominated by beech *Nothofagus*, or mixed forests dominated by beech with Rimu *Dacrydium cupressinum* or podocarps, often with poorly developed subcanopy and understorey, and generally open ground-layer, sometimes dominated by ferns (Dawson *et al.* 1978; Gill 1980; Onley 1980, 1983; Tas. Bird Rep. 5), or open or dense Kanuka forest (Gill 1980); and, in Aust., wet eucalypt forests with dense understorey (Ratkowsky & Ratkowsky 1977; Friend 1982; Ratkowsky 1983; Hingston 1994; Tas. Bird Rep. 6), or in mixed wet sclerophyll-cool-temperate rainforest, comprising eucalypts and beech (Tas. Bird Rep. 5). Occasionally occur in forests after logging, sometimes soon after logging, and sometimes well after establishment of secondary regrowth (Onley 1983; Loyn 1985; Freeman 1999; CSN 30).

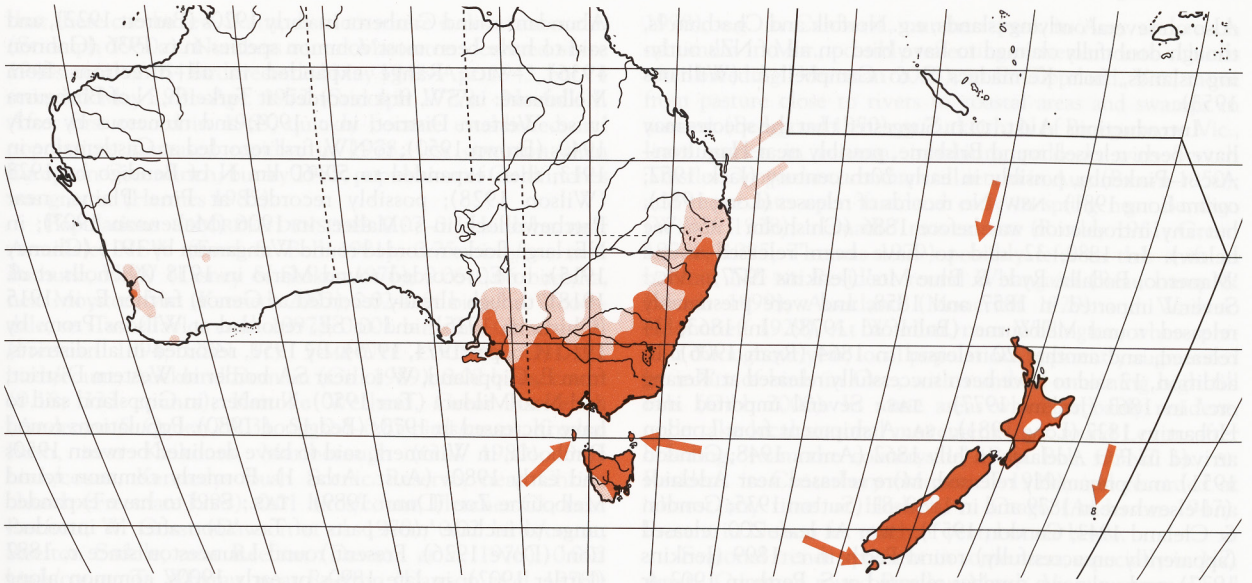
On outlying or offshore islands, usually inhabit similar habitats to populations on mainland, e.g. on Norfolk I. inhabit farmland (Hermes 1985); on Kermadec Is, recorded in gardens (CSN 20); on Noises Is, in open sites infested with weeds, especially Sow Thistle *Sonchus oleraceus* (Cunningham & Moors 1985); and on Chatham Is, in forest, on beach and along roadsides (Freeman 1994; CSN 43).

DISTRIBUTION AND POPULATION Widespread throughout most of Europe S of c. 60°N, extending E into w. Asia, and S to n. Africa; occur from British Isles and Iberian Pen. (though also occur farther W on Azores, Madeira and Canary Is in Atlantic Ocean), E to headwaters of Ob and Yenisey Rs in w. Siberia, Kazakhstan, Tien Shan Mts in Sinkiang Province of nw. China, and in n. India and w. Nepal, and from c. 60°N (i.e. excluding most of Scandinavia and n. Russia), S to Mediterranean coast of n. Africa (between Morocco and Egypt), Jordan, nw. Saudi Arabia, n. Iraq and w. Iran (Silby 1980; de Schauensee 1984; Flint *et al.* 1984; Inskipp & Inskipp 1985; Grimmett *et al.* 1999; BWP). Successfully introduced to HANZAB region (see Introductions, below), and introduced, with varied success, to Canada, USA, Bermuda, Argentina, Cape Verde Is and possibly S. Africa (Long 1981).

Aust. Introduced; widespread in SE; also small populations in Perth and Darwin. **Qld** Thought not to have been introduced, but range expanded N from NSW (Long 1981). Confined to SE, mainly round Brisbane; also occur round a few other regional centres. In Brisbane, occur in small numbers, mainly in ne., e. and se. suburbs, from Brighton SE to Wellington Pt; and also recorded S and W of Brisbane, at Moorooka, Taringa, Jindalee, Upper Brookfield and Ipswich (Anon. 1972; Roberts 1979; Woodall 1987; Storr 19; Qld Bird Reps 1986, 1989, 1991); also occasionally recorded farther afield, e.g. farther NE, on Moreton I. (Vernon & Martin 1975a), farther E, on N. Stradbroke I. (Vernon & Martin 1975b), and farther S, at Logan Reserve (Dawson *et al.* 1991). Elsewhere in SE, often recorded round Stanthorpe, and very occasionally on Fraser I., Gold Coast, and, on Great Divide, round Warwick (Vernon & Barry 1972; Aust. Atlas 1, 2; Storr 19). **NSW** Widespread on and E of Great Divide, from Richmond R. District in NE, S to Nadgee NR in SE, though patchily spread at each end of range (Morris *et al.* 1981; Gosper 1986; Hoskin 1991; Gosper & Baker 1997; Chafer *et al.* 1999; Gosper & Holmes 2002; Aust. Atlas 1, 2; NSW Bird Reps). Scattered W of Great Divide, though not N of 31°S; occur W to line joining e. Mastermans Ra., Gunnedah, Warrumbungle NP, Dubbo, L. Cowal, Griffith and Tooleybuc; outside this area, also occasionally occur farther downstream

along Murray R., between Gol Gol and Wentworth or even farther W, and very occasionally elsewhere in Lower Western Region, e.g. Balranald, near Menindee, Ivanhoe and Coombie Stn, N of Roto (Hobbs 1961; Morris *et al.* 1981; Cooper & McAllan 1995; Aust. Atlas 1, 2; NSW Bird Rep. 1984). **Vic.** Widespread, though sparsely scattered, in some mountainous areas of Gippsland and North East Region, and in Mallee (Vic. Atlas). **Tas.** Widespread in most areas except SW; mostly occur N and E of line joining Cockle Ck, Ellendale, Derwent Bridge, Wayatinah, Cradle Mt, Rapid R., and Marawah; farther W, also recorded at several sites in area from Ahrberg Bay and Tullah S to Strahan and Franklin R. Very occasionally recorded in SW, e.g. Maatsuyker I., Stephens Bay (South West C.), Melaleuca Inlet–Moth Ck, Whalers Cove–Davey Head and Trumpeter I. (Green & Mollison 1961; Brothers 1979; Thomas 1979; White 1985; Schulz & Kristensen 1994; Aust. Atlas 1, 2; Tas. Bird Reps). Also occur on islands in Bass Str., including Hunter Grp, King I., and Kent, Hogan and Furneaux Grps (Green 1969; Green & McGarvie 1971; Whinray 1971; Pinner & Bird 1974; Morton & Braithwaite 1976; Garnett *et al.* 1991; Bryant & Holdsworth 1992; Peter & Starks 1993; Holdsworth 1997; Bryant 1999; Aust. Atlas 1, 2). **SA** Widespread S of 33°S, E of Spencer Gulf; though generally widespread within this area, recorded at only scattered sites round n. Coorong, and, in Murray–Mallee Region, largely confined to areas near Murray R., though also occasionally recorded in small numbers elsewhere within the region, and largely absent from n. Adelaide Plain, N of Le Fevre Pen. Outside this area, recorded farther N at Melrose, Baroota Reservoir and Yandiah Railway Siding in s. Flinders Ras (with historical record farther N at Hawker; Jeffery 1958), and at Plumbago Stn, Olary Ridge and Mutooroo in Lower N.; and farther W, on s. Eyre Pen., in area bounded by Tod Reservoir, Port Lincoln and Mt Dutton (Mack 1970; Eckert 1972; SAOA 1977; Carpenter & Matthew 1986; P. Taylor 1987; Winslet & Winslet 1987; Stove 1994; Aust. Atlas 1, 2; S. Aust. Bird Reps). **WA** Small population round metropolitan Perth, with records from L. Coogee and Bibra L. N to Tuart Hill and Herdsman L., and E to Gosnells and Herne Hill; also very occasionally recorded farther N at Wanneroo and in Yanchep NP (Long 1981, 1988;





Anon. 1996a, 1997, 1998b, 1999, 2003; Crossley & Crossley 1996; Storr 28; Aust. Atlas 1, 2). Elsewhere, small population recorded round Albany (Long 1988; Serventy & Whittell; Storr 35), which remained extant till at least early 1980s (Aitken 1981; Freeman 1981; Aust. Atlas 1; *contra* Long 1981), though not recorded in Aust. Atlas 2. Odd records round Kalgoorlie and Collie presumably refer to escapes, not populations (Long 1988). NT Small populations recorded in various suburbs of Darwin, mainly n. suburbs such as Nightcliff and Casuarina, but also S to Mindil Beach, and E to Holmes Jungle and Berrimah (Goodfellow 2001; Aust. Atlas 1). Single record, presumably of escape, at Alice Springs, 2 Jan. 1978 (Aust. Atlas 1).

NZ Introduced; widespread, though absent or sparsely scattered in some mountainous or forested areas (NZCL). NI: Widespread; occur in all districts, though either sparsely scattered or absent from some parts of area from e. Bay of Plenty and adjacent areas of East Coast to n. Hawkes Bay (generally areas W of e. slopes of Raukumara, Huiarau and n. Ruahine Ras), and thence W through much of Volcanic Plain and Wanganui, though more widespread in these areas than European Greenfinch *Carduelis chloris* (NZ Atlas; CSN). Also occur on numerous offshore islands, such as Three Kings, Moturoa, Great Barrier and Noises Is (Adams 1971; Ramsay & Watt 1971; Bell 1976; Cunningham & Moors 1985; NZ Atlas). SI: Generally widespread, though sparsely scattered in parts of Marlborough, mainly in area between Richmond and Inland Kaikoura Ras, and either absent or sparsely scattered in Puketeraki and Craigieburn Ras and parts of Arthurs Pass NP in Canterbury, Hawkdun, Lammermoor and Lammerlaw Ras in Otago, and much of Southland, W of line joining Invercargill and Lumsden, except in coastal areas from near Colac W and N to Resolution I., and from Kaherekoau Mts N to Awarua Pt; also either absent or sparsely scattered in inland parts of W. Coast, on S. Alps away from narrow coastal plain, and in adjacent areas of w. Otago and w. Canterbury (Hall-Jones 1966; Robertson 1982; NZ Atlas; CSN). Also occur on Stewart I. and associated islets (e.g. Blackburn 1965; Cooper 1991; NZ Atlas).

Norfolk I. Widespread on main island (Schodde *et al.* 1983), and large flocks recorded on Phillip I. (Hermes *et al.* 1986). First recorded in Aug. 1963 (Wakelin 1968).

Lord Howe I. Vagrant. Three, 9 May 1970 (Fraser 2004); 4–5, June–July 1982 (Fraser 2004); five, 16 June, 26 July 1983 (Fraser 2004); ten, 27 July 1983 (Fraser 2004); two, 28 May

1985 (McAllan *et al.* 2004); single, 26 Feb.–1 Mar. 1986 (NSW Bird Rep. 1986); three, 9 June 1988 (McAllan *et al.* 2004); single, 27 July 1988 (McAllan *et al.* 2004); single, 11 Mar. 1989 (McAllan *et al.* 2004); 20+, 10–14 Sept. 1996 (NSW Bird Rep. 1996); single, 25 Dec. 1999–1 Jan. 2000 (NSW Bird Rep. 2000); unknown number, Sept. 2001 (Aust. Atlas 2); two, 19 May 2003 (McAllan *et al.* 2004); five, 9 and 20 Sept. 2003 (McAllan *et al.* 2004).

Macquarie I. Vagrant (Anon. 1987). Single specimens collected on 17 Apr. 1956 (Keith & Hinds 1958) and 5 May 1967 (Merilees 1971).

Kermadec Is Vagrant. Raoul I.: First recorded in 1885 (Merton & Veitch 1986); recorded subsequently on 17 May 1907, when single bird shot (Sorensen 1964); three in 1940 (Sorensen 1964); a few small flocks in winter 1972 (Veitch *et al.* 2004); one or two, May–June 1973 (Merton & Veitch 1986; Veitch *et al.* 2004; CSN 20); single specimen collected 18 May 1983 (Veitch *et al.* 2004); single, 7–9 June 1994, and two on 17 June 1994 (Veitch *et al.* 2004). Single recorded on Macculey I., Aug. 1966 (Merton 1970); and two on Curtis I., 15 Sept. 1988 (Veitch *et al.* 2004).

