

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 ZOSTEROPIDAE white-eyes

A fairly large and morphologically homogeneous family of small warbler-like arboreal passerines, typically with prominent white eye-ring, fine bill and vestigial outermost primary (p10). The family comprises 82–96 species in 10–13 genera, mainly with a tropical and subtropical distribution, across Africa, islands of the Indian Ocean (including Réunion, Mauritius and Seychelles), Asia, including the Indian subcontinent, Philippines and Indonesia, Papuan Region, A'asia, and islands of the sw. Pacific Ocean (Sibley & Monroe 1990; Monroe & Sibley 1993; Coates *et al.* 1997; Fry *et al.* 2000; Peters). Total of seven species of *Zosterops* in HANZAB region, two of which almost certainly extinct. In this treatment we follow most modern works (Mees 1957, 1961, 1969; Moreau 1957; Sibley & Ahlquist 1990; Christidis & Boles 1994; Peters) in recognizing white-eyes as a distinct family with close affinities to the Old World warblers (family Sylviidae). Early authors (Gadow 1884; Stresemann 1927–34) placed white-eyes with honeyeaters (Meliphagidae) or closely affiliated with honeyeaters, sunbirds and flowerpeckers. However, DNA–DNA hybridization data (Sibley *et al.* 1988; Sibley & Ahlquist 1990) indicate white-eyes are part of the sylvioid lineage of passerines, and were consequently placed between cisticolas and Old World warbler by Sibley & Monroe (1990) and Monroe & Sibley (1993). In this treatment, we place Zosteropidae immediately after the Sylviidae (following Christidis & Boles [1994], cf. DAB who place them before the Sylviidae).

Size varies from small (e.g. Pygmy White-eye *Oculocincta squamifrons*: total length 9 cm) to medium-small (e.g. Black-capped Speirops *Speirops lugubris*: total length 13.5–15 cm). The family share the following morphological characteristics (summarized from Mees 1957; Bock 1962; Beecher 1953; Fry *et al.* 2000; DAB). Wings vary from rather short and slightly rounded at tips to rather long and fairly pointed. Ten primaries; outermost (p10) vestigial; p6–p8 longest. Nine secondaries, including three tertials. Tail fairly short or moderately long, rather square or slightly notched at tip; 12 rectrices. Bill usually short, slender and rather straight or slightly decurved; slight notch near tip of upper tomium. Nostrils slit-like, semi-operculate. Rictal bristles present. Tongue short, extensile, bifid on distal portion, each half with brush-like tip; adapted for capillary action when feeding on nectar and flower or fruit fluids. Musculature of jaw similar to that of bulbuls (Pycnonotidae), but protractor muscles expanded and one of posterior palatine retractors split to accommodate salivary gland. Large palatine salivary gland diagnostic. Legs and feet rather short, but fairly strong; tarsal scaling laminiplantar. Skull rather similar to that of Old World warblers (Sylviidae) in structure. Ectethmoid foramen single slit. Lachrymals fused. Tips to maxillo-palatine processes clavate, thickened and furrowed. Zygomatic processes differ from Old World warblers, being thickened and squarely truncated. Humerus with two pneumatic fossae, but second fossa poorly developed in some species.

Following are shared plumage characteristics (summarized from Coates *et al.* [1997]; Fry *et al.* [2000]; Mayr & Diamond [2001]; DAB; and this study). Plumages usually rather drab olive, dark green or brighter yellow-green, and often yellow on underparts, particularly on chin, throat, vent and undertail-coverts; and with a distinct ring of feathering round eye, white in most but black in some (e.g. Sanford's White-eye *Woodfordia lacertosa*, most dark-eyes *Lophozosterops*, *Heleia*, *Madanga*, *Tephrozosterops*); a few species have rather uniformly dark-brownish plumage (e.g. Fernando Po Speirops *Speirops brunneus*) or even uniform rufous upperbody (Bicoloured White-eye *Tephrozosterops stalkerii*) or throat (Rufous-throated White-eye *Madanga ruficollis*). Sexes alike in plumage; in some species, adult males slightly larger than adult females. Juveniles slightly duller than adults. Nestlings naked or with sparse down at hatching; in at least some species, nestlings have two dark tongue-spots (Maclean & Vernon 1976). Fledge in juvenile plumage. Post-juvenile (first pre-basic) moult partial in some, but complete in others; and can vary from partial to complete within species. Adults undergo one complete post-breeding (pre-basic) moult each year. Primaries moult outward; usually starting at p1, but possibly starting at more than one node in some individuals of some species. Moult of tail centrifugal. Moult of tail and body apparently start at about same time as, or just before, start of moult of primaries.

Occupy most wooded habitats, occurring from coasts and lowlands to mountain regions. Commonly in primary and secondary forest and rainforest, with many species associated with forest edges, woodlands, shrublands and heath, and a wide range of modified habitats, such as plantations, orchards, wooded cultivation, farmland, residential areas, and parks and gardens; some species commonly in mangroves. African species possibly more often in open habitats, such as savanna woodland, shrubland, heathland and farmland, than elsewhere. Many species (especially island species) habitat generalists, e.g. Pemba White-eye *Zosterops vaughani* of Pemba I., w. Africa, found in gardens, mangroves, forest, bushland and hedges in grassland, though others more specialized, e.g. Great Truk (or Faichuk) White-eye *Rukia ruki*, confined to dense native montane forest on Truk I. and White-chested *Z. albogularis* and Slender-billed *Z. tenuirostris* White-eye restricted to rainforest on Norfolk I. In HANZAB region, Yellow White-eye *Zosterops luteus* shows evidence of seasonal shifts in use of habitat, e.g. breeding in mangroves but wintering in nearby acacia shrubland (Pratt *et al.* 1987; Coates 1990; Coates *et al.* 1997; Doughty *et al.* 1999; Grimmett *et al.* 1999; Fry *et al.* 2000; Robson 2000, 2002; see species accounts).

Mainly sedentary or resident, sometimes with local or altitudinal movement (e.g. Oriental White-eye *Zosterops palpebrosus*), others partly migratory, with wintering range largely overlapping breeding range (e.g. Abyssinian White-eye *Z. abyssinicus*), or mainly migratory, with some resident populations at lower latitudes (e.g. Chestnut-flanked White-eye *Z. erythropleurus*). The many island endemics sedentary or resident (e.g. Fernando Po Speirops, Golden White-eye *Cleptornis marchei*), but members of family historically mobile, with marked ability to repeatedly colonize remote islands, including the colonization of NZ by Silvereye in the mid-19th century. In HANZAB region, most species apparently sedentary, with some local movements, with the notable exception of Silvereye *Zosterops lateralis*, which is partly migratory with complex patterns of movement characterized by marked subspecific variation, ranging from sedentary (subspecies *vegetus*), resident (subspecies *chloronatus*), erratic or dispersive (e.g. subspecies *cornwalli*) to partly migratory, with resident and migratory populations (e.g. subspecies *lateralis*) (de Schauensee 1984; van Marle & Voous 1988; Coates 1990; Dickinson *et al.* 1991; Coates *et al.* 1997; Pratt *et al.* 1997; Doughty *et al.* 1999; Grimmett *et al.* 1999; Fry *et al.* 2000; Robson 2000; Griffioen & Clarke 2002; see species accounts).

Omnivorous. Feed mainly on insects and fruit, but also often take other invertebrates, and nectar (for which tongue adapted [see above]) and seeds; some also eat other plant material, such as flowers, buds and exudates. Some species also take artificial foods round human habitation; and claimed that Silvereye observed feeding on carrion. Arboreal, foraging primarily in vegetation, often in midstorey and canopy, but also in herbs and shrubs closer to ground; food also occasionally taken on ground, or while in flight. Forage mainly by gleaning, usually from foliage, twigs and branches, and from both upper and undersurfaces of substrates. Also use bill to probe substrates such as bark, rolled-up leaves and flowers; bill often inserted into substrate and then opened to permit inspection and to gain access to food items (zirkelning). Fruit either plucked and swallowed whole (if small), or flesh pecked off *in situ*. Some prey taken by sallying, either by sally-striking at flying insects, or sally-hovering to take items from other substrates. Some species occasionally take food by other methods, e.g. pierce or slit flowers with bill to take nectar, lick exudates or other substrates, or lunge at flushed prey. When foraging from perches, sometimes adopt acrobatic postures, such as reaching sideways, or hanging upside-down, sometimes by one foot. Often forage in small flocks, in both breeding and non-breeding seasons; and many species also occur commonly in mixed-species foraging flocks. Some species (e.g. Silvereye, Cape White-eye *Zosterops pallidus*) feed on and cause damage to cultivated fruits, and as such are considered pests by orchardists (Ali & Ripley 1974; Coates 1990; Coates *et al.* 1997; Fry *et al.* 2000; DAB; see species accounts).

Gregarious; usually seen in small flocks of up to c. 20, but also seen singly or in pairs. Sometimes gather in large flocks, particularly at sources of abundant food or when on migration. Where known, usually monogamous. Co-operative breeding recorded in Seychelles White-eye *Zosterops modestus* and Mascarene White-eye *Z. borbonicus*. Where known, both sexes incubate and share other parental care. Usually nest solitarily, but some sometimes form loose colonies with pairs nesting within c. 15 m of each other. Silvereye known to defend territories, but some others do not show any overt territorial behaviour. Highly social. Allopreening or huddling occurs regularly in several species. Often show much agonistic behaviour within foraging flocks. Seldom engage in overt fights, but often assume threat postures with sleeked plumage or with wings lowered and quivered, and often also peck at and displace others. Song thought to have both agonistic and sexual functions. Sexual behaviour poorly known in most species (Gill 1971; Ali & Ripley 1974; Greig-Smith 1979; Skutch 1987; Coates 1990; Fry *et al.* 2000; DAB; see species accounts).

Highly vocal. Voices rather weak but quite far-carrying. Song usually consists of pleasant warbling or tinkling jingle. Often sing as part of dawn chorus. Utter wide variety of short calls that can include whistles, chirps, trills, chattering and grating, buzzing or nasal sounds. Some species also known to be excellent mimics (Skead & Ranger 1958; Gill 1971; Ali & Ripley 1974; Coates 1990; Fry *et al.* 2000; DAB; see species accounts).

Usually nest solitarily, but sometimes in loose colonies. Where known, mostly monogamous, but co-operative breeding recorded in some species (see above). Nests usually suspended from forks in thin twigs (mostly horizontal forks, sometimes vertical), or sometimes between stems of leaves, in shrubs or trees, or sometimes in creepers, reeds or bamboo, and often well concealed by foliage; African Yellow White-eye *Z. senegalensis* also recorded nesting in leafless cacti. Build small, neat, open cup-shaped nests; of grass, rootlets and moss, often with other material such as plant stems and down, twigs, bark, leaves, lichen or fibres from palms or other plants, often bound and fixed to nest-site with spider web; some decorated externally with egg-sacs of spiders or sometimes with moss or other material; nests lined with fine grass, rootlets, hair, palm fibres or other fine material. Where known, construction by both sexes. Eggs varyingly oval, and range from lustreless to glossy; usually white or pale blue, greenish blue, bluish green or turquoise, occasionally bluish white, and usually unmarked, but in a few species with very fine darker speckling. Clutch-size 1–6, but in most species, usually 2–3. Where known, eggs laid on successive days and incubated by both sexes. Incubation period 10–16 days, but usually 10–12 days. Where known, nestlings fed and brooded by both sexes. Fledging period 9–15 days or more. Where known, fledgelings fed by both sexes, and dependent on parents for up to c. 3 weeks. Some species parasitized by cuckoos (including *Cuculus*, *Chrysococcyx*, *Cacomantis*, *Eudynamis*) and, in Africa, white-eyes also principal hosts of Green-backed Honeybird *Prodotiscus zambeziae* (Ali & Ripley 1974; Coates 1990; Coates *et al.* 1997; Fry *et al.* 2000; Robson 2000; see species accounts).

A total of 24 species currently considered globally threatened, representing c. 25% of the family. One species, Robust White-eye *Zosterops robusta* of Lord Howe I., EXTINCT; six species CRITICALLY ENDANGERED, all of which are island endemics, including White-chested White-eye of Norfolk I. in HANZAB region (and which almost certainly extinct); other critically endangered species are Mauritius Olive White-eye *Z. chloronothus* of Mauritius, Sangihe White-eye *Z. nehrkorni* of Sangihe I., Indonesia, and Rota Bridled White-eye *Z. rotensis* and Golden White-eye of N. Mariana Is, and Faichuk White-eye of Micronesia; six ENDANGERED, including Slender-billed White-eye of Norfolk I. in HANZAB region; and eleven considered VULNERABLE, including Christmas Island White-eye *Z. natalis* of Christmas I. in HANZAB region. A further 13 species considered near-threatened. Main cause of declines and ongoing threats are loss, degradation and fragmentation of habitats, through burning, logging, grazing, clearing for agriculture, and introduced weeds; and introduced predators, mainly through predation of nests and adult by introduced rats *Rattus* and, on some islands, Brown Tree Snake *Boiga irregularis*, or Common Myna *Acridotheres tristis* (Garnett & Crowley 2000; Stattersfield & Capper 2000; BirdLife International Species Factsheets, available at <http://www.birdlife.org/datazone/species/index.html> [accessed Sept. 2005]; see species accounts).

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Zosterops lateralis **Silvereye**

COLOUR PLATE FACING PAGE 1753

Sylvia lateralis Latham, 1802 (1801), *Index Orn., Suppl.*: 55 — Nova Hollandia = region of Port Jackson, New South Wales.

Specific name based on 'Rusty-sided Warbler' of Latham (1801), *Gen. Synop. Birds*, Suppl. I, p. 169 (Latin *lateralis*, of the side, from *latus*, the side).

OTHER ENGLISH NAMES Common, Eastern, Green-backed, Grey-backed, Grey-breasted, Southern or Western Silvereye or White-eye; Yellow-vented White-eye; Rusty-sided Warbler; Bush Canary; Winter Migrant; Blightie, Blight-bird or Spectacled Blight-bird; Button-eye, Cherrypicker, Girdle-eye, Grape-eater, Greenie, Grinnell, Little Grinnell, Ring-eye, Silvey, Twinkie, Waxeye, White-eye.

MAORI NAMES Tauhou, Karupatene.

POLYTYPIC Nominate *lateralis*, Tas., e. Bass Str. islands (Furneaux Grp), wintering in coastal and subcoastal se. Aust. N to central-e. Qld (Shoalwater Bay), colonized and established on Norfolk I. and throughout NZ, reaching Kermadec, Chatham, Snares, Auckland, Antipodes, Campbell and Macquarie Is; *ochrochrous* Schodde & Mason, 1999, King I., Bass Str., wintering on adjacent se. Aust. mainland?; *pinarochrous* Schodde & Mason, 1999, South-East of SA, Murray-Mallee and Murray Riverland region W to SA gulfs, Flinders Ra. and e. and central Eyre Pen., intergrading with *westernensis* (Quoy & Gaimard) through w. and central Vic. to s.-central NSW, and with ensuing subspecies on Kangaroo I. and along w. coast of Eyre Pen. to head of Great Aust. Bight; *chloronotus* Gould, 1841, sw. Aust., N on w. coast to L. Macleod and islands off Shark Bay, E to head of Great Aust. Bight, and inland to e. and ne. Wheatbelt and mulga-eucalypt boundary; *tephropleurus* Gould, 1855, Lord Howe I.; *westernensis* (Quoy & Gaimard, 1830), coastal to near-inland se. Aust., W to Port Phillip Bay and central Murray R., inland to outer-w. slopes of Great Divide and Riverina, NSW, and N to Southern Tablelands and upper reaches of Lachlan R. Drainage Basin, NSW, intergrading with ensuing subspecies N along Great Divide and e. coast to Hunter R. Drainage Basin, NSW; *cornwalli* Mathews, 1912, coastal and subcoastal central-e. Aust., S to n. Hunter R. Drainage Basin, N to s. Burdekin R. Drainage Basin, Qld, and inland to inner-w. drainage basins of Great Divide, intergrading with ensuing subspecies through n. Burdekin R. Drainage Basin, Qld; *vegetus* Hartert, 1899, coastal and subcoastal ne. Qld between n. Burdekin R. Drainage Basin and Temple Bay, C. York Pen.; *chlorocephalus* A.J. Campbell & S.A. White, 1910, cays of s. Great Barrier Reef between Capricorn Grp and cays off Repulse Bay. Extralimitally, up to eight further subspecies in New Caledonia, Loyalty I., Vanuatu, Banks I., and Fiji.

FIELD IDENTIFICATION Length 12 cm (11–13); wing-span 17 cm (15–19); weight 11 g. Small, plump bird with large, rounded head and short, sturdy, chisel-like bill, short neck, moderately long, pointed wings, tips of which fall just short of uppertail-coverts, and fairly short tail with slightly forked tip. Same shape and size as Pale *Zosterops citrinellus* and Yellow *Z. luteus* White-eyes, and smaller than Slender-billed *Z. tenuirostris* and White-chested *Z. albugularis* White-eyes on Norfolk I. (see respective accounts for individual detail on differences). Larger and more thickset than Brown Thornbill *Acanthiza pusilla*, Western Gerygone *Gerygone fusca* or Grey Warbler *G. igata*, with more rounded undercarriage and proportionately shorter tail with slight fork. Similar in size to White-browed Scrubwren *Sericornis frontalis*, which is similarly thickset, though perhaps more so, with larger body, but head smaller and tail shorter with rounded tip. Sexes alike, and seldom distinguishable, but within pair, some females have paler flanks. No seasonal variation. Juvenile like adult, but with much narrower white eye-ring, less contrasting dark-grey (not black) lores and duller overall with brownish tinge to grey saddle (except subspecies *chloronotus*); also have softer texture to plumage, narrow tail-feathers and pinkish base to bill with brownish (not black) tip and yellow gape. Immature poorly known and probably indistinguishable from adult in field. Complex geographical variation; nine subspecies recognized by DAB (q.v.) and Geographical Variation, below, for more detail. **Adult males** SE. MAINLAND AUST.: Top of head and nape, olive-green; lores, black; eye-ring broad and

distinct, white; broken in front by black of lores, and narrowly bordered below by black feathering; ear-coverts and malar area, olive-green, concolorous with top of head. Hindneck, sides of neck, mantle and scapulars, grey, forming distinct grey saddle; back, rump and uppertail-coverts, olive-green, with slight greyish tinge to back. Uppertail, dark grey with olive-green edges to feathers. Upperwing mostly olive-green; entire secondary coverts, olive-green; primary coverts and alula mostly olive-green with dark centres to feathers which sometimes show through; tertials, olive with dark-grey inner webs; remiges, black with narrow, bright olive-green edges that form series of stripes on closed wing. Chin and throat, pale lemon-yellow. Centre of breast, pale grey, forming diffuse breast-band, and grading to slightly darker grey on sides of breast; flanks, rich brown with slight rufous tinge, contrasting with breast; belly, vent and thighs, white, contrasting strongly with flanks; undertail-coverts, pale yellow-olive. Undertail, dark grey. Underwing mostly white, sometimes with slight lemon tinge and narrow blackish trailing edge; in detail: coverts mostly white, sometimes with yellow-olive leading edge; remiges grey-black with distinct white edges to inner webs. Bill mostly black on upper mandible, with pale bluish-grey cutting edge; lower mandible mostly bluish grey, sometimes with pinkish tinge and black tip. Iris, dark reddish-brown. Orbital ring, black. Legs, grey with brownish or bluish tinge. **Variation** **SUBSPECIES CHLORONOTUS**: From sw. and s. WA and sw. SA. Differs from subspecies in se. Aust. by: Entire upperparts, olive, lacking grey saddle; head, back, rump and

uppertail-coverts duller and paler; chin and throat slightly brighter lemon-yellow; flanks, pale brown; and undertail-coverts, bright lemon-yellow. **NOMINATE LATERALIS**: Occur in Tas., and migrate to se. mainland Aust.; also on NZ and Norfolk I. and other outlying islands. Similar to se. mainland Aust. subspecies (see above), but mainly differ by: chin and throat, pale-grey, sometimes with slight pale-yellow wash on sides of throat (never all pale lemon-yellow); flanks said to be darker and more chestnut, but this distinction subtle, and usually too much overlap in coloration to be useful. **N. AUST.**: Become paler farther N, especially subspecies *vegetus* from ne. Qld; head and upperparts, more yellowish olive; chin and throat, brighter lemon-yellow; flanks have pale-brown suffusion (not solidly rich brown); and undertail-coverts, bright lemon-yellow. **SUBSPECIES TEPHROPLEURUS**: Endemic to Lord Howe I. Largest subspecies (see Measurements). Probably not separable from se. mainland Aust. birds; top of head and upperparts duller than se. Aust. birds; chin and throat, bright yellow; and undertail-coverts, pale yellow. **Adult female** Usually indistinguishable from male, but if pair seen together (applicable only to those subspecies with darker brown flanks, especially *lateralis* and *westernensis*), females sometimes have paler brown flanks. **Juvenile** Similar to adult, but differs by: Tends to be slightly smaller; and feathers have looser texture. Loes, dark brown, not black, contrasting with rest of face; eye-ring narrower, sometimes almost absent; chin and throat, off-white with slight cream tinge; grey saddle has dirty-brownish tinge. Juveniles of subspecies with richly coloured flanks tend to have much paler light-brown wash to flanks. Tail-feathers narrower, with pointed tips. Bill, blackish on upper mandible with pinkish-orange cutting edge; lower mandible mostly pinkish orange, with black tip and yellow gape. Iris, dark reddish-brown. Orbital ring, grey. Legs and feet, pinkish brown. **Immature** Poorly known, probably not separable from adult in field.

Similar species Only likely to be confused with other white-eyes *Zosterops*; species whose ranges overlap (or potentially so) with that of Sivereye are: Pale White-eye of islands off C. York Pen. and in n. Great Barrier Reef; Yellow White-eye in e. Qld; and Slender-billed and White-chested White-eyes from Norfolk I.; see those species accounts for differences.

Occasionally occur singly or in pairs, but often in small flocks, and sometimes congregate in large flocks, occasionally of hundreds, especially when on passage. Continually move about in vegetation, calling softly while gleaning insects from leaves and branches, taking fruit, seeds or nectar; occasionally seen foraging on ground. Flight undulating, though less so than that of finches, on broad wings with slightly pointed tips, with members of flock continually overtaking each other. Flocks often move rapidly through bushland or gardens, often giving Contact Calls (see below). When on ground, hop rapidly, and when disturbed, fly quickly to perch. Sometimes quite tame, often visiting bird-tables. Males give at least two types of Songs, comprising beautiful, high-pitched trilling and warbling; sometimes mimic other species when singing. Also utter four different types of calls, most familiar of which is plaintive Contact Call, of which there are three different varieties, each differing in structure (see Voice). Calls of subspecies *chloromotus* said to be harsher than those of other subspecies.

HABITAT Inhabit most habitats with moderate cover of vegetation, especially shrubs, including shrublands, heathlands, woodlands, forests, rainforests and mangroves. Also often occur in modified habitats, especially gardens, orchards and vineyards (see below). Occur from coasts up to alpine habitats (during snow-free months), where recorded at elevations of up to 1850 m asl (e.g. Child 1975; R.H. Green *et al.* 1989; Osborne & Green 1992; Beauchamp & Parrish 1999; Hewish *et al.* 1999; ACT Atlas).

Aust. Often inhabit shrubland, including dense coastal scrub, dominated by shrubs such as Coast Tea-tree, Coastal Beard-heath *Leucopogon parviflorus*, Boobyalla *Myoporum insulare*, Coastal Wattle and Moonah *Melaleuca lanceolata*, or mixed associations of these plants (e.g. White 1921; Dickison 1932; Storr *et al.* 1952; Baxter 1989; Chan & Sutton 1993; Mitchell *et al.* 1996; Gosper 1999); or dense riparian shrubs (Bryant 1930; Green 1969; Bedgood 1980); or dense thickets, e.g. of Moonah, Summer Scented Wattle *Acacia rostellifera* and Slender Cypress-pine (Davies 1980). Also often occur in shrublands dominated by acacias, such as Brigalow, Western Coastal Wattle *Acacia cyclopsis*, Summer Scented Wattle or Dogwood Wattle *A. coriacea* (Morgan 1918; Sedgwick 1949a; Watson 1959; McEvey & Middleton 1968; Wells & Wells 1974; Abbott 1977b; Davies 1980; Leach & Hines 1987; Leach 1995; Storr 21, 26); or in low chenopod shrublands, with saltbush *Atriplex*, bluebush *Maireana* or samphire (White 1913; Perryman 1937; Hobbs 1961; Matheson 1976; Hewish *et al.* 1999; Storr 21, 24), e.g. near Torquay, Vic., recorded in low open coastal saltmarsh dominated by Beaded Glasswort *Sarcocornia quinqueflora* and Common Sea Heath *Frankenia pauciflora*, with thickets of taller (up to 2 m tall) Shrubby Glasswort *Sclerostegia arbuscula*, occurring in all levels (J.M. Peter). Also often occur in open or dense shrubby heathlands in coastal areas, alpine areas or inland semi-arid areas, with diverse mixture of shrubs (MacGillivray 1928; Ridpath & Moreau 1966; Abbott 1976; Gell 1977; Kikkawa *et al.* 1979; Pyke 1985; Pyke & Recher 1988; Morris 1989; Pyke *et al.* 1989; Hingston 1994; Mitchell *et al.* 1996; Possingham & Possingham 1997); and sometimes in taller, mixed heathland-mallee habitats (Saffer 2001). Sometimes also inhabit mallee shrublands or woodlands, often dominated by eucalypts, e.g. Giant Mallee, and sometimes in association with other low shrubs, such as Broombush *Melaleuca uncinata*, Bullockbush *Alectryon oleifolius* or saltbush *Rhagodia* (Mack 1961; Sedgwick 1964; Gell 1977; Woinarski 1989; Possingham & Possingham 1997; Baxter & Paton 1998). Also occur in most types of eucalypt woodlands and forests, often with shrubby understorey, e.g. in dry sclerophyll forests and woodlands, such as box-ironbark associations in e. Aust. (Egan *et al.* 1997; Tzaros 2005) and open Wandoo woodland and forest in sw. WA (Masters & Milhinch 1974; Arnold 1989, 2003; Davis & Recher 2002); and wet sclerophyll forests, including in moist gullies, such as forests dominated by Flooded Gum *Eucalyptus rudis*, Sydney Blue Gum *E. saligna* or Blackbutt in e. NSW (Recher 1975), Alpine Ash and Messmate *E. obliqua* in Vic. and n. Tas. (Ratkowsky & Ratkowsky 1977; Emison & Porter 1978; French 1990) and Karri in sw. WA (Tingay & Tingay 1983); in subalpine areas, inhabit low Snow Gum woodland (Gall & Longmore 1978). Also occur in other woodlands and forests dominated by other types of trees, either with single species dominant, or in mixed association, sometimes with eucalypts, including forests or woodlands of casuarinas such as Drooping Sheoak, paperbarks such as Mallee Honey Myrtle *Melaleuca brevifolia*, Scented Paperbark *Melaleuca squarrosa* or Moonah, cypress-pines *Callitris* such as White Cypress-pine or Slender Cypress-pine, banksias, Willow Myrtle *Agonis flexuosa*, Pandanus, or Pisonia *Pisonia grandis* (MacGillivray 1928; Clarke 1967; McEvey & Middleton 1968; Milledge 1972; Abbott 1976; Gell 1977; Emison & Porter 1978; Davies 1980; Catterall *et al.* 1982; Kikkawa & Wilson 1983; Halse *et al.* 1985; Walker 1986; Matthew & Carpenter 1993; Wood 1995; Wheeler & Calver 1996; Possingham & Possingham 1997; Lowry 1998; Major *et al.* 2001; Duckworth 2002a). Also occur in regrowth (e.g. Storr 1953; Luyk 1980; Tingay & Tingay 1983; Smith 1984; Laurance *et al.* 1996). Sometimes recorded in rainforest, ranging from cool-temperate rainforest to tall tropical rainforest (White 1946; Lavery & Hopkins 1963; Kikkawa *et al.* 1965; Ridpath & Moreau 1966; Kikkawa 1968;

especially scattered in parts of Western District, Wimmera, Mallee and Northern Country (Aust. Atlas 1, 2; Vic. Atlas).

Tas. Widespread (Thomas 1979; Aust. Atlas 1, 2); scattered nature of records in SW probably reflects paucity of observers. Also widespread on islands in Bass Str. (e.g. Green 1969; Green & McGarvie 1971; Whinray 1970, 1971, 1972; Pinner & Bird 1974; Brothers & Davis 1985; Field & Field 1989; Garnett *et al.* 1991; Aust. Atlas 1, 2) and offshore islands elsewhere (Milledge 1972; Brothers 1979; White 1985; Tas. Bird Rep. 10). **SA** Widespread from Vic. border W to near Denial Bay, and mainly N to 32°S, though also occur at a few scattered sites farther N to 31°S, e.g. Woomera, Childara Rockhole and Yumbarra CP (Mees 1969; Stove 1994; Horton 2000; Aust. Atlas 1, 2), except in n. Flinders Ras, where recorded N to Brindana Gorge and Mt Fitton (Hornsby 1997; Aust. Atlas 1, 2). Outside this range, also recorded at Billa Kalina Stn, SW of L. Eyre (SA Bird Rep. 1982–99) and occasionally farther W, at scattered sites on Nullarbor Plain W of Denial Bay, between Yalata and WA border and N to Cook (Mees 1969; Ford 1971; Carpenter & Matthew 1997; Aust. Atlas 1, 2; Hall). **WA** Widespread in S, SW and W, mainly in area bounded by line from Eucla to Kellerberrin (though also commonly occur farther N in Kalgoorlie), thence N to Cue, and thence W to Zuytdorp Cliffs, but also occur farther N in coastal and near-coastal areas of Gascoyne Region, to round Pt Cloates (Mees 1969; Arnold & Weeldenburg 1990; Saunders & Ingram 1995; Johnstone *et al.* 2000; Serventy & Whittell; Storr 16, 21, 26, 28, 35; Aust. Atlas 1, 2). Also occur on many offshore islands (e.g. Abbott 1977a,b; Lane 1982; Storr 21, 24, 27, 35).

NZ Widespread from North C. and C. Reinga S to Stewart I. and associated islets. **NI:** Widespread on mainland

(NZ Atlas; CSN); also recorded on many offshore islands (including record on remote Three Kings Is; Ramsay & Watt 1971), though apparently absent from Poor Knights Is (Kinsky & Sibson 1959; Bartle & Sagar 1987; CSN 37). **SI:** Widespread, though sparsely scattered in some areas on e. slopes of S. Alps and farther E, such as area between Wairau R. and Inland Kaikoura Ra. in Marlborough, some subcoastal areas of n. Canterbury, and inland areas of s. Canterbury, but especially in Otago, though this may reflect, at least in part, difficulty of access for observers. Also occur on Stewart I. and associated islets (NZ Atlas; CSN).

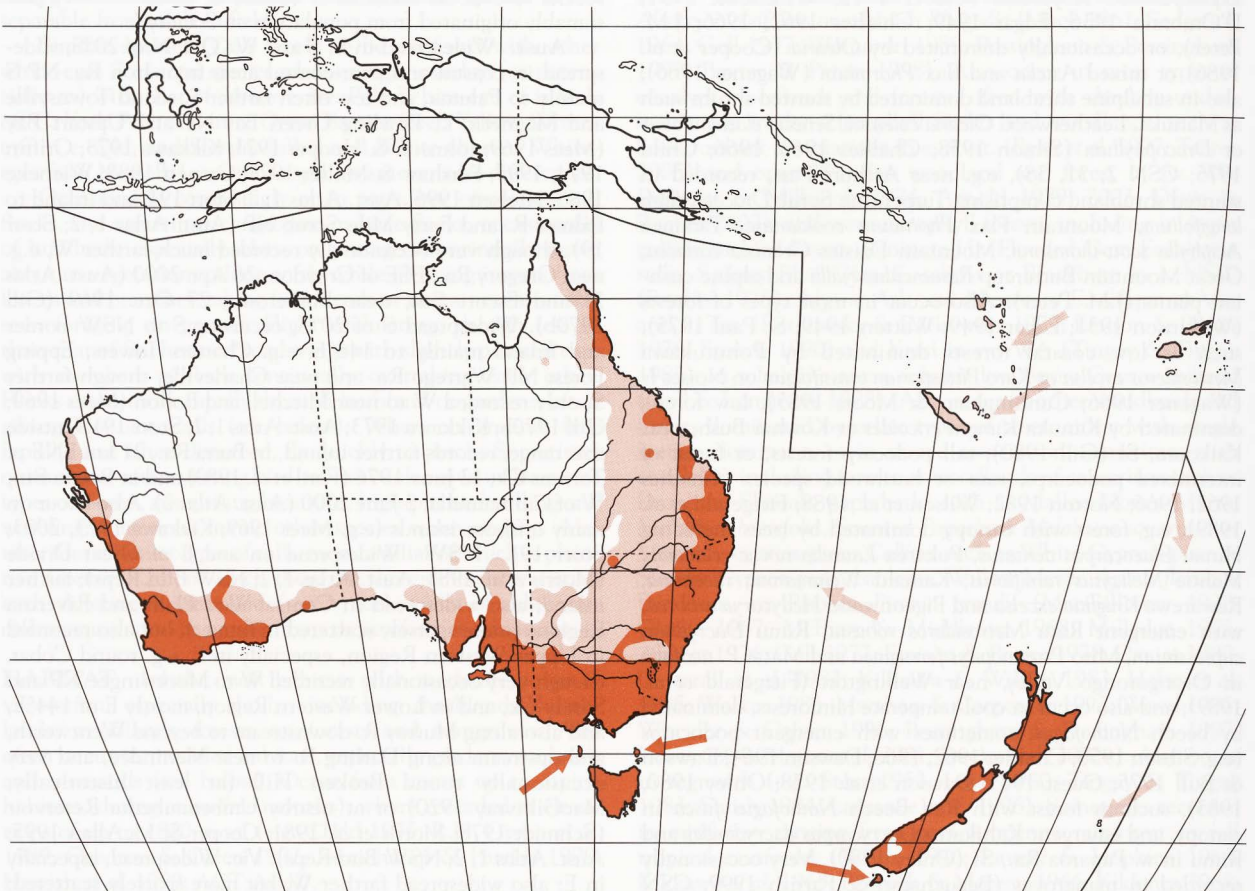
Lord Howe I. Subspecies *tephropleurus* widespread (Hutton 1991; McAllan *et al.* 2004). N nominate and other subspecies unsuccessfully introduced (see Introductions, below).

Norfolk I. Widespread breeding resident; also present on Phillip I. (Schodde *et al.* 1983; Hermes 1985; Hermes *et al.* 1986; Moore 1999). Third most numerous and widespread species, and most widespread native species (Schodde *et al.* 1983; Bell 1990). First recorded in 1904 (North 1904).

Macquarie I. Vagrant (Anon. 1987); single record, June 1915 (Falla 1937; Green 1989).

Kermadec Is Present in small numbers on Raoul I., Macauley I., Curtis I. and L'Esperance Rock, with largest flock of 45 birds recorded on Macauley I. in Sept. 1988 (Veitch *et al.* 2004). First recorded on Raoul and Macauley Is in 1887, when 'not plentiful' (Smith 1887; Cheeseman 1888); three recorded on Curtis I. and four on L'Esperance Rock, 15 Sept. 1988 (Veitch *et al.* 2004).

Chatham Is Common and widespread breeding resident (Freeman 1994; Nilsson *et al.* 1994); most abundant bird in remnant forests on Chatham I. (CSN 26), and described as most numerous passerine in South East I. (CSN 38; *contra*



Nilsson *et al.* 1994); also common on Pitt I., and small numbers on Mangere and Little Mangere Is (Freeman 1994). First recorded after storm in 1861 (Fleming 1939; Oliver), though also said to have arrived in mid-1850s (Thomson 1922).

Snares Is Common breeding resident (Horning & Horning 1974; Miskelly *et al.* 2001; CSN 24). Third most abundant passerine (Warham 1967).

Auckland Is Common on Auckland, Enderby and Rose Is (Taylor 1971; CSN 19 Suppl.), but possibly absent from Adams I. (CSN 19 Suppl.).

Antipodes Is Probably vagrant; not recorded before 1969: c. 10 recorded and a dead one found, Jan.–Mar. 1969 (Warham & Bell 1979); two, 1 Dec. 1978; two, 3 Dec. 1978; two, 6 Nov. 1995; single, 7 Nov. 1995 (Tennyson *et al.* 2002).

Campbell I. Widespread breeding species, first recorded in 1874 (Bailey & Sorensen 1962).

Breeding Aust. Throughout much of range, including on many offshore islands. In ne. Aust., mostly confined to Atherton Region (Wet Tropics), between site near Bloomfield R. and Mt Fisher (NE of Ravenshoe), though also recorded farther S in Paluma Ra. (Griffin 1995; Aust. Atlas 1, 2; NRS). Most records in e. Aust. occur on or E of Great Divide S from Pleystowe, near Mackay, extending from coast inland to w. slopes, though in n. NSW, single record in Aust. Atlas 1 much farther W at Brewarrina. Widespread in Vic. and Tas., and throughout most of range in SA, W to Ceduna. In WA, occasionally recorded at Eyre Bird Observatory, but mostly in area from C. Arid NP W to w. coast, and mostly N to 31°S (but also recorded farther N at Kalgoorlie), though more sparsely scattered E of 117°E; also recorded farther N in coastal and near-coastal areas between Three Springs and Carnarvon (Griffin 1995; Johnstone *et al.* 2000; Aust. Atlas 1, 2; NRS). **NZ** Probably throughout range, including on many offshore islands (CSN). **Outlying islands** Recorded on Lord Howe, Norfolk, Chatham, Snares and Campbell Is; possibly also breed on Auckland Is, but vagrants on Macquarie I. and Antipodes Is not recorded breeding (see above).

Introductions Lord Howe I. About 11 Silvereyes, sent from Sydney, released in July 1924; another 12 or so from Norfolk I. released in 1931, and a further eight in c. 1936 (Hindwood 1940b). **Outside HANZAB Region** Record of release of unknown number from NZ in Cook Is in 1926 (Oliver) may actually refer to release on Tahiti before 1938 (Guild 1938; Pratt *et al.* 1987), though also said to have originated from Tas. (Long 1981). Also said to have been released on Tetiaroa in 1973, possibly accidentally (Thibault 1976; Long 1981).

Change in range, populations Aust. Population on Lady Elliot I., Qld, disappeared between 1863 and 1873, when guano-mining operations destroyed all vegetation; island was recolonized in late 1970s, after regeneration had occurred (Walker 1986; Kikkawa 2003). Declines in numbers have been recorded in various areas in mainland Aust.: in se. Qld, appeared to decline between 1979–80 (mean 3.8 birds/count) and 1999–2000 (1.6 birds/count) (Woodall 1995, 2002); in Maroubra, suburban Sydney, declined between 1940s and 1980s (Bell 1983); in Aldinga Scrub NP, SA, declined between 1989 and 1995 (Ashton 1996); and declines also recorded in Wheatbelt of s. WA (Saunders & Ingram 1995), e.g. in Moore R. Valley, between early 1900s and early 1950s (Whitlock 1905; Loaring & Serventy 1952), and similarly declined in Wongan Hills (Milligan 1904; de Rebeira & de Rebeira 1977). Range in s. NSW expanded to include parts of Riverina in early 1920s, with first record in July 1920 (McKeown 1923), and common by late 1930s (Hindwood 1940a); and in WA, range expanded to include Kalgoorlie since c. 1943 (Slater 1955; Serventy & Whittell). **NZ** Said to have been first recorded, at Milford Sound, in c. 1832 (Thomson 1922; Oliver), and possibly elsewhere in Southland

and Otago in first half of 19th century, but apparently did not become established, though some believed that a population persisted in s. SI (Drummond 1909a; Turbott 1967). Next recorded in winter of 1856, when appeared on both NI and SI in great numbers: Waikanae in June and in Canterbury in July, and Dog I. in Foveaux Str.; also recorded at Wellington soon after (remained there for 3 months before leaving) and also in Nelson (Drummond 1909a; Thomson 1922; Andersen 1926; Stead 1932; Turbott 1967; Oliver). Expansion of range on SI paralleled that on NI, but more rapid. Regularly recorded in Nelson 1856–61; recorded in Otago in 1860 and n. Canterbury in 1861 (Oliver); by that time said to have been widespread in SI (Hutton & Drummond 1904; Oliver), coinciding with first record on Chatham Is (Fleming 1939; Oliver), though first record there may have been in 1856 or 1857 (Thomson 1922). Occurred regularly round Wellington 1858–61, and said to be widespread in s. NI in early 1860s; range expanded E to include Hawkes Bay in 1861, with breeding recorded at Te Wairoa in 1862; reached Napier in 1862, Wanganui in 1863, Great Barrier I. in c. 1864, Auckland in 1865, Bay of Islands in 1867 and North C. in 1868 (Hutton & Drummond 1904; Thomson 1922; Stead 1932; Bell & Brathwaite 1964; Oliver). Numbers round Wellington and in Hawkes Bay increased greatly in 1880s (Guthrie-Smith 1910; Turbott 1967). By early 1900s, recorded on many outlying islands, from Kermadec Is S to Campbell I. (Hutton & Drummond 1904; Drummond 1909a; Bailey & Sorensen 1962; Veitch *et al.* 2004; Oliver). Abundant by 1920s (Thomson 1922); considered one of the most (if not the most) plentiful species in NZ in 1920s and early 1930s (Stidolph 1922; Wilkinson 1931; Stead 1932). In more recent times, numbers recorded at various sites in Northland were lower, mostly significantly or highly significantly lower, in 1993 than in 1979, though this does not necessarily reflect an overall trend (Pierce *et al.* 1993; see Populations, below); and populations in W. Hutt, Wellington, declined 1981–92, with mean of 2.44 birds/10-min count in 1981–82, and 1.04 birds/count in 1992–93 (Gibb 2000a). **Lord Howe I.** Introduced nominate *lateralis* said to have been common by late 1920s (Sharland 1929), and still common in 1940, when populations have been increasing (Hindwood 1940b), but apparently died out between then and early 1970s (Disney & Smithers 1972; Fullagar & Disney 1975), probably before mid-1960s (McKean & Hindwood 1965).

Anomalies In some areas, numbers fluctuate wildly between years (e.g. Lane 1972b; Lashmar 1987; Templeton 1992) and though large numbers sometimes occur when on migration (e.g. Sutton 1990; see Movements, below, for details), these have been ignored here; large numbers occasionally appear in an area, remain for a period, then abruptly disappear; most well known was colonization of NZ in winter of 1856, when great numbers suddenly appeared at several sites from Waikanae, NI, S to Dog I. in Foveaux Str, then suddenly disappeared after a few months, and then reappeared in greater numbers round Wellington 2 years later (see Changes in range, populations, above, for details). Other influxes recorded at Akaroa in 1913 and 'enormous numbers' appeared in many areas of NZ in autumn 1926 (Moncrieff 1929). More recently, thousands arrived on Cuvier I., off Coromandel Pen., S. Auckland, on 11 July 1961, then departed as suddenly as they arrived, 12 days later (Blackburn 1967; CSN 9); 'huge numbers' and 'vast numbers' recorded in Murray–Mallee and South East Regions of s. SA from late 1963 till Mar. or Apr. 1964, but occurred in small numbers thereafter, and subsequent influx into Mt Lofty Ras, May–July (SA Bird Rep. 1964); in 1974–75, large influx recorded on n. Le Fevre Pen., SA, with numbers subsequently declining to low levels by 1977 (Winslet & Winslet 1987), influx coinciding with large numbers round Ivanhoe, Cobar and elsewhere in w. NSW

(Schmidt 1978; NSW Bird Rep. 1974); and huge influx recorded round Fernhill, Hawkes Bay, in Feb. 1992 (CSN 41).

Status Subspecies *tephropleurus* of Lord Howe I. vulnerable (Garnett & Crowley 2000). On Heron I., probability of extinction in 100 years calculated at 15% (Brook & Kikkawa 1998).

