Order **PASSERIFORMES**

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

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

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

The Passeriformes divide into two main groups:

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

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

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

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

MENURIDAE (lyrebirds): two species in one genus; endemic to Aust.;
ATRICHORNITHIDAE (scrub-birds): two species in one genus; endemic to Aust.;
CLIMACTERIDAE (A'asian treecreepers): six species in two genera breeding in Aust.;
MALURIDAE (Australopapuan fairy-wrens, emu-wrens and grasswrens): 22 breeding species in three genera in Aust.;
MELIPHAGIDAE (honeyeaters and Aust. chats): 76 species in 26 genera in Aust. and NZ, all breeding;
PARDALOTIDAE (pardalotes, scrubwrens, thornbills and allies): 51 species (one extinct) in 15 genera in HANZAB region, all breeding;
PETROICIDAE (A'asian robins): 23 species in eight genera in HANZAB region, all breeding;
ORTHONYCHIDAE (logrunners): two breeding species in one genus in Aust.;
POMATOSTOMIDAE (A'asian babblers): four breeding species in single genus in Aust.;
CINCLOSOMATIDAE (whipbirds, wedgebills, quail-thrushes and jewel-babblers): eight breeding species in two genera in Aust.;
NEOSITTIDAE (sitellas): single species breeding in Aust.;
PACHYCEPHALIDAE (whistlers, shrike-thrushes and allies): 17 species in seven genera in HANZAB region, all breeding;
DICRURIDAE (monarchs, flycatchers, fantails and drongos): 19 species in seven genera in HANZAB region, all breeding;
CAMPEPHAGIDAE (cuckoo-shrikes, trillers and minivets): eight species (one extinct) in two genera in HANZAB region, all breeding;
ORIOLIDAE (Old World orioles and figbirds): three species in two genera in Aust., all breeding;
ARTAMIDAE (woodswallows, butcherbirds and currawongs): 14 species in four genera in HANZAB region, all breeding;
PARADISAEIDAE (birds of paradise): five breeding species in two genera in Aust.;
CORVIDAE (crows and jays): six breeding species in single genus in Aust. and NZ, including one introduced to NZ;
CORCORACIDAE (Aust. mudnesters): two species in two monospecific genera, endemic to Aust.;
CALLAEIDAE (NZ wattlebirds): three species (one extinct) in three monospecific genera, endemic to NZ;
LANIIDAE (shrikes): two species in HANZAB region, one accidental to Prince Edward Is, the other accidental to Christmas I.;
PTILONORHYNCHIDAE (bowerbirds): ten species in seven genera in Aust. (nine species) and NZ (one species), all breeding; Piopio of NZ probably extinct (Heather & Robertson 1997);
ALAUDIDAE (larks): two breeding species in HANZAB region (including one successfully introduced to Aust. and NZ);
MOTACILLIDAE (wagtails and pipits): eight species in two genera in HANZAB region, only two breeding (one on South Georgia), the rest non-breeding visitors or accidentals;
PRUNELLIDAE (accentors): one species successfully introduced to NZ;
PASSERIDAE (Old World sparrows and A'asian finches): 22 species in nine genera (including four successful introductions) in HANZAB region, all breeding;
FRINGILLIDAE (Old World finches): seven species in four genera in HANZAB region, all introduced except one naturally occurring vagrant to South Georgia;
EMBERIZIDAE (buntings, cardinals, tanagers and allies): two successfully introduced species, occurring NZ and Lord Howe I.;
NECTARINIIDAE (sunbirds and spiderhunters): single breeding species in Aust.;
DICAEIDAE (flowerpeckers): single breeding species in Aust.;
HIRUNDINIDAE (swallows and martins): eight species in four genera in HANZAB region, including four breeding species in Aust. and NZ, one non-breeding visitor and three accidentals;
PYCNONOTIDAE (bulbuls): one successfully introduced species in Aust.;
SYLVIIDAE (Old World warblers): 13 species in eight genera in HANZAB region, including ten breeding species (one extinct) in Aust. and NZ, and three accidental to region;
ZOSTEROPIDAE (white-eyes): seven species (one extinct) in single genus in HANZAB region, all breeding;
MUSCICAPIDAE (Old World flycatchers, thrushes and chats): eight species in six genera in HANZAB region, including five breeding species (two introduced), and four accidentals (including one on Prince Edward Is);
STURNIDAE (starlings and mynas): five species in four genera, four breeding in HANZAB region (including two species successfully introduced, and one species now extinct), and one accidental.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Family **PASSERIDAE** Old World sparrows

A rather small, morphologically homogeneous family of small, stout-bodied and largely seed-eating passerines, with short to moderately long wings, short legs and thick, finch-like bills. Some species, especially House Sparrow *Passer domesticus* and Eurasian Tree Sparrow *P. montanus*, strongly associated with human habitation, and among the most successful of all birds. The family, as defined here (see below), comprises *c.* 36 species in four, or possibly five, genera, distributed across Eurasia, Africa, Middle East, Indian subcontinent, and s. and se. Asia, including w. Indonesia E to Bali; some species have been introduced to N. America and the Neotropics (Sibley & Ahlquist 1990; Sibley & Monroe 1990; Monroe & Sibley 1993; Peters). The four genera are: *Passer* (true sparrows); *Petronia* and *Carpospiza* (rock sparrows or rockfinches); and *Montifringilla* (snowfinches); a possible fifth genus, *Gymnoris*, is recognized in some works (Svensson & Grant 1999), but usually subsumed in *Petronia*. Two species, House Sparrow and Tree Sparrow, successfully introduced to HANZAB region (Christidis & Boles 1994; Peters; DAB). Christidis & Boles (1994) combined the subfamilies Passerinae (Old World Sparrows), Ploceinae (weaverbirds, widowbirds and allies) and Estrildinae (grass-finches, waxbills, mannikins, whydahs and allies) into one large and morphologically heterogeneous family Passeridae. Here we follow BWP and DAB in restricting the family to the Old World sparrows, with no subfamilies distinguished.

The taxonomic history of the family is complex. Sharpe (1888) placed *Passer*, *Petronia* and *Montifringilla*, along with cardueline finches, in the family Fringillidae. He placed all other passerids (the four Passeridae genera listed above) in the family Ploceidae, which comprised two subfamilies, Viduinae (widowbirds, parasitic wydahs, estrildid finches and some weaverbirds) and Ploceinae (all other passerids, including most weaverbirds), the division based mainly on relative length of the outermost primary (p10) (Sharpe 1890). Chapin (1917) found length of p10 to vary greatly within the weaverbirds, and used presence or absence of mouth-markings in nestlings and skeletal anatomy to define subfamilies within the Ploceidae; he also placed Old World sparrows in the Fringillidae (which have very small p10 and whose nestlings lack distinct mouth-markings). (For further discussion on taxonomy of estrildid finches, weaverbirds and allies, see introduction to family Estrildidae; and see introductions to Motacillidae and Prunellidae for discussion of affinities between those groups and passerids.) Sushkin (1927) placed Old World sparrows in a distinct subfamily, Passerinae, within the Ploceidae, based on similarities in structure of palate, pattern of post-juvenile moult, and nest architecture to ploceid weaverbirds. Based on external anatomy, Sushkin (1927) placed the following subfamilies in the Ploceidae: Ploceinae (most weaver species), Passerinae (Old World sparrows, which he believed were the closest relatives to Ploceinae), Estrildinae (estrildid finches and allies), Bubalornithinae (buffalo-weavers), Plocepasserinae (sparrow-weavers, social-weavers) and Sporopipinae (*Sporopipes* weavers). This latter treatment found widespread general acceptance, with slight modifications according to author (Delacour 1943; Beecher 1953; Tordoff 1954). Beecher (1953) included Old World sparrows as a subfamily Passerinae in the Ploceidae, based mainly on their similarities with weaverbirds and wydahs in jaw musculature. Based on examination of red blood-cell antigens, Mainardi (1958) found a close relationship between Estrildinae and Passerinae. Collias & Collias (1964) retained *Passer* in the subfamily Passerinae (family Ploceidae), despite their nests showing no close resemblance to those of other subfamilies in Ploceidae. Ziswiler (1965) examined the seed-opening mechanism, palate structure and alimentary canal of passerids, and concluded that Old World sparrows, including *Passer* and *Montifringilla*, should be placed in the ploceid subfamily Passerinae; he also concluded that these differ from estrildid finches, which represent a distinct family, Estrildidae. This was largely supported by Bentz (1979) in his studies of limb musculature.

Based on studies of egg-white proteins (Sibley 1970) and uropygial gland waxes (Poltz & Jacob 1974), *Passer* was found to be unlike ploceid weavers and estrildid finches, and possibly more closely related to fringillid and emberizid finches. Sibley (1970) therefore suggested *Passer* be included in a distinct family, Passeridae. This was later supported by Bock & Morony (1978) in their studies of the skeleto-muscular system of the tongue, and they also separated weaverbirds and allies (Ploceidae) from estrildid finches (Estrildidae). More recent studies on chromosomes (Christidis 1986, 1987b) and allozymes (Christidis 1987a,b) lend support to the family Passeridae comprising three subfamilies: Passerinae, Estrildinae and Ploceinae. Evidence from DNA–DNA hybridization (Sibley & Ahlquist 1990) supports an expanded Passeridae, including the aforementioned three subfamilies, as well as Motacillinae (wagtails and pipits) and Prunellinae (accentors). The passerid lineage is thought to have diverged from the sunbirds (Nectariniidae) and subsequently, an estimated 20–25 million years ago, ancestors of Old World sparrows (Passerinae) diverged from ancestors of estrildid finches (Estrildinae), weavers and allies (Ploceinae), motacillids and accentors (Sibley & Ahlquist 1990). Accordingly, DAB recognizes the Passeridae as a distinct family (cf. Christidis & Boles 1994) and we follow this treatment here.

The largest in the family is probably Snowfinch *Montifringilla nivalis* (total length 17–19 cm, weight *c.* 35 g), the smallest probably Dead Sea Sparrow *Passer moabiticus* (total length 12 cm, weight *c.* 16 g). The family has the

following morphological and osteological characteristics (summarized from BWP and DAB): Wings rather broad, but varying from rather short and slightly rounded at tips (*Passer*) to moderately long and slightly pointed at tips (*Petronia*, *Montifringilla*). Ten primaries; p10 very short (10–25% length of longest primary), but not vestigial. Nine secondaries, including three tertials. Tail rather short to moderately long, with rather square or slightly notched tip; 12 rectrices. Bills short and robust, conical and tapering to point; see Ziswiler (1965) for anatomy and functional morphology of bills. Nostrils large; narial depression semi-operculate (Beecher 1953), partly covered by feathering from forehead and a few short bristles. Rictal bristles poorly developed. Legs and feet rather short and stout; tarsus sharply ridged on rear surface (acutiplantar); tarsal scaling laminiplantar. Hindclaw rather short. Syrinx with well-developed bony pessulus (Warner 1972). Tip of tongue has unique seed-cup supported by distinctive bone, the preglossale, which articulates with the anterior tips of the paired paraglossalia of the tongue skeleton (Bock & Morony 1978). Humerus with double pneumatic fossa (Bock 1962). Ectethmoid foramen either long and slit-like, or doubled (as in *Passer*; see DAB). Zygomatic processes massive and compoundly crested. Maxillo-palatine processes thickened. Medial palatine shelves reduced. Small tooth-like projections at mandibular angle.

Plumages usually in brown or grey tones, with varying black, white, rufous or yellow tones, depending on species. Most have dark streaking to upperbody, and males of several species, especially *Passer*, have black bibs. Most species also have prominent white tips to upperwing-coverts, particularly median secondary coverts. Sexes alike in most species, but differ in plumage in some *Passer*. In some species, significant seasonal variation in appearance of plumage with wear, e.g. males of some *Passer* brighter and more boldly marked in worn plumage as tips to feathers become abraded to reveal more boldly coloured bases. Colour of bills varies seasonally in many species, e.g. in most *Passer*, bill black in breeding condition, but paler with flesh-coloured base in non-breeding. Nestlings hatch naked (*Passer*, *Petronia*) or with dense down (*Montifringilla*, *Carpospiza*). Nestlings lack mouth markings (cf. nestling Estrildidae). Most species acquire adult plumage in a complete post-juvenile (first pre-basic) moult, but *Carpospiza* undergoes a partial post-juvenile moult to first immature plumage. Adults undergo a complete post-breeding (pre-basic) moult each year. Primaries moult outward. Tail moult symmetrical or asymmetrical.

Mostly occupy dry, open habitats. Many species of *Passer* closely associated with human habitation, inhabiting cities, suburbs, rural towns and cultivation, though also occur in open woodland (e.g. Eurasian Tree Sparrow), savanna (e.g. Swahili Sparrow *P. suahelicus*) or savanna woodland (e.g. Cape Sparrow *P. diffusus*), or riparian woodland (e.g. Dead Sea Sparrow). By contrast, rock sparrows *Petronia* seldom associated with human habitation, and mainly found in woodland, savanna, and rocky areas; and snowfinches *Montifringilla* inhabit barren mountainous areas (occurring as high as 5200 m asl in the Himalayas). Pale Rockfinch *Carpospiza brachydactyla* poorly known, but inhabits sparse shrublands, including alpine shrublands, in arid regions. In HANZAB region, House and Tree Sparrows mainly occur in modified habitats, and commonly associated with human habitation or activities, such as city and suburban parks and gardens, streets, railway stations and shopping centres, and in farming land and orchards. Only occasionally in natural habitats away from settlement (Heinzel *et al.* 1977; King *et al.* 1978; Mackworth-Praed & Grant 1980; van Marle & Voous 1988; Sibley & Monroe 1990; Maclean 1993; AOU 1998; Orn. Soc. Japan 2000; Robson 2002; Fry & Keith 2004; Knight & Beale 2005; BWP).

Most species sedentary, with some local movements, but some species partly or wholly migratory. Most species of *Passer* sedentary or resident, with some local movements, but several make seasonal altitudinal movements in central Asia (e.g. Russet Sparrow *P. rutilans*). Petronias also tend to undertake altitudinal movements in central Asia, though Chestnut-shouldered Petronia *P. xanthocollis* is partly migratory. Snowfinches *Montifringilla* are generally described as resident, but movements poorly understood, and Black-winged Snowfinch *M. adamsi* undertakes seasonal altitudinal movements in Nepal (moving from up to 5100 m asl in summer to winter at the balmy altitudes below 3445 m asl); possibly other snowfinches also make altitudinal movements. Pale Rockfinch is a short-distance migrant. In HANZAB region, House and Tree Sparrows sedentary or resident, with some evidence of local movements by House Sparrow (especially juveniles); extralimitally, House Sparrow mainly sedentary in w. Palaearctic, but central Asian populations migratory; and Tree Sparrow mainly sedentary or resident, but nominate *montanus* considered a summer visitor in n. Europe and an altitudinal migrant in w. Pakistan (de Schauensee 1984; Flint *et al.* 1984; Summers-Smith 1988; Maclean 1993; Grimmett *et al.* 1999; Robson 2000; Griffioen & Clarke 2002; BWP).

Omnivorous, but mainly eat seeds, especially of wild grasses and cultivated grain, which gleaned mainly from ground or directly from seed-heads; also take many invertebrates, mainly insects, which taken either from ground or from foliage of trees and shrubs; and some fruit or berries also taken by most species. Species associated with human habitation, especially House and Eurasian Tree Sparrows, eat much artificial food, such as scraps, and readily come to gardens and parks to feed. Predominantly forage on ground, less often in trees and shrubs; and mostly forage by gleaning. Some species, such as House and Spanish *Passer hispaniolensis* Sparrows, occasionally sally-strike insects from air; and many species also sally-hover to take insects from foliage and seeds from seed-heads. On ground, typical gait a hop (*Passer*, *Petronia*) or hop and walk (*Montifringilla*, *Carpospiza*) but sometimes run, somewhat like a lark. Most species gregarious, and can forage in large flocks, particularly during non-breeding season; some species, such as House Sparrow, can form massive foraging flocks of hundreds of thousands of birds in grain or

stubble fields, and are thus significant pests of cultivation, particularly grain crops. Some species, such as Parrot-billed Sparrow *P. gongonensis*, less gregarious, and tend to forage in smaller flocks, and most species less gregarious during breeding season, when often forage singly, in pairs or in smaller flocks. Often forage with other sparrows and finches (Grimmett *et al.* 1999; Fry & Keith 2004; BWP; see species accounts).

Many species gregarious throughout year, but some form flocks only in non-breeding season (e.g. Snowfinch). Mating system typically monogamous, at least socially, but with occasional polygyny recorded, and at least one species (Rock Sparrow *P. petronia*) appears to be usually polygamous; co-operative breeding also recorded occasionally (e.g. House Sparrow and Sudan Golden Sparrow *Passer luteus*). Several species form strong, lifelong pair-bonds (e.g. House Sparrow). Parental care usually shared between sexes, but in some species, only female incubates (e.g. Yellow-throated Sparrow *Petronia xanthocollis*). Most, if not all species, are territorial; and most species nest in loose colonies. In colonies, usually defend only the nest-site, and forage outside territory. Some nest solitarily, and defend an all-purpose territory. Some species roost communally (e.g. Sudan Golden Sparrow), particularly in non-breeding season. Several species roost in nests, at least when breeding. Social behaviour quite well known. All appear to scratch head indirectly. *Passer* often both bathe in water and dust-bathe; and sunning recorded in many species. All genera except *Passer* perform display flights, and species in *Montifringilla* perform rather elaborate song-flights. Sexual behaviour quite conspicuous in some species. When calling to nearby female, males of several species of *Passer* shiver lowered wings (e.g. House Sparrow [q.v.]) but in several others, males raise wings above back and flick them (e.g. Dead Sea Sparrow). Seldom clump together, and allopreening not recorded with certainty. Vocalizations generally rather harsh and often include chirping, grating or wheezing sounds. Song of most species rather simple, and functions in advertising (Ivanitski 1986; Summers-Smith 1988; Fry & Keith 2004; BWP).

Most species loosely colonial, but some nest solitarily. Typically monogamous, but there is polygamy and co-operative breeding. Use wide variety of nesting sites, including: holes in trees, rocks, cliffs and banks; branches of trees and shrubs; man-made structures; foundations of nests of larger species, including corvids and birds of prey; and old or appropriated nests, or old nest-sites of other species (including swallows, martins and woodpeckers). In *Passer*, nests usually domed or globular, with side entrance, though those in cavities sometimes lack roof; in other genera, nests more often flat or cup-shaped, without roof. Nests variously made of grass, twigs and sometimes other plant material; and lined with softer material, including feathers, hair, wool and fine plant material, such as plant down. Built by both sexes in *Passer*, usually by female only in other genera. Material may be added after laying has begun. Eggs usually oval or sub-elliptical, smooth and slightly glossy. Eggs usually white or whitish, marked (sometimes heavily) with spots and blotches of brown and grey, though those of *Montifringilla* white and unmarked. Usually clutch-size 3–6, but smaller and larger clutches recorded occasionally, particularly among genus *Passer*. Eggs usually laid on successive days. Incubation typically by both sexes, by female only in some species (e.g. Northern Grey-headed *Passer griseus*, Arabian Golden *P. euchlorus*, Pale Rock and Yellow-throated Sparrows, and Snowfinch); where incubation shared, apparently only female incubates at night. Incubation period 9–18 days, mostly 11–16 days; usually begins before completion of clutch. Nestlings brooded by both sexes or, in Dead Sea and Rock Sparrows, by female only; nestlings fed by both parents and, in some species, by helpers. Fledging period 10–25 days, but usually 11–21 days. Fledgelings typically dependent on parents for 1–2 weeks or more. Most species rear two or more broods per season, though Pale Rock Sparrow said to produce single brood (Ali & Ripley 1974; Ivanitski 1986; Summers-Smith 1988; Fry & Keith 2004; BWP).

