

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 ordinarily (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, varyingly enlarged ectethmoids; basipterygoid processes vestigial. Atlas notched or perforated; 14 cervical vertebrae (13 in *Clamator*). Sternum double-notched to almost entire on either side, both spina interna and externa present (fused in *Clamator*) or only spina externa (*Eudynamys*, *Scythrops*). Muscle formula ABXY or AXY (ABEXY in *Clamator*). Feet rather weak, adapted for perching; zygodactyl, with outer toe permanently reversed; tarsi, scutellate; toes have short claws; hypotarsus has two closed canals. Carotids paired. Syrinx tracheo-bronchial. Tongue small, cartilaginous. No crop; caeca present, rather long. Uropygial gland well-developed, naked. Plumage of body, soft and sleek; no down or afterfeathers; contour feathers close in varied tracts but without apterium between dorsal-cervical and interscapular tracts. Wings usually pointed, rounded in some; ten primaries; 9–12 secondaries, eutaxic; four feathers in alula. Tail ranges from short to long and graduated; ten rectrices.

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

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

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

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

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

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

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

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

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

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

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

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

(Campbell; North); 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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Cacomantis flabelliformis Latham, 1801, *Index Orn. Suppl.* — Nova Hollandia = Sydney area, New South Wales.

The specific epithet mirrors Latham's (1801) 'Fan-tailed Cuckow' (Latin *flabellum*, a small fan, and *forma*, shape or form).

OTHER ENGLISH NAMES Ash-coloured Cuckoo.

POLYTYPIC Nominate *flabelliformis*, e. Aust., from C. York Pen. S to Vic. and Tas., then W along s. coast to Eyre Pen., with gap to sw. Aust. Extralimitally, four subspecies: *excitus*, Rothschild & Hartert, 1907, New Guinea highlands; *pyrrhophanus* (Veillot, 1817), New Caledonia, Loyalty and Solomon Is; *schistaceigularis*, Sharpe, 1900, Vanuatu and Banks Is; *simus* (Peale, 1848), Fiji.

FIELD IDENTIFICATION Length 24–28 cm; wingspan 34–42 cm; weight c. 50 g. Medium-sized, slim-bodied cuckoo with long tail that appears rounded (not fan-shaped) at tip. Very similar in shape to, but bigger than, Chestnut-breasted Cuckoo *Cacomantis castaneiventris*; bigger than Brush Cuckoo *C. variolosus*, with longer and rounded (not square-ended) tail. Adult dark blue-grey above with bold white notches along edges of uppertail; and mostly rufous-brown below with bold white barring to undertail. Sexes differ slightly: female paler below, with more obvious and extensive fine dark vermiculations along sides. Juvenile distinctive: dark brown above, indistinctly scaled dark rufous; paler below with fine dark mottling and barring; tail notched and barred buff-white. Immatures very similar to respective sexes of adult, but often separable in close view. Calls distinctive and diagnostic. **Adult male** Most of head and neck, and whole upperbody, uniform dark blue-grey, slightly paler on chin and upper throat, and with narrow white fringes to lateral uppertail-coverts. Uppertail slightly darker than rest of upperparts, grey-black, narrowly tipped white and boldly notched white along sides. Folded wing mostly dark blue-grey, as upperbody, with usually prominent short white strip along edge below carpal joint; remiges slightly darker brownish-grey; a few birds in fresh plumage can have fine white fringes to some coverts; in flight, upperwing mostly brownish grey grading to dark blue-grey on secondary coverts. Lower throat to breast, rufous-brown, grading to light rufous-brown on belly and flanks, which are often finely vermiculated dark grey; undertail-coverts usually slightly darker and more uniform rufous-brown than belly, contrasting with small white area on

vent and thighs; with wear, underbody appears more strongly vermiculated and much paler rufous-brown, though usually retain brighter rufous-brown band across upper breast. Undertail, dark grey, boldly barred and tipped white. Pattern of underwing striking: dark grey with broad light rufous-brown to cream leading coverts and broad white stripe across bases of remiges. Bill, black; palate, bright orange, conspicuous when bird calls. Iris, dark brown. Orbital ring prominent, yellow. Legs and feet, yellow. **Adult female** Very similar to adult male (especially worn males); differ by: underbody always noticeably paler, especially on breast, where bright rufous-brown confined to narrow band across upper breast (cf. entire breast and much of foreneck in males in other than very worn plumage); and grey vermiculations slightly bolder and often extend onto vent and much of or whole breast (breast unmarked in males). **Juvenile** Very different from adult, appearing much darker and browner above and densely mottled below. Head and neck mostly dark brown, finely mottled rufous-brown; chin and throat, off-white, grading to rufous-brown on sides of neck and buff on foreneck, all finely mottled dark brown. Upperbody and secondary coverts, dark brown, rather like top of head, with rufous-brown scaling to coverts; rest of upperwing as adult. Uppertail, black-brown, with light rufous-brown notching along sides. Most of underbody, cream to off-white, densely barred and mottled dark grey-brown; undertail-coverts, pale rufous-brown, usually broadly barred darker. Undertail, dark brown, boldly barred buff and occasionally tipped white. Underwing much as adult. Bill, blackish with varying pinkish to yellow base to lower mandible. Pale-yellow gape obvious in recently fledged birds.

Inside of mouth dull yellow at first. Iris, greyish brown. Orbital ring, pale yellow with greenish tinge, narrow and inconspicuous. Gradually attain adult coloration to all bare parts. **Immature male and female** Very similar to respective adult sexes; differ by: usually retain a few worn and faded brown juvenile secondaries, tertials and greater secondary coverts, which contrast noticeably with fresh, adult-like rest of wing; and, when fresh, new median and greater secondary coverts typically have broader, light-brown to off-white scaling.

Similar species In n.e. Qld, often confused with **Chestnut-breasted Cuckoo**; in n. and e. Aust., also confused with **Brush Cuckoo**; see those texts.

Usually seen singly, occasionally in twos or small groups. Inhabit wide variety of forests and woodlands. Conspicuous in breeding season, when perch prominently and call persistently, day and night. Often encountered sitting quietly on branch, stump or other perch in characteristic upright position with tail pointing directly down; or in less upright pose, with wings often drooping below level of tail. Females much quieter and less conspicuous than males; tend to call from lower perches and from cover. Arboreal but forage mainly on ground. Flight easy and undulating; on alighting, usually raise and lower tail. Calls of male during breeding season distinctive and diagnostic: commonest call a repeated, slow, mournful descending trill; also utter a mournful whistled *p-whoop* with a downward slur and a rising whistled *p-whoop* and other slight variants. Female much less vocal; commonest call a shrill, high-pitched *chiree*.

HABITAT Prefer well-timbered areas with well-developed understorey or ground-layer; often in foothills and ranges (Whitlock 1939; Lord 1956; Warham 1960; Bedggood 1970; Masters & Milhinch 1974; Vic. Atlas) including gullies (Ratkowsky & Ratkowsky 1977; Loyn 1980) and along watercourses (Jones 1981; NSW Bird Rep. 1989); mostly in understorey, and virtually within 10 m of ground (Marchant 1992; S. Marchant). Mainly in tall wet sclerophyll (*Eucalyptus*) forests and woodlands, such as forests of Mountain Ash *E. regnans*, Jarrah *E. marginata* or Karri *E. diversicolor* (Sedgwick 1968; Ratkowsky & Ratkowsky 1977; Loyn 1980, 1985a,b; Abbott 1981; Nichols & Nichols 1984; Thomas 1986; Hingston 1994; Vic. Atlas), including forests that have been logged or burnt (Ratkowsky 1978, 1985; Porter & Henderson 1983; Kavanagh *et al.* 1985; Shields *et al.* 1985; Smith 1985). In Mountain Ash forest in central Vic., mainly recorded in forest older than 39 years, and rarely in logged forest (Loyn 1985a). Also occur in tropical, subtropical or temperate rainforests (Kikkawa *et al.* 1965; Wheeler 1967; Bravery 1970; Gill 1970; Recher 1975; Roberts 1979; Shields *et al.* 1985; Griffin 1995), usually in clearings, at edges, or in areas regenerating after logging (Bourke & Austin 1947; Storr 1953; Napier 1969b; Smithers 1977; Shields *et al.* 1985; Laurance *et al.* 1996; Storr 19). Sometimes occur in lower vegetation types, including mallee vegetation, among native pines *Callitris*, and in casuarinas (Jones 1952; Boehm 1965; Sedgwick 1986; Baxter 1989; Saunders & Ingram 1995) and high altitude stands of Snow Gum *Eucalyptus pauciflora* (Osborne & Green 1992); or in more open dry sclerophyll forests or woodlands with sparse heath understorey or grass ground cover (Kikkawa *et al.* 1965; Thomas 1986; Leach 1988; Bridges 1994; Hingston 1994; Slater 1995), including open woodlands dominated by Mulga *Acacia aneura*, Myall *A. sowdenii*, Gidgee *A. cambagei* or Brigalow *A. harpophylla* in semi-arid areas (Noske 1978a; Leach 1988; Matthew & Carpenter 1993), and occasionally also paperbark *Melaleuca* woodlands (Storr 1965; Halse *et al.* 1985). Occasionally

reported from: heathland (Ridpath & Moreau 1966; Kitchener *et al.* 1975; McFarland 1988; Aust. Atlas); wet tussock sedgelands and moors (Ridpath & Moreau 1966); grasslands (Cooper 1974); or above tree-line (Osborne & Green 1992); among mangroves (Hindwood 1935; Roberts & Ingram 1976), usually on migration (Storr 19). Sometimes in wooded farmland (McEvey 1965; Bravery 1970; Nichols & Nichols 1984; Sedgwick 1984; Saunders & Ingram 1995; cf. Conole 1981); orchards (McEvey 1965; Ridpath & Moreau 1966; Fielding 1979); or plantations of pines *Pinus* or other trees (Storr 1965; Pawsey 1966; Stevens 1975; Friend 1982). Also occur in towns and other settled areas, mainly in parks and gardens (e.g. Dove 1931b, 1938, 1939; Brown 1950; Hindwood & McGill 1951; McEvey 1965; Baldwin 1975; Paton 1976; Sutton 1990).

Usually feed on ground; sometimes take prey from bark on trunks or branches of trees at low levels; very occasionally forage among foliage of shrubs or trees, or in air (Chisholm 1938; Pawsey 1966; Young 1973; Loyn 1985a; Recher & Holmes 1985; Recher *et al.* 1985; Hingston 1994; Laurance *et al.* 1996). In forests of Southern Tablelands, NSW, almost all foraging (86% of prey attacks) on ground (0–≤0.2 m) or among shrub layer (0.2–≤4 m; 12%), with rest (2%) in subcanopy (4.0–10 m) or canopy (>10 m). Mean height of foraging, 0.5 ± 1.8 m (Recher & Holmes 1985; Recher *et al.* 1985). In Mountain Ash forests of central Vic., forage mostly in middle storey (Loyn 1985a).