Populations Total population of subspecies *chlorocephalus* on Bushy I., Qld, estimated at c. 30 birds (Kikkawa 1997a). On Norfolk I., population in Norfolk I. NP estimated at c. 1400 (Moore 1999). On Snares Is, total population estimated at c. 100–200 pairs, 1985–87 (Miskelly *et al.* 2001). **RECORDED DENSITIES:** **Aust.** Up to 25.4 birds/ha, Heron I., Qld (Kikkawa & Wilson 1983); 5.0 and 0.86 birds/ha, near Tallegalla, Qld (Leach & Watson 1994); 0.57 birds/ha, Bollon, Qld (Cody 1991); up to 5.2 birds/ha, Corinda, suburban Brisbane (Walters 1985); 0.03–0.88 birds/ha and 0.01–0.12 birds/ha, near Armidale, NSW (Ford & Bell 1981; Ford *et al.* 1985); 0.13–1.96 birds/100 m along 1.2-km transect, New England NP, NSW (McFarland 1984a); 1.1 birds/ha, Hawkesbury R., NSW (Keast 1985a); 0.69–3.62 birds/ha, Puckeys Reserve, near Wollongong, NSW (Wood 1995); 0–0.75 birds/ha, near Bombala, NSW (Recher & Holmes 1985); 0.1–0.3 and 0.1–0.8 birds/ha, near Eden, NSW (Kavanagh *et al.* 1985; Kavanagh & Stanton 2003); 0.02–0.36 birds/ha, near Canberra (Bell 1980b); 0.38–1.5 birds/ha, Kosciuszko NP, NSW (Davey 2002a); maximum of 0.75 birds/ha, Olinda SF, Vic. (Mac Nally 1997); 0–0.64 birds/ha, near Moyston, Vic. (Kennedy 2003); 0.12–0.13 birds/ha, near Woodsdale, Tas. (Taylor *et al.* 1997); 0.94–8.21 birds/ha, Eyre Bird Observatory, WA (Davies 1982); 0–1.2 birds/ha, near Jarrahdale, WA (Wykes 1985); 1.6 birds/ha, Margaret R., WA (Keast 1985a); 0.10–0.16 birds/100 m along 800-m transects, Kellerberrin district, WA (Arnold & Weeldenburg 1990). **NZ** NI: 2.54 birds/5-min count, Raetea, Northland, 1979 (Pierce *et al.* 1993); 1.76 birds/5-min count, same site, 1993 (Pierce *et al.* 1993); 2.13 birds/5-min count, Puketi, Northland, 1979 (Pierce *et al.* 1993); 1.6 birds/5-min count, same site, 1993 (Pierce *et al.* 1993); 2.79 birds/5-min count, Mataraua, Northland, 1979 (Pierce *et al.* 1993); 1.28 birds/5-min count, same site, 1993 (Pierce *et al.* 1993); 1.78 birds/5-min count, Russell, Northland, 1979 (Pierce *et al.* 1993); 1.54 birds/5-min count, same site, 1993 (Pierce *et al.* 1993); 2.56 birds/5-min count, Omahuta, Northland, 1979 (Pierce *et al.* 1993); 1.9 birds/5-min count, same site, 1993 (Pierce *et al.* 1993); 1.35 birds/5-min count, Waipoua, Northland, 1979 (Pierce *et al.* 1993); 0.6 birds/5-min count, same site, 1993 (Pierce *et al.* 1993); 3.22 birds/5-min count, Auckland Domain (Gill 1989); 0.8 birds/5-min count (1.46; 333 counts), Kaitoke Wetland, Great Barrier I. (Anderson & Ogden 2003); 0.34 birds/5-min count (before rat poison distributed), 0.50 birds/5-min count (soon after poison dropped), and 2.8 birds/5-min count (5 months after poison dropped), Red Mercury I. (Robertson *et al.* 1993); <0.1–c. 2.5 birds/10-min count (estimated from graph), W. Hutt Hills (Gibb 2000b); 1.04–2.44 birds/10-min count (annual means, 1981–92), in same area (Gibb 2000a); c. 0.07–4.8 birds/10-min count (monthly means, 1981–92; estimated from graph), in same area (Gibb 2000a); 1.79 birds/5-min count, Ohau Gorge, near Levin (Gill 1983). **SI:** 2.6 birds/5-min count, near Nelson (Clout & Gaze 1984); 0.53–0.73 birds/5-min count, Kowhai Bush, Kaikoura, Marlborough (Gill 1980); c. 1.2–3.2 birds/5-min count (estimated from graph), Kennedys Bush Scenic Reserve, near Christchurch (Freeman 1999); 5 birds/ha, near Dunedin (Kikkawa 1960); 0.21–4.8 birds/5-min count, w. Paparoa Ra. (Onley 1980); 3.08 birds/5-min count, Fletcher Ck, near Reefton (Dawson *et al.* 1978); 3.78 birds/5-min count, Reefton Saddle, near Reefton (Dawson *et al.* 1978); 2.81 birds/5-min count, Te Wharau, near Reefton (Dawson *et al.* 1978); 0.58 birds/5-min count, Rahu Saddle, near Reefton (Dawson *et al.* 1978); 0.02–0.26 birds/5-min count, Ohikanui Valley, near Westport

(Wilson *et al.* 1988); 5.39 and 3.05 birds/5-min count, near Karamea (Onley 1983). **Chatham Is** 0.09 birds/ha, s. Chatham I. (Freeman 1994; CSN 37); 2.16 birds/5-min count, Tuku, Chatham I. (West 1988); 1.2 birds/5-min count, South East I. (West 1988).

THREATS AND HUMAN INTERACTIONS Considered a pest by orchardists, easily gaining access through mesh of most bird-netting to feed on ripening soft fruits and cherries, grapes and berries, both in Aust. and NZ. Also considered a major disseminator of environmental weeds (see Food: Pest status). Because of perception of pest status, 'a crusade was organized for its destruction' by early settlers (Drummond 1909a), and either shot or poisoned (Chisholm 1908a; White 1909); still occasionally shot or otherwise killed, sometimes in thousands (ABBBS 1970, 1977, 1978, 1979, 1984a, 1985; Passmore 1982; Burton 1996). One orchardist killed many by knocking them from fruit trees with a stick (Belcher 1914). Conversely, eat many invertebrate pests harmful to fruit, vegetables and cultivated flowers (e.g. Chisholm 1908a, 1910; Wilkinson 1924, 1931; Leach 1928; Stidolph 1931; Chisholm 1933, 1934, 1938; Officer 1958; Cooper 1974a; Fielding 1979; R.H. Green *et al.* 1989): originally called Blightbird in NZ, because the earliest Silvereyes there virtually eliminated American Blight or Woolly Aphids *Schizoneura lanigera* from Apple crops (Hutton & Drummond 1904; Drummond 1909a; Thomson 1922; Stead 1932; Turbott 1967; Oliver). Attracted to artificial feeding sites, such as feeding tables in gardens (see Food). Often killed by Cats (e.g. McLean 1912; Moncrieff 1935; Bull 1954, 1955; Kinsky 1957; Wakelin 1968; Mees 1974; ABBBS 1968a,b, 1984b, 1986, 1988; Dowling *et al.* 1994; Oliver) and very occasionally by Dogs (Dowling *et al.* 1994). Abundance of subspecies *tephropleurus* on Lord Howe I. said to have been a factor in withstanding massive build-up of rats in 1920s (Fullagar *et al.* 1974). Occasionally struck by vehicles (ABBBS 1971b, 1974; 1980; Brown *et al.* 1986; Lepski 1992; Taylor & Goldingay 2004) or collide with windows (Salter 1960; ABBBS 1971a, 1987; CSN 28) or light-houses (Le Souëf 1907; Drummond 1909a; Stuart-Sutherland 1922). Very occasionally formerly kept in captivity (E.C. Chisholm 1932b). Despite relatively recent arrival in NZ, formerly hunted by Maori, who named it *tauhou* ('stranger') (Thomson 1922): Silvereyes were knocked down with a stick, sometimes two or three at a time, either when attracted to birds tied to a special structure (*tau maimoa*) or when feeding in fruiting shrubs (St Paul 1975; Oliver); eaten whole, having barely been plucked or cleaned, and large numbers preserved in fat (Drummond 1909a; Oliver); prisoners on Chatham I. used eel-traps to capture them (Drummond 1910). In NZ, effective seed dispersal by Silvereyes can disseminate native plants into areas where few indigenous shrubs or birds exist, creating new habitat for endemic birds (Williams & Karl 1996); and Silvereyes may be important agents for seed dispersal in some forests (O'Donnell & Dilks 1994).

MOVEMENTS Sedentary, resident or part-migratory, and sometimes described as nomadic. Different subspecies undertake different patterns of movement; and overlapping ranges of subspecies in e. Aust. complicate analysis, especially when subspecies not specified in report; recent taxonomic revision (DAB) further complicates interpretation of reports. Movements studied intensively, but very complex and not fully understood (Clarke *et al.* 1999; Griffioen 2001). Detailed studies of movements, including migratory restlessness (sometimes referred to as Zugunruhe) (Chan 1994b, 1995a; see below), Pre-migratory fattening (Chan 1994a), banding studies (see below) and a discussion of the possible basis of partial migration (Chan & Kikkawa 1997). Local movements influenced by availability of food (Edwards 1925; Lord 1956;

Robinson 1960; Bedgood 1973a; Paton 1973; Brown & Brown 1982; Lashmar 1987; Hingston 1994; Heather & Robertson 2000; Vic. Atlas; CSN 6), e.g. peak numbers of migratory birds in Brisbane Water NP, NSW, were correlated with period of peak nectar production (Pyke & Recher 1988). Movements also affected by rainfall inland, e.g. appeared in Broken Hill after 2 years of drought (MacGillivray 1920). Tendency to migrate may be influenced by genetic, social and environmental factors; some birds may migrate regardless of external circumstances, while others influenced by behaviour of conspecifics or environmental conditions, such as weather and food supply (Chan & Kikkawa 1997). Both sexes migrate (Mees 1974; Chan & Kikkawa 1997). Some movement between sw. WA and se. Aust. suggested by limited banding recoveries (see Banding).

Described as resident or present throughout year at many sites in e. Aust. (e.g. Longmore 1978; Taylor 1984; Bell & Ford 1987; Morris 1989), e.g. sedentary nature of local birds in Sydney confirmed by banding, with some individuals trapped in every month (Lane 1962b, 1972a; Swanson 1968); many resident populations are, however, augmented by an influx of migratory birds (often identified as nominate *lateralis*), during autumn–winter, e.g. at Logan Reserve, se. Qld (Dawson *et al.* 1991), in sw. NSW (Hobbs 1961), and on Kangaroo I., SA (Baxter 1989); and in NZ, e.g. Wellington, NI (Gibb 2000a), and Dunedin, SI (Kikkawa 1962).

NOMINATE LATERALIS: (= 'Tas.-type' or 'buff-flanked' birds). Occur throughout Tas., including Furneaux Grp; also occur throughout NZ, from whence various outlying islands have been colonized. Reports identifying this subspecies made on the basis of flank-colour should be treated with caution (see Plumages). Broad-scale analysis of bird atlas and count data from e. Aust. found strong evidence for seasonal 'Coastal Y' pattern of movement, characterized by birds leaving Tas. and moving N along e. coast of mainland Aust. and also through inland se. Aust. (see Griffioen & Clarke 2002). Nominated *lateralis* part-migratory, leaving Tas. in autumn, wintering in se. Aust. as far N as se. Qld, and returning in spring to breed (Frith 1969; Green 1989, 1995; Thomas 1979; see below). Suggested that small proportion of population undertakes long-distance movements (Griffioen 2001; Griffioen & Clarke 2002) with large numbers wintering in Tas. (Lane 1968; Frith 1969), though abundant trans-Bass Str. migrant (Sutton 1998). Banding data indicates movement through coastal se. Aust. (Liddy 1966b; Napier 1969), though several birds banded in Tas. in winter and recovered in Sydney the following year on almost same date, and vice versa, indicating that some may not migrate (i.e. may winter in Tas.) each year (Mees 1974; Storr 19).

Departure and birds on n. passage TAS.: Depart autumn (Green 1995). N. passage over e. Bass Str., e.g. Eddystone Pt, Swan I. and Flinders I., recorded Mar. to late Apr. (Green 1969; Field & Field 1989; Tas. Bird Rep. 14); and in w. Bass Str., e.g. Hunter, Walker and King Is, Mar.–Apr. (McGarvie & Templeton 1974; Tas. Bird Rep. 14). VIC.: Mostly recorded on n. passage, flying in from over Bass Str., e.g. at C. Woolamai, Wilsons Prom. and near Seaspray, Mar. to early May, though occasionally till early June (Lane & Battam 1971; Garnett *et al.* 1991; Vic. Bird Rep. 1983); lighthouse on Clifly I., E of Wilsons Prom., struck by many in mid-Apr. (Le Souéf 1907). Become common in autumn in E. Gippsland (Ingle 1910). ACT: Recorded on passage through Canberra, Mar.–Apr., though direction of movement described as E, N and NW (Marchant 1973; Clark & Lenz 1978; Purchase 1994). NSW: N. passage recorded in Eurobodalla Shire mostly early or mid-May (though sometimes in mid-Apr.) to early or late July (e.g. Whiter 1994, 1995; Whiter & Andrew 1997, 1998); and through Barren Grounds Bird Observatory, May–June (Jordan 1984; Jordan & Jordan 1987; Bramwell 1990).

Non-breeding Winter throughout coastal se. Aust., NW to Adelaide and NE to Cooloola NP (proportion of 'Tas.-type birds' declines between Sydney and Brisbane), though many winter in Tas.; number of birds moving N along coastal e. Aust. varies between years (Lane 1972b). QLD: Some 'brown flanked' birds arrived Heron I., Capricorn Grp, May (Kikkawa 1970); present round Moreton Bay, late Apr. or May till Aug.–Sept., with rate of capture peaking at 5% of total in July (Agnew 1921; Robertson 1971; Durrant & MacRae 1994). NSW: Present in New England NP, Apr.–Oct. (McFarland 1984a); Orange, autumn–winter (Heron 1973); Sydney, May–Sept. (Lane 1972b); Illawarra Region, Apr.–Sept., though a few said to remain throughout year (Souter 1980; Smith & Chafer 1987; Chafer *et al.* 1999). Farther W, present in SW Apr. to early Sept. (Hobbs 1961), and a few recorded at Ivanhoe each winter (NSW Bird Rep. 1974). **PROPORTION OF 'TAS.-TYPE BIRDS' IN NSW:** At Kingscliff, comprised 5% of total banded in winter (n unknown) (Liddy 1966b); at Minnie Waters, 22% of winter population (N unknown) (Lane 1972b); at N Ryde, 61% of total population (n unknown) (Lane 1972b); and at Five Dock, comprised 1.6% of 189 caught (Lane 1972b). ACT: Autumn–winter visitor to Canberra (Veerman 2003). VIC.: Winter visitor to Dookie (Bedgood 1973a); present round Bendigo late Mar. to early Apr., comprising up to 26% of total population (Burton 1996). Present in winter on Wilsons Prom. (Cooper 1975). TAS.: Many winter on Flinders I. (Green 1969); and numerous at Lutana, Hobart, Apr.–Aug. (Thomas 1972). SA: Present on Kangaroo I. autumn–winter, arriving in May (Lashmar 1987; Baxter 1989).

Return and birds on s. passage NSW: Recorded on s. passage through Illawarra Region round Sept. (Chafer *et al.* 1999), e.g. Barren Grounds Bird Observatory, July–Oct. (Jordan 1984; Jordan & Jordan 1987; Bramwell 1990). VIC.: Observed on s. passage across e. Bass Str., late June to Jan., mainly mid-Sept. to mid-Nov. (Chan & Sutton 1993). TAS: Return in spring (Green 1995); Aug.–Oct. (Pizey & Knight 1997). Observed on s. passage over Albatross I. in Sept. (Brothers & Davis 1985) and over Black Pyramid in late Nov. (Green & McDonald 1963). Arrive Devonport early Sept. (Dove 1933). Mobile flock on Ninth I., late Sept. or early Oct. (Littler 1910) may have comprised returning birds.

NZ (Nominated *lateralis*) Colonized NZ unaided (see Distribution and Population). Said to have migrated between NI and SI in first few years of arrival, before becoming established on both islands (Oliver). Most movements recorded on SI, where often observed moving N in autumn and winter, possibly crossing into NI, e.g. via Farewell Spit (Dennison *et al.* 1981), but movement across Cook Str. not confirmed (Heather & Robertson 2000); sometimes also descend to lowlands from high altitudes, and occasionally also move S in autumn to overwinter in S of SI. Migratory movements less often described in NI, where usually described as resident or present throughout year, e.g. in Northland (Moncrieff 1929), Auckland (Fleming 1943), Masterton (CSN 1), Wellington (Wilkinson 1924, 1927; Wodzicki 1946), and Wanganui (CSN 41); also described as present throughout year on SI, in Canterbury (Stead 1932). Mobile flocks recorded in autumn and winter in Auckland, where suggested to be aggregations of the local breeding population (Fleming 1943); Wellington (Stidolph 1937; Cunningham 1946a); Kaikoura, where non-breeding visitors (Dean 1990); and n. Otago (Cunningham 1946a).

Departure and birds on autumn passage SI: Leave w. Paparoa Ra., late Feb. (Onley 1980). N. passage mostly reported Apr.–June, e.g. in Otago and Canterbury, from c. mid-Apr. (Oliver), including late Apr. to early May near Christchurch (Stead 1932; Cunningham 1946a); and in West Coast, at Greymouth in June (Grant 1970) and Charleston, Apr. and

June (CSN 31); move into Nelson, mid-Mar. to Apr. (Moncrieff 1929), where recorded on passage at Farewell Spit, mid-May (Dennison *et al.* 1981). Conversely, recorded on s. passage through Dunedin, mid-Apr. (CSN 3), and Granity, W. Coast, in Apr. (CSN 35); and also once recorded on w. passage over Christchurch, Apr. (Dawson 1961). NI: Leave Wellington in Mar. (Moncrieff 1929) or Apr.–May (Gibb 2000a), with flocks moving through Paekakariki in late Mar. (Moncrieff 1929); and, in Manawatu, depart Ohau R., near Otaki, early Apr. (Stidolph 1949). Elsewhere, flocks on n. passage recorded in Wairarapa, late Mar. (Moncrieff 1929); in Volcanic Plateau in late autumn (Moncrieff 1929); part of population in Bay of Plenty departs in late summer to autumn (Moncrieff 1929); and most plentiful in Auckland in late autumn (Moncrieff 1929), possibly reflecting birds on passage.

Non-breeding NI: In various areas, such as Port Whangarei in Northland, Taumuranui in Volcanic Plateau and Kapiti I. in Wellington, arrive in autumn, and often remain till spring (Moncrieff 1929; Wilkinson 1931; Beauchamp & Parrish 1999), e.g. arrive at Fernhill, near Hastings, Feb.–Mar. (CSN 41) and Dargaville in Apr. (CSN 19), and present round Rotorua Mar.–Sept. (CSN 6, 7). SI: Winter visitor to many areas, including Akaroa and Orari in Canterbury, Waikaia (N of Gore), Glenorchy (NW of Queenstown), and various places in West Coast (Moncrieff 1929; CSN 1), e.g. in Marlborough, arrive in May and remain till Sept. on mainland (Moncrieff 1929; CSN 28), but present on Brothers Is, Mar.–Oct. (Sutherland 1952). Elsewhere, mostly arrive Mar.–May, e.g. at Christchurch, Hildethorpe, Dunedin and Clinton in Otago, and Riverton, W of Invercargill (Anon. 1904; Moncrieff 1929; Taylor 1949; CSN 1, 19, 31), but once arrived at Alexandra in late Jan. after exceptionally cool summer (CSN 31).

Return NI: Return to Wairarapa, Sept. (Stidolph 1937) and Wellington in spring (Moncrieff 1929). SI: Flocks appeared in Nelson, in Aug., moving S (Moncrieff 1929).

Outlying islands Nominatate *lateralis* resident on most outlying islands (see Distribution and Population), but occasional visitor to Kermadec Is, sometimes appearing after sw. gales (Iredale 1910; Sorensen 1964); and vagrants have reached Macquarie and Antipodes Is (Anon. 1987; Tennyson *et al.* 2002).

Subspecies *vegetus* Occur in ne. Qld. Described as sedentary, resident or present throughout year; local movements considered 'nomadic' (Bravery 1970; Gill 1970a; Griffin 1995; Nielsen 1996; Griffioen 2001; Storr 19).

Subspecies *chlorocephalus* Endemic to Capricorn and Bunker Grps, Qld. Sedentary, with occasional movement between islands; winter range centred round breeding territories, with adults ranging over smaller areas than juveniles (Kikkawa 1976; Catterall *et al.* 1989; Slater 1994).

Subspecies *cornwalli* Occur in se. Qld, and e. and ne. NSW. Described as erratic migrant in se. Qld, tending to move N in autumn and S in late winter to early spring (Storr 19). Once recorded on Heron I., Capricorn Grp, in winter; birds on n. passage were probably blown off course by strong s. or w. winds (Kikkawa 1970).

Subspecies *westernensis* Occur in se. NSW and e. Vic. Some migrate N along e. coast in winter (Vic. Atlas). **Departure** Leave E. Gippsland in Mar.–May, when e. or ne. movements recorded (Bedggood 1970; Burbidge 1985; Crawford & Howard 1989); begin to leave ACT Mar. to mid-May (Lamm & Wilson 1966; Tidemann *et al.* 1988; ACT Atlas). Leave Barren Grounds Bird Observatory after summer (Jordan 1984; Jordan & Jordan 1987; Bramwell 1990). **Return** Arrive E. Gippsland Sept., and recorded in steady continuous w. or sw. movement parallel to coastline, usually Sept.–Oct. (Bedggood 1970; Vincent 1978; Crawford & Howard 1989; Dow & Dow 1989).

Subspecies *ochrochous* Occur on King I. No information.

Subspecies *pinarochoous* Occur in w. Vic and e. SA. Described as locally nomadic in Vic. (Vic. Atlas), though regularly leave Naracoorte, se. SA, by late Feb. and return by early Oct. (Attiwill 1972). Recoveries of banded birds suggest some SE–NW movement (Lane 1972b): one banded at Dunmore, Vic., Mar. 1966, was recovered at Nildottie, SA, Apr. 1966, 453 km NNW; and another, banded near Adelaide, June 1965, was recovered at Meredith, Vic., Oct. 1965, 571 km ESE (Lane 1972a).

Subspecies *chloronotus* Occur in w. SA and WA. Usually considered resident throughout most of range in WA (e.g. Alexander 1921; Jenkins 1931; Ford 1965; Storr 1966; Heron 1970; Masters & Milhinch 1974; Congreve & Congreve 1985; Sedgwick 1988; Abbott 1995; Mawson & Massam 1995; Storr 24, 26). In Wheatbelt, resident in areas of high rainfall, but seasonal visitor or nomadic in lower-rainfall areas, and status varies between years; some probably make short-range N–S movements, wintering inland and moving to coast in summer (Ambrose 1991; Saunders & Ingram 1995). At Manjimup, resident population augmented by nomadic birds Dec.–June, peaking Jan.–Feb. (Brown & Brown 1982). Generally visit South-East Interior late May to Nov. (Storr 26). In Eucla Div., autumn–winter visitor to inland parts (Storr 27), while at Eyre Bird Observatory, small resident population irregularly augmented by roving flocks (Congreve & Congreve 1985; Ashton *et al.* 1996; Dymond 1988). No difference in abundance between summer and winter in s. WA (Clarke *et al.* 1999).

Subspecies *tephropleurus* Lord Howe I.; resident (McAllan *et al.* 2004).

Unknown subspecies or mixed flocks DEPARTURE OR BIRDS ON N. PASSAGE SA: Recorded on n. passage through C. Jervis, early May (Paton 1988). VIC.: N. passage round Geelong, Apr.–May (Russell 1987; Hewish 1997). ACT: Migratory flocks in autumn said to contain at least four plumage types (Anon. 1976); recorded on n. passage late Mar. to June (Crawford 1994; ACT Atlas). NSW: Birds on n. passage mostly recorded autumn or early winter, e.g. in Eurobodalla Shire, mostly Mar.–July (e.g. Whiter 1994, 1995, 1996), but sometimes as early as early Feb. and as late as mid-Aug. (Whiter 1993; Whiter & Andrew 1998); near Wollongong, late Feb. to mid-July (Lane & Battam 1971); near Sydney, Apr.–May (Gilbert 1935; Lane & Battam 1971); large mobile flocks in autumn round Comboyne, SW of Port Macquarie (Chisholm 1934), probably reflect birds on n. passage;

Plate 49

(K. Franklin)

Christmas Island White-eye *Zosterops natalis* (page 1730)
1 Adult

Pale White-eye *Zosterops citrinellus* (page 1734)
SUBSPECIES ALBIVENTRIS: 2 Adult; 3 Juvenile; 4, 5 Adult

Yellow White-eye *Zosterops luteus* (page 1737)
NOMINATE LUTEUS: 6 Adult; 7 Juvenile; 8, 9 Adult
SUBSPECIES BALSTONI: 10 Adult

Robust White-eye *Zosterops strenuus* (page 1793)
11 Adult

Slender-billed White-eye *Zosterops tenuirostris* (page 1794)
12 Adult

White-chested White-eye *Zosterops albogularis* (page 1798)
13 Adult

Kempsey, June (NSW Bird Rep. 2000); and near Kingscliff, Apr.–May (Liddy 1966a,b). Pale-flanked birds absent after Apr. in New England NP (McFarland 1984a). QLD: Recorded on n. passage on Fraser I., autumn–winter (Sutton 1990).

NON-BREEDING: QLD: Flocks of mixed subspecies move through Logan Reserve, near Brisbane, Apr.–Sept. (Dawson *et al.* 1991). NSW: Flocks of mixed subspecies abundant round Armidale, Apr.–Sept. (Ford *et al.* 1985; Bell & Ford 1987); Hunter Region, Apr.–Sept. (Morris 1975); Campbelltown, in winter (Leishman 1994); and round Ivanhoe, late Mar. to Aug. (NSW Bird Rep. 1974). Otherwise, unknown subspecies recorded wintering in various areas, e.g. Blue Mts (Hardy & Farrell 1990); Menai, Apr.–Sept. (Egan 1997); Illawarra Region, May–Sept. (Gibson 1977); Wentworth, autumn–winter (Cheney & Morgan 1920); and Cobar (Schmidt 1978). In addition, small flocks recorded round Moree in autumn, but do not remain (Morse 1922). VIC.: Present Laverton, Mar.–Oct. (Watson 1955). SA: Autumn–winter visitor to Adelaide (Whatmough 1978) and Port Wakefield (Taylor 1987); present Le Fevre Pen., Mar.–Sept. (Winslet & Winslet 1987).

RETURN AND BIRDS ON S. PASSAGE: NSW: Recorded on s. passage at Tweed Heads, early Nov. (Lane & Battam 1971); farther S, move through Sydney and Illawarra Regions, Aug.–Oct. (Lane & Battam 1971) with 'mainland' birds appearing at Barren Grounds Bird Observatory in summer (Jordan 1984; Jordan & Jordan 1987; Bramwell 1990); in SE, s. passage noted in Eurobodalla Shire, mainly Sept.–Oct. (Marchant 1979, 1992; Whiter 1987, 1993, 1994, 1996; Whiter & Andrew 1997) and near Bombala in Oct. (Recher & Holmes 1985). Pale-flanked birds recorded in New England NP from Aug. (McFarland 1984a). ACT: Recorded on s. passage, Sept.–Oct. (ACT Atlas; Lamm & Wilson 1966; Marchant 1973). VIC.: Arrive Melbourne or occur on s. passage, late Aug. to Sept. (Thomas 1969; Lane & Battam 1971); and birds on s. passage recorded in spring at Barunah Plains, W of Geelong (Russell 1921), though once in Geelong, large flocks seen flying S for several days in early June (Hewish 1995). SA: Small flock seen briefly round L. Frome in Oct.; thought to have been birds on passage (McGilp 1923).

Altitudinal movements Recorded in both Aust. and NZ, moving to high elevations to breed, then descending to lowlands in winter (e.g. Oliver). In S. Highlands of NSW, seldom recorded >800 m asl in May and June, and return to ranges in Sept. (ACT Atlas), e.g. summer breeding visitor to Thredbo Valley, up to 1830 m asl (Gall & Longmore 1978); and summer visitor to upland Mountain Ash forests near Toolangi, Vic. (Loyn 1985a). Elsewhere, movement down Hollyford R. valley in mid-May (CSN 5) may reflect altitudinal movement; and winter visitors to Richmond R. district, ne. NSW (Gosper 1992) and Minginui, NI (CSN 4, 5, 7, 8, 9), thought to have come from higher altitudes. Further, in lowland forest near Punakaiki, numbers increase from Jan., peak in April, declining to June (Onley 1980), possibly reflecting altitudinal movements.

Nature of passage When on migration, often occur in large, tightly bunched flocks of up to 500 birds (e.g. Chisholm

1934; Dennison *et al.* 1981; Chan & Sutton 1993; Heather & Robertson 2000); recorded in continuous stream, >50 m wide, flying S from Tweed Heads (Lane & Battam 1971), and at Greymouth, SI, passed at rate of c. 2000 birds/h at peak (Grant 1970). Sometimes recorded in mixed-species migratory flocks with honeyeaters, e.g. Yellow-faced Honeyeaters *Lichenostomus chrysops* (Liddy 1966a,b; Whiter 1993). Call constantly from within migratory flocks (Stead 1932; Cunningham 1946a; CSN 5; D.P.A. Pool); such calling suggested to induce and maintain cohesion of flock (Chan & Sutton 1993; see Social Behaviour: Flock behaviour). During migration, fly 'very high' or 'at a fair height' (Moncrieff 1929; CSN 31), e.g. flight observed at c. 200–600 m asl (Chan 1994a), c. 15–200 m (Dennison *et al.* 1981), 100 m (Brothers & Davis 1985), or c. 45 m (Lane & Battam 1971). When crossing Bass Str., sometimes fly via chains of islands, e.g. seen passing over Black Pyramid and Albatross I., apparently *en route* from King I. (Green & McDonald 1963; Brothers & Davis 1985), and congregated on Swan I., ne. Tas., before flying directly towards Clarke I., in Furneaux Grp (Field & Field 1989); however, also seen flying directly S from Wilsons Prom., Vic., over open sea rather than towards nearby chains of islands (Chan & Sutton 1993). Once, birds on n. passage on Fraser I., se. Qld, doubled back on reaching Sandy C. and encountering open water (Sutton 1990). Birds on n. passage arrived at C. Jervis, SA, travelling from ESE, then briefly milled around or settled, before taking off in different direction, this time NE or ENE along n. coastline of Fleurieu Pen. (Paton 1988). Observed on n. passage at Farewell Spit, SI, presumably about to cross Cook Str., flying E along line of spit, but not to tip, which points SE (Dennison *et al.* 1981). Near Dargaville, NI, flock once arrived from S, from across water rather than along coast (CSN 19). Often migrate at night (Anon. 1904; Le Souëf & Macpherson 1920; Gilbert 1935; Stead 1932; Stidolph 1937; Cunningham 1946a; Dawson 1961; Liddy 1966b; Mees 1969; Crawford & Howard 1989; Purchase 1994), with movements recorded at all times during darkness, e.g. in evening (Le Souëf & Macpherson 1920; Stidolph 1937; Lane & Battam 1971), 03:00 (D.P.A. Pool) or shortly before or at dawn (Ashby 1928; Crawford 1994; Wilson 1999; CSN 5). Nocturnal n. passage near Wollongong, NSW, ceased by dawn, Feb. to early Apr., but then extended into daylight till July (Lane & Battam 1971). At Wilsons Prom. and C. Liptrap, s. Vic., mostly take off from 1 h before sunrise to c. 10:00 (Chan & Sutton 1993). Diurnal passage at Farewell Spit, SI, recorded throughout morning, but diminished towards noon (Dennison *et al.* 1981). Large-scale migration also recorded during day elsewhere (Grant 1970; Chan & Sutton 1993). Flight when on migration swift (Moncrieff 1929), with speed estimated at c. 48–56 km/h (Lane & Battam 1971). For behaviour of flocks on migration, see Social Behaviour: Flock behaviour.

PRE-MIGRATORY FATTENING: Birds trapped at C. Liptrap, Vic., Oct.–Nov., showed pre-migratory fattening, with twice the lipid reserve of birds in winter. Calculated that 0.6 g of mobilizable fat required to cross Bass Str. non-stop; most birds had >1 g, with excess fat possibly providing safety margin in case of unfavourable winds (Chan 1994a, 1995d). In addition, some pre-migratory fattening suggested by weights of nominate *lateralis* on Deal I., Tas., and Wilsons Prom., s. Vic., in autumn and spring (Garnett *et al.* 1991).

MIGRATORY RESTLESSNESS: Migratory restlessness described near Wellington, with flocks circling and calling excitedly, after which numbers of Silvereyes declined (Gibb 2000a). In study of wild-caught 'resident' and 'migrant' birds in captivity, elevated nocturnal activity recorded only in 'migrants' in autumn and spring, and higher diurnal activity and more night restlessness in 'migrants' in winter. Migratory restlessness usually began before dawn and continued till c. 2–3 hours after dawn (Chan 1994b, 1995a).

Plate 50

(K. Franklin)

Silvereye *Zosterops lateralis* (page 1745)

SUBSPECIES VEGETUS: 1 Adult

SUBSPECIES CORNWALLI: 2 Adult

SUBSPECIES TEPHROPLEURUS: 3 Adult

SUBSPECIES WESTERNENSIS: 4 Adult; 5 Juvenile; 6, 7 Adult

NOMINATE LATERALIS: 8 Adult male; 9 Adult female

SUBSPECIES CHLORONOTUS: 10 Adult; 11 Juvenile;

12, 13 Adult

Banding AUST.: Most banded land bird in Aust. Of 299,968 banded in Aust., 1953–June 2003, 15,274 recoveries (5.1%), of 10,349 birds: 14,849 (97.2%) <10 km from banding place; 231 (1.5%) 10–49 km; 50 (0.3%) 50–99 km; and 144 (0.9%) >100 km (ABBBS). **LONG-DISTANCE RECOVERIES:** From Margaret R., WA, to near Braidwood, NSW (3159 km, 103°, 123 months, Apr., +1); Aldinga Scrub CP, SA, to near Mt Saddleback, WA (2022 km, 271°, 70 months, Oct., +1); Marion Bay, SA, to Helena Valley, WA (1974 km, 274°, 17 months, Sept., +1); Hastings Point, NSW, to Don, Tas. (1569 km, 203°, 10 months^D, July, +1); Pallara S, Qld, to Wimpy, Vic. (1454 km, 225°, 7 months, Sept., +1); Yurager NP, NSW, to Swanwick, Tas. (1444 km, 197°, 7 months, June, +1); Port Fairy, Vic., to Minnie Water, NSW (1397 km, 50°, 61 months, July, +1); near Cudgen, NSW, to Silvan, Vic. (1301 km, 214°, unknown, June, +1); Yanakie, Vic., to Tatham, NSW (1276 km, 32°, 3 months^P, Mar., +1); Exeter, Tas., to near Uralla, NSW (1255 km, 21°, 26 months, July, +1) (ABBBS). **LONGEVITY:** AUST.: Adult banded at Earlwood, NSW, 1 August 1986, recaptured near banding place over 13 years after banding (ABBBS); adult banded in Sandy Ck CP, SA, 26 Feb. 1972, recaptured at banding site over 9 years 2 months later (Hutchins 2005). NZ: Adult banded at Lower Hutt, NI, 17 June 1983, recaptured near banding place over 11 years after banding (Cossee 1997).

Banding studies confirm migratory movement between Tas. and NSW (Hitchcock 1961; Liddy 1966b; see above). Though >200,000 birds banded by 1995, only 32 recovered soon enough after banding to provide information on timing of movements (Clarke *et al.* 1999). In banding study on Kangaroo I., SA, birds banded in autumn had lowest rate of retrapping, and suggested to have been mainly migrants on passage; birds banded in winter retrapped at steady rate throughout year, and most likely resident birds (Lashmar 1987). Recoveries indicate movement between Kangaroo I. and adjacent mainland, mainly Fleurieu Pen. (Paton & Paton 1980; Lashmar 1987).

FOOD Wide variety of fruits and insects, also nectar, other invertebrates, food scraps, flowers and seeds. **Behaviour** Forage from ground up to canopy of trees and in air, using various foraging methods, especially gleaning from foliage among shrub-layer. Often forage in small groups, and often in mixed-species flocks. Sometimes glean fruit from trees, and sometimes thus considered highly destructive in orchards (see below).

DETAILED STUDIES: On Heron I., Qld (Henderson 1977 [May 1974–75, Nov. 1974–75, Oct. 1973 and Oct. 1975]; Catterall 1978 [Oct. 1972–Mar. 1973, May and Aug. 1973, Sept. 1973–Jan. 1974, May 1974, Dec. 1974], Catterall 1985 [May 1974–75]; Catterall *et al.* 1982 [Sept. 1972–Mar. 1973 and Sept. 1973–Jan. 1974], Catterall *et al.* 1989 [1972–73; June–July 1981–82; May–July 1979–83]; Jansen 1990 [15 July–2 Aug. 1987]); near Armidale, ne. NSW, 1981–82 and 1984 (Ford *et al.* 1986); near Bombala, in se. NSW and ne. Vic., Oct. 1980–Jan. 1981 (Recher *et al.* 1985; Holmes & Recher 1986); at Lerderderg Gorge, near Bacchus Marsh, Vic., Dec.–Mar. 1997–98 and 1998–99, and Feb.–Mar. 2000 (Stanley 2001); at Maggs Mt, Tas., 1976–86 (R.H. Green *et al.* 1989); round Manjimup and Pemberton, sw. WA, Jan.–Mar. 1970–72 and Aug. 1970 (Matthiessen & Springett 1973); at Dryandra, sw. WA, 6–15 Aug. 1995 (Recher & Davis 1998); near Perth, sw. WA, Apr.–July 1980 (Tullis *et al.* 1982); on Rottnest I., May–July 1993 (Wheeler & Calver 1996); near Nelson, SI, June–July 1976 and May–Aug. 1977 (Moed 1979), and Feb. 1992–June 1993 and Dec. 1993–June 1994 (Williams & Karl 1996); at Kowhai Bush, Kaikoura, SI, May 1976–Sept. 1977 (Gill 1980); at Christchurch Botanic Gardens, 29 May–5 Aug. 1967 (East 1967); at Windbag Valley, SI, Oct. 1983–Dec. 1985 (O'Donnell & Dilks 1994);

and on Norfolk I., 1 Oct.–3 Dec. 1987 (Robinson 1988); also laboratory studies on fruit choice of captive birds (Puckey *et al.* 1996; Giles & Lill 1999; Stanley *et al.* 2002).

FORAGING ASSOCIATIONS: Forage singly, in twos and in flocks ranging from a few birds up to 50–60, and very occasionally hundreds (e.g. Cohn 1926; Favaloro 1926; Gilbert 1935; Fleming 1943; Cunningham 1946a; Ryder 1948; Cooper 1975; Field & Field 1989; R.H. Green *et al.* 1989; McFarland 1994; Peter 2000; CSN). Large flocks typically occur autumn–winter, when food scarce, though may congregate at abundant food sources at any time (e.g. Dove 1906b; Jerrard 1932; McNamara 1937; Fleming 1943; Ryder 1948; Kikkawa 1962; Baxter 1989; Heather & Robertson 2000; CSN 2, 4, 6, 26). On Heron I., forage singly when gathering food for nestlings and fledgelings (Kikkawa & Wilson 1983; Wilson & Kikkawa 1988); and commonly in flocks of 4–5 to 30 birds (or sometimes singly, in twos or very small groups) in non-breeding season (Catterall 1978, 1985; Catterall *et al.* 1982). In non-breeding season, adults tend to forage in twos or small groups of 4–6 birds, whereas juveniles more common in larger flocks (Catterall 1978; Catterall *et al.* 1989). On Heron I., of 415 foraging observations of adults and 1083 of juveniles, 60% of adults were in flocks of <5 (includes singles and twos), 25% 5–10 birds and 15% >10; and 27% of juveniles in flocks of <5, 30% 5–10 birds and 43% >10 (Catterall *et al.* 1989). In Hale CP, SA, of 80 observations of foraging on nectar of Flame Heath *Astroloma conostephioides*, seven (8.8%) were of single birds, twos or flocks of up to four, and 73 (91.2%) were of flocks of five or more (Wheal 1996). Often forage in mixed-species flocks (e.g. Erickson 1951). AUST.: In Dryandra SF, WA, of 13 mixed-species flocks containing Silvereyes, one comprised two species and 12 comprised three or more species; associated with 12 other species, but mostly with Weebill *Smicromis brevirostris*, Western Gerygone, Inland *Acanthiza apicalis*, Western *A. inornata* and Yellow-rumped *A. chrysorrhoa* Thornbills, Golden Whistler *Pachycephala pectoralis* and Grey Fantail *Rhipidura fuliginosa* (Davis & Recher 2002). In Black Mt Reserve, ACT, of 27 birds seen, 15 (40.7%) were in five mixed-species feeding flocks (Bell 1980a). Often feed with thornbills and honeyeaters in Sandy Ck CP, SA (Rix 1976); and with other passerines at Logan Reserve, Qld (Dawson *et al.* 1991). On Swan I., Tas., flocks of up to c. 30 Silvereyes foraged with White-fronted Chats *Epthianura albifrons* among beachcast seaweed (Field & Field 1989). Also recorded foraging with fairy-wrens *Malurus*, including Superb *Malurus cyaneus* and Splendid *M. splendens* Fairy-wrens (Mollison 1961; Haines 1968; Ashford 1992), Spotted Pardalote *Pardalotus punctatus* and Striated Pardalote *P. striatus* (Carpenter & Matthew 1997), Speckled Warbler *Chthonicola sagittata* (Tzaros 1996), Brown Thornbill (Mitchell 1997), various honeyeaters, such as Yellow-faced, Yellow-tufted *Lichenostomus melanops*, Yellow-plumed *L. ornatus*, Fuscous *L. fuscus*, White-plumed *L. penicillatus*, White-naped *Melithreptus lunatus*, Brown Lichmera *indistincta* and New-Holland *Phylidonyris novaehollandiae* Honeyeaters and Eastern Spinebill *Acanthorhynchus tenuirostris* (Keast 1975; Ashford 1992; Gladstone 1996; Mitchell 1997), Golden Whistler *Pachycephala pectoralis* (Mollison 1961), House Sparrow *Passer domesticus* (Mollison 1961; Haines 1968; Cooper 1974a), Mistletoebird *Dicaeum hirundinaceum* (Griffiths 1977), Red-whiskered Bulbul *Pycnonotus jocosus* (Haines 1968), Australian Reed-Warbler *Acrocephalus australis* (Haines 1968) and Common Blackbird *Turdus merula* (Mollison 1961). At Hughes, ACT, 200 passed rapidly through garden, feeding with other species as part of a 'bird wave' (Leonard 1996). NZ: At Kowhai Bush, SI, of 76 mixed-species foraging flocks recorded during non-breeding season, Silvereyes present in 26 (34.2%) with mean 4.2 (1.8; 2–8) Silvereyes/flock. Of 248 Silvereyes observed foraging, 92 (37.1%) were in mixed-species flocks; seasonally, proportions

in mixed-species flocks were: none in spring (n=25 birds); 19.0% in summer (n=63); 43.1% in autumn (n=51); and 53.2% in winter (n=109). Of 26 mixed-species flocks with Silvereyes: 21 (80.8%) contained Grey Warblers, 17 (65.4%) had Brown Creepers *Mohoua novaeseelandiae*, 11 (42.3%) had Grey Fantails, seven (26.9%) had Common Redpolls *Carduelis flammea* and four (15.4%) had Common Chaffinches *Fringilla coelebs* (Dean 1990). At Puketitiri, Hawkes Bay, NI, up to 15 fed regularly with 6–8 Greenfinches *Carduelis chloris* in Apr. and May (Lewis 1961). Recorded foraging with finches, including House Sparrows (Taylor 1989; CSN 39); Grey Fantails sometimes follow foraging Silvereyes, feeding on insects they disturb (Stidolph 1950; Blackburn 1967). **OUTLYING ISLANDS:** On Norfolk I., often forage with Slender-billed and White-chested White-eyes (Mees 1969; Rooke 1986). On Chatham I., associate with Chatham Island Warblers *Gerygone albofrontata* and Grey Fantails (Dennison *et al.* 1978, 1979).

FORAGING TERRITORIES: On Heron I., adults forage over smaller areas than juveniles. In winter, range-length (farthest distance between foraging sites at which individual recorded): of 459 adults: 44% were <50 m, 47% 50–299 m and 9% ≥300 m; of 431 juveniles: 33% <50 m, 48% 50–299 m and 19% ≥300 m. Adults forage near breeding territories, typically concentrated round abundant food sources, and often defended against individuals or small groups of intruders. In two winters, mean distances between nest-site from previous season and feeding sites where chasing observed were 23.0 m (11.96; 21) and 31.9 m (24.18; 29). Same area probably used throughout year for most foraging, though ranges change with availability of food (Catterall *et al.* 1982, 1989).

FORAGING HEIGHTS: Forage at all heights among vegetation, and occasionally on ground (Keast 1975; Henderson 1977; see Table 1). On Heron I., exhibit greater diversity of foraging heights than on mainland (Scott *et al.* 2003). Of 82 observations of foraging near Armidale, foraging heights were: 16.9% on ground; 27.7%, 1–2 m above ground; 33.7%, 3–5 m; 13.3%, 6–9 m; 3.6%, 10–14 m; and 4.8%, 15+ m (Ford *et al.* 1986). In Weddin Mt NP, NSW, mainly foraged at 1–4 m (Turner 1992); and 0.2–4.0 m in ACT (Er 1997). Near Bombala, mean foraging height 6.8 m (5.7; 530 foraging obs.): 5% on ground (≤0.2 m); 43%, 0.2–4.0 m above ground; 28%, 4.1–10.0 m; and 24%, >10.0 m (Recher *et al.* 1985). In Dryandra SF, WA, of 78 observations of foraging, mean height 3.6 m (4.3): 54% on ground or up to 0.1 m above; 15%, 1.1–5.0 m; and 31%, >5.0 m. Of 622 observations of foraging on Rottnett I. (combined May, June, July data): 44% on ground; 39% up to 1.5 m above ground; 6%, 1.5–3.0 m; 9%, 3.0–4.5 m; and 2%, >4.5 m. Of 406 observations of foraging in banksia woodland near Perth: 34% on ground; 23%, 1 m above ground; 9%, 2–3 m; 30%, 4–6 m; and 4%, >6 m (Tullis *et al.* 1982). Of 141 observations of foraging in Christchurch Botanic Gardens (estimated from diagram), 5% on ground; 50%, <0.6 m above ground; 27%, 0.6–3.6 m; and 18%, >3.6 m. Of 68 observations of foraging on Norfolk I.: 11.8%, ≤1 m above ground, 7.4%, 1–2 m; 32.4%, 2–5 m; 35.3%, 5–10 m; 10.3%, 10–15 m; and 2.9%, 15–35 m (Robinson 1988). For frequency distribution of foraging heights at Kowhai Bush, see Gill (1980).