Chatham Is Small numbers on Chatham and Pitt Is (Freeman 1994; CSN 36, 43, 45), though locally common on parts of Chatham I. (CSN 42). Said to have been first recorded in 1894, when some flew out to sea to escape bushfires on NI, and landed *en masse* on SS *Ohau*; many flew ashore when vessel arrived at Chatham I. (Lindsay *et al.* 1959).

Snares Is Recorded sporadically in small numbers (Warham 1967; Warham & Keeley 1969; Horning & Horning 1974; Sagar 1977; Miskelly *et al.* 2001). First recorded in 1900 (Ogilvie-Grant 1905).

Antipodes Is Vagrant. Two, Bollons I., 1900 (Ogilvie-Grant 1905); 20–25, main island, 25 Apr. to early June 2001 (Imber 2004). Also, single recorded at 46°31'S, 174°58'E, at sea between Akaroa and Antipodes Is, 20 Apr. 2000; and 12 at 48°S, 179°E, at sea between Bounty and Antipodes Is (Imber 2004).

Auckland Is First recorded in 1907 (Waite 1909). Small numbers (Yaldwin 1975; Penniket *et al.* 1986). Recorded on boat near Auckland Is in Apr. 1991 (CSN 39).

Campbell I. Probably occasional visitor (Bailey & Sorensen 1962); though breeding recorded (Williams 1953), probably not established (Heather & Robertson 2000). First recorded (specimen collected) in 1900 (Ogilvie-Grant 1905).

Breeding Throughout most of range in Aust. and NZ.

Also on several outlying islands, e.g. Norfolk and Chatham Is, though doubtfully claimed to have bred on all of NZ's outlying islands, from Kermadecs S to Campbell I. (Williams 1953).

Introductions Aust. QLD: Suggested that the species may have been released round Brisbane, possibly near Hamilton–Ascot–Pinkenba, possibly in early 20th century (Jack 1952; *contra* Long 1981). NSW: No records of releases (Long 1981), but any introduction was before 1886 (Chisholm 1926; see below). In 1880, 32 said to have been released round 'Maneroo, Bodalla, Ryde & Blue Mts' (Jenkins 1977). VIC.: Several imported in 1857 and 1858, and were presumably released round Melbourne (Balmford 1978). In 1863, 34 released, and another 20 released in 1864 (Ryan 1906). In addition, 12 said to have been successfully released at 'Kerang etc.' in 1863 (Jenkins 1977). TAS.: Several imported into Hobart in 1827 (Long 1981). SA: A shipment from London arrived in Port Adelaide in July 1862 (Anon. 1948; Condon 1951) and presumably released; more released near Adelaide and elsewhere in 1879 and in 1880–81 (Sutton 1935; Condon & Cleland 1942; Condon 1951). WA: At least 200 released (apparently unsuccessfully) round Perth in c. 1899 (Jenkins 1977), and unknown number released at S. Perth in 1902 or 1903 (Long 1988). Speculated that small population that had become established by 1930s resulted from subsequent escapes, not deliberate introduction (Jenkins 1935, 1959, 1977). Small population became established round Albany in 1950s and 1960s (Jenkins 1959; Long 1981, 1988). Records at Kalgoorlie and Collie before 1970s thought to have originated as escapes from local aviaries, not deliberate introductions, and have not become established (Long 1988). NZ: Records of introductions by acclimatization societies summarized from Thomson (1922). NI: In Auckland, 11 released in 1867 and 44 in 1871. Single released in Wellington in 1877, 52 in 1880, 22 in 1881 and 103 in 1883. SI: Ten released in Nelson in 1862. In 1871, 95 released in Canterbury, and a further release, of unknown number, in 1875. Three released in Otago in 1867, 30 in 1868, 54 in 1869 and 31 in 1871.

Change in range, populations Aust. Range has expanded to include much of SE, but unclear whether this expansion was entirely unassisted, or whether undocumented releases occurred round various regional centres. QLD: Recorded on Stradbroke I. in 1919 (Chisholm 1925). By mid-1920s, said to have been established round Stanthorpe 'for several years', and possibly present in Warwick by then (Chisholm 1925); established round suburban Brisbane well before 1930, but unclear whether released there or range expanded N from NSW (Jack 1952; Jenkins 1977; Long 1981). NSW: Established round Sydney by 1886 (Chisholm 1926). Range expanded NW from Sydney to become established round Sofala and Hill End by 1925, and reached Gilgandra by 1939 (Bourke 1957). Farther N, occasionally seen at Boree, S of Armidale, by early 1920s (Norton 1922), and established at Tamworth, Armidale and Glen Innes by 1925 (Alexander 1925; Lawrance 1925; Wright 1925) and recorded along Macleay R. at about same time (de Warren 1928). First recorded round Leeton in 1920 (McKeown 1923) and widespread in Riverina by mid-1920s (Chisholm 1924). Population round Tumbarumba said to have increased 'enormously' in early 1920s (Chisholm 1924); and round Comboyne, inland from Camden Haven, population increased in 1930s (Chisholm 1934). More recently, populations in several areas appear to have declined: in Sydney Region, seldom recorded in recent years (NSW Bird Rep. 1995); in Blue Mts, formerly abundant round Katoomba, but now unusual (NSW Bird Rep. 1999); in Illawarra Region (NSW Bird Rep. 2000); in Eurobodalla Shire, between mid-1970s and 1990 (Whiter 1987, 1989, 1991), but by mid-1990s apparently stabilized (Whiter 1996); and round Barham, on Murray R. in sw. Riverina, since 1980s (Disher 2000). ACT:

Abundant round Canberra in early 1920s (Barrett 1922), and said to have been most common species in c. 1936 (Gannon 1936). VIC.: Range expanded in all directions from Melbourne: in SW, first recorded at Turkeith, N of Birregurra in se. Western District, in c. 1904, and numerous by early 1940s (Brown 1950); to NW, first recorded at Castlemaine in 1913, then expanded to 50–60 km N of Bendigo by 1928 (Wilson 1928); possibly recorded at Pine Plains, near Patchewollock in s. Mallee, in 1906 (McLennan 1907); in NE, large flocks recorded round Wangaratta by 1915 (Cheney 1915); to E, recorded round Marlo in 1918 (Nicholls *et al.* 1918), though already recorded at Genoa, farther E, in 1915 (Chisholm 1915); and to SE, recorded at Wilsons Prom. by 1910 (Cooper 1974, 1975). By 1950, recorded in all districts, from E. Gippsland, W to near SA border in Western District, and N to Mildura (Tarr 1950). Numbers in Gippsland said to have increased in 1970s (Bedgood 1980). Populations round Dimboola, in Wimmera, said to have declined between 1950s and early 1980s (Aust. Atlas 1). Formerly common round Melbourne Zoo (Dunn 1989). TAS.: Said to have expanded range to include 'most parts' of Tas. 'soon after its introduction' (Dove 1926). Present round Launceston since c. 1882 (Littler 1902); in late 1890s or early 1900s, common along Derwent R. from Hobart upstream to Ouse, thence upstream along Ouse R.; this coincided with numbers increasing round Launceston, Underwood and Hadspen; and range expanded to include LaTrobe and Devonport at about same time (Littler 1902); large flocks recorded in n. Tas. in 1908–09 (Fletcher 1909; Chisholm 1926). Population round Devonport said to have increased greatly in early 1930s (Dove 1933). SA: Established in N. Adelaide by 1914 (Morgan 1914). Unclear whether birds in SE resulted from expansion of range SE from Adelaide or W from Vic. (Condon 1962); present round Mt Gambier in 'hordes' in 1919 (Morgan 1919). First recorded round Renmark in 1917 (Morgan 1917). Colonized Kangaroo I. by 1907 (Cooper 1947; Abbott 1974) and abundant by 1930s, but population declined thereafter till c. 1960, when seldom recorded, though numbers gradually increased between then and 1980s (Lashmar 1988). Numbers in Sandy Ck CP declined after late 1960s (Rix 1976). Recorded W to Port Lincoln and possibly elsewhere on Eyre Pen. in 1923 (Sutton 1924; Cleland 1925). WA: Population in Perth, probably derived from aviary escapes, first noted in 1933 (Jenkins 1959); in late 1930s and early 1940s, established in city and suburbs, with range expanding (Anon. 1943; Jenkins 1939, 1941, 1942). By 1948, though not generally plentiful round suburban Perth, range had expanded to include several suburbs, mainly from Cottesloe E to Bayswater, Maylands and Belmont, with records farther afield at Caversham and Kenwick (D.L. Serventy 1948; V.N. Serventy 1948). By 1967, occurred in areas W of Darling Scarp from Wanneroo and Upper Swan S to sites near Armadale, Forrestdale and Bibra L., with vagrant farther S at Rockingham (Long 1988), but population declined after 1963 (Stranger 1997; Serventy & Whittell) and considered extinct or nearly so by mid-1970s (Jenkins 1977; Serventy & Whittell; Storr 28), though small population persists, often dismissed as aviary escapes (e.g. Anon. 1996a,b, 1997, 1998a; Standring 1997). In addition to population round Perth, a small population, comprising c. 20 birds, discovered in Albany in 1955 (Jenkins 1959); The Authorities attempted to extirpate this population (Jenkins 1959), but still present in Jan. 1957 (Sedgwick 1957); survived till at least 1980 (Aust. Atlas 1), but apparently became extinct. NZ Little published on expansion of range or increase in populations. Quickly became established round all centres where released, and range expanded rapidly from there; widespread and abundant throughout by 1920s, by which time had also successfully colonized Auckland Is and Chatham Is (Thomson 1922); by 1950, stated that 'it is so widely spread

that there can be few, if any, districts where it does not occur' (Stidolph 1950a). Numbers round Masterton declined since 1940s: total of 184 birds recorded May 1942–Apr. 1943, but 74 recorded May 1971–Apr. 1972 (Stidolph 1977). **Norfolk I.** After first record in 1963, quickly became established and population increased rapidly; in 1978, less common than European Greenfinch, but by 1985, population of Goldfinches was greater (Hermes 1985).

Populations RECORDED DENSITIES: 0.07–0.31 birds/ha, near Armidale, NSW (Ford & Bell 1981); 0.75 birds/ha, near Bathurst, NSW (Disney & Stokes 1976); 0.06–0.66 birds/ha, near Moyston, Vic. (Kennedy 2003); 0.02–0.06 birds/ha, Woodsdale, se. Tas. (Taylor *et al.* 1997); 0.001 birds/ha, Chatham I. (Freeman 1994; CSN 37). **5-MINUTE COUNTS:** **NI** 0.1 birds/count, Auckland Domain (Gill 1989); 0.02 birds/count (0.18; 333 counts), Kaitoke Wetland, Great Barrier I. (Anderson & Ogden 2003). **SI** 0.3–0.85 birds/count, Kowhai Bush, near Kaikoura, Marlborough (Gill 1980); 0.05 birds/count, Kennedys Bush Scenic Reserve, near Christchurch (Freeman 1999); 0.01 birds/count, Fletcher Ck, near Reefton, W. Coast (Dawson *et al.* 1978); 0.02 birds/count, Reefton Saddle, near Reefton (Dawson *et al.* 1978); 0.002 birds/count, Te Wharau, near Reefton (Dawson *et al.* 1978); 0.004 birds/count, Rahu Saddle, near Reefton (Dawson *et al.* 1978); 0.4 birds/count (Clout & Gaze 1984b); 0–0.31 birds/count, near Karamea (Onley 1983).

THREATS AND HUMAN INTERACTIONS Populations may have declined in se. Aust. due to changed farming practices, especially use of herbicides, and other methods of weed control, such as slashing or grading along roadsides and railway lines, which affect availability of favoured food plants (Aust. Atlas 1; Vic. Atlas). Occasionally killed by vehicles on roads (Vestjens 1973; Lepschi 1992). Very occasionally killed by Cats (Dowling *et al.* 1994). Once recorded colliding with lighthouse (Mellor 1906). Claimed to be beneficial for agriculture, eating seeds of weeds, especially those of thistles (e.g. Le Souëf 1913; Chisholm 1924, 1926, 1933; Bridgewater 1932; Oliver), but also considered pest of fruits and vegetables (see Food: Pest status); one man shot 50 birds in a season, as they fed on his seeding flowers (Jenkins 1939).

MOVEMENTS Probably resident or sedentary, undertaking local movements during non-breeding season, mainly comprising shifts in habitat (see below). No evidence for large-scale seasonal movements in Aust. (Aust. Atlas 1; Vic Atlas; ACT Atlas) or NZ (Heather & Robertson 2000), though some movements occur, possibly altitudinally, and birds sometimes recorded on passage. Readily cross water: suggested that some regularly cross at least part of Bass Str., and possibly Cook Str. (see below); and birds originating from NZ mainland have reached various outlying islands unaided (see Distribution and Population). Movements reflect availability of food (Moncrieff 1929; Clout & Gaze 1984a). Extraliminally, some populations sedentary, others partly migratory (BWP).

