

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

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

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

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

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

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

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

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

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

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

There has been much argument and controversy about how cuckoos deposit eggs in nests of hosts, particularly enclosed nests or nests that seem inaccessible. Many claims of cuckoos carrying its egg in its bill, or even its foot, from ground to host-nest (see species accounts). However, detailed studies have shown that cuckoos lay directly in nest of host-species and all claims of carrying eggs to nests must be considered doubtful. Chance (1922, 1940) proved conclusively that the Common Cuckoo lays its eggs directly in open cup-shaped nests of hosts (taking only a few seconds) and this has been confirmed since (Wyllie 1981). In HANZAB region, some cuckoos habitually parasitize hosts with domed nests with very small entrances, such as thornbills *Acanthiza* and scrubwrens *Sericornis*; Brooker *et al.* (1988) and Brooker & Brooker (1989b) have shown that Horsfield's and Shining Bronze-Cuckoos lay in the normal way in the nests of fairy-wrens *Malurus* and thornbills *Acanthiza*. The entrances of nests of Brown Thornbills *A. pusilla* parasitized by Fan-tailed Cuckoos are characteristically enlarged, damaged or distorted compared with those of unparasitized nests (S. Marchant). In HANZAB region, all species except Channel-billed Cuckoo lay single egg per host-nest, and most species usually remove egg of host after laying; the whole process takes only a few seconds. Channel-billed Cuckoos (and, 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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Cuculus pallidus **Pallid Cuckoo**

COLOUR PLATE FACING PAGE 672

Columba pallida Latham, 1802 (1801), *Index Orn. Suppl.*: 60 — Nova Hollandia = New South Wales.

The specific name alludes to the pale-grey upperparts (Latin *pallidus*, pallid, pale).

OTHER ENGLISH NAMES Unadorned Cuckoo; Grasshopper or Mosquito Hawk; Rain, Scale, Semitone, Storm, Weather or Wet Bird; Brain-fever Bird; Harbinger-of-Spring.

MONOTYPIC

FIELD IDENTIFICATION Length c. 31 cm; wingspan c. 52 cm; weight 80–85 g. Medium-large cuckoo with decurved bill, rather small head, long pointed wings and long rounded tail that combine to give rakish falcon-like jizz typical of genus. Slightly smaller than Oriental Cuckoo *Cuculus saturatus*; much bigger than Fan-tailed Cuckoo *Cacomantis flabelliformis*. Combination of obvious dark eye-stripe that continues down sides of neck, white spot in centre of nape, bold pale spotting on edges of tail, and fine pale spots on upperwing-coverts, diagnostic among cuckoos. Sexes differ markedly. Adults polymorphic:

adult male has light-grey and dark-grey morphs (but variation between these probably continuous); adult female has light-rufous and dark-rufous morphs. No seasonal variation. Juvenile separable. Immatures very similar to respective sexes of adult; some possibly separable with close views (see Plumages). Call unmistakable. **Adult male LIGHT-GREY MORPH:** Top of head, hindneck and upperbody, grey, with white spot in centre of nape, which is usually partly concealed but can be prominent when exposed, such as when nape ruffled by wind. Supercilium, chin, throat, foreneck and sides of neck, pale grey with con-

trasting narrow and often patchy dark-grey or blackish eye-stripe that continues down sides of neck. Lateral uppertail-coverts finely spotted white. Upperbody becomes darker, grey-brown with wear. Uppertail, black-brown, contrasting noticeably with paler upperparts, and boldly notched white or pale buff along edges of rectrices. Upperwing: secondary coverts, grey, as upperbody, and remiges and primary coverts slightly darker, black-brown; primaries and smaller secondary coverts have fine white fringes when fresh, grading to fine white spotting on larger secondary coverts and, often, on secondaries and tertials; narrow white patch on leading edge of folded wing, just below carpal joint, often prominent at rest. Breast, belly and fore-flanks, pale grey, grading to white on vent and undertail-coverts; rear-flanks (and sometimes vent) finely barred grey, and undertail-coverts have prominent narrow dark barring. Undertail, blackish, broadly barred white. Underwing: most coverts, cream, finely barred grey; greater coverts, pale grey (finely barred off-white in some); remiges, brown-grey, with broad white barring across all but distal third of primaries, barring merging into broad white band across bases of inner primaries. Bill, grey-black, typically with conspicuous slightly paler base; inside of mouth and gape, orange, often prominent when calling. Iris, brown to black-brown. Orbital ring prominent, yellow. Legs and feet, cream. **DARK-GREY MORPH:** Typically differs from light-grey morph by: slightly darker and browner upperparts; a varying rufous patch on hindneck; and pale spotting on upperwing larger, more extensive and more prominent. **Adult female DARK-RUFIOUS MORPH:** Forehead, crown and nape, blackish brown, coarsely streaked rufous-brown, and often with rather uniform blackish-brown lateral crown-stripes; white spot on nape as adult male. Hindneck varies from rufous-brown streaked blackish, to blackish with coarse rufous-brown streaking or spotting. Supercilium, white, finely streaked darker; merges into finely dark-streaked lores and grades to buff on upper sides of neck. Blackish eye-stripe separates whitish supercilium and pale-grey chin and throat, and is typically mottled rufous-brown where it merges with varying gorget on lower neck, which is most extensive on sides of neck (in some, extends narrowly across upper breast). Saddle, dark brown, coarsely mottled rufous-brown; rest of upperbody, brown, finely spotted white to buff or rufous-brown. Tail like adult male, but pale markings can be buff or rufous-brown. Upperwing: secondary coverts, secondaries and tertials, dark brown, coarsely mottled and spotted rufous-brown (much as saddle); folded primaries, black-brown, finely fringed buff-white at tips and with small rufous-brown spots along edges of outer webs, which sometimes join to form narrow wavy line. Underbody and underwing as adult male except for slightly broader dark barring on rear-flanks and undertail-coverts and continuation of gorget onto upper breast. **LIGHT-RUFIOUS MORPH:** Intermediate between dark-grey morph of adult male and dark-rufous morph of adult female. Differs from light-rufous morph female by: little or no rufous-brown streaking on cap, and patch on hindneck typically paler; dark eye-stripe sharply demarcated, and often has streaky rufous-brown or buff lower border; does not have a gorget; less rufous-brown spotting above (typically confined to mantle and a few scapulars); pale notching on uppertail, white, rarely buff; and, on upperwing, pale spotting and notching smaller and usually white or occasionally buff, but seldom rufous. **Juvenile** Strikingly different from adults. Forehead, lores, chin and throat, dark grey, giving dark-faced appearance; throat can be coarsely streaked white. Crown, nape and hindneck coarsely streaked black-brown and white. Bold white supercilium extends over eye and ear-coverts to

sides of nape; prominent blackish eye-stripe continues down sides of neck to sides of upper breast; eye-stripe bordered below by diffuse off-white moustachial stripe that merges with streaked chin and throat. Saddle and rump coarsely streaked dark brown and white or buff (especially on mantle and scapulars); uppertail-coverts, dark brown with fine white scaling. Uppertail, black-brown, boldly notched white and pale buff on edges of rectrices. Upperwing, black-brown, with bold white spotting and notching and fringing to remiges and coverts. Folded wing shows prominent white shoulder-patch contrasting with darker scapulars. Upper breast, dark brown, finely streaked off-white; rest of underbody appears white, streaked grey-brown. Underwing: secondary coverts, white; leading primary coverts finely barred grey-brown and white; greater primary coverts and remiges, grey, spotted or barred white except on distal third or so of primaries and, in some, tips of secondaries. Bill, grey with off-white cutting edges and tip. Orbital ring, pale yellow. Iris, brown. Legs and feet, pale pink but soon attain adult coloration. **Immature male and female** Very similar to adults and not always separable in field; at least some can be distinguished in close view by a few retained worn juvenile secondaries contrasting with adjacent fresh ones (see Plumages).

Similar species Adult males and juveniles unlikely to be mistaken, but females and immatures sometimes confused with **Oriental Cuckoo**, from which readily separated by combination of: (1) white nape-spot and dark eye-stripe (Oriental has neither); (2) spotted or notched upperwing-coverts (lacking in all Oriental except for some adult and immature females); and (3) mostly uniform pale lower underbody, with much finer and fainter barring, restricted to rear-flanks and undertail-coverts (Oriental always has complete bold blackish barring from lower breast to vent and relatively bolder barring on undertail-coverts). Bare parts also differ: Pallid has duller and less conspicuous pale base to bill, dark iris, and cream legs and feet (adult and immature Oriental have pale-yellow to orange iris and much brighter yellow to orange legs, feet and base of bill). Calls also very different; see Voice.

Usually seen singly, occasionally in twos or threes. Inhabit wide variety of open forests, woodlands and scrublands and most open country. Conspicuous in breeding season when call loudly from exposed positions, day and night; otherwise quiet and unobtrusive. Arboreal but forage mainly on ground. Flight swift, direct and falcon-like, often somewhat undulating, including brief glides on closed wings. Flight-silhouette distinctive, with small rounded head, long pointed wings, and long rounded tail. On alighting, tail often raised and lowered; at rest, often let wings drop below tail. Calls distinctive: loud melancholy series of about ten, usually ascending, whistled notes, uttered persistently day or night; also utter demented *crookyer*, *crookyer*; and hoarse brassy whistle.

