

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 *Eudynamis 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, varying 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 *Eudynamis 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 *Eudynamis*. 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, extraliminally, *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. Extraliminally, 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); extraliminally, 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. Extraliminally, 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; extraliminally, 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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Chrysococcyx lucidus **Shining Bronze-Cuckoo**

COLOUR PLATE FACING PAGES 736, 737

Cuculus lucidus Gmelin, 1788, *Syst. Nat.* 1: 421 — Queen Charlotte Sound, New Zealand.

The specific is based on the name 'Shining Cuckoo' given to this species by Latham (1782; *Gen. Synop. Birds*, 1 [2]) from the Latin *lucidus*, shining, bright (*lux, lucis*, light).

OTHER ENGLISH NAMES Bronze Cuckoo; Broad-billed, Golden or New Zealand Bronze-Cuckoo; Greenback; Whistler. **NZ:** Shining Cuckoo.

POLYTYPIC Nominate *lucidus*, breeds NZ and Chatham Is, migrating to non-breeding areas in sw. Pacific (mainly Solomon Is); occurs in e. coastal Aust. and offshore islands on passage; subspecies *plagosus* (Latham, 1802), Tas., e. Aust. and sw. Aust., some migrating as far N as New Guinea and Lesser Sundas in non-breeding season. Extralimitally: *layardi* (Mathews, 1912), New Caledonia, Loyalty Is, New Hebrides, Banks and Santa Cruz Is; *harterti* Mayr, 1932, Renell and Bellona Is.

FIELD IDENTIFICATION Length 13–18 cm; wingspan 25–32 cm; weight 25 g. Small bronze-cuckoo, slightly bigger than Horsfield's Bronze-Cuckoo *Chrysococcyx basalis*. In all plumages readily distinguished from other bronze-cuckoos by diagnostic combination of iridescent green upperparts (with or without contrasting maroon-bronze cap and mantle), white underbody with bold and mostly complete dark barring (much

reduced but always present in juvenile), very white face with fine dark mottling throughout but no distinct pale supercilium or dark eye-stripe, no rufous in wings, and little or no rufous in tail. Ascending whistled call diagnostic. Sexes differ slightly in plumage and colour of bare parts. Juvenile distinct: duller generally, with much less extensive and prominent ventral barring. Marked geographical variation. Two well-marked sub-

species in HANZAB region: Aust.-breeding *plagosus* and nominate *lucidus* of NZ, which also occurs as passage migrant along e. coast of Aust. during autumn and spring; both treated separately below. **SUBSPECIES PLAGOSUS: Adult male** Top of head, hindneck and upper mantle, maroon-bronze, with dull-green gloss visible in some lights, usually contrasting obviously with bright iridescent green rest of upperparts; some have indistinct white speckling in centre of forehead, and a few have bright-green gloss over top of head and hindneck (though these areas never look as vividly green as rest of upperparts). Face, white, sharply demarcated from dark cap and finely mottled dark brown throughout, though mottling often stronger on ear-coverts, forming diffuse (though never solid) dark ear-patch. Chin, throat and foreneck, white (continuous with white of face), narrowly barred dark. White tips to lateral uppertail-coverts often show as neat row of white bars down sides of rump. When closed, uppertail appears dull olive-green with brighter green gloss, and with diffuse blackish subterminal band and white notching along edges of outermost rectrices; when spread, strongly barred black-and-white outermost rectrices are exposed, as are white tips to all but central pair, but tail never shows any rufous. Upperwing: tertials and all secondary coverts, bright iridescent green as rest of upperparts; rest of wing, blackish. Underbody, white with complete bold narrow dark-brown barring except for narrow break along midline of belly and vent in most birds; barring shows strong green iridescence (and sometimes a faint purplish gloss) in direct light. Undertail: when closed (so only t5 exposed), appears boldly barred black-and-white; when spread, appears dark grey with narrow black subterminal band, white tips to all but central pair of rectrices, boldly barred black-and-white outermost rectrices (t5) and suggestion of same pattern on penultimate pair (t4); a few birds show hints of or clear narrow rufous bars on underside of t4. Underwing: leading coverts and wing-pit, white with narrow dark barring; rest, dark grey with broad white stripe across bases of remiges, prominent in flight. Bill, grey-black to black with small and inconspicuous (or no) paler patches at base of lower mandible. Iris varies: mostly dark to light brown, but often reddish brown or rarely, red, yellow, pale grey or white. Orbital ring very narrow, pale green. Legs and feet, grey to blackish with paler dirty-white or yellowish soles. **Adult female** Very similar to adult male and with much overlap (see Plumages, Sexing); tend to differ by: more apt to lack white speckling on forehead; cap, duller maroon, with little or no bronze-green gloss; maroon of cap extends well onto and often over entire mantle and sometimes onto outer scapulars; barring on underbody less iridescent and duller, and always broken in midline of belly and vent by broader streak of white; and dark barring on throat also duller and less iridescent, and tends to become narrower and more irregular on chin, which is often all-white. **Juvenile** Differs from adults by: no white speckling on forehead, and entire top of head and hindneck duller, brown, with only subtle maroon or olive-green iridescence. Centre of chin, throat and foreneck, off-white, grading to mottled or diffusely barred brown on sides and on ear-coverts, latter sometimes showing as diffuse dark ear-patch. Rest of upperbody, tertials and secondary upperwing-coverts less glossy and duller green, grading to olive-brown on mantle; secondary coverts have diffuse brown scaling that appears maroon in strong direct light; lateral uppertail-coverts lack obvious white tips; and ground-colour of uppertail is duller, olive-brown. Underbody, white, washed pale grey-brown and faintly barred on sides of, or sometimes over, whole of upper breast; barring on rest of underbody duller and less extensive than adult, being restricted to flanks and lateral

undertail-coverts, leaving broad white blaze through centre of lower breast to vent. Bill, black, with larger and paler dirty-yellow or pink base to lower mandible at first, but this soon becomes duller and smaller. Gape puffy and yellowish at fledging and soon becomes duller and less conspicuous. Iris, dark brown, with varying paler-grey or brown outer ring. Orbital ring slightly broader, pale green or yellowish to white. Dependent juveniles still growing wings and tail appear rather plain greenish brown above, with lower face and throat contrastingly paler cream and finely mottled grey-brown, lacking any suggestion of dark eye-stripe.

NOMINATE LUCIDUS: While adult male *lucidus* readily separable from male *plagosus*, adult females much more difficult to identify because colour and pattern of head, neck and dorsal plumage broadly overlaps; juveniles even more difficult to separate. Differences from *plagosus* (see Plumages for more detail): **Adult male** Typically has much more white speckling on forehead, extending, in midline, back to level of mid-crown; and sides of head whiter, with sparser dark mottling. Rest of cap, iridescent green, appearing concolorous with rest of upperparts (strong contrast between cap and upperparts in *plagosus*). Upperbody, iridescent green, with much fainter bronze iridescence. Dark ventral barring typically appears iridescent green, seldom with any trace of maroon iridescence. Bill noticeably broader at base when viewed from below, with larger and more prominent pale base to lower mandible. **Adult female** More similar in plumage to adult male *plagosus* than to adult male *lucidus* or female *plagosus*. Differs from adult male *lucidus* by: (1) Usually little white speckling on central forehead, though extent varies from none to as much as in adult *plagosus*; (2) top of head and neck, iridescent maroon-bronze, usually with faint green gloss from centre of crown to hindneck, though cap seldom as vividly green as in male; (3) sides of head generally more heavily mottled brown (but whiter than in adult male *plagosus*); (4) chin usually more white than adult male *lucidus* or either sex of *plagosus*, though barring of throat often extends as brown mottling onto chin; (5) upperparts mostly as male but with slightly stronger maroon-bronze gloss to mantle, usually only uppermost mantle but, rarely, all of mantle and inner scapulars have maroon-bronze gloss, and a few lack any maroon-bronze gloss; (6) iridescence of dark ventral barring duller, less green and more maroon (similar in appearance to adult male *plagosus*). **Juvenile** Very similar to juvenile *plagosus* and not always separable (see Plumages); best distinguished by always more strongly barred sides of underbody.

Similar species Often confused with **Horsfield's** and sometimes **Little** and **Gould's Bronze-Cuckoos**; see those texts.

Inhabit wide variety of forests and woodlands, preferring denser, possibly wetter, habitats than Horsfield's Bronze-Cuckoo. Seen singly or in twos, occasionally in small groups. Normally rather inconspicuous among foliage, but more obvious in breeding season when call from high, but not usually exposed, perches (cf. Horsfield's) and perform noisy chasing communal displays. Flight swift, direct and slightly undulating, as other bronze-cuckoos. Main Whistling Call, uttered by adult and usually only during breeding season, and often also at night, a distinctive clear and repeated whistle *kui-kui-kui-kui...* that ends in downslurred whistled *tiu-tiu-tiu*, latter notes recalling downslurred whistle of Horsfield's, only with distinctly more wavering quality.

HABITAT In AUST., a wide variety of wooded habitats, from lightly wooded country to rainforest; mostly in canopy (Roberts

1979; Porter & Henderson 1983; Loyn 1985a,c; Marchant 1992; Vic. Atlas); sometimes at high altitudes, up to >1800 m asl (Osborne & Green 1992). Usually in forests and woodlands dominated by *Eucalyptus*: from dense wet forests, such as Mountain Ash *E. regnans* forests in e. Aust., Jarrah *E. marginata* and Karri *E. diversicolor* forests in WA, to dry open assemblages, such as River Red Gum *E. camaldulensis* woodlands (Bedgood 1973; Roberts & Ingram 1976; Abbott 1981; Nichols & Nichols 1984; Loyn 1985a,c; Vic. Atlas). In e. Aust., inhabit both mature forest and forest regenerating after logging (Loyn 1980, 1985a,c; Kavanagh *et al.* 1985; Smith 1985). Sometimes in alpine and subalpine habitats, including Snow Gum *E. pauciflora* woodland and tall herbfields (Longmore 1973; Loyn 1985a; Schulz 1991; Osborne & Green 1992); in dense paperbark *Melaleuca* thickets and woodland; or open Brigalow *Acacia harpophylla* woodland (Johnstone 1983; Garnett & Bredl 1985; Ford 1987; Leach & Hines 1987; Leach 1988); once recorded among native pines *Callitris* in dry gully (NSW Bird Rep. 1983). Sometimes in mallee shrubland, and coastal scrub or heath (Gibson 1977; Horrocks & Brown 1993; Storr 27; SA Bird Rep. 1975). Sometimes in pine *Pinus* plantations (Friend 1982); also in farmland, including wooded pasture and orchards (Bravery 1970; Dell 1971; Sedgwick 1984). Also occur in built-up areas, mainly in parks and gardens (Sedgwick 1968; Napier 1969; Gibson 1977; McKilligan & McKilligan 1987; Howe & Dell 1990; NSW Bird Rep. 1994). Rarely in rainforest (Robertson & McGill 1948; Cooper 1974), but sometimes in rainforest regrowth (Laurance *et al.* 1996). Said that generally in more densely wooded habitats than those inhabited by Horsfield's Bronze-Cuckoo (Vic. Atlas). In NZ, occur up to c. 1200 m asl, but prefer low altitudes. Mainly in dense or open forests: native forests and remnant patches, including mixed podocarp-broadleaf forest (Sibson 1958; Hilton 1969; Lambert 1970; Edgar 1978; Falla *et al.* 1979; Wilson *et al.* 1988; Oliver; CSN). Also occur in plantations of exotic pines *Pinus*, macrocarpa *Cupressus* or firs *Abies* (Dawson 1951, 1954; Blackburn 1962; St Paul 1976; Oliver; CSN); and said to prefer exotic forests in some areas (CSN 7). Often among willows *Salix* along waterways; in wooded farmland; among weedy growths of lupins, gorse or ragwort (Edgar 1961; St Paul 1976; CSN). Though occur in some 'scrublands', said to avoid extensive blocks of manuka *Leptospermum* (St Paul 1976; Oliver; *contra* CSN). Often in suburban areas, in parks and gardens, or on golf courses (Stidolph 1977; Guest & Guest 1987, 1993; CSN). Rarely among mangroves (CSN 19 [Suppl.], 31). Vagrant on Auckland Is recorded feeding on ground in *Dracophyllum longifolium* shrubland (McClelland & Moore 1991).

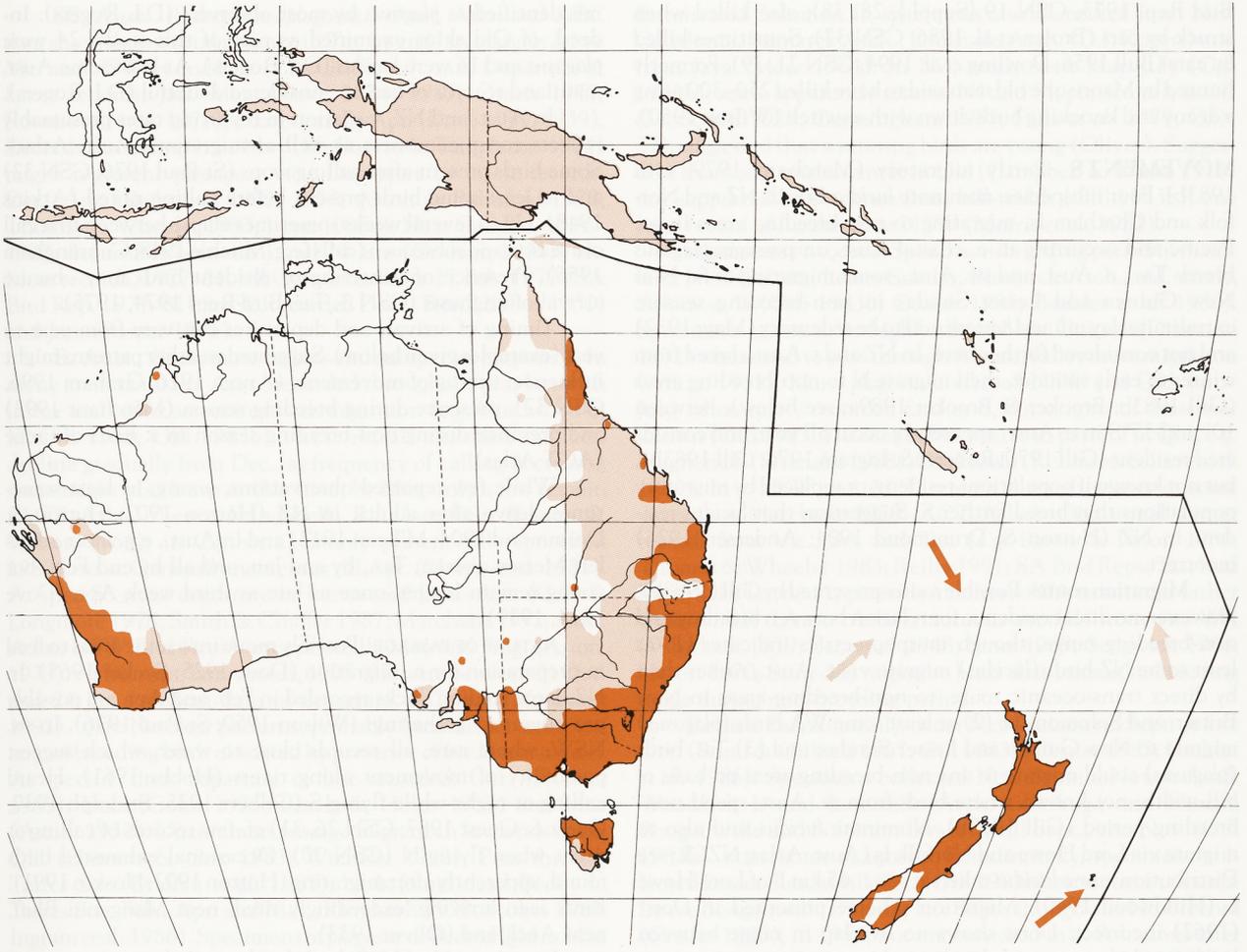
In AUST., usually forage among foliage of crowns of trees, particularly those infested with caterpillars (Young 1973; Ford & Bell 1981; Keast 1985; Loyn 1985a,b; Ford *et al.* 1986); usually in forests and woodlands, but sometimes in gardens (Sedgwick 1968) and once among citrus trees (Bravery 1970). In NZ, mostly forage among foliage of trees and shrubs, especially those infested with insect larvae, particularly kowhai *Sophora* and fruit trees; sometimes among grapevines; also among weeds, such as ragwort and lupins (Wilkinson & Wilkinson 1952; Guddop 1954; Edgar 1961; Oliver; CSN). Once seen feeding on green berries in hawthorn *Crataegus* tree (CSN 4). Rarely, forage on ground (St Paul 1976; CSN 19 [Suppl.]); once seen foraging among stones beneath willows and gorse (CSN 32). Rarely, feed aerially in forests (CSN 42).