FORAGING SITES: Forage in various sites, including on ground, among ground-cover, in low or tall shrubs in understorey, canopy of trees and in emergent trees (Fleming 1943; Bourke & Austin 1947; Cashion 1958; East 1967; Gepp & Fife 1975; Catterall 1978; Dennison *et al.* 1978; Gill 1980; Friend 1982; Kikkawa & Wilson 1983; Loyn 1985b; Jansen 1990; Curry 1991; O'Donnell & Dilks 1994; Chan 1995b; Taylor *et al.* 1997; Hall). **SUBSTRATES:** Often forage among foliage or on branches of trees or shrubs; invertebrates taken mostly from foliage, including clumps of dead leaves, and bark

of branches (e.g. Barton 1930; Wilkinson 1931; Atkinson 1966; Horning & Horning 1974; Keast 1975; Catterall 1978; Hornsby 1978; Skinner 1979; Abbott 1981; Ford & Bell 1981; Kikkawa & Wilson 1983; Loyn 1985a; Jansen 1990; Wheeler & Calver 1996; Peter 2000; Hewish 2002b); prey also taken from crevices and underneath bark (Dove 1906b; Chisholm 1908a; Edgar 1949; Turbott 1967; Catterall 1978; Gill 1980; Kikkawa & Wilson 1983; Jansen 1990; CSN 20). On Heron I., recorded foraging on immobilized insects trapped in water droplets on leaves following rain (Catterall 1978). Also often feed at flowers, taking nectar, pollen or invertebrates from flowers (Gannon 1932; Geary 1932; Anon. 1934; Liddy 1963; Keast 1975; Hutton 1991; Gosper 1992; Wheeler & Calver 1996), or eating flowers themselves (Lawrence 1961; Ashton 1985; Forde 1986; Metcalf 1988; Vanstone & Paton 1988; Cleland; CSN 20, 38); and feed on fruit, or on invertebrates among fruit, such as between segments of unripe fruit of *Pandanus* (e.g. Belcher 1914; Oliver 1922; Carter 1924; Jerrard 1932; Ryan 1953; St Paul 1975; Catterall 1978, 1985; Kikkawa & Wilson 1983; Backhouse 1985; French 1989; Jansen 1990; Green 1993; Williams & Karl 1996; Wheeler & Calver 1996; Gosper 1999; Peter 2000; Stanley 2001). Occasionally feed on sap oozing from wound in trunk of tree (Horning & Horning 1974; Gosper 1999). Sometimes forage among grass or rushes, taking seeds from seed-heads, or insects disturbed by rising water (Cooper 1974a; CSN 22). Also occasionally recorded foraging on ground, including among leaf-litter, taking fallen fruit, insects and possibly seeds (Littler 1901; Anon. 1915; Watson 1959; Storr 1965; Ashton 1985; Paton *et al.* 1988; Wheeler & Calver 1996; CSN 35, 49); sandhoppers taken from seashore (Oliver). Sometimes take flying insects in air (Anon. 1915; Catterall 1978; Nix 1979; Kikkawa & Wilson 1983; Taylor 1989; Jansen 1990; Gould; CSN). **STUDIES:** Of 82 observations of foraging near Armidale: 63.9% among leaves, 15.7% at flowers, 9.6% at fruit, 1.2% on branches, 1.2% on trunks of trees, and 8.4% among grass. Of 130 observations of foraging in Kosciuszko NP, se. NSW (when snow-cover patchy or absent): 5% on trunks of trees, 14% among foliage of trees, 34% in shrubs, 32% on snow, and 15% on meltback (Osborne & Green 1992). Of 530 observations of foraging near Bombala: 41% among foliage and twigs, 27% on bark on branches, 25% at flowers, 2% on loose bark, and 5% on ground; and of these 530 observations: 24% in canopy, 28% in subcanopy, 43% in shrubs, and 5% on ground (Recher *et al.* 1985). Of 12 observations of foraging in Broombush shrubland in nw. Vic., all were among foliage (Woinarski 1989). Of 224 observations of foraging at 15 sites in temperate rainforest in Tas.: 93% among foliage, 4% at

Table 1. Foraging height distribution of Silvereyes in 589 observations of foraging at two sites on Heron I. (Henderson 1977).

Height (m)	Site 1: grassy patch		Site 2: ring of figs	
	May	Nov.	May	Nov.
0	27	10	21	44
1	5	20	9	36
2	15	11	16	30
3	8	6	10	24
4	17	15	6	39
5	36	18	21	28
6	41	13	12	7
7	10	2	5	1
8	5	6	1	5
>8	2	5	2	0
No. of feeding obs.	166	106	103	214

flowers, 1% in herb-layer, and 2% in leaf-litter (Thomas 1980). Of 440 observations of feeding on insects on Culeenup I., Yunderup, WA: 15% among foliage of trees, 3% among twigs, 6% on outer branches, 18% on inner branches, 21% on upper trunk, 13% on lower trunk, 13% among foliage of saplings, and 11% in low shrubs (Keast 1975). Of 78 observations of foraging at Dryandra: 23% among foliage and twigs, 29% on bark of branch, 6% on bark of tree-trunk, and 41% on ground. Of 56 observations of foraging on Hen I., NI: 59% in live foliage in canopy, 14% in twigs (live and dead), and 27% in live foliage of lower branches and understorey (Merton 1966). Of 70 observations of foraging at Kowhai Bush: 34% among foliage, 9% in twigs, 6% on branches, 42% on tree-trunks, and 9% in leaf-litter; and of these 70 observations of foraging, most (87%) were in understorey. Of 141 observations of foraging in Christchurch Botanic Gardens (estimated from diagram): 5% in canopy, 13% in 'main part' of trees, 27% in shrub-layer and lower branches of trees, c. 50% in field-layer, and 5% on ground. Of 9708 observations of foraging in Windbag Valley (estimated from diagram): c. 5% in emergent foliage, c. 20% on top of canopy, c. 17% in canopy, c. 29% in upper understorey, c. 28% in lower understorey, and <1% on ground. Of 78 observations of foraging on Norfolk I.: 52.6% among foliage, 28.2% at flowers, fruit or buds, 15.4% on branches, and 3.8% on ground (Robinson 1988).

PLANTS USED: On Heron I. (Catterall *et al.* 1989), of 165 observations of foraging by adults in *Pisonia* forest on Heron I.: 53% in *Pisonia*, 30% in *Ficus*, 12% in herbs, 4% in *Pipturus*, and 1% in other vegetation; and of 366 observations of foraging by juveniles: 33% in *Pisonia*, 34% in *Ficus*, 12% in herbs, 19% in *Pipturus*, and 3% in other vegetation; of 271 observations of foraging by adults in layered woodland: 28% in *Casuarina*, 17% in *Argusia*, 12% in *Scaevola*, 19% in herbs, and 24% in other vegetation; and of 742 observations of foraging by juveniles: 27% in *Casuarina*, 15% in *Argusia*, 14% in *Scaevola*, 31% in herbs, and 14% in other vegetation. Adults spent significantly more time than juveniles foraging in plants which provided large insects; juveniles mainly foraged on plants with many small insects or small fruits. For details of monthly comparisons of different vegetation used for foraging at two sites on Heron I., see Henderson (1977). In Brisbane, of 71 observations of foraging in winter 1985: 50.7% in exotic plants, and 49.3% in native plants; and, of 25 observations of foraging in winter 1986: 76% in native plants, and 24% in exotic plants (R.J. Green *et al.* 1989). Of 82 observations of foraging near Armidale: 50.7% in bipinnate acacia, 18.7% in Broad-leaved Stringybark, 10.7% in other shrubs, 9.3% in grass, 8.0% in mistletoe *Amyema*, and 2.7% in Yellow Box. Of 530 observations of foraging near Bombala: 43% in rough-barked eucalypts, 24% in smooth-barked eucalypts in woodland, 3% in smooth-barked eucalypts in forest, 14% in Gippsland Waratah *Telopea oreades*, 5% in acacias, 5% in other shrubs, and 6% among ground-cover (Holmes & Recher 1986). Of 17 observations of foraging in e. suburban Melbourne: 41.2% in eucalypts, and 58.8% in other native plants (Green 1984). Of 42 observations of foraging at Dryandra: 66.7% in Wandoo, 9.5% in Marri and 23.8% other vegetation, including other eucalypts, casuarinas, acacias and other shrubs, and ground-cover. On Rottnest I., of 208 observations of foraging in May: 49% on substrates other than plants, 38% in Coastal Saltbush *Rhagodia baccata*, and 13% in Moonah *Melaleuca lanceolata*; of 199 observations of foraging in June: 31% in Moonah, 26% in Coastal Saltbush, 14% in Prickle Lily *Acanthocarpus preissii*, 9% in other unident. plants, and 19% on substrates other than plants; and of 215 observations of foraging in July: 30% in Moonah, 5% in other unident. plants, 1% in Prickle Lily, and 65% on substrates other than plants. Once seen feeding over kelp (Tas. Bird Rep. 19), but unclear whether kelp was floating in water or on

beach, or whether birds foraged in air above kelp or on it. Recorded taking spiders from nest of nursery spider (CSN 28). Occasionally take food scraps from nests of other birds, such as Osprey *Pandion haliaetus* or Black Noddy *Anous minutus* (Warham 1956; Catterall 1978). Observed taking insects from cow-pats (CSN 35). Attracted to artificial feeding sites, such as feeding tables in gardens (Wilkinson 1924; Cunningham 1946a; Dawson & Cresswell 1949; Hodgkins 1949; Kikkawa 1962; McCaskill 1973; Armstrong 1992; CSN); in some areas of NZ, this contributes a high proportion of food eaten in winter (Kikkawa 1962). On some islands, occasionally enter kitchens or dining rooms in search of food (Wilkinson 1931; Warham 1956; Bingham 1977; Catterall 1978, 1985; Catterall *et al.* 1982; Kikkawa & Wilson 1983). Also invade camps in quest of victuals (McLean 1912; White 1946; CSN 4). Pick flesh and fat from meat and carcasses of sheep, rabbit and deer (McLean 1912; Dawson 1951; Cartwright 1954; CSN 1), and once ate mutton fat out of tins (Penniket 1956). Feed from pig troughs and fowl feeders, and take vegetable peelings from garbage bins (McLean 1912; Wilkinson 1931; CSN 1). Seen catching moths attracted to lighthouse (Wright 1961).

FORAGING METHODS: Use many methods to search for, attack and handle food. **SEARCH:** When searching for insects in vegetation, systematically search upper and undersurfaces of leaves, under bark on trunks and branches, sometimes flicking off pieces of bark with bill (Edgar 1949; Catterall 1978; CSN 19 Suppl., 20); when searching for aphids on fruit trees, hop along branches, systematically investigating damp bark (Chisholm 1908a). Occasionally scan for prey from perch (O'Donnell & Dilks 1994). In SA, when searching for nectar in Golden Wattle, jumped between branches, visiting multiple nectaries in each tree before moving, usually to adjacent tree (Vanstone & Paton 1988). **BEHAVIOUR OF FORAGING FLOCKS:** Regularly make early morning flights in search of new food sources, e.g. fruiting fig trees (Catterall 1978). On arrival at feeding sites, flocks disperse quickly and begin foraging (Turbott 1967; CSN 19 Suppl.), moving rapidly between sites, e.g. hopping between branches (Belcher 1914; Cooper 1974a; Catterall 1978; Catterall *et al.* 1982; Kikkawa & Wilson 1983). On Heron I., when foraging flocks spread out over area, each member of flock moved in same direction; individuals continuously searched a small area, eating any food items found. Flocks repeatedly move through same area, typically foraging in one direction for 10–30 min, then circling back. Movement between areas initiated by several birds briefly taking flight (for 2–5 s) with rest of flock following (Catterall 1978). When individuals or small groups feeding in Potato crops, continually moved between crop and nearby vegetation (Matthiessen 1973). **ATTACK:** Forage mostly by gleaning, but also by probing, sallying, hanging and reaching. Sometimes adopt unusual or acrobatic positions to procure food, including hanging upside-down by one foot. Some foraging methods, usually of adults, appeared specialized to take large insects, e.g. birds foraging in casuarinas would sometimes spend 5 min repeatedly pecking base of clump of needles to obtain insects (Catterall 1978). **GLEANING:** On Heron I., most prey taken by gleaning, birds searching through vegetation with characteristic 'side-to-side' movement, constantly changing orientation of head and body. Ants are gleaned individually, being taken in rapid succession (Catterall 1978, 1985; Catterall *et al.* 1982; Jansen 1990). When eating pieces of large fruit, such as Pears or pawpaw, sometimes remove so much flesh from fruit that birds are able to disappear inside hole thus excavated (Belcher 1914; Hutton 1991). **PROBING:** Occasionally probe crevices and curled leaves in search of invertebrates (e.g. Catterall 1978; Jansen 1990); sometimes gape bill (zirkeln) when probing to enlarge opening; sometimes repeated movements required to open crevices fully (Catterall 1978). Very occasionally

probe nests of spiders (CSN 1, 37). Nectar and insects extracted from flowers by probing, often while REACHING DOWN or HANGING (Dove 1927; Davidson 1950; East 1967; Cooper 1974a; Keast 1975; Catterall 1978; McFarland 1984b, 1994; Gould). Because of short bill, often entire head inserted into large flowers (Cooper 1974a; CSN 22); or at long tubular flowers, otherwise inaccessible, pierce base of flower with bill to reach nectaries (Serventy 1961; McCulloch 1977; Parker 1977; Paton 1986; Brooker 2001). LICKING: Lick pollen from flowers (Gilbert 1939) and sap (Gosper 1999). LUNGING: Often lunge, with audible snap of bill, to catch flies and aphids flushed from grass and flowers (Catterall 1978). PULLING: On Heron I., invertebrates often exposed by using bill to dislodge loose bark (Catterall 1978). SALLYING: Often sally after flying insects (Anon. 1915; Kikkawa & Wilson 1983; Gould; CSN 19 Suppl., 20, 22). Often sally among swarming insects, initially perching on elevated vantage-point, then launching into highly directional, powered flights, sometimes vertically or nearly so, turning rapidly with minimal aerobatics, snatching prey with audible bill-snap, then hovering briefly before gliding back to perch; such flights often repeated, and often several birds sally simultaneously (Catterall 1978; Nix 1979; Taylor 1989). Sallying flights 1–2 m (Catterall 1978; Taylor 1989), or 10–30 m or more (Nix 1979). On Heron I., observed capturing insects in long grass by flying at grass-stem, catching insect in feet, then carrying it to ground, where eaten while held underfoot (Catterall 1978). Of 244 observations of foraging on insects in banksia woodland at Jandakot, WA, 49 (20%) were by sallying (Tullis *et al.* 1982). At L. Leschenaultia, WA, one seen sally-pouncing at and then repeatedly attacking huntsman spider on ground; attacks continued after spider immobilized (Wells 2002). SCREENING: Once seen foraging in 'weaving, bat-like fashion, after the manner of swallows' (CSN 24). KLEPTOPARASITISM: Once seen stealing food from House Sparrow (CSN 25). STUDIES: Of 82 observations of foraging near Armidale: 96.3% by gleaning, and 3.7% by probing (Ford *et al.* 1986). Of 530 observations of foraging near Bombala: 46% by gleaning or hang-gleaning from foliage, 29% gleaning or hang-gleaning from branches or loose bark, and 25% gleaning or probing flowers (Recher *et al.* 1985). At Lerderderg Gorge, Vic., birds foraging on different types of fruit used different methods according to shape and structure of plant; of 61 observations of foraging in Tree Violet *Hymenanthera dentata*: 55.7% by gleaning, 36.1% reaching, and 8.2% hanging; of 71 observations of foraging in Common Fig *Ficus carica*: 54.9% by gleaning, 32.4% reaching, and 12.7% hanging; of 87 observations of foraging in Mealy Saltbush *Rhagodia parabolica*: 47.1% by gleaning, 26.6% hanging, and 26.3% reaching. Having removed fruits from Mealy Saltbush, usually flew to nearby eucalypts to eat fruit (Stanley 2001). Of 78 observations of foraging at Dryandra: 76% by gleaning, 18% probing, and 6% sally-hovering (Recher & Davis 1998). On Rottnest I., forage mainly by gleaning. Of 208 observations of foraging in May: 44% gleaning, 38% eating fruit or nectar (method not stated; possibly includes gleaning), 7% screening, 6% probing or tearing, 2% sally-striking on substrate other than air, 1% sally-pouncing, and 1% sally-striking in air; of 199 observations of foraging in June: 67% by gleaning, 26% eating fruit or nectar (method not stated; possibly includes gleaning), 3% probing or tearing, 2% screening, 1% sally-pouncing, and 1% sally-hovering; of 215 observations of foraging in July: 98% by gleaning, 1% by probing or tearing, and 1% sally-striking on substrate other than air (Wheeler & Calver 1996). Of 70 observations of foraging at Kowhai Bush: 98.6% by gleaning, 38.6% reaching up to glean, 17.1% hang-gleaning, and 1.4% hover-gleaning (Gill 1980). Of 141 observations of foraging in Christchurch Botanic Gardens: hang upside-down and cling sideways to foliage and twigs while feeding. Of 9708 observations of foraging in

Windbag Valley, c. 95% were of gleaning (estimated from diagram). Of 75 observations of foraging on Norfolk I.: 69.3% by gleaning, and 30.7% probing (Robinson 1988). Effect of age on foraging success was studied on Heron I.; adults significantly more efficient, both in terms of time spent foraging and number of captures per attempt than first- and second-year birds (Jansen 1990, which see for details).

FOOD SELECTION: Studies of wild-caught birds (trapped at Bacchus Marsh, Vic.) in captivity indicate that birds from this location generally showed strong preference for red fruit, both artificial and natural, though preferences for white and yellow fruits varied. In addition, when offered translucent fruits, took significantly more fruit without seeds than those with seeds, and of fruits with seeds consumed, took significantly more fruits with large seeds than those with small seeds. For further details, see Puckey *et al.* (1996), Giles & Lill (1999), Stanley (2001) and Stanley *et al.* (2002). On Heron I., seldom ate male figs (probably unpalatable and difficult to penetrate epicarp), and also avoided galled parts of female figs; wild-caught captive birds mostly ate female figs, and also fruit of *Pipturus* (Henderson 1977). In six trials of birds caught in wild, caged under field conditions and offered a choice of three species of psyllids (lerp and their larvae): birds ate more of *Glycaspis fuscovena* (9.3% of 129) than of *Lasiopsylla striatus* (0% of 75) or *Creiis* (0% of 204); lerp of *Glycaspis* contained more soluble sugars than those of the other species. Also took lerp and psyllid nymphs more often than lerp only (Woinarski *et al.* 1989). Suggested that birds cannot reach nectar at base of long tubular corollas (Paton & Ford 1977). Preference trials in captivity show birds prefer nectar of Marri over other foods (Rooke 1984a).

HANDLING OF FOOD: FRUIT: Small fruits often swallowed whole (St Paul 1975; Catterall 1978, 1985; French 1989; Williams & Karl 1996; Gosper 1999). Slightly larger fruits, near upper limit of what can be swallowed, often removed from plant, and ruptured to expose flesh. In ne. NSW, fruit of Dwarf's Apples *Breynia oblongifolia* and Black Nightshade *Solanum nigrum* were bashed against branches to break skin before being swallowed (Gosper 1999). Near Bulla, Vic., removed berry of African Boxthorn and flew to ground, where berry was rubbed up and down against a fallen branch, rupturing skin; exposed flesh and seeds then eaten (Peter 2000). Fruit or seed-pods removed from plant occasionally held in one foot while being consumed (Catterall 1978; CSN 3). Often have difficulty handling slightly larger fruits, and often drop them (Gosper 1999; Stanley 2001), e.g. at Lerderderg Gorge, 11.3% of 372 Tree Violet fruits handled were dropped, but only dropped 2% of 934 smaller fruits of Mealy Saltbush. Larger fruit, such as figs *Ficus* and European Olives *Olea europaea*, usually left attached to plant, and consumed by puncturing skin with bill, then repeatedly pecking flesh from fruit (Belcher 1914; Carter 1924; Jerrard 1932; Catterall 1978, 1985; Backhouse 1985; Forde 1986; Paton & Paton 1987; Paton *et al.* 1988; Green 1993; Burrows 1994; Rogers 1998; Gosper 1999; Peter 2000; Spennemann & Allen 2001; Stanley 2001; North; CSN 38; R.K. Hicks). Often, just a small hole is made in one end, through which the contents are extracted, leaving skin remaining apparently intact (Dove 1906b; Anon. 1915; Barton 1930); damaged fruit often left hanging in trees, either as bare stone, stalk or flaccid skin (Dove 1906b; Belcher 1914; Ryan 1953; Cooper 1974a). On Heron I., often test fruit with bill before feeding (Henderson 1977). FLOWERS: When feeding on *Feijoa* flowers, remove petals, or occasionally hold stems with one foot while shredding and eating petals (Lawrence 1961; Metcalf 1988). INVERTEBRATES: Large insects or their larvae may be softened by being beaten against a branch, or repeated pecking, to assist swallowing (Hodgkins 1949; Stidolph 1950; Catterall 1978; Catterall *et al.* 1989). Wings often removed from insects

before remainder eaten, though wings sometimes also consumed (Stidolph 1950; CSN 1). After attacking huntsman spider, bird removed its legs, and continued to peck abdomen before picking it up and flying away (Wells 2002). Once, one dipped a grasshopper, insect larvae and bread into tin filled with syrup or honey, then flew to nest with nearly fledged young (CSN 19 Suppl.). For food-handling and feeding behaviour of wild-caught birds in captivity, see Harrison (1968).

SEASONAL VARIATION: Recorded taking all main food items (insects, fruit and nectar) throughout year, and said to feed on pollen in winter (e.g. Littler 1901; Anon. 1915; Froggatt 1921; Chisholm 1926a, 1926b; Leach 1928; McNamara 1937; Gilbert 1939; Lewis 1961; Horning & Horning 1974; Ashton 1985; Vanstone & Paton 1988; French 1990; Beauchamp & Parrish 1999; Gibb 2000a; North; Oliver; CSN 5, 9, 38). Different types of fruits taken throughout year reflect seasonal availability, e.g. at Dunedin, SI, fruits of native plants eaten mostly Feb.–May (Kikkawa 1966); in W. Hutt Hills, NI, fruit taken Jan.–July, but mostly Feb.–May (Gibb 2000a); on Heron I., Sandpaper Figs eaten in spring and autumn (Henderson 1977); and round Geelong, Vic., attack orchards in late Nov. to feed on soft, ripe fruit (Belcher 1914). At Maggs Mt, Tas., feed mainly on insect larvae in spring and early summer, then switch to ripening fruits in summer and autumn (R.H. Green *et al.* 1989). Similarly, consumption of nectar greatest during peak flowering season, e.g. in Windbag Valley, nectar most important in spring and summer, comprising 8–26% of food Oct.–Feb. In Aldinga–Sellicks Scrub CP, SA, feed on fruit of Coastal Beard-heath *Leucopogon parviflorus* in summer and early autumn, fruit of *Rhagodia* in winter, nectar of *Xanthorrhoea semiplana* from late winter to mid-spring, and nectar of *Banksia marginata* from midsummer to autumn (Ashton 1985). In NZ, feed extensively on food provided by people during winter (Wilkinson 1924; Dawson & Cresswell 1949; Hodgkins 1949; Kikkawa 1962).

FORAGING TIMES: In observations over 4 days (5–8 July 1943) at artificial feeding-site in Dunedin, began foraging at 08:00–08:28, and stopped at 16:38–17:07; though activity decreased in middle of day, there was seldom a 15-min period when site not visited (Marples 1945). Elsewhere, arrive at vineyards at dawn and remain till dusk (Burton 1990; North). In winter on Heron I., spent c. 80% of observation time, 06:00–17:00, foraging, with no regular variation in foraging rates during day; mostly ate figs and fruit of *Pipturus* 06:00–08:00, leaving few fruits available for rest of day; foraged for insects lowest early in morning and late in afternoon (Catterall 1978, 1985).

SEXUAL AND INTERSPECIFIC COMPARISONS: Near Nelson, SI, diet of sexes similar, though males consumed significantly more beetles ($P < 0.05$) (Moeed 1979). For comparison of foraging behaviour with Slender-billed White-eyes on Norfolk I., see that account.

FEEDING ADAPTATIONS: Use sharp bill to puncture skin of fruit to gain access to pulp (Dove 1906b; Belcher 1914; Froggatt 1921; Carter 1924; Paton & Paton 1987). Tongue is bifurcated and brush-tipped, for taking nectar and pollen (Froggatt 1921; Gilbert 1939; Cooper 1974a; Heather & Robertson 2000); see Cooper (1974a) for photograph of tongue, and Moreau *et al.* (1969) for detailed description and illustration.

PEST STATUS: Considered a pest by orchardists, easily gaining access through mesh of most bird-netting to feed on ripening soft fruits and cherries, grapes and berries, both in Aust. (e.g. Ryan 1953; Robinson 1960; Napier 1967, 1969; Harrison 1968; Knight & Robinson 1978; Fielding 1979; Rooke 1984b; Backhouse 1985; R.H. Green *et al.* 1989; Bomford & Sinclair 2002; Serventy & Whittell) and in NZ (e.g. Hutton & Drummond 1904, 1909a; Thomson 1922; Stead 1932; Phillips & Lindsay 1948; Dawson & Cresswell 1949; Turbott

1967; Oliver); e.g. in Tas., Silvereyes damaged fruit in 65% of orchards in which they were recorded (Fielding 1979). When feeding on grapes, pierce fruit with bill, causing juice to spill onto other grapes, which can ruin entire bunch, as spilt juice encourages fungal infection (Backhouse 1985; Burton 1990), and thus implicated in spreading diseases of fruit, such as brown rot (Oliver). However, apparently often only eat fruit that has already been damaged by other birds (Oliver 1922; Wilkinson 1931; Robinson 1960; Baker 1980; CSN 21), and some cherry orchardists claim that Silvereyes have 'no tangible effect on the crop' (Cooper 1974a). At Murray Bridge, SA, responsible for 62% of attacks on Apricots in orchards, but 97% of fruits attacked ($n=241$) had already been pecked by other birds (Paton & Reid 1983). Also considered a major disseminator of environmental weeds (Cooper 1959; Lowe 1959; Bomford & Sinclair 2002), such as Bridal Creeper *Asparagus asparagoides*, Ink Weed *Phytolacca octandra* and possibly Blackberries (Gannon 1936; Hyem 1937; McNamara 1937; Cleland 1952; Stansbury 2001); in se. Qld, aid dispersal of Lantana (Liddy 1985), and to compound the problem, also eat Lantana Leaf-mining Beetles *Uraplata girardi* and *Octotoma scabripennis*, introduced to control the weed (Liddy 1982). However, also eat pest insects (see Threats and Human Interactions).

DRINKING: Sometimes drink from bird baths, water tanks or troughs, or taps (Zietz 1914; Warham 1956; Paton & Paton 1980; Sympton 2003). Also drink from fresh water soaks (Watson 1959). On Kapiti I., sometimes drank from spout in Mahoe tree which had filled with rainwater (Wilkinson 1927); occasionally drink dewdrops from leaves (Sargent 1928). Once seen drinking frozen drops of water as they melted (Kloot & McCulloch 1980). Readily drink milk (Wilkinson 1931; Taylor 1949).

Detailed studies Aust. On HERON I. (direct observation of 6204 items eaten over two winters; fru. % refers to bites of fruit; Catterall 1989): **Plants MONOCOTYLEDONS:** Pandanaceae: *Pandanus tectorius* fru. 0.9%. **DICOTYLEDONS:** Goodeniaceae: *Scaevola sericea* fru. 0.9; Moraceae: *Ficus opposita* fru. 0.8; Urticaceae: *Pipturus argenteus* fru. 0.9. **Animals INSECTS:** 96.5.

Also on HERON I. (observation of 3592 items eaten, May 1973 and May 1974 [possibly a subset of Catterall 1989 data above]; Catterall 1985): **Plants MONOCOTYLEDONS:** Pandanaceae: *Pandanus tectorius* fru. 2.5%. **DICOTYLEDONS:** Goodeniaceae: *Scaevola sericea* fru. 0.5; Moraceae: *Ficus opposita* fru. 5.4; Urticaceae: *Pipturus argenteus* fru. 5.3. **Animals INSECTS:** 86.4.

Near GREEN MT, LAMINGTON NP, QLD (fruit items observed, 1985–95; Church 1997): **Plants DICOTYLEDONS:** Anacardiaceae: *Eucoschinus falcata* (observed in Jan.); Araliaceae: *Polyscias elegans* (Apr.–July); Celastraceae: *Celastrus subspicata* (May); Euphorbiaceae: *Omalanthus nutans* (Jan.); Mimosaceae: *Acacia maidenii* (Dec.–Jan.); Moraceae: *Ficus platypoda* (Jan.); Myrsinaceae: *Rapanea howittiana* (Jan.); Phytolaccaceae: *Phytolacca octandra* (Feb.–Apr., June); Piperaceae: *Piper novae-hollandiae* (Dec.–Feb.); Pittosporaceae: *Pittosporum undulatum* (Apr.–June); Rhamnaceae: *Alphitonia excelsa* (Dec.–Apr.); Rutaceae: *Melicope micrococca* (Mar.–Apr.); Sapindaceae: *Elattostachys xylocarpa* (Apr.–Jun.); Guioa semiglaucula (Feb.); Sarcopteryx stipata (Dec.–Jan.); Solanaceae: *Solanum americanum* (Feb., Apr., Dec.); Urticaceae: *Dendrocnide excelsa* (June); Verbenaceae: *Lantana camara* (Dec.–Jan., Apr.–July).

In coastal dune communities from LENNOX HEAD to MORUYA HEADS, EUROBODALLA NP, NSW (plant items observed, Mar. 1995–July 1997; Gosper 1999): **Plants MONOCOTYLEDONS:** Cyperaceae: *Gahnia clarkei* sds. **DICOTYLEDONS:** Asteraceae: *Chrysanthemoides monilifera rotundata* fru.; Epacridaceae: *Leucopogon parviflorus* fru.; *Monotoca elliptica*

fru.; Euphorbiaceae: *Breynia oblongifolia* fru.; Fabaceae: *Erythrina* nectar; *Kennedia rubicunda* nectar; Mimosaceae: *Acacia sophorae* sap, sds; Myrtaceae: *Eucalyptus gummifera* nectar; *E. pilularis* nectar; *E. robusta* nectar; *Leptospermum laevigatum* nectar; Phytolaccaceae: *Phytolacca octandra* fru.; Pittosporaceae: *Pittosporum undulatum* sds; Proteaceae: *Banksia integrifolia* nectar; *Persoonia lanceolata* nectar; Sapindaceae: *Alectryon subcinereus* sds; *Guioa semiglauca* sds; Solanaceae: *Solanum nigrum* fru.; Verbenaceae: *Lantana camara* fru.

In forests near HEALESVILLE, VIC. (seeds in 167 faecal samples from birds trapped late summer to autumn of 1987 and 1988; French 1989, 1990): **Plants** DICOTYLEDONS: Araliaceae: *Polyscias sambucifolia* 133 sds (in 16 samples); Mimosaceae: *Acacia dealbata* 6 (1); Pittosporaceae: *Pittosporum bicolor* 35 (2); Rosaceae: *Rubus* 10 (7); Rubiaceae: *Coprosma quadrifida* 997 (132). **Animals** Invertebrate remains (small amount).

In LERDERDERG GORGE, VIC. (whole seeds in faecal samples and fruit items observed, Dec. 1997–Mar. 1998 [206 faecal samples] and Jan.–Mar. 1999 [203 faecal samples]; Stanley 2001, which see for mean number of seeds, mean number of seed species and mean number of seeds of *R. parabolica*, *H. dentata*, *S. aviculare* and *P. octandra* per faecal sample): **Plants** (Seeds unless stated.) MONOCOTYLEDONS: Liliaceae: *Asparagus asparagoides*. DICOTYLEDONS: Chenopodiaceae: *Atriplex prostrata*; *Rhagodia parabolica*; Mimosaceae: *Acacia implexa*; Moraceae: *Ficus carica* fru.; Phytolaccaceae: *Phytolacca octandra*; Rosaceae: *Rubus*; Santalaceae: *Exocarpos cupressiformis*; Solanaceae: *Solanum aviculare*; Violaceae: *Hymenantha dentata*.

At MAGGS MT, TAS. (gut contents of 162 birds collected 1976–86; R.H. Green *et al.* 1989): **Plants** Fruit, seeds (including unident. present in significant numbers in samples taken spring and autumn, especially Feb.–Mar.). DICOTYLEDONS: Mimosaceae: *Acacia* sds (in seven samples, 9 Feb.); Rosaceae: *Rubus fruticosus* sds (one sample, 18 Mar.). **Animals** INSECTS: Unident.: ad. (one sample, 16 Dec.); Coleoptera: Carabidae: larv. (a few in samples 16 Dec.); Chrysomelidae: ad. (a few, Jan.–Feb.); Paropsinae: ad. (rare, 25 Nov.), larv. (abundant, Sept.–Nov.); Nitidulidae: ad. (one sample, 19 Oct.); Lepidoptera: unident. larv. (a few, Oct.–Nov.); Gelechioidea: larv. (a few, Dec.); Geometridae: Ennominae: larv. (a few, Oct.–Feb.); Lasiocampidae: larv. (rare, Oct.–Nov.); Pyralidae: larv. (common, Oct.–Dec.); Neuroptera: Chrysopidae: larv. (one sample, 16 Feb.).

Round MANJIMUP AND PEMBERTON, WA (gizzard contents of 240 birds collected 1970–72; summarized in Table 2; Matthiessen & Springett 1973).

Round MANJIMUP AND PEMBERTON, WA (arthropods collected from gizzards of 21 birds, Jan.–Feb. 1970; mean of 24 arthropods, including mean of 13 larvae, per gizzard; Matthiessen 1973): INSECTS: Coleoptera 34% of arthropods; Diptera 3; Hemiptera 3; Hymenoptera 6; Lepidoptera larv. 54 (99% of which were *Phthorimaea operculella*). Vegetable matter, consisting of soft pulp and small seeds, also present.

In PERTH and on GARDEN I., WA (seeds in faecal samples of 67 birds netted 1996–98; Stansbury 2001): **Plants** MONOCOTYLEDONS: Araceae: *Zantedeschia aethiopica* 1 sd; Liliaceae: *Asparagus asparagoides* 25. DICOTYLEDONS: Chenopodiaceae: *Rhagodia baccata* 10; Epacridaceae: *Leucopogon parviflorus* 2; Rhamnaceae: *Spyridium globulosum* 14.

In banksia woodland near PERTH, WA (236 arthropods from faecal samples of 40 birds netted Apr.–July 1980; Tullis *et al.* 1982): **Animals** INSECTS: Coleoptera 22%; Diptera 9%; Hemiptera 1%; Hymenoptera (other than Formicoidea) 5%; Formicoidea 37%; other invertebrates 26%.

NZ In W. HUTT HILLS, near WELLINGTON, NI (foods observed, 1981–92; fruits eaten mainly Feb.–May, nectar June–Jan.; nectar unless otherwise stated; for monthly breakdown, see Gibb 2000a): **Plants** MONOCOTYLEDONS:

Agavaceae: *Cordyline australis* fru., *Phormium*; Aloeaceae: *Aloe*; Kniphofia. DICOTYLEDONS: Chaenomeles; Araliaceae: *Pseudopanax arboreus* fru.; Ericaceae: *Erica cerinthoides*; *Rhododendron*; Fabaceae: *Chamaecytisus palmensis*; *Sophora*; Lamiaceae: *Rosmarinus officinalis*; Mimosaceae: *Acacia*; Moraceae: *Ficus carica* fru.; Myrtaceae: *Callistemon*; *Eucalyptus ficifolia*; *Lophomyrtus*; *Metrosideros excelsa*; *M. fulgens*; *M. robusta*; Onagraceae: *Fuchsia*; Proteaceae: *Banksia integrifolia*; *Grevillea*; *Knightsia excelsa*; *Telopea*; Rosaceae: *Malus sylvestris* fru.; *Prunus avium*; *P. domestica*; *Pyracantha* fru.; *Rubus fruticosus* fru.; Rubiaceae: *Coprosma robusta* fru.; Scrophulariaceae: *Digitalis purpurea*; Solanaceae: *Lycopersicon esculentum* fru.; *Solanum nigrum* fru.; Theaceae: *Camellia*; Vitaceae: *Vitis vinifera* fru.

In orchard near NELSON, SI (contents of alimentary canals of 98 birds collected June–July 1976 and May–Aug. 1977; Moeed 1979): **Plants** Unident. fruit (13 items in 13 birds). DICOTYLEDONS: Fabaceae: *Ulex europaeus* sds (9 in 5); Rosaceae: *Malus domestica* fru. (75 in 75); Solanaceae: *Solanum nigrum* sds (97 in 5). **Animals** (Adults unless stated) SPRINGTAILS: Collembola 13% freq., 2.1% no., mean 2.0 (range 1–8) number of items in birds with that food, comprised of: Entomobryidae (22 items in 11 birds); Sminthuridae (5 in 2). ANNELIDS: Terricolae (4 in 4). CRUSTACEANS: Amphipoda 2%, 0.2%, 1.0 (1 item in each bird) (2 in 2). TICKS: 2%, 0.7%, 4.5 (1–8) (9 in 2); SPIDERS: 23%, 2.7%, 1.5 (1–3), comprised of: Araneidae: *Celaenia* (10 in 6); Linyphiidae (5 in 4); Lycosidae (5 in 2); Micryphantidae: *Erigone* (5 in 4); Theridiidae: *Pholcomma* (10 in 7); Opiliones 1%, 0.1%, 1.0 (1 item in each bird), comprised of: Phalangidae (1 in 1); Pseudoscorpionidea 1%, 0.1%, 1.0 (1 item in each bird). INSECTS: Blattodea 1%, 0.1%, 1.0 (1 item in each bird), comprised of: Choriosoneuridae (1 in 1); Coleoptera 34%, 12.7%, 5.1 (1–35), comprised of: Apionidae: *Apion ulicis* (81 in 12); *A. metrocedros* (1 in 1); Archeocrypticidae: *Archeocrypticus topali* (3 in 2); Cerambycidae (3 in 2); Chrysomelidae (1 in 1); Coccinellidae unident. (1 in 1); *Coccinella undecimpunctata* (1 in 1); *Rhyzobius ventralis* (8 in 4); Curculionidae: *Hyperodes bonariensis* (18 in 8); Lathridiidae unident. (1 in 1); *Aridius bifasciatus* (41 in 13); *Corticicara hirtalis* (6 in 4); Staphylinidae (2 in 1); Diptera

Table 2. Composition of food of Silvereyes in four sampling periods: Jan.–Feb. 1970, Jan.–Mar. 1971 and Jan.–Mar. 1972 (data combined; n=191 birds); and Aug. 1970 (n=49 birds). 1 = % frequency of occurrence; 2 = maximum number of items per bird (Matthiessen & Springett 1973).

	Jan.–Feb. 1970	Jan.–Mar. 1971	Jan.–Mar. 1972	Aug. 1970
FOOD	1	2	1	2
Plant matter	43.5	–	18	–
Spiders	4.2	4	16	1
Collembola	–	–	59	45
Insects				
Lepidoptera	68.6	47	24	11
Potato Moth larv.	62.3	47	–	–
Plusia larv.	30.9	10	–	–
Unident. larv., pupae, ads	4.2	2	–	–
Hemiptera	49.2	140	41	30
Aphids	15.2	50	31	30
Other	40.8	140	18	25
Coleoptera	38.2	40	86	45
Gonocephalum larv.	8.4	24	–	–
Other	32.5	40	–	–
Hymenoptera	18.3	19	27	6
Diptera	11.5	12	20	10
Neuroptera	7.9	20	–	–

53%, 23.5%, 5.9 (1–46), comprised of: Chironomidae (227 in 33); Drosophilidae: *Drosophila melanogaster* (3 in 2); Ephydriidae: *Hydrellia tritici* (27 in 7); Heleomyzidae: *Allophylopsis scutellata* (4 in 3); Lonchoptera unident. (1 in 1); *Lonchoptera dubia* (4 in 3); Mycetophilidae unident. (2 in 1); *Mycetophila* (3 in 3); Tipulidae (38 in 10); Hemiptera 54%, 46.5%, 11.5 (1–54), comprised of: unident. Aphidoidea (113 in 13); unident. Aphididae (89 in 7); *Eriosoma lanigerum* (259 in 13); *Myzus cerasi* (3 in 2); unident. Cicadellidae (2 in 2); *Nesoclutha pallida* (13 in 5); Eriococcidae: *Eriococcus* (25 in 8); Lygaeidae: *Nysius* (18 in 11); Nabidae: *Nabis* (24 in 14); Psyllidae (66 in 7); Hymenoptera 7%, 0.9%, 1.7 (1–3) (12 in 7); Lepidoptera 32%, 7.8%, 3.3 (1–15), comprised of: ad. (2 in 2); unident. Gelechiidae larv. (49 in 15); *Stathmopoda* larv. (5 in 4); unident. Geometridae larv. (3 in 3); *Pseudocoremia suavis* larv. (1 in 1); unident. Noctuidae larv. (3 in 3); *Graphania ustistriga* larv. (2 in 2); unident. Oecophoridae larv. (1 in 1); *Barea* larv. (2 in 1); *Cryptolechia* larv. (1 in 1); unident. Tortricidae larv. (14, 4); *Batodes jactana* larv. (1 in 1); *Ctenopseustis obliquana* larv. (16 in 2); *Planotortrix excessana* larv. (2 in 1); Psocoptera 10%, 2.1%, 2.4 (1–8), comprised of:

Peripsocidae: *Ectopsocus* (24 in 10); Thysanoptera 8%, 1.1%, 1.8 (1–3) (14, 8).

In three patches of rainforest near NELSON, SI (faecal samples and observations of foraging at three sites: EVES Feb. 1992–Feb. 1993, MARSDEN Feb.–June 1993, and FAULKNERS Dec. 1993–June 1994; summarized in Table 3; Williams & Karl 1996).

In AHURIRI SUMMIT BUSH SCENIC RESERVE, PORT HILLS, SI (fruits seen eaten; Burrows 1994): **Plants** MONOCOTYLEDONS: Agavaceae: *Cordyline australis*. DICOTYLEDONS: Araliaceae: *Pseudopanax arboreus*; *P. crassifolius*; *Schefflera digitata*; Caprifoliaceae: *Leycesteria formosa*; *Sambucus nigra*; Cornaceae: *Griselinia littoralis*; Elaeocarpaceae: *Aristotelia serrata*; Grossulariaceae: *Ribes sanguineum*; Onagraceae: *Fuchsia excorticata*; Pittosporaceae: *Pittosporum eugenioides*; Polygonaceae: *Muehlenbeckia australis*; Rosaceae: *Rubus cissoides*; *R. fruticosus*; Rubiaceae: *Coprosma lucida*; *C. robusta*; *C. rotundifolia*; Violaceae: *Melicytus ramiflorus*.

In WINDBAG VALLEY, SI (9708 observations of foraging; O'Donnell & Dilks 1994): Unident. items (possibly invertebrates) 73.2% no. **Plants** Fruit 10.5, nectar 7.6, seed 0.1,

Table 3. Composition of fruit component of bird diet at three localities in NZ (* = not determined; † = faeces containing seeds; ‡ = faeces without seeds; # = from observations only; Williams & Karl 1996).

FRUIT	EVES (n=108)		MARSDEN (n=106)		FAULKNERS (n=106)	
	% freq.	% dry wt	% freq.	% dry wt	% freq.	% dry wt
Indigenous fruit						
<i>Aristotelia serrata</i>	–	–	4.2	2.0	–	–
<i>Coprosma grandifolia</i>	1.9	0.2	3.0	1.8	–	–
<i>C. rhamnoides</i> #	–	–	–	–	–	–
<i>C. robusta</i>	3.7	1.0	10.3	11.3	–	–
<i>C. rotundifolia</i>	0.9	0.4	–	–	–	–
<i>Cordyline australis</i>	–	–	2.4	*	–	–
<i>Coriaria arborea</i>	–	–	2.4	0.5	–	–
<i>Dacrycarpus dacrydioides</i>	–	–	–	–	10.5	9.7
<i>Fuchsia excorticata</i> #	–	–	–	–	–	–
<i>Ileostylus micranthus</i>	–	–	3.0	1.5	0.8	0.1
<i>Leucopogon fasciculatus</i> #	–	–	–	–	–	–
<i>Macropiper excelsum</i>	–	–	13.9	6.1	–	–
<i>Melicytus ramiflorus</i>	5.6	5.9	40.0	19.3	–	–
<i>Muehlenbeckia australis</i>	10.3	6.6	6.1	3.4	–	–
<i>Pennantia corymbosa</i>	–	–	4.2	23.5	–	–
<i>Pittosporum tenuifolium</i>	–	–	2.4	*	–	–
<i>Podocarpus hallii</i>	25.2	66.6	4.8	10.1	60.1	51.9
<i>Prumnopitys taxifolia</i>	–	–	–	–	4.8	14.7
<i>Pseudopanax arboreus</i>	29.0	12.2	18.8	11.7	–	–
<i>Schefflera digitata</i>	3.7	0.7	4.8	0.5	–	–
<i>Solanum aviculare</i> #	–	–	–	–	–	–
Introduced fruit						
<i>Arbutus unedo</i> (seeds)	–	–	–	–	4.0	9.1
<i>A. unedo</i> (pulp) ‡	–	–	–	–	13.8	*
<i>Asparagus asparagoides</i> #	–	–	–	–	–	–
<i>Berberis glaucocarpa</i>	1.9	2.1	–	–	–	–
<i>Crataegus monogyna</i>	1.9	0.2	–	–	–	–
<i>Euonymus europaeus</i> #	–	–	–	–	–	–
<i>Leycesteria formosa</i>	15.0	3.9	13.9	1.0	–	–
<i>Ligustrum sinense</i>	–	–	–	–	13.8	14.1
<i>Lonicera japonica</i>	–	–	–	–	3.2	0.3
<i>Passiflora mollissima</i> #	–	–	–	–	–	–
<i>Rubus fruticosus</i>	1.9	*	–	–	–	–
<i>Sambucus nigra</i>	–	–	5.5	5.5	–	–
<i>Solanum nigrum</i>	–	–	24.2	1.9	0.8	0.1
<i>S. pseudocapsicum</i> #	–	–	–	–	–	–
Unidentified pulp	–	–	–	–	2.4	*
% presence of fruit	86.0		78.0		78.0	
Fruit species per sample	1.6 (1.1; 108)		1.6 (0.8; 106)		1.4 (0.9; 106)	

honeydew <0.1, leaves or buds <0.1, moss <0.1, lichen <0.1 (see below for sources of fruit, nectar, leaves or buds). GYM-NOSPERMS: Podocarpaceae: *Dacrydium cupressinum* fru.; *Dacrydium cupressinum* fru., nectar; *Podocarpus hallii* fru.; *P. totara* fru. DICOTYLEDONS: Araliaceae: *Pseudopanax colensoi* fru., nectar; *P. crassifolia* fru., nectar; *P. edgerleyi* fru.; *P. simplex* fru., lvs, buds; *Schefflera digitata* fru.; Coriariaceae: *Coriaria arborea* fru.; Cornaceae: *Griselinia littoralis* fru.; Cunoniaceae: *Weinmannia racemosa* nectar; Elaeocarpaceae: *Aristotelia serrata* fru.; Chloranthaceae: *Ascarina lucida* fru.; Escalloniaceae: *Carpodetus serratus* fru.; Fagaceae: *Nothofagus menziesii* nectar; Icacinaceae: *Pennantia corymbosa* nectar; Lorantheae: *Peraxilla* fru., nectar; Myrsinaceae: *Myrsine australis* fru.; *M. divaricata* fru.; Myrtaceae: unident. *Metrosideros* nectar; *M. umbellata* nectar; *Neomyrtus pedunculata* fru.; Onagraceae: *Fuchsia excorticata* fru., nectar; Rubiaceae: *Coprosma foetidissima* nectar; Ranunculaceae: *Clematis paniculata* nectar; Ripogonaceae: *Ripogonum scandens* fru.; Rosaceae: *Rubus* fru.; Rubiaceae: *Coprosma* fru.; *C. foetidissima* fru.; *C. rotundifolia* fru.; Violaceae: *Melicety ramiflorus* nectar; Winteraceae: *Pseudowintera colorata* fru. **Animals** Invertebrates 8.1.

