

## Order STRIGIFORMES

A rather homogeneous group of small to large, soft-plumaged birds with raptorial adaptations of feet and bill, and mainly nocturnal habits. Two families recognized: Strigidae (typical owls, including boobook or hawk-owls, scops-owls, eagle-owls, fish-owls, and pygmy-owls) and Tytonidae (barn or masked owls); between 133 and 178 species in 24–29 genera. On all continents except Antarctica, with centres of diversity in N. and S. America, Eurasia and Africa (Sibley & Ahlquist 1990; Schodde & Mason 1997). Most closely allied to Caprimulgiformes (nightjars and allies) (Burton 1973; Sibley & Ahlquist 1990; Christidis & Boles 1994; BWP). Based on DNA–DNA hybridization studies (Sibley *et al.* 1988; Sibley & Ahlquist 1990; Sibley & Monroe 1990) it has been suggested that the Caprimulgiformes should be placed within the Strigiformes (see Caprimulgiformes) but this view has been challenged (Christidis & Boles 1994) and not followed here. In the past, have also been placed with the Falconiformes (diurnal birds of prey), but this no longer accepted (Burton 1973; Christidis & Boles 1994).

Strigiformes characterized by (from Sibley & Ahlquist 1990; Schodde & Mason 1997; BWP): Palate schizognathous with desmognathous tendency, or desmognathous; vomer small and discrete. Basipterygoid processes functional. Nares holorhinal and impervious. Syrinx bronchial with one pair of muscles. Fourteen cervical vertebrae. *Musculus expansor secundariorum* and biceps slip absent; *M. tensor patagium brevis* with wristward slip. Pelvic muscle formula A or AD. No *M. ambiens*. Two carotids. Coracoids connected. Flexor tendons Type 1. Hypotarsus simple. Tongue fleshy. Caeca large, long, with expanded ends. No crop. Oil gland (uropygial gland) well developed. Nostrils hidden by stiff bristles. Wings large, broad in proportion to length of body; 11 primaries, p11 much reduced; 12–18 secondaries; diastataxic. Tail short to moderate; 10–13 rectrices, usually 12. Hypotarsus with single deep furrow. Strong powerful feet with sharp curved claws (shared only with Falconiformes, which resemble Strigiformes only by convergence). Three toes forward and one hindtoe (anisodactylous); outer toe reversible; have strong talons for catching prey.

Appearance distinctive and familiar, with eyes facing forward and encircled by a facial disk or mask of modified feathers. See well by day but better by night, though said not to see in absolute darkness; hearing excellent, apparently most highly developed in Tytonidae (Thomson 1964; Fry *et al.* 1988; Schodde & Mason). Structure of facial disk aids in directing sound toward ears, at least in some species (see below). Ear-openings often placed asymmetrically on skull to aid in pinpointing origin of sounds. Eyeballs shaped like tapering cylinders; cannot rotate up, down or sideways; to focus on an object, must rotate whole head to bring it into view; neck can be moved through c. 270°. Bill hooked, with cere at base. Body plumage generally rather dense and soft, and edges of remiges frayed; these characters aid in silent flight. See introductions to Strigidae and Tytonidae for other general features, development of plumage, and moult strategies.

Occur in most habitats, from arid and semi-arid zones to tropical rainforest, alpine regions, and arctic moorland and tundra. Some species regularly in cultivated country, at least when foraging. Arboreal, terrestrial or both. Many require hollows, and therefore old trees, in which to nest, and are adversely affected by the removal of hollow-bearing trees (see below). Others nest in caves, in disused buildings, or on ground among rank vegetation (see below).

Worldwide, range from sedentary, to irruptive and dispersive, to migratory (mostly forms breeding in temperate zones); most Tytonidae considered sedentary or resident. In HANZAB region, *Ninox* mostly sedentary, with post-fledging dispersal poorly known; some of Tas. population of Southern Boobook *Ninox novaeseelandiae leucopsis* migrate N across Bass Str. in winter; Brown Hawk-Owl *Ninox scutulata* vagrant to HANZAB region and has resident tropical populations and migratory temperate populations. Three of five *Tyto* in HANZAB region sedentary or resident; Barn Owl *T. alba* and Grass Owl *T. capensis* irruptive and dispersive, with movements and breeding depending on abundance of their main prey, so that numbers in a region may follow a boom-and-bust cycle; coastal populations of Grass Owl, however, appear more stable perhaps because supply of food more consistent.

Raptorial predators. Some species occasionally take carrion (e.g. Powerful Owl *Ninox strenua*). Mainly nocturnal or crepuscular, though some diurnal or partly so (BWP). Use highly developed night vision, acute hearing, and silent flight to locate and catch prey, sometimes in complete darkness. Carnivorous; feed exclusively on animals: from earthworms, snails and insects, to frogs and reptiles and small and medium-sized birds and mammals; many species feed on small mammals, especially irruptive species; many Aust. forest-dwelling species feed on arboreal marsupials. Methods of hunting vary, both methods of searching and methods of attack; individual species will use variety of methods depending on type of prey being hunted. SEARCHMETHODS include: (1) LOW SLOW QUARTERING, in silent flights (e.g. Masked Owl *Tyto novaehollandiae*, Grass Owl in HANZAB region); and (2) CONCEALED and UNCONCEALED PERCH-HUNTING, birds perching on fence posts, low branches and the like, scanning for prey using sight and hearing; long-stay, short-stay or both (e.g. Barking Owl *Ninox connivens*, Southern Boobook, Sooty Owl *Tyto tenebricosa*, Masked Owl); and (3) SUSTAINED HOVERING (e.g. Barn Owl). KLEPTOPARASITISM, or attempted kleptoparasitism, also observed



(see Southern Boobook). **ATTACK METHODS** include: *SALLY-STRIKING*, taking prey directly from foliage, branches or trunks of trees (e.g. Sooty Owl), or from air (e.g. Powerful Owl); *SALLY-POUNCING* from perches to catch prey on ground (e.g. Barn Owl); and *HOVER-DROP* from aerial searches (e.g. Barn Owl). Occasionally attack in direct *TAIL-CHASES* (e.g. Powerful Owl); *FLUSH-PURSUIT*, crashing into foliage to disturb prey (e.g. Rufous Owl *Ninox rufa*); or *GROUND-HUNTING AND STALKING*, running after prey on ground (e.g. Little Owl *Athene noctua*). Use any method singly or in combination depending on type of prey being hunted. In Barn Owl in ne. Vic., use of different search and attack methods varied seasonally; success also varied between methods (McLaughlin 1994). **DETECTION OF PREY:** By both sight and sound; Tytonidae highly adapted for detection by sound, probably more so than Strigidae. Adaptations well known in Barn Owl, which relies largely on hearing for detection of prey (e.g. Glue 1974; Knudsen 1981; Bunn *et al.* 1988). The facial disk of the Barn Owl is composed of modified feathers (see Tytonidae) and acts as a reflector of high-frequency sounds; two troughs running through the facial disk, from the forehead to below the bill, funnel sounds to the ears, which are long slits positioned asymmetrically near the eyes; the left ear is oriented downward and more sensitive to sounds from below, and the right is oriented upward and more sensitive to sounds from above; the asymmetry of the ears and differences in loudness between the ears used to determine elevation of sounds; horizontal location determined by using minute differences in loudness and timing of sound waves reaching each of the ears. Direction of movement of prey can also be determined by using sound. To increase the likelihood of a successful attack, the Barn Owl spreads its talons and aligns them with long axis of the body of prey; experimental studies showed that even in complete darkness alignment of strike changed with changes in the axis of the body of the prey. Claimed that can locate prey to within 1–2° in both horizontal and vertical planes (Knudsen 1981).