Usually roost among foliage of trees or shrubs. Sometimes perch on powerlines (CSN 30, 37). Young bird once recorded resting on window sill (Macdonald 1955).

DISTRIBUTION AND POPULATION Widespread from Lesser Sundas E through New Guinea to Louisiade and Bismarck Archs, Bougainville, Solomon Is, New Caledonia, Santa Cruz and Vanuatu, and e., s. and w. Aust. and NZ (Stokes 1980; Hadden 1981; Gill 1983b; Coates 1985; White & Bruce 1986; Bruggella 1992).

Aust. Widespread from w. C. York Pen. to s. Eyre Pen.; also widespread in WA, from w. Great Aust. Bight N to Shark Bay. **Qld** Sparsely scattered on w. C. York Pen. N from Edward R. to islands in Torres Str. (Draffan *et al.* 1983; Garnett & Bredl 1985; Aust. Atlas). Widespread along e. coast, from Iron Ra. S to NSW border, and inland into central regions, to line from Forty Mile Scrub NP (W of Tully), through Longreach to St George (Storr 19; Aust. Atlas; Qld Bird Reps). Single record farther W at Croydon, in North-central District (Ford *et al.* 1980). Also recorded on several offshore islands (Kikkawa 1976; Storr 19). **NSW** Widespread W to c. 145°E, and to 144°E in Riverina. Rarely farther W, into Upper and Lower Western Regions, at Cobar, Wilcannia, Mootwingee NP, and near Broken Hill (Schmidt 1978; Brooker & Brooker 1989a; Cooper & McAllan 1995; Aust. Atlas; NSW Bird Reps). **Vic.** Generally widespread in all areas S of 36°S; only records farther N are along Murray R., near Jingellic (NSW), and between Cobram and Barmah State Park (Vic. Atlas); no Aust. Atlas records in Mallee District, but twice recorded (breeding) in w. Mallee (Brooker & Brooker 1989a) and vagrant to Wyperfeld NP (R.H. Loyn). **Tas.** Widespread, including islands in Bass Str. (Green 1969; Green & McGarvie 1971; McGarvie & Templeton 1974; Thomas 1979; Newman *et al.* 1984). **SA** Mainly confined to S of 34°S. Occur in South-East Region but rarely in lower reaches of Murray R., and generally absent in e. Murray-Mallee Region; mostly occur Mt Lofty Ras, including Fleurieu Pen.; Kangaroo I.; Adelaide Plains, and s. Yorke and Eyre Pens (SAOA 1977; Baxter 1989; Stove 1994; Aust. Atlas; SA Bird Reps). Rarely recorded farther N, including records at Alligator Gorge in Flinders Ras, at Spring Hill CP in Lower North Region, and near Port Pirie (Brooker & Brooker 1989a; SA Bird Reps). **WA** On Nullarbor Plain, regularly recorded at Eyre (Martindale 1980; Congreve 1982; Congreve & Congreve 1985; Dymond 1988), Burnabie (Storr 27) and elsewhere (Reilly *et al.* 1975); possibly more widespread there than indicated by Aust. Atlas. Farther W, scattered records in w. Eucla Div., from round Israelite Bay NW to Moir Rock and L. Medcalf; widespread W of 120°E, mainly SW of line between L. Cronin and Geraldton, with a few scattered records N to Carnarvon (Saunders & Ingram 1995; Serventy & Whittell; Aust. Atlas). Few records in mid-W or NW: isolated records in Gascoyne Region at Mileura Stn, Murchison R. and Landor Stn on middle reaches of Gascoyne R. (Serventy & Whittell); and at Dampier and Roebourne in Pilbara Region (Storr 16; Aust. Atlas); in Kimberley Div., recorded near Anna Plains (adult, 25 Feb. 1986; Ford 1987); at Anna Plains Stn (juvenile and adult, 13 Mar. 1994; AWSG); Roebuck Bay (single young in post-juvenile moult, 27 Mar. 1996; AWSG); round Broome (Oct. 1989, Mar. 1990, Apr. 1991; Collins 1995); and near C. Berthelot (immature, 17 Apr. 1977; Ford & Johnstone 1981). **NT** Single specimen, collected Alexandra, 25 Dec. 1905, said to be this species (Ingram 1907; Storr 4) but reidentified as immature Horsfield's Bronze-Cuckoo (Parker 1970).

NZ NI Widespread in all regions (NZ Atlas; CSN), and on some offshore islands (Hicks *et al.* 1975; Cunningham & Moors 1985; Tennyson & Pearce 1995; CSN). **SI** Recorded all regions but not widespread throughout. **MARLBOROUGH:** Many records in Marlborough Sounds and in Seaward Kaikoura Ra.



CANTERBURY: Scattered records from lower reaches of Waipara R., S to Banks Pen. and mouth of Rakaia R.; also many records at w. edge of Canterbury Plains, S to Timarau. Sparsely scattered farther W in Southern Alps. **OTAGO, SOUTHLAND:** Widespread from Otago Pen. to e. Toetoes Bay; scattered records round Invercargill and on Stewart I. Farther W, widespread but scattered records in Fiordland, extending into nw. Otago. Sparsely scattered records elsewhere. **WEST COAST, NELSON:** Widespread (NZ Atlas; CSN).

Lord Howe I. Regular visitor (Disney & Smithers 1972; Hutton 1991).

Norfolk I. Regular breeding migrant. Widespread in small numbers, including Philip I. (Schodde *et al.* 1983; Hermes 1985; Hermes *et al.* 1986).

Kermadec Is Vagrant. Said to have been recorded on Raoul I., <1890 (Cheeseman 1887, 1890); one heard calling, 17 Nov. 1966 (Merton 1970).

Chatham Is Regular breeding migrant (Fleming 1939; West 1988; Freeman 1994; Nilsson *et al.* 1994).

Macquarie I. Single, 25 Nov. 1898 (Campbell).

Snares Is Vagrant. Single specimen, 12 Nov. 1976 (Sagar 1977).

Auckland Is Single, Ocean I., 30 Nov. 1989 (McClelland & Moore 1991).

Breeding In Aust., widespread throughout most of range, though fewer records inland; mostly S of 25°S, but farther N, scattered records near Rockhampton and Mackay, and also

recorded along ne. coast from Ayr N to Cooktown; isolated record in sw. Kimberley Div. (Brooker & Brooker 1989a; Storr 11, 19; Aust. Atlas; NRS). In NZ, probably throughout range; may potentially breed anywhere because of wide distribution of host Grey Warbler *Gerygone igata*. Also breed on Norfolk (Schodde *et al.* 1983; Hermes 1985) and Chatham Is (Fleming 1939; Dennison *et al.* 1984). May have bred on Lord Howe I. (Mathews) but not since extinction of Lord Howe I. Warbler *Gerygone insularis* (Disney & Smithers 1972). Extralimitally, breed Vanuatu and New Caledonia, but apparently not Lesser Sundas, New Guinea or Solomon Is (Gill 1983b).

Populations In *Eucalyptus* forests and woodlands in Aust.: 0.02–0.42 birds/ha near Armidale, NSW (Ford & Bell 1981; Ford *et al.* 1985); 0.1 birds/ha at Wollomombi, NSW (Aust. Atlas); 0.1 birds/ha along Hawkesbury R., NSW (Keast 1985); 0.07 birds/ha round Canberra (Bell 1980); up to 0.47 territories/ha at Boola Boola SF, Vic. (Loyn 1980); 0.4 birds/ha along Margaret R., WA (Keast 1985). At Eden, NSW, up to 0.3 birds/ha/h counted (Kavanagh *et al.* 1985). At L. Wanaka, NZ, four birds recorded in radius of c. 91 m (CSN 20). On Great Barrier I., three young Cuckoos recorded in c. 4 ha (CSN 21). In Dec. 1962, five pairs estimated in c. 137.6 ha on Big Chicken I. (Skegg 1964). On Chatham Is, six birds recorded in 12,500 ha (CSN 37). Said to have declined in Wheatbelt of WA since 1940s (Saunders & Ingram 1995).

Often killed by flying into obstacles, such as windows or lighthouses (Stokes 1983; Hermes 1985; Taplin 1991; NSW

Bird Rep. 1973; CSN 19 [Suppl.], 28, 38); also killed when struck by cars (Brown *et al.* 1986; CSN 37). Sometimes killed by cats (Bull 1956; Dowling *et al.* 1994; CSN 21, 39). Formerly hunted by Maori: one old man said to have killed 250–300 using a decoy and knocking birds down with a switch (Wilson 1950).

MOVEMENTS Partly migratory (Marchant 1979; Gill 1983b). Four subspecies: nominate *lucidus* breeds NZ and Norfolk and Chatham Is, migrating to non-breeding areas in sw. Pacific and occurring in e. coastal Aust. on passage; *plagosus* breeds Tas., e. Aust. and sw. Aust., some migrating as far N as New Guinea and Lesser Sundas in non-breeding season; extralimital *layardi* and *harterti* said to be sedentary (Mayr 1932) and not considered further here. In NZ and s. Aust., breed from winter to early summer, then migrate N to non-breeding areas (Gill 1983b; Brooker & Brooker 1989a; see below); between 10° and 35°S in e. Aust. apparently occur all year, and considered resident (Gill 1970; Roberts & Ingram 1976; Gill 1983b), but not known if populations resident, or replaced by migratory populations that breed farther S. Suggestion that *lucidus* resident in NZ (Hutton & Drummond 1904; Andersen 1926) incorrect.

Migration routes Possible routes presented by Gill (1983b). However, no direct evidence for relation between breeding and non-breeding range, though morphometrics indicate: (1) at least some NZ birds (*lucidus*) migrate via e. Aust., rather than by direct trans-oceanic route, to non-breeding areas in New Britain and Solomons Is; (2) at least some WA birds (*plagosus*) migrate to New Guinea and Lesser Sundas; and (3) Tas. birds (*plagosus*) could migrate to any non-breeding areas on basis of bill-width; not known where birds from se. Aust. spend non-breeding period (Gill 1983b). Nominate *lucidus* said also to migrate via Lord Howe and Norfolk Is (Aust. Atlas; NZCL; see Distribution); one *lucidus* taken at sea c. 65 km E of Lord Howe I. (Hindwood 1940). Migration scheme presented in Dorst (1962) incorrect; Dorst shows no overlap in range between *lucidus* and *plagosus*, with *lucidus* making trans-oceanic migration and *plagosus* making broad trans-Aust. migration; scheme wrong in that, at least, there is: (1) use of e. Aust. by *lucidus* migrating to and from NZ; (2) no evidence of passage through central Aust. or NT; and (3) non-breeding area in mid-e. Aust. not shown. Not known how many, if any, use trans-oceanic route described by Fell (1947).

At least some, and probably many, *lucidus* migrate via e. Aust. on both n. and s. passage. Formerly thought only a few NZ birds occurred in e. Aust., mostly in autumn, occasionally in spring (e.g. Aust. Atlas). However, study of bill-measurements suggested e. Aust. an important route for *lucidus* on both n. and s. passage (Gill 1983b). Acceptable records of *lucidus* (specimens, captures, sightings) from NSW, Feb.–Apr. (Falla 1953; NSW Bird Reps 1975, 1977, 1978; D.I. Rogers); and from Qld, Mar.–Apr. (Qld Bird Rep. 1985; D.I. Rogers); one undated specimen from C. York Pen. (QM 018490) suggests *lucidus* might migrate through e. Aust. to or from n. Qld (also see Wilson 1965).

Abundance of *lucidus* on passage in Aust. has probably been underestimated (e.g. Gibson 1977) because: (1) many observers do not distinguish NZ and Aust. birds; (2) no evidence that NZ migrants call when they are in Aust., and forest-dwelling cuckoos that are not calling are easily overlooked; and (3) the most widely used identification literature makes no mention of the extensive sexual variation in *lucidus*, and field characters stressed in the literature only work for adult males; thus juvenile and adult female *lucidus* in Aust. probably

misidentified as *plagosus* by most observers (D.I. Rogers). Indeed, of Qld skins examined as part of this study, 24 were *plagosus* and 16 were *lucidus* (D.I. Rogers). At least some Aust. mainland records of *lucidus* considered doubtful (D.I. Rogers).

In Aust. and NZ, variation in reporting rates presumably reflects conspicuousness as well as migration (Aust. Atlas). Some birds present after calling stops (St Paul 1976; CSN 32) and at least some birds present before calling noted (Atkins 1948). Up to several weeks sometimes elapse between first call of a season and subsequent calls (e.g. Mitchie 1948; Cunningham 1955). Presence of wintering or resident birds may obscure arrival of migrants (CSN 3; Tas. Bird Reps 1974, 1975).

Timing of arrivals and departures can vary from year to year (examples given below). Suggested weather patterns might influence: timing of movements (Anon. 1916; Graham 1996, CSN 37), presence during breeding season (Marchant 1992) and presence during non-breeding season in s. parts of range (ACT Atlas).

While few reported observations, young, at least sometimes, leave after adults, in NZ (Hutton 1902; Hutton & Drummond 1904; M'Lean 1912) and in Aust., e.g. most adults left Mersey district, Tas., by end Jan. and all by end Feb., but young remain longer, once as late as third week Apr. (Dove 1934, 1939).

NATURE OF PASSAGE: Possibly move into some areas to feed in preparation for n. migration (Dove 1925; Secker 1965). In NZ, large feeding flocks recorded in Feb. and Apr. are possibly pre-migratory gatherings (Wilson 1950; St Paul 1976). In sw. NSW, where rare, all records close to water, which suggest possibility of movement along rivers (Hobbs 1961). Heard calling at night while flying S (Gilbert 1935; Stidolph 1937; Guest & Guest 1987; CSN 26, 31) cf. few records of calling at night when flying N (CSN 30). Occasional exhausted birds found, apparently after migrating (Hutton 1902; Hoskin 1991). Birds seen arriving 'exceedingly tired' near Manganui Bluff, near Auckland (Oliver 1933).

In e. Aust. N of 35°S, both *lucidus* and *plagosus* occur and most records not identified to subspecies. Records of *lucidus* in e. Aust. thus incomplete, and no true picture of the timing and patterns of movements in e. Aust. can yet be gained. No confirmed records of *lucidus* in WA, SA, Tas. or Vic., and records from these considered below to be *plagosus*. Only *lucidus* recorded NZ. No records of *plagosus* from Lord Howe I. (Hindwood 1940).

Departure NZ (Nominate *lucidus*.) Leave Jan.–Apr., though departures recorded as early as Nov. and as late as May (M'Lean 1912; Smith 1926; Fell 1948; Macdonald 1955; Graham 1996; Oliver; see below). Suggested that leave earlier from S than N (Hutton & Drummond 1904; Dove 1906). However, at specific sites in SI, departures or latest records Jan.–Mar. (Moncrieff 1929; Dean 1990; CSN), exceptionally Nov. (CSN 30); and in NI, Nov.–Apr. (Wilkinson 1927; Moncrieff 1929; Guest & Guest 1987; St Paul 1976; CSN). Timing can vary, e.g. last recorded at Charleston, SI, 3 Mar. 1984 and 18 Jan. 1985 (CSN 32, 33); last heard Clevedon, NI, 12 Feb. 1986 and 15 Jan. 1987 (CSN 34, 35); last dates, 1947–60, at Tihoi, Mingingui and Waiiau, NI, ranged from 16 Dec. to 28 Mar. (St Paul 1976).

Lord Howe I. Irregular visitor or straggler (Hindwood 1940; Hutton 1991; Oliver); sometimes during or after storms when assumed to have been blown off normal course (Hindwood 1940). Singles (subspecies not identified) recorded Feb.–Mar. (McKean & Hindwood 1964; NSW Bird Reps 1973, 1974, 1986). **Norfolk I.** Regular, with most records till Feb. (Schodde *et al.* 1983).

