

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 AXI (AX in *Dicrurus* [drongos]). *Ambiens* absent. Iliofemoralis externus usually absent, but present in some groups as 'developmental anomaly' (Raikow 1982). Tensor proptagialis brevis tendon present. Hypocleideum present (except Menuridae [lyrebirds]). Wings eutaxic. Usually ten primaries, but p10 often reduced or absent; 11 primaries in Menuridae (lyrebirds), most Eurylaimidae (broadbills), most Furnariidae (ovenbirds), and some Passeri (oscines [see below]). Usually nine secondaries (ten in Menuridae [lyrebirds]). Usually 12 rectrices, but from six (*Stipiturus* [Maluridae]) to 16 (Menuridae). Lesser primary and secondary coverts usually reduced or absent (Zeidler 1966; Morlion 1985; Winkler & Jenni 1996), but a few well-developed lesser primary coverts are present in Superb Lyrebird (Morlion 1985). Uropygial preen glands naked. No basipterygoid process. Nasal glands minute. Foot anisodactyl. Hallux incumbent, large and directed backwards; toes 2, 3 and 4 directed forward; digital formula 2-3-4-5. Deep plantar tendons usually of type VII (lacking vinculum), but often type I in Eurylaimidae (broadbills). Spermatozoa bundled with coiled head and large acrosome.

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

The Passeriformes divide into two main groups:

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

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

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

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

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- MENURIDAE (lyrebirds): two species in one genus; endemic to Aust.;
- ATRICHORNITHIDAE (scrub-birds): two species in one genus; endemic to Aust.;
- CLIMACTERIDAE (A'asian treecreepers): six species in two genera breeding in Aust.;
- MALURIDAE (Australopapuan fairy-wrens, emu-wrens and grasswrens): 22 breeding species in three genera in Aust.;
- MELIPHAGIDAE (honeyeaters and Aust. chats): 76 species in 26 genera in Aust. and NZ, all breeding;
- PARDALOTIDAE (pardalotes, scrubwrens, thornbills and allies): 51 species (one extinct) in 15 genera in HANZAB region, all breeding;
- PETROICIDAE (A'asian robins): 23 species in eight genera in HANZAB region, all breeding;
- ORTHONYCHIDAE (logrunners): two breeding species in one genus in Aust.;
- POMATOSTOMIDAE (A'asian babblers): four breeding species in single genus in Aust.;
- CINCLOSOMATIDAE (whipbirds, wedgebills, quail-thrushes and jewel-babblers): eight breeding species in two genera in Aust.;
- NEOSITTIDAE (sitellas): single species breeding in Aust.;
- PACHYCEPHALIDAE (whistlers, shrike-thrushes and allies): 17 species in seven genera in HANZAB region, all breeding;
- DICRURIDAE (monarchs, flycatchers, fantails and drongos): 19 species in seven genera in HANZAB region, all breeding;
- CAMPEPHAGIDAE (cuckoo-shrikes, trillers and minivets): eight species (one extinct) in two genera in HANZAB region, all breeding;
- 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.
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The Aust. oscines fall into two distinct clusters, each with at least three major supra-familial lineages (DAB): One cluster is the Passerida, comprising the 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, taxonomy of subspecies follows DAB.

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

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

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

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

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

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

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

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

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

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

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

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

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

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Family STURNIDAE starlings, mynas and oxpeckers

A fairly large family of morphologically rather homogeneous, small to medium-large and usually gregarious passerines, with robust bodies, rather long pointed wings, fairly pointed bills and rather short legs and, in adults, often glossy plumage. As defined here (see below), the family comprises 110–115 species in 26–27 genera, distributed through Africa, Eurasia, including the Indian subcontinent, Japan, the Philippines and Indonesia, islands of Indian Ocean (Réunion, Andaman and Nicobar Is), Australo-Papuan region and islands of sw. Pacific Ocean (Amadon 1956; Sibley & Monroe 1990; Monroe & Sibley 1993; Feare & Craig 1998; Peters). Several early works consider starlings to be related to various other groups, including weaverbirds, crows, birds of paradise, butcherbirds, Old World orioles and drongos (Sharpe 1890; Reichenow 1914; Stresemann 1927–34; Amadon 1943; Delacour & Vaurie 1957; Bock 1963). Starlings have been placed in, or alongside, weaverbirds (Ploceidae) by several authors (Mayr & Amadon 1951; Berndt & Meise 1960; Peters). Wetmore (1960) placed starlings near NZ wattlebirds (Callaeidae), shrike-vireos *Vireolanius* and shrikes (Laniidae). However, DNA–DNA hybridization data (Sibley & Ahlquist 1984, 1990) indicate: (1) the nearest relatives to starlings are mockingbirds *Mimus* and thrashers *Toxostoma*, whose next closest relatives are true thrushes (subfamily Turdinae within the Muscicapidae); (2) starlings are part of the superfamily Muscipoidea, which includes waxwings, dippers, true thrushes, Old World flycatchers and allies; and (3) mockingbirds and thrashers diverged from starlings 23–28 million years ago. Consequently, Sibley & Monroe (1990) and Monroe & Sibley (1993) placed mockingbirds and thrashers in a tribe (Mimini) separate from starlings, mynas and oxpeckers (tribe Sturnini). In this study, we follow conventional treatments (Mayr & Greenway 1962; BWP; Peters; DAB) in treating starlings, mynas and oxpeckers as Sturnidae and keeping mockingbirds and thrashers as a separate family Mimidae. Fry *et al.* (2000) treat oxpeckers as a full family Buphagidae, but most works (Mayr & Greenway 1962; Feare & Craig 1998; BWP; Peters) treat them as a subfamily, Buphaginae, within the Sturnidae.

Seven species, in four genera, recorded in HANZAB region: three species of *Aplonis*, one of which, Tasman Starling *A. fusca*, is extinct; three species of *Sturnus*, two of which are vagrants and one introduced; and one species of *Acridotheres*, Common Myna *A. tristis*, which is introduced. In addition, two other species were unsuccessfully introduced to Christmas I.: PALE-BELLIED MYNA *Acridotheres cinereus*, c. 1904 and HILL MYNA *Gracula religiosa*, c. 1923. Neither became established (Chasen 1933; Long 1981; Christidis & Boles 1994).

Size varies from fairly small (e.g. Violet-backed Starling *Cinnyricinclus leucogaster*: total length 15–17 cm, weight 38 g) to medium-large (e.g. Bristle-crowned Starling *Onychognathus salvadorii*: total length 39–42 cm, weight 160 g). In HANZAB region, smallest is Purple-backed Starling *Sturnus sturninus* (total length 16–19 cm, weight 50 g) and largest is Common Myna (total length 22–27 cm, weight 130 g). Following characteristics shared by the family (summarized from Beecher [1953], Bock [1962], Warner [1972], Feare & Craig [1998], Fry *et al.* [2000], BWP and DAB). Wings usually rather long and pointed at tips, but fairly short, broad and rounded at tips in a few (e.g. Babbling Starling *Neocichla gutturalis*). Ten primaries; p10 short, and vestigial in some species. Nine secondaries, including three tertials. Tail varies from rather short and square at tip (e.g. Singing Starling *Aplonis cantaroides*) to very long and graduated (e.g. some *Onychognathus*); 12 rectrices. Bill varies according to diet and foraging behaviour: rather short to moderately long, fairly pointed, strong, and slightly decurved in some (e.g. most *Sturnus*, *Aplonis*) to more robust and rather straight in others (e.g. *Acridotheres*, *Gracula*); oxpeckers have very robust and thickened bills adapted for removing ticks from ungulates. Slight notch near tip of upper tomium. Nostrils semi-operculate; usually unfeathered, but some (e.g. most *Acridotheres*, *Gracula*) have more extensive feathering over nares. Rictal and nasal bristles vary from prominent to very weakly developed. Many species have modified structures of head, including wattles (e.g. Wattled Starling *Creatopthera cinerea*, Hill Myna *Gracula religiosa*) or bare periophthalmic skin (e.g. some *Acridotheres* and *Sturnus*). Tongue has bifid tip; nectarivorous Brahminy Starling *Sturnus pagodarum* has brush-like tip. Legs and feet rather strong; tarsus fairly long in some (e.g. *Acridotheres*), rather short in others (e.g. some *Sturnus*). Tarsal scaling laminiplantar. Syrinx has wide pessulus. Skull often rather narrow anteriorly (see Moreno 1986 for illustration of skull of Common Starling *Sturnus vulgaris*). Ectethmoid foramina usually doubled. Medial palatine plate back-sloped, with vestigial or no medial palatine processes. Humerus usually with double pneumatic fossae.

The family has the following plumage characteristics (summarized from Feare & Craig [1998], Fry *et al.* [2000], BWP and DAB). Colour of plumage varies greatly. Adults of many species have glossy black, purplish, violet or dark-greenish plumage, particularly on upperparts (e.g. *Lamprotornis*, *Aplonis*, Violet-backed Starling, some *Sturnus*); some have boldly pied appearance (e.g. *Streptocitta mynas*, Asian Pied Starling *Sturnus contra*); while others have rather dull combinations of brown, white, grey, russet or buff tones. Some species have bright areas of yellow or rufous on head or wing (e.g. Golden-crested Myna *Ampeliceps coronatus*, red-winged starlings *Onychognathus*); and a few species have other distinctive markings, including black hoods (e.g. Rose-backed Starling *Sturnus roseus*), pale scapular bands (e.g. some *Sturnus*), supercilia (e.g. Fiery-browed Starling *Enodes erythrophris*) or white patches at base of primaries (e.g. Common Myna, Hill Myna). Many species have distinctive feather-modifications, including

erect feathering on forehead and narial area (e.g. some *Acridotheres* and *Aplonis*), prominent helmets or crests (e.g. Rose-backed Starling, *Basilornis mynas* and some *Acridotheres mynas*), ear-tufts or 'lappets' (e.g. *Basilornis mynas*) and lanceolate feathering on throat and breast (e.g. some *Sturnus* and *Aplonis*). Sexes usually alike, but obviously plumage-dimorphic in some species (e.g. red-winged starlings, Golden-crested Myna, Chestnut-cheeked Starling *Sturnus philippensis*). Juveniles duller than adults and often very different (e.g. juvenile *Aplonis* lack glossy plumage and have dark streaking to otherwise whitish underparts). Nestlings vary at hatching: naked (e.g. African Pied Starling and at least some *Lamprotornis*), naked except for a few patches of sparse down (e.g. Rose-backed Starling) or covered with dense down (e.g. Common Starling). Nestlings lack markings of mouth or tongue. Fledge in juvenile plumage. Moults of most Asian and African species poorly understood and following based mainly on European species. Usually undergo a complete post-juvenile (first pre-basic) moult to adult plumage or adult-like first immature plumage; some undergo a partial post-juvenile (first pre-basic) moult to adult-like first immature plumage, extent of which can even vary between individuals within species (e.g. Common Starling). Adults undergo a single complete post-breeding (pre-basic) moult annually. Primaries moult outward, starting at p1. Moult of tail starts during early stage of moult of primaries; moult of body possibly starts just before start of moult of primaries.

Occupy a wide range of habitats, including rainforest, forest, forest edges and clearings, woodlands, shrublands and grasslands, heathland, rocky areas, and a wide range of modified habitats including pasture, cultivation, cattle yards, plantations, and streets, parks and gardens of cities, towns and villages, including heavily built-up areas; some species very well adapted to modified habitats and often commensal with humans, including Common Starling and Common Myna of HANZAB region (and similarly elsewhere where introduced). *Onychognathus* starlings often in montane rocky habitats; *Sturnus* starlings tend to occupy open areas; and *Aplonis* starlings typically in forest, forest edges, clearings and regrowth, sometimes in modified areas with trees (White & Bruce 1986; Coates 1990; Dickinson *et al.* 1991; Doughty *et al.* 1999; Fry *et al.* 2000; Robson 2000; BWP).

Range from sedentary or resident (e.g. White-billed Starling *Onychognathus albirostris*), resident with local dispersion (e.g. Red-winged Starling *O. morio*) or altitudinal movements (e.g. Kenrick's Starling *Poeoptera kenricki*), partly migratory (e.g. Common Starling) to wholly migratory over long distances (e.g. Rose-backed Starling). African breeding species tend to be restricted to local dispersive movements or partial short-distance migration mostly within breeding range (e.g. Chestnut-bellied Starling *Lamprotornis pulcher*); Eurasian breeding species often partly migratory or migratory (e.g. Purple-backed Starling); se. Asian and Melanesian species generally sedentary or resident (e.g. *Aplonis* starlings). In HANZAB region: Metallic Starling *Aplonis metallica* partly migratory, with a large proportion moving N in Mar.–Apr., probably to winter in New Guinea; Singing Starling either irregular visitor or resident on some islands of Torres Str.; introduced Common Myna and Common Starling sedentary or resident, with no evidence of seasonal movements; and vagrant Rose-backed and Purple-backed Starlings migratory (White & Bruce 1986; Coates 1990; Dickinson *et al.* 1991; Doughty *et al.* 1999; Fry *et al.* 2000; Robson 2000; Griffioen & Clarke 2002; BWP; see species accounts).

Omnivorous. Mainly eat fruit and insects, but diet in many species supplemented with other foods, including nectar, other invertebrates (e.g. spiders, snails, centipedes, worms, ticks), seeds and grain, food scraps, small vertebrates (e.g. lizards, frogs, mice, nestlings), leaves, flowers, buds, carrion, and eggs of birds; some specialize on certain foods such as nectar (e.g. Brahminy Starling) or orthopteran insects (e.g. Wattled Starling, Rose-backed Starling). Mostly arboreal, foraging in trees and shrubs: glean from foliage; probe bark, crevices, lichens, moss and the like; pluck or peck at fruit; and probe flowers for nectar or, occasionally, insects. Some species forage to varying degree on ground, and a few (e.g. *Neocichla*, *Zavattariornis*, *Acridotheres* and especially *Sturnus*) primarily terrestrial. On ground, walk, hop, or sometimes run after mobile prey, and glean food from surface of ground; some (e.g. *Creatophora* and especially *Sturnus*) also take prey from below surface by probing with bills; when probing soft soil, bill thrust into soil and then opened to expose prey. Some also take insects from air by sallying from perches or from ground, and Chestnut-bellied Starling seen to pluck fruit while hovering. Some species opportunistic, scavenging for food round human habitation or activity. Many species associate with other birds, often other Sturnidae, when foraging; and some associate with grazing mammals, usually to capture prey disturbed by mammals, or to pick ectoparasites from mammals themselves, but sometimes to perch on and use mammals as vantage points to detect prey on ground. Some species (e.g. Common Starling, Rose-backed Starling, Common Myna) feed on commercial fruit or cereal crops or both; and Common Starling, and to lesser extent Common Myna, considered agricultural pests for this reason, both in HANZAB region and extralimally (Ali & Ripley 1972; Fry *et al.* 2000; BWP).

All are gregarious; gather in large flocks both for foraging (see above) and for roosting. Some gather in huge flocks at sources of food, e.g. Wattled Starling can congregate in hundreds of thousands. Usually monogamous. Some form new pair-bonds each season, or even after each breeding attempt, but pair-bonds long-term in others. Co-operative breeding usual in several species (e.g. Chestnut-bellied Starling, Golden-breasted Starling *Lamprotornis regius*). Usually only female incubates, but in some species male does so occasionally. Feeding of nestlings and fledgelings usually shared between sexes, and with helpers in co-operatively breeding species. Most loosely colonial when breeding, and usually defend small territory near nest; sometimes only defend nest-entrance. Co-operatively breeding species maintain a group territory. Extra-pair copulation and egg-dumping fairly common.

Most tend to be rather conspicuous in their habits, and some rather bold (e.g. Common Myna), but others tend to be shy and flighty (e.g. Wattled Starling). Scratch head indirectly. Anting recorded in many species. Tend to avoid physical contact and do not clump, but some species allopreen. Usually show little agonistic behaviour when foraging, but can be aggressive in defence of nest, and in some species altercations often lead to physical fights. In Common Starling, fights often result in death of one or sometimes both participants (Ali & Ripley 1972; Skutch 1987; Coates 1990; Fry *et al.* 2000; BWP; DAB; see species accounts).

All rather vocal, though vocalizations rather unspecialized, consisting of wheezing creaks, rattles and whistles, often mixed with mimicry. Some mynas can be trained to imitate human speech with surprising accuracy. Calls mostly simple and often loud, harsh and grating (Coates 1990; Fry *et al.* 2000; BWP; DAB).

Most species loosely colonial. Typically monogamous; some species breed co-operatively. Most species nest in holes, especially in trees, but also in cliffs and buildings. However, some build nests in forks of tree (e.g. Brown-winged Starling *Aplonis grandis*), and Metallic Starlings build nest suspended from branches; several species will use nest-boxes. Most build bulky bowl-shaped nest within cavity, but some build globular or domed nests with entrance at side or top (e.g. Superb Starling *Lamprotornis superbus*, Metallic Starling). Nests variously made of grass, twigs, leaves and other plant material; and lined with softer material, including feathers, hair, wool, moss and fine plant material such as down. Sometimes shed snakeskin incorporated into nests. Nests usually built by both sexes or by female only, but in Common Starling, usually built by male. Material may be added after laying has begun. Eggs usually oval or sub-elliptical; smooth and slightly glossy. Usually pale bluish-green with brownish or reddish spots, but lack spots in *Sturnus*, *Acridotheres* and *Creatophora*. Usual clutch-size 2–6, with tropical species usually laying smaller clutches. Where known, eggs usually laid on successive days. In most, only female incubates but in some species male does so occasionally. Incubation period 11–18 days. Nestlings usually brooded by female only. Feeding of nestlings and fledgelings usually shared between sexes, and with helpers in co-operatively breeding species. Fledging period 18–35 days. Fledgelings typically dependent on parents for 1–2 weeks or more. Most species rear two or more broods per season, but some species produce only single broods at some localities (Ali & Ripley 1972; Campbell & Lack 1985; Skutch 1987; Coates 1990; Fry *et al.* 2000; BWP; DAB; see species accounts).

A total of 14 species considered globally threatened, with all but one of which (Abbott's Starling *Cinnyricinclus femoralis*) island species. Five species EXTINCT, all island species, including one from HANZAB region, Tasman Starling of Norfolk and Lord Howe Is; rest extralimital (Kosrae Starling *Aplonis corvina*, Mysterious Starling *A. mavornata*, Rodrigues Starling *Necropsar rodericanus* and Réunion Starling *Fregilupus varius*). Another two species, Pohnpei Mountain Starling *A. pelzelni* of Micronesia, and Bali Starling *Leucopsar rothschildi*, CRITICALLY ENDANGERED, the latter primarily through unregulated trapping for avicultural trade; two species, White-eyed Starling *A. brunnei-capillus* of Bougainville and Solomon Is, and Black-winged Starling *Sturnus melanopterus* of Java and Bali considered ENDANGERED; and four species considered VULNERABLE (Santo Mountain Starling *A. santovestris*, Rarotonga Starling *A. cinerascens*, Abbott's Starling of e. Africa, and White-faced Starling *Sturnus albofrontatus*). A further nine species are near threatened (Stattersfield & Capper 2000; BirdLife International Species Factsheets, available at <http://www.birdlife.org/datazone/species/index.html> [accessed Sept. 2005]). Within HANZAB region, Torres Str. population of Singing Starling considered near threatened (Garnett & Crowley 2000; see species accounts).

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Sturnus vulgaris Linnaeus, 1758, *Syst. Nat.* 10(1): 167 — Europa = Sweden.

The Genus is directly from Latin *sturnus*, a starling. This perky and quarrelsome starling is a commensal of man, and has been introduced throughout his world (Latin *vulgaris*, common).

OTHER ENGLISH NAMES Starling or English, European or Northern Starling.

POLYTYPIC Nominate *vulgaris* introduced to se. Aust. and NZ, and widespread in NZ and se. Aust., including Tas. and islands in Bass Str., W to Eyre Pen. and head of Great Aust. Bight, and N to central Flinders Ra., SA, central Murray–Darling Drainage Basin, NSW, and se. Qld to Dawson R. Drainage Basin and Keppel Bay, central-e. Qld, also Norfolk, Lord Howe, Kermadec, Chatham, Snares, Auckland, Antipodes, Campbell and Macquarie Is; indigenous to all Europe (including British Isles) except south, E to Ural Mts, wintering S to n. Africa and Middle East. Extralimitally, 10–12 subspecies from Faeroe Is, Outer Hebrides and Azores E through central and s. Asia to Mongolia and mid-Lena R., Russia, and S to Asia Minor, n. Iraq, Pakistan and n. India to Nepal.

FIELD IDENTIFICATION Length 21 cm (19–22); wing-span 35 cm (32–38); weight 80 g (75–100). Following based on Beaman & Madge (1998), Feare & Craig (1998) and BWP. Medium-sized, plumpish yet energetic passerine, with slender, pointed bill and shallow, sloping forehead; short but distinct hackles visible on throat when singing; short, triangular wings with pointed tips; and short, square-cut tail. Smaller and more slender than Common Mya *Acridotheres tristis* and Common Blackbird *Turdus merula*. Sexes differ, with female appearing more heavily spotted than male; marked seasonal difference in plumages and bill colour of adults; and juveniles separable from adults, appearing dull brown with pale throat. No geographical variation in appearance within HANZAB region. **Adult male (fresh plumage)** Almost entirely glossy black, with iridescent green and purple sheen in some lights, sometimes appearing black at a distance, though have pale tips to feathers which give spotted appearance; feathers of head, neck and upperbody have buff tips, appearing as fine spotting or streaking on head, coarser on back; tail-feathers have pale-buff outer edges and tips. On upperwing, wing-coverts and remiges have pale-buff edges and tips, appearing as series of pale parallel lines. Feathers of throat elongated and pointed, visible as hackles when bird singing; tips of feathers of underbody, white or grey, which, from throat to belly, appear as fine, pale spotting, and on vent and undertail-coverts, forming chevrons. Undertail, dark greyish. Underwing, dark greyish with faint whitish or pale-buff fringes to wing-coverts. Bill, blackish; iris, dark brown. Legs and feet, reddish brown. **Adult male (worn plumage)** All pale fringes and tips to feathers lost, giving plumage entirely dark, glossy appearance, without spotting and chevrons (especially so on crown and underparts), or pale edges to tail and upperwing. Bill progressively turns yellow, starting at base; when base of upper mandible yellow, base of lower mandible, blue-grey, horn-grey, slate or blue-black. Legs

and feet said to be lighter brown in n. hemisphere (BWP). **Adult female (fresh plumage)** Largely similar to adult male (fresh plumage), but differ by: generally less glossy; pale tips to feathers of body larger, giving more heavily spotted appearance; and feathers of body, including hackles on throat, shorter. Bill as male. Iris, brown, usually with pale inner or outer ring, only visible in close view. Legs and feet as male. **Adult female (worn plumage)** Similar to male (worn plumage), but some birds retain pale spotting. Bill turns yellow; when base of upper mandible yellow, base of lower mandible pinkish white to fleshy pink; other bare parts as above. **Juvenile** Sexes alike. Most of head, dark grey-brown, often with faint pale-greyish streaks on ear-coverts; lores, dark or sooty brown, often edged with indistinct, short paler greyish stripe that extends above and below eye; chin and throat, pale greyish or off-white with grey-brown streaking or mottling on throat. Hindneck and upperparts, dark grey-brown, concolorous with crown, though sometimes feathers of mantle and scapulars narrowly fringed buff forming faint buff flecking or scaling; uppertail-coverts marked with buff chevrons. Uppertail, dark grey-brown, with broad buff outer edges. Upperwing, dark grey-brown, with narrow buff-grey fringes to coverts, remiges and tertials; becomes paler grey-white and more distinct with wear. Chin and throat, grey-white, lightly streaked or mottled grey-brown. Breast, upper belly and flanks, grey-brown, sometimes faintly streaked darker brown; lower belly and vent, grey-white, with tips of feathers grey-brown, giving mottled or streaked appearance. Thighs and undertail-coverts, grey-brown with buff fringes. Tail, dark grey-brown, faintly edged whitish. Underwing, pale brown-grey. Bill, horn-black or black, with pale cutting edges and pale base to lower mandible. Iris, brown to grey-brown or grey; c. 3 weeks after fledging, turns dark grey-brown, dark brown or black-brown in male, and light sepia-brown or light grey with yellow tinge in female. Legs and

feet, grey-brown, brown or chestnut. **First immature** Most juvenile plumage replaced with adult-like plumage, but retain brown juvenile plumage on head, hindneck, chin, throat and upper breast. **MALE:** When post-juvenile moult complete, plumage generally as adult male, but more heavily spotted on head and body, similar to that of adult female in fresh plumage, from which distinguished by: bill, dark horn with paler cutting edges (blackish in female); feathers of throat shorter than adult; tips of tail-feathers more rounded than adult, with less clearly defined pale fringes. **FEMALE:** As adult female in fresh plumage, but more heavily spotted and less glossy; feathers of throat shorter; and tips of tail-feathers rounded. Iris as adult female.

Similar species Combination of blackish plumage and yellow bill may superficially recall Common Blackbird (q.v.). In flight, silhouette can recall woodswallows *Artamus*, but flight of which usually slower and less direct, and sometimes includes soaring; woodswallows generally move independently within flock (flocks of Starlings often wheel around in unison); also note twittering calls of woodswallows in flight.

Gregarious; during day, occasionally seen in twos or small flocks, but often form much larger flocks, sometimes comprising hundreds or thousands of birds, especially when congregating in evening before roosting. Behaviour in such large flocks recalls that of *Calidris* sandpipers, swirling and flowing in spectacular synchrony. At other times, flight swift and direct, with rapid wing-beats interspersed with occasional glides, some of which with wings held against body, resulting in gentle undulations. Pugnacious; aggressively displace other species from nest-hollows. Forage mostly on ground, rapidly probing for invertebrates among short grass, while walking steadily with a quick, erratic, high-stepping, almost waddling gait, jerking head with each step; sometimes run to seize food, but never hop. Alert, and wary of people. Usually noisy, especially round roost-sites, uttering varied Song comprising medley of chirrups, whistles, gurgles, warbles, buzzes and clicks, and often including excellent mimicry; also give harsh, scolding Alarm Call, and various other chattering calls.

HABITAT Often inhabit built-up areas and farmland, usually where trees or artificial structures are available for roosting and nesting, and with open grassy areas for foraging. Sometimes also recorded in open forests or woodlands, less often in shrublands, including heathland, and seldom occur in dense, wet forest. In coastal areas, often recorded on shores and adjacent cliffs; also often occur round terrestrial wetlands, especially where there are reeds in which to roost. Occasionally in grasslands (see below). Occur from coasts to alpine areas up to 1900 m asl (Wheeler 1966; Gall & Longmore 1978; Vic. Atlas).