Other records—Aust. Plants Fruit^{1,6,8,12,15,20,21,23,26,27,29,30,31,32,33,34,35,39,47,50,53,54,58,71,78,87,88,98,104,115,120,122,135,136,143,148,156,166,195,208,211,212,213,214,215,217}; nectar^{15,34,58,62,68,81,87,98,112,137,138,143,148,150,156,160,161,172,177,195,217}; manna¹⁶⁰; pollen⁶⁸; seeds^{15,16,20,47,63,110,120,123,213,214,215,217}; vegetable matter^{14,16,47,213,214}; leaves²⁰⁷; buds²¹⁴. GYM-NOSPERMS: Zamiacae: *Macrozamia riedlei* fru.^{85,113,162}. MONOCOTYLEDONS: Agavaceae: *Cordyline australis* fru.¹⁸³; Aloeaceae: *Aloe* nectar¹³¹; Haemodoraceae: *Anigozanthos* nectar^{132,161}; *A. flavidus* nectar⁹⁵; *A. manglesii* nectar^{51,109,161}; *A. manglesii* × *bicolor* nectar¹⁶¹; Conostylis aculeata nectar⁷⁴; Iridaceae: *Chasmanthe aethiopica* nectar¹⁵⁸; *Watsonia* nectar²⁰⁷; Liliaceae: *Asparagus asparagoides* fru.¹⁶²; *A. plumosus* sds⁹¹; *Dianella* fru.¹¹⁹; *D. revoluta* fru.¹⁶²; Kniphofia caulescens nectar¹³¹; *Lachenalia* nectar¹³¹; *Thysanotus nudicaulis* fru.¹⁶²; Pandanaceae: *Pandanus tectorius* fru.^{135,136,148}; Poaceae: sds^{81,92}; Xanthorrhoeaceae: *Xanthorrhoea* nectar¹⁰⁷; *X. australis* nectar²²²; *X. semiplana* nectar¹⁵⁸. DICOTYLEDONS: Honey-suckle fru.⁵; Aizoaceae: *Carpobrotus aequilaterus* fru.¹⁶²; *Tetragonia expansa* fru.¹⁶²; *T. implexicoma* fru.¹⁶²; Anacardiaceae: *Schinus molle* fru.^{20,22,23,38,162,185,188,212,213,217}, sds^{20,91,112,214}; *S. terebinthifolius* fru.¹⁹⁸; Annonaceae: *Asimina trilobata* fru.¹⁷⁷; Apocynaceae: *Alyxia buxifolia* fru.^{147,218}; Aquifoliaceae: *Ilex* fru.¹²⁰; Araliaceae: *Polyscias elegans* fru.^{171,175}; *P. murrayi* fru.¹²⁷; Bignoniaceae: *Tecoma* nectar¹³¹; Boraginaceae: *Cordia subcordata* nectar¹³⁵; *Echium vulgare* nectar⁷; *Tournefortia* fru.⁴³; Caprifoliaceae: *Sambucus nigra* fru.¹⁸³; Caricaceae: *Carica papaya* fru.¹¹¹; Chenopodiaceae: sds²¹⁴; *Atriplex semibaccata* fru.¹⁶²; *Chenopodium* sds²¹⁴; *C. trigonon* fru.^{139,140}; *Enchylaena* fru.¹⁶³; *E. tomentosa* fru.^{31,88,162}; *Rhagodia* fru.^{158,162,163}, sds²¹⁴; *R. baccata* fru.²¹⁶, sds^{47,116}; *R. parabolica* fru.¹⁸⁹; *Threlkeldia diffusa* fl.³¹, sds^{162,214}; Cucurbitaceae: *Diplocyclos palmatus* fru.⁶¹; Ebenaceae: *Diospyros* fru.^{27,213}; *D. kaki* fru.¹⁵⁷; Elaeocarpaceae: *Elaeocarpus obovatus* fru.¹⁷¹; *Sloanea australis* fru.¹⁷¹; Epacridaceae: nectar²¹³; *Acrotriche* fru.¹⁶²; *Astroloma conostephioides* fru.¹⁶², nectar^{77,133,194}; *A. humifusum* fru.¹⁶²; *Brachyloma ericoides* fru.¹⁶², nectar¹³³; *Leucopogon* fl.^{15,213}, fru.^{106,213}, sds²¹³; *L. parviflorus* fru.^{105,158}; *L. revolutus* nectar¹⁴⁴, fru.¹⁴⁴; *L. verticillatus* fru.¹⁴⁵; Ericaceae: *Arbutus unedo* fru.^{58,183}; *Rhododendron* nectar⁸¹; *Vaccinium* fru.²⁰⁸; Euphorbiaceae: *Omalanthus populifolius* fru.^{157,171,175}; Fabaceae: *Chamaecytisus proliferus* fl.¹⁹²; *Crotalaria laburnifolia* nectar¹³¹; *Erythrina* nectar⁵¹; *E. coraliodendrum* nectar⁵⁸; *E. indica* nectar¹⁵⁷; *Hardenbergia comptoniana* nectar⁷⁴; *Templetonia retusa* nectar⁵¹; Goodeniaceae: *Scaevola sericea* fru.^{135,136,148}, nectar¹³⁵; Hamamelidaceae: *Liquidambar* sds¹²¹; Lauraceae: *Cinnamomum camphora* fru.³⁸; *Persea* nectar²¹⁹; Leguminosae: sds^{16,213,214}; Lorantheae: fru.^{23,58,73}, nectar⁷³; *Amyema cambagei*¹¹², fru.^{162,165}; *A. gaudichaudii* fru.⁷³; *A. linophyllum* nectar¹⁶⁵;

A. miquelii nectar^{165,184}, fru.⁷³; *A. miraculosum* nectar¹⁶⁵; *A. pendulum* nectar¹⁶⁵; *A. preissii* nectar^{51,165}, fru.^{51,162,165}; *A. quandang* nectar¹⁶⁵; *Lysiana exocarpi* fru.¹⁶²; Malvaceae: *Malva parviflora* sds²¹⁴; Meliaceae: *Melia azedarach* fru.¹⁸²; Mimosaceae: *Acacia* fru.¹⁶³, sds^{92,214}; *A. celastriifolia* nectar⁵¹; *A. ligulata* fru.¹⁶²; *A. melanoxylon* fru.¹⁶²; *A. pycnantha* nectar^{169,181}; *A. saligna* nectar⁷⁴; *A. sophorae* fru.¹⁶²; *A. terminalis* nectar¹⁵¹; *Albizia lophantha* nectar^{51,157}; Moraceae: *Ficus* fru.^{23,24,27,45,50,54,55,70,79,81,108,109,112,152,175,211,212,213,215}; *F. carica* fru.^{10,162,213}; *F. coronata* fru.¹⁸²; *F. obliqua* fru.^{171,175}; *F. opposita* buds¹³⁰, fru.^{44,130,135,136,148}; *F. platypoda* fru.^{162,182}; *F. superba* fru.¹⁸²; *Morus* fru.^{8,39,55,173,186,202,212}; *M. alba* fru.¹⁸⁴; *M. nigra* fru.¹⁶²; Musaceae: *Musa acuminata* fru.¹⁷⁷; Myoporaceae: *Eremophila* nectar²¹⁶; *Myoporum* sds²¹⁴; *M. insulare* fru.^{112,162,170,171}; *M. tetrandrum* fru.¹⁴⁴; Myrtaceae: sds²¹⁴; *Acmena smithii* fru.¹⁸⁷; *Astarea fascicularis* nectar¹⁴⁴; *Callistemon* nectar^{81,120,216}; *C. citrinus* nectar^{157,183}; *C. viminalis* nectar¹⁵⁷; *Calothamnus* nectar¹⁶¹; *C. quadrifidus* nectar²¹⁶; *C. sanguineus* nectar⁵¹; *Eucalyptus* lvs²⁰⁷, nectar^{18,161,216}; *E. angulosa* nectar⁷⁶; *E. calophylla* nectar^{24,144}; *E. cornuta* nectar¹⁴⁴; *E. cosmophylla* nectar¹³³; *E. cypellocarpa* nectar¹⁹³; *E. diversicolor* nectar¹⁴⁴; *E. fasciculosa* nectar¹⁵⁸; *E. ficifolia* nectar⁵¹; *E. gomphocephala* nectar¹⁸⁵; *E. leucoxyloides* nectar^{133,157}; *E. marginata* nectar¹⁴⁴; *E. platypus* nectar²¹⁶; *E. rudis* nectar⁷⁴; *E. saligna* nectar¹⁵⁷; *Feijoa* fl.¹⁶⁷; *F. sellowiana* fl.⁹⁴; *Grevillea* nectar^{81,155,161,183}; *G. barklyana* nectar¹⁵⁷; *G. petrophiloides* nectar¹⁶¹; *G. punicea* nectar¹⁵⁷; *Leptospermum* nectar¹⁶¹; *Melaleuca* nectar^{20,81,161}; *M. lanceolata* nectar²¹⁶; *M. quinquerivaria* nectar¹⁵⁷; *Metrosideros thomasi* nectar¹⁵⁵; *Psidium cattleianum* sds¹⁷⁷; Olacaceae: *Olex benthamiana* fru.¹⁶²; Oleaceae: *Ligustrum lucidum* fru.⁷⁵; *Notelaea longifolia* fru.¹⁶²; *Olea europaea* fru.^{10,23,158,162,168,205}; Onagraceae: *Fuchsia* nectar¹³¹; Phytolaccaceae: *Phytolacca octandra* unident. items^{65,89,212}, fru.^{15,213}, sds²¹³; Piperaceae: *Piper novae-hollandiae* fru.^{175,191}; Pittosporaceae: *Billardiera* fru.¹⁶²; *Pittosporum* fru.¹²⁵, nectar²⁰; *P. phylliraeoides* nectar¹⁰⁰; *P. undulatum* nectar¹⁵⁷, fru.¹⁵⁷, sds^{80,171}, sticky substance surrounding seeds in capsule⁸⁰; Polygonaceae: sds²¹⁴; *Muehlenbeckia* fl.¹⁵⁸, fru.¹⁶³; *M. adpressa* fru.²¹⁶; *M. gunnii* fru.¹⁶²; Proteaceae: *Adenanthos* nectar¹⁶¹; *A. cuneatus* nectar⁵¹; *Banksia* nectar^{94,161}; *B. asplenifolia* nectar⁹⁷; *B. coccinea* nectar²⁴; *B. ericifolia* nectar^{157,184,197}; *B. grandis* nectar²⁰⁶; *B. marginata* nectar^{133,158,197}; *B. ornata* nectar¹³³; *B. spinulosa* var. *collina* nectar¹⁸⁴; *Dryandra armata* lvs²⁰⁷; *Hakea* nectar¹⁶¹; *H. preissii* nectar⁵¹; *Pyrandia* fru.^{162,213}; *Stenocarpus sinuatus* nectar⁵⁸; *Telopea oreades* nectar¹⁶⁰; Punicaceae: *Punica granatum* fru.²⁰; Rhamnaceae: *Alphitonia excelsa* fru.¹⁷¹; *Rhamnus* sds¹¹²; Rosaceae: *Chaenomeles speciosus* nectar⁸¹; *Cotoneaster* fru.^{117,142,157,199}; *Crataegus* fru.^{41,157}; *Eriobotrya japonica* fru.¹⁶²; *Fragaria vesca* fru.²³; *Malus* fru.^{157,162}; *M. sylvestris* fru.^{29,112,125,152,184,208}; *Photinia serrulata* fru.¹⁸⁴; *Prunus* nectar¹⁸⁶; *P. amygdalus* nectar²⁰; *P. armeniaca* fru.^{23,81,153,212}; *P. avium* fru.^{1,5,20,86,103,104,208,212}; *P. cerasifera* fru.^{125,184}; *P. domestica* fru.^{48,120,162,184,212}, nectar⁸¹; *P. persica* fru.^{45,48,157,187,212}; *P. persica* var. *nectarina* fru.⁴⁸; *Pyracantha* fru.^{157,164,199}; *Pyrus* fru.¹⁶²; *P. communis* fru.^{20,27,29,208}, nectar⁵¹; *Rosa*²¹⁷; *R. rubiginosa* fru.^{162,199}; *Rubus fruticosus* fru.^{15,51,53,66,96,101,112,142,160,162,199,213,220}; *R. idaeus* fru.^{23,213}; *R. rosifolius* sds²¹³; Rubiaceae: *Coprosma* fru.^{125,158}; *C. billardieri* fru.^{54,122}; *C. lucida* fru.¹⁷; *C. quadrifida* fru.^{180,220}; *Rondeletia amoena* nectar¹⁵⁵; *Trukia stipularis* sds¹⁷⁷; Rutaceae: *Citrus limon* fru.^{112,210}; *C. sinensis* fru.^{93,112,210}; *Correa* nectar¹³¹; *Diplolaena* nectar^{126,161}; Santalaceae: *Choretrum glomeratum* fl.¹⁶², fru.¹⁶²; *Exocarpos* fru.^{162,213}; *E. cupressiformis* fru.²⁵; Saxifragaceae: *Ribes* fru.¹⁻⁵; Solanaceae: *Browallia jamesonii* nectar¹⁵⁵; *Capsicum* fru.¹⁵⁶; *Lycium ferocissimum* fru.^{40,51,53,158,183,203,216}, nectar¹¹⁸, pollen¹¹⁸; *Lycopersicon* fru.¹⁵⁶; *Nicotiana simulans* fru.⁷²; *Physalis* fru.¹²⁰; *Solanum* fru.²⁴, sds¹¹⁶; *S. aviculare* fru.²⁰⁰; *S. laciniatum* fru.¹⁶²; *S. mauritanium* fru.¹²⁰; *S. nigrum* unident. item²¹³, fru.^{129,162}; *S. opacum* unident. item⁸⁹; *S. simile* fru.¹⁰⁰; Thymelaeaceae: *Pimelea microcephala* fru.¹⁶²; *P. serpyllifolia*

fru.¹⁶²; *Wikstroemia indica* fru.⁵⁷; Urticaceae: *Dendrocnide excelsa* fru.¹⁷⁵; *Pipturus argenteus* fru.^{135,136,148}; Verbenaceae: *Avicennia marina* nectar⁶⁴; *Lantana nectar*¹⁵⁴, fru.^{49,57,111}; *L. camara* unident. item¹¹², fru.^{72,98}, nectar⁹⁹, sds⁹⁹; Violaceae: *Hymenanchera dentata* fru.^{125,179}; Vitaceae: *Parthenocissus inserta* fru.⁵; *Vitis vinifera* fru.^{5,6,8,23,24,27,32,45,53,54,56,67,70,102,108,109,120,156,162,172,208,211,213,214,215}, juice¹⁷⁴, sds²¹⁴; Zygophyllaceae: *Nitraria billardierei* fru.²¹⁶. **Animals** Arthropods⁹⁸. **SPRINGTAILS:** Collembola¹⁵⁶. **MITES:** Acarina^{16,213}. **SPIDERS:** 15,34,119,120,136,156,176,204,213,214,217; Heteropodidae²⁰⁹; Salticidae^{15,213}. **INSECTS** 1,3,4,5,6,8,11,14,15,16,19,20,21,22,23,27,30,33,35,42,43,44,45,47,58,62,63,74,75,87,92,115,118,120,122,124,130,135,136,141,143,146,148,149,152,159,160,172,195,211,212,213,214,215; eggs^{15,16,213}, larv.^{15,60,124,213,214}; Blattodea¹⁵⁶: larv.⁹⁸; Coleoptera^{14,15,16,31,52,98,156,177,213,214}; Carabidae^{134,214}; Chrysomelidae²¹⁷; *Ditropidus*⁹⁸; *Octotoma scabripennis* ad.⁹⁹; *Parops* larv.²¹⁴; *Uroplata girardi* ad.⁹⁸, larv.⁹⁸; Coccinellidae²¹⁷; Curculionidae^{16,98,120,134,213,214,217}; Polyphrades²¹⁴; Scarabaeidae: *Diphysphala*²¹⁴; Staphylinidae^{15,213}; Diptera^{15,31,53,135,136,156,176,211,213}; all stages³⁴; Chironomidae²¹³; Syrphidae²¹⁷; Tephritidae²; Hemiptera^{156,176,177,214}: honeydew¹⁶⁰; bugs^{53,213}; scale^{5,35,40,46,52,120}; Homoptera^{118,136,176,214}; larv.^{120,214}; Aphididae^{1,6,8,13,16,20,22,23,27,28,33,34,35,36,50,53,69,81,90,112,115,120,135,172,177,196,212,213,214}; *Aphis gossypii*⁹; *Cavariella aegopodii*^{96,97}; *Eriosoma lanigerum*^{5,36,54}; *Macrosiphum rosae*^{21,54}; *Nicotallis ulmi-parvifoliae* ad.¹⁸³, larv.¹⁸³; Cicadellidae^{53,120}; Jassinae²¹⁴; Coccidae⁵³; *Saissetia oleae*^{47,213,214}; Membracidae: larv.³¹; Pentatomidae³¹; Psyllidae^{15,213,217}; lerp^{160,214}, lerp larv.²¹⁴; Ricaniidae: *Scolytopa australis*^{15,213}; Hymenoptera^{120,156,176,214}; wasps²¹⁴; Braconidae²¹³; Formicidae^{135,136,176,214,217}: alates²¹⁴; *Camponotus consobrinus*²¹⁴; *Iridomyrmex*²¹⁷; *Pheidole*: alates²¹⁴; *P. megacephala*¹³⁰; Ibalitidae: *Ibalia leucospoides*²²¹; Ichneumonidae^{214,217}; cocoon²¹⁴; Siricidae: *Sirex noctilio*²²¹; Tenthredinidae: *Caliroa cerasi*^{1,8,196}; Lepidoptera^{27,33,34,120,156,201}; larv.^{15,16,22,31,35,36,46,53,69,98,119,120,136,176,213,214,217}, ad.¹³⁶; *Margaronia excelsalis* larv.¹³⁰; Geometridae: larv.^{182,217}; Noctuidae²¹⁷; *Chryso deixis* larv.^{15,213}; *Helicoverpa armigera* larv.^{36,37}; Plutellidae: larv.²¹³; Psychidae: larv.⁶; Sphingidae: larv.^{16,135,149,213}; Tortricidae: *Cydia pomonella*^{1,8,35}, all stages^{33,36}; Neuroptera^{15,120,213}; Orthoptera^{136,156}: grasshoppers¹²⁰; Acrididae¹²⁰; Phthiraptera¹⁵⁶; Thysanoptera^{15,156,213}. **Other matter** Blight³⁰; food scraps, including fruit and vegetable peelings^{12,135,136,148,152}; sugar^{82,83,128}; syrup⁸⁴; jam^{82,83}; bread¹³⁵; blended oats with sugar¹⁷⁸; cheese¹³⁵; meat¹³⁵; fibrous matter²¹⁵; charred paper²¹⁴; mineral particles²¹⁴; quartz grains^{15,213}; polystyrene beads¹⁹⁰. For items accepted by wild-caught birds in captivity, see Harrison (1968), French (1996) and Rienks & Catterall (2000). For bait used in traps, see Lashmar (1987).

REFERENCES: ¹ Littler 1901; ² Milligan 1903; ³ Nicholls 1905; Dove ⁴ 1906a, ⁵ 1906b, ⁶ 1907, ⁷ 1927; Chisholm ⁸ 1908a, ⁹ 1910; White ¹⁰ 1909, ¹¹ 1920, ¹² 1946; ¹³ Batey 1910; Cleland ¹⁴ 1910, ¹⁵ 1911, ¹⁶ 1912, ¹⁷ 1952; ¹⁸ Chandler 1913; ¹⁹ Mellor & White 1913; ²⁰ Belcher 1914; ²¹ Morgan 1914; ²² Zietz 1914; Anon. ²³ 1915, ²⁴ 1983; ²⁵ Lawrence & Littlejohns 1916; ²⁶ White 1919; ²⁷ Froggatt 1921; ²⁸ Norton 1922; Wolstenholme ²⁹ 1922, ³⁰ 1929; ³¹ Lea 1923; ³² Carter 1924; Chisholm ³³ 1924, ³⁴ 1926a, ³⁵ 1926b, ³⁶ 1933, ³⁷ 1934; ³⁸ MacPherson 1924; ³⁹ Barnard & Barnard 1925; Cohn ⁴⁰ 1926, ⁴¹ 1942; ⁴² Favalaro 1926; MacGillivray ⁴³ 1926, ⁴⁴ 1928; ⁴⁵ McGilp 1926; ⁴⁶ Morgan *et al.* 1926; Sutton ⁴⁷ 1926, ⁴⁸ 1928; ⁴⁹ de Warren 1928; ⁵⁰ Leach 1928; ⁵¹ Sargent 1928; ⁵² Jarvis 1929; ⁵³ Newman 1929; ⁵⁴ Barton 1930; ⁵⁵ Serventy 1930; ⁵⁶ Chenery 1932; ⁵⁷ E.C. Chisholm 1932a; Gannon ⁵⁸ 1932, ⁵⁹ 1936; ⁶⁰ Geary 1932; ⁶¹ Jerrard 1932; ⁶² Marshall 1934; ⁶³ Gray 1935; ⁶⁴ Hindwood 1935; ⁶⁵ Hyem 1937; ⁶⁶ McNamara 1937; ⁶⁷ Whitlock 1937; ⁶⁸ Gilbert 1939; ⁶⁹ Souter 1942; ⁷⁰ Whittell 1942; ⁷¹ Fleming 1943; Keast ⁷² 1944, ⁷³ 1958a, ⁷⁴ 1975, ⁷⁵ 1996; Rix ⁷⁶ 1945, ⁷⁷ 1976; ⁷⁸ Bourke & Austin 1947; Cooper ⁷⁹ 1948, ⁸⁰ 1959, ⁸¹ 1974a; Tarr ⁸² 1949a, ⁸³ 1949b; ⁸⁴ Taylor 1949; ⁸⁵ Loaring 1952; ⁸⁶ Ryan 1953; ⁸⁷ Lord 1956; ⁸⁸ Boehm 1957; ⁸⁹ Condon 1958; ⁹⁰ Officer 1958; ⁹¹ Lowe 1959; ⁹² Watson 1959; ⁹³ Robinson

1960; ⁹⁴ Lawrence 1961; ⁹⁵ Serventy 1961; Liddy ⁹⁶ 1963, ⁹⁷ 1966b, ⁹⁸ 1982, ⁹⁹ 1985; ¹⁰⁰ Storr 1965; ¹⁰¹ Wilson & Wilson 1966; ¹⁰² Hutchison 1967; Napier ¹⁰³ 1967, ¹⁰⁴ 1969; Wheeler ¹⁰⁵ 1967, ¹⁰⁶ 1972, ¹⁰⁷ 1973; ¹⁰⁸ Harrison 1968; ¹⁰⁹ Jenkins 1968; ¹¹⁰ McEvey & Middleton 1968; ¹¹¹ Wakelin 1968; Mees ¹¹² 1969, ¹¹³ 2003a; ¹¹⁴ Napier 1969; ¹¹⁵ Vestjens & Vestjens 1970; ¹¹⁶ Green & McGarvie 1971; ¹¹⁷ Bedgood 1973b; ¹¹⁸ Paton 1973; Rose ¹¹⁹ 1973, ¹²⁰ 1999; ¹²¹ Burrows 1974; ¹²² Mollison 1974; Fielding ¹²³ 1976, ¹²⁴ 1979; ¹²⁵ Fleming 1976; ¹²⁶ Keighery 1976; ¹²⁷ Mannes 1976; ¹²⁸ Bingham 1977; ¹²⁹ Griffiths 1977; ¹³⁰ Henderson 1977; ¹³¹ McCulloch 1977; ¹³² Parker 1977; ¹³³ Paton & Ford 1977; ¹³⁴ Vestjens 1977; Catterall ¹³⁵ 1978, ¹³⁶ 1985; ¹³⁷ Ford 1979; Ford *et al.* ¹³⁸ 1979, ¹³⁹ 1985, ¹⁴⁰ 1986; ¹⁴¹ Nix 1979; ¹⁴² Harris 1980; ¹⁴³ Thomas 1980; Abbott ¹⁴⁴ 1981, ¹⁴⁵ 1995; ¹⁴⁶ Ford & Bell 1981; ¹⁴⁷ Garnett *et al.* 1991; Catterall *et al.* ¹⁴⁸ 1982, ¹⁴⁹ 1989; ¹⁵⁰ Ford & Paton 1982; ¹⁵¹ Kendrick 1983; ¹⁵² Kikkawa & Wilson 1983; ¹⁵³ Paton & Reid 1983; McFarland ¹⁵⁴ 1984b, ¹⁵⁵ 1994; ¹⁵⁶ Rooke 1984a; ¹⁵⁷ Smith *et al.* 1984; ¹⁵⁸ Ashton 1985; ¹⁵⁹ Loyn 1985a; ¹⁶⁰ Recher *et al.* 1985; ¹⁶¹ Hopper & Burbidge 1986; ¹⁶² Forde 1986; ¹⁶³ Milewski 1986; ¹⁶⁴ Mulvaney 1986; ¹⁶⁵ Reid 1986; ¹⁶⁶ Lashmar 1987; ¹⁶⁷ Metcalf 1988; ¹⁶⁸ Paton *et al.* 1988; ¹⁶⁹ Vanstone & Paton 1988; ¹⁷⁰ Baxter 1989; ¹⁷¹ Floyd 1989; ¹⁷² R.J. Green *et al.* 1989; ¹⁷³ Buchanan 1990; ¹⁷⁴ Burton 1990; ¹⁷⁵ Holmes 1990; ¹⁷⁶ Jansen 1990; ¹⁷⁷ Hutton 1991; ¹⁷⁸ Ashford 1992; ¹⁷⁹ Aston 1992; ¹⁸⁰ French *et al.* 1992; ¹⁸¹ Elliot 1993; ¹⁸² Green 1993; Lepshi ¹⁸³ 1993, ¹⁸⁴ 1997; Hewish ¹⁸⁵ 1994, ¹⁸⁶ 1997, ¹⁸⁷ 1998, ¹⁸⁸ 2002a, ¹⁸⁹ 2002b; ¹⁹⁰ Mitchell 1995; ¹⁹¹ Water-house 1995; ¹⁹² Gladstone 1996; ¹⁹³ Mac Nally 1997; ¹⁹⁴ Wheel 1996; ¹⁹⁵ Wheeler & Calver 1996; ¹⁹⁶ Davey 1997; ¹⁹⁷ Egan 1997; ¹⁹⁸ Panetta & McKee 1997; ¹⁹⁹ Er *et al.* 1998; ²⁰⁰ Rogers 1998; ²⁰¹ K.A. Wood 1998; ²⁰² Hubregste 1999; ²⁰³ Peter 2000; ²⁰⁴ Rienks & Catterall 2000; ²⁰⁵ Spennemann & Allen 2000; ²⁰⁶ Stranger 2000; ²⁰⁷ Brooker 2001; ²⁰⁸ Bomford & Sinclair 2002; ²⁰⁹ Wells 2002; ²¹⁰ Talmage 2003; ²¹¹ Gould; ²¹² North; ²¹³ Cleland; ²¹⁴ Lea & Gray; ²¹⁵ Hall; ²¹⁶ Storr ²¹⁷; ²¹⁷ FAB; ²¹⁸ SA Bird Rep. 1966–67; ²¹⁹ H.A. Ford; ²²⁰ R.K. Hicks; ²²¹ J.L. Madden; ²²² J.M. Peter.

Other records—NZ Plants Fruit^{2,3,4,5,12,20,25,26,30,33,36,39,50,51}; nectar^{2,3,5,33,36,39,52}; seeds³⁰. **GYMNOSPERMS:** Podocarpaceae: *Dacrydium cupressinum* fru.⁵⁰; *Dacrydium cupressinum* fru.⁵⁰; *Podocarpus* fru.^{61,71}; *P. nivalis* fru.³⁴. **MONOCOTYLEDONS:** Agavaceae: *Cordyline australis* fru.^{52,73}; *Phormium* nectar^{51,52,56,61}, sds⁷³; *P. tenax* nectar⁴³; Liliaceae: *Asparagus* fru.⁵²; *Kniphofia caulescens* nectar^{59,61}; Pandanaceae: *Freycinetia banksii* fru.⁵⁰, nectar⁵⁰; Poaceae: sds^{56,64}. **DICOTYLEDONS:** Actinidiaceae: *Actinidia chinensis* fru.⁵⁷; Araliaceae: *Nothopanax arboreum* fru.⁶¹; *Pseudopanax* fru.²⁶; *P. arboreum* fru.^{61,68}; *P. lessonii* fru.^{43,70}; *Schefflera digitata* fru.^{60,67}; Asteraceae: thistles sds⁵²; *Olearia* sap³²; *Solidago* sds⁵⁶; Berberidaceae: *Berberis* fru.⁵²; *B. darwinii* fru.⁴⁷; *Mahonia japonica* fru.²⁹, nectar²⁹; Caprifoliaceae: *Lonicera* fru.⁵²; *Sambucus* fru.⁵²; Celastraceae: *Euonymus europaeus* fru.⁵²; *Coriaria* fru.⁶¹; Cornaceae: *Dendrobenthamia capitata* fru.⁴⁸; *Griselinia littoralis* fru.⁵⁰; Elaeocarpaceae: *Aristotelia serrata* fru.^{51,57,58,60}; Ericaceae: *Arbutus unedo* fru.^{48,52,63}; *Rhododendron* nectar²⁶; Escalloniaceae: *Carpodetus serratus* fru.^{26,38,57,60}; Fabaceae: *Chamaecytisus proliferus* sds⁵⁴; *Melilotus* sds⁷³; *Sophora* unident. item²¹, nectar^{50,51,61}; Grossulariaceae: *Ribes* nectar⁵; Icacinaceae: *Pennantia corymbosa* unident. item^{58,60}; Loganiaceae: *Geniostoma rupestre* var. *ligustrifolium* fru.⁵⁰; Loranthaceae: *Ileostylis micranthus* fru.⁵³; Malvaceae: *Abutilon* nectar⁵⁹; *Hoheria* nectar⁶¹; *H. angustifolia*²⁶; Meliaceae: *Dysoxylum spectabile* fru.⁷¹; Melianthaceae: *Melianthus major* nectar³¹; Mimosaceae: *Acacia* nectar^{49,57}; *A. mearnsii* nectar⁶¹; Moraceae: *Ficus* fru.^{3,30,61}; Myoporaceae: *Myoporum laetum* fru.²¹, nectar^{26,75}; Myrsinaceae: *Myrsine australis* fru.²⁶; Myrtaceae: *Eucalyptus* nectar⁵⁰; *Feijoa* calyx⁶², fl.^{44,61,71,77}; *Grevillea* nectar^{59,72}; *Metrosideros* nectar^{26,50,51}; *M. fulgens* nectar⁴⁵; Oleaceae: *Ligustrum* fru.^{13,18,56,57}; Onagraceae: *Fuchsia* unident. item⁵³, fru.⁵⁰, nectar^{50,51}; *F. excorticata* nectar²⁶;

Papilionaceae: *Sophora microphylla* nectar²⁶; Phytolaccaceae: *Phytolacca octandra* unident. items^{27,61}, fru.^{28,61}; Piperaceae: *Macropiper excelsum* fru.⁷⁴; *Pittosporum crassifolium* nectar^{59,73}; *P. eugenioides* nectar²⁶, fru.²⁶; *P. tenuifolium* sds⁷, nectar²⁶, fru.²⁶; Polygonaceae: *Muehlenbeckia* fru.²⁶, sds⁶; *M. australis* fru.⁷⁶; *M. axillaris* fru.⁶⁷; *Rumex* unident. item⁵²; Proteaceae: *Banksia* nectar⁵⁰; *Knightia excelsa* nectar^{50,51}; *Cotoneaster* fru.^{19,61}; *C. rotundifolia* fru.²⁹; *C. serotina* fru.⁵²; *Crataegus* fru.^{57,61}; *Malus* fru.⁷¹; *M. purpurea* fru.²⁹; *M. sylvestris* fru.^{1,10,35}; *Prunus avium* fru.^{1,30,51}; *P. campanulata* nectar⁶⁴; *P. cerasifera* fru.⁷¹; *P. domestica* fru.^{1,2,30,51}, nectar⁵⁷; *P. persica* fru.^{3,10,51}; *Rubus australis* sds³⁰; *R. fruticosus* fru.^{59,60}; Rubiaceae: *Coprosma* unident. item⁶¹, fru.^{16,26,34,39,50,51,52,57,61,74}; *C. australis* fru.³⁷; *C. lucida* fru.^{37,60}; *C. macrocarpa* fru.⁴³; *C. propinqua* fru.³⁷; *C. repens* fru.^{73,76}; *C. robusta* fru.^{36,37,77}; *Rondeletia* nectar⁶⁶; *Citrus sinensis* fru.⁶¹; Salicaceae: *Salix* nectar^{61,67}; Saxifragaceae: *Ribes* nectar¹⁵, fru.³⁰; Scrophulariaceae: *Hebe* nectar⁵⁹; Solanaceae: *Cestrum nocturnum* fru.⁶¹; *Solanum laciniatum* fru.⁷⁴; *S. nigrum* unident. item²⁷; *S. pseudocapsicum* fru.⁵³; Umbelliferae: *Foeniculum vulgare* nectar⁷⁴; Verbenaceae: *Avicennia marina* nectar⁶⁸; *Vitex lucens* nectar^{50,51,71}; Violaceae: *Hymenanchera* fru.³⁹; *Meliccytus ramiflorus* fru.^{26,38,61,67}; Vitaceae: *Vitis vinifera* fru.^{50,54,61}; Winteraceae: *Pseudowintera axillaris* fru.⁴⁰. **Animals** Invertebrates^{29,34,36}. **MOLUSCS:** Gastropods²⁶. **CRUSTACEANS:** Amphipods⁵¹. **SPIDERS:** Pisauridae⁶⁷; nest⁷⁰. **INSECTS:** 2,3,5,12,14,17,20,28,29,30,33,34,39,41,46,51; eggs³³, larv.^{11,30,33}; Coleoptera^{30,50}; Diptera^{32,50,61}; Hemiptera⁵⁰; scale^{33,51}; Aphididae^{4,5,30,32,51,65,77}; *Eriosema lanigerum*^{1,3,50,51}; Cicadellidae: *Edwardsiana australis*³⁵; Cicadidae¹³; Coccidae: *Coccus*³⁰; Margarodidae: *Ultracoelostoma assimile* honeydew⁴²; Psyllidae³²; Hymenoptera: Tenthredinidae: *Caliroa cerasi*⁷; Lepidoptera^{24,52}; larv.^{30,50,62,64}; Hepialidae: *Wiseana* ad.⁸; Plutellidae: *Plutella xylostella*⁵¹; Tortricidae: pupae⁶²; Orthoptera: grasshoppers³⁰. **Other matter** Blight⁵⁹; food scraps, including fruit and vegetable peelings^{2,5,33,51,57}; sugar^{2,5,39}; honey^{25,39}; syrup^{5,25,39,55,68}; jam^{25,31}; bread^{4,5,13,25,39,50,53}; porridge²⁵; cake⁵; butter^{5,51}; meat, including sheep, venison and rabbit^{2,5,13,16,22,25,50,52,57}; fat^{2,13,23,25,33,39,50,51,52,57,69}; suet^{4,5,51}. For bait used in traps, see Marples (1945), Cunningham (1946b) and Lashmar (1987).

REFERENCES: ¹ Drummond 1909b; ² McLean 1912; ³ Oliver 1922; Wilkinson ⁴ 1924, ⁵ 1931; Stidolph ⁶ 1925, ⁷ 1931, ⁸ 1950; ⁹ Cunningham 1946a; ¹⁰ Phillipps & Lindsay 1948; ¹¹ Ryder 1948; ¹² Dawson & Cresswell 1949; ¹³ Hodgkins 1949; ¹⁴ Clark 1950; ¹⁵ Davidson 1950; ¹⁶ Dawson 1951; ¹⁷ Sutherland 1952; ¹⁸ Mac-Donald 1953b; ¹⁹ Lewis 1961; Edgar ²⁰ 1949, ²¹ 1962; ²² Cartwright 1954; ²³ Pennick 1956; ²⁴ Wright 1961; Kikkawa ²⁵ 1962, ²⁶ 1966; ²⁷ Blundell & McKenzie 1963; ²⁸ Merton 1966; ²⁹ East 1967; ³⁰ Turbott 1967; ³¹ Simpson 1973; ³² Horning & Horning 1974; ³³ St Paul 1975; ³⁴ Child 1978; ³⁵ Baker 1980; ³⁶ Gill 1980; ³⁷ Onley 1980; ³⁸ Dunn 1981; ³⁹ Falla *et al.* 1981; ⁴⁰ Norton 1982; ⁴¹ Clout & Gaze 1983; ⁴² Gaze & Clout 1983; ⁴³ Cunningham & Moors 1985; ⁴⁴ Metcalf 1988; ⁴⁵ Wilson *et al.* 1988; ⁴⁶ Taylor 1989; ⁴⁷ Allen & Lee 1992; ⁴⁸ Sibson 1993; ⁴⁹ Beauchamp & Parrish 1999; ⁵⁰ Heather & Robertson 2000; ⁵¹ Oliver; CSN ⁵² 1, ⁵³ 2, ⁵⁴ 3, ⁵⁵ 4, ⁵⁶ 5, ⁵⁷ 6, ⁵⁸ 7, ⁵⁹ 8, ⁶⁰ 9, ⁶¹ 19 Suppl., ⁶² 20, ⁶³ 21, ⁶⁴ 22, ⁶⁵ 23, ⁶⁶ 26, ⁶⁷ 28, ⁶⁸ 31, ⁶⁹ 35, ⁷⁰ 37, ⁷¹ 38, ⁷² 39, ⁷³ 41, ⁷⁴ 42, ⁷⁵ 43, ⁷⁶ 44, ⁷⁷ 45.

Young Fed by both parents (see Breeding). On Heron I., nestlings and fledgelings fed equally by each parent, though some evidence that one parent tends to invest more effort than the other in older fledgelings (Kikkawa 1987; Wilson & Kikkawa 1988). On Heron I., nestlings <7 days old fed mostly insects, with proportion of fruit in diet increasing with age (Catterall 1978; Catterall *et al.* 1982; Kikkawa & Wilson 1983; Eguchi 1993; Robertson 1997). At ten nests with 5–6-day-old nestlings, of 144 mouthfuls of food fed: 74% comprised insects (mean 10.7 items in 90-min observation period), and 26% figs (3.7 items/90 min); excludes one nest next to fruiting fig tree,

where 53 mouthfuls of fig and 13 insects were provided in 90 min. Five nests with 8–10-day-old nestlings received 107 mouthfuls: 57% insects (12.2 items/90 min, not significantly different from 5–6 day-old nestlings), and 43% figs (9.2 items/90 min, significantly different from 5–6 day-old nestlings). Reduced provision of insects in first week led to greater nestling mortality (Catterall 1978; Catterall *et al.* 1982). In Capricorn Grp, Qld, young at one nest raised almost entirely on figs (Cooper 1948). In Sydney, nestlings may have been fed nectar (Cooper 1974a). In Auckland, nestlings fed at 9–14 min intervals, with visits alternating between sexes; 3 days before fledging, male visited every 13–14 min, and female 10–11 min (Fleming 1943). At New Plymouth, NI, three 10-day-old nestlings were fed 263 times in 4 h; both parents visited nest at 3-min intervals, with visits lasting 10 s, though sometimes fed twice in 5 s, and once not fed for >20 min (Medway 1955). On Heron I., 5–6 day-old nestlings fed at c. 15 min intervals; intervals shortened to c. 8 min just before fledging (Kikkawa & Wilson 1983; Robertson 1997). At Wollongong, NSW, two 8-day-old nestlings received mean of 3.7 meals/nestling/h (1.1–5.2; 24). More feeding visits were observed early in morning (15 in 87 min) than late in afternoon (2 in 55 min); duration of visits 5–110 s (median 10 s) with longer visits associated with large food items (K.A. Wood 1998). Nestlings fed on insects up to 25 mm long (Gross 1963; K.A. Wood 1998). On Heron I., insects fed to nestlings were usually >5 mm, or >4.5 mg; parents ate smaller insects and carried large prey to nest (Catterall 1978; Catterall *et al.* 1982). Large insects usually mashed in bill or broken up before being fed to young (Medway 1955; K.A. Wood 1998; Oliver). On Heron I., parents typically carried insects to nest one at a time, which fed to single nestling; billfuls of fig pulp or food scraps often given to multiple nestlings (Catterall *et al.* 1982; Wilson & Kikkawa 1988). At nest with three nestlings, parents always brought three insects, one given to each chick (MacDonald 1951). On Heron I., fledgelings observed being fed fish regurgitated by Black Noddies (Catterall 1978). Fledgelings fed for up to 3 weeks after leaving nest (Wilkinson 1931; Fleming 1943; Wilson & Kikkawa 1988).

No detailed studies—Aust. **Plants** Fruit⁷. **DICOTYLEDONS:** Moraceae: *Ficus* fru.^{3,4,5}; Rosaceae: *Malus sylvestris* fru.⁶; *Prunus cerasifera* fru.³; *Rubus fruticosus* fru.¹⁰; *Pyrus communis* fru.⁸; Rubiaceae: *Coprosma* fru.⁸. **Animals** Arthropods⁵. **INSECTS:** 2,4,6,7,9, larv.²; Diptera^{4,5}; Lepidoptera: ads^{4,5,9}; Noctuidae: *Agrotis infusa*⁹; Orthoptera: Tettigoniidae^{4,5,9}. **SPIDERS:** 2,4,5; Desidae: *Badumna insignis*⁹. **FISH:** Regurgitated fish⁴. **Other matter** Food scraps⁷. For diet of wild caught, hand-raised nestling, see Rentz (1991).

REFERENCES: Cooper ¹ 1948, ² 1974a; ³ Wheeler 1972; ⁴ Catterall 1978; ⁵ Catterall *et al.* 1982; ⁶ Kikkawa & Wilson 1983; ⁷ Wilson & Kikkawa 1988; ⁸ Hewish 1997; ⁹ K.A. Wood 1998; ¹⁰ R.K. Hicks.

No detailed studies—NZ. **Plants** Fruit⁶. **DICOTYLEDONS:** Myrtaceae: *Feijoa* fl.¹¹. **Animals** **INSECTS:** 1,7: ads⁶, larv.⁶; Diptera^{3,5}; Tipulidae⁹; Hemiptera: Flatidae: *Siphanta acuta*⁴; Lepidoptera⁹: ads⁸, larv.^{3,4,5,7,10}; Noctuidae: ads². **SPIDERS:** 6,7.

REFERENCES: ¹ MacDonald 1951; ² Welch 1951; ³ Medway 1955; ⁴ Gross 1963; ⁵ Horning & Horning 1974; ⁶ Falla *et al.* 1981; ⁷ Oliver; CSN ⁸ 20, ⁹ 24, ¹⁰ 34, ¹¹ 38.