No species considered globally threatened.

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Passer domesticus House Sparrow

COLOUR PLATE FACING PAGE 1112

Fringilla domestica Linnaeus, 1758, *Syst. Nat.* 10(1): 183 — Europa = Sweden.

The generic name is Latin *passer*, a sparrow; the specific name highlights a preferred habitat of this commensal of man, from Latin *domesticus*, domestic (from *domus*, a house).

OTHER ENGLISH NAMES Sparrow; English or European Sparrow; Flying or Avian Rat; Sprog, Spadger, Spriggy or Spidgie.

POLYTYPIC Nominate *domesticus*, w. and n. Europe and w. Russia through Kazakhstan and central and e. Siberia to nw. Manchuria, Amurland, n. Sakhalin and n. Hokkaido, Japan; introduced and established throughout e. Aust., from C. York Pen. and s. islands of Torres Str., S and W through w. L. Eyre Basin to Eyre Pen. and Great Aust. Bight; throughout NZ, including Stewart I.; and on Norfolk I. Also introduced N. and S. America, Caribbean islands, Hawaiian islands, Falkland Is, and S. Africa. Extralimitally, another 10–11 subspecies from s. Europe through Middle East, n. Africa and Saudi Arabia to n. Iran, s. Kazakhstan, nw. Xinjiang, China, Himalayas and s. Asia to Laos.

FIELD IDENTIFICATION Length 15 cm (14–17); wingspan 21.5 cm (19–25); weight 29 g. Large-headed and rather heavy-billed sparrow with flat crown, solid body and fairly long tail; when perched, tips of folded wings extend just past uppertail-coverts. In flight, wings appear broad with rounded tips, and tail slightly flayed outward with slight notch in centre of tip. Slightly larger than Eurasian Tree Sparrow *Passer montanus* but with proportionately shorter tail. Sexes very different in adults: male strikingly patterned grey, black, white and chestnut, with conspicuous grey cap and black bib; females fairly dull brown with conspicuous pale supercilium. Considerable seasonal variation in adult males resulting from wear of plumage and changes in colour of bill. Juveniles very similar to adult female; juvenile males and females differ only slightly. No geographical variation in HANZAB region. **Adult male** FRESH PLUMAGE (late summer to autumn): Pattern of head and neck distinctive. Forehead, crown and centre of nape, grey with faint buff tinge (formed by buff fringes to feathers), forming neat grey cap bordered below by bold black eye-stripe across lores to sides of nape, isolating small white spot behind upper rear corner of eye, and merging with light-chestnut band extending from behind eyes to cover hindneck and sides of neck, and curving round behind rear ear-coverts to end in point below lower rear ear-coverts. Ear-coverts and most of malar area, pale grey, combining to form large oval cheek-patch; anterior malar area, chin, throat and upper breast, black, forming distinct black bib mottled grey on lower part. White of lower sides of neck extends below pale cheek-patch to form small white notch behind chestnut point bordering rear of cheek-patch, though notch can be hidden in some postures. Mantle and scapulars broadly streaked rufous and buff, overlain with slightly narrower, but still bold, black streaks; sometimes grey bases to feathers show through in patches, especially on upper mantle and scapulars; back, rump and uppertail-coverts, brownish grey, forming contrasting greyish rump-patch, especially noticeable in flight. Uppertail, dark brown, grading to blackish brown subterminally, and with neat buff or light-brown fringes to all rectrices. Patterning of upperwing complex. Secondary coverts mostly chestnut with: black streaking to all secondary coverts; buff fringes to tips of marginal coverts; very broad white or cream tips to median secondary coverts, which form distinct broad whitish upper wing-bar; narrow white, cream or buff tips to greater secondary coverts, which form a second and narrower pale wing-bar; and primary coverts mostly blackish with reddish-brown fringes, broadest on greater coverts, but with outermost primary coverts white, forming narrow white stripe along leading edge of wing. Tertials, black with neat, broad rufous fringes; secondaries, grey-black with narrow rufous outer edges; and primaries, dark grey with pale-rufous edges and fringes to tips, very narrow on most but broader at bases of primaries, and combining to form small patch of pale rufous on folded wing. Lower breast below black bib, grey, grading to off-white on belly, and to cream or white on undertail-coverts, with broad dark-grey shaft-streaks to coverts. Undertail, grey with narrow off-white or cream fringes to rectrices. Underwing: coverts mostly off-white, with dark-grey bases to primary coverts forming fine dark mottling along leading edge of outerwing; remiges mostly dark grey with buff-white stripe along inner edge of each feather. Bill, grey-brown with broad dull-yellowish or flesh-coloured base to lower mandible and narrow blackish tip; gape, yellowish brown. Iris, dark brown. Orbital ring, blackish grey. Legs and feet, pinkish brown. WORN PLUMAGE (spring to early summer): Brighter and more boldly marked than fresh plumage, from which differs by: darker, leaden grey, cap, and chestnut of head and neck also darker, all lacking any buff tinge; and, most obviously, black bib much larger, extending over all but sides of breast (only upper breast in fresh plumage) and with no pale mottling. Also differ by wholly black bill. **Adult female** Top of head, hindneck and sides of neck, greyish brown, with faint blackish streaking to hindneck. Off-white to pale-buff supercilium extends above dark greyish-brown lores (slightly darker than malar area) and narrow greyish-brown rear eye-stripe from behind eyes across upper ear-coverts (and broadening towards hindneck); narrow and indistinct eye-ring, dull white. Malar area and ear-coverts, light grey-brown; and chin and throat, off-white or pale greyish-buff, with darker grey mottling in some birds forming faint and diffuse dark-greyish bib (but never matching any adult male). Mantle and scapulars, rufous-

brown with heavy black streaking and faint olive-brown streaking; back, rump and uppertail-coverts, olive brown, diffusely streaked blackish brown, barely contrasting with mantle. Tail as adult male. Upperwing much as adult male but chestnut and rufous replaced by duller rufous-brown. Most of underbody, light brownish-grey, sometimes with olive tinge, but centre of belly, off-white, faintly streaked light brownish-grey, and undertail-coverts as adult male. Undertail and underwing also as adult male. Seasonal variation in plumage not obvious as in adult male; very worn birds lack rufous tone to upperparts and have uniform light brownish-grey underparts. Bare parts as adult male at equivalent times of year. **Juvenile male** Similar to adult female, from which differs by: Supercilium slightly more buff, and many also have small white spot behind upper rear corner of eye (as in adult male); most also have small dark-grey bib (but never as obvious as in adult male); upperparts slightly paler brown, with pale-rufous and black streaks to mantle and scapulars; uppertail paler, dark brown, neatly edged pale rufous and tipped with pale buff, and rectrices also narrower and more pointed at tips; upperwing like that of adult female but with neat buff fringes to tips of feathers, and bar across tips of median coverts less well defined and more buff than white; and underbody paler, more brownish grey, and centre of belly cleaner white. Further, when juveniles in fresh plumage, in late spring to summer, adults are in worn plumage or actively moulting. Bill, pale pinkish-brown or pale pinkish-grey with yellow gape. Legs and feet, blue-grey. **Juvenile female** Very similar to juvenile male and differ from adult female in much the same way. However, most juvenile females (c. 95% of birds) differ from juvenile males by uniformly off-white chin and throat, much as adult female (rest have small bib as in most juvenile males; see Sexing).

Similar species In HANZAB region, only likely to be confused with **Eurasian Tree Sparrow**, and then only in poor views; see that text for details. Should not be confused with **Dunnock** *Prunella modularis* or **Common Redpoll** *Carduelis flammea*; see comments in accounts for those species. Adult female and juvenile Sparrow have some superficial resemblance to adult and juvenile **Bushlark** *Mirafra javanica*, but plumages very different and the two should be readily distinguished by: dark-brown tail with neat buff or light-brown fringes to rectrices but lacking broad white edges to tail (in Bushlark, tail has conspicuous narrow white outer edges, conspicuous in flight); unmarked and greyish breast (Bushlark has prominent dark streaking on off-white to buff breast); shorter, deeper and heftier bill (slightly longer and more strongly decurved in Bushlark); and rounded head with no crest (Bushlark sometimes shows short, blunt crest when feathers raised).

Strongly gregarious; usually in small flocks, though also often seen singly or in twos; larger flocks often form in autumn–winter. Flocks sometimes mix with Eurasian Tree Sparrows in areas of overlap. Mostly associated with human habitation or activity, where often tame and confiding, for example foraging on and under outdoor tables at restaurants and cafés when people seated, though can be quite shy and wary away from human contact. Mainly forage on ground, but also often forage in shrubs, trees and standing crops; often attracted to artificial sources of food. Usual stance often almost horizontal or partly upright, with tail held above level of lowered body. Hop over ground or between perches, sometimes accompanied by flicks of wings and tail; never run. Flight fairly direct, on whirring wings, even over long distances. In flight, flocks compact, and individuals within flock seldom change position. Often noisy (see Voice, and descriptions above).

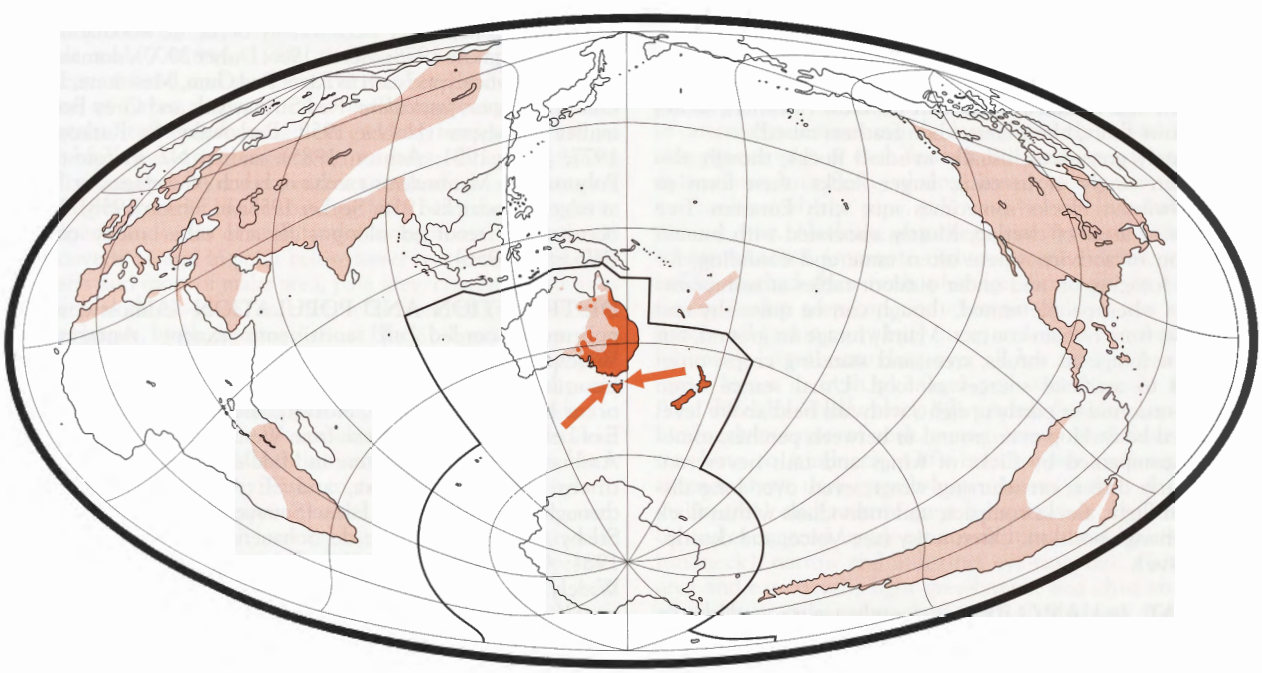
HABITAT In HANZAB region, mainly occur round human habitation (Sage 1957; Gibson 1977; Innes *et al.* 1982), but sometimes in grasslands, woodlands or forests away from settlement (e.g. Wodzicki 1956; Hobbs 1958; see below). Recorded from sea level to at least 1200 m asl (Sibson 1958; ACT Atlas).

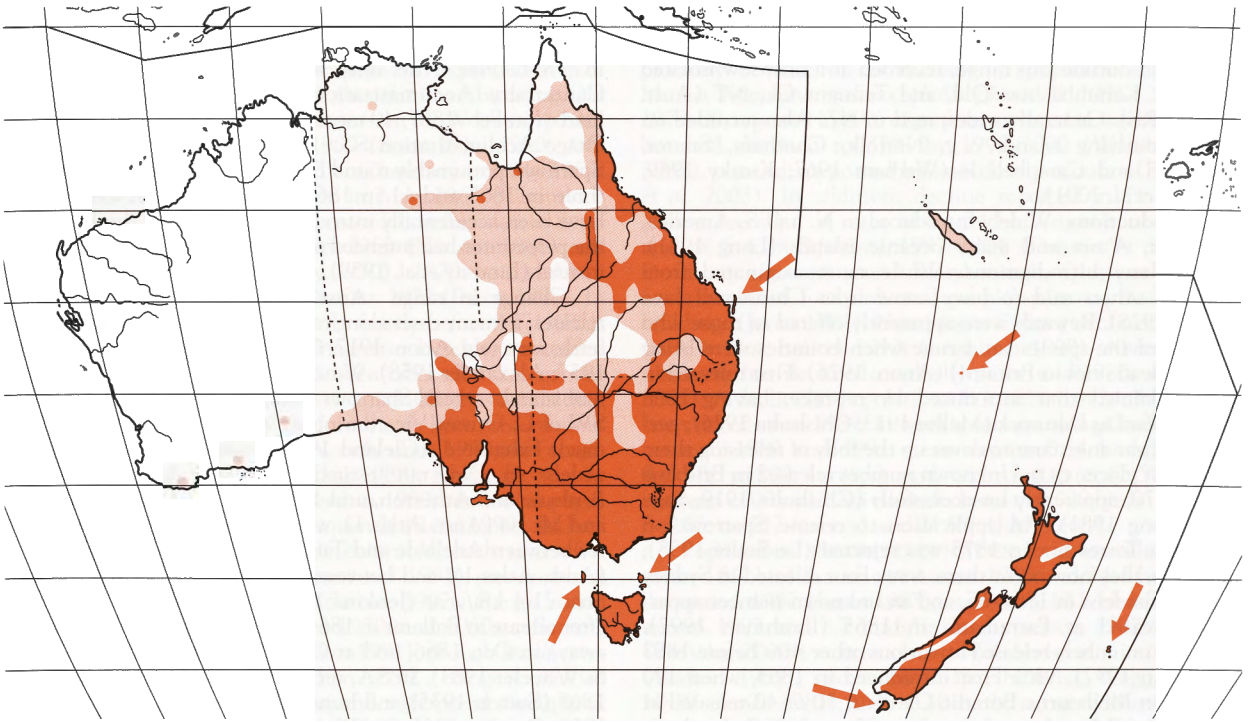
Mainly inhabit settled regions, especially urban and suburban areas, where they tend to be more common in older, better established suburbs (Jones 1981, 1983; Mason 1985; Green 1986; Green *et al.* 1989; Lenz 1990; Woodall 1995; ACT Atlas), and frequently in rural towns (Hobbs 1961; McEvey 1965; McEvey & Middleton 1968; Gill 1970; Green & McGarvie 1971; Horton 1975; Bedggood 1980; Leach & Hines 1987; Vic. Atlas); also often round farm houses and outbuildings (Cunningham & Wodzicki 1948; Hobbs 1961; Skegg 1963; Mack 1970; Morris 1975; Bedggood 1980; Conole 1981a; Loyn 1985), especially where holdings are small and close together (ACT Atlas). In settled areas, often seen in streets (Campbell 1943; Kloot & McCulloch 1980; Green *et al.* 1989; Kloot 2000), parks and gardens, especially with mown lawns (Beruldsen 1979; Green 1986; McKilligan & McKilligan 1987; Guest & Guest 1987, 1993; Gill 1989; Green *et al.* 1989; Norris *et al.* 1995; Disher 2000); and in rural gardens, often occur round fowlyards or other sources of food (e.g. Stirling *et al.* 1970; ACT Atlas). At Hamilton, NI, abundance of Sparrows declined with increase in proportion of native plants in gardens (Day 1995). Also often occur in farmland, especially grain crops and stubble and pasture (Hobbs 1955b, 1958; Sage 1957; Ridpath & Moreau 1966; McEvey & Middleton 1968; Dawson 1970; MacMillan 1981; MacMillan & Pollock 1985; Disher 2000), and in orchards (Ridpath & Moreau 1966; Fielding 1979; R.T. Baker 1980). Often found where grain spilt, such as along roadsides or railway lines or sidings (see Food). Also occur in weedy areas such as industrial sites (Morris 1975), saltworks (Watson 1955), sediment ponds (Beauchamp & Parrish 1999) and rubbish tips (Loyn 1985). Occasionally recorded far from settlement, including uninhabited islands (Hobbs 1955b, 1958, 1961; Wodzicki 1956; Boehm 1957; Bedggood 1972; Child 1975). Away from settlement, recorded in such habitats as: treeless saltbush shrublands (Hobbs 1955b, 1958); open grasslands, including upland tussock grasslands (Hobbs 1958; Child 1975; Ashton 1985); coastal heathlands (Morris 1986) and coastal scrub (Gosper 1999a); and otherwise open plains (Disher 2000). Also occasionally occur in grassland with sparsely scattered trees (Hobbs 1955b; Ridpath & Moreau 1966; McEvey & Middleton 1968; Longmore 1978). Very occasionally occur in woodlands or forests (Longmore 1978; Morris 1986; Disher 2000), dominated in Aust. by eucalypts, such as River Red Gum, Messmate, Pink Gum *Eucalyptus fasciculosa*, Red Stringybark and Grey Box or mallee eucalypts (Hobbs 1958; Ratkowsky & Ratkowsky 1977; Jones 1981; Ashton 1985), and in NZ in forests of Pohutukawa *Metrosideros excelsa* or beech *Nothofagus*, at least at edges (Wodzicki 1956; Secker 1958a,b; Sibson 1958). Very occasionally recorded along cliffs and other rocky coasts (Wodzicki 1956).

DISTRIBUTION AND POPULATION Almost cosmopolitan; recorded all continents except Antarctica. Widespread in Eurasia from Iberian Pen. and British Isles, E to Ussuriland in e. Siberia, mostly S of Arctic Circle (though occur beyond 70°N in n. Norway, and not so far N in area E of Lena R.), S to n. Africa, from Western Sahara E to Egypt, Arabian Pen. and elsewhere in Middle East, Indian subcontinent, w. and n. China, and SE Asia, from Burma, E through n. Thailand to Laos (Summers-Smith 1963, 1988; Silsby 1980; Long 1981; de Schauensee 1984; Flint *et al.* 1984; Grimmett *et al.* 1999; Robson 2000, 2002; BWP). Widely introduced: in N. America, widespread from Canada, in s. Yukon and Newfoundland, S to Veracruz and Oaxaca in Mexico (Long 1981; AOU 1998); in S. America, widespread from w. Colombia and Ecuador, and lower reaches of Amazon

R. (though largely absent from Amazon R. Drainage Basin), S to Patagonia (Long 1981; Ridgely & Tudor 1989; Harris 1998); in s. Africa, where widespread from sw. Angola and Malawi S to s. Cape Province of S. Africa (Clancey 1980; Long 1981; Maclean 1985; Dean 2000); in A'asia, widespread in e. Aust. and most of NZ (see below), and, though first recorded in PNG in 1976 (Ashford 1978) and few records before 1990 (Coates 1990), now established in Port Moresby (Carter *et al.* 1997). Also widely introduced (deliberately or otherwise) to many oceanic islands, from Iceland S to Falkland Is (see Long 1981).