HABITAT Mainly open habitats with sparse understorey. Inhabit wide range of lightly timbered country, such as open woodlands, shrublands, wooded grasslands and farmland (McEvey 1965; Gibson 1977; McKean 1985; Jones 1986; Saunders & Ingram 1995; Vic. Atlas), usually dominated by *Eucalyptus* or *Acacia*. On plains or ridges, inhabit dry open *Eucalyptus* woodlands, sometimes with *Acacia* understorey (Conole 1981; Bridges 1994); in riparian or other wetland communities, often occur among stands of River Red Gum *E. camaldulensis* or Black Box *E. largiflorens* (Schodde & Glover 1955; McEvey 1965; Johnstone *et al.* 1977; Boekel 1980; Close & Jaensch 1984; Gibson 1986; Hall; Vic. Atlas). Also inhabit mallee *Eucalyptus* shrubland with sparse shrubby understorey or

spinifex ground-cover (Jones 1952; Ford & Sedgwick 1967; Gell 1977; Johnstone *et al.* 1979; Close & Jaensch 1984; Sedgwick 1986; Saunders & Ingram 1995; Vic. Atlas). Often in open woodlands or shrublands dominated by Gidgee *A. cambagei*, Mulga *A. aneura*, Myall *A. souidenii* or Pindan *A. tumida* on sandplains, sand-dunes or at edge of gibber plains (Ford & Sedgwick 1967; Badman 1979; Brooker *et al.* 1979; Johnstone 1983; Start & Fuller 1983; Close & Jaensch 1984; Gibson 1986; Gibson & Cole 1988; Bellchambers & Carpenter 1990; Hall). Also occur in dry open *Eucalyptus* forests, often near edges, but less often in tall wet sclerophyll forests (Cooper 1974; Roberts & Ingram 1976; Ratkowsky & Ratkowsky 1977, 1980; Abbott 1981; Nichols & Nichols 1984; Smith 1984; Shields *et al.* 1985; Vic. Atlas). Sometimes occur in recently logged forests (Loyn 1980, 1985; Kavanagh *et al.* 1985). Occasionally in *Banksia* or *Melaleuca* woodland or thickets (Roberts & Ingram 1976; Johnstone 1983; Halse *et al.* 1985). In rural areas, prefer partly cleared farmland, or grassy paddocks with nearby shelterbelts or roadside remnants of trees or shrubs (Cameron 1932; McEvey 1965; Morris 1975; Halse *et al.* 1985; Sedgwick 1986; Saunders & Ingram 1995; Vic. Atlas; J.M. Peter). Occasionally in pine *Pinus* plantations, orchards and vineyards (McEvey 1965; Fielding 1979; Friend 1982; Backhouse 1985); or in suburbs, in parks, gardens, golf courses or similar (Whitlock 1939; McEvey 1965; Morris 1975; Paton 1976; Thompson 1982; How & Dell 1990; Watts 1993). Usually occur only in areas with some trees or shrubs (Terrill & Rix 1950; Hall), but sometimes seen on treeless plains, including spinifex plains (Hobbs 1961; Gibson 1986; Hall); rarely in grasslands (Cooper 1974; Longmore 1978; McKean 1985; Jones 1986). Sometimes among low dense vegetation, including coastal dune-scrub, saltbush, bluebush, samphire or heathland, especially if scattered emergent trees present (Kilpatrick 1932; Ford & Sedgwick 1967; McEvey & Middleton 1968; Recher 1975; Parker & Lashmar 1976; Roberts & Ingram 1976; Bedgood 1980; Pyke 1985; Bellchambers & Carpenter 1990; Hall; Vic. Atlas). Sometimes in mangroves (Seton 1972; Garnett & Bredl 1985a; Smith & Johnstone 1985). Rarely in monsoon rainforest, usually in clearings (Storr 1953; Woinarski 1993; Aust. Atlas); sometimes at margins of temperate rainforest (Napier 1967).

Often forage on open ground or among grass in open areas, such as open forests and woodlands, clearings, farmland and gardens (Burgess 1933; McGilp 1935; Jackson 1949; McCulloch 1966; Clarke & Clarke 1970; Young 1973; Brooker *et al.* 1990; Watts 1993; Hall). Sometimes also feed among foliage of trees or shrubs (Hobbs 1961; Brooker *et al.* 1990; Hall). Seen foraging on trunks of trees during caterpillar plague (Young 1973). Once seen feeding among fruiting clump of pendulous mistletoe (Cooper 1958). Rarely, feed aerially (Cameron 1932).

Mostly roost in trees or shrubs (Lord 1956; Woodell *et al.* 1985). Often perch in dead trees (McGilp 1949; Frith 1969; Parker & Lashmar 1976; Hall), but also commonly seen perched on overhead wires or on fences (Dove 1926, 1934a,b, 1939a; Cameron 1932; Benn 1938; Francis 1942; Condon 1947; Frith 1969; Clarke & Clarke 1970; Guest 1991; Watts 1993).

DISTRIBUTION AND POPULATION Mainly found Aust.; also occur s. New Guinea and Timor, where considered to be vagrant from Aust., though also suggested there may be a resident population (McKean *et al.* 1975; Mees 1976; Stronoch 1981; Coates 1985; White & Bruce 1986).

Aust. Widespread in most regions, though possibly more sparsely distributed in N. **Qld** Sparsely scattered records from South-west Region N to se. Gulf of Carpentaria and C. York

Pen.; rarely on islands in Torres Str. Widespread S of 18°S to NSW border, and W to c. 143°E (Draffan *et al.* 1983; Storr 19; Aust. Atlas). Sometimes also on nearshore islands (e.g. Kikkawa 1976; Wieneke 1988; Sutton 1990; Storr 19). **NSW** Widespread all regions (Morris *et al.* 1981; Cooper & McAllan 1995; Aust. Atlas; NSW Bird Reps). **Vic.** Widespread all regions (Vic. Atlas). **Tas.** Widespread along n. coast, and E of line joining Launceston and Southport. Outside these areas, scattered records in Lake Country in Midlands; rarely in W round Queenstown and Strahan (Thomas 1979; Aust. Bird Reps). **SA** Widespread in all regions, though Aust. Atlas indicates that there are areas where no or few records N of L. Eyre and in far W, on e. Nullarbor Plain and parts of Great Victoria Desert (Aust. Atlas; SA Bird Reps). Rarely, on Kangaroo I. (Baxter 1989). **WA** May occur throughout, but Aust. Atlas shows several areas with few or no records. Sparsely scattered on Nullarbor Plain, but more widespread elsewhere in Eucla Div. (Aust. Atlas; Storr 27). Widespread W of line from C. Arid N to Roebuck Bay (Aust. Atlas); said to occur throughout Pilbara Region (Fletcher 1980; Storr 16), though in W, Aust. Atlas only shows records near coast. Generally widespread in Kimberley Div. (Storr *et al.* 1975; Johnstone *et al.* 1977; Smith *et al.* 1978; Aumann 1991; Storr 11; Aust. Atlas). Scattered records in Great Sandy and Gibson Deserts, but virtually absent from Great Victoria Desert (Johnstone *et al.* 1979; Start & Fuller 1983; Aust. Atlas; Storr 22). **NT** Scattered records in Top End, mainly from Darwin and Melville I., E to Gove Pen. (though generally absent from n. and e. coasts), and S to Roper R.; said to have been recorded on Groote Eylandt. Sparsely scattered farther S, from Keep R. and Victoria R. Downs E to lower McArthur R. and Sir Edward Pellew Is, and S to c. 18°S, although many records along Stuart Hwy, where many observers. Not recorded from Barkly Tableland. Widespread S of 19°S, except in some e. areas, such as E of Murchison and Davenport Ras, and e. Simpson Desert, where generally absent (Schodde 1976; Boekel 1980; McKean 1985; Gibson 1986; Gibson & Cole 1988; Storr 7; Aust. Atlas; H.A.F. Thompson & D.K. Goodfellow).

NZ Vagrant. All singles: Craig Flat, near Beaumont, Otago, May–Oct. 1939, 1940, 17 Sept. 1941 (specimen); Okarito, Dec. 1941; Greymouth, Mar. 1942 (Oliver; NZCL); Wairarapa, 1977 (NZCL); Omarama, Otago, 12 Jan. 1990 (Guest 1991).

Lord Howe I. Single specimen, 1877 (Hindwood 1940).

Norfolk I. Singles, 23 May and mid-June 1984 (Hermes *et al.* 1986).