Roost in trees (Lord 1956), but no other information. Often perch high in tall trees or among clumps of shrubs, such as *Acacia* (Dove 1934a; Watson 1955; Marchant & Höhn 1979; Baxter 1989); also perch on fences, posts, aerials, overhead wires, clotheslines or guttering on houses (Condon 1938; Dove 1938; Matheson 1976; Baxter 1989; Field & Field 1989).

DISTRIBUTION AND POPULATION SW. Pacific: in Fiji, Vanuatu, New Caledonia, Solomon Is (occasionally), New Guinea from e. Owen Stanley Ra. W to Vogelkop, on Aru Is and Aust. (Delacour 1966; Hoogerwerf 1971; Holyoak 1979; Coates 1985; Beehler *et al.* 1986; Bregulla 1992).

Aust. Qld Mostly in E. Single Aust. Atlas record in se. Gulf of Carpentaria at Normanton. Widespread C. York Pen., including islands in Torres Str., S to line joining Kowanyama and Cooktown. Widespread S of Cooktown, to c. 19°S, and recorded W to near Georgetown. S of 19°S, widespread E of line from Charters Towers to Cunnamulla. Rare in South-western Region, with single record c. 38 km W of Eulo, 12 May 1977 (Noske 1978a; Draffan *et al.* 1983; Storr 19; Aust. Atlas). **NSW** Widespread, W to w. slopes of Great Divide; scattered records farther W, to w. Riverina and e. Upper and Lower Western Regions, to line from Barham, N to near Bourke. W of here, only scattered records, along Darling R. downstream of Wilcannia, and isolated records round Broken Hill (Hobbs 1961; Cooper & McAllan 1995; Aust. Atlas; NSW Bird Reps). **Vic.** Widespread, though more sparsely distributed W of 144°E (Vic. Atlas). **Tas.** Widespread (including King and Flinders Is); more sparsely distributed in W (Green 1969; Green & McGarvie 1971; Thomas 1979; Tas. Bird Reps). **SA** Widespread S of 32°S, from Plumbago Stn (W of Broken Hill), to Quorn, Wipipippee Hills (s. L. Gairdner) and Streaky Bay. Few records N or W of this: at Wilpena Pound, Kingston Bore (S of L. Eyre), W of Oodnadatta, Yumbera CP (NW of Ceduna) and e. Nullarbor Plain (McGilp 1944; Matthew & Carpenter 1993; Stove 1994; Aust. Atlas; SA Bird Reps). **WA** Scattered records s. Nullarbor Plain. Elsewhere, widespread S and W of line joining Israelite Bay and Geraldton; few records beyond this

area: various sites S of Kalgoorlie, near Kalbarri and, once, near Cooloomia (Sedgwick 1949; Reilly *et al.* 1975; Serventy & Whittell; Aust. Atlas; Storr 21, 26, 27). **NT** Vagrant. Single specimens, Alice Springs, 1894 (Condon 1948; Terrill & Rix 1950); Groote Eylandt, 24 May 1948 (Deignan 1964). Reports near Elliott, Banka Banka, Barrow Ck and in Macdonnell Ras all doubtful (Jarman 1944a,b; Ellis 1948; Storr 7).

NZ Vagrant; singles: Specimen, Governors Bay, Lyttleton Harbour, 15 June 1960 (Turbott & Scarlett 1964); Wanaka, 19–21 Sept. 1991 (Guest 1992; CSN 41); Haast Village, Oct. 1991 (CSN 41); Karikari Bay, Oct. 1991 (CSN 41).

Lord Howe I. Vagrant; single specimens: Feb. 1882 (Ramsay 1882); May 1911 (Hindwood 1940).

Breeding Throughout much of range, though generally less often reported in inland. Scattered records coastal Qld, from Cooktown to Fraser I.; widespread in e. NSW and throughout Vic., islands of Bass Str., e. and central Tas. and s. SA; in WA, recorded breeding at Eyre Bird Observatory, on Nullarbor Plain, but mostly breed in areas S and W of line from Albany to Morawa (Brooker & Brooker 1989; Aust. Atlas; NRS).

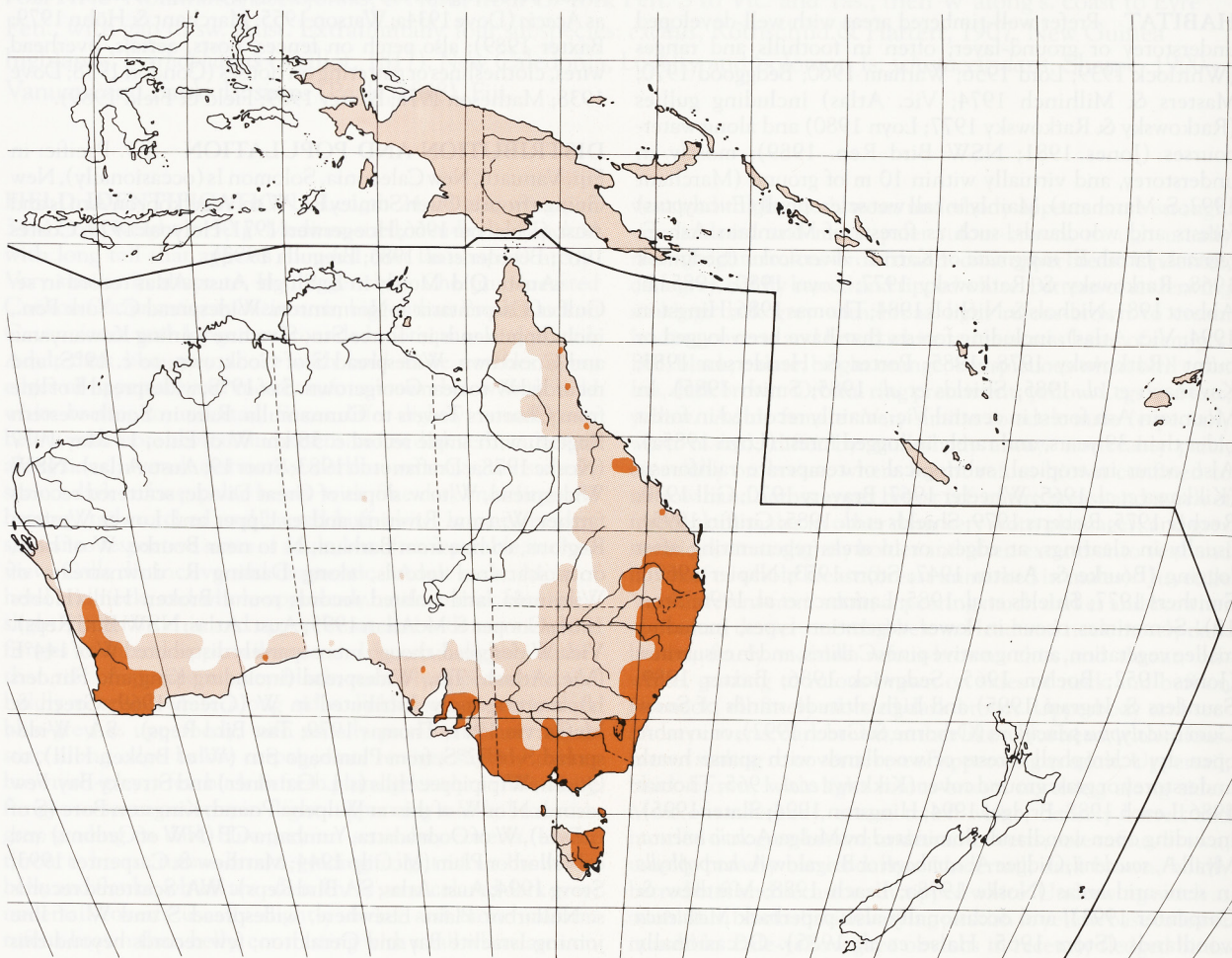
Populations Near Armidale, NSW, 0.01–0.04 birds/ha (Ford & Bell 1981; Ford *et al.* 1985); at Black Mtn, ACT, 0.3–0.9 birds/10 ha (Bell 1980); and at Boola Boola SF, Vic., up to 53 territories/km² (Loyn 1980); near Wollongong, NSW, 0.04 birds/ha (Wood 1995); at Margaret R., WA, 0.1 birds/ha (Keast 1985). At Moruya, NSW, estimated six birds in <1 ha of woodland (Marchant & Höhn 1979). Estimates of densities

from woodland along S. Alligator R. (Keast 1985) probably of Brush Cuckoo (M.G. Brooker & L.C. Brooker).

Sometimes killed by cats (Turbott & Scarlett 1964; Rose 1975; Dowling *et al.* 1994).

MOVEMENTS Partly migratory (Condon 1962; Marchant 1979; S. Marchant). Various considered migratory (Campbell), non-migratory (Hyem 1936), resident (Gill 1970; Roberts & Ingram 1976; Hardy & Farrell 1990; Hoskin 1991; Wieneke 1992; North) and nomadic (Attiwill 1972; Morris 1975; Turner 1992), seasonally nomadic (Gibson 1977; Hoskin 1991) or partly nomadic (Morris *et al.* 1981). Migration considered incomplete and irregular (Belcher 1914; Gilbert 1935; McEvey 1965).

Patterns of movements throughout Aust. complex and not properly known; timing and extent of movements vary across range. For migratory birds, relations between breeding and non-breeding areas poorly known; generally considered to move N from se. states in non-breeding season (e.g. Anon. 1987; Vic. Atlas). General pattern of reporting rates in e. Aust. suggest movement takes birds N and inland in winter (Aust. Atlas), but studies at individual sites reveal no clear patterns. In Qld, resident and apparently migratory, breeding winter, spring and summer; in n. Qld mostly winter and spring visitor, in s. Qld seasonal occurrences span all seasons. In se. mainland Aust., partly migratory, but occurrence and breeding season vary between regions: in SE, highest reporting rate and peak breeding in spring; in SA Ranges, highest reporting rates in winter



and spring and peak breeding in spring. In Tas., migratory, some possibly resident; mostly occur between late winter and summer, and peak breeding in spring; apparently move to mainland in non-breeding season. In sw. WA, partly migratory; resident in lower SW, with part of population migrating from there to N, and breeding late winter to early spring (Brooker & Brooker 1989; Aust. Atlas). However, throughout range there are exceptions to these general patterns of occurrence, other seasonal patterns of occurrence reported, and many remain outside season when most common. Thus at many sites recorded throughout year (e.g. Wheeler 1943; Watson 1955; Schmidt 1978; Smith 1984; Osborne & Green 1992; Leishman 1994; Vic. Bird Rep. 1985; Vic. Atlas); at some sites, remain throughout year in only some years, e.g. at Warrumbungle NP, NSW (NSW Bird Reps 1981, 1982), Murphys Ck, Qld (Lord 1933). Unknown whether presence of birds outside breeding period represents resident population or influx from other areas (e.g. Rix 1943; Marchant 1992). Suggested that records from s. areas in autumn or winter possibly transients from S, drifting through over different distances and different times to N (S. Marchant).