Aust. Introduced. **Qld** Widespread. On C. York Pen., recorded at sparsely scattered sites (e.g. Weipa and Edward R. on w. coast, Iron Ra. and Coen in E, and Southwell Stn in between) and generally absent in area from 15°S S to 17°S, from e. shores of Gulf of Carpentaria E to 144°E (i.e. area W of Atherton Region [Wet Tropics]). Generally widespread elsewhere, though scattered nature of distribution in some parts of South-Central and South-Western Regions possibly reflects distribution of station homesteads (Beruldsen 1979; Bruce 1979; Garnett & Bredl 1985; Aust. Atlas 1, 2; Storr 19). Also occur on various islands in Torres Str., from Boigu and Saibai S to Thursday I. (Draffan *et al.* 1983; Carter *et al.* 1997; Carter 1999; Aust. Atlas 1, 2); and some islands in Great Barrier Reef, S to Lady Elliot I. (Walker 1986, 1987; Smith 1987; Aust. Atlas 1, 2), as well as other offshore islands, such as Fraser, Moreton and Stradbroke Is (Vernon & Martin 1975a,b; Sutton 1990). **NSW** Widespread (Morris *et al.* 1981; Cooper & McAllan 1995; Aust. Atlas 1, 2) but sparsely scattered in Central-west Plain and Upper and Lower Western Regions (Cooper & McAllan 1995; Aust. Atlas 1, 2), where usually associated with towns, settlements or homesteads, but sometimes recorded well away from human habitation (Chisholm 1929; Hobbs 1955b, 1958, 1961; see Habitat). **Vic.** Widespread, but sparsely scattered in E. Gippsland, mountainous areas of Great Divide in n. Gippsland and s. North-East Region, and in Sunset Country of Mallee (Vic. Atlas). **Tas.** Mostly recorded in N and E. In N, widespread in coastal and subcoastal areas from Woolnorth E to Swan I. and Great Musselroe Bay, and from coast S to mouth of Arthur R., Nabageena and Preolenna in NW, and thence S to line joining L. Cethana, Cressy, Porcupine (27 km W of Mathinna), and Herrick. Also occur farther S, at scattered sites in uplands N of Esk R. Valley, and along e. and se. coasts, from St Helens S to s. Bruny I. and Southport, and inland along Midland and Lyell Hwys, and in intervening area (Thomas 1979; Field & Field 1989; Aust. Atlas 1, 2). Largely absent from W, with isolated records, mainly from Granville Harbour and Tullah, S to Strahan and Queenstown (Thomas 1979; Aust. Atlas 1, 2), and vagrants in SW (White 1985), e.g. at Moth Ck, a few times before 1961 (Green & Mollison 1961), Cockle Ck, Dec. 1973 (Tas. Bird Rep. 3) and on Maatsuyker I., Jan. 1975 (Brothers 1979). Also occur on islands in Bass Str., including Hunter Grp (Pinner & Bird 1974; Bryant & Holdsworth 1992), King I. (Green & McGarvie 1971; Holdsworth 1998), Furneaux Grp (Green 1969; Tas. Bird Rep. 24) and Deal I. (Whinray 1971; Garnett *et al.* 1991). **SA** Generally widespread S of 29°S, and E of 134°E (Stove 1994; Aust. Atlas 1, 2), though sparse distribution in more remote areas often reflects distribution of homesteads, e.g. in Lower North Region, Willauran Ras and n. Eyre Pen., and Gawler Ras (Bonnin 1965; Mack 1970; Badman 1981; Baxter & Paton 1998; Aust. Atlas 1) and similarly on some offshore islands, e.g. Wedge I. (Bonnin & Angove 1980). Outside this range, recorded at scattered sites farther N, in L. Eyre Drainage Basin, from round Merty Merty Stn on Strzelecki Track, N to Pandi Pandi Stn on Birdsville Track, and W to Oodnadatta and Nilpinna Stn; and on e. Nullarbor Plain, recorded from Ceduna W to Koonalda Stn and N to Transcontinental Railway, at Cook and Ooldea (Badman 1979, 1989; Mollenmans *et al.* 1984; Klau 1988; Aust. Atlas 1, 2). **WA** No records in Aust. Atlas (Aust. Atlas 1, 2). Since mid-1960s, recorded in small numbers at various widely scattered sites, mainly associated with transport: in Eucla Div., recorded at Border Village and Eucla (both on Eyre Hwy), at Rawlinna (on Transcontinental Railway), Kewdale (railway yard) and Esperance (on jetty in port). Records elsewhere mostly at or near ports: Albany, Kwinana and Fremantle (Long 1988; Serventy & Whittell; Storr 27), though very occasionally recorded away from ports and other main transport routes, e.g. colony comprising *c.* 60 birds at Mariginiup, *c.* 25 km N of Perth, in early 1994 (Anon. 1994). Unidentified sparrows also





recorded at Bunbury, Geraldton, Broome and Derby (Long 1988). **NT** Occasional records in Top End, but few published, mainly from round Darwin, e.g. Sanderson, Dec. 1979–Feb. 1980 (Aust. Atlas 1); single female, Fannie Bay, Darwin, Jan.–Feb. 1980 (Aust. Atlas 1); pairs in suburban Darwin, at Palmerston and Stuart Park in 1992, apparently arrived by road transport (Chapman 2000); record at Cullen Bay, Darwin, in 1998 (Goodfellow 2001), actually of Eurasian Tree Sparrow (Chapman 2000). Elsewhere in Top End, also recorded at Katherine, Aug. 1981 (Aust. Atlas 1). Most records are from farther S, mainly in Barkly Tableland, from Anthony Lagoon Police Stn S to L. Nash, and especially along Barkly Hwy, W to Tennant Ck, where well established (Goodfellow 2001; Aust. Atlas 1, 2). Other isolated records farther S, at Tobermorey Stn, where apparently established, and Mt Ebenezer, where recorded in June 1981 (Aust. Atlas 1, 2).

NZ Introduced and widespread, though absent or sparsely scattered in some mountainous or forested areas (NZ Atlas). **NI** Generally widespread in all districts, from C. Reinga and North C., S to C. Palliser, 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 e. and s. Volcanic Plain, to n. Wanganui. Also recorded on various offshore islands, from Three Kings Grp S to N. Brother I. in Cook Str. (Turbott & Buddle 1948; Gaston & Scofield 1995; NZ Atlas; NZCL; CSN). **SI** Generally widespread in Marlborough, Canterbury and Otago, in area E and S of line from Inland Kaikoura Ra., through Puketeraki and Craigieburn Ras, L. Coleridge and Makarora R., to L. Wakatipu. Also widespread in e. and s. Southland, including Stewart I. and associated islets, but either absent or recorded at a few sparsely scattered sites in Eyre and Umbrella Mts, and largely absent from Fiordland, W of line from Mossburn to nw. Te Waewae Bay, though a few records near Preservation Inlet, and recorded at scattered sites between Manapouri and Milford Sound, especially along road N of Te Anau. Generally widespread in West Coast, W of S. Alps, from Jackson Bay NE to Karamea; in Nelson, generally absent from Kahurangi NP, but widespread round C. Farewell and Farewell Spit, and, farther S, from Collingwood S to Ls Rotorua and Rotoiti, extending E to w. slopes of Spenser, St Arnaud and Richmond Ras in w. Marlborough, but largely absent between there and Inland Kaikoura Ra. (NZ Atlas; CSN).

Norfolk I. Widespread in cleared areas; also recorded on Philip I. (Schodde *et al.* 1983; Hermes *et al.* 1986). First recorded in 1930s (Williams 1953; Hermes 1985).

Chatham Is Occur in small numbers on Chatham, Pitt and South East Is (Freeman 1994; Nilsson *et al.* 1994), though locally common at Te One and Waitangi (CSN 43). Said to have colonized naturally in *c.* 1880 (Oliver), but also said to have been introduced (see below); numbers increased by early 1920s (Thomson 1922; Heather & Robertson 2000).

Snares Is Recorded in small numbers (Warham 1967; Horning & Horning 1974; Miskelly *et al.* 2001), with up to 14 birds in 1976–77 (Sagar 1977), but population declined by 1980s, with five resident in 1986–87, and only twice recorded in 1990s (Miskelly *et al.* 2001). First recorded in 1947 (Fleming 1948).

Campbell I. Vagrant. Reported in 1907 (Waite 1909), and unidentified sparrows also said to have been seen before 1960, though these thought to have been Dunnocks (Westerskov 1960); first confirmed record was of single bird, Jan. 1963 (Kinsky 1969). A few subsequent published reports: about nine, Feb. 1965 (Kinsky 1969); unknown number seen almost daily (and three nests found), Jan. 1968 (Kinsky 1969); three birds (two males and a female), 5 July 1976–1 Feb. 1977, possibly breeding (CSN 24).

Auckland Is Vagrant but no details. Probably first recorded in early 1940s (Williams 1953; Yaldwin 1975; NZCL).

Antipodes Is Vagrant. Single, Nov. 1978 (Tennyson *et al.* 2002).

Prince Edward Is Three (ship-assisted), 13 Apr. 1976 (Burger *et al.* 1980).

S. Georgia Single (ship-assisted), late 1950s (Prince & Payne 1979).

Breeding Widespread in e., se. and s. Aust., mainly E and S of line joining Cairns, ne. Qld, to Ceduna, SA, though only recorded at sparsely scattered sites in East-Central, South-

Central and South-Western Regions of Qld and w. Central-West Plain and e. Upper and Lower Western Regions of NSW; and outside this range, recorded at a only few isolated sites, e.g. Karumba, nw. Qld, and Tennant Ck, NT (Aust. Atlas; NRS). Generally widespread in NZ. Also recorded on various outlying islands, e.g. Norfolk, Chatham, Snares, Auckland and Campbell Is (Warham 1967; Kinsky 1969; Miskelly *et al.* 2001).

Introductions Widely introduced to N. and S. America, S. Africa, A'asia and many oceanic islands (Long 1981). **Aust.** Many introductions. While most originated from England, others said to have come from China and Java (Hardy 1928). Rewards were apparently offered to those who introduced the species (at a time when bounties were being paid for dead ones in Britain!) (Anon. 1926). First released in 1863. Claimed that introduced by mistake, having been misidentified as Dunnock (Mellor 1913; Chisholm 1926); perhaps this was an excuse to cover up the folly of releasing them in the first place. QLD: Unknown number released in Brisbane in 1869–70, apparently unsuccessfully (Chisholm 1919; Sage 1957; Long 1981). An application to release Sparrows on islands in Torres Str. in 1875 was rejected (Le Souëf 1958); regardless, they now occur there. NSW: Four released in Sydney Botanic Gardens in 1864–65, and an unknown number apparently released at Parramatta in 1865 (Leishman 1997). Unknown numbers released at various other sites before 1883 (Leishman 1997). VIC.: First introduced in 1863, when 120 released in Melbourne Botanic Gardens, 30 or 40 released at Pentridge (Coburg), and another 80 said to have been released by Mr Sprigg at unknown site; in 1864, another 125 released at St Kilda, Pentridge, Boroondara (Camberwell) and Ballarat; in 1865, another 28 released in Ballarat Botanic Gardens; unknown number released in Melbourne in 1866. In 1867, many captured in Melbourne and released elsewhere in Vic.: six released at Kyneton and 14 at Ararat, together with unknown numbers at Beechworth, Benalla, Somerton, Geelong, Meredith, Winchelsea, Warrnambool, Portland, St Arnaud, Maryborough, Ballarat, Daylesford, Castlemaine, Heathcote and Gisborne, and sites along Murray R.; and 100 more imported and released in 1872 (Ryan 1906; Hardy 1928; Tarr 1950; Le Souëf 1958; Balmford 1978; Long 1981; Thomas & Wheeler 1983; Heathcote 1999). TAS.: First released in *c.* 1860s, when unknown number released in Launceston, having been imported from Adelaide; apparently mistakenly thought to have been Eurasian Tree Sparrows (Littler 1902); and others said to have been shipped from Melbourne for release in Hobart in 1867 (Le Souëf 1958). SA: Unknown number released in 1863, presumably round Adelaide (Sutton 1935; Condon 1951, 1962). WA: First recorded in 1897 or 1898, when five recorded in Perth, probably having arrived accidentally by boat, and others have arrived similarly in 1903, 1911–12, 1927, 1930, 1946 and 1957, and apparently almost annually between mid-1960s and 1980s (Long 1988; M. Massam). **NZ** Probably many introductions, apparently in attempt to combat insect and weed pests, but, in turn, becoming a pest in its own right. Acclimatization societies initiated introductions (and congratulated themselves on their success), but later, when the species became a pest, dissociated themselves from any involvement (Thomson 1922; Moncrieff 1931); other introductions were probably done privately (many birds were sold at auction, and acclimatization societies offered substantial inducements, of up to £1 10 s for a pair, for immigrants to bringSparrows with them), and were thus without any published details; ten releases detailed in Thomson (1922; on which account below based unless stated). NI: In Auckland, 300 imported and released in Aug. 1859 (Hargreaves 1943),and two (survivors of 72 shipped) released in 1865, and another 47 in 1867. Unknown number introduced into Wanganui in 1866. SI: Single imported into Nelson in 1862; another single (the sole avian survivor of the voyage) introduced in 1864, and six more introduced at Stoke in 1871. Five (the only survivors of 156 imported by Canterbury Acclimatization Soc.) released at Lyttleton Harbor in Feb. 1867; 40 more released later in same year. The Otago Acclimatization Soc. admitted releasing 'one or two' Sparrows, presumably round Dunedin, but actually introduced three in 1868 and 11 in 1869. OUTLYING ISLANDS: Said to have been accidentally introduced to Pitt I. in Chatham Grp; the perpetrator had intended to release Skylarks *Alauda arvensis* instead (Lindsay *et al.* 1959).

Change in range **Aust.** Range expanded rapidly after releases, in many cases along roads or railways, following human settlement (e.g. Anon. 1917; Cleland 1919; Bourke 1957; Sage 1957; Alexander 1958). Wind-blown birds easily able to colonize islands: several Sparrows landed aboard a vessel *c.* 320 km SW of C. Otway, Vic., during strong ne. wind, and were 'not much exhausted' (Cleland 1906). Rate of expansion varied widely: in Qld, rate estimated at 85.3 km/year between Brisbane and Atherton, and 103.6 km/year between Brisbane and Mt Isa (Aust. Atlas 1), while in more inhospitable country between Adelaide and Tarcoola, SA, rate was 6.7 km/year (Aust. Atlas 1), and between Fowlers Bay and White Wells Stn, 21.4 km/year (Jenkins 1959). *19TH CENTURY*: In Vic., after release in Ballarat in 1864, recorded at Daylesford (35 km away) in Oct. 1866, and at Creswick in Nov. 1866 (Thomas & Wheeler 1983). In SA, recorded in Mt Gambier, in SE, in 1868 (Sutton 1935) and hundreds recorded by 1874 (Sutton 1935; Condon 1951, 1962), probably having expanded across border from Vic.; probably reached Mt Mary, in Murray–Mallee Region, in 1890s (Boehm 1957); and present on Kangaroo I. in 1893 and well established by 1910 (Cooper 1947). Reached Queanbeyan, NSW, in 1886 (Wilson 1999). Recorded on Deal I., Kent Grp, in Bass Str. in 1890 (Le Souëf 1891). *EARLY 1900S*: Recorded throughout Vic. (though still not present in Wyperfeld NP by 1929 [Hanks 1930]), and parts of Tas. (including islands in Bass Str., but not some areas W of Hobart), SA and s. NSW (Littler 1902; Ryan 1906), though first recorded in Murrumbidgee Irrigation Area in *c.* 1916 (McKeown 1923). In inland SA, reached Copley in *c.* 1900, Wooltana Stn in *c.* 1904 and Moolwatana Stn in 1907 (Jenkins 1959). Arrived at Port Lincoln, SA, some time before 1909, as said to have been numerous by then (Hall 1910). *1910S–1920S*: Timing of expansion into se. WA not clear: first record at Eucla, near SA–WA border, said to have been in 1914 (Long 1988) or *c.* 1917 (Serventy & Whittell); and recorded Mundrabilla Stn, *c.* 100 km farther W, in either Aug. 1914 (Jenkins 1959; Storr 27) or *c.* 1918 (Long 1988; Serventy & Whittell), though also asserted that date of *extermination* (not arrival) at Mundrabilla Stn was 1918 (Storr 27); also unconfirmed report from Rawlinna in 1927 (Anon. 1928). Claimed that expansion of range across Nullarbor Plain was thwarted by decline in use of horses as transport, thus depriving Sparrows of food in manure (Jenkins 1959), but more probably checked by arid climate (Sage 1957; Aust. Atlas 1). Reached N to L. Frome, SA, by 1919 (McGilp 1919) and Callabonna in 1920 (Jenkins 1959). By *c.* 1920, recorded Dalby and Bunya Mts, W of Brisbane (Sage 1957). Widespread throughout NSW by early 1920s (Leishman 1997). In inland SA, reached Marree, William Ck and Oodnadatta by 1920s (Simpson 1931; Chisholm 1950; Condon 1962), though in trip along Strzelecki Track in 1923, recorded only as far N as Murnpeowie Stn, S of L. Blanche (Cleland 1925); also first recorded on Pearson I., Investigator Grp, off w. Eyre Pen., in 1923 (Hornsby 1978). In Qld, occurred N to at least Rockhampton in 1926 (Chisholm 1926) (and said that by 1960 the species had still not occurred farther N, except for vagrants at Mackay; Aust. Atlas 1). *1930S*: By mid-1930s, range had expanded to reach

MacPherson Ras, on Qld–NSW border, having 'penetrated as far as Tyalgum, Limpinwood and similar centres' (Marshall 1935), but no indication whether range had expanded from N or S, though Chisholm (1919) thought that birds in Qld resulted from n. expansion of range from NSW in early 20th century, said to have been *c.* 1900 (Storr 19). *1950s AND 1960s*: In nw. Qld, first recorded at Cloncurry in early 1950s (Carruthers 1966) and at Mt Isa in Mar. 1965 (Carruthers 1966; Horton 1975); in ne. Qld, recorded at Innisfail in Sept. 1964 (Gill 1970), Townsville in 1965 (Nielsen 1996) and Atherton in Oct. 1965 (Bravery 1970). *1970s AND BEYOND*: First recorded in Gawler Ras, SA, Oct. 1972 (Paton 1975). In Qld, first arrived on Lady Elliot I. shortly before 1971 (Fien 1971; Walker 1986), and on Magnetic I. seldom recorded before 1985 (despite having been recorded in nearby Townsville for 20 years), but now established as a breeding resident (Wieneke 1988). Said to have been recorded at Cook, e. Nullarbor Plain, sw. SA, only since 1980, and considered resident by mid-1980s (Klau 1988); Roxby Downs, in inland SA, probably first colonized in 1980s, and local population has increased greatly subsequently (Read 1999). In Bass Str., Deal I. has been repeatedly colonized, each time after local population eradicated (Garnett *et al.* 1991), presumably as small numbers cross Bass Str. (Sutton 1997). Range round Sydney said to have expanded in 1970s and 1980s, reflecting pattern of suburban sprawl (Hoskin 1991), though inconceivable that not already present there. **NZ** Range expanded rapidly after initial introductions, and widespread throughout settled areas by mid-1890s (NZ Atlas). Considered 'thoroughly acclimatized' in Auckland in 1868, just a year after release (Thomson 1922). In Canterbury, by 1869 said to have been 'particularly numerous' round Kaiapoi, *c.* 32 km from Lyttleton, where five had been released 2 years earlier; and, in 1871, were 'thoroughly established [in Canterbury] and no need for further importations' (Thomson 1922). Recorded in Fiordland in early 1900s (Hall-Jones 1966), but apparently did not persist. Populations at Port Whangarei increased significantly between 1969–71 and 1979–80, after change in land-use (Beauchamp & Parrish 1999). **Norfolk I.** After first record in late 1930s, common by 1962 (Anon. 1963), and the second most common passerine (after Common Starling *Sturnus vulgaris*) by 1967 (Wakelin 1968).