Considered resident, or seen throughout year (presumably sedentary of HANZAB), at many sites. **Aust.** Resident or seen throughout year in parts of Hunter Region of NSW (Stuart 2001; NSW Bird Reps 1987, 1999); Illawarra Region (Gibson 1977; Chafer *et al.* 1999); in ACT and adjacent parts of se. NSW and ne. Vic. (Basten 1975; Anon. 1976; Thomas & Gilmore 1976; Taylor 1984; Er & Tidemann 1996; Whiter 1996; NSW Bird Reps 1993, 1994); n. Vic. (Bedggood 1972, 1973); central and s. Vic. (Thomas & Wheeler 1983; Dedman *et al.* 1998; Baverstock & McCarthy 2000), including round Melbourne (Watson 1955; Fleming 1976; Humpheys 1986); Tas. (Fielding 1979); and in SA (Symon 1946; Ashton 1985; Baxter 1989). In some areas where considered resident, undertake local seasonal movements into different habitats (Hewish

1998), e.g. in Canberra, numbers peak in Aug. and reach minimum in Mar., possibly reflecting movement into suburbs after breeding (Veerman 2003); in E. Gippsland, Vic., move from pasture close to rivers to coastal areas and swamps in autumn (Bedggood 1970); at Turkeith, N of Birregurra, w. Vic., leave garden in autumn, inhabiting paddocks with Scotch Thistles *Onopordum acanthum* till return in Aug. (Brown 1950); and move into open farmland early in spring near Bendigo (Wilson 1928); 'nomadic' movements (Rowley 1961; Green 1977b, 1995; Thomas 1979) possibly refer to this shift in habitat. **NZ NI:** Resident round Whangarei (Beauchamp & Parrish 1999), Auckland (Moncrieff 1929) and Waikato (Moncrieff 1929). At W. Hutt, near Wellington, where present throughout year, local populations apparently augmented by influx of birds in Oct., with numbers remaining high till Feb. (Gibb 2000). In some areas where probably resident, undertake local seasonal movements, e.g. round Levin, after breeding, 'roam the countryside' (Rep. Bull. OSNZ 3). **SI:** Resident in Canterbury (Moncrieff 1929); and recorded at 'almost any time' at Herbert, n. Otago (Anderson 1947). Present in Nelson for much of year, but see below.

Seasonal trends apparent in some areas, especially in NZ. **Aust.** Common round Bacchus Marsh, Vic., in summer and autumn (Hewish 2002); and claimed that birds arrived at various sites in suburban Melbourne, Sept.–Oct., remaining till Feb.–Apr. (Thomas 1969); and in Tas., said to have left Kindred and Cleveland, Feb.–Mar., after breeding (Fletcher 1909; Thomas 1969). **NZ NI:** Formerly autumn–spring visitor round Whangarei (Beauchamp & Parrish 1999); and arrive at Minginui in autumn and leave late winter (CSN 6, 8, 9). Spring–summer visitor to The Noises, in Hauraki Gulf (Cunningham & Moors 1985). **SI:** Present in Nelson for much of year: breeding birds present mid-Sept. to early Mar., then possibly fly N to cross Cook Str. (see below); claimed that these subsequently replaced by birds from farther S, which move about in open country till spring, then leave in spring and are replaced when breeding birds return (Moncrieff 1929); this possibly simply describes local movements into different habitats (see above). Described as summer visitor to Dunedin (Kikkawa 1966).

In some areas, altitudinal movements recorded, e.g. in n. Vic., move from Strathbogie Ra. onto plains in winter (Bedggood 1972); on NI, suggested that birds move from Volcanic Plateau towards coast in winter (CSN 6); numbers increase at Te Aroha, on Hauraki Plains, in winter (Moncrieff 1929), possibly reflecting altitudinal movements; and in Paparoa Ra., SI, arrive in lowland forest in foothills in autumn, and leave after winter (Onley 1980). Conversely, on Mt Wellington, Tas., occur >800 m asl late autumn to winter, then move to open country at lower elevations in mid-Sept. (Ratkowsky & Ratkowsky 1977, 1978).

Movements over water BASS STR.: In e. Bass Str., numbers usually increase in winter at Wilsons Prom. and on Kent Grp (Garnett *et al.* 1991). Farther W, of 98 Aust. Atlas 2 records from King I., 1998–2003, 40 were Apr.–May, and 40 were Oct.–Dec., possibly reflecting movement; and on Albatross I., N–S movements recorded in Mar. and Sept. (Brothers & Davis 1985). **COOK STR.:** Suggested that birds fly N across Nelson Bay in Mar., possibly crossing Cook Str. (Moncrieff 1929); occur seasonally on The Brothers, July–Oct., leaving after food supply exhausted (Sutherland 1952). Once, a Goldfinch struck lighthouse at C. Palliser, Jan. (Mellor 1906); and small flock, probably of this species, seen flying S from near C. Campbell, c. 6 km offshore, possibly having just crossed Cook Str., in Apr. (Abernethy 1956).

Nature of passage In NZ, occasionally recorded, apparently on passage, e.g. large numbers seen on n. passage at Millerton and C. Foulwind, on w. coast, early in morning, Apr.–June (CSN 35); and similarly, birds on n. passage recorded

passing at rate of 106 birds/h at Christchurch, early Apr. (CSN 37). In Kaimanawa Mts, NI, c. 1500 m asl, large flocks seen flying S in Feb. and early Mar. (CSN 9, 19).

Banding Of 6664 banded in Aust., 1953–June 2003, 76 recoveries (1.1%) of 66 birds. All but one of these recoveries <10 km from banding place (ABBBS). Longest recorded movement was adult banded at Berri, SA, 10 Mar. 1966, retrapped at Bordertown, SA, 233 km S, over 5 months later (Purchase 1969). Of 355 banded in NZ, 1950–96, seven recoveries 1988–93; no information on recoveries at other times (Cossee 1989, 1992, 1993, 1995, 1997, 1998a,b; Cossee & Wakelin 1991). **LONGEVITY:** Adult banded at Manning Reserve, SA, 17 January 1987, recaptured at banding place over 4 years 9 months after banding (ABBBS). Said that oldest Goldfinch recorded in NZ was nearly 8 years old (Heather & Robertson 2000).

FOOD Seeds, mostly of introduced composites; occasionally invertebrates; rarely, nectar. **Behaviour** Feed mainly on seeds of thistles and other weeds (Chisholm 1924, 1926, 1933; Middleton 1970a; Baxter 1989). Forage on ground and at all levels in vegetation (East 1967; Green 1984). **DETAILED STUDIES:** At Clayton, Vic., Jan. 1963–Feb. 1965 (Middleton 1970a); Christchurch Botanic Gardens, winter 1967 (East 1967); Christchurch International Airport, Mar. 1968–Feb. 1969 (Moeed 1975); Windbag Valley, SI, Oct. 1983–Dec. 1985 (O'Donnell & Dilks 1994). **FORAGING ASSOCIATIONS:** Occasionally forage singly or in twos (Dove 1919; Horning & Horning 1974; Brothers 1979; Fielding 1979; Cunningham & Moors 1985; Baxter 1989; Tas. Bird Rep. 5; CSN 1, 24, 37, 38), but usually in small flocks of up to c. 14 (Chisholm 1934; Crockett 1954b; Rowley 1961; Skegg 1963; Middleton 1970a; Brothers 1979; Grant 1983; Cunningham & Moors 1985; Owen & Sell 1985; Baxter 1989; Tas. Bird Rep. 16; CSN) or larger ones of up to 50 (Tarr 1950; Crockett 1954a; Loyn *et al.* 1986; NSW Bird Rep. 1997; Tas. Bird Rep. 9; CSN). Sometimes also recorded in larger flocks of 50–200 (Chisholm 1926; Cooper 1974; Gepp & Fife 1975; Lenz 1981; Loyn *et al.* 1986; Baxter 1989; NSW Bird Rep. 1987; Tas. Bird Rep. 5, 30; CSN); and occasionally 200–1000 congregate round abundant food sources (Stidolph 1950b; Blundell & McKenzie 1963; CSN); once, c. 2000 fed in low saltmarsh (Falla *et al.* 1981). Large feeding flocks usually form in non-breeding season, with smaller flocks during breeding season (Middleton 1970a; Baxter 1989). Occasionally recorded in mixed-species feeding flocks, usually with other seed-eating species, especially finches such as European Greenfinches (Moeed 1975; Loyn *et al.* 1986; CSN 21, 38), House Sparrows (Secker 1953; Moeed 1975; Brothers 1979; Loyn *et al.* 1986; Rowe 1991; CSN 21, 38), Red-browed Finches (Fleming 1976), Diamond Firetails *Stagonopleura guttata* (Rowe 1991), Common Redpolls *Carduelis flammea* (Secker 1953; East 1967; Sagar 1976; CSN 26) or Double-barred Finches *Taeniopygia bichenovii* (Vic. Bird Rep. 1985), or parrots such as Eastern Rosellas *Platycercus eximius* (CSN 4) or Orange-bellied Parrots *Neophema chrysogaster* (Starks *et al.* 1992). Very occasionally forage with other species, such as Flame Robins *Petroica phoenicea* (Fleming 1976) and Yellow-rumped Thornbills (Vic. Bird Rep. 1985). At Clevedon, NI, present in large congregations of finches feeding on seeds of Red-root Pigweed *Amaranthus retroflexus* in crops (Blundell & McKenzie 1963, which see for species composition). Near Gunning, NSW, fed with House Sparrows and Diamond Firetails on seed-heads of *Paspalum* at roadside; Firetails perched on seed-heads, bending them to ground, where all birds fed on them (Rowe 1991). Usually drink in small flocks (Badman 1981; Stranger 1997). **FORAGING HEIGHTS AND SITES:** Often forage on ground (Tarr 1950; Pawsey 1966; Cooper 1974, 1975; Gepp & Fife 1975; Er 1997; Taylor *et al.* 1997; Er *et al.* 1998; Hingston & Black 1998;

Hewish 2002); of 96 observations of foraging in e. suburban Melbourne, all were on ground (Green 1984). In Christchurch Botanic Gardens, foraged mainly above ground; of 154 observations of foraging, 10–15% were on ground, <5% were up to c. 0.6 m above ground; 25% were 0.6–4 m above ground; 5% were 6.5–13 m above ground; and 50–55% were in main part of tree (estimated from diagram) (East 1967). At Windbag Valley, of 987 observations of foraging, c. 16% in emergent foliage, c. 64% on top of canopy, c. 8% in canopy, c. 4% in upper understorey, c. 1% in lower understorey and c. 6% on ground (estimated from diagram). Often forage on ground (see above), including lawns or sports grounds, especially where infested with dandelions (Ryder 1948; Tarr 1950; Fleming 1976; Falla *et al.* 1981; CSN); sometimes feed on fallen, fire-released seeds on ground in burnt areas (Cooper 1974, 1975; Hingston & Black 1998); and recorded eating seeds from hay spread on ground in paddocks (Moncrieff 1929). On beaches, occasionally forage along tideline or on wet sand (CSN 19 Suppl., 20), or among low pioneering vegetation, such as Marram Grass *Ammophila arenaria* or sea rocket *Cakile* (Sagar 1976; Loyn *et al.* 1986; Holdsworth 1997). At Blackmans Bay, Tas., gleaned seeds washed onto footpath from building site (Tas. Bird Rep. 16). Also forage in low vegetation, such as grasses, sedges and rushes (CSN 24; Ann. Locality Rep. 9), thistles (Ryder 1948), low shrubs, such as glasswort *Sarcocornia* and Rosemary *Rosmarinus officinalis* (Loyn *et al.* 1986; CSN 37; Ann. Locality Rep. 9), taller shrubs such as Sunshine Wattle *Acacia botrycephala* (Loyn 1980) and trees, especially at seed-pods in *Liquidambar* (Burrows 1974; Davies 1974; CSN 26, 29; J.M. Peter), sometimes among foliage in canopy (Gepp & Fife 1975; Gill 1989; Tas. Bird Rep. 5), and, once, flowers in eucalypt (Loyn *et al.* 2002). In Christchurch Botanic Gardens, of 154 observations of foraging, mostly foraged in trees: 75% in twigs (<10 mm diameter), and 2.5% from branches (10–100 mm diameter), and also occasionally on ground, 7.5% on lawn and 5.0% on paths (estimated from diagram) (East 1967). Usually forage in open sites, especially areas infested with thistles and other weeds, including farmland, and occasionally in clearings in forests or woodlands (see Habitat). **FORAGING METHODS:** At Windbag Valley, foraged almost entirely by gleaning (n=987 observations of foraging). Glean (pluck) seeds from seed-heads, either while clinging to vertical stems (East 1967), by bending stalk towards ground, where seeds eaten (Kloot 1969), perching above, pulling stalk upward with beak and holding seed-head with claw (Davies 1974), or by hanging upside-down from branches to reach seed-head (East 1967; Heather & Robertson 2000; CSN 22). In Christchurch Botanic Gardens, foraged from twigs by clinging (53%), and by hanging upside-down (18%) (estimated from diagram). Extracted seeds from fallen seed-pods of *Liquidambar* by perching on pod and prising out seeds (Hewish 2002). Once observed gleaning (plucking) seeds from seed-head of grass *Phalaris* by perching on stem, then biting stem, causing it to fracture but not break, so that seed-head then hung below the fracture; Goldfinch then sidled down the two parallel stems to take seeds from seed-head (Forshaw 2003). Flowers often torn apart to get at seeds (Dove 1919; Moncrieff 1929; CSN 23), and once observed hovering to tear at flower of Cornflower *Centaurea cyanus* (Dove 1919). Seeds occasionally gleaned from outside of strawberries (Thomson 1922), and very occasionally probe fruit (Fielding 1979); and pierce holes in soft-shelled almonds to get kernels (Anon. 1920a). Occasionally tear buds apart (Littler 1903; Kloot 1969); and sometimes peck at leaves themselves (Lowe & Lowe 1976; CSN 19 Suppl.). Once recorded probing lawn, apparently to feed on underground stems of Kikuyu Grass *Pennisetum clandestinum* (CSN 21). When foraging on ground, large flocks move forward, with birds at rear of flock flying forward and landing in