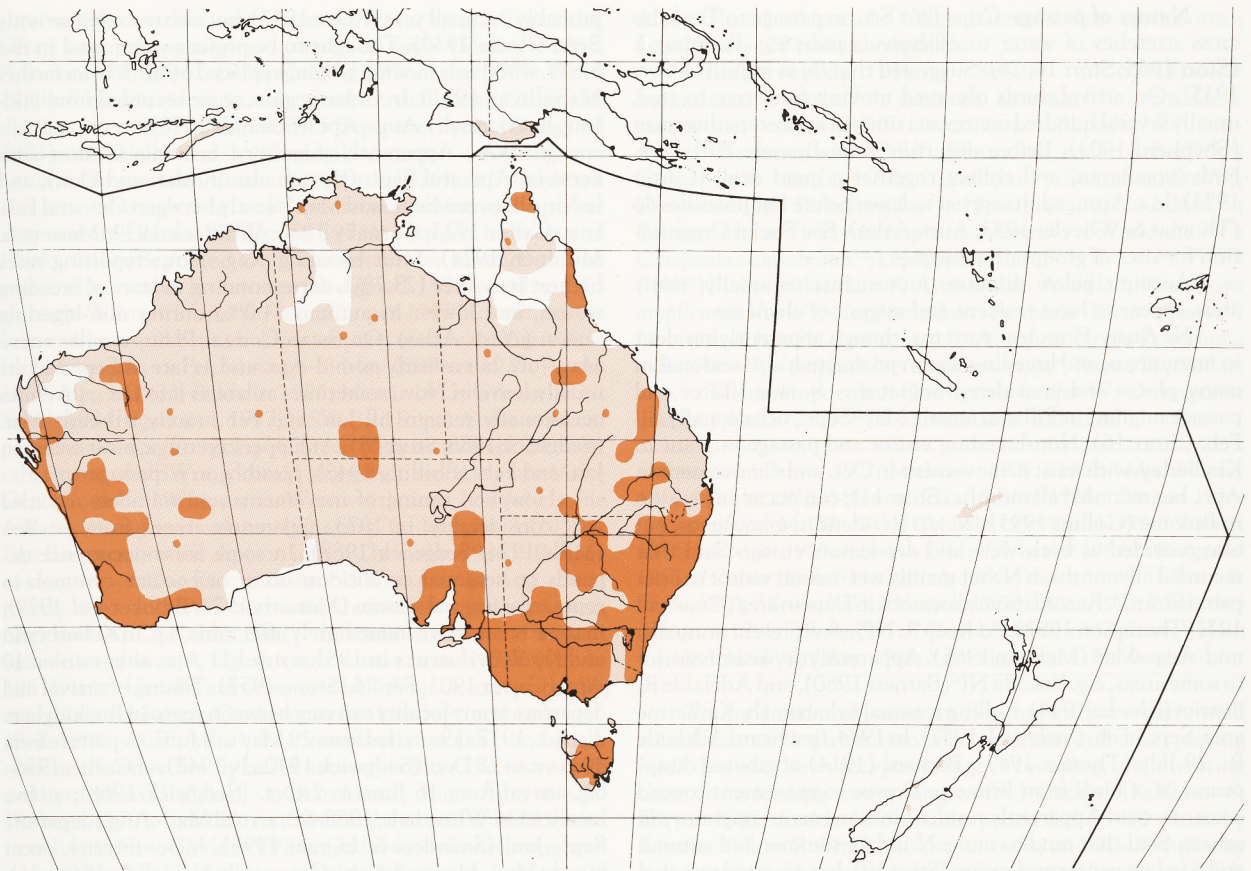
Christmas I. Single, 20 Oct. 1977; single, specimen, 28 Dec. 1980 (Stokes *et al.* 1987).

Macquarie I. Single, specimen, 23 Sept. 1990 (Tas. Bird Rep. 20).

Breeding Widespread S of 20°S. Farther N, scattered records between Townsville and Cooktown; on w. C. York Pen., at Edward R.; in Top End, between East and West Alligator Rs, and Darwin; and near Tennant Creek (Thompson 1982; Brooker & Brooker 1989; Aust. Atlas; NRS).

Large numbers recorded Maroubra, NSW, in 1946 (Bell 1983). Claimed to have been more common than usual round Sydney in 1981 (NSW Bird Rep. 1981). Large numbers Dareton, NSW, June–Oct. 1988, coincident with plague of hairy caterpillars (NSW Bird Rep. 1988).

Populations At Inverell, NSW, recorded at density of c. 1 bird/4 ha (Baldwin 1975). Along Hawkesbury R., NSW, density 0.08 birds/ha (Keast 1985). Near Eden, NSW, 0.3 birds/ha/h in logged forest (Kavanagh *et al.* 1985). At Boola Boola SF,



Vic., recorded at densities of 11 territories/km² (Loyn 1980).
Sometimes struck by cars (Vestjens 1973).

MOVEMENTS Migratory or partly migratory, but patterns of movement poorly understood, even though much information in literature. Also described as nomadic (Attiwill 1972) or possibly resident (Storr *et al.* 1975). In general, considered to be typically migratory in S, and resident or partly migratory in parts of N. However, many areas appear to have resident and migratory elements, and there is considerable variation in timing of breeding and in timing of occurrence of birds between regions and, sometimes, between sites within regions. Breeding tends to become progressively later from W to E, and from N to S; further, breeding season in n. Aust. protracted, with eggs in all months except Apr. (supporting resident nature of n. populations); breeding season less protracted in s. Aust. (Brooker & Brooker 1989; see Breeding). Relations between breeding and non-breeding areas, if any, not known; often said or assumed, without evidence, that birds in S come from N (e.g. Belcher 1914; Rix 1976; Slack 1993; Serventy & Whittell).

Seasonality in occurrence, or detection, reported from throughout Aust., more particularly in S. Such variation assumed to indicate movements, though there is considerable seasonal variation in rates of calling (see Voice), and part of variation in reporting rates can be attributed to increased conspicuousness when calling (Aust. Atlas). Further, lack of calling does not always indicate absence, with sight-records before birds first heard in an area, or after calling has stopped and birds assumed to have left (e.g. Belcher 1914; Dove 1922; Marchant 1989; see winter records in se. Aust., below); possible

that many remain outside season and are silent (Roberts 1936). See Voice for other factors that may influence calling behaviour. Even where calling thought to indicate arrival, first call does not necessarily provide information on arrival time of most birds, e.g. in 1939 first heard Devonport area, Tas., 5 Sept., but most did not arrive till 1 Oct. (Dove 1940).

Where records available, considerable year-to-year variation in timing of arrival and departure and in numbers present (e.g. Berney 1906; Anon. 1930; Irby 1933; Lord 1933; Chisholm 1940; Masters & Milhinch 1974; Bedgood 1980; Wieneke 1992; Saunders & Ingram 1995; Vic. and NSW Bird Reps). Some correspondence between timing of nesting of hosts and arrival of Cuckoos (Gilbert 1935). Can occur in unusually low numbers (e.g. Anon. 1921a; Dove 1939b; Brandon 1951), not occurring in some years in areas where normally present (e.g. Sedgwick 1988; see Mills 1974); or can occur in unusually high numbers (Belcher 1914; Mellor 1921; Harvey 1932; Bell 1983; SA Bird Rep. 1969–70; NSW Bird Rep. 1983), even to areas where usually rare or absent (Pearse 1933; NSW Bird Rep. 1980). Suggested, with little hard evidence, that variation in timing and numbers related to seasonal factors (Rix 1976), such as local rainfall (Brown 1950) or inland drought (Morris 1975). Also suggested that availability of caterpillars possibly governs movements (Sedgwick 1940b, 1949); large numbers at Dareton, June–Oct. 1988, coincided with plague of caterpillars (NSW Bird Rep. 1988).

Status of extralimital populations not certain; suggested that New Guinea records are migrants from Aust. (Beehler *et al.* 1986); records from Wallacea may be vagrants from Aust. or resident breeding populations (White & Bruce 1986).

Nature of passage Cross Bass Str. on passage to Tas.; also cross stretches of water to offshore islands, e.g. Rottneest I. (Storr 1965; Storr 16, 28). Suggested that fly at night (Gilbert 1935). On arrival, birds observed moving from tree to tree, usually several hundred metres at a time, in a constant direction (Shepherd 1903). Before departure from Broome Hill, WA, birds 'vociferous, and collect together a great deal' (Carter 1923). In s. Aust., adults appear to leave before last juveniles do (Thomas & Wheeler 1983; Aust. Atlas). See Social Organization for sizes of groups on passage.

Account below discusses movements regionally; many areas appear to have resident and migratory elements.