Changes in populations INCREASES: Local populations have increased rapidly soon after arrival at various sites. After having been released in Kyneton, Vic., in 1863 (see Introductions, above), regarded as a pest there by 1890, when thousands present (Heathcote 1999). By *c.* 1900, numbers in NSW had increased to such an extent that considered a pest (Anon. 1909), and hundreds present in Sydney Botanic Gardens by 1903 (Leishman 1997). After first record on Kangaroo I., SA, in 1890s, abundant by early 1920s, and remained so till at least 1980s (Lashmar 1988); numbers on Wedge I., SA, were so great in 1916 that they were a serious pest to nearby Barley crops (Morgan 1916; White 1916); said to have been 'amazingly plentiful' throughout between Port Augusta and Adelaide in 1926 (Serventy 1927). Soon after arrival at Innisfail, ne. Qld, in 1964, population increased rapidly (Gill 1970). Numbers round Charters Towers, Qld, said to be increasing (Britton & Britton 2000). DECREASES: Population round Adelaide said to have decreased greatly between 1890s and early 1950s (Cleland 1952). Declines in populations in various areas of Aust. have been detected in recent years. Population in Townsville, ne. Qld, declined 'remarkably' between 1980–81 and 1996–97, having previously been the most common species, comprising 36.4% of all birds seen, but later comprised just 16.6%; this is correlated with a marked increase in local population of Common Mynas *Acridotheres tristis* (Jones & Wieneke 2000; see Populations, below). Numbers in suburban Brisbane were formerly rather stable, with no great overall variation between 1972 and 1983 (Woodall 1987), but population has subsequently declined, probably because of an increase in populations of Noisy Miners *Manorina melanocephala* (Woodall 1996, 2002); in 1979–80, reported in 69% of gardens surveyed in weekly surveys, but had declined to 37% by 1999–2000 (Woodall 1995, 2002), a trend supported by anecdotal accounts (Rollinson *et al.* 2003). In addition, decline reported in Brisbane R. Valley: recorded at rates of 13–34 birds/survey in 1981–96, and at 5–6 birds/survey 1997–2004 (Danson *et al.* 2005). Declining numbers round Maryborough, Qld, attributed to fewer backyard fowlyards and people sparrow-proofing their buildings (Jones 1981). Numbers in Sydney declined substantially in first half of 1990s (Leishman 1997). Abundance in Canberra has declined markedly since mid-1980s (Veerman 2002). A decline in populations in e. suburban Melbourne has been noted since 1989; in weekly surveys along Gardiners Ck, between 1989 and 1992 mean density 0.54 birds/ha (0.64; 0–3.58; n=207 surveys) and reporting rate 85.5%, while between 2000 and 2003 these declined to 0.029 birds/ha (0.077; 0–0.63; n=187 surveys) and 21.9% (J.M. Peter).

Populations RECORDED DENSITIES: In Townsville, ne. Qld, mean 18.7 birds/ha in wet season 1980 and 14.4 birds/ha in dry season 1980 (Jones 1983), and mean 10.8 birds/ha in wet season 1997 and 8.7 birds/ha in dry season 1997 (Jones & Wieneke 2000); maximum of 12.4 birds/ha, Corinda, Qld (Walters 1985); maximum of 35.1 birds/ha, Wagga Wagga, NSW (Jones 1981); 0.03–0.30 birds/ha, near Moyston, Vic. (Kennedy 2003). NUMBERS RECORDED IN 5-MIN COUNTS: 0.01 birds/count (0.18; 333 counts), Kaitoke Wetland, Great Barrier I. (Anderson & Ogden 2003); 0.01 birds/count, Porarari, W. Paparoas, SI (Onley 1980).

THREATS AND HUMAN INTERACTIONS Usually, but not always, commensal with human settlement. Considered a major pest, especially to agriculture (see Food: Pest status). Often attracted to artificial sources of food (see Food). Said to have eradicated cattle ticks from agricultural areas N of Auckland (Oliver), and many other harmful insect pests and seeds of noxious weeds eaten (Littler 1902; Ryan 1906; Morgan 1914; Cheney 1915; Chisholm 1926, 1929; Moncrieff 1929; Gray 1936; Chisholm 1938; Pearse 1938; Chandler 1939; Hargreaves 1943; Lord 1956; Dawson 1970). Nests in houses said to spread vermin (Lord 1956); sometimes cause damage to structures by building nests in guttering, rainwater pipes or chimneys (Oliver); and nests built in fruit trees prevent effective spraying by insecticides, thus allowing scale insects to survive (Lowe 1959). Also blamed for spreading seeds of noxious weeds (Cleland 1952). Sparrows arriving in WA, NT and some remote stations and national parks elsewhere (e.g. Kinchega NP, NSW) normally shot or otherwise dispatched (e.g. trapped or poisoned) by The Authorities (Schmidt 1978; Long 1988; Henle 1989; Goodfellow 2001; M. Massam), and shot by private landholders elsewhere (e.g. Hyem 1937). During construction of Transcontinental Railway linking WA and SA, Capt. S.A. White was employed to shoot any Sparrows that appeared at construction camps as the line progressed westward (Alexander 1958; Jenkins 1959); between 1897 and 2005, 118 Sparrows were destroyed in WA (Long 1988; M. Massam). Similarly, Sparrows arriving on Deal I. in Bass Str. are extirpated (Garnett *et al.* 1991); and on King I., also in Bass Str., >1000 trapped and destroyed in 1 week at Loorana (McGarvie & Templeton 1974). Sometimes poisoned with baited grain, and bounties paid on their eggs (Thomson 1922; Hobbs 1980; M. Massam). In 1890, in Kyneton, Vic., local council offered a prize for the destruction of Sparrows and their eggs, and 11,385 eggs and 1497 birds were destroyed (Heathcote 1999); and in SA, in *c.* 1883, the government paid bounty of a ha'penny per head on 37,875

heads, and 2/6d [two shillings and a sixpence] per 100 eggs on 209,793 eggs, and payment of bounties continued till early 1930s (Condon 1951, 1962); bounties also paid round Rutherglen, n. Vic. (McEvey 1965). Various methods of poisoning and wholesale trapping used in Vic., but to little avail (Ryan 1906); for details of methods used to reduce numbers of Sparrows extralimitally, including designs of special traps, see Tegetmeier (1899). In some areas, however, locals forbade destruction of Sparrows because of their propensity to eat insects (Jenkins 1959). Often caught by Cats (e.g. Burrows 1968; Waddington & Cockrem 1987; Dowling *et al.* 1994), and, in NZ, sometimes killed by introduced Common Brushtail Possums *Trichosurus vulpecula* (Morgan 1981; Brown *et al.* 1993; McLeod & Thompson 2002). Often killed by vehicles on roads (Vestjens 1973; Lepschi 1992b; Lord & Moverley 1992); and sometimes collide with windows (ABBBS 2001) and said to also occasionally, panic-stricken, collide with walls of buildings when being pursued by Grey Butcherbirds *Cracticus torquatus* (Mack 1961). In Wellington, roosting Sparrows were deliberately disturbed by firemen spraying hoses onto the roost-tree after dark (Brockie 1983).

MOVEMENTS Sedentary, possibly resident. Usually described as sedentary or resident in HANZAB region (see below). Distribution often closely follows human settlement, and may spread quickly to new settlements, but little evidence of long-distance movement (see below). Broad-scale analysis of bird atlas and count data in e. Aust. found suggestive evidence of no movements (Griffioen & Clarke 2002). However, regular summer movements of large numbers observed in ne. NSW over two years (see below) but no subsequent reports of this behaviour. Capable of crossing water: have repeatedly recolonized Deal I., Bass Str., after each eradication (Garnett *et al.* 1991); small numbers seen either heading out to sea from Wilsons Prom. or flying in from Bass Str. (Sutton 1997); and several once landed aboard ship *c.* 320 km SW of C. Otway (Cleland 1906). Also capable of more sustained flight over large stretches of water, as shown by unassisted colonization of some outlying islands (see Distribution and Population).

Described as resident or sedentary throughout much of range in HANZAB region: in Qld, round Mt Isa in NW (Horton 1975), islands in Torres Str. (Draffan *et al.* 1983), Magnetic I. in NE (Wieneke 1988), and round Rockhampton (Longmore 1978); in NSW, round Mungindi (Costello 1981) and E of Great Divide, from Hunter Region S to South Coast, including round Sydney (Morris 1975, 1986, 1989; Gibson 1977; Smith & Chafer 1987; Whiter 1991); in ACT (Basten 1973; Taylor 1984, 1987; Er & Tidemann 1996); in Vic. (Vic. Atlas), including near Shepparton (Rowley 1961) and suburban Melbourne (Fleming 1976; Humphreys 1986; Norris *et al.* 1995); in Tas. (Fielding 1979; Green 1995); in SA, on Fleurieu Pen., Mt Lofty Ras, Kangaroo I., round Adelaide (Symon 1946; Clarke 1966; Ford & Paton 1976; Ashton 1985; Winslet & Winslet 1987; Baxter 1989); islands in Spencer Gulf (Stirling *et al.* 1970; Paton 1973), and Roxby Downs (Read *et al.* 2000) and Cook (Klau 1988); and in NZ (Heather & Robertson 2000), including Port Whangarei, Northland (Beauchamp & Parrish 1999), lower reaches of Waikanae R., Wellington (Wodzicki 1946) and Herbert, Otago (Anderson 1947). Also resident on Norfolk I. (Schodde *et al.* 1983).

Few movements reported. Exceptional movements of large numbers, mostly of immature birds, observed crossing from NW to SE over lower reaches of Tweed R. in late summer 1968–70, with estimated average of 20,000 birds per day and maximum of 50,000 birds per day: arrived in flocks of *c.* 25, then paused and formed larger flocks before crossing; these movements recorded Jan. to mid-Mar., with numbers peaking in mid-Feb., and some return movement also noted mid-Mar. Birds usually crossed in groups of *c.* 100, but once, after backlog occurred, eventually crossed in tight group of *c.* 3000 birds. Consistently crossed at same spot, with flight-path ≤40 m wide, and usually at *c.* 50 m above river, but lower in windy weather. Movements began in afternoon and stopped round sunset. Return movements occurred at sunrise, flying *c.* 65 m above water (Guthrie 1971). At Inverell, n. NSW, form flocks in autumn and most leave area, but numbers increase again before nesting Nov.–Jan. (Baldwin 1975); extent of movements not known and probably largely local. Seasonal differences also recorded elsewhere. In counts at L. Wendouree, Ballarat, Vic., numbers increased dramatically Sept.–Nov., declined dramatically in Jan.–Feb., then remained stable till Sept.; and at Alfredton, near Ballarat, recorded in largest numbers in Dec.–Jan., and lowest numbers in autumn (Thomas & Wheeler 1983); in Vic. generally, reporting rates lowest in autumn–winter, though reason unknown (Vic. Atlas). In NZ, form flocks in autumn and winter, which possibly move locally into different habitats, vacating settlements in autumn, possibly moving to parks and reserves (Moncrieff 1929). Most numerous at Port Whangarei in autumn–winter (Beauchamp & Parrish 1999).

Banding Aust. Of 24,813 banded, 1953–June 2003, 689 recoveries (2.8%), of 543 birds: 688 (99.9%) <10 km from banding place; and one (0.1%) 10–49 km (ABBBS). Longest distance between banding and recovery was adult male banded at Two Wells, SA, 20 Sept. 1987, recovered at Kilkenny, SA, 29 May 1990, 32 km SSE, 32 months[D], Sept., 1+, M (ABBBS 2001). **NZ** Of 24,743 banded 1950–87, 2237 recoveries: 97% at banding site, 12 (1%) <15 km from banding site, 35 (2%) 15–30 km, 15 (1%) 30–100 km, and six (<1%) >100 km, including one of 317 km and another of 236 km (Waddington & Cockrem 1987; Cossee 1989). Other long-distance recoveries include movements of 85 km from Hawera to Raetihi, and 65 km from Ward to Picton (Heather & Robertson 2000). In NZ, homing ability demonstrated when at least eight of 58 (13.8%) banded birds released at Taita Research Stn, Lower Hutt, NI, in Aug. 1985, returned to site of original capture: six of 20 (30%) banded birds returned to site 5.7 km away, up to 186 days after release; and two of eight birds returned to site 4.7 km away, up to 130 days after release (Waddington & Cockrem 1987). LONGEVITY: In HANZAB region, adult male banded at Blackwood, SA, 23 Apr. 1979, recaptured at Hawthorndene, SA, over 7 years 6 months after banding (ABBBS). Extralimitally, oldest banded bird 12 years 11 months (BWP).

FOOD Seeds and invertebrates, mainly insects; sometimes also fruit and nectar. **Behaviour** Opportunistic; forage on ground and among vegetation, and take insects from air (McKenzie 1948; Hodgkins 1949; Stidolph 1974; CSN 5, 21, 23), exploiting a wide variety of foraging sites (see below) but relying heavily on artificial food sources, especially during extreme weather when other food is scarce (Chisholm 1926; Chisholm 1933; Wood 1998). DETAILED STUDIES: Near Hastings, NI, Jan. 1977–June 1978 (MacMillan 1981) and Nov. 1978–Feb. 1979 (MacMillan & Pollock 1985); and at Christchurch International Airport, SI, Mar. 1968–Feb. 1969 (Moeed 1975). FORAGING ASSOCIATIONS: Occasionally forage singly (Elgar & Catterall 1981), but usually forage in flocks of varying size, from small flocks of up to 15 (Crockett 1954; Gibson 1961; Stidolph 1974; Elgar & Catterall 1981; Holdsworth 1998; Miskelly *et al.* 2001; CSN 21) to flocks of 15–50 (McKenzie 1948; CSN 4, 5), *c.* 250 (Blundell & McKenzie 1963) or sometimes 1000 to many thousands (Guthrie 1971; CSN 45, 47, 48). Often congregate in large flocks at sources of abundant food in autumn–winter (McKenzie 1979; Sibson 1983). In Hawkes Bay, NI, birds feeding in crops formed loose flocks that moved slowly as individuals flew to a new foraging site, and occasionally whole flock took flight and settled

elsewhere (Dawson 1970). Often forage with other species, and occasionally form mixed-species foraging flocks. Often forage with other finches, sparrows or buntings, including Eurasian Tree Sparrows, Diamond Firetails *Emblema guttata*, European Goldfinches *Carduelis carduelis*, European Greenfinches *Carduelis chloris*, Common Redpolls and Yellowhammers *Emberiza citrinella* (Jones 1937; Blundell & McKenzie 1963; Dawson 1970; Moeed 1975; Brothers 1979; Rowe 1991; CSN), or other seed-eating species, such as Orange-bellied Parrots *Neophema chrysogaster* (Starks *et al.* 1992). In e. suburban Melbourne, often formed mixed-species foraging flocks with Eurasian Tree Sparrows, comprising 40–60% of birds in flocks (J.M. Peter). Near Gunning, NSW, foraged co-operatively with Diamond Firetails and European Goldfinches; Firetails perched on Paspalum seed heads, weighing them down to the ground where all three species were able to feed (Rowe 1991). Sometimes also observed foraging with Rainbow Bee-eaters *Merops ornatus*, fairy-wrens *Malurus*, Figbirds *Sphecotheres viridis*, White-browed *Artamus superciliosus* and Masked Woodswallows A. *personatus*, Red-whiskered Bulbuls *Pycnonotus jocosus*, Australian Reed-Warblers *Acrocephalus australis*, Silvereyes *Zosterops lateralis*, Common Blackbirds *Turdus merula* and Common Mynas (Haines 1968; Child 1974; Cooper 1974; Johnson 1993; CSN 5). Sometimes compete for scraps with Common Mynas, Silver Gulls *Larus novaehollandiae* and Australian White Ibis *Threskiornis molucca* (Bedggood 1970; Morris 1983). Sometimes forage among horses (Chisholm 1926; Jenkins & Ford 1960), possibly taking seeds from manure. **FORAGING HEIGHTS AND SITES:** Forage in wide variety of sites and from many substrates. Mainly forage *ON GROUND* (e.g. East 1967; Green 1984; Baxter 1989; Green *et al.* 1989; M. Massam), often on lawns or in gardens (Gannon 1932a; McKenzie 1948; Hodgkins 1949; McKilligan & McKilligan 1987) or in streets, malls and other urban environments (e.g. Hubregste 1992; Brockie & O'Brien 2004; see Habitat, and below); also forage for fallen seeds or fruits at bases of trees, including in orchards (R.T. Baker 1980; Paton *et al.* 1988), for spilt grain round silos, in grain yards, along railway lines and rail sidings and on and beside roads (Campbell 1943; Baxter 1989; Beauchamp & Parrish 1999; CSN 5, 23; see Pest status below) and in pastures, crop fields and stubble fields (Ellis 1940; Moeed 1975; CSN 35, 38, 45, 47; also see Pest status). However, also often forage *ABOVE GROUND*, in trees and shrubs, taking insects or fruits from among foliage, flowers or buds or occasionally from trunks (Sutton 1928; Chisholm 1938; Campbell 1943; Hodgkins 1949; Perry 1965; Benham 1968; Stidolph 1974; Fielding 1979; Paton & Reid 1983; Nix 1985; Rose 1999; Gibb 2000; Peter 2000; CSN 5, 23; see Foraging methods below). Often forage in fruit trees in orchards (Sutton 1928; R.T. Baker 1980; Gregory-Smith 1983; Paton & Reid 1983; Forde 1986; Paton *et al.* 1988; Heather & Robertson 2000; Bomford & Sinclair 2002; see also Pest status below) and also often forage above ground in standing crops, taking grain while perched in crops (Chisholm 1933; Dawson 1970; MacMillan 1981; also see Habitat, and Pest Status below). Occasionally forage in air, sallying for flying insects (Ashby 1932; Campbell 1943; Nix 1979; Draffan *et al.* 1983; Taylor 1989; Johnson 1993; Gibb 2000; Perkins 2000; CSN 21). Also reported to catch flying insects as insects left their hive or nest (Ashby 1932; Anon. 1944; Poppelwell 1963; Johnson 1993), but not clear whether insects taken in air or from substrate (see Foraging methods below). In e. suburbs of Melbourne, of 466 observations of foraging: 413 (88.6%) were on ground, 37 (7.9%) in native plants, five (1.1%) in exotic plants, two (0.4%) in air and nine (1.9%) at other sites (Green 1984). At Monash Univ., Melbourne (Apr.–Aug. 1975), of 20 observations of foraging, 18 on ground and two in exotic plants (Green *et al.* 1989). In Brisbane, of 103 observations of foraging (May and Aug. in both 1985 and 1986): 37 (35.9%) on ground, 28 (27.2%) in native plants and 38 (36.9%) in exotic plants (Green *et al.* 1989). In Christchurch Botanic Gardens, of 604 observations of foraging: 55.4% were scavenged from people; 14.5% from lawn; 12.1% were taking seeds from ground; 9.6% from soil; 3.6% from paths; 2.4% seeds from above ground; and 2.4% from leaf-litter (East 1967). In Wheat crops in Hawkes Bay, NI, of 287 grains lost from standing crop (all to Sparrows), none taken at heights of up to *c.* 28 cm; 18% from *c.* 30.5–43 cm; 41.5% from *c.* 46–58.5 cm; and 40.4% >58.5 cm (Dawson 1970). *OTHER SITES*: Occasionally forage on beaches and exposed mudflats (Hodgkins 1949; Oliver). Often glean insects from radiator grilles or smeared on windscreens of vehicles (Wilson 1954; Hobbs 1955a; McDonald 1971; Quinn 1972; Flux & Thompson 1986; Flux & Thompson 1988; CSN 48; J.M. Peter). Often attracted to artificial sources of food, especially bird-feeding tables in parks and gardens and fowlyards (e.g. Geary 1932; Campbell 1943; Gibson 1961; Stirling *et al.* 1970; Child 1974; Brothers 1979; Baxter 1989; Butterfield 1992; Wood 1998; Gibb 2000; Rollinson *et al.* 2003; Oliver; CSN), and on discarded food scraps (Barrett 1916; Sutherland 1952; Crockett 1954; Bedggood 1970; Morris 1983; Clark 1993). Often forage round outdoor tables of cafés and restaurants, even picking round feet of seated patrons and immediately flying to take crumbs and scraps from vacated tables; also enter and forage indoors in shopping centres and the like (Hubregste 1992; NZRD; P.J. Higgins). Sometimes take food scraps from rubbish bins and tips (Fleming 1976, 1987) and forage round houses (Roberts 1940; Hale 1949; Brothers 1979; Elgar & Catterall 1981; Somers 1991). At a guesthouse, birds were hand-fed crumbs by patrons, and some birds even entered bedrooms in search of food (Graham 1948). Seen foraging on roof of freight containers *c.* 3 m high (M. Massam). **FORAGING METHODS:** *SEARCH*: Seen searching with head down, interspersed with periodical scanning for predators by raising head and looking from side to side (Elgar & Catterall 1981). Some birds systematically move along rows of parked cars, searching for insects stuck in radiator grilles (Flux & Thompson 1986). *ATTACK*: Food gathered by gleaning, hanging, probing and sallying. On ground, mainly glean seeds (East 1967) or pull up, or tear shoots from, seedlings, including vegetable crops (Littler 1902; Oliver; see Pest status). Glean (pluck) seeds from seed-heads of Wheat by perching on stalk of plant (Dawson 1970), and seen to glean seeds from birch tree *Betula* while hanging from branches (CSN 21). Also probe flowers, for nectar or insects (Hodgkins 1949; Oliver; CSN 22), sometimes by hanging upside-down from branches (Perry 1965; Benham 1968; Bedggood 1974); sometimes pierce holes in base of Kowhai *Sophora microphylla* flowers to obtain nectar (Stidolph 1974). Said to tear buds and blossom from fruit trees (NZRD; see Pest status); and to tear flesh from some fruits, including Blackberries and fallen olives (Cleland 1932; Paton *et al.* 1988; also see Pest status). In Hawkes Bay, NI, birds gathered in Wheat crops as they matured (fed mostly on milky grain); and flocks feeding on grain foraged close to cover or perches; most grain taken from ears >58 cm tall and none from ears <30 cm tall; birds feeding on grain removed entire grain and left bracts intact (Dawson 1970). Seen to dig up and eat bulbs of Thread Iris *Gyndandriris setifolia* during food shortages (Boehm 1990). Glean insects from branches and foliage of plants and occasionally from trunks of trees (Chisholm 1938; Campbell 1943; Cooper 1974; Morrison 1981; Nix 1985; CSN 5), including hang-gleaning aphids from underside of leaves (CSN 23); also occasionally feed on lerp (Nix 1985). Glean spiders and insects from spider webs (Somers 1991) and insects from vehicles (see above). Seen to catch cicadas by flying to trees, snatching cicada from trunk and then returning to ground with prey (Gosper 1999a; CSN 5); if cicadas escaped, birds made repeated sally-strikes till they