front of lead birds (Middleton 1970a). **FOOD-HANDLING:** Seed-heads sometimes held on ground under foot (Davies 1974). **FORAGING TIMES:** Usually forage early in morning and late in afternoon (Tarr 1950; Burrows 1974; CSN 4). At Clayton, Vic., during non-breeding season, arrived at foraging sites soon after sunrise, with number of foraging birds peaking c. 2 h later; foraging activity and flock-size declined by 12:00, but increased later in afternoon, before dispersing c. 1 h before sunset (Middleton 1970a). In Willouran Ras, SA, two arrived to drink at water drum at 09:30 and remained for 2 h (Badman 1981). **SEASONAL VARIATION:** Monthly volumes of major foods at Clayton, Vic., shown in Table 1; in addition, seasonal preferences for food plants determined by observation: Apricot *Prunus armeniaca* buds Jan.; Slim Amaranth *Amaranthus hybridus* Jan.–Mar.; Field Marigold *Calendula arvensis* Feb.–Apr., rush *Juncus* Mar.; Bushy Aster *Aster dumosus* Mar.; Zinnia Mar.; Flax-leaved Fleabane *Erigeron bonariensis* Mar.–Apr.; Gorse *Ulex europaeus* May; *Liquidambar styraciflua* June–July; Annual Bluegrass *Poa annua* Aug.; Yorkshire Fog Grass *Holcus lanatus* Aug.–Dec.; Common Dandelion *Taraxacum officinale* Sept.; and Common Daisy *Bellis perennis* Sept. (Middleton 1970a). In Western Hutt Hills, NI, fed on lavender *Lavandula* May–July, Pohutukawa *Metrosideros excelsa*, Mouse-ear Chickweed *Cerastium glomeratum*, Dandelion and Scrub Nettle *Urtica incisa* in June, and Prickly Sow Thistle *Sonchus asper* Oct.–Dec. (Gibb 2000). At Windbag Valley, fed on seed in winter and early spring, and on invertebrates in late spring. Though insects eaten throughout year, prominent in diet in spring (Middleton 1970a; Heather & Robinson 2000). **FEEDING ADAPTATIONS:** Crush seeds with strong, conical bill (Chisholm 1933). **PEST STATUS:** Sometimes considered a pest. One strawberry-grower in NZ complained that Goldfinches ruined his crop by picking out the seeds, thus destroying the fruit, and allowing them to become infected with bacteria and fungi (Anon. 1921; Thomson 1922; Oliver); and an entire crop of Canola seed, covering 4–6 ha, said to have been eaten by Goldfinches (CSN 2; Oliver). Also claimed to 'strip valuable flower and vegetable seed from our gardens' (Campbell 1905; Moncrieff 1929; Jenkins 1938, 1939; Hodgkins 1949), shred leaves of vegetables (Lowe & Lowe 1976), and destroy buds on peach trees (Littler 1903); and claimed to have been harmful to 'the smaller fruits, such as cherries, strawberries and paper shell almonds, but [not] ... the larger fruits', but without evidence to confirm this (Anon. 1920a, 1921). Seen eating Apples in orchard, but only fruit that had already been damaged (Baker 1980). Also said to foul fruit around nest-sites in orchards (Fielding 1979). In contrast, feed heavily on seeds of thistles and other weeds (Le Souëf 1913; Dove 1919; McKeown 1923; Bridgewater 1932; Chisholm 1924, 1926, 1933, 1934; Oliver), and also take scale and other pest insects (Littler 1902; Gregory-Smith 1983).

Detailed studies—Aust. Near MELBOURNE, VIC. (440 food items from gut contents of 240 birds; Middleton 1970a): **Plants** (All seeds.) Seeds 10.83% freq.; trace items (21 different seed-types) 23.75. **MONOCOTYLEDONS:** Poaceae: *Echinochloa crus-galli* 8.33. **DICOTYLEDONS:** Asteraceae: *Arctotheca calendula* 25.83; *Cirsium vulgare* 4.58; *Hypochaeris radicata* 29.17; *Inula graveolens* 9.58; *Sonchus oleraceus* 10.42; Chenopodiaceae: *Chenopodium album* 5.42; Plantaginaceae: *Plantago lanceolata* 15.83; Polygonaceae: *Polygonum aviculare* 10.00; *Rumex crispus* 9.17. **Animals** COLLEMBOLA: Poduridae 0.42. **INSECTS:** Coleoptera: Curculionidae: larv. 0.83; Diptera: larv. 0.42; Hemiptera: Aphididae 9.17; Cicadellidae: Jassinae 1.25; Psyllidae 3.75; Hymenoptera: Heloridae 0.42; Lepidoptera: Noctuidae: larv. 0.83; Tortricidae: *Epiphyas postvittana* larv. 2.92; Thysanoptera 0.42. **Other matter** Grit.

Detailed studies NZ At CHRISTCHURCH INTERNATIONAL AIRPORT (unknown number of crop contents from six birds feeding on airfield pasture and in adjacent farmland; collected

March 1968–Feb. 1969; Moeed 1975): **Plants** (All seeds.) **MONOCOTYLEDONS:** Poaceae: *Anthoxanthum odoratum* 3.73% no., 83.33% freq.; *Lolium* 16.17, 66.67; *Poa* 12.69, 100; *Stipa* 2.49, 33.33; *Vulpia* 6.72, 66.67. **DICOTYLEDONS:** Asteraceae: *Taraxacum* 28.86, 100; Caryophyllaceae: *Stellaria media* 16.92, 83.33; Chenopodiaceae: *Chenopodium album* 3.48, 66.67; Geraniaceae: *Erodium* 1.00, 16.67; Oxalidaceae: *Oxalis* 7.96, 66.67. **Other matter** Grit.

Other records—Aust. Plants (Seeds unless stated.) Seeds^{3,8,14,15,30,37,41,43,46}, vegetable matter³³. **MONOCOTYLEDONS:** Cyperaceae³⁵; Juncaceae: *Juncus*²⁵; Poaceae^{4,23,32,46}; *Aira cupaniana*⁴⁸; *Dactylis glomerata*¹⁷; *Holcus lanatus*²⁵; *Paspalum*²⁷; *Phalaris*⁴⁶; *Poa*^{35,59}; *P. annua*²⁵. **DICOTYLEDONS:** Amaranthaceae: *Amaranthus hybridus*²⁵; *A. retroflexus*⁵⁸; Asteraceae^{3,8,11,23,26,32,37,38,41,45,47}; *Aster dumosus*²⁵; *Bellis perennis*²⁵; *Calendula arvensis*²⁵; *Centaurea*²¹; *C. calcitrapa*^{21,25}; *C. cyanus*^{5,8}; *C. melitensis*⁴²; *Cichorium intybus*²⁵; *Cirsium vulgare*³⁴; *Cosmea*¹⁴; *Cosmos*⁷; *C. bipinnatus*⁴⁰; *Cynara cardunculus*^{21,25}; *Erigeron bonariensis*²⁵; *Helianthus*²⁵; *H. annuus*^{7,16,22,41}; *Lactuca sativa*³³; *L. serriola*⁴⁹; *Onopordum acanthium*^{12,13,14,15,20,21}; *Senecio*³⁷; *Silybum marianum*⁶; *Sonchus oleraceus*⁵⁵; *Taraxacum officinale*^{24,25}; *Xanthium spinosum*⁵⁶; *Zinnia*²⁵; Boraginaceae: *Echium lycopsid*⁴²; Brassicaceae: *Brassica oleracea* sds³³, lvs³³; *Cakile*⁴⁴; *C. maritima*⁵³; Casuarinaceae: *Allocasuarina littoralis*⁵¹; *A. verticillata*^{42,48,51,54,61}; *Casuarina cunninghamiana*⁴⁸; Chenopodiaceae⁴⁴; *Beta vulgaris*³³; *Halosarcia halocnemoides*⁴⁴; *Sarcocornia quinqueflora*^{44,61}; *Sclerostegia arbuscula*⁴⁴; *Suaeda australis*^{44,60}; Dipsacaceae: *Scabiosa*⁴²; Fabaceae: *Phaseolus vulgaris*³³; *Pisum sativum*³³; *Ulex europaeus*²⁵; Frankeniaceae: *Frankenia pauciflora*⁴⁴; Hamamelidaceae: *Liquidambar styraciflua*^{25,28,31,50,52,57,61}; Myrtaceae: *Eucalyptus nectar*⁴⁵; *Leptospermum*³⁰; *L. myrsinoides*^{29,30}; Onagraceae: *Oenothera stricta*⁵⁵; Polygonaceae: *Polygonum*^{35,58}; *Rumex*³⁵; Rosaceae fru.¹⁰; *Malus sylvestris*³⁶; *Prunus dulcis*^{9,10}; *P. armeniaca* buds²⁵; *P. avium* fru.¹⁰; *P. persica* buds². **Animals** **INSECTS:** Coleoptera: Curculionidae⁵⁸; Hemiptera scale^{1,41}; Hymenoptera: Ibalidae: *Ibalia leucospoides*³⁹; Ichneumonidae: *Rhyssa persuasoria*³⁹.

REFERENCES: Littler¹ 1902, ² 1903; ³ Campbell 1905; ⁴ McLennan 1907; ⁵ Fletcher 1909; ⁶ Le Souëf 1913; ⁷ Morgan 1914; ⁸ Dove 1919; Anon.⁹ 1920b, ¹⁰ 1921; ¹¹ McKeown 1923; Chisholm¹² 1924, ¹³ 1926, ¹⁴ 1933, ¹⁵ 1934; ¹⁶ Edwards 1925; ¹⁷ Wright 1925; Chisholm¹⁸ 1933, ¹⁹ 1934; ²⁰ Brown 1950; ²¹ Cleland 1952; ²² Jack 1952; ²³ Pawsey 1966; ²⁴ Kloot 1969; ²⁵ Middleton 1970a; Rowe²⁶ 1973, ²⁷ 1991; ²⁸ Burrows 1974; Cooper²⁹ 1974, ³⁰ 1975; ³¹ Davies 1974; ³² Fleming 1976; ³³ Lowe & Lowe 1976; ³⁴ Green 1977a; ³⁵ van Tets et al. 1977; ³⁶ Fielding 1979; ³⁷ Harris 1980; ³⁸ Lenz 1981; ³⁹ Madden 1982; ⁴⁰ Grant 1983; ⁴¹ Gregory-Smith 1983; ⁴² Ashton 1985; ⁴³ Loyn 1985; Loyn et al.⁴⁴ 1986, ⁴⁵ 2002; ⁴⁶ Baxter 1989; ⁴⁷ Garnett et al. 1991; Lepschi⁴⁸ 1993, ⁴⁹ 1997; Hewish⁵⁰ 1995, ⁵¹ 1996, ⁵² 2002; ⁵³ Holdsworth 1997; ⁵⁴ Hingston & Black 1998; ⁵⁵ Gosper 1999; NSW Bird Rep.⁵⁶ 1987, ⁵⁷ 2000; ⁵⁸ FAB; ⁵⁹ Tas. Bird Rep. 9; ⁶⁰ R.K. Hicks; ⁶¹ J.M. Peter.

Other records—NZ Plants (Seeds unless stated.) Seeds^{2,7,8,15,20,23,38}. **FILICOPHYTES:** Pteridaceae: *Pteridium esculentum* spores⁴. **GYMNOSPERMS:** Cupressaceae: *Chamaecyparis pisifera*¹¹; Taxodiaceae: *Cryptomeria japonica*³³. **MONOCOTYLEDONS:** Cyperaceae²⁴; Juncaceae²⁴; Poaceae^{3,15,24,45}, lvs²³; *Agrostis capillaris*³⁶; *Ammophila arenaria*¹⁴; *Cortaderia*²⁰; *Poa*^{22,35,45}; *P. annua*^{12,32,41}; *Spartina townsendii*¹⁸; Typhaceae: *Typha orientalis*³¹. **DICOTYLEDONS:** Unident. nettle^{6,40}; Amaranthaceae: *Amaranthus retroflexus*^{9,22}; Asteraceae^{1,2,3,4,7,8,13,20,23,28,29,30,31,45}; *Calendula*^{2,34}; *Carduus*²²; *Cassinia*²; *Centaurea cyanus*²⁸; *Chrysanthemum leucanthemum*²⁷; *C. parthenium*²⁸; *Cosmos* sds^{43,44}, fl.⁴⁵; *Erechtites hieracifolia*³¹; *Erigeron*³¹; *Helenium*²⁸; *Hieracium* lvs³¹; *Onopordum acanthium*^{2,22}; *Senecio*^{2,29,30}; *S. jacobae*^{29,30}; *Solidago*²⁸; *Sonchus asper*²¹; *S. oleraceus*^{41,43}; *Tagetes*⁴; *Taraxacum officinale*^{3,21,23,28,30,33,47};

Table 1. Monthly proportion (%) of volume of food items in guts of 240 European Goldfinches near Melbourne (Middleton 1970a). Each monthly sample comprised 20 birds.