In Aust. and NZ, often inhabit built-up areas, including cities, suburbs and rural towns, especially in areas with parks and gardens (e.g. Gannon 1932; Secker 1963; Morris 1975; BFNC 1976; Paton 1976; Stidolph 1977b; Harris 1980; Morris *et al.* 1981; Brockie 1983; McKilligan & McKilligan 1987; Green *et al.* 1989; Sibson 1989; Guest & Guest 1993; Woodall 1995, 2002; Moverley 1997; Brooker & Brooker 1998; CSN; *pace* Longmore 1978); also in other open grassy areas such as playing fields, golf courses or airfields (Selby 1949; Forshaw & Muller 1978; Morris 1989; Purchase & Purchase 1991; Vic. Atlas; NSW Bird Rep. 1985; CSN 37). In outer suburban Melbourne, recorded in all suburbs, ranging from newly established residential areas to those >50 years old (Mason 1985); in Canberra, more abundant in more recently established suburbs than in older ones (Lenz 1990a). In suburban Hamilton, NI, abundance not significantly correlated with amount of native vegetation or total plant biomass (Day 1995). Also often occur in farmland, where there are trees to roost in, especially in pasture (e.g. Moncrieff 1929; Skegg 1963;

McEvey 1965; Blackburn 1967; Green 1969; Gepp & Fife 1975; Leach & Hines 1987; Baxter & Paton 1998; Vic. Atlas; ACT Atlas; CSN 37), favouring short, intensively managed pasture over rough pasture (Gill 1977); and also crops (including newly sown paddocks or stubble), vineyards or orchards (McKeown 1923; Chisholm 1924; Jenkins 1929; Hindwood & McGill 1951; Lord 1956a; McEvey 1965; Ridpath & Moreau 1966; Fielding 1979; Baker 1980; Backhouse 1985; CSN 33, 41), including in irrigated areas (McKeown 1923; Hobbs 1961; Vic. Atlas). Often occur in farmland with patches or strips of remnant native vegetation (Ick-Hewins 1917; Emison & Porter 1978; Emison 1992). Occasionally occur in open forests or woodlands, especially round margins (Heron 1973; Loyn 1980). In Aust., these are usually dry sclerophyll forests or woodlands dominated by various eucalypts, with a sparse to well-developed understorey of shrubs and small trees, and ground-cover of grasses or sedges (e.g. Jones 1952; Clarke 1967; Ridpath & Moreau 1966; Recher *et al.* 1971; Thomas 1986; Leishman 1994; Er & Tidemann 1996; Er 1997; Possingham & Possingham 1997; Taylor *et al.* 1997; Er *et al.* 1998; Kennedy & Overs 2001; McDonald 2001; Davey 2002a,b), including mallee woodland (McEvey & Middleton 1968; Possingham & Possingham 1997); also occasionally recorded in forests dominated by casuarinas, cypress-pines or acacias, such as Brigalow (Clarke 1967; Leach 1995); however, seldom enter ungrazed forests, even after logging (R.H. Loyn), but once recorded in clearing in dry sclerophyll forest with regrowth of understorey species (Bell 1980). Seldom recorded in wet sclerophyll forest (Morris 1986), usually round disturbed areas (Loyn 1985a). In NZ, very occasionally recorded in native forests, e.g. in Orongorongo Valley, NI, in forest with canopy comprising *Hinau* *Elaeocarpus dentatus*, *Pukatea* *Laurelia novaezelandiae*, *Kamahi* *Weinmannia racemosa*, *Mahoe* *Meliccytus ramiflorus*, *Pigeonwood* *Hedycarya arborea*, *Rewarewa* *Knightia excelsa*, *Pate* *Schefflera digitata*, and *Pseudopanax*, with emergent *Rata* *Metrosideros robusta*, *Rimu* *Dacrydium cupressinum*, *Matai* *Prumnopitys taxifolia* and *Miro* *P. ferruginea*, highly modified by browsing activities of Common Brushtail Possums *Trichosurus vulpecula* (Fitzgerald *et al.* 1989; Gibb 1996), and sometimes in logged forests, e.g. in W. Paparoa Ra., SI, in logged forest with a few scattered *Rimu* and *Silver Beech* *Nothofagus menziesii* with shrubby understorey (Onley 1980); or, on offshore islands, forests dominated by *Pohutukawa* *Metrosideros excelsa* or *Turepo* *Paratrophis microphylla* (Skegg 1963; Robertson *et al.* 1993). In both Aust. and NZ, occasionally recorded in or at edges of plantations of exotic pines, both recently established and older ones (Weeks 1949; Secker 1954; Friend 1982; Owen & Sell 1985; CSN 5). Also occasionally recorded in shrublands or thickets of shrubs, such as low chenopod shrublands, with a few emergent mallee eucalypts and extensive open areas (Boehm 1952), scattered, stunted acacias along creeks (Badman 1979), thickets of *Taupata* *Coprosma repens* or *African Boxthorn* (Wilkinson 1927; Brockie 1983; Lashmar 1988; Baxter 1989; CSN 37), or areas infested with other woody weeds such as *Bitou Bush* *Chrysanthemoides monilifera* (Morris 1989). Very occasionally occur in shrubby heathland, from coasts to alpine areas and in semi-arid inland areas (Ridpath & Moreau 1966; Morris 1986; Reilly 1991; Osborne & Green 1992; Possingham & Possingham 1997; Davey 2002a; Storr 27); and in stunted alpine herbfields (Longmore 1973; Child 1975; Osborne & Green 1992). In coastal areas, occasionally occur in mangroves (Mellor 1927b; Jenkins 1929; Hindwood 1935; Gosper 1981), but more often on beaches, exposed mudflats or rock-platforms (Turbott 1947; Hodgkins 1949; Sagar 1976; Pierce 1980; Coyle 1983; Owen & Sell 1985; Schulz & Kristensen 1994; Ashton & Black 1997; Holdsworth 1998; Storr 27; CSN 24, 26, 41), and roost or nest on nearby cliffs (Sutton 1926; Moncrieff 1928; Richdale 1942;

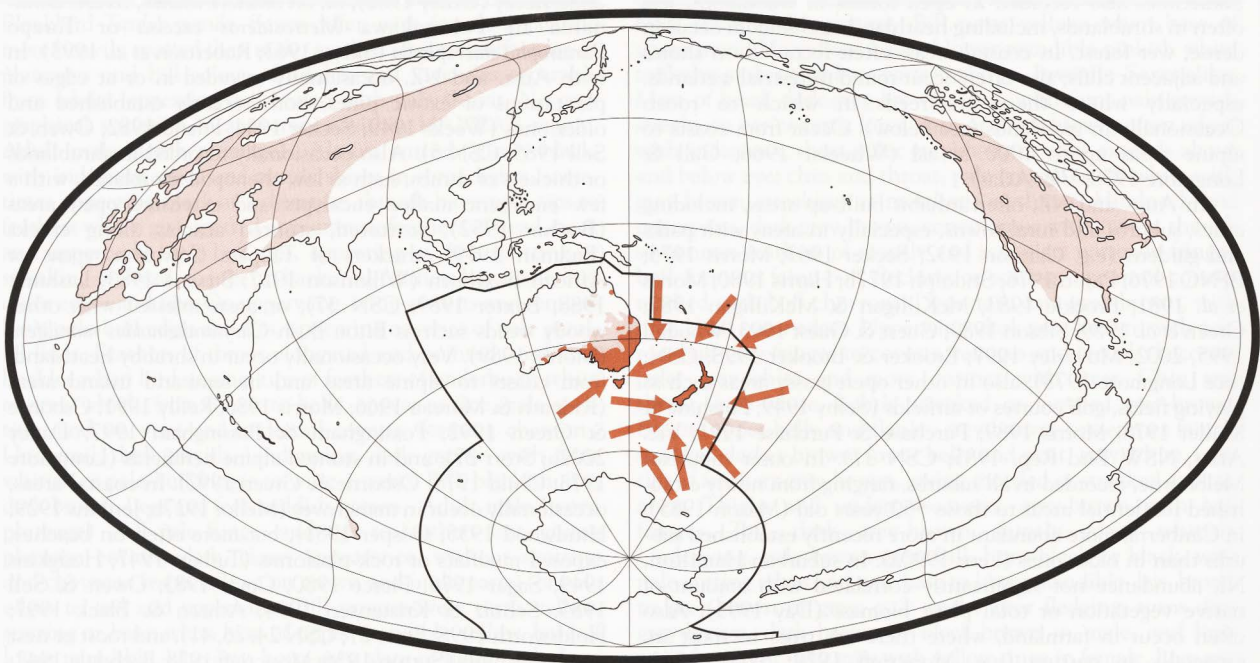
Cooper 1947; Sibson 1947; Chambers *et al.* 1955; Green & McDonald 1963; Sorenson 1964; Edgar *et al.* 1965; Wagener 1966; Stirling & Johns 1969; Cunningham & Moors 1985; Baxter 1989; Schulz & Kristensen 1994; Loh 2000; Miskelly *et al.* 2001). Often seen around margins of terrestrial wetlands, especially swamps with reed beds, where Starlings often roost (Bryant 1930; Thomas 1957; Morris 1975; Longmore 1978; Gosper 1981; Ross & Olsen 1988; Read & Ebdon 1998; Read *et al.* 2000); also round effluent ponds with banks covered with rank weeds (Stidolph 1977a; Carter *et al.* 1995). Sometimes inhabit grassland, usually with a few scattered trees or shrubs (Cooper 1974, 1975; Gregory-Smith 1987; Morris 1989; Osborne & Green 1992; Bourne 2002; Davey 2002b; ACT Atlas).

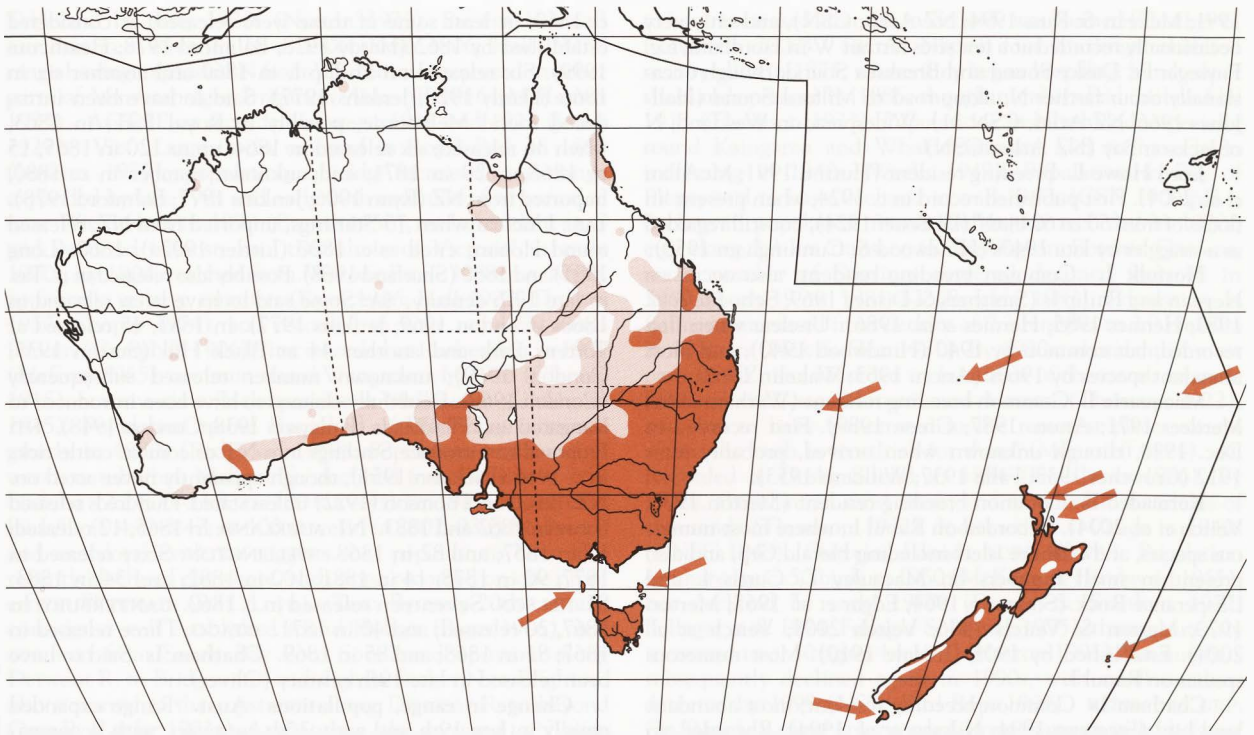
On outlying islands, inhabit similar habitats to those outlined above, including farmland, settlements, edges of forests (e.g. on Kermadec Is, dominated by Pohutukawa, Nikau *Rhopalostylis sapida* and Mapou *Myrsine australis*; or on Chatham Is, *Olearia* forest), herbfields, beaches and cliffs (Edgar *et al.* 1965; Wakelin 1968; Smithers & Disney 1969; Warham 1969; Merilees 1971; Disney & Smithers 1972; Schodde *et al.* 1983; Hermes 1985; Hermes *et al.* 1986; Merton & Veitch 1986; Nilsson *et al.* 1994; Veitch 2003).

DISTRIBUTION AND POPULATION Widespread in Europe and elsewhere in n. hemisphere. Occur throughout Europe; E of Ural Mts, occur in central and s. Siberia and n. Kazakhstan, E at least to L. Baikal and possibly farther E to middle reaches of Lena R.; and from c. 65°N to c. 50°N. Also occur in n. Africa, from Morocco E to Egypt. In Middle East, widespread from Syria, Lebanon and Israel, S to n. Arabian Pen. and E through Iraq to c. 50°E in w. Iran; farther E, recorded at a few scattered sites elsewhere in Iran, but more widespread farther N in Turkmenistan and Uzbekistan, and farther W in s. and e. Pakistan, with ranges in both areas meeting in ne. Afghanistan and s. Tajikistan, and thence extending NE to Kyrgyzstan, se. Kazakhstan and Xinjiang Zizhiq Province in nw. China, and SE into n. India and Nepal, with scattered records farther S in India; and vagrants recorded in Thailand and se. Asia (Silby 1980; de Schauensee 1984; Flint *et al.* 1984; Inskipp & Inskipp 1985;

Grimmett *et al.* 1999; Fry *et al.* 2000; Robson 2000, 2002; BWP). Successfully introduced into North America, where widespread, and South Africa in 19th century and several Caribbean islands in 20th century (Long 1981; AOU 1983; Fry *et al.* 2000). In sw. Pacific Ocean, established in Fiji (Pratt *et al.* 1987), where said to have arrived unaided in 1920s or early 1930s, possibly from Kermadec Is (Hill 1952; Watling 1982); and occur in Tonga, where first recorded on Tongatapu, presumably also having arrived from Kermadecs, and subsequently colonized various other islands (Dhont 1976; Rinke 1987, 1991). Vagrant to New Guinea (Coates 1990) and possibly Vanuatu (Bregulla 1992). In HANZAB region, successfully introduced to Aust. and NZ, but colonized many outlying islands unaided.

Aust. Introduced; widespread in E, SE and S. **Qld** Widespread in SE, mainly bounded by line from shores of Shoalwater Bay, through Emerald and Mitchell, to Byra Stn, c. 32 km WNW of Goodooga Gate. Also widespread but much more sparsely scattered farther W, in area N to Clermont and Winton, W to Boulia, Sandringham Stn, Birdsville, Nappa Merry Stn, and L. Bindegolly, near Thargomindah (Schrader 1981; Storr 19; Aust. Atlas 1, 2; Qld Bird Rep. 1985). Occasionally occur at a few scattered sites farther N, but generally not established: in Gulf Country, recorded at Mt Isa, Camooweal, Sweers I. (N of Burketown) and Karumba; on C. York Pen., at Pormpuraaw, Iron Ra. and Musgrave Stn; at scattered sites in Atherton Region (Wet Tropics), from near Cooktown S to Ingham; and farther S at Connolly Stn (N of L. Dalrymple) and Merinda (Gill 1970; Forshaw 1975; Forshaw & Muller 1975, 1978; Nielsen 1996; Eades 1998; Wieneke 2000; Anon. 2004; Aust. Atlas 1, 2; Storr 19). Also occasionally recorded on offshore islands (Vernon & Barry 1972; Domm & Recher 1973; Vernon & Martin 1975; Kikkawa 1976; Sutton 1990; Durrant & MacRae 1994; Storr 19; Qld Bird Rep. 1990). **NSW** Widespread, but recorded at sparsely scattered sites in Upper and Lower Western Regions (Morris *et al.* 1981; Cooper & McAllan 1995; Aust. Atlas 1, 2). **Vic.** Widespread (Aust. Atlas 1, 2; Vic. Atlas), including on some offshore islands, e.g. Gabo I. and islands off Wilsons Prom. (Reilly 1978; Wainer & Dann 1979; Lane & Battam 1981; Howe 2001). **Tas.** Widespread (Thomas 1979; Aust.





Atlas 1, 2), though few records in S or SW, between Cockle Ck and Macquarie Heads, with a few scattered records at Maatsuyker I., Melaleuca, Port Davey, Trumpeter Isl. and between Sloop Pt and C. Sorell, and very occasionally farther inland (Brothers 1979; White 1985; Schulz & Kristensen 1994; Aust. Atlas 1, 2; Tas. Bird Reps 8, 10, 12); and, in W, between Macquarie Harbour and Pieman R.; though occur in coastal and subcoastal sites, seldom recorded at inland sites, e.g. Rosebery (Fielding 1976; Thomas 1979; Aust. Atlas 1, 2; Tas. Bird Rep. 3). Also occur on islands in Bass Str., from King I. E to Furneaux Grp and N to Kent Grp (Serventy 1965; Green 1969; Whinray 1970, 1971; Green & McGarvie 1971; Thomas 1979; Garnett *et al.* 1991; Holdsworth 1998; Bryant 1999; Aust. Atlas 1, 2; Tas. Bird Reps 8, 28), and on islands elsewhere, e.g. Shouten I. (Tas. Bird Rep. 3), Bruny I. (Aust. Atlas 1, 2) and Iron Pot (Tas. Bird Rep. 21). SA Widespread in area S of line from Waukatanna Waterhole, through Mungerannie Waterhole (205 km NE of Marree along Birdsville Track) to Yumbarra CP, and thence E along railway line to Cook, and along Eyre Hwy W to site W of Eucla, near WA border (Klau 1988; Badman 1989; Stove 1994; Aust. Atlas 1, 2). Very occasionally recorded outside this area, e.g. Oodnadatta (Condon 1969; Aust. Atlas 1) and Ooldea (Jenkins 1959; Condon 1969). Also occur on offshore islands, e.g. Baudin Rocks, Kangaroo I., Troubridge I. and various islands in s. Spencer Gulf or otherwise off Eyre Pen., such as Sir Joseph Banks, Gambier, S Neptune and Investigator Grps (Bonnin 1968; Eckert 1970; Stirling *et al.* 1970; Hornsby 1978; Bonnin & Angove 1980; Lane 1985; ABBBS 1992; SA Bird Reps 1968–69, 1976). WA Occasionally recorded, mostly in s. Eucla Div., at scattered sites from Eucla W to Salmon Gums and L. Gore, W of Esperance, and N to Trans-Aust. Railway line (Coyle 1983; Anon. 1985, 1989, 1993; Hooper & Wells 1988; Long 1988; ABBBS 1994, 1998; Ashton *et al.* 1996; Serventy & Whittell; Aust. Atlas 1, 2; Storr 27). Very occasionally recorded farther W, with records at scattered sites in South West Div., from Bremer Bay, Feb. 1988, and Manypeaks, 1988 (Bush 1989; Storr 35), W to round Perth, e.g. on Garden I., June 1963 (Storr 28, 35) and

Mosman Park, June 1987 (Vervest & Jaensch 1987), and N to Bulbrook, 24 Sept. 1981, and Bruce Rock, Nov. 1980 (Aust. Atlas 1); historical records at Albany in 1917 (Anon. 1917) and Gingin in 1936 (Jenkins 1937); and historical unconfirmed report from suburban Guildford in 1906, though these may have been wattlebirds (Jenkins 1959), and possibly others (Whittell 1950). Vagrants farther N, e.g. in Mid-eastern Interior Region, at L. Mason, Oct. 1984, and Carnegie Stn, c. late 1980s (Howell 1990; Storr 22), and in Kimberley Div., e.g. singles round Broome, 3 June 1988 and Mar. 1990 (Vervest 1988; Collins 1995). NT Vagrant. Recorded at Darwin in June 1996 (McCrie 2000) and apparently occasionally at other times (Goodfellow 2001). Very occasionally recorded farther S: Marqua Stn, June 1981 (Aust. Atlas 1) and round Alice Springs, June 2001 (Aust. Atlas 2).

NZ Introduced; widespread (NZ Atlas; CSN). Often occur on offshore islands (Oliver), many of which are used only as roosts by birds flying in from mainland (e.g. Wagener 1966; Stirling & Johns 1969; Blackburn 1970; Adams 1971; Edgar 1978; Brockie 1983; Oliver; CSN). NI: Widespread from C. Reinga and North C., S to n. shores of Cook Str., though occur at sparsely scattered sites in forested uplands associated with Raukumara, Huiarau, Ahimanawa and Kaweka Ras in nw. and w. East Coast, e. and s. Volcanic Plateau and nw. Hawkes Bay (NZ Atlas; CSN). Also recorded on most offshore islands, from Three Kings Grp S to islands in Cook Str. (e.g. Ramsay & Watt 1971; Gaston & Scofield 1995; NZ Atlas; CSN). SI: Widespread in coastal and subcoastal parts of Nelson and Marlborough, and also farther inland in lowlands associated with Motueka and Wairoa R. Drainage Basins, upstream to Nelson Ls NP, and also at scattered lowland sites bounded by Richmond, St Arnaud and Spenser Ras in N and W, and Inland Kaikoura Ras to the S. Generally widespread in Canterbury and Otago, though absent in S. Alps, SW of Arthurs Pass, and patchy in adjacent areas to the E in nw. and w. Canterbury and central and w. Otago (NZ Atlas; CSN); also widespread in much of Southland, E of Te Wae Wae Bay and L. Te Anau, including Stewart I. and associated islets (Cooper *et al.* 1986; Cooper

1991; McLean & Russ 1994; NZ Atlas; CSN), and only very occasionally recorded at a few sites farther W in Fiordland, e.g. Puysegur Pt, Dusky Sound and Breaksea Sound, though occasionally occur farther N, along road to Milford Sound (Hall-Jones 1966; NZ Atlas; CSN 31). Widespread in Westland, N of Jackson Bay (NZ Atlas; CSN).

Lord Howe I. Breeding resident (Hutton 1991; McAllan *et al.* 2004). First published record in c. 1924, when present 'in flocks of from 50 to 60 birds' (Le Souéf 1924), but still regarded as a straggler by late 1940s (Hindwood & Cunningham 1950).

Norfolk I. Common breeding resident; also occur on Nepean and Philip Is (Smithers & Disney 1969; Schodde *et al.* 1983; Hermes 1985; Hermes *et al.* 1986). Unclear when first recorded, but common by 1940 (Hindwood 1940), and most abundant species by 1960s (Anon. 1963; Wakelin 1968).

Macquarie I. Common breeding resident (Warham 1969; Merilees 1971; Anon. 1987; Green 1989). First recorded in Dec. 1930, though unknown when arrived, probably after 1912 (Crowther 1933; Falla 1937; Williams 1953).

Kermadec Is Common breeding resident (Merton 1970; Veitch *et al.* 2004). Recorded on Raoul I., where most numerous species, and offshore islets including Herald Grp, and also present in small numbers on Macauley I., Curtis I. and L'Esperance Rock (Sorensen 1964; Edgar *et al.* 1965; Merton 1970; Merton & Veitch 1986; Veitch 2003; Veitch *et al.* 2004). Established by 1908 (Iredale 1910). Most numerous species on Raoul I.

Chatham Is Common breeding resident; most abundant land bird (Freeman 1994; Nilsson *et al.* 1994). Recorded on Chatham, Pitt, South East, Mangere, Little Mangere, Star Keys, The Pyramid, Pinnacle and Murumurus Is (Freeman 1994; CSN 26, 28, 37, 38).

Bounty Is Vagrant; single, 26 Feb. 1926 (Darby 1970).

Antipodes Is Resident in small numbers (Tennyson *et al.* 2002). Recorded on main island, Bollons I., Archway I., and Orde Lees Isl., and seen flying from main island towards Windward Is (Warham & Bell 1979; Tennyson *et al.* 2002). First recorded in 1950 (Williams 1953; Warham & Bell 1979).

Snares Is Breeding resident in small numbers on North East I.; also occasionally recorded on Broughton I. (Miskelly *et al.* 2001).

Auckland Is Common breeding resident (Williams 1953; Penniket *et al.* 1986). First recorded in early 1940s (Marples 1946).

Campbell I. Common breeding resident (Williams 1953; Bailey & Sorensen 1962). First recorded in 1907, when occurred in flocks (Waite 1909).

Breeding Aust. Widespread throughout core range, where recorded S of line from Rockhampton, Qld, through Terlings (between Moree, NSW, and Goondiwindi, Qld), Brewarrina and Cobar, NSW, and Woomera, SA, to Moondrah Tanks, on e. Nullarbor Plain, SA (Aust. Atlas 1, 2; NRS); very occasionally recorded N or W of this line, e.g. Tully, Roma and Mitchell in Qld and Muloorina Stn, Roxby Downs and Kingoonya in SA (Read *et al.* 2000; Aust. Atlas 1, 2; NRS). **NZ** Widespread, including on offshore islands (CSN). **Outlying Islands** Recorded on all outlying islands mentioned above except Antipodes Is (Tennyson *et al.* 2002) and possibly Bounty Is, for which information lacking.

Introductions Probably many private, and thus undocumented, releases (Thomson 1922; Balmford 1978; Long 1981). **Aust. QLD:** Unknown number imported into Brisbane in 1869; unclear whether released or not, but if so, unsuccessful (Chisholm 1919). **NSW:** Unknown number imported into Sydney in 1856 or earlier (Balmford 1978). Some released in 1880, having been obtained either from Vic. or NZ (Jenkins 1977; Long 1981). **VIC.:** A large number imported into Melbourne (from Sydney and possibly elsewhere) in 1857, and another lot arrived, possibly from Britain, in 1858 and more in

c. 1860; at least some of these were released, as considered established by 1862 (Hardy 1928; Balmford 1978; Heathcote 1999). Six released on Phillip I. in 1860 and another six in 1866 (Hardy 1928; Jenkins 1977). Said to have been introduced round Melbourne, possibly in Royal Park, in 1863, when 36 released; six released in 1864; up to 120 in 1865; 15 in 1866; c. 20 in 1871; and unknown number in c. 1880, imported from NZ (Ryan 1906; Jenkins 1977; Balmford 1978). **TAS.:** Unclear when 75 Starlings, imported from NZ, released round Hobart; cited as c. 1800 (Littler 1902a), 1860 (Long 1981) and 1880 (Sharland 1968). Possibly also released in n. Tas. in late 19th century. **SA:** Some said to have been released in 1860s (Condon 1969; Jenkins 1977). In 1881, 45 released at Torrens Park and another 44 at Black Hill (Sutton 1935; Condon 1969); unknown number released subsequently (Condon 1969). Doubtfully claimed to have been introduced to Kangaroo and Flinders Is (Finlayson 1938; Condon 1948). **NT:** Proposed to introduce Starlings into NT to combat cattle ticks in c. 1916 (Dickison 1951), though apparently never acted on. **NZ** Based on Thomson (1922) unless stated. Hundreds released between 1862 and 1883. **NI AUCKLAND:** In 1865, 12 released; 15 in 1867; and 82 in 1868. **WELLINGTON:** Sixty released in 1877; 90 in 1878; 14 in 1881; 100 in 1882; and 34 in 1883. **SI NELSON:** Seventeen released in c. 1862. **CANTERBURY:** In 1867, 20 released; and 40 in 1871. **OTAGO:** Three released in 1867; 81 in 1868; and 85 in 1869. **Chatham Is** Said to have been released in late 19th century (Oliver).