were recaptured (CSN 5). Observed perching on guttering of house to gather termites that had landed on roof and then drifted into gutter (Hale 1949). Flying insects such as bees also taken as they enter or leave nest or hive (Ashby 1932; Anon. 1944; Poppelwell 1963; Johnson 1993), with bees then carried to ground (Poppelwell 1963). Flying insects sometimes taken by sallying (Ashby 1932; Campbell 1943; Anon. 1944; Ross 1980; Draffan *et al.* 1983; Nix 1985; Gibb 2000; Perkins 2000; CSN 21, 47). When sally-striking flying insects, usually attack <30° from vertical, before hovering briefly and gliding back to perch (Nix 1979). Also recorded sally-hovering for flying insects, then returning to perch in nearby shrub (Taylor 1989). Sally-pounce onto flying termites as they land (Hale 1949). Occasionally take insects by flush-pursuit, deliberately dislodging them by flying into foliage of ragwort plant (CSN 5). Once chased and killed a small skink (Tas. Bird Rep. 22), though not known whether skink was eaten. Also seen hanging underneath balls of dripping, honey and rolled oats to feed (Davey 1997). KLEPTOPARASITISM: Once, male chased a Red Wattlebird *Anthochaera carunculata* that had caught an insect; Wattlebird attempted to eat the insect, but dropped it and Sparrow swooped and stole it (Standen 2001). Also recorded taking food from bill of Silvereye, in manner of a skua *Stercorarius* (CSN 37), and attempting to take seeds from bills of European Greenfinches (CSN 38). HANDLING OF FOOD: Berries of African Boxthorn are crushed in bill, with seeds and flesh swallowed and skin then discarded (Peter 2000). However, also seen to tear flesh from other fruits, such as Blackberries and olives, thus not dispersing seeds (Paton *et al.* 1988; Cleland 1992). Remove wings of cicadas and legs of stick insects before ingestion (CSN 2, 5, 39). Cicadas seen placed on back and hammered with bill, or held in bill and beaten against ground (Gosper 1999a); insects collected from car radiators also beaten against ground before ingestion (Quinn 1972). Once seen to beat a lizard on footpath before flying off with it (Binns 1966). FORAGING TIMES: Usually forage early in morning and late in afternoon (Elgar & Catterall 1982). SEXUAL DIFFERENCES: No significant difference between diet of males and females near Hastings, NI (MacMillan 1981). PEST STATUS: A major pest of agriculture. Cause much damage to cereal crops, such as Wheat, Maize, Oats, Barley and Rice, eating much grain before harvest (Littler 1902; AOU 1906; Anon. 1909; Morgan 1916; Chisholm 1926; Ellis 1940; Campbell 1943; Condon 1951; Dawson 1970; Heather & Robertson 2000; Oliver). Also raid orchards, especially of Apples, Apricots, Cherries, Grapes and Peaches, eating or damaging buds and young or ripe fruit or knocking ripening fruit to the ground (Anon. 1909; Edwards 1925; Sutton 1928; Condon 1951; Lowe 1959; Fielding 1979; Gregory-Smith 1983; Paton & Reid 1983; Heather & Robertson 2000; Bomford & Sinclair 2002; Oliver). However, considered by some fruit-growers to do little damage (Morgan 1917), and while Apples sometimes eaten in orchards, usually only eat fruit that has already been damaged (R.T. Baker 1980). Sometimes attack vegetable crops, feeding on seeds and pulling up seedling Peas, beets and brassicas (Littler 1902; Campbell 1905; Anon. 1909; McGilp 1928; Heather & Robertson 2000; Bomford & Sinclair 2002; Oliver). Also considered a nuisance in gardens, where they destroy flowers and pick out germinating seedlings (Littler 1902; Campbell 1905; Thomson 1922; Lord 1956; Leishman 1997; Oliver). Often steal food from poultry, livestock and other domestic animals (Anon. 1909; Campbell 1943; Dawson & Cresswell 1949; Heather & Robertson 2000; Oliver) and take grain from grain storages (Campbell 1943). Also prey on commercial and beneficial insects (Anon. 1909). At Richmond, NSW, contents of stomachs and crops of 109 birds examined: 88% contained grain, 47% weed seeds, 1.8% grapes, 15.5% noxious insects, 31% insects that have no effect on crops, and 1% beneficial insects (Anon. 1909). In Hawkes Bay, NI, mean loss of grain caused by Sparrows in 11 Wheat crops was 4.6% (1–23%); and mean loss of grain in four Barley crops was 9.3% (6–19%) (Dawson 1970). Near Hastings, NI, Wheat and Maize eaten in 17 of 18 months sampled, and comprised 4–88% by volume of monthly plant food intake (MacMillan 1981). Claimed also to have some beneficial effects by eating aphids, grasshoppers and other noxious insects that harm gardens and agricultural crops (Littler 1902; Campbell 1905; Lord 1956; Oliver). SEASONAL VARIATION: Vegetable matter eaten throughout year (MacMillan 1981), and insects taken mainly in summer and occasionally in spring (Chisholm 1933; Campbell 1943; Hodgkins 1949; St Paul 1975; MacMillan 1981), with diet reflecting seasonal availability of various seeds and insects (MacMillan 1981; MacMillan & Pollock 1985): Near Hastings, NI, fed mostly on small-grained cereals, mainly Wheat, in summer; seeds of African Boxthorn, Barley-grass *Critesion murinum* and nettle *Urtica urens* in summer–autumn; seeds of Wireweed *Polygonum aviculare* and Willow Weed *Persicaria maculosa* in autumn; seeds of Fat Hen *Chenopodium album* in autumn–winter; Maize, and seeds of redroot and amaranth *Amaranthus* in winter; and maize, and seeds of Annual Meadow-grass *Poa annua*, Chickweed *Stellaria media* and storksbill *Erodium* in spring. When feeding on crops, birds first fed on standing crops, then moved to stubbles as crops harvested; foraged on weeds in lucerne paddocks and pasture and in African Boxthorn hedges throughout the year (MacMillan 1981). INTERSPECIFIC COMPARISONS: For differences between diets of adult Sparrows and European Greenfinches see MacMillan (1981; also see data in European Greenfinch account this volume). DRINKING: Drink from troughs (Turbott 1947; Paton & Paton 1980; Green 1990).

Detailed studies Near HASTINGS, NI (contents of stomachs of 401 birds, and months in which items recorded [where stated]; MacMillan 1981): **Plants** (For many species, actual item eaten [seeds, fruit, etc.] not stated.) Unident. plant fragments 9.2% freq., all months. MONOCOTYLEDONS: Poaceae: *Bromus catharticus* 0.5, Jan., Mar.; *Critesion murinum* sds 11.5, Jan.–June; *Digitaria* 0.2, Nov.; *Glyceria* 1.5, Mar., Oct.–Dec.; *Lolium* 2.2, Jan.–May; *Poa annua* 13.5, Jan., July–Nov.; *Rytidosperma* 0.5, Jan., Nov.; *Setaria viridis* 3.5, Mar.–June, Aug.–Sept.; *Triticum aestivum* 35.7, Jan.–June, Sept.–Dec.; *Zea mays* 22.4, Jan.–Mar., May–Oct. DICOTYLEDONS: Amaranthaceae: *Amaranthus* sds 35.2, Jan.–Oct.; Asteraceae: *Cotula australis* 0.2, Mar.; Caryophyllaceae: *Stellaria media* 13.2, Feb., May, Aug.–Nov.; Chenopodiaceae: *Chenopodium album* 9.2, Jan.–Sept., Dec.; Fabaceae: *Medicago arabica* 0.5, June, Dec.; *Pisum sativum* 0.1, Nov.–Dec.; *Trifolium* (*T. glomeratum* and *T. repens*) 5.0, Jan.–Apr., June, Aug.–Nov.; Fagaceae: *Quercus* 0.2, June; Geraniaceae: *Erodium* 8.0, Jan., Mar., Oct.–Dec.; Lamiaceae: *Nepeta cataria* 0.2, Mar.; Mimosaceae: *Acacia* 0.5, Apr., Aug.; Polygonaceae: *Persicaria maculosa* 4.5, Mar.–June, Aug.; *Polygonum aviculare* 4.0, Jan., Apr.–July, Sept.; *Rumex crispus* 0.5, Feb., June; Primulaceae: *Anagallis arvensis* 0.2, June; Solanaceae: *Lycium ferocissimum* fru. 6.7, Jan.–May, Dec.; Urticaceae: *Urtica urens* sds 5.0, Jan.–May, Nov.–Dec. **Animals** ARTHROPODS: Unident. 7.0, all months. SPRINGTAILS 0.7. INSECTS (Ads unless stated): Coleoptera: unident. 3.2, Jan.–Mar., Aug., Oct.–Nov.; Carabidae: unident. 0.5, Dec.; *Clivina australasiae* 1.2, Mar.–Apr., July, Sept., Nov.; *Cicindela tuberculata* 1.7, Jan., Apr., Nov.–Dec.; Chrysomelidae: *Paropsis charybdis* 0.7, Oct., Dec.; Coccinellidae: *Coccinella undecimpunctata* 0.5, Dec.; Curculionidae: *Graphognathus leucoloma* 4.2, larv. 0.5, Jan.–Apr., Sept., Dec.; *Listroderes delaiguei* 2.2, Jan., Mar., Oct.–Dec.; Elateridae: *Agrypnus variabilis* 4.5, Jan.–Apr., Sept.–Dec.; Scarabaeidae: unident. 1.5, Oct.–Dec.; unident. *Aphodius* 0.5, Oct.; *A. pseudolividis* 0.5, Jan., July; *Costelytra zealandica* 0.7, Nov.; *Pyronota festiva* 0.2, Nov.; Diptera: Chironomidae 1.0,

July–Sept.; Muscidae 0.2 (months unknown); Sarcophagidae: *Hybopygia varia* 0.7, Dec.; Sphaeroceridae: *Kimosina thomasi* 0.2, June; Tipulidae larv. 0.2, Aug.; Hemiptera: Aphididae 2.2, Mar., May, Aug.–Oct.; Cicadellidae 0.7, May, Nov.–Dec.; Pentatomidae 0.2, Jan.; Hymenoptera: Braconidae: *Alysia manducator* 0.2, Oct.; Lepidoptera: Noctuidae: *Graphania ustistriga* larv. 1.5, Jan., Dec.; Odonata: *Xanthocnemis zealandica* 0.7 (months unknown).

At CHRISTCHURCH INTERNATIONAL AIRPORT, SI (1035 food items from crop contents of 15 birds feeding on airfield and adjacent farmland, Mar. 1968–Feb. 1969; Moeed 1975): **Plants** (All seeds.) MONOCOTYLEDONS: Poaceae: *Anthoxanthum odoratum* 1.84% no., 26.67% freq.; *Avena* 9.47, 60.00; *Lolium* 15.56, 33.33; *Stipa* 7.15, 33.33; *Triticum* 16.81, 86.67; *Vulpia* 5.80, 33.33. DICOTYLEDONS: Caryophyllaceae: *Stellaria media* 24.35, 26.67; Chenopodiaceae: *Chenopodium album* 3.67, 20.00; Geraniaceae: *Erodium* 0.48, 13.33; Papilionaceae: *Cytisus* 0.68, 20.00; *Trifolium* 7.34, 40.00; *Ulex* 0.48, 13.33; *Vicia* 4.83, 20.00; Polygonaceae: *Polygonum* 1.06, 13.33. **Animals** INSECTS: Coleoptera ads 0.48, 20.00.

Other records—Aust. Plants (Seeds unless stated.) Seeds, including grain and 'germinating grain[2,3,4,8,9,10,18,19,20,26,34,35,57,72,76,77], fruit[3,4,17,18,20,38,56,76], vegetables[38], buds[4], seedlings[4], tops of young plants[35]. GYMNOSPERMS: *Cupressus*[65]. MONOCOTYLEDONS: Agavaceae: *Cordyline australis* fru.[61]; Iridaceae: *Gynandriris setifolia* bulbs[66]; Poaceae[75,77]; *Avena sativa*[77]; *Hordeum vulgare*[14]; *Oryza sativa*[32]; *Panicum*[75]; *Paspalum*[67]; *Phalaris aquatica*[61]; *Triticum aestivum*[34,51,72,75,77]; *Zea mays*[8,75]. DICOTYLEDONS: Amaranthaceae[8,75]; Asteraceae: *Chrysanthemoides monilifera rotunda* fru.[71]; *Helianthus annuus*[27,34]; *Hypochaeris radicata*[75]; *Onopordum*[77]; Boraginaceae: *Echium plantagineum*[77]; Caprifoliaceae: *Vaccinium* fru.[62]; Chenopodiaceae: *Atriplex semibaccata* fru.[59]; *Beta vulgaris* lvs[62]; *Chenopodium album*[71]; *Enchylaena tomentosa* fru.[62]; Fabaceae: *Pisum sativum*[22]; Hamamelidaceae: *Liquidambar styraciflua*[49]; Mimosaceae: *Acacia sophorae*[69,71,72]; Moraceae: *Ficus* fru.[24,72]; *F. carica* fru.[59]; *Morus alba* fru.[17]; Myrtaceae: *Callistemon* nectar[72]; *Eucalyptus* nectar[48]; *Eucalyptus leucoxylon* nectar[43]; Oleaceae: *Olea europea* fru.[63,64]; Oxalidaceae: *Oxalis* buds[11]; Papaveraceae: *Papaver*[34]; Polygonaceae: *Polygonum*[75]; *P. aviculare* unident. item[77], fru.[43]; Proteaceae: *Banksia* nectar[48]; *B. integrifolia* nectar[53]; *Grevillea banksii* nectar[45]; *G. rosmarinifolia* nectar[48]; Rosaceae: *Cotoneaster* nectar[48]; *Eriobotrya japonica* fru.[59]; *Malus sylvestris* fru.[62]; *Prunus armeniaca* fru.[58,59]; *P. avium* fru.[56,59]; *P. domestica* fru.[23,59]; *P. persica* fru.[23]; *Rubus fruticosus* fru.[12]; Solanaceae: *Lycium ferocissimum* fru.[59,73]; Vitaceae: *Vitis vinifera* fru.[4,41]. **Animals** Unident. invertebrates[57]. ANNELIDS: Oligochaetes[13]. SPIDERS[33,76,77]. INSECTS[3,4,13,18,19,20,26,40,46,47,52,72,74,76]: Coleoptera[75]: Curculionidae[77]; Scarabaeidae[15,77]; Diptera: Calliphoridae[35,75]: *Calliphora oceaniae*[75]; Oestridae: larv.[18]; Stratiomyiidae: larv.[44], ads[60]; Hemiptera: scale[34,53,55]; Aphididae[1,2,4,5,13,21,34,35,56,75,78]: honeydew[53]; Cicadidae[34,70]: *Cyclochila australasiae* ads[78]; Psyllidae[2,53]: lerp[53]; Hymenoptera: Apidae[4,5,6,36]; Formicidae[75,77]: alates[25]; *Oecophylla smaragdina* alates[68]; *Pheidole* alates[61]; Isoptera[35,75]: alates[34,77]; Lepidoptera: larv.[13,34,56], ads[34,47,75]; Noctuidae[75]: *Agrotis infusa*[16]; Pieridae: *Pieris rapae* ads[5]; Plutellidae: *Plutella xylostella* ads[35], larv.[75]; Orthoptera[20,39,47]: grasshoppers[29,30,31,40,56]; Acrididae: ads[61,75]; *Chortoicetes terminifera*[7]. **Other matter** Bread[34,55]; crumbs[50]; honey[42]; meat scraps[34]; scraps[26,54,76]; mash[26]; gravel and grit, including quartz[9,51,75].