Intake On Heron I., feed mainly on small insects; proportions of sizes of insects taken in two winters: 34% were 1–2 mm; 64%, 2–5 mm; 1%, 5–8 mm; and 1%, >8 mm (Catterall 1989). On same island, proportions of sizes of insects taken May 1973 and May 1974 (combined data from *Pisonia* forest and layered woodland; possibly a subset of Catterall 1989 data above): 20% were 1–2 mm; 77%, 2–5 mm;

1%, 5–8 mm; and 1%, >8 mm (Catterall 1985). Of 440 insects eaten on Heron I., 15 July–2 Aug. 1987, 96.8% were <5 mm (Jansen 1990). For details of rates of energy derived from insects and fruit eaten on Heron I., see Catterall (1985). Rates of intake did not differ between sexes (Catterall 1978), but adults captured large insects at greater rate than juveniles, and juveniles consumed more small insects than adults (Catterall *et al.* 1989). As a result, adults obtained far more energy from large insects (>5 mm) than juveniles, which relied on smaller insects (≤ 5 mm) for bulk of intake (Catterall 1978). Similarly, when foraging for fruit in fig *Ficus* trees, adults had greater rates of intake than juveniles; differences were greatest where densities of figs low, due to social dominance of adults, which able to spend more time foraging (Henderson 1977). Total rates of capture of insects on Heron I. c. 1–3 insects/min, with capture success greater during longer (>20 s) foraging bouts, which probably indicates birds remain longer at sites with more food (Catterall 1978, 1985). Foraging success varies with group-size; in layered woodland, flocks of ≥ 5 birds were more successful than pairs or small groups when foraging on small insects, but in *Pisonia* forest, pairs or small groups more successful than groups of ≥ 5 (Catterall 1978). In Lerderderg Gorge, Vic., of 228 faecal samples, mid-Dec. 1997 to mid-Mar. 1998: 42% contained fruit only, 52.2% contained both fruit and insects, and 5.7% contained insects only; of 214 faecal samples, early Jan. to late Mar. 1999: 71.5% contained fruit only, 25.2% fruit and insects, and 3.3% insects only. In addition, 81.4% of samples with fruit contained seeds of one plant species (Stanley 2001, which see for further detail). At same site visited Common Fig significantly more often than either Mealy Saltbush or Tree Violet, with little difference between Mealy Saltbush and Tree Violet; and duration of foraging visits were significantly longer in Common Fig (mean visit length 328 s, estimated from graph) than either Tree Violet (mean visit length 50 s) or Mealy Saltbush (59 s), but no difference in length of visits between Tree Violet and Mealy Saltbush. Significantly more fruits were eaten per visit in both Common Fig (16.7 bites/visit) and Mealy Saltbush (13.3 fruits/visit) than in Tree Violet (4.8 fruits/visit), many of which were dropped (see Handling, above) (Stanley 2001, which see for details). In Lamington NP, se. Qld, and Border Ras NP, ne. NSW, duration of 56 visits to fruiting plants: 87% 0–4.9 min and 13% 5.0–9.9 min (estimated from graph) (Green 1993, which see for rates of visitation). At Kenmore, Qld, rates of visitation to flowers: *Rondeletia amoena* 2.0 visits/h, *Grevillea* 'Honey gem' 0.9 visits/h, New Zealand Christmas Bush *Metrosideros thomasi* 0.6 visits/h, and *Browallia jamesonii* 0.2 visits/h (McFarland 1994). At Healesville and Mt Donna Buang, Vic., 95.8% of 167 faecal samples examined contained fruit remains, with 8.2 seeds/sample in those samples that contained seeds (French 1989, 1990). Often visited Prickly Currant Bush *Coprosma quadrifida*, where, in 1986, made 0.26 visits/shrub-hour (1 shrub-hour = observation at single shrub for 1 h) with mean length of visit 0.68 min (122 shrub-hours); and in 1987, 0.12 visits/shrub-hour, with mean length of visit 0.67 min (217 shrub-hours). Birds consumed 9.9 (5.50; 21) fruits/min, or c. 6 fruits per visit (French 1989, 1990). Of 406 observations of foraging during winter in banksia woodland near Perth, 60% were insects; of 236 insects eaten (identified in faeces): 32%, ≤ 2 mm; 41%, 2–4 mm; 17%, 4–6 mm; 10%, >6 mm (Tullis *et al.* 1982). Near Nelson, SI, size of invertebrates eaten varied from 2 mm for aphids (Hemiptera: Aphididae) to 10–15 mm for caterpillars (Moeed 1979). In *Nothofagus* forest near Nelson, SI, time/activity budget (in 441 5-s periods): 77% spent foraging, comprising 32% feeding on honeydew of *Ultracoelostoma assimile*, 25% feeding on insects, and 20% general foraging (Gaze & Clout 1983). When feeding on apricots in orchard at Murray Bridge, SA, made 10.4 (9.0; 1–48; 209) pecks/visit

(Paton & Reid 1983). For intake of birds in captivity, see Kikkawa (1962).

SOCIAL ORGANIZATION Well known. **DETAILED STUDIES:** On Heron I., of colour-banded birds, Sept. 1967–Feb. 1970 (Kikkawa & Wilson 1983), Sept. 1972–Mar. 1973 and Sept. 1973 to late Jan. 1974 (Catterall *et al.* 1982), and in winters of 1972, 1973 and 1979–1983 (Catterall *et al.* 1989) and 1988 and 1989 (Kikkawa & Catterall 1991); at Armidale, NSW, observations at feeding table, July–Sept. 1961 (Kikkawa 1968); in Auckland, of colour-banded birds, Aug. 1939–Nov. 1940, with sporadic observations till Jan. 1942 (Fleming 1943); at Dunedin, of colour-banded birds, in winters of 1959 and 1960 (Kikkawa 1961a). **Gregariousness** Throughout range, at any time of year, often seen singly, in twos, or in small flocks of up to c. 15 (e.g. Moncrieff 1929; Cunningham 1946a; Blackburn 1967; Mees 1969; St Paul 1975; Nilsson *et al.* 1994; Gould; Hall; Storr 21, 26, 27, 28, 35; see also Food), but outside breeding season often occur in much larger flocks, especially in migratory subspecies (see also Movements; and Food). In **MAINLAND E. AUST. AND TAS.** (various subspecies), usually form flocks when migrating, and may contain 300–500 birds (Frith 1969; Chan & Sutton 1993). At Toowoomba, se. Qld, maximum monthly flock-size (defined as number of birds in garden at any one time), was 9–42 birds Sept.–Apr., and 79–97 birds May–Aug. (McKilligan & McKilligan 1987). On Fraser I., se. Qld, migrating flocks in autumn may comprise 500–1200 birds (Sutton 1990). In e. NSW, congregate in flocks of up to 200 in Mar., which persist till July or later (Gilbert 1935; North). At Wilsons Prom. and C. Liptrap, Vic, recorded in migrating flocks of up to 250, but usually 20–50; flocks of 30–50 often occur during peak migration period (mid-Sept. to mid-Nov.), and larger flocks usually recorded after poor weather (Cooper 1975; Chan & Sutton 1993). On **HERON I.** (subspecies *chlorocephalus*), mostly occur in flocks of 4–30 in winter (Kikkawa 1980a, 1987; Catterall *et al.* 1982; Kikkawa & Wilson 1983; Catterall 1989). In **W. AUST.** (subspecies *chloronotus*), occasionally recorded in flocks of 40–100 from Dec.–July (Storr 21, 27, 28, 35). At Harvey, WA, flocks break up in early summer and start to re-form in Feb. (Sedgwick 1988). In hot, dry weather, often drink and bathe in large flocks; >50 seen together at water (Mees 1969). In **NZ** (nominat *lateralis*), usually form flocks of 20–30 in Mar., with large flocks (e.g. up to several hundred) recorded late Apr. to July; flocks disintegrate when pairs leave to establish territories, either breaking up suddenly in late Aug. or Sept., or gradually reduce in size; usually only seen singly, in twos or small flocks Oct.–Dec. (Moncrieff 1929; Cunningham 1946a; Edgar 1949; Kikkawa 1961a; Grant 1970; Dennison *et al.* 1981; CSN 2, 5, 26). In winter in Dunedin, mean flock-size 9.5 (n=141) at feeding site (Kikkawa 1961b). In July on Cuvier I., sometimes form flocks of 1000+ (Blackburn 1967). **MIXED-SPECIES FLOCKS:** Throughout range, often recorded in mixed-species flocks; some recorded as foraging flocks and some as migratory flocks. In **AUST.**, recorded in migratory flocks and foraging flocks with various other species (see Movements, Food). Sometimes also recorded in flocks with Chestnut-rumped Thornbills *Acanthiza uropygialis*, Western Spinebills *Acanthorhynchus superciliosus*, Rufous Whistlers *Pachycephala rufiventris*, Willie Wagtails *Rhipidura leucophrys* or Red-browed Finches *Neochmia temporalis* (Chisholm 1924; Sedgwick 1949b, 1956; Schodde 1956; Hewish 2002a; Hall). Occurred in 4% of 53 mixed-species flocks in Black Mt NR, ACT (Hermes 1981). In se. Aust., flocks can include varying numbers of conspecifics with up to 40 other birds (Hall). In **NZ**, recorded in foraging flocks with numerous other species (see Food). Also recorded in flocks with parakeets *Cyanoramphus*, Whiteheads *Mohoua albicilla* and Yellowheads *M. ochrocephala*, Grey Fantails,

European Goldfinches *Carduelis carduelis*, and European Greenfinches (Edgar 1949; CSN 19 Suppl., 23, 24, 39).

Bonds Well known on Heron I., but poorly known elsewhere. Two birds initially trapped together often retrapped together, including in winter, suggesting pairs remain together within winter flocks (Marples 1944; Lane 1962a, 1972b), and remain paired from one breeding season to the next (Stead 1932). Breed in pairs at many locations (e.g. Fleming 1943; Mees 1969; Marchant 1992; K.A. Wood 1998; NRS), so probably socially monogamous throughout range. On HERON I.: Usually socially monogamous (Kikkawa & Wilson 1983; Kikkawa 1987, 2003; Wilson & Kikkawa 1988; Catterall 1989) and genetically monogamous (Robertson *et al.* 2001), though polygamy recorded twice. In both cases, two males formed a bond with one female; bond persisted for entire breeding season, despite continual conflict between the males (Kikkawa 1987). Usually form lifelong pair-bonds that are maintained throughout year (Kikkawa & Wilson 1983; Kikkawa 1987, 2003; Wilson & Kikkawa 1988). Re-pairing usually only occurs after death of partner (Kikkawa 1987, 2003), but divorces occasionally recorded (see below). Of 35 pairs that bred in two successive seasons (1968–69 and 1969–70), 26 maintained same pair-bond and nine had new partners; six of those with new partners had replaced dead partners. Of 20 pairs that bred in another two successive seasons (1969–70 and 1970–71), two changed partners. Reasons for divorce not known (Kikkawa & Wilson 1983). Those that re-pair usually do so with an experienced breeder rather than first-year bird, and most often with bird from nearby territory; few re-paired in same breeding season in which partner died (Kikkawa 1987, 2003). Juveniles usually pair permanently during first non-breeding season, and associate from about Mar. onwards (Kikkawa 1961a,b; Catterall *et al.* 1989; see also Social Behaviour: Sexual Behaviour). Extra-pair copulations not observed on Heron I., and using DNA fingerprinting techniques, no evidence of extra-pair paternity or intraspecific brood parasitism (Kikkawa 1987; Robertson & Kikkawa 1994; Robertson 1997; Robertson *et al.* 2001). **MATE-GUARDING:** Close association of pair during egg-laying period (see below) first interpreted as mate-guarding (e.g. Kikkawa 1987), but more recent studies suggest males do not guard females (e.g. Robertson *et al.* 2001; Kikkawa 2003). On Heron I., time of greatest synchrony between partners appeared to correspond to laying of first clutch (Catterall *et al.* 1982), and at that time male also said to escort female to feeding site at first light (Kikkawa 1987). During breeding season, partners spend >50% of time within 5 m of each other. Though suggestive of mate-guarding, close pair association not positively related to fertility of female (Robertson *et al.* 2001). Furthermore, after separation, females initiated pair reunion as often as males, irrespective of season (Robertson & Kikkawa 1994; Robertson 1997). **SEX-RATIO:** On Heron I., sex-ratio unbiased (Kikkawa 1987). **Parental care** Both sexes brood and feed nestlings and fledgelings, and remove faecal sacs (see Breeding). One parent tends to invest more effort than the other in older fledgelings, but this not dependent on sex (Kikkawa 1987; Wilson & Kikkawa 1988). **Dispersal of young** On HERON I., though newly independent young often tolerated within territories of breeding adults, often join loose non-territorial flocks (Catterall *et al.* 1982). Natal dispersal usually well within available distances on island, i.e. seldom disperse to other islands (Kikkawa 1987, 2003), and only a few males showed strong philopatry to natal area (Kikkawa 1987). Capable of breeding in first year (Catterall *et al.* 1982; Kikkawa 1987). Most first-year birds did not establish territories near natal site (Kikkawa & Wilson 1983), usually five to seven territory-distances away; mean distance between natal nest and first nest built in first year in which egg laid, 159.1 m (2–442; 57) in males, and 174.1 m (14–440; 70) in females (Kikkawa

1987). First-year birds tended to remain in their natal habitat after dispersal (Kikkawa 1987). Elsewhere, in migratory populations, first-year birds thought to depart on migration earlier than adults, and said to be more dispersive than adults (Keast 1958b).

Breeding dispersion Breed in pairs (Kikkawa 1968, 2003). **Territories** Well studied on Heron I., with some observations elsewhere. **HERON I.:** Pairs defend territories late Aug.–Apr. (Catterall *et al.* 1982; Kikkawa & Wilson 1983; Catterall 1989), and $\geq 85\%$ of population occupies territories in summer (Catterall *et al.* 1982). Most aggressive encounters between neighbours occurred early in breeding season, and at specific locations in canopy; frequency and intensity of aggressive encounters waned once young hatched (Catterall *et al.* 1982). Both members of pair defend territory (see Social Behaviour: Agonistic Behaviour). Defended area usually limited to nest-plant, though sometimes included foliage of adjacent trees, and sometimes restricted to only part of nest-tree (Kikkawa & Wilson 1983). Courtship and nesting confined to territory, but birds often forage and collect nesting material outside territory (Catterall *et al.* 1982; Kikkawa & Wilson 1983; Robertson 1997). Of 28 nesting territories over 2–3 years, 17 pairs occupied same or nearby territory in consecutive years (Kikkawa & Wilson 1983). In winter, territories not actively defended, but adults tend to have larger home-range, centering on summer breeding territories (Catterall *et al.* 1982, 1989). Density of territories differed between years, with mean of 6.4 pairs/ha in 1972 and 11 pairs/ha in 1973 (Catterall *et al.* 1982). In years of high-population density, territorial disputes often occur in crowded areas (Kikkawa 1987). Territories also unevenly distributed across island; when island divided into quadrats of 0.36 ha, number of nests in each quadrat varied from none to ten (Kikkawa & Wilson 1983). Density of territories highest in areas near favoured food sources, especially areas with high density of fig *Ficus* trees (Catterall *et al.* 1982; Kikkawa & Wilson 1983; see also Food). Breeding dispersion also appears to be influenced by dominance (see below), with dominant pairs attaining territories with easy access to concentrated sources of food (Kikkawa & Wilson 1983). **MAINLAND AUST.:** In three suburbs of Canberra, recorded at densities of 0.34, 0.60 and 0.87 territories/ha (Lenz 1990). At Moruya, NSW, recorded at 0.35 nesting pairs/ha (Marchant 1992). **NZ:** In Auckland, both pairs and single males attempt to defend territories from c. Aug. Some territories vacated in Aug.–Oct. before establishing nest; vacated either by pairs, or by males unable to attract mate, and these possibly driven away by neighbours. One male held same territory in three successive seasons, and at least four pairs held same territory for two successive seasons. Breeding density in Auckland, c. 1.2–2 pairs/ha (Fleming 1943). Attempts by non-territorial birds to roost in territory resulted in aggressive defence from territory-holders (Fleming 1943). **Social hierarchy** On Heron I., at Armidale, and Dunedin, individual differences in social status detected through agonistic interactions at feeding sites, especially when food was a limiting factor (Kikkawa 1961a, 1968, 1980a, 1987; Kikkawa & Wilson 1983). Individuals were ranked according to success in aggressive encounters over food (Kikkawa 1961a, 1987). **FACTORS AFFECTING STATUS:** Males usually more aggressive than females, and had higher mean dominance rank than females (Kikkawa 1961a, 1987). On Heron I., there was a high proportion of dominant birds among those hatched early in breeding season, and many submissive or non-interactive birds were among those hatched later (Kikkawa 1980a; Kikkawa *et al.* 1986). Also on Heron I., of 12 aggressive juveniles, seven had both parents dominant, and submissive juveniles mostly had at least one non-aggressive parent. There was also a tendency for dominant juveniles to have dominant fathers and for submissive juveniles to have submissive mothers (Kikkawa

et al. 1986). Adults more likely to be socially dominant at feeding stations than juveniles (Catterall *et al.* 1989). Begging fledgelings were usually avoided by birds visiting feeding site, and seldom attacked (Kikkawa & Wilson 1983). At Armidale, migrants usually dominant over resident birds, but difference not significant (Kikkawa 1968). One year on Heron I., migrants arrived in poor condition and were thought to have been dominated by resident subspecies; some migrants had head injuries, thought to have been caused by pecking by residents (Kikkawa 1970). **CONSEQUENCES OF STATUS:** At Dunedin, dominant birds fought more often with other birds of high rank, and subordinates tended to avoid dominant birds (Kikkawa 1961a). Those initiating agonistic encounters won 97% of encounters, regardless of dominance status; most initiators were dominant birds (Kikkawa & Wilson 2002). On Heron I., subordinate birds less likely to be involved in aggressive encounters than other birds (Kikkawa & Wilson 1983). On Heron I., dominance status of individuals changed little from year to year (Kikkawa 1987), and those ranked highly dominant in winter had no trouble attaining food at feeding site in breeding season (Kikkawa & Wilson 1983). Among breeding birds, c. 40% of subordinate males and c. 37% of subordinate females died after one year of breeding. Dominant birds bred for ≥ 3 seasons, subordinate males bred for mean 2.7 seasons, and subordinate females for 2.1 seasons (Kikkawa 1987). Some birds on Heron I. did not hold territories, or failed to reproduce, and these 'floaters' tended to flock in areas where there were no nesting territories. These were probably subordinate birds, and were vigorously attacked by territory-holders in established territories (Kikkawa & Wilson 1983). In years of high population density, up to 100 birds remained as floaters in population (Kikkawa 1987). Readily form social hierarchies in captivity; for further details, see Kikkawa (1961a, 1968, 1980b) and Wilson (1994).

Roosting Pairs usually roost close together, side by side (Stead 1932; Fleming 1943). On Heron I., after start of laying, male roosts alone while female roosts in nest (Kikkawa & Wilson 1983; Robertson *et al.* 2001). During nestling stage in NZ, adults settled to roost at 19:00 (Medway 1955). In NZ, birds on migration roosted in densely vegetated gully (Grant 1970), and another flock, high in Kaimanawa Mts, sheltered in large tussock of grass (CSN 19 Suppl.). In NZ, several pairs roosted low on lee-side of pine trees on windy nights (Stead 1932). Once, when temperature reached 46 °C, several sheltered from heat among bark and branches at base of mallee eucalypt (Ashwell 1980).

SOCIAL BEHAVIOUR Reasonably well known. Detailed studies in Auckland, of colour-banded birds, Aug. 1939–Nov. 1940, with sporadic observations till Jan. 1942 (Fleming 1943); in Dunedin, of colour-banded birds, during winters of 1959 and 1960 (Kikkawa 1961a); and on Heron I., Qld, of colour-banded birds (Kikkawa 1997b), Sept. 1967–Feb. 1970 (Kikkawa & Wilson 1983), and Jan. 1983, Dec. 1983, and Jan.–Feb. 1985 (Wilson & Kikkawa 1988). Often quite tame and easily approached; occasionally enter buildings (Belcher 1914; Wilkinson 1931; Tarr 1949a,b; St Paul 1975; Bingham 1977). **Maintenance behaviour** Preening birds usually spread out, either in pairs or individually, often well away from feeding place (Kikkawa 1961a). At Hamilton, NI, up to six pairs seen perched close together in tree, some with feathers ruffled, and others allopreening (CSN 20; see also Sexual Behaviour: Allopreening). Recorded preening in shrub after bathing nearby (Harris & Clifford 1998). Bathe singly or in flocks of up to 20, often in bird-baths, other dishes with water, and sometimes in creeks (Merilees 1969; Sutton 1990; Hutton 1991; Harris & Clifford 1998; CSN 30, 37). Once, one bathed by fluttering wings in dew-covered leaves in two different trees (CSN 24). Captive birds seen actively anting (Chisholm

1959). **Flock behaviour** Both while preparing to migrate, and during migration, flocks rather noisy, and actively call as a group (Frith 1969; Grant 1970; Chan & Sutton 1993; Gibb 2000a), sometimes giving Warbling Song (Fleming 1943). Flocks often heard calling while migrating at night, thought to induce and maintain flock organization (Gilbert 1935; Stidolph 1937; Chan & Sutton 1993; D.P.A. Pool). In autumn, when preparing to depart, flocks become restless and often take off, circle and settle again (Le Souëf & MacPherson 1920; Gibb 2000a; see also Movements). At C. Liptrap, Vic., this restlessness classified into three phases: Phase 1: Flock repeatedly takes off, circles low over vegetation, chattering, then dives back into vegetation, with others gradually joining flock. Phase 2: Flock takes off and circles, gradually gaining altitude, but sometimes returns to vegetation. Phase 3: Flock gains height, and when sufficiently high, flies away with rapid wing-beats (Chan 1995c). Elsewhere, flocks seen circling before moving off, with more birds joining as it goes, till finally rising out of sight (Stidolph 1949; Field & Field 1989). During migration, similar behaviour also seen when resuming flight after roosting for the night (see below). From observations of several flocks near Greymouth, SI, when rousing from roost in morning, gave long calls at first, as flock began to assemble, becoming more rapid and excited, and reached fast twitter when flock took off; sometimes flock made short flight and returned before setting off at altitude (Grant 1970). One migrating flock of c. 100 birds flew in tight formation (Dennison *et al.* 1981). Once, in Sept., when a flock in flight approached another flock perched in trees, flock in trees called, attracting attention of flock in flight, which circled round, but then continued in original direction; c. 30 min later, flock in trees flew in direction other flock had flown, and while flying at c. 60–80 km/h, rose and fell 'like an animated cloud' (Le Souëf 1930). At Kowhai Bush, SI, when in mixed-species flocks, Silvereyes were aggressive among themselves, but not towards other species. Sometimes formed nuclear species of flock, leading flock direction, but only when Brown Creepers absent, but these flocks appeared less stable than those led by Brown Creepers, and often disbanded within 15 min (Dean 1990). **Loafing behaviour** Once, in winter, one perched on stick, apparently asleep; did not move when stroked, and was removed and replaced on perch without waking; after 70 min, bird woke, fed, then flew away (Lane 1983). **Other behaviour** Once gave Whisper Song between bouts of preening (Macdonald 1953a). Once, in late Jan. at Nelson, SI, one gave display of unknown motivation: shortly after landing in tree, bird turned slightly to left, then bowed deeply, with head below level of perch, and head, back and tail in straight line; slowly returned to original position, then bowed to right. Continued bowing when another bird landed c. 30 cm above, pausing between bows; second bird watched, hopping agitatedly from branch to branch, never >0.5 m from first bird. After longer than usual pause in performance, first bird fluffed its feathers then shook them back into place, and then both birds flew away (CSN 19). Once, in Southland, seen landing on backs of House Sparrows rather than on snow (J. Wood 1998).

Agonistic behaviour Aggressive to conspecifics during breeding season, especially in territories. Both members of a pair defend territories whether partner present or not (Fleming 1943; Catterall *et al.* 1982; Kikkawa & Wilson 1983; Robertson & Kikkawa 1994; Robertson *et al.* 2001). Territory defended through displays and vocalizations (Slater 1993). When feeding or collecting nest-material, birds usually pass through other territories, where often attacked (Fleming 1943). Members of flocks often aggressive to each other (Dean 1990); aggressive encounters involve only two birds at a time (Kikkawa 1968), indiscriminately attacking others in crowded conditions (Kikkawa & Wilson 2002). Humidity affects level

of aggression in flock (Williams *et al.* 1972). Song thought to act as territorial advertisement signal with deterrent characteristics (Slater 1993). When singing, bill raised in air and throat appears to throb (Andersen 1926). In NZ, use Territorial Song and Warbling Song to advertise territory (see Voice). Warbling Song performed during lead-up to breeding season, and possibly more sexual in function (see Sexual Behaviour); change to Territorial Song when nest-building begins (Fleming 1943). In one pair, male twice began to sing, but was stopped both times when female attacked him as soon as first notes uttered (Andersen 1926). **RESPONSE TO PLAYBACK OF SONG:** Territorial owner responded to playback of Song by perching, with sleeked plumage, within 5 m of speaker, then moving to within 0.5 m of speaker, continually scanning area while making short flights round speaker. When playback stopped, owner flew away. Both male and female territorial owners responded in this manner to playback of Song, either singly or together. Do not usually give vocal response to playback of Song, but one male responded to playback of his own Song by singing, and Alarm Calls from neighbouring territories sometimes heard during playback (Slater 1991). **Threat** Perform several behaviours and postures, both singly and in combination, directed towards an opponent in threat. Given as intention to attack, and opponent responds either by retreating or with retaliatory Threat display (Kikkawa 1961a; CSN 20). Usual attitude of Threat includes Wing Flutter, Open Beak and Forward Body given simultaneously, sometimes accompanied by Challenge Call or Beak Clatter (Kikkawa 1961a; Kikkawa & Wilson 2002). In crowded situations where opponents unfamiliar, Threat behaviour, such as Open Beak, Wing Flutter and Challenge Call, used more often than more aggressive behaviours such as Peck, Attack, Chase and Beak Clatter (Kikkawa & Wilson 2002). The following Threat behaviours have been described: **WING FLUTTER:** Wings lowered slightly and vibrated rapidly, with remiges parted slightly (Kikkawa 1961a; Kikkawa *et al.* 1986; Wilson 1994; Kikkawa & Wilson 2002). Continues as long as hostility remains (Kikkawa 1961a). Recognized as Threat by several authors, and also described as 'wing shivering' (CSN 20) or 'wing quivering' (Wilkinson 1931). **FORWARD BODY:** Tilt body at 40° ($\pm 10^\circ$) to horizontal, with head higher than tail, and feathers sleeked, legs slightly flexed and head pointing towards opponent; feathers usually sleeked, but rectrices sometimes raised and spread (Kikkawa 1961a; Wilson 1994). **OPEN BEAK** (= Gaping of Kikkawa *et al.* [1986]): Wide opening of beak while facing opponent (Kikkawa 1961a; Wilson 1994). **CHALLENGE CALL:** Given during threat, attack or chase, especially when fighting over food (Slater 1994; Wilson 1994; Kikkawa & Wilson 2002; see Voice). **UPRIGHT BODY:** Assume posture in which legs extended fully to form part of vertical body-axis, and gaze directed at opponent (Wilson 1994). Usually given in retaliation to other Threat displays, and often escalate into Aerial Combat (Kikkawa & Wilson 2002; see below). Description of Head-up Posture with raised feathers of crown or body (Kikkawa 1961a) probably same display. **BEAK CLATTER:** Rapidly repeated snapping sound produced by bill during aggressive interactions (Wilson 1994). Often accompanies Attack (including supplanting) or Chasing, rather than Threat (Kikkawa *et al.* 1986; Wilson 1994; Kikkawa & Wilson 2002). **Attack** Sometimes intensify Threat by hopping or flying towards opponent, varying from low-intensity approaches to supplanting attacks in which aggressor replaces perching site of opponent (Wilson 1994). **Chasing** Sometimes winner of aggressive encounter chases loser in succession of flights or hops (Kikkawa *et al.* 1986; Wilson 1994). Mostly used to defend territory, but sometimes individuals chased while feeding (Kikkawa 1961a; Falla *et al.* 1981). Intruders on territory Chased if they flee only a short distance after Threat (Kikkawa 1961a). Once, adult entered

nest with nestlings while owners absent, but was chased out of nest-tree on return of one parent (Kikkawa & Wilson 1983). **Fighting** Attacks resulting in physical contact vary from a simple Peck to intense Aerial Combat. Sometimes fall to ground during fierce Fighting (Wilkinson 1931); victor usually resumes previous activity, e.g. feeding, and defeated bird leaves (Kikkawa 1961a). On Heron I., Fighting often occurred at artificial feeding sites, where most fights lasted <5 s, though some lasted >20 s. Two-thirds of all Fights at artificial feeding site were over food, and these lasted significantly longer than other Fights (Catterall 1989). **PECKING:** Movement in which closed beak is thrust towards an opponent (Kikkawa *et al.* 1986; Wilson 1994). Two types seen: low-intensity pecking and high-intensity pecking. (1) **LOW-INTENSITY PECKS:** Aimed at body, but barely touching feathers. Seen among members of flock when feeding, bathing or perched close together, and given when jostling for position, or for no apparent reason (Kikkawa 1961a). Sometimes thrust of bill makes no contact (Kikkawa *et al.* 1986). (2) **HIGH-INTENSITY PECKS:** Vigorous pecks at climax of fighting, usually while facing bill to bill with opponent. Usually occurs when neither bird backs down after threat behaviour such as Wing Flutter, Upright Body, Challenge Calls or Beak Clattering (Kikkawa 1961a). Often accompanies Aerial Combat. **AERIAL COMBAT:** Both birds rise vertically into air with rapid wing movements, sometimes directing savage pecks at head of opponent, or clawing at each other (Wilson 1994). Often given in retaliation to Threat or Attack, and often follows Upright Body (Kikkawa & Wilson 2002). **Avoidance and submissive behaviour** Submissive birds turn bill away, avoid Threat or Attack, or flee (Kikkawa 1968), and avoid direct view of aggressive bird by approaching food sources via unfavourable route, e.g. do not use perch at level of food source, but one above or below, from which they have to stretch or hang to reach food (Kikkawa 1961a). **Social dominance** Dominant birds exhibit all threat behaviours listed above (Kikkawa 1968). When Peck given between pair, male always dominant, and female responds by abandoning position, or by turning bill away; such pecking is low intensity, and apparently ritualized (Kikkawa 1961a). **Alarm** Utter Alarm Call when intruder near nest-site, and sometimes several neighbours also give Alarm Calls; given in response to presence of intruders such as Southern Boobook *Ninox novaeseelandiae*, Sacred Kingfisher *Todiramphus sanctus*, Cat or person (Fleming 1943; Slater 1991, 1994; see also Voice). Away from nest, give Alarm Calls in response to predators; e.g. once given while scolding Grey Butcherbird *Cracticus torquatus* that had caught one of flock (Mees 1969); when New Zealand Falcon *Falco novaeseelandiae* flew overhead, several flew to trees and gave Alarm Calls (Porter & Dawson 1968). Strident Alarm Calls attract both adults and juveniles (Kikkawa & Wilson 1983). **Other interspecific interactions** **AUST.:** Once, seen threatening two Superb Fairy-wren fledgelings, with Open Beak and quivering wings (Bradley & Bradley 1958). Once, while foraging in tree with several others, one lunged at sparrow *Passer* and stabbed it with bill, killing sparrow instantly (Campbell). Flock once harried Common Koel *Eudynamis scolopacea* that had a live Silvereye in its bill; victim called and flapped its wings, and flock called back (Gosper 1965). On another occasion, two harried Green Tree Frog *Litoria caerulea* with Silvereye in its mouth (Morgan 1993). Incubating parent once sat tight and did not move, even when person within c. 1 m of nest (Gross 1963). **NZ:** Recorded mobbing or scolding Southern Boobook (Cunningham & Moors 1985; CSN 31), and mobbing Sacred Kingfisher (Gibb 2000a). At food sources, usually retreated when Bellbird *Anthornis melanura* landed nearby, and usually avoided House Sparrows, but occasionally adopted threat posture in front of Sparrow (Kikkawa 1961a). Once, mating Grey Fantails were attacked in territory (Fleming 1943), and on another occasion, several became

agitated and gave Alarm Calls during noisy border dispute between two Grey Fantails (Dennison *et al.* 1979). In mixed-species flocks, seldom aggressive with other species (Dean 1990).

Sexual behaviour In Aug., in Auckland, most sexual activity occurs in morning (Fleming 1943). Territorial Song thought to function in mate attraction, in addition to territorial function (Slater 1993; see also Agonistic Behaviour). In NZ, Warbling Song (see Voice) thought to be more sexual in nature than Territorial Song. One male changed from singing Territorial Song to Warbling Song when his partner died (Fleming 1943). **Pair-formation** Juveniles usually pair permanently during first non-breeding season, and members of pairs remain together when foraging in flocks; juvenile pairs identifiable by allopreening and repeated association (Kikkawa 1961a; Catterall *et al.* 1989; see also Social Organization: Bonds). **Pair-bond maintenance** Pair-bond maintained throughout year (see Social Organization: Bonds); members of pair actively seek close contact with each other, and pair-bond thought to be strengthened by frequent huddling and allopreening (Kikkawa 1987; Robertson & Kikkawa 1994; Robertson 1997). In winter flocks, pairs easily recognized by movement together, lack of threat postures, ritualized pecking by male, and by allopreening (Kikkawa 1961a). **HUDDLING:** When paired, often sit side by side on branch, tucked close together (Stead 1932). **ALLOPREENING:** Recorded throughout year, and in adults usually indicates pair-bond (Kikkawa & Wilson 1983). Recorded within family group before young independent (see Relations within family group). After independence, but before first breeding season, first-year birds sometimes change allopreening partner, presumably before forming pair-bond (Kikkawa & Wilson 1983). Pair usually sit close together on perch, sometimes in contact, and each in turn preens the other round head, neck and upper breast, or occasionally preen each other at same time (Wilkinson 1931; McCaskill 1973; CSN 20). Sometimes one raises head and points bill upward while being preened (CSN 20). Bouts of allopreening last 1–5 min (McCaskill 1973). Sometimes several pairs allopreen in same tree or nearby (McCaskill 1973; CSN 20). Allopreening often followed autopreening or period of feeding (McCaskill 1973). In winter, pairs spend much time allopreening during rest periods (Kikkawa & Wilson 1983), and once seen allopreening while perched in sun on cold morning, just after sunrise (CSN 20). During breeding season, allopreening follows nest-site selection and copulation (see below), and often occurs in territory after disturbance near nest, or after period of alarm (Kikkawa & Wilson 1983). **COURTSHIP CALL:** When sexually excited, both members of pair utter Courtship Call; given while spreading tail and quivering wings and body, or by perched bird while allopreening; sometimes male gives call while following female or collecting nest-material (Fleming 1943; Slater 1994; NZRD; see also Voice). **WING-FLICKING:** Once, two often flicked wings while moving about tree, foraging and performing mimicry (Haywood & Green 2003). Wings raised when flicking (cf. lowered in threat) (Kikkawa 1961a). Function not known. **Nest-site selection** Initially, pair hop through tree in agitated manner; one then stops at potential nest-site and performs weaving movement of head and bill; weaving movement then repeated at same or different site, between bouts of hopping. During performance, one or both birds quiver wings, and sometimes give low warbling call (probably Courtship Call). Occasionally one presents piece of nesting material to the other, who then manipulates it for a few minutes before dropping it. Nest-building usually begins at one of the weaving sites within 1–2 days. Display often preceded and followed by allopreening (Kikkawa & Wilson 1983). **Copulation** Takes place early in morning within territory, sometimes at nest-site. Wing-quivering by female always precedes copulation, and

male sometimes quivers wings after mounting. Copulation followed by allopreening (Kikkawa & Wilson 1983). Of 14 copulations observed, all except one were within fertile period of female; one was 13 days before start of laying (Robertson *et al.* 2001). Male anatomy for sperm storage is consistent with low-frequency copulation; no extra-pair copulation and low sperm competition observed in subspecies *chlorocephalus* (Robertson 2005).

Relations within family group No information on behaviour of nestlings. Entire brood usually fledges on same day (Wilson & Kikkawa 1988). For first few days after fledging, fledgelings huddle together on perches among dense foliage in or near nest-tree, giving loud begging calls when parents in sight within c. 10 m, then stop when fed or when parents leave. From 3–4 days after fledging, fledgelings follow parents and beg continuously. Sometimes fledgelings beg to adults other than their parents, who very occasionally feed them; sometimes strong begging causes adult to flee or to peck fledgeling. Both parents defend fledgelings against other birds, and often huddle with young (Wilson & Kikkawa 1988). When begging for food, fledgeling raises and flutters wings (c.f. lowered in threat) (Kikkawa 1961a). After fledging, young remain in family group for c. 2 weeks, when continue begging (Fleming 1943; Kikkawa & Wilson 1983; Wilson & Kikkawa 1988). Allopreening observed: fledgelings preened siblings, and parents preened dependent young (Kikkawa & Wilson 1983). When approaching independence, begging young ignored or sometimes attacked by adults (Fleming 1943). Fledgelings and juveniles often attracted to nests of others by calls of nestlings; once, 12 independent young congregated round one nest with nestlings (Kikkawa & Wilson 1983). **Anti-predator responses of young** Young explode from nest when disturbed (St Paul 1975). **Parental anti-predator strategies** When person replaced young which had been blown from nest, adults performed injury-feigning distraction display (NRS). Once, at nest with nestlings, adult with spider in bill stayed on nest while Laughing Kookaburras *Dacelo novaeguineae* were nearby, and departed once Kookaburras had left; parent possibly concealed nestling from potential predator (K.A. Wood 1998). Once, lone, small naked nestling disappeared from nest on day after banding, but caught one year later; thought that parents may have moved nestling to another nest after disturbance (Mack 1965).

VOICE Some aspects very well known, especially from studies on Heron I., but others need more study (e.g. geographical variation, and Song other than Territorial Song). **DETAILED STUDIES:** On Heron I., of variation in Songs, 1985–87, in population where >90% individually colour-banded (Slater 1991, 1993); in Brisbane and on Heron I., of variation in calls (Bruce & Kikkawa 1988; Slater 1994; Robertson 1996); at Ebenezer, near Windsor, NSW, of temporal patterns in vocalizations (Keast 1985b, 1993, 1994a,b); and in Auckland, Aug. 1939–Jan. 1942, of general life history including vocalizations (Fleming 1943). Sonagrams of Territorial Song in Slater (1993), and of calls in Bruce & Kikkawa (1988), Slater (1994) and Robertson (1996). Vocabulary quite extensive, and includes several different calls and two to four types of Song (Mees 1969). Considered by some as one of best songsters in Aust. (e.g. Hartshorne 1953, 1973). **ANNUAL PATTERN:** Throughout range, call at any time of year (e.g. Dove 1907; Sutton 1919; Gibb 2000a,b), though in NZ, Alarm Call heard more often late Aug. to Oct. (Fleming 1943). Territorial Song mostly given just before and during breeding season, c. Aug.–Dec. (Dove 1906b; Stead 1932; Fleming 1943; Sibson 1949b; Mees 1969; St Paul 1975; Slater 1993; Keast 1994b; CSN 5, 6, 21), but sometimes at other times of year, e.g. Jan. in SA (Sedgwick & Sedgwick 1950), late Apr. or early May in

WA (Mees 1969), and Jan.–Mar. in NZ (Fleming 1943; Gibb 2000a; CSN 2, 24). At Clevedon, NI, one young bird starting to sing in Jan. (CSN 9). Territorial Song not usually heard in winter (Mees 1969; Gibb 2000b), but very occasional records of Song in June and July in NZ (e.g. CSN 1, 2, 20), possibly Territorial Song. In NZ, first recorded date of Territorial Song differed between years; possibly triggered by sustained increase in daily temperature, e.g. in 1939 first sang Territorial Song on 6 Sept. after warm period of c. 5 days, and in 1940 first started 17 Sept., also following a warm period of c. 5 days (Fleming 1943). During dawn chorus at Ebenezer, did not sing in Apr. (though present); gave Territorial Song at rate of 15–25 s/min in Aug. and late Sept. to Nov.; 6–14 s/min in early Sept., and on sunny days in Dec.; and at <6 s/min in Jan., and on wet days in Dec. (Keast 1994b). Whisper Song mostly given in autumn and winter (Chisholm 1950; Mees 1969; CSN 20), but also in spring (Dove 1906b; MacDonald 1953a). At Ashburton, NI, one gave Whisper Song two or three times per week from early May through whole winter (CSN 20). In NZ, Warbling Song heard July–Nov. (Fleming 1943); also said to occur in autumn (NZRD). DIURNAL PATTERN: *SPRING AND SUMMER*: Most vocal activity early in morning and late in afternoon (e.g. Fleming 1943; Keast 1985b; Gibb 2000b), with some vocalizations long after sunset (Hutton & Drummond 1904; Keast 1985b). At Wellington, more vocal 08:00–11:59 than at other times of day (Gibb 2000b). On Simmonds I., NI, last passerine heard calling at dusk, and second heard at dawn (Wagener 1966). Males sing most Territorial Song in early morning, starting before sunrise with dawn chorus (Campbell & Barnard 1917; Fleming 1943; Mees 1969; Catterall *et al.* 1982; Keast 1985b; Slater 1991, 1993). Dawn chorus of Silvereye performed in dim light, and usually lasts 15–20 min (Mees 1969; Kikkawa & Wilson 1983; Slater 1993; Robertson 1997). On Heron I., individuals gave mean 6–7 Songs/min during dawn chorus, though both rate of singing and length of Song varied much (Slater 1993). Timing of dawn chorus of Silvereye varies, depending on time of sunrise, location and weather conditions (see below); many observations state time of calling, but do not indicate timing in relation to dawn. At least in Aust., Silvereyes often start contribution to dawn chorus c. 20–30 min before sunrise (Campbell & White 1910; Sedgwick & Sedgwick 1950; Mees 1969; Keast 1985b; Robertson 1997). Near Te Teko, NI, sang and called a few minutes before sunrise (Taylor 1975). Sometimes sing during day, but at much lower levels, and singing activity usually increases slightly in evening till sunset (Fleming 1943; Kikkawa & Wilson 1983; Keast 1985b, 1993; Slater 1993). At Ebenezer, individuals occasionally sang for periods of many minutes during day (Keast 1985b). In Wellington, heard singing 10:00–14:00 (Gibb 2000b). Once, one gave Whisper Song in hottest part of afternoon (Dove 1929). During daylight, more often give calls than Song (Keast 1985b). In Wellington, heard calling 06:00–18:00 in spring and summer (Gibb 2000b). In spring, usually first call a few minutes after first species to call in morning, and often one of the last to stop calling after sunset (Keast 1985b). At Netherby, SA, heard calling up to 85 min before sunrise (Sutton 1919). *AUTUMN*: In Wellington, heard calling 08:00–10:00 (Gibb 2000b). *WINTER*: In Wellington, heard calling 14:00–18:00 (Gibb 2000b). *EFFECT OF WEATHER*: At Ebenezer, timing and quantity of singing in early mornings in Dec.–Jan. varied with weather conditions (see Table 4). Singing started significantly earlier on sunny mornings than on rainy mornings: started singing 20–25 min before sunrise on sunny days, with peak rate of singing 10–25 min before sunrise; on foggy days, started singing 25–30 min before sunrise, with peak rate of singing 5–30 min before sunrise; on overcast days, started singing 12–19 min before sunrise, with peak rate of singing 0–15 min before sunrise; and on rainy days, started singing 8–14 min

before sunrise, with peak rate of singing from 10 min before sunrise to 10 min after (Keast 1994a). *MIGRATING FLOCKS*: Flocks call actively before take-off on migration (Chan & Sutton 1993; Chan 1995c). While migrating, flocks noisy, calling continuously (Frith 1969; Dennison *et al.* 1981; Falla *et al.* 1981), and at night, migratory activity can be detected by collective calling of flock (Stidolph 1937; Chan & Sutton 1993; CSN 5; D.P.A. Pool). Just before migrating across water, often perch silently in shrubs, and then make collective calls just as they take off together (Chan & Sutton 1993; Chan 1995c). At Greymouth, SI, migratory flocks started calling upon waking at roost in morning; rate of calling gradually became more rapid and excited, becoming a fast twitter, then flock suddenly took off (Grant 1970). Once, two different flocks called to each other as one in flight passed another in a tree (Le Souëf 1930). Calling thought to induce and maintain flock organization during migration (see Social Behaviour: Flock behaviour). *MIMICRY*: Well-known mimic (A.H. Chisholm 1932, 1965a,b). Mimicry forms a large component of Whisper Song (Chisholm 1950; Bishop & Bishop 1976). In Qld, mimicked calls of Laughing Kookaburra, Sacred Kingfisher, Eastern Whipbird *Psophodes olivaceus*, Willie Wagtail and Magpie-lark *Grallina cyanoleuca*, and Golden-headed Cisticola *Cisticola exilis* (A.H. Chisholm 1932, 1946, 1965b). In Long Forest, Vic., mimicked calls of Whistling Kite *Haliastur sphenurus*, Sacred Kingfisher, White-throated Tree-creeper *Cornobates leucophaeus*, Striated Pardalote, Superb Fairy-wren, White-browed Scrubwren, Speckled Warbler, Weebill, Brown Thornbill, Red Wattlebird *Anthochaera carunculata*, White-plumed Honeyeater, Eastern Spinebill, Scarlet Robin *Petroica multicolor*, Varied Sitella *Daphneositta chrysoptera*, Golden Whistler, Rufous Whistler, Grey Shrike-thrush *Colluricincla harmonica*, Restless Flycatcher *Myiagra inquieta*, Grey Fantail, Willie Wagtail, and Black-faced Cuckoo-shrike *Coracina novaehollandiae* (Hewish 2000, 2002b). In SA, mimic parts of calls of Crimson Rosella *Platycercus elegans*, Weebill, Golden Whistler, Black-faced Cuckoo-shrike, Common Blackbird and Common Starling *Sturnus vulgaris* (Cleland 1928; Ashton 1985; Haywood & Green 2003). In WA, mimic Australian Ringneck *Barnardius zonarius*, Pallid Cuckoo *Cuculus pallidus*, Golden and Rufous Whistlers, Magpie-lark and Grey Butcherbird (Chisholm 1950; Mees 1969). In Tas., one mimicked Pallid Cuckoo and Song Thrush *Turdus philomelos* (Dove 1906b). In NZ, mimic Dunnock *Prunella modularis* and Skylark *Alauda arvensis* (MacDonald 1953a). At Mt Kembla, NSW, several mimicked song of Common Canary *Serinus canaria* which was in cage nearby (McNamara 1946). *PLAYBACK EXPERIMENTS*: In Perth, birds avoided foraging in areas where white noise was broadcast with frequency range of 3.5–5.5 kHz, chosen as a frequency range similar to that of Contact Calls; thought that white noise interfered with communication between individuals in foraging flocks (Knight & Robinson 1978). On Heron I., both male and female territory-holders responded to playback of Territorial Song (see Social Behaviour: Agonistic Behaviour). Neighbours did not appear to avoid singing at same time nor were they stimulated to sing by others, and territory-holders did not differentiate between Songs of neighbours and Songs of strangers (Slater 1991). *GEOGRAPHIC VARIATION*: Poorly known. Territorial Song of nominate *lateralis* gave impression of being slightly richer and more varied than that of subspecies *chloronotus* (Mees 1969). Territorial Song of subspecies *chlorocephalus*, from islands in Capricorn Grp, did not appear to differ from that of birds on adjacent mainland (nominate *lateralis* or subspecies *cornwalli*) (Gilbert 1926); and structure of all three types of Contact Calls of subspecies *chlorocephalus* on Heron I. did not appear to differ from those from Brisbane (nominate *lateralis* or subspecies *cornwalli*) (Slater 1994; Robertson 1996). Calls of *chloronotus* possibly slightly

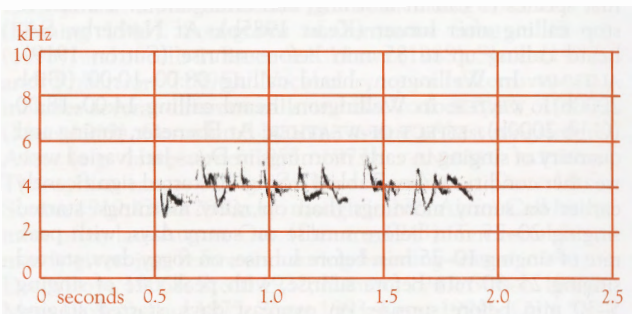
harsher than those in e. Aust. (Pizzey 1980; Morcombe 2000). **INDIVIDUAL VARIATION AND REPERTOIRES:** Each individual possesses a range of different syllables available for use in Song, and also several versions of each Contact Call. **SONG REPERTOIRES:** Individuals possess large repertoire of syllables uttered in varied order to create different Songs, but also utter some of these syllables in set sequences, and each individual also possesses a repertoire of such sequences (Slater 1993). Possession of repertoire of several different Songs (probably sequences) noted at Ebenezer (Keast 1993). A more detailed analysis of repertoires was undertaken on Heron I. (Slater 1993), where syllable repertoire size from recordings of 17 individuals (5–22 Songs measured per bird) comprised mean 45.1 syllables (9.40; 24.5–60.3; 17) (Bruce 1989; Slater 1993). From birds with ≥ 300 syllables recorded, total repertoire estimated from asymptote at mean 53.1 syllables (4.43; 49.3–60.3; 5). Syllable repertoire of individuals did not appear to vary from year to year, and appears to be established in first year. From recordings of 21 individuals, $\geq 23\%$ of syllables were common to repertoire of all birds, but maximum extent to which individuals shared syllables was 41%; birds of same age tended to have similar repertoire of syllables. Within one Song Bout, syllables not usually repeated immediately; once uttered, a syllable not repeated till mean of 13.7 syllables later. Every individual possessed sequences of syllables that were often repeated within one Song, throughout a Song Bout, or on different days. A sequence was a group of three or more syllables that occurred at least twice in same order. From 23 individuals and 384 songs, 117 different sequences were found, each consisting of 3–11 syllables. Recordings of complete dawn chorus of two males each contained 70 and 58 Songs, 888 and 1127 syllables, and 13 and 19 sequences, with 55% and 59% of syllables in sequences, and ten and one Song without sequences. Songs that did not contain sequences were usually brief, or near end of Song Bout. During dawn chorus, males tended to sing a group of sequences, and then at intervals introduce new sequences, and drop others. Estimated that probably sing 46–67% of sequence repertoire in one dawn chorus (Slater 1993). **CALL REPERTOIRES:** Study of birds from Brisbane and Heron I. found that many individuals possessed more than one type of structure for a particular Contact Call. Five of 15 individuals had two Variable Calls that differed in structure, six of 15 had two Linear Calls, and 15 of 27 individuals had two Short Calls (Robertson 1996). Each individual able to accurately discriminate and recognize its mate's Contact Calls over those of other familiar birds or strangers; and vocal mate recognition was present in both sexes. Silvereyes from both locations responded most strongly to Linear Calls and least to Short Calls. Females also responded significantly more to Variable Calls of partner than to those of

Table 4. Effect of weather on timing and quantity of Territorial Song heard in mornings in spring. Foggy days were characterized by dense mist with visibility c. 5 m; dull days by heavy cloud cover and low light levels; and rainy days by continuous precipitation throughout morning. Song rates measured as number of seconds that groups of 2–3 birds sang, per minute of observation ($n =$ days of observation). Observations made in 5-min blocks from 40 min before sunrise to 2.5 h after sunrise (Keast 1994a).