Change in range, populations Aust. Range expanded rapidly in late 19th and early 20th centuries, with accompanying increase in populations (Ryan 1906; Chisholm 1926); this continues today. **Qld SOUTH EAST:** Said to have expanded range from NSW (Chisholm 1919; Jenkins 1977); first reported in 1913 (Storr 19), and plentiful in S in 1910s (Anon. 1918a); established in Brisbane before 1920s (Chisholm 1919), and also reached Stanthorpe by that time (Storr 1973). Recorded at Gympie in 1921, lower reaches of Albert R. by 1923, and established on Darling Downs by c. 1925 (Lord 1956a; Storr 1973), where 'great numbers' recorded by early 1930s (Cameron 1932). A few recorded at Rockhampton in 1924, but apparently did not become established there (Alexander 1950); not recorded there in 1930 (Kinghorn 1931). By 1950, common round Brisbane and outlying areas, and also in coastal areas N to Maryborough, but said not to have reached N to Rockhampton (Tarr 1950). General range said not to have expanded N beyond Maryborough in early 1970s (Storr 1973), but common farther N at Rockhampton by late 1970s (Longmore 1978; Aust. Atlas 1), and this considered n. limit in late 1980s (Storr 19). Populations in se. Qld declined between 1979–80 and 1999–2000; in garden bird surveys, mean number of Starlings recorded declined from 1.4 birds/survey in 1979–80 to 0.46 birds/survey in 1999–2000 (Woodall 2002). **TROPICAL AREAS:** First recorded at Port Douglas in 1944 (Sharland 1953) but did not become established; recorded at Innisfail in Sept. 1965 (Gill 1970). Comparison of records in Aust. Atlas 1, 2 shows that very few records in tropical areas by early 1980s, but recorded increasingly at many scattered sites in Tropics by early 2000s (Aust. Atlas 1, 2). **CENTRAL AND WESTERN AREAS:** Comparison of records in Aust. Atlas 1, 2 shows that between early 1980s and early 2000s, range has expanded W into Cooper Ck Drainage Basin (Aust. Atlas 1, 2). **NSW** Absent from parts of suburban Sydney in mid-1880s (Chisholm 1926) but common in Sydney Botanic Gardens by 1913 (Leishman 1997). Widespread in settled areas by 1920s, range having expanded from Sydney (Chisholm 1926; Leishman 1997), e.g. first recorded round Moree in c. 1917 (Morse 1918; Clee 1920); recorded at Narrabri in c. 1919 (Cleland 1919); present in small numbers near Barrington in mid-1920s (but very common 10 years later) (Hyem 1937); and numerous on New England

Tableland by early 1920s (Norton 1922). Present in small numbers in s. Riverina by c. 1906 (Ryan 1906; Hall 1907), range having expanded N from Vic., but not reported in other parts of Murrumbidgee Irrigation Area till 1916 (McKeown 1923). **ACT** First recorded between 1913 and 1927 (Jones 1929). **Vic.** Large flocks reported in Royal Park in 1885 (Jenkins 1977); population quickly increased and range expanded by late 19th and early 20th centuries; first recorded near Winchelsea in 1898 (Brown 1950), and abundant in S and occurred 'almost over the whole of Victoria' in early 1900s; by 1906, reached from Wilsons Prom. N into s. NSW, apparently in large numbers (Ryan 1906; Hall 1907; Thomas 1957; Cooper 1974), and recorded in huge numbers round Drouin (Campbell 1906); first recorded at Rutherglen in 1909 (McEvey 1965); common round Wangaratta by 1915 (Cheney 1915), at same time flocks present at Mallacoota (Chisholm 1915). Population round Bungil, E of Wodonga, increased greatly in 1950s (Bedgood 1959). Population at Bennettswood, e. suburban Melbourne, declined from density of 2.52 birds/ha (2.24; 0–13.8; n=100 surveys) in 1989–90, to 0.27 birds/ha (0.4; 0–3.47; n=100 surveys) in 2002–03 (J.M. Peter); and anecdotal evidence suggests that populations have also recently declined elsewhere, with none recorded on one property in Wimmera (R.H. Loyn). **Tas.** By early 20th century, considered well established round Hobart (Ryan 1906), and common from Sandy Bay E to Sorell and upstream along Derwent R. to Bridgewater and slightly farther N to Brighton; also occurred farther upstream along Derwent R. to beyond Ouse R. (Littler 1902a). At that time, also occurred in N, with birds shot at Launceston and at nearby Evandale and Longford, and along lower reaches of Tamar R. at Georgetown and Low Head; and in NW, at Northdown and Sassafras (Littler 1902a,b); these n. records presumably resulted from local releases, as apparently no records in intervening areas between there and Hobart. First recorded at Devonport in 1905 (Dove 1905). By late 1940s, recorded upstream along Derwent R. to L. St Clair (Wilson 1950). Not recorded in SW till late 1960s, when observed round Bathurst Harbour (White 1985), though earlier unconfirmed reports from Port Davey (Green & Mollison 1961); first recorded at Strathgordon in Dec. 1976 (Tas. Bird Rep. 6). **SA** Range had expanded to include Mt Lofty by 1892 (Condon & Cleland 1942). Numbers rapidly multiplied, and by 1919, more plentiful than ever (Anon. 1919). Occurred in all settled parts of the State by 1950 (Condon 1951). No obvious change in range between early 1980s and early 2000s (Aust. Atlas 1, 2). **YORKE AND EYRE PENS AND ADJACENT OFFSHORE ISLANDS:** Established on Eyre Pen. by 1900 (Hall 1910; Condon 1951), but recorded no farther N than Port Augusta in 1920s (Cleland 1923, 1929); and not recorded in Gawler Ras till after 1923 (Paton 1975). Established on Kangaroo I. before 1910 (Cooper 1947), and on Althorpe I. (between Kangaroo I. and sw. Yorke Pen.) and Wedge I. (between Yorke and Eyre Pens) by 1916 (Morgan 1916; White 1916), and common there by early 1920s (Lashmar 1988). **E. NULLARBOR PLAIN:** Reached Ooldea in Jan. 1917, well before Trans-Aust. Railway had reached there (Jenkins 1959). **SOUTH EAST:** 'Hordes' of Starlings recorded round Mt Gambier in 1918 (Morgan 1919), and numerous round Millicent in 1922 (Sutton 1922b). **MURRAY–MALLEE:** Plentiful at Renmark in 1917 (Morgan 1917), but not recorded at Kinchinda, near Murray Bridge, till 1922 (Sutton 1922a); very common at Waikerie in 1933 (Kuss 1933), and though apparently widespread by 1938 (Brandon 1938), only very occasionally recorded round Berri by then (Mack 1961). **NORTH EAST:** Recorded at L. Frome by 1919 (McGilp 1919), though only in small numbers (McGilp 1923). Recorded at Muloorina, near Marree, in 1963 (SA Bird Rep. 1963). **NZ** After early increases, overall population said to have declined in 1940s after use of DDT around that time, but numbers said

to have increased after the insecticide was banned (Heather & Robertson 2000). **NI:** At Napier, four Starlings inhabited nearby cliffs in 1875, where they began breeding; hundreds of thousands present by 1886, though numbers had declined by 1913 (Thomson 1922). Populations in Northland, especially round Kaingaroa and Whakarewarewa, said to have been increasing in 1940s (Weeks 1949). Population in Bay of Plenty said to have declined in mid-1960s (CSN 19 Suppl.); decline in population round Wellington recorded in 1970s, e.g. along 2.4-km transect in Wellington Botanic Gardens, mean number of Starlings detected declined from 48 in 1969–71 to 19 in 1981–82 (Brockie 1983). Population at Belmont increased from density of 0.2 birds/ha to 2.0 birds/ha in 10 years (Flux & Flux 1981). By 1920s, abundant in most parts of NZ, and recorded in hundreds of thousands at some favoured sites, e.g. Moturoa and Marton (Thomson 1922), and said to have 'penetrated to the remotest places except where the bush is too thick for them' (Moncrieff 1924). **SI:** Recorded at Dusky Sound in 1884 (Hall-Jones 1966). By 1920s, abundant in most areas, and recorded in hundreds of thousands (Thomson 1922). Increased in s. Otago in 1940s (DNFC 1948). **Outlying Islands** **LORD HOWE I.:** Population estimated at c. 50 birds in 1960 (McKean & Hindwood 1965), but declined by early 1970s (Disney & Smithers 1972; Fullagar *et al.* 1974; Fullagar & Disney 1975), then apparently increased to c. 50 again by 1990 (Hutton 1991), but numbers subsequently declined again in 1990s, with small numbers detected by 1999 (NSW Bird Rep. 1999). **KERMADEC GRP:** On Raoul I., numbers recorded along transect in both forest and along roads have declined since 1967 (Veitch 2003).

Populations Total populations on outlying islands estimated at: 50 birds, Lord Howe I. (Hutton 1991); c. 10,000 birds, Chatham Is (Nilsson *et al.* 1994); <10 pairs, Snares Is (Miskelly *et al.* 2001). **RECORDED DENSITIES:** **Aust.** 0.2 birds/ha (0.31; 0–1.26; n=36 surveys), Archerfield Airport, Brisbane (Woodall 1999); up to 6.19 birds/ha, Corinda, suburban Brisbane (Walters 1985); 0.31 and 0.11–0.16 birds/ha, near Armidale, NSW (Ford & Bell 1981; Ford *et al.* 1985); 0.77±0.22 birds/ha, Wollongong, NSW (Wood 1995a); 0.08 birds/ha, near Canberra (Bell 1980); 0.43–0.77 birds/ha, Oakey Hill Nature Park, Canberra (Pell & Tidemann 1994); 1.75–2.53 birds/ha, Lyons, suburban Canberra (Pell & Tidemann 1994); 1.54–2.70 birds/ha, Weston, suburban Canberra (Pell & Tidemann 1994); 0.13 birds/ha, Kosciuszko NP, NSW (Davey 2002a); 0.8 birds/ha, undisclosed site, South-west Slopes Region, NSW (Kennedy & Overs 2001); 2 birds/ha, Rotamah I. (Aust. Atlas 1); 1.78 birds/ha (1.51; 0–13.8; n=522 surveys), Gardiners Creek, Bennettswood, e. suburban Melbourne (J.M. Peter); 4.21 birds/ha (6.18; 0–28.7; n=46 surveys), Darling Square, Melbourne (W.K. Steele); 0.4–3.4 birds/ha, suburban Melbourne (White *et al.* 2005); c. 2.5 birds/ha, Mildura, Vic. (Thomas 1957); 0.02–0.05 birds/ha, near Woodsdale, Tas. (Taylor *et al.* 1997); 0.25 birds/ha, near Campbell Town, Tas. (Recher *et al.* 1971). **NZ** 0.2–2.0 birds/ha, Belmont, NI (Flux & Flux 1981); 1.43 birds/5-min count, Red Mercury I. (Robertson *et al.* 1993); c. 0.1–3 birds/10-min count (estimated from graph), W. Hutt Hills, NI (Gibb 2000b); 0.67–1.38 birds/10-min count (annual means, 1981–92), same area (Gibb 2000a); c. 2.6–4.8 birds/10 min count (monthly means, 1981–92; estimated from graph), same area (Gibb 2000a); 4 birds/km (52.16; 1.72–8.77; 56), between Foxton and Palmerston, NI (32.5 km) (Gill 1977). 0.1 birds/5-min count, W. Paparoa Ra., SI (Onley 1980); 0.92 birds/5-min count, South East I., Chatham Is (West 1988).

THREATS AND HUMAN INTERACTIONS Introduced to HANZAB region because of its reputation for eating pest insects and their larvae; beneficial effects of voracious insectivorous proclivities mentioned in many early references

(e.g. Littler 1902a; Hall 1907; Burbury 1920; Thomson 1922; Edwards 1925; Chisholm 1926, 1938; McGilp 1928; Sharland 1929; Ashby 1930; Bridgewater 1932; Muggeridge 1933; Pearse 1935, 1938; Sutton 1935; Lord 1956a,b; Oliver), and some early settlers eagerly awaited their arrival in the district (Anon. 1925); in NZ, encouraged by farmers by erecting many nest-boxes; this continued from early 1900s till at least 1980s (Bull 1973; Purchas 1981). Considered beneficial to production of flax *Phormium*, being an important pollinator (McCann 1956, 1964). However, pest in orchards, damaging or eating fruits; also a nuisance round intensive livestock production, eating and fouling grain fed to animals; and pull up newly germinated grain (see Food: Pest status). Sometimes considered a pest when congregating to roost in large numbers, with accumulation of faeces a health hazard, and excessive noise levels, usually from calling birds, but the roar of wings of one large flock audible from c. 400 m away (Le Souëf 1922; Thomson 1922; Brockie 1983; Bomford & Sinclair 2002; CSN 5; J.M. Peter). Formerly, large numbers roosting on telegraph lines interrupted communications by causing short circuits (Anon. 1922). Nests in buildings considered 'objectionable' and unhygienic (Jenkins 1929; Anderson 1949), being a major source of lice (Chisholm 1926, 1933); and occasionally cause fire-hazards (Hermes 1985), while those in guttering may cause water-damage (Bomford & Sinclair 2002; CSN 8). When released in Tas., initially afforded legal protection, but after becoming a nuisance in orchards, this was 'practically abolished'; subsequently caught and used instead of pigeons in shooting matches (Littler 1902a); similar activities practised elsewhere (Sharland & Hindwood 1941). Any Starlings recorded in WA are extirpated immediately by The Authorities (Long 1988; Aust. Atlas 1; Storr 27), e.g. 200 killed on Nullarbor Stn in 1980–81 (Aust. Atlas 1) and 2536 destroyed in WA in 2001–02 (M. Massam); also occasionally shot elsewhere (e.g. Anon. 1918b; Jenkins 1929; Miller 1939; Quinn 1959; ABBBS 1979), including in organized 'shooting drives' (McEvey 1965); many other methods used to try to scare the birds from orchards are ineffective (Jenkins 1929). Population in NZ said to have declined during widespread use of DDT (Heather & Robertson 2000). Occasionally killed by Cats (Bull 1956; Rose 1975; ABBBS 1982; Flux & Flux 1992; Dowling *et al.* 1994), by rats or mustelids (Fleming 1947; Clarke 1966; Purchas 1981; Flux & Flux 1992) or Little Owls *Athene noctua* (Hornby School 1946; Anderson 1949; Rule 1977). Often killed by vehicles on roads (Vestjens 1973; Lepschi 1992); and very occasionally killed by colliding with lighthouses (Mellor 1906). Widely blamed for evicting native birds from their nests (e.g. Hall 1907; White 1922; Anon. 1925; Souter 1928; Jenkins 1929; Chisholm 1933, 1938; Oliver 1934; Serventy 1937; Favaloro 1942; Sharland 1943b; Watt 1947; Boehm 1952, 1957; Wilkinson & Wilkinson 1952; Lord 1956a; Thomas 1957; Bedggood 1959; Storey 1971; Schodde *et al.* 1983; Hermes 1985; Ashton 1987; Butler & Merton 1992; Tzaros 1993; Powlesland *et al.* 2001; Oliver; Tas. Bird Rep. 10). Doubtfully suggested that large feeding flocks of Starlings might deprive Australian Magpies *Gymnorhina tibicen* and other species of feeding opportunities (Thomson 1922; Sharland 1943a). Soon after release in NZ, blamed for driving out Common Mynas from where they had previously been established (Thomson 1922; Moncrieff 1931); more recently, some declines in numbers of Starlings suggested to have possibly been caused by competition or harassment from Mynas (Stoddart 1956; Edgar 1971; Woodall 2002; CSN 9, 19 Suppl.). Also blamed for spreading seeds of weeds (see Food: Pest status). One bird kept as pet and was taught to talk (Deeming 1946). Increase in populations, and associated expansion of range, associated with settlement, and enhanced by clearance of forest and provision of permanent supply of water in dry areas (Aust. Atlas 1; Vic Atlas).

MOVEMENTS Probably sedentary or resident in Aust. and NZ (see below). Broad-scale analysis of bird atlas and count data from e. Aust. found strong evidence for no movement (Griffioen & Clarke 2002); and no evidence of migration in NZ (Heather & Robertson 2000). However, many accounts describe local movements (see below). During non-breeding season, flocks may be mobile, moving throughout an area, or moving into different habitats (Moncrieff 1929; Frith 1969; Heather & Robertson 2000; Vic. Atlas; ACT Atlas; see below). Able to cross expanses of sea, as probably regularly cross Bass Str., and colonized various outlying islands (see below). Extraliminally, generally migratory in N and E of breeding range in Europe, though, in urban areas, increasingly becoming resident, and part-migratory or resident in S and W of range (BWP). Introduced populations in ne. USA part-migratory or resident (Davis 1960). Recorded as vagrant as far S as central Thailand and in se. Asia (Lekagul & Round 1991; Robson 2000, 2002).

Aust. Widely considered sedentary, resident or seen throughout year throughout range: in QLD (Longmore 1978; Durrant & MacRae 1994; Noyce 1997); NSW (Gannon 1932; Gibson 1977; Gall & Longmore 1978; Schmidt 1978; Gosper 1981; Morris 1986; Smith & Chafer 1987; Morris 1989; Osborne & Green 1992; Whiter 1992, 1994, 1995; Leishman 1994; Egan *et al.* 1997); ACT (Marchant 1973; Anon. 1976; Taylor 1984, 1987b; Taylor *et al.* 1986; Er & Tidemann 1996; ACT Atlas); VIC (Thomas 1957; Rowley 1961; Bedggood 1970, 1973, 1980; Fleming 1976; Thomas & Gilmore 1976; Humphreys 1986); TAS. (Fielding 1979; Brothers & Davis 1985; Field & Field 1989); SA (Clarke 1967; Ford & Paton 1976; D.C. Paton & J.B. Paton 1980; Ashton 1985, 2001; Winslet & Winslet 1987; Baxter 1989). **NZ** Described as resident or present throughout year (Heather & Robertson 2000): in NI, at Port Whangarei (Beauchamp & Parrish 1999); Waikanae R. Estuary (Kirk & Wodzicki 1943; Wodzicki 1946); W. Hutt Hills (Gibb 2000a); and, at Tikokino, Hawkes Bay, one leucistic bird not recorded outside area of c. 40 ha over 30 months (Stevens 1959); and in SI, at Herbert, in n. Otago (Anderson 1947) and Greymouth (CSN 42).

Often undertake local movements each day, flying several kilometres (e.g. up to 30 km) between foraging areas and roost-sites (Thomson 1922; Moncrieff 1929; Kirk & Wodzicki 1943; Wodzicki 1946; Thomas 1957; Skegg 1963; Heather & Robertson 2000). Local movements with a more seasonal component also occasionally described in **Aust.** **NSW:** Described as 'possibly nomadic' in Hunter Region (Morris 1975), probably referring to local movements. Present in alpine areas (>1800 m asl) in Snowy Mts only during snow-free months (Osborne & Green 1992). Small numbers seen at Burrewarra Pt, near Moruya, Feb.–May and Sept., described as birds on passage (Whiter 1992, 1995). **VIC.:** Local movements of resident birds recorded in E. Gippsland, congregating at coastal swamps between L. Tyers and Marlo, Jan.–Apr. (Bedggood 1980). Resident population round Mildura, Vic., augmented by influx of visitors Jan.–Apr. when orchard fruit is ripening, and remaining May–Aug., decreasing markedly Sept.–Dec. (Thomas 1957). **TAS.:** In Launceston, move from built-up areas into surrounding open farmland in mid-Nov., remaining till at least late Jan. (Liddy 1968). **SA:** Present throughout year in Parra Wirra Recreation Park in Mt Lofty Ras, but numbers decline briefly after breeding season, with dispersal of independent young (Clarke 1967). Local movements also described in **NZ.** **NI:** Leave built-up areas in Northland in late Jan.–Feb., presumably heading for nearby farmland, and most return Aug.–Sept., though a few remain in farmland till Oct. (Moncrieff 1929). Flocks range over Auckland during non-breeding season, but no migratory movement noted (Moncrieff 1929). In Taranaki, move from built-up areas into farmland after breeding, and into river valleys and

seashores in drought of 1926 (Moncrieff 1929). Visit Wellington in summer (Moncrieff 1929). **SI:** Mobile flocks noted moving round Nelson in autumn (Moncrieff 1929).

OTHER MOVEMENTS: Some evidence for movement at least partway across Bass Str.: large numbers seen flying out to sea or returning across sea from Wilsons Prom. each year (Sutton 1998); and occurrence on various islands in Bass Str., e.g. in e. Bass Str. repeatedly recolonize Deal I. (Garnett *et al.* 1991); recorded striking lighthouse on Goose I., Furneaux Grp, at night (Anon. 1913, 1914); flock of 60–70, apparently on migration, seen on Swan I., Mar. 1989 (Field & Field 1989); and in sw. Bass Str., flocks of up to 100 often seen passing N or S over Albatross I. throughout year (Brothers & Davis 1985). Occasional longer-distance movements recorded, as indicated by occurrence of vagrants well outside usual range, e.g. at Camooweal, nw. Qld, Oct. 1966 (Smith 1970), Iron Ra., C. York Pen., Oct. 1974 (Forshaw & Muller 1975) and Broome, WA (Collins 1995), and by colonization of remote areas, such as Roxby Downs, SA, and outlying islands from Norfolk I. and Kermadec Grp S to Campbell and Macquarie Is (see below, and Distribution and Population). Recurrent records in Eucla Div., WA, e.g. at Eyre Bird Observatory and Forrest, indicate w. movements from SA, along coast, Trans-Aust. railway line, Eyre Hwy and line of microwave towers, and suggested that some fly across waters of Great Aust. Bight (Congreve & Congreve 1985; Dymond 1988; McNee 1989; Ashton *et al.* 1996; Storr 27).

Outlying islands Reached various outlying islands unaided (see Distribution and Population). Before established on Lord Howe I., flocks occasionally appeared after strong winds but did not stay long (Le Souëf 1924; Hindwood 1940). Considered resident on Lord Howe, Norfolk, Macquarie, Kermadec, Chatham, Antipodes, Snares, Auckland and Campbell Is (see Distribution and Population). On Kermadec Grp, regular daily movements recorded between Raoul I. and Meyer Is (Merton 1968); and on Antipodes Grp, one seen flying between main island and Windward Is (Tennyson *et al.* 2002).

Nature of passage Birds crossing from mainland to roost on Kapiti I. fly at high altitudes in good weather, and low over water during storms; and when moving along coastline into strong headwind, keep low to ground behind line of sand-dunes (Wilkinson 1927; Kirk & Wodzicki 1943).

Banding Of 31,154 banded in Aust., 1953–June 2003, 5712 recoveries (18.3%), of 3250 birds; 5659 (99.1%) were <10 km from banding place; 32 (0.6%) 10–49 km; 13 (0.2%) 50–99 km; and eight (0.1%) >100 km (ABBBS). Of 782 banded at Launceston, Tas., 1960–63, 63 recoveries (8.1%), 59 within 1.6 km of banding place, and all within 21 km (Liddy 1968). **LONG-DISTANCE RECOVERIES:** Bird banded near Mallala, SA, recovered near Eucla, WA (986 km, 284°, 3 months^D, July, +1, F); bird banded at Fowlers Bay, SA, recovered near Condingup, WA (940 km, 256°, 44 months, Apr., +1); bird banded at Fowlers Bay, SA, recovered near Condingup, WA (939 km, 254°, 44 months, Apr., +1); bird banded at Lyrup, SA, recovered near Mallala, SA (202 km, 263°, 38 months, June, +2, F); bird banded at Exeter, Tas., recovered at Oatlands, Tas. (116 km, 163°, 29 months^D, May, +1); bird banded at Exeter, Tas., recovered at Oatlands, Tas. (116 km, 163°, 8 months, May, +1); bird banded at Launceston, Tas., recovered at Oatlands, Tas. (115 km, 213°, 22 months, May, +1) (ABBBS). **LONGEVITY:** Adult banded at Mallala, SA, 13 June 1970, recovered near banding place over 14 years 1 month after banding (ABBBS). **NZ:** 18,371 banded to 1996 (Kinsky 1957; Cossee 1989, 1992, 1993, 1995, 1997, 1998a,b; Cossee & Wakelin 1991). Of 6682 banded to 1974, 402 recoveries (6.0%) (Robertson 1975).

FOOD Invertebrates (mainly insects), fruit and nectar.
Behaviour Forage mainly on ground by probing; forage in

small to large flocks, and also take flying insects by sallying (Selby 1949; East & Pottinger 1975; Coleman 1977; Nix 1979; Gibb 2000a; Oliver). Often forage in association with livestock in paddocks (East & Pottinger 1975; Coleman 1977; Ross 1980), and take fruit from trees when available; serious pest in Aust. and NZ, causing damage to soft fruits, especially Grapes; also act as agent of dispersal of environmental weeds (Cleland 1952; Thomas 1957; Dawson & Bull 1970; Fielding 1979; Baker 1980; Spennemann & Allen 2000; Bomford & Sinclair 2002). **DETAILED STUDIES:** Round Mildura, Vic., July 1953–June 1954 (Thomas 1957); in Hawkes Bay, NI, July 1971–June 1972 (Moed 1980); at Havelock N, Hawkes Bay, NI, Dec. 1974 (Moed 1975); in Canterbury, SI (East & Pottinger 1975); at W. Melton, Canterbury, SI, 1968–71 (Coleman 1977). **FORAGING ASSOCIATIONS:** Usually forage in small to large flocks, or sometimes in pairs during breeding season (Moncrieff 1929; Fleming 1947; Merton 1968; Vestjens & Vestjens 1970; Merilees 1971; Anon. 1976; Stidolph 1977a; Vestjens 1977; Baxter 1989). Flocks generally comprise ≤500 birds, though flocks of up to 2000 recorded occasionally (Littler 1902a; Condon 1935; Brandon 1951; Skemp 1952; Bell 1955; Watson 1955; Lord 1956b; Cole 1963; Bell & Braithwaite 1964; Noonan 1966; Dunn 1981; Coyle 1983; Owen & Sell 1985; Burton 1990; Robertson *et al.* 1993; Tas. Bird Rep. 28; CSN 1, 6, 41). Foraging associations of ≥1000 birds most common in evening, when birds gather together to roost (Tas. Bird Rep. 28). At Masterton, NI, flock of 5000+ recorded foraging on airfield in early Sept. (Selby 1949). At W. Melton, flock-size varied significantly between breeding and non-breeding seasons ($P < 0.001$): breeding birds usually foraged in groups of <10, and seldom >30 birds; during non-breeding season, foraged mostly in flocks of <20, though flocks of 50–100 birds also common, and occasionally foraged in flocks of 100–500. Foraging flocks generally form in autumn and winter (Napier 1969; Anon. 1976; Pell & Tidemann 1994; Heather & Robertson 2000). Sometimes forage with other species: often forage with Spotted Turtle-doves *Streptopelia chinensis*, Eastern Rosellas *Platycercus eximius* and Common Mynas (Kloot & McCulloch 1993; J.M. Peter); in suburban Brisbane, recorded foraging near floodwaters with Cattle Egrets *Ardea ibis* and Torresian Crows *Corvus orru* (Woodall 1986); and once recorded foraging on ground with Dusky Woodswallows *Artamus cyanopterus* (Andrew 1981). Once, single Starling recorded in huge feeding flock comprising seven species of honeyeaters, Satin Bowerbirds *Ptilonorhynchus violaceus*, Weebills *Smicromis brevirostris*, a Striated Pardalote *Pardalotus striatus*, Red-browed Finches *Neochmia temporalis*, Galahs *Eolophus roseicapillus*, a Crimson Rosella *Platycercus elegans* and a Common Myna in suburban Canberra (Lindenmayer 1993); and at Urrbrae, SA, 50+ recorded feeding with 250+ Galahs, 90+ Little Ravens *Corvus mellori*, 12 Red-rumped Parrots *Psephotus haematonotus*, nine Australian Magpies, five Crested Pigeons *Ocyphaps lophotes*, two Magpie-larks *Grallina cyanoleuca*, and two Willie Wagtails *Rhipidura leucophrys* (Saunders 1983). In NZ, recorded feeding among seaweed in association with gulls *Larus*, Rock Doves *Columba livia* and House Sparrows *Passer domesticus* (Oliver); at W. Melton, occurred in mixed-species feeding flocks with House Sparrows and other small passerines, and followed ploughs with gulls and Rooks *Corvus frugilegus* (Coleman 1977); and at Tapora, NI, recorded foraging in pasture with c. 5000 Silver Gulls *Larus novaehollandiae*, c. 30 Bar-tailed Godwits *Limosa lapponica*, a few Black-winged Stilts *Himantopus himantopus*, c. 400 South Island Pied Oystercatchers *Haematopus finschi* and flocks of Yellowhammers *Emberiza citrinella* (Sibson 1966). Often associate with livestock when foraging, perching on backs of cattle and sheep to remove ticks or feed on insects disturbed by grazing animals (Bligh 1928; Moncrieff 1929; Kinghorn 1931; Bedgood 1959; East

& Pottinger 1975; Coleman 1977; Ross 1980; Bush 1989). **FORAGING TERRITORIES:** Foraging areas not defended during breeding season (Heather & Robertson 2000); travel up to 4 km from roost-sites to feed (Thomas 1957; Coleman 1977). At W. Melton, foraging range decreased during breeding season, with foraging activity focused round nest-sites; mean distance between nest-site and foraging areas of four pairs ranged from 108 m (103.0; 30) to 216 m (172.5; 30). **FORAGING HEIGHTS AND SITES:** Take most food from or near ground, in short grass, such as on lawns, pasture and playing fields, or among leaf litter; also from vegetation (Noonan 1966; Robertson *et al.* 1993; Pell & Tidemann 1994; Taylor *et al.* 1997; Vic. Atlas; CSN 23). Invertebrates taken from both surface of ground and beneath ground (East & Pottinger 1975; Wilson 1979; Harris 1980). Of 36 observations of foraging in Kosciuszko NP, NSW, all were on ground (Osborne & Green 1992); and of 28 observations of foraging in eucalypt woodland in ACT, all were on ground (Er *et al.* 1998). In coastal areas, also forage along beaches and intertidal mud flats, especially at low tide, among beachcast seaweed (e.g. White 1916; Turbott 1947; Warham 1969; Sagar 1976; Coyle 1983; Owen & Sell 1985; Nilsson *et al.* 1994; Schulz & Kristensen 1994; Tas. Bird Rep. 26). Sometimes take flying insects in air (Le Souëf 1908; Green 1966a; Wallace & Gosper 1967; Nix 1979; Lepschi 1986; Gibb 2000a; CSN 21, 22). At Armidale, NSW, sallied for flying ants 15–30 m above ground (Wallace & Gosper 1967). Very occasionally catch bees entering hives (Oliver; CSN 3). Also take fruit from trees (Ryan 1906; Mellor 1925; Noonan 1966; Baker 1980; CSN 4, 5); and sometimes visit flowering trees or shrubs for nectar, especially in NZ (Sutton 1931; Sibson 1956; McCann 1964; Oliver; Tas. Bird Rep. 20; CSN 2, 3). On Raoul I., Kermadec Grp, forage in crowns of Kermadec Palm *Rhopalostylis cheesemani*, and on branches of Kermadec Island Pohutukawa *Metrosideros kermadecensis* in canopy (Merton & Veitch 1986; Veitch 2003). Often forage at sites of artificial abundance of food, such as among refuse and on roads (Graham 1948; McCann 1964; Counsilman 1974b; Loyn 1985b), and once among dried Apple waste spread over ground in paddocks (Noonan 1966). Also recorded feeding on mats of green algae (CSN 26); and taking food from surface of water in sewage ponds (Stidolph 1977a). In e. suburban Melbourne, of 822 observations of foraging: 806 (98.1%) on ground, 11 (1.3%) in eucalypts and five (0.6%) in exotic plants (Green 1984). In another study in e. suburban Melbourne, of 31 observations of foraging: 26 (83.9%) on ground, three (9.7%) in exotic plants, and two (6.5%) native plants; and in suburban Brisbane, of nine observations of foraging, seven (77.8%) on ground, one (11.1%) in exotic plant and one (11.1%) in native plant (Green *et al.* 1989). In Hawkes Bay, of prey items in pasture: 55% on ground, 32% above ground on vegetation, and 13% below ground (Moeed 1980, which see for seasonal breakdown). **FORAGING METHODS: SEARCH, INCLUDING BEHAVIOUR IN FLOCKS:** Large flocks forage by 'roller feeding', in which birds at rear of flock continually fly over flock to take up position in front, constantly changing leadership of flock (Thomas 1957; East & Pottinger 1975; Coleman 1977). Unable to locate subterranean grass grubs without probing; probe randomly till grub detected; sometimes turn over sheep droppings when foraging (East & Pottinger 1975). Foraging behaviour varies with flock-size: birds in large flocks usually forage near each other, often within pecking distance; in smaller flocks, feed independently of one another, usually 1–2 m apart (Coleman 1977). Flocks sometimes forage systematically, foraging across large areas over several days or weeks (Selby 1949; Thomas 1957), revisiting profitable foraging sites over several days (Moeed 1976). Raids on vineyards are usually brief, birds attacking fruit at edge of vineyard, closer to cover to which they may easily escape (Thomas 1957; Burton 1990; see Social Behaviour for use of lookouts).