Capture prey with hawk-like talons; tear and eat prey using short hooked bill, often holding food with feet. Usually eat food soon after capture, though sometimes cache prey (e.g. Little Owl); *Ninox* often roost during day with remains of prey held in talons (e.g. see Powerful Owl). If flying with prey, often carry small prey in bill, large prey in talons. Small prey usually swallowed whole; large to medium-sized prey eaten piecemeal, often from head down (e.g. Glue 1967, 1974; Morton 1975; Schodde & Mason). Indigestible matter, such as arthropod exoskeleton and vertebrate bones, hair and feathers, regurgitated as pellets, which are roughly cylindrical, with rounded ends, and varyingly compressed. Fresh pellets of Aust. *Tyto* have dark glazed appearance, a result of the drying of the mucous coating secreted on the pellet before egestion; those of more insectivorous species, for example Southern Boobook, generally smaller, rounder and of looser composition (Morton 1975; Smith 1983). Suggested that pellets formed by muscular action in the gizzard during digestion; it is then passed to the proventriculus where it is stored till the stimulus for egestion received (Smith & Richmond 1972). Regurgitated pellets usually contain a good skeletal record of all vertebrate prey consumed, plus the hair of mammals; it is possible to recover evidence of each prey item consumed that forms a pellet (e.g. Ticehurst 1935; Wallace 1948; Glue 1967; Raczyński & Ruprecht 1974); such pellets often used in studies of diet of owls (see species accounts). Owls have acidic stomachs, with pH of 2.35, which digest 20–50% of skeletal material swallowed (see Schodde & Mason).

Owls characteristically nocturnal or crepuscular; roost during daylight, often in dark holes, such as tree-hollows or among dense foliage; some diurnal or partly diurnal (Thomson 1964; Fry *et al.* 1988; BWP); some normally crepuscular or nocturnal species known to hunt during daylight, probably when food in short supply (e.g. Grass Owl). In HANZAB region, all basically nocturnal or crepuscular or both, though Barking Owl sometimes vocal and active by day (Schodde & Mason). Cryptically patterned and coloured plumage camouflages birds when roosting during day (Thomson 1964; Campbell & Lack 1985; Schodde & Mason). Sleep with head erect and eyes closed by twin eyelids (Schodde & Mason). Roosting owls often harassed by smaller species of birds (e.g. McNabb 1994; Fleay; Schodde & Mason). Food often taken to habitual roosts to be eaten, and such sites often marked by pellets, remains of prey and excreta (e.g. Fleay; Schodde & Mason). Some species seem to sunbathe, e.g. Little Owl (Thomson 1964).

Social organization, behaviour and breeding best known for the cosmopolitan Barn Owl (Tytonidae) (e.g. Bunn & Warburton 1977; Bunn *et al.* 1982; Fry *et al.* 1988; Taylor 1994; BWP). Strigiformes usually monogamous, nesting in individual pairs which are apparently permanent. Outside HANZAB region, some males of some species known to be polygynous (e.g. Tawny *Strix aluco*, Snowy *Nyctea scandiaca*, Short-eared *Asio flammeus* and Boreal *Aegolius funereus* Owls). Some species of Tytonidae show some flexibility in social organization, usually breeding as solitary pairs but sometimes forming loose colonies (e.g. Grass Owl, Barn Owl), and such species may not form permanent pairs (includes Barn and Grass Owls in Aust.); others both permanently paired and territorial, with some such species also having ritualized evening duets by males and females during courtship (includes Lesser Sooty *Tyto multipunctata*, Sooty and Masked Owls in Aust.; see Schodde & Mason). Said that young owls can breed when c. 1 year old (Campbell & Lack 1985); in HANZAB region, some may breed at 10–11 months (e.g. Barking Owl, Barn Owl), and others may pair when 1 year old but not breed till 2 years old (e.g. Boobook Owl, Powerful Owl) (Fleay). During breeding, parents partition labour: usually only female incubates while male hunts and brings food to female; both sexes care for young (Thomson 1964; Campbell & Lack 1985; Fry *et al.* 1988; BWP) but usually only female broods and feeds young nestlings (Schodde & Mason). Most appear to be territorial (Campbell & Lack 1985), though some within HANZAB region can form loose colonies (see above). Few quantitative studies of territories or of home-ranges within HANZAB



region, and most claims of use and defence of territories and, especially, size of territories or home-ranges speculative and unsubstantiated, with few claims supported by studies of individually marked birds. Territorial owls can be very aggressive towards other birds of prey, especially during the breeding season; birds of prey and smaller owls form as much as 3–5% of the total food of the Eurasian Eagle-Owl *Bubo bubo* (Campbell & Lack 1985). In circumstances of aggression or threat, often respond with loud bill-snapping or clicking sounds (Thomson 1964; Fleay). Many species perform threat displays with head lowered, eyes wide open, feathers of back raised and wings held out; some also lower wings when feigning injury (Fry *et al.* 1988; Fleay). In defence, masked-owls often hiss, churr and snap bills, while crouching and swaying from side to side with wings outstretched and head thrust forward (Fleay; Schodde & Mason; Hollands). Calls probably important in social behaviour of all nightbirds; in owls, they are diagnostic of species and announce existence of occupied areas or territories and presence of individuals (Campbell & Lack 1985). Strigidae often call monotonously in territories and, during incubation, males seem to call brooding females away from the nest to feed them (Schodde & Mason). Compared with Strigidae, Tytonidae show some very different behaviour: do not call monotonously and, in Aust., only the Sooty Owl seems to call territorially from perches; have more ritualistic defence displays; males feed incubating females at and in nests, apparently never calling females off nest to be fed outside (Schodde & Mason). All *Ninox* breeding in HANZAB region utter double-noted call for advertisement or contact; in Aust. Tytonidae, advertising or contact calls are screeches, except in Sooty and Lesser Sooty Owls, which utter long siren-like descending whistles. Use of playback of calls commonly used to locate owls and is a standard procedure in survey work (e.g. Debus 1995). However, unnecessary use of playback, particularly during breeding season, can disturb and stress owls (McNabb 1994; Debus 1994, 1995).

Some species breed seasonally, others when conditions favourable, especially when food abundant (Thomson 1964; Campbell & Lack 1985); in HANZAB region, *Ninox* strictly seasonal (Fleay; Schodde & Mason); some species of *Tyto* breed opportunistically at any time of year (Debus 1994; Hollands). Most nest in holes in trees, rocks, cliffs or buildings, or sometimes in old nests of other species of birds, such as corvids and hollows of woodpeckers; the most well-known tytonid, the Barn Owl, often nests in hay-lofts, as well as other structures. Usually do not construct nests (Thomson 1964; Campbell & Lack 1985; Fry *et al.* 1988; Schodde & Mason); eagle-owls *Bubo* sometimes dig nest cavities into uninhabited anthills; some, such as Snowy Owl and Grass Owl, nest on ground or in low vegetation, and they may make a shallow scrape and even add some nest-material (Campbell & Lack 1985). Eggs white (Campbell & Lack 1985; Fry *et al.* 1988; Schodde & Mason); rounded in *Ninox*, oval in Tytonidae (Fleay; Schodde & Mason). Clutch-size varies, from one to 14; size of clutch sometimes related to availability of food (Thomson 1964; Campbell & Lack 1985). Olsen & Marples (1993) summarize breeding season, clutch-size and dimensions, shape and volume of eggs for all Aust. breeding species except Lesser Sooty Owl and Christmas Island Hawk-Owl *Ninox natalis*. Lay at intervals of 48 h (Schodde & Mason) or several days (Campbell & Lack 1985). Incubation begins with laying of first egg, resulting in asynchronic hatching, which enables stronger young to survive if food becomes short (Thomson 1964; Campbell & Lack 1985; Fry *et al.* 1988; Schodde & Mason). Usually female incubates (always in *Tyto*). Incubation period often >30 days (Thomson 1964); it is for all Aust. species. Little nest-hygiene in Tytonidae; said to be somewhat better in *Ninox* (Fleay; Hollands). Adult strigids seem to enter nesting hollows feet first; most tytonids head first, at least in Aust. species (Hollands). Young semi-altricial and nidicolous; hatch with eyes and ears closed, and a sparse covering of white natal down; unable to regulate temperature independently (Thomson 1964; Campbell & Lack 1985; Fry *et al.* 1988; Schodde & Mason). Nestlings either then begin pre-juvenile moult to juvenile plumage (Strigidae) or develop a second (mesoptile) down (Tytonidae), usually within c. 2 weeks of hatching (see Family accounts). In Aust., *Tyto* have longer fledging period and, size for size, are slower to develop than species of *Ninox* (Hollands).

Worldwide, 26 species of owls considered threatened. Overall, the major threatening process is extensive clearance and fragmentation of habitat, particularly in tropical zones (Collar *et al.* 1994). In HANZAB region, the only extinct taxa are Laughing Owl *Sceloglaux albifacies* of NZ and the Lord Howe I. and Norfolk I. subspecies of the Southern Boobook (*Ninox novaeseelandiae albaria* and *N.n. undulata* respectively); several other taxa threatened, either vulnerable (Christmas Island Hawk-Owl), rare (Powerful Owl, Rufous Owl *N. rufa queenslandica*, Masked Owl *Tyto novaehollandiae novaehollandiae*, Sooty Owl *T. tenebricosa tenebricosa*) or insufficiently known (Rufous Owl *N. rufa meesi*, Masked Owl *T. novaehollandiae kimberli*, *T.n. melvillensis*) (Garnett 1993). The impact of forestry on populations of forest-dwelling owls in Aust. contentious and not fully understood in HANZAB region. Several species of forest owls in Aust. thought to be threatened both by clearance of forests for agriculture and intensive forestry, which result in a shortage of large hollows suitable for nesting (see Milledge *et al.* 1991; Kavanagh & Peake 1993; Debus 1994; Kavanagh & Bamkin 1995; Kavanagh *et al.* 1995; Kavanagh 1997; also see accounts for Sooty, Masked, and Powerful Owls [Habitat, Distribution]). Fragmentation and degradation of forests by altered fire regimes, urbanization and clearance of habitat also threats; in n. Aust., changed fire regimes, in particular increased frequency of fires late in dry season, destroy nesting trees at edges of forests (Roberts 1977; Lundie-Jenkins 1993; Garnett 1993; Chafer & Anderson 1994). Use of rodenticides in canefields in n. Qld implicated in local declines of several species (Young & De Lai 1997).



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## Family STRIGIDAE typical or hawk owls

Small to very large owls with forward-facing eyes within weakly developed facial disks. Vary considerably in size, from the Eurasian Eagle-Owl *Bubo bubo bubo* (66–75 cm total length and weighing 1.2–2.9 kg) to the tiny Least Pygmy-Owl *Glaucidium minutissimum* (12–14 cm total length). About 123–161 species in 22–27 genera; found on all continents except Antarctica, and on many islands. Ten species in five genera recorded HANZAB region: most in *Ninox* (five breeding species and one vagrant); monotypic Laughing Owl *Sceloglaux albifacies* of NZ extinct; one species of *Ketupu* recorded as early vagrant to Cocos-Keeling Is; one introduced species of *Athene* extant in NZ; and a species of *Strix* introduced to NZ but not established. Strigidae sometimes split into two subfamilies, Buboninae and Striginae, based on rather poorly defined differences in the structure of the ear (e.g. BWP).

The following characters differentiate Strigidae and Tytonidae (based on Sibley & Ahlquist 1990; Schodde & Mason 1997; BWP). Facial disk weakly developed (= mask) and more or less circular. Skull rather broad. Ears large, often positioned asymmetrically, with little covering or flap. Manubrium present in sternum. Metasternum deeply two-notched each side. Furcula free from carina. Oil gland (uropygial gland) naked. Emarginations on inner webs of 1–6 primaries; edges of remiges frayed. No aftershafts. Tail rounded. Feathers of tarsi point forward. Tarsometatarsus has bony ring on ventral surface of proximal end. Inner toe shorter than middle toe; claw of middle toe not pectinate.

Adults of most species have generally brown or reddish-brown plumage, often with paler barring, spotting or streaking. Face has modified feathers radiating out around eye forming small indistinct mask or facial disk. Many species (but not in HANZAB region) have flexible tufts of feathers above the eyes that are under muscular control; these possibly aid individual identification and communication (Burton 1973). All contour feathers rather soft. Iris usually rather bright, often yellow, red, or orange; other bare parts usually rather dull brown, yellow, grey or black. Sexes usually similar in plumage. Often sexually dimorphic in size, but which sex is larger varies between species. Post-breeding moult of adults complete. Primaries moult outward.

Nestlings hatch in sparse covering of natal (protoptile) down. Natal down replaced in pre-juvenile moult to juvenile plumage, which on body appears very downy. This plumage often referred to as a second, mesoptile, down or a mesoptile plumage (e.g. BWP) but treated as a juvenile plumage in this work because (1) most body-feathers in this plumage are semi-pennaceous with distinct shafts and loosely knot projecting barbs and are not truly downy; and (2) the semi-pennaceous body-plumage grows at the same time as clearly pennaceous and undeniably juvenile remiges and rectrices. See Tytonidae for further discussion of pre-juvenile and juvenile plumages. Adult plumage attained at 2–15 months old (BWP). For discussion of general biology, see introduction to Strigiformes.

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*Athene noctua* Little Owl

*Strix noctua* Scopoli, 1769, *Annus I, Hist.-Nat.*, p. 22 — Carniolia (= Krain).

In Greek mythology, Athene or Athena (Minerva of the Romans) was the goddess of wisdom, war, and the liberal arts, whose favourite bird was the owl, an ancient association from her primitive role as goddess of the night. The specific name is from Latin *noctua*, the owl sacred to Minerva.

**OTHER ENGLISH NAMES** Brown or German Owl; European Little-Owl; Little Grey-Owl; Owl.

**POLYTYPIC** Between 15 and 17 subspecies recognized, extending throughout Europe, Asia and n. Africa and Middle East. Introduced to NZ. See Distribution, and Geographical Variation for details.

**FIELD IDENTIFICATION** Length 21–23 cm; wingspan 54–58 cm; weight c. 175 g. Small compact tubby flat-headed owl with short tail and proportionately long legs. Smaller than Southern Boobook *Ninox novaeseelandiae*. Adult easily recognized by heavy white spotting to upperparts and bold dark streaking to underbody; fierce yellow eyes set in frowning face; and fast and markedly undulating flight. Sexes alike. No seasonal variation. Juvenile greyer and more uniform than adult, with softer feathering; cap virtually unspotted and foreneck and upper breast more uniformly dark. **Adult** Diffuse facial disk mainly white, with indistinct dusky crescent on centre of ear-coverts tapering forward across cheeks to meet bill, emphasizing white forehead and short thick supercilia; and prominent neat black-brown border to lower edge between disk and white chin and throat; overall effect is of frowning face, adding to fierce, baleful stare of yellow eyes. Top of head, hindneck, sides of neck, upperbody and secondary upperwing-coverts, dark brown boldly spotted white, with neat fine spotting on cap, sparse and dull spotting on mantle, and large oval spots on scapulars and coverts; spotting on outer scapulars align to form prominent pale scapular lines. Rest of upperwing, and uppertail, dark brown with bold narrow broken off-white to buff barring. Breast, dark brown with bold white spotting; grades to white ground, sparsely and narrowly streaked dark brown, on lower belly, vent and undertail-coverts; legs fully feathered, white. Undertail, white barred dark grey. Underwing, white with faint dark-brown mottling and spotting on lesser and median coverts, bold dark-brown tips to greater coverts, and bold narrow dark-brown barring across remiges. Bill, pale green-yellow. Cere, grey. Iris, pale yellow. Orbital ring, black. Feet, yellow-brown or grey-brown. **Juvenile** Similar to adult but greyer and much more uniform, with softer, downy texture to plumage: cap, dark brown with finer and buff, not white, spotting; spotting on rest of upperparts less distinct; facial disk, greyer and less strongly patterned; foreneck and breast almost uniform, dark grey-brown, merging into dark grey-brown streaking on lower underbody, which is paler and less sharply defined than in adult. Newly fledged birds much smaller than adult. Bill mostly olive-yellow, with some grey at base and pale yellow at tip of upper mandible; cere, slate-blue to dark purple-grey or purple-green; feet, fleshy grey or dusky grey.

**Similar species** None. Easily distinguished from Southern Boobook by: small size and squat appearance; proportionately shorter tail, and longer slimmer legs; diffuse facial disk, with prominent white supercilia and forehead (face sooty grey in Boobook); and mainly white legs, with more heavily feathered toes (legs and feet yellow in Boobook).

In NZ, mainly inhabit farmland or well-treed parks and gardens in suburbs or other settled areas; often seen along roads. Generally seen singly or in pairs. More terrestrial than most other owls in HANZAB region. Nocturnal and crepuscular but often also seen during day, either in frequent brief low flights in open, or when perched conspicuously. Roost in dense cover, sometimes in holes; when disturbed, often fly from cover and perch in full view in open. Stance usually erect but, particularly in excitement or alarm, adopt half-upright, twisted or hunched attitudes and bob up and down repeatedly. On ground, walk nimbly or move in fast loping run on long legs. Normal flight fast, low and undulating (at least during day); when hunting or in escape flight, action less bounding and more direct, with more regular wing-beats. **VOICE:** Commonest call a clear arresting *kiewick* or terse whistled *whiu* or *kiew*; when defending territory also utter slower, rather melancholy *pee-oo* or *paw-ut*; extralimitally, give tern-like *kip-kip-kip*... when alarmed and excited; also utter variety of chattering, screeching and other calls (see Voice).

**HABITAT** In NZ, usually only in open farmland with scattered trees, especially willows *Salix* along watercourses; or well-treed parks and gardens in suburbs or other settled areas. May occur along edges of patches of native vegetation, but said not to penetrate them; occasionally occur in scrubby foothills, wasteland or rocky places. Often seen along roads; once recorded taking off from airport runway (Bailey 1955; Williams & Harrison 1972; Pierce 1980; Oliver; NZRD; CSN; P. Reese). In natural range, inhabit open areas, avoiding tall or dense vegetation; prefer dry unwooded mountains, and cliffs of gullies, gorges and ravines; deserts; or sparsely vegetated steppes or plains, sometimes supporting thorn scrub with sparse ground cover. Also inhabit farmland, particularly that supporting hedgerows or old orchards (de Schauensee 1984; Flint *et al.* 1984; Fry *et al.* 1988; BWP).

In NZ, nest in hollows in trees (mainly willows) and in crevices or holes in cliffs, rocks, quarries and old buildings; also nest in holes in banks, reportedly including old rabbit burrows (School 1946; Rule 1977; Falla *et al.* 1979; Oliver; CSN). Sometimes nest in haystacks and once between bales of hay inside a barn (CSN 19 Suppl.; P. Reese).

Said usually to feed on ground in open areas (Falla *et al.* 1979; NZRD), typically hunting from a perch, such as fence post or pole (P. Olsen). Often forage on roads and along roadsides (NZRD; P. Reese), and along ecotone between farmland and native vegetation (Oliver). Sometimes forage around haystacks (CSN 19 Suppl.), and may be attracted to lights to feed on insects (CSN 2).



In NZ, roosting sites include old open barns or dense sheltered hedgerows (Chambers 1989). Often perch in trees or hedges, on buildings, rocks or ledges on cliffs, fences, telephone poles and overhead wires (School 1946; Dunedin FNC 1949; NZRD; CSN); once seen perched on jib of crane (CSN 19 Suppl.).

**DISTRIBUTION AND POPULATION** Widespread in n. hemisphere, from British Isles, Iberian Pen. and Morocco, E through Europe and n. Africa, the Middle East and central Asia to e. Transbaikal region of Russia, ne. China and n. Korean Pen.; n. boundary extends from Denmark and e. Baltic countries, E along c. 57°N to Ural Mts, and at c. 50°N farther E; s. boundary extends from s. Algeria, n. Niger to e. Ethiopia and nw. Somalia, s. Arabian Pen., s. parts of Iran and Pakistan, s. Himalayas and near Yangtze Kiang (Gore & Won 1971; de Schauensee 1984; Flint *et al.* 1984; Fry *et al.* 1988; BWP). Introduced to British Isles and NZ (Long 1981).

**NZ** Introduced (see below). **NI** No recent records (NZ Atlas). Released at Rotorua in early 20th century (see below); seen and heard there in July–Aug. 1958 (CSN 8). Said to have occurred near Hawera in s. Taranaki in 1920s (Oliver). Unconfirmed and undated report from Wanganui, some time between 1963 and 1970 (CSN 19 Suppl.), and several unconfirmed reports from near Wellington in 1950s (Oliver). **SI** Widespread E of main divide (NZ Atlas). Scattered records in Nelson and Marlborough, from s. Golden Bay to islands in Marlborough Sounds; rarely, inland near St Arnaud and Lewis Pass. Scattered records in coastal areas from near Blenheim S through Seaward Kaikouras to Pegasus Bay. Widespread round Christchurch and Banks Pen., extending inland on Canterbury Plains to Glentui and Sheffield, and once much farther inland at L. Sarah. Farther S, widespread in s. Canterbury and throughout Otago, mainly W to line from Fairlie (E of L. Tekapo) to Pisa Ra., though scattered records farther W at L. Tekapo and L. Hawea; many records at Queenstown and elsewhere around L. Wakatipu. Also widespread in Southland, W to Orepuki, Waiiau R. and Blackmount, and once to Port Craig, w. Te Waewae Bay;

sometimes farther W into Fiordland NP. Recorded on Stewart I. to 1956–57 but not since. A few scattered records on West Coast, where may be increasing, mainly between Franz Josef and Rotokuhu, SE of Westport; recently in Hokitika area (Dunckley & Todd 1949; Fleming 1950; Falla *et al.* 1979; NZ Atlas; NZCL; CSN; B.M. Stephenson).

**Breeding** Possibly throughout range.

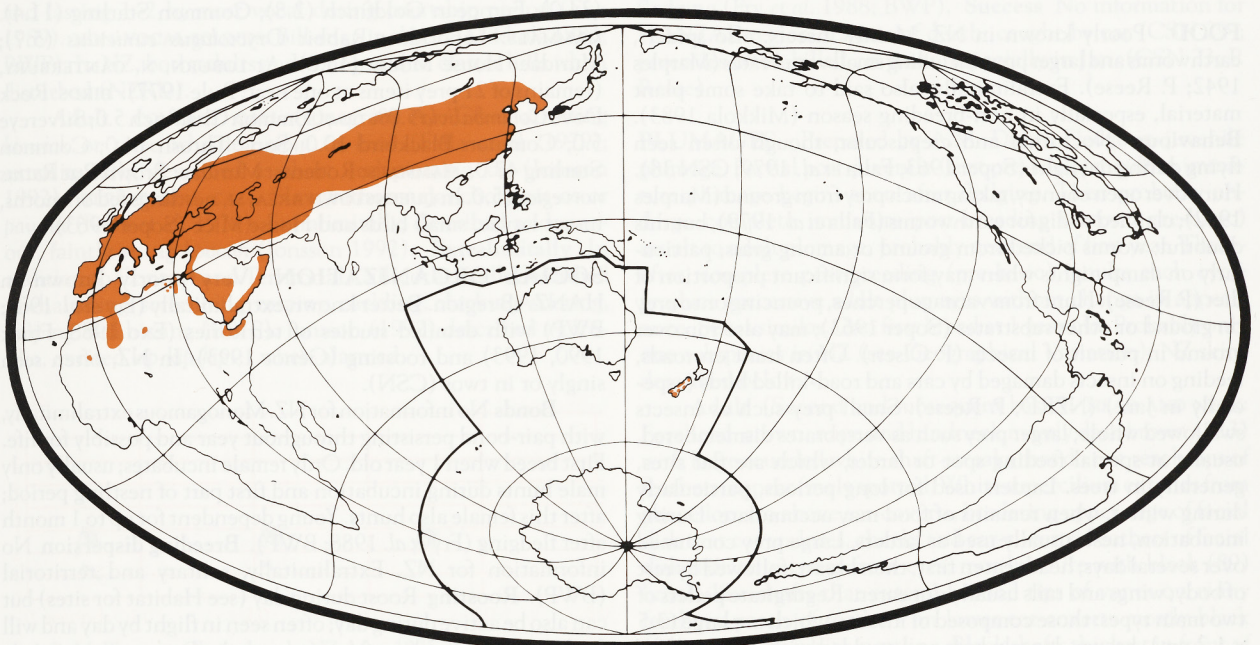
**Introductions** Introduced to NZ to combat exotic passerines raiding orchards in central Otago (Oliver); found to be of little value in controlling finches (CSN 19 Suppl.; *contra* Oliver), but may be of some use controlling harmful insects (Oliver). Most liberations in SI. In 1906, 28 brought to Otago from Germany: 14 released at Ashley Downs and 14 at Alexandra. More brought to Otago and released in 1907 (39 released at Alexandra), 1908 (80 released at various locations) and 1910 (72 imported: 14 released, and rest sold to farmers; some may have been released in n. Canterbury) (Thomson 1922; Kinsky 1973; Long 1981; Oliver); their origin not known but thought to have been Germany (Vaurie 1965). A pair was also released at Rotorua in 1908 (Long 1981). Some said to have been transferred unsuccessfully to NI (possibly after 1908) (Falla *et al.* 1979; Long 1981).

**Change in range** By 1909, said to have been well established in Otago, and had reached Invercargill by 1915 and Stewart I. by 1920s (Thomson 1922; Long 1981; Oliver). By 1940, range said to have expanded N to Parnassus in n. Canterbury (Marples 1942). By 1950s, populations said to have been increasing (Bailey 1955); scattered records in Nelson and Marlborough (Oliver) and firmly established in Marlborough in 1962 (CSN 19 Suppl.); now widespread e. SI (NZ Atlas).

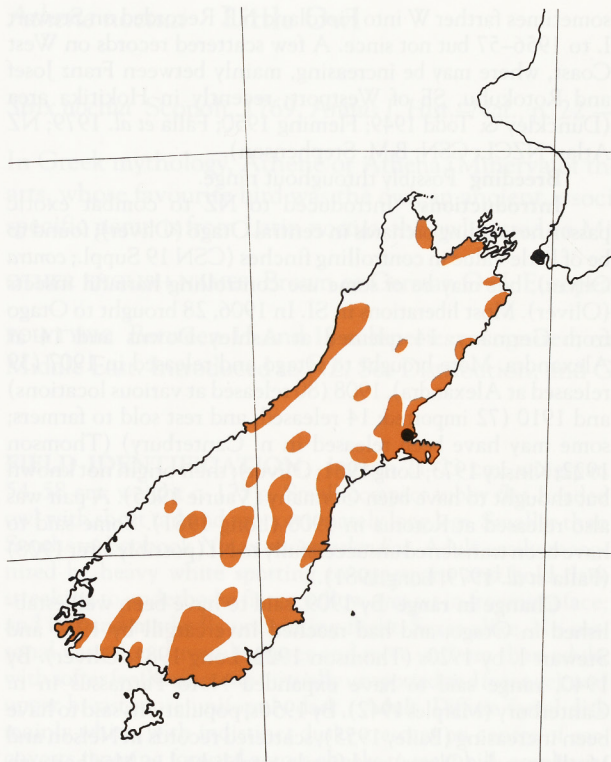
**Populations** In 1954, population in Whataroa Mtn Valley estimated at c. 250 birds (Jackson 1954).

Sometimes injured or killed on roads (CSN 23, 32); may fly into windows if dazzled by lights (CSN 8). Occasionally killed by cats (CSN 29).

**MOVEMENTS** In NZ, considered resident (Moncrieff 1929), as in w. Palaearctic (BWP); extraliminally, also considered







sedentary (Ginn 1973). Recorded throughout year at some sites, e.g. Christchurch area, L. Wainono (s. Canterbury) and Dunedin (Pierce 1980; OSNZ Ann. Rep. 1940–41; CSN 37). Spread to Stewart I. unassisted (Oliver 1933; Oliver; see Distribution); able to disperse at least 18 km over water. In Europe, dispersal of first-year birds occasionally >50 km, but usually <20 km (BWP).

**Banding** Of 14 banded from 1964–72, one recovery in 1971–72, but no details (Robertson 1972, 1973; also see Sibson 1966).

**FOOD** Poorly known in NZ. Mainly insects; also spiders, earthworms and larger prey, including small vertebrates (Marples 1942; P. Reese). Extraliminally, also said to take some plant material, especially in non-breeding season (Mikkola 1983).

**Behaviour** Nocturnal and crepuscular, though often seen flying during daylight (Soper 1963; Falla *et al.* 1979; CSN 38). Hunt over open country, taking much prey from ground (Marples 1942); claimed to dig for earthworms (Falla *et al.* 1979), but this doubtful; worms picked from ground or among grass, particularly on damp nights when may form significant proportion of diet (P. Reese). Hunt from vantage perches, pouncing onto prey on ground or other substrates (Soper 1963); may also run over ground in pursuit of insects (P. Olsen). Often hunt on roads, feeding on insects damaged by cars and road-killed birds (especially in Jan.) (NZRD; P. Reese). Small prey such as insects swallowed whole; larger prey such as vertebrates dismembered, usually at special feeding spot or larder, which are flat sites, generally in trees. Larders used for long periods, particularly during winter, when remains of food may accumulate. During incubation, nests usually used as larders. Large prey consumed over several days; heads eaten first, then breast, followed by rest of body; wings and tails usually not eaten. Regurgitate pellets of two main types: those composed of insects, which are large (3.5 × 1.2 cm), brown, loosely knit and studded with fragments of

insects; and those composed of birds and rodents, which are compact and composed of bones embedded in grey matrix (Soper 1963). For food and feeding behaviour of both adults and nestlings in Palaearctic and n. Africa, see BWP and references therein and Mikkola (1983); in Indian subcontinent, see Ali & Ripley (1969) and Roberts (1991).

**Detailed studies** SI (5403 invertebrate and 41 vertebrate prey items from 242 stomachs, collected 1938–40; % no. of vertebrates and invertebrates calculated separately; Marples 1942): **Invertebrates** ANNELIDS: Oligochaetes 1.7% no. of total invertebrates. MOLLUSCS: Gastropods tr. SPIDERS: Araneae: Araneidae 5.0; Idiopidae: *Arbanitis gillesii* and *A. huttoni* 2.4; Opilionids tr. DIPLOPODS: tr. CRUSTACEANS: Isopoda tr. INSECTS: Unident. 4.0; Coleoptera: unident. 10.5; Carabidae 3.3; Cerambycidae tr.; Curculionidae 1.5; Elateridae tr.; Scarabaeidae 14.7. **Vertebrates** AMPHIBIANS: Hylidae: *Hyla aurea* 19.5% no. of total vertebrates. REPTILES: Gekkonidae: *Hoplodactylus* 9.5. BIRDS: Unident. 12.0; Skylark *Alauda arvensis* 2.5; Grey Fantail *Rhipidura fuliginosa* 2.5; Common Blackbird *Turdus merula* 2.5; Song Thrush *T. philomelos* 17.0; Hedge Sparrow *Prunella modularis* 2.5; House Sparrow *Passer domesticus* 2.5; European Greenfinch *Carduelis chloris* 2.5; Common Redpoll *C. flammea* 2.5; Common Starling *Sturnus vulgaris* 2.5. MAMMALS: Muridae: House Mouse *Mus domesticus* 22.0.

In QUEENSTOWN AREA, SI (remains found at larders; Soper 1963): INSECTS: Coleoptera: beetles; Dermaptera: earwigs; Lepidoptera: moths. BIRDS: Skylark; Common Blackbird; Song Thrush; Common Chaffinch *Fringilla coelebs*; Common Starling; European Greenfinch; European Goldfinch *Carduelis carduelis*; Common Redpoll.

**Other records** Common Starling nestlings (Anderson 1949).

**Young** Fed mainly small birds and insects. SI (remains of 106 vertebrate prey and large number of insects; from pellets and remains in nests at 16 sites; Marples 1942): INSECTS: AMPHIBIANS: Hylidae *Hyla aurea* (1.8% no. of total vertebrates). BIRDS: Unident. (1.0); Silvereye *Zosterops lateralis* (1.0); Richard's Pipit *Anthus novaeseelandiae* (6.6); Common Blackbird (5.7); Song Thrush (13.2); Hedge Sparrow (1.8); House Sparrow (34.0); European Goldfinch (2.8); Common Starling (11.4). MAMMALS: Leporidae: Rabbit *Oryctolagus cuniculus* (5.7); Muridae: House Mouse (15.0). At LOBURN, N. CANTERBURY, (remains of 21 prey items at one nest; Rule 1977): BIRDS: Rock Dove *Columba livia* 5.0% no.; Common Chaffinch 5.0; Silvereye 5.0; Common Blackbird 10.0; Song Thrush 14.0; Common Starling 47.0. MAMMALS: Rodents: Muridae: Brown Rat *Rattus norvegicus* 5.0. In QUEENSTOWN AREA, SI, nestlings fed on moths, insect larvae, small birds and House Mice (Soper 1963).

**SOCIAL ORGANIZATION** Very poorly known in HANZAB region. Better known extraliminally (Fry *et al.* 1988; BWP) with detailed studies of territories (Exo 1988; Finck 1990, 1993) and roosting (Génot 1993). In NZ, often seen singly or in twos (CSN).

**Bonds** No information for NZ. Monogamous extraliminally, with pair-bond persisting throughout year and possibly for life. First breed when 1 year old. Only female incubates; usually only male hunts during incubation and first part of nestling period; after this female also hunts. Young dependent for up to 1 month after fledging (Fry *et al.* 1988; BWP). **Breeding dispersion** No information for NZ. Extraliminally, solitary and territorial (BWP). **Roosting** Roost during day (see Habitat for sites) but can also be active during day; often seen in flight by day and will feed in sunlight; also often seen perched on posts or power



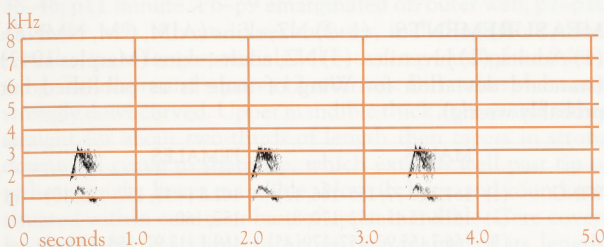
poles. Sometimes seem to bask in sun on exposed perches (School 1946; Falla *et al.* 1966; Oliver; CSN 30, 31, 38).

**SOCIAL BEHAVIOUR** Very poorly known in HANZAB region. Better known extraliminally (Mikkola 1983; Fry *et al.* 1988; BWP).

**Agonistic behaviour** In NZ, when disturbed, fly from cover and often sit on perch in open (Chambers 1989); also said to hiss and clatter bill (NZRD). When approached, said to perform characteristic Bobbing Display, often rotating head (NZRD). Seen to be mobbed by Bellbirds *Anthornis melanura* (CSN 38), Common Starlings and Common Blackbirds; individual Blackbirds seen to knock Owls from perches (School 1946). **Sexual behaviour** No information for NZ. Extraliminally, when selecting nest-site, male calls from inside hollow and female flies into it; copulation often follows. Male usually chases or flies round female before copulation. Pair face each other on branch or fence, where male bobs up and down, weaving and dancing before female; female in turn bobs up and down and then slightly opens and flutters lowered wings before copulation. Members of pair also courtship-feed, cache food and allopreen (Mikkola 1983; Fry *et al.* 1988; BWP). **Relations within family groups** No primary information for NZ. Extraliminally, both members of pair defend young; adults call, attack, or adopt range of aggressive postures (BWP).

**VOICE** Poorly known in HANZAB region, with only available information from secondary sources (e.g. NZRD). Well studied extraliminally: general accounts, including sonagrams, in Glutz von Blotzheim & Bauer (1980), Mikkola (1983) and BWP; also detailed studies of repertoire (Exo & Scherzinger 1989), daily and seasonal pattern of calling (Exo 1989), and geographical variation in Territorial Call (Exo 1991). In NZ, some calls soft and plaintive, others louder and more strident; Contact Call heard all year, Territorial Call given at dusk in breeding season (Falla *et al.* 1979); Contact Call said to be heard most often during autumn and winter (NZRD). Extraliminally, study of wild and captive birds in Germany found peaks of vocal activity just after sunset and before sunrise, and lasting 1–2 h; most vocal during courtship period (Exo 1989). **NON-VOCAL SOUNDS:** Bill-snap in threat (Mikkola 1983; BWP). In NZ, both adults and young said to clatter bills when disturbed (NZRD).

**Adult CONTACT CALL** (sonagram A): Clear arresting *kiewick* or terse whistled *whiu* or *kiew* (Falla *et al.* 1979); extraliminally, described as short and piercing *kiu* (Jonsson 1992). **TERRITORIAL CALL:** Slow, rather melancholy *pee-oo* or *paw-ut* (Falla *et al.* 1979). Extraliminally, described as drawn-out, faintly rising *koooh* (Jonsson 1992). **Extraliminally** In addition to Contact and Territorial Calls, other calls described as chattering, screeching, rasping, cackling, clucking, snoring, yelping and hissing (BWP). Jonsson (1992) described a tern-like, excited *kip-kip-kip*... when alarmed.



A L.B. McPherson; Christchurch, NZ, Mar. 1975; P106

**Young** Young said to utter wheezy snore when adults approach nest (NZRD). Beg with steady drawn-out *hiss* (Jonsson 1992). Young utter monosyllabic and disyllabic calls in first week, becoming harsh or hissing in second week; rasping snoring in fourth week (BWP).

**BREEDING** Poorly known in HANZAB region and most information in secondary sources unsubstantiated or based on unstated extraliminally sources. Extraliminally, detailed studies by Schonn (1986), Exo (1988), Génot (1993, 1994), Gassmann & Baumer (1993) and Gassmann *et al.* (1994), and several detailed general accounts (e.g. Glutz von Blotzheim & Bauer 1980; Fry *et al.* 1988; BWP). Breed solitarily.

**Season** Said to lay in Oct. (NZRD). Nests with chicks found Dec.–Jan. (Rule 1977; CSN 38). **Site** Usually in holes or crevices; in trees, buildings or haystacks, cliffs, rocks or banks (Falla *et al.* 1966; Moon 1992; Oliver; CSN). One nest in hollow 1 m above ground in trunk of willow *Salix*, which had spreading crown c. 20 m diameter; many perches within radius of c. 50 m, mainly 1–5 m above ground, had remains of prey below them (Rule 1977). Another nest high in a shingle pit (School 1946). **Nest, Materials** No information for HANZAB region.

**Eggs** White, rounded (Falla *et al.* 1966; Moon 1992). **Clutch-size** Two to four or five; near Queenstown, normally three (Falla *et al.* 1966; Moon 1992). **Laying** Said to be at 2-day intervals (NZRD). **Incubation** By female only. **INCUBATION PERIOD:** 28 days (Falla *et al.* 1966; Moon 1992). Extraliminally, only male hunts during incubation (BWP).

**Young** Altricial; nidicolous. Nestling covered in white down (NZRD). Extraliminally, young nestlings brooded by female; male brings food at first; both adults hunt and feed young later in nesting period (BWP). **FLEDGING PERIOD:** Extraliminally, fledge at 30–35 days (Fry *et al.* 1988; BWP). In NZ, claim of c. 26 days (Falla *et al.* 1966) doubtful.

**Fledging to maturity** Said that after fledging both parents continue to feed young for some weeks (NZRD). Young continue to return to nest to roost during day after fledging (P. Olsen). Extraliminally, dependent for up to 1 month after fledging (Fry *et al.* 1988; BWP). **Success** No information for HANZAB region. Causes of death: caught by cat (CSN 29); juveniles often killed on roads, especially in Jan. (CSN 23; P. Reese).

**PLUMAGES** Prepared by A.M. Dunn. Fledge in juvenile plumage. Partial post-juvenile (first pre-basic) moult to immature plumage begins soon after fledging. Then probably undergo complete immature post-breeding (second pre-basic) moult to adult plumage, probably near end of first year. Thereafter, complete post-breeding (pre-basic) moults each cycle produce successive adult plumages without change in appearance. Sexes similar. Can first breed at 1 year old. Probably only one subspecies in NZ (see Geographical Variation); NZ skins described below.

**Adult** (Second and subsequent basic). **HEAD AND NECK:** Forehead, crown, nape and hindneck mostly dark brown (223) with large rounded white shaft-streaks that do not reach tips of feathers; appear finely spotted. White supercilium extends from above lores to above ear-coverts, bordering upper edge of facial disk that covers lores, cheeks and ear-coverts. Feathers of facial disk radiate outward from eyes; mostly white with black (89) bristle-like shafts that extend beyond tips of vanes on many feathers; patch of feathers on lower ear-coverts mostly black (89) with some white mottling. Black shafts thickest in front of



eye and radiate out over bill. Chin and sides of throat and neck bordering facial disk, white. Centre of throat appears mottled; feathers, dark grey (83) with broad buff (c123D) tips. Foreneck, white. Sides of neck appear mottled brown and white; feathers, white with dark-brown (c223) edges. **UPPERPARTS:** Feathers of mantle mostly white with dark-brown (119A) fringes that are narrow on upper mantle and broad on lower mantle. Scapulars like mantle but dark-brown (119A) fringes much broader and conceal most of rounded white centres to feathers; visible white centres of larger scapulars often align to form scapular lines. Back, rump and uppertail-coverts similar to scapulars but white of feather forms a mostly concealed broad white bar across middle of feather and bases wholly dark brown (119A). A dark-brown (119A) shaft-streak often bisects white areas of feathers of mantle and scapulars (but not other tracts). **UNDERPARTS:** Breast mostly dark brown (c21) with paired irregular, white spots on edge of each feather; spots often not at same level on feather, one often near base on one side and one near tip on other side; sometimes feathers narrowly edged white. Flanks and belly similar to breast but amount of white on feathers increases and amount of dark brown (c21) decreases toward rear so that feathers of lower belly mostly white with thick irregular dark brown (c21) streak in centre of feather. Vent, undertail-coverts, thighs and feathering of tarsus mostly white; some feathers of vent and undertail-coverts have narrow dark-brown (c21) shaft-streaks. Toes sparsely covered with white bristle-like feathers. **TAIL:** All rectrices, brown (119B) with 3–4 broken cream (92) bars and tip; bars broken near shafts and narrowly bordered by darker black-brown (c119); bars c. 5 mm wide and spaced c. 12 mm apart. Underside as uppertail but paler (though no difference in colour matches). **UPPERWING:** Lesser secondary coverts, dark brown (119A) with concealed white bar near base of feather. Median and greater secondary coverts, dark brown (119A) with large rounded white spots at sides of feathers; spots occasionally meet to form white bar. Lesser and median primary coverts, dark brown (119A). Alula, dark brown (119A) with white to cream (92) spots alternating along each side of feather. Greater primary coverts, dark brown (119A) with a pair of large pink-buff (121D) spots about one-third of length of feather near tip. All remiges, dark brown (119A) with rows of paired off-white to pink-buff (121D) spots along edges; spots sometimes meet to form partial bars that become faint toward shafts. Spots or partial bars 7–10 mm wide, spaced c. 12 mm apart at edges. **UNDERWING:** Most coverts, white with some dark-brown (119A) mottling or streaking; and dark-grey bases (83). Greater secondary coverts, dark brown (119A) with white bases; and sometimes with pair of large white spots in middle of feathers. Remiges patterned as upperwing but paler; ground-colour appears brownish grey (c79); pale bars much as upperwing.

**Downy young** Down short, dense and white (BWP).

**Juvenile** All feathers of body very soft and down-like, much softer and fluffier than in adult. **HEAD AND NECK:** Forehead, crown, nape, hindneck and sides of neck, brown (28) with fine light grey-brown (119D) and buff (124) mottling. Facial disk similar to adult but smaller. Chin, white. Throat, brown (28) with some white mottling. Foreneck, white with brown (28) tips to feathers giving mottled appearance. **UPPERPARTS:** Pattern similar to that of adults but paler; ground-colour, brown (119B). **UNDERPARTS:** Upper breast, white with brown (28) tips to feathers; rest of breast evenly mottled brown (28) and white. Belly and flanks, white or cream (92) with diffuse brown (28) shaft-streaks. Vent, undertail-coverts and feathers on tarsus and toes, white. Feathers of thighs very

downy, light grey-brown (c119D). **TAIL:** Like adult. **UPPERWING:** All coverts patterned like adult but paler; ground-colour, brown (c28). Remiges like adult but more pointed at tips. **UNDERWING:** Like adult.

**Immature** (First basic). Like adult, and most probably indistinguishable; none identifiable among skins examined. However, extraliminally, first-year birds retain juvenile remiges, tail and greater primary coverts (BWP), and some may be distinguished from adult by pointed tips of primaries or heavier wear of primaries.

**BARE PARTS** Based on photos (Moon 1979, 1992; Moon & Lockley 1982; Chambers 1989; NZRD) and published information. **Adult** Bill, straw-yellow (c57). Cere, grey (c85). Iris, pale yellow (157). Orbital ring, black (89). Feet, yellow-brown (c24) or light brown-grey (c44). Claws, black (89). **Downy young** Bill: at hatching, whitish pink or greyish pink (BWP); later, greyish straw-yellow (greyish 57). Cere and skin, pink at hatching but darken to grey after a few days (BWP). Iris, pale yellow (c157); also described as amber-yellow (BWP). Feet, pink at hatching but darken to grey after a few days (BWP); later, brownish grey (c80). **Juvenile** (From BWP.) Bill, olive-yellow with pale-yellow tip and greyish base. Corner of gape, pale yellow or pale orange. Cere, slate-blue, dark violet-grey or blackish violet-green. Iris and orbital ring, as adult. Legs, yellow or yellow-grey; feet, flesh-grey or dusky grey.

**MOULTS** Based on examination of 19 adult and ten juvenile skins (AIM, AM, CM, NMNZ) and published information. Little information from HANZAB region. **Adult post-breeding** (Third and subsequent pre-basic). Complete; primaries outward. Little information available from NZ; only one adult moulting primaries (Jan., with moult sequence N<sup>4</sup>3<sup>1</sup>1<sup>0</sup>6); only one adult with active moult of body (Mar.). In Europe: usually begin moult of primaries after young fledge or independent, but late breeders occasionally begin when young hatching (Stresemann & Stresemann 1966; BWP); moult of rectrices begins c. 1 month after start of moult of primaries; rectrices shed almost simultaneously and replaced rapidly in irregular sequence (Mayr & Mayr 1954; BWP); moult of body begins when PMS 10–25 and usually finished just before moult of primaries; lesser and median upperwing-coverts replaced first, followed by mantle and scapulars; feathers of toes replaced last (BWP). **Post-juvenile** (First pre-basic). Partial, involving head, body and wing-coverts (BWP). All NZ material collected Dec.–Mar.; seven, from Jan. to Mar., had active moult of body. Information from Europe suggests it begins soon after fledging and is finished within 6–7 weeks, at c. 4 months old (BWP). Face and lesser and median upperwing-coverts replaced first; crown, neck, feathers of legs and toes replaced last (BWP). **Immature post-breeding** (Second pre-basic). No information, either in NZ or overseas. Extent probably similar to adult, timing possibly slightly earlier than adult.

**MEASUREMENTS** (1–2) NZ, skins (AIM, CM, NMNZ): (1) Adults; (2) Juveniles. (3) NZ, adults, skins (Marples 1942) (standard deviation for Wing of male is as published but probably wrong).

	MALES	FEMALES	
WING	(1) 161.3 (3.77; 155–166; 12)	162.8 (4.37; 157–170; 10)	ns
	(2) 161.6 (5.45; 152–170; 8)	157, 160	
	(3) 166.7 (55.90; 157–179; 45)	169.1 (17.97; 158–180; 45)	ns
TAIL	(1) 76.9 (2.88; 71–81; 11)	75.5 (1.96; 72–79; 10)	ns



	(2)	76.4 (5.04; 71–83; 8)	71, 75	
BILL C	(1)	14.0 (0.47; 13.1–14.8; 12)	14.1 (0.58; 13.4–14.9; 10)	ns
	(2)	14.1 (0.54; 13.2–14.6; 8)	13.7, 13.9	
	(3)	14.8 (0.20; 13.5–16.0; 39)	14.6 (0.19; 13.0–16.0; 36)	**
BILL S	(1)	19.4 (1.13; 17.5–21.9; 12)	20.3 (0.60; 19.2–21.3; 11)	*
	(2)	20.6 (0.89; 19.3–22.0; 8)	20.8, 21.4	
BILL	(3)	19.3 (0.24; 17.0–21.0; 45)	19.2 (0.17; 18.0–20.0; 41)	*
TARSUS	(1)	35.5 (1.34; 32.5–37.0; 11)	35.8 (1.14; 34.2–37.0; 10)	ns
	(2)	35.6 (0.85; 34.2–36.7; 8)	35.3, 36.2	
	(3)	39.9 (1.05; 38.0–42.0; 44)	39.8 (1.14; 38.0–42.0; 43)	ns
TOE C	(1)	27.4 (1.09; 26.7–29.0; 4)	27.7 (2.15; 26.3–30.9; 4)	ns
	(2)	26.7 (0.66; 26.0–27.6; 4)	25.7, 27.3	
	(3)	30.6 (1.22; 27.0–33.0; 47)	30.6 (0.28; 29.0–32.0; 45)	ns

Significance of bill-length in determining sex not clear; result from museum specimens shows females have larger bills, but results from Marples (1942) show males have larger bills. Adult males had significantly longer bills (Bill S) than juvenile males ( $P < 0.05$ ). All other comparisons between ages and sexes not significant.

Measurements of fresh road-killed female from Hokitika: Wing 164.0 mm; Tail 78.8 mm; Bill (method not specified) 18.7 mm; Bill W 8.4 mm; Tarsus 39.5 mm; Total Head-length 48.1 mm (B.M. Stephenson).

**WEIGHTS** (1–2) NZ, museum labels (AIM, NMNZ): (1) Adults; (2) Juveniles.

	MALES	FEMALES
(1)	166.9 (19.1; 145–204; 9)	181.8 (38.11; 133–242; 6)
(2)	143.9 (30.83; 100–176; 7)	133, 170

Adult weights by month: (3) NZ, live (Marples 1942).

MONTH	MALES	FEMALES
JAN.	(3) 146 (n=1)	142, 171, 191
FEB.	(3) 171 (139–203; 7)	170 (163–181; 14)
MAR.	(3) 173 (141–216; 13)	154 (143–169; 7)
APR.	(3) 170 (142–193; 24)	177 (148–210; 25)
MAY	(3) 170 (146–191; 7)	199 (173–220; 10)
JUNE	(3) 224 (212–273; 6)	227 (142–298; 12)
JULY	(3) 224 (203–253; 5)	209 (167–238; 5)
AUG.	(3) 207 (198–227; 5)	175, 177, 227
SEPT.	(3) 174 (166–186; 3)	176 (141–211; 10)
OCT.	(3) 165 (143–187; 6)	194 (174–231; 5)
NOV.	(3) 154 (142–180; 5)	189, 229
DEC.	(3) 155 (145–175; 11)	160 (139–177; 8)

Weights vary slightly over course of year in NZ. Heaviest in winter and lightest in summer.

**STRUCTURE** Wing broad and rounded at tip. Eleven primaries: p7 or p8 longest; p10 18–25 mm shorter, p9 3–6, p8 0–2, p7 0–2, p6 4–7, p5 17–22, p4 25–30, p3 31–36, p2 36–42, p1 38–46; p11 minute. P6–p9 emarginated on outer web; p7–p10 on inner web. About 13 secondaries, including about three tertials; tips of longest tertials fall between p4 and p5 on folded wing. Tail short and square; 12 rectrices. Bill rather short and strongly downcurved. Upper mandible thick at base and rather straight for about two-thirds of length then tapers in strong downward curve to sharp tip, which extends well past tip of rather straight lower mandible. Nostrils large and round and situated within cere near base of upper mandible. Cere covers base of upper mandible to about one-quarter of its length. Tarsus long, thick and fully feathered. Tibia fully feathered.

Toes partly feathered. Outer toe 67–77% of middle, inner 82–99%, hind 50–56%.

**AGEING** Some down can cling to tips of feathers of juvenile plumage for up to 3–4 weeks after fledging; retained longest on crown, flanks and thighs (BWP).

**GEOGRAPHICAL VARIATION** Much variation across natural range in Europe, n. Africa and w. Asia. Taxonomy contentious and number of subspecies recognized varies, e.g. 12 (BWP), 13 (Vaurie 1960) and 17 (Peters). Subspecies vary in size, and colour and pattern of plumage, such as amount of spotting or barring (see BWP).

Within HANZAB region, introduced to NZ. Probably only one subspecies introduced and at least some were imported from Germany (see Distribution). Subspecies *vidalii* is found in much of West and East Germany, but intergrades with nominate *noctua* in s. Germany (BWP). Those introduced to NZ probably one of these two subspecies or from hybrids of the two. Allocation of NZ population to a particular subspecies probably not possible (Kinsky 1973). No geographical variation within NZ population. Kinsky (1973) claimed that there were two colour-phases in NZ: dark brown and light brown; he further claimed that same phases found in European skins examined. However, no such variation found in skins examined this study or photos of c. 15 birds (P. Reese). Further, no such variation recognized in European populations (e.g. BWP).

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Volume 4, Plate 39

Little Owl *Athene noctua* (page 812)  
 1 Adult; 2 Juvenile; 3, 4 Adult

Southern Boobook *Ninox novaeseelandiae* (page 852)  
 NOMINATE NOVAESEELANDIAE: 5, 6 Adult; 7 Juvenile  
 SUBSPECIES BOOBOOK: 8, 9 Adult; 10 Juvenile; 11, 12 Adult  
 SUBSPECIES LURIDA: 13, 14 Adult  
 SUBSPECIES OCELLATA: 15 Adult  
 SUBSPECIES LEUCOPSIS: 16 Adult  
 SUBSPECIES UNDULATA: 17 Adult