FOOD ITEM	% VOLUME												
	J	F	M	A	M	J	J	A	S	O	N	D	
Capeweed													
<i>Arctotheca calendula</i>	27.1	15.0	–	–	–	–	–	0.3	13.8	42.6	30.7	13.9	
Spear Thistle													
<i>Cirsium vulgare</i>	21.7	10.1	7.0	–	–	–	–	–	–	–	–	3.0	
Cats-ear													
<i>Hypochaeris radicata</i>	8.0	16.5	22.0	31.5	16.5	12.3	–	–	–	–	7.2	29.3	
Yellow Dock													
<i>Rumex crispus</i>	0.6	–	4.5	0.6	1.2	0.7	–	0.3	–	–	–	–	
Sow Thistle													
<i>Sonchus oleraceus</i>	0.3	3.2	–	–	–	0.3	0.5	5.4	–	7.6	–	0.1	
Common Barnyard Grass													
<i>Echinochloa crus-galli</i>	–	3.5	23.6	3.8	0.3	–	–	–	–	–	–	–	
Wireweed													
<i>Polygonum aviculare</i>	–	–	–	12.1	11.2	2.5	9.0	0.6	–	–	–	–	
Fat Hen													
<i>Chenopodium album</i>	–	–	–	1.5	0.3	6.9	2.0	–	–	–	–	–	
Stinkwort													
<i>Inula graveolens</i>	–	–	–	–	3.4	7.0	8.8	1.2	–	–	–	–	
Narrow-leaved Plantain													
<i>Plantago lanceolata</i>	–	–	–	–	–	–	2.3	23.7	27.9	1.3	11.5	–	
Unident.													
–	–	–	–	–	–	9.7	18.2	6.6	–	–	–	–	
Cumulated trace items (21 unident. types)	1.6	4.4	0.9	–	4.9	4.7	8.2	7.5	5.4	–	2.4	1.7	
Seed fragments	38.1	47.3	42.0	50.1	61.6	55.4	46.5	50.2	50.9	41.8	40.0	48.5	
Insects	2.6	–	–	0.4	0.6	0.5	4.5	4.2	2.0	6.7	8.2	3.5	

Zinnia^{2,28,31}; Betulaceae: *Alnus glutinosa*¹¹; *Betula*¹¹; Caryophyllaceae: *Cerastium glomeratum*²¹; *Chenopodium album*²⁵; *Sarcocornia*^{24,43}; *S. australis*¹⁶; Brassicaceae: *Brassica napus*^{23,26}; *B. rapa*⁴³; *Lobularia maritima*³¹; Dipsacaceae: *Scabiosa*^{2,28}; Fagaceae: *Nothofagus*⁴⁹; *N. menziesii*¹⁹; Geraniaceae: *Erodium cicutarium*²²; Guttiferaceae: *Hypericum androsaemum*²⁷; Hamamelidaceae: *Liquidambar styraciflua*^{35,37,38}; Labiatae: *Lavandula*^{21,35}; *Rosmarinus officinalis*^{40,42,43}; Myrtaceae: *Metrosideros excelsa*^{21,24,41}; Platanaceae: *Platanus*⁴; Podocarpaceae: *Dacrydium cupressinum*¹⁹; Polygonaceae: *Muehlenbeckia complexa*¹⁰; *Rumex*³²; Rosaceae: *Fragaria vesca*^{22,23}; *Malus sylvestris*¹⁵; Umbelliferae: *Foeniculum vulgare*⁴⁶; Urticaceae: *Urtica*³⁹; *U. incisa*²¹. **Animals** Unident. invertebrates¹⁹. **SPIDERS**²²: Pisauridae: *Dolomedes minor*¹⁷. **INSECTS**: Larv.¹⁷; Diptera²²; Hemiptera²²; Aphididae²²; Lepidoptera: larv.²². **OTHER MATTER**: Grit⁴⁸.

REFERENCES: ¹ Wilkinson 1924; ² Moncrieff 1929; ³ Ryder 1948; ⁴ Hodgkins 1949; ⁵ Secker 1953; ⁶ Stidolph 1950b; Crockett 7 1954a, ⁸ 1954b; ⁹ Blundell & McKenzie 1963; ¹⁰ Skegg 1963; ¹¹ East 1967; ¹² Horning & Horning 1974; ¹³ Child 1975; ¹⁴ Sagar 1976; ¹⁵ Baker 1980; ¹⁶ Falla *et al.* 1981; ¹⁷ Lane 1984; ¹⁸ Owen & Sell 1985; ¹⁹ O'Donnell & Dilks 1994; ²⁰ Beauchamp & Parrish 1999; ²¹ Gibb 2000; ²² Heather & Robertson 2000; ²³ Oliver; ²⁴ Ann. Locality Rep. 9; ²⁵ OSN Bull. 1941–42; CSN 26 2, 27 3, 28 4, 29 8, 30 9, 31 19 Suppl., 32 20, 33 22, 34 23 35 26, 36 28, 37 29, 38 31, 39 34, 40 35, 41 36, 42 37, 43 38, 44 39, 45 41, 46 42, 47 47, 48 48; ⁴⁹ Clout & Gaze 1984.

Young Initially fed by female only, but by both parents after c. 7 days (see Breeding). Very occasionally fed invertebrates (Lane 1984; Heather & Robertson 2000). Fed by parents for up to c. 3 weeks after fledging (Middleton 1970b; Heather & Robertson 2000). For details of feeding young in one nest by a third bird that assisted parents, see Breeding (Young). At one nest, young fed before 06:30, and 17:00–19:00 (CSN 1); at another nest, where helper present, fed 06:50–08:05, 09:00–09:55, 13:30–15:00 and 17:15–18:30 (Lane 1984).

No detailed studies. (All from Heather & Robertson 2000.) **Animals** INSECTS: Diptera; Hemiptera: Aphididae; Lepidoptera: larv.

SOCIAL ORGANIZATION Well known extraliminally (see Conder 1948; BWP), but poorly known in HANZAB region. Campbell (1972) examined breeding ecology at Havelock North, NZ. Occur singly, in twos or small flocks at any time of year; more gregarious in non-breeding season, often forming larger flocks of hundreds or sometimes thousands (Moncrieff 1929; Watson 1955; Hudson 1963; Bedgood 1970; Middleton 1970a; Longmore 1973; Aust. Atlas 1; Tas Bird Rep. 26; CSN 1, 3, 19, 32). Often form mixed-species flocks, especially with other finches (for details, see Food: Foraging associations). After becoming independent round mid-Nov., young gather in small flocks (Middleton 1970b); at Laverton, Vic., in Apr., one flock of c. 80 mostly comprised immatures (Watson 1955).

Bonds Breed in pairs (Middleton 1970b). In late July to Aug., at Clayton, Vic., pairs apparently formed within flock (Middleton 1970b). **Co-operative breeding** Once, a third bird helped at nest, feeding nestlings and, once, sitting on nest (Lane 1984). **Parental care** Only female incubates (Middleton 1970b; *contra* Lane 1984). Both sexes attend fledgelings (Middleton 1970b).

Breeding dispersion Often nest in loose colonies (Middleton 1970b). One colony near L. Charm, Vic., spread over c. 0.3 ha, and contained maximum of 55 nests in a season, with 44 active at one time, some of which 1 m apart (Lowe & Lowe 1976). At Mystic Park, Vic., 18 pairs nested in c. 6 ha (Lowe 1959). In ACT, seven nests found within c. 0.1 ha (Lenz 1982). Twice at Clayton, Vic., two pairs nested in same tree, 2.5 m and 4.0 m apart (Middleton 1970b). In an orchard near Taradale, NI, nested at density of c. 27 pairs/ha (Niethammer 1970). **Territories** Established after nest-site chosen; small, and size diminishes as nesting progresses. At Clayton, Vic., radii of territories varied from up to 15 m early in nest-building stage, to 2 m, immediately before young fledged (Middleton 1970b). In two suburbs of Canberra,

recorded at densities of 0.04 and 0.05 territories/ha (Lenz 1990).

Roosting Roost communally. Leave roosts in small groups shortly after sunrise, and small groups return to roost-sites 1 h before sunset (Middleton 1970a). Near Sydney, small flocks roosted in mangroves (Hindwood 1935).

SOCIAL BEHAVIOUR Well known extralimittally (see Conder 1948; BWP), but poorly known in HANZAB region.

Agonistic behaviour In late July to Aug., at Clayton, Vic., **THREAT DISPLAYS** and **PIVOTING DISPLAYS** became common (Middleton 1970b). Extralimittally, give Threat Display by facing opponent with head forward, bill open, tail lowered and feathers ruffled; when performing Pivoting Display, bird leans forward on slightly flexed legs with wings slightly lowered, and pivots from side to side while singing or calling (Conder 1948; BWP). At Clayton, Vic., males spend much time defending territory early in nesting stages, but after eggs laid, most territorial defence by female; incubating female often leaves nest to chase intruders (Middleton 1970b). **Alarm** Fly to cover on hearing alarm call of New Holland Honeyeater *Phylidonyris novaehollandiae* (Jurisevic & Sanderson 1994). **Interspecific aggression** Recorded mobbing Sacred Kingfisher *Todiramphus sanctus* (Gibb 2000).

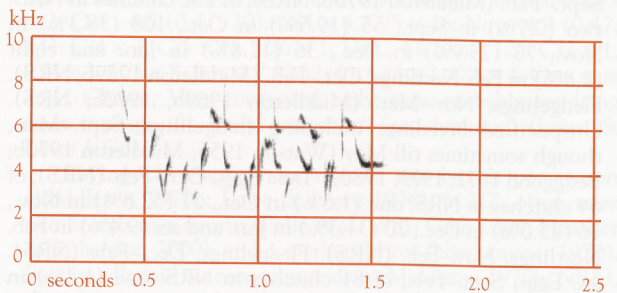
Sexual behaviour At onset of breeding season, performed sexual chases comprising rapid erratic flights while still in flock (Middleton 1970b). Male feeds incubating female on nest (Middleton 1970b; Lane 1984). Extralimittally, when courting, both partners also perform Pivoting Display with each pivoting at different speed, and sometimes perform Butterfly Flight during sexual chases (see BWP for details). **COPULATION** first occurred during late stages of nest-building (Middleton 1970b; see Conder 1948 for description). Extralimittally, female solicits copulation by crouching with tail raised and wings lowered, and sometimes shivered (see BWP for details).

Relations within family group When selecting potential nest-site, male leads female to various sites, settling in suitable forks, often with piece of nesting material held in bill, swivelling round and uttering soft calls, probably Begging Calls; female usually responds by settling in same spot and copying behaviour of male. Pairs often search suitable habitats systematically, investigating several sites before making a final decision (Middleton 1970b). Extralimittally, both sexes seen to lead search for nest-site, and not known which sex chooses final site (BWP). At nest where three adults fed nestlings, as each adult fed young, other two adults constantly twittered (Lane 1984). Fledgelings utter loud begging calls when being fed (Middleton 1970b). **Anti-predator responses of young** Nestlings fledge prematurely if disturbed, bursting from nest (Middleton 1970b). **Parental anti-predator strategies** Incubating bird sits tight on nest, allowing itself to be touched (Lowe & Lowe 1976). Adults feign injury if disturbed while brooding nestlings, performed mainly when young newly hatched, and ceasing when young 4 days old (Campbell 1972).

VOICE Well known extralimittally (see BWP, and references therein), but little published information from HANZAB region; sonagrams in BWP. In W. Palearctic, repertoire of

adults consists of male and female Song, Subsong, and six calls (BWP). Described as a 'beautiful songster' (Chisholm 1933), with Song described as pretty and pleasant, catchy, cheerful and jaunty (Pizzey 1980; Heather & Robertson 2000; J.M. Peter; G.D. Price); 'often their notes drown the songs of other species in the garden' (Barrett 1922). Song is most often reported vocalization in HANZAB region. Some parts of Song said to resemble those of European Greenfinch (Bryant 1939) or vaguely like that of Silvereye *Zosterops lateralis* (Hartshorne 1953). Sometimes given by single birds, and sometimes by many birds in flock (Moncrieff 1924; J.M. Peter). Often given from perch, e.g. overhead wires, fences, branches, shrubs or top of thistles (Burrows 1955; Heather & Robertson 2000; CSN 4; J.M. Peter). Said that first seen more often than first heard (Gibb 2000), though when one or two birds flying overhead, call often attracts attention of observer (J.M. Peter). Undescribed call given when selecting nest-site (Middleton 1970b). **SEASONAL PATTERN:** In NZ, mostly start singing in mid- to late Sept., though sometimes earlier, in early Sept., but often not till Oct. (sometimes late Oct.); continue till Jan. or early Feb., though some sing till Apr. or, very occasionally, May (Cunningham & Wodzicki 1948; Andrew 1967; Falla *et al.* 1981; Gibb 2000; Heather & Robertson 2000; CSN); in days or weeks preceding and after main Song period, some males give incomplete Song, as though 'tuning up or fading' (Falla *et al.* 1981), or given in short bursts (CSN 1, 3). Call given throughout most of year (Gibb 2000). For monthly breakdown of singing and calling at W. Hutt, see Table 2. Heard singing Oct.–Dec. on Noises Is (Cunningham & Moors 1985), but unclear whether it was singing or observation that ceased in Dec. In Aust., sing in spring (Pizzey 1980). **DIURNAL PATTERN:** Little information. In list of species participating in dawn chorus near Te Teko, NI, on 27 Oct., Goldfinch was first heard calling at 06:26 (4 min after sunrise) (Taylor 1975). Heard singing in mid-morning (CSN 3).