PROBING: Probe ground for invertebrates (Phillipps & Lindsay 1948; Badman 1979; Wilson 1979). Single probes can sometimes comprise several thrusts of bill (East & Pottinger 1975), and often accompanied by bill gaping ('zirkelning'), birds opening bill c. 2 cm while embedded in earth to enlarge openings; technique appears to be learnt when young (Gannon 1932; Thomas 1957; East & Pottinger 1975; Martin 1987; Kloot 1993); also use zirkelning action to separate grass (Terrill 1946). At Christchurch International Airport, birds effectively probed to depth of 20 mm (n=150 holes). At Winchmore, SI, probes (n=300) ranged from 10–30 mm; mean depth of probe increased from 0.9 cm in hardest soil used to 1.5 cm in softest soil; avoided zirkelning in hard soil, instead making a rapid series of shallow probes, possibly attempting to find a soft spot among turf. Rates of probing (n=484), Mar.–June, ranged from 2.0–57.3 probes/min, with mean rate increasing from 23.4 probes/min in Mar. to 33.9 probes/min in June. Rates of probing were lower on rainy days, when soil soft, than on dry days. Though probing is apparently random (see Search), it was concentrated in areas of high densities of grass grubs, increasing search time in areas of abundant food (East & Pottinger 1975). **ATTACK:** Forage mainly by probing and sallying, and less often by lunging or gleaning (see below). Often sally after flying insects, especially during warm, calm conditions, and on still evenings (Le Souëf 1908; Wallace & Gosper 1967; Lepschi 1986; Gibb 2000a; Heather & Robinson 2000; CSN 21, 22; J.R. Starks). Prey usually eaten after returning to perch (Le Souëf 1908; Wallace & Gosper 1967; Gibb 2000a). Observed sallying vertically among swarms of insects; scanned sky from elevated perches before launching into unidirectional, powered flights of 10–30+ m, usually <30° from vertical, snatching prey with minimal acrobatics and hovering briefly before gliding back to perch. Few flights unsuccessful, and usually returned to preferred perch, either directly or after consuming prey (Green 1966a; Nix 1979). Sometimes jump into air to catch aerial prey (East & Pottinger 1975). Near Murray Bridge, SA, for 15 min, large flock seen rising intermittently into air in unison among swarm of grasshoppers, alighting after short flight, having captured prey (Condon 1935). Very occasionally also recorded screening, in manner of swallows *Hirundo* or woodswallows *Artamus* (Wallace & Gosper 1967; CSN 22). Once at Masterton, NI, seen sally-striking by flying low over water of sewage ponds to snatch food from water's surface (Stidolph 1977a). Once seen waiting for cicada nymphs to emerge from ground, then pouncing and eating them (Anon. 1920). Sometimes forage by lunging; when foraging in short grass, usually walk with head well forward, making sudden forward lunges after mobile insects (East & Pottinger 1975). Also forage by gleaning, often leaning backward to pull large earthworms from soil (East & Pottinger 1975). Once seen gleaning prey from surface of leaves of Moreton Bay Fig (McCulloch 1997a). Once, at Mystic Park, Vic., young bird, having failed to glean individual insects from spider webs, then swallowed entire webs; ate four large masses of web, punctuated with bouts of beak-cleaning (Lowe 1958). Also peck at marrow of bones given to Dogs; some excavate substantial hollows into centre of large bones, several centimetres deep and large enough for Starling to insert entire head and neck (Robertson 1992; T. Peter). Sometimes swallow ants after anting (Lindsay 1960; see Social Behaviour). Also observed methodically stripping seed-heads of *Paspalum* with bill (Thomas 1957). **FOOD HANDLING: INVERTEBRATES:** Once seen beating caterpillar on ground repeatedly before swallowing it (Terrill 1938). Snails caught among plants in garden taken onto lawn and removed from shells with a few sharp jerks, and swallowed immediately (CSN 36). Cicadas captured by sallying taken back to perch and dismembered, then body and wings eaten (Gibb 2000a). Captive birds rubbed earthworms against floor

of cage before swallowing them, apparently to remove particles of soil (East & Pottinger 1975). **FRUIT:** Fruit such as olives may be swallowed whole (Fuller 1942; Thomas 1957) or have the flesh pecked off (Thomas 1957; Paton *et al.* 1988), and olives once said to have been 'sucked dry' (Fuller 1942). Figs are broken open (Thomas 1957), while grapes are gleaned (plucked) rather than pecked (Bomford & Sinclair 2002; *contra* Thomas 1957). Unlike most species, Starlings puncture previously undamaged fruit in orchards (Baker 1980). Fruit may be carried for some distance in bill before being eaten (Thomas 1957; Paton *et al.* 1988). **FOOD SELECTION:** Formerly considered opportunistic, feeding on locally abundant or available food with little selectivity, at least with regard to invertebrates (Thomas 1957; Moeed 1976), but recently shown that though abundance of food important, preferences exist for certain types of food (East & Pottinger 1975; Coleman 1977; Moeed 1980). At W. Melton, NI, birds changed foraging sites and behaviour in accordance to preferences for certain foods, with ease of capture a major factor in selection of prey; most abundant items were sometimes favoured, but not always. Similarly, in Hawkes Bay, though spiders, Stem Weevils *Hyperodes bonariensis* and Clover Weevils *Listroderes delaiquei* abundant, few were eaten, suggesting a preference for other items, but other species, such as *Haplener*, *Aphodius* and earthworms, were eaten only when abundant (Moeed 1980). For details of dietary preferences of captive birds, see Coleman (1977) and East & Pottinger (1975). **FORAGING TIMES:** Forage throughout day (Thomas 1957; Coleman 1977; Baker 1980), though suggested that mainly attack fruit early in morning (around 07:00) and from 16:00 till sunset (Thomas 1957). **SEASONAL VARIATION:** Seasonal variation in diet occurs at all locations where studied in detail. Different types of fruits taken throughout year reflect seasonal availability, e.g. round Mildura, Vic., Grapes *Vitis vinifera* taken Feb.–Dec., peaking Feb.–June; currants *Ribes* and Tomatoes *Lycopersicon esculentum* eaten Dec. and Jan.; Olives *Olea europaea* Oct.–Nov. and June; and figs *Ficus* in Dec. and Feb.–Mar. Invertebrates, especially beetles, were taken throughout year, as were ants, which peaked in diet in May. Spiders were eaten in all months except Mar., and snails were eaten in May and June and Sept.–Mar., peaking during Jan. and Feb. Moths and their larvae were eaten June–Jan., mostly in late winter and spring, earwigs were eaten mainly Oct.–Feb., peaking in Dec., grasshoppers eaten Mar.–July and Sept.–Jan., and cockroaches May–Feb. (Thomas 1957). In Hawkes Bay, beetles and bugs eaten throughout year, peaking mid- to late winter and early spring; moths and caterpillars taken in all months except Dec., mostly late summer to winter; earthworms eaten throughout year, peaking in winter and early spring; flies mainly eaten in spring and summer, though *Hybopygia varia* larvae eaten in Apr.; spiders eaten throughout year; molluscs eaten in most months; earwigs mostly eaten in autumn, winter and spring; grasshoppers eaten in summer and autumn; Hymenoptera eaten Apr.–Dec; millipedes eaten in all months except Aug. and Jan.–Feb.; Slaters *Porcellio scaber* and centipedes eaten infrequently. Plant material eaten throughout year, mostly in summer and autumn, when birds fed on abundant fruit (Moeed 1980, which see for monthly breakdown). In W. Hutt Hills, NI, fruit eaten Dec.–June, and nectar Nov.–Feb.; and cicadas eaten Jan.–Mar. (Gibb 2000a, which see for monthly breakdown). At Christchurch International Airport, adult beetles eaten throughout year, and beetle larvae Mar.–Oct., peaking May–June. Moths and caterpillars eaten throughout year, moths Oct.–Apr., and caterpillars Mar.–Oct. and Dec.; bugs eaten mostly in summer and autumn, peaking in Dec.; earthworms eaten in low numbers Mar.–Sept; spiders eaten throughout year, peaking Oct.–Nov. Grasshoppers eaten Nov.–July, mostly summer and autumn; flies eaten in warmer months, especially Nov. and Jan.; and earwigs eaten in low

numbers throughout year. Seeds eaten late summer and early autumn, and grass and clover-leaves eaten occasionally (Moeed 1976, which see for monthly breakdown). At W. Melton, NI, fed mostly on beetles throughout year, though individual species in diet varied seasonally; moths, bugs and spiders also eaten throughout year, but moths mostly May–Oct., bugs Nov.–Apr., and spiders Feb.–July; flies mostly eaten Feb.–Apr.; and earthworms especially eaten May–Oct. Plant material mainly eaten Feb.–July (Coleman 1977 [which see for seasonal breakdown]). In Canterbury, foraging methods changed seasonally. During Jan. and Feb., foraged mainly by lunging, with only occasional probing. Probing increased during Mar., corresponding to increased availability of grass grub larvae, and was main foraging strategy in mid- to late autumn and winter (East & Pottinger 1975). **INTERSPECIFIC COMPARISONS:** Probe for food more than Common Mynas (Moeed 1975). Much overlap between diets of nestlings of Starlings and Mynas at Havelock N, NI, though species composition and proportions of various items in diet differed. Nestlings of Starlings fed more beetles, moths, earwigs, isopods and earthworms than Mynas, and also ate grasshoppers (which absent from diet of Mynas); Mynas ate more bugs, flies, dragonflies, spiders, snails, bees, wasps or ants, and fruit than Starlings, and also ate millipedes (which absent from diet of Starlings) (Moeed 1975; Wilson 1979). At Havelock N, diets of the two also reflect different foraging sites to some extent: Starlings, which forage more in open areas, contained more invertebrates common in open pasture, whereas diet of Mynas dominated by species usually associated with taller grass (Moeed 1975). Main ecological difference is that Starlings often forage in large flocks in open areas, and Mynas forage mainly in small flocks near cover (R.H. Loyn). **PEST STATUS:** Major agricultural and environmental pest in HANZAB region. Considered a pest in orchards, damaging or eating fruits such as cherries, Grapes, Peaches, strawberries, Pears and Apples (e.g. Littler 1902a; Campbell 1905; Hall 1907; Thomson 1922; Mellor 1931; Boehm 1939; Cleland 1952; Thomas 1957; McEvey 1965; Dawson & Bull 1970; Bull 1973; Fielding 1979; Onley 1980; Burton 1990; Bomford & Sinclair 2002; *contra* Morgan 1917; Chisholm 1924, 1926, 1933; Lord 1956a; Oliver; CSN 5). In Tas., 80% of orchardists claimed Starlings damaged fruit (Fielding 1979). Round Mildura, Vic., 88.2% of 76 birds sampled in Dec. 1953 and Jan. 1954 contained currants, each bird with mean of 5.3 currants; 88.2% of 85 birds sampled Feb.–Apr. 1954 contained sultanas, each bird with mean of 3.3 sultanas; and 17.3% of 98 birds sampled Mar.–May 1954 contained seed-grapes, each bird with mean of 1.5 seed-grapes (Thomas 1957). Damage not confined to fruit actually eaten, as many are left damaged on trees, where conducive to mould; others are knocked from trees or racks (Edwards 1925; Mellor 1931; Ryan 1953; Thomas 1957), and round Mildura, Vic., amount of fruit wasted was equal to, if not more than, amount consumed (Thomas 1957). Also attack cereal crops, pulling germinating grain from soil (Anon. 1918b; Bligh 1928; Kinghorn 1931; Bull 1973; Cleland; Oliver); and eat and foul grain fed to livestock (Anon. 1989; Bomford & Sinclair 2002). Act as agent of dispersal for various noxious weeds, such as African Boxthorn and European Olive (Anon. 1916; Mellor 1922b; Jenkins 1929; Wilkinson 1927; Cleland 1952; Thomas 1957; Hudson 1966; Paton *et al.* 1988; Spennemann & Allen 2000; Bomford & Sinclair 2002). Adversely affect populations of native birds (see Threats and Human Interactions). **DRINKING:** Observed drinking from puddles, bird-baths, garden ponds and water trough (Vellenga 1965; D.C. Paton & P.A. Paton 1980; J.M. Peter).

Detailed studies Round MILDURA, VIC. (food items observed and stomach contents [including 4501 distinguishable animal items] of 400 birds; Thomas 1957): **Plants** Fruit

(observed); unident. seeds (found in ten birds); vegetable matter (including plant stems, vine tendrils, strands of flax, lawn clippings, leaves, grass blades) 5.5% freq. **MONOCOTYLEDONS:** Palmae: fru., sds 2.8; Poaceae: *Avena* sds 0.8; *Paspalum* sds (obs.); *Triticum aestivum* sds 0.3. **DICOTYLEDONS:** Cactaceae (probably *Opuntia*): spines >0.5; Chenopodiaceae: *Atriplex* (including *A. muelleri*) sds 5.8; Fabaceae: *Trifolium* sds 0.5; Moraceae: *Ficus* fru. 3.3; *Morus* fru. (obs.); Oleaceae: *Olea* sds 0.5; Polygonaceae: *Rumex crispus* sds, seed-pod 0.3; Solanaceae: *Lycium ferocissimum* fru., sds 6.0; *Lycopersicon esculentum* sds 1.0; Vitaceae: *Vitis vinifera* fru. (frequency unknown). **Animals** NEMATODES 1.0 (mean number of items in birds with this food), <1.0 (% no. of total invertebrate items), 0.3 (% freq.). **MOLLUSCS:** Bivalves: Hydridae 1.0, <0.1, 0.3; Gastropods 10.2, 24.8, 27.3. **CRUSTACEANS:** Isopods: Porcellionidae 3.7, 0.2, 0.8. **CHILOPODS** 1.0, <0.1, 0.3. **SPIDERS:** Araneida (including Salticidae, Thomisidae) 2.2, 1.9, 9.8. **SCORPIONS:** Pseudoscorpionida 1.0, <1.0, 0.3; Scorpionida 1.1, 0.2, 1.8. **INSECTS:** Blattodea: 1.6, 1.1, 8.0; Coleoptera: water beetles (Caraboidea: Dytiscidae, Hydrophiloidae: Hydrophilidae) 1.66, 0.2, 1.5; Caraboidea (including Carabidae, Carabidae: Cicindellidae, iodoform beetles) 2.2, 3.5, 17.5; Chrysomeloidea (including Cerambycidae: longicorns, Chrysomelidae) 1.18, 0.9, 8.3; Cleoidea (including Cleridae, Melyridae) 1.4, 0.2, 2.0; Cucujoidea (including Coccinellidae) 1.25, <0.1, 0.8; Curculionidea (including Curculionidae: *Otiorhynchus cribricollis*) 2.9, 15.9, 61.8; Elateroidea 1.5, 1.0, 7.5; Scarabaeoidea (including Scarabaeidae) 1.64, 1.0, 7.0; Tenebrionidea (including Anthicidae, Tenebrionidae) 3.2, 7.5, 26.3; Dermaptera 2.3, 2.6, 12.8; Diptera (including aeroplane flies, Muscidae: *Musca domestica*, Oestridae, Tabanidae, Tipulidae) 1.9, 0.7, 4.0; Hemiptera (including plant bugs, Cydnoidea, Gerridae, Reduviidae) 1.31, 1.0, 8.8; Gerridae 1.0, <0.1, 0.3; Hymenoptera (including wasps, wingless wasps, Apoidea, Sphecidae) 1.1, 0.2, 2.5; Formicidae 9.7, 17.2, 20.0; Isoptera 210.0, 9.3, 0.5; Lepidoptera larv. (including wood-borers, Noctuidae: armyworms, cutworms) 6.5, 7.9, 13.8; Odonata (including Anisoptera, Zygoptera) 1.0, 0.2, 2.5; Orthoptera (including Acrididae: *Chortoicetes terminifera*, Gryllidae, Gryllotalpidae, Rhaphidophoridae) 2.0, 2.1, 12.0. **REPTILES:** Lizards (including Scincidae) 1.0, <0.1, 0.5. **BIRDS:** Feathers 1.3% freq. **Other matter** Quartz, chert, sand (3.5); mud or soil (3.5).

In HAWKES BAY, NI (12076 items from gizzards of 334 birds, combined monthly data; Moeed 1980, which see for monthly breakdown): **Plants** (Plant material comprised fruit or seeds or both, except for grass and clover leaves.) Grass and clover lvs 11.7% freq. **MONOCOTYLEDONS:** Liliaceae: *Asparagus officinalis* 7.2. **DICOTYLEDONS:** Fabaceae: *Pisum sativum* 2.7; Rosaceae: *Malus sylvestris* 4.2; *Pyrus communis* 3.0; Solanaceae: *Lycopersicon esculentum* 2.4; *Solanum nigrum* 14.1; Vitaceae: *Vitis vinifera* 10.5. **Animals** ANNELIDS: Oligochaetes: earthworm chaetae - (% no.), 52.4 (% freq.); Lumbricidae: *Allolobophora* (other than chaetae) 2.3, 12.0. **MOLLUSCS:** Gastropods: unident. slug <0.1, 0.6; Helicidae: *Helicella caperata* <0.1, 1.5; Hydrobiidae: *Potamopyrgus antipodarum* 0.4, 4.8; Planorbidae: *Physastra variabilis* <0.1, 0.6; Valloniidae: *Vallonia excentrica* 0.1, 1.5. **CRUSTACEANS:** Isopods: Porcellionidae: *Porcellio scaber* 0.2, 0.6. **DIPLOPODS** 1.1, 15.7. **CHILOPODS** <0.1, 1.8. **SPIDERS:** Ixodidae <0.1, 0.3; Lycosidae 0.9, 9.6. **INSECTS:** Coleoptera: Apionidae: *Apion ulicis* ads 0.2, 0.6; Archeocrypticidae: *Archeocrypticus topali* ads 10.9, 22.5; Carabidae: *Haplaner* ads 17.4, 24.3; *Hypharphax australis* ads 3.6, 14.4; *Megadromus capito* ads <0.1, 1.5; Chrysomelidae: *Paropsis charybdis* ads 0.2, 1.5; Cicindellidae: *Neocicindela tuberculata* ads 0.2, 2.1; Cleridae: *Necrobia ruficollis* ads <0.1, 0.3; Coccinellidae: *Coccinella undecimpunctata* ads <0.1, 1.8; *Scymnus notescens* ads 0.3, 2.1; Curculionidae: *Graphognathus*

leucoloma ads 3.6, 29.3; *Hyperodes bonariensis* ads 5.3, 25.7; *Listroderes delaigui* ads 11.9, 54.8, larv. 2.9, 5.7; Dytiscidae: *Rhantus pulverosus* ads <0.1, 0.3; Elateridae: *Agrypnus variabilis* ads 3.1, 47.9, larv. 1.1, 11.4; Scarabaeidae: *Aphodius* ads 12.3, 20.4; *Aphodius granarius* ads 3.3, 8.1; *Costelytra zealandica* ads 1.3, 6.0, larv. 0.2, 0.9; Staphylinidae: *Xantholinus anthracinus* ads 0.4, 5.4; Dermaptera: Forficulidae: *Forficula auricularia* ads 0.7, 9.0; Diptera: Calliphoridae: *Calliphora vicina* larv. <0.1, 0.3; Drosophilidae: *Scaptomyza* ads <0.1, 0.3; Muscidae: ads <0.1, 1.8; Sarcophagidae: *Hybopygia varia* ads 0.2, 1.8, larv. 1.2, 4.5; Sciaridae: ads <0.1, 0.3; Therevidae: *Anabarrhynchus* larv. <0.1, 0.3; Hemiptera: Cicadellidae: *Amphipsalta* ads <0.1, 0.9; Lygaeidae: *Nysius* ads 5.9, 16.2; Pentatomidae: *Dictyotus caenosus* ads 1.9, 16.2; Hymenoptera: cocoon 0.4, 0.3; Formicidae: *Chelaner antarcticus* ads 0.2, 2.7; Ichneumonidae: *Degithina hersilia* ads 0.2, 3.0; Pterocormus promissorius ads 0.1, 2.1; Vespidae: *Vespa germanica* ads <0.1, 0.9; Lepidoptera: pupa <0.1, 0.3; Coleophoridae: *Coleophora* larv. 1.8, 5.4; Crambidae: *Orocrambus* larv. 0.4, 2.1; Hepialidae: *Wiseana cervinata* larv. <0.1, 1.2; Noctuidae: *Agrotis ipsilon* ads <0.1, 0.3, larv. 0.5, 1.5; *Pseudaletia separata* ads <0.1, 0.3, larv. 2.0, 16.2; Orthoptera: Acrididae: *Locusta migratoria* ads <0.1, 0.6; *Phaulacridium marginale* ads 0.4, 5.1; Gryllidae: *Pteronemobius bigelowi* ads <0.1, 0.3; Tettigoniidae: *Conocephalus semivittatus* ads <0.1, 0.3. **Other matter** Grit 3.3% freq.

In W. HUTT HILLS, NI (423 foraging observations, 1981-92; Gibb 2000a, which see for monthly breakdown): **Plants** **MONOCOTYLEDONS:** Agavaceae: *Cordylina australis* fru. 7.6% no.; *Phormium* nectar 59.8. **DICOTYLEDONS:** Moraceae: *Ficus carica* fru. 13.5; Myrtaceae: *Metrosideros excelsa* nectar 3.3; *M. robusta* nectar 0.5; Rosaceae: *Malus* fru. 5.7; Rubiaceae: *Coprosma robusta* fru. 0.7. **Animals** **INSECTS:** Hemiptera: Cicadidae (mostly *Amphipsalta cingulata*) 9.0.

At CHRISTCHURCH INTERNATIONAL AIRPORT, SI (gizzard contents of 163 birds; Moeed 1976, which see for monthly breakdown and % freq. of invertebrate items): **Plants** **MONOCOTYLEDONS:** Poaceae: grass blades; *Avena* sds; *Triticum* sds. **DICOTYLEDONS:** Fabaceae: *Pisum* sds; *Trifolium* lvs; Rosaceae: *Rubus* sds. **Animals** ANNELIDS: Oligochaetes: earthworm cocoons; Lumbricidae. **MOLLUSCS:** Gastropods: Punctidae: *Laoma*. **SPIDERS:** Lycosidae. **HARVESTMEN:** Phalangidae: *Phalangium opilio*. **INSECTS:** Coleoptera: larv.; Carabidae: *Hypharphax* ads; *Metaglymma monilifer* ads; Cleridae: *Necrobia rufipes* ads; Coccinellidae: *Coccinella undecimpunctata* ads; Cryptophagidae: *Atomaria* ads; Curculionidae: *Desiantha maculata* ads; *D. variabilis* ads; *Hyperodes bonariensis* ads; *Irenimus aequalis* ads; *Listroderes delaigui* ads; *Otiorhynchus ovatus* ads; Elateridae: *Lacon variabilis* ads, larv.; Scarabaeidae: *Aphodius howitti* ads, larv.; *Costelytra zealandica* ads, larv.; *Pyronota setosa* ads; Tenebrionidae: *Enneboeus* ads; Dermaptera: Forficulidae: *Forficula auricularia*; Diptera: Asilidae: *Sarapogon* ads; Chironomidae: *Chironomus* ads; Sarcophagidae: *Sarcophaga milleri* ads, larv.; Syrphidae: *Melanostoma fuscata* ads; Therevidae: *Anabarrhynchus* ads; Hemiptera: Acanthosomatidae: *Rhopalimorpha lineolaris*; Cydnoidea: *Choerocydnus nigrosignatus*; Lygaeidae: *Nysius*; *N. huttoni*; Pentatomidae: *Dictyotus caenosus*; Reduviidae: *Oncocephalus*; Lepidoptera: larv.; Coleophoridae: *Coleophora* larv.; Crambidae: *Orocrambus* ads, larv.; Hepialidae: *Wiseana cervinata* larv.; Noctuidae: *Agrotis* ads, larv.; *Aletia* ads, larv.; *Persectania* larv.; Pyralidae: *Witlesia* ads; Orthoptera: Acrididae: *Phaulacridium marginale*; Gryllidae: *Nemobius bivittatus*; Tettigoniidae: *Conocephalus bilineatus*.

At W. MELTON, CANTERBURY, SI (gizzard contents of 406 birds, combined seasonal data, items recorded <10 times omitted; Coleman 1977, which see for seasonal breakdown): **Plants** Unident. plant material 21.2% vol. of stomach contents, 3.6% freq. **MONOCOTYLEDONS:** Poaceae: *Triticum* or *Hordeum* 39.3, 28.3. **DICOTYLEDONS:** Chenopodiaceae:

Chenopodium album sds 27 (no. of items), 3.0% freq.; Fabaceae: *Trifolium dubium* sds 151, 9.9; Solanaceae: *Solanum nigrum* sds 25, 0.2. **Animals** ANNELIDS: Terricolae: Lumbricidae: unident. 141, 36.9. CRUSTACEANS: Isopoda: Porcellionidae: *Porcellio scaber* 23, 3.4. CHILOPODS: Lithobiomorpha: Henicopidae unident. 1, 0.2; Scolopendromorpha: Gonibregmatidae unident. 25, 4.2. SPIDERS: Araneida: Lycosidae: unident. 1008, 59.9; Phalangida: Phalangidae: *Phalangium opilio* 16, 3.0. INSECTS: Coleoptera: Carabidae: *Hypharphax abstrusus* 231, 13.5; *H. antarcticus* 67, 6.9; *Mecyclothorax rotundicollis* 33, 2.5; *Metaglymma monolifer* 19, 3.4; Chrysomelidae: *Atrichatus aeneicollis* 15, 0.7; Coccinellidae: *Coccinella leonina* 31, 3.9; *C. undecimpunctata* 13, 3.0; Curculionidae: *Desiantha maculata* 274, 27.3; *Epitimetes grisealis* 130, 6.7; *Gonipterus scutellatus* 22, 2.0; *Hyperodes bonariensis* 2105, 70.4; *Irenimus aequalis* 5504, 83.3; *Listroderes delaiugui* 174, 11.8; *Otiorynchus sulcatus* 64, 7.9; Elateridae: *Conoderus exsul* ads 154, 7.6, larv. 32, 5.9; *Lacon variabilis* ads 685, 61.6, larv. 104, 8.9; Scarabaeidae: *Aphodius howitti* ads 170, 10.6, larv. 617, 9.1; *Costelytra zealandica* ads 291, 7.1, larv. 1734, 20.7; *Pyronota setosa* 29, 0.2; Staphylinidae: *Xantholinus* 102, 15.3; Tenebrionidae: *Enneboeus* ads 3163, 67.2, larv. 16, 1.0; Dermaptera: Forficulidae: *Forficula auricularia* 35, 4.4; Diptera: Calliphoridae: unident. larv. 528, 4.4; Muscidae: unident. ads 12, 1.7, larv. 787, 19.2; Sarcophagidae: *Sarcophaga milleri* 158, 9.6; Hemiptera: Cicadellidae: *Deltoccephalus taedius* 31, 4.4; Cydnidae: *Chocrocynus nigrosignatus* 69, 0.5; *Philapodemus australis* 78, 0.5; Lygaeidae: *Nysius* 68, 3.2; *Nysius huttoni* 5261, 52.5; Pentatomidae: *Dictyotus caenosus* 167, 15.0; Reduviidae: *Oncocephalus* 126, 10.1; Hymenoptera: Braconidae: *Apanteles* 21, 1.2; Ichneumonidae: unident. 92, 7.6; Lepidoptera: Coleophoridae: *Coleophora* ads 62, 3.0, larv. 816, 20.7; Hepialidae: *Wiseana* larv. 307, 17.5; Hyponomeutidae: *Plutella maculipennis* ads 57, 1.0, larv. 1034, 4.7; Noctuidae: unident. larv. 71, 5.4; *Agrotis ipsilon* larv. 231, 16.5; *Aletia moderata* larv. 17, 2.2; *A. temenaula* larv. 43, 3.7; *Ariathisa comma* larv. 86, 3.2; Pieridae: *Pieris rapae* larv. 31, 2.2; Pyralidae: *Witlesia sabulosella* larv. 3376, 41.1; Orthoptera: Gryllidae: *Nemobius* 18, 3.4. **Other matter** Small stones 25, 0.5; meat 1, 0.2.