	SONG RATE (S/MIN)		
	Before sunrise	First hour after sunrise	1–2.5 hours after sunrise
Fine sunny days	13.2 (2.1; 5)	0.9 (0.3; 5)	0.3 (0.2; 5)
Foggy days	16.2 (3.0; 4)	0.03 (0.01; 4)	0.03 (0.09; 4)
Dull, overcast days	0.03 (0.09; 4)	0.3 (0.02; 4)	0.09 (0.09; 4)
Rainy days	5.7 (1.2; 4)	1.4 (0.2; 4)	0.3 (0.1; 4)

other familiar birds or strangers (Robertson 1996). **NON-VOCAL SOUNDS:** During aggressive interactions, produce Beak Clatter in which bill is rapidly and repeatedly snapped during aggressive interactions, often accompanied by high-intensity Pecking and Wing Fluttering (Kikkawa 1961a; Wilson 1994; see Social Behaviour: Agonistic behaviour). Often given in flight (Kikkawa & Wilson 2002).

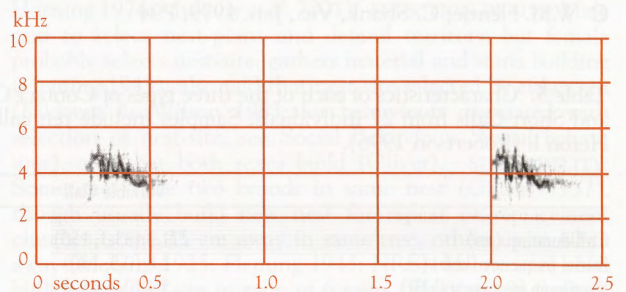
Adult Difficult to determine the number of distinct types of Song since different authors use different terminology and different methods to describe Song. Most Song can be classified into two main types: Territorial Song and Whisper Song. Most often perform Territorial Song, often simply referred to as Song (e.g. Kikkawa & Wilson 1983; Keast 1993; Slater 1993). Sometimes also perform Whisper Song, which includes mimicry. Two other types of Song have been described (see below), but not known whether these are distinct types of Song or merely variations of Territorial Song or Whisper Song. Only males sing, usually from high perches at dawn (Catterall *et al.* 1982; Kikkawa & Wilson 1983; Kikkawa 1987). On Heron I., males sang more after start of laying than before, and most males increased output of song through nesting cycle (Robertson *et al.* 2001). In Auckland, Warbling Song performed c. July–Oct. during lead-up to breeding season, but began to change to Territorial Song in c. Sept., when nest-building began (Fleming 1943). **TERRITORIAL SONG (= Ordinary Song of Mees [1969]; Challenge Song of Fleming [1943]):** Loud, rather powerful, sweet and pleasant, consisting of rapid succession of discrete syllables that include trills, warbles and high-pitched notes (Hutton & Drummond 1904; Campbell & White 1910; Fleming 1943; Hartshorne 1953; Mees 1969; St Paul 1975; Pizzey 1980; Keast 1993; Aust. RD). See sonagram A. Many notes resemble louder types of Contact Calls (Stead 1932; Hartshorne 1953; Mees 1969). Also described as chirping song (Campbell & Barnard 1917) or twittering song (Frith 1969). Rather simple but not monotonous, with quality of happiness (Mees 1969); like fairy chimes (Hartshorne 1953). Said to be somewhat similar to Song of Dunnock (Falla *et al.* 1981); European Goldfinch (Hartshorne 1953); Common Blackbird (St Paul 1975); or Canary (Andersen 1926). Sequences of Song variously rendered as: *tyee lee dyee lee...tyee lee dyee lee tyee lee djulee...tyee tyē yee ye tyee dee delee lae lee...tjah lee dye lee dyee lee lee dyee dye dyee...tyee tyee tyē deele...* (Mees 1969); *tiu tiu tiu ti-u i-u-i tweet twee-wee wee wee-weet tiu-tiu ti-u-eet twee wee-wee-wee-weet tiu tiu tweet* (Andersen 1926); and *tswEEP-cheeip, peeip-a-chweip, cheeip* (Morcombe 2000). Extremely varied in both tone and volume (Pollard 1930), but range in tone and pitch much less than those of Warbling Song (Fleming 1943). At Ebenezer, frequency range of Song, 2.0–4.0 kHz; each Song 3.0–3.6 s in length, uttered at maximum 6–8 Songs/min, or maximum 20–26 s/min (Keast 1993). On Heron I., each Song lasted c. 5 s, and comprised mean 16 discrete syllables (Slater 1993). Also on Heron I., mean length of Song Bouts during dawn chorus 3.6–6.6 s ($n=6$ individuals each singing 39–76 songs),



A F.W. van Gessel; Kooragang I., NSW, Nov. 1991; P94

alternating with silent periods of mean 3.2–5.1 s (Slater 1991). In WA, Song Bouts 4–7 s long, with intervals of 2–4 s (Mees 1969). Carrying power of Song varies with conditions. On Heron I., Song had acoustic range of <50 m (Slater 1991), but elsewhere sometimes audible over 300–400 m (Fleming 1943; Hartshorne 1953). On Heron I., sound-level pressure of Song c. 71 dB when 5 m from singer; and c. 125 dB at 1 cm; these measurements suggest that while singing, bird cannot hear another's Song (Slater 1991). Given only by males (Fleming 1943; Kikkawa & Wilson 1983; Kikkawa 1987; NZRD), usually from tree-top or other high perch within territory (Mees 1969; Kikkawa & Wilson 1983). In NZ, usually uttered from conspicuous position (Fleming 1943; NZRD), but on Heron I., often given from concealed perch (Kikkawa & Wilson 1983). Do not use fixed song-post, but shift positions between bouts of singing (Slater 1993). Usually sing while alone (Andersen 1926), but occasionally when perched beside female partner (Stead 1932). Performed most strongly at dawn, when female not in sight (Kikkawa 1987). Apparently associated with mated pair attached to territory, and usually heard before nest-building starts, but after period of Warbling Song; decreases during incubation (Fleming 1943). Probably functions to announce territory, to attract female, and to stimulate her to breed (Slater 1993; see also Social Behaviour). **WHISPER SONG** (= Subdued Song of Mees [1969]): Sweet, soft, pleasant whispered melody uttered as continuous flow of mimicry interspersed with own notes (A.H. Chisholm 1932, 1946, 1950, 1965b; Frith 1969; Mees 1969; Campbell). Sometimes described as Subsong (e.g. Frith 1969; Mees 1969; Pizzey 1980), and said that individuals sing inwardly to themselves (Dove 1906b, 1907; Campbell). Mimicry can be difficult to detect, and audible only at short distance (Dove 1906b, 1907; A.H. Chisholm 1932, 1946; St Paul 1975). Song contains some rich notes and can give impression of larger bird singing at distance (Dove 1918; Cleland 1928; Hartshorne 1953). In Ewen Ponds CP, SA, uttered by two over 5–10 min (Haywood & Green 2003). Usually given while concealed in foliage (Mees 1969), and sometimes while foraging (Haywood & Green 2003; Campbell). Motive and function of Whisper Song not known. **WARBLING SONG**: Described in NZ by Fleming (1943), but not known whether a distinct type of Song or a variation of Territorial or Whisper Song (A.M. Dunn). Described as series of trills, warbles and slurs uttered at low volume, and only by males. Usually given from inconspicuous perch in shrub or tree. Thought to be characteristic of earliest stages of establishing territory and pair-formation, and starts several weeks before Territorial Song. Gradually replaced by Territorial Song once nest established, but returns if nest fails or when partner dies. Resembles Songs of Song Thrush and Canary, but much quieter (Fleming 1943). **ANOTHER POSSIBLE TYPE OF SONG**: Once in Dec., near Highbury, WA, several birds uttered Song in kind of chorus in morning twilight; song consisted of same basic phrase repeated, and rendered as *teer tēē tēē tee tee tee teerr tēē*, and did not contain any Contact Call types of notes. Not as loud as Territorial Song; louder and less varied than Whisper Song, and lacking mimicry. Unclear whether this forms a distinct type of Song (Mees 1969). **CONTACT CALLS**: Contact calls can be divided into three types; Short, Variable and Linear Calls, each with significantly different structure from the others (Bruce & Kikkawa 1988; Slater 1994; Robertson 1996); frequency ranges similar (1.0–6.0 kHz), but average duration dissimilar (see Table 5). **SHORT CALL**: A short, soft call uttered by both sexes, given when in close contact (Bruce & Kikkawa 1988; Robertson 1996); also described as faint conversational twitter, barely audible from 3–4 m (Andersen 1926). Uttered repeatedly between flock members and pairs while foraging (Andersen 1926; Bruce & Kikkawa 1988), or flying in close proximity (Slater 1994). Examination of sonagrams showed

large variation in structure both within and between the calls of individuals (Bruce & Kikkawa 1988; Slater 1994; Robertson 1996). Traces of sonagrams fell into two broad categories; those with an upside-down U-shape, and those with an M-shape. There was no sexual distinctiveness or individual or contextual consistency between different Short Calls (Slater 1994). **VARIABLE CALL**: Loud call given only by males (Bruce & Kikkawa 1988; Robertson 1996). Louder than Short Call, and used to maintain contact over larger distances (Bruce & Kikkawa 1988; Robertson 1996). Two such calls are shown in sonagram **B**. On Heron I., calls of each individual were structurally similar when repeated within bout of calling, but could appear quite dissimilar on other occasions. Structure very similar among siblings, but calls of father and son not similar (Slater 1994). In Brisbane, no individual produced more than one structure for their Variable Call, and birds of same flock shared similar call. Thought that Variable Call probably aids flock cohesion in migrating birds (Slater 1994). **LINEAR CALL**: Loud call uttered by both sexes; louder than Short Call, and used to maintain contact over greater distances (Bruce & Kikkawa 1988; Robertson 1996). Though both on Heron I. and in Brisbane call structure varied both within and between individuals, in Brisbane individuals showed some consistency in frequency range of linear part of call: 3.6–4.5 kHz (n=9 individuals) (Slater 1994). **OTHER INFORMATION ON CONTACT CALLS**: Various described as slurred, plaintive note (White 1913; Andersen 1926; A.H. Chisholm 1932; Gould) or sharp, high-pitched whistle (Stead 1932); and variously rendered as drawn-out, peevish *cheew* (Aust. RD), *peep* (St Paul 1975), chirping *cli-cli-cli* (Falla *et al.* 1981; NZRD), rather plaintive *cree* (Falla *et al.* 1981; NZRD), clear, peevish *tseep* (Morcombe 2000), *pēēūh...pēēūh...pēēūh...* (Mees 1969), staccato *chip chip* (Pizzey 1980), plaintive *zee zee* (Soper 1976), or thin, peevish-sounding little whistle *psee* (Frith 1969; Pizzey 1980). Use contact calls to maintain vocal contact while foraging and flying, and loud calls used when separated from flock (Bruce & Kikkawa 1988). Call described as Searching Call, and uttered as long-drawn, plaintive, high-pitched and rather penetrating call when separated from flock, rendered as *pyēēūw...pyēēūw* (Mees 1969), probably either Variable or Linear Call. Probably utter contact calls during migration; such calls from flocks in flight described as sharp twitter (Hutton & Drummond 1904; Andersen 1926; Frith 1969). Contact calls uttered more or less continuously by members of flock when moving through foliage, or when flying from tree to tree (Mees 1969). Said to be always quickly answered (Hutton & Drummond 1904). Upon release, 42.5% of males uttered Variable Call, 7.5% uttered Linear Call, 7.5% uttered Short Call, and the remainder did not call; 38.4% of females uttered Linear Call, 5.8% uttered Short Call, and the remainder did not call (Bruce & Kikkawa 1988). Utter modified Contact Calls when incubating, feeding young and as threat call (Falla *et al.* 1981). Calls described as Home Flight Calls and uttered



B W.M. Flentje; Heathcote, Vic., June 1985; P94

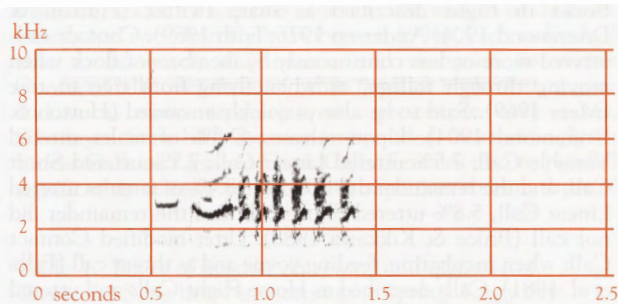
regularly by one or both of pair as they approach nest or nest-site (Fleming 1943) are probably Contact Calls. **ALARM CALL:** Short, low and loud call often repeated; also described as whistle-like, grating or nasal call (Mees 1969; Campbell). Various rendered as *sihrr...sihrr...* (Mees 1969) or *swang* (Fleming 1943; NZRD); or when flushed, as *swang di-di-di-di-di* (Fleming 1943), *wee-ee-ee-ee-ee* (Pizzey 1980) or mournful, repeated *o-dear, o-dearie* (Wilkinson 1931). See sonagram C. On Heron I. and in Brisbane, two types recorded; usually utter trisyllabic call, but sometimes give monosyllabic call ending with sharp increase in frequency. Highest amplitude of calls was 2–3 kHz (Slater 1994). Given when alarmed or agitated, usually in response to intruders near nest or to presence of predators (see Social Behaviour: Agonistic Behaviour). Seldom uttered outside breeding season; and when birds occupy territories, can be uttered together by several birds, especially in evening (Fleming 1943). **COURTSHIP CALL** (= Whisper Song of Fleming [1943]): Soft whispered trills, audible only within a few metres (Fleming 1943; Slater 1994). Uttered by one or both sexes, often while quivering wings when sexually excited, and sometimes while allopreening (Fleming 1943; Slater 1994). Usually given near start of breeding season (Slater 1994). Low warbling call uttered with quivering wings while searching for nest-site (Kikkawa & Wilson 1983) probably same call. **CHALLENGE CALL** (= Agonistic Call of Slater [1994]; angry cries of Wilkinson [1931]; and Aggressive Vocalization of Kikkawa *et al.* [1986]): Harsh call with highest amplitude frequency at 5–7 kHz. Uttered during threat or attack, often while fighting over food, and used in association with loud, single or rapidly repeated Short Call (Wilson 1994; Slater 1994). Often accompanied by high-intensity Pecking and Wing Fluttering (Kikkawa 1961a; Kikkawa & Wilson 2002). Occasionally utter other sharp calls while attacking or chasing others (Kikkawa & Wilson 2002), but these not further described.

Young Nestlings and dependent fledgelings have distinctive vocalizations, but when c. 6 months old, calls of juveniles same as those of adults (Slater 1994). **BEGGING CALLS:** Distinctive loud calls uttered by nestlings and dependent fledgelings when begging (Catterall *et al.* 1982; Kikkawa & Wilson 1983). That uttered by fledgeling rendered as *ee-chéeta*

(Falla *et al.* 1981), given for ≥ 2 weeks after leaving nest (Kikkawa & Wilson 1983; Wilson & Kikkawa 1988). **FLEDGELING CALL:** Double call uttered by dependent fledgelings, rendered as *sēē-sīrr sēē-sīrr* (Mees 1969); possibly same as Begging Call.

BREEDING Well known; study of banded population in Auckland (Fleming 1943); study of banded birds over many seasons on Heron I. (subspecies *chlorocephalus*) (Kikkawa 1970, 1987, 2003; Kikkawa & Wilson 1983); 976 records in NRS to Dec. 2003.

Season Aust. Throughout range, breeding recorded in all months, but mostly Sept.–Jan. (see below). From NRS, eggs, mid-July to early Apr., but nestlings also recorded in mid-June, indicating eggs laid in late May or early June; of 561 clutches: three (0.5%) were in July, four (0.7%) in Aug., 34 (6.1%) in Sept., 135 (24.1%) in Oct., 118 (21.0%) in Nov., 158 (28.2%) in Dec., 81 (14.4%) in Jan., 13 (2.3%) in Feb., six (1.1%) in Mar., and nine (1.6%) in Apr. (NRS). QLD: **SUBSPECIES VEGETUS** (ne. Qld): Eggs, June–Feb. and Apr. (Lavery *et al.* 1968; NRS [n=7]). Nestlings, Aug., Oct., Nov. and Jan. (NRS [n=7]). Unspecified breeding, including fledgelings, all months, but mostly Aug.–Nov. or Sept.–Feb. (Bravery 1970; Gill 1970a; Storr 19; Aust. Atlas 1, 2; NRS). **SUBSPECIES CORNWALLI** (e. and se. Qld): Eggs, Sept.–Jan., Mar. and Apr. (Cobcroft 1993; NRS [n=25]). Nestlings, Sept.–May (Lord 1956; NRS [n=18]). Unspecified breeding, including fledgelings, Aug.–May (Storr 19; Aust. Atlas 1, 2; NRS). **SUBSPECIES CHLOROCEPHALUS** (Capricorn and Bunker Grps): Onset of season associated with spring rain (Kikkawa & Wilson 1983). Eggs, Aug.–Apr., with peak in Sept. or Oct. (MacGillivray 1928; Cooper 1948; D'Ombra 1964; Kikkawa 1970; Kikkawa & Wilson 1983). Nestlings, Oct.–Dec. (MacGillivray 1928; Cooper 1948; D'Ombra 1964; Kikkawa & Wilson 1983). Unspecified breeding, including fledgelings, nearly all months, but mostly Oct.–Feb. (Kikkawa 1970, 1987; Kikkawa & Wilson 1983). NSW–ACT: **SUBSPECIES CORNWALLI AND WESTERNENSIS COMBINED:** Eggs, Aug.–Mar. (Marchant 1981; Morris *et al.* 1981; North; ACT Atlas; NRS); of 156 clutches in NRS, mid-Sept. to early Mar., with most (69.9%) late Nov. to mid-Jan.: four (2.6%) in Sept., 13 (8.3%) in Oct., 32 (20.5%) in Nov., 61 (39.1%) in Dec., 34 (21.8%) in Jan., nine (5.8%) in Feb., and three (1.9%) in Mar. Nestlings, late Sept. to mid-Apr. (K.A. Wood 1998, 2000; ACT Atlas; NRS); of 194 records in NRS, most (75.8%) Nov.–Feb. Unspecified breeding, including fledgelings, Sept.–Apr. (Gilbert 1937; Swanson 1971; Marchant 1973; Anon. 1976; Gibson 1977; Lenz 1981; Taylor *et al.* 1987; Aust. Atlas 1, 2; ACT Atlas; NRS). VIC.: **SUBSPECIES WESTERNENSIS AND PINAROCHROUS COMBINED:** Eggs, Sept.–Feb. (Wainer & Dann 1979; Campbell; NRS); of 95 clutches in NRS, mid-Sept. to mid-Feb., with most (71.6%) late Oct. to mid-Nov., and late Dec. to late Jan.: two (2.1%) in Sept., 15 (15.8%) in Oct., 20 (21.1%) in Nov., 26 (27.4%) in Dec., 29 (30.5%) in Jan., and three (3.2%) in Feb. Nestlings, late Sept. to late Feb., and in mid-June (NRS [n=111]) with most (91.0%) Oct.–Jan.



C W.M. Flentje; C. Shank, Vic., Jan. 1979; P94

Table 5. Characteristics of each of the three types of Contact Calls. Variable and Linear Calls were sampled from 15 individuals, and Short Calls from 27 individuals. Samples include ten calls from each individual. Includes individuals from Brisbane and Heron I. (Robertson 1996).

	Variable Call	Linear Call	Short Call
Call duration (ms)	271.2 (33.3; 150)	306.7 (67.2; 150)	142.7 (47.0; 270)
Initial frequency (kHz)	2.8 (0.5; 150)	3.5 (0.8; 150)	3.2 (1.0; 270)
Maximum frequency (kHz)	5.4 (0.2; 150)	4.9 (0.5; 150)	4.8 (0.6; 270)
End frequency (kHz)	3.3 (0.3; 150)	3.2 (0.2; 150)	3.4 (0.5; 270)
Number of peaks	4.2 (1.6; 150)	1.3 (0.6; 150)	1.7 (1.0; 270)

Unspecified breeding, including fledgelings, Aug.–May, and late June (Chisholm 1908b; Littlejohns 1921; Dickison 1932; Bedgood 1970, 1972, 1973a; Aust. Atlas 1, 2; NRS). **TAS.:** **NOMINATE LATERALIS:** Eggs, early Oct. to late Jan.; of 35 records in NRS: six (17.1%) in Oct., ten (28.6%) in Nov., 12 (34.3%) in Dec., and seven (20.0%) in Jan. Nestlings, late Oct. to early Feb. (NRS [n=29]). Unspecified breeding, including fledgelings, Sept.–Jan. and Mar. (Aust. Atlas 1, 2; NRS). **SA:** **SUBSPECIES PINAROCHROUS AND INTERGRADES WITH CHLORONOTUS:** Eggs, late June, and early Sept. to late Feb. (Parsons 1928; Sutton 1929, 1930, 1931; Cleland 1932; Brummitt 1934; Storr 1947; Attiwill 1972; NRS); of 157 clutches in NRS, early Sept. to late Jan., with most (75.2%) early Oct. to early Nov., and in mid- and late Dec.: 14 (8.9%) in Sept., 74 (47.1%) in Oct., 29 (18.5%) in Nov., 35 (22.3%) in Dec., and five (3.2%) in Jan. (NRS). On Kangaroo I., eggs, early Aug. to late Nov. (Lashmar 1937, 1942). Nestlings, mid-Sept. to early Feb. (Sutton 1923, 1929, 1930; NRS); of 132 records in NRS, most (76.5%) mid-Oct. to late Dec. Unspecified breeding, including fledgelings, July–Mar. and May (Anon. 1915; Pedler & Ragless 1978; Lane 1985; Aust. Atlas 1, 2; NRS [n=28]). In Aldinga Scrub CP, SA, breed Sept. to early Jan., with peaks in Oct. and Dec. (Ashton 1987). **WA:** **SUBSPECIES CHLORONOTUS:** Eggs, July–Feb. (Hall 1902; White 1921; Carter 1924; Tarr 1949a; Sedgwick & Sedgwick 1950; Carnaby 1954; Robinson 1955; Ford 1957; Slater 1962; Storr 1965; Campbell; NRS); of 86 clutches in NRS, mid-July to early Feb., with most (72.1%) Oct.–Dec.: three (3.5%) in July, four (4.7%) in Aug., 12 (14.0%) in Sept., 22 (25.6%) in Oct., 23 (26.7%) in Nov., 17 (19.8%) in Dec., four (4.7%) in Jan., and one (1.2%) in Feb. (NRS). Nestlings, early Aug. to mid-Feb., and mid-Apr. (Carter 1924; Slater 1962; Brooker 2001; Campbell; NRS); of 96 records of nestlings in NRS, two (2.1%) in Aug., 12 (12.5%) in Sept., 23 (24.0%) in Oct., 27 (28.1%) in Nov., 21 (21.9%) in Dec., nine (9.4%) in Jan., one (1.0%) in Feb., none in Mar., and one (1.0%) in Apr. Unspecified breeding, including fledgelings, July (or possibly June) to Mar. (Ford & Stone 1957; Wykes 1985; Brooker 2001; North; Storr 21, 27, 28; Aust. Atlas 1, 2; NRS). Round Northam, unspecified breeding Aug.–Nov. in Jarrah forests, and till Jan. along rivers, where breeding activity peaks in Nov. (Masters & Milhinch 1974). **NZ NOMINATE LATERALIS:** Unspecified breeding, including fledgelings, Sept.–Mar. (Blackburn 1965; Oliver; see below). **NI:** Eggs, early Sept. to late Feb. (Gross 1963; Rep. Bull. OSNZ 3; CSN 2, 3, 5). Nestlings, Nov.–Jan. and mid-Mar. (Ryder 1948; Gross 1963; Rep. Bull. OSNZ 3; CSN 2, 3). Unspecified breeding, including fledgelings, Oct.–Mar. (Fleming 1943; Marples 1944; Gross 1963; Kikkawa 1966; CSN). In Auckland, start of breeding influenced by temperature, with onset of laying c. 5 days after period of warm weather (Fleming 1943, which see for more detail). **SI:** Eggs, mid-Oct.; nestlings, early Oct., mid- and late Jan. Unspecified breeding, including fledgelings, Sept. to mid-Feb. (Stidolph 1949; Gill 1994; CSN). **OUTLYING ISLANDS:** **NORFOLK I.:** **NOMINATE LATERALIS:** Unspecified breeding Nov. and Dec. (Bell 1990). **LORD HOWE I.:** **SUBSPECIES TEPHROPLEURUS:** Two clutches, mid-Jan. and late Mar. (Mees 1969). **SNARES IS:** **NOMINATE LATERALIS:** Nestlings, late Nov., early Feb. Unspecified breeding, including fledgelings, late Sept. to early Dec. (Horning & Horning 1974; Miskelly et al. 2001).

Site Usually among dense foliage, suspended from thin fork of outer branch of tree, sapling or shrub, or sometimes in creeper; seldom in grass (Dove 1907; White 1921; Stidolph 1925; MacGillivray 1928; Sutton 1929; Wolstenholme 1929; Kikkawa & Wilson 1983; Campbell; Oliver; NRS). **AUST.:** Of 747 nests in NRS, 624 (83.5%) were in trees or shrubs, 115 (15.4%) were in creepers supported by trees, shrubs or artificial structures, four (0.5%) in grapevines, two (0.3%) in grass, and two (0.3%) in ferns. Of the 624 sites in trees or shrubs, 85

(13.6%) were in acacias, including Kangaroo Thorn *Acacia paradoxa*, Prickly Moses *A. verticillata* and Cootamundra Wattle *A. baileyana*; 50 (8.0%) in paperbarks, including Swamp Paperbark and Chenille Honey-myrtle *Melaleuca huegelii*; 44 (7.1%) in tea-tree, including Prickly Tea-tree and Coastal Tea-tree; 43 (6.9%) in fruit trees, mainly Orange and Apple; 38 (6.1%) in casuarinas, mostly Drooping Sheoak; 30 (4.8%) in mistletoe, often Harlequin Mistletoe *Lysiana exocarpi*; 24 (3.8%) in eucalypts, including Black Box and Pink Gum; 21 (3.4%) in daisy-bush *Olearia*; 18 (2.9%) in *Leucopogon*; 12 (1.9%) in Sweet Bursaria; and remainder in various other plants too numerous to mention. Of the 115 sites in creepers, nests were recorded in appleberry *Billardiera*, dodder, Old Man's Beard *Clematis aristata*, coral pea *Hardenbergia* and honeysuckle (NRS). In Aldinga Scrub CP, SA, of 124 nests, 48 (38.7%) were in Kangaroo Thorn, 28 (22.6%) in Downy Dodder-laurel *Cassytha pubescens*, 25 (20.2%) in mistletoe and 23 (18.5%) in Drooping Sheoak (Ashton 1987). At Gooseberry Hill, WA, of 59 nests, 16 (27.1%) were in *Acacia pulchella*, 12 (20.3%) in Honey Bush *Hakea lissocarpa*, six (10.2%) in *Drosera hastiflora*, six (10.2%) in Marri, five (8.5%) in *Trymalium ledifolium*, five (8.5%) in Wandoo, three (5.1%) in grass-trees *Xanthorrhoea*, and remaining six in various other trees or shrubs (Brooker 2001). Other published records include nests in *Astroloma*, *Baeckea*, cypress-pine, *Calythrix*, tea-tree, paperbark, Kangaroo Thorn, Jacaranda *Jacaranda mimosifolia*, Laurustinus *Viburnum tinus*, *Solanum simile*, *Syncarpia*, *Nitraria schoberi*, *Olearia axillaris*, hawthorn, fruit trees, including Pear; almond trees, monkey-nut tree, hydrangea, and *Wisteria* vine (Dove 1907; Chisholm 1908b; Zietz 1914; Littlejohns 1921; White 1921; Edwards 1925; McGilp 1925; Wolstenholme 1929; Dickison 1932; Sharland 1937; Ford 1962; Storr 1965; Rix 1976; Cobcroft 1993; North). On Houtman Abrolhos, WA, one pair nested near ground in prostrate pigface *Carpobrotus* (Hall 1902); one nest was against roof of hut, between two coils of wire (Tarr 1949a); another suspended from thin rope in hut (Warham 1956). One nest attached to small stalagmites in limestone cave (Ford 1962). On Capricorn Grp, of 173 nests, 60% were in terminal fork of *Pisonia grandis* branch (Kikkawa & Wilson 1983); also often nest among dense foliage of Native *Celtis paniculata*, and in various other plants, such as *Convolvulus*, *Cassia*, *Scaevola*, *Pandanus*, casuarinas and a few introduced plants (MacGillivray 1928; Cooper 1948; D'Ombra 1964; Kikkawa 1970; Kikkawa & Wilson 1983). **NZ:** Often nest in Manuka *Leptospermum scoparium* or Tauhinu *Cassinia leptophylla*, but also in various other trees and shrubs, such as *Coprosma*, Tawa *Beilschmiedia tawa*, Totara *Podocarpus totara* or Gorse *Ulex europaeus*, and in creepers, such as Kiwi Fruit *Actinidia deliciosa* vine (McLean 1912; Stidolph 1925; Wilkinson 1931; Gross 1963; Oliver; CSN 3, 39). **OUTLYING ISLANDS:** On Norfolk I., many nests in outer branches of Olive *Olea europaea* (Bell 1990). On Snares Is, of 11 nests, eight (72.7%) were in Kokomuka *Hebe elliptica*, and singles (9.1%) each in *Brachyglottis*, *Olearia* and *Polystichum* (Horning & Horning 1974; Miskelly et al. 2001). **SELECTION OF SITE:** Male said to select nest-plant and defend territory, but female probably selects nest-site, gathers material and starts building (Fleming 1943); also said that nest-site selected by either sex (Kikkawa & Wilson 1983; for behaviours associated with selection of nest-site, see Social Behaviour: Sexual behaviour), and that both sexes build (Oliver). **SITE FIDELITY:** Sometimes raise two broods in same nest (Gilbert 1937), though usually build new nest for repeat or replacement clutches, some 15 cm away in same tree, others up to 40 m away (McGilp 1925; Fleming 1943; NRS). In one tree, nests built near same site in each of 6 years (Fleming 1943). Both males and females with new partners may nest near (0.9–3 m) site of successful nest from previous year (Fleming 1943). On

Heron I., pairs usually use same species of nest-plant within and between seasons, even after change of mate. Females with new mates nested significantly farther from previous nest-site than males with new mates, and changed nest-plant (but not species of nest-plant) more often than persisting pairs. Mean distance between successive nests: same pairs within season, 14.8 m (2.0–72.1; 577); same pairs between seasons, 19.6 (2.0–78.4; 274); males with new mates after partner died, 23.3 (2.0–109.0; 134); females with new mates after partner died, 50.3 (2.0–310.5; 115); divorced males, 29.5 (2.0–95.0; 7); divorced females, 44.1 (21.5–110.9; 7) (Kikkawa 1987, which see for more details). **PROXIMITY TO OTHER NESTS:** Some nests 6 m apart (CSN 31); and claimed that two or three pairs sometimes nest in same tree (Anon. 1915). Use same nest-plant as Grey Fantail, Spotted Turtle-Dove *Streptopelia chinensis* (90 cm away) and White-throated Gerygone *Gerygone olivacea* (Ashton 1987; NRS). One pair nested 3.5 m from nest of Red-whiskered Bulbul (NRS). **MEASUREMENTS (m):** Height of nest: **AUST.:** Throughout range, 2.0 (1.15; 0.25–12.0; 912) (NRS); usually 0.9–4.3, occasionally up to 9.1 (Anon. 1915; Sutton 1929; North). On Kangaroo I., SA, 1.65 (0.54; 0.9–2.7; 11) (Lashmar 1937, 1942; NRS); at Gooseberry Hill, WA, median 1.0 (0.4–6.0; 31) (Brooker 2001). In fruit trees, c. 1.8; one nest in monkey nut tree, >6.1 (Chisholm 1908b); in trees and shrubs along coast of WA, 3.0–6.1 (White 1921). In Capricorn Grp, usually 0.9–1.2 (MacGillivray 1928; Cooper 1948; D'Ombra 1964); 0.3–1.2 (Kikkawa 1970; Kikkawa & Wilson 1983). **NZ:** Usually <2.1 (Wilkinson 1931); 1.3–3.0 (Stidolph 1949; Gross 1963; CSN 31). **SNARES IS:** 1.5–5.0 (n=7) (Miskelly *et al.* 2001). Height of nest-plant, 3.0 (1.95; 0.3–18.0; 340) (NRS); on Capricorn Grp, 0.5–15 (Kikkawa 1970; Kikkawa & Wilson 1983).

Nest, Materials Neat, loosely woven pensile cup, attached by rim to fork with grass, shreds of bark and spider web; made of soft, dry grass, shreds of stringybark, twigs, fibrous rootlets, tendrils, plant stems, palm fibre, moss, or down from thistle or dandelion, and sometimes wool, cotton, string, cloth or other artificial fibre; usually bound with spider web, occasionally plant fibre and hair, and once with cotton thread; lined with fine grass, plant fibre, rootlets, horsehair, and sometimes wool (e.g. McLean 1912; White 1921; Stidolph 1925; MacGillivray 1928; Gross 1963; Cobcroft 1993; K.A. Wood 1998; Campbell; North; Oliver; NRS). Exterior often decorated with green-and-white spider egg-sacs, or occasionally lichen (MacGillivray 1928; Gross 1963; K.A. Wood 1998; Campbell; North); single nests decorated with paperbark, bits of green-and-white plastic and a piece of green carpet pile (Cobcroft 1993) with flowers of tea-tree (NRS), and wallaby fur (D'Ombra 1964). On Heron I., often made from plant fibre, dry grass, spider web and casuarina needles (Kikkawa & Wilson 1983). Nests sometimes made almost entirely of one type of material, e.g. cotton and fine string (Chisholm 1908b), or casuarina needles (North). One nest on Houtman Abrolhos, WA, was made of seaweed (Hall 1902). In garden in Wollongong, NSW, five nests were made from pieces of Asparagus Fern *Protasparagus plumosus*, and lined with coconut fibre pulled from hanging pot-plant, 14–39 m away (K.A. Wood 1998). Rim of nest round or elliptical, and diameter generally narrower than that of main cup of nest (Dove 1907). Both sexes carry material and build nest, contributing equally (Wilkinson 1931; Oliver; NRS), though Fleming (1943) implied that only female builds. Sometimes desert partly built nest and start new one, sometimes within 7 days, or after >1 month (Fleming 1943). Material sometimes taken from old nests or other active ones (Kikkawa & Wilson 1983; NRS), and steal material from active nests of Yellow-rumped Thornbill and Mistletoebird (Brown & Brown 1986; Ashton 1987). Analysis of composition of one nest near Esperance, WA, including type, number and length of material:

nest comprised 11 grass stems (mean length 15.7 cm, maximum 66.8 cm), 85 other stems (10.2, 20.3), four hairs (16.8, 22.4), 31 roots (7.4, 15.7), 15 dead leaves, 390 seed-hairs of *Clematis*, 475 plant fragments (–, <5.1), and unknown number of grass seed-heads and pieces of green wool; another nest comprised 25 grass stems (9.4, 14.5), 20 hairs (26.2, 74.7), 20 roots (not measured), and unknown number of plant fragments (Sedgwick & Sedgwick 1950). Five nests at Mangerton, NSW, comprised 363–522 pieces of material; framework comprised 57–130 pieces, c. 100 mm long; lined with over 200 pieces of plant fibre, most 20–100 mm long, longest 420 mm; most had 5–10 small pieces of blue-green wool or felt 4–6 mm long, and two to four white spider egg-sacs; three nests had up to four cotton threads, 160–500 mm long, woven into framework and around rim; one nest contained over 200 hair-like plant fibres, 50–100+ mm long (K.A. Wood 1998, which see for more details). One nest contained long strands of white hair, many 30 cm long, longest 48.3 (Campbell). Nests take 3–14 days to build (Kikkawa & Wilson 1983; Ashton 1987). Build new nest for repeat or replacement clutches; three or more nests built each season (McGill 1925; Fleming 1943; Kikkawa & Wilson 1983; NRS). One pair added material to lining of nest during incubation (NRS). **MEASUREMENTS (cm):** External diameter, 5.7–8.5; external depth, 4.4–7.6; internal diameter, 3.5–6.4; internal depth, 3.2–4.5 (no N) (Sedgwick & Sedgwick 1950; Gross 1963; D'Ombra 1964; Cobcroft 1993; Campbell; North; NRS); corresponding measurements of one small nest, 4–5, 4–5, 4, 3–4 (NRS). On Lord Howe I., dimensions of rims of two nests: 6.4 × 3.8 and 5.7 × 5.1 (Dove 1907). Thickness of wall of nest, 0.6–1.2 (n=5); inside volume of nest, 71.2 cm³ (8.4; 62–82; 5) (K.A. Wood 1998).

Eggs Oval or rounded oval; smooth and slightly glossy, lustrous; uniform pale blue, light bluish-green or greenish blue (Campbell; North). **MEASUREMENTS:** Throughout range, 16.4 (0.45; 15.7–17.3; 18) × 12.2 (0.38; 11.4–12.7) (K.A. Wood 1998; Campbell; North); 17.3 (17.0–17.5; 7) × 12.1 (12.0–12.5) (Anon. 1915). **SUBSPECIES CHLOROCEPHALUS:** Three eggs in clutch, 17.5 × 12.8, 17.4 × 12.8, 17.0 × 12.6 (Kikkawa 1970). In WA: 16.8 (15.6–17.8; 13) × 12.4 (12.0–12.8) (Serventy & Whittell). **NOMINATE LATERALIS:** On Lord Howe I.: 18.6 × 15, 19.4 × 15.2 (corrected by Mees [1969] from erroneous measurements originally given by Mathews); 19.1 × 14.2, 19.1 × 14.5 (Mees 1969). In NZ, 17.5 (0.53; 16.8–18.0; 4) × 13.3 (0.22; 13.0–13.5) (Oliver).

Clutch-size Two to four (Anon. 1915; Campbell); usually three, sometimes four (North). From NRS, for acceptably complete clutches: **N. QLD:** C/2 × 1, C/3 × 1. **s. QLD:** 2.92 (0.29; 12); C/2 × 1, C/3 × 11. **NSW:** 2.75 (0.54; 76); C/2 × 23, C/3 × 49, C/4 × 4. **vic.:** 2.7 (0.65; 40); C/1 × 1, C/2 × 13, C/3 × 23, C/4 × 3. **TAS.:** 2.84 (0.6; 19); C/2 × 5, C/3 × 12, C/4 × 2. **SA:** 2.18 (0.51; 76); C/1 × 3, C/2 × 57, C/3 × 15, C/4 × 1. **WA:** 2.70 (0.74; 57); C/1 × 2, C/2 × 21, C/3 × 29, C/4 × 4, C/5 × 1 (NRS). From other sources: **QLD:** Subspecies *vegetus*: C/2 × 2, C/3 × 1 (Storr 19). Subspecies *chlorocephalus*: C/3 × 70 (n=72; other two clutch-sizes not stated) (Kikkawa & Wilson 1983); C/1 (<1%), C/2 (1%), C/3 (97%), C/4 (1%), C/5 (<1%) in >2000 clutches (J. Kikkawa); subspecies *cornwalli*: C/4 × 1 (Storr 19). **SA:** 2.17 (0.43; 89); C/1 × 2, C/2 × 70, C/3 × 17 (Ashton 1987). **WA:** Usually three, occasionally two, especially early in season (Sandland & Orton 1922); early clutches invariably two, later clutches usually three (Campbell); 2.4 (0.52; 83); C/2 × 51, C/3 × 31, C/4 × 1 (Storr 21, 27, 28). One nest with six eggs (Tarr 1949a). **NZ:** Usually three, sometimes four (McLean 1912; Wilkinson 1931; Rep. Bull. OSNZ 3); three or four (Oliver); when numerous in an area, lay C/4 rather than C/3 (Dove 1907). **LORD HOWE I.:** Two clutches of two eggs collected (Mees 1969).

Laying Begins as soon as nest complete (NRS); in four pairs, laying began 6–13 days after start of nest-building

(Fleming 1943). Eggs laid daily (Fleming 1943; NRS), and second and third eggs of one clutch laid within 29 h (NRS). Said to raise only one brood per season in Adelaide, but will lay replacement clutches if eggs removed (McGilp 1925). Elsewhere, lay multiple clutches, usually two or three, but sometimes up to five (Anon. 1915; Kikkawa 1987; Oliver). On Heron I., first-year birds usually produce one brood; older birds usually two or three broods, some up to five (Kikkawa 1987). Lay second clutch after first brood successful; one pair laid second clutch 25 days after first brood fledged (4 days after independence); one laid second clutch 60 days after laying first egg of first clutch; other estimates (± 5 days) between successive layings after successful broods: 54, 55 and 59 days, and after an unsuccessful brood, 47 days (Fleming 1943). One pair laid a new clutch while still feeding fledgelings from previous brood (NRS). Also re-lay after failure; a pair recorded incubating second clutch within 11 days of abandoning first clutch; and a pair laid three clutches after first two taken by observer (McGilp 1925; Fleming 1943; NRS). One pair laid in nest which had been removed by person, then replaced but not re-suspended (Ashton 1987).