Adult SONG OF MALE: Distinctive, liquid tinkle, rendered as *twiddle-ee-twiddle-ee-dee* (Pizzey 1980), *twiddly-diddly twiddly-diddly* (J.M. Peter) or *tswitt-witt-witt* (Falla *et al.* 1981; Heather & Robertson 2000). See sonagram A. Given as series of phrases, which, though separated by short pauses (<0.1 s), sometimes delivered so rapidly as to sound almost continuous; often begin with rapid sequence of slurred disyllabic call-type units, followed by canary-like trilling, and concluding with a harsh, drawn-out nasal *ziar* (BWP). 'Joyous note-calls' given by presumed male from perch while accompanying presumed female collecting nesting material (McGill 1946; Burrows 1955)



A R. Buckingham; Cann R., Vic., Jan. 1983; P94

Table 2. Monthly breakdown of proportions (%) of vocalizations of European Goldfinches heard at W. Hutt, near Wellington, 1981–92; figures estimated from graph (Gibb 2000).

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Song	35	13	25	0	0	0	0	0	0	22	32	22
Call	65	87	75	100	100	100	100	0	100	78	68	78

probably refers to Song of Male. **SONG OF FEMALE:** Not recorded in HANZAB region; similar to Song of Male, but more subdued and less sustained (BWP). **SUBSONG:** Described as soft rambling version of full Song (Heather & Robertson 2000) or tinkling notes (Pizzey 1980). Given in flight (Pizzey 1980; Heather & Robertson 2000). **CONTACT CALL:** Shrill, clear *pee-yu* (Falla *et al.* 1981) describes either this call or Flock Call. Scratchy, drawn-out, canary-like *tweet* (Pizzey 1980) possibly also describes this call; and undescribed twittering call given by adult returning to nest to feed nestlings (Lane 1984) possibly also this call. Given slowly, quietly and conversationally in intimate pair contact, and more urgently when signalling intention to fly, or, when in flock, given while feeding or pausing to preen; possibly indicates mild alarm in some circumstances (BWP). **FLOCK CALL:** Given while feeding in flock; may indicate mild alarm (BWP). Shrill, clear *pee-yu* (Falla *et al.* 1981) possibly describes this call. **ALARM CALL:** Said to have been noisy when perched within 1 m of kingfisher (CSN 30); though call not described, possibly refers to this call. **OTHER CALLS:** One bird briefly gave a squeal, lasting for c. 2 s, when fatally attacked by Sacred Kingfisher (Grant 1983). Three other calls reported extraliminally: Attraction Call, Excitement Call and Begging Call (BWP).

Young Nestlings give squeaky *ee ee*, *tzee* or other similar sounds (BWP). Fledgelings utter loud begging calls when being fed (Middleton 1970b); extraliminally, fledgelings give *di-wetwet* or *tsi-vit tsi-vit*, with rate of delivery increasing with level of excitement (BWP).

BREEDING Well known in HANZAB region from 622 records in NRS and detailed study of breeding biology at Clayton, Vic., Nov. 1962–Feb. 1965, with supplementary data from Wantirna, Vic., and questionnaire (Middleton 1970b). Campbell (1972) examined breeding biology at Havelock North, NZ.

Southern Aust. Eggs, Sept.–Mar., with peak in Nov. and Dec.; of 506 clutches in NRS: three (0.6%) in Sept.; 80 (15.8%) in Oct.; 173 (34.2%) in Nov.; 141 (27.9%) in Dec.; 88 (17.4%) in Jan.; 20 (3.9%) in Feb.; and one (0.2%) in Mar. (NRS). NSW: Eggs, Sept.–Mar. (Morris *et al.* 1981; NRS); of 79 clutches in NRS: eight (10.1%) in Oct., 22 (27.8%) in Nov., 28 (35.4%) in Dec., 16 (20.3%) in Jan., four (5.1%) in Feb. and one (1.3%) in Mar. Nestlings, Oct.–Mar. (Hindwood 1930; NRS). Unspecified breeding, including fledgelings, Sept.–Mar. (Bourke 1957; Marchant 1973; Taylor *et al.* 1986; I. Taylor 1987; Veerman *et al.* 1988, 1989; NRS). VIC.: Eggs, Sept.–Feb. (Middleton 1970b; NRS); of 282 clutches in NRS: two (0.7%) in Sept., 55 (19.5%) in Oct., 108 (38.3%) in Nov., 73 (25.9%) in Dec., 36 (12.8%) in Jan. and eight (2.8%) in Feb. Nestlings, Oct.–Feb. (Middleton 1969b; NRS). Fledgelings, Nov.–Mar. (Middleton 1969b, 1970b; NRS). Unspecified breeding, including fledgelings, Sept.–Mar., though sometimes till May (Watson 1955; Middleton 1970b; Bedgood 1972, 1973, 1980). TAS.: Eggs, Oct.–Feb. (NRS); of 64 clutches in NRS: one (1.6%) in Oct., 21 (32.8%) in Nov., 16 (25.0%) in Dec., 20 (31.3%) in Jan. and six (9.4%) in Feb. Nestlings, Nov.–Feb. (NRS). Fledgelings, Dec.–Feb. (NRS). SA: Eggs, Sept.–Feb.; of 81 clutches in NRS: one (1.2%) in Sept., 16 (19.8%) in Oct., 22 (27.2%) in Nov., 24 (29.6%) in Dec., 16 (19.8%) in Jan. and two (2.5%) in Feb. Nestlings, Sept.–Feb. (NRS). Unspecified breeding, including fledgelings, Sept.–Mar. (Sutton 1922a,b; SA Bird Rep. 1977–81; NRS). WA: Eggs, Oct.–Dec. (Johnstone & Storr 2004).

NZ: Eggs, mid-Oct. to mid-Feb. (Niethammer 1970; Lane 1984; Heather & Robertson 2000; CSN 1, 6, 31, 34). NT: Eggs, Oct.–Feb. (Niethammer 1970; CSN 6, 34); nestlings, Dec. and Feb.–Mar. (CSN 1, 31, 34). Unspecified breeding, including fledgelings, late Oct. to Mar. (Wilkinson &

Wilkinson 1952; Gibb 2000; CSN 1, 6, 26, 31). ST: Eggs, Nov.–Feb. (Lane 1984; CSN 1, 31); nestlings, Dec.–Feb. (CSN 1, 2, 31). Unspecified breeding, including fledgelings, Nov.–Mar. (Lane 1984; CSN 1, 2, 5).

Site Usually in fork in outer branch, sometimes in centre, near top of shrub or tree, often concealed among foliage (Leach 1928; Middleton 1970b; Lowe & Lowe 1976; Falla *et al.* 1981; Heather & Robertson 2000; NRS). One nest wedged between two pine-cones on branch of Monterey Pine (NRS); another among flower and buds of blooming rose (Lowe & Lowe 1976). Of 553 records of nest-plant throughout range Aust. in NRS, 69 (12.5%) in cypress *Cupressus*, 64 (11.6%) in Apple trees, 53 (9.6%) in *Prunus* trees, 33 (6.0%) in pines *Pinus*, 31 (5.6%) in tea-trees *Leptospermum*, 30 (5.4%) in paperbarks *Melaleuca*, 23 (4.2%) in Grape, 22 (4.0%) in acacias, 21 (3.8%) in eucalypts, including saplings, 18 (3.3%) in Pear trees, 13 (2.4%) in roses *Rosa*, ten (1.8%) in hawthorn *Crataegus*, ten (1.8%) in *Citrus* trees, nine (1.6%) in almond trees, eight (1.4%) in casuarinas, eight (1.4%) in mulberry *Morus* trees, eight (1.4%) in tamarisks *Tamarix*, six (1.1%) in ash trees, six (1.1%) in *Cotoneaster* and five (0.9%) in Common Cassinia *Cassinia aculeata*, with remainder in various other trees and shrubs. Often nest in exotic trees and shrubs, especially conifers (Leicester 1959; Middleton 1970b; Anon. 1976; Lowe & Lowe 1976; Lenz 1982; NRS). At Clayton and Wantirna, Vic., of 166 nests, 152 (91.6%) were in exotic plants. Of 111 nests at Clayton: 55 (49.5%) in Monterey Cypress *Cupressus macrocarpa*, 34 (30.6%) in Lawson Cypress *Chamaecyparis lawsonia*, three (2.7%) in each of Horse Chestnut *Aesculus hippocastanum* and English Oak *Quercus robur*, two (1.8%) in each of English Elm *Ulmus procera*, Desert Ash *Fraxinus oxycarpa*, Marri and Sweet Pittosporum, and one (0.9%) each in Southern Mahogany, Liquidambar *Liquidambar styraciflua*, Common Boobialla *Myoporum insulare*, Bracelet Honey-myrtle *Melaleuca armillaris*, Brush Cherry *Syzygium paniculata*, Ovens Wattle *Acacia praevisissima*, *Cotoneaster* and pine *Pinus*; and of 55 nests at Wantirna: 41 (74.5%) in Apple, nine (16.4%) in Monterey Pine, two (3.6%) each in Hickory Wattle *Acacia implexa* and Blackwood, and one (1.8%) in Lambert Cypress *Cupressus macrocarpa lambertiana*. Often nest in conifers, especially cypress *Cupressus* and pines *Pinus* (Moncrieff 1929; Brown 1950; Rowley 1965; Anon. 1976; Stranger 1997; Gibb 2000; Heather & Robertson 2000; Serventy & Whittell; CSN 1; NRS), and near Rand, NSW, often in cypress-pines *Callitris* (Bourke 1957). Also often nest in deciduous or citrus fruit trees in orchards, and in grapevines (Morgan 1914; Leach 1928; McGilp 1928; Brown 1950; Frith & Tilt 1959; Leicester 1959; Lowe 1959; Heather & Robertson 2000; NRS); and in prickly shrubs, such as hawthorn *Crataegus*, African Boxthorn, Gorse *Ulex europaeus*, roses *Rosa* and brambles of Blackberries (Barrett 1922; Leicester 1959; Vestjens & Vestjens 1970; McLennan & MacMillan 1985; CSN 1). Occasionally nest in other exotic trees and shrubs in gardens (e.g. Leicester 1959; Lowe & Lowe 1976; CSN 1), and once in jasmine *Jasminum* creeper in garden (J.M. Peter). Sometimes nest in native trees and shrubs, e.g. in Aust., occasionally in eucalypts, including saplings, and acacias (Brown 1950; Leicester 1959; Lowe & Lowe 1976; Ashton 1985), and at Bool Lagoon, se. SA, many nests in tea-trees *Leptospermum* (Brummitt 1934); and in NZ, recorded in Manuka *Leptospermum scoparium*, Tauhinu *Cassinia leptophylla* and other small-leaved shrubs (Wilkinson & Wilkinson 1952), kowhai *Sophora* (Lane 1984), and in mangroves (CSN 31). Once, on D'Urville I., SI, nested in dried octopus tentacle, which formed circle c. 75 mm in diameter, in tool box on floor of shed (CSN 19). Often, multiple nests in same nest-plant (Middleton 1970b), placed 1–5 m apart; once, six nests (though several were old) in same tree (NRS); at L. Charm, Vic., six active nests in *Wisteria* covering pergola,

2.5 × 1.8 m; five nests close together in Golden Ash *Fraxinus excelsior*; three nests in grapevine (Lowe & Lowe 1976); and two nests built on steel support trestle for a glory vine (NRS). Some nests re-used for multiple nesting attempts in same season, or another built nearby (Lowe & Lowe 1976; NRS). Some nests near nests of other passerines, including one 4 m from nest of Willie Wagtail *Rhipidura leucophrys*, and another within 0.5 m of nest of Red-browed Finch. Other nests near nest of triller *Lalage*, and one near empty nest of Red-capped Robin *Petroica goodenovii* (NRS). Sometimes compete with Superb Fairy-wrens *Malurus cyaneus* for nest-sites in pencil pines (Rowley 1965). Near Hastings, NI, nest in shrubs with Silvereyes, Common Blackbirds *Turdus merula* and Song Thrushes *T. philomelos* (McLennan & MacMillan 1985). For details of behaviour associated with selection of nest-site, see Social Behaviour. MEASUREMENTS (m): AUST.: Height of nest, 2.4 (1.24; 0.3–10.0; 586) (NRS). At Clayton Vic., 5.0 (1.4–12.2; 111); at Wantirna, Vic., 2.6 (0.9–7.6; 55) (Middleton 1970b). At Laverton, Vic., 1.7 in Sugar Gums *Eucalyptus cladocalyx*, 15.2 in pines *Pinus* and 1.2–2.0 in Tamarisks *Tamarix aphylla* (Watson 1955). In nw. Vic., 1.0–1.2 in grapevines and 2.0–2.5 or more in citrus trees or other shrubs (Lowe 1959; Lowe & Lowe 1976). Elsewhere, 1.5–12.2 (Frith 1969). NZ: Height of nest, 1.8 (0.35; 1.4–2.1; 4) (Lane 1984; CSN 1); 2 (1–6) (Heather & Robertson 2000); 1.5–3.5 (Falla *et al.* 1981).