Other records—Aust. Fungi Ground fungus (possibly *Clavaria*)¹⁰⁷. **Plants** *Fruit*^{1,4,5,11,12,16,26,27,28,29,30,33,35,36,37,42,44,52,53,55,58,107}; seeds^{3,7,79,107}; vegetable matter^{28,78,107,108}; vegetables⁵³; leaves and buds^{28,107}. **FERNS**: Marsileaceae: *Marsilea* spore case²⁸. **MONOCOTYLEDONS**: Agavaceae: *Cordylina australis* fru.⁹¹; Liliaceae: *Asparagus asparagoides* fru.⁸⁹; Poaceae: grass¹⁰⁷, sds^{42,55,106}; *Eragrostis* sds¹⁰⁷; *Panicum* sds⁷⁸; *Triticum aestivum* sds^{4,28,107,108}; Xanthorrhoeaceae: *Xanthorrhoea australis* nectar³⁹. **DICOTYLEDONS**: Amaranthaceae: sds⁷⁸; Anacardiaceae: Peppercorn tree fru.²²; Asteraceae: *Chrysanthemoides monilifera* fru.¹⁰⁴; Chenopodiaceae: *Atriplex semibaccata* sds²⁸; Epacridaceae: *Astroloma humifusum* sds¹⁰⁸; *Leucopogon parviflorus* fru.⁷⁷, sds⁷⁷; Fabaceae: *Medicago* sds⁷⁸; *M. sativa* lvs¹⁰⁷; *Sophora japonica* fru.⁹¹; *Trifolium* lvs¹⁰⁷, sds⁴²; Fagaceae: *Quercus* fru.¹⁰⁰; Lauraceae: *Cinnamomum camphora* fru.³⁴; Loranthaceae⁶²: *Muellerina eucalyptoides* fru.^{89,94}; Mimosaceae: *Acacia sophorae* seed-pods⁷⁷, sds^{77,103}; Moraceae: *Ficus* fru.^{12,15,20,24,42,49,54,78}; *F. carica* fru.⁸⁹; *F. hemeana* fru.⁴⁵; *Morus* fru.^{20,40,49}; *M. alba* fru.⁹¹; *M. nigra* fru.^{89,91}; Myrtaceae: *Eucalyptus* nectar¹⁰⁹; Oleaceae: *Olea europaea* fru.^{15,45,54,89,96,105}; Polygonaceae: *Polygonum aviculare* sds¹⁰⁷; Proteaceae: *Grevillea robusta* nectar¹¹¹; Rhamnaceae: *Rhamnus* fru.¹⁵; Rosaceae: *Crataegus* fru.^{8,15}; *Eriobotrya japonica* fru.⁸⁹; *Fragaria vesca* fru.^{38,89}; *Malus* fru.⁹¹; *M. sylvestris* fru.^{11,15,70,92}; *Prunus* fru.⁸⁹; *P. armeniaca* fru.⁸⁶; *P. avium* fru.^{2,12,58,106}; *P. cerasifera* fru.⁹¹; *P. domestica* fru.^{28,37,92}; *P. laurocerasus* fru.⁹²; *P. persica* fru.^{38,58}; *Pyracantha*: fru.^{93,101}; *P. angustifolia* fru.⁹¹; *P. fortuneana* fru.⁹¹; *Pyrus communis* fru.^{11,91}; *Rubus* fru.¹⁵; *R. fruticosus* fru.⁸⁹; Rubiaceae:

Coprosma fru.¹⁵; Santalaceae: *Exocarpos* fru.⁸⁹; Solanaceae: *Capsicum* fru.⁹⁸; *Lycium ferocissimum* fru.^{23,40}, sds³; Sterculiaceae: *Brachychiton populneus* sds¹⁵; Vitaceae: *Vitis vinifera* fru.^{12,24,28,37,40,42,67,88,89,97,106,108}, stems²⁸. **Animals** Invertebrates^{81,101}; lucerne parasites⁷; pieces of bone, bone marrow^{99,112}. **ANNELIDS**^{1,16}; Lumbricidae^{56,77}. **MOLLUSCS**: Bivalves: *Planorbis*¹⁰⁷; Gastropods: snails²¹; Limacidae¹⁰⁸; Littorinidae: *Melaraphe unifasciata*¹⁰⁸; *Lymnaea*¹⁰⁸. **CRUSTACEANS**⁷: Isopods: Porcellionidae^{84,108}. **DIPLOPODS**^{107,108}. **TICKS**: Acarina^{36,42,55,108}; Ixodidae: *Boophilus microplus*⁶⁰. **SPIDERS**^{14,69,72,73,78,107,108}; egg-sac¹⁰⁸; Lamponidae¹⁰⁷; Lycosidae¹⁰⁸; Pisauridae¹⁰⁸; Salticidae¹⁰⁸. **INSECTS**^{3,12,13,16,17,25,26,28,29,30,31,32,33,35,36,40,42,68,75,80,82,83,95,107}; larv.^{1,12,26,42,60,65,77,107}; Blattodea¹⁰⁸: Blaberidae: *Calolampra irrorata*¹⁰⁸; *Laxta granicollis*¹⁰⁸; Coleoptera^{28,30,45,75,77,78,107}; larv.⁴⁸; water beetles⁷⁸; wireworms^{12,85,107}; Carabidae²⁸; 54,78,107,108; ads⁷³, larv.^{107,108}; *Clivina*¹⁰⁸; *Promecoderus*¹⁰⁷; *Sarticus*¹⁰⁸; Chrysomelidae^{14,72,73,78,107,108}; larv.¹⁰⁸; *Paropsis* ads¹⁰⁸; Cleridae⁶⁹; Coccinellidae¹⁰⁷; Curculionidae^{28,69,72,73,78,107,108}; ads⁶⁹; *Citona*¹¹⁰; Amycterinae¹⁰⁸: *Cubicorhynchus maculatus*¹⁰⁷; *Ethemaia sellata*¹⁰⁷; Dermestidae: *Dermestes vulpinus* larv.¹⁰⁸; Elateridae^{69,78,107}; ads⁶⁹, larv.^{69,108}; *Lacon*¹⁰⁸; ads⁶⁹; *L. guttatus* ads⁶⁹; Elaterinae: larv.⁶⁹; Lycidae: *Chauliognathus lubugris* ads⁹¹; Scarabaeidae^{107,108}; larv.¹⁰⁸; Aphodiinae¹⁰⁸: *Aphodius* larv.⁶⁹; Dynastinae¹⁰⁸: *Heteronychus arator*⁷⁵; Melolonthinae^{78,108}; larv.⁶⁶; *Diphucephala*¹⁰⁸; Scarabaeinae: *Onthophagus*¹⁰⁸; *O. australis*⁶⁹; Staphylinidae^{72,73,78,108}; larv.¹⁰⁸; Tenebrionidae^{78,107,108}; larv.⁶⁹; *Chalcopteris*¹⁰⁷; Dermaptera^{78,108}: Forficulidae^{14,107}; Diptera^{14,102,107}; ads¹⁰⁸, larv.^{107,108}, pupae¹⁰⁸; Bibionomorpha: Mycetophilidae¹⁰⁷; Ephydroidea: Drosophilidae: *Drosophila*¹⁰⁸; Muscoidea: *Musca* pupae¹⁰⁸; Calliphoridae: larv.^{3,29}; *Lucilia*¹⁰⁸; *L. cuprini* ads⁹¹; Oestridae: ads³⁵, larv.³⁵; Sciomyzoidea: Coelopidae⁷⁴; ads¹⁰⁸, larv.¹⁰⁸, pupae¹⁰⁸; Syrphoidea: Syrphidae: *Eristalis* larv.¹⁰⁸; *E. tenax* larv.¹⁰⁷; Tabanoidea: Stratiomyidae⁹⁰; larv.^{69,108}; Tabanidae¹⁰⁸; Hemiptera¹⁰⁷: scale¹⁰⁷; Heteroptera⁶⁹; Aphididae: *Tinocallis ulmiparvifoliae* ads⁹¹, nymphs⁹¹; Cicadidae^{75,107,108}; nymphs⁶; Corixidae⁷⁸; Cydnidae¹⁰⁸; Lygaeidae¹⁰⁸; Pentatomidae^{78,108}; *Cuspicona*¹⁰⁷; Psyllidae¹⁰⁷; Hymenoptera: wasps¹⁰⁸; Formicidae^{55,64,72,76,77,78,107,108}; alates^{71,107}; *Camponotus*¹⁰⁸; *Ectatomma*¹⁰⁸; *Iridomyrmex*¹⁰⁸; *Myrmecia* ads⁹¹; *Pheidole*⁶⁹; Ponerinae⁶⁹; Isoptera^{69,107}; Lepidoptera: larv.^{3,11,16,17,26,28,40,41,42,61,69,73,78,107,108}, pupae¹⁰⁸; moths¹⁰⁷; Arctiidae: *Spilosoma glatignyi*⁵¹; Hepialidae: *Oncopera intricata* larv.^{69,87}; Noctuidae: ads^{73,108}; cutworms^{30,31,107}; armyworm or cutworm larv.^{55,107,108}; *Agrotis*⁶⁹: ads¹⁰⁷, larv.¹⁰⁷; *A. infusa* larv.¹⁸; *Amphipyra sanguinipuncta* larv.⁶⁹; *Persectania ewingii* larv.⁶⁹; *Plusia* larv.¹⁰⁷; Psychidae: larv.¹⁰⁸; Pyralidae: *Herpetogramma licarsisalis* larv.¹⁰⁷; Thyrididae: larv.⁶⁹; Odonata: Zygoptera¹⁰⁸; Orthoptera¹⁰⁷: grasshoppers^{11,29,30,31,32,33,42,43,48,49,50,55,57,59,69,78,107,108}; Acrididae^{77,107,108}; *Chortoicetes terminifera*^{9,47}; Gryllidae^{77,107,108}; *Gryllus servillei*¹⁰⁸; *Teleogryllus commodus*⁷³; Gryllotalpidae¹⁰⁷; *Gryllotalpa*²⁸; Tettigoniidae^{78,108}; Thysanura: Lepismatidae¹⁰⁷. **REPTILES**: Squamata: Agamidae¹⁰⁸. **BIRDS**: Eggshells, remains of egg¹⁰⁷. **Other matter** Filament¹⁰⁷; crumbs¹⁹; livestock feed¹⁰; spider web covered with mosquitoes (Diptera: Culicidae)⁶³; quartz gravel²⁸.

REFERENCES: ¹ Littler 1902a; Anon. ² 1905, ³ 1916, ⁴ 1918b, ⁵ 1919, ⁶ 1920, ⁷ 1925, ⁸ 1940, ⁹ 1948, ¹⁰ 1989; ¹¹ Campbell 1905; ¹² Ryan 1906; ¹³ Le Souëf 1908; Cleland ¹⁴ 1910, ¹⁵ 1952; ¹⁶ Morgan 1914; Slaney ¹⁷ 1915, ¹⁸ 1922; ¹⁹ Barrett 1916; ²⁰ White 1919; ²¹ Burbury 1920; Mellor ²² 1920b, ²³ 1925, ²⁴ 1931; McGilp ²⁵ 1921, ²⁶ 1928; McKeown ²⁷ 1923, ²⁸ 1934; Chisholm ²⁹ 1924, ³⁰ 1926, ³¹ 1933, ³² 1934, ³³ 1938, ³⁴ MacPherson 1924; ³⁵ Edwards 1925; ³⁶ Bligh 1928; ³⁷ Nicholls 1928; Sutton ³⁸ 1928b, ³⁹ 1931; ⁴⁰ Jenkins 1929; ⁴¹ Ashby 1930; ⁴² Kinghorn 1931; ⁴³ Bridgewater 1932; ⁴⁴ McGilp 1934; ⁴⁵ Gannon 1932; ⁴⁶ McKeown 1934; ⁴⁷ Condon 1935; ⁴⁸ Currie 1935; ⁴⁹ Pearse

1935; ⁵⁰ Brummitt 1937; ⁵¹ Terrill 1938; ⁵² Boehm 1939; ⁵³ Miller 1939; ⁵⁴ Fuller 1942; ⁵⁵ Jarvis 1943; ⁵⁶ Terrill 1946; ⁵⁷ Brandon 1951; ⁵⁸ Ryan 1953; ⁵⁹ Watson 1955; ⁶⁰ Lord 1956a, ⁶¹ 1956b; ⁶² Keast 1958; ⁶³ Lowe 1958; ⁶⁴ Lindsay 1960; ⁶⁵ Quinn 1961; ⁶⁶ Cole 1963; ⁶⁷ McEvey 1965; Green ⁶⁸ 1966a, ⁶⁹ 1966b; ⁷⁰ Noonan 1966; ⁷¹ Wallace & Gosper 1967; van Tets *et al.* ⁷² 1969, ⁷³ 1977; ⁷⁴ Warham 1969; Rose ⁷⁵ 1973, ⁷⁶ 1974; ⁷⁷ 1999; ⁷⁸ Vestjens 1977; ⁷⁹ Badman 1979; ⁸⁰ Nix 1979; ⁸¹ Harris 1980; ⁸² Ross 1980; ⁸³ Ford & Bell 1981; ⁸⁴ Coyle 1983; ⁸⁵ Gregory-Smith 1983; ⁸⁶ Paton & Reid 1983; ⁸⁷ Wall 1983; ⁸⁸ Backhouse 1985; ⁸⁹ Forde 1986; Lepschi ⁹⁰ 1986, ⁹¹ 1993, ⁹² 1997; ⁹³ Mulvaney 1986; ⁹⁴ Reid 1986; ⁹⁵ Woodall 1986; ⁹⁶ Paton *et al.* 1988; ⁹⁷ Burton 1990; ⁹⁸ Magarry 1992; ⁹⁹ Robertson 1992; ¹⁰⁰ Kloot & McCulloch 1993; ¹⁰¹ Pell & Tidemann 1994; ¹⁰² Schulz & Kristensen 1994; ¹⁰³ McCulloch 1997b; ¹⁰⁴ Gosper 1999; ¹⁰⁵ Spennemann & Allen 2000; ¹⁰⁶ Bomford & Sinclair 2002; ¹⁰⁷ Cleland; ¹⁰⁸ FAB; ¹⁰⁹ Tas. Bird Rep. 20; ¹¹⁰ SA Bird Rep. 1976; ¹¹¹ J.M. Peter; ¹¹² T. Peter.

Other records—NZ Plants Fruit^{2,7,14,17,23,24}; seeds²; nectar^{6,7,24}. **GYMNOSPERMS:** Podocarpaceae: *Dacrycarpus dacrydioides* fru.^{1,19,22,23,24,27,29,37}; *Dacrydium cupressinum* fru.^{17,24,27,30}; *Prumnopitys ferruginea* fru.²⁴; *P. taxifolia* fru.^{22,24}. **MONOCOTYLEDONS:** Agavaceae: *Cordylina* fru.^{24,36,38,40}, sds³⁹; *C. australis* fru.¹⁹; *Phormium* nectar^{6,7,20,23,24,25,26,31}; *P. tenax* nectar^{8,9}; *Arecaceae:* *Rhopalostylis sapida* fru.¹⁰; *Poaceae* sds^{14,24}. **DICOTYLEDONS:** Caprifoliaceae: *Sambucus nigra* fru.^{17,22}; *Cornaceae:* *Griselinia littoralis* fru.²⁴; *G. lucida* fru.¹; *Ebenaceae:* *Diospyros* fru.³⁵; *Elaeocarpaceae:* *Arctostelia serrata* fru.^{1,24}; *Fabaceae:* *Sophora* nectar^{24,26}; *Myrtaceae:* *Eucalyptus*³¹; *Feijoa* nectar^{9,41}; *Metrosideros robusta* nectar^{24,31}; *M. excelsa* nectar^{8,9,23,31}; *Onagraceae:* *Fuchsia* fru.^{1,24}; *F. excorticata* fru.¹⁹; *Polygonaceae:* *Muehlenbeckia* seed-pods²; *M. australis* unident. item⁴⁰; *Rosaceae:* *Cotoneaster* fru.³¹; *Fragaria vesca* fru.¹³; *Malus sylvestris* fru.^{13,16,27,28}; *Prunus avium* fru.¹³; *P. domestica* fru.¹³; *P. persica* fru.¹³; *Pyrus communis* fru.¹³; *Rubus* fru.¹³; *Rubiaceae:* *Coprosma repens* fru.²⁴; *C. retusa* fru.²⁵; *C. robusta* unident. item⁴⁰; *Sapindaceae:* *Alectryon excelsus* fru.²²; *Saxifragaceae:* *Ribes nigrum* fru.¹³; *R. rubrum* fru.¹; *Solanaceae:* *Solanum aviculare* fru.²²; *Vitaceae:* *Vitis vinifera* fru.^{13,14,23,31,34}. **Animals** Invertebrates^{18,23}. **ANNELIDS**^{2,11,23}; Oligochaetes: Lumbricidae: *Allolobophora caliginosa*¹⁵; *Lumbricus rubellus*¹⁵. **MOLLUSCS:** Gastropods: snails^{23,35}. **TICKS**^{2,14}. **SPIDERS**²³. **INSECTS**^{2,7,12,16,24,32,33}. **Coleoptera:** Curculionidae: *Hyperodes bonariensis*¹⁵; *Irenimus*¹⁵; Lycidae: *Costelytra zealandica* ads¹⁵, larv.^{2,3,15,23,27}; **Diptera:** Chironomidae: *Chironomus* ads¹⁸, larv.¹⁸; Hemiptera: Aphididae: nymphs³³; Lygaeidae: *Nysius huttoni*¹⁵; Hymenoptera: Apoidea²⁶; Lepidoptera: Hepialidae: *Wiseana* larv.²³; Noctuidae: armyworms³¹; Orthoptera: Gryllidae^{2,31}. **REPTILES:** *Squamata*²¹. **BIRDS:** Eggs²⁴; Passeriformes: Alaudidae: eggs¹⁴. **MAMMALS:** Phalangeridae: Common Brushtail Possum *Trichosurus vulpecula* carrion³¹. **Other matter** Scrap⁴; bread³⁷; meat³⁷.

REFERENCES: ¹ Thomson 1922; ² Moncrieff 1929; ³ Phillipps & Lindsay 1948; ⁴ Stidolph 1950; ⁵ Bell 1955; McCann ⁶ 1956, ⁷ 1964; Sibson ⁸ 1956, ⁹ 1989; ¹⁰ Edgar *et al.* 1965; ¹¹ Burrows 1968; ¹² Merton 1968; ¹³ Dawson & Bull 1970; ¹⁴ Bull 1973; ¹⁵ East & Pottinger 1975; ¹⁶ Baker 1980; ¹⁷ Dunn 1981; ¹⁸ Merton & Veitch 1986; ¹⁹ Burrows 1994; ²⁰ Freeman 1994; ²¹ Bell 1996; ²² Williams & Karl 1996; ²³ Heather & Robertson 2000; ²⁴ Oliver; CSN ²⁵ 2, ²⁶ 3, ²⁷ 4, ²⁸ 5, ²⁹ 6, ³⁰ 8, ³¹ 19 Suppl., ³² 21, ³³ 22, ³⁴ 33, ³⁵ 36, ³⁶ 37, ³⁷ 38, ³⁸ 41, ³⁹ 43, ⁴⁰ 44, ⁴¹ 47.

Young Fed by both sexes; continues for 1–2 weeks after fledging (see Breeding). Composition and size of meals varies with age. At W. Melton, NI, nestlings up to 5 days old were given small amounts, often single items, of soft-bodied invertebrates, such as moths, caterpillars, bugs and spiders; older nestlings given more 'hard' foods, e.g. adult beetles, and diet

more varied than that of younger birds. Older nestlings also ate more, with meals comprising up to ten items, depending on size of prey (e.g. single large item, or several smaller items). Number of nestlings fed per visit also changed with age: fed two nestlings per visit on 12 of 16 visits to brood of 4-day-old nestlings, and single nestling fed on other visits; when 8 days old, single nestling received food on 24 of 26 visits, and two fed on other two occasions (Coleman 1977). Adults may carry three or more caterpillars to nest at a time (Slaney 1915). **FEEDING RATES:** At W Melton, NI, four broods averaged one feeding visit every 6.5 min; means for individual broods were 3.7–9.1 min. Rates of visitation apparently not affected by age or brood-size, though typically lowest round midday; in mid-Nov., when nestlings most abundant, averaged 134.6 feeding visits/day. At Horny, Canterbury, two females using same nest with at least five chicks, 2–4 days old, made combined total of 16 visits in 45 min (Hornby School 1946). At nest with four nearly fully fledged young in Tas., each parent visited nest at c. 5-min intervals (Green 1965). **INTAKE:** At W. Melton, NI, 8-day-old nestlings ingested c. 3.4 g dry weight of food per day, of which c. 2.45 g able to be metabolized, giving daily energy intake of c. 53.64 kJ/day; for energy derived from major food items, see Table 1. Older nestlings ate similar-sized food to adults, ranging from 2-mm Hemiptera nymphs to 30-mm Noctuidae larvae. In Tas., fed mostly grasshoppers c. 65 mm long; and twice, 10-cm lizards swallowed without difficulty (Green 1965). In Hawkes Bay, food eaten by nestlings significantly larger than that eaten by adults (Moeed 1980).

Detailed studies Near HASTINGS, HAWKES BAY, NI (gizzard contents [including 1186 invertebrate items] of 62 nestlings, 2–14 days old, combined Nov.–Dec. data; Moeed 1980): **Plants** Grass and clover lvs c. 50% freq., sds 13%. **Animals** **ANNELIDS:** Terricolae: Lumbricidae: *Allolobophora* 7.0 (% no. of total invertebrate items), 20 (number of nestlings with food item). **MOLLUSCS:** Gastropods: slugs <0.1, 1; Hydrobiidae: *Potamopyrgus antipodarum* 0.9, 4; Planorbidae: *Physastra variabilis* 0.5, 2. **SPIDERS:** Araneida: Lycosidae 4.8, 15; Opiliones: Phalangidae: *Phalangium opilio* 0.3, 2. **INSECTS:** Coleoptera: Archeocrypticidae: *Archeocrypticus topali* ads 1.1, 8; Carabidae: *Haplener* ads 1.1, 5; *Hypharpax australis* ads 5.3, 29; *Megadromus capito* ads 0.3, 3; Chrysomelidae: *Paropsis charybdis* ads 0.7, 3; Cleridae: *Necrobia ruficollis* ads <0.1, 1; Coccinellidae: *Coccinella undecimpunctata* ads 0.3, 3; Curculionidae: *Hyperodes bonariensis* ads 2.5, 18; *Listroderes delaignei* ads 0.8, 9; Dytiscidae: *Rhantus pulverosus* ads 0.3, 3; Elateridae: *Agrypnus variabilis* ads 3.5, 33, larv. 3.7, 14; Scarabaeidae: *Aphodius* ads 0.6, 3; *Aphodius granarius* ads 3.8, 21; *Costelytra zealandica* ads 24.4, 38; *Pyronota festiva* ads 0.3, 2; Staphylinidae: *Xantholinus anthracinus* ads 1.0, 8; Dermaptera: Forficulidae: *Forficula auricularia* ads 0.8, 8; Diptera: Calliphoridae: *Calliphora vicina* ads 0.3, 4, larv. 2.2, 2; Muscidae: ads 3.5, 13, larv. 0.3, 1; Sarcophagidae: *Hybopygia varia* ads 3.5, 25, larv. 14.0, 6; Hemiptera: Cicadellidae: *Amphipsalta* ads <0.1, 1; Lygaeidae: *Nysius* 0.7, 2; Pentatomidae: *Dictyotus caenosus* ads <0.1, 1; *Nezara viridula* ads 0.5, 3; Hymenoptera: Formicidae: *Chelaner antarcticus* ads 0.8, 4; Ichneumonidae: *Degithina hersilia* ads <0.1, 1; Lepidoptera: Crambidae: *Orocrambus* ads 1.1, 7; Hepialidae: *Wiseana cervinata* ads 0.8, 6; Noctuidae: *Agrotis ipsilon* larv. 1.9, 1; *Pseudaletia separata* larv. 5.6, 35; Odonata: Coenagrionidae: *Xanthocnemis zealandica* ads <0.1, 1; Orthoptera: Acrididae: *Phaulacridium marginale* ads 0.3, 2; Gryllidae: *Pteronemobius bigelowi* ads <0.1, 1.

At HAVELOCK NORTH, HAWKES BAY, NI (gizzard contents [including 556 invertebrate items] of 19 nestlings 3–16 days old; Moeed 1975): **Plants** **MONOCOTYLEDONS:** Poaceae: sds 1 (number of nestlings containing item); *Zea mays* sds 1. **DICOTYLEDONS:** Rosaceae: *Prunus cerasus* fru. 2. **Animals** (First figure refers to % no. of invertebrate items [excluding

Table 1. The energetics of major foods of nestlings at W. Melton, Canterbury (L = larv.; A = ads; after Coleman 1977).

FOOD		Mean calorific value of digestible components (kJ)	Number of animals taken from nestlings	Total energy of digestible tissues taken (kJ)
<i>Agrotis ypsilon</i>	L	2.148	268	574.88
<i>Nysius huttoni</i>	A	0.017	800	12.05
<i>Conoderus exsul</i>	L	0.188	113	21.17
<i>Costelytra zealandica</i>	A	0.385	385	147.40
<i>Irenimus aequalis</i>	A	0.059	124	7.07
<i>Neoitamus</i>	A	0.368	93	34.14
Unident. Lycosidae	A	0.193	255	48.53

Oligochaetes]; second figure refers to number of birds containing item.) ANNELEDS: Oligochaeta -, 19. MOLLUSCS: Gastropods: snails 2.2, 9. CRUSTACEANS: Isopods 2.2, 7. SPIDERS: Araneida: Lycosidae 1.4, 3. INSECTS: Coleoptera: *Macylothorax* ads 2.9, 11; Carabidae: *Hypharpx* ads 2.9, 7; Chrysomelidae: *Paropsis* ads 1.1, 4; Coccinellidae: *Coccinella undecimpunctata* ads 1.4, 2; Curculionidae: *Graphognathus leucoloma* ads 26.4, 18; *Hyperodes* ads 4.9, 8; *Listroderes* ads 7.4, 10; Elateridae: *Lacon variabilis* ads 1.1, 5; Scarabaeidae: *Costelytra zealandica* ads 6.1, 11; *Saprosites* ads 1.6, 7; Staphylinidae: ads 4.1, 8; *Creophilus oculus* ads 0.4, 1; *Leptacinus* ads 0.4, 1; Tenebrionidae: *Cilibe* ads 0.7, 2; Dermoptera: Forficulidae: *Forficula auricularia* ads 1.4, 4; Diptera: Muscidae ads 2.5, 4; Sarcophagidae: *Sarcophaga milleri* larv. 4.1, 4; Hemiptera: Cicadidae: *Rhodopsalta* ads 5.0, 12; Lygaeidae: *Nysius huttoni* ads 4.1, 4; Pentatomidae: *Dictyotus* ads 2.2, 7; Hymenoptera: Ichneumonidae ads 1.3, 4; Lepidoptera: Coleophoridae: *Coleophora* larv. 0.4, 1; Noctuidae: ads 2.7, 6, larv. 6.3, 15, pupae 0.4, 2; Pyralidae: *Crambus* larv. 1.6, 4; Odonata: Coenagrionidae: *Xanthocnemis* ads 0.5, 1; Orthoptera: Acrididae: *Phaulacridium marginale* ads 0.4, 2.