Incubation By both sexes, in equal proportions; possibly only by female at night (Fleming 1943; Kikkawa 1987; Robertson 1997; Oliver; NRS). Often begins when second egg laid, though occasionally with first or third egg (Fleming 1943; Gross 1963; NRS). Change-over at nest occurs every 20 min or so (Kikkawa & Wilson 1983), or every 30 min (Gross 1963). Synchrony of hatching varies; eggs of C/2 often hatch within 24 h, and once within 12 h; eggs of C/3 often asynchronous, with third egg hatching a day after first two, though occasionally all hatch within 24 h, and once within 22 h; in C/4, eggs hatch over >24 h (Fleming 1943; Gross 1963; NRS). Eggshells removed or eaten at or soon after hatching (Gross 1963; NRS). Unhatched eggs may remain in nest after brood fledged (NRS). One bird sat on empty nest for >7 days (Ashton 1987). Eggs hatch at any time of day (Gross 1963; NRS). **INCUBATION PERIOD:** From laying to hatching, assuming eggs hatch in order laid: for first-laid eggs, 11.8 days (0.56; 15): 11 days \times 4, 12 days \times 10, 13 days \times 1; for second and third eggs, 10.9 days (0.77; 22): 10 days \times 7, 11 days \times 22, 12 days \times 2, 13 days \times 1 (NRS). From laying of last egg to hatching of last nestling, in C/3, 11 days \pm 12 h; in C/2, 12 days \pm 12 h (Fleming 1943). In C/3, from start of incubation, 10 days \times 3 (Gross 1963). Otherwise, variously given as c. 10 days (Wilkinson 1931; Campbell); 10–12 days (Serventy & Whittell); 11 or 12 days (Dickison 1932; Jarman 1939; Ashton 1987; Oliver); or 12–14 days (Kikkawa & Wilson 1983). One bird sat on an infertile clutch for 13 days (CSN 20).

Young Altricial, nidicolous. Blind and naked at hatching, except for two small tufts of off-white down on top of head, comprising 2–4 downy feathers; down present at hatching or before c. 2 days old (Brooker & Brooker 1987; Gill 1994; Kikkawa 2003; NRS). At 4 days old, eyes start to open; at 6 days, eyes open, and primary pins visible; at 7 days, feathers erupt from primary-pins, and feathers appear on upperparts; at 9 days, most of body feathered but still patchy on head; at 10 days, fully feathered (Kikkawa 2003). **Parental care** Both sexes brood and feed young; possibly only female broods at night (Wilkinson 1931; Terrill 1938; Fleming 1943; Medway 1955; Kikkawa & Wilson 1983; Kikkawa 1987; Robertson 1997; K.A. Wood 1998; NRS). Nestlings brooded till fledging (Ashton 1987), but older nestlings generally not brooded except in strong sun or rain (Fleming 1943). From observations ($n=195$ min over three periods) of two 8-day-old nestlings at Wollongong, NSW: brooded for 34% of observation time, in bouts of median 4.1 min (2.0–14.5; 12); from 06:33–08:00 (87 min), nestlings brooded for 43.4 min (50% of observation time), and four faecal sacs voided; from

13:48–14:41 (53 min), brooded for 14.5 min (27%), and three faecal sacs voided; from 17:25–18:20 (55 min), brooded for 11.8 min (21%), and no faecal sacs voided (K.A. Wood 1998). From observations of 582 feeds by nine pairs, 51% brought by female; though no significant difference between sexes in proportion of items brought to nest or distance carried to nest, in two pairs, male tended to travel further (Wilson & Kikkawa 1988). Faecal sacs removed or swallowed by feeding adult, who then broods till mate arrives (Fleming 1943). **Growth WEIGHT (g):** *SUBSPECIES CHLOROCEPHALUS:* At hatching, 2.0; at 2 days, 4.0; 4 days, 6.0; 6 days, 8.0–9.0; 7 days, 8.5–11.5; 8 days, 10.0–12.5; 9 days, 10.5–13.0; 10 days, 11.0–13.5; 11 days, 11.5–13.5; 13 days, 11.5–14.0; 17 days (post-fledging), 12.0–14.0; 23 days, 13.0–14.0 (no N) (Kikkawa 2003). *SUBSPECIES CHLORONOTUS:* At Gooseberry Hill, WA, at 1 day, mean c. 1.0; 3 days, c. 3.0; 5 days, c. 4.7; 7 days, c. 7.0; 9 days, c. 7.4; 11 days, c. 7.8 (estimated from graph; Brooker 2001). In NZ, one newly hatched nestling (*subspecies lateralis*) weighed 1.2 (Gill 1994). **OTHER MEASUREMENTS (mm):** *SUBSPECIES CHLOROCEPHALUS:* WING: At 6 days, 19–24; 7 days, 25–30; 8 days, 31–38; 9 days, 35–41; 10 days, 41–43; 11 days, 42–44; 13 days, 46–50; 17 days (post-fledging), 53–55; 23 days, 59–62 (no N) (Kikkawa 2003). **TAIL:** At 7 days, 1–6; at 8 days, 6–9; 9 days, 10–12; 10 days, 11–13; 11 days, 13–16; 13 days, 20–23; 17 days (post-fledging), 25–30; 23 days, 45–48 (no N) (Kikkawa 2003). *SUBSPECIES CHLORONOTUS:* WING: At Gooseberry Hill, WA, at 1 day, mean c. 5; 3 days, c. 8; 5 days, c. 15; 7 days, c. 26; 9 days, c. 32; 11 days, c. 38 (estimated from graph; Brooker 2001).

Fledging to independence **FLEDGING PERIOD:** From hatching to fledging, 10.7 days (0.91; 40): 9 days \times 2, 10 days \times 17, 11 days \times 13, 12 days \times 7, 13 days \times 1 (NRS). A brood of three, from last hatched, 9 days 14.4 \pm 7.6 h (Gross 1963); 10 days (Wilkinson 1931; Ashton 1987; Campbell; Oliver); or 12 days (Serventy & Whittell). From hatching of last egg to fledging of entire brood, 9 days (two broods of one, one brood of two), and 11 days (one brood of two); oldest nestling of one brood fledged at 12 days (Fleming 1943). At 07:00 on day of fledging, one nestling from brood of two moved 15 cm from nest and began preening, scratching and wing-stretching; 2 min later, second nestling followed to nearby twig, and both continued preening till 07:35, when they flew to nearby tree (Blackburn 1965). Once, two fledgelings remained in nest-tree for 2 days after leaving nest, but did not roost in nest at night; moved away with parents on third day; independent c. 18 days after leaving nest (NRS). Fledging not always synchronous (NRS). Of 156 fledgelings, mean number of 1.9 per brood (Kikkawa & Wilson 1983). Both sexes feed fledgelings (NRS). After leaving nest, fledgelings fed in nest-tree for a few hours, but family group usually leaves area round nest within a day; remain together for c. 2 weeks, during which time fledgelings become more independent, being fed progressively less often by parents; in three broods, interval between fledging and last known feed from parents, 16, 18 and 21 days (Fleming 1943). Fledgelings fed by parents for 10–20 days after leaving nest (Wilkinson 1931; Wilson & Kikkawa 1988). Both parents feed fledgelings equally at first, but older fledgelings fed by one parent only; as demand for food by fledgelings decreased, either through brood-reduction or greater independence of young, one parent deserted fledgelings before the other (Wilson & Kikkawa 1988).

Success For 129 nests where clutch-size, number hatched and number fledged known: of 322 eggs, 193 (59.9%) hatched, and 135 (41.9%) fledged, equal to 1.05 fledgelings per nest; of the 193 nestlings that hatched, 69.9% fledged. For 236 nests where clutch-size and hatching success known but outcome not known, of 599 eggs, 437 (73.0%) hatched. Of 356 nests where outcome known, 179 (50.3%) were successful and 177 failed (NRS). In Dunedin, of 22 nests, 19 fledged

total of 51 young (Kikkawa 1960). On Heron I., mean number of young fledged per season: first-year male as parent, 1.27 (n=63); first-year female, 1.32 (n=53); older male, 2.25 (n=147); older female, 2.13 (n=123); fledging success higher for second-year birds with same mates than with different mates, and for older birds which re-mated with older birds than with first-year birds (Kikkawa 1987, which see for more details). In Aldinga Scrub CP, SA, of 96 nests, 49 (51%) were successful, and 47 failed (Ashton 1987). Near Auckland, for 11 nests of known clutch-size and outcome: from 30 eggs, 26 (86.7%) hatched, and 21 (70.0%) fledged; of 19 fledgelings from nine broods that could be located 1 week after leaving nest, 15 (78.9%) were still alive (Fleming 1943). A recently hatched, naked nestling, which was banded, disappeared from nest but nevertheless survived, being re-trapped in following season (Mack 1965). If clutch reduced to one egg, usually desert nest (Fleming 1943); one nest abandoned at start of laying after first egg taken (NRS). Often one nestling from brood of two or three disappears from nest (Fleming 1943). Two nests attached to leaves failed when leaves shed by tree, one spilling nestlings onto ground, causing abandonment of other brood (Cobcroft 1993; Johnson 1994). Another brood failed after nest blown from tree (CSN 48). One clutch abandoned after being disturbed by olive-pickers (Cleland 1932). Young often die after fledging prematurely from disturbed nests (St Paul 1975). One nest failed when sitting bird died after becoming entangled in string used to make nest (Chisholm 1908b). Nestlings taken by Pied *Strepera graculina* and Grey S. *versicolor* Currawongs and Cats (Wood 2000; NRS). Once, Laughing Kookaburra flew off with entire nest in its bill (Campbell 1927). Once, a Cat removed nest from nest-plant, carried it to ground, then picked out the nestlings (NRS). A nest with a nestling was found on ground below an active nest of Square-tailed Kite *Lophoictinia isura* (Brown *et al.* 2000). One nest demolished by bulldozer (NRS). CUCKOOS: Parasitized by Pallid Cuckoo, Fan-tailed Cuckoo *Cacomantis flabelliformis*, Horsfield's Bronze-Cuckoo *Chrysococcyx basalus* and Long-tailed Cuckoo *Eudynamis taitensis* (Ashby 1934; Miller 1935; Stidolph 1949; Ford 1957; Ford & Stone 1957; McLean 1988; Brooker & Brooker 1989; Storr 28; Campbell; HANZAB 4); of 976 nests in NRS, none was parasitized. One nest from which young had fledged contained an egg of Horsfield's Bronze-Cuckoo buried in bottom (Calderwood 1952).

PLUMAGES Prepared by J.S. Matthew. Naked at hatching; recently hatched birds have two small patches of down on top of head. Undergo complete or partial post-juvenile (first pre-basic) moult to adult (if moult complete) or adult-like first immature plumage (if moult partial). Once adult plumage attained, complete post-breeding (pre-basic) moult each cycle produces successive adult plumages with no change in appearance. Said that some birds undergo partial adult pre-breeding (pre-alternate) moult (Swanson 1971), but evidence for this is equivocal (see Moults). Sexes very similar or alike. Nominative *lateralis* described below based on examination of skins of 32 adult males, 22 adult females and four juveniles collected from mainland Tas. (ANWC, MV, QVM, SAM).

Adult male (Definitive basic). **HEAD AND NECK:** Forehead, crown, nape, anterior sides of neck, upper lores and ear-coverts, bright olive (50). Hindneck and posterior sides of neck, dark brownish-grey (c79), fairly sharply demarcated from top of head, with olive (c50) tinge towards nape. Lower lores, grey-black (82), forming narrow loreal stripe. Rather broad and diagnostic white eye-ring, narrowly broken by grey-black (82) in front and very narrowly bordered by grey-black (82) below. Malar area, pale yellow-olive (c52). Chin and throat, whitish grey (ne) or greyish white (ne) in centre, grading to pale yellow-olive (c52) or yellow (c55) at sides; some

birds have faint yellow-olive (c52) wash on centre of chin and throat. A few very short black (89) bristles protrude from interramal area. **UPPERPARTS:** Mantle, upper back and scapulars, rich grey (c84) with olive (c50) tinge to longest scapulars and upper back; feathers, grey (c84); longest scapulars and feathers of upper back grading olive (c50) at tip. Lower back, rump and uppertail-coverts, bright olive (50); rather sharply demarcated from grey mantle. All feathers of upperparts have concealed grey (87) bases. **UNDERPARTS:** Breast, pale grey (c86) or greyish (c84) with faint light-brown (26) wash on lower breast. Centre of belly, thighs and vent, white or off-white (ne), some with faint pale-yellow (c157) wash. Flanks and sides of belly, light brown (c123A) or warm brown (121C, 37), fairly sharply demarcated from belly; see Sexing for slight differences between males and females in colour of flanks. Undertail-coverts, off-white (ne) or pale greyish (c86), grading pale yellow (157) or yellow-olive (52) at tip of most coverts. Axillaries, white. All feathers have concealed dark-grey (83) bases. **UPPERTAIL:** Rectrices, dark brown (119A, 121); t1-t5 with narrow olive (50) outer edges; t2-t6 with concealed narrow white inner edges. Shafts, dark red-brown (221A). **UNDERTAIL:** Greyish (c84); markings similar to uppertail, but white inner edges prominent and outer edges usually concealed; shafts to rectrices, white. **UPPERWING:** Marginal and median secondary coverts, grey (c84) with olive (50) fringes. Greater secondary coverts, greyish (c84) with olive (50) fringes to outer webs and tips. Marginal and median primary coverts, dark brown (121) with narrow olive (50) tips. Greater primary coverts, dark brown (121) with olive (50) outer edges. Feathers of alula, dark brown (121) or blackish brown (119). Tertiaries, dark brown (c119A) with broad olive (50) or yellow-olive (c52) outer edges. Secondaries and primaries, similar to tertiaries; outer edges paler yellow-olive (c52) on outer primaries, edges grading cream (c92) towards tips of p5-p8; p9 lacks outer edge; inner webs have concealed white edges. Shafts of remiges, dark red-brown (221A). Outer edges to remiges combine to form rather broad olive (50) panel on folded wing. **UNDERWING:** All underwing-coverts, off-white (ne) or white; in some, outer marginal primary coverts have yellow-olive (52) tips. Remiges, light brownish-grey (c80) with clear white inner edges; outer edges concealed; shafts, off-white (ne), light brownish (c223D) on outer primaries.

Adult female Very similar to adult male, some apparently not distinguishable. See Sexing, below, for more details.

Nestling Newly hatched nestling from NZ has down (Gill 1994). Acquire two small coronal patches of white down by c. 2 days old (Brooker & Brooker 1987). Recently hatched nestlings in NZ have pair of off-white coronal down-patches, with 2-4 feathers per patch; one nestling examined also had a single down-feather on left side of head in occipital position (Gill 1994).

Juvenile Very similar to adult, from which differs by: **HEAD AND NECK:** Loreal stripe slightly paler (dark brownish [c121]) and slightly less sharply demarcated than in adult. Hindneck, brownish (c119B); feathers softer and more loosely textured than adult. Malar area, chin and throat, greyish white (ne) with very faint yellow-olive (52) tinge on malar area and sides of chin and throat. Eye-ring slightly narrower than in adult. In subspecies *chlorocephalus*, eye-ring absent at time of fledging and first appears c. 4 days after fledging (Kikkawa 2003). See Geographical Variation for other differences from adult in other subspecies. **UPPERPARTS:** Mantle, back and scapulars, brownish (c119B) or dull brownish-grey (c79) with faint olive (51) tinge, which more distinct on back; feathers of mantle softer and more loosely textured than adult. Rump and uppertail-coverts, duller olive (c51), slightly brighter olive (c50) on uppertail-coverts, but still duller than in adult. **UNDERPARTS:** Feathers of breast softer and more loosely textured than in adult. Flanks slightly paler (pale 39).

TAIL: Similar to adult, but rectrices slightly narrower and more acute at tips; inner webs less incurved at tips than in adult. **UPPERWING:** Similar to adult, but wing-coverts and alula slightly paler (grey-brown [c91] or dark brown [c119A]) with duller olive (c51) fringes. Remiges have concealed pinkish-buff (c121D) or pinkish-cream (ne) inner edges. See Structure and Ageing for differences in shape of alula. **UNDERWING:** As adult, but remiges have pinkish-buff (c121D) or pinkish-cream (ne) inner edges (cf. clearer white in adults). Two longest feathers of alula, paler (brown [c28]) with broader and more rounded tips than in adult.

First immature (First basic). Very similar to adult (see Ageing for more details). Following discussion based on all subspecies. In e. Aust. (probably not including nominate), some birds said to undergo complete post-juvenile moult (Keast 1953; Swanson 1971); these birds presumably acquire adult plumage in this moult. Others, probably late-hatched birds, undergo partial post-juvenile moult and retain some juvenile feathers, especially remiges (Keast 1953; Swanson 1971). In nominate, birds that undergo partial post-juvenile moult very similar to adults in appearance, but retain juvenile remiges and probably greater primary coverts (and rectrices in at least some birds); retained juvenile remiges more worn than those of adult at same time of year, this obvious in autumn to early winter. At least some birds undergo partial post-juvenile moult, including inner primaries; for example, one first immature from Vic. in June (MV B8687) has adult-like plumage, but retained juvenile p5–p9 (which more worn and paler than rest of primaries), alula, and all juvenile rectrices (which narrower and more pointed at tip than those of adult); another skin (MV B4314) from Vic. in May, probably nominate *lateralis*, and resembles adult, but retained juvenile p5–p9, all rectrices and alula. Two skins (NMNZ) from NZ are identical to adults but have synchronous growth-bars to primaries, suggesting these are first immatures with retained juvenile remiges.

BARE PARTS Based on examination of photos (unpubl.: R.P. Allen; G.S. Chapman; R. Drummond; P.R. Marsack; J.S. Matthew; also standard sources), data from live birds captured in Vic. (K.G., A. & D.I. Rogers), museum labels (MV) and other sources as cited. Subspecies combined unless otherwise stated. **Adult** Bill: upper mandible, dark grey (83) with pinkish-white (ne) or greyish-white (ne) tomium and around nostrils; lower mandible, pinkish white (ne), pale bluish-grey (pale 88) or greyish white (ne) with narrow dark-grey (83) tip; bill also described as dark grey on upper mandible with blue-grey or creamy-grey base to lower mandible (Rogers *et al.* 1986); also brown with paler base or entire lower mandible (MV). Gape, greyish (c84) or pinkish white (ne); also described as cream or flesh-coloured (K.G., A. & D.I. Rogers; MV); basis for variation not known. Palate described as off-white, cream or pale pinkish (K.G., A. & D.I. Rogers; MV). Orbital ring, black (89) or dark grey (c83). Iris, brown (119B), light brown (239) or rufous-brown (c38); also described as grey to brown, colour unrelated to sex or age (Kikkawa 2003), light brown, dark grey or olive (K.G., A. & D.I. Rogers). Legs and feet, pinkish brown (219C); also described as dark grey, blue-grey, grey-pink (K.G., A. & D.I. Rogers), light grey, dark flesh or brown (Hall). Soles described as buff (K.G., A. & D.I. Rogers; MV). **Nestling** Gape described as yellow (Brooker & Brooker 1987). Legs described as pink when ready to fledge (Kikkawa 2003). **Juvenile** Photo (P.R. Marsack) of recently fledged bird shows: Upper mandible, dark grey (c83) with flesh-yellow (ne) base to tomium. Lower mandible, flesh-yellow (ne) with narrow dark-grey (83) tip. Gape, yellow (55), rather swollen. Iris, dark (ne). Feet, pinkish grey (ne). Several birds captured Vic. from Dec.–Feb. were aged as 'first year' birds; these had yellow gape and palate varying from yellow to pink (K.G., A. & D.I. Rogers); some of these birds had started

post-juvenile moult but others had apparently not yet started post-juvenile moult. Bare parts of recently fledged bird described as follows (Rogers *et al.* 1990): Bill, yellowish orange. Gape, yellow. When c. 4 days after fledging, legs described as black and mouth as orange; gape loses yellow coloration by c. 10 days after fledging (Kikkawa 2003). **First immature** Apparently similar to adult. Combined sources (Rogers *et al.* 1986, 1990; K.G., A. & D.I. Rogers) suggest gape changes from yellow in juvenile to flesh-pink or grey in immature.

MOULTS Based on examination of skins of: 17 adult subspecies *vegetus*; four adult *chlorocephalus*; 23 adult *westernensis* and *cornwalli* or intergrades between these; 23 adult nominate from Tas. and 16 from NZ; 28 adult and six juvenile *pinarochrous*; 43 adult and three juvenile *chloronotus* (AM, ANWC, HLW, MV, NMNZ, QVM, SAM); birds captured Vic. 1982–91 (nominate and *westernensis* combined; K.G., A. & D.I. Rogers) and other information as cited. Subspecies combined unless otherwise stated. **Adult post-breeding** (Third and subsequent pre-basic). Complete. Primaries moult outward, usually starting at p1. Between 1–5 primaries growing at once, though Swanson (1971) recorded no more than three growing at once; p1 and p2 shed almost simultaneously (Swanson 1971; K.G., A. & D.I. Rogers). Following unconventional pattern of primary-moult observed in bird captured in Vic. in Feb.: 3¹2¹N¹1¹N¹3¹O², suggesting moult of primaries started at two or more nodes. In Sydney, some birds arrest or suspend moult of primaries when raising second brood for season; in these birds, moult interrupted before moulting p6 (Swanson 1971). Following skins also showed evidence for arrested or suspended moult of primaries: two collected from NZ in June–July, two from NSW in Aug., and one from C. York Pen. in Dec., had inner 1–7 primaries new and rest worn. Individual duration of moult of primaries estimated at 2–3 months (Keast 1954); this supported by following observation from Vic.: bird caught 26 Dec. 1983 had not yet started moult of primaries and recaptured 10 Mar. 1984 (c. 2.5 months later) with PMS 43 (K.G., A. & D.I. Rogers). Keast (1954) stated that each primary takes 2.5 weeks to grow. Swanson (1971) stated that mean individual duration of moult of remiges is 83 days, based on recaptures of birds within a moult-cycle (75–100; n=18 birds); maximum duration of 100 days from birds which suspended or arrested moult of primaries. Duration of moult of remiges varies from year to year, as shown by following individual captured numerous times in Sydney; duration 90 days in 1968, 114 days in 1969 (when moult interrupted by breeding) and 84 days in 1970 (Swanson 1971). Table 6 summarizes timing of moult of primaries in adults in e. Aust. and Tas.; these results indicate moult usually occurs Jan.–Apr., but some birds apparently not starting till late summer to early autumn. Moult also said to occur Jan.–Apr. in Vic. (Rogers *et al.* 1986) and in Sydney (Swanson 1971). There is considerable variation in primary moult-score between individuals on a given day; for example, at a site in Vic., PMS on 11 Mar. 1984 varied from 2–42 (K.G., A. & D.I. Rogers). Geographical variation in timing of moult not fully understood. In investigation of timing and individual duration of moult in captive Silvereyes sourced from wild populations in Tas. and near Sydney, NSW (U. Munro): (1) Tas. birds started moult of primaries earlier (mean starting date 21 Jan. ± 15.8 days) than birds from near Sydney (mean starting date 1 Feb. ± 14.8 days); (2) Tas. birds finished moult of primaries earlier (mean finishing date 23 Mar. ± 6.7 days) than birds from near Sydney (mean finishing date 6 Apr. ± 13.2 days); (3) mean individual duration of primary-moult for Tas. birds was 91 days, 21 days less than birds from near Sydney, which 112 days; (4) mean individual duration of tail-moult was 84 days for Tas. birds, 28 days less than birds from near Sydney,

which were 112 days; and (5) differences in timing and duration of moult between Tas. and mainland birds probably reflects different life-cycles, Tas. birds requiring moult to be finished before undertaking autumn migration and mainland birds not constrained by movements to same degree. Mees (1969) indicated nominate *lateralis* undergo post-breeding in Tas. from Jan.–Mar.; moult finished before start of migration to mainland Aust. in autumn (see Movements). Less known about timing of moult in WA; from skins collected in sw. WA, active moult of primaries recorded from: Oct. (1 of 7; PMS 23), Dec. (1 of 8; PMS 23) and Mar. (2 of 3; PMS 28, 29). Mees (1969) stated that in subspecies *chloronotus* from WA, moult of remiges mainly occurs Feb.–Apr., but some birds start as early as Sept. The limited data here indicates timing of moult of primaries similar to that in e. Aust., but some birds start earlier, in mid- to late spring. In n. Qld (subspecies *vegetus*), moult recorded in June and July (feather-tracts not specified; Hall), but this may include birds undergoing pre-breeding moult (see below); one skin collected on s. C. York Pen. had active moult of primaries in May (PMS 31); eight skins (*vegetus* as confirmed by plumage) collected May–July had all primaries new (similar to birds in se. Aust.). Mees (1969) recorded one *vegetus* with moult of wing in June. These results suggest most birds in n. Qld undergo moult at similar time to, or slightly later than, birds in se. Aust. Mees (1969) noted that *tephropleurus* from Lord Howe I. were in ‘full moult’ in Nov. and Jan.; all four skins (ANWC) collected on Lord Howe I. in Feb. had active moult of primaries, mean PMS 37.8 (5.91; 29–42); one collected in Sept. had all primaries worn. Following data from Dunedin, SI: none of 31 captured in first half of Jan. had active moult; 11 of 34 in last half of Jan. and first half of Feb. had active moult (tracts not specified); four of 27 in first half of May had active moult; one bird in Feb. had active moult of wings and tail; no birds captured Mar.–Apr. (Marples 1945). Of 16 skins collected in NZ, Apr.–Sept., none with active moult of primaries; one of one in Apr., six of eight in June and two of three in July had all primaries new, rest from Apr.–July, one of one in Aug. and one of one in Sept. with all primaries slightly worn (this study); combined results suggest timing of moult in NZ similar to that in se. Aust., but more data needed. Secondaries moult inward. Moult of secondaries starts when moult of primaries about halfway through, before p4 and p5 fully grown (Swanson 1971; this study). Innermost secondaries often not replaced till after p8 and p9 are shed; moult of tertials often starts at s8 and no more than two tertials under one-third grown at any time (Swanson 1971). Moult of tail centrifugal; timing much as primaries, but can start earlier; recorded as early as Oct. in Vic. and Sept. in SA and NZ (this study). Mees (1969) recorded single birds from SA with moult of tail in June and July; one nominate from Tas. with moult of

tail in Aug. Swanson (1971) stated that moult of tail starts at t1 when moult of primaries about halfway through; and also that some birds replace t1 and t2, then there is a time-lapse before t3–t6 are shed, resulting in moult-contrast in tail. Moult of body starts before start of moult of primaries, and probably not finished till after finish of moult of primaries; recorded as early as Aug. in Vic.; moult of body not recorded June or July in s. Aust. (Mees 1969; this study). **Adult pre-breeding** (Probably first and subsequent pre-alternate). Little known. Apparently partial, involving mostly feathers of head (Swanson 1971). One skin, from NSW in early Aug., had active moult of head, body and inner greater secondary upperwing-coverts; another skin, from nw. Vic. in mid-Sept., had active moult of head, body and secondaries (s1 new, s2 half-grown, s3 pin, rest worn). More data needed on variation in extent of moult and if all, or just some, of population undergo pre-breeding moult. Birds in Sydney region said to have brighter plumage after moult, especially just before breeding season, than at end of breeding season before moulting again; pre-breeding moult resulting in brighter plumage not specifically referred to (Lane 1966). Birds show markedly increased thyroid gland activity 2–3 weeks before partial spring moult (Keast 1953). Pre-breeding moult in Sydney starts in mid-Aug. with a few feathers on head, followed by feathers of eye-ring, chin and surrounding cloaca; estimated that individual duration of pre-breeding moult c. 65 days, with peak in Sept. and finishing round early Oct. (Swanson 1971). Table 7 summarizes moult of body in birds from e. Aust. and Tas.; the results suggest pre-breeding moult of body occurs in some birds from Aug.–Oct. Extent to which pre-breeding and post-breeding body-moult overlap not known. **Post-juvenile** (First pre-basic). Not fully understood due to difficulty distinguishing first immatures from adults. Probably partial in some birds and complete in others (Keast 1953; Swanson 1971; this study). Involves all feathers of body, most wing-coverts, and varying number of, or no, remiges, rectrices and greater primary coverts. In Vic., recorded Dec.–Apr. (K.G., A. & D.I. Rogers). One juvenile from Vic. starting moult of primaries (PMS 5) in Mar.; likewise, a few captured in Vic. in Mar. undergoing moult of primaries and body. Two first immatures collected in Vic. in Aug. with inner 5–7 primaries new and outers worn, and with synchronous growth-bars to tail; these possibly underwent partial post-juvenile moult of primaries. Two first immatures in Vic. in autumn (see Plumages above) retained juvenile p5–p9 (and associated greater primary coverts), alula and all rectrices. Birds hatched early in season undergo complete post-juvenile moult, but late-hatched birds undergo partial post-juvenile moult and retain some juvenile feathers, especially remiges (Keast 1953; Swanson 1971). **First immature post-breeding** (Second pre-basic). No information. Timing

Table 6. Summary of timing of moult of primaries in adults (skins and live combined) from e. Aust. (from ne. Qld S to Vic. and e. SA) and Tas. Mean PMS calculated using only those with active moult.

	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE
No. examined	1	12	8	43	25	62	53	27	21	76	16	20
No. with PMS of 45	1	2	0	2	1	0	13	2	9	70	15	20
No. with active moult	0	0	0	0	0	3	13	21	12	4	1	0
Mean PMS	–	–	–	–	–	11	12	12	30	33	–	–

Table 7. Summary of body-moult in adults (skins and live combined) from e. Aust. and Tas.

	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
No. examined	18	3	25	42	14	27	1	18	6	13	13	43
No. with body-moult	5	3	9	7	1	0	0	6	1	1	0	2
No. with no body-moult	13	0	16	35	13	27	1	12	5	12	13	41

and extent probably similar to adult post-breeding, but this needs confirmation. **First immature pre-breeding** (First pre-alternate). No information; not known if pre-breeding moult occurs in immatures.

MEASUREMENTS SUBSPECIES VEGETUS: (1) N. Qld, from C. York Pen. S to about Townsville, adults, skins (AM, AMNH, ANWC, HLW, MV, QM, SAM); skins from AM, AMNH and QM measured by R. Schodde & I.J. Mason.

	MALES	FEMALES	
WING	(1) 58.4 (1.80; 55-61; 35)	56.5 (1.93; 51-60; 19)	**
TAIL	(1) 39.7 (1.95; 36-43; 35)	39.1 (1.47; 37-41; 19)	ns
BILL S	(1) 13.6 (0.53; 12.7-14.5; 14)	13.3 (1.06; 11.3-14.8; 7)	ns
TARSUS	(1) 16.7 (0.98; 15.3-18.7; 14)	16.1 (0.83; 15.2-17.6; 7)	ns

SUBSPECIES CORNWALLI: (2) SE. Qld and ne. NSW, adults, skins (AM, AMNH, ANWC, HLW, MV, QM); skins from AM, AMNH and QM measured by R. Schodde & I.J. Mason.

	MALES	FEMALES	
WING	(2) 60.1 (2.17; 56-66; 43)	58.8 (1.77; 56-63; 33)	**
TAIL	(2) 41.9 (2.23; 38-49; 41)	41.1 (1.97; 37-45; 32)	ns
BILL S	(2) 13.0 (1.34; 10.9-14.9; 11)	13.0 (0.71; 11.9-14.1; 10)	ns
TARSUS	(2) 16.8 (1.18; 15.1-20.2; 13)	17.0 (1.02; 15.3-18.6; 8)	ns

SUBSPECIES CORNWALLI: (3) Brisbane, se. Qld, live adults, unsexed (Clegg *et al.* 2002b). (4) Mainland opposite Heron I., Qld, live adults, unsexed (Kikkawa 1970).

	UNSEXED
WING	(3) 59.5 (1.57; 29)
	(4) 58.2 (2.02; 55-61; 71)
TAIL	(3) 42.1 (2.15; 29)
	(4) 43.7 (1.42; 40-47; 70)
BILL F	(3) 10.2 (0.44; 29)
THL	(3) 27.9 (0.73; 29)
TARSUS	(3) 16.3 (0.49; 29)
	(4) 17.3 (0.50; 16.4-18.5; 70)

SUBSPECIES CHLOROCEPHALUS: (5) Capricorn & Bunker Is, s. Great Barrier Reef, Qld, adults, skins (AM, AMNH, ANWC, QM).

	MALES	FEMALES
WING	(5) 64.9 (2.19; 61-69; 7)	62
TAIL	(5) 47.3 (2.29; 43-50; 7)	47
BILL S	(5) 15.4 (0.94; 14.1-16.5; 5)	14.4
TARSUS	(5) 18.8 (0.58; 18.2-19.4; 5)	19.6

SUBSPECIES CHLOROCEPHALUS: (6-8) Heron I., s. Great Barrier Reef, Qld, live birds, unsexed: (6-7) Kikkawa (1970): (6) Adults; (7) Immatures (after post-juvenile moult); (8) Clegg *et al.* (2002b). (9-20) Various islands of s. Great Barrier Reef, ages combined, wings not flattened (Kikkawa 2003): (9) Bushy I.; (10) Tyron I.; (11) North West I.; (12) Wilson I.; (13) Wreck I.; (14) Heron I.; (15) Erskine I.; (16) One Tree I.; (17) Masthead I.; (18) Hoskyn I.; (19) Lady Musgrave I.; (20) Lady Elliot I.

	UNSEXED
WING	(6) 64.8 (1.65; 62-68; 21)
	(7) 63.0 (1.28; 60-66; 165)
	(8) 64.6 (1.76; 85)
	(9) 62.3 (1.74; 60-65; 11)
	(10) 63.3 (1.33; 62-66; 16)
	(11) 63.7 (1.45; 61-66; 14)
	(12) 64.2 (1.05; 62-66; 12)
	(13) 63.6 (1.36; 62-66; 22)
	(14) 63.6 (1.54; 61-66; 41)
	(15) 62.3 (1.48; 60-64; 6)

	(16) 63.5 (1.47; 61-67; 31)
	(17) 63.7 (1.19; 61-65; 25)
	(18) 62.4 (1.75; 60-65; 14)
	(19) 63.3 (1.63; 61-65; 21)
	(20) 63.6 (1.14; 62-66; 30)
TAIL	(6) 49.3 (1.47; 46-51; 21)
	(7) 48.0 (1.43; 46-51; 143)
	(8) 46.8 (1.48; 85)
	(9) 47.2 (2.36; 44-50; 11)
	(10) 47.7 (1.16; 45-49; 16)
	(11) 47.8 (1.63; 44-50; 14)
	(12) 49.2 (1.39; 47-52; 12)
	(13) 47.4 (1.67; 44-51; 22)
	(14) 48.2 (1.52; 45-57; 41)
	(15) 47.4 (1.20; 46-50; 6)
	(16) 48.5 (1.49; 45-52; 31)
	(17) 48.5 (1.31; 46-52; 25)
	(18) 47.4 (1.29; 46-50; 14)
	(19) 47.8 (1.77; 45-51; 21)
	(20) 47.1 (2.31; 43-51; 30)
BILL F	(6) 11.5 (0.41; 10.7-12.3; 21)
	(7) 11.5 (0.38; 10.4-12.3; 163)
	(8) 11.8 (0.65; 85)
	(9) 11.8 (0.51; 11.0-12.7; 11)
	(10) 11.9 (0.36; 11.0-12.2; 16)
	(11) 11.9 (0.23; 11.5-12.3; 14)
	(12) 11.8 (0.39; 11.2-12.6; 12)
	(13) 11.8 (0.44; 11.0-12.7; 22)
	(14) 11.6 (0.41; 10.7-12.1; 41)
	(15) 11.8 (0.29; 11.5-12.2; 6)
	(16) 11.7 (0.37; 10.8-12.4; 31)
	(17) 12.0 (0.46; 10.8-12.4; 25)
	(18) 12.0 (0.27; 11.5-12.5; 14)
	(19) 11.8 (0.52; 11.5-12.7; 21)
	(20) 11.6 (0.42; 9.9-12.2; 30)
THL	(8) 31.3 (0.64; 85)
TARSUS	(6) 19.7 (0.72; 18.7-21.0; 20)
	(7) 19.7 (0.64; 17.7-21.0; 165)
	(8) 19.1 (0.64; 85)
	(9) 19.8 (0.48; 18.6-20.3; 11)
	(10) 20.4 (0.60; 19.4-21.4; 16)
	(11) 20.7 (0.85; 19.0-22.0; 14)
	(12) 20.5 (0.75; 19.2-21.8; 12)
	(13) 20.4 (0.79; 18.4-21.4; 22)
	(14) 20.1 (0.71; 19.4-22.1; 41)
	(15) 20.6 (0.60; 19.8-21.5; 6)
	(16) 20.6 (0.59; 19.6-21.8; 31)
	(17) 20.7 (0.46; 19.9-21.8; 25)
	(18) 20.3 (0.49; 19.5-21.0; 14)
	(19) 20.0 (0.72; 19.1-21.1; 21)
	(20) 19.9 (0.54; 18.6-21.0; 30)

SUBSPECIES TEPHROPLEURUS: (21) Lord Howe I., adults, skins (AM, AMNH, ANWC, QM).

	MALES	FEMALES	
WING	(21) 60.3 (2.16; 58-64; 6)	61.3 (2.22; 59-64; 4)	ns
TAIL	(21) 46.4 (2.51; 43-50; 5)	46.5 (1.91; 44-48; 4)	ns
BILL S	(21) 14.2, 15.9, 16.3	14.5, 15.0, 16.2	
TARSUS	(21) 18.4, 18.6, 18.8	18.2, 18.3, 19.4	

SUBSPECIES TEPHROPLEURUS: (22) Lord Howe I., live adults, unsexed (Clegg *et al.* 2002b).

	UNSEXED
WING	(22) 61.2 (1.43; 101)
TAIL	(22) 46.9 (1.51; 101)
BILL F	(22) 12.2 (0.54; 101)
THL	(22) 31.0 (0.83; 101)
TARSUS	(22) 18.4 (0.52; 101)

SUBSPECIES WESTERNENSIS: (23) SE. NSW, ACT and Vic. E of c. 145°E, adults, skins (AM, ANWC, HLW, MV).

	MALES	FEMALES	
WING (23)	61.4 (1.59; 58–65; 28)	60.4 (1.50; 58–64; 20)	*
TAIL (23)	44.3 (2.37; 40–49; 28)	42.8 (1.99; 39–48; 20)	*
BILL S (23)	13.0 (0.82; 11.7–14.6; 11)	14.1, 14.1, 14.3	
TARSUS (23)	17.2 (0.91; 16.3–19.6; 11)	15.3, 17.2, 19.0	

SUBSPECIES NOT KNOWN (PROBABLY WESTERNENSIS, PINAROCHROUS, INTERGRADIENT POPULATIONS AND NOMINATE): (24) Vic., live birds, ages combined, unsexed (Rogers *et al.* 1986).

	UNSEXED
WING (24)	61.5 (1.86; 148)
TAIL (24)	46.5 (1.77; 142)
THL (24)	28.1 (0.56; 75)

NOMINATE LATERALIS: (25–26) Tas., skins (ANWC, MV, QVM, SAM): (25) Adults; (26) Juveniles. (27) NZ (mostly NI), adults, skins (NMNZ). (28) Dunedin, SI, NZ, skins, ages combined, sexed by dissection (Marples 1945).

	MALES	FEMALES	
WING (25)	61.0 (1.05; 58–63; 32)	60.1 (1.34; 57–62; 22)	**
(26)	61, 61, 61	–	
(27)	61.4 (2.08; 57–65; 25)	60.7 (1.03; 59–63; 13)	ns
(28)	64.0 (1.67; 61–68; 31)	62.9 (1.25; 60–65; 30)	**
TAIL (25)	46.7 (2.40; 40–51; 31)	45.3 (2.49; 40–50; 21)	*
(26)	45, 45, 46	–	
(27)	46.2 (2.81; 40–51; 25)	45.9 (1.55; 43–49; 13)	ns
(28)	47.9 (1.55; 44–50; 26)	46.9 (3.00; 43–51; 29)	ns
BILL S (25)	13.2 (0.76; 11.6–14.5; 32)	13.3 (0.67; 12.4–14.5; 22)	ns
(26)	12.0, 12.2, 13.5	–	
(27)	13.0 (0.99; 11.0–14.4; 23)	13.1 (0.63; 12.2–13.9; 13)	ns
(28)	11.2 (0.44; 10.5–12; 29)	11.3 (0.46; 10–12; 29)	ns
BILL F (25)	17.4 (0.63; 15.7–18.9; 32)	17.6 (0.73; 16.5–19.1; 22)	ns
(26)	17.5, 17.6, 18.3	–	
(27)	17.5 (0.80; 16.0–19.8; 25)	17.1 (1.15; 14.9–18.3; 13)	ns
(28)	17.6 (1.03; 16–19; 31)	17.3 (0.68; 15.5–18.5; 30)	ns

NOMINATE LATERALIS: (29–33) Live adults, unsexed (Clegg *et al.* 2002b): (29) Tas.; (30) Dunedin, SI, NZ; (31) Palmerston N, NI, NZ; (32) Chatham I., NZ; (33) Norfolk I. (34) Dunedin, SI, NZ, live birds, ages combined, unsexed (Marples 1945). (35) Orongorongo Valley, NI, NZ, live birds, ages combined, unsexed (Robertson *et al.* 1983). (36) Tas., live birds, ages combined, unsexed (Rogers *et al.* 1990). (37) Norfolk I., live birds, ages combined, unsexed (Bell 1990). (38) Snares Is, live adults, unsexed (Miskelly *et al.* 2001).

	UNSEXED
WING (29)	61.0 (1.60; 55–64; 58)
(30)	62.6 (1.71; 59–66; 91)
(31)	60.5 (1.95; 56–64; 18)
(32)	63.4 (2.26; 22)
(33)	61.0 (1.85; 56–66; 34)
(34)	62.7 (1.67; 58–68; 311)
(35)	61.7 (1.49; 57–67; 810)
(36)	61.3 (1.65; 56.5–65; 117)
(37)	62.1 (10)
(38)	61.4 (1.0; 58–66; 14)
TAIL (29)	44.7 (1.79; 40–48; 58)
(30)	45.6 (1.81; 41–49; 91)
(31)	44.7 (1.90; 42–47; 18)
(32)	47.2 (1.70; 44–50; 22)
(33)	44.7 (1.84; 40–49; 34)
(34)	47.4 (2.90; 42.5–50.5; 56)
(36)	47.7 (1.90; 40.5–52; 120)
(37)	43.0 (10)
BILL F (29)	10.0 (0.72; 7.9–11.4; 58)
(30)	9.9 (0.47; 8.8–11.0; 91)
(31)	9.5 (0.48; 8.8–10.3; 18)
(32)	9.8 (0.46; 8.9–10.4; 22)
(33)	10.6 (0.38; 9.6–11.3; 34)

(34)	9.3 (0.31; 8.5–10.5; 59)
(37)	10.2 (10)
(38)	10.7 (0.8; 8.6–11.8; 14)
THL (29)	28.4 (0.83; 58)
(30)	28.9 (0.62; 91)
(31)	28.0 (0.54; 18)
(32)	29.3 (0.76; 22)
(33)	28.9 (0.60; 22)
(34)	28.2 (0.62; 26.0–29.9; 98)
(37)	28.5 (10)
TARSUS (29)	17.0 (0.53; 15.5–18.3; 58)
(30)	17.4 (0.49; 16.4–18.5; 91)
(31)	17.2 (0.58; 16.2–18.2; 18)
(32)	17.9 (0.40; 17.3–18.8; 22)
(33)	17.0 (0.61; 16.1–18.8; 34)
(34)	17.6 (0.71; 15.5–19; 109)
(37)	17.4 (10)
(38)	16.2 (1.2; 14.4–18.0; 14)

SUBSPECIES OCHROCHROUS: (39) King I., skins, adults and first immatures combined (ANWC, HLW, QVM).

	MALES	FEMALES
WING (39)	60.9 (0.78; 60–62; 9)	–
TAIL (39)	45.2 (2.99; 41–51; 9)	–
BILL S (39)	13.4 (0.82; 13.2–13.6; 4)	–
TARSUS (39)	17.8 (0.24; 17.5–18.0; 4)	–

SUBSPECIES PINAROCHROUS: (40–41) NW. Vic. and SA from SE W to n. Eyre Pen., skins (AM, AMNH, ANWC, HLW, MV, SAM): (40) Adults; (41) Juveniles.

	MALES	FEMALES
WING (40)	57.1 (1.74; 54–62; 23)	55.9 (1.53; 54–59; 15)
(41)	54.5 (2.38; 51–56; 4)	55
TAIL (40)	45.2 (2.35; 42–50; 23)	43.8 (2.32; 39–47; 16)
(41)	44.3 (1.50; 43–46; 4)	44
BILL S (40)	12.8 (0.57; 11.6–13.5; 19)	12.7 (0.62; 11.3–14.0; 15)
(41)	11.8 (0.55; 11.2–12.5; 4)	13.7
TARSUS (40)	16.7 (0.84; 15.4–18.9; 19)	16.9 (0.82; 15.7–18.3; 15)
(41)	16.6 (0.85; 15.4–17.4; 4)	17.3

SUBSPECIES CHLORONOTUS: (42) WA, adults, skins (AM, HLW, MV, SAM, WAM).