REFERENCES: [1] Littler 1902; [2] Campbell 1905; [3] AOU 1906; Anon. [4] 1909, [5] 1942, [6] 1944, [7] 1948; Cleland [8] 1910, [9] 1911, [10] 1912, [11] 1932, [12] 1952; Morgan [13] 1914, [14] 1916; [15] Cheney 1915; [16] Slaney 1922; [17] Edwards 1925; Chisholm [18] 1926, [19] 1929, [20] 1933, [21] 1938; [22] McGilp 1928; [23] Sutton 1928; [24] Moncrieff 1929; [25] Ashby 1932; Gannon [26] 1932a, [27] 1935; [28] Chisholm 1933; Pearse [29] 1935, [30] 1938; [31] Gray 1936; [32] Ellis 1940; [33] Roberts 1940; [34] Campbell 1943; [35] Jarvis 1943; [36] Terrill 1944; [37] Hale 1949; [38] Condon 1951; [39] Hobbs 1955a; [40] Lord 1956; [41] Lowe 1959; [42] Hudson 1965; [43] Perry 1965; [44] Green 1966, [45] Benham 1968; [46] McDonald 1971; [47] Quinn 1972; [48] Bedggood 1974; [49] Burrows 1974; [50] Baldwin 1975; [51] Vestjens 1977; Nix [52] 1979, [53] 1985; [54] Harris 1980; [55] Morrison 1981; [56] Gregory-Smith 1983; [57] Jones 1983; [58] Paton & Reid 1983; [59] Forde 1986; Lepschi [60] 1986, [61] 1993, [62] 1997; [63] Paton & Paton 1987; [64] Paton *et al.* 1988; [65] Green *et al.* 1989; [66] Boehm 1990; [67] Rowe 1991; [68] Johnson 1993; [69] McCulloch 1997; Gosper [70] 1999a, [71] 1999b; [72] Rose 1999; [73] Peter 2000; [74] Standen 2001; [75] Cleland; [76] Aust. Atlas 1; [77] FAB; [78] J.M. Peter.

Other records—NZ Plants (Seeds unless stated.) Seeds, including grain[3,6,21,24,25,26,34], fruit[4,25,26], nectar[5,25], buds[26]. FILICOPHYTES: Roots[30]. GYMNOSPERMS: Cupressaceae: *Chamaecyparis pisifera*[14]; *Pinus*[32]; Pinaceae: *Cedrus deodara*[14]; *Tsuga*[14]; Podocarpaceae: *Dacrycarpus dacrydioides* fru.[36]; *Podocarpus totara* fru.[36]. MONOCOTYLEDONS: Agavaceae: *Phormium*[35,38]; *P. tenax* nectar[26]; Poaceae: Sds[14,25,31,42]; *Cortaderia*[38]; *C. selloana*[23]; *C. toetoe*[25]; *Cynodon*[34]; *Hordeum vulgare*[15,25]; *Paspalum*[4]; *Pennisetum clandestinum* stems[33]; *Poa annua*[4]; *Psamma arenaria*[39]; *Triticum aestivum*[15,25]; *Zea mays*[25]. DICOTYLEDONS: Amaranthaceae: *Amaranthus blitoides*[25]; *A. retroflexus*[11,25]; Asteraceae: *Calendula*[34]; *Carduus*[23]; *Helianthus annuus*[36]; *Lactuca sativa* shoots[27]; *Taraxacum officinale*[28]; Betulaceae: *Betula*[14,33]; Brassicaceae: *Brassica*[25]; Chenopod-iaceae shoots[27]; *Chenopodium album*[25]; Fabaceae: seedlings[25], shoots[27]; Fagaceae: *Nothofagus*[9]; Mimosaceae: *Acacia* nectar[23]; Myrtaceae: *Callistemon* nectar[33]; *Metrosideros excelsa*[24], nectar[5,13,26]; Papilionaceae: *Sophora* nectar[17]; Polygonaceae: *Muehlenbeckia australis* fru.[41]; *Rumex*[28]; Rosaceae: *Fragaria vesca* fru.[27]; *Malus sylvestris* fl.[27], fru.[20]; *Prunus armeniaca* fl.[27]; *P. avium* fru.[25,26]; *P. persica* fl.[27], fru.[26]; Rubiaceae: *Coprosma lucida* fru.[39]; *C. repens* fru.[31,38,41]; *C. robusta* fru.[32]; Vitaceae: *Vitis vinifera* fru.[25,26]. **Animals** SPIDERS[25]. INSECTS[13,22,26,33]: Coleoptera[25]; Diptera[25]; Hemiptera: Aphididae[34]; Cicadellidae[25]; Cicadidae[18,24,25,30,31,37,38,40]; Hymenoptera: Apidae[12]; Lepidoptera: larv.[25], ads[1,20,28,31]; Orthoptera: Acrididae: ads[25]; Phasmatodea[29,37]. **Other matter** Bread[4,10,16]; crumbs[2]; sugar[27]; meat scraps or fat[4]; scraps[7,8].

REFERENCES: [1] Moncrieff 1929; [2] Graham 1948; [3] Dawson & Cresswell 1949; [4] Hodgkins 1949; [5] Wilkin 1950; [6] Condon 1951; [7] Sutherland 1952; [8] Crockett 1954; [9] Secker 1958a; [10] Gibson 1961; [11] Blundell & McKenzie 1963; [12] Poppelwell 1963; [13] McCann 1964; [14] East 1967; [15] Dawson 1970; [16] Child 1974; [17] Stidolph 1974; [18] St Paul 1975; [19] Jackson 1976; [20] R.T. Baker 1980; [21] Sibson 1983; [22] Flux & Thompson 1986; [23] Beauchamp & Parrish 1999; [24] Gibb 2000; [25] Heather & Robertson 2000; [26] Oliver; [27] NZRD; CSN [28] 1, [29] 2, [30] 4, [31] 5, [32] 19 Suppl., [33] 21, [34] 23, [35] 29, [36] 38, [37] 39, [38] 41, [39] 42, [40] 43, [41] 44, [42] 48.

Young Nestlings fed by both parents (see Breeding). Diet mainly insects (including grasshoppers, aphids and beetles) and other invertebrates, especially during first week or so, with proportion of plant material increasing as nestlings grow (Anon. 1909; Chisholm 1926, 1929, 1933; MacMillan 1981; MacMillan & Pollock 1985; Oliver; CSN 6). Near Hastings, NI, arthropods comprised 84% by volume of diet of nestlings 1–5 days old (rest plant matter), 49% at 6–10 days old, and 38% at ≥11 days old; nestlings ≥11 days old were fed mostly Peas and cereal grains, mainly Wheat or Barley (MacMillan 1981; MacMillan & Pollock 1985). Stated that when ≥11 days old diet like that of adults but data indicates that nestlings this age still eat more arthropods than adults, e.g. arthropods comprised ≤20% of adult diet in any month and usually <10%, but comprised 21–56% (by volume) of diet of nestlings ≥11 days old (MacMillan 1981). Beetles were main

arthropod item fed to nestlings of all ages, though beetles and caterpillars fed to nestlings <5 days old in roughly equal proportions; nestlings 1–5 days old fed significantly more leafhoppers, grasshoppers, flies and spiders than older young; older nestlings fed proportionately fewer arthropods and significantly more Peas and cereal than young nestlings; little variation in nestling diets between seasons (MacMillan & Pollock 1985). At one nest with B/2 on day after hatching, nestlings fed at intervals of 0.5–2 min 06:30–07:30 then fed only occasionally 07:30–11:00, though often visited by parents; young fed more regularly 11:00–13:00, though less often than in early morning, but fed only sporadically after 13:00 till dusk (Lane 1979). Food for nestlings collected from up to 1.6 km from nest (Dawson 1970). Young continue to be fed regularly for 1–2 days after fledging (Lane 1979); extralimitally, fed by adults for up to 14 days after leaving nest (Summers-Smith 1963). At Dunedin, SI, fledgeling seen to feed at feeding table (CSN 5). In Sydney, adult seen picking meat from bone and feeding it to fledgeling (Campbell 1943).

Detailed studies Near HASTINGS, NI (items in stomachs of 308 nestlings collected Nov. 1977–Feb. 1978 and Nov. 1978–Feb. 1979; MacMillan & Pollock 1985, which see for breakdown by month and age, and relative volumes of major food items): **Plants** (Seeds unless stated.) Unident. seeds 17.5% freq. MONOCOTYLEDONS: Poaceae: *Triticum aestivum* and *Hordeum vulgare* (combined) 33.4; *Critesion murinum* 4.2; *Glyceria* 1.9; *Lolium* 0.3; *Poa annua* 6.2; *Rytidosperma* 0.3; *Setaria viridis* 5.2. DICOTYLEDONS: Amaranthaceae: *Amaranthus* 2.3; Asteraceae: *Crepis capillaris* 0.6; *Taraxacum officinale* 0.3; Caryophyllaceae: *Stellaria media* 1.6; Fabaceae: *Pisum sativum* peas 33.8; *Trifolium* 1.3; Geraniaceae: *Erodium* 1.3; *Geranium molle* 0.3; Polygonaceae: *Polygonum aviculare* 0.6; Urticaceae: *Urtica urens* 2.6. **Animals** Unident. arthropods 33.4. SPIDERS: Unident. 7.8; Araneidae: *Araneus* 2.6; Desidae: *Ixeuticus martius* 0.3; Lycosidae: *Lycosa* 1.0; Oxyopidae: *Oxyopes gregarius* 1.0. OPILIONES: Phalangiidae: *Phalangium opilio* 9.1. SPRINGTAILS 0.6. INSECTS (Ads unless stated): Coleoptera: unident. 1.9; Anthribidae: *Euciodes suturalis* 0.3; Carabidae: unident. 9.4; *Cicindela tuberculata* 3.6; *Clivina australasiae* 1.9; *Hypharpax antarcticus* 1.0; *Rhytisternus miser* 0.3; Cerambycidae: *Oemona hirta* 0.3; *Xylotoles laetus* 1.6; Chrysomelidae: *Paropsis charybdis* 7.8; Coccinellidae: *Coccinella undecimpunctata* 25.6, larv. 6.5; Curculionidae: unident. 2.3; *Graphognathus leucoloma* 21.8, larv. 1.0; *Listroderes delaiguei* 16.9; *L. obliquus* 0.3; Dermestidae: *Dermestes* 0.3; Elateridae: *Agrypnus variabilis* 23.7; Histeridae: *Carcinops pumilio* 0.3; Melyridae: *Arthracanthus* larv. 0.3; Scarabaeidae: unident. 13.3; *Aphodius pseudolividis* 0.6; *Ataenius picinus* 0.3; *Costelytra zealandica* 4.9; *Pyronota festiva* 9.7; Dermaptera: Forficulidae: *Forficula auricularia* 1.3; Diptera: unident. 4.2; Asilidae 0.3; Calliphoridae: *Lucilia* 1.0; Chironomidae 0.3; Muscidae 1.6; Sarcophagidae: *Hybopygia varia* 10.7; Syrphidae: larv. 0.3; *Melanostoma fasciatum* 1.6; Tipulidae 0.3; Hemiptera: unident. 1.9; Aphididae 4.9; Cicadellidae 25.6; Cicadidae 9.7; Miridae 3.2; Nabidae 1.6; Pentatomidae 3.9; Hymenoptera: Braconidae: *Alysia manducator* 0.3; Lepidoptera: Noctuidae: unident. fragments 26.3; *Agrotis ipsilon* larv. 15.9; *Graphania ustistriga* ads 1.3, larv. 3.2; Nymphalidae: *Bassaris* 9.4; Mantodea: Mantidae: *Orthodera ministralis* 1.6; Odonata: Coenagrionidae: *Xanthocnemis zealandica* 7.1; Orthoptera: Acrididae: *Phaulacridium marginale* 27.6; Gryllidae: *Teleogryllus commodus* 1.0.

Other records—Aust. Plants DICOTYLEDONS: Moraceae: *Ficus* fru.[7]. **Animals** INSECTS[1,2,3,4]: Hemiptera: Aphididae[2]; Orthoptera: grasshoppers[2,5]. **Other matter** Meat[6]. (REFERENCES: [1] Anon. 1909; Chisholm [2] 1926, [3] 1929, [4] 1933, [5] 1938; [6] Campbell 1943; [7] Rose 1999.)

Other records—NZ Animals Invertebrates[2]. INSECTS[3]: Coleoptera[4]. **Other matter** Foods scraps[1]; bread[1]; porridge[1]. A male Common Starling observed feeding House Sparrow nestlings the following items: worm (Annelida), click beetle (Coleoptera), and lepidopteran ads and larv.[1]. (REFERENCES: [1] Burrows 1968; [2] Heather & Robertson 2000; [3] Oliver; [4] CSN 6.)

SOCIAL ORGANIZATION Poorly known in HANZAB region but well known extralimitally (see Summers-Smith 1988; BWP). Highly gregarious. Usually seen in flocks, but also often seen singly or in twos. Flocks vary from a few birds to hundreds or thousands (Tarr 1950; Watson 1955; Guthrie 1971; Morris 1975; CSN 4; also see Food). Often form large flocks in autumn–winter (Watson 1955; McGarvie & Templeton 1974; Baldwin 1975). At Toowoomba, se. Qld, maximum monthly size of flocks (number of birds in garden at any one time), 39–78 birds (McKilligan & McKilligan 1987). Often forage with or form mixed-species flocks with Eurasian Tree Sparrows; also sometimes form flocks with other finches, sparrows or buntings, especially when foraging, such as European Goldfinches and Diamond Firetails (e.g. Chisholm 1926; Rowe 1991; NSW Bird Rep. 1990; also see Food). In NZ, form large mixed-species flocks with European Goldfinches, Common Starlings, Common Mynas, Silvereyes and Skylarks (CSN 36; also see Food).

Bonds Breed in simple pairs (Burrows 1968; Lane 1979). Extralimitally, essentially monogamous, with most pairs remaining together for life and re-using nest-sites from year to year, but sometimes polygamous and promiscuity might be frequent (Summers-Smith 1988; BWP). Extralimitally, capable of breeding within first year (Summers-Smith 1963, 1988). **Co-operative breeding** At nest with second brood, a female, other than parent and possibly from first brood, twice fed nestlings (Lane 1979). Extralimitally, helping behaviour very occasionally recorded (Summers-Smith 1988). **Parental care** Both parents incubate, feed and brood nestlings and remove faecal sacs, and feed fledgelings (see Breeding). Extralimitally, fledgelings fed for c. 2 weeks after leaving nest (Summers-Smith 1988; BWP).

Breeding dispersion Often nest in small colonies, with several nests in same shrub. At Waitaki R., SI, one shrub contained ten nests and another held nine (CSN 4). At Aramiro, NI, one tree contained 15–20 nests, at least five of which were communal, each with several nest-chambers within same structure (CSN 20). Extralimitally, mainly breed in loose colonies of 10–20 pairs, with occasional isolated pairs; colony typically spread over 0.25–0.5 ha and separated from other colonies by unused but apparently identical habitat. Size of colony not apparently determined by availability of sites. Also sometimes form mixed colonies with Eurasian Tree Sparrows (Summers-Smith 1988; BWP). For details of breeding densities in different habitats in w. Europe, see BWP.

Roosting Usually roost communally in shrub or tree, often in large numbers. Roost-sites include a large rata *Metrosideros* (Moncrieff 1929), English Oak *Quercus robur* (Pescott 1996; CSN 33), a clump of bamboo (Pearse 1933), reed beds (Watson 1955) and palm trees (Kloot & McCulloch 1980; Norris *et al.* 1995); at Wollongong, NSW, one roost-site in Canary Island Date Palms *Phoenix canariensis* had been used for 30–40 years (Wood 1995). In Para Wirra Recreation Park, SA, small numbers roosted in large Scarlet Bottlebrush *Callistemon macropunctatus* in Sept.; and 100–120 roosted in Olive trees in Feb.–Mar. (Clarke 1966). At Hastings, NI, c. 14,500 roosted in Oak trees in Civic Square in July (Dawson 1967). In Wellington, birds flew to roost-site between 18:40 and 21:15 in Dec. (Brockie 1983). At one nest in Dunedin, in Oct.–Nov., mean departure from nest in morning at 04:44 (04:23–05:08; 16), 7 min after sunrise; and mean time of final arrival in evening 17:17 (17:09–18:44; 16), 50 min before sunset; timing probably influenced by site of nest (it was in a dark hole) (Marples & Gurr 1943).

SOCIAL BEHAVIOUR Little information for HANZAB region but well known extralimitally (see Summers-Smith 1988; BWP). Generally considered wary but not shy (Summers-Smith 1988; BWP). However, commonly associate with human settlements and human activity, where often bold and conspicuous (P.J. Higgins; see Habitat, Food). Seen to open electronic doors at shopping centres by fluttering in front of sensors (Hubregste 1992; Brockie & O'Brien 2004). Once, a male and a female each tore large pieces of paper from a sheet of paper that was c. 30 cm square, probably for nesting material (Macdonald 1951). **Flock behaviour** Utter Contact Calls throughout year (see Voice). Very noisy when flying in to roost (Moncrieff 1929; see Voice). **Displays** In NI, seen to perform COMMUNAL DISPLAY in all months, but most often Aug.–Oct., and least often in Feb.–Mar. (Secker 1958b, 1966, 1975). During Communal Display, several males chase one female; also observed giving Communal Display to Common Blackbirds posturing in tree, Silvereyes fighting at feeder, twice to helicopter flying overhead, and once to Sparrow caught in trap that was being approached by person (Secker 1975). Communal Display also seen in Melbourne and in se. NSW, in Aug. (Secker 1975). See Summers-Smith (1954) for full description of Communal Display. **Maintenance behaviour** Often bathe in dust, creating round shallow holes (Blacklock 1968; CSN 4). At Florieton, SA, bathed in puddle created by leaking water-tank (Pearce 1935). When bathing in water, enter at shallow end, then splash and drink, and will bathe several times if not disturbed (Vellenga 1965). Also seen to bathe with Common Starlings (Vellenga 1965). Once one seen anting, using sugar ants *Camponotus innexus*, in company with five Common Mynas and two Common Starlings; birds picked up ants, rapidly rubbed them down wing, then discarded them, before performing action on other wing (Wheeler 1951). In another possible incidence of anting, one sat or lay on ground near nest of tiny black ants, with bill pushed into mantle and under wing (Boehm 1995).

Agonistic behaviour One attacked reflection in car bumper (CSN 22). Once, an injured male was attacked vigorously by another male; others of both sexes showed transient interest but did not intervene. Injured bird lay on ground and aggressor stood beside or on it and pecked its head, wing-tips and cloaca. Injured bird often squawked and limped or fluttered away but did not retaliate. Injured bird was later killed by observer and placed on ground. When corpse was lying on its back, it was examined by attacker but not touched; when it was placed upright, it was again attacked till it fell over, then attacker lost interest (Dawson 1968). **Alarm** Utter Alarm Calls in presence of predator or potential predators (see Voice), e.g. when New Zealand Falcon *Falco novaeseelandiae* flew overhead (Porter & Dawson 1968). Give Distress Calls when fleeing from, or caught by, avian predators, including Southern Boobook *Ninox novaeseelandiae*, Pied Currawong *Strepera graculina*, and Australian Hobby *Falco longipennis* (Brandon 1938; Sibson 1989; J.M. Peter; see Voice). While foraging, periodically raise head and look from side to side, which thought to be surveying for predators (Elgar & Catterall 1981). Seen to scold Cats (Secker 1975). **Escape** Become panicked when pursued by Grey Butcherbird, and said to occasionally collide fatally with walls and other objects in attempts to escape (Mack 1961). Foraging Sparrows scattered when attacked by New Zealand Falcon; fled to fence and perched in holes in wire netting; Falcon landed atop of fence and looked down on them as they looked up. When Falcon tried to stoop, Sparrows flew to safety out other side of fence (Jackson 1976). **Interspecific aggression** Observed mobbing Sacred Kingfisher *Todiramphus sanctus*, New Zealand Pigeon *Hemiphaga novaeseelandiae* and Nankeen Night Heron *Nycticorax caledonicus* (Watson 1998; Gibb 2000; CSN 22). Also seen chasing or attacking pigeons (Bell 1994), Silver Gull (CSN 4) and male Superb Fairy-Wren *Malurus cyaneus* (Burrell 1909), and once pecked at toe of Fuscous Honeyeater *Lichenostomus fuscus* that was perched above it (Conole 1981b). Also often interfere with birds at nest-sites. Sometimes chase swallows from their perches and interfere with or usurp their nests (Edgar 1966). At Kenthurst, NSW, attacked Red-browed Finches *Neochmia temporalis* in feeding areas and at their nests (Jasper 1965). Sometimes attack nesting Tree Martins *Hirundo nigricans* at entrances to their nests (Mellor 1930; Gates 1996). Once, male chased Common Starling to nest-hole and grasped its tail (CSN 34); and another attacked Starling at entrance to nest-box over which they were haggling (Tily 1947). Sometimes aggressively oust Sacred Kingfishers, Tree Martins, Fairy Martins *Hirundo ariel* and pardalotes from their nests (Favaloro 1942; Roberts 1955; see also Breeding). Once when attempting to usurp nest of Sacred Kingfisher from nest-hollow in arboreal termitarium, male Sparrow sat on top of termitarium and chattered with wings drooping (Hindwood 1959). NEST-DESTRUCTION: Destroy nests of many native birds (Cheney 1915; Chandler 1939). Once threw eggs out of nest of Welcome Swallow *Hirundo neoxena* and then destroyed nest; also destroy nests of Southern Whitefaces *Aphelocephala leucopsis* (Cheney 1915).