SE. Aust. (Subspecies *plagosus*.) Aust. Atlas and ABC data show almost total absence in Tas. by end Jan.; largely leave Vic. and NSW by end Feb. (P.A. Griffioen). TAS.: Departure or latest records, Jan.–Mar. (Dove 1934, 1939; Green 1977; Rounsevell *et al.* 1977), exceptionally Apr. (Dove 1934, 1939). Records from King I. in May (McGarvie & Templeton 1974) might represent passage. VIC.: Departure or latest records, Dec.–Apr. (Bedgood 1972, 1973; Aston & Balmford 1978; Thomas & Wheeler 1983; Loyn 1985c). Near Cobden, 1896–1902, departures between 1 and 24 Jan. (Graham 1903). SA: Most records, 1977–81, till Oct., latest date 27 Feb. 1977 (SA Bird Rep. 1977–81); in SE, recorded Dec. (Terrill & Rix 1950) and Jan. (Baxter 1995).

E. Aust. (Nominate *lucidus* and subspecies *plagosus*.) In many areas of mid-e. Aust., recorded throughout year but with influx and efflux associated with migration (e.g. Hindwood & McGill 1958; Gill 1983b). ACT: At all altitudes, numbers decline gradually from Dec., as frequency of calling decreases; some might also leave at this time; by Mar. only a few remain (ACT Atlas). Leave Brindabella Ra., late Feb. (Lamm & Wilson 1966); in Canberra, mainly present till Apr. (Bell 1980). NSW: Generally numerous till Apr. (Morris *et al.* 1981). At specific sites, departure or last record Dec.–Apr. (Gall & Longmore 1978; Smith & Chaffer 1987; Marchant 1992; Aust. Atlas; NSW Bird Reps); exceptionally May and Aug. (Anon. 1930). At Moruya, last records, 1975–85, were between 21 Dec. and 24 Jan.; median date of departure, 6–7 Jan. (Marchant 1992). QLD: No clear patterns, probably because departures, if any, of breeding birds obscured by presence of birds year-round. At specific sites, departure or last recorded: Oct. (Holmes 1987), Dec. (Cohn 1925; Leach & Hines 1987) and Mar. (Anon. 1930). Uncommon passage migrant in lowlands of ne. Qld (Garnett & Cox 1983; Wieneke 1992). Pass through Torres Str. (Draffan *et al.* 1983); birds found dead Booby I., Torres Str., Feb., Apr. and May (Kinghorn 1928; Stokes 1983; Ingram *et al.* 1986). Specimens of *plagosus* collected Qld in Mar. (Ford *et al.* 1980).

WA (Subspecies *plagosus*.) At specific sites or areas in SW Region, departure or last records, Nov.–Feb. (Jenkins 1931; Sedgwick 1940b, 1942, 1973, 1988; Saunders & Ingram 1995; Storr 28), once Apr. (Heron 1970). Latest date at Rottnest I., 31 Aug. (Storr 1965), is unusually early. Usually leave Swan Coastal Plain between mid-Nov. and early Jan., juveniles occasionally remaining till Feb. or early Mar. (Sedgwick 1940b, 1942; Storr 28). Some variation in timing of departure: left Avon R. between Northam and Toodyay, third week Nov. 1988, and in third week Dec. 1989 and 1990; left Pingrup second week Jan. 1988 and third week Nov. 1989 (Saunders & Ingram 1995). In n. WA, one collected Derby, 20 Oct. 1910 (Söderberg 1918); one Oct. record from Broome (Collins 1995).

Non-breeding Non-breeding range of different populations not well known. Populations breeding HANZAB region may overlap at least in Guadalcanal, Bismarck Arch. and Irian Jaya (Iredale 1956; Gill 1983b). Specimens collected Lesser Sundas from Apr.; New Guinea from Apr. or early Mar. (Rand & Gilliard 1967; Gill 1983b; Coates 1985; Beehler *et al.* 1986); New Britain, New Ireland, Woodlark I. and Louisiade Arch., from Mar.; and Nissan, Bougainville and Solomon Is mostly from Mar. but also Jan.–Feb. (Gill 1983b). Extraliminally, N of about 10°S (Lesser Sundas, New Guinea and Solomon Is) apparently do not breed and only present in austral winter (Gill 1983b). Not recorded Bali (Mason & Jarvis 1989) or Java (Andrew 1992).

NOMINATE LUCIDUS: Spend non-breeding period in New

Britain and Solomon Is; specimens also identified from New Caledonia, Bismarck Arch., Louisiade Arch. (D.I. Rogers) and Irian Jaya (Mees 1964). In NZ, rarely seen May–July (Gill 1983b); some apparently remain NI and SI, particularly n. NI (Moncrieff 1929; Cunningham 1955; Falla *et al.* 1979; CSN 37); suggested that wintering birds are young (Oliver). Suggestion that some might winter in Qld (Campbell & White 1910) not supported by evidence from bill-width (Gill 1983b); one June record of *lucidus* from NSW (Morris *et al.* 1981).

SUBSPECIES PLAGOSUS: Spend non-breeding period in mainland New Guinea, Lesser Sundas, Bismarck Arch. and, rarely, Solomon Is (Gill 1983b; Coates 1985; Beehler *et al.* 1986). Specimens taken in e. highlands of New Guinea (Diamond 1972) where said to pass through Aiyura Valley on n. migration (Anon. 1981). Many *plagosus* collected NSW and Qld, Jan.–July, when rarely recorded farther S, but origins of these not known (Gill 1983b). Recorded in winter in parts of n. Qld, e.g. Magnetic I. (Wieneke 1988), Cooktown (Robinson & Laverock 1900). In s. NSW and ACT, remain through winter in some years (e.g. Marchant 1979; ACT Atlas). Occasional winter records from Vic., SA and Tas. (e.g. Paton & Paton 1980; Thomas & Wheeler 1983; Reilly 1991; SA Bird Reps; Tas. Bird Reps; R.H. Loyn). Apparently absent sw. WA in autumn rather than winter (Aust. Atlas); autumn records from sw. WA (Whitlock 1939; Serventy 1948; Storr 1965; Sedgwick 1968; Heron 1970; Storr 28) might be birds that remain in breeding range during non-breeding period.

Return Extraliminally, occur New Guinea till Sept. or late Oct. (Rand & Gilliard 1967; Gill 1983b; Coates 1985; Beehler *et al.* 1986). Specimens collected New Britain, New Ireland, Woodlark I. and Louisiade Arch. till Aug.; and Nissan, Bougainville and Solomon Is mostly till Sept., also Nov. (Gill 1983b). **SUBSPECIES PLAGOSUS:** Extraliminally, specimens collected Lesser Sundas till Oct. (Gill 1983b). **NOMINATE LUCIDUS:** Leave Bougainville I. mostly late Sept., though one Nov. record (Coates 1985); in 1953, not encountered in e. Solomons after Sept. (Cain & Galbraith 1956). One specimen (MV B6208) collected c. 640 km N of North Cape, NZ, in late Oct. (D.I. Rogers) suggesting possibility of some trans-oceanic passage to NZ. Regular to Norfolk I., where records from Aug. and specimens from Oct. and Nov. (Schodde *et al.* 1983; D.I. Rogers). Suggested some passage might take place off e. Aust. coast (Storr 19) but on single specimen. Apparently mix with *plagosus* while on migration in e. Aust.; birds of both subspecies caught only minutes apart in Oct. 1963 at L. George, NSW (Wilson 1965). Nominate collected and captured in Qld, Sept.–Nov. and in NSW, Aug.–Nov. (Wilson 1965; D.I. Rogers).

E. Aust. (Nominate *lucidus* and subspecies *plagosus*.) QLD: Pass through Torres Str. (Draffan *et al.* 1983). Arrival or first records at specific sites: June–Aug. (Cohn 1925; Anon. 1930; Perkins 1973); earlier records, in Apr.–May (Holmes 1987; Leach & Hines 1987), possibly wintering birds. NSW: Generally arrive in E in Aug.–Sept. (Gilbert 1935); most numerous from Aug. (Morris *et al.* 1981). Arrival or first record, July–Oct. (Anon. 1930; Hyem 1936; Heron 1973; Bell 1986; Smith & Chaffer 1987; NSW Bird Reps); exceptional arrival in late June (Anon. 1930) possibly wintering bird. At Moruya, first season records, 1975–85, between 20 July and 8 Sept., with median date of arrival, 8–9 Aug. (Marchant 1992). ACT: Usually arrive Aug.–Sept., though timing unpredictable, with first arrival any time between late July and late Aug. (ACT Atlas); arrive Brindabella Ra., late Sept. (Lamm & Wilson 1966); present Canberra mainly from Oct. (Bell 1980).

SE. Aust. (Subspecies *plagosus*) Aust. Atlas and ABC

data show return to se. Aust. and Tas. in Sept., and steady increase in Oct.–Nov. (P.A. Griffioen). NSW: Apparent influx to Sydney region in spring (Hoskin 1991). Arrivals of *plagosus*, Aug. and Sept. (NSW Bird Rep. 1978). vic.: Arrived or first recorded, July–Oct. (Barrett 1905; Bedgood 1972, 1973; Aston & Balmford 1978; Loyn 1980, 1985c; Thomas & Wheeler 1983; Vic. Bird Reps). Near Cobden, 1896–1902, arrivals between 1 and 30 Sept. (Graham 1903). At least some apparently move through Wilsons Prom. to Tas. (Cooper 1975). TAS.: Arrive or first recorded, Aug.–Oct. (Dove 1922, 1928, 1929, 1935; Thomas 1969; Green 1977, 1989; Tas. Bird Reps). On King I., arrival 29 Aug. 1966, 8 Aug. 1972 (Thomas 1969; Green & McGarvie 1971; McGarvie & Templeton 1974); in Devonport district, arrived 10 Oct. 1921, 8 Oct. 1927, 23 Sept. 1928, 22 Oct. 1934, 30 Sept. 1942, 13 Sept. 1943, 19 Sept. 1944 (Dove 1922, 1928, 1929, 1935; Lawrence 1945). SA: Earliest date 1977–81, 26 Aug. 1981 (SA Bird Reps 1977–81); arrivals also from July (Anon. 1920; Chenery & Morgan 1920; Terrill & Rix 1950).

NZ Suggested that arrive in independent flocks at separate points on coast (Fell 1948); said not to be widely distributed till Oct., though first arrivals earlier than this (Falla *et al.* 1979). No distributional pattern in first arrival dates (Cunningham 1955), *contra* claims that arrive later in SI than NI (Hutton 1902; Stidolph 1922; Williams 1973). Range of dates when first heard, 29 June–8 Nov. (CSN data for 41 years between 1943 and 1995). Study of arrival in 1952 and 1953: most early arrivals probably individuals or small numbers and could make landfall anywhere; main migration of larger flocks about end Sept; arrival dates at particular sites varied by up to 23 days between years; main migration c. 1 week later in 1953 than 1952 (Cunningham 1955). Near Waiau, NI, said to arrive at coast 1 week or more earlier than in high country (St Paul 1976). Suggested that timing of arrival related to weather patterns in e. Aust. and Tasman Sea (Graham 1996); said usually to arrive with n. wind (Andersen 1926). NI: Range of dates when first heard: Far North, 23 Sept.–13 Oct.; Northland, 15 Sept.–11 Oct.; Auckland, 11 Sept.–31 Oct.; South Auckland, 2 Sept.–14 Oct.; Bay of Plenty, 20 Sept.–16 Oct.; Waikato, 22 Sept.–12 Oct.; Gisbourne–Wairoa, 29 June–29 Sept.; Hawkes Bay, 19 Sept.–5 Oct.; Taranaki, 16 Sept.–17 Oct.; Wellington, 22 Sept.–4 Oct. (CSN data for 36 years between 1943 and 1995). At specific sites, arrive or first recorded: Aug.–early Nov., mostly Sept.–Oct. (see for example Cunningham 1953, 1955), e.g. at Wellsford, 1938–52, arrival from 24 Sept. to 26 Oct.; at Tihoi, Minginui and Waiau, 1946–47 and 1949–60, arrival from 17 Sept. to 7 Oct. (Cunningham 1953, 1955; St Paul 1976); at Titirange, w. Auckland, 1986–95, arrival from 16 Sept. to 7 Oct. (Graham 1996). Late June record probably wintering bird. st: Range of dates when first heard: Nelson, 13 Sept.–10 Oct.; West Coast, 27 Sept.–18 Oct.; Otago, 18 Sept.–8 Nov.; Southland, 5–17 Oct. (CSN data for 22 years between 1943 and 1995). At specific sites, also arrive or first recorded Sept.–Oct. (Moncrieff 1929, 1938; Anon. 1948; CSN). At Ngatimoti, 1923–37, arrivals from 16 Sept. to 20 Oct. (Moncrieff 1938); at Puerua, s. Otago, 1943–46, arrivals 16 to 28 Oct. (Anon. 1948).

First reach Stewart I. early Nov. (Fell 1948). Regular to Chatham Is (Fleming 1939; CSN 43); on South East I., arrive early Oct. (Nilsson *et al.* 1994), but heard Chatham I. 25 Sept. 1961 (Freeman 1994).

WA (Subspecies *plagosus*). Assumed to migrate S via NT and Kimberley Div. (Johnstone 1983), but no confirmed records from NT and few confirmed records in NW or mid-W (see

Distribution) where possibly occur only on passage (Serventy & Whittell). In SW, arrive or first recorded, June–Oct. (Anon. 1930; Whitlock 1939; Sedgwick 1940a, 1942, 1968, 1973, 1988; Heron 1970; Saunders & Ingram 1995; Storr 28), exceptionally Apr.–May (Serventy 1948; Storr 1965; Masters & Milhinch 1974; Storr 28) which may be birds that stayed in non-breeding season. Arrived Avon R. first week July 1988, third week July 1989, and third week May 1990; arrived Pingrup third week June 1988, first week Aug. 1989 and fourth week July 1990 (Saunders & Ingram 1995). Said to occur on Rottneest I. during s. passage (Storr 28).

Breeding In sw. and se. Aust. and NZ, present and breed from winter to summer; between 10°S and 35°S (except possibly mid-WA where situation unclear) tend to occur all year and breed (Gill 1983b; Brooker & Brooker 1989a; see Breeding). In SE and Tas. Regions, reporting rates highest in spring (14.2% and 17.7% respectively) and lowest in winter (3.4% and 0.1%) (Aust. Atlas). Speculation that at least some fidelity to breeding sites (Michie 1948). Changes in local distribution between years might indicate birds do not return to same locations each year (Paton *et al.* 1994). Near Reefton, SI, NZ, apparent shift to higher altitudes Oct.–Dec. possibly a movement in search of Grey Warbler nests to parasitize (Dawson *et al.* 1978). Some annual variation in occurrence (Lord 1956; Leach & Hines 1987; Norris *et al.* 1995); presence during breeding season at Moruya possibly affected by drought (Marchant 1992). Some annual variation in numbers occurring at particular sites (Ford & Stone 1957; Secker 1965; Masters & Milhinch 1974; Nilsson *et al.* 1994); at Minginui, NI, NZ, average number of birds seen per count day varied between 15 seasons, 1946–61, from 0.10 to 2.64 (St Paul 1976). Little information from extralimital parts of range, but thought to be absent from n. non-breeding areas during summer (Gill 1983b).

Banding Of 803 banded in Aust. and New Guinea, 1953–96, 31 recoveries (4%); all (100%) <10 km from banding site. Of 28 banded in NZ to 1974, 4 recoveries (14%) (Robertson 1975). Adult banded Auckland killed following day <500 m from capture site (Bull 1956).

FOOD Almost entirely insects and their larvae, especially hairy caterpillars (Lepidoptera). **Behaviour** Poorly known. Mostly arboreal; usual feed in foliage of canopy of forests and woodlands; also reported feeding in foliage of shrubs and understorey; occasionally feed on ground and also reported to feed aerially (see Habitat and references therein). At Culeenup I., WA (n=20 feeding obs.), 80% in foliage of trees, rest of time spent feeding among small branches and twigs (Keast 1975). Feed singly (North; CSN 19 [Suppl.]) or in small groups of up to five birds (Potts 1946; Ford 1963; Segwick 1968). At Wollomombi, NSW, join in insectivorous mixed-species feeding flocks during Mar.–May; species involved mainly thornbills *Acanthiza* and other small insectivorous birds, e.g. Superb Fairy-wren *Malurus cyaneus*, White-throated Gerygone *Gerygone olivacea*, that are both major hosts of Cuckoos and nuclear species of mixed-species feeding flocks (Bell 1986). Feed mainly by gleaning (Ford *et al.* 1986); often seen collecting caterpillars from infested trees and shrubs, such as grapevines (North; CSN 32) and fruiting trees in orchards (North); also from citrus trees (Bravery 1970), and in NZ, seen collecting insects on kowhai *Sophora* tree (Potts 1946; CSN 19 [Suppl.]). When feeding on larvae of Magpie Moth *Nyctemara amica*, collect a number of larvae in bill before perching on a branch and mandibulating larvae till viscera and intestinal matter squeezed out and swallowed; exoskeleton discarded (Smith 1931). Said to take bird

eggs from nests of host, open them from one end, swallow contents, and discard shell (Morris 1978; Macdonald & Gill 1991).