At W. MELTON, CANTERBURY, SI (3665 items from 337 nestling samples, including gizzard contents; combined yearly data, items recorded <10 times omitted; Coleman 1977, which see for % freq.): **Plants** DICOTYLEDONS: Rosaceae: *Prunus avium* fru. 0.8% no. **Animals** ANNELEDS: Oligochaetes: Lumbricidae 2.7. CRUSTACEANS: Isopods: Porcellionidae: *Porcellio scaber* 1.3. SPIDERS: Lycosidae 7.0. HARVESTMEN: Phalangidae: *Phalangium opilio* 7.0. INSECTS: Coleoptera: Carabidae: *Hypharpx abstrusus* 5.1; *H. antarcticus* ads 5.3; *Metaglymma monilifer* ads 1.5; Coccinellidae: *Coccinella undecimpunctata* ads 1.1; Curculionidae: *Hyperodes bonariensis* ads 0.3; *Irenimus aequalis* ads 3.4; *Listroderes delaiquei* ads 0.4; Elateridae: *Conoderus exsul* ads 0.6, larv. 3.1; *Lacon variabilis* ads 2.6; Scarabaeidae: *Aphodius howitti* ads 0.7; *Costelytra zealandica* ads 10.6; Dermoptera: Forficulidae: *Forficula auricularia* ads 0.4; Diptera: Asilidae: *Neoitamus* ads 2.5; *Saropogon* ads 0.3; Calliphoridae: *Calliphora laemica* larv. 0.7; Muscidae: ads 1.7, larv. 1.3; Hemiptera: Cicadidae: *Melampsalta* ads 0.4; Lygaeidae: *Nysius huttoni* ads 21.8; Pentatomidae: *Dictyotus caenosus* ads 1.0; Lepidoptera: Coleophoridae: *Coleophora* ads 4.4; Crambidae: *Crambus* larv. 0.6; Heliidae: *Wiseana* ads 0.8, larv. 0.3; Noctuidae: *Agrotis ipsilon* ads 1.2, larv. 7.3; *Ariathisa comma* larv. 0.3; *Persectania aversa* larv. 0.7; Pyralidae: *Witlesia sabulosella* ads 0.9.

Other records **Plants** MONOCOTYLEDONS: Agavaceae: *Phormium nectar*¹². DICOTYLEDONS: Solanaceae: *Lycium ferocissimum* fru.². **Animals** DIPLOPODS⁷. MOLLUSCS: Gastropods¹⁰. MYRIAPODS¹⁰. INSECTS^{3,4,5}: Coleoptera: Scarabaeidae: *Onthophagus australis*⁷; Lepidoptera: larv.¹; Heliidae: *Oncopera intricata* larv.⁸; Orthoptera: grasshoppers^{6,9}; Acrididae: *Phaulacridium vittatum*⁷. REPTILES: Squamata⁶: Scincidae: *Leiopisma nigriplantare*¹¹. For items fed to hand-raised nestling, see Deeming (1946).

REFERENCES: AUST.: ¹ Slaney 1915; ² Beck 1921; ³ Jenkins 1929; ⁴ Chisholm 1933; ⁵ Bryant 1936; Green ⁶ 1965, ⁷ 1966b; ⁸ Wall 1983; ⁹ SA Bird Rep. 1976. NZ: ¹⁰ Coleman 1977; ¹¹ Nilsson *et al.* 1994; ¹² CSN 3.

Intake In Hawkes Bay, NI, size-classes of invertebrate prey items (n=12,008) eaten by adults: 2–5 mm, 55%; 6–10 mm, 27%; 11–20 mm, 12%; 21–30 mm, 4%; and 31–40 mm, 2% (Moed 1980, which see for seasonal breakdown). Third-instar grass grubs (mean dry weight 0.028 g) and earthworms (0.10 g), major prey species in Canterbury, have mean metabolizable energy content of 0.44 and 1.06 kJ per item respectively (East & Pottinger 1975). For energy derived from major foods of birds at W. Melton, SI, see Table 2. At Winchmore, SI, field observations in Mar. showed earthworms were captured at rate of 1 worm/100 probes, or 15.1 worms/h, deriving 16.02 kJ/h; by June, rate had increased to 2.2 worms/100 probes, or 45.0 worms/h, deriving 47.71 kJ/h (East & Pottinger 1975). For estimated feeding rates and energy intake from grass grubs in Canterbury, see East and Pottinger (1975).

SOCIAL ORGANIZATION Some aspects well known in HANZAB region. Very well known extraliminally (see Feare & Craig 1998; BWP). **DETAILED STUDIES:** At Belmont, near Wellington, NI, 1970–79, population of c. 400 pairs with most females and some males colour-banded (Flux 1978, 2003; Flux & Flux 1981, 1992). Round Mildura, Vic., July 1953–June 1954 (Thomas 1957). **GREGARIOUSNESS:** Usually occur in flocks, sometimes large (see below), but also often seen singly, in twos or small groups (e.g. Kinghorn 1931; Chisholm 1936; Secker 1946, 1948; Sibson 1949b; Cooper 1972; Domm & Recher 1973; Sutton 1990; Garnett *et al.* 1991; Schultz 1991). Flock-sizes usually larger in autumn and winter (non-breeding season) than in spring and summer (breeding season) (see below); and often form large flocks when flying to roost (see Roosting, below). Sometimes juveniles or immatures form large flocks together (Chisholm 1926). Occasionally forage with other species (see Food: Foraging associations), and once, vagrant at Iron Ra., Qld, always seen with c. 20 Magpie-larks (Forshaw & Muller 1975). In AUST., often form large flocks of hundreds or thousands, or sometimes tens of thousands, Feb.–July (e.g. Clee 1920; Anon. 1922; Kinghorn 1931; Watson 1955; McEvey 1965; Cooper 1974, 1975; Baldwin 1975; Gosper 1981; Woodall 1999; Vic. Bird Rep. 1987), though during this time also occur in smaller flocks of up to 100 (e.g. Gall & Longmore 1978; Garnett *et al.* 1991). In breeding season (c. Sept.–Jan.), usually recorded in smaller flocks, of up to 50 (e.g. Giblin 1924; Gall & Longmore 1978; Costello 1981; Horrocks & Brown 1993). Near Mildura, Vic., both frequency and size of flocks declined from early Sept. to late Dec. (Thomas 1957). On mainland NZ, often form flocks of several hundred (Moncrieff 1929; Cunningham & Wodzicki 1948; CSN 4, 5, 23), and occasionally of 1000–4500 during non-breeding season (DNFC 1949; CSN 4, 6, 19, 33), and occur in smaller flocks, of up to 50, in breeding season

Table 2. Energetics of major animal foods of free-flying Starlings at W. Melton, Canterbury, SI (L = larv.; A = ads; after Coleman 1977).

FOOD		Mean dry weight of species (g)	Calorific value of digestible components per animal (kJ)	No. of items taken from gizzards	Total energy of digestible tissue eaten (kJ)	Total energy ingested for each animal group (kJ)
<i>Nysius huttoni</i>	A	0.0008	0.017	5261	88.09	
<i>Dictyotus caenosus</i>	A	0.0084	0.163	167	27.26	115.35
<i>Agrotis ypsilon</i>	L	0.1080	2.148	231	496.14	
<i>Coleophora</i>	L	0.0005	0.013	816	10.26	
<i>Witlesia sabulosella</i>	L	0.0123	0.247	3376	833.93	
<i>Wiseana</i>	L	0.1510	3.035	307	931.86	2272.55
<i>Neoitamus</i>	A	0.0235	0.368	10	3.35	
<i>Sarcophaga milleri</i>	A	0.0055	0.105	158	16.54	19.89
<i>Irenimus aequalis</i>	A	0.0032	0.059	5504	322.63	
<i>Hyperodes bonariensis</i>	A	0.0005	0.008	2105	17.63	
<i>Desiantha maculata</i>	A	0.0040	0.071	274	9.51	
<i>Enneboeus</i>	A	0.0008	0.013	3163	39.73	399.40
<i>Costelytra zealandica</i>	A	0.0216	0.385	291	112.08	
<i>Aphodius howitti</i>	A	0.0200	0.364	170	61.92	
<i>Lacon variabilis</i>	A	0.0163	0.297	687	204.23	
<i>Hypharfax abstrusus</i>	A	0.0040	0.071	231	16.45	442.59
<i>Conoderus exsul</i>	L	0.0109	0.188	32	6.03	
<i>Aphodius howitti</i>	L	0.0220	0.389	617	240.24	
<i>Costelytra zealandica</i>	L	0.0243	0.431	1734	747.76	994.03
Unident. Lycosidae	A	0.0091	0.193	1008	194.14	194.14
Unident. Lumbricidae	A	0.0402	0.904	141	127.53	127.53

(Secker 1948; Walker 1953; CSN 1, 5). Round Auckland, tend to move about in flocks in summer, autumn and winter, but in spring, nesting birds become widely distributed (Moncrieff 1929). On offshore islands, usually seen singly, in twos or flocks of up to 50 (e.g. Sibson 1947; Dawson 1950; Kinsky & Sibson 1959; Bell 1960; Edgar 1962; Blackburn 1967, 1968; Reed 1976; Cooper *et al.* 1986; Cooper 1991), though sometimes form larger flocks of 80 to several hundred on Little Barrier I. (McKenzie 1948; Sibson 1949a; Chambers *et al.* 1955). On OUTLYING ISLANDS, usually occur in flocks of up to 50 (Le Souëf 1924; Edgar *et al.* 1965; McKean & Hindwood 1965; Warham 1967; Miskelly *et al.* 2001; Tennyson *et al.* 2002); though on Kermadec Is., occasionally in flocks of c. 300 (Edgar *et al.* 1965) or c. 1500 (Merton & Veitch 1986); on Chatham Is, flocks of c. 100 (Bell 1955); and on Macquarie I., flocks of 75–250 in non-breeding season (Stirling & Johns 1969; Merilees 1971); see also Roosting, below.

Bonds Not well known in HANZAB region, but usually nest in pairs (e.g. Edwards 1955; Wightman 1956; NRS). Extraliminally, both monogamous and polygamous (see BWP for details). In Christchurch, thought that two females laid eggs in one nest; later, two birds, thought to have been female, seen feeding nestlings (Hornby School 1946). **Sex-ratio** Near Mildura, Vic., of 335 collected and sexed by dissection, 60% were male (Thomas 1957); sex-ratio similarly male-biased extraliminally (Thomas 1957; BWP). **Parental care** Both sexes incubate and brood, though mostly by female, and both feed young with about equal contribution (see Breeding). Male thought to guard nest (Hornby School 1946). Once, when pair nested in nest-box beside that of House Sparrows, male Starling fed nestling Sparrows and removed their faeces (Burrows 1968).

Breeding dispersion Nest either as solitary pairs (e.g. Wightman 1956; Napier & Singline 1979; NRS) or in colonies (e.g. Skemp 1952; Flux 2003); more than one pair often nest in same tree (Thomas 1957). Near Mildura, Vic., often nest colonially, but for other nesting pairs, nearest nests often ≥ 800 m away; distribution of nesting pairs apparently fairly even (Thomas 1957). In colony in Wellington, nests 15 m apart (Secker 1948). At Belmont, NI, population nested in

500 nest-boxes on 1500 ha of farmland; nest-boxes were spaced 2–3 m apart in groups of 10–15, with c. 100 m between groups of boxes (Flux & Flux 1981). In same area, thought that some nest-boxes unused because dominant male controlled an adjacent box, though since some unused nest-boxes were not near dominant males, and population included excess females capable of breeding, some social constraint probably prevented expansion of colony and excess birds from breeding (Flux 2003). In two suburbs of Canberra where most nests in buildings, recorded at densities of 0.34 and 0.44 territories/ha; in another suburb, where most nests in hollows, recorded at 2.30 territories/ha (Lenz 1990a). One colony at Belmont, NI, comprised c. 60 pairs (Flux 2003). **Territories** At Belmont, NI, defended area within c. 1–2 m of nest-site for most of year. Visited nest-site nearly every day throughout year except in Jan. and Feb., usually at dawn and in evening (Flux & Flux 1981).

Roosting Usually roost communally at night; roosts vary in size from just a few birds to many thousands (see below). When incubating, female roosts in nest at night (Flux & Flux 1981); very occasionally, male roosts beside incubating female (J.E.C. Flux), but generally not known where male roosts at that time, possibly at communal roost (Secker 1948). **SIZE OF ROOSTS:** In AUST., size of roosts varies much; often very large in rural areas, varying from c. 100 birds, up to 50,000 or more (Bryant 1919; Le Souëf 1922; Thomas 1957; Guthrie 1964; McGarvie & Templeton 1974; Gochfeld 1978; Mooney 1981, 1989; Templeton 1992), though some much smaller, e.g. <12 roosting in tree in garden (Thomas 1957), c. 12 seen roosting on cliffs (Vic. Bird Rep. 1987), and 60 seen resting on cliffs (Schultz & Kristensen 1994). In Wollongong, NSW, trees used for roosting usually held up to 30 birds, with maximum 85 recorded in one tree; some held only two to four roosting birds (Wood 1995a). In NZ, often congregate in large roosts in rural areas or on offshore islands, varying from several hundred up to 74,000 (Wilkinson 1927; Moncrieff 1929; Cunningham & Wodzicki 1948; Skegg 1963; Hudson 1966; Adams 1971; Brockie 1983; CSN), though sometimes in flocks of c. 6 birds (Crockett 1954), or up to 100 birds (Thoresen 1967). One roost in Auckland usually held c. 200 during winter (Councilman 1974a). One very large roost on Motuotau I. (Rabbit I.) held hundreds of thousands (CSN 28). **OUTLYING**

ISLANDS: On Chatham Is, up to c. 10,000 roost on South East I. (Nilsson *et al.* 1994; CSN 28, 38); on Norfolk I., one roosting flock of $\geq 50,000$ birds seen (Hermes *et al.* 1986); and on Macquarie I., 1378 birds counted at one roost (Merilees 1971). SITES: In AUST., roost in wide variety of sites. Most often in trees and shrubs (e.g. Le Souëf 1922; Bryant 1930; Gochfeld 1978), including palms *Phoenix* (Gochfeld 1978; Wood 1995a), boxthorn (Wheeler 1960), oaks *Quercus* (Sharland & Crane 1922), eucalypts (Templeton 1992), and various pines, including Norfolk Island Pine (Guthrie 1964; Wood 1995a); sometimes roost in mangroves (Jenkins 1929; Hindwood 1935), Blackberry brambles (Bryant 1919), on cliffs (Schultz & Kristensen 1994; Vic. Bird Rep. 1987), and in reed beds (Bryant 1930; Thomas 1957; Ross & Olsen 1988). Once, on King I., roosted among boulders (McGarvie & Templeton 1974). Near Mildura, Vic., all known roost-sites in district were in reed beds, usually remote from densely populated areas; preferred at least partly green reeds, and roosted ≥ 30 cm below top of reeds, though thought not to descend to water-level; none was observed perching < 30 cm above water (Thomas 1957). Also recorded roosting beneath bridges (Kloot & McCulloch 1980; Mooney 1981, 1989), and in roofs of buildings (Schulz 1991). Often fly several kilometres from foraging areas to roost-sites (Thomas 1957). Use of roost-site sometimes discouraged by presence of raptor, e.g. Swamp Harrier *Circus approximans* (Thomas 1957). Sometimes roost with other species, e.g. in Wollongong, NSW, shared roosts with many Common Mynas and a few House Sparrows (Wood 1995a, b). In NZ, often roost in large trees (Moncrieff 1929; Thoresen 1967; CSN 1, 21, 23), often in forests (Skegg 1963; Nillson *et al.* 1994), including pine plantations (CSN 5), or in clumps of trees (Wilkinson 1927); often roost in lone trees including pines, Pohutukawa *Metrosideros excelsa*, ash, ornamental elm, and large eucalypts (Brockie 1983); or in prickly shrubs, such as gorse (CSN 1). Sometimes roost on cliffs (Crockett 1954; CSN 34); on Meyer I., Kermadec Grp, roosted on leeward side of summit ridges (Merton & Veitch 1986). Often fly from mainland to roost on offshore islands (Moncrieff 1929; Kirk & Wodzicki 1943; Crockett 1954; Skegg 1963; Blackburn 1970; Adams 1971; Flux & Flux 1981; Brockie 1983; CSN 8, 20); one such flight > 3 km across water (Wilkinson 1927). Some islands thought to be used because they are free of rats (Brockie 1983). Some roosts used for many years (Brockie 1983; CSN 35), whereas others used only temporarily (Brockie 1983; CSN 1). Sometimes roost with other species, e.g. in Auckland, one roost of c. 200 usually also held > 200 Common Mynas and c. 300 House Sparrows (Councilman 1974a). PATTERNS OF USE: Throughout HANZAB region, some communal roosts used throughout year, but with numbers peaking in autumn and winter (Secker 1948; Thomas 1957; Merton & Veitch 1986; CSN 8, 35), and others used only in autumn and winter (Moncrieff 1929; Gibson 1977; Flux & Flux 1981). During breeding season, not known whether those using communal roosts are males or young from previous season (Secker 1948). Usually settle to roost at about sunset (Moncrieff 1929; Hudson 1966; Brockie 1983), but sometimes arrive at roost-site up to 80 min before sunset (Mooney 1981; Wood 1995b; CSN 33, 36), or as late as 10 min after sunset (Wood 1995b). At Wollongong, NSW, numbers gradually increased in area round roost-site till c. 25 min before sunset, then birds began entering roost-trees at constant rate for next 25–30 minutes (Wood 1995b). Birds start to fly towards roost-site at various times, determined by both distance from roost and weather, e.g. in Wellington sometimes start flying to roost-site at about sunset (Secker 1954), sometimes > 30 min before sunset, and, on overcast days, sometimes up to 2.5 h before sunset (Brockie 1983). On Simmonds I., NI, in Dec., started arriving from mainland c. 2–2.5 h before sunset (Wagener 1966). On Kermadec Is, all birds arrived at one

roost-site within c. 15 min, with last arrivals c. 10 min before sunset (Merton & Veitch 1986). On Chatham Is, flocks began flying to roost-site c. 45 min before sunset, and movement to roost-site lasted 30 min (Nilsson *et al.* 1994). Departure from roost in morning usually between first light and sunrise (Bryant 1930; Thomas 1957; Wagener 1966; Wood 1994) and leave roosts more quickly than they assemble (Councilman 1974a). At one roost-site in swamp near Mildura, Vic., departure took only a few minutes, and roost was deserted by sunrise, though times of departure and arrival changed with water levels in swamp (Thomas 1957). Near Wellington, birds spent longer at roosts in winter: spent c. 16 h at roost in June but only c. 9 h in Dec. (Brockie 1983). APPROACH TO ROOST-SITES: Often approach roost from several different directions (Le Souëf 1922; Thomas 1957; Mooney 1981; Merton & Veitch 1986), often along well-defined flight-paths (Thomas 1957; Brockie 1983; Merton & Veitch 1986) which tend to follow coastline or low-lying areas such as valleys, avoiding hills (Kirk & Wodzicki 1943; Secker 1946; Brockie 1983), and once seen following railway line (CSN 5). Approach roost-site in flocks of varying size, often in flocks of 3–50 birds (e.g. Le Souëf 1922; Skegg 1963; Wagener 1966; Blackburn 1970; Merton & Veitch 1986), but flocks approaching large roosts sometimes form long, narrow skeins that extend for several kilometres and may contain several thousand birds (Wilkinson 1927; Jenkins 1929; Kirk & Wodzicki 1943; Thomas 1957; Brockie 1983; CSN 5). When travelling long distance to roost-site, often land temporarily at RESTING POINTS along flight path, and seldom stop at places other than regularly used Resting Points (Thomas 1957). Round Mildura, Vic., Resting Points were usually dead trees with good view of surroundings, but also included overhead wires and roofs; flocks often converged in air, or joined others at Resting Points (Thomas 1957). Several flight-paths often converge at ASSEMBLY POINTS, usually near roost-site, where birds gather before proceeding to roost-site (Moncrieff 1929; Thomas 1957; Brockie 1983). Round Mildura, Vic., main Assembly Points were usually trees, usually within 400 m from roost-site; dead trees at edge of swamp where birds roosted were especially favoured, and most assembled in these trees shortly before sunset (Thomas 1957). In Hobart, birds assembled for 5–10 min in several large trees before heading to roost beneath bridge in flocks of 100–150 birds (Mooney 1981). Resting Points possibly also act as Assembly Points (Thomas 1957). At Wollongong, NSW, flew directly from foraging sites to roost-sites without congregating elsewhere (Wood 1995b). DEPARTURE FROM ROOST-SITES: Usually leave roost in smaller flocks than those that approach roost, and departing flights more difficult to identify (Wagener 1966; Brockie 1983), as birds fly in all directions (Moncrieff 1929), but at one roost near Mildura, Vic., birds rose from roost more or less in unison (Thomas 1957). Often stop to forage during departure (Brockie 1983), but resting sites used haphazardly (Thomas 1957).

SOCIAL BEHAVIOUR Some aspects well known in HANZAB region. Very well known extraliminally (see Feare & Craig 1998; BWP). DETAILED STUDIES: At Belmont, near Wellington, NI, 1970–79, population of c. 400 pairs with most females and some males colour-banded (Flux 1978, 2003; Flux & Flux 1981, 1992). Round Mildura, Vic., July 1953–June 1954 (Thomas 1957). **Flock behaviour, including behaviour near roost** Large flocks often fly in tight formation (Thomas 1957), sometimes performing spectacular aerobatics, comprising synchronised wheeling and banking manoeuvres (Barrett 1916; Thomas 1957; Brockie 1983; CSN 19, 24). These often performed over roost-sites or when gathering to approach roost-site (Le Souëf 1922; Jenkins 1929; Hindwood 1935; Graham 1948; Thomas 1957; Wagener 1966; Brockie 1983).

When gathering at coast before flying to roost on island, flocks wheeled and banked directly above shoreline, gradually gaining height, waiting for others to join flock (Brockie 1983). In Wellington, flock sang at Assembly Point before heading to roost, with two crescendos of Song c. 10 min apart (Secker 1946). Near Mildura, Vic., when ready to settle, flock dived from Assembly Point into reed beds and settled rapidly; birds appeared to sleep clasping any convenient stalk (Thomas 1957). In Sydney, after reaching roost-site, birds moved from tree to tree, crowding closer together till finally all packed into a dozen trees (Guthrie 1964). At Wollongong, NSW, first birds to enter roost-trees perched for several minutes on uppermost palm fronds before moving closer to trunk. Most late arrivals flew directly from feeding grounds and entered trees; they alighted among bases of fronds where other birds were clustered (Wood 1995b). Often sing and chatter at roost, audible up to c. 800 m away (see Voice). Noise from roost decreases as darkness descends, but never completely quiet (Guthrie 1964). At one roost, combined calling of Starlings and Common Mynas was intense for c. 15 min before and after sunset (Wood 1995b). Near Mildura, Vic., when departing roost-site in morning, birds rose from roost more or less in unison, and dispersed with little noise and no preliminary flight display (Thomas 1957). Aerobatics used when evading predators (see Agonistic Behaviour). Once, in Sydney, large flock repeatedly surrounded two Black-faced Cuckoo-shrikes *Coracina novaehollandiae* in flight; when the Cuckoo-shrikes separated, both were followed by part of flock; Cuckoo-shrikes repeatedly evaded the Starlings, only to be overtaken and surrounded again. Neither species showed any sign of aggression (Sedgwick 1955). **Maintenance behaviour** Often recorded ANTING in HANZAB region by placing ants directly on plumage, usually beneath wings (e.g. Chisholm 1935; Fearnley 1956; Jones 1959; Lindsay 1960; Ordish 1980; CSN 8, 19). Usually pick up several ants in bill, raise wing without spreading it, and push bill under wing, pressing bill and wing hard against body and then withdrawing bill, to repeat operation on other wing (Jones 1959; Black 1960; CSN 19). Ants mainly rubbed on underside of primaries near edge of wing-linings (Wheeler 1951; Smith 1969). One observer did not see ants applied to any other part of body in several minutes' observation (Smith 1969), but others have seen ants applied to tail-feathers and breast (Ordish 1980; CSN 19). When anting, birds described as hurrying or dancing about excitedly, but silently (Lindsay 1960; Smith 1969; Ordish 1980); and move about with appearance of frantic haste, and sometimes appear to stumble and fall back on their tails (Smith 1969). Sometimes ruffle feathers and crouch before resuming search for more ants (Black 1960). Ants usually discarded after use (Wheeler 1951; Fearnley 1956), but once said to be eaten (Lindsay 1960). Anting once lasted ≥ 15 min (Wheeler 1951). Recorded anting with other species including House Sparrow and Common Myna (Wheeler 1951). Recorded BATHING in garden pond, puddle, at edge of lake or river, and in guttering of roof, splashing in shallow water (Vellenga 1965; Cockrem 1979; J.E.C. Flux; J.M. Peter). When bathing in lake, large flocks split into smaller groups before entering water; once in water, birds kept close together, all facing same direction, and chattered continuously. Sometimes, two or three flocks of c. 30 all bathed at once (Cockrem 1979). After bathing in pond, perched together in tree and preened, chattering and scolding. Sometimes bathed at same time as House Sparrows (Vellenga 1965). **Vocalizations** Male sings while slowly flapping wings (Pizzey 1980). On at least three occasions, one spent most of day in nest-box, singing to its reflection in mirror fixed to ceiling; continued to sing at dusk, when all other Starlings had ceased activity (CSN 1). **Strangers at nest** Calls of nestlings often attracted adults, especially young males, to nest; over 8 years at Belmont, NI, ≥ 30 banded first-year males

seen entering nest-boxes containing nestlings; they neither helped nor hindered in any way. At one nest with 9-day-old nestlings, within 1 h, four or five adults (as well as parents) entered nest-box singly, and each spent 2–3 min inside before flying away. Visitors did not feed nestlings, and parents showed little aggression towards them. Occasionally strange fledgelings tried to enter nest-boxes but were chased off by owners. Once, one strange fledgeling returned to nest-box after being vigorously chased by parents, and took up position inside entrance. However, the resident 19-day-old nestlings attacked juvenile from rear and bundled it out; same juvenile returned almost immediately, with same result (Flux 1978). **Aberrant behaviour** Once after laying egg on lawn, bird sat beside egg and went to sleep for 30 min; observer then stroked bird, with no response; it was then covered with box and inspected at 30-min intervals, and after c. 2 h, bird woke up and flew away (Lane 1983).

Agonistic behaviour Rather aggressive, both towards other species and conspecifics (Flux & Flux 1992; see below). Usually chase others that land near nest (Secker 1948; Flux 1978). **Fighting** Often fight over ownership of nest-sites (Hornby School 1946; Flux & Flux 1992; Bell 2004). During intense fights, two combatants grip each other with claws, often while facing each other head to tail and lying on substrate (Flux & Flux 1992; Bell 2004), and occasionally continue to fight, even when picked up by person (Hornby School 1946; Flux & Flux 1992). During one fight, one stood on the other's breast and pecked vigorously at its head (CSN 22). Once, at Wellington, NI, two Starlings, both thought to have been female, were locked in intense grappling fight for ≥ 45 min, during which they tumbled down a roof, fell c. 4 m onto a deck, where they kept fighting, and then fell c. 4 m to ground where fight continued. For most of fight, they gripped each other facing head to tail, one grasped foot of the other in its bill, and other's head in its foot. While fighting, both often flicked their wings. Mostly, the two lay on their sides, but occasionally one was in more upright posture, able to peck at other and flap its wings over it. Thought to have been fighting over nearby nest-site. During the first 25 min of fighting, another bird (probably male) sang continuously from perch above nest-site (Bell 2004). **LETHAL FIGHTS:** At Belmont, fights inside nest-boxes usually resulted in the death of one combatant, and occasionally both died. During such fights, combatants were silent and motionless except for occasional muscle contractions of the wings or feet. Some did not even disengage when picked up and carried to ground. Each bird attempted to grasp opponent's bill, often resulting in symmetrical head-to-tail position in which sharp claw of one was thought to enter brain through eye socket. Such fights were usually over preferred nest-boxes, and most were in boxes containing nests being built. Of 46 fights inside nest-boxes where sex known, 24 between males and 22 between females. Of those between females, 15 were between adults, three between an adult and an immature and four between immatures; the proportion of immatures in fights was higher than that in population. Of those between males, 21 were between adults, two between an adult and an immature, and one between immatures. Most fights inside nest-boxes occurred during breeding season (Sept.–Dec.), but also recorded in Apr., May and July (Flux & Flux 1992). **Interspecific interactions** Sometimes seen chasing or fighting with other species; in Aust., these include Australian Ringneck *Barnardius zonarius*, Orange-bellied Parrot *Neophema chrysogaster*, Black-faced Cuckoo-shrike and House Sparrow (Mellor 1927a; Favaloro 1942; Thomas 1957; Loyn 1986); and in NZ, Bellbird *Anthornis melanura* and Common Myna (Wilkinson 1927; Booth 1963). These fights often at or near hollows used for nesting, and sometimes succeed in usurping hollows or nest-boxes from other species (see Breeding). **Alarm** Near Mildura, Vic., foraging

flocks constantly vigilant and flush at slightest disturbance (Thomas 1957), and on Macquarie I., fled with noisy Alarm Calls when anyone approached feeding areas (Stirling & Johns 1969). On subantarctic islands, described as shy, wary and unapproachable (Warham 1967; Stirling & Johns 1969; Miskelly *et al.* 2001). However, one in n. Qld flew only short distance when flushed and resumed foraging (Smith 1970). One uttered Distress Call just before Peregrine Falcon *Falco peregrinus* captured and killed it (Bedgood 1959). When flock approaches foraging area, suggested that it possibly uses 'scouts' that precede main flock; at any sign of danger these said to warn others by veering away sharply; also said to watch behaviour of corvids *Corvus* as warning of danger (Thomas 1957). At one roost-site, flock twice flushed by gunfire, but further shots had no effect (Thomas 1957). Once, nest-box containing eggs was rotated 90° in horizontal plane, and when female returned, she initially perched motionless at entrance, repeatedly looking in and out of nest-entrance, then uttered *jit jit* call for 4 min; finally, she flew to another perch to look at nest from a distance, before returning and entering nest. Subsequently, she left nest at slightest disturbance (Hornby School 1946). **EVADING PREDATORS:** When pursued by Australian Hobby *Falco longipennis*, one dived and zigzagged through trees and then crashed into shrub (Schrader 1974), and similarly, another escaped from Hobby by flying into bushy tree (Cameron 1933). Another was able to escape from pursuing Australian Magpie by suddenly flying very high (Quinn 1961). When startled by Brown Falcon *Falco berigora*, one flock took off, uttering harsh cries, and then rapidly flew into dense shrubs (Bedgood 1959). After one taken by Peregrine Falcon, rest of flock took off silently and flew in opposite direction (Bedgood 1959). At one roost-site in Hobart, Starlings formed spectacular spiralling flocks if raptors present; of 76 attempts by raptors to catch Starlings in such spiralling flocks, only eight were successful, and all were of birds that had left flock (Mooney 1981). At roost-site at Sutton, NSW, large flock wheeled and turned as one in presence of Black Falcon *Falco subniger*; when Falcon attempted to isolate one from flock, flock simply parted, allowed Falcon to pass through their midst, and then re-formed almost immediately; at least eight unsuccessful attempts observed in 40 min. On following evening, Starlings behaved in identical fashion, though no Falcons present (Ross & Olsen 1988). **MOBBING:** Flocks of Starlings recorded mobbing several species, including Whistling Kite *Haliastur sphenurus*, goshawk *Accipiter*, Swamp Harrier, New Zealand Falcon *Falco novaeseelandiae* and Little Owl (Mellor 1920a, 1922a, 1924; Hornby School 1946; Watson 1955; CSN 21, 23, 41, 48). While chasing and harassing raptors, flock moves in perfect formation, flying in unison (Mellor 1924; CSN 23). Once, four joined group of five Australian Magpies in harassing two Swamp Harriers (CSN 41).