	MALES	FEMALES
WING (42)	55.9 (1.51; 52–58; 28)	55.1 (1.08; 54–57; 23)
TAIL (42)	45.9 (1.97; 41–50; 27)	44.8 (2.35; 39–50; 23)
BILL S (42)	12.9 (0.75; 11.6–14.2; 25)	12.9 (0.66; 11.8–14; 19)
TARSUS (42)	16.9 (0.63; 15.5–18.1; 28)	17.0 (0.65; 15.8–18.3; 20)

INTERGRADES BETWEEN CHLORONOTUS AND PINAROCHROUS: (43–44) Adults, skins (AM, AMNH, ANWC, SAM): (43) W. and s. Eyre Pen.; (44) Kangaroo I.

	MALES	FEMALES
WING (43)	57.6 (1.08; 55–59; 12)	57.7 (0.71; 57–59; 9)
(44)	58.0 (1.10; 57–59; 11)	–
TAIL (43)	43.7 (0.98; 42–45; 12)	44.1 (1.36; 43–47; 8)
(44)	43.8 (1.66; 41–46; 11)	–

WEIGHTS SUBSPECIES VEGETUS: (1) N. Qld, from C. York Pen. S to about Townsville, adults, from museum labels (ANWC) and Hall (latter including some from zone of intergradation between subspecies *vegetus* and *cornwalli*). **SUBSPECIES CORNWALLI:** (2) SE. Qld and ne. NSW, adults, from museum labels (ANWC, QM). **SUBSPECIES TEPHROPLEURUS:** (3) Lord Howe I., adults, from museum labels (ANWC). **NOMINATE LATERALIS:** (4–5) Tas., from museum labels (ANWC, QVM): (4) Adults; (5) Juveniles. **NOMINATE LATERALIS:** (6–7) NZ: (6) Mostly NI (<10% of birds from SI), adults, from museum labels (NMNZ). (7) Dunedin, SI, ages combined,

sexed by dissection (Marples 1945). **SUBSPECIES OCHROCHROUS:** (8) King I., ages combined, from museum labels (ANWC, QVM). **SUBSPECIES PINAROCHROUS:** (9) NW. Vic. and SA, adults, from museum labels (MV) and Hall. **SUBSPECIES CHLORONOTUS:** (10) WA, adults, from museum labels (MV).

	MALES	FEMALES	
(1)	11.8 (1.31; 9.0–13.0; 16)	11.0 (0.57; 9.9–12.1; 11)	ns
(2)	11.5 (1.09; 10.0–13.0; 7)	12.7 (2.48; 10.0–17.5; 8)	ns
(3)	13.2, 13.3, 14.5	13.5, 13.7, 14.0	
(4)	11.6 (0.89; 10.0–13.5; 23)	11.8 (1.32; 9.5–15.0; 21)	ns
(5)	11.3, 12.7	–	
(6)	12.4 (1.72; 9.0–14.1; 14)	12.6 (1.38; 10.2–14.6; 10)	ns
(7)	13.9 (1.22; 11.0–16.0; 25)	12.9 (1.36; 11.0–16.5; 19)	**
(8)	11.3, 11.3, 11.8	–	
(9)	10.5 (1.95; 8.5–12.5; 5)	12.0	
(10)	9.3 (0.51; 8.8–10.0; 5)	9.1 (0.62; 8.0–10.0; 9)	ns

SUBSPECIES CORNWALLI: (11) Brisbane, se. Qld, adults (Clegg *et al.* 2002b). (12) Mainland opposite Heron I., Qld, adults (Kikkawa 1970). **SUBSPECIES CHLOROCEPHALUS:** (13–15) Heron I., s. Great Barrier Reef, Qld: (13–14) Kikkawa (1970): (13) Adults; (14) Immatures (after post-juvenile moult); (15) Clegg *et al.* (2002). **SUBSPECIES TEPHROPLEURUS:** (16–17) Lord Howe I.: (16) Adults (Clegg *et al.* 2002b); (17) Ages combined (J. Kikkawa). **SUBSPECIES NOT SPECIFIED (MAINLY SUBSPECIES WESTERNENSIS AND NOMINATE COMBINED):** (18) Canberra, ages combined, Feb.–Apr. 1963 (McKean 1965). (19) Sydney, ages combined, Apr.–June 1963 (Walker 1964). **NOMINATE LATERALIS:** (20–24) Adults (Clegg *et al.* 2002b): (20) Tas.; (21) Dunedin, SI, NZ; (22) Palmerston N, NI, NZ; (23) Chatham I., NZ; (24) Norfolk I. **NOMINATE LATERALIS:** (25–27) Ages combined. (25) Orongorongo Valley, NI, NZ (Robertson *et al.* 1983). (26) Tas. (Rogers *et al.* 1990). (27) Norfolk I. (Bell 1990). (28) Snares Is, adults (Miskelly *et al.* 2001). (29) Little Barrier I., NZ, ages not specified (Gill & Veitch 1990).

	UNSEXED
(11)	10.2 (0.9; 29)
(12)	9.9 (1.45; 8.0–14.1; 54)
(13)	14.1 (1.16; 12.2–16.0; 20)
(14)	13.6 (0.90; 10.2–15.9; 164)
(15)	14.1 (1.03; 85)
(16)	12.4 (0.93; 101)
(17)	13.3 (0.99; 11.5–15.0; 66)
(18)	10.9 (1.32; 130)
(19)	12.0 (10.0–14.8; 137)
(20)	11.8 (0.89; 9.5–13.8; 58)
(21)	12.6 (0.83; 11.0–15.5; 91)
(22)	12.0 (1.07; 9.0–15.0; 18)
(23)	13.5 (1.07; 11.5–16.0; 22)
(24)	11.8 (0.67; 10.5–13.0; 34)
(25)	12.9 (1.14; 9.5–16.9; 1083)
(26)	11.7 (0.94; 9.5–15.0; 167)
(27)	12.0 (10)
(28)	12.1 (1.1; 10.1–16.5; 32)
(29)	12.9 (1.06; 11.7–14.5; 5)

ANOVA reveals no significant seasonal variation in weight of 350 birds captured in Vic. 1982–91 ($F_{3,346} = 1.36$, $P=0.25$; data from K.G., A. & D.I. Rogers) with mean weights according to season as follows: summer 10.9 (0.87; 8.8–13.4; 171); autumn 10.9 (0.86; 9.4–13.4; 98); winter 10.6 (0.94; 8.8–12.8; 31); spring 10.8 (1.00; 9.5–15.1; 50); factors such as time of day and subspecific variation should probably be taken into account for more refined analysis of seasonal variation in weight. In ACT in autumn, migratory birds from Vic. weigh more than residents; migrants were distinguished from residents by subtle differences in flank-colour which, as discussed below (see Geographical Variation); probably not significantly different between populations in mainland se. Aust. (McKean

1965). Kikkawa (1980) investigated weight changes in relation to social hierarchy in Silvereyes at Armidale, NSW, in winter, and found weight gain over 6 weeks was lower in birds with an interrupted food supply than in birds with uninterrupted food supply. On Heron I., immatures weighed less than adults in winter (Kikkawa 1980a).

At Dunedin, SI, 1939–43, mean monthly weights: Jan. 13.0 ($n=55$); Feb., 13.0 (10); Apr., 13.4 (15); May, 14.0 (334); June, 14.5 (481); July, 14.4 (701); Aug., 13.9 (402); Sept., 13.4 (490); Oct., 12.6 (22); Nov., 12.3 (2); Dec., 12.2 (3); maximum mean weight was in second half of June, 14.6 g (12.5–18.0; 187); minimum mean weight was in first half of Dec., 12.0 g ($n=2$). Further, diurnal weight variation from May–Sept. indicates birds gain c. 4% weight from 08:30 to 11:30, lose c. 1.5% from 11:30 to 13:30, then gain c. 4% from 13:30 to 17:30; mean weight at 17:30 is c. 7% higher than at 08:30 (Marples 1945).

At Margaret R., WA, subspecies *chloronotus* in vineyards are in physiological stress in Mar. when body-fat content is low (Rooke *et al.* 1986). Subspecies *chlorocephalus* weigh up to 40% less than *cornwalli*, and basal metabolic rate of *chlorocephalus* is also up to 40% less than in *cornwalli* (Pillans 2001).

STRUCTURE Wing fairly long and slightly pointed at tip; tip of longest primary falls to about one-third length of tail. Ten primaries, p10 vestigial. Wing-formula differs slightly between subspecies: longest usually p7 or p8, these varying by ≤ 1 mm; in nominate *lateralis*, p8 usually longest (7 of 11 skins), less often p7 (3 of 11) and p7 and p8 sometimes = (1 of 11); p9 1–4.5 mm shorter than longest, p6 usually 0.5–3 mm shorter than p7 or p8, but often longest primary in subspecies *chloronotus* and *pinarochrous*; p5 1–7, p4 4–10, p3 7–14, p2 8–17, p1 9–18; see Geographical Variation for details of wing-formulae. Nine secondaries including three tertials; tip of longest tertial falls shorter than tip of secondaries on folded wing. Longest feather of alula narrow and pointed at tip in adults; broader and more rounded at tip in juveniles. Tail fairly long, rather narrow and slightly forked or squarish at tip when closed; 12 rectrices; longest varies, but one or more of t2–t6; t1 2–5 mm shorter than longest. Bill fairly short and slender, about three-quarters length of head; upper mandible slightly decurved; slight notch near tip of upper tomium. Tarsus fairly short and slender, compressed laterally; scaling laminiplantar. Tibia fully feathered. Middle toe 14.0 mm (1.22; 12.4–15.1; 5); inner and outer toes 70–80% length of middle, hindtoe 75–90%. Hindclaw, c. 4 mm.

SEXING Slight size-dimorphism; adult males have longer mean length of Wing than adult females (see Measurements). Not known if cloacal examination useful for sexing birds (Rogers *et al.* 1986). Sexes do not differ, or only slightly different, in plumage. Kikkawa (1963) compared skins of 51 males and 44 female nominate collected in SI in winter in 1958–60 and found males tend to have richer and darker reddish-brown flanks (cf. females with paler and less rich yellowish-brown flanks); in a pair, male has noticeably darker flanks than female. This largely supported by observations of birds in NZ (Fleming 1943) and e. Aust. (Kikkawa 1963; Lane 1966; DAB). However, Mees (1969) compared skins (from ANWC) of six males and seven females from ACT and Tas. and found no reliable difference between sexes in coloration of plumage; McKean (1965) examined c. 20 sexed skins from ACT and found no reliable difference between sexes in coloration of plumage; and Marples (1945) also found no correlation between sexes in colour of underparts in comparison of 30 sexed skins from Dunedin, SI. Present study compared skins (ANWC, QVM) of 26 adult male and 21 adult female nominate collected in Tas. throughout year (sexed by examination of gonads) and indicates following subtle differences between

sexes: (1) males tend to have slightly richer yellow-olive malar area and sides of chin and throat than females; (2) males tend to have richer brown (121C, 37) or russet-brown (ne) flanks and sides of belly, which contrast more strongly with white centre of belly (cf. adult females which have paler flanks and sides of belly, contrasting less strongly with duller off-white centre of belly); however, c. 20% of male skins have plumage identical in appearance to females and this apparently not related to plumage-wear. Lombert (1988) conducted colorimetric analysis on plumage and discriminant function analysis on morphometric characters for populations throughout e. Aust. and Tas.; discussion of these analyses outside scope of this work, but briefly: (1) there was considerable overlap between sexes for all discriminant functions and for individual morphometric characters, and birds could not be reliably sexed by these characters; (2) on average, males have brighter plumage than females, but there is much overlap in plumage-colour and brightness at all localities throughout e. Aust. and Tas.

AGEING Juveniles distinguishable by plumage and bare parts (q.v.). First immatures difficult to distinguish from adults, and some probably acquire adult plumage in complete post-juvenile moult when only a few months old (see Moults). Some retain all or most juvenile remiges, greater primary coverts, alula and rectrices; retained juvenile rectrices slightly narrower and more acute at tips than those of adult, and often have synchronous growth-bars or fault-bars (asynchronous in adults). Adult-like birds with synchronous growth-bars or fault-bars to primaries or secondaries, or both, are probably first immatures with retained juvenile remiges. In late autumn and early winter in s. Aust., retained juvenile remiges, alula and rectrices should be paler and more worn than those of adults at same time of year. Retained juvenile remiges have duller pinkish-buff inner edges (cf. white in adults). Juvenile two longest feathers of alula are broader and slightly rounded at tips (cf. narrow and distinctly pointed at tip in adults); some first immatures retain juvenile alula and are distinguishable with close examination in the hand. See First immature (in Plumages above) for further discussion. Hutchinson (1967) used skull pneumatization and iris-colour to determine age of birds in WA; he found juvenile have little or no pneumatization, and usually (61.4% of birds) have light (yellow-brown or pale-grey) iris; immatures (presumably birds finished post-juvenile moult, but less than 1 year old) have half to three-quarters of skull pneumatized and either dark (grey or grey-brown) iris (60% of birds) or light iris (40%); 'advanced immatures' (presumably immatures nearing 1 year old) have skull nearly fully pneumatized (no information on iris-colour); and adults have pneumatized skull and usually have dark iris (70% of birds).

GEOGRAPHICAL VARIATION Very complex. Views concerning subspecies differ considerably and a complete discussion of taxonomic changes over time is beyond the scope of this work (see Mees [1969] and DAB for more details). Some authors (Mees 1969; Peters) recognize up to 15 subspecies, 6–7 in HANZAB region, and a further 6–8 extraliminally on islands in sw. Pacific Ocean. Based on large series of skins collected during breeding season, DAB recognized nine subspecies in HANZAB region, with the following approximate breeding ranges (see Masthead for more detail on distributional limits): *vegetus* from n. Qld S to about Burdekin R. Drainage Basin; *chlorocephalus* on cays of s. Great Barrier Reef, including Capricorn and Bunker Grps; *cornwalli* from central-e. Qld S to about Hunter R. Valley, e. NSW; *westernensis* from se. NSW, ACT and e. Vic.; *lateralis* on mainland Tas. and Furneaux Grp; *ochrochrous* on King I., w. Bass Str.; *pinarochrous* from nw. Vic. and mainland s. SA, including most of Eyre and Yorke Pens; and *chloronotus* from far w. SA and WA. Subspecies intergrade where their breeding ranges abut, the intergradient popula-

tions showing a blend of traits of parental populations (DAB). Mees (1969) and Peters recognized 6–8 subspecies in sw. Pacific Ocean, on New Caledonia, Loyalty Is, Vanuatu, Banks Is and Fiji; for detailed discussion on extralimital subspecies see Mees (1969).

Some of the subspecies recognized in DAB previously referred to under different names. For example, populations from w. SA and WA traditionally considered subspecies *gouldi* and some authors (Ashby 1925, Mack 1932) even recognized these as a distinct species, Western Silvereye *Z. gouldi*. DAB (for nomenclatural reasons explained therein) recognized them as subspecies *chloronotus*. Populations over much of e. Aust., from about Mackay, mid-e. Qld, S through NSW and ACT, to e. Vic., usually considered subspecies *familiaris* (Mees 1969), but DAB considered these as two subspecies, *westernensis* and *cornwalli*, which intergrade over a fairly broad zone of e. NSW, from about Hunter R. S towards s. coast. Populations in n. Qld, N from about Mackay, previously referred to as subspecies *ramsayi*, but type material (from Palm I.) said to be intergradient between those from far n. Qld and *cornwalli* farther S (DAB). Accordingly, DAB rejected *ramsayi* and considered populations N of about Burdekin R. Drainage Basin as subspecies *vegetus*. Populations from SA, W to w. Eyre Pen., and w. Vic. inland to sw. NSW, previously considered subspecies *halmaturina* (Mees 1969), but DAB claimed the type material (from Kangaroo I.) is intergradient between *chloronotus* and the dull-plumaged population breeding in se. SA. DAB thus rejected *halmaturina* and considered breeding populations in se. SA and nw. Vic. as a new subspecies, *pinarochrous*. Mees (2003b) cautioned, with some merit, against rejection of subspecies names which have been commonly used historically. However, in the present study we accept the taxonomy of DAB while emphasizing the need for further genetic analyses of breeding populations.

Lombert (1988) examined morphometric, colorimetric and allozymic variation in e. Aust. populations; that study indicates: (1) populations in ne. Qld and Tas. are well differentiated with regard to size, feather-pigmentation and allozymes; (2) both populations are separate and homogeneous; (3) mainland se. Aust. populations, from Vic. N to se. Qld (termed subspecies *familiaris* in that study; = *westernensis* and *cornwalli* in DAB), are genetically and morphologically heterogeneous and intermediate between Tas. and ne. Qld; and (4) within *familiaris* variation does not fit a purely clinal pattern, and there are two areas showing significant morphological differentiation compared with other populations of *familiaris*, Brisbane–Tamborine Mt, se. Qld, and Galston–Wedderburn region, central-e. NSW. Degnan & Moritz (1992) investigated phylogeography of *Z. lateralis* and Yellow White-eye *Z. luteus* using restriction-enzyme site mapping of the entire mitochondrial DNA (mtDNA) genome. Results for *Z. luteus* are discussed in account for that species. Their studies revealed significant genetic divergence between populations of *Z. lateralis*, with the following key findings (subspecies according to Mees [1969]): (1) highest levels of sequence divergence (2.3%) were between populations from e. coastal Aust. and those from sw. WA and SA (Kangaroo I. and SA Gulfs region), consistent with that reported between some avian interspecific comparisons; (2) break between e. and w. sequences occurs well within range of subspecies *halmaturina* and not where ranges of *halmaturina* and western *gouldi* abut as proposed by Mees (1969); (3) low levels of divergence throughout mainland e. Aust. and Tas.; (4) populations on Heron I., Qld (subspecies *chlorocephalus*) are genetically very similar to those on opposite mainland, despite significant morphological differences (see below), but the data suggests little gene flow between them. Latter study therefore supports recognition of *pinarochrous* in SA and *gouldi* (or *chloronotus*) in WA, but not the subspecific divisions proposed by DAB in

e. coastal Aust. or Tas. More detailed genetic and morphological analyses of various island populations, including those in NZ and on Norfolk and Chatham Is, are discussed below.

There are some overall trends in size across Aust. Throughout range on mainland e. Aust. and Tas., simple linear regression reveals significant N to S increase in length of Wing ($P < 0.01$; $r^2 = 0.34$), Tail ($P < 0.01$; $r^2 = 0.55$) and Tail:Wing ratio ($P < 0.01$; $r^2 = 0.33$) in adult males ($n = 108$ skins, those from mainland se. Aust. collected Sept.–Mar.). From E to W across s. mainland Aust., there is a decrease in length of Wing ($P < 0.01$; $r^2 = 0.49$) and an increase in Tail:Wing ratio ($P < 0.01$; $r^2 = 0.54$) in adult males ($n = 69$; those from mainland se. Aust. collected Sept.–Mar.). Birds from island populations, such as those on cays of s. Great Barrier Reef, Norfolk and Chatham Is and SI of NZ, are larger than their ancestors from mainland Aust. and Tas. (see discussion below). Plumage variation in this species mainly involves: (1) colour and tone of upperparts, especially extent of grey; (2) extent and richness of yellow on chin, throat and undertail-coverts; and (3) colour of flanks. Primary-formulae also vary between subspecies (discussed in detail below).

The following descriptions of subspecies based on examination of skins collected during breeding season (Sept.–Mar.) in e. Aust., or throughout year in other regions. Possible that some birds collected during breeding season are non-breeding migrants, and this may complicate analysis of geographical variation. The fact that fresh plumage is attained at end of, or just after, breeding season (when migration probably occurs) also makes direct comparison of fresh-plumaged breeding residents difficult. A clearer understanding of movements and geographical variation requires more detailed genetic analyses, especially from e. Aust. and SA, using materials collected throughout year.

NOMINATE LATERALIS: See Plumages for full description. Wing rather pointed at tip, with p8 longest primary and p5 said to always be longer than p9 (Mees 1969; DAB). There are some exceptions to this; eight of 15 skins from Tas. had p8 longest, three of 15 had p7 longest, and rest had p7 and p8 equal length; in these skins, all except one had p5 shorter than p9, the other with p5 and p9 equal length (this study). Pointed wing probably reflects migratory nature of this subspecies (see Movements). On mainland Aust., examination of skins indicates nominate *lateralis* migrate W to about Adelaide and N to about Shoalwater Bay, central-e. Qld (Mees 1969, 1974; DAB). Difficulty in distinguishing nominate from some mainland subspecies, especially *westernensis*, makes assessment of movements difficult. Examination of series of skins (SAM) from round Adelaide and Fleurieu Pen., SA ($n = 35$, Apr.–Sept.) suggests small numbers of nominate *lateralis* visit that region in non-breeding season; two of these skins, one in May and one in Sept., have plumage matching that of nominate, whereas all others are of local breeding subspecies *pinarochrous* (see description below); all 14 skins collected in that region, Oct.–Mar., are from mainland breeding populations. Of ten skins (SAM) from se. SA, two (both collected in Feb.) have plumage identical to nominate. Of 81 birds collected (HLW, MV) or captured (K.G., A. & D.I. Rogers) in Vic. from Apr.–Sept., three (3.7%) were Tas. nominate and rest were mainland birds. These limited results suggest a small proportion (<10%) of birds on mainland se. Aust. in autumn to early spring are Tas. migrants, but more data needed.

Nominate *lateralis* has colonized most of NZ, Norfolk I., Chatham Is, and other outlying islands over past c. 170 years (see Distribution and Population); original source of these populations was Tas. (Mees 1969; Clegg *et al.* 2002b). Comparison of morphometrics (this study) indicates no significant difference between adult skins from Tas. and NZ (mostly from NI). However, adults from Dunedin, SI (data from Marples 1945), have longer Wing and Tail ($P < 0.01$; sexes

separate) than adults from Tas. (data from this study). This largely supported by studies of Clegg (2000) and Clegg *et al.* (2002b), who used canonical discriminant analysis to describe morphological variation among different island populations, and found: (1) birds from SI have larger body-size than those from Tas.; (2) birds from Chatham Is have larger body-size than those from SI and Tas.; (3) birds from NI have smaller body-size than those from SI; and (4) Norfolk I. birds have similar body-size but larger bill than those on NI and in Tas. Suggested that morphological differentiation of these island populations results from directional natural selection and not random genetic drift alone (Clegg *et al.* 2000b). Examination of skins (NMNZ) of 105 adults from throughout NZ (including Campbell, Auckland and Chatham Is) indicates plumage is identical to nominate from Tas. (this study). However, c. 20% of these skins have richer yellow (c55) chin and throat than Tas. nominate; a few birds also have uniform pale-yellow (157) undertail-coverts. Marples (1945) found that 5% of birds captured at Dunedin ($n = 655$ captured May–Sept.) had yellow throat and undertail-coverts, and 20% had yellow undertail-coverts only. It is possible there has been subtle change from Tas. ancestral stocks in plumage of these recently colonized populations, but direct comparison of larger number of skins from Tas. and NZ is needed.

Nominate *lateralis* colonized Norfolk I. from NI in 1904 (North 1904). Skins collected on Norfolk I. in 1926 have narrower bills than those collected in 1912–13 and in 1968–69 (Grant 1978). Latter author hypothesized that changes in bill morphology did not result from hybridization with endemic Slender-billed White-eye *Z. tenuirostris*, but rather through natural selection whose direction was reversed after 1926. Estoup & Clegg (2003) suggested that Norfolk I. was colonized by a small founder population of c. 20 birds, whereas NI, SI and Chatham Is were colonized by larger founder populations of 150–200 birds each.

SUBSPECIES VEGETUS: Adults have shorter Wing, Tail and Tarsus and lower Tail:Wing ratio ($P < 0.01$; sexes separate) than adult nominate. Compared with nominate, DAB indicated *vegetus* have shorter wing-length (56–60 cf. 60–65 in nominate) and lower tail:wing ratio (0.65–0.70 cf. 0.67–0.73 in nominate). Wing tends slightly less pointed at tip than in nominate, probably reflecting more sedentary nature of this subspecies compared with nominate (see Movements); in *vegetus*, p5 usually longer than p9 (Mees 1969; DAB; this study). DAB stated p7 longest primary (cf. usually p8 in nominate), but a few birds have p6 longest (this study). Plumage description based on examination of skins (ANWC, HLW, MV, SAM) of 21 adults collected throughout year. Similar to nominate, from which differs by: **Adult Sexes** alike. **HEAD AND NECK:** Ear-coverts slightly paler, yellowish olive (c52), contrasting slightly with top of head. Malar area, chin and throat, yellow (55). **UPPERPARTS:** Mantle, upper back and scapulars, rich grey (84), lacking any olive coloration and more sharply demarcated from olive lower back. Rest of upperparts as nominate, but rump and uppertail-coverts slightly brighter yellow-olive (rich 52). **UNDERPARTS:** Breast, grey (c84), usually with faint yellow (c55) tinge on upper breast. Flanks, pale greyish (c86) with faint light-brown (c26) tinge. Entire belly, vent and thighs, off-white (ne), some birds with faint pale-yellow (157) wash. Undertail-coverts, yellow (55). **UPPERWING:** As nominate, but fringes or edges to wing-coverts and remiges brighter yellow-olive (c52), so upperwing appears slightly brighter overall. **Juvenile** No information. Undertail-coverts become paler and less yellow between about Innisfail and Burdekin R. Drainage Basin, probably reflecting intergradation with subspecies *cornwalli* (DAB). Mees (1969) suggested intergrade zone is farther S, around Mackay, but DAB stated that skins ($n = 9$) from this area do not differ from *cornwalli*. DAB also stated populations from Cooktown to Cardwell

have greyer belly and deeper citrine-yellow throat than those on C. York Pen.

SUBSPECIES CORNWALLI: Adults have shorter Wing ($P < 0.05$) and Tail ($P < 0.01$; sexes separate), and lower Tail:Wing ratio ($P < 0.01$) than adult nominate. Adults have longer Wing and Tail ($P < 0.01$; sexes separate) than subspecies *vegetus* farther N. Primary-formula and wing-shape as for *vegetus* (Mees 1969; DAB; this study). Plumage description based on examination of skins of 21 adults collected Sept.–Mar. (ANWC, HLW, MV, QM). Very similar to *vegetus*, from which differs by: **Adult HEAD AND NECK:** Yellow of malar area, chin and throat usually less rich, slightly paler and brighter (same colour number). **UPPERPARTS:** As *vegetus*, but some birds have faint olive (50) tinge on upper back and longest scapulars. **UNDERPARTS:** Flanks, light brown (c26), much paler than in nominate. Undertail-coverts, off-white (ne) with pale-yellow (157) tinge, in some birds more uniformly pale yellow (157). Rest as *vegetus*. DAB stated that this subspecies extends from about Burdekin R. Drainage Basin, central-e. Qld, to about Hunter R., NSW, with little change in plumage apart from slightly richer russet flanks towards S.

SUBSPECIES CHLOROCEPHALUS: A large island subspecies. Adult males have longer Wing, Tail, Bill S and Tarsus ($P < 0.01$) than adult male *cornwalli*, and longer Wing, Bill S and Tarsus ($P < 0.01$) than adult male nominate. Kikkawa (2003) indicated *chlorocephalus* larger and weigh more than *cornwalli* from Armidale in ne. NSW, and Brisbane. Variation in morphometrics between different island populations of Capricorn and Bunker Grps shown in Measurements and Kikkawa (2003). Primary-formula as for *vegetus* and *cornwalli* (Mees 1969; DAB). Based on examination of skins of nine adults (collected on Heron, North-West and Lady Musgrave Is) (AM, ANWC, MV, QM), there is no consistent difference in plumage from adult *cornwalli* from mainland Qld or ne. NSW; this supported by Mees (1969). However, DAB indicated *chlorocephalus* have duller yellow throat with distinct citrine cast (cf. brighter yellow with little citrine cast in *cornwalli*) and paler grey, less brown flanks.

Restriction-enzyme mapping of mtDNA indicates population on Heron I. closely related to those on opposite mainland, but differences in haplotype frequencies suggest low current levels of gene-flow between these populations (Degnan & Moritz 1992). DNA fingerprinting using minisatellite sequences also suggests little significant gene-flow between populations in Capricorn Grp, including Heron I., and those on mainland (Degnan 1993). That study also found low levels of genetic variation on Lady Elliot I., s. Bunker Grp, c. 100 km SE of Capricorn Grp; this low level of variation may be due to a population bottleneck during recent founding of populations on the island (Degnan 1993). Small numbers (up to 50) of birds from mainland Aust. (distinguished by size) appear on Heron I. from May to Aug. each year, but no observational data to suggest these breed here (Kikkawa 1970). The evolution and morphological differentiation of recent island colonists, including *chlorocephalus*, have been discussed by Clegg *et al.* (2002b). Comparison of morphological and molecular genetic characteristics (see Clegg *et al.* [2002a] for molecular data) in Heron I. populations with those from Brisbane concluded: (1) Heron I. birds are consistently larger than their mainland ancestral populations; (2) it is unlikely that genetic drift alone accounts for level of morphological divergence from mainland populations, especially if there is gene-flow from those populations, and directional natural selection may have played a role in the evolution of *chlorocephalus*; and (3) the species has probably colonized Heron I. over the past 3000–4000 years. Large size of resident Heron I. birds apparently associated with dominance behaviour (Robinson-Wolrath & Owens 2003).

SUBSPECIES WESTERNENSIS: Mees (1969) did not recognize

this subspecies, but considered populations breeding on mainland se. Aust., from se. Qld to e. Vic., as subspecies *familiaris*. This supported by analysis of mtDNA, which indicates little genetic divergence between populations in se. Aust. and ne. Aust. (Degnan & Moritz 1992). Nonetheless, skins collected from se. Aust. in breeding season have plumage which differs consistently (see description below) from skins collected in se. Qld and ne. NSW (DAB). They are recognized as subspecies *westernensis* (DAB), whose breeding distribution approximates the zone of intergradation between previously recognized subspecies *familiaris* and *halmaturina* (Mees 1969). Adults have shorter Tail and lower Tail:Wing ratio ($P < 0.01$; sexes separate) than adult nominate from Tas. Adult *westernensis* have longer Wing and Tail ($P < 0.01$; sexes separate) than adult *cornwalli* farther N. Primary-formula similar to nominate *lateralis*, with wing tending more pointed at tip than *cornwalli* farther N; p5 usually shorter than p9; p8 usually longest primary, but p7 in some birds and occasionally p7 and p8 equal length (Mees 1969; DAB; this study). As in nominate *lateralis*, rather pointed wing probably reflects migratory nature of this subspecies (see Movements). Plumage descriptions based on examination of skins of 23 adults and three juveniles, all collected Sept.–Mar. (ANWC, HLW, MV). Differs from nominate by: **Adult Sexes alike (see Sexing).** **HEAD AND NECK:** Malar area, chin and throat, yellow-olive (52) or yellow (c55), usually grading slightly paler (same colour number) on centre of chin and throat; in a few birds, yellow-olive does not extend to centre of chin and throat, these resembling most richly pigmented nominate. **UPPERPARTS:** Mantle, back and scapulars, greyish (c84) or dark brownish-grey (dark 79) with olive (c50) tinge to longest scapulars and upper back, tending slightly less sharply demarcated from olive top of head than nominate. **UNDERPARTS:** As nominate, but flanks paler cinnamon-brown (c39) or light brown (26) in both sexes, fairly diffusely demarcated from duller off-white (ne) belly and vent; some birds have faint pale-yellow (157) tinge to belly and vent. Undertail-coverts as nominate, but uniformly pale yellow (157) in a few birds (2 of 23 skins examined). **Juvenile** As juvenile nominate. Photo (P.R. Marsack) and information in Rogers *et al.* (1990) indicate eye-ring indistinct or absent in recently fledged birds; when present, comprises a few pale-yellowish (c157) feathers; also described as brownish (Rogers *et al.* 1990); fully feathered eye-ring is narrower than in adult.

Intergradation between *cornwalli* and *westernensis* thought to occur over a zone c. 200 km wide from Hunter R. valley S to about Batemans Bay, central e. NSW; this based on increase in brightness of yellow on throat and decrease in russet on flanks from S to N (DAB).

SUBSPECIES OCHROCHROUS: Recently described subspecies breeding on King I., w. Bass Str. (DAB). Previously considered by Mees (1969) to be nominate *lateralis*. DAB stated that adults have paler plumage, especially flanks, than respective sexes of nominate from Tas. Adult females said to be similar to adult male *westernensis*, but King I. birds have whiter throat (DAB). DAB stated *ochrochrous* resemble nominate but have paler flanks. However, four specimens (HLW, QVM) examined in present study more closely resemble *westernensis*, having pale-yellow (c157) undertail-coverts (cf. off-white in nominate). King I. birds have same primary-formula as nominate (this study).

SUBSPECIES PINAROCHROUS: Recently described subspecies (DAB), previously considered as subspecies *halmaturina* (Mees 1969). Degnan & Moritz (1992) found that populations from SA Gulfs region (Eyre and Yorke Pens, Kangaroo I.) have distinctive mtDNA haplotypes which are more closely related to those in sw. WA than in e. Aust. Adults have shorter Wing and Tarsus ($P < 0.01$; sexes separate), Tail ($P < 0.05$; males only) and Bill S ($P < 0.05$; sexes separate) than adult nominate from Tas. Adults have shorter Wing ($P < 0.01$; sexes separate) than adult

westernensis. Wing tends more rounded at tip than in nominate and *westernensis*, probably reflecting more sedentary nature of the subspecies (DAB). DAB stated that p7 usually longest primary, and relative lengths of p5 and p9 vary, with p5 longer or shorter than p9, or sometimes p5 and p9 equal length; this supported by Mees (1969). Examination of skins (n=10; this study) indicates p8 (1 of 10) or p6 (1 of 10) occasionally longest primaries, but usually p7; p5 either longer than p9 (5 of 10) or shorter than p9 (5 of 10). Plumage descriptions based on examination of skins of 15 adult males, 11 adult females and two juveniles collected from nw. Vic. W to Adelaide and Flinders Ras, SA, all from Sept.–Mar. (HLW, MV, SAM). Very similar to *westernensis*, from which differs by: **Adult** Sexes similar (but see comment in underparts). **HEAD AND NECK:** Top of head, slightly duller olive (c50). Malar area, chin and throat, greyish white (ne) with faint yellow-olive (52) tinge to malar area and sides of throat when fresh, lost or becoming very faint with wear; a few birds have slightly richer yellow-olive (52) tinge to this area, but not known if these are migrants from farther E. **UPPERPARTS:** Mantle, back and scapulars, slightly paler and more brownish (greyish brown [c91]). DAB stated that dull citrine (olive) extends variably from top of head to upper back; this supported by examination of skins here in which some birds have faint dull-olive (c50) tinge to upper back. **UNDERPARTS:** As *westernensis*. DAB stated that females have brownish-grey flanks whereas males have dull russet-brown flanks. Present study found no obvious difference between sexes in colour of flanks in skins examined; both sexes have light-brown (c26) flanks, slightly duller with wear, but males tend slightly richer (same colour number). Undertail-coverts, off-white (ne) with faint pale-yellow (157) tinge (as in nominate examined here). **UPPERWING:** Fringes or edges to wing-coverts and remiges, slightly duller olive (c50).

Intergradation between *pinarochrous* and *westernensis* thought to occur over a wide zone encompassing most of w. half of Vic. (except mallee of far nw. Vic), from line between w. Port Phillip Bay and Echuca–Swan Hill region W to Millicent–Beachport region, far se. SA; this based on examination of 24 skins collected in this region which show increasingly yellow chin and throat and richer russet flanks from W to E (DAB).

SUBSPECIES CHLORONOTUS: Previously considered as subspecies *gouldi* (Mees 1969), but DAB recognized *chloronotus* as the senior synonym for nomenclatural reasons outlined there. We follow DAB here, but Mees (2003b) cautioned against rejection of commonly used names such as *gouldi*. Degnan & Moritz (1992) found unique series of mtDNA haplotypes in populations from sw. WA, and these were more closely related to mtDNA in birds from SA Gulfs than coastal e. Aust. Adults have shorter Wing and Tarsus ($P < 0.01$; sexes separate) than adult nominate, and shorter Wing than adult *pinarochrous* ($P < 0.01$ males; $P < 0.05$ females). Rather rounded tip to wings compared with nominate, reflecting more sedentary nature (Mees 1969; DAB; see Movements). Primary-formula as for *pinarochrous* (DAB). This supported by examination of 11 adult skins from sw. WA (this study) which shows: p7 usually longest primary (10 of 11), but sometimes p8; p6 sometimes equal longest with p7 (3 of 11 skins); p5 usually longer than p9 (8 of 11), but sometimes equal (2 of 11) or shorter (1 of 11). Plumage description based on examination of skins of 52 adults and three juveniles (HLW, MV, SAM). Differs from nominate by: **Adult** Sexes alike. **HEAD AND NECK:** Top of head, duller olive (c50), much as *pinarochrous*. Sides of neck, malar area, chin and throat, yellow-olive (52) or yellow (c55). **UPPERPARTS:** Uniform olive (c50), slightly richer olive (50) on uppertail-coverts. **UNDERPARTS:** Most of underparts similar to *westernensis* and *pinarochrous*, but flanks light brownish-grey (c80) with rather faint light-brown (26) tinge. Belly more often tinged pale yellow (157) than in nominate. Undertail-

coverts, yellow (c55). **UPPERWING:** Fringes or edges to wing-coverts and remiges, duller olive (c50), similar to *pinarochrous*. **Juvenile** Similar to juvenile nominate except for: (1) Malar area, chin and throat, pale yellow (pale 55), paler than adult *chloronotus*; (2) top of head, hindneck and upperparts, uniform dull olive (c51), duller than adult, with faint greyish-brown (c91) tinge, especially to hindneck; (3) undertail-coverts, pale yellow (157, pale 55), paler than adult.

Range of *chloronotus* extends to w. SA coast, as indicated by two skins (SAM) collected c. 13 km SW Nullarbor HS; both skins appear identical to skins from sw. WA (n=19). Subspecies *chloronotus* said to intergrade with *pinarochrous* in w. SA Gulfs region and on Kangaroo I. (DAB). Mees (1969) also stated that these two subspecies (recognizing *halmaturina* rather than *pinarochrous*) hybridize in area from Streaky Bay W to about Ceduna, w. Eyre Pen. Skins (SAM) from Eyre Pen. (n=5), islands in s. Spencer Gulf (n=9) and Kangaroo I. (n=11) resemble *pinarochrous* from round Adelaide (see above), but one adult skin (SAM B18645) from Reevesby I., s. Spencer Gulf, shows plumage intermediate between *chloronotus* and *pinarochrous*; this bird has rich-yellow chin and throat, and mostly olive upperparts except for greyish-brown mantle with faint olive tinge. An adult captured SW of Nundroo, sw. SA, in Aug. 2004 (G.A. Carpenter) resembles *pinarochrous*, but has olive tinge to parts of hindneck, mantle and upper back, and rest of upperparts uniform olive; this bird may also be intergradient between *chloronotus* and *pinarochrous*. Examination of more birds from w. SA and se. WA, on and round Nullarbor Plain, needed to confirm the nature, if any, of intergradation between these subspecies.

SUBSPECIES TEPHROPLEURUS: Long-billed subspecies endemic to Lord Howe I. Clegg *et al.* (2002b) estimated that this population established on Lord Howe I. for up to c. 300,000 years. Some authors consider this to be a distinct species, Lord Howe I. White-eye *Z. tephropleurus* (Hindwood 1940b; Sibley & Monroe 1990; Monroe & Sibley 1993; Clegg *et al.* 2002b), but we follow Mees (1969) and DAB in considering them as subspecies of *Z. lateralis*. Mack (1932) combined Lord Howe I. populations with those from n. and ne. Qld (including *chlorocephalus*) as *Z. tephropleura*. Adults have much longer Bill S ($P < 0.01$; sexes combined) and longer Tarsus ($P < 0.01$; sexes combined) than adult nominate from Tas., *westernensis* and *cornwalli* from mainland e. Aust. Adults also have longer Tail ($P < 0.01$; sexes combined) than adult *westernensis* and *cornwalli*. Wing rounded at tip, reflecting sedentary nature of this subspecies (Mees 1969; DAB). Longest primary p6 or p7; p4 and p5 usually longer than p9 (DAB). Plumage description based on examination of skins (ANWC) of two adult females and three adult males collected in Feb. Very similar to *westernensis*, from which differs by: **Adult** Sexes alike. **HEAD AND NECK:** Malar area, chin and throat, yellow (c55), slightly paler than *cornwalli* from se. Qld and ne. NSW. **UNDERPARTS:** Breast said to be mid-grey with brownish cast grading to fuscous-grey on flanks (DAB). Examination of skins here suggests little obvious difference from *westernensis*, but *tephropleurus* have light-brownish (c26) flanks grading to brownish grey (ne) anteriorly, and merging with similarly coloured sides of breast. Undertail-coverts, pale yellow (157); similar to, or slightly richer than, *cornwalli*.

Extent to which mainland Aust. birds migrate to Lord Howe I. not known. Hindwood (1940b) stated that most Silvereyes seen on Lord Howe I. in 1936 were 'typical *lateralis*'. However, all 19 skins collected from the island said to be *tephropleurus*, with no evidence of mainland Aust. birds (DAB). One skin examined here (MV B15669) collected in 1981 closely resembles *westernensis*, having off-white (ne) undertail-coverts with faint pale-yellow tinge, pale-yellow tinge to chin and upper throat, and light-brown flanks. About 11 birds from Taronga Zoological Gardens, Sydney, were sent

to Lord Howe I. in July 1924; from 1931–36, a small number of birds from Norfolk I. were released on Lord Howe I. (Hindwood 1940b); not known if descendants of these birds are still present.

Extralimital subspecies These are summarized briefly here from Mees (1969). Relationships between these subspecies unclear and validity of some subspecies (such as those on Vanuatu) uncertain. Overall, most subspecies have grey mantle and broadly resemble *e. Aust. cornwalli*, but subspecies *valuensis* has uniform greenish upperparts rather like *chloronotus* from *w. Aust.* Pacific island subspecies typically have p5 longer than p9 (as in sedentary subspecies from *Aust.*). **SUBSPECIES GRISEONOTUS:** Endemic to New Caledonia. Rather large. Adult skins have following measurements: Wing (males 63.5 [60–66; 12]; females 62.0 [60–65; 10]), Tail (males 47.1 [45.5–49; 12]; females 45.3 [43.5–47; 10]); Bill S 13.4 (12.0–14.5; 21; sexes combined); Tarsus 18.9 (17.8–20; 22; sexes combined). Wing rather rounded at tip; p5 longer than p9, with p9 proportionately much shorter than p5 compared with *Aust.* subspecies. Plumage very similar to subspecies *cornwalli* from *e. Aust.* **SUBSPECIES MELANOPS:** Endemic to Lifu, Loyalty Is. A large subspecies; adult skins have following measurements (sexes combined): Wing 63.5 (61–65; 11); Tail 47.4 (45–50; 11); Bill S 14.3 (13.3–15.3; 11); Tarsus 19.4 (19–20; 10). Wing-structure and plumage similar to *griseonotus*, but forehead and forecrown blackish. **SUBSPECIES NIGRESCENS:** Endemic to Maré and Uvea Is, Loyalty Is. Adult skins have following measurements: Wing (males 62.6 [60.5–65; 20]; females 62.9 [59–65; 13]); Tail (males 47.1 [44–50; 20]; females 47.0 [43–49; 13]); Bill S 11.4 (10–12; 32; sexes combined); Tarsus 19.3 (17.3–20.3; 32; sexes combined). Wing-structure similar to other Pacific island subspecies. Plumage intermediate between *griseonotus* and *melanops*, with blackish forehead but not forecrown; undertail-coverts, white with almost no yellow. **SUBSPECIES VATENSIS:** Endemic to *s. Vanuatu*. A large subspecies. Adult skins have: Wing (males 69.0 [65.5–74; 25]; females 67.9 [66–70; 19]); Tail (males 51.2 [48–56; 25]; females 49.4 [46–53; 19]); Bill S 15.7 (14–17; 41; sexes combined); Tarsus 20.8 (19.5–22; 43; sexes combined). Wing-structure similar to other Pacific island subspecies. Plumage similar to *melanops* but black of forehead and forecrown less prominent. **SUBSPECIES TROPICUS:** Endemic to *n. Vanuatu*, including most of Banks Grp and Torres Grp. Very similar to *vatensis* in plumage and wing-structure, but smaller; size similar to *griseonotus*, but with longer bill (Bill S 15.3 [14.3–16; 26; sexes combined]). **SUBSPECIES VALUENSIS:** Endemic to *Valua I.* in Banks Grp, *n. Vanuatu*. A rather distinct subspecies, with upperparts uniform green. Adult skins (sexes combined) have: Wing 65.1 (64.5–66; 7); Tail 45.9 (44.5–47.5; 7); Bill S 15.0 (14–15.5; 6); Tarsus 20.0 (18.5–20.8; 7). Wing-structure similar to other Pacific island subspecies. **SUBSPECIES FLAVICEPS:** Endemic to *Fiji*. Adult skins have: Wing (males 61.7 [58–66; 41]; females 60.7 [57.5–64; 32]); Tail (males 44.9 [41–50; 41]; females 43.9 [41–47; 32]); Bill S 13.7 (12.3–15; 76; sexes combined); Tarsus 18.4 (17–19.5; 80; sexes combined). Wing-structure similar to other Pacific island subspecies. Plumage very similar to *griseonotus* but grey on upperparts possibly slightly less extensive. Examination of four adult skins (MV; this study) indicates these are very similar to *cornwalli*, some birds with entirely cream-white (ne) flanks, lacking any light-brown colour.

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Silvereye *Zosterops lateralis* (page 1745)
 SUBSPECIES VEGETUS: 1 Adult
 SUBSPECIES CORNWALLI: 2 Adult
 SUBSPECIES TEPHROPLEURUS: 3 Adult
 SUBSPECIES WESTERNENSIS: 4 Adult; 5 Juvenile; 6, 7 Adult
 NOMINATE LATERALIS: 8 Adult male; 9 Adult female
 SUBSPECIES CHLORONOTUS: 10 Adult; 11 Juvenile; 12, 13 Adult