Detailed studies In SI, NZ (460 prey items in 20 stomachs; Gill 1980): INSECTS: Coleoptera: Coccinellidae 55% freq., 27.2% no. (mostly *Coccinella undecimpunctata* and *Adalia bipunctata*); Dermaptera 5, 0.2; Diptera: Tipulidae 40, 8.9; Ephemeroptera 5, 0.2; Hemiptera 5.0, 0.4; Hymenoptera: Formicidae 10, 2.0; Lepidoptera: larv. 50, 45.9; ad. moths 10, 3.0; Odonata: Lestidae *Austrolestes colensis* 10, 2.2; Plecoptera: Austroperlidae: *Austroperla cyrene* 15, 8.6; unident. 15, 1.3.

Other records MOLLUSCS³³. ARANEAE: Spiders^{26,32}; Pholcidae². INSECTS^{1,29,30,32,34,38,45}: Coleoptera⁴¹: Chrysomelidae²²; Diptera^{2,26}; Hemiptera^{26,32}: Coccoidae³³; Corixidae²²; Hymenoptera: Formicidae^{26,27}; Symphyta⁴⁰; Tenthredinidae: *Caliroa cerasi*^{2,33}; Lepidoptera (larv. unless stated)^{2,3,5,9,11,13,15,16,17,19,26,29,30,32,33,34,35,36,37,38,39,42,43,46}: Arctiidae: *Nyctemara amica*^{6,7,8,10,21,25,33}; *Spilosoma glatignyi*^{18,31}; Geometridae^{14,24}: *Pholodes sinistraria*⁴; Limacodidae²⁹: *Doratifera*³¹; Lymantriidae²⁴; Noctuidae²²; *Agarista agricola*³⁰; Nymphalidae: *Danaus plexippus*⁴⁶; Sphingidae^{43,44}; Thaumetopoeidae: *Ochrogaster lunifer*²⁰; Odonata⁴¹. BIRDS (all eggs): Grey Warbler^{12,28}; Yellow-rumped Thornbill *Acanthiza chrysorrhoa*²³; Chaffinch *Fringilla coelebs*¹².

REFERENCES: ¹ Campbell & White 1910; ² Fulton 1910; ³ M'Lean 1911; ⁴ Cleland 1912; ⁵ MacGillivray 1914; ⁶ Grimmer 1922; ⁷ Moncrieff 1929; ⁸ Smith 1931; ⁹ Lord 1939; ¹⁰ Graham 1940; ¹¹ Potts 1946; ¹² Michie 1948; ¹³ Wilkinson & Wilkinson 1952; ¹⁴ Green 1966; ¹⁵ Kenneally 1968; ¹⁶ Sedgwick 1968; ¹⁷ Bravery 1970; ¹⁸ Dell 1971; ¹⁹ Green & McGarvie 1971; ²⁰ Young 1973; ²¹ St Paul 1976; ²² Vestjens 1977; ²³ Morris 1978; ²⁴ Lamothe 1979; ²⁵ Gill 1980; ²⁶ Ford 1985; ²⁷ Bell 1986; ²⁸ Macdonald & Gill 1991; ²⁹ Rose 1997; ³⁰ North; ³¹ Cleland; ³² Lea & Gray; ³³ Oliver; ³⁴ Hall; CSN ³⁵ 1, ³⁶ 5, ³⁷ 6, ³⁸ 19 [Suppl.], ³⁹ 23, ⁴⁰ 28, ⁴¹ 30, ⁴² 31, ⁴³ 32, ⁴⁴ 37, ⁴⁵ 38, ⁴⁶ 41.

Food eaten by captive injured birds in Cunningham (1955) and Blackburn (1963).

Young Fed insects and insect larvae by hosts (Gill 1982a). Food provided by Grey Warbler host included smooth-skinned larvae of several species of moth, beetles and green leafhoppers (Smith 1931; Woolley 1997). In nests of Grey Warblers, nests with Cuckoo visited less often than nests with 3–4 Warbler nestlings; feeding rate of Cuckoo varied from 5 feeds/h at 1–3 days old to maximum of 15 feeds/h at 16–18 days old (Gill 1982b).

Intake Gizzard has a soft thick non-keratinous inner layer. When larval Magpie Moths *Nyctemara amica* ingested, clusters of their spines, in regular rows, pierce lining of gizzard. Stomach contents: mean of 23 insects/stomach (maximum 62; n=20), mostly 1–15 mm long (399 insects measured; >80% <15 mm long) (Gill 1980).

SOCIAL ORGANIZATION Poorly known. Seen singly, in twos or small groups (Morris 1975; Longmore 1978), and often in trios (Marchant 1979). Solitary in non-breeding season; only in breeding season are two, possibly pair, or more seen together (North). Report of one flock of 15–20 birds (CSN 1). Appear usually to migrate in small groups of 6–10 (Fell 1947; Cunningham 1955; Ford 1963); solitary birds also seen coming in from sea; one flock of c. 200 may have just arrived after migration (Oliver). In sw. WA, arrive in small groups that forage together early in season; by Aug., disperse into territorial pairs (Ford 1963); in NZ, migratory groups remain together for 1–2 days after arrival (Gilbert 1935). Observations in spring–

summer of up to about five birds gathering to feed at concentration of caterpillars (Potts 1946; Sedgwick 1968). Communal displays of up to c. 12 birds occur in spring–summer (see below).

Bonds Form pairs during breeding season, at least during laying period (Ford 1963; Gill 1983a). Polyandry said to occur (Oliver). Possibly do not return to NZ to breed till second year (Gill 1983a). **Parental care** Adults said sometimes to feed fledgelings (Anon. 1910; Oliver; CSN 1), but this almost certainly misinterpretation of courtship feeding. Also claimed that adults sometimes teach young to sing (Oliver), but this seems unlikely. Fed by host-parents for 3–4 weeks after fledging (Gill 1982a; Brooker & Brooker 1989b). In NZ, 2–3 fledgelings sometimes associate together, for up to several days, with only one pair of host-parents feeding them all (Parkin 1954; Oliver; CSN 1, 6).

Breeding dispersion Observed to return to same breeding site in 2 successive years (Michie 1948; Gill 1983a). One bird seen 0.8–1.2 km from nest where it fledged 2 years earlier (Gill 1983a). **Territories, Home-range** In NZ, pairs appear to occupy exclusive home-ranges, at least during laying; at Kowhai Bush, estimated to be perhaps up to 20 ha in area (Gill 1983a). In sw. WA in breeding season, pairs said to establish territories with definite boundaries, usually of considerable area, e.g. one of c. 270 ha (Ford 1963).

Roosting Early in breeding season, one roosted in same tree for 1 month or more, calling often at night (North).

SOCIAL BEHAVIOUR Poorly known. Inconspicuous and difficult to observe except when calling (Gill 1983a). **Flock behaviour** Fly at night on migration, calling in flight (Gilbert 1934, 1935; Stidolph 1937). Migratory groups call often on arrival (Gilbert 1935). **Communal display** From late winter to summer, up to c. 12 birds, but often only about six, gather at a site, often high in trees, call repeatedly and fly from perch to perch; occurs at any time of day, lasting up to 1 h or more but usually only 5–10 min; usually give Call Note (see Voice) during display, but also occasionally give quieter musical chatter (Parsons 1923; Watson & Bull 1950; Wilson 1950; Guddop 1954; Fitzgerald 1960; Edgar 1961; Blackburn 1962; Dell 1971; Gill 1982a; CSN 1). When calling, sit erect and flick wings out, partly or fully (Watson & Bull 1950; Gill 1982a), wave them simultaneously (Wilson 1950), or fan both wings and tail vigorously (Dell 1971). Also described as slow pursuit, with rather slow raising and lowering of wings, each wing often not quite in synchrony, accompanied by calling (Sedgwick 1955). Courtship feeding during Communal Display not recorded (*contra* inference of Watson & Bull 1950). Once, lone bird giving Whistling Call was joined by another, and Communal Display began; 2–3 other birds arrived in next few minutes and joined display and stayed till it stopped after c. 5 min and all dispersed (Watson & Bull 1950). Said to leave Communal Display two at a time (St Paul 1976). Playback of calls induces birds to approach and begin displaying (Gill 1982a). Groups of displaying males in spring reported by M'Lean (1911), probably engaged in Communal Display. Sometimes one of a pair will chase a newcomer, both giving call typical of Communal Display; sometimes lone bird gives this call but not continuously as in Display (Dell 1971). Once, a bird calling on dead branch was joined by another; wing-quivering and excited chirruping took place before first bird flew off closely followed by second (Rix 1976). Four birds seen apparently driving one another, with much calling, off branch at top of tree (Moncrieff 1925). **Calling behaviour** Most calling in spring–summer; typically from high perch in canopy, sometimes from dead

branch at top of tree, but often among foliage (cf. Horsfield's Bronze-Cuckoo). Call day and night (Stidolph 1937; Macdonald 1951; Cunningham 1955; St Paul 1976; Schodde 1980; North; Serventy & Whittell). During breeding season, will call from same area for long periods (Macdonald 1951); one roosted in same tree for 1 month or more, calling often at night (North). In NZ, adults said sometimes to give Begging Call to Grey Warblers, which respond by feeding them (St Paul 1976; CSN 1), but ageing may have been wrong; apparent begging of one female during courtship feeding also attracted Grey Warbler (CSN 6).

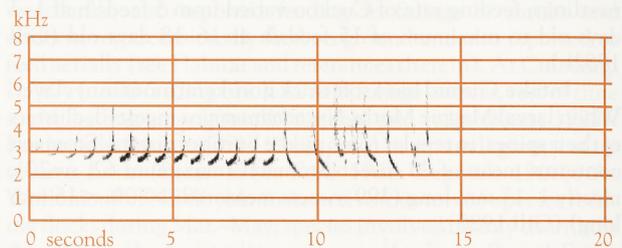
Sexual behaviour Behaviour described as courtship by Strahan probably referring to Communal Display (see above), function of which not known with certainty. **Courtship feeding** Recorded often in spring–summer (Sedgwick 1968; St Paul 1976; CSN 1, 4, 37). In one pair, recipient begged with fluttering wings whenever the other found food (CSN 1). A probable male giving usual Whistling Call appeared more excited than a second bird; first then fed caterpillar to second, which made quiet cheeping noises while presumed male acted excitedly and wagged tail (CSN 6). **Copulation** One male fed female then attempted copulation three times without success; female then flew c. 50 m and male followed and fed her 19 more times before copulation occurred; neither called (Serventy 1958). One female called for long period before being joined by a male and copulating c. 1 min later (Rix 1936).

Relations within family group Nestlings in nest of Grey Warbler have Begging Call similar to that of young Warblers (Gill 1982a; McLean & Waas 1987), but adult Warblers can distinguish between calls (McLean & Rhodes 1991). Nestlings often peck at Grey Warbler hosts immediately after being fed (Gill 1982a); one nestling appeared to keep silent between feeds (Wakelin 1967). Once able to fly well, fledgelings beg loudly almost continuously, while waiting for hosts to bring food or while following host-parents around; when host approaches, call lengthens and becomes more rapid and is accompanied by fluttering of wings (Stidolph 1939; Wakelin 1967; Gill 1982a; McLean & Waas 1987; North). Adult Cuckoos said sometimes to feed fledgelings (see above). At one nest with Cuckoo nestling, two adult Cuckoos always nearby, though never fed nestling, and were not seen again after nestling depredated (Hanscombe 1915). **Anti-predator responses of young** From 7 days old, screech loudly and rhythmically when removed from nest and if provoked during handling; from 11–14 days old, respond to visual stimuli and give Defensive Display, in or out of nest: lift head high, gape widely or incline bill downward and raise feathers of crown and throat; lunge and snap at passing objects and keep intruder in sight by turning head. Older nestlings often respond to handling by discharging brown, sticky, but not foul-smelling, fluid from cloaca. Newly fledged young fly weakly and behave secretively, perching silently and still for long periods, till able to fly well (Gill 1982a).

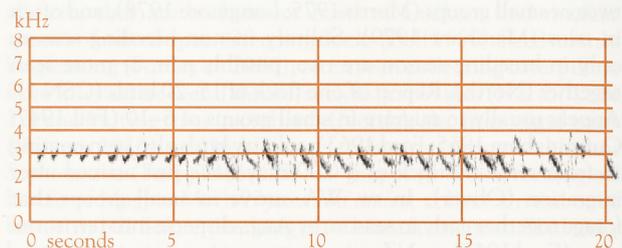
VOICE Reasonably well known, but only anecdotal information. Sonagrams of calls of nestling in McLean & Waas (1987). Main calls are penetrating upsurred and downslurred whistles. Adults have two main calls: Whistling Call and Call Note; variety of other sounds given occasionally. Whistling Call difficult to locate (Buller 1888; Fulton 1910; Moncrieff 1924; Cunningham 1955; Oliver), perhaps because birds move head while calling (St Paul 1976). Most calling spring–summer (Fulton 1910; Wilkinson 1924; Macdonald 1951; St Paul 1976; Schodde 1980); in Aust., said to call less often in winter

(North). In NZ, though present, may not call early and late in season (Fulton 1910; Cunningham 1955; Oliver). Call during day and at night (Fulton 1910; Wilkinson 1924; Macdonald 1951; North); in NZ, Whistling Call can be given by perched birds at night, sometimes for long periods, and Call Note given at night by flying birds (Potts 1874; Stidolph 1931, 1937; Macdonald 1951); Whistling Call once given at night by bird disturbed by earthquake (St Paul 1976). Most calling when perched (Fulton 1910; Moncrieff 1924; Macdonald 1951; Rix 1976; North), but also call in flight; in NZ, both Whistling Call and Call Note heard from birds in flight (Michie 1948; St Paul 1976), and Call Note heard from birds in flight at night (Stidolph 1931, 1937); in Aust., heard to call in flight while on passage (Gilbert 1935). No information on differences in repertoire between sexes, if any (Gill 1982a); no information on any other sexual differences in calling. Birds, apparently adult, said to utter 'call of a juvenile' in response to nearby Grey Warblers (St Paul 1976). In some years, Whistling Call of all birds in a particular district said to be uttered at much greater speed (Cunningham 1955). Whistling Call similar throughout range from WA to se. Aust. and NZ (Willis 1997). Downslurred notes of Call Note and at end of Whistling Call similar to, but much faster than, Descending Call of Horsfield's Bronze-Cuckoo (Sedgwick 1940b; Dell 1971; Serventy & Whittell; R.H. Loyn). Respond to playback of taped calls (Gill 1982a).