Sexual behaviour Little information from HANZAB region. Males often start building nest while apparently unpaired, and suggested that unpaired males place decorations on nest to attract female (Thomas 1957; see also Breeding). Some chases described as sexual (Secker 1948), but not described further. Before copulation, female crouches slightly, and droops and quivers wings, repeated several times over 2–3 min. Copulation takes place silently and while perched, e.g. on power-lines or in trees. Male often appears to lose interest before female, and flies away (Thomas 1957). Extraliminally, male sings much during nest-building period and, when female approaches nest, male increases intensity of song and also performs Wing-Wave display while singing; Copulation Call occasionally uttered during copulation (see BWP for details).

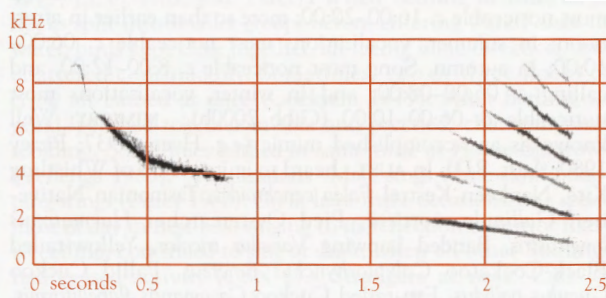
Relations within family group Extraliminally, nestlings first utter weak begging calls on day after hatching, and beg strongly by 4 days old (BWP). **Anti-predator responses of**

young No information from HANZAB region. Extraliminally, for first few days after hatching, nestlings beg when disturbed; after eyes open, nestlings remain quiet when disturbed; at c. 12 days old, nestlings attempt to escape when handled; from c. 15 days, sometimes fledge prematurely if disturbed (BWP). **Parental anti-predator strategies** Once, when Little Owl raided nest and took nestlings, parents squawked noisily and swooped at Owl, which ignored them (Anderson 1949); elsewhere, parents repeatedly chased Little Owl away from nest with nestlings, and sometimes perched beside of Owl (sometimes within c. 0.5 m), calling loudly (Hornby School 1946). Once, when Common Mynas pulled nestlings from nest, parents made great fuss but did not attack Mynas (Stoddart 1956).

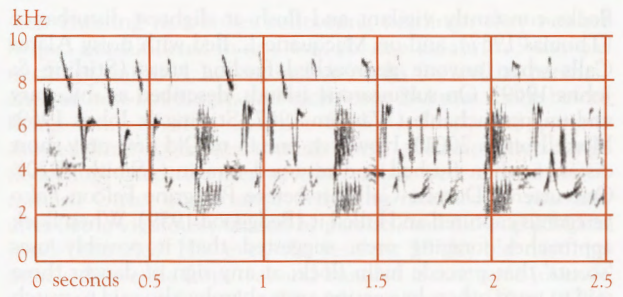
VOICE Not well known in HANZAB region; well known extraliminally (see Feare & Craig 1998; BWP). Within HANZAB region, detailed studies include one that monitored synchronism of breathing with Song (Shiels 1986), and studies of Song and mimicry near Armidale, ne. NSW, Canberra, and Auckland (Adret-Hausberger 1988, 1989; Adret-Hausberger & Jenkins 1988; Hausberger *et al.* 1991). Most song uttered by males, but extraliminally, females occasionally sing in autumn and winter; both sexes give various calls (Pizzey 1980; Feare & Craig 1998; BWP). Extraliminally, 11 different calls reported in addition to song (BWP). Noisy at and near roost-site; when assembling near roost-site, on still evening, noisy chatter sometimes audible over c. 800 m (Thomas 1957; Guthrie 1964; Wood 1995b), and when heard in distance, said to sound like heavy rain (Bryant 1930). However, in roost shared with Common Mynas at Wollongong, NSW, calls of Starlings almost inaudible over din from Mynas (Wood 1995b). Often sing from perch near nest (e.g. Bell 2004). **ANNUAL AND DIURNAL PATTERNS:** Sing and call throughout year; mostly given in morning and late in afternoon or evening (Gibb 2000b). Usually start calling well before sunrise (Wood 1994). At Netherby, SA, from late July to early Sept., first heard calling 30–56 min before sunrise, except on one rainy morning when did not call till 21 min after sunrise (Sutton 1919). At Rototua, NI, in Oct., started singing 15 minutes before sunrise (Taylor 1975). In evening, often sing and call at roost-site or in trees nearby (e.g. Secker 1946; Wood 1995b; CSN 4); sounds from roost decrease as darkness descends, but never completely quiet (Guthrie 1964), and sometimes calling heard at various degrees of intensity throughout night (e.g. CSN 20). At Wollongong, NSW, heard calling for c. 15 min before and after sunset (Wood 1995b). In Wellington, Song increased in volume as birds gathered to roost; once, volume increased from c. 70 min before sunset (Secker 1948); on another occasion, Song heard at 32 min and 42 min before sunset and, once, within a few min of sunset (Secker 1946). Sometimes continue to sing till sunset or later, with volume declining rapidly at dusk, and sometimes stop singing c. 20 min before sunset (Secker 1946, 1948, 1954). A study of conspicuousness of birds in Wellington revealed that in spring, vocalizations of Starlings most noticeable c. 16:00–20:00; more so than earlier in afternoon; in summer, vocalizations most noticeable c. 06:00–10:00; in autumn, Song most noticeable c. 8:00–12:00, and calling c. 06:00–08:00; and in winter, vocalizations most noticeable c. 06:00–10:00 (Gibb 2000b). **MIMICRY:** Well known as an accomplished mimic (e.g. Hyem 1937; Pizzey 1980; Aust. RD). In AUST., heard to imitate calls of Whistling Kite, Nankeen Kestrel *Falco cenchroides*, Tasmanian Native-hen *Gallinula mortierii*, Pied Oystercatcher *Haematopus longirostris*, Banded Lapwing *Vanellus tricolor*, Yellow-tailed Black-Cockatoo *Calyptorhynchus funereus*, Pallid Cuckoo *Cuculus pallidus*, Fan-tailed Cuckoo *Cacomantis flabelliformis*, Horsfield's Bronze-Cuckoo *Chrysococcyx basalis*, Southern

Boobook *Ninox novaeseelandiae*, Sacred Kingfisher *Todiramphus sanctus*, Superb Fairy-wren *Malurus cyaneus*, Brown Thornbill *Acanthiza pusilla*, Yellow-rumped Thornbill *A. chrysorrhoa*, Noisy Miner *Manorina melanocephala*, White-plumed Honeyeater *Lichenostomus penicillatus*, Scarlet Robin *Petroica multicolor*, Dusky Robin *Melanodryas vittata*, Crested Shrike-tit *Falcunculus frontatus*, Grey Shrike-thrush *Colluricincla harmonica*, Magpie-lark, Willie Wagtail, Black-faced Cuckoo-shrike, Grey Butcherbird *Cracticus torquatus*, Australian Magpie, Singing Bushlark *Mirafra javanica*, Silvereye *Zosterops lateralis* and Common Blackbird (Rodda 1920; Sutton 1925, 1927; Chisholm 1932, 1937, 1949; Hyem 1937; Condon 1957; Skemp 1957; Howard & Crawford 1989). Also heard to make sound like cackling hen (Skemp 1957). In NZ, heard to imitate calls of Yellow-eyed Penguin *Megadyptes antipodes*, Black Swan *Cygnus atratus*, Paradise Shelduck *Tadorna variegata*, Brown Quail *Coturnix ypsilophora*, California Quail *Callipepla californica*, Purple Swamphen *Porphyrio porphyrio*, oystercatcher *Haematopus*, Black-winged Stilt, Kelp Gull *Larus dominicanus*, Silver Gull, fledgeling roseella *Platycercus*, parakeet *Cyanoramphus*, Shining Bronze-Cuckoo *Chrysococcyx lucidus*, Southern Boobook, Little Owl, Sacred Kingfisher, Grey Warbler *Gerygone igata*, Tui *Prosthemadera novaeseelandiae*, Grey Fantail *Rhipidura fuliginosa*, Australian Magpie, House Sparrow, Common Chaffinch *Fringilla coelebs*, European Goldfinch *Carduelis carduelis*, Yellowhammer, Silvereye, Common Blackbird, Song Thrush *Turdus philomelos*, and Common Myna (Ick-Hewins 1920; Edgar *et al.* 1965; Hausberger *et al.* 1991; CSN). Also heard to mimic domestic goose and domestic hen, a cicada, croak of a frog, neigh of a horse, whistling of people, and blows of a hammer (Hausberger *et al.* 1991). **NON-VOCAL SOUNDS:** When large flock flushed, noise from wings makes loud swooshing sound, like gust of strong wind (Thomas 1957; Hudson 1966), audible over c. 400 m (CSN 4). In presence of raptor, wings of flock said to make a peculiar whistling noise (Quinn 1959).

Adult SONG: Complex sequence of notes that can include wheezes, clicks, small thin rattles, chattering, piping notes, and characteristic descending whistle, sometimes interspersed with mimicry (Bryant 1928; Skemp 1957; Guthrie 1964; Pizzey 1980; Morcombe 2000). Some notes barely audible (Pizzey 1980), and some thought to be too short in wavelength for the human ear to hear (Guthrie 1964). Sonagrams **A** and **B** show small sections of Song that includes characteristic descending whistles; within each of these sonagrams, all vocalizations shown may not be uttered by same individual. Can include phrases rendered as *chwee*, high *tizz-tzz*, harsh, rasping *tch-cheer*, and clear whistled *fee-oooo* (Morcombe 2000; Aust. RD). One once sang continuously for c. 25 min (Bell 2004). **ALARM CALLS:** Utter scolding, harsh, descending *tcheer*, possibly same as that sometimes uttered as part of Song; or sharp *dick!* uttered singly or staccato (Pizzey 1980). One showing much agitation uttered *jit jit* while perched at entrance to nest (Hornby School 1946). Once, when startled by Brown Falcon, flock uttered harsh cries (Bedggood 1959).



A R.Buckingham; Bendigo, Vic., Sept. 1986; P94



B R.Buckingham; Bendigo, Vic., Sept. 1986; P94

Squawks and loud calls heard when Little Owl near nest (Hornby School 1946; Anderson 1949), possibly these calls. **DISTRESS CALL:** Shrieking cry; once uttered by one just before Peregrine Falcon captured and killed it (Bedggood 1959). **Other calls** Utter hoarse calls (Edgar *et al.* 1965). While approaching roost-site, one that seemed unsettled uttered *tchirck tchirck* (Secker 1946), and another made grating noise (Secker 1948). While bathing, chatter continuously (Cockrem 1979); after bathing, several often chatter and scold while perching and preening (Vellenga 1965). Other vocalizations described extraliminally but not reported in HANZAB region include Flock Call, Threat Call, Attack Call, Chip Call, Snarl Call and Copulation Call (see BWP for details).

Young Nestlings sometimes call (e.g. Warham 1969; Flux 1978), described as cheeping (CSN 5). Immatures insistently utter harsh descending *tcheer* when alarmed (Pizzey 1980). Young said to utter hoarse calls (Edgar *et al.* 1965).

BREEDING Well known, both in HANZAB region and extraliminally. **DETAILED STUDIES:** Round Mildura, nw. Vic., over two breeding seasons (Thomas 1957); Belmont, NI 1970–79 (Flux 1978, 1987; Flux & Flux 1981, 1992); Hawkes Bay, NI (Purchas 1981); Bundoora, Vic. (Ambrose 1982); and various smaller, less detailed studies (e.g. Hornby School 1946; Secker 1948). Total of 1070 records in NRS to Dec. 2003. Usually breed in pairs, sometimes polygynous; and sometimes in colonies (BWP; NRS).

Season Some local populations show remarkable synchrony of laying dates (J.E.C. Flux). **Aust.** Eggs, late July to late Dec.; of 447 clutches in NRS, most (86.6%) late Sept. to late Nov.: two (0.4%) in July, eight (1.8%) in Aug., 71 (15.9%) in Sept., 192 (43.0%) in Oct., 153 (34.2%) in Nov., and 21 (4.7%) in Dec. (NRS). **QLD:** No records of eggs in NRS. Nestlings, Sept. and Oct. (NRS [n=2 broods]). Unspecified breeding, including fledgelings, Aug.–Feb. and Apr. (Aust. Atlas 1, 2; NRS); of 76 records in Aust. Atlas 1, 2, most (92.1%) Sept.–Dec.: three (3.9%) in Aug., eight (10.5%) in Sept., 29 (38.2%) in Oct., 22 (28.9%) in Nov., 11 (14.5%) in Dec., none in Jan., two (2.6%) in Feb., none in Mar., and one (1.3%) in Apr. **NSW–ACT:** Eggs, late Aug. to early Dec. (Morris *et al.* 1981; Lenz 1990a; ACT Atlas; NRS); of 92 clutches in NRS, most (90.2%) mid-Sept. to mid-Nov.: two (2.2%) in Aug., 14 (15.2%) in Sept., 47 (51.1%) in Oct., 27 (29.3%) in Nov., and two (2.2%) in Dec. (NRS). Nestlings, late Aug. to late Jan. (ACT Atlas; NRS); of 217 broods in NRS, most (82.0%) early Oct. to early Dec. (NRS). Unspecified breeding, including fledgelings, all months except June (Baldwin 1975; Anon. 1976; Lenz 1980; Costello 1981; Gosper 1981; Taylor *et al.* 1986; Taylor 1987a; Aust. Atlas 1, 2; ACT Atlas; NRS); of 767 records in Aust. Atlas 1, 2, most (88.4%) Sept.–Dec.: five (0.7%) in July, 31 (4.0%) in Aug., 100 (13.0%) in Sept., 229 (29.9%) in Oct., 216 (28.2%) in Nov., 133 (17.3%) in Dec., 36 (4.7%) in Jan., 11 (1.4%) in Feb., two (0.3%) in Mar., two (0.3%) in Apr. and two (0.3%) in May. **VIC.:** Eggs, second half of July to late Dec. (Thomas

1957; Ambrose 1982; NRS); of 194 clutches in NRS, most (91.8%) late Sept. to late Nov.: 20 (10.3%) in Sept., 79 (40.7%) in Oct., 80 (41.2%) in Nov., and 15 (7.7%) in Dec. (NRS). At Bundoora, Vic., most first clutches laid Oct. and Nov.; and second clutches late Nov. and Dec. (Ambrose 1982). Nestlings, mid-Sept. to early Jan. (Tarr 1950; Thomas 1957; Ambrose 1982; NRS [n=339 broods]); of 339 records in NRS, most (80.5%) mid-Oct. to early Dec. Unspecified breeding, including fledgelings, all months (Bedggood 1970, 1972; Aust. Atlas 1, 2; NRS); inspection of hollows can start in May, but usually in June (Thomas 1957; Ambrose 1982). Of 809 records in Aust. Atlas 1, 2, most (91.3%) Sept.–Dec.: five (0.6%) in July, 16 (2.0%) in Aug., 93 (11.5%) in Sept., 262 (32.4%) in Oct., 243 (30.0%) in Nov., 141 (17.4%) in Dec., 38 (4.7%) in Jan., three (0.4%) in Feb., two (0.3%) in Mar., four (0.5%) in Apr., one (0.1%) in May, and one (0.1%) in June. TAS.: Eggs, early Oct. to early Dec. (Green 1965; NRS); of 30 clutches in NRS: 16 (53.3%) in Oct., 11 (36.7%) in Nov. and three (10.0%) in Dec. (NRS). Nestlings, early Oct. to mid-Dec. (Green & MacDonald 1963; Thomas 1965; NRS [n=37 broods]). Unspecified breeding, including fledgelings, June–Apr. (Green 1965; Aust. Atlas 1, 2; Tas. Bird Reps 3, 12; NRS); of 276 records in Aust. Atlas 1, 2, most (88.0%) Oct.–Dec.: two (0.7%) in July, four (1.4%) in Aug., 17 (6.2%) in Sept., 74 (26.8%) in Oct., 108 (39.1%) in Nov., 61 (22.1%) in Dec., six (2.2%) in Jan., one (0.4%) in Feb., one (0.4%) in Mar., one (0.4%) in Apr., none in May, and one (0.4%) in June. SA: Eggs, late July to early Dec. (SA Bird Rep. 1977–81; NRS); of 131 clutches in NRS, most (80.2%) late Sept. to early Nov.: two (1.5%) in July, six (4.6%) in Aug., 37 (28.2%) in Sept., 50 (38.2%) in Oct., 35 (26.7%) in Nov., and one (0.8%) in Dec. (NRS). Nestlings, early Aug. to mid-Dec. (Hindwood 1961; NRS); of 175 broods in NRS, most (74.3%) late Aug. to mid-Nov. (NRS). Unspecified breeding, including fledgelings, all months (Mellor 1926; Whatmough 1978; Paton & Pedler 1999; Read *et al.* 2000; Aust. Atlas 1, 2; SA Bird Rep. 1977–81; NRS); of 491 records in Aust. Atlas 1, 2, most (89.8%) Sept.–Dec.: five (1.0%) in July, 22 (4.5%) in Aug., 76 (15.5%) in Sept., 184 (37.5%) in Oct., 118 (24.0%) in Nov., 63 (12.8%) in Dec., eight (1.6%) in Jan., three (0.6%) in Feb., three (0.6%) in Mar., two (0.4%) in Apr., three (0.6%) in May, and four (0.8%) in June. WA: Unspecified breeding recorded in spring (Storr 27). NZ Eggs, Sept.–Dec.; brood of nestlings mid-July suggests laying early July or late June (Cunningham 1941–42; Burrows 1968; Heather & Robertson 2000; CSN 6; see below). Laying of first clutches highly synchronized, with most eggs laid within 7 days of mean date of laying (Flux & Flux 1981); in most parts of NZ, first eggs laid in second or third week of Oct.; late nesters (usually first breeders) or replacement clutches in early Nov.; second clutches in late Nov. and early Dec. (Heather & Robertson 2000). NT: Eggs, early Oct. to early Dec. (Wagener 1966; Flux & Flux 1981, 1992; Purchas 1981; CSN 2); at Belmont, NT, first clutches laid from mid-Oct., and second clutches from early Dec. (Flux 1978). Nestlings, mid-July, and mid-Nov. to mid-Jan. (Deeming 1946; Cunningham & Wodzicki 1948; Wright 1962; Wagener 1966; Moeed 1975; Flux 1978; Flux & Flux 1992; CSN 2, 6, 21). Unspecified breeding, including fledgelings, Oct., Nov. and Feb. (Cunningham & Wodzicki 1948; Secker 1948; Skegg 1963; Cunningham & Moors 1985; Flux & Thompson 1985; CSN 9). At Belmont, long-term trend for date of first clutches to be later each year: c. 12 Oct. in 1970, and 25 Oct. in 1986 (Flux 1987), but laying dates subsequently stabilized, at c. 20 Oct. (J.E.C. Flux). ST: Eggs, Oct. and Nov. (Hornby School 1946; CSN 1, 34, 36). Nestlings, late Oct., Nov. (Hornby School 1946; CSN 1, 34, 36). Unspecified breeding, including fledgelings, Oct.–Dec. and Feb. (Richdale 1942; CSN 1, 2, 34, 37). **Outlying islands** LORD HOWE I.: Entering hollows Nov.

(McKean & Hindwood 1965). NORFOLK I.: Breeding Aug.–Nov. (Hermes *et al.* 1986). MACQUARIE I.: Nestlings, Nov. (Warham 1969). CHATHAM IS: Eggs, mid-Nov.; unspecified breeding, Oct.–Dec. (Nilsson *et al.* 1994). KERMADEC IS: Unspecified breeding Oct.–Dec. (Sorensen 1964; Merton & Veitch 1986).

Site Breed in almost any site that provides protection from weather. Natural sites: Often nest in hollows in trees, especially in eucalypts, but also in others such as in mangroves, Coast Banksia, palm trees, Pohutukawa *Metrosideros excelsa*, *Xanthorrhoea* and, on Norfolk I., Norfolk Island Pines and Norfolk Island Hibiscus *Lagunaria patersonia*, and on Chatham Is, in Chatham Island Akeake *Olearia traversii*; and in hollow stumps or logs (e.g. Clee 1920; Chisholm 1926; Leach 1928; Jenkins 1929; Kuss 1933; Sharland 1947; Skemp 1952; Thomas 1957; Edgar *et al.* 1965; Thomas 1965; Wakelin 1968; Napier 1969; Fleming 1976; Costello 1981; Ambrose 1982; Hermes *et al.* 1986; Merton & Veitch 1986; Ashton 1987; Bush 1989; Emison 1992; Nilsson *et al.* 1994; Flux 2003); occasionally in centre of tree-fern or in epiphytic plants on trees (Chaffer 1945; Cooper 1974; St Paul 1977; Gosper 1981; Flux 2003; NRS). Often occupy hollows formerly used by other species, including Chestnut Teal *Anas castanea*, Superb Parrot *Polytelis swainsonii*, Eastern Rosella, Australian Ringneck, Blue Bonnet *Northiella haematogaster*, Red-rumped Parrot, Blue-winged Parrot *Neophema chrysostoma*, Australian Owllet *Nightjar Aegotheles cristatus*, Brown Treecreeper *Climacteris picumnus*, woodswallows *Artamus* and House Sparrow (White 1922; Kinghorn 1924; Giblin & Swindells 1927; Oliver 1934; Hood 1935; Sharland & Hindwood 1941; Rix 1943; Anon. 1974; Rix 1976; Emison 1992; Tzaros 1993; NRS). Also nest in holes and crevices in banks, road cuttings and cliffs, especially near coasts or on offshore islands (e.g. Richdale 1942; Cooper 1947; Hodgkins 1949; Wightman 1956; Green & MacDonald 1963; Sorensen 1964; Challies 1966; Wagener 1966; Thoresen 1967; Smithers & Disney 1969; Warham 1969; Beruldsen 1972; Cooper 1974; Hermes *et al.* 1986; Merton & Veitch 1986; Flux 2003; CSN 1, 2, 19; NRS). One pair nested in tunnel formerly occupied by Sacred Kingfisher (CSN 19); and at Haast, SI, colony once recorded nesting in occupied rabbit burrows (Moreland 1911). Also often nest in artificial sites, including under roofs or in holes in walls of buildings (e.g. Chisholm 1926; Jenkins 1929; Bryant 1936; Thomas 1957; Green 1965; Wheeler 1966; Napier 1969; Lenz 1980; Hermes *et al.* 1986; Flux 2003; CSN 21; NRS); nest-boxes and other hollow-forming features, such as fence-posts, pipes, electrical switch-boxes, air-conditioners, metal drums and machinery (e.g. Sutton 1928a; Cunningham 1941–42; Watson 1955; Thomas 1957; Green 1965; Cooper 1975; Purchas 1981; Norman 1982; Merton & Veitch 1986; Tzaros 1993; Flux 2003; CSN 8; NRS). Very occasionally nest on ground, including under vegetation and in pile of rocks (Sutton 1930; Bedggood 1959; Green 1965; Wagener 1966; Heather & Robertson 2000; NRS). Of 1000 nest-sites in NRS: 51.0% were in hollows in living or dead trees, mainly eucalypts, and occasionally in *Angophora*, banksias, casuarinas or introduced species; 13.6% in cavities in buildings; 12.8% in nest-boxes; 9.9% in hollow fence-posts; 3.8% in stacked fruit cases; and 2.5% in stumps, with remainder in various other hollow-forming sites (NRS). Once seen entering hole in arboreal termitarium, probably excavated by Sacred Kingfishers (Hindwood 1959). Very occasionally breed in old nests of Osprey *Pandion haliaetus*, White-browed Babbler *Pomatostomus superciliosus* and Magpie-lark (Tarr 1950; NRS). Unusual nest-sites include: in loose fold of rolled-up awning (Thomas 1957); in pocket of coat hanging in shed (CSN 24); on tractors which moved about farms (Hodgkin 1949; CSN 28); and in wool of live sheep (Anon. 1911; Hindwood 1961). Nest communally, or in colonies, where nests may be 1 m

apart (Thomas 1957; NRS). Recorded nesting in same tree as Osprey, Black-shouldered Kite *Elanus axillaris*, Nankeen Kestrel, Galah, Little Corella *Cacatua sanguinea*, Scaly-breasted Lorikeet *Trichoglossus chlorolepidotus*, Red-rumped Parrot, Southern Boobook, Australian Owlet Nightjar, Zebra Finch *Taeniopygia guttata*, House Sparrow, Tree Martin *Hirundo nigricans* or Common Myna (Bryant 1941; Hobbs 1979; Gates 1996; NRS). At Taiaroa Head, SI, recorded breeding on ledges of cliffs among nests in mixed colony of Spotted Shags *Phalacrocorax punctatus* and Stewart Island Shags *P. chalconotus* (J.M. Peter). Also nest in buildings with Common Myna (Fleming 1976) or Willie Wagtail (NRS); and one pair nested in six-compartment nest-box, beside nest of House Sparrow (Burrows 1968). **SELECTION OF SITE:** Near Mildura, Vic., only males investigated hollows (Thomas 1957). Inspect many hollows before breeding, and continue to perch on and examine unused hollows throughout breeding season; newly fledged young often inspect and enter hollows early in summer (Ambrose 1982). Within 30 min of contractors finishing transporting a prefabricated building, Starlings were seen carrying material under its roof (CSN 19). Sometimes copy other Starlings in choice of sites, e.g. at Belmont, NI, four pairs nested behind softboard wall lining in deserted house in 1970; in 1971, 15 pairs nested in building (Flux 2003). **CHOICE OF NEST-BOXES:** At Bundoora, Vic., preferred deep nest-boxes rather than shallow ones; and preferred boxes containing remains of old nests rather than ones cleared of nest remains, with 82% (no N) of sites used contained remains of a previous nest; c. 69% (no N) preferred nest-boxes with entrance-hole 6 cm diameter, c. 12% with 9-cm entrance-hole, and c. 19% with 12-cm entrances (Ambrose 1982). At Belmont, NI, of 280 nest-boxes with entrance-hole to one side, occupancy rate was 92% (88–96%), whereas 220 nest-boxes with a central entrance-hole had 65% (57–72%) occupancy rate (Flux & Flux 1981). In Hawkes Bay, NI, most young fledged from nest-boxes with basal area 310cm², and significantly fewer from boxes ≥ 520 cm² or those of 180 cm² (Moeed & Dawson 1979). **COMPETITION WITH OTHER SPECIES:** Actively usurp occupied hollows of other species, including Australian Ringneck, Crimson Rosella, Blue Bonnet, Swift Parrot *Lathamus discolor*, Mulga Parrot *Psephotus varius*, Orange-bellied Parrot, Blue-winged Parrot, Sacred Kingfisher, Striated Pardalote, Black Robin *Petroica traversi*, New Zealand Tomtit *P. macrocephala*, House Sparrow and Common Myna; take over sites by aggressively excluding or even killing other species and by filling hollow with nest-material, sometimes building on top of active nests (Souter 1928; Moncrieff 1931; Favalaro 1942; Watt 1947; Green 1965; Cooper 1975; Ambrose 1982; Emison 1992; Gleeson 1997; Powlesland *et al.* 2001; Tas. Bird Rep. 10; NRS). Hollows used by Starlings said to become fouled and unusable by other species for some time (Rix 1943). Once Starling laid egg in clutch of Australian Ringneck, and adults fought over hollow (Favalaro 1942). Much competition for nest-sites with Common Mynas, which destroy most accessible Starling nests and take over their territories (Moeed 1975). **SITE-FIDELITY:** Pairs may nest in same site for years (Sutton 1928a; Skemp 1952; NRS). **RE-USE OF SITES:** Sometimes use same site for second clutch after success or failure of first clutch (Thomas 1957; Green 1965; NRS). If nest removed from site, try repeatedly to rebuild nest in same site (Hodgkin 1949). **MEASUREMENTS (m):** HEIGHT OF NEST: In tree-hollows, 5.1 (4.97; 0.1–33; 477); in roofs or ceilings of buildings, 3.5 (1.00; 2.2–9.0; 101); in cavities in walls, 2.7 (1.01; 1.0–7.0; 28) (NRS). HEIGHT OF NEST-PLANT: 13.4 (8.40; 1.8–50.0; 217) (NRS).