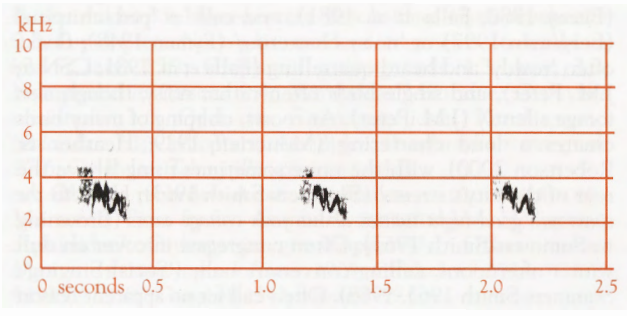
Sexual behaviour Very little information for HANZAB region. **Copulation** SOLICITATION DISPLAY: Once, female unsuccessfully solicited male, with her body more or less prostrate, rump exposed, tail lowered and wings lowered and quivering (Lepschi 1992a; see BWP). Once female gave Copulation-invitation Call and male mounted her sideways and copulated (CSN 1). Once, three males attempted forced copulation with a female; one of them was partner of female (Burrows 1968).

Relations within family group Anti-predator responses of young No information for HANZAB region. Extralimitally, young become silent on hearing Alarm Calls of parents (Summers-Smith 1988; BWP). **Parental anti-predator strategies** When Common Starling approached nest, pair called loudly but did not approach Starling. Later, female gave Alarm Call when Cat took a fledgeling (Burrows 1968). Loud Alarm Calls given by group of adults after nestling taken by Australian Magpie *Gymnorhina tibicen* (Savell 1950). At another nest, pair were 'buffeting and scolding' White-browed Babbler *Pomatostomus superciliosus* as it raided nest and killed nestlings (Ashby 1918). Extralimitally, mob predators at nests (BWP).

VOICE Little published information for HANZAB region, but well known extralimitally (see Summers-Smith 1963, 1988; BWP; and references therein); sonagrams in BWP, Lowther & Cink (1992) and Jurisevic & Sanderson (1994). Extralimitally, repertoire of adults consists of a rudimentary Song, Subsong, and at least eight calls (BWP). Though four different call-types reported extralimitally (Chirp, Churr, Nasal and Pleading; see BWP), most reports from HANZAB region refer to chirping or chirruping (see below). Often described as noisy (Serventy 1927; Symon 1948) or garrulous (Pizzey 1980; Falla *et al.* 1981), and calls as 'pert chirping' (Leishman 1997) or 'noisy chattering' (Symon 1948); flocks often 'rowdy' and heard quarrelling (Falla *et al.* 1981; CSN 5; J.M. Peter), and single birds often rather noisy, though also forage silently (J.M. Peter). At roosts, chirping of many birds creates a loud chattering (Moncrieff 1929; Heather & Robertson 2000), with the noise sometimes rising 'above the roar of the city's streets' (Summers-Smith 1963); *Hark 'tis the sparrow's good-night twitter about your cottage eaves* (Browning in Summers-Smith 1963). Often congregate in cover on dull winter afternoons, calling conversationally ('Social Singing'; Summers-Smith 1963, 1988). Often call for no apparent reason (Summers-Smith 1963). Calls often said to resemble those of other species, especially Masked Woodswallow (Mathews

1918; Sutton 1938; Boehm 1951; J.M. Peter), *Neophema* parrots (Boehm 1951), Chirruping Wedgebill *Psophodes cristatus* (Ford & Parker 1973) and Rufous-throated Honeyeater *Conopophila rufogularis* (Jarman 1945). At Netherby, SA, 29 July–1 Sept, first heard calling mean 41.2 min before sunrise (5.14; 28–51 min; 34 days) (Sutton 1919). In list of species participating in dawn chorus at Wollongong, NSW, on 11 Feb., first heard calling 17 min before sunrise (Wood 1994). Call at any time of day (Summers-Smith 1963).

Adults SONG (= Ecstatic Call of Summers-Smith [1963, 1988]): Repeated sequence of chirps and chirruping (Summers-Smith 1963; BWP); rendered as *cheerp-cheerp-chid-dip-chiddip* (J.M. Peter). Given by single male to attract a partner or by several males in group display (BWP). When given by several males in unison, said to develop into a 'fairly regular song of 8–10 notes with some approach to rhythm' (Falla *et al.* 1981). CONTACT CALL (= Advertising Call of Summers-Smith [1963, 1988]): Most common call (Summers-Smith 1963, 1988). Usually comprises familiar chirping; rendered as often repeated disyllabic *chiddip* (J.M. Peter) or *cheer-up* (Hermes 1985) (see sonagram **A**), or monosyllabic *chip* or slightly more drawn-out *cheerp* (J.M. Peter). Said to be usually disyllabic, but sometimes sounds monosyllabic (Summers-Smith 1963, 1988). Given throughout year for social cohesion, and also used to attract mate or to proclaim ownership of nest-site; unmated males may call more excitedly and continuously as breeding season proceeds; also used in various other contexts (Summers-Smith 1963, 1988; BWP). FLIGHT CALL: Give soft, low-pitched *churrip* (with second syllable accentuated) in flight (Summers-Smith 1963). Weak chirp given when flushed from foraging (Jarman 1945); rendered as quiet monosyllabic *rit* (J.M. Peter). COPULATION INVITATION CALL: Whining cheep given by female as invitation for male to copulate (Bull. Rep. OSNZ 3). Rendered as *quee-quee-quee* or variations thereof (Summers-Smith 1963; BWP). THREAT CALL: Chattering given by male perched on termitarium (in which both Sparrows and Sacred Kingfishers were attempting to nest) when Kingfisher approached (Hindwood 1959) probably refers to this call. Commotion made by three males when attempting to force copulation with female (Burrows 1968) also possibly this call. Extralimitally, described as a rattling *churr-r-r-it-it-it-it* (Summers-Smith 1988; BWP). ALARM CALL: Grating rattle (Pizzey 1980) or sharp chattering *chip-chip-chip-chip* directed at predator or other threat (M.A. Weston), given in 'chorus when danger is near' (Sutton 1927). Consists of chatter of broad frequency, with peak frequency of 5.9 kHz, minimum frequency of 2.2 kHz, and duration of each note 0.041 s (Jurisevic & Sanderson 1994). Given when fledgeling taken by predator (Burrows 1968; M.A. Weston) and when New Zealand Falcon flew overhead (Porter & Dawson 1968); also given when scolding potential predators (Secker 1975). Loud chirruping given by group of adults after nestling taken by Australian Magpie (Savell 1950) also describes this call; and loud protests of adults when Common Starling entered nest-site (Burrows 1968) probably also this call. Extralimitally, different Alarm Calls given in presence of aerial and terrestrial predators (Summers-Smith 1963; BWP). DISTRESS CALL: Squeak when fleeing Southern Boobook (Sibson 1989) or Pied Currawong (J.M. Peter), and squeal when clutched in talons of Australian Hobby (Brandon 1938). Rendered as shrieking *chree chree* (Summers-Smith 1988; BWP). Injured bird squawked when attacked by congeners (Dawson 1968). OTHER CALLS: Give undescribed call to nestlings when arriving at nest with food (Lane 1979). Three other calls reported extralimitally: Subsong, Social Singing Call and Nest-relief Call (Summers-Smith 1963; BWP).



A F.W. van Gessel; Umina, NSW, Dec. 1987; P94

Young Nestlings noisy (Stidolph 1922); squeak loudly when offered food (Burrows 1968), rendered as soft, sibilant and shrill *sheep-sheep-sheep* (Summers-Smith 1963; BWP); begging fledgeling gave loud *cheerp* calls at rate of *c.* 1 call/s (J.M. Peter). Also said to chatter in morning (Stidolph 1922).

BREEDING Not well known in HANZAB region, but quite well known extralimitally (e.g. Summers-Smith 1963; BWP). No major studies in Aust.; single study of eggs in Christchurch (Dawson 1964); 436 records in Aust. NRS to Oct. 2003. Nest colonially and solitarily (see Social Organization).

Season Aust. Breeding recorded in all months, but mostly Oct.–Jan. (see below). Eggs recorded Sept.–Mar. (NRS; see below); of 217 clutches in NRS, most (77.0%) late Oct. to mid-Dec.: four (1.8%) in Sept., 70 (32.3%) in Oct., 81 (37.3%) in Nov., 49 (22.6%) in Dec., 13 (6.0%) in Jan. (NRS); nestlings recorded mid-Aug. and late Sept. to mid-Feb. (n=177). QLD: Eggs recorded Sept.–Jan. in N (Lavery *et al.* 1968; Lavery 1986); no other egg data (J.R. Starks). Nestlings recorded Oct. (NRS [n=1]). Fledgelings and unspecified breeding recorded all months, but mainly spring (Horton 1975; Draffan *et al.* 1983; Storr 19; Aust. Atlas 1, 2; NRS [n=3 records fledgelings]). NSW–ACT: Eggs, Sept.–Mar. (Morris *et al.* 1981; ACT Atlas; NRS [n=12]). Nestlings, Aug.–Feb. (Clancy 1980; ACT Atlas; NRS [n=29]). Fledgelings and unspecified breeding reported all months except June (Hobbs 1961; Baldwin 1975; Rose 1999; NSW Bird Rep. 1996; Aust. Atlas 1, 2; ACT Atlas; NRS [n=13 records fledgelings]); unspecified breeding once recorded in period 7 June–8 July (Aust. Atlas 1). VIC.: Eggs, early Oct. to late Jan., with most (73.5%) late Oct. to mid-Dec. (NRS [n=136]). Nestlings, mid-Oct. to mid-Jan. (McCulloch 1973; NRS [n=75]). Otherwise, fledgelings and unspecified breeding recorded in all months (Bedggood 1972, 1973; Vic. Atlas; Aust. Atlas 1, 2; NRS [n=17 records fledgelings]). TAS.: Eggs, Oct.–Dec. (Tas. Bird Rep. 7; NRS [n=5]). Nestlings, Nov.–Jan. (Tas. Bird Rep. 7; NRS [n=6]). Unspecified breeding reported all months except May (Aust. Atlas 1, 2). No published records of fledgelings or unspecified breeding (J.R. Starks). SA: Eggs, mid-Sept. to late Jan. (NRS [n=64]). Nestlings, late Sept. to late Jan. (NRS [n=66]). Fledgelings and unspecified breeding recorded in all months (Ashton 1987; Aust. Atlas 1, 2; NRS [n=11 records fledgelings]). NT: Single record of unspecified breeding, in late Sept. (Aust. Atlas 2). **NZ** Eggs, Sept.–Jan. (Marples & Gurr 1943; Kinsky 1957; Burrows 1968; Dawson 1972; Lane 1979). Nestlings, Nov.–Feb. (Kinsky 1957, 1969; Burrows 1968; Lane 1979; MacMillan & Pollock 1985). Otherwise, fledgelings and unspecified breeding recorded July–Apr. (Lane 1979; Marples & Gurr 1943; Miskelly *et al.* 2001; Oliver; CSN 5, 6).

Site Nest in wide variety of sites. In dense shrubs (often African Boxthorn, but also in lignum), in mistletoes and dense vines or creepers, in forked branches of small trees or shrubs, and in crown of palms or pandanus; in hollows in dead trees (especially eucalypts); in cliffs; in old nests of Welcome Swallows or Fairy Martins, in base of active nests of raptors (including of Osprey *Pandion haliaetus*, Black-shouldered Kite

Elanus axillaris, Brown Falcon *Falco berigora* and Nankeen Kestrel *F. cenchroides*), walls of nests of Chestnut-crowned Babbler *Pomatostomus ruficeps*, and under or on old nest of Little Raven *Corvus mellori* and Australian Magpie, and also reported from crevice in gypsum mound in Silver Gull colony. Also often in artificial cavities, such as under eaves or in walls of buildings, in pipes, guttering, chimneys, air-conditioners, nest-boxes, plant-pot in window box, on top of pile on jetty, and in ears of giant concrete Koala (D'Ombrain 1903; Campbell 1943; Watson 1955; Wodzicki 1956; Hobbs 1958, 1979; Lowe 1959; Edgar 1966; Warham 1967; Burrows 1968; Napier 1969; Fleming 1976; Lane 1979; Hyett 1980; Conole 1981a; Draffan *et al.* 1983; Walker 1986; Ashton 1987; Field & Field 1989; Morris 1989; Vic. Atlas; NSW Bird Rep. 1995, 1996; Tas. Bird Rep. 7; CSN 34; NRS; J.R. Starks). One pair usurped nest of Sacred Kingfisher in arboreal termitarium (Gannon 1932b; Hindwood 1959); another took over new nest of Eastern Spinebill *Acanthorhynchus tenuirostris* (Hindwood 1943); and often usurp newly completed nests of Fairy Martins (NRS). One pair successfully fledged young from a nest in vent of guard van of train, which travelled a daily round trip of *c.* 50 km (Stidolph 1922). Compete for sites with Common Starlings (Tily 1947), though possibly not usually successfully (Field & Field 1989); sometimes nest near or beside Common Starlings (Burrows 1968; NRS). One nest in shrub was next to, and almost touching, active nest of Common Blackbird (Child 1975). Up to 12 nests can be found in one shrub (Baxter 1989). Re-use nests for repeat clutches (Marples & Gurr 1943; Ashton 1987; NRS). May return to same site in consecutive seasons (Lane 1979; Ashton 1987; NRS). MEASUREMENTS (m): Height of nest, 3.8 (3.11; 0.75–28; 370) (NRS). Height of nest-plant or structure, 7.2 (6.00; 1.9–35; 121) (NRS).

Nest, Materials Nest usually domed or spherical, with side entrance, though may be reduced to an open cup if in confined space (Oliver; NRS). Usually made of grass, and sometimes a few twigs, bark, rootlets, leaves or bits of other material, such as string, paper, cloth, electrical insulation or fibreglass; mostly lined with feathers, but also wool, plant down, hair or string (Williamson 1950; Watson 1955; Kesley 1993; Oliver; NRS). Nests in a Silver Gull colony were made of grass and sea-heath *Frankenia*, probably taken from Gull nests, and lined with Gull feathers (Watson 1955). One nest under eaves of roof contained some mud (NRS). One nest in NZ comprised 1614 pieces of material, of which 947 (58.7%) were feathers and 433 (26.8%) were grass stalks, up to 70 cm long; exterior was made of twigs, grass and rootlets, interior of tops of green fescue stalks, and lining of wool, string (up to 146 cm long), hair and feathers; nest also contained a few bits of bark, cloth, threads, electrical insulation and paper (Williamson 1950). Both sexes collect material and build (Hindwood 1959; NRS); in suburban Sydney, female collected most material (Kesley 1993), but extralimitally, most of building done by male, and a replacement nest built entirely by male (Summers-Smith 1963). Extralimitally, most material collected within 20–50 m of nest (BWP), but near Dunedin, SI, feathers lining one nest collected from up to 180 m away (Williamson 1950). One pair plucked feathers from a Barbary Dove *Streptopelia risoria* (Kinsky 1957). Tear pieces of paper and carry them to nest (Howick 1951; see also Social Behaviour). Also seen pulling glass fibres from corrugated roofing, and bark from stringybark tree, probably for nesting material (Kesley 1993). Extralimitally, sometimes remove old nest before adding fresh material, and construction can take from 2 days to several weeks (Summers-Smith 1963; BWP). Construction of one nest: on Day 1, built open platform of grass; on Day 3, built sides up to 5 cm high; on Day 4, sides extended to 7.5 cm; on Day 5, curved roof being formed; on Day 7, dome almost complete; on Day 8, lining being added; with no apparent additions to nest by Day 14 (NRS). One pair excavated depression, 9 × 5 cm, in flower-pot in a window-box, removing soil with bills and claws, taking *c.* 24 h; depression then lined with straw; lower branch of pot-plant was woven into roof of nest; small tunnel added, facing away from front of window box (Lane 1979). Extralimitally, continue to add lining material after eggs laid (Summers-Smith 1963; BWP). When re-using a nest, both adults maintained and repaired nest during nestling period and after fledging (Lane 1979). Extralimitally, both adults add fresh material to nest between broods (BWP). Rebuild if nest destroyed (Campbell 1943). Occasionally seen dismantling nests of Southern Whiteface in tree-hollows (Cheney 1915), though not known whether to steal material or usurp hollow. MEASUREMENTS (cm): *AUST.*: No information (J.R. Starks). *NZ*: 20.3 wide × 17.8 deep (Williamson 1950). *EXTRALIMITALLY*: For free-standing nests, external diameter 21.3 (17.0–23.5; 26), external height 21.9 (14.0–31.0; 24) and internal diameter 8.9 (6.0–12.0; 26); for nests in unrestricted cavity (n=55), external diameter 40.2, external depth 14.8, internal diameter 9.6, and depth of cup 4.4 (BWP).

Eggs Little information for HANZAB region. EXTRALIMITALLY: Elliptical; smooth; slightly glossy; white, or faintly tinted greenish or greyish, varyingly marked with spots, speckles or blotches of grey, blue-grey, greenish grey, purplish grey, black or purplish brown; seldom unmarked (BWP). AUST.: Described as greyish white, with brown or grey speckles and blotches (Frith 1969) but possibly based on extralimital descriptions. NZ: In Canterbury, SI, much variation in colour and markings (including from pure white to almost black, and bright reddish-pink) and varyingly marked with large and small blotches of various shades and tints, though sometimes unmarked (Smith 1926a). Last egg of clutch usually has fewer spots than rest; and penultimate egg sometimes intermediate in colour between last egg and rest of clutch. Size, colour and markings of eggs said to be characteristic for each female, even in successive clutches (Dawson 1964). MEASUREMENTS: *AUST.*: Given as 22–25 × 15–17 (Frith 1969) and 24 × 16 (Aust. RD) but both probably based on extralimital sources. *NZ*: 21.9 (1.20; 18.7–25.0; 225) × 15.3 (0.57; 13.8–16.7) (Dawson 1964, which see for details of variation in measurements with age of female); 22.5 × 15.7 (Oliver). *IN W. PALAEARCTIC*: 22.2 (18.0–25.0; 1464) × 15.7 (13.4–17.5) (BWP). WEIGHT: *NZ*: When fresh, 2.88 (0.32; 1.94–3.85; 217); daily weight loss differed significantly between periods of incubation (n=43 eggs): 0.013±0.012 g/day before start of incubation; 0.032±0.007 during incubation; and 0.070±0.036 just before hatching (Dawson 1964).