Adult WHISTLING CALL: Sustained series of upsurred double notes, sometimes followed by fewer downslurred double notes *kui-kui-kui-kui-kui-kui-kui-kui... . . . tiu-tiu-tiu...* (Fulton 1910; Cunningham 1955; Oliver); upsurred note also described as high-pitched deliberate *fee* (Pizzey 1980), and as penetrating, drawn-out *teer* (Keast 1993); downslurred note also described as descending *pee-eerr* (Pizzey 1980). At Ebenezer, NSW, Whistling Call typically of 6–10 penetrating, drawn-out and upsurred *teer* notes, uttered over several minutes at 3–5 calls/min (Keast 1993). Whistling Call may include quiet notes described as *whiti-whiti-ora* (Fulton 1910; Falla *et al.* 1979), or, in pauses between downslurred notes, 1–3 triple notes (Andersen 1917). Sonagram **A** shows Whistling Call consisting of upsurred notes followed by four downslurred *tiu* notes (other notes occurring between second and third *tiu* and after fourth *tiu* may be *whiti-whiti-ora* referred to above); sonagram **B** shows final segment of calling sequence lasting c. 5 min (all the preceding



A J. Kendrick; P100



B F. van Gessel; Taree, NSW, July 1988; P40

notes, not shown, having been upslurred). As many as 176 upslurred notes have been counted in a single call (Cunningham 1955). Pattern of upslurred and downslurred notes may be as in sonagrams A and B, or may be a series of upslurred notes, sometimes with a final downslurred note, which usually not given if call only of six or so notes, but almost always if of 15–20 notes (Dell 1971; Campbell; North; Serventy & Whittell). Early in season only *kui-kui-kui...* or only *tiu-tiu-tiu...* sometimes heard (Fulton 1910; St Paul 1976), and recordings examined included series consisting entirely of downslurred notes and entirely of upslurred notes. **CALL NOTE:** Clear downslurred *tsee-ew* or *tsiu*, similar to last downslurred notes of Whistling Call (Falla *et al.* 1979); downslurred notes *pee-er* uttered in continuous series (Dell 1971); also described as sigh (Stidolph 1931, 1937). Given often during Communal Display, and, at height of Display, calls from all birds involved may be nearly continuous (Watson & Bull 1950; Fitzgerald 1960; Edgar 1961; Falla *et al.* 1979; Gill 1982a); uttered in continuous series during Communal Display (Dell 1971); also given by both members of a pair when chasing newcomers, and sometimes, but never as continuous series, by solitary birds (Dell 1971). Also heard at night: in flight in NZ (Stidolph 1937); and when perched in Aust. (R.H. Loyn). **Other calls** Once, quiet cheeping given by bird being fed during courtship feeding (CSN 6). Two birds once heard to give excited chirruping during display behaviour, accompanied by wing-quivering (Rix 1976). Reports of the following calls during Communal Display: rather musical chattering, softer than Call Note (Fitzgerald 1960); constant trilling chatter (Edgar 1961); and unusual *wit-wit-here-er* (Sedgwick 1955), a description similar to *whiti-whitiora* of Whistling Call. Perched bird gave repeated quail-like *air-bee-care* with middle syllable softer and more drawn out, and variants *air-bare-beee*, *air-bare-keee*, and *air-beee-care-tare* (Smith 1967). Low, brief but undescribed sounds reported from feeding birds (Potts 1874). Also *peewau-peewau* in alarm (Potts 1874).

Young **BEGGING CALL:** Peeping call. Begin calling soon after hatching; when nestling older, call audible to 10–20 m, and changes from short peep to longer whine as host-parent approaches with food, each call being similar to corresponding call of young Grey Warbler (though whine shorter) (Gill 1982a; McLean & Waas 1987). Nestling about to fledge silent between feeds (Wakelin 1967). Newly fledged young often perch silently and immobile for long periods; once they can fly well, cheep loudly, including when following host-parents in flight (Gill 1982a). Constant twittering or piping from young able to fly well, when harassing hosts for food (Fulton 1910). Said that may utter single-note Begging Call all day at rate of 160 notes/min (NZRD). **ALARM CALL:** Nestlings utter loud rhythmic screech *eee-eee-eee* on removal from nest and if provoked during handling (Gill 1982a; McLean & Waas 1987). **JUVENILE CALLS:** In mid-Feb., within 2 weeks of disappearance of down-feathers, heard to give first part of Whistling Call, *kui-kui-kui...* (Fulton 1910).

BREEDING Well known; Brooker & Brooker (1989a) reviewed 909 records in Aust., to 1987, of Cuckoo eggs and nestlings, feeding of Cuckoo chicks, and general statements of parasitism from literature, museum and private egg-collections, NRS, ABBBS and unpublished information; studied for four seasons at Gooseberry Hill, WA (Brooker & Brooker 1989b); 80 records in NRS to July 1997 available for analysis. Detailed study over three seasons at Kowhai Bush, Kaikoura, NZ (Gill 1982a, 1983a). Nest parasite.

Season **AUST.:** Eggs, late July to early Jan., most (74.5%;

n=47) mid-Oct. to mid-Dec.; young, late Aug. to mid-Jan. (NRS); laying, July–Jan., most (77.5%; n=635) Sept.–Nov. (Brooker & Brooker 1989a). **NZ:** Laying, mid-Oct. to early Jan.; hatching, late Oct. to mid-Jan.; fledging, mid-Nov. to early Feb. (Gill 1982a); one fledgeling being fed, mid-Mar. (CSN 31).

Site Usually select hosts that build dome-shaped nests but also parasitize open nests (North). **AUST.:** Usually select enclosed nests of thornbills *Acanthiza*, particularly Yellow-rumped Thornbill in open country farmland and Brown Thornbill *A. pusilla* in forest; also nests of gerygones *Gerygone*, scrubwrens *Sericornis* and fairy-wrens *Malurus*; will also parasitize open nests, mainly honeyeaters Meliphagidae and robins *Petroica*; occasionally lay in enclosed nests of predominantly seed-eating finches Passeridae and Fringillidae; one egg found in nest of Brown Treecreeper *Climacteris picumnus* in tree-hollow (Campbell); record of Cuckoo egg in clutch of Tree Martin *Hirundo nigricans* eggs (Mattingly 1906; Chandler 1910; White 1915; Jenkins 1931; Ford & Stone 1957; Brooker & Brooker 1989a; Campbell; North; NRS; R.H. Loyn). Of 909 records of eggs or young in nest, or of feeding of fledgelings, 585 (64.4%) were thornbills, 86 (9.5%) *Gerygones*, 58 (6.4%) *Sericornis*, 52 (5.7%) fairy-wrens (Brooker & Brooker 1989a). Species recorded with Cuckoo eggs or young in nest are: Brown Treecreeper, Superb Fairy-wren, Splendid Fairy-wren *M. splendens*, Variegated Fairy-wren *M. lamberti*, White-winged Fairy-wren *M. leucopterus*, Red-backed Fairy-wren *M. melanocephalus*, Yellow-throated Scrubwren *Sericornis citreogularis*, Large-billed Scrubwren *S. magnirostris*, Scrubtit *Acanthornis magnus*, Rufous Fieldwren *Calamanthus campestris*, Speckled Warbler *Chthonicola sagittatus*, Weebill *Smicromis brevirostris*, Mangrove Gerygone *Gerygone levigaster*, Western Gerygone *G. fusca*, Large-billed Greynone *G. magnirostris*, White-throated Gerygone, Fairy Gerygone *G. palpebrosa*, Brown Thornbill, Inland Thornbill *A. apicalis*, Tasmanian Thornbill *A. ewingii*, Western Thornbill *A. inornata*, Buff-rumped Thornbill *A. reguloides*, Yellow-rumped Thornbill, Yellow Thornbill *A. nana*, Striated Thornbill *A. lineata*, Yellow-faced Honeyeater *Lichenostomus chrysops*, Yellow-tufted Honeyeater *L. melanops*, White-eared Honeyeater *L. leucotis*, Yellow-plumed Honeyeater *L. ornatus*, White-plumed Honeyeater *L. penicillatus*, Brown-headed Honeyeater *Melithreptus brevirostris*, New Holland Honeyeater *Phylidonyris novaehollandiae*, Tawny-crowned Honeyeater *P. melanops*, Eastern Spinebill *Acanthorhynchus tenuirostris*, Black Honeyeater *Certhionyx niger*, Crimson Chat *Ephianura tricolor*, Orange Chat *E. aurifrons*, White-fronted Chat *E. albifrons*, Jacky Winter *Microeca fasciata*, Scarlet Robin *Petroica multicolor*, Red-capped Robin *P. goodenovii*, Pink Robin *P. rodinogaster*, Hooded Robin *Melanodryas cucullata*, Dusky Robin *M. vittata*, Eastern Yellow Robin *Eopsaltria australis*, White-browed Robin *Poecilodryas superciliosa*, Grey-headed Robin *Heteromyias albispecularis*, Varied Sittella *Daphoenositta chrysoptera*, Grey Shrike-thrush *Colluricincla harmonica*, Spectacled Monarch *Monarcha trivirgatus*, Satin Flycatcher *Myiagra rubecula*, Grey Fantail *Rhipidura fuliginosa*, Willie Wagtail *R. leucophrys*, White-winged Triller *Lalage sueurii*, Masked Woodswallow *Artamus personatus*, Black-faced Woodswallow *A. cinereus*, Yellow-bellied Sunbird *Nectarina jugularis*, House Sparrow *Passer domesticus*, Crimson Finch *Neochmia phaeton*, Red-browed Finch *Neochmia temporalis*, European Goldfinch *Carduelis carduelis*, Welcome Swallow *Hirundo neoxena*, Tree Martin, Clamorous Reed-Warbler *Acrocephalus stentoreus*, Golden-headed Cisticola *Cisticola exilis*, Silvereye *Zosterops lateralis* (Mattingly 1906; Chandler 1910; Jenkins 1931; Ford & Stone 1957; Brooker & Brooker 1989a; North; NRS; R.H. Loyn). **NORFOLK I.:** main host, Grey Warbler

(Schodde *et al.* 1983). NZ: Main host, Grey Warbler; no reliable records of other host-species on mainland (Gill 1983a); egg found in nest of House Sparrow (Smith 1926). CHATHAM IS: Parasitize Chatham Island Warbler *Gerygone albofrontata* (Dennison *et al.* 1984; CSN 30). For list of species observed feeding fledgelings, where feeders were not original hosts or where host-species not known, see Fledging to independence. MEASUREMENTS: Height of nest of host: in Aust., 1.7 (1.10; 0–6.1; 55) (NRS); in NZ, in nests of Grey Warbler, 1.8 (1.5–2.4; 4) (Stidolph 1939). SELECTION OF HOST-NEST: Direct and unobtrusive scrutiny of potential hosts may be important in Cuckoo locating nest. Once, Cuckoo suddenly sleeked its feathers and stiffened, head in line with body and at 45° to the horizontal, as two foraging Grey Warblers approached to within a few metres; Cuckoo remained still except for rotation of head to keep Warblers in view, who seemed not to notice Cuckoo; later, Warbler's nest found nearby with its clutch parasitized (Gill 1982a). For domed nests, entrance of parasitized nests usually twice as wide as unparasitized nests (Campbell). Nests that may have been damaged by Cuckoo during laying are repaired by host (Stidolph 1939). Cuckoo said to have laid its egg by forcing itself through entrance of nest and out through opposite wall; damage later repaired by host (Oliver). Cuckoo eggs laid before those of host may be buried in lining of nest by host (Ford 1963).

Egg LUCIDUS: Broad oval to elliptical; uniform olive-brown, greenish white or very pale olive, often clouded with brownish grey (Campbell); 16 eggs from NZ described as olive-green, with ground-colour of pale grey-green overlaid with finely mottled olivaceous pigment; some eggs darker than others and some had lost patches of pigment (Gill 1982a). PLAGOSUS: Elliptical; finely textured; glossy; uniform bronzy olive (Campbell); compressed elliptical or elongated oval; close-grained, smooth; lustreless; olive-brown, sometimes pale greenish-olive, others with a distinct bronzy-brown hue (North). Colour may be removed with moisture, revealing a pale-blue shell (Campbell; North). MEASUREMENTS: PLAGOSUS: 18.4 (17.0–20.3; 84) × 12.6 (11.7–14.7) (HLW, in Brooker & Brooker 1989a). LUCIDUS: 18.7 (1.15; 17.3–20.1; 4) × 12.6 (0.56; 12.0–13.1) (Gill 1982a). WEIGHT: PLAGOSUS: c. 1.6, or 6.8% of adult body-weight (Brooker & Brooker 1989a). LUCIDUS: 1.9 (n=2) on day of laying; 1.9 (n=2) 0–4 and >5 days after laying; equal to 8.0% of adult body-weight (Gill 1983a).

Clutch-size One egg per host nest; in Aust.: E/1 × 802, E/2 × 31. Nests parasitized by Shining Bronze-Cuckoo sometimes contain eggs of other cuckoo species: in Aust., Horsfield's Bronze-Cuckoo × 22 nests, Fan-tailed Cuckoo *Cacomantis flabelliformis* × 14, Brush Cuckoo *Cacomantis variolosus* × 1 (Brooker & Brooker 1989a).

Laying Cuckoo may deposit egg at any stage during laying period of host (Hanscombe 1915; Whittell 1933; NRS). In seven nests of Grey Warbler, one egg was laid 1 day before completion of host-clutch, one on day of completion, others, 1, 2, 2, 7 and 9 days after completion of host-clutch (Gill 1983a). Eggs laid before those of host often buried in lining of nest (Brooker & Brooker 1989a). Lay directly into nest of host, sitting in nest (Linton 1930). One Cuckoo observed, and videotaped, laying directly in nest of Yellow-rumped Thornbill then retreating backward from nest; egg laid at 06:50, c. 1 h after sunrise; Cuckoo spent 18 s at nest (Brooker *et al.* 1988; Brooker & Brooker 1989a); Milhinch (1972) caught and released a Cuckoo at entrance of nest of Yellow-rumped Thornbill; Cuckoo had its head and half of body inside nest, tail and one wing outside; nest contained egg of Thornbill and egg of

Cuckoo. Lay directly in nest of Grey Warbler (Stidolph 1939). Usually remove egg of host when laying (Gill 1983a; Brooker & Brooker 1989a). Keartland in North claims to have several times found Cuckoos on ground with freshly laid eggs but does not claim they carry eggs to host's nest.

Incubation By host (NRS). INCUBATION PERIOD: In Aust., for four eggs in nests of Yellow-rumped Thornbills, from start of incubation to hatching, between 13 days 12 h and 14 days 19 h (Brooker & Brooker 1989b). In NZ, in nests of Grey Warbler, 15.5 days (13–17; 3), depending on when it was laid in relation to clutch of Warbler (Gill 1983a).

Young Altricial, nidicolous. At hatching, blind and mostly naked (see Plumages). In Aust., at hatching, yolk-sac visible beneath skin of abdomen as orange patch c. 150 mm² in area; 3 days after hatching, c. 6 mm²; gone by 4 days old; at 6–11 days, covered in pin; at 14 days, well feathered (Brooker & Brooker 1986). In NZ, for 16 young: at 1–5 days, eyes partly open; at 6–9 days, feathers in pin on all tracts and eyes fully open; at 10–14 days, most trichoptiles shed and most feathers erupting from sheaths; from 15 days, sheaths become less conspicuous as plumage develops; egg-tooth shed at 15–17 days (Gill 1982a). Contents of host-nest ejected within 33–96 h (Brooker & Brooker 1989b); 42–56 h (Brooker & Brooker 1989a); in a nest of Buff-rumped Thornbill, ejected within 24 h of Cuckoo hatching (Hanscombe 1915). In NZ, Cuckoo usually hatches before young of Grey Warbler host; young evicted when Cuckoo 4 days old (3–7; 7); in one nest where Warbler chick hatched 2 days before Cuckoo, Warbler remained in nest with Cuckoo chick for 7 days till Cuckoo reached Warbler's weight and it was then ejected by Cuckoo (Gill 1983a). Chicks start to grip nest with their toes soon after hatching (Gill 1982a); when observer tried to remove a 6-day-old chick from nest of Grey Warbler, Cuckoo clung to bottom of nest with its feet and called loudly; one Warbler immediately came to nest (Stidolph 1939). **Growth PLAGOSUS:** Weight and measurements of chicks raised by Yellow-rumped Thornbills summarized in Table 1. Length of body (mm) of one chick: at hatching, 30; 7 days, 65; 11 days, 77 (NRS). LUCIDUS: Weight and measurements of chicks raised by Grey Warblers shown in Table 2; weight on day before fledging, 21.8 (1.39; 8). At fledging: length of wing, 60–65; length of tail, 30–35; length of tarsus, 21.5 (0.52; 9) (Gill 1983a).

Plate 33

Black-eared Cuckoo *Chrysococcyx osculans* (page 705)
1 Adult (fresh); 2 Adult (worn); 3 Juvenile

Horsfield's Bronze-Cuckoo *Chrysococcyx basalis* (page 713)
4 Adult male; 5 Adult female; 6 Juvenile

Shining Bronze-Cuckoo *Chrysococcyx lucidus* (page 726)
NOMINATE LUCIDUS: 7 Adult male; 8 Adult female; 9 Juvenile
SUBSPECIES PLAGOSUS: 10 Adult male; 11 Adult female; 12 Juvenile

Little Bronze-Cuckoo *Chrysococcyx minutillus* (page 744)
NOMINATE MINUTILLUS: 13 Adult male
SUBSPECIES BARNARDI: 14 Adult male; 15 Juvenile

Gould's Bronze-Cuckoo *Chrysococcyx russatus* (page 752)
16 Adult male; 17 Juvenile

Hybrid Little C. *minutillus* × Gould's C. *russatus* Bronze-Cuckoo
18 Adult female

Host-care, Role of sexes One chick in nest of Buff-rumped Thornbill fed actively by host till 09:00, after which feeding visits declined; then fed more actively from c. 14:00 till 17:00 (Hanscombe 1915). A chick in nest of Yellow-rumped Thornbill fed till 13 days old then abandoned when hosts began building new nest nearby; chick fledged successfully (Brown 1994).