Nest, Materials Cup-shaped nest; appearance (including neatness) varies much (Leach 1928; Frith 1969; Middleton 1970b; Heather & Robertson 2000; Serventy & Whittell; NRS). Usually made of rootlets or grass or both, often with spider web; sometimes also incorporate twigs, plant stems, leaves, feathers, wool or lichen; and very occasionally also include bark, string, moss, silk from cocoons or spider egg-sacs, cottonwool, flowers, pine needles, hair, fishing line, dandelion bulbs, catkins from English Oak or acacia bracts (Wilkinson & Wilkinson 1952; Burrows 1955; Frith 1969; Middleton 1970b; Lowe & Lowe 1976; Heather & Robertson 2000; Oliver; CSN 19; NRS). Usually lined with plant down, feathers or wool, and sometimes hair or fur (from Cat, Dog, Cow or Horse), fine grass, bark fibre and rootlets, or string, cotton threads or rope fibres; one lined with coconut fibre (Wilkinson & Wilkinson 1952; Frith 1969; Middleton 1970b; Heather & Robertson 2000; Oliver; Serventy & Whittell; NRS). Nests sometimes decorated with spider web, grass, oak catkins, lichen, downy leaf buds, Sheep Sorrel *Rumex acetosella* and wattle phyllodes (Middleton 1970b). Female collects material and builds nest, though male accompanies her when gathering material (McGill 1946; Burrows 1955; Middleton 1970b; Gibb 2000; Heather & Robertson 2000; CSN 34; NRS); once, both sexes reported building (CSN 1). Material often collected from introduced plants (Middleton 1970b). Once collected spider web from wall of shed near nest by perching on branch near wall and, taking some web in its bill, tugging vigorously, till it was lying horizontally with back down and breast up; when web failed to come free, bird jumped backward, still gripping silk in its bill, and the web came loose; a 15-cm length was carried to nest. Process took c. 1 min, and was repeated till entire web removed (Burrows 1955). Another bird seen gathering fibres from rope clothesline (McGill 1946). Nests built in four stages: (1) foundation is built and bound in place with spider web; (2) cup built; (3) cup lined; and (4) nest camouflaged with lichen and spider web (Middleton 1970b). At Clayton, Vic., nests built throughout day, with activity peaking early in morning and late in afternoon; female usually builds nest in bouts of 20–40 min, with intervals 4.3 ± 0.7 min between bouts (n=66 periods of observation). Rate of building determined by stage of construction, distance to materials and inclination; apparently unaffected by inclement weather. Mean building time of 17 successful nests was 7.1 days (1.95; 4–11)

(Middleton 1970b). Most nests take 4–7 days to build, though one took 11 days (NRS). Nests used earlier in season or in previous year sometimes refurbished (NRS). Sometimes steal nesting material from Superb Fairy-wrens (Rowley 1965); twice recorded using or refurbishing abandoned nests of Silvereyes, with addled egg of Silvereye left in nest, among eggs of Goldfinch (NRS). MEASUREMENTS (cm): Of two nests: external diameter, 8.0–9.0; external depth, 8.0; internal diameter, 5.5; internal depth, 3.2–4.4 (NRS); in WA (N unknown): 8.9, –, 5.1–6.4, 3.2 (Serventy & Whittell). One nest 7.6 wide and 6.4 deep; on another, wall of nest-cup 1 thick (NRS).

Eggs Ovoid. White, bluish white, pale blue, blue, pale grey, or bluish pink, sparsely marked with spots and blotches of reddish brown, pale reddish-brown, brown, pink or black, sometimes concentrated at large end (Frith 1969; Beruldsen 1980; Falla *et al.* 1981; Heather & Robertson 2000; Oliver; Serventy & Whittell; NRS). MEASUREMENTS: In e. suburban Melbourne, 16.4 (15.0–19.0; 77) × 12.6 (12.1–13.2) (Middleton 1970b). Elsewhere, 17.0 × 12.0 (Heather & Robertson 2000; Oliver); 17.0 × 13.0 (Serventy & Whittell); 18.0 × 13.0 (NRS). Width more constant than length; length can thus be used to indicate size (Middleton 1970b); using length as an index, first egg of clutch apparently largest, second egg smallest, with subsequent eggs increasing in size; from 16 clutches in e. suburban Melbourne, mean size of first egg 16.7 (15.1–18.2; 13) × 12.4 (12.1–12.3); second egg, 16.1 (15.0–17.5; 15) × 12.6 (12.5–13.1); third egg, 16.2 (15.3–17.7; 12) × 12.7 (12.6–13.0); fourth egg, 16.3 (15.1–17.5; 12) × 12.7 (12.8–13.2); fifth egg, 16.5 (15.1–17.6; 9) × 12.8 (12.9–12.4) (Middleton 1970b).

Clutch-size Usually three or four (McEvey 1965; Serventy & Whittell); three to six (Frith 1969); four or five (Wilkinson & Wilkinson 1952; CSN 1); four to seven (Falla *et al.* 1981); five or six (Oliver); up to six (McGilp 1928); four or five, but ranging from two to six (Heather & Robertson 2000). From NRS: 4.6 (0.58; 139): C/3 × 5, C/4 × 43, C/5 × 89, C/6 × 2. At Griffith, NSW, 3.7 (1.05; 136) (Frith 1957). At Clayton, Vic., 4.8 (0.50; 54): C/3 × 1, C/4 × 11, C/5 × 41, C/6 × 1. At Wantirna, Vic., 4.5 (0.60; 21): C/3 × 1, C/4 × 9, C/5 × 11. At L. Charm, Vic., 4.7 (n=44) (Lowe & Lowe 1976). At Kindred, Tas., 4.7 (0.71; 36): C/3 × 2, C/4 × 10, C/5 × 21, C/6 × 3 (Leicester 1959). On Swan Coastal Plain, WA, C/5 × 2 (Storr 28). In NZ, 4.6 (0.64; 2–6; 129) (Niethammer 1970); also, 5.0 (3–6) (Middleton 1970b). At Taradale, NI, 4.05 (n=98) (Niethammer 1970). At Clayton, Vic., mean clutch-size decreased as breeding season progressed, but not significantly (P>0.05): mean clutch-size Sept., 5.0 (n=2): C/5 × 2; Oct., 4.8 (0.41; 20): C/4 × 4, C/5 × 16; Nov., 4.9 (0.47; 14): C/4 × 2, C/5 × 11, C/6 × 1; Dec., 4.6 (0.67; 12): C/3 × 1, C/4 × 3, C/5 × 8; Jan. 4.7 (0.52; 6): C/4 × 2, C/5 × 4. One nest at L. Charm, Vic., contained eight eggs, probably resulting from intraspecific brood parasitism (egg-dumping) (Lowe & Lowe 1976).

Laying In Aust., raise one or two broods per season (Middleton 1970b; Lowe & Lowe 1976); in NZ, often raise two broods in a season (Falla *et al.* 1981; Gibb 2000; Heather & Robertson 2000), and sometimes three (Niethammer 1970). Eggs usually laid on consecutive days (Middleton 1970b; NRS), though sometimes laying interval >24 h, and, once, >48 h (NRS). In one nest, two eggs laid between 08:15 on 4 Nov. and 10:35 next day (NRS). Eggs usually laid before dawn (Middleton 1970b; NRS), though in one nest, egg laid 11:30–17:00 (NRS). Occasionally lay replacement clutches. One nest contained three eggs on 14 Nov., and was empty on 22 Nov., but when checked on 28 Nov., it had four eggs; another nest had five eggs on 8 Nov., but all gone on 12 Nov.; when next examined on 22 Nov., five eggs present (NRS). Intraspecific brood parasitism (egg-dumping) suspected, as at L. Charm, Vic., a nest contained eight eggs (Lowe & Lowe 1976).

Incubation By female only (Middleton 1970b; *contra* Lane 1984). Eggs usually hatch over a day or two (Cole 1908; CSN 6; NRS). At Clayton, Vic., females incubated in stints of >1 h, separated by 5 (3–7) min intervals, when they often left nest to pursue intruders; and eggs usually hatched within 26 h of one another, in order of laying (Middleton 1970b). In one nest, all eggs in clutch of five hatched within 28 h 9 min, and another clutch of five within 29 h 18 min (NRS). Time of day of hatching varies, e.g. 15:10–16:15, 08:00–14:45, 07:30–17:05, and between 17:15 one day and 09:35 on the next; in clutch of five, first three eggs hatched 08:10–17:05 (NRS). Male feeds female on nest by regurgitation (Middleton 1969b, 1970b; Lane 1984; Heather & Robertson 2000). When eggs hatching, female often inspects nest-contents, or eats or removes shell fragments. **INCUBATION PERIOD:** AUST.: From NRS: laying to hatching, 13.6 days (1.19; 12–16; 60 eggs in 17 nests); completion of clutch to hatching, 11.8 days (0.74; 10–14; 53 eggs in 15 nests). At Clayton, Vic., 13.2 days (1.62; 12–16; 29 nests) (Middleton 1970b); 12–13 days (Frith 1969). NZ: 12 days (11–13) (Heather & Robertson 2000); 13 days (12–14) (Middleton 1970b); 12–13 days (Falla *et al.* 1981).

Young Altricial, nidicolous. Hatch blind and either naked or with sparse down (Middleton 1969b; NRS). Newly hatched nestlings usually have down on head and back; one described as having small lines of hair, including a single line forming circle on crown; down also develops on wings. Eyes open at 7–10 days old. Pins possibly develop at 5 days old, but usually 6–8 days, with feathers sprouting at 8–11 days old. Fully feathered by 12–13 days old (NRS), though remiges and rectrices not fully grown till 2 weeks after fledging (Middleton 1969b). Female broods nestlings for first 5–7 days after hatching (Lane 1984; Heather & Robertson 2000); at that time, male gives food to female, who then feeds it to nestlings (Heather & Robertson 2000); later, both parents feed nestlings by regurgitation (Lane 1984; Heather & Robertson 2000; CSN 34; NRS). When adult arrives at nest, nestling extends bill upward with gape opened wide. When feeding nestlings, adult first points bill upward with neck extended, peristaltic movements of neck then seen and adult then plunges bill downward into gape of each nestling in turn, with each nestling fed for ≤ 2 s at a time (Lane 1984). Eyes and bills of nestlings cleaned by adults, but nest-sanitation not recorded (Lane 1984). At one nest, pair assisted by a third bird, which sat on nest and fed young. When three adults arrived, they all perched round nest, then one would feed each chick in rapid succession, with 1–2 s between feeds; second and third adults then did the same; adults then left together. Each chick was fed on each visit; there were several feeding bouts a day, with chicks fed four or five times per bout at 10–15 min intervals (Lane 1984).

Fledging to independence **FLEDGING PERIOD:** AUST.: 15.3 days (1.24; 14–17; 31) (NRS). At Clayton, Vic., 11–17 days: 15.2 days (1.50) at nine successful nests, 1963–64, and 14.9 days (2.16) at 13 successful nests, 1964–65. Elsewhere in Aust., c. 14 days (Frith 1969). NZ: 14 days (12–17) (Heather & Robertson 2000); 13 days (12–14) (Middleton 1970b); 13–14 days (Falla *et al.* 1981). Young often fledge prematurely when approached by people, exploding from nest (Middleton 1970b; NRS). Sometimes young of brood all fledge within moments of one another (Middleton 1970b), but sometimes fledge over 24–48 hrs (NRS). Some said to leave nest by climbing out (Middleton 1970b). At one nest, one young fledged 10:07–16:45; remaining two fledged between 16:45 that day and 09:05 the next (NRS); at another nest, one fledged at 09:00 (Lane 1984). When fledging, fly a few metres to nearby cover (Middleton 1970b). Young that fledge earlier than rest of brood sometimes return to nest, eventually leaving with rest of brood (CSN 6; NRS). Fledgelings fed by both adults for 2–3 weeks (Heather & Robertson 2000); at

Clayton, Vic., fledgelings from five nests were last seen being fed by parents 14–20 days after fledging.