Throughout range, timing of arrival and departure of migratory population at any location varies (e.g. Fletcher 1918, Sharland 1924; Saunders & Ingram 1995), as do numbers recorded (e.g. Sedgwick 1940; Taylor 1987). Timing of movements can also vary from year to year at same sites (e.g. Dove 1919, 1928, 1933, 1934a, 1935a; Ashton 1996). Weather might influence occurrence; in ACT rarely recorded in May, but appeared in exceptionally mild spell in May 1989 (ACT Atlas); at Coombie Stn, NSW, more appear in years of average rainfall (NSW Bird Rep. 1992). Even suggested that timing of arrival affected by sunspot cycle and its associated effect on rainfall (Dove 1934b). Some local movements made in response to availability of food (e.g. Baxter & Berris 1995).

Seasonal variation in numbers or occurrence complicated by greater conspicuousness in breeding season, especially behaviour when calling, and frequency of use of calls (Aust. Atlas; see Social Behaviour, Voice). Birds sometimes recorded in areas where no calls heard for months (Hall 1917; Marchant 1979); calling in some areas might be interspersed with periods of silence (Marchant 1979), possibly influenced by weather (Robinson 1949). In ACT, impossible to determine whether decrease in records Nov.–Feb. reflects movement or reduction in calling (ACT Atlas). On King I., Tas., calling heard in all months of year (Tas. Bird Rep. 1972). Interpretation of seasonal trends also complicated because demographics of migratory and non-migratory portions of population not known. No studies have separated resident from migratory populations, or separated different migratory populations; and banding studies needed to separate resident from migratory birds in any particular area. Nothing known on age-specific movements; birds wintering N of breeding range in Qld (Storr 19) and birds that winter on Kangaroo I., SA, said to be mostly immature (Baxter & Berris 1995).

Non-breeding visitors of Aust. subspecies said to occur in New Guinea and Aru Is (Coates 1985; Beehler *et al.* 1986), though only a few acceptable specimens (Mees 1982).

NATURE OF PASSAGE: Few observations (e.g. Brown 1950; Clarke 1967). In sw. NSW, pass through from early Aug. to mid-Oct.; no return passage apparent (Hobbs 1961). In Caniambo district, no definite direction of movement (Bedggood 1973). Migrants usually arrive Sydney area singly or in small parties; in Aug. heard calling as fly S in evening and just before sunrise; once heard calling at 01:00 flying N (Gilbert 1935). Two birds recorded 32 km W of Booby I., Torres Str., 3 Oct. 1979 (Draffan

et al. 1983). Many found dead, in poor condition, in Aug. and Sept. in Caniambo district, Vic. (Bedggood 1973). One struck lighthouse at C. Wickham, Tas., in Apr. 1905 (Anon. 1906). Cross large stretches of water, e.g. Bass Str., Tasman Sea, Torres Str., to Kangaroo I. (see below).

E. mainland Aust. Patterns of movements vary and no obviously consistent trends. Said to move N in Qld in autumn and S in spring (Storr 19). Laying recorded in e. Qld and Atherton Regions, Aug.–Jan. (Brooker & Brooker 1989). N. QLD: Mainly spring and winter migrant (e.g. Garnett & Cox 1983; Garnett & Bredl 1985; Wieneke 1988). In Atherton Region, reporting rates in spring (12.1%) and winter (11.4%) similar, and higher than in summer (4.3%) and autumn (8.1%) (Aust. Atlas); between 1950 and 1969, earliest record 24 May, latest record 22 Aug. (Bravery 1970). Recorded Torres Str. in winter and spring (Draffan *et al.* 1983). Resident in some places (e.g. Gill 1970), though even where recorded all year, seasonality in numbers recorded (e.g. at Paluma Ra., seen and heard most often Apr.–May, Griffin 1995). s. QLD: No clear pattern of seasonal occurrence. Mainly spring–summer migrant in some areas (e.g. Leach & Hines 1987; Templeton 1992) but autumn–spring migrant in others (e.g. Jones 1981; Dawson *et al.* 1991). Resident in some areas (e.g. Lord 1956); at Cooloola, numbers appear stable throughout year (Roberts & Ingram 1976), though most seen in heathland in autumn (McFarland 1988). Even where recorded all year, seasonality in numbers recorded (e.g. Leach & Hines 1987). At some locations, pattern changes between years; at Murphys Ck, stayed through winter in large numbers in 1930; left 28 Apr. and first heard 6 Sept. in 1931; none heard after 31 May but heard 26 Aug. in 1932 (Lord 1933).

In SE and n. Murray–Darling Regions, laying recorded July–Feb., with peak in Oct.–Nov. (Brooker & Brooker 1989); in SE, reporting rate in spring (32.3%) higher than other seasons (12.0–17.1%) (Aust. Atlas); in Murray–Darling, reporting rates in spring (7.5%) and winter (6.6%) similar, and higher than in summer (1.9%) and autumn (2.8%) (Aust. Atlas). NSW: Mainly late autumn–spring migrant, with arrivals from late autumn to early winter (Apr.–May), or present at locality from late autumn, through to late spring–summer (Aug.–Oct.) (e.g. D'Ombra 1921; Morse 1922; Althofer 1934; Baldwin 1975; Costello 1981; Morris 1986; NSW Bird Rep. 1988). At some sites, mainly late winter–spring (Aug.–Sept.) to autumn (Apr.) migrant (e.g. Chisholm 1938; Heron 1973; McFarland 1984). Study at Moruya, on se. coast: pattern of occurrence complex, with records from all months, but fewest in Feb., June and July; probable that truly absent in June and July, returning in Aug.; adults left about Jan., with juveniles staying for c. 1 month longer; these replaced by incomers (probably from S) that either wintered till June or passed through irregularly (Marchant 1992); if leave Moruya, birds not away for more than c. 3 months (Marchant 1979). Breeding migrant to Thredbo Valley, where first and last records 1 Sept. and 1 Nov. in 1969; 18 Sept. and 3 Oct. in 1970; and 18 Oct. and 6 Feb. 1971–72 (Gall & Longmore 1978), but short stays possibly represent passage. ACT: Mainly spring–autumn migrant, with first arrivals in winter. Arrive last week July, ubiquitous by Oct.; records decline about Nov., rare by Jan. and Feb., and most gone by Mar. Trends in numbers at high altitudes lag c. 3 months behind lower sites, probably because hosts breed later (ACT Atlas). In Brindabella Ra., arrive early Sept. and leave late Apr. (Lamm & Wilson 1966; Tidemann *et al.* 1988). Some apparently stay for autumn and winter (Bell 1986; ACT Atlas). VIC.: Reporting index highest Aug.–Jan.; breeding,

Oct.–Mar. (Vic. Atlas); mainly late winter–spring to summer–autumn migrant (e.g. Ingle 1910; Bedggood 1972, 1973; Thomas & Wheeler 1983; Loyn 1980, 1985a; Dunn 1989). However, at some sites mainly autumn–spring migrants (e.g. Bright & Taysom 1932; Hore-Lacy 1965; Norris *et al.* 1995). First arrivals recorded late July–Oct., once late May (Campbell 1902; Cheney 1915; Ford 1918; Cohn 1925; Anon. 1930; Shanks 1949; Thomas 1969); arrival Scotts Ck, Cobden, 1896–1902, from 5 to 31 Aug. (Graham 1903). Some passage recorded: in 1988, captured Wilsons Prom. in Mar. and recorded in Apr., then disappeared till next Sept. (Garnett *et al.* 1991); pass through Turkeith, in Western Districts, June and July, with a Feb. record (Brown 1950). Resident in some areas (e.g. Vic. Atlas).

In SA Ranges and s. Murray–Darling Regions, eggs laid July–Dec., with peak in Sept. (Brooker & Brooker 1989); in SA Ranges, reporting rates in spring (5.4%) and winter (6.1%) similar, and higher than in summer (2.6%) and autumn (3.1%) (Aust. Atlas). SA: Mainly late autumn–winter to spring migrant (e.g. Ashby 1917; Whatmough 1978; Paton & Paton 1980; Taylor 1987; Paton *et al.* 1994). Occurrence later in some areas, with birds present from winter to summer (e.g. Pawsey 1966; Baxter 1980). At Parra Wirra NP, transient, recorded only in Mar.–Apr. (Clarke 1967), suggesting passage to s. areas. Recorded from S from most months (SA Bird Reps 1977–81); at Aldinga Scrub CP, recorded in all months, and for 3–5 months of most years (Ashton 1996).

Tas. Mainly breeding migrant, late winter to summer (Brooker & Brooker 1989); move N in autumn–winter. Proportion of population that leaves is not known but suggested most do so (Dove 1917); some remain in winter (e.g. Dove 1931a, 1935b; Lawrence 1945; Green & McGarvie 1971; Rounsevell *et al.* 1977; Green 1995), though at some sites, winter only in some years (e.g. Napier 1969a). Arrive mid-Aug.–Sept., eggs recorded Sept.–Jan. (with most laying in Oct. and Nov.), leave Mar.–Apr. (Fletcher 1902; Thomas 1969; Mollison 1974; Green 1977, 1989; Brooker & Brooker 1989; Tas. Bird Reps), though at some sites arrive later or leave earlier (e.g. Oct. or Feb.; Mollison 1974; Green 1977). Timing of first records can vary: at Devonport, first heard 24 Aug. 1918, 22 Aug. 1927, 30 Aug. 1932, 14 Aug. 1933, 23 Sept. 1934 (Dove 1919, 1928, 1933, 1934a, 1935a; see also Fletcher 1902).

WA Partly migratory; resident in higher-rainfall zone of lower SW and some other areas, and breeding migrant as far N as Wheatbelt, late autumn to spring (Saunders & Ingram 1995; see below); eggs laid July–Jan., with peak laying in Aug., and few breeding records in summer (Brooker & Brooker 1989; see Breeding). Between 1976 and 1981, in summer, only recorded S of 31°S (Aust Atlas). Leave lower SW from mid-Mar. or early Apr. (Serventy & Whittell). At Porongurup Ra., recorded July–Nov., once Jan. (Abbott 1981). Arrived Broome Hill 14 July 1908, 8 July 1910, 17 July 1912 (Carter 1924). At Mt Saddleback SF, near Boddington, Jan. 1978 – Mar. 1980, recorded Aug.–Oct. (Nichols & Nichols 1984). At Bickley, Swan R. district, arrive May (Serventy 1948). Arrive Swan Coastal Plain, Apr., exceptionally late Feb.; leave July–Aug. but some stay till Nov. (Storr 28); at Harvey, recorded Mar.–July, mostly May–July, with juveniles seen Dec. (Sedgwick 1988); at Rockingham, appeared 17 June to 9 July, 1937–39 (Sedgwick 1940). On Rottne I., generally arrive in May or June and stay till Oct. or Nov. (Storr 1965; Saunders & de Rebeira 1993). In Northam district, regular between late Mar. and mid-Oct. (Masters & Milhinch 1974); arrived Avon R. from first week in Apr. to second week in May, 1988–90; arrived Pingrup, from fourth week June to fourth week July (Saunders

& Ingram 1995). Rare winter visitor (from mid-May to early Sept.) to se. interior (Storr 26). At some localities recorded in some years but not others (e.g. Saunders & Ingram 1995). Beside higher-rainfall zone of lower SW, also apparently resident in some other areas (e.g. Carnaby 1933; Anon. 1996).

Banding Of 1194 banded in Aust., New Guinea and Micronesia, 1953–96, 65 recoveries (5.4%): 64 (98.5%) <10 km from banding site; 1 (1.5%), 10–49 km. Maximum displacement between banding and recovery site, 14 km. Retraps at banding site up to nearly 2 years after banding (ABBBS 1971). Some recoveries suggest at least some fidelity to natal site, e.g. one found dead c. 3 km from natal site >66 months after banding (ABBBS 1965).

FOOD Mainly insects, particularly lepidopteran larvae. **Behaviour** Usually feed on ground, but also low in shrubs and trees, on trunks and branches and, occasionally, among foliage; rarely, forage aerially; for details of foraging substrate and heights, see Habitat. At Wollomombi, NSW, join in insectivorous mixed-species feeding flocks during spring and summer; species mainly thornbills *Acanthiza*, and other small insectivorous birds, e.g. Superb Fairy-wren *Malurus cyaneus*, White-throated Gerygone *Gerygone olivacea*, and Varied Sitella *Daphoenositta chrysoptera*, which are both major hosts of Cuckoos and nuclear species of mixed-species feeding flocks. Cuckoos modified foraging behaviour according to nuclear species of flock and foraged at height similar to that of nuclear species (Bell 1986). **FORAGING BEHAVIOUR:** Catch prey by sallying; mainly by sally-pounce from low perches (<1.5 m above ground) to ground or low foliage (Recher & Holmes 1985; Green 1995). At Bondi SF, NSW, of 100 feeding observations: 86% sally-pouncing, 12% sally-strike, 1% sally-hover, and 2% gleaning (Recher & Holmes 1985; Recher *et al.* 1985). At same site, mean rate of prey-attacks, 0.5 ± 0.1 attacks/min ($n=14$ foraging acts in 74 min obs.); birds made 0.03 ± 0.024 hops/min and 0.8 ± 0.2 flights/min, changing perch 0.8 times/min (Holmes & Recher 1986).

No detailed studies. **Animals** ARANEAE: Spiders¹⁰. CHILOPODS: Centipedes¹⁰. INSECTS: Blattodea: cockroaches^{10,13}; Coleoptera: ads¹⁶, larv.¹⁴; Cantheridae¹⁰; Carabidae¹⁵; Curculionidae¹⁰; Elatiridae¹⁰; Scarabaeidae¹⁷; Tenebrionidae: *Lepispilus sulcicollis*^{7,15}; Diptera: larv.¹⁰; Hemiptera: Lygaeidae¹⁴; Pyrrhocoridae: *Dindymus versicolor*¹⁴; Hymenoptera¹⁴; Formicidae: *Componotus*¹⁷; Pergidae: *Philomastix macleaii*¹⁴; Lepidoptera: larv.^{1,2,3,5,7,9,10,12,13,14,15,16,18}; Amatiidae larv.¹⁷; Anthelidae: *Anthela*⁸; Arctiidae larv.¹³; Hepialidae: *Oncopera intricata*^{7,15}; Limacodidae: *Doratifera* larv.^{12,13}; Noctuidae: *Agarista agricola* larv.¹⁵; *Agrotis infusa* larv.^{4,17}; *Phalaenoides glycine*¹³; Nymphalidae: larv.¹⁷; Thaumetopoeidae: *Ochrogaster lunifer*^{6,11}; Orthoptera: ads¹⁷. MAMMALS: Unident. skin¹⁰.

REFERENCES: ¹ Dove 1909; ² Mathews 1909; ³ Cheney 1915; ⁴ Slaney 1922; ⁵ Morgan 1933; ⁶ Chisholm 1938; ⁷ Lea 1938; ⁸ Stewart 1947; ⁹ Green 1966; ¹⁰ Green & McGarvie 1971; ¹¹ Young 1973; ¹² Rose 1993; ¹³ 1997; ¹⁴ Cleland; ¹⁵ Lea & Gray; ¹⁶ Hall; ¹⁷ FAB; ¹⁸ T. Saunders.

Extralimitally, see Cain & Galbraith (1956), Holyoak (1979), and Lamothe (1979).

Young Little known. Seen to be fed caterpillars (lepidopteran larvae) by host-parents (McKeown 1944). One fledgling fed one caterpillar/min for 10 min by White-browed Scrubwrens *Sericornis frontalis* (Serventy 1958). Another young being fed by Superb Fairy-wrens *Malurus cyaneus* received the following in 1.5 min: one worm (Annelida), two spiders

(Araneae), two flies (Diptera), one moth (Lepidoptera), one dragonfly (Odonata), many larv. (Lepidoptera) and craneflies (Diptera: Tipulidae) (Selby 1929).

SOCIAL ORGANIZATION Poorly known. Usually seen singly or in twos or small groups (Gill 1970; Morris 1975; Nichols & Nichols 1984; Coates 1985; Gould). In breeding season, 2–3 can occur together (North); appear to occur in groups of up to six (Marchant 1979). Migratory birds usually arrive at breeding sites singly or in small parties (Gilbert 1935). Report of four foraging together in May (Cleland 1932).

Bonds Probably do not breed as simple pairs (Marchant 1992). **Parental care** Nest parasite. Young raised by host-parents but adult Cuckoos often seen near nest where egg or young present (Howe 1905; Campbell 1907). One unequivocal observation of adult female seen near nest with what was almost certainly her own offspring; subsequently adult female, together with host-parents, fed young for up to 5 days after young fledged before disappearing while the host-parents continued feeding fledgeling for 2 weeks after fledging (Ambrose 1987).

Breeding dispersion At Moruya, NSW, during breeding season, loose groups of 3–5 males, 1–2 females and one or more juveniles thought to roam over area of perhaps 30–50 ha; not known if laying females stayed in one area or not (Marchant 1992). One adult female known to return to same area in two consecutive breeding seasons (Ambrose 1987). Suggested, with only circumstantial evidence, that birds return to lay eggs in nests of same birds used in previous years (Campbell 1907). One adult seen within 2 km of natal area (Gill 1983).

Roosting One said to have roosted regularly in same tree (Lord 1956).

SOCIAL BEHAVIOUR Poorly known. Conspicuous only when calling (Gould). **Flock behaviour** Can call in flight during movements (e.g. Gilbert 1935). **Calling behaviour** Most details of calling behaviour, and use of calls during day and through year, summarized in Voice. During breeding season at Moruya, loose groups, of 3–5 males, 1–2 females and one or more juveniles, often found in radius of c. 30 m giving Trills, Whistles and Chireees. Males perch on bare branches and call without attacking other males; females reply, often immediately, to calls of other females and sometimes chase or displace one another, but thought not to be territorial behaviour as aggression rarely seen and then only early in breeding season (Marchant & Höhn 1979; Marchant 1992; S. Marchant).

Agonistic behaviour Trill considered territorial call (Keast 1993), but further study needed. Aggression rarely seen, and then only early in breeding season. One female thought to have attacked another (Marchant & Höhn 1979). Individuals in group of four foraging together in May would occasionally make a scolding noise when near another (Cleland 1932).

Sexual behaviour **Courtship feeding** Usually observed in spring (S. Marchant); observed in May in area where resident, so perhaps can occur year-round (Noske 1978b). One male Trilled persistently and occasionally Whistled; female then appeared and male fed her three times with caterpillars, in next 15 min, each time female flying to same perch as male, who would hop close to and feed her; female gave Chireee several times in this period (Marchant & Höhn 1979). One probable male and female took frequent short flights, usually landing within 1 m of each other; after about six flights, male landed closer to female and fed her; male called but female was silent entire time; birds then appeared to become aware of observer and male flew close to observer and landed in conspicuous

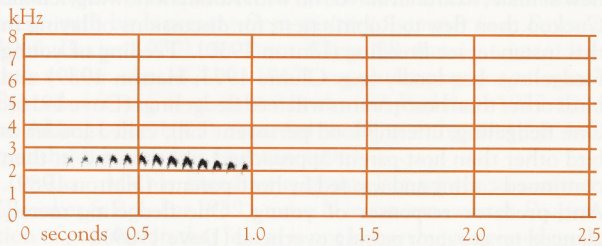
position while female flew away (Smithers 1977). **Copulation** One adult male gave single high-pitched Whistle at 10–15-s intervals and another, said to be juvenile, flew in and perched c. 9 m away; when juvenile landed, caller flew over and landed beside it, paused momentarily then mounted. Juvenile adopted posture with tail slightly arched and wings lowered so that tips almost touched; copulation lasted c. 4 s then male hopped off, paused briefly then flew off, other following soon after; both moved about area for 20 min but did not interact again except once when briefly perched on same branch. Birds observed for 2 h and no courtship feeding seen and female did not call (Smedley 1983).

Relations within family group Male said to act as decoy at host-nests so that female can gain access and lay (Linton 1930). One female observed to flutter to ground near active nest of Pink Robins *Petroica rodinogaster* and sit silently and still on ground while male foraged nearby; soon afterwards female uttered subdued call and male instantly stopped foraging and moved round nest, lowering wings and spreading tail; Robins flew at male, who then moved off with Robins following; female Cuckoo then flew to Robin's nest; for discussions of laying in this instance, see Breeding (Linton 1930). **Feeding of young** Fledgelings beg loudly (e.g. Clunie 1973; Hatton 1989) and birds other than host-parents will feed fledgelings (Dove 1916). One fledgeling, uttering loud persistent call, called louder as bird other than host-parent approached and then fed it, then continued calling and was fed by host-parents (Hatton 1989). **Anti-predator responses of young** One fledgeling merely glanced up at raptor passing overhead (Dove 1909).

VOICE Quite well known from study at Moruya, NSW, by Marchant & Höhn (1980), on which account based unless stated. Three main calls distinguished (Marchant & Höhn 1980; North). Trill and Whistle probably given only by males, Chireee probably only by females, but same bird seen to utter both Trill and Chireee (Howard & Crawford 1989). In breeding season, males give Trill often, perching conspicuously on bare branches, usually at least 5–8 m above ground; when Whistling, usually perch closer to ground, sometimes in dense thickets. Females unobtrusive and quiet; Chireee usually given from within shrubs and understorey, and rarely >5 m above ground (Marchant & Höhn 1979); Chireee of one female often answered by Chireee of another female (Marchant & Höhn 1980). Trill labelled territorial call by Keast (1993), but further study needed; probably functions as advertising call (see Social Behaviour). Males Trill persistently during breeding season and occasionally during winter (Dove 1905; Lord 1956; Gibson 1977; Marchant 1979; Marchant & Höhn 1979; Schodde 1980; Vic. Bird Rep. 1985); in Canberra, ACT, called consistently during mild winter, but thought not to call in normal winters (Gourlay 1974). In Tas., Whistle also heard in June (Dove 1928). At Moruya, NSW, Trill and Whistle given persistently from Aug. to Jan.; calling rare for c. 6 weeks at end of breeding season, in late summer, when adults have left area and most birds present are juveniles; juveniles also leave area c. 1 month later; said that local population then replaced by birds migrating from S and there is a resurgence in calling during autumn, with use of Trill increasing slightly and Whistles given occasionally; usually only intermittent Trilling heard after this (in winter), with levels of calling probably dependent on numbers wintering in area. Use of Chireee begins later and finishes earlier than other calls, and not given outside breeding season (Marchant & Höhn 1979; Marchant 1992; also see Gibson 1977). Also said to call at night on migration (Gilbert 1935).

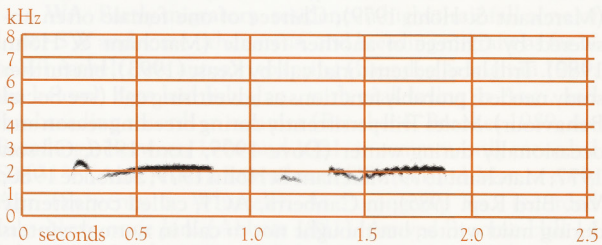
Trill given throughout day and at night, often with peaks of calling about dawn and dusk; often given for prolonged periods (Anon. 1926; Sutton 1928; Marshall 1934; Lord 1956; Marchant & Höhn 1979; Dawson *et al.* 1991); can utter Trill continuously for up to 1 h, then less often for longer (Keast 1993). Said that Trill soft at dawn but increases in loudness as light increases (Lord 1956). Chireee of one bird regularly answered by another, with reply often so rapid as to suggest antiphonal calling (Marchant & Höhn 1979). Trill of New Caledonian birds more wavering than that of birds in se. Aust. (Stokes 1980). Call of Fijian birds described as long wavering whistles *too-wee* or *too-wi*, becoming *tu-wi wi-weee* when apparently sung in duet by two or possibly three birds (Holyoak 1979); may be a variation of Trill, or an upslurred Whistle. Trill similar to that of Chestnut-breasted Cuckoo (q.v.).

Adult TRILL (sonagram A): Strong, but rather sad, slow downward trill *peeeeer* (Pizzey 1980). Usually uttered in clusters of 2–3/min, at maximum rate of 12–14 clusters/min (Keast 1993). During courtship feeding (q.v.), when male fed female

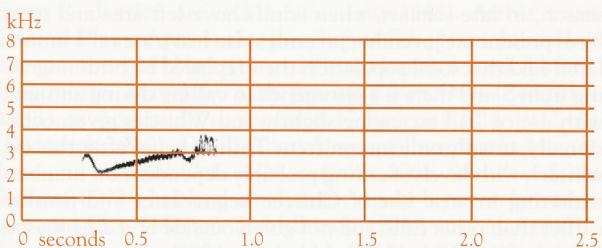


A F. van Gessel; Wollombi, NSW, Aug. 1987; P40

three times in 15 min, male uttered Trill persistently. **WHISTLE**: Normal call *p-who* with a downward slur, but during persistent bouts of this call a *p-who* with upward inflection and other variations often inserted. Recording from which sonagram B taken had *p-who* calls in pairs, linked by a brief syllable, and with second *p-who* more tremulous. Male uttering Whistle at intervals of 10–15 s attracted juvenile female, and copulation took place (Smedley 1983). Male occasionally uttered Whistle during courtship feeding (q.v.). **CHIREEE** (sonagram C): Excited



B F. van Gessel; Wollombi, NSW, Aug. 1987; P40



C R. Buckingham; Rotamah I., Vic., Sept. 1982; P40

shrill slurred high-pitched *chireee*. Given by female during courtship feeding (q.v.), and in reply to other females. **Other calls** Abrupt tremulous calls heard in Aug. from group in flight, just before daybreak (Gilbert 1935). Birds in group of four foraging together would occasionally utter scolding noise (Cleland 1932). Female apparently ready to lay uttered subdued, slightly trilling chirp of three notes (Linton 1930); may be Chireee.

Young Persistent loud high-pitched call from juvenile begging food from host (Hatton 1989). In Fiji, fully fledged young uttered continuous plaintive almost cicada-like *zeep-zeep-zeep* when begging from host (Clunie 1973).

BREEDING Not well known and no major studies. Brooker & Brooker (1989) reviewed 662 records, to 1987, of eggs and nestlings, feeding of Cuckoo chicks, and general descriptions of parasitism, from literature, museum and private egg-collections, NRS, ABBBS and unpublished information. Sixty-nine records in NRS up to July 1997 available for analysis. However, similarity of eggs to those of Brush Cuckoo calls into question the identification of some eggs attributed to Fan-tailed Cuckoo, including records in NRS (S. Marchant). Nest parasite.

Season Main months of laying progressively later from W to E; timing of laying coincides with that of major hosts. Throughout range (NRS): eggs (n=27), late Aug.–late Dec., most (78%), mid-Oct.–early Dec.; young (n=28), mid-Sept.–early Mar., most (71%), late Oct.–late Dec. For 469 records of nestlings and fledgelings, adjusted to estimated months in which eggs probably laid: in ne. Aust. (N of 28°S; n=19) laying, Aug.–Jan., more (37%) in Nov. than other months; in se. Aust. (S of 28°S; n=318) July–Feb., with most (88%) Sept.–Dec.; in s. WA (n=59) July–Jan., most (80%) Aug.–Oct. (Brooker & Brooker 1989).

Site Usually select hosts that build enclosed, dome-shaped nests, on or close to ground; mostly scrubwrens *Sericornis*, Rockwarbler *Origma solitaria*, Speckled Warbler *Chthonicola sagittata*, heathwrens *Hylacola*, fairy-wrens *Malurus*, and thornbills *Acanthiza*; less often parasitize hosts that build open cup-shaped nests, mainly robins Petroicidae, honeyeaters Meliphagidae, whistlers *Pachycephala* and fantails *Rhipidura* (H.L. White 1914; Brooker & Brooker 1989; Campbell; NRS). Of 503 records of host-nests with either Cuckoo eggs or nestlings that fledged successfully, 230 (45.7%) were of scrubwrens, 156 (31.0%) thornbills, 34 (6.8%) fairy-wrens, 37 (7.4%) Rockwarblers, 26 (5.2%) Speckled Warblers, 20 (4.0%) with heathwrens (Brooker & Brooker 1989). Of 44 records of eggs and nestlings in NRS, 21 (47.7%) were in nests of Brown Thornbill *Acanthiza pusilla*, and 11 (25%) in nests of White-browed Scrubwren. Most common hosts will vary with location, e.g. in Sydney area, NSW, most common hosts Brown Thornbill, Rockwarbler, Speckled Warbler and White-browed Scrubwren; N of Sydney in NSW, Large-billed Scrubwren *S. magnirostris* and Yellow-throated Scrubwren *S. citreogularis* (Hindwood 1930; North). Occasionally lay in nests of predominantly seed-eating Red-browed Firetail *Neochmia temporalis* and Beautiful Firetail *Stagonopleura bella* (Dove 1916; Favaloro 1933). Species recorded with either Cuckoo eggs or young in nest are: Superb Fairy-wren *Malurus cyaneus*, Red-winged Fairy-wren *M. elegans*, Variegated Fairy-wren *M. lamberti*, Red-backed Fairy-wren *M. melanocephalus*, Southern Emu-wren *Stipiturus malachurus*, Striated Grasswren *Amytornis striatus*, Pilotbird *Pycnoptilus floccosus*, Rockwarbler, Yellow-throated Scrubwren, White-browed Scrubwren *S. frontalis*, Tasmanian Scrubwren *S. humilis*, Large-billed Scrubwren, Scrubtit *Acanthornis magnus*,

Chestnut-rumped Heathwren *Hylacola pyrrhopygia*, Shy Heathwren *H. cauta*, Redthroat, Striated Fieldwren *Calamanthus fuliginosus*, Speckled Warbler, Western Gerygone *Gerygone fusca*, White-throated Gerygone *G. olivacea*, Brown Thornbill, Inland Thornbill *Acanthiza apicalis*, Buff-rumped Thornbill *A. reguloides*, Yellow Thornbill *A. nana*, Yellow-rumped Thornbill *A. chrysorrhoa*, Lewin's Honeyeater *Meliphaga lewinii*, Yellow-faced Honeyeater *Lichenostomus chrysops*, Mangrove Honeyeater *L. fasciogularis*, White-eared Honeyeater *L. leucotis*, Yellow-throated Honeyeater *L. flavicollis*, Yellow-tufted Honeyeater *L. melanops*, Yellow-plumed Honeyeater *L. ornatus*, White-plumed Honeyeater *L. penicillatus*, Brown-headed Honeyeater *Melithreptus brevirostris*, White-naped Honeyeater *M. lunatus*, New Holland Honeyeater *Phylidonyris novaehollandiae*, Bar-breasted Honeyeater *Ramsayornis fasciatus*, White-fronted Chat *Epthianura albifrons*, Scarlet Robin *Petroica multicolor*, Red-capped Robin *P. goodenovii*, Rose Robin *P. rosea*, Pink Robin *P. rodinogaster*, Dusky Robin *Melanodryas vittata*, Eastern Yellow Robin *Eopsaltria australis*, Varied Sittella *Daphoenositta chrysoptera*, Golden Whistler *Pachycephala pectoralis*, Rufous Whistler *P. rufiventris*, Rufous Fantail *Rhipidura rufifrons*, Grey Fantail *R. fuliginosa*, Willie Wagtail *R. leucophrys*, White-winged Triller *Lalage sueurii*, Dusky Woodswallow *Artamus cyanopterus*, Red-browed Firetail, Beautiful Firetail, Mistletoebird *Dicaeum hirundinaceum*, Clamorous Reed-Warbler *Acrocephalus stentoreus*, Little Grassbird *Megalurus gramineus*, Silvereye *Zosterops lateralis* and Rufous Bristlebird *Dasyornis broadbenti* (Chandler 1910; Fletcher 1911; Campbell 1915; Howe 1915; H.L. White 1915; Dove 1916; Purnell 1920; Gogerley 1924; Howe 1928; Linton 1930; McGilp 1941; Brooker & Brooker 1989; Campbell; North; Storr 28; NRS). One Cuckoo found its way into a closed boat shed to parasitize a Rockwarbler's nest (Hindwood 1930). **MEASUREMENTS:** Height of nest of host, 0.7 m (1.48; 0–9.0; 38) (NRS).

Nest, Materials Width of entrance of parasitized nests said to be larger than unparasitized nests; average width of entrance of nests of Striated Thornbill *Acanthiza lineata* parasitized by Cuckoo, 50–76 mm cf. unparasitized nests of 25 mm; entrance of a nest of Brown Thornbill said to have been enlarged by Cuckoo, with hood that usually conceals entrance pushed back, so that eggs easily seen (Campbell). When chick in nest of Brown Thornbill became too large for nest, it worked its head, neck and shoulders through entrance to be fed (Dove 1923); one chick broke out of nest of White-throated Gerygone when it grew too large (Gogerley 1924).

Eggs Rounded to compressed, elongate or stout oval; close-grained, finely textured; smooth; slightly lustrous or glossy; dull white (Campbell; North), thickly covered all over with very small dots of pale purplish-brown, intermingled with similar, but fewer, underlying spots of light slate-grey, mainly at larger end (North); or minutely freckled with chestnut and purplish brown, and with a distinct band of similar markings round larger end (Campbell); two eggs, pearly white, blotched with umber and light purple (Campbell). Very similar to those of White-browed Scrubwren (Barrett 1906, 1916; Campbell 1907); similar to, but larger than eggs of Inland Thornbill (Brooker & Brooker 1989). **MEASUREMENTS:** 21.3 (0.90; 19.6–22.9; 12) × 15.6 (0.93; 14.2–17.5) (Littler 1910; Campbell; North; NRS); 21.4 (19.8–24.6; 61) × 15.2 (14.5–16.8) (HLW, in Brooker & Brooker 1989). Eggs of Fan-tailed said to be typically larger than eggs of Brush Cuckoo, but study needed; for two nests said to contain eggs of both Fan-tailed Cuckoo and Brush Cuckoo, Fan-tailed Cuckoo eggs (21.1 × 15.0 and 21.4 × 16.4) c. 11% longer and 23% wider than Brush Cuckoo eggs

(19.3 × 13.1 and 18.9 × 12.4) (HLW). **WEIGHT:** c. 2.6, or 5.6% adult body-weight (Brooker & Brooker 1989).

Clutch-size Lay one egg in host's nest. Occasionally, two eggs recorded in host-nests, almost certainly laid by different females but further study needed: E/1 × 562, E/2 × 12 (Brooker & Brooker 1989). One Brown Thornbill nest contained two Cuckoo eggs, and claimed that probably laid by same bird as they were said to be almost identical in size, shape and colour (Mattingley 1907).

Laying May lay at any stage during laying period of host; often remove egg of host after laying. If Cuckoo lays before host lays, host may abandon nest or bury egg in lining of nest (Jackson 1920; North; NRS). One egg laid between dusk and 09:30 next morning (McGilp 1941). Method of laying not studied and much speculation in early literature as to whether egg laid directly in nest or laid elsewhere and carried to nest in bill or feet (e.g. Dove 1920; Campbell; see introduction to Cuculidae). Only two published observations of laying behaviour, both of which claim Cuckoos carry their eggs to host's nest: one said to have carried its egg in bill and placed it in nest of White-throated Gerygone; a check of nest immediately afterwards revealed only a Cuckoo egg in nest (Gogerley 1924); another claimed that female Cuckoo flew from ground to active nest of Pink Robin holding its egg in its foot, sat on nest and released egg, then backed up onto rim of nest, seized an egg of host with bill and flew off (Linton 1930; also see Social Behaviour); further study needed and such observations cannot be accepted. In one parasitized nest, eggs of host were dented, as if Cuckoo egg had been roughly deposited on top of them (Campbell). One egg found deposited on a bare stump (Campbell). A Fan-tailed Cuckoo said to have removed an egg of Pallid Cuckoo from a nest of White-eared Honeyeater then deposited its own egg; the Honeyeaters had not yet laid and subsequently deserted nest (Campbell). Eggs of other cuckoos occasionally found in nests parasitized by Fan-tailed: egg of Horsfield's Bronze-Cuckoo *Chrysococcyx basalis* in 14 nests; Shining Bronze-Cuckoo *C. lucidus* in nine; Pallid Cuckoo in two; Brush Cuckoo in one (Brooker & Brooker 1989). One egg hatched c. 24 h before eggs of host (Campbell 1907).

Incubation By hosts (NRS). **INCUBATION PERIOD:** From completion of host-clutch to hatching: < 13 days 5 h for one egg in nest of Inland Thornbill (Brooker & Brooker 1989).

Young Altricial, nidicolous. Blind and naked at hatching; at c. 5 days, eyes open; at 7 days, some feathers in pin; at c. 14 days, well-feathered (Campbell 1907; Mathews). For one chick raised by Inland Thornbills: at 7 days, feathers in pin on wings and body; at 9 days, feathers on wings had emerged from pins; at 11 days, feathers emerged over whole of body except back; at 13 days, feathers on back emerged; at 15 days, fully feathered (Brooker & Brooker 1989; L.C. & M.G. Brooker). Eject eggs or young of host from nest, within 48 h of hatching; if egg or young of host replaced in nest, Cuckoo may re-eject it within 60–90 s, or co-habit with it for a time before re-ejecting it; one Cuckoo chick, c. 48 h old, immediately re-ejected host-chick after it was replaced by observer six times; did not try to eject dead host-chick when replaced in nest 24 h later (Campbell 1907, 1915; see introduction to Family). One chick ejected a newly hatched Horsfield's Bronze-Cuckoo chick (North). **Growth** Weight and length of wing and tail of one chick raised by Inland Thornbills in Table 1. Weight of one chick c. 48 h old, c. 7.7 g (Campbell 1907). **Host care, role of sexes** Host broods and provides all food and defence of nest (Chaffer 1930; NRS). At one nest, White-browed Scrubwren hosts attacked a skink *Ctenotus* that was attacking Cuckoo nestling (Chaffer 1930).

Table 1. Growth of single chick (L.C. & M.G. Brooker).

| AGE (days) | 1 | 5 | 9 | 11 | 15 | 17 |
|-------------------|-----|-----|------|------|------|------|
| WEIGHT (g) | 2.4 | 7.7 | 18.4 | 22.0 | 28.9 | 31.7 |
| LENGTH (mm) of P4 | – | – | 8.0 | 15.0 | 33.0 | 41.0 |
| LENGTH (mm) of T1 | – | – | 3.0 | 7.0 | 19.0 | 26.0 |

Fledging to independence FLEDGING PERIOD: 16 or 17 days; tended by hosts for 3 or 4 weeks after hatching (Mathews). Fledgelings may be fed by birds other than hosts, and by more than one species at once, e.g. one fledgeling was fed by a Brown Thornbill, a female Pink Robin and several Tasmanian Scrubwrens (NRS). One fledgeling was fed by two adult Cuckoos (NRS). For list of species seen feeding chicks, other than known hosts, see Brooker & Brooker (1989).

Success From 25 eggs, 12 (48%) hatched; for nests of known outcome, from 23 eggs, 10 (43.5%) hatched, 5 (21.7%) fledged; of 20 nests with chicks (including nests with chicks but not found at egg stage), 14 (70%) fledged (NRS). Nests failed after being damaged or destroyed, eggs disappeared, eaten, collected by observer, or young died in nest (NRS).

PLUMAGES Prepared by D.I. Rogers. Fledge in distinctive juvenile plumage, which replaced in a nearly complete post-juvenile (first pre-basic) moult. Resultant immature plumage very similar to adult plumages, usually or always separable by retained juvenile secondaries. Adult plumage first attained in complete second pre-basic (post-breeding) moult when about 1 year old. Age of first breeding not known; probably when 1 year old (immature males at this age have been collected when calling) but possibly earlier since a juvenile (presumably female) has been seen copulating (see Smedley 1983). Sexes separable except in juvenile plumage. Nominate *flabelliformis* of Aust. described below.

Adult male (Second and subsequent basic). **HEAD AND NECK:** Crown, nape, hindneck and ear-coverts, uniform dark bluish-grey (c78) grading to slightly paler grey (85–86) on chin and upper throat. Foreneck and lower throat, rufous-brown (340). **UPPERPARTS:** Uniformly dark bluish-grey (c78) except that slightly more brownish-grey (c83) tinge at base of feathers sometimes exposed on scapulars. Lateral uppertail-coverts have narrow white outer edges meeting series of small rounded white half-bars on outer webs. **UNDERPARTS:** Breast, rufous-brown (340) grading to light rufous-brown (c39) on belly, flanks and undertail-coverts; undertail-coverts typically slightly darker and more uniform than belly, contrasting with a small off-white patch on vent and thighs. Belly and flanks often vermiculated dark grey (83); feathers have fine dark-grey (83–84) vermiculations, sparse or absent at tips. With wear, barring of flanks and belly more exposed and obvious, and rufous fades; in very worn birds (Nov.–Feb.), rufous-brown can be reduced to a narrow band across uppermost breast or be wholly lost, with most or all of breast, belly, flanks and undertail-coverts, light rufous-brown (pale 39) or (in patches) buff (124). All feathers of underparts have concealed fluffy grey (84) bases, which can impart a subtle grey tinge to faded areas of very worn birds. **TAIL:** Grey-black (82) with complex white markings that become progressively larger on outer feathers: small white spot at tips of t2 (rarely t1) to t5; series of small white spots along shafts of t2–t5 and rarely, t1; and series of white half-bars along edges of feathers. Half-bars and spots along shafts large on outer feathers, and on t5, and often t4, meet and form broad, complete, irregular white bars. **UPPERWING:** Remiges, primary coverts and alula, dark brownish-grey (c83) becoming slightly paler grey-brown (c119A) with wear. Marginal coverts outside carpal

joint, white, often concealed by alula. Secondary coverts, dark bluish-grey (c78), as upperparts. In some, greater and median secondary coverts have varying off-white fringes, which typically narrow but up to 1 mm wide and with buff (124) tinge in a few; such birds possibly immatures without retained juvenile remiges and therefore difficult to age. **UNDERWING:** Remiges mostly grey (84) to dark grey (83); secondaries have large white bases and primaries have white centres, which form broad white stripe that peters out at about p9; p10 has white spot near base of inner web, off-set from rest of stripe. Greater primary coverts and bases of greater secondary coverts, grey (84) to dark grey (83); tips of greater secondary coverts, cream (c54, vermiculated with grey [84] on inner feathers), increasing in width toward innerwing and forming part of pale wing-bar. Lesser and median secondary coverts, light rufous-brown (c39) to buff (124), sometimes with traces of dark-grey (c83) vermiculation, especially at bend of wing.

Adult female (Second and subsequent basic). Differ from similar adult male only in ventral colouring; first confirmed and described by Marchant & Höhn (1979). **UNDERPARTS:** Rufous less dark than males, and underparts more extensively barred (Marchant & Höhn 1979); reliable sexing usually possible, though appearance of fresh females and worn males similar. When fresh (about Apr.–Oct.) ground-colour of breast typically lighter rufous-brown (ne), and rufous-brown confined to band across upper breast (cf. all breast and much of foreneck in males). Fine grey barring of flanks and belly much more extensive, extending onto much, or sometimes all, of breast (cf. unmarked breast of males); upper breast can appear unbarred in some, though feathers have concealed grey vermiculation at bases. Off-white patch on vent usually larger than in males and more often has some grey vermiculation extending onto it from flanks. Undertail-coverts usually have broad diffuse white tips (if present, very narrow in males).

Nestling Naked at hatching (Brooker & Brooker 1989).

Juvenile Sexes similar. **HEAD AND NECK:** Forehead, crown, nape, hindneck, and upper ear-coverts vary, appearing mostly dark brown in some, finely mottled paler in others; feathers, dark grey-brown (121) with narrow rufous-brown (123A–38) tips and varying broad black-brown (c119, c121) subterminal bands; some birds also have rufous-brown (123A–38) band below dark subterminal bands. Chin and throat, off-white grading to buff (124) on foreneck and light rufous-brown (38, 39) on sides of neck; chin, throat, foreneck and sides of neck faintly and irregularly barred; bars, grey-brown (c119A, 79) with narrow dark-brown (121, 119) margins. **UPPERPARTS:** Rather uniform, warm dark-brown, like top of head. Feathers of mantle, scapulars and back, dark brown (119A, 119B) with narrow rufous-brown (c340) tips (rapidly reduced by wear) and varying, slightly narrower, dark-brown (121) subterminal bars; feathers have concealed grey (83–84) bases. Rump and uppertail-coverts similar but ground-colour brownish grey (c79) in some. **UNDERPARTS:** Upper breast like foreneck: cream (c54) to white, faintly marked by broad and irregular grey-brown (119B) bars that do not contrast strongly. Lower breast, belly, vent and flanks similar but with whiter ground-colour, and denser paler-brown (c119B) barring. Undertail-coverts, pale rufous-brown (223D–39) with varying, broad dark-brown (c121) bars that are often patchy and occasionally absent; ground-colour always darker than belly. **TAIL:** Black-brown above, with series of light rufous-brown notches along sides; barred dark brown and buff below, sometimes with contrastingly whiter tips. Feathers, black-brown (119) or dark brown (121); t1 and t2 have narrow light rufous-brown (38, 39) tips and series of light rufous-brown

(38, 39) triangular spots along edges; latter markings broaden to half-bars on t3, which also has light rufous-brown (38, 39) spots near shaft; on t4 and t5 these markings meet and form complete bars across feathers. Light rufous-brown areas of outer feathers (typically t3–t5) irregularly blotched white, especially at tips and inner edges of rectrices. **UPPERWING:** Remiges, dark greyish-brown (c119A), slightly browner than in adults, though little difference when worn. Secondaries, tertials and inner primaries have narrow light-brown (121C) fringes that peter out on central primaries; these markings paler brown (119C–119D) and narrower when worn. Secondary coverts, greyish brown (c119A) with warm-brown (121C) fringes c. 1 mm wide. Primary coverts and alula have slightly darker grey-brown (c121) ground-colour and narrower white fringes with varying brown (121C) patches within. **UNDERWING:** Lesser and median coverts, buff (124) to cream (54). Inner greater secondary coverts have dark-grey (83) tips and varying light-brown (223C) subterminal markings. Rest as adult.

Immature male (First basic). Similar to adult male, differing by: (1) Median and greater secondary coverts typically have broader light-brown (124) to off-white fringes than in later plumages; difference accentuated because, at the same time, wing-coverts likely to be fresher than those of adults (see Moults); (2) Most or all retain 1–6 juvenile secondaries (usually 2–4) which are more worn and narrower than new secondaries, with rather rounded distal corner to outer web (cf. more square corners in secondaries grown in subsequent moults). Many also retain some outer secondary coverts (from 1–2 greater coverts, to 6+ greater and median and c. 5 lesser coverts). Ageing on first two characters requires caution as there may be slight overlap between width of pale fringes on coverts, and because a few adults retain one or more secondaries from preceding basic plumage; when worn, difference in shape between basic and juvenile secondaries barely noticeable. Nevertheless, any Fan-tailed Cuckoo combining retained worn secondaries with broad light-brown fringes to some secondary coverts almost certain to be immature.

Immature female (First basic). Similar to adult female. As in immature males, can usually be distinguished from adults on basis of retained juvenile secondaries and broader pale fringes to some first basic secondary coverts.

BARE PARTS From photos (Flegg & Longmore 1994; Aust. RD; NZRD; Strahan; unpubl.: J.N. Davies, R. Shepherd), museum labels (AM, ANWC, HLW, MV, SAM, WAM), Brooker & Brooker (1986, 1989), Hall, and unpublished banding records (BATH). **Adult male** Bill, grey-black (82) to black (89), sometimes with paler base to lower mandible (possibly more common in females than males); this usually yellowish (–) to olive-brown (–) and often confined to underside, so not normally visible. Gape usually paler than bill, pale buff-yellow (ne) to pink or orange; usually small and concealed by feathers. Mouth usually deep reddish-orange (c116), but described in a few as yellow, yellow-orange or rich flesh-pink (Cleland 1913; Hall). Iris most often black-brown (119) but lighter, more reddish brown in some birds; sometimes shows lighter-brown inner or outer ring; and, in a few, wholly yellow-brown (–) or yellow (–). Orbital ring 1 mm wide, contrasting, pale yellow (157) to bright yellow (55), sometimes with orange tinge. Legs and feet, pale yellow (157) to orange-yellow (c17), often with olive-brown tinge in centres of scales (especially on tarsus; absent on soles). Claws, grey-black (82, 89). **Nestling** At hatching: eyes closed; gape, cream (54), mouth and tongue, orange-yellow (–); bare skin, grey (c84) on head, hindneck,

lower back and legs, grading to flesh-pink (c3) on belly and uppermost back; soles, pink (c7); uropygial gland large and obvious (1 mm, cf. hardly noticeable in *Chrysococcyx* of similar age). Grey on skin of head, body and legs becomes darker, more purplish grey (c83) and more extensive with age, though belly remains dark flesh-pink (c3) till feathered. By 11–13 days: iris, dark brown (121); gape, yellow-orange (18); mouth, orange (17); legs and feet, steely grey (c84) with bright-yellow (–) to orange-yellow (–) soles, oil-gland 2.5 mm. **Juvenile** Bill: at first light brown (–) with dark-brown culmen, tomlia and cere, soon becoming mainly dark grey (83) to grey-black (82, 89) with paler base to lower mandible. Pale base ranges from light pinkish-brown (123A–221D) to pinkish orange (c6) or yellow (–); occupies basal 30–65% of lower mandible. Gape, cream (ne) or yellow (c157) to pale orange (c17), inconspicuous except when very young. Palate from dull yellow (possibly only in youngest birds) to deep orange. Iris, greyish brown (c19, c119B) to dark greyish-brown (c119A) or black-brown (119), often with inner ring darker than outer; iris probably becomes darker and browner with age and is creamy grey in some juveniles before fledging. Orbital ring, pale yellow (157); at first very narrow and inconspicuous with green (–) or grey (–) tinge; later as adult. Feet at first have strong pink tinge; adult colour attained before post-juvenile moult. **Immatures** Similar to adult but more often have noticeable pale base to lower mandible; usually this marking similar in colour to that of adults, but orange-buff (118) in some.

MOULTS Based on Aust. records from 131 adults and 83 younger birds, mainly from skins (AM, ANWC, HLW, MV, QVM, SAM, TMAG) and partly from banding records (BATH). **Adult post-breeding** (Second and subsequent pre-basic). Complete, or nearly so; seven adults retained a few feathers through two moults, usually 1–2 secondaries or one or two of p3, p5 and p7; in one, two median coverts retained. Most moult in late summer and autumn. Moult begins with body, usually about Dec. but rarely as early as Sept.; moult of tail can also begin before moult of remiges; moult of secondaries occurs at same time as moult of primaries, which are usually last feathers to finish. Earliest record of active moult of primaries 28 Oct. (PMS 4); such early start unusual, and most from spring and early summer show no moult (11 records from Oct., nine from Nov. and six from Dec.). Few adults collected with active moult of primaries: Jan. (PMS 19, 20), Mar. (24, 26, 30), Apr. (48) and May (49); eight of nine from Apr. had already finished moult of primaries, as had all 19 examined from June. Rarely interrupt moult of primaries but some can have suspended moult in one wing and active moult in other. Sequence of moult of primaries, complex: usually moult alternating primaries, with growing feathers separated by at least one fully grown feather; grow 1–5 primaries concurrently. No single sequence of primaries by all birds, but following patterns observed: (1) p9 and p7 start at same time, usually before, but sometimes after, other outer primaries, but never while p6, p8 or p10 moult; (2) other outer primaries typically in sequence p5–p10–p8–p6; (3) inner primaries in sequence p4 and p1 (simultaneously)–p2–p3 or p4 and p2 (concurrently)–p1–p3; moult of p1 and p3 usually coincides with that of p5, p8 and p10. Sequences of moult of secondaries and tail complex but not known. **Post-juvenile** (First pre-basic). Nearly complete: most or all arrest moult before finishing moult of secondaries, retaining 2.9 secondaries (1.33; 1–6; 19) till complete second pre-basic moult. Many also retain some outermost secondary coverts (see Immature male); less commonly retain a few juvenile primaries. Moult of body

starts just before moult of remiges and rectrices, mainly Dec.–Mar., starting on breast and scapulars then moving to belly and rump. Moult of primaries usually in autumn, later than in adults; in se. Aust., active moult recorded Mar. (PMS 9, 10), Apr. (PMS 37, 40) and May (PMS 44); some have finished moult by mid-Apr. and last birds do not begin moult till late Feb. Two birds examined had very different timing of moult: Tas. bird had undertaken much moult of body and had PMS 19 by 5 Oct.; and bird on C. York Pen. was in early moult of body and had PMS 17 on 9 June. For sequence of moult of primaries, see Adult post-breeding above. Sequence of moult of tail complex, varying and poorly understood; usually start at t1, then moult t5 or t2; t3 and t4 usually among last feathers to be replaced.

MEASUREMENTS (1–5) Skins (AM, ANWC, HLW, MV, QVM, WAM, TMAG, WAM): (1–3) Adults: (1) E. Aust.; (2) Tas.; (3) WA; (4) Aust., juveniles; (5) Aust., immatures with first basic primaries and tail.

| | MALES | | FEMALES | | |
|--------|-------|----------------------------|----------------------------|----|--|
| WING | (1) | 144.4 (3.38; 138–151; 42) | 140.6 (3.76; 134–147; 18) | ** | |
| | (2) | 145.4 (3.04; 140–153; 23) | 141.8 (3.63; 136–146; 5) | ** | |
| | (3) | 143.8 (2.94; 139–150; 25) | 141.6 (4.51; 134–146; 5) | ns | |
| | (4) | 134.8 (4.90; 126–142; 13) | 134.5 (2.16; 130–138; 11) | ns | |
| | (5) | 141.9 (3.73; 136–150; 22) | 139.3 (3.95; 133–146; 14) | ns | |
| TAIL | (1) | 140.5 (4.30; 130–149; 45) | 135.4 (6.39; 123–151; 17) | ** | |
| | (2) | 143.5 (4.67; 134–153; 23) | 135.2 (3.56; 132–140; 5) | ** | |
| | (3) | 138.8 (4.96; 129–152; 25) | 134.2 (5.76; 127–143; 5) | ns | |
| | (4) | 127.8 (9.34; 114–147; 15) | 126.3 (5.26; 118–135; 11) | ns | |
| | (5) | 136.0 (5.23; 127–145; 26) | 131.9 (5.11; 124–139; 15) | * | |
| BILL S | (1) | 21.5 (1.25; 18.2–23.5; 41) | 21.4 (1.06; 19.0–22.6; 15) | ns | |
| | (2) | 21.9 (1.35; 19.0–23.5; 21) | 22.4 (0.67; 21.6–23.2; 5) | ns | |
| | (3) | 22.1 (0.94; 19.3–23.8; 22) | 21.7, 21.7, 21.9 | ns | |
| | (4) | 20.5 (1.50; 17.6–22.2; 13) | 20.2 (1.48; 17.3–22.3; 12) | ns | |
| | (5) | 21.4 (1.20; 18.1–23.5; 24) | 21.9 (1.23; 19.8–23.7; 12) | ns | |
| BILL N | (1) | 12.7 (0.49; 11.8–13.8; 41) | 12.7 (0.62; 11.7–13.8; 15) | ns | |
| | (2) | 12.9 (0.56; 12.1–14.1; 20) | 12.9 (0.37; 12.6–13.5; 5) | ns | |
| | (3) | 12.9 (0.47; 11.8–14.0; 22) | 12.7, 12.8, 13.0 | ns | |
| | (4) | 11.4 (0.79; 9.4–12.6; 13) | 11.3 (0.93; 9.1–12.6; 12) | ns | |
| | (5) | 12.7 (0.52; 12.0–14.1; 25) | 12.8 (0.58; 12.0–13.8; 12) | ns | |
| TARSUS | (1) | 19.7 (0.97; 18.0–22.2; 31) | 19.6 (0.63; 18.3–20.2; 13) | ns | |
| | (2) | 19.7 (0.74; 18.2–20.7; 9) | 19.0 (0.45; 18.4–19.6; 5) | ns | |
| | (3) | 19.5 (0.78; 18.5–20.6; 5) | – | | |
| | (4) | 19.8 (1.03; 18.3–21.7; 7) | 19.9 (1.15; 19.8–23.0; 7) | ns | |
| | (5) | 19.6 (0.51; 18.2–20.2; 16) | 19.9 (0.41; 19.4–20.4; 6) | ns | |
| TOE C | (1) | 20.8 (0.78; 19.5–22.2; 18) | 21.2 (0.88; 19.9–22.2; 6) | ns | |
| | (2) | 21.5 (0.80; 20.3–22.5; 6) | 20.8 (0.78; 19.5–22.2; 18) | ns | |
| | (4) | 20.6 (1.19; 18.7–21.8; 7) | 20.8 (1.13; 19.8–23.0; 6) | ns | |
| | (5) | 21.2 (0.59; 19.7–21.8; 10) | 20.3, 21.3, 22.2 | ns | |

Males have longer wings and tail than females. Geographical variation within Aust. measurements negligible, except tail of Tas. adult males significantly longer than on mainland. When localities combined, juveniles have significantly shorter wings, tail and bill than adults or immatures; first basic wing and tail of immatures significantly shorter than those of adults.

WEIGHTS Aust., from museum labels (as above).

| | MALES | FEMALES | |
|-----------|--------------------------|-------------------------|----|
| ADULTS | 49.8 (4.39; 42.6–65; 32) | 49.9 (3.09; 45–53.5; 7) | ns |
| JUVENILES | 45.3 (5.08; 36.9–51; 8) | 49.6 (5.18; 43–57; 5) | ns |
| IMMATURES | 47.3 (7.33; 31.5–59; 12) | 50.1 (7.34; 42–62; 5) | ns |

Aust., sexes combined (above labels; ABBBS; BATH).

Adults include first basic immatures that have completed post-juvenile moult of body and arrested post-juvenile moult of remiges and upperwing-coverts; juveniles include birds in active post-juvenile moult of body.

| | ADULTS | JUVENILES | |
|-------|---------------------------|--------------------------|----|
| JAN. | 48.1 (4.41; 39–52.5; 11) | 45.7 (5.18; 38–56; 9) | ns |
| FEB. | 46.9 (5.77; 38–54; 6) | 47.9 (5.95; 36.9–57; 16) | ns |
| MAR. | 50.5 (3.19; 46.7–56; 10) | 46.5 (2.94; 42–51; 11) | * |
| APR. | 48.0 (3.24; 44.0–53.5; 8) | 51.5 (5.67; 47–62; 6) | ns |
| MAY | 49.5 (7.27; 44–68; 10) | 44.5, 50.1, 50.1 | ns |
| JUNE | 47.7 (3.13; 43–53.3; 16) | 49, 47.5, 50 | ns |
| JULY | 51.3 (5.75; 44–62; 9) | – | |
| AUG. | 46.6 (3.59; 41.5–55; 15) | 37.8, 50, 57 | |
| SEPT. | 49.1 (6.81; 31.5–69; 29) | 34, 47.5 | |
| OCT. | 50.8 (6.74; 42–69.5; 21) | 46.1 (8.56; 34–57; 6) | ns |
| NOV. | 47.2 (4.03; 38–59; 23) | 37, 42, 43 | * |
| DEC. | 42.7 (2.80; 38.5–46; 7) | 43.0 (4.67; 39–55; 12) | ns |

Sexes similar in weight; juveniles slightly lighter than adults (differences significant when dates combined). Possible slight seasonal variation, e.g. one-way ANOVA showed differences in monthly weights to be significant in adults ($F_{11,153} = 1.958$, $P < 0.05$) and juveniles ($F_{10,65} = 2.332$; $P < 0.05$). In juveniles this may be related to age (lightest birds were from spring and early summer) but causes of seasonal variation in adults not known.

STRUCTURE Wing rather short, pointed. Ten primaries: p8 longest; p10 43–53 mm shorter, p9 3–7 shorter, p7 3–8 shorter, p6 13–20, p5 25–35, p4 33–44, p3 41–51, p2 48–56, p1 51–62. Nine secondaries, including three tertials (and not including small unidentified feather that may be an innermost tertial or may be a covert). Tail long, gradually tapered at tip; ten feathers; t5 37–51 mm shorter than t1. Toes slender; outer hindtoe c. 85% length of outer front, inner front c. 64%, inner hind c. 43%; claws narrow and strongly curved, c. 7 mm long on outer front toe and 5–6 mm long on other toes. Large bare vascular areas on underparts recorded in adults banded in Vic. in Sept. and (receding) in Dec. (Rogers *et al.* 1986; K.G., D.I. & A. Rogers); these appear identical to brood-patches, though no reason to believe adults ever incubate eggs. Rest of structure similar to that of Brush Cuckoo (q.v.), except bill proportionately longer and tuft of feathering on front of tarsus smaller.

GEOGRAPHICAL VARIATION Negligible within Aust.; populations from ne. Qld and sw. WA have been treated as separate subspecies in the past but do not differ from nominate *flabelliformis* of se. Aust. in plumage (Hartert 1925; Hall); nor is there any striking variation in size in Aust. About four other subspecies in New Guinea and sw. Pacific, all darker than Aust. birds and differing from one another mainly in size, thickness of bill and colour of upperparts. Following summary of variation based mainly on Amadon (1942) and Hartert (1925), and examination of skins at MV; see Mason (1982) for review of nomenclature.

Subspecies *excitus* much darker than *flabelliformis*; upperparts, oily slate-grey with greenish or bluish sheen; chin, dark grey; rest of underparts, dark rufous-brown with dirty clouded effect caused by fine slaty vermiculations; similar in size to Aust. birds but wing and tail shorter. Subspecies *pyrrhophanus* also darker above than *flabelliformis*; upperparts described as black glossed green (Amadon 1942), but in one female skin examined, dark slate-grey; underparts, deep rufous; wing and tail long and bill slender (bill said to be small by

Amadon [1942] but longer than in Aust. birds). Population of Solomon Is was considered a separate subspecies, *meeki*, by Hartert (1925) but is very similar to New Caledonian *pyrrhophanus* and the two subspecies were lumped by Amadon (1942). Subspecies *schistaceigularis* similar in plumage to *pyrrhophanus*, but grey of head extends over whole throat and onto upper breast; also has shorter wing and tail and much heavier bill. Subspecies *simus* small, with very broad bill; unlike other subspecies, it is polymorphic: 'normal' morph similar to *pyrrhophanus* but has lighter, more brownish-green upperparts; black morph almost wholly slate-grey to sooty black (in both juveniles and adults) except for white underwing-bar and white marginal coverts outside carpal joint; intermediates occur, with varying black barring on rufous underparts.

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Brush Cuckoo *Cacomantis variolosus* (page 677)

NOMINATE VARIOSUS: 1 Adult male; 2 Adult female, unbarred morph; 3, 4 Adult female, barred morph; 5 Juvenile; 6 Adult male; 7 Juvenile
 SUBSPECIES DUMETORUM: 8 Adult male

Chestnut-breasted Cuckoo *Cacomantis castaneiventris* (page 688)

9 Adult male; 10 Juvenile; 11 Adult male

Fan-tailed Cuckoo *Cacomantis flabelliformis* (page 692)

12 Adult male; 13 Adult female; 14 Juvenile; 15 Adult male; 16 Juvenile