Table 1. Mean length of fourth primary and longest rectrix; combined data from growth-curves in Brooker & Brooker (1989b) and unpublished data from them.

Age (days)	Mean weight ¹	Fourth Primary ²	Longest Rectrix ³
2	2.2	–	–
4	4.0	–	–
6	6.8	–	–
7	–	3.5	1.5
8	10.4	5.3	2.7
10	–	12.5	7.5
14	19.1	24.5	14.3
16	–	31.4	20.0
17	–	35.5	24.0
18	20.9	–	–

¹N=1–4 chicks; ²n=3–5 chicks; ³n=3–5 chicks.

Table 2. Increase in weight and length of tarsus (from Gill 1982a) and culmen (from growth-curve in Gill 1983a); Age 0 is day on which chick first found.

AGE	WEIGHT	TARSUS	CULMEN
0	1.6 (0.22; 1.2–1.9; 7)	7.3 (0.43; 6.6–7.7; 7)	5.9 (n=1)
2	3.1 (0.43; 2.4–3.7; 7)	9.5 (0.49; 8.8–10.3; 7)	7.1 (n=1)
4	5.3 (1.84; 3.3–7.1; 4)	11.6 (0.93; 10.4–12.4; 4)	8.5 (n=1)
6	7.8 (1.82; 5.2–9.2; 6)	13.2 (1.09; 11.8–14.5; 6)	9.8 (n=1)
8	11.8 (2.46; 9.0–13.6; 3)	15.5 (0.89; 14.5–16.2; 3)	11.2 (n=1)
10	15.4 (2.45; 12.4–17.4; 5)	16.5 (0.90; 15.1–17.4)	12.4 (n=1)
12	18.5 (1.89; 15.9–20.1; 5)	18.2 (0.74; 17.4–19.0; 5)	13.1 (n=1)
14	21.0 (0.72; 20.3–22.0; 4)	19.1 (0.61; 18.5–19.8; 4)	14.1 (n=1)
16	22.2 (0.37; 21.8–22.6; 4)	20.2 (0.22; 19.9–20.4; 4)	14.9 (n=1)
18	21.7 (1.32; 20.3–22.9; 3)	21.3 (0.40; 20.8–21.6; 3)	14.9 (n=1)

Fledging to independence FLEDGING PERIOD: In Aust., 18–23 days (n=4) in nests of Yellow-rumped Thornbill; 22 days in one nest of Western Thornbill (Brooker & Brooker 1989b); 16–21 days (n=5) (Brown 1994; NRS). In NZ, 19±1 days (n=3) in nests of Grey Warbler (Gill 1983a). May leave nest before

being able to fly (Stidolph 1939). In NZ, both host Warblers care for fledgeling for first 3–4 days; thereafter, nearly always responsibility of male; fed for up to 28 days after fledging, possibly longer (Gill 1982a). Fledgelings beg vigorously and will follow host-parents (Gill 1982a). Species observed feeding fledgelings where feeders were not original hosts or where host-species not known are: Aust.: Striated Thornbill (one fledgeling fed by six Striated Thornbills), Brown Honeyeater *Lichmera indistincta* (NRS); NZ: Grey Fantail (CSN 22); one fledgeling seen directing begging at a Bellbird *Anthornis melanura* but was ignored (CSN 32); a fledgeling investigated then entered a deserted nest of House Sparrow and was fed there by a Grey Warbler (Cunningham 1949). Adult Cuckoo seen feeding nestling (Howe 1905) and fledgeling (Brooker & Brooker 1989a).

Success In AUST.: From 38 eggs, 13 (34.2%) hatched, 8 (21.1%) fledged; nests failed from desertion or because egg broken, in nests or on ground below nests; one egg broken accidentally by observer; young found dead in nest or on ground below nest (NRS). Of 35 eggs laid in nests of Yellow-rumped Thornbill, 21 (60.0%) hatched, 17 (48.6%) fledged; failure of eggs through predation, burial, desertion or accident; of 18 eggs laid in nests of Western Thornbill, 13 (72.2%) hatched, 11 (61.1%) fledged; failures through burial, desertion (Brooker & Brooker 1989b). In NZ: from 23 eggs, 16 (69.9%) hatched, 12 (52.2%) fledged; of four that failed to fledge, three taken by predator, one died following inclement weather (Gill 1983a). Host deserted a nest that was parasitized by both Shining and Horsfield's Bronze-Cuckoos (Littlejohns 1943).

PLUMAGES Prepared by D.I. Rogers. Fledge in juvenile plumage, which is replaced in first autumn or winter in complete post-juvenile (first pre-basic) moult. Resultant immature plumage usually indistinguishable from adult. Thereafter perform one complete moult annually, in non-breeding areas. Sexes differ slightly in adult plumage. Subspecies *plagosus* from se. Aust. and nominate *lucidus* from NZ described below.

Adult male (First and subsequent basic). SUBSPECIES *PLAGOSUS*: HEAD AND NECK: Forehead, crown, nape and hindneck, maroon-bronze (c31) with dull-green gloss visible in some lights; a few birds have a bright-green (c60) gloss over much of top of head; perceived colour varies with light conditions but never looks as vividly green as upperparts. In some birds, forehead (especially in centre) finely speckled by large white central spots to some feathers. Lower throat and foreneck, white, evenly barred by dark-brown (119A) bars, which are about half width of white bars, show strong green (160) iridescence in direct light, and may also show faint purple gloss. In some birds this pattern continues onto upper throat and chin; in others dark barring looks more mottled and irregular on chin because bars more chevron-shaped (even dark streaks on each web of feathers of chin of a few birds); dark barring on feathers of chin tends to be less glossy than on throat. At sides of throat, dark barring grades to irregular brown (119B–119A) mottling over most of face. Ear-coverts and feathers of supercilium, white, with brown (119A–119B) bars or tips that are only slightly iridescent; these areas usually look rather evenly mottled brown, but in some, ear-coverts look mainly brown with less exposed white than rest of face; sometimes dark-brown tips to feathers align behind gape to form narrow brown moustachial stripe. At extreme sides of foreneck there is very occasionally a buff (124) tinge to white ground-colour. UPPERPARTS: Brilliant iridescent green (60, 62 or 159) grading on mantle to iridescent maroon-bronze (c31), like top of head. Much variation in

Plate 34

Black-eared Cuckoo *Chrysococcyx osculans* (page 705)
1, 2 Adult (fresh); 3 Adult undertail

Horsfield's Bronze-Cuckoo *Chrysococcyx basalis* (page 713)
4, 5 Adult; 6 Adult male undertail; 7 Adult female undertail

Shining Bronze-Cuckoo *Chrysococcyx lucidus* (page 726)
SUBSPECIES *PLAGOSUS*: 8, 9 Adult male; 10 Adult male undertail;
11 Adult female undertail

Little Bronze-Cuckoo *Chrysococcyx minutillus* (page 744)
SUBSPECIES *MINUTILLUS*: 12, 13 Adult male; 14 Adult male undertail

Gould's Bronze-Cuckoo *Chrysococcyx russatus* (page 752)
15, 16 Adult male; 17 Adult male undertail

extent of maroon-bronze tinge on mantle, in part varying with light conditions, maroon iridescence appearing browner but more extensive in dull light. Lateral uppertail-coverts have broad white outer edges (c. 3 mm wide distally), and shorter feathers also have white half-bar (1–3 mm wide) on outer web (usually meets shaft but often tapers before doing so); these are exposed in some postures to form regular barring. **UNDERPARTS:** White, evenly barred by dark-brown (119A) bars (about half width of white bars) that show strong green (160) iridescence in direct light, and may also show faint purple gloss. Barring complete, except for narrow break in midline of belly and vent of most birds. **UPPERTAIL:** Mainly olive-brown (c48) with green (c160) iridescence and narrow dark subterminal band formed by large smudgy black-brown (119) spot near centre of tip of each rectrix. On t3–t5, white spots at tips of inner webs often visible. On outer web of t5, a series of 4–5 white spots along outer edge (the more distal ones often bordered orange-buff [118]) can make edge of tail look spotted. **UNDERTAIL:** Mostly light grey (85) with narrow grey-black (82) subterminal band and white spots at tips of inner webs of t2 or t3 to t5. T5 barred by dark and pale bars of roughly equal width: pale bars white except for warm-buff (223D) tinge near tip of outer web of some birds; dark bars, light grey (85) at tips and edges, grading to black in centre and base of feather. Often on t4, sometimes on t3, and rarely on t2, light-grey (85) inner web has light rufous-brown (39–223D) spots or bars with varying black (82) lower borders. Feathers have grey-black (82) bases. **UPPERWING:** All secondary coverts and tertials, bright iridescent green (60–62) with concealed dark-brown (c121) bases, broadest on inner webs. Alula and primary coverts, mainly dark greyish-brown (c121) with faint green iridescence on innermost coverts. Primaries and secondaries, dark brown (c121), with increasingly broad zone of green iridescence along outer edge of inner secondaries. Inner greater and median secondary coverts have very narrow buff (c123A) fringes that bleach to white with wear; even narrower white outer edges often present on tertials, secondaries and sometimes primaries. **UNDERWING:** Most coverts, white with dark grey-brown (119A–119B) barring that shows faint green iridescence in some lights. Greater primary coverts, light grey (85–84), inner feathers have irregular blackish (c82) subterminal lines broken by white tips and half-bars. Primaries and secondaries, grey (84–85); secondaries have large white panel at base of inner webs and inner eight or so primaries have large white panel on centres and inner edges of inner webs; these markings join as broad white wing-stripe that has narrow light rufous-brown (38–39) trailing border. Greater secondary coverts, white with sparse irregular light-brown barring, so inconspicuous that these feathers look continuous with pale wing-bar.

NOMINATE LUCIDUS: Differences from *plagosus*: **HEAD AND NECK:** Forehead typically has much white speckling, extending in midline of head back to level of mid-crown; feathers have broad white subterminal bands, broadest on inner webs and usually broadest in midline of forehead. Ground-colour of forehead, crown and nape, iridescent green (c160), sometimes with weak maroon-bronze (c31) gloss visible in strong lights; concolorous with upperparts or only slightly more bronze (cf. strong contrast in *plagosus*). Sides of face much more white; rear of supercilium and ear-coverts at least 60% white, with ear-coverts barred darker brown (c121); supercilium slightly broader. Dark barring of chin and throat slightly darker brown (121) and glossier green. **UPPERPARTS:** Mantle, iridescent green with much weaker bronze iridescence. White markings of lateral uppertail-coverts larger: outer web has white outer edge that is

3–4 mm wide distally and wraps around to almost meet tip of shaft; white half-bar extends to shaft (typically without tapering) and is c. 3 mm wide. **UNDERPARTS:** Dark ventral bars have stronger green (c160) iridescence and seldom show any trace of maroon iridescence. **TAIL:** T5 usually lacks rufous or buff markings and rufous spots on t4 small (<2 mm in diameter) or absent; no rufous spots on t3 or t2. **WINGS:** As *plagosus*.

Adult female (First and subsequent basic). Differences from adult males (also see Sexing): **SUBSPECIES PLAGOSUS:** **HEAD AND NECK:** White speckling of forehead sparser than in most males, and usually none. Top of head, maroon (31) with bronze-green gloss that is duller than in most males and usually wholly absent. Sides of head tend to look less neatly barred than in males because: dark subterminal bars or tips of feathers usually broader; and bars dark brown (119A–119B), with less or no green iridescence. Often have buff (124) tinge to white ground-colour at sides of foreneck, caused by buff (124) tips or central bars to feathers. Barring of throat, dark brown (c119A), typically with little or no green iridescence and tends to become narrower and more irregular on chin, which often predominantly white. **UPPERPARTS:** Maroon iridescence extends farther onto mantle, typically over whole mantle, and encroaches onto innermost scapulars; in some, subtle maroon tinge can extend through back onto uppermost rump. **UNDERPARTS:** Dark barring slightly narrower than most males, and less strongly iridescent. Dark barring always broken in midline of belly and vent, and resultant white streak usually broader than in males. **TAIL:** Rufous spots on t4 seldom absent. **UPPERWING:** As male. **UNDERWING:** Dark barring of coverts slightly less iridescent.

NOMINATE LUCIDUS: Plumage more similar to that of adult male *plagosus* than to adult male *lucidus* or adult female *plagosus*. For further information on frequency of occurrence of various plumage states, see Table 3. **HEAD AND NECK:** Forehead typically has a little white speckling near base of culmen; rarely, no white or it is as extensive as in some adult male *plagosus*. Top of head, iridescent maroon-bronze (c31), usually with a faint green (c260) gloss from central crown to nape and hindneck; seldom as vividly green as male *lucidus*. Face usually whiter than in male *plagosus* but with more brown mottling than male *lucidus*; this formed by broader dark-brown (c121) tips to ear-coverts. Chin usually more white than male *lucidus* or either sex of *plagosus*, but often barring of throat extends onto chin as indistinct brown mottling. **UPPERPARTS:** Ground-colour mainly iridescent green but with a slightly stronger maroon-bronze (c31) tinge to some of mantle, usually only uppermost mantle but, rarely, whole of mantle and innermost scapulars; in a few there is none. White of lateral uppertail-coverts slightly narrower than in male *lucidus* and rather similar to male *plagosus*. **UNDERPARTS:** Iridescence of dark-brown ventral barring slightly weaker, less green and more maroon than male *lucidus*, but hardly different from adult male *plagosus*. **TAIL:** Shows similar range of variation to adult male, but more apt to have rufous spots on t4 (see Sexing) and buff (223D) tinge on parts of white spots of t5. **WINGS:** As adult male.

Nestling SUBSPECIES PLAGOSUS: Mainly or entirely naked at hatching. Three nestlings had four patches of short, coarse white hair-like feathers (trichoptiles) on head: one behind each eye and a pair on back of head; these down patches inconspicuous, only 2 mm long (Brooker & Brooker 1986; Marchant 1986). **NOMINATE LUCIDUS:** More feathered than *plagosus*. Head and back sparsely covered by coarse white hair-like trichoptiles: c. 40 long and wavy trichoptiles on head, mainly behind eye and on nape; c. 20 long and wavy trichoptiles on dorsolateral tracts of back; many other shorter trichoptiles

in these areas and on caudal and alar tracts, where they are less than 1 mm long (Gill 1982a).

Juvenile Differences from adult male *plagosus*. **SUBSPECIES PLAGOSUS:** HEAD AND NECK: No white speckling on forehead. Crown, nape and hindneck, brown (23–28) with subtle maroon (c31) or olive-green (51) iridescence. Chin and throat, off-white in centre grading to pale grey-brown (119D) on sides of throat and on ear-coverts. Some diffuse grey-brown (c119B) mottling on each feather of throat causes diffuse mottling or barring; on ear-coverts, mottling broadens to diffuse barring, and coverts can look darker than rest of face. **UPPERPARTS:** Less glossy. Mantle, olive-brown (ne) with varying olive (150) and, rarely, maroon (31) iridescence. Rest, dull green (c150–ne; only faintly iridescent) with diffuse brown (ne) fringes to feathers of back and scapulars, which appear to be tinged maroon in strong direct light. No bold white markings on lateral uppertail-coverts: instead, have narrower pale edges, wholly buff (124) in some but with varying white areas in others; and have no pale half-bars. **UNDERPARTS:** Upper breast, pale grey-brown (119D) sometimes grading to off-white in centre; rest of underparts, white. Flanks have brown (119A–119B) bars with subtle green (c150) iridescence, never joining in midline, except barring extends onto lateral undertail-coverts and, rarely, extends right across undertail-coverts. **UPPERTAIL:** Ground-colour, olive-brown (c29) with less green iridescence; smudgy black-brown (119) subterminal bands usually broader, and white tips usually smaller and less sharply defined, and often wholly absent. White spots along outer edge of t5 usually smaller and less sharply defined and often tinged buff (124). **UNDERTAIL:** Mainly light grey (85) with narrow white tips and diffuse grey-black (82) subterminal band; some have light rufous-brown (c39) barring on t4 and inner feathers like that of adults, but often only have a light rufous-brown (c39) patch on t4 that tapers out or is absent on inner feathers. T5 like adults, but white spots on inner web often bordered pale rufous (c39). **UPPERWING:** Ground-colour of secondary coverts, dull green (c150–ne; faintly iridescent) with diffuse brown (ne) fringes that appear to have slight maroon tinge. Secondary coverts have light-brown (c39) fringes. Green gloss on outer webs of tertials and inner secondaries duller and less extensive than in adults; otherwise, remiges as adult except that feathers slightly narrower, especially at tips of outer webs. **UNDERWING:** Barring of coverts paler grey-brown (c119B), without iridescence.