N. Aust. Few clear patterns, though apparently resident in many areas, and breeding season protracted; also seasonal in many places and considered migratory. **n. WA:** Visitor and passage migrant in Pilbara, mostly May–Sept., occasionally till Feb. (Storr 16). Non-breeding visitor and passage migrant in Kimberley; with most n. movement in Oct. and s. movement in Apr., but recorded all months (Storr 11); can occur any season in Broome (Collins 1995). **n. NT:** Resident in many areas, but also recorded as both wet- and dry-season visitor. Said that recorded all months in N, but mainly wet-season visitor to drier parts (Storr 7). Records from all seasons in Darwin area (Crawford 1972; Thompson 1982). At Keep R. NP, a few present annually, mid-Aug.–Mar. (McKean 1985). Apparently dry-season visitor to some areas, e.g. Kakadu NP (Barnett 1980), and Adelaide R. district (Rhodes 1944). Calling seasonal in Larrimah–Katherine area, Sept.–Feb. (Sedgwick 1947). In 1944, first heard Adelaide R., 29 July (Thomas 1947). Barnard (1914) attributed disappearance of birds from Brunette Downs to movement toward coast. **n. QLD:** Apparently resident in some areas, migratory in others. Said that tend to move N in late summer and autumn and S in late winter and spring (Storr 19), but reported seasonal trends suggest no clear pattern. In Burnett R. district recorded from Aug. 1927 to June 1928 (Anon. 1930). Appear about Sept. at Coomoooolaroo Stn, Duarina district (Barnard & Barnard 1925). Migratory in Mt Isa area, arriving Aug.–Nov., appear to breed, then leave Apr. or May (Horton 1975). Recorded in all months in Burdekin region (Seton 1972); recorded in all seasons in Richmond district (Berney 1906). Most records in Wet Tropics from mid-autumn to late winter (Nielsen 1996). Recorded May–Nov. in NE (Wieneke 1992). In Rockhampton area, uncommon spring migrant with occasional records for other seasons (Longmore 1978). Occasional summer visitor to Townsville (Lavery & Hopkins 1963); regular passage migrant Townsville Town Common (Garnett & Cox 1983). Rare but regular to Atherton, Apr.–Aug. (Bravery 1970). At Edward R. Settlement, C. York Pen., where considered migratory, adults numerous in Mar., and arrival audible 13 Sept. 1980 (Garnett & Bredl 1985a,b). Recorded Torres Str. (Draffan *et al.* 1983), but not specified if birds were undertaking movement.

Central Aust. Little information. Records from some areas suggest residence, in other areas occurrence appears seasonal. Most seasonal patterns relate to main presence from autumn to late winter or early spring, but at Cobar and ne. SA (see below) birds seasonally absent for a period between autumn and spring. In sw. NT, mainly recorded May–Sept., but also Jan.–Feb. (Storr 7). In n. SA, apparently present throughout year (Terrill & Rix 1950), but seasonality reported from at least some areas: spring migrant in ne. SA, leaving by autumn (Mack 1970); at L. Frome, many present June–Aug. (McGilp 1923); recorded L. Eyre region, Apr.–Sept.; Willouran Ra., May–Aug., Nov. and Jan. (Badman 1981); at Minnie Downs,

probably occur all year (Reese 1933), but also recorded arriving Sept. (Reese 1930). Thought to be present year-round in nw. NSW, with birds moving S being replaced by birds from farther N (Sullivan 1931). In Cobar region, some recorded from mid-July, but normally Aug.–Apr. (Schmidt 1978).

S. WA Apparently migratory, arriving at most sites between Apr. and Sept. (though also in Mar. and Oct.), and leaving between Sept. and Mar., mostly between Oct. and Feb. (e.g. Carter 1923; Carnaby 1933; Whitlock 1939; Masters & Milhinch 1974). Most breeding Aug.–Nov.; reporting rates highest in winter (23.7%), corresponding to start of breeding season, and lowest in autumn (4.0%) during non-breeding season (Aust. Atlas). On Swan Coastal Plain, usually arrive May–July, but as early as mid-Apr. and as late as Sept.; adults usually leave in Nov., sometimes as late as late Dec.; juveniles occasionally remain till Jan. and Feb., rarely till early Mar. (Sedgwick 1988; Storr 28). At Upper Liveringa, most common Jan. and Feb. (Shilling 1948), possibly on n. passage.

However, timing of movements and numbers recorded vary considerably. In 1973, apparently absent from sw. WA (Mills 1974; Sedgwick 1988). In some areas occurrence depends on seasonal conditions; occur or become common in some areas in good seasons (Moriarty 1972; Brooker *et al.* 1979); in some areas arrive immediately after rains, e.g. in Kellerberrin and Kwolyin districts in 1951 arrived 11 Apr. after rain on 10 Apr. (Carter 1903; Ford & Stone 1957). Timing of arrival and departure at any locality can vary between years: in Rockingham district, 1937–39, arrival from 29 May to 4 June, departure from 30 Nov. to 28 Dec. (Sedgwick 1940a,b, 1942); at Collie, 1956–61, arrival from 16 June to 2 Oct. (Sedgwick 1968); at five localities in Wheatbelt, 1988–90, arrival Mar.–Aug., departure Sept.–Jan. (Saunders & Ingram 1995). In se. interior, occur mostly Mar.–May and Aug.–Oct., rarely Nov.–Feb. (Storr 26), suggesting passage; occur mid-e. interior Apr.–Jan., mostly May–Oct. (Storr 22). Occur Gascoyne mostly May–Sept. (Storr 21). Occur Eucla Div., from late Apr. to mid-Feb. (Storr 27). Some recorded in s. WA outside usual season of occurrence for a particular area (e.g. at Rockingham, Sedgwick 1940b).

SE. Aust. Apparently migratory. Occurrence in many areas seasonal: usually arrive in winter, with most breeding Sept.–Dec.; usually leave spring or summer; some residency reported. Reporting rates highest in spring (20.5% in SE, and 22.0% in Murray–Darling Regions) when breeding, and lowest in autumn (1.5% in SE, 4.7% in Murray–Darling) during non-breeding season (Aust. Atlas). **s. SA:** Usually arrive in first week June or earlier and numbers increase till Aug.; begin to leave in Nov., and by Dec. most left are juveniles, which leave before end of Feb. (Terrill & Rix 1950; Condon 1962; also see Anon. 1921b; Jarman 1937; Souter 1942; Clarke 1967; Cox 1973; Whatmough 1978; Paton *et al.* 1994). Between 1977 and 1981, most records Aug.–Feb., but many Mar.–July (SA Bird Reps 1964, 1977–81). In Wakefield district, 1968–85, earliest record 21 June, latest 24 Oct. (Taylor 1987). In some parts occurrence not strictly seasonal (e.g. Aldinga–Sellicks Beach Scrub, Ashton 1985) and sometimes occurrence irregular (Attwill 1972). In some areas stay for only a few months (e.g. July–Aug. at Willunga, SA, Symon 1946), even only a few days (e.g. 11–13 Aug. 1920 at Adelaide Plains, Anon. 1921b). Calls also recorded outside Aug.–Feb. period (e.g. May–July, Anon. 1939). **vic.:** Occur and breed s. parts in late winter, spring and summer; some present year-round in drier n. habitats (Vic. Atlas). Arrive from June to Oct.; leave from Oct. to May (Ingle 1910; Russell 1921; Bright & Taysom 1932; Burgess 1933; Brown 1950; Watson 1955; McEvey 1965; Vic. Bird Rep. 1986–87);

thus reported arrival and departure dates span all months. Often occur in spring or summer or both (McEvey 1965; Roberts 1975; BFNC 1976; Fleming 1976; Loyn 1980; Dunn 1989). Passage evident in some areas; move through Caniambo district, between 20 Aug. and 15 Sept. each year (Bedgood 1973); at Trialla and L. Coradgil, common in spring and autumn but not seen in summer (Hirth 1976); at Strathbogie Ra., move through Aug. and Sept., return in Mar. and Apr. but very rare in summer (Bedgood 1972); between L. Tyers and Marlo, influx Sept. and Oct., few remain for summer and no noticeable exodus in autumn (Bedgood 1980); said to pass through Wilsons Prom. to Tas. (Cooper 1975). NSW: Arrive between June and Sept., but most reports of arrivals Aug.–Oct.; leave from Jan. or Feb. through to May (Gilbert 1935; Anon. 1937; Heron 1973; Baldwin 1975; Morris 1975; Gibson 1977; Smith 1984; Egan *et al.* 1997; NSW Bird Reps). Some seasonal patterns do not fit spring–summer pattern evident in most other parts of NSW: e.g. round Mungindi, recorded late Mar.–Oct. (Costello 1981); arrive Wentworth area, end July; some remain throughout winter (Chenery & Morgan 1920); at Barellan, remain till Apr or June (Chisholm 1938). Passage evident in some areas, e.g. in sw. NSW, s. passage Aug.–Dec., mostly Sept. and Oct., and comparatively few on n. passage, Mar. and Apr. (Hobbs 1961). In some areas, some remain outside usual season, e.g. through winter in sw. NSW (Hobbs 1961). ACT: Usually arrive second half Aug. or, exceptionally, as early as mid-July; in Canberra, arrive late Sept. and early Oct. (Bell 1986; ACT Atlas). Few recorded after Jan., and these usually juveniles. Rarely heard autumn–winter, but more so in mild years (ACT Atlas). s. QLD: Mostly Aug.–Apr., se. Qld (Roberts 1979). In 1972, arrival at eight sites S of 26°S varied from July to Nov. (Perkins 1973). Odd records from throughout year at Murphys Ck; earliest arrival 17 July, latest departure 20 Jan. (Lord 1956), but Apr. and June arrivals, and Apr. departure, recorded (Lord 1933, 1937, 1939). At Meandarra, a few occur in winter (Whitmore *et al.* 1983). TAS.: Earliest arrival King I., 30 Aug. 1968; latest, 3 Mar. 1972 (McGarvie & Templeton 1974). Generally arrive mainland Tas. in Sept., but as early as July or as late as Aug.–Oct.; generally leave Dec.–Feb., but as late as Apr. and May (e.g. McLymont 1902, 1906; Fletcher 1913, 1918; Sharland & Crane 1922; Lawrence 1945; Thomas 1968; Tas. Bird Rep. 1994). Reporting rates highest in spring (30.0%) and lowest in winter (0.9%) (Aust. Atlas); breeding mostly Oct.–Dec. (see Breeding). Occasionally recorded in winter (e.g. Althofer 1934; Tas. Bird Reps).

Banding Of 67 banded in Aust., 1953–96, no recoveries.

FOOD Almost entirely insects, mostly caterpillars; also beetles and grasshoppers and occasionally plant material. **Behaviour** Poorly known. Forage arboreally (Cooper 1958; Hobbs 1961; Young 1973) and on ground (Burgess 1933; Jackson 1949; McCulloch 1966; Young 1973; Watts 1993); rarely, feed aerially (Cameron 1932). At Wyperfeld NP, Vic., five birds seen feeding on ground in radius of c. 28 m (McCulloch 1966). At Kakadu NP, NT, often forage on ground, among low shrubs and grass (Brooker *et al.* 1990). At Culeenup I., WA, of 25 feeding observations, 20 (80%) on ground, and 4 (20%) in branches of trees (Keast 1975). Forage by sally-pouncing from vantage points (Hall; Strahan). On ground, make rather small short hops (Hall). Foraging behaviour said to be exactly like that of Common Cuckoo *Cuculus canorus* (Hall).

At MANJIMUP, SW. WA (24 items in one stomach; Matthiessen 1973): Unident. spiders 8% freq.; Coleoptera: beetles 8; Orthoptera: grasshoppers 84. In NZ (one stomach of bird found

dead; Oliver): Annelids: Oligochaetes: a few earthworms; Lepidoptera: 28 hairy caterpillars;

Other records **Plants** Seeds². **DICOTYLEDONS:** Loranthaceae: berries^{15,26}. **Animals** **ARANEAE**^{26,32}: Lycosidae³¹. **CHILOPODS:** centipedes^{26,32}. **DIPLOPODS:** millipedes^{26,27,32}. **INSECTS:** Unident. ads^{2,14,25,27,31}; Blattodea: cockroaches^{26,30,32}; Coleoptera: beetles^{26,28,30}; Carabidae³²; Scarabaeidae^{19,32}; Phasmatodea: Phasmatidae²⁸; Hemiptera: Cicadidae^{26,32}; Pentatomidae³²; Hymenoptera: wasps³²; Formicidae^{26,32}; *Campontus consobrinus*¹⁸; Lepidoptera: larv.^{2,3,4,5,7,8,9,19,20,21,22,26,27,28,29,30,31,33,35}; Amatiidae: larv.³²; Anthelidae: *Anthela*¹⁷; *Pterolocera amplicomis* larv.¹⁹; Eupterotidae: *Panacela lewinea* larv.²⁴; Noctuidae: larv.³⁰; *Agrotis* larv.¹⁹; *A. infusa* larv.⁶; *Persectania ewingii* larv.¹⁹; Nymphalidae: *Danais menippe*¹; *Teara*¹; Psychidae: larv.¹⁶; Thaumetopoeidae: *Ochrogaster lunifer*^{12,23}; Orthoptera: grasshoppers^{11,13,21,26,29,31,32}. **AMPHIBIANS:** Tadpoles³⁴.

REFERENCES: ¹ Berney 1907; Mathews ² 1909, ³ 1910; ⁴ MacGillivray 1914; ⁵ White 1918; ⁶ Slaney 1922; ⁷ Sutton 1928; ⁸ Burgess 1933; ⁹ Morgan 1933; ¹¹ McGilp 1935; ¹² Chisholm 1938; ¹³ Lord 1939; ¹⁴ Watson 1955; ¹⁵ Cooper 1958; ¹⁶ Hobbs 1961; ¹⁷ Wheeler 1964; ¹⁸ Bedgood 1965; ¹⁹ Green 1966; ²⁰ McCulloch 1966; ²¹ Frith 1969; ²² Clarke & Clarke 1970; ²³ Young 1973; ²⁴ Vestjens 1977; ²⁵ Watts 1993; ²⁶ Saunders & Ingram 1995; ²⁷ Rose 1997; ²⁸ Gould; ²⁹ North; ³⁰ Cleland; ³¹ Hall; ³² FAB; ³³ NSW Bird Rep. 1988; ³⁴ M. Maurovic; ³⁵ T. Saunders.

Young Loud and persistent Begging Calls a supernormal stimulus attracting attention of host-parents and other passing birds that may be in receptive stage of breeding, and diverting them from feeding own young to feed Cuckoo (Kikkawa & Dwyer 1962; Smith 1989). One young fed 15–18 times by Eastern Yellow Robin *Eopsaltria australis*, and 20–30 times by Yellow-tufted Honeyeater *Lichenostomus melanops* in 1.5 h (Smith 1989). Recently fledged young may attend nests of other birds and intercept food being brought to host's nestlings, or take possession of nest by throwing out its occupants (Chaffer 1973; Woodell *et al.* 1985; Hughes & Hughes 1997). Young often reported to be fed, mostly caterpillars, by adult Pallid Cuckoos (Greenwood 1910; Hanscombe 1915; Learmonth 1949; Lamm & White 1950; Cooper 1958; Harrison 1995; Campbell; North); such behaviour described as either deliberative, where adult Cuckoo feeds young or juvenile exclusively, or adventitious, when adult Cuckoo assists host-parents in feeding young (Nichols 1998). At Bendigo, Vic., an adult Cuckoo fed a juvenile a total of 17 berries in six visits (Cooper 1958); at Turners Marsh, n. Tas., an adult Cuckoo fed newly fledged juvenile four times in 6 min (Nichols 1998).

Food given by host-parents (stated when known): **Plants** Seeds⁹; nectar (fed by White-fronted Honeyeater *Phylidonyris albiglans*)⁶; Loranthaceae: berries (ad. Pallid Cuckoo)⁴ (but see Social Organization: Bonds); Verbenaceae: *Lantana* berries (Red-whiskered Bulbul *Pycnonotus jocosus*)². **Animals** **INSECTS** (Yellow-tufted Honeyeater, Brown-headed Honeyeater *Melithreptus brevirostris*; Yellow-throated Miner *Manorina flavigula*, Rufous-throated Honeyeater *Conopophila rufogularis*, Fuscous Honeyeater *Lichenostomus fuscus*, Grey Fantail *Rhipidura fuliginosa*, Red-capped Robin *Petroica goodenovii*)^{1,3,4,6}; Coleoptera: Scarabaeidae ads (Black-headed Honeyeater *Melithreptus affinis*)⁷; Homoptera: nymph⁷; Hymenoptera: wasps⁷; Formicidae⁷; Lepidoptera: ads (Eastern Yellow Robin, Yellow-tufted Honeyeater)⁸, larv.^{8,9}; Tortricidae larv.⁷; Xyloryctidae larv.⁷; Orthoptera: grasshoppers⁹. (**REFERENCES** ¹ MacGillivray 1914; Chaffer ² 1945, ³ 1973; ⁴ Cooper 1958; ⁶ Hobbs 1990; ⁷ Green 1966; ⁸ Smith 1989; ⁹ Hall.)

SOCIAL ORGANIZATION Virtually unknown. Nearly always seen singly, occasionally two together (Crawford 1972; Nichols & Nichols 1984; North; Hall). At large concentration of birds in Tas. in spring, all were solitary and no interactions seen (Littler 1904). Rare records of up to 12 or more in same small area in autumn–winter, perhaps congregating at concentrations of food (Burgess 1933; Brooks 1945), but composition of these loose parties not known. In autumn, 3–4 birds often seen chasing one another (North). On s. passage, said to fly in small parties of 7–8; a group of five seen late Jan. perhaps preparing to migrate N (Gilbert 1935). Much confusion in literature (including most field guides) of identification characters of adult females, juveniles and immatures; many reports of juveniles and immatures almost certainly of adult females (see Sexing).

Bonds Mating system not known. Pairs occupy same area (said to be territory) throughout breeding season, with one pair roosting in same tree each night (Lord 1956); also rare reports of two birds feeding fledgelings for several days (Hanscombe 1915; North), but no conclusive evidence whether males and females remain together after mating. **Parental care** Nest parasite, but many reports of supposed fledgeling Cuckoos being fed by adult Cuckoos (Brown 1936; Le Souëf 1943; Jackson 1949; Learmonth 1949; Kikkawa & Dwyer 1962; Watts 1993; Campbell; North), in some cases assisting host-parents or other birds that are feeding young Cuckoos (see Food). Many reports probably instances of courtship feeding by adults that have been misinterpreted as a result of incorrect ageing of birds observed. Cases where young Cuckoos being fed by adult Cuckoos and supposed host-parents (or other birds) at same time more difficult to dismiss as incorrect ageing and misidentification of courtship feeding and are probably genuine cases of adults feeding young, though not necessarily their own. Fledgelings remain near host's nest and are fed by host-parents for several weeks (Barrett 1905); one stayed within area of c. 0.5 ha for 6 weeks (Hardy & Hardy 1973). Often take up position at other nests to be fed by succession of host-parents (see below).

Breeding dispersion Territories Claimed that pairs hold territory during breeding season (Lord 1956; Frith 1969), but little hard evidence. However, sometimes birds assumed to be same pair remain in same area during breeding season (Lord 1950; Skemp 1950). Scale Call said to be territorial call (Keast 1993), also without hard evidence. Further study needed.

Roosting Two birds, claimed to be territorial pair, roosted each night in a native fig within territory (Lord 1956).

SOCIAL BEHAVIOUR Virtually unknown, and observations rare. Inconspicuous except when calling. During breeding season, Scale Call given often, for prolonged periods, day and night. Call much on arrival in breeding areas (Mellor 1921). Calling apparently influenced by weather, e.g. appear very noisy on calm cloudy days (Brandon 1937); see Voice for more details. In autumn, 3–4 birds often seen chasing one another while uttering loud Shrieks (North); small parties of 7–8 observed calling in flight; group of five seen in late Jan., flying low and calling (Gilbert 1935).

Agonistic behaviour Scale Call said to be territorial call (Keast 1993). Two birds that roosted in same tree each night, and claimed to be territorial pair, gave Scale Call at dawn each day (Lord 1956); suggested that Hoarse Call (of same birds) probably a warning call when intruders enter territory (Lord 1956). In spring, two or more males sometimes seen chasing each other (Gould). **Alarm** When disturbed, fly close to

ground for some distance before perching (Littler 1904).

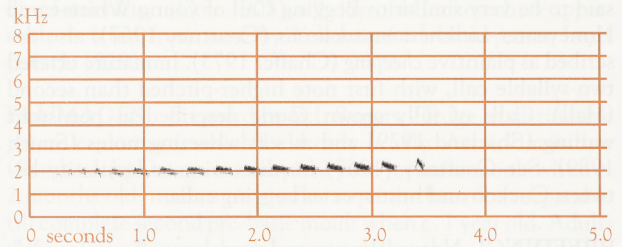
Sexual behaviour In late winter, pairs often chase each other about while calling (Mellor 1921, 1926; Condon 1935). Two observations of female approaching perched male, giving Scale Call, then uttering single loud Hoarse Call and perching some distance from male; male repeated Scale Call then flew toward female giving Three-note Call; female then gave Hoarse Call again and male replied with partial Scale Calls several times before pair flew off; female appeared to be highly excited and to ruffle feathers of head (Condon 1947). Said that Scale Call by males used to advertise presence and that female accepts male by spreading and quivering wings (Strahan). **Courtship feeding** Males feed females during courtship (White 1950; Crawford 1972; Masters & Milhinch 1974; Noske 1978, 1981); further, many observations of adults thought to be feeding young may be courtship feeding by adults that have been wrongly aged (see above). Once, male sat on fence with caterpillar in bill and uttered 9–10 soft peeps; bird assumed to be female soon flew to male, who allowed female to take food from him (male did not place food in female's bill); similar performance occurred several minutes later, after which female flew off (Clarke & Clarke 1970). Fleming (1979) also reported that female approached male to be fed. Skemp (1950) reported that male gave Scale Call when had food for female; she would reply with harsh call and male would then fly to and feed her. Noske (1978) also noted calling of female before courtship feeding; some accounts of supposed adults feeding fledgeling, which are probably misinterpreted cases of courtship feeding, likewise note calling of recipient before other bird flew in and fed it (Le Souëf 1943; Learmonth 1949; Watts 1993), but in another case, recipient made no calls during prolonged period of observation though was fed several times (Kikkawa & Dwyer 1962), nor did female in observation of courtship feeding by Clarke & Clarke (1970). In another case, bird assumed to be female took food from male and, while accepting it, trembled body and vibrated partly opened wings, as fledgelings do when begging (Klapste 1981). Some observations, in which sexes apparently positively identified, of females feeding males (Lord 1950; Robinson 1950), including one of female taking food to male after copulation (Robinson 1950). **Copulation** Once, one female gave short call and male flew in from some distance away and mounted; female then flew off and returned with food and fed it to male. In another instance, calling female was answered with different call by male, who then flew in and mounted; after separating, both rotated tails for 1–2 min and female crouched once or twice as if inviting further copulation (Robinson 1950). In one pair that was regularly observed, one member once seen to feed other immediately before copulation (Lord 1956). Observation of laying outside usual breeding season suggested as possible evidence of sperm storage by females (Marchant 1989). However, such laying within extremes of breeding season in se. Aust. (see Breeding) and may just be example of opportunistic mating and laying.

Relations within family group Fledgelings often fed by several birds other than true host-parents; these often different species, and often feed young Cuckoos at same time as host-parents. Will also move to other active nests and beg there, sitting either on or near nest, perhaps when true host-parents decrease rate of feeding. Many reports of fledgelings being fed by adults (see above). Fledgelings call loudly for long periods, either perching in one spot or moving from perch to perch, often following host-parents. When host-parent or any other bird approaches, immediately beg vigorously, with wings half spread and quivered, head thrust forward, bill wide open, and

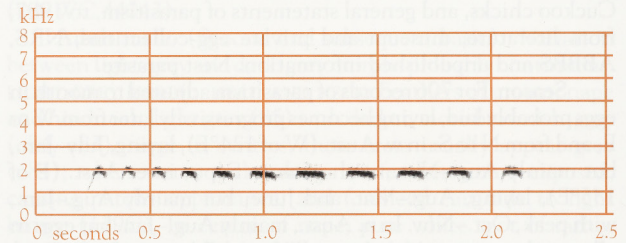
loud and rapid calling. Sometimes attacked by birds other than host-parents when begging to them, but will continue begging and can subsequently be fed by them (Brent 1906; Dove 1916; Sharland 1929; Chaffer 1945, 1973; Lienau 1947; Learmonth 1949; Cooper 1958; Kikkawa & Dwyer 1962; Frith 1969; Hardy & Hardy 1973; Woodell *et al.* 1985; Smith 1989; Hobbs 1990; Watts 1993; Ley & Williams 1994; Campbell; North; Hall; Serventy & Whittell). Gaping of young when attacked is possibly defence reaction (Hall).

VOICE Quite well known. A total of six adult calls described in literature; at Hawkesbury R., NSW, Keast (1993) recognized repertoire of 2–3 calls. Calls described as monotonous, protracted and stereotyped (Keast 1993). Call throughout day, and also at night, for prolonged periods (Carter 1903; Berney 1906; Chenery & Morgan 1920; White 1921; Sutton 1925, 1928; Marshall 1934; Angel 1936; Boehm 1950; Morris 1975; North; Mathews). May utter Scale Call continuously for up to 1 h, then less frequently for longer (Keast 1993). In central Aust., Scale Call often repeated or incessant and often heard at night (D.A. Curl). Scale Call uttered more commonly at night if moonlit, but also when quite dark (Anon. 1918). In n. Qld Scale Call given at dawn, and also, interspersed with *keer* (see Repeated Peep below), when feeding (Lord 1956). In sw. WA, no lag between arrival and calling, with both occurring toward end of June; in n. agricultural districts, arrived early June or even earlier, but did not call till mid-July (Gentili 1950). At Lockleys, SA, calls repeated continuously, week after week, during Aug. (Mellor 1921). Near Newcastle, NSW, call at night on arrival in spring (Morris 1975). Near Katherine, NT, call from mid-Sept. to end of Feb. (Sedgwick 1947). Said that Shriek heard only in autumn (North); this observation probably from area of Sydney, NSW. Calling often related to weather conditions. Survey over one season in WA indicated connection between calling and rain (hence vernacular Rain Bird, Weather Bird, Storm Bird, Wet Bird) (Gentili 1950). Calling considered both to herald rain (Shilling 1948; NSW Bird Rep. 1992) and to occur after rain (Masters & Milhinch 1974). In central Aust., Scale Call commonly heard after summer rains (D.A. Curl). In mild winters at Casino district, NSW, call through winter (Irby 1933). In at least some areas near Adelaide, SA, very vocal on calm cloudy days from mid-June to late July (Brandon 1937). Although many secondary sources say that Scale Call given only by male and Hoarse Call only by female (e.g. Slater 1970; Pizzey 1980; Aust. RD; Strahan), Scale Call and Hoarse Call were both uttered by fully grown young being fed by adult (Howard & Crawford 1989), implying that either Scale Call or Hoarse Call uttered by both sexes. Latter supported by observation of Lord (1956) that Hoarse Call given by both sexes. Female said never to utter Scale Call, and to call rarely (White 1913). During copulation one bird uttered Repeated Peep and the other Hoarse Call (Robinson 1950; Buckingham & Jackson 1990). At Uluru NP, NT, consistent differences between Scale Calls of individuals in timbre and number of notes and, in some cases, intervals between calls (D.A. Curl).

Adult SCALE CALL: 'A song like sap, reed notes that climb/Like beads in water, clear and fine' (Campbell 1989). Loud series of whistled notes, usually increasing in pitch (sonagram A); pitch may decrease then increase (sonagram B), or increase, decrease, then increase. At Uluru NP, NT, call typically consists of 4–5 soft staccato tonal notes, often descending slightly and inaudible at a distance, preceding ten less rapid tonal notes, which carry farther and ascend in chromatic scale; total number of notes in calls of several individual birds ranged



A J. Courtney; Swan Vale, NSW, Oct. 1967; P40



B E. Slater; Hughes, ACT, Oct. 1987; private 99

from 13 to 19. One bird typically gave calls composed of 14 notes (0.73; 13–15; 20), with interval between calls during incessant calling of 8.6 s (1.2; 7–11; 10); another typically gave calls of 17 notes (1.3; 15–19; 12), with interval between calls of 13.5 s (4.8; 7–23; 10) (D.A. Curl). On Hawkesbury R., NSW, described as succession of c. 16 ascending notes: 4–5 short notes and 12 longer notes in ascending scale; average length of typical call 2.68 s (2.56–2.80) (based on sample of five calls); maximum of 8–10 songs/min (Keast 1993). Given mostly, or solely, by male during day and at night, with seasonal use varying greatly (see above). Usually given while perched; in central Aust., typically given from bush at height of c. 2 m, or from higher, more exposed perch in dead tree (D.A. Curl). Very occasionally given in flight; in Sydney, NSW, heard to utter Scale Call vigorously while flying rapidly at c. 100 m high, in small flocks, just before sunrise in Aug. (Gilbert 1935). Function not certain; said to be territorial call (Keast 1993), or to advertise presence to mates (Strahan). **HOARSE CALL:** Single hoarse brassy whistle (Pizzey 1980; Mathews); described as harsh *cheer* or *year-ack* (Condon 1947); hoarse sharp note (Robinson 1950); and as hoarse *creer-ik* (Lord 1956). Suggested to function in defence of territory (Lord 1956). **REPEATED PEEP:** During courtship feeding, male with food gave 9–10 soft Peeps, attracting female, who took food (Clarke & Clarke 1970). Soft monotonic *keer-keer-keer*, repeated many times by members of pair when feeding (Lord 1956), probably same call; similarly *kew-kew-kew* heard from bird in flight (Hall). **THREE-NOTE CALL:** *Toy-it-yer, toy-it-yer* given by male while flying toward female during probable sexual behaviour (Condon 1947). A three-note call, not described further, uttered by birds flying in small flock that were thought about to migrate (Gilbert 1935). **CLUCK:** Adult feeding young gave repeated whistling clucks (North). **SHRIEK:** Loud discordant shrieks, uttered when 3–4 birds chasing one another (North).

Young BEGGING CALL: Descriptions vary. Sustained *tzwit-tzvit* of nestling when begging said to be very similar to Begging Call of nestling Red Wattlebird *Anthochaera carunculata* (Serventy & Whittell). Recently fledged young give continual *chirrup, chirrup, chirrup* (Brent 1906) or thin piping (Cooper 1958). Fledged young also utter single brief high-pitched *chick*,

said to be very similar to Begging Call of young White-eared Honeyeater *Lichenostomus leucotis* (Courtney 1967); also described as plaintive *cheeping* (Chaffer 1973). Immature uttered two-syllable call, with first note higher-pitched than second (Hall). Calls of fully grown young described as persistent wailing (Sharland 1929) and as soft wheezing notes (Smith 1989). See Courtney (1967) for discussion of similarity between Cuckoo and host-species begging calls.

BREEDING Not well known and no major studies; 89 records in NRS available for analysis. Brooker & Brooker (1989) reviewed 1052 records of Cuckoo eggs and nestlings, feeding of Cuckoo chicks, and general statements of parasitism, to 1987, from literature, museum and private egg-collections, NRS, ABBBS and unpublished information. Nest parasite.

Season For 706 records of parasitism adjusted to month in eggs probably laid, laying becomes progressively later from W to E, and from N to S: in w. Aust. (W of 124°E), laying, July–Jan., but mainly Aug.–Nov., with peak in Sept.; in e. Aust. (E of 135°E), laying, Aug.–Mar. and June, but mainly Aug.–Jan., with peak, Oct.–Nov. In n. Aust., mainly Aug.–Jan. but eggs in all months except Apr.; in sw. WA and SA, eggs Aug.–Dec., rarely in July and Jan.; in NSW and Vic., Sept.–Dec., rarely in Aug. and Jan.; in Tas., Oct.–Dec., rarely Sept. and Jan. (Brooker & Brooker 1989). Other records: NT: young, late July (NRS); SA: eggs, early Oct. to late Nov. (Attiwill 1972); NSW: eggs, early Aug. to early Jan.; young, late Aug. to early Jan. (NRS); Vic.: eggs, early Oct. to early Dec.; young, early Sept. to mid-Dec. (NRS). Tas.: fledgelings, Dec. (Tas. Bird Rep. 24).

Site Usually select insectivorous hosts that build open, cup-shaped nests. Mostly honeyeaters (Meliphagidae) but also robins (Petroicidae), flycatchers (Dicruridae), whistlers (Pachycephalidae) and woodswallows *Artamus*. Also said to parasitize species that build enclosed nests, e.g. Aust. wrens (Maluridae), scrubwrens *Sericornis*, fieldwrens *Calamanthus*; occasionally lay in nests of ground-nesting Richard's Pipit *Anthus noveaeelandiae*, and in nests of predominantly seed-eating finches (Passeridae). One instance of Rainbow Bee-eater *Merops ornatus* raising a Cuckoo chick; nest found with Cuckoo chick in tunnel; as chick grew it came nearer to entrance of tunnel, eventually leaving tunnel altogether to perch on a ledge near entrance; remained on ledge at night and stayed nearby 'till it was a large bird' (Cheney 1914). Hosts usually about half size of Cuckoo (North). Of 55 hosts from 21 species in NRS, most (64%) in nests of honeyeaters, including Yellow-faced Honeyeater *Lichenostomus chrysops* (16%), Singing Honeyeater *L. virescens* (9%), White-plumed Honeyeater *L. penicillatus* (7%) and Bell Miner *Manorina melanophrys* (7%); also in nests of Willie Wagtail *Rhipidura leucophrys* (13%) and Rufous Whistler *Pachycephala rufiventris* (5%). Of 1052 records of parasitism of nests or observations of birds feeding fledgelings (but see Family introduction): 693 (65.9%) were honeyeaters, including 277 (26.3%) *Lichenostomus*, 145 (13.8%) *Melithreptus* and 80 (7.6%) *Anthochaera*; 48 (4.6%) were woodswallows and 47 (4.5%) were whistlers *Pachycephala* (Brooker & Brooker 1989). Species recorded with either Cuckoo eggs or young in nest (but not necessarily successfully fledging a Cuckoo chick) are: Rainbow Bee-eater, White-throated Treecreeper *Cormobates leucophaeus*, Superb Fairy-wren *Malurus cyaneus*, Red-backed Fairy-wren *M. melanocephalus*, Southern Emu-wren *Stipiturus malachurus*, White-browed Scrubwren *Sericornis frontalis*, Tasmanian Scrubwren *S. humilis*, Striated Fieldwren *Calamanthus fuliginosus*, Rufous Fieldwren *C. campestris*, Large-billed Gerygone *Gerygone magnirostris*, Brown Thornbill *Acanthiza*

pusilla, Red Wattlebird, Little Wattlebird *Anthochaera chrysoptera*, Spiny-cheeked Honeyeater *Acanthagenys rufogularis*, Striped Honeyeater *Plectorhynchalanceolata*, Helmeted Friarbird *Philemon buceroides*, Noisy Friarbird *P. corniculatus*, Regent Honeyeater *Xanthomyza phrygia*, Blue-faced Honeyeater *Entomyzon cyanotis*, Bell Miner, Noisy Miner *Manorina melanocephala*, Yellow-throated Miner, Lewin's Honeyeater *Meliphagalewinii*, Yellow-faced Honeyeater, Singing Honeyeater, Yellow Honeyeater *Lichenostomus flavus*, White-eared Honeyeater, Yellow-throated Honeyeater *L. flavicollis*, Yellow-tufted Honeyeater, Purple-gaped Honeyeater *L. cratitius*, Grey-headed Honeyeater *L. keartlandi*, Yellow-plumed Honeyeater *L. ornatus*, Grey-fronted Honeyeater *L. plumulus*, Fuscous Honeyeater, White-plumed Honeyeater, Black-chinned Honeyeater *Melithreptus gularis*, Strong-billed Honeyeater *M. validirostris*, Brown-headed Honeyeater, White-naped Honeyeater *M. lunatus*, Black-headed Honeyeater, Brown Honeyeater *Lichmera indistincta*, Crescent Honeyeater *Phylidonyris pyrrhoptera*, New Holland Honeyeater *P. novaehollandiae*, White-cheeked Honeyeater *P. nigra*, White-fronted Honeyeater, Tawny-crowned Honeyeater *P. melanops*, Bar-breasted Honeyeater *Ramsayornis fasciatus*, Eastern Spinebill *Acanthorhynchus tenuirostris*, Western Spinebill *A. superciliosus*, White-fronted Chat *Epthianura albifrons*, Jacky Winter *Microeca fascinans*, Scarlet Robin *Petroica multicolor*, Red-capped Robin, Flame Robin *P. phoenicea*, Hooded Robin *Melanodryas cucullata*, Dusky Robin *M. vittata*, Eastern Yellow Robin, Western Yellow Robin *Eopsaltria griseogularis*, White-browed Babbler *Pomatostomus superciliosus*, Varied Sittella *Daphoenositta chrysoptera*, Crested Shrike-tit *Falcunculus frontatus*, Crested Bellbird *Oreocica gutturalis*, Olive Whistler *Pachycephala olivacea*, Red-lored Whistler *P. rufogularis*, Golden Whistler *P. pectoralis*, Rufous Whistler, Bower's Shrike-thrush *Colluricincla boweri*, Grey Shrike-thrush *C. harmonica*, Leaden Flycatcher *Myiagra rubecula*, Satin Flycatcher *M. cyanoleuca*, Restless Flycatcher *M. inquieta*, Magpie-lark *Grallina cyanoleuca*, Rufous Fantail *Rhipidura rufifrons*, Grey Fantail, Willie Wagtail, Spangled Drongo *Dicrurus bracteatus*, Black-faced Cuckoo-shrike *Coracina novaehollandiae*, White-winged Triller *Lalage sueurii*, Olive-backed Oriole *Oriolus sagittatus*, Figbird *Sphecotheres viridis*, White-breasted Woodswallow *Artamus leucorhynchus*, Masked Woodswallow *A. personatus*, White-browed Woodswallow *A. superciliosus*, Black-faced Woodswallow *A. cinereus*, Dusky Woodswallow *A. cyanopterus*, Little Woodswallow *A. minor*, Richard's Pipit, European Greenfinch *Carduelis chloris*, European Goldfinch *C. carduelis*, House Sparrow *Passer domesticus*, Red-whiskered Bulbul, Clamorous Reed-Warbler *Acrocephalus stentoreus*, Silvereye *Zosterops lateralis*, Common Blackbird *Turdus merula* (Cole 1908; Cheney 1914; H.L. White 1915; Dove 1916; Sharland 1922; Marshall 1931; Benn 1938; McGilp 1941; Masters & Milhinch 1974; Brooker & Brooker 1989; Campbell; North; NRS). **MEASUREMENTS:** Height of nest of host: 2.6 m (2.53; 0.3–12.0; 33) (NRS). Two nests, 183 m apart (NRS).

Eggs Inclined to oval; finely textured; glossy; fleshy pink, darkest on apex and with a few small reddish or chestnut spots (Campbell); rounded or elongated oval; close-grained, smooth; slightly lustrous; fleshy pink, sometimes with a few scattered dots of a darker hue (North). Said to resemble closely those of honeyeaters, particularly Yellow-tufted Honeyeater (Ramsay 1865) and Singing Honeyeater (McGilp 1941). **MEASUREMENTS:** 23.9 (20.8–26.2; 126) × 17.4 (15.0–19.6) (HLW in Brooker & Brooker 1989); 25.9 (3.95; 24.1–35.6; 8) × 17.7 (0.37; 17.3–18.3) (Wilson 1910; Campbell; North).

Clutch-size Usually lay only one egg in each parasitized

nest; nests occasionally contain two or three Cuckoo eggs, though probably laid by different birds (H.L. White 1915; Brooker & Brooker 1989; NRS). For number of Cuckoo eggs per parasitized nest: E/1 × 832 nests, E/2 × 10, E/3 × 1 (Brooker & Brooker 1989). Cuckoo usually removes an egg of host so that number of eggs in nest remains same (Dove 1916; Brooker & Brooker 1989; NRS).

Laying Usually lay in nests already containing eggs, though sometimes lay before host starts laying; eggs found buried in lining of nests suggests Cuckoo laid before host had finished building nest (Brent 1905; Campbell). No studies of laying, but almost certainly lay directly into nest of host, like closely related Common Cuckoo *Cuculus canorus* and Aust. *Chrysococcyx* (Wyllie 1981; Brooker & Brooker 1989; see also Cole 1907; McGilp 1941; Campbell). Claims that egg may be laid on ground and carried to nest in bill (e.g. Campbell) wrong.

Incubation Solely by hosts. One Cuckoo egg hatched in early morning (Campbell 1915). **INCUBATION PERIOD:** 12–14 days (Campbell).

Young Altricial, nidicolous. Naked and blind at hatching (North). Eggs or young of host ejected from nest after Cuckoo hatches, usually within 24 h (Cole 1908; Campbell 1915; see introduction to Cuculidae). Occasionally smother or trample weak or sickly nestlings (Cole 1908); in one Red Wattlebird's nest, Cuckoo took 11 days to evict Wattlebird chick (Dove 1916). **Growth** No information. **Host care, Role of sexes** Hosts brood and feed Cuckoo chick. Other birds may assist in feeding chick, e.g. one chick fed by seven different Bell Miners; at another nest, at least three Yellow-plumed Honeyeaters fed Cuckoo chick, every 1–2 min (NRS).

Fledging to independence Hosts continue to feed chick after fledging (Campbell; North), e.g. after fledging from nest of Brown-headed Honeyeaters, one fledgeling fed by up to four Honeyeaters (NRS). Other species often feed fledgelings, e.g. one fledgeling fed by two Strong-billed Honeyeaters and a Superb Fairy-wren (Dove 1916); another fed by two Rufous Whistlers and three Fuscous Honeyeaters (NRS); one fed by a Black-headed Honeyeater and a Yellow-throated Honeyeater (Tas. Bird Rep. 22); fledgeling with Black-headed Honeyeaters also fed by a Dusky Robin, which ignored its own young for at least 40 min (Tas. Bird Rep. 24); fledgeling fed by a pair of White-plumed Honeyeaters and a pair of House Sparrows (North). Fledgelings will also perch beside nests with eggs or young and be fed by adults of nest, which then ignore their own offspring (Chaffer 1973; NRS). One fledgeling Cuckoo may have evicted nestling Rufous Whistler then stayed next to their nest to be fed (NRS). Adult Cuckoos occasionally feed fledgelings (see Social Organization). Adult Singing Honeyeater feigned injury to protect feathered Cuckoo chick (NRS). For list of species recorded as hosts, but not known whether they raised a Cuckoo chick or just fed a fledgeling, see Brooker & Brooker (1989). **FLEDGING PERIOD:** No information.

Success From 39 eggs, 14 (35.9%) hatched; for nests of known outcome, from 37 eggs, 12 (32.4%) hatched, 5 (13.5%) fledged; of 17 nests with chicks (including nests with chicks but not found at egg stage), 9 (52.9%) fledged (NRS). Eggs failed to hatch because they were: deserted by hosts; fell through nest; found broken in or below nest; disappeared from nest; chicks sometimes found dead in nest or on ground below nest; one chick removed by observer to save young of host (NRS). Nests in which Cuckoos lay before host has begun laying usually abandoned by host without laying (North). Laying by Cuckoo may damage nest, which may then lose all eggs (NRS; S. Marchant). Young that hatch in nests of European Goldfinch

die of starvation (Cole 1908); a 9-day-old Cuckoo chick apparently evicted from nest by Yellow-tufted Honeyeater hosts (Leach 1929).

PLUMAGES Prepared by D.I. Rogers. Fledge in distinctive juvenile plumage, which held only briefly. Attain immature (first basic) plumage in complete post-juvenile moult when c. 2 months old; immatures similar to adults but often separable till complete second pre-basic moult when c. 1 year old. Adults differ markedly, and both sexes polymorphic. Probably first breed when 1 year old, judging by immature collected with convoluted oviduct containing almost fully developed egg (ANWC 44043).

Adult male (Second and subsequent basic). Variation between light-grey and dark-grey morphs probably continuous. **LIGHT-GREY MORPH: HEAD AND NECK:** Feathers of crown, nape and hindneck, light grey (85) with darker, more brownish-grey (c84, c83), tinge in centres; these areas usually appear grey (c84); when worn, dark centres to feathers more exposed, causing patchy appearance, and forehead can fade to light brown (119C). In centre of nape, pure white spot of rather downy feathers usually partly concealed, but contrasts strongly when fully exposed. Supercilium, upper ear-coverts, chin, throat and foreneck, pale grey (c86) to grey-white (ne), interrupted by narrow and often patchy dark grey-brown (121) or black-brown (119) eye-stripe that runs from base of upper mandible, through eye and continues on to lower ear-coverts and down sides of neck. **UPPERPARTS:** When fresh, uniform brownish grey (ne) except for series of white spots along outer edges of longest uppertail-coverts; feathers, grey (84) to dark grey (83) with narrow grey-brown (c119C) fringes. Uppertails appear more patchy with wear: centres of feathers gradually become brown (119B); and rump and uppertail-coverts can look faintly streaky as area round shafts of feathers becomes darker and