Clutch-size Two to seven, usually three to five, in HANZAB region (McEvey 1965; Oliver; NRS; see below) and extralimitally (BWP). AUST.: 4.09 (1.01; 42): C/2 × 2, C/3 × 9, C/4 × 17, C/5 × 12, C/6 × 1, C/7 × 1 (NRS); in Aldinga Scrub CP, SA, 3.91 (0.70; 11): C/3 × 3, C/4 × 6, C/5 × 2 (Ashton 1987). NZ: 3.90 (0.61; 109): C/2 × 1, C/3 × 23, C/4 × 71, C/5 × 14 (Dawson 1964).

Laying Eggs laid on consecutive days (Marples & Gurr 1943; Dawson 1964; Lane 1979; NRS). In NZ, laid between dusk and 05:00 (Dawson 1964). Extralimitally, usually laid in early morning (Summers-Smith 1963). Laying can begin 3 days after completion of nest (Lane 1979), or within 7 days (Marples & Gurr 1943), and, once, ≥12 days after completion (NRS). Can raise three or occasionally four broods per season (Dawson 1972). Laying of second clutch started 4 days after first brood fledged (Lane 1979); some successive clutches laid so quickly that eggs are partly incubated by nestlings of previous broods (Oliver). For extralimital details of interval between successive broods, or laying of replacement clutches, see Summers-Smith (1963) and BWP.

Incubation By both sexes (Lane 1979). Begins with

penultimate egg, though sometimes incubate sporadically before this (Dawson 1964). Eggs usually hatch in morning (Lane 1979). Clutch does not always hatch synchronously, and can be spread out over 2–4 days (Lane 1979). Extralimitally, effective incubation begins with laying of third egg, with mean length of stints of incubation 11 min for female and 8.9 min for male; female incubates at night (Summers-Smith 1963, which see for full details of incubation and hatching). An unhatched egg was removed 2 days after rest of clutch hatched (Lane 1979), though, extralimitally, said that infertile eggs not removed (Summers-Smith 1963). INCUBATION PERIOD: *AUST.*: Said to be 12–14 days (Frith 1969), probably based on extralimital data. *NZ*: *c.* 12 days (10.75–16; 68 clutches) (Dawson 1964); from completion of clutch, 13 days × 5 eggs, 14 days × 1 egg (Lane 1979); *c.* 13 days (Oliver). *EXTRALIMTALLY*: Mean 12 days (9–18; 95 clutches); 12 days (n=28 clutches; Summers-Smith 1963); 13.7 days (n=100 eggs in 35 nests; Sengupta 1981).

Young Altricial, nidicolous. Blind and naked at hatching (NRS). For extralimital details of growth and development, see Summers-Smith (1963). **Parental care** Nestlings fed by both adults (Burrows 1968; Lane 1979; NRS). At nest with B/2, each nestling was fed alternately, one coming to entrance to be fed, then retiring and other moving forward (Lane 1979); for rates of feeding, see Food (Young). At a nest with B/4, mean interval between visits, 4.73 min (4.38–5.13); young probably brooded while adult roosting in nest at night (for timing see Social Organization: Roosting) (Marples & Gurr 1943). At one nest with a second brood, a female-plumaged bird, other than parent, twice visited nest and fed chicks (Lane 1979). Both adults brood (Lane 1979). In one nest, nestlings brooded for 2–3 min during intensive feeding periods; brooded for shorter periods when intensity of feeding declined (Lane 1979). Both adults remove faecal sacs, which are either swallowed or carried away from nest (Lane 1979). Dead nestlings removed by male and dropped on ground nearby (Lane 1979). For extralimital details of parental care and development of young, see Summers-Smith (1963). Once, Common Starling repeatedly fed House Sparrow nestlings in nest-box and removed their faecal sacs (Burrows 1968; also see Food).

Fledging to independence FLEDGING PERIOD: 13 days × 2, 15 days × 3 (Lane 1979); said to be 15 days (Frith 1969 [probably based on extralimital data]). Extralimitally, 14.4 days (11–19) (Summers-Smith 1963). Extralimitally, usually fledge in morning (Summers-Smith 1963). Two newly fledged young fed regularly on first day and occasionally on next day (Lane 1979); extralimitally, fed by adults for up to 14 days after leaving nest (Summers-Smith 1963). Fledgelings may return to nest for several days after fledging (Marples & Gurr 1943).

Success Where clutch-size, hatching success and outcome known (excluding nests destroyed by observer), from 80 eggs, in 20 nests, 34 (42.5%) hatched, and 16 (20%) young fledged, equal to 0.8 young fledged per nest; from 126 eggs, in 32 nests, 72 (57.1%) hatched; of 156 nests where outcome known, 42 (26.9%) were successful and 114 failed (including many nests destroyed by observers) (NRS). In Aldinga Scrub CP, SA, of 20 nests where outcome known, 12 (60%) were successful and eight failed; 53% of eggs laid fledged young (Ashton 1987). Nests and eggs often deliberately destroyed (see Threats and Human Interactions). One nest deserted after nest damaged by stone-throwing boys (Hindwood 1959). One clutch failed when female died on eggs (NRS). PREDATORS: Nestlings taken by Australian Magpie through hole made in side of nest (Chandler 1944); nestlings taken by Square-tailed Kite *Lophoictinia isura* (Clancy 1980) and Long-tailed Cuckoo *Eudynamys taitensis* (Kinsky 1957). Fledgelings taken by Laughing Kookaburra *Dacelo novaeguineae* (Caswell 1987), and by Cat (Burrows 1968). Nests robbed by Pied Currawong (Vellenga 1980). CUCKOOS: Parasitized by Long-tailed and Pallid *Cuculus pallidus* Cuckoos, and Horsfield's *Chrysococcyx basalis* and Shining C. *lucidus* Bronze-Cuckoos (Smith 1926b; *HANZAB* 4).

PLUMAGES Prepared by J.S. Matthew. Following summarized from BWP. Naked at hatching, but develop covering of down soon after. Fledge in juvenile plumage. Complete post-juvenile (first pre-basic) moult to adult (basic) plumage starts when 4–6 weeks old. Thereafter, a complete post-breeding (pre-basic) moult each cycle produces successive adult (basic) plumages with no change in appearance. Sexes differ obviously in adult plumage, very slightly in juveniles. Up to 13 subspecies recognized; nominate *domesticus* probably only subspecies in HANZAB region. For detailed descriptions of plumages, see BWP and Summers-Smith (1988), and summary in Field Identification above.

Hybrids Rarely, hybridize with Eurasian Tree Sparrow (e.g. Harris *et al.* 1989, BWP).

BARE PARTS See BWP and Summers-Smith (1988) for full details, and summary in Field Identification above. **Adult male** In HANZAB region, seasonal changes in colour of bill much as for n. hemisphere, but timing differs by *c.* 6 months; examination of skins (MV) indicates bill entirely black in winter and early spring, just before breeding season; after breeding season, during post-breeding moult, from Jan.–Apr., bill becomes paler, dark brown (ne) or greyish brown (ne) with dull-yellowish (ne) or flesh-coloured (ne) base, often with small black (89) spot at base of lower mandible and narrow tip. Keve (1964–65) stated that adults in Aust. have black bills from Aug. to Nov., and sometimes in Dec. For detailed information on seasonal variation in bill colour in n. hemisphere, see BWP and references therein. **Juvenile** 'Immatures' (probably referring to juveniles or birds undergoing post-juvenile moult) from Vic. had bill and gape, yellow (Rogers *et al.* 1986). Adult non-breeding bill colour acquired in post-juvenile moult (BWP).

MOULTS Based on examination of skins of 33 adults and three juveniles from se. Aust., and 19 adults from NZ (MV, NMNZ) and other information as cited. **Adult post-breeding** (Second and subsequent pre-basic). Complete. Primaries outward, starting at p1. In England, moult of primaries takes *c.* 60 days for males, but period probably more varied for females (BWP, see which for details on timing and sequence). In Aust., active moult of primaries recorded from skins collected Feb. (1 of 1; PMS 14) and Apr. (1 of 2; PMS 29), these birds with conventional moult of primaries and 2–3 primaries growing at once; other skins from Apr. (other 1 of 2), May (4 of 4), July (2 of 4) and Aug. (1 of 4) had primaries new; others from July–Aug. and all 17 from Sept.–Jan. had all primaries worn. Rogers *et al.* (1986) stated that complete moult occurs Dec.–Mar. in Vic. In NZ, active moult of primaries recorded from skins collected Jan. (1 of 1; PMS 43); skins collected July (12 of 12) and Aug. (1 of 2) had primaries new or very slightly worn; others from Aug. (other 1 of 2), Sept. (1 of 1) and Nov. (4 of 4) had all primaries worn. Combined results suggest that moult of primaries occurs from early summer to early autumn in HANZAB region, resulting in fresh plumage in autumn and early winter (see Field Identification); insufficient data to compare timing of moult between populations in Aust. and NZ. One skin, from Vic. in Nov., had inner four primaries slightly worn and rest heavily worn; this bird had possibly arrested moult of primaries. Arrested moult has been recorded in introduced populations in USA and w. Africa (Summers-Smith 1988). Almost no information on timing of moult of secondaries, tail and body in HANZAB region; skins with active moult of primaries also had active moult of body. See

BWP for sequence of replacement of feathers in n. hemisphere populations. **Post-juvenile** (First pre-basic). Complete. Acquire adult plumage in this moult. In n. hemisphere, starts when 4–6 weeks old, but timing varies according to date of hatching (BWP). Almost no information from HANZAB region. In se. Aust.: none of three juveniles collected Nov.–Jan. had started moult; and one juvenile collected Mar. was starting moult of body. Rogers *et al.* (1986) stated that 'immatures' (presumably referring to juveniles) undergo complete moult Dec.–Mar. in Vic.

MEASUREMENTS NOMINATE *DOMESTICUS*: (1–3) NZ, adult, skins: (1–2) NI (Niethammer 1971): (1) Wellington; (2) Maraekakaho; (3) NI and SI (including several from Maraekakaho) (NMNZ [this study]). (4–5) SE. Aust., skins (MV): (4) Adults; (5) Juveniles. (6–7) England, adult skins: (1) BWP; (2) Niethammer (1971).

		MALES	FEMALES	
WING	(1)	76.9 (2.07; 73–82; 62)	73.9 (1.73; 70–77; 26)	**
	(2)	79.2 (1.59; 72–81; 76)	77.2 (1.03; 75–79; 19)	**
	(3)	77.4 (1.38; 75–80; 19)	–	
	(4)	76.3 (1.63; 74–80; 19)	72.2 (1.59; 70–76; 13)	**
	(5)	70, 70, 74	70	
	(6)	76.2 (1.87; 71–81; 199)	74.3 (1.50; 72–78; 32)	**
	(7)	76.8 (1.59; 72–81; 76)	74.1 (1.35; 72–77; 28)	**
TAIL	(1)	55.9 (2.34; 50–60; 64)	54.3 (1.99; 50–58; 26)	**
	(2)	57.5 (1.62; 55–61; 23)	55.2 (1.32; 53–58; 19)	**
	(3)	58.1 (2.82; 50–62; 19)	–	
	(4)	56.7 (2.40; 52–61; 19)	54.1 (2.02; 51–58; 12)	
	(5)	50, 50, 60	45	
	(7)	55.4 (1.87; 50–59; 73)	53.3 (1.76; 51–57; 19)	**
BILL S	(3)	15.0 (0.61; 13.8–15.9; 19)	–	
	(4)	14.4 (0.89; 12.5–15.5; 18)	14.9 (0.57; 13.9–15.8; 13)	ns
	(5)	12.5, 12.6, 13.7	12.5	
	(6)	15.4 (0.51; 14.5–16.1; 14)	15.8 (0.35; 15.5–16.3; 4)	ns
TARSUS	(3)	19.3 (0.89; 17.5–20.6; 19)	–	
	(4)	18.8 (0.76; 17.3–20.4; 19)	18.0 (0.45; 17.3–18.9; 11)	ns

NOMINATE *DOMESTICUS*: (8–10) Aust., live, unsexed: (8–9) Vic. (Rogers *et al.* 1986): (8) Adults; (9) 'Immatures' (probably juveniles); (10) Qld, adults (Rogers *et al.* 1990).

		UNSEXED
WING	(8)	76.8 (2.19; 41)
	(9)	72.8 (2.51; 15)
	(10)	74.1 (2.97; 69–79; 35)
TAIL	(10)	55.3 (2.97; 48–60; 35)
THL	(8)	32.2 (0.61; 36)
	(9)	30.9 (1.03; 15)
	(10)	32.0 (0.80; 30.2–33.4; 35)
TARSUS	(10)	18.4 (0.96; 16.7–20.5; 35)

WEIGHTS NOMINATE *DOMESTICUS*: (1–3) NZ, adults: (1) Wellington, NI (Niethammer 1971); (2) Maraekakaho, NI (Niethammer 1971); (3) NI and SI (including several from Maraekakaho) (NMNZ [this study]). (4–5) SE. Aust., skins (MV): (4) Adults; (5) Juveniles. (6) Germany, adults (Niethammer 1971).

	MALES	FEMALES	
(1)	28.3 (2.09; 23–33; 63)	28.6 (2.49; 25–33; 26)	ns
(2)	30.7 (2.20; 26.5–34; 20)	30.7 (1.49; 25–33.6; 19)	ns
(3)	28.8 (3.06; 21.5–34.1; 16)	–	
(4)	27.0 (1.40; 24–28; 11)	27.7 (2.60; 23–30; 9)	ns
(5)	23, 28	15	
(6)	29.5 (1.30; 26.5–32; 125)	29.5 (1.95; 27–32; 119)	ns

NOMINATE *DOMESTICUS*: (7–9) Aust., live, unsexed: (7–8) Vic. (Rogers *et al.* 1986): (7) Adults; (8) 'Immatures' (probably referring to juveniles); (9) Qld, adults (Rogers *et al.* 1990).

	UNSEXED
(7)	(23.9–31.6; 45)
(8)	(19.1–28.7; 15)
(9)	26.6 (1.99; 24.0–29.5; 15)

Mean weights of adults from UK: males 28.6; females 28.5 (Summers-Smith 1988). Mean weight of juveniles from UK 23.8 (n=1030; BWP).

AGEING Juveniles distinguished from adults by plumage and bare parts; see Field Identification, Summers-Smith (1988) and BWP for details.

SEXING Adults show obvious dimorphism in plumage and slight differences in size (*contra* Rogers *et al.* 1986). Juveniles show slight differences in plumage: chin and throat often dark grey in males, more uniform whitish in females; see Field Identification, Summers-Smith (1988), Svensson (1992) and BWP for details.

GEOGRAPHICAL VARIATION Complex in n. hemisphere. Little known of geographical variation in Aust., but some morphological differentiation within NZ populations (A. Baker 1980). Number of subspecies recognized varies from 11 (Peters) to 12 (Vaurie 1949, 1956) or 13 (Summers-Smith 1988; BWP). Geographical variation in Eurasian populations discussed in detail in several works (Vaurie 1956, 1959; Johnston & Selander 1973; Summers-Smith 1988; BWP). In Eurasia, variation largely involves size, depth of bill, tone of plumage and width of streaking on upperparts (BWP). Variation in size is mostly clinal, wing-length increasing with longitude in both European and Asian populations (Summers-Smith 1988). The various subspecies are placed into two main groupings (summarized from BWP): (1) Palaearctic *domesticus* group, comprising about seven subspecies, including nominate *domesticus* from UK and most of w. and n. Europe; birds in this group are large and adult males have greyish sides of head and neck, extensively grey underparts and rather pale rufous upperparts. (2) Oriental *indicus* group, comprising about six subspecies, including wide-ranging subspecies *indicus*; birds from this group tend to be smaller, and adult males have white sides of head and neck and white underparts, and rich-rufous upperparts.

Nominate *domesticus* probably only subspecies in Aust. (DAB; Peters) as birds thought to have originally been imported from UK and perhaps also nw. Europe (Balmford 1978; Long 1981). Little known about geographical variation within Aust. DAB stated that skins (n=34) from se. Aust., central Qld, L. Eyre Drainage Basin and Norfolk I. all have plumage consistent with nominate *domesticus*. Rogers *et al.* (1990) stated that birds from Qld are similar in size to birds in Vic. Sage (1957) found no difference in plumage characters, length of tail and bill, or depth of bill between skins from Vic. (n=5) and w. Europe (*c.* 250 skins). However, he suggested that Aust. birds have slightly shorter wing (mean 72 mm; sexes combined) than European birds. Keve (1964–65) found that skins from mainland Aust. (n=27 males, 10 females) and Tas. (n=1 male) resemble skins from England in size and plumage, but are smaller than skins from continental Europe. Measurements of skins from England and se. Aust. (this study) are similar (see Measurements); there is no significant difference in Wing of adult males, but adult females from se. Aust. have shorter Wing ($P<0.01$) than those from England. Adult skins from se. Aust. have shorter Bill S ($P<0.01$; sexes separately) than those from England. However, differences in Bill S may be due, at least in part, to differences in collecting season. In n. hemisphere, bill is longer (by up to 12% in Germany) in summer than in winter, largely owing to seasonal differences in degree of abrasion of bill: less in summer when

birds feed largely on soft insects, and more in winter when birds feed on hard seeds. Such seasonal differences in length of bill have also been found in introduced populations in USA (Summers-Smith 1988; BWP).

Populations in NZ also introduced from England (Thomson 1922; Niethammer 1971; A. Baker 1980) and are therefore nominate *domesticus*. Following observations suggest NZ and Aust. populations have diverged from each other: (1) adult male skins from NZ have longer Wing, Bill S and Tarsus ($P<0.05$) than adult male skins from Aust. (this study); (2) Keve (1964–65) stated that skins from NZ (n=7 males, 6 females) have brighter reddish upperparts and brighter white underparts than birds from Aust. Of 16 skeletal characters measured from birds collected at 13 localities across NZ, from Kaikohe S to Stewart I. (A. Baker 1980); in summary: (1) there was slight morphological variation between different localities in NZ; (2) of the 16 skeletal characters analysed, significant variation between localities was found for 13 (males) and eight (females) characters; (3) there was an overall trend, along an approximate N–S axis, of larger body size towards warmer locations in n. NZ and smaller size in cooler regions, contrary to Bergmann's Rule; (4) males and females show different patterns of variation, possibly in response to different environmental factors; (5) variation between sites in NZ was lower than for introduced populations in N. America, suggesting that stocks introduced to NZ were less genetically diverse than those introduced to N. America, or that weaker selective pressures have operated in NZ, or both. Niethammer (1971) found that birds from Maraekakaho, NI, have longer Wing and Tail, and weigh more ($P<0.01$; sexes analysed separately), than birds from Wellington; he suggested the former population has diverged from original stocks introduced from England whereas population from Wellington has not.

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Dunnock *Prunella modularis* (page 1059)
SUBSPECIES *OCCIDENTALIS:* **1** Adult male; **2** Juvenile; **3** Adult male

House Sparrow *Passer domesticus* (page 1070)
NOMINATE *DOMESTICUS:* **4** Adult male (fresh plumage); **5** Adult male (worn plumage); **6** Adult female; **7** Juvenile; **8** Adult male

Eurasian Tree Sparrow *Passer montanus* (page 1089)
9 Adult (fresh plumage); **10** Adult (worn plumage); **11** Juvenile; **12** Adult

Java Sparrow *Lonchura oryzivora* (page 1270)
13 Adult; **14** Juvenile