NOMINATE LUCIDUS: HEAD AND NECK: Varying white speckling on forehead probably less extensive on average than in adult female *lucidus* but with similar range of variation. Ground-colour of top of head, glossy green (260), slightly less glossy than adult male *lucidus*, and less bronze than adult female *lucidus* or juvenile or adult female *plagosus*. Face, white with diffuse brown (119B–119C) barring and tips to feathers, broadest on ear-coverts where there can appear to be a diffuse brown ear-patch. Behind gape, brown tips to feathers can align as narrow moustachial stripe. Chin and throat, white; not boldly barred, but there are one or two irregular, convex brown (119B) bars on each feather that cause distinct mottling on throat and sometimes chin (cf. more uniform appearance of juvenile *plagosus*). **UPPERPARTS:** Slightly less glossy than adult *lucidus*. Lateral uppertail-coverts slightly smaller than in adult *lucidus*; have white outer edge, broadest near tip of feathers, and usually lack white half-bar on outer web; when present, this marking narrower than in adult *lucidus* and rather similar to adult *plagosus*. **UNDERPARTS:** Mainly white with diffuse, but dense, brown (119B) barring on breast that is narrower and more

convex than in adults and often reduced to inconspicuous vermiculation; can appear like diffuse brown gorget when seen at distance. Flanks more broadly barred dark brown (119A), with dark bars showing faint green gloss in some lights; dark bars are separated by white mid-ventral line. In general, underparts much more boldly barred below than juvenile *plagosus* (which has broader white mid-ventral line). **TAIL:** Like juvenile *plagosus* but: (1) white spots on outer web of t5 tend to be broader, joining those on inner web, so that feather looks barred; (2) often lack buff tinges on t5; and (3) outer feathers tend to have less rufous blotching, restricted to t4 or wholly absent.

Immatures (First basic). Very similar to subsequent plumages and not reliably separable on present knowledge; a few differ from adults in retaining one or two juvenile primaries or secondaries (slightly shorter and narrower than newer adult remiges), but this appears to be atypical.

BARE PARTS From photos (Coates 1985; Moon 1988, 1992; Flegg & Longmore 1994; Aust. RD; NZRD; Strahan, unpubl.: J.N. Davies, R. Jessop & P. Collins, P. Marsack, R. Shepherd), museum labels (AM, ANWC, HLW, MV, QM, WAM), and descriptions from birds captured for banding (Rogers *et al.* 1986; A., K.G. & D.I. Rogers; R.P. Allen). **Adult male SUBSPECIES PLAGOSUS:** Bill, grey-black (82) to black (89); some (c. 40% of birds, judging by colour on skins) have inconspicuous pair of brownish, yellowish or pale-grey (81) patches at bases of mandibular rami; these markings small (1–3 mm in diameter) and sometimes join narrowly across gonys. Gape and palate, black (82–89). Iris varies greatly, with no obvious relation to date, age or locality; typically dark brown (121) to light brown (c39), often paler on outer iris than near pupil; often have reddish-brown (38, 340) tinge, strongest near pupil; wholly yellow or golden iris reported on 17% of labels, pale grey to white on 13% of labels, and red on one label. Orbital ring, pale green (162), very narrow. Tarsus and toes, grey (84, 87) to dark grey (83) or blackish; sometimes with faint olive or brown tinge; scutes very narrowly edged white; soles, dirty white to buff or yellow; claws, dark grey (83) to grey-black (82). **NOMINATE LUCIDUS:** Bill typically differs from adult *plagosus* in having sharply contrasting and extensive pale base to lower mandible: bluish grey (c87) in only photos available; also described as flesh and brownish (labels, NZRD). Extent of pale base appears similar in skins and live birds; in skins, pale base broadest (5–7 mm) on mandibular rami, extends to cutting edge and sometimes onto gape, and is narrowest (2–4 mm) on gonys. Palate, flesh (one label). Iris, usually reddish brown; the little data available suggest similar range of variation to adult male *plagosus* but no records of pale grey to white irides. Orbital ring usually similar to adult male *plagosus*, but very dark grey (c83) in one photo. Feet as adult male *plagosus*. **Adult female PLAGOSUS:** Bill as adult male; based on skins, c. 60% have small pale patches at base of lower mandible. Iris similar to male in most; pink recorded (two labels) and no records of yellow irides. Orbital ring, pale blue-green or yellowish green to grey-cream or cream-grey. Rest as male. **LUCIDUS:** Iris similar to adult male *lucidus* in some; light brown and pale greyish-ivory recorded on two labels. Rest as male. **Nestling PLAGOSUS:** Mostly from WA study by Brooker & Brooker (1986 and unpubl. photos). Iris, dark brown (c121). Bill initially pinkish brown (ne, similar to skin of back of head), becoming predominantly grey-black (82) like juvenile by 'porcupine stage'. Gape, bright yellow (55), sometimes fading slightly by c. 14 days old. Mouth, pale yellow, darkening to orange-yellow by 8–10 days. Legs, and toes, orange at hatching, changing to dark greenish-grey or khaki by Day 5.

Published descriptions from e. Aust. (Marchant 1986) differ slightly from those of WA, probably reflecting differences between observers rather than geographical variation: skin of body, orange-pink (c3), dark apricot, pinkish yellow or pink streaked with yellow on at least shoulders, with dark-grey (83) patches on lower back and head that vary considerably in size and darkness, in part through individual variation and in part because extent and intensity of dark pigment increases with age. At 'porcupine stage' (6–11 days), skin of breast, dark maroon-brown. *LUCIDUS*: From Gill (1982a). Iris, dark brown. Bill, grey with pink area at base; becomes darker with much smaller pink area at base by Days 10–14. Gape, white, usually becoming pale yellow in first 5 days. Mouth and tongue, pink; tongue develops grey tip in first 5 days; edges of buccal lining sometimes yellowish from Days 10–14. Legs, grey with pale soles and white claws; become blue-grey with pale-yellow soles by Days 10–14. Skin, dark grey apart from a pink area on hind-neck that sometimes extends onto back and belly. **Juvenile PLAGOSUS**: Iris, dark brown (121–121A) with varying grey or grey-brown (c27) outer ring that is sometimes tinged olive or hazel. Orbital ring narrow but consistently broader than that of adult: pale green (c162) to greenish yellow (c57) in some, pale grey to whitish in others. Bill, black (82), initially with dirty-yellow (c53) or dirty-pink (c3) base to lower mandible, which is similar in shape and extent to pale base of lower mandible of adult *lucidus*; pale area at base quickly becomes smaller and light brownish-grey (c44) with age, and can be virtually lost before post-juvenile moult occurs. Gape, puffy and yellow (53) at fledging; becomes less conspicuous and duller with age; in at least some, gape as adult before post-juvenile moult finished. Palate, yellow. Feet similar to adult; labels suggest that tarsus and toes more apt to have a green tinge. *LUCIDUS*: Similar to juvenile *plagosus*. **Immatures** Labels of the few skins identified suggested bare parts as adult, but not clear when palate becomes black, or whether variation in colour of iris is related to age.

MOULTS Based on skins of c. 225 adults and c. 75 younger birds, *lucidus* and *plagosus* combined (AM, ANWC, AIM, CM, HLW, MV, NMNZ, QM, QVM, SAM, TMAG, WAM), supplemented by banding data (P. Collins, R. Jessop) and information in Stresemann & Stresemann (1961), Schodde (1977) and Hall. **Adult post-breeding** (Second and subsequent pre-basic). Complete, generally occurring in non-breeding areas after n. migration though few specimens from non-breeding areas available; over 90% of available skins were collected Aug.–Jan. and showed no moult of remiges or body. Stresemann & Stresemann (1961) considered sequence of primary-moult to be outer primaries in sequence (p9 and p7 concurrently)–p5–p8–p6; inner primaries in sequence (p1 and p4 concurrently)–p2–p3; p10 independent but always moulted after p9 fully grown. This sequence consistent with the four *plagosus* examined by Stresemann & Stresemann (1961) and the six other records available here. In *plagosus* in non-breeding areas in New Britain, active moult of primaries recorded late May (PMS 16, 17) and 7 Aug. (PMS 41); in Aust., active moult recorded earlier: Feb. (PMS 2, 39 in Tas., 29 in n. WA), Mar. (PMS 9 in n. WA, 47, 49 in n. NSW and s. Qld), and Apr. (PMS 9 in n. Aust.). In *lucidus* passing through Aust. on n. migration (Mar.–Apr.), no traces of active or suspended moult; and moult finished in all specimens collected on s. migration through Aust. (Aug.–Nov., mainly Sept.–Oct); in Bougainville, moult recorded July–Aug., completed in specimen collected in Sept. (Schodde 1977). **Post-juvenile** (First pre-basic). Complete. In *lucidus*, moult must occur in non-breeding areas and post-juvenile moult

probably finished before s. migration (about Sept.) when then indistinguishable from adults: birds migrating N through e. Aust. in Mar.–Apr. have full juvenile plumage, and no immatures detected among 11 adults examined on s. migration or the 80 or so examined from NZ. Also likely that many *plagosus* begin n. migration before beginning post-juvenile moult. However, five of 17 juveniles collected in Jan.–Feb. showed early traces of moult of body and one had moulted most feathers of body (but no remiges) by end of Feb.; latest records of birds in full juvenile plumage are from Mar.–Apr. (Vic. and n. WA). Only three records available of *plagosus* that had started moult of primaries, all from birds that may have been staging: one in n. WA, on 27 Mar. (P. Collins, R. Jessop), and two from central e. coastal Qld (one, in Apr., had PMS of 17 and was in late stages of moult of body and tail; the other, in May, similar but had suspended all moult with PMS 10 and only four new rectrices). Sequence of primary-moult of these records was consistent with that of adults. Except for an undated photograph of a *plagosus* in post-juvenile moult from s. New Guinea (Coates 1985), no direct information for *plagosus* from non-breeding areas N of Aust. Moult typically finished before return to breeding areas in Aug.–Oct., though a few *plagosus* examined had retained one or two scattered juvenile primaries or secondaries.

MEASUREMENTS (1–3) Nominate *lucidus*, skins (AM, AIM, CM, MV, NMNZ, QVM): (1) NZ, adults; (2) E. coastal Aust., migrant adults; (3) Juveniles, localities combined.

	MALES	FEMALES	
WING	(1) 104.1 (2.09; 101–112; 40)	104.2 (1.99; 99–109; 38)	ns
	(2) 104.8 (1.91; 102–108; 12)	105.0 (1.41; 103–107; 6)	ns
	(3) 101.2 (2.25; 98–105; 26)	100.3 (2.23; 97–105; 17)	ns
TAIL	(1) 68.7 (2.33; 63–75; 39)	68.8 (2.19; 64–73; 36)	ns
	(2) 68.8 (2.22; 66–71; 4)	72	
	(3) 66.1 (1.91; 63–69; 23)	65.8 (2.29; 62–70; 16)	ns
BILL S	(1) 18.2 (0.65; 16.9–19.7; 38)	18.6 (0.62; 17.0–19.5; 35)	ns
	(2) 18.4 (0.69; 17.1–19.4; 10)	18.6 (0.67; 18.0–19.7; 6)	ns
	(3) 17.1 (1.33; 14.4–19.1; 21)	17.1 (1.07; 15.8–19.2; 13)	ns
BILL N	(1) 11.2 (0.42; 10.1–11.9; 39)	11.6 (0.50; 10.8–12.4; 35)	ns
	(2) 11.5 (0.42; 10.8–12.0; 11)	11.8 (0.39; 11.1–12.0; 5)	ns
	(3) 10.5 (0.54; 9.5–11.5; 23)	10.6 (0.60; 9.7–11.8; 14)	ns
BILL W	(1) 5.72 (0.246; 5.3–6.2; 38)	5.86 (0.346; 4.8–6.3; 35)	**
	(2) 5.79 (0.291; 5.3–6.3; 12)	5.90 (0.155; 5.7–6.1; 6)	ns
	(3) 5.22 (0.355; 4.2–6.0; 23)	5.38 (0.254; 5.0–5.8; 15)	ns
TARSUS	(1) 18.6 (0.71; 16.8–20.7; 36)	18.8 (0.57; 17.6–20.2; 33)	ns
	(2) 18.8 (0.50; 18.4–19.5; 4)	18.3	
	(3) 18.5 (0.58; 17.5–19.7; 22)	18.5 (0.314; 18.0–19.1; 16)	ns
TOE C	(1) 18.3 (0.58; 17.2–18.9; 12)	18.2 (0.66; 17.2–19.4; 16)	ns
	(2)		
	(3) 19.3 (1.65; 17.7–22.8; 7)	18.62 (0.48; 18.1–19.3; 5)	ns

(4–8) Subspecies *plagosus* (AM, ANWC, HLW, MV, QM, QVM, SAM, TMAG, WAM): (4–7) Adults: (4) Tas.; (5) Vic.; (6) NSW and Qld; (7) S. WA; (8) Aust., juveniles.

	MALES	FEMALES		
WING	(4) 104.9 (2.31; 101–110; 24)	105.3 (1.78; 102–110; 23)	ns	
	(5) 105.7 (2.57; 98–110; 34)	105.8 (1.72; 103–108; 11)	ns	
	(6) 104.4 (2.12; 101–108; 17)	106.5 (1.98; 103–109; 6)	**	
	(7) 106.3 (2.25; 99–110; 26)	105.6 (2.91; 101–110; 11)	ns	
	(8) 100.6 (3.61; 96–108; 11)	99.7 (1.21; 98–101; 6)	ns	
	TAIL	(4) 68.0 (1.78; 64–72; 24)	68.7 (1.72; 66–72; 23)	ns
		(5) 68.4 (2.54; 63–72; 34)	69.6 (3.21; 65–77; 11)	ns
		(6) 67.3 (2.29; 63–69; 9)	65, 67	
(7) 68.5 (2.26; 65–72; 13)		69.3 (2.50; 66–72; 4)	ns	
(8) 64.9 (2.95; 61–69; 8)		62.8 (2.23; 61–66; 6)	ns	
BILL S		(4) 18.1 (0.51; 17.2–19.0; 23)	18.2 (0.69; 16.9–19.8; 22)	ns

	(5) 17.4 (1.08; 15.2–19.1; 33)	17.8 (0.95; 16.1–19.2; 11)	ns
	(6) 17.7 (0.56; 16.7–18.7; 16)	17.9 (0.62; 16.7–18.3; 6)	ns
	(7) 17.6 (0.73; 16.5–18.9; 24)	17.3 (1.27; 15.3–19.1; 8)	ns
BILL N	(8) 16.6 (1.26; 15.0–18.6; 12)	16.4 (1.80; 13.7–18.5; 7)	ns
	(4) 11.4 (0.45; 10.5–12.0; 23)	11.6 (0.46; 10.7–12.5; 22)	ns
	(5) 11.4 (0.59; 10.0–12.8; 32)	11.3 (0.51; 10.6–12.3; 9)	ns
	(6) 11.3 (0.41; 10.2–11.8; 16)	11.4 (0.59; 10.3–11.9; 6)	ns
	(7) 11.1 (0.38; 10.5–11.9; 23)	11.2 (0.42; 10.6–12.1; 9)	ns
	(8) 10.2 (0.77; 9.3–11.4; 12)	10.3 (0.73; 9.1–11.5; 7)	ns
BILL W	(4) 4.95 (0.168; 4.7–5.3; 23)	4.92 (0.159; 22)	ns
	(5) 4.94 (0.255; 4.1–5.3; 34)	4.85 (0.169; 4.6–5.1; 11)	ns
	(6) 4.82 (0.270; 4.0–5.2; 17)	4.97 (0.398; 4.6–5.7; 6)	ns
	(7) 4.72 (0.271; 3.8–5.3; 25)	4.68 (0.365; 3.7–5.0; 10)	ns
	(8) 4.58 (0.34; 3.9–5.0; 12)	4.66 (0.282; 4.3–5.1; 7)	ns
TARSUS	(4) 17.0 (0.95; 15.5–19.1; 15)	17.3 (0.92; 15.7–18.9; 16)	ns
	(5) 17.2 (0.85; 15.3–20.0; 28)	17.5 (0.48; 16.9–18.1; 9)	ns
	(6) 16.6 (0.68; 15.4–17.3; 6)	17.6, 19.8	
	(7) 16.9 (0.56; 16.0–18.0; 10)	16.8, 17.6, 17.9	
	(8) 17.4 (1.24; 16.0–19.5; 7)	16.3 (0.95; 15.4–17.5; 5)	ns
TOE C	(4) 17.6, 17.6, 19.4	16.8, 19.0	
	(5) 18.0 (0.68; 16.7–19.0; 10)	19.0 (0.69; 18.5–20.0; 4)	*
	(6) 16.6, 20.0	–	
	(7) 17.6, 17.9	16.9, 17.8, 19.3	
	(8) 16.5	–	

Sexes hardly differ in size; in the few samples above where sexes differ significantly in size, females larger than males. Wing, Tail, Bill S, Bill N and Bill W of juveniles significantly smaller than adults.