Success For 70 nests where clutch-size, number hatched and outcome known: of 323 eggs, 150 (46.4%) hatched and 65 (20.1%) fledged; equivalent to 0.93 fledgelings per nest; 17 nests (24.3%) successfully fledged at least one young; of 17 successful nests: mean clutch-size, 4.65; mean number of young fledged, 3.82. Of 34 nests where clutch-size and number hatched known, but number of young fledged unknown: of 158 eggs, 148 (93.7%) hatched; of 339 nests where outcome known, 117 (34.5%) successfully fledged at least one young, and 222 (65.5%) failed. In addition, 34 nests had well-feathered young, capable of leaving nest when last seen, and 13 nests had young that were presumed to have fledged successfully (NRS). At Clayton, Vic., of 76 nests with complete clutches, 38 (50.0%) hatched eggs and 22 (28.9%) fledged young; of 306 eggs, 149 (48.7%) hatched and 79 (25.8%) young fledged. At successful nests, 67 (91.8%) of 73 eggs hatched and 58 (79.5%) young fledged. Mean number of young fledged per nest (n=16 nests) 3.7 (0.8; 2–5); in six nests, all eggs progressed to fledge young. Nesting success appeared to increase as season progressed: of three nests in Sept., one (33.3%) successful; of 40 nests in Oct., six (15.0%) successful; of 36 nests in Nov., eight (22.2%) successful; of 22 nests in Dec., six (27.3%) successful; and of nine nests in Jan., three (33.3%) successful. Near Taradale, NI, from 98 nests: of 397 eggs, 249 (62.7%) hatched, and 195 (49.1%) young fledged (Niethammer 1970). Nest-failures mostly attributed to: (1) predation; (2) wind blowing nests from trees and damaging or spilling contents; or (3) heavy rainfall soaking nests, leading to desertion; a few nests failed due to human disturbance (NRS). At Clayton, Vic., main causes of nest failure were predation, wind and desertion; of 85 nests, 35 (41.2%) apparently failed due to predation, 20 (23.5%) were deserted, 15 (17.6%) failed due to strong wind, six (7.1%) due to human disturbance, and remainder due to other causes. Predation also major cause of failure round Temuka, SI, where nests often torn apart and eggs smashed (Pennycook 1949). Grey Shrike-Thrush *Colluricincla harmonica* seen to take nestlings from one nest at Railton, Tas. (NRS). Eggs and nestlings taken by Swamp Harriers *Circus approximans*, Laughing Kookaburras *Dacelo novaeguineae*, Pied Currawongs *Strepera graculina*, Square-tailed Kites *Lophoictinia isura* (Tibicen 1978; McLennan & MacMillan 1985; Borella & Borella 1997; NRS); at one nest, a Noisy Friarbird *Philemon corniculatus* appeared to take Goldfinch nestlings to feed to its own young; and eggs in another nest destroyed by a butcher-bird *Cracticus* (NRS). Grey Shrike-Thrushes and Singing Honeyeaters *Lichenostomus virescens* sometimes harass nesting birds and pull nests apart, leading to desertion (Stranger 1997; NRS). Once, newly completed nest was usurped by Superb Fairy-wrens (McGarvie 1957). Nests also fail due to predation by ravens *Corvus* (Lowe & Lowe 1976). Rats and mustelids also take eggs and nestlings (Moors 1983; CSN 2); Cats thought to have killed nestlings in several nests (NRS); and suggested that Common Ringtail Possums *Pseudocheirus peregrinus* responsible for predation at two nests (NRS). Nestlings occasionally parasitized by fly larvae (Thompson 1903; Hindwood 1930; NRS). **CUCKOOS:** Sometimes parasitized by Pallid Cuckoo *Cuculus pallidus* and Horsfield's *Chrysococcyx basalis* and Shining C. *lucidus* Bronze-Cuckoos (Shepherd 1907; Cole 1908; Ey 1944; Chisholm 1945; McGilp 1945, 1956; Napier 1969; Beruldsen 1980; Campbell; SA Bird Rep. 1969–70; NRS). Though most nests deserted when cuckoo egg discovered, a few pairs successfully raise cuckoos (Cole 1908; Bryant 1933).

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 slightly in adults and first immatures. About 14 subspecies occur in n. hemisphere. Subspecies *britannica* thought to be subspecies introduced to HANZAB region (Niethammer 1971; DAB). Descriptions of plumages and bare parts given in BWP and Field Identification (q.v.).

MOULTS Following based largely on published information from Aust. (Middleton 1969b; Rogers *et al.* 1986) and NZ (Niethammer 1971). See Svensson (1992), Jenni & Winkler (1994) and BWP for detailed discussion on moults in n. hemisphere. **Adult post-breeding** (Second, or third, and subsequent pre-basic). Complete; primaries moult outward. In Britain, moult of primaries starts at p1 from mid-July to mid-Aug., and finished after c. 70 days, from mid-Sept. to late Oct. Following information from Aust. comes from study near Melbourne (Middleton 1969b), unless stated otherwise. Moult data recorded from 252 adults captured 1963–65: (1) active moult of primaries occurs Dec.–May; (2) moult of primaries starts at p1, with two or three primaries growing at once; (3) moult of secondaries inward, starting at s1 when p5 or p6 shed, and usually finishing at about same time as moult of primaries; (4) moult of tertials follows sequence s8–s9–s7 and finished before s5 shed; (5) moult of greater primary coverts synchronous with corresponding primary, and moult of greater secondary coverts starts when p4 shed; (6) moult of tail starts when p4 or p5 shed and finished before moult of primaries; (7) sequence of moult of rectrices usually t2–t3–t4–t1–t5–t6; (8) moult of head starts when p4 shed and many feathers replaced simultaneously; (9) moult of body starts soon after moult of primaries and occurs simultaneously in all feather-tracts; and (10) a distinct overlap between breeding season and moult-period, some females with egg in oviduct, incubating eggs or feeding nestlings, and with active moult of primaries. Table 3 summarizes moult of primaries near Melbourne (from Middleton 1969b). Individual duration of moult estimated at 2.5–3 months, comparable with duration in n. hemisphere. Rogers *et al.* (1986) recorded active moult of primaries and body in Vic. in Mar. At Taradale, NZ, Niethammer (1971) found all 15 adults collected in mid-Feb. had 'full moult', presumably including primaries; he also stated breeding and moult seasons overlap in NZ. **Post-juvenile** (First pre-basic). In n. hemisphere, either partial (in N of range) or complete (in S) (BWP). Jenni & Winkler (1994) gave details on variation in extent of moult in continental Europe; involves all feathers of head and body, all or most marginal and median coverts, and varying number of, or all, greater secondary coverts; some birds, especially those which replace at least seven greater secondary coverts, replace 1–3 tertials and 1–6 rectrices. A few replace up to four of p1–p7; these birds also replaced all greater secondary coverts, tertials and all or some rectrices; feathers of alula and greater primary coverts seldom replaced (Jenni & Winkler 1994). Near Melbourne, post-juvenile moult starts c. 1 month after

fledging; scapulars replaced first, then rest of body-feathers, then feathers of face and tertials (c. 2 months after fledging); primaries and secondaries not replaced (Middleton 1969b). **First immature post-breeding** (Second pre-basic). Those birds which undergo partial post-juvenile moult acquire adult plumage in complete second pre-basic moult, when c. 1 year old (Middleton 1969b).

MEASUREMENTS **SUBSPECIES BRITANNICA:** (1) Vic., adult skins (MV). (2) NZ (NI, SI, Auckland and Campbell Is combined), adult skins (NMNZ). (3–4) Adults, skins (Niethammer 1971): (3) NZ; (4) Britain. (5) Britain, skins (BWP).

		MALES	FEMALES	
WING	(1)	75.8 (1.86; 72–78; 9)	72.0 (2.45; 70–75; 4)	*
	(2)	76.4 (2.61; 72–82; 16)	–	
	(3)	77.6 (1.70; 75–82; 20)	76.2 (2.64; 71–81; 11)	*
	(4)	77.8 (1.47; 75–80; 24)	75.0 (1.80; 73–78; 6)	**
	(5)	78.8 (1.92; 76–82; 21)	75.9 (1.36; 74–78; 13)	**
TAIL	(1)	48.7 (1.73; 46–51; 9)	47.0 (2.45; 45–50; 4)	ns
	(2)	47.3 (2.41; 42–51; 16)	–	
	(3)	48.4 (1.64; 46–51; 19)	46.8 (44.5–50.5; 11)	
	(4)	48.0 (1.59; 46–51; 23)	47.3 (46.5–48.5; 6)	
	(5)	46.8 (1.64; 44–50; 18)	46.2 (0.91; 44–48; 13)	ns
BILL S	(1)	14.0 (0.82; 12.8–15.2; 9)	13.1 (0.97; 12.1–14.1; 4)	ns
	(2)	14.3 (0.83; 12.9–15.8; 16)	–	
	(5)	15.8 (0.62; 14.7–17.2; 19)	15.1 (0.53; 14.0–16.2; 13)	**
BILL N	(1)	10.3 (0.33; 9.9–11.0; 9)	9.9 (0.39; 9.3–10.1; 4)	ns
	(5)	11.1 (0.57; 9.8–12.0; 19)	10.5 (0.50; 10.1–11.6; 13)	**
TARSUS	(1)	14.8 (0.39; 14.3–15.3; 9)	14.4 (0.68; 13.5–15.0; 4)	ns
	(2)	15.3 (0.71; 14.1–16.4; 15)	–	
	(5)	15.0 (0.37; 14.3–15.5; 16)	14.3 (0.36; 13.6–14.8; 11)	**

SUBSPECIES BRITANNICA: (6) Vic., live birds, ages combined (Rogers *et al.* 1986).

		UNSEXED
WING	(6)	(74–81; 11)
TAIL	(6)	(46–51; 9)
THL	(6)	(26.7–29.3; 11)

WEIGHTS **SUBSPECIES BRITANNICA:** (1) Vic., adults, from museum labels (MV). (2) NZ (NI, SI, Auckland and Campbell Is combined), adults, from museum labels (NMNZ). (3) NZ, adults, from museum labels (Niethammer 1971).

	MALES	FEMALES
(1)	14.5 (0.58; 14–15; 4)	14.1, 14.5, 15.0
(2)	13.7 (1.57; 11.0–16.2; 13)	–
(3)	15.8 (14–18; 11)	15.1 (14–16; 7)

Rogers *et al.* (1986) gave weight range for unsexed birds captured in Vic. as 12.6–17.2 g (n=14). Ash (1964) gave mean weight of birds (sexes and ages combined) from s. England as 15.8 (1.40; 11.5–18.2; 50).

STRUCTURE See BWP for details.

AGEING Discussed in Svensson (1992) and Jenni & Winkler (1994); see also Field Identification. Juveniles readily distinguished by plumage and bare parts (see BWP and Field Identification). In Aust., most birds retain juvenile primaries,

Table 3. Summary of timing of moult of primaries in adult European Goldfinches near Melbourne, Jan. 1963–Feb. 1965 (from Middleton 1969b).

	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE
No. examined	0	0	0	0	35	49	22	37	22	27	13	47
No. with PMS 45	0	0	0	0	0	0	0	0	0	2	9	47
No. with active moult	0	0	0	0	0	18	18	37	22	27	4	0

secondaries, alula, greater primary coverts and varying number of juvenile rectrices, tertials and greater secondary coverts in post-juvenile moult. These birds acquire first immature plumage, which differs from adult plumage by following (Svensson 1992; Jenni & Winkler 1994; BWP): (1) most birds retain outer 1–3 juvenile greater secondary coverts, which have buff-white or yellowish-white tips (cf. yellow in adults) and show moult-contrast with less worn, replaced adult-like inner coverts; this contrast less obvious by spring when tips abraded; (2) some birds show moult-contrast between retained juvenile tertials (which have buff tips) and less worn adult-like tertials (with white tips) replaced in post-juvenile moult; this also less obvious in spring; (3) retained juvenile alula, primaries and secondaries more worn and duller than those of adult (which glossier black) at same time of year, but this not obvious by spring; (4) most birds retain some, or all, juvenile rectrices which narrower and more pointed at tips than those of adult; this not obvious by spring.

SEXING Adults and first immatures differ slightly in plumage and size, males larger on average (Svensson 1992; BWP; see Measurements above). Adult males have: usually more extensive crimson-red face (6–12 mm from base of lower mandible to upper throat), extending slightly behind eye and to forehead; black nasal bristles (projecting from lower forehead); glossy black crown; some have white patch on inner web of t4; extensively black marginal and inner median secondary upperwing-coverts, narrowly tipped brown. Adult females usually have: less extensive orange-red or red face (4–8 mm from base of lower mandible to chin but not upper throat), not extending behind eye; light brown-grey or blackish-grey nasal bristles; drabber, less glossy crown, some birds with grey-buff mottling on rear-crown; rarely have white patch on inner web of t4; marginal and inner median secondary coverts, dark brown with broad grey-brown fringes and black subterminal bar (Svensson 1992; BWP).

GEOGRAPHICAL VARIATION In n. hemisphere, slight variation in w. Palearctic, but more marked in Asia (see BWP for details). Up to 14 subspecies recognized (Peters), falling into two broad groups which sometimes considered different species: (1) *CARDUELIS* group (comprising up to ten subspecies) in w. Palearctic, E to n. and w. Iran and w. Siberia; these have black crown, nape and bar on sides of neck, and distinct white spots at tips of remiges; and (2) *CANICEPS* group (comprising four subspecies) in central Asia and Himalayas, E to w. Mongolia and L. Baikal, s. Siberia; these have longer bill, duller greyish crown and nape, and lack white spots at tips of remiges, but have long white stripe along outer edges of tertials (BWP). Populations introduced to HANZAB region thought to be subspecies *britannica* (Niethammer 1971; DAB), which occurs naturally in Britain, w. and nw. France, w. Netherlands and w. Belgium (BWP; Peters). Some birds from Aust. said to be closer in plumage coloration to nominate *carduelis* (DAB) which occurs naturally over most of continental w. Europe; nominate have slightly duller brown upperparts and belly (in fresh plumage), more extensively brown ear-coverts, and duller whitish belly than *britannica* (BWP). Birds from Tas. and SA said to be smaller than those from e. mainland Aust. (DAB), but no supporting data given. Within HANZAB region: adult males from NZ have longer Tarsus ($P < 0.05$) than adult males from mainland Aust. (see Measurements). Adults from Aust. (skins; this study) have shorter Wing and Bill S ($P < 0.01$; sexes separate) than adult *britannica* from Britain (data from skins; BWP); also, adult males from Aust. have longer Tail ($P < 0.01$) than adult males from Britain. These differences in morphometrics suggest populations in HANZAB region have diverged slightly from populations in Britain and Europe, but more data needed to confirm this.

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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