Nest, Materials Bulky platform with cup-shaped depression. Mainly made of dry grass and straw, but also varying amounts of other material, such as twigs, leaves, pine needles, feathers, fur and refuse, including pieces of paper, plastic, foil,

cloth, lengths of thread or rope; depression lined with softer material such as leaves, feathers, wool or paper, or occasionally unlined (Boehm 1948; Thomas 1957; Bedggood 1959; Wheeler 1966; Ambrose 1982; NRS). Sometimes nest-cavities filled to entrance with material (Ambrose 1982); once, a 10-cm wide downpipe was filled with 1.8 m of material, mostly dry seed-pods (CSN 8). On Simmonds I., NI, when nesting in rock crevices, do not build nest, but nests on ground under vegetation made of grass and small twigs (Wagener 1966). Pluck wool from sheep to line nest (Boehm 1948; Bedggood 1959); and steal material from nests of House Sparrows (CSN 1). Visit and examine many other hollows while breeding, often near nest-site, and sometimes build nests (some incomplete) in these hollows without using them (Ambrose 1982). Some nests, in early stages of building, contain green leaves, flowers and other colourful objects, considered to have been placed there by unattached males seeking a mate (Thomas 1957); extralimitally, this practice suggested to act as defence against nest parasites (BWP). Both sexes build (Secker 1948; Ambrose 1982; NRS). Extralimitally, where migratory, male begins building before females arrive in breeding areas; base of nest built entirely by male, but female contributes to lining; fresh green material and flowers added by male but sometimes removed by female (BWP). Construction takes a few days (Ambrose 1982); one nest completed and first egg laid in 6 days (NRS); extralimitally, construction takes 4.6 days (2–9; no N) (BWP). One pair laid first egg when nest was just a rough lining of grass at bottom of nest-box; continued to build during laying, and by time fourth egg laid, nest was completed and lined (Green 1965). Sometimes continue to add material to lining during incubation (NRS). Nests become flattened and covered with faeces as nestlings grow (Ambrose 1982). Nest for second clutch sometimes built on top of earlier nest, though some old material usually cleaned out by male first (BWP). Once, when refurbishing nest in nest-box, male sat deep in nest and kicked backward vigorously, deepening and rounding nest (Hornby School 1946). Often re-line old nests from previous seasons; in one season, only 18% (no N) of nests were completely new; occasionally remove soiled material before re-lining, and also remove cold eggs or dead chicks (Ambrose 1982; NRS); sites can take 7–9 days to clean out and rebuild (NRS). Some pairs start building new nest within 2 days of removal of old nest (Cunningham 1941–42). Near Hunterville, NI, excavate holes in dry banks of pumice in road or rail cuttings, and enlarge crevices in banks (Flux 2003); and at Belmont, NI, excised neat circular holes, 5 cm diameter, through softboard wall lining in abandoned house to nest in wall-cavity (Flux 2003). **MEASUREMENTS (cm):** No information from HANZAB region. Extralimitally, size of base depends largely on size of cavity; diameter of cup, 10.0 (0.9–15.3; 11); depth, 9.5 (6.8–14.0; 11) (BWP).

Eggs In HANZAB region, oval; various shades of blue (Jenkins 1929; Frith 1969; Oliver; NRS). Extralimitally, also described as sub-elliptical; smooth, sometimes glossy; usually blue, but very occasionally white (BWP). **MEASUREMENTS:** Little information from HANZAB region; in NSW, 30.3 (1.22; 28.1–33.0; 30) \times 21.2 (0.49; 20.3–22.3) (NRS [n=8 clutches]); at Belmont, NI, 29.9 (23.5–36.0; 147) \times 21.0 (17.6–23.0) (J.E.C. Flux). Extralimitally, 29.7 (26.5–34.5; 1549) \times 21.2 (20.0–22.5) (BWP).

Clutch-size One to nine, but usually four or five (Jenkins 1929; Frith 1969; Heather & Robertson 2000; NRS). From NRS: 4.6 (0.96; 2–7; 186): C/2 \times 3, C/3 \times 21, C/4 \times 57, C/5 \times 80, C/6 \times 21, C/7 \times 4. Near Mildura, Vic., usually four or five, sometimes three (Thomas 1957); in Tas., four to six, usually five (Green 1965). In NZ, 4.2 (0.85; 2–6; 49) (Niethammer 1970). At Belmont, NI, mean clutch-size was 4.48 (0.02; 2050), but declined as season progressed (Flux & Flux 1981). Clutch-size influenced by intraspecific clutch parasitism and

polygyny; clutches of more than six probably usually laid by more than one female (see Laying, below). Extralimitally, when laying eggs in another's nest, second female sometimes removes a host egg (BWP); this possibly also occurs in HANZAB region (NRS).

Laying Eggs usually laid daily (Cunningham 1941–42; Thomas 1957; Green 1965; CSN 1; NRS); in one nest, five laid in 4 days (Cunningham 1941–42); in another nest, second egg laid 24.5–42 h after first (NRS). Begins on day after completion of nest (NRS). Eggs laid overnight or in morning (Hodgkin 1949; NRS). In area with apparent shortage of nest-sites, laying in five nests began 7 days after sites became available (Flux & Flux 1992). Once, two females laid in same nest at same time, laying eight eggs in 5 days, and a ninth laid 6 days after eighth (Hornby School 1946). Breed up to three times in a season, raising several successive broods (Chisholm 1926; Skemp 1952; Thomas 1957; Green 1965; Frith 1969; Flux 1978; Lenz 1981; Ambrose 1982). Re-lay in same nest after success of first clutch (Green 1965) and after failure of first clutch (Hornby School 1946). Second clutches usually started within 8–10 days of fledging of first brood (NRS). One pair laid first egg of replacement clutch 6 days after unhatched eggs disappeared from nest (Hornby School 1946). At Belmont, NI, laying of second clutches occurs 45 days after laying of first (Flux & Flux 1981). Extralimitally, laying of second clutches occurs 40–50 days after laying of first (BWP). One pair, after five eggs removed from nest-box, laid another egg next day; this was removed, and on each successive day another egg was laid (and removed by observer) till total of 20 eggs laid; nest then abandoned (Skemp 1952). If egg lost during laying, replacement egg may be laid, but eggs lost during incubation not replaced (NRS). Some records of dump-laying (Hornby School 1946; Heather & Robertson 2000; NRS); at Belmont, NI, of 2052 clutches, 1970–79, 13.5% had extra eggs (J.E.C. Flux); extralimitally, intraspecific clutch parasitism more widespread, with up to 46% of clutches parasitized by other Starlings (BWP). Eggs sometimes laid away from nests; twice, a broken egg found in fireplace of house, having been dropped down chimney (Thomas 1957); one bird seen to land, lay an egg, try unsuccessfully to pick it up, then leave (CSN 21); another occasion, female landed on lawn and laid an egg (Lane 1983; for details of behaviour, see Social Behaviour [Aberrant behaviour]).

Incubation By both sexes, but mostly female, and only by female at night (Burrows 1968; Heather & Robertson 2000; NRS), though at Belmont, NI, male very occasionally recorded roosting beside incubating female (J.E.C. Flux). Extralimitally, by female only, but male said to spend up to 29% of day on nest reducing heat loss from eggs rather than incubating; female sits for c. 71% of daytime for first clutches and c. 88% for second clutches; mean length of stints on nest, female 10.8 min (n=41), male 14.1 min (n=15); female can complete incubation alone but nest left unattended longer than when male participates, and when left unattended, eggs often covered with leaf (BWP). Start of incubation varies; begins with completion of clutch (Heather & Robertson 2000; NRS) or with penultimate egg, resulting in asynchronous hatching, with last egg hatching up to 24 h later than others (Cunningham 1941–42; NRS), though one C/3 took >46 h to hatch (NRS). Hatch at any time of day (NRS). Adults remove eggshells (CSN 6); unhatched eggs disappear from nests, usually within 5 days (Hornby School 1946; NRS). **INCUBATION PERIOD:** From completion of clutch, 11.6 days (0.66; 11–13; 33): 11 days × 17 eggs, 12 days × 13, 13 days × 3 (Cunningham 1941–42; NRS); at Belmont, NI, 11.6 days (11–15; 187) (J.E.C. Flux); 10–11 days (Thomas 1957). Extralimitally, 12.2 days (11–15; 84) (BWP).

Young Altricial, nidicolous. Hatch blind and naked (NRS). Eyes still closed at 5 days old; develop sparse down on

head and back within first week; eyes open at 9 days (NRS). Nestlings of unknown age have ashy-grey down (Wagener 1966). **Growth** On six nestlings, 21 days old, outer primary length 68–75, and longest rectrix 48–55; on 25-day-old nestling (n=1), outer primary length 69, and longest rectrix 47 (Flux & Thompson 1985). **WEIGHT** (g): Mean weight of nestlings at Belmont, NI: 6 days old, 34.5 (7.72; 7–56; 496); at 12 days old, 69.5 (9.91; 24–88; 475); and at fledging (20–23 days), 78.4 (5.14; 63–92; 373) (Thompson & Flux 1988). **Parental care** Both adults feed young in about equal proportions (Green 1965; NRS). In one nest, first two nestlings to hatch not fed on day of hatching; next day, two more eggs hatched and female began feeding them, two at a time, then brooded nestlings for 5 min before leaving to forage; during 45-min observation when brood 3–4 days old, parents visited nest 16 times to feed nestlings (Hornby School 1946). In other nests, parents made feeding visits once every 5 min or so (Green 1965; NRS); for nests in tree-hollows with large nestlings, mean interval between feeding visits, 1.8 min (no N); duration of each visit, 19.1 s (no N) (Ambrose 1982). In one nest where two females laid in same nest, both females fed nestlings (Hornby School 1946). One pair continued to feed large nestlings after nest and brood removed from under roof and placed in nearby nest-box, but another pair abandoned recently hatched nestlings after similar move (Thomas 1957). When food in short supply, parents selectively starve one or more chicks in turn to reduce brood-size early in nestling period; conversely, may selectively fatten one nestling when food is plentiful (Flux & Thompson 1995). Both sexes brood, but mostly by female; male broods in morning, and only brooded by female at night (J.E.C. Flux). Extralimitally, at hatching, brooding nearly continuous; amount of brooding decreases till mostly brood only at night by end of first week, ceasing by 10 days; decrease in day brooding more rapid in larger broods and higher ambient temperatures (Westerterp *et al.* 1982; BWP). Once, male Starling, while still incubating his clutch in six-compartment nest-box, fed House Sparrow nestlings in adjoining compartment and removed their faecal sacs (Burrows 1968, which see for details). **NEST-SANITATION:** Parents remove faeces (NRS). Larger nestlings climb up hollows to void faeces, sometimes out of hollow, but sometimes on inner wall of hollow, which may become caked with faeces (Thomas 1957).

Fledging to independence **FLEDGING PERIOD:** 20 days (18–24; no N) (Heather & Robertson 2000); c. 21 days (Thomas 1957); fledge when disturbed at 20–22 days (NRS); if undisturbed, usually fledge at c. 23 days (19–26; 89), but capable of flying at 18–19 days old (Wilson 1979). Weight at fledging not correlated with brood-size or clutch-size (Thompson & Flux 1991). Parents feed fledgelings for 1–2 weeks (Bryant 1936; Wall 1983; Heather & Robertson 2000; NRS). A fledgeling that fell into wall-cavity was fed by parents through ground-level vent (Bryant 1936); calls from fledgelings which fluttered to ground from nest-box on hot day were ignored by parents, and brood died (Thomas 1957). Extralimitally, brood parasitism occasionally occurs, where fledgelings from first brood or from unrelated nest sometimes enter nest, and fed by adults, sometimes resulting in death of younger brood (Flux 1978); once, 21-day-old fledgeling which flushed from its nest-box was found 4 days later in another nest-box with a brood of five younger nestlings (Flux & Thompson 1985). Once, Starling nestling, 18–19 days old, was found in nest-box with three Common Myna nestlings; only Myna adults brought food to nest, but apparently did not feed Starling; not known whether Starling hatched from egg laid in Myna nest, or entered nest as fledgeling (Wilson 1979).

Success From NRS: In 42 nests where clutch-size, hatching and fledging success known: of 185 eggs, 107 (57.8%) hatched and 53 (28.6%) young fledged, equal to 1.26

fledgelings per clutch; 24 clutches (57%) did not fledge any young. For 104 nests where clutch-size and hatching known, but outcome unknown: of 466 eggs, 350 (75.1%) hatched. Of 232 nests where outcome known, 98 (42.2%) were successful and 134 failed, of which 38 (28.4%) were destroyed by people (NRS). At Belmont, NI, of 17,326 eggs, 8950 (52%) hatched and 5770 (33%) fledged, equal to 1.63 fledgelings per nest (Flux & Flux 1981). In NZ, success almost nil at nest-sites accessible to Common Mynas (Councilman 1974b). In Hawkes Bay, of 428 nest-boxes, 59% were occupied (most nests with eggs) on 19 Oct.; due to pressures of predation, rate of occupancy progressively declined, to 43% (7–47) on 31 Oct., 22% on 29 Nov., 18% on 6 Dec., 5% on 13 Dec., and zero on 20 Dec.; Stoats were found in some nest-boxes (Purchas 1981). Many nests destroyed by people (e.g. Favalaro 1942; NRS); and often evicted from hollows by Common Mynas (Clayton 1970). Eggs can disappear from clutches during incubation (NRS), and parasitic females sometimes remove egg of host (see Clutch-size, above). Eggs taken by rats (CSN 1); eggs and nestlings taken by Noisy Friarbird *Pheleon corniculatus* (Chaffer 1945); and young taken by New Zealand Falcon (Sopp 1957), Brown Goshawk *Accipiter fasciatus* (NRS), Little Owl (Hornby School 1946; Rule 1977), Pied Currawong *Strepera graculina* (Crowe 1978; Lenz 1990b) and Common Myna (Stoddart 1956; Wright 1962); Stoats kill incubating females (Flux & Flux 1992). Once, broken eggs and dead nestlings found after unseasonable snow-storm (Bull & Dawson 1969). Nests in trees destroyed by logging (St Paul 1949). On Raoul I., Kermadec Grp, 12 dead fledgelings once found beneath cliffs, apparently having fallen from nest-holes (Merton & Veitch 1986). Nests may become infested with mites (NRS); see also Laird (1950), Powlesland (1978) and Petersen (1979).

PLUMAGES Prepared by J.S. Matthew. Naked at hatching. Develop cover of down within 1 week of hatching (NRS). Fledge in juvenile plumage. Most undergo complete post-juvenile (first pre-basic) moult, starting within 2 months of fledging, resulting in first immature (first basic) plumage which superficially resembles adults of respective sexes (Feare & Craig 1998; BWP). A few birds undergo partial post-juvenile moult, also resulting in adult-like first immature plumage. Acquire adult plumage in complete first immature post-breeding (second pre-basic) moult, probably when c. 1 year old. Sexes differ in adults and first immatures. Descriptions of plumages and bare parts of nominate *vulgaris* given in Feare & Craig (1998) and BWP; also see and Field Identification, above.

BARE PARTS See BWP and Field Identification, above; see also Ageing and Sexing, below, for more information on bill- and iris-colour. In n. hemisphere, seasonal variation in adult bill-colour pronounced. In breeding season in n. hemisphere (Mar.–June): adult males have yellow bill with blue-grey, slate or blue-black base to lower mandible; adult females have bill yellow with paler yellow, pink-white, light pink or pink-flesh base to lower mandible (BWP). In residents or part-migrants in non-breeding season in n. hemisphere (Nov.–Feb.): adults of both sexes have black bill with slight grey, green or brown tinge, often with paler grey-brown or greyish-white tomtia (BWP). Rogers *et al.* (1986) indicated seasonal variation in colour of bill in HANZAB region similar to that in n. hemisphere, but timing of breeding and non-breeding seasons differs by c. 6 months; in non-breeding season, both sexes have black bills; in breeding season (Sept.–Dec.), bill yellow with slate-grey (males) or pink (females) base to lower mandible. Examination of skins (MV; this study) indicates: all of nine adult males collected Aug.–Dec. had bill mostly yellow with varying dark-grey base to lower mandible and narrow blackish tip; all of nine adult males collected Jan.–June had

black bill, some birds with small amount of yellow at one or more of base of lower mandible, tomtia or extreme tip; all of six adult females collected Jan.–May had bill, black, two with flesh-coloured tomtia and extreme base to lower mandible; all of six adult females collected June–Dec. had dull yellowish or flesh-coloured bill, with varying extent of dark-grey at base of lower mandible and at tip.

MOULTS For details on timing and extent of moult in n. hemisphere, see Svensson (1992), Jenni & Winkler (1994) and BWP. Information from HANZAB region based on examination of skins of 43 adults, two first immatures and two juveniles (MV, NMNZ), and other information as cited. **Adult post-breeding** (Third and subsequent pre-basic). Complete (Rogers *et al.* 1986; Svensson 1992; Jenni & Winkler 1994; Feare & Craig 1998; BWP). Primaries moult outward. In n. hemisphere, starts at p1 in May–July and finishes Aug.–Sept., sometimes as late as Oct.; individual duration of moult of primaries c. 80 days (Svensson 1992; Jenni & Winkler 1994; Feare & Craig 1998; BWP). In skins from s. Aust. (Vic., SA), active moult of primaries recorded from: Jan. (4 of 4; mean PMS 25.3 [4.27; 20–30]), Feb. (1 of 1; PMS 24) and Mar. (1 of 2; PMS 48); these birds from Jan.–Mar. had two primaries growing at once; another one in Mar., and all 14 collected Apr.–July had all primaries new (or only slightly worn in July); all nine collected Aug.–Oct. and Dec. had all primaries worn. In skins from NI, active moult of primaries recorded from: Jan. (1 of 1; PMS 29) and Feb. (1 of 1; PMS 40), both birds with two primaries growing at once; all three in May with all primaries new; and all seven from Aug.–Nov. with all primaries worn. These results indicate moult of primaries occurs c. Jan.–Mar. in HANZAB region. Niethammer (1971) stated that moult in NZ starts by early Jan. and finishes in first half of Feb. Not known if any birds suspend moult of primaries or undergo unconventional (eccentric) moult of primaries as sometimes occurs in n. hemisphere, in response to poor body condition (BWP). Moult of secondaries starts when PMS 23–34 (BWP), but no information from HANZAB region. In n. hemisphere, moult of tail starts when PMS 15–25, and usually centrifugal, finishing with t6 when PMS 45–50 or after finish of moult of primaries (BWP); little information on moult of tail in HANZAB region; one skin with PMS 27 starting moult of tail at t1. Timing of moult of body much as primaries; see Field Identification and BWP for variation in appearance according to degree of plumage wear. **Post-juvenile** (First pre-basic). Usually complete (Bullough 1942; Rogers *et al.* 1986; Svensson 1992; Jenni & Winkler 1994; Feare & Craig 1998; BWP). Primaries moult outward. A few birds retain one or more of the following: one to a few secondaries, tertials, wing-coverts, feathers of alula or p10. In n. hemisphere, moult starts at sides of belly, mantle and marginal coverts before start of moult of primaries, followed by p1, then rest of wing-coverts, tertials and rest of body when PMS 10–40, then alula, feathers of head and neck when PMS 33–40 (BWP). In HANZAB region, active moult of primaries recorded from one skin collected in Vic. in mid-Feb. (PMS 32); this bird also starting moult of secondaries (4¹2¹0⁴) and tail (N¹2¹0⁴), and about halfway through moult of tertials, wing-coverts and body. **First immature post-breeding** (Second pre-basic). No information, but timing and extent probably much as adult post-breeding.

MEASUREMENTS **NOMINATE VULGARIS:** (1) SE. Aust., adults, skins (MV). (2) NZ, adults, skins (NMNZ). (3–4) Adults, skins (Niethammer 1971): (3) NZ; (4) England. (5) Vic., live adults, sexed by colour of plumage and iris (Rogers *et al.* 1986). (6) Belmont, NI, live adults, sexed by length of hackle and colour of bill (J.E.C. Flux). (7) England and s. Scotland, adults, skins, collected in breeding season (BWP);

first immatures and adults combined for tarsal measurements; tail measurements include skins from Scandinavia and continental Europe. (8) Britain, Scandinavia and continental Europe, skins, juveniles (BWP).

	MALES	FEMALES	
WING	(1) 125.1 (3.07; 119-130; 23)	121.4 (3.37; 115-127; 14)	**
	(2) 126.8 (2.58; 123-132; 18)	-	
	(3) 128.6 (2.87; 122-133; 21)	126.9 (121-133; 11)	
	(4) 125.5 (2.33; 122-129; 13)	122.5 (120-126; 8)	
	(5) (125-135; 11)	(124-129; 6)	
	(6) 125.5 (121-132; 11)	122.2 (116-126; 66)	
	(7) 132.5 (2.23; 129-136; 13)	129.1 (2.57; 126-134; 8)	**
	(8) 124.4 (2.20; 121-129; 25)	121.4 (2.68; 117-126; 21)	**
TAIL	(1) 62.7 (2.22; 60-68; 21)	61.6 (1.94; 59-65; 13)	ns
	(2) 63.4 (2.93; 60-69; 19)	-	
	(3) 63.3 (2.29; 60-67; 22)	61.2 (58-64; 11)	
	(4) 59.0 (2.00; 55-61; 13)	57.9 (54-61; 7)	
	(5) (60-66; 4)	-	
	(7) 64.1 (2.24; 60-68; 27)	61.8 (2.01; 58-65; 19)	**
	(8) 60.4 (1.79; 58-64; 19)	58.8 (2.20; 55-62; 14)	*
	(9) 29.0 (1.36; 26.6-31.0; 22)	29.0 (1.01; 27.8-31.5; 12)	ns
BILL S	(2) 28.5 (1.10; 26.5-30.6; 18)	-	
	(7) 29.0 (1.22; 27.6-30.3; 8)	28.9 (0.76; 27.6-29.9; 7)	ns
	(5) (52.8-55.7; 11)	(51.9-55.4; 6)	
THL	(1) 29.2 (1.03; 27.4-31.4; 23)	28.6 (0.87; 26.7-30.5; 14)	*
	(2) 28.7 (0.68; 27.4-29.8; 18)	-	
TARSUS	(7) 30.5 (0.81; 28.8-32.2; 58)	29.7 (0.85; 27.6-31.2; 50)	**

WEIGHTS *NOMINATE VULGARIS*: (1) SE. Aust., adults, from museum labels (MV). (2) NZ, adult males, from museum labels (NMNZ). (3) NZ, adults (Niethammer 1971): (4) Vic., live adults, sexed by colour of plumage and iris (Rogers *et al.* 1986). (5) Belmont, NL, Oct.-Dec. (J.E.C. Flux). (6-7) Netherlands, adults (BWP): (6) Nov.-Feb.; (7) Apr.-June.

	MALES	FEMALES	
(1)	81.3 (7.28; 75-98; 9)	83.5 (6.68; 75.6-94; 7)	ns
(2)	78.3 (8.93; 63-88.4; 9)	-	
(3)	79.6 (70-87; 12)	69.2, 70.4, 77.9	
(4)	(80-92; 16)	(70-81; 7)	
(5)	86.4 (72-98; 64)	84.3 (70-107; 539)	
(6)	82.7 (8.43; 70-94; 14)	79.9 (9.17; 65-91; 7)	ns
(7)	82.7 (7.87; 74-94; 7)	78.3 (6.97; 70-95; 11)	ns

See Coleman & Robson (1975) for more details on weights in NZ populations.

STRUCTURE See BWP for details.

AGEING See Svensson (1992), Rogers *et al.* (1986) and BWP for details.

SEXING See Svensson (1992), Rogers *et al.* (1986) and BWP for details.

GEOGRAPHICAL VARIATION Complex in n. hemisphere, involving distinctive variation in colour of gloss of plumage, colour of underwing-coverts and colour of plumage in juveniles; less marked variation in pale spotting on underparts and size, with birds from Indian subcontinent distinctly smaller than those from Britain, Europe and w. Asia (BWP). Up to 12 subspecies recognized in n. hemisphere, ranging from e. Atlantic Is, British Isles, Scandinavia, Europe E to Ural Mts, Caucasasia and sw. Asia (Afghanistan, Uzbekistan, Iran) E to L. Baikal and w. Mongolia and S to Indian subcontinent (see Feare & Craig 1998 and BWP for detailed discussion on variation between and within subspecies). Some authors (Bullough 1942; Meinertzhagen 1947) separate British populations from those in Scandinavia and w. Europe as subspecies *britannicus*, but others (Feare & Craig 1998; Peters; BWP) combine them as nominate *vulgaris*.

Populations introduced to HANZAB region thought to be nominate *vulgaris* (Niethammer 1971; Feare & Craig 1998; Peters; DAB). No known geographical variation in Aust. (DAB). Since their introduction to NZ in 19th century, there has been much differentiation in external morphology between various locations, but these show no consistent geographical pattern; when 16 characters, including seven external characters, measured from specimens collected at eight sites on NI and SI: (1) there was no consistent pattern, clinal or otherwise, of geographical variation between sites, variation apparently haphazard; (2) there was significant difference between sexes in level of interlocality differentiation for some morphological characters, e.g. males showed higher differentiation than females, especially in size and shape of bill, but females showed stronger correlation between bill- and body-size and environmental variables; (3) intersexual competition has resulted in divergence of feeding niches and, in females, much of the variation in bill characters explained by environment variables, especially winter temperatures; (4) results support hypothesis that genetic variation in original founding populations in NZ has subsequently increased through random differentiation of isolated populations (Ross & Baker 1982). Ross (1983) investigated genetic differentiation (allozymic variation) in winter populations in NZ and Great Britain: (1) of 24 loci sampled, 11 showed allelic variation; NZ populations had 23 alleles at these loci, two alleles unique to NZ; populations from Britain had 31 alleles at the same loci, 11 of these alleles unique; (2) NZ populations showed only slight loss of genetic variation compared with those in Britain; levels of heterozygosity and proportion of polymorphic loci similar between populations in NZ and Britain; (3) winter populations from Britain and Europe are genetically highly homogeneous (Nei's distance: 0.0001; Roger's distance: 0.0081; 15 localities from England and Scotland), whereas winter populations in NZ show rather high levels of genetic divergence between localities (Nei's distance: 0.0024; Roger's distance: 0.0187; 15 localities on NI and SI, NZ); (4) patterns of genetic (allelic) variation between locations in NZ are apparently random and do not show obvious clinal or geographical trends; these patterns probably reflect random genetic processes rather than directional selection; (5) apparently random variation in morphometric characters (see Ross & Baker [1982] and summary above) supports hypothesis that random genetic drift has amplified genetic variation present in original founding populations, or is the result of bottlenecks in NZ population. DAB stated that populations on Norfolk and Lord Howe Is probably colonized unaided from NZ (see Distribution and Population).

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Metallic Starling *Aplonis metallica* (page 1896)
NOMINATE METALLICA: 1 Adult; 2 Juvenile; 3 Immature; 4, 5 Adult

Common Starling *Sturnus vulgaris* (page 1906)
NOMINATE VULGARIS: 6 Adult male (fresh plumage); 7 Adult male (worn plumage); 8 Adult female; 9 Juvenile; 10 Immature; 11, 12 Adult male

Purple-backed Starling *Sturnus sturninus* (page 1934)
13 Adult male; 14 Adult female

Singing Starling *Aplonis cantoroides* (page 1903)
15 Adult; 16 Immature