WEIGHTS Mostly from labels (ANWC, AM, MV, NMNZ, QM, QVM, SAM, TMAG, WAM); with data from Hall.

	MALES	FEMALES	
<i>LUCIDUS</i>			
ADULTS	25.6 (3.68; 16.7–32.0; 16)	24.4 (3.41; 18.5–29.0; 12)	ns
JUVENILES	22.2 (3.10; 16.0–27.5; 12)	21.8, 21.8	
<i>PLAGOSUS</i>			
ADULTS	23.3 (3.65; 17–35; 38)	24.5 (2.55; 18.0–28.5; 30)	ns
JUVENILES	21.7 (2.42; 20.0–27.5; 9)	–	

No significant differences apparent between sexes or age-classes. Analysis showed no striking seasonal variation in weights (e.g. one-way ANOVA showed no significant variation in adult *plagosus* between months [$F_{9,95} = 1.629, P < 0.05$]). Probable that *lucidus* must gain weight for long direct flights in migration, but this not reflected in available data, suggesting that samples inadequate in and round periods of migration. Weight gain of nestlings in Gill (1983b; *lucidus*), and Marchant (1986) and Brooker & Brooker (1986, 1989b) (*plagosus*).

STRUCTURE Wing somewhat narrow, pointed. Ten primaries: p8 longest; p10 30–34 mm shorter in *lucidus*, 33–42 mm shorter in *plagosus*, but rest of wing-formula similar in both subspecies; p9 2–6 mm shorter, p7 3–5, p6 10–15, p5 19–23, p4 24–30, p3 31–35, p2 35–39, p1 40–43. Nine secondaries,

Table 3. Plumage characters of adults (figures are percentages; N given in brackets).

PLUMAGE CHARACTERS	<i>LUCIDUS</i>		<i>PLAGOSUS</i>	
	MALE	FEMALE	MALE	FEMALE
SPECKLING ON FOREHEAD (Heavy, Slight, None)	87, 13, 0 (53)	5, 88, 7 (43)	13, 58, 29 (72)	10, 43, 48 (40)
GREEN SHEEN ON CROWN (Strong, Slight, None)	83, 17, 0 (53)	2, 70, 28 (43)	1, 33, 65 (72)	10, 7, 83 (30)
GREEN OF UPPERPARTS (Much, Some, Little)	85, 15, 0 (52)	5, 77, 18 (44)	4, 54, 42 (72)	7, 40, 53 (30)
BARRING OF CHIN (Barred, Mottled, White)	46, 44, 10 (52)	2, 43, 55 (44)	47, 47, 6 (72)	60, 33, 7 (30)
WHITE ON FACE (Much, Some, Little)	90, 8, 2 (52)	61, 17, 61 (41)	6, 64, 31 (72)	10, 60, 30 (30)
RUFIOUS SPOTS ON T4 (None, Small, Large)	42, 36, 22 (50)	26, 7, 67 (39)	18, 37, 45 (71)	13, 43, 43 (30)

including three tertials. Tail proportionately slightly shorter than in Black-eared Cuckoo *Chrysococcyx osculans* but otherwise similar in shape, with slightly rounded tip; ten rectrices; t1 5–8 mm longer than t5 in *lucidus*, 3–6 mm in *plagosus*. Bill similar in shape to that of Black-eared Cuckoo but proportionately longer (c. 90% length of skull) and broader at base; bill of *lucidus* broader than that of *plagosus* and this difference usually apparent from above or below, though in both subspecies, structure of bill similar and width tapers gradually from base to tip (Fig. 1; also see Measurements). Outer hindtoe, c. 86% width of outer front; inner front c. 64%, inner hind c. 45%; claws narrow and pointed, 4–7 mm long.



Figure 1 Ventral view of bill (a) Nominate *lucidus* (b) Subspecies *plagosus*

SEXING In adults, sexes differ slightly in several plumage characters; overlap occurs in most of these features, but in combination they usually allow reliable sexing. Key features are summarized in Table 3, which lists numbers of birds of each sex with given plumage characters (e.g. in adult male *lucidus*, 46 specimens examined had heavy white speckling of forehead, seven had slight white speckling and none lacked white speckling). Most plumage features listed in table are self-explanatory. Green of upperparts = Extent of very strong green iridescence on upperparts; if heavy, it extends to head and neck; if some, it extends to upper mantle; if faint, it only extends to lower mantle and most of mantle is maroon-bronze. Measurements are of little use in Sexing, but colour of iris may prove to be helpful with further study.

RECOGNITION See Horsfield's Bronze-Cuckoo.

GEOGRAPHICAL VARIATION Marked; four subspecies differing in measurements and plumage. Following based on major reviews of Mayr (1932), Gill (1983b) and this study. Little geographical variation within Aust. *plagosus* (described above). Bill narrower in isolated WA population than in e. Aust. (Gill 1983b; this study [bill of adults sexes combined from s. WA significantly narrower bills than those from Tas. or Vic.; Z-tests, $P < 0.01$; see Measurements]); no significant differences found in any other measurements. No obvious geographical variation in plumage within Aust. *plagosus* (e.g. χ^2 [performed separately for each sex] of plumage characters in Table 3 showed no significant differences between adults from Tas. [21 males, 23 females], Vic. [30 males, 8 females] or s. WA [26 males, 11 females]).

Nominate *lucidus* of NZ differs from *plagosus* in all plumages (including nestlings) and has broader bill; plumages and measurements described above and Table 3 summarizes differences in plumages from *plagosus*. *Lucidus* occurs in e. Aust. in spring and autumn, on n. and s. passage (see Movements). In e. Aust., subspecific identification of *lucidus* poses problems. In all plumages, bill-width an invaluable guide; in this study, bill-width of adult *lucidus* 5.80 (0.294; 91) and of adult *plagosus* 4.92 (0.228; 113). Where there is no prior information on relative representation of *lucidus* and *plagosus*, only 4.5% of birds will be incorrectly identified if those with bill-width of >5.3 treated as *lucidus* and those ≤5.3 treated as *plagosus*; for birds with bill-width between 5.1 and 5.5, identification solely on bill-width unreliable and probability of correct identification is <95%. When basing identification on bill-width, care must be taken to measure width of upper mandible at exactly level of front edge of nostrils, as different observers often record slightly different values for this measurement (e.g. compare data of Gill 1983b with data here); also not known if bill-width influenced by post-mortem shrinkage. Plumages also an important guide to subspecific identification. Adult male *lucidus* usually has diagnostic combination of heavy white speckling on forehead, strong green sheen on top of head, green (rather than maroon-bronze) sheen on mantle, and large white face. These plumage characters also vary sexually (more common in males, see Table 3) and are correlated with pattern of chin; brightest birds, with whitest ear-coverts and forehead, greenest upperparts and crown, also tend to have heavier dark barring on chin. Difficulties in subspecific identification of adults usually caused by similarity of brightest male *plagosus* and dullest female *lucidus*; such troublesome individuals often separable as chin of brightest male *plagosus* typically heavily barred, and dullest female *lucidus* usually extensively or wholly white. In a few cases, identification of adults not possible on plumage characters or bill-width; in such cases, colour of base of bill is important. Available data (see Bare Parts) suggest that large pale base of lower mandible of adult *lucidus*, compared with minute pale area or wholly black lower mandible of adult *plagosus*, diagnostic. However more information needed on variation in both subspecies. Colour of bill of less use in identifying juveniles, which initially have extensive pale base to lower mandible in both subspecies; in very young juveniles there is also a danger that bill may have not attained full width. Accordingly, although most juvenile *plagosus* are much less strongly barred below than juvenile *lucidus*, with diagnostic buff outer edges to lateral uppertail-coverts, there are a few that may defy accurate subspecific identification.

Subspecies *layardi* slightly smaller than A'asian subspecies (e.g. Wing 97.6 [95–101; 18]; Tail 65.1 [66–73; 18]; Mayr 1932), but with longer heavier bill (e.g. Bill S 19.7 [18.5–21; 18]; Mayr 1932) and width at base is at least as broad as in *lucidus*. Differs more obviously in plumage. Forehead, grey (84) or grey-brown (119B) grading to maroon (ne) on lores, ear-coverts, nape and hindneck; white on forehead and face confined to traces on supercilium; chin and throat white, almost unbarred. Upperparts and upperwing similar to adult male *plagosus*. Dark-brown (c119A) barring of underparts and underwing faintly tinged green (c260) and narrower than in subspecies of HANZAB region; on sides of breast, distal ends of feathers strongly tinged light brown (123A). Rufous areas of tail much larger than in subspecies of HANZAB region, forming rufous (38–40) barring across t2–t4; white half-bars and spots of t5 broadly bordered light rufous-brown (ne); white spots at tips of rectrices much smaller, usually confined to central one or two feathers.

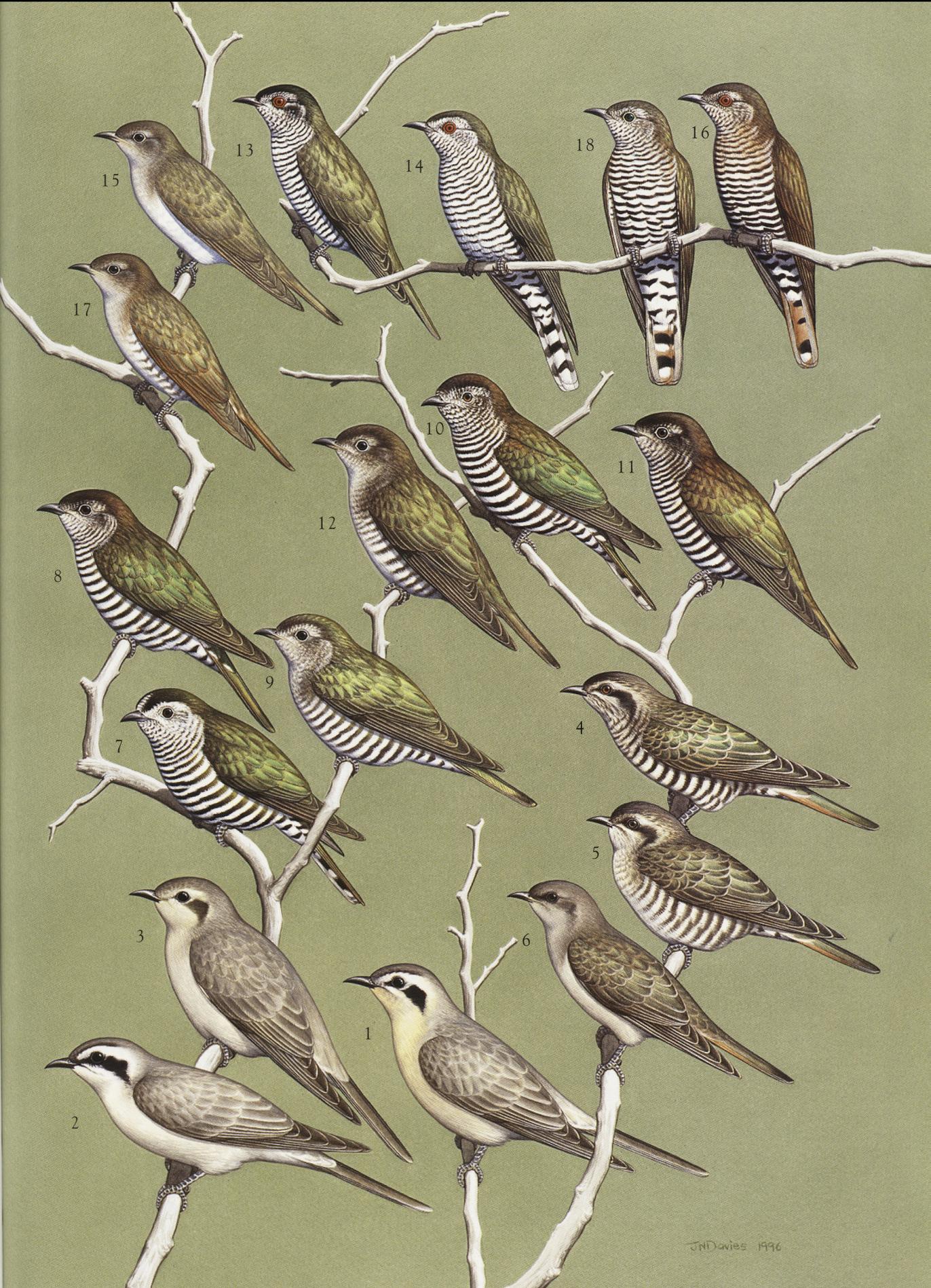
Subspecies *harterti* most similar to *layardi* but smaller (e.g. Wing 90–95, Tail 60–63, Bill S 19–19.5). Male has coppery crown, hindneck and mantle showing strong iridescence; all of throat, underparts and underwing barred (barring very glossy); rufous on tail confined to t4 and t3. Unlike *layardi*, female differs markedly from male, having dull-purple crown; bronze hindneck and mantle slightly glossed green; and light-brown wash on throat and breast, especially at sides; and more rufous in tail.

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Black-eared Cuckoo *Chrysococcyx osculans* (page 705)
 1 Adult (fresh); 2 Adult (worn); 3 Juvenile

Horsfield's Bronze-Cuckoo *Chrysococcyx basalis* (page 713)
 4 Adult male; 5 Adult female; 6 Juvenile

Shining Bronze-Cuckoo *Chrysococcyx lucidus* (page 726)
 NOMINATE *LUCIDUS*: 7 Adult male; 8 Adult female; 9 Juvenile
 SUBSPECIES *PLAGOSUS*: 10 Adult male; 11 Adult female; 12 Juvenile

Little Bronze-Cuckoo *Chrysococcyx minutillus* (page 744)
 NOMINATE *MINUTILLUS*: 13 Adult male
 SUBSPECIES *BARNARDI*: 14 Adult male; 15 Juvenile

Gould's Bronze-Cuckoo *Chrysococcyx russatus* (page 752)
 16 Adult male; 17 Juvenile

Hybrid Little *C. minutillus* x Gould's *C. russatus* Bronze-Cuckoo
 18 Adult female



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Black-eared Cuckoo *Chrysococcyx osculans* (page 705)
 1, 2 Adult (fresh); 3 Adult undertail

Horsfield's Bronze-Cuckoo *Chrysococcyx basalis* (page 713)
 4, 5 Adult male; 6 Adult male undertail; 7 Adult female undertail

Shining Bronze-Cuckoo *Chrysococcyx lucidus* (page 726)
 SUBSPECIES PLAGOSUS: 8, 9 Adult male; 10 Adult male undertail; 11 Adult female undertail

Little Bronze-Cuckoo *Chrysococcyx minutillus* (page 744)
 SUBSPECIES MINUTILLUS: 12, 13 Adult male; 14 Adult male undertail

Gould's Bronze-Cuckoo *Chrysococcyx russatus* (page 752)
 15, 16 Adult male; 17 Adult male undertail