Order CUCULIFORMES

A diverse and heterogeneous group, thought on the basis of DNA–DNA hybridization studies (Sibley & Ahlquist 1990) to comprise six families: (1) CUCULIDAE: True cuckoos and koels of Old World; all parasitic; roughly 46–54 species in 13–17 genera; *Cuculus* and *Chrysococcyx* largest genera (both in HANZAB region); (2) CENTROPODIDAE: Coucals, ground-cuckoos and couas of Palaeotropics; non-parasitic; about 39–42 species in three genera; (3) COCCYZIDAE: New World cuckoos, with about 18 species; (4) OPISTHOCOMIDAE: Monotypic Hoatzin *Opisthocomus hoatzin* of Amazonia; systematic position disputed and sometimes thought to be closer to Galliformes (e.g. Brush 1979; Campbell & Lack 1985); Sibley & Ahlquist (1973) suggested most closely related to Guira Cuckoo *Guira guira* (Crotophagidae); (5) CROTOPHAGIDAE: Anis of Neotropics; four species in two genera; gregarious, non-parasitic, communally breeding species; (6) NEOMORPHIDAE: New World ground-cuckoos and road-runners; 13 species, three of which parasitic, in six genera. About 143 species in total; on all continents except Antarctica, with species diversity greatest in the Tropics; generally absent from higher latitudes of North America and Eurasia, and s. South America (s. Chile and Argentina). Cuculiformes appear to be an ancient lineage with no close living relatives (Sibley & Ahlquist 1990). Turacos, or louries (Musophagidae), endemic to Africa, have traditionally been placed in this order (e.g. Sibley & Ahlquist 1972), but studies of DNA–DNA hybridization (Sibley & Ahlquist 1990), osteology, myology and pterylography (Lowe 1943), structure and pigmentation of feathers (Brom 1991; Dyck 1992), and development of young, diet and feather lice (Rowan 1983) suggest there are no close affinities between the turacos and Cuculiformes; they are best kept separate ordinally (Rowan 1983; Fry *et al.* 1988; *contra* Campbell & Lack 1985).

Range from small (*c.* 15 cm) to large (*c.* 70 cm). Most have rather short, slender bills; straight or decurved; in some, bills large to massive (e.g. *Scythrops*). Holorhinal; nares more or less impervious. No basipterygoid processes; no cere; and rostrum immovable. Palate desmognathous, with small vomer. Fourteen cervical vertebrae (13 in *Clamator*), 17–18 presacral vertebrae, four dorsal vertebrae; atlas perforated; furcula present, no bony canal formed by coracoid, four ribs each sternum. Foot zygodactyl, with fourth toe permanently reversed; flexor tendons type 1; podotheca scutellate. Oil-gland, bilobed; naked in most families; has small tuft in some Opisthocomidae. Afterfeathers absent or small, eyelashes present. Ten primaries; 9–13 secondaries, eutaxic; usually ten rectrices (eight in Crotophagidae).

One species at least, the Common Cuckoo *Cuculus canorus*, has been known since antiquity because the calls of males during the breeding season attract attention and because its parasitic habits are mysterious and intriguing. For centuries, its two-note call has been incorporated in madrigals and in the works of such composers as Beethoven, Delius and Saint-Saens. The vernacular name of the bird in many languages is based onomatopoeically on its call. Parasitic habits were first recorded in ancient Vedic literature about 2000 BC for Common Koel *Eudynamys scolopacea* (Friedmann 1964) and Aristotle (384–322 BC) was aware of the matter. Yet the breeding habits of many species are still unknown or incompletely known. Many species were first described scientifically in the last half of the 18th century by such workers as Linnaeus and Latham; nearly all had been described by the middle of the 19th century, though there has been much re-arrangement since then into genera and subspecies. All species that occur in Aust. and NZ had been described by 1867, by Latham, Gould, Horsfield, Gmelin and others.

The mobility of members of the Order is as diverse as its other characters. All species are capable of flight, which varies from the swift and direct flight of long-distance migrants with their comparatively long, narrow and pointed wings (e.g. Oriental Cuckoo *Cuculus saturatus*), to the gliding flight of short-winged tropical forest-dwelling malkohas, and the awkward slow flight of short-winged tropical coucals (Centropodidae). Within Cuculidae, the flight of larger species is generally swift, noticeably direct, undulating and rather hurried, with deep rapid wing-beats not rising above the horizontal and often surprisingly like the flight of small species of *Accipiter*; indeed the general appearance, flight-silhouette and actions of these cuckoos bears some resemblance to these small birds of prey so that several species bear the name hawk-cuckoo. Species of *Cacomantis*, however, fly from perch to perch directly with undulating flight or bursts of rapid wing-beats interspersed with short glides. *Scythrops* often flies in pairs and quite high, with strong powerful wing-beats. Most adult cuckoos have a long tail which is used both as a rudder in slow flight and, in the case of cursorial ground-living cuckoos, as a steering device. Typical cuckoos awkward on ground, with shuffling walk (body and tail swivelling) and hopping. When on ground, coucals are generally slow and clumsy in their movements, but move rapidly in pursuit of prey. When capturing ground-prey, move forward with slow stalking walk, changing to hop and run when close to prey, and either ambush or chase down prey using 'flush and rush' method.

Only Cuculidae and Centropodidae occur in HANZAB region, and other families not considered further here.

Occur in most habitats, from open shrublands in arid and semi-arid zones to tropical rainforest. Some species largely arboreal; others at least partly arboreal; and others largely terrestrial (especially Centropodidae). Migratory and resident (Payne 1997). Most detailed migration studies of Black-billed *Coccyzus erythrophthalmus* and Yellow-

billed Cuckoos *C. americanus* (Coccyzidae); these species migrate at night, orientate by stars and make direct flights of up to 4000 km (Payne 1997). Worldwide, species of Cuculidae resident, migratory and partly migratory. Tropical species tend to be resident, and temperate species tend to be migratory. Where species have widespread latitudinal distributions, same pattern of tropical residents and temperate migrants often apparent at populational level (Payne 1997). Worldwide, all Centropodidae considered resident except for populations of two species inhabiting dry areas, which are apparently migratory (Payne 1997). Nearly always solitary or, in monogamous species, in pairs. Most coucals and some cuckoos monogamous; others promiscuous. Monogamous species generally territorial. Vocal, advertising territories and for mates. Displays, both agonistic and sexual, well developed. Courtship feeding probably universal. For full details of social organization, social behaviour and breeding, see Family discussions.

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Family CUCULIDAE   true cuckoos and koels

About 46–54 species of obligate brood-parasites in about 13–17 genera; 13 species in five genera in HANZAB region. The limits of Cuculidae not firmly established, and whether or not allied, non-parasitic forms (i.e. the 15 or so species of Old World malkohas [Phaenicophainae]) should be regarded as Cuculidae is not clear; status of extralimital *Clamator* is complex (unusual in possessing large crests, and in details of sequence of moult, structure of sternum and pelvis, and pelvic musculature) and warrants investigation (Schodde & Mason 1997). Following Schodde & Mason (1997) we only discuss true cuckoos and koels (including *Clamator*) in the following summary.

Small to large, rather slender birds. Following diagnosis based on Witherby *et al.* (1938) and Schodde & Mason (1997). Bills slightly decurved, and usually small, though bill stout in some, and massive in *Scythrops*; nostrils swollen and rounded, often with distinctive 'crater-shaped' raised rim; and rictal bristles vestigial. Nasal septum imperforate. Palate desmognathous, with vestigial and incomplete vomer; maxillary processes swollen and straight; lachrymals moderately enlarged to vestigial, sometimes almost reaching jugal bar, free from thin, varyingly enlarged ectethmoids; basipterygoid processes vestigial. Atlas notched or perforated; 14 cervical vertebrae (13 in *Clamator*). Sternum double-notched to almost entire on either side, both spina interna and externa present (fused in *Clamator*) or only spina externa (*Eudynamys, Scythrops*). Muscle formula ABXY or AXY (ABEXY in *Clamator*). Feet rather weak, adapted for perching; zygodactyl, with outer toe permanently reversed; tarsi, scutellate; toes have short claws; hypotarsus has two closed canals. Carotids paired. Syrinx tracheo-bronchial. Tongue small, cartilaginous. No crop; caeca present, rather long. Uropygial gland well-developed, naked. Plumage of body, soft and sleek; no down or afterfeathers; contour feathers close in varied tracts but without apterium between dorsal-cervical and interscapular tracts. Wings usually pointed, rounded in some; ten primaries; 9–12 secondaries, eutaxic; four feathers in alula. Tail ranges from short to long and graduated; ten rectrices.

Adults often intricately patterned; not usually brightly coloured, but some species brilliantly glossed green (e.g. *Chrysococcyx*) or blue-black (e.g. koels). Most have barred tails; some have brightly coloured bare parts. Sexual dimorphism in plumage striking in many species, slight to negligible in many others; *Cuculus* often polymorphic, with barred (so-called hepatic) morph only occurring in some or all females. Males often slightly larger than females. Young altricial and nidicolous; hatch naked or with sparse, stiff, hair-like down; in first week of life, species that evict eggs from host-nest (e.g. *Cuculus, Chrysococcyx*; see species accounts) have hollow in back in which balance host's egg while it is pushed from nest. Colouring of nestlings mimics that of host-nestlings in some species (see below for more details). Juveniles usually differ markedly from adults; adult plumage usually attained in complete first or second pre-basic moult when no more than 1 year old. Primaries replaced in complex 'transilient' sequence that varies markedly between species; see Stresemann & Stresemann (1961, 1966) for reviews.

Occur throughout Eurasia, Africa and Madagascar, to islands of sw. Pacific Ocean and A'asia; distribution centred in Palaeotropics (Schodde & Mason 1997). In Aust., one species or another spread throughout continent; Pallid Cuckoo *Cuculus pallidus* and Horsfield's Bronze-Cuckoo *Chrysococcyx basalis* are the most widespread, occurring in all States; most others are confined to, or more common, in e., n. and sw. Aust. (Aust. Atlas; see species accounts). In NZ, Shining Bronze-Cuckoo *C. lucidus* widespread in most regions, and the Long-tailed Cuckoo *Eudynamys*

taitensis, though more restricted in range, is also quite widespread (NZ Atlas; see species accounts). Worldwide, inhabit a wide variety of habitats, ranging from open shrublands in arid and semi-arid zones (e.g. Black-eared Cuckoo *Chrysococcyx osculans*) to tropical rainforest (e.g. Chestnut-breasted Cuckoo *Cuculus castaneiventris*). For parasitic species, breeding habitat is as that of host-species (and no details are given in the texts).

Migratory, partly migratory or resident. Species breeding in temperate regions usually but not always strongly migratory; for example, reasonably well-known European breeding population of Common Cuckoo *Cuculus canorus* breeds Apr.–July, and moves to sub-Saharan Africa in n. hemisphere autumn and winter, thus crossing the Equator; most cuckoos or populations of cuckoos breeding in s. Africa are migratory (Payne 1997; BWP). In HANZAB region, only Chestnut-breasted Cuckoo thought to be non-migratory, though some species poorly known (e.g. Black-eared Cuckoo); Oriental Cuckoo *Cuculus saturatus* spends non-breeding period in n. Aust., moving from breeding grounds in Asia (BWP). Most species breeding in HANZAB region move to non-breeding areas in lower latitudes, in n. Aust., Asia or Pacific islands (e.g. Long-tailed Cuckoo). In many cases relationship between breeding and non-breeding areas poorly known (e.g. Brush *Cacomantis variolosus* and Pallid Cuckoos) and complicated by overlap of populations during migration (e.g. in e. Aust. for the Shining Bronze-Cuckoo) or on non-breeding grounds (e.g. in Moluccas for Channel-billed Cuckoo *Scythrops novaehollandiae*). In some species, populations in n. Aust. appear to be resident (e.g. Shining Bronze-Cuckoo, Goulds Bronze-Cuckoo *Chrysococcyx russatus*) and in a number of species extralimital forms are non-migratory (e.g. populations of Little Bronze-Cuckoo *Chrysococcyx minutillus*). Some species make long trans-oceanic flights (e.g. Long-tailed Cuckoo). Commonly strike windows and lighthouses during migration. Young of many species thought to remain for first year in breeding range, or in non-breeding range; thus often thought to account for out-of-season records. Some evidence that young leave breeding areas after adults; in at least some extralimital members of family that are migratory (e.g. Common Cuckoo), adults leave breeding grounds before young (BWP). Similar pattern is apparent in at least some species breeding in HANZAB area, e.g. Fan-tailed Cuckoo *Cacomantis flabelliformis* and Pallid Cuckoo (see accounts). Some migratory species appear to lay down pre-migratory fat (Payne 1997); a little evidence suggests this may occur in at least some species in HANZAB region (e.g. Oriental Cuckoo, Bigg & Bigg 1988); further research needed. At least some migrate at night (e.g. Pallid Cuckoo and Long-tailed Cuckoo). Appears to be little strong evidence for any strictly diurnal migrants in HANZAB area (see accounts); claim that Channel-billed Cuckoo migrates during daytime (Payne 1997) neither differentiates migratory from local movements nor accounts for evidence of nocturnal movements (see account).

Understanding of movements hampered by lack of knowledge of relations between detectability and calling. For example, arrival dates based on first calling assume birds call as soon as they arrive; additionally, earliest arrivals might not be indicative of main arrival. Consequently, first arrivals based on calls warrant cautious interpretation. Further, problems relate to difficulty with assigning birds as breeders or non-breeders; e.g. breeding populations of Channel-billed Cuckoo on Bismarck Arch. only recently discovered (Mason & Forrester 1996). Further studies of geographical variation (e.g. Gill 1983) needed.

Mainly insectivorous; many specialize on hairy, sometimes toxic, caterpillars usually avoided by other birds. Stomachs often found to be lined profusely with hairs from caterpillars. Not all insectivorous: in HANZAB region, Common Koel *Eudynamys scolopacea* and Channel-billed Cuckoo eat fruits as well as insects, and Long-tailed Cuckoo rather carnivorous, eating small vertebrates. Mostly diurnal feeders, though, in HANZAB region, Long-tailed Cuckoo at least partly nocturnal. Forage solitarily, less often in pairs; may occasionally form small feeding groups. Feed mostly on or near ground, though able to obtain food at any level, from tops of trees to ground. Usually hunt through foliage and glean prey as they hop or creep about, or sit on lower perches, watching for prey on ground or in low vegetation, which captured by sally-pounce. Prey normally bashed against branches till gut and toxic contents removed before it is swallowed. Bills of most species show no special adaptations, though frugivorous species show some, e.g. large laterally compressed bill of *Scythrops* and unusually decurved and hooked bill of *Eudynamys*. Proventriculus large and well developed, and walls are twice as thick as those of stomach. Excrete indigestible matter by regurgitation; can periodically shed the weak lining of stomach (Wyllie 1981).

Social organization and behaviour complex and vary greatly but generally poorly known; best known from some African and European species (Wyllie 1981; Rowan 1983; Fry *et al.* 1988; BWP). Most species obligate brood-parasites. Common Koel, Channel-billed Cuckoo and *Clamator* monogamous, forming bonds lasting at least for a season; otherwise promiscuous or perhaps polygynous; Long-tailed Cuckoo may form leks (McLean 1988). Apart from migration when small flocks can occur, monogamous species usually seen in pairs and other species mostly solitary; larger gatherings occur occasionally at sources of food. Some species territorial, including monogamous ones; others not territorial (Wyllie 1981). Males highly vocal; call to advertise territory or for mates; females of monogamous species also vocal in contrast to other species. Display behaviour, both sexual and agonistic, well developed and varying; often includes display flights and chases and usually noisy. Communal gatherings of several birds calling, chasing and displaying common in non-monogamous species. Courtship feeding probably universal (Smithers 1977; Rowan 1983); in many species occurs before, during or after copulation; in non-frugivorous species, male usually feeds female caterpillars. Feeding of fledgelings by adults commonly reported (e.g. Moreau & Moreau 1939; see species

accounts, such as Shining Bronze-Cuckoo) but many probably misidentified cases of courtship feeding (Rowan 1983). However, other cases are unequivocal (e.g. Ambrose 1987), though even these may be misdirected courtship feeding by adult cuckoos. Only in monogamous species is it usual for males to assist females with laying by distracting the hosts; these species are also only ones in which females often lay repeatedly in the same nest and the nestlings do not eject eggs or young of hosts (e.g. see species accounts). Nestlings produce foul-smelling liquid faeces when disturbed. Fledgelings beg persistently and attract others besides foster-parents to feed them.

Obligate brood-parasite. Breeding reasonably known for most species in HANZAB region; Brooker & Brooker (1989a) undertook a detailed review of the breeding biology of all Aust. cuckoos, summarizing records of cuckoo eggs and nestlings, feeding of cuckoo chicks, and general statements of parasitism, based on published literature, museum and private egg-collections, records in NRS and ABBBS, and unpublished data. The breeding of parasitic cuckoos has long attracted human attention and, as it is not easily observed, somewhat mysterious, and rouses strong feelings in some people, it has given rise to many myths. Typically lay single egg in nest of passerine smaller than itself and at the same time remove an egg of the host; usually all incubation and care of nestlings and fledgelings by host. Breeding generally seasonal, with timing of laying coinciding with laying by host-species. Female cuckoo finds nest of host by watching nest-building birds inconspicuously from a concealed perch, and by searching through habitat of host-species. Cuckoo often visits nest when owner is away feeding, though in some species, mate distracts hosts while female lays in nest (Linton 1930; Payne 1997). Chance (1922, 1940) found that in fairly open country, female Common Cuckoos spent many hours at a vantage point, sitting quietly and watching the activities of potential hosts, no doubt trying to find nests. However, in woodland and forest in se. Aust., Fan-tailed Cuckoos and Shining Bronze-Cuckoos have been seen searching furtively through low understorey and not feeding; it may be a different strategy used in denser vegetation (S. Marchant). Females may also be able to carry a mature egg in the oviduct for a day or so in emergencies because developing embryos have been reported in newly laid eggs (Liversidge 1961; Perrins 1967; Payne 1973). It has also been suggested that females may be able to store sperm (Marchant 1989).

There has been much argument and controversy about how cuckoos deposit eggs in nests of hosts, particularly enclosed nests or nests that seem inaccessible. Many claims of cuckoos carrying its egg in its bill, or even its foot, from ground to host-nest (see species accounts). However, detailed studies have shown that cuckoos lay directly in nest of host-species and all claims of carrying eggs to nests must be considered doubtful. Chance (1922, 1940) proved conclusively that the Common Cuckoo lays its eggs directly in open cup-shaped nests of hosts (taking only a few seconds) and this has been confirmed since (Wyllie 1981). In HANZAB region, some cuckoos habitually parasitize hosts with domed nests with very small entrances, such as thornbills *Acanthiza* and scrubwrens *Sericornis*; Brooker *et al.* (1988) and Brooker & Brooker (1989b) have shown that Horsfield's and Shining Bronze-Cuckoos lay in the normal way in the nests of fairy-wrens *Malurus* and thornbills *Acanthiza*. The entrances of nests of Brown Thornbills *A. pusilla* parasitized by Fan-tailed Cuckoos are characteristically enlarged, damaged or distorted compared with those of unparasitized nests (S. Marchant). In HANZAB region, all species except Channel-billed Cuckoo lay single egg per host-nest, and most species usually remove egg of host after laying; the whole process takes only a few seconds. Channel-billed Cuckoos (and, extralimitally, *Clamator*) usually lay two or three eggs per host-nest but can lay up to five; they also do not necessarily remove an egg of host. Extralimitally, Common Koels lay more than one egg per nest (Baker 1934). Clutch-size of an individual female cuckoo has rarely been established but may be about ten in Common Cuckoo (Chance 1922, 1940); probably fewer in Aust. species. Some nests can contain eggs of more than one species of cuckoo, and cuckoos will remove eggs of other cuckoos. Laying usually occurs during or shortly after laying of host-clutch; eggs laid before those of host usually deserted or buried in nest. Eggs have hard and thick shell that resists cracking when female lays from above nest (Payne 1997).

In some species, the eggs closely match those of the host. Such mimicry is well known in Common Cuckoo and several Indian species (e.g. Baker 1942). In HANZAB region, mimicry is known for eggs of Horsfield's Bronze-Cuckoo, Pallid and Channel-billed Cuckoos; sometimes the match is so close that it is almost impossible to distinguish between cuckoo's eggs and those of the host. Other cuckoos, such as Shining Bronze-Cuckoo and Fan-tailed Cuckoo, make no attempt to mimic host-eggs; both these cuckoos use as hosts species that build covered and domed nests, where light inside nest is probably very poor and mimicry rather pointless (Marchant 1972b; S. Marchant). Although long lists of host-species are known for many parasitic cuckoos, most use the nests of only a few species regularly, and female cuckoos of the same species may lay eggs that closely mimic those of different hosts; non-mimetic eggs are possibly laid in nests of other hosts when suitable nests of preferred host are not available (Baker 1942; Rowan 1983). However brood parasitism by cuckoos arose, the evolution of egg-mimicry can most reasonably be assumed to be an effort to mislead the host-species and to lessen the chance of it removing a strange egg from its nest or deserting it altogether, thus ensuring the breeding success of the cuckoo; no doubt the more closely the parasite's eggs resemble those of host, the less chance of the host rejecting them or deserting its nest. A full discussion of the evolution of mimicry of host-eggs is beyond this summary; see Marchant (1972b), Brooker & Brooker (1989a,b), Baker (1942), Rowan (1983) and Payne (1997) for further discussion.

Mean size of eggs varies from 17.9 × 12.1 for Horsfield's Bronze-Cuckoo to 43.7 × 30.5 for Channel-billed Cuckoo

(Campbell; North); extralimitally, smallest eggs 16.9 × 12.3, of Asian Emerald Cuckoo *Chrysococcyx maculatus* (Baker 1934). Cuckoos sometimes destroy contents of nests, probably to induce hosts to nest again and provide a suitable nest for parasitizing (Fien 1970; Marchant 1972a). Incubation period ranges from 12 to 25 days and is generally shorter than that of host-species. Young altricial, nidicolous. Generally do not develop down, but young of some species can hatch with a few trichoptiles or wisps of short down (Brooker & Brooker 1989a). Young of most species (and all species in HANZAB region except Channel-billed Cuckoo) eject eggs or young of host, usually within 48 h; Channel-billed Cuckoos generally do not evict eggs or young of host and will share nest with both conspecifics and young of host. Extralimitally, in India, Common Koel do not eject eggs or young of host, and young of Common Koel and host often found together in nest, though, like Channel-billed Cuckoo, young of cuckoo usually out-compete young of host, which often disappear from nest (Baker 1934; Ali & Ripley 1969; Goddard & Marchant 1983). Cuckoo young specially adapted, with broad flattened back to evict eggs or young of host by manoeuvring them onto its back tipping them out of nest (see above). Method of evicting young of host well-described for Brush (Hindwood 1930), Fan-tailed and Pallid Cuckoos (Cole 1908; Campbell 1915), Horsfield's Bronze-Cuckoo (Campbell), and Common Koel (Gosper 1964): chick works to gain a position under eggs or young of host till they are lodged on Cuckoo's back and against wall of nest; Cuckoo stiffens neck and rests head against bottom of nest for extra support; then reaches behind with wings to gain purchase on rim of nest for extra leverage and by pushing and pulling up and backward with legs, wings and shoulders, ejects eggs or young of host from nest. Little data for other species but method of eviction probably similar. Develop rapidly; most cuckoos fledge at 16–20 days, depending on host-species; up to *c.* 4 weeks for Channel-billed Cuckoo, Common Koel and Long-tailed Cuckoo. Fledgelings dependent on foster parents for up to 6 weeks; may be fed by birds other than hosts, and by more than one species. Adult Pallid Cuckoos known to feed fledgeling Cuckoos; extralimitally, Common Koel females will feed fledgelings (Ali & Ripley 1969).

It is worth noting that correct identification of the eggs of parasitic cuckoos can be difficult. In preparing these accounts, we have been made aware of one probable example of misidentification. We have been informed that cards in the NRS for the Fan-tailed Cuckoo from the se. coast of NSW in the 1970s and 1980s ought to be disregarded because identification of the cuckoo was not positively confirmed: the eggs and young could just as likely have been those of the Brush Cuckoo (S. Marchant). Rowan (1983), when dealing with S. African cuckoos, found herself faced with similar problems and rejected every record that was not supported by clearly identified fledgeling cuckoos. This has not been done in this summary, and caution needs to be exercised in interpreting the data presented.

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Eudynamys taitensis   **Long-tailed Cuckoo**

Cuculus taitensis Sparrman, 1787, *Mus. Carls.* 2: pl. 32 — no locality = Tahiti.

Specifically named after the type-locality.

OTHER ENGLISH NAMES Long-tailed Koel; Sparrow Hawk, Home Owl, Screecher, Screamer; Koekoea.

MONOTYPIC

FIELD IDENTIFICATION   Length 40–42 cm; wingspan 47–52 cm; weight *c.* 120 g. Large cuckoo with broad pointed wings, very long graduated tail (slightly longer than body in adult, equal to or slightly shorter than body in juvenile) and gently rounded at tip, and short stout bicoloured bill with slightly hooked tip. Adults have buff streaked cap, white supercilium, bold dark eye-stripe and thinner dark moustachial and malar stripes, rufous-brown barring to brown upperparts, and dark streaking to white underparts. Sexes alike and no seasonal variation. Juvenile very different from adult: spotted rather than barred above, and buff rather than white below and on sides of head and neck. Immatures not separable. **Adult** Top of head and hindneck, dark brown, boldly streaked buff. Supercilium, white, bordered below by bold dark-brown eye-stripe continuing down sides of neck; cheeks, chin, throat and foreneck, white with thin dark-brown moustachial and malar stripes and fine black-brown streaking on chin and throat. Rest of upperparts, dark brown, closely barred rufous-brown, and with some fine white spotting on upperwing-coverts; tail indistinctly tipped white. Underbody, white, with coarse black-brown streaking that grades to chevrons on sides of vent and undertail-coverts. Undertail as uppertail but duller. Underwing: coverts, buff to cream; remiges, dark grey with bold cream barring. Bill bicoloured: cream to pinkish with dusky brown or blackish top of upper mandible. Iris, light yellow-brown to red-brown. Orbital ring, olive-green. Legs and feet, olive-grey or olive-green. **Juvenile** Differences from adult: Pale streaking of cap and hindneck, cream; pattern of dark stripes on head and neck similar to adult, but ground-colour of supercilium, cheeks,

chin, throat and foreneck, buff, not white. Rest of upperbody and all upperwing-coverts boldly spotted white; upperside of remiges and uppertail closely barred cream or buff. Underbody, buff, with finer and sparser dark streaking (not extending onto chin and throat) that is sparser in midline of breast and, in some, grades into finer rosethorn-shaped streaking on midline of breast; undertail-coverts and thighs sparsely barred darker. Underwing-coverts, rich buff, as underbody. Iris, brown. Orbital ring, duller and darker, grey-brown. Legs and feet vary from olive-green, as in some adults, to paler pinkish-yellow.

Similar species Usually unmistakable in NZ and on larger islands of Tasman Sea, where it is the only regularly occurring large cuckoo. In these areas, and possibly e. Aust., beware confusion with superficially similar female and juvenile **Common Koel** *Eudynamys scolopacea*; ADULT and IMMATURE Long-tailed easily distinguished from same of Koel by: (1) upperparts boldly barred rufous-brown, with a little white spotting on secondary coverts (body and wings boldly spotted white and tail closely barred white in Koel); (2) underbody, white with bold dark streaking (white to buff with fine dark barring in Koel); (3) head has dark cap clearly streaked buff (solid black in Koel); and prominent white supercilium and narrow dark moustachial and malar stripes (prominent white moustachial stripe and broad black or rufous-streaked malar stripe in Koel); (4) iris: paler, buff to red-brown (darker red in Koel); (5) bill bicoloured (wholly whitish in Koel). JUVENILES differ by: (1) upperbody and upperwings boldly spotted buff, and tail closely barred buff (boldly barred cream to rufous-brown and black in Koel); (2) underbody, buff with prominent dark streaking (white to buff-

white with fine dark barring in Koel); (3) head-pattern and bill much as adult (in Koel: cap cream to rich buff with varying dark median crown-stripe; bold black eye-stripe broadens onto ear-coverts, and separated from broad smudgy dark malar stripe by narrow white moustachial stripe; and bill wholly grey-black with small pale tip). Long-tailed Cuckoo also slimmer, with proportionately longer tail in adults (not juveniles) and very different calls (see below).

Usually seen singly, in twos, occasionally in small groups of up to five birds. In NZ and on passage, prefer montane forest but occur from sea level to 1200 m asl. Cryptic and wary; usually skulk high in forest canopy and often only seen in flight when flushed by approaching observer. Active throughout day and night. Often perch lengthways on branches and let wings drop below level of tail, as typical of other large cuckoos. Normal flight fast, direct and purposeful, with continuous wing-beats; sometimes fly with long swooping glides and erratic changes of direction. Flight-silhouette unmistakable: long pointed wings, narrow protruding head and neck, and long projection of body and tail behind wings (more than twice width of wings in adult, though noticeably shorter in juveniles). More often heard than seen. Calls very loud and difficult to locate. Usual call, uttered on migration and in NZ, a distinctive loud penetrating drawn-out grating whistle or whizzing sound *whiz-z-z-z-z-t* or *zzwheesht*, shrill and upslurred, and often uttered at night; also utter rapid ringing, prolonged *zip-zip-zip-zip* or loud *rrrp pe-pe-pe-pe-pe*. Fledgelings utter constant trill when host-parents nearby; trill notes resemble those of fledgeling Whitehead *Mohoua albicilla* and Yellowhead *Mohoua ochrocephala*.

HABITAT Forests on mainland and nearshore or offshore islands, from sea level to *c*. 1200 m asl. In mountainous areas, more often on vegetated ridges than in valleys (Sibson 1949; Dawson 1950; Penniket 1955). Usually in dense, closed canopy of native forests dominated by beech *Nothofagus*, broadleaf species or podocarps, or mixtures thereof, and with or without shrub layer (Anon. 1958; Challies 1962, 1966; Blackburn 1965; Guest 1975; St Paul 1976; Wilkinson & Guest 1977; CSN).

Often among plantations of pines *Pinus* or other exotic trees (Weeks 1949; Dawson 1951; Edgar 1974; St Paul 1976; CSN). Sometimes in more stunted vegetation, such as Manuka *Leptospermum scoparium* scrub adjacent to forests or on river-flats, high-altitude stands of stunted *Nothofagus*, which can extend into subalpine zone near bush-line, or stunted coastal vegetation (Guy 1947; Dawson 1951; Challies 1962, 1966; CSN). Sometimes also in suburban areas, in parks and gardens or golf courses (Guest & Guest 1993; CSN) and said to occur in secondary regrowth (NZRD). Vagrant on Snares Is recorded among canopy of *Olearia* (Sagar 1977).
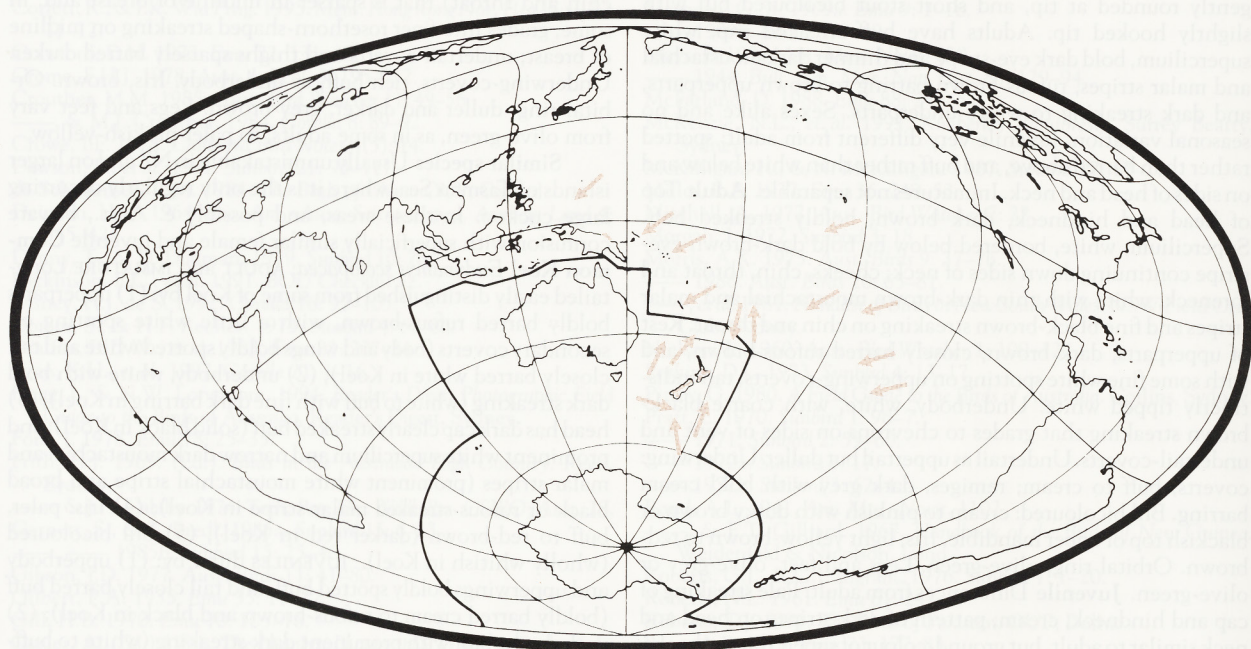
Breeding habitat as that of hosts. On Little Barrier I., most breeding (14 of 17 parasitized nests) occurs 250 m asl (McLean 1988); on Stewart I. and adjacent islands, usually at lower elevations (I.G. McLean).

Usually forage in canopy of densely foliaged trees, or below canopy among dense shrubs (Turbott 1967; St Paul 1976; CSN 32). Rarely, forage on ground, sometimes among stones or on beach (Wilkinson & Wilkinson 1952; St Paul 1976; CSN 5, 7). Two records of hawking for insects above canopy (CSN 30; C.F.J. O'Donnell).
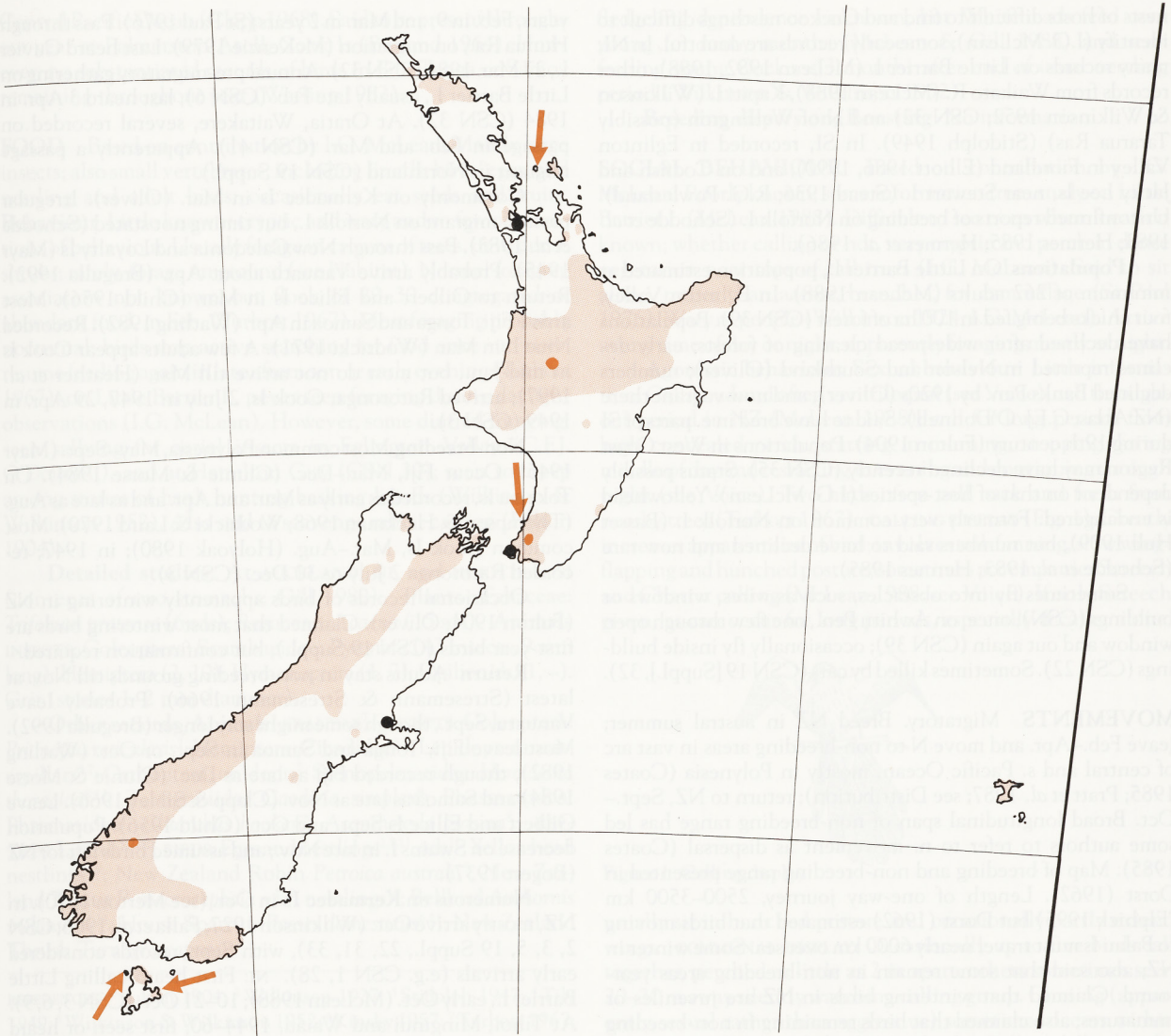
No information on roosting habitat. Often perch in canopy, among thick foliage (Turbott 1967; St Paul 1976; McLean 1988). May seek refuge from attacking passerines in densely foliaged trees or among thick ferns or other undergrowth (Turbott 1967; St Paul 1976; Oliver). Apparently exhausted bird once found sheltering among long grass (CSN 41).

DISTRIBUTION AND POPULATION Breed NZ; in non-breeding period, mostly in central Polynesia, but widely scattered in central and s. tropical Pacific Ocean, from New Caledonia and Vanuatu, n. New Guinea and Bismarck Arch., N to Micronesia, including Palau, Caroline and Marshall Is, and E to Marquesas, Tuamotu and Pitcairn Is (Delacour 1966; Coates 1985; Pratt *et al*. 1987; Bregulla 1992; NZCL).

NZ Widespread central NI, w. SI and montane valleys of e. SI. **NI** In Northland and Auckland Regions sparsely scattered from w. Parengarenga Harbour S to suburban Auck-

land, and on Coromandel Pen. Elsewhere, range coincides with that of host-species Whitehead: common on Little Barrier I. (and sometimes occur on Great Barrier I.); widespread from Waikato and Bay of Plenty Regions, in areas bounded to N by line from w. Tauranga Harbour and Hamilton, E to Hicks Bay and Waipiro in East Coast Region; recorded S through ne. Hawkes Bay, Volcanic Plain, n. Wanganui and e. Taranaki Regions, to line joining Napier and Wanganui; rarely on Taranaki Pen. Also occur farther S, in Tararua Ras, and S to se. Palliser Bay (CSN; NZ Atlas). **SI** Distribution generally coincides with combined ranges of host-species Brown Creeper *Mohoua novaeseelandiae* and Yellowhead; widespread W of main divide. Scattered records in Nelson and n. and w. Marlborough; in Canterbury, mainly in mountainous w. areas, and rarely on plains, with single record at Ashburton and two recent records from Banks Pen.; many scattered records in w. and s. Otago and adjacent areas of Southland, such as Catlins NP; also on Stewart I. and satellite islets. Widespread from Fiordland NP, round w. Te Waewae Bay, NE through West Coast Region to near Westport, and middle reaches of Karamea R. (CSN; NZ Atlas; C.F.J. O'Donnell).

Kermadec Is Uncommon resident (Cheeseman 1890; Sorensen 1964; Merton 1970; Oliver).

Chatham Is Vagrant. Historical reports not confirmed (Archey & Lindsay 1924; Fleming 1939). Single, Chatham I., Mar. 1946 (CSN 2); single, South-East I., Dec. 1982 (Nilsson *et al.* 1994).

Snares Is Vagrant. Single, 29 Nov. to 10 Dec. 1976 (Sagar 1977).

Auckland Is Said to be straggler (Oliver) but no details.

Lord Howe I. Irregular visitor (Hutton 1991).

Norfolk I. Irregular visitor on passage (Schodde *et al.* 1983); recent records: singles, 19 Oct. 1996, 4 Jan. 1997 (Anon. 1996, 1997).

Aust. No confirmed records. **Qld** Report of single, Cato I., 6 Oct. 1960 or 28 Nov. 1961 (Hindwood *et al.* 1963). **NT** Reports at Buffalo Ck, near Darwin, 27 May 1980 (Thompson 1982) and Mt Todd area, 1989 (H.A.F. Thompson & D.K. Goodfellow). Doubtful report from Maningrida (Thompson 1982).

Breeding Confined to NZ; thought to reflect distribution of host-species. Few published records in 20th century, because

nests of hosts difficult to find and Cuckoo nestlings difficult to identify (I.G. McLean); some early records are doubtful. In NI, many records on Little Barrier I. (McLean 1982, 1988); other records from Waikato R. (McLean 1988), Kapiti I. (Wilkinson & Wilkinson 1952; CSN 32) and N of Wellington (possibly Tararua Ras) (Stidolph 1949). In SI, recorded in Eglinton Valley in Fiordland (Elliott 1986, 1990); and on Codfish and Jacky Lee Is, near Stewart I. (Stead 1936; R.G. Powlesland). Unconfirmed reports of breeding on Norfolk I. (Schodde et al. 1983; Hermes 1985; Hermes et al. 1986).

Populations On Little Barrier I., population estimated at minimum of 262 adults (McLean 1988). In Eglinton Valley, four chicks being fed in 100 ha of forest (CSN 39). Populations have declined after widespread clearing of forests; early declines reported in Nelson and Southland (Oliver); numbers declined Banks Pen. by 1920s (Oliver), and now vagrant there (NZ Atlas; C.F.J. O'Donnell). Said to have bred in e. parts of SI during 19th century (Fulton 1904). Populations in West Coast Region may have declined recently (CSN 35). Status possibly dependent on that of host-species (I.G. McLean): Yellowhead is endangered. Formerly very common on Norfolk I. (Basset Hull 1909), but numbers said to have declined and now rare (Schodde et al. 1983; Hermes 1985).

Sometimes fly into obstacles, such as wires, windows or buildings (CSN); once, on Awhitu Pen., one flew through open window and out again (CSN 39); occasionally fly inside buildings (CSN 22). Sometimes killed by cats (CSN 19 [Suppl.], 32).

MOVEMENTS Migratory. Breed NZ in austral summer; leave Feb.–Apr. and move N to non-breeding areas in vast arc of central and s. Pacific Ocean, mostly in Polynesia (Coates 1985; Pratt et al. 1987; see Distribution); return to NZ, Sept.–Oct. Broad longitudinal span of non-breeding range has led some authors to refer to n. movement as dispersal (Coates 1985). Map of breeding and non-breeding range presented in Dorst (1962). Length of one-way journey, 2500–3500 km (Elphick 1995) but Dorst (1962) estimated that birds moving to Palau Is must travel nearly 6000 km over sea. Some winter in NZ; also said that some remain in non-breeding areas year-round. Claimed that wintering birds in NZ are juveniles or immatures; also claimed that birds remaining in non-breeding areas are also immatures.

Recorded striking or flying through windows and buildings during periods of n. and s. passage (CSN 22, 23, 34, 35, 36, 38, 41). Suggested that may migrate at night, in flocks (Fulton 1904; Andersen 1926; Oliver), but no strong evidence. Heard calling in flight at night in Oct.–Dec. (St Paul 1976; CSN 7, 24, 31, 35) and Feb.–Mar. (CSN 9, 23). Maximum flight-speed at least 80 km/h (Sparrow 1984). Said, without evidence, that birds island-hop, with some non-stop flights of up to 3000 km (NZRD). Said that adults probably migrate before juveniles (Heather et al. 1997).

Departure Said that most leave NZ in Feb. and Mar. (Stresemann & Stresemann 1966; Oliver), but many records in NZ in and after Apr., (e.g. Oliver; CSN 19 Suppl.). Birds heard flying N as early as Jan. (CSN 9, 20). SI: In 1988, last heard Codfish I., 4 Apr. (CSN 36). In ne. Fiordland, frequency of records decline from start of Feb. (Lambert 1970). At Franz Joseph and L. Wahapo heard up to 13 Feb. in 1961 (CSN 9). In c. 1840, passed through Cook Str. area in Apr. (Oliver). NI: Leave Kapiti I., mid-Mar. though juveniles recorded late Mar. (Wilkinson 1927). At Te Matai SF, present till early Mar. 1983 (CSN 31). Last seen or heard at Tihoi, Minginui and Waiau, 1944–60, between 16 Jan. and 9 Mar.; last recorded in Jan. in 6

years, Feb. in 9, and Mar. in 2 years (St Paul 1976). Pass through Hunua Ra., on migration (McKenzie 1979). Last heard Cuvier I., 27 Mar. 1984 (CSN 32). Annual pre-migratory gathering on Little Barrier I., usually late Feb. (CSN 6); last heard 3 Apr. in 1984 (CSN 32). At Oratia, Waitakere, several recorded on passage in Feb. and Mar. (CSN 41). Apparently a passage migrant in Northland (CSN 19 Suppl.).

Commonly on Kermadec Is in Mar. (Oliver). Irregular passage migrant on Norfolk I., but timing not stated (Schodde et al. 1983). Pass through New Caledonia and Loyalty Is (Mayr 1945). Probably arrive Vanuatu about Apr. (Bregulla 1992). Return to Gilbert and Ellice Is in Mar. (Child 1956). Most arrive Fiji, Tonga and Samoa in Apr. (Watling 1982). Recorded Niue I. in Mar. (Wodzicki 1971). A few adults appear Cook Is in mid-Jan., but most do not arrive till Mar. (Heather et al. 1997); arrived Rarotonga, Cook Is, 2 July in 1947, 29 Apr. in 1949 (CSN 3).

Non-breeding Most common Polynesia, May–Sept. (Mayr 1945). Occur Fiji, Mar.–Dec. (Clunie & Morse 1984). On Tokelau Is, recorded as early as Mar. and Apr. and as late as Aug. (Thompson & Hackman 1968; Wodzicki & Laird 1970). Most common Cook Is, Mar.–Aug. (Holyoak 1980); in 1947, recorded Rarotonga 2 July to 30 Dec. (CSN 3).

Occasional records of birds apparently wintering in NZ (Fulton 1904; Oliver). Claimed that most wintering birds are first-year birds (CSN 19 Suppl.), but confirmation required.

Return Adults stay in non-breeding grounds till Nov. at latest (Stresemann & Stresemann 1966). Probably leave Vanuatu, Sept., though some might stay longer (Bregulla 1992). Most leave Fiji, Tonga and Samoa in Sept. or Oct. (Watling 1982), though recorded Fiji as late as Dec. (Clunie & Morse 1984) and Samoa as late as Nov. (Clapp & Sibley 1966). Leave Gilbert and Ellice Is Sept. and Oct. (Child 1956). Population decrease on Swains I. in late Nov.; and assumed birds left for NZ (Bogert 1937).

Numerous on **Kermadec Is** in Oct. (see Merton 1970). In **NZ**, mostly arrive Oct. (Wilkinson 1927; Falla et al. 1966; CSN 2, 3, 5, 19 Suppl., 22, 31, 33), with Sept. records considered early arrivals (e.g. CSN 1, 28). NI: First heard calling Little Barrier I., early Oct. (McLean 1988); 10–21 Oct. (CSN 3, 6, 9). At Tihoi, Minginui and Waiau, 1944–60, first seen or heard between 18 Sept. and 28 Nov.; first recorded in Sept. in 1 year, Oct. in 9 years, Nov. in 7 years (St Paul 1976). First call Gisborne, 24 Aug. in 1955 (CSN 6). First call Karioi SF, 10 Oct. in 1959 (CSN 9). In c. 1840, passed through Cook Str. area in Oct. (Oliver). SI: At Farewell Spit, first heard 2 Nov. 1946 (CSN 2). In 1975, first recorded at L. Mapourika, 29 Oct. (CSN 23). In 1947, first seen Te Awa 15 Dec. (Ryder 1948). At Vauxall, Dunedin, first call 28 Sept. 1952 (CSN 5). Arrival in Southland may be delayed till Nov. (Fulton 1904).

Breeding Rare on Norfolk I., Oct.–Feb. (Hermes 1985). Present NZ, Oct.–Feb. (St Paul 1976) but stay longer in some localities, e.g. in L. Waikaremoana area 1952–53, plentiful Oct.–Apr. (CSN 5). Occur year-round at Kermadec Is (see Merton 1970) where suggested that birds are driven to island when migrating and stay there (Iredale 1910) but do not breed (Merton 1970). Banding has shown that adults return to same general area year after year (Heather et al. 1997).

Some said to remain in extralimital Pacific non-breeding areas during breeding season, and these birds said to be young (Dorst 1962; Stresemann & Stresemann 1966; Heather et al. 1997). Thus, first-year birds would remain in tropical areas for c. 18 months before making first return to NZ (Stresemann & Stresemann 1966). Records from all seasons from Swains I., s.

Central Pacific Ocean (Clapp 1968). Said to be present throughout year at Palmerston Atoll, Cook Is (Burland 1964). However, no substantiated records of birds in Fiji, Tonga or Samoa remaining throughout year (Watling 1982).

FOOD Based on contribution by I.G. McLean. Mainly large insects; also small vertebrates, including lizards, birds' eggs, and nestling and adult birds; occasionally eat seeds and fruits. **Behaviour** Little known; cryptic and wary and so few observations of behaviour. Usually forage in crowns of trees, or in dense shrubs; rarely, forage on ground (see Habitat). Normal foraging association not known but flock of 20–30 congregated at abundant food, in Feb. (Turbott 1967). Most foraging probably nocturnal; birds stop active searching for food once sun rises; resume feeding again in late afternoon or early evening (Turbott 1967); on Little Barrier I., never seen foraging during daylight observations (I.G. McLean). However, some diurnal foraging: seen sallying for aerial insects in Eglington Valley (C.F.J. O'Donnell), and at Hamilton City (CSN 30); seen to creep among stones of bank hunting basking lizards (Wilkinson & Wilkinson 1952). Also said to scavenge rabbit carrion (Fulton 1904).

Detailed studies At AUCKLAND, NI, and HOKITIKA, SI (contents of two stomachs; Gill 1980): **Plants** Fabaceae: *Trifolium pratense* (6 sds); Rosaceae: *Acaena* (15 sds). **Animals** INSECTS: Coleoptera: Scarabaeidae: *Pyronota* (43 insects, 9 mm long); Hemiptera (2, 10); Hymenoptera (1, 7); Opilionids (1, –). Grit (stones 1–2 mm diameter).

Other records Animals ARANEAE[7]. INSECTS: Coleoptera: *Prionopus reticularis*[7]; Hemiptera: Cicadidae[3,7]; Lepidoptera: caterpillars[3,7]; Orthoptera: unident.[7]: Stenopelmatidae: *Hemideina thoracica*[8,13]; Tettigoniida: *Caedicia simplex*[8]; Phasmatodea: Phasmatidae[7]: *Clitarchus hookeri*; *Acanthoxyla prasina*[8]. REPTILES: Lizards[5,7,11]. BIRDS: Eggs and nestlings[2,7,11], ads[12]; Yellowhead nestlings[4,9]; New Zealand Robin *Petroica australis*[5]; New Zealand Tomtit *P. macrocephala* ads[2], nestlings[10]; Bellbird *Anthornis melanura*[1,11]; House Sparrow *Passer domesticus*[6,11]; New Zealand Thrush *Turnagra capensis*[7].

REFERENCES: [1] Fulton 1904; [2] Wilkinson 1927; [3] Stidolph 1947; [4] Tily 1949; [5] Wilkinson & Wilkinson 1952; [6] Kinsky 1957; [7] Turbott 1967; [8] Reed 1980; [9] Elliot 1996; [10] Beaven 1997; [11] Oliver; [12] CSN 3, [13] 7).

Young Fed by host-parents; on insects, mostly caterpillars (Turbott 1967).

SOCIAL ORGANIZATION Based on contribution by I.G. McLean. Poorly known; some information from study on Little Barrier I. (McLean 1988). Usually seen singly or in twos (Turbott 1967); or singly or in small groups of 2–5 birds (McLean 1988). In breeding season, groups of up to five birds call and display together (St Paul 1976; McLean 1988; see below). Once, hundreds seen in flocks of 20–30 in Feb., apparently congregating at abundant food (Turbott 1967). Can form flocks before migration.

Bonds Do not form pairs. Suggested to have lek mating system, in which calling groups (see below) are males displaying to attract females; leks not long-lived and display sites not defended as is typical of other species, but ephemeral, constantly breaking up and re-forming at same or other locations (McLean 1988). **Parental care** Claim that adult Long-tailed Cuckoos reared young on Kermadec Is (Fulton 1904) seems unlikely, especially as Long-tailed Cuckoo not otherwise known to breed there and there are no suitable hosts. Period of

fledgeling dependence unknown, but Whiteheads feed own young for many months (McLean & Gill 1988) and seen feeding young Cuckoos 3 months after end of usual nestling period (Wilkinson & Wilkinson 1952).

Breeding dispersion, Roosting No information.

SOCIAL BEHAVIOUR Based on contribution by I.G. McLean. Poorly known; some information from study on Little Barrier I. (McLean 1988). Difficult to see even when location known; whether calling or not, very cryptic and perch in dense vegetation near tops of tall trees (I.G. McLean). Said to sit along, rather than across, branches, for camouflage (St Paul 1976). Wary of people (Wilkinson 1924; I.G. McLean). Active at any time of day or night, apparently foraging mostly at night.

Agonistic behaviour, Sexual behaviour Little information. Calls loud and often ventriloqual (see Voice); call throughout period in NZ (McLean 1988); call for long periods from high concealed perch, starting in morning, stopping during middle of day and restarting in evening and continuing through night (see Voice). Two birds often call back and forth from nearby trees (Turbott 1967). CALLING DISPLAY (Fig. 1): Greatly increases apparent size of bird; involves tail-fanning, slow wing-flapping and hunched posture; sometimes accompanies Screech and Chatter calling (McLean 1988; see Voice). If only Screech given, as can occur for long periods, especially if caller alone,
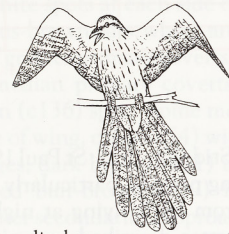

Figure 1 Calling display

usually sit in hunched posture and occasionally partly extend wings. COMMUNAL DISPLAY: Occasionally up to five birds call together, perched as little as 2 m apart; others sometimes seen 20–30 m away silently watching calling group. Chasing (apparently sexual rather than aggressive) sometimes occurs within groups of calling and displaying birds. Call and display for reasons other than mating, as birds continue to call after breeding ended (McLean 1988; see also St Paul 1976).

Relationships within family group Young raised by host-parents. However, adult Cuckoos often nearby, apparently watching fledgelings; once, fledgeling and adults appeared to call to each other (McLean 1988). Occasionally Whiteheads observed feeding two young Cuckoos (Wilkinson & Wilkinson 1952; McLean 1982) probably because second chick adopted, as Whiteheads with fledgelings often form large flocks containing several families. **Begging of young** Begging Call of nestlings and fledgelings fostered by Whiteheads similar to those of host-species (Wilkinson 1947; McLean & Waas 1987). Fledgelings beg continuously from hidden location and do not follow host-parents about (as young of host do) but make infrequent long flights of up to 200 m, and host-parents follow them. Fledgelings will beg from birds, and species, other than host-parents (McLean 1988).

VOICE Reasonably well known. Sonagram of fledgeling in McLean & Waas (1987). Calls very loud, deafening if bird close to observer (I.G. McLean). Calls difficult to locate (Buller 1888; Fulton 1904; St Paul 1976). Call during day and night.

Loud Shrieks frequent in morning; become drowsier, quieter and less frequent toward midday, then not heard till evening approaches; then call through night (Fulton 1904; Wilkinson 1924). Once heard to call when disturbed by earthquake (St Paul 1976). Sometimes call in groups (Buller 1888; St Paul 1976; McLean 1988; see Social Behaviour). Sometimes young and adults seem to call to each other (I.G. McLean). Not known whether only one or both sexes call; suggested to have lek mating system, and that loud calls and displays allow one sex to choose between competing individuals of other (McLean 1988). Respond to imitation of calls (Wilkinson 1924).

Adult SHRIEK and CHATTER: Shriek and Chatter may be given independently, or as combined call of one or several Shrieks followed by series of Chatters (McLean 1988; I.G. McLean). Sonagram A shows a Shriek followed by a Chatter. Shriek is loud penetrating drawn-out grating whistle or whizzing sound *whiz-z-z-z-t* or *zzwheesht* (Fulton 1904; Falla *et al.* 1979), shrill and upslurred, with burring throb (Andersen 1911, 1926). Also described as ringing *rrrp* (Falla *et al.* 1979) and as
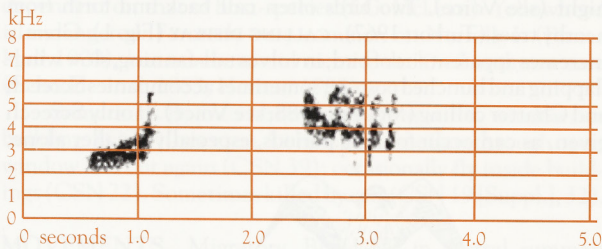
A J. Kendrick; P100

screech (Wilkinson 1924; Stidolph 1937; St Paul 1976; McLean 1988). Often given for long periods, particularly if bird alone (McLean 1988). Heard from birds flying at night (Stidolph 1937; St Paul 1976). Chatter described as rapidly repeated *wheet-wheet-wheet…*, ringing prolonged *zip-zip-zip…* or loud *pe-pe-pe…* (Andersen 1913, 1926; Falla *et al.* 1979). Chatter may be given in flight (Andersen 1913, 1926). Chatter reported from many birds gathered in large tree (St Paul 1976). Calling Display (see Social Behaviour) performed only when Shriek and Chatter both given (McLean 1988). **Other calls** Great twittering heard from large flocks, just before migration (Andersen 1915). Alarm whistle and subdued conversational notes reported without details, though also given in musical notation (Andersen 1911). Rapidly repeated *wheet-wheet-wheet* when two birds circling over trees (Andersen 1913). Defiant crowing sound given when settling on perch after being chased by Tuis *Prosthemadera novaeseelandiae* (Fulton 1904). Rattling chuckle or cluck when flying low among trees at night (Fulton 1904).

Young BEGGING CALL: Nestling being raised by Whiteheads uttered *cheep-cheep* notes that closely resemble those of host-parent; becomes *whir-r-r-r*, resembling winding of watch, very similar to that of young Whitehead, when host-parent near (Wilkinson 1947). Fledgeling utters constant trill whenever host-parents nearby, with calling rate and length of trill increasing with approach of host; older fledgelings call continuously. Trill very similar to those of fledgeling Whiteheads and Yellowheads and can only be distinguished with experience; calls of Cuckoos tend to be longer, but individual elements given at slower rate than hosts (22.6 versus 43.1 elements/s respectively). Main frequencies (Cuckoo, 7940 Hz; Whitehead, 7940; Yellowhead, 8250) and maximum frequencies (9520, 9840, 9840) were virtually identical for all three species; mini-

mum frequencies similar for Cuckoo (7300 Hz) and Yellowhead (6670), but some elements of Whitehead trills were lower (2700 Hz) (McLean & Waas 1987). Nestlings give harsh squeak when touched (Wilkinson 1947).

BREEDING   Studied over three summers on Little Barrier I. (McLean 1988), and as part of study of Yellowheads at Knobs Flat, Eglington Valley, SI (Elliott 1990). Nest parasite.

Season Laying, Nov. and Dec. (Oliver); egg, early Jan. (Kinsky 1957); dependent fledgelings, early Jan. to early Mar. (Wilkinson 1947; Stidolph 1949; CSN 25, 33). In NI, breeding begins mid-Nov., c. 3 weeks later than main host, Whitehead (McLean 1988; McLean & Gill 1988). At Knobs Flat, eggs, late Oct. to early Jan. (Elliott 1990).

Site Usually select species that build open nests; mainly Whitehead in NI, and mainly Brown Creeper M. *novaeseelandiae* and hole-nesting Yellowhead in SI; will also parasitize nests of New Zealand Robin, Grey Fantail *Rhipidura fuliginosa* and Silvereye *Zosterops lateralis* (McLean 1988; Oliver). Eggs have been found in nests of New Zealand Tomtit, Bellbird, Tui, Song Thrush *Turdus philomelos*, House Sparrow and European Greenfinch *Carduelis chloris* (Stead 1936; Stidolph 1949; Kinsky 1957; Cunningham 1966; McLean 1988; Oliver). Records of parasitism of Grey Warblers *Gerygone igata* (Potts 1885; Buller 1888; Smith 1931; St Paul 1976) not substantiated and probably based on confusion with Shining Bronze-Cuckoo *Chrysococcyx lucidus* (McLean 1988). MEASUREMENTS: Height of parasitized nests: four estimates, 0.6, 1.8, 2.0 and 2.7 m (Wilkinson 1947; Stidolph 1949; Wilson 1959); in Yellowhead nest-cavities, 10–35 m above ground (C.F.J. O'Donnell).

Nest, Materials Chick said to have fallen through bottom of nest of Silvereye, probably because it grew too heavy (Stidolph 1949). MEASUREMENTS: At Knobs Flat, for six parasitized Yellowhead nests: mean cross-sectional area of entrance of nest-hole, 86.6 cm²; mean depth of nest-cavity, 6.6 cm; mean cross-sectional area of nest-cavity, 222.2 cm² (Elliott 1990).

Eggs Oval, tapering a little at both ends, one end more pointed; creamy white, spotted and blotched all over with purplish brown and grey, denser at larger end (Oliver). Oval to elliptical, almost round; white, tinted with cream or creamy pink, freely spotted and streaked with purplish brown and having underlying spots of grey; markings larger and more numerous at larger end (Stead 1936). MEASUREMENTS: 23.7 (1.08; 22.5–26.0; 8) × 17.8 (0.22; 17.0–18.0) (Stead 1936; Cunningham 1949; Stidolf 1949; Wilkinson & Wilkinson 1952).

Clutch-size Lay one egg per host-nest (Stead 1936).

Laying Method of laying not studied. At laying, probably remove egg of host (Elliott 1990). Claim that laid egg on ground, carried in bill and deposited in nest of Grey Warbler (Cunningham 1949) doubtful and confirmation needed.

Incubation Hosts provide all incubation. An egg moved by observer from one Whitehead nest to another was found on ground below nest next morning (Wilkinson 1936). INCUBATION PERIOD: Not known; estimated, based on body-size, to be c. 16 days (McLean 1988).

Young Altricial, nidicolous. Naked and blind at hatching (Elliott 1990). Said to eject young of host from nest (Wilkinson & Wilkinson 1952). However, not always able to eject Yellowhead chicks from nest; Cuckoo chick usually pushes Yellowhead chicks onto rim of nest, where they die, but, at two nests, shape of nest-cavity meant that Yellowhead chicks always fell back into nest; by 17 days old, both Cuckoo chicks had lost the urge to eject host-chick; in both nests, Yellowhead and

Cuckoo chicks were raised together and fledged successfully (Elliot 1990). **Host care, Role of sexes** Host provides all feeding and brooding (Stidolph 1947; Wilkinson & Wilkinson 1952). A Whitehead parent fed chick by plunging its head into gaping bill of Cuckoo (Wilkinson 1947). Both host parents, and sometimes other members of social group, feed chick; mean interval between feeding visits, 10.3 min (7.79; 5–25; 6) (Stidolph 1947; I.G. McLean). In Eglinton Valley, Yellowheads raised a mixed clutch of one Cuckoo and one Yellowhead to fledging (O'Donnell *et al.* 1992); soon after fledging, Cuckoo abandoned because young Yellowhead moved through forest following parents, while Cuckoo stayed at nest-site waiting to be fed (Elliott 1990; C.F.J. O'Donnell).

Fledging to independence FLEDGING PERIOD: *c.* 29 days in Yellowhead nests (Elliott 1990). One chick remained in nest of New Zealand Robin for at least 3 weeks (Fulton 1904). Estimated, based on body-size, to be 21 days (McLean 1988). One observation of three Whiteheads feeding two Cuckoo fledgelings; Cuckoos probably from different host-parents, as Whiteheads with fledgelings often form large flocks of several families (Wilkinson & Wilkinson 1952; McLean 1982). Fledgelings fed by Grey Warbler (Oliver). Period of fledgeling dependence not known; Whiteheads feed their young for many months (McLean & Gill 1988) and have been seen feeding Cuckoo chicks in late Mar. (Wilkinson & Wilkinson 1952). Fledgeling Cuckoos do not follow their host-parents (McLean 1988; Elliott 1990).

Success At Knobs Flat, SI, six (6.3%) of 95 Yellowhead nests were parasitized by Cuckoos (Elliott 1990); at another site, two (8%) of 24 nests of Yellowhead successfully fledged Cuckoos (O'Donnell *et al.* 1992). On Little Barrier I., mean rate of brood parasitism in Whiteheads, calculated as percentage of successful Whitehead flocks (those with fledgelings) that had a Cuckoo fledgeling, 16.5%; significantly higher above 250 m asl (35.7%) than below 250 m asl (5.4%) (McLean 1988). Parasitized clutch of Brown Creeper eaten (Wilson 1959).

PLUMAGES Prepared by A.M. Dunn. Hatch naked; fledge in juvenile plumage. Very little information available from non-breeding grounds, where most moult occurs. Post-juvenile (first pre-basic) moult occurs in non-breeding areas or *en route*; moult probably complete and probably results in adult plumage. Thereafter complete post-breeding (pre-basic) moults each cycle produce successive adult plumages without change in appearance. Sexes similar. Age at first breeding, not known.

Adult (Definitive basic) HEAD AND NECK: Forehead, crown, nape and hindneck, dark brown (121) to black-brown (c119) with very narrow, buff (123D) to buff-brown (39) shaft-streaks to feathers; feathers of hindneck also have buff-brown (39) spots or partial bars at sides of each feather. Supercilium, from base of upper mandible near nostrils to above ear-coverts, off-white with some buff-brown (39) streaking. Lores, black-brown (119) with some indistinct buff (124) speckling. Ear-coverts, as cap, dark brown (121) to black-brown (c119) with very narrow buff (123D) to buff-brown (39) shaft-streaks to feathers. Lores and ear-coverts combine to form dark eye-stripe. Feathers of cheeks, sides of throat and sides of neck, white, streaked with black-brown (119) shaft-streaks, which are narrowly edged buff-brown (39); shaft-streaks on sides of throat and neck thickest and align to form dark moustachial stripe. Chin, centre of throat and foreneck mostly white, usually with narrow black-brown (119) shaft-streaks, which are finely edged buff-brown (39). Thickness of streaking on chin, throat and foreneck varies greatly between individuals; in most, streaks

align to form thin malar stripe, but in some streaks are very faint or absent. UPPERPARTS: All feathers, dark brown (121) to black-brown (119) with buff-brown (39) to rufous-brown (340) barring; most feathers have three bars but up to five bars on longer feathers, such as scapulars and uppertail-coverts; bars near tips tend to be paler. Longer uppertail-coverts have white tips or paired white spots at tip. In some birds, many feathers have a very short and slender white shaft-streak near tip; possibly related to age but insufficient information. UNDERPARTS: Breast, belly, vent and flanks, white, with broad dark-brown (121) to black-brown (119) shaft-streaks, which are often narrowly edged buff-brown (39) and rounded near tip of feathers; can sometimes have buff-brown (39) blotch in middle of some shaft-streaks at sides of breast. Amount of buff-brown (39) in feathers varies individually. Thighs and undertail-coverts, white, with dark-brown (121) to black-brown (119) chevrons; longest undertail-coverts have 3–4 chevrons or broken bars. UPPERTAIL: Evenly barred with alternating dark-brown (121) and rufous-brown (c136) bars *c.* 5 mm wide; bars curve toward tip near shaft; tip, white, and bordered subterminally by dark-brown bar. Edges of outer 2–3 rectrices often paler, grading to off-white. UNDERTAIL: As uppertail but slightly paler. UPPERWING: All secondary coverts, alula and greater primary coverts, dark brown (121) to black-brown (119) with rufous-brown (c236) barring and off-white tip or a pair of off-white spots at each side of tip; each feather has two or three rufous-brown bars, which are usually broken near shaft; white tips of greater primary coverts small and indistinct. Most lesser and median primary coverts, dark brown (121) with rufous-brown (c136) spots; some median primary coverts near leading edge of wing, cream (54) with dark-brown (121) inner webs. Remiges, dark brown (121) to black-brown (119) with widely spaced buff-brown (c39) bars that become slightly darker on inner secondaries (approaching rufous-brown [136]); bars *c.* 5 mm wide and spaced *c.* 12 mm apart and broken near shaft; barring begins *c.* 5 cm from tip on outer four primaries, closer to tip on rest of remiges. Secondaries and inner primaries often have narrow white tip; occasionally outer primaries have small fuzzy off-white spot near tip. UNDERWING: Most coverts, buff (124) to cream (54); a few outer coverts have very fine black (89) shaft-streaks. Remiges, dark grey (83) with bold cream (92) barring. Inner primaries and all secondaries usually have very small indistinct cream (92) spot near tip.

Downy young Naked at hatching (Elliot 1990; C.F.J. O'Donnell).

Juvenile Upperparts more spotted, and underparts more buff than in adult. HEAD AND NECK: Forehead, crown, nape and hindneck, dark brown (121) to black-brown (119) with narrow cream (54) shaft-streaks to feathers; streaks on hindneck broader than elsewhere and rounded near tips of feathers. Broad buff (123D) to yellow-brown (123C) supercilium extends from base of upper mandible, near nostrils, to side of hindneck. Broad dark-brown (121) to black-brown (119) eye-stripe, with some scattered buff (123D) spotting and streaking, extends from lores through eye and ear-coverts and curves down sides of neck below supercilium. Rest of sides of neck below continuation of eye-stripe, yellow-brown (123C). Most of cheeks, chin, throat and foreneck, buff (123D) to yellow-brown (123C) with faint black-brown (119) tips to most feathers, with black-brown (119) moustachial and malar stripes that extend down sides of throat. UPPERPARTS: All feathers, dark brown (121) to black-brown (119) with large rounded off-white to cream (92) subterminal spot and a concealed off-white bar, which is broken near shaft; longer scapulars and uppertail-coverts have several

broken bars. UNDERPARTS: Breast, belly, vent and flanks, yellow-brown (c123C) to buff (123D) with dark-brown (121) to black-brown (119) shaft-streaks, which are narrower than in adult and usually pointed near tip of feather; in some birds, shaft-streaks flare into a rosethorn near tip. Undertail-coverts, cream (92) with widely spaced dark-brown (121) barring. Thighs, buff (c123D) with dark-brown (121) chevrons or irregular-shaped markings. TAIL: All rectrices, dark brown (121) with off-white tip and buff (c124) barring; bars c. 5 mm wide and spaced c. 8 mm apart. UNDERTAIL: As uppertail but paler. UPPERWING: Lesser and median secondary coverts, black-brown (119) with large cream (54) subterminal spot; often have concealed cream (54) bar in middle of feather, which often broken near shaft. Most lesser and median primary coverts, dark brown (c121) with small cream (54) subterminal spots; some median primary coverts near outer edge of wing, cream (54) with dark-brown (c121) tip. All greater coverts, alula and remiges, dark brown (121) to black-brown (119) with 2–3 cream (54) to buff (124) bars and cream (54) subterminal spot. Bars usually broken near shaft of feathers and, on primaries, are sharp and well defined on inner web but fuzzy and indistinct on outer web. Subterminal spots large on secondaries, small on inner primaries and none on outer five primaries; spot reaches tip on innermost primary and outer 2–3 secondaries. UNDERWING: All coverts, buff (124); a few outer coverts have very fine black (89) shaft-streaks. Remiges, dark grey (83) with bold cream (92) barring; inner primaries and all secondaries have small cream (92) spot near tips.

Immature (First basic). No information and not known if separable from adults. No birds identifiable as immatures found in skins examined as part of this study. Stresemann & Stresemann (1966) say first-year birds do not return to NZ with adults in first breeding season but remain in tropical areas for c. 18 months (see Movements). No skins examined from non-breeding areas during breeding season (Oct.–Feb.).

BARE PARTS   Based on photos (Chambers 1989; Moon 1992; NZRD) and museum labels (NMNZ). **Adult** Bill bicoloured: upper mandible, blackish, brown or light brown-horn along top of culmen, with pale-horn or cream (c92) cutting edges, but also described as all olive-grey; lower mandible, cream (c92), but also described as yellow, pinkish grey, or light greyish-buff. Iris, light yellow-brown, yellowish buff, light brown, red-brown or brown. Orbital ring, greenish yellow or olive-green. Legs and feet, pale olive-green, olive-green, olive-grey or dark olive-grey. Soles, yellow. Claws, dark grey or black. **Downy young** Little information. Bare skin, grey-black or dark brown (Elliot 1990; C.F.J. O'Donnell). Gape, orange (Stidolph 1947) or yellow (Stidolph 1949). **Juvenile** Bill: upper mandible, dark brownish-grey (brownish 83) or dark brown along top of culmen, with paler or pink (c108D) cutting edges; lower mandible, pale horn, yellow or pink (c108D). Gape, pink. Iris, brown. Orbital ring, grey-brown (c19). Legs and feet, pink-buff (c121D); also described as olive-green or yellowish-olive, usually with yellow edges to scales. Soles, yellow. Claws, black.

MOULTS   Based on examination of 49 adult and 43 juvenile skins (AIM, CM, HLW, NMNZ) and published information as cited. **Adult post-breeding** (Probably second and subsequent pre-basic). Little data. Of skins collected NZ (n=44), none had active moult of primaries and only one, from Jan., had very slight moult of body. Suggests moult does not normally begin till after leaving NZ breeding grounds (in Feb.–Mar.). Moult of primaries probably begins in May and is well advanced by July

(Stresemann & Stresemann 1966). Only three skins had active moult of primaries, and these were all collected from non-breeding areas, one in Mar. (PMS=3) and two in June (PMS = 6 and 10); all three had active moult of body. Sequence of primary-moult difficult to determine from skins examined, but appear to begin by replacing every second feather and then replacing remaining primaries; the three moulting skins had the following sequences: $1^1O^11^1O^51^1O^1$, $O^53^1O^13^1O^2$ and $O^23^1O^11^1O^13^1O^31^1O^1$. Stresemann & Stresemann (1961) found that all odd numbered primaries replaced first, followed by even numbered primaries once former are fully grown, though p1 and p2 can be moulted outside this sequence. Moult of primaries can begin with any of the odd-numbered primaries or p2 (Stresemann & Stresemann 1961). **Post-juvenile** (First pre-basic). Very little information. Most skins examined were not moulting. The following based on two skins in primary-moult (NMNZ) and published sequences of primary-moult of nine birds (Stresemann & Stresemann 1966). Probably complete. Sequence of primaries similar to that of adult; first primaries replaced are p2, p3, p7 or p9; last to be replaced are p6, p8 or p10; p1, p4 and p5 did not fit easily into a strict sequence. Moult of primaries begins about Nov. and finishes Mar. or Apr. (Stresemann & Stresemann 1966). How such moults relate to movements of first basic birds not known (adults return to NZ Sept.–Oct.); suggested that some that remain in non-breeding range in austral summer are juveniles and immatures, which do not return to NZ till late in second year.

MEASUREMENTS   Skins (AIM, CM, NMNZ): (1) NZ and Nuie, Savaii and Tonga Is, adults; (2) NZ, juveniles.

		MALES	FEMALES	
WING	(1)	189.0 (3.49; 183–197; 23)	185.5 (5.11; 176–196; 25)	**
	(2)	171.5 (6.43; 157–181; 17)	173.6 (4.10; 164–181; 16)	ns
TAIL	(1)	226.8 (6.04; 211–236; 21)	220.2 (7.63; 204–237; 23)	**
	(2)	183.2 (13.5; 158–204; 18)	184.0 (11.72; 149–200; 17)	ns
BILL S	(1)	33.4 (1.32; 29.5–35.0; 17)	33.5 (0.73; 32.0–35.7; 23)	ns
	(2)	30.4 (2.30; 27.3–35.0; 14)	32.2 (1.29; 30.4–34.4; 14)	*
BILL N	(1)	18.0 (0.84; 15.6–19.4; 23)	17.6 (0.79; 16.0–19.2; 24)	ns
	(2)	14.4 (1.23; 12.7–17.1; 18)	15.0 (1.30; 12.9–17.1; 16)	ns
TARSUS	(1)	34.9 (1.15; 33.4–37.3; 23)	34.7 (1.05; 32.5–36.6; 24)	ns
	(2)	34.2 (1.11; 31.2–35.8; 18)	34.5 (0.89; 32.6–36.3; 16)	ns
TOE C	(1)	30.6 (1.21; 28.7–32.6; 11)	30.9 (1.11; 29.2–33.3; 12)	ns
	(2)	30.4 (1.82; 27.9–33.2; 9)	31.3 (1.15; 29.7–33.4; 12)	ns

Wing-length of live birds from Orongorongo Valley, NZ, 189.2 (187–192; 4) (Robertson *et al.* 1983, which see for a few other measurements).

WEIGHTS   (1–2) From museum labels (AIM, CM, NMNZ): (1) NZ and Nuie I., adults; (2) NZ, juveniles.

	MALES	FEMALES	
(1)	110.4 (22.47; 74–153; 9)	124.2 (16.05; 93–148; 10)	ns
(2)	95.0 (25.16; 60–128; 6)	117.3 (24.09; 80–146; 6)	ns

Unsexed live birds from Orongorongo Valley, NZ, 126.0 (111–140; 4) (Roberston *et al.* 1983).

STRUCTURE   Wing long, narrow and pointed. Ten primaries: p7 or p8 longest; p10 62–69 mm shorter, p9 25–29, p8 0–5, p7 0–3, p6 6–14, p5 22–31, p4 36–47, p3 49–60, p2 60–71, p1 71–83. Ten secondaries including about three tertials; tips of longest tertials fall short of p2 on folded wing. Tail long and

wedge-shaped at tip; ten rectrices. Bill straight, slightly shorter than head; culmen long, slightly convex near base and more strongly convex near sharp tip; lower mandible rather straight, gently tapering to tip; cutting edges of both upper and lower mandibles have slight curve to match convexity of culmen. Nostrils large and slit-like. Tarsus long and laterally compressed, with some feathering near tibio-tarsal joint; scutellate. Tibia fully feathered. Outer front toe longest, outer hind 77–86% of outer front, inner front 66–69%, inner hind 44–54%.

GEOGRAPHICAL VARIATION   None.

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Volume 4, Plate 35

Common Koel *Eudynamys scolopacea*   (page 760)
1 Adult male; **2** Adult female, dark type; **3** Adult female, pale type; **4** Juvenile (still growing); **5** Juvenile (fully grown); **6** Immature male;
7 Adult male; **8** Adult female, dark type; **9** Adult female, pale type

Long-tailed Cuckoo *Eudynamys taitensis*   (page 773)
10 Adult; **11** Juvenile; **12, 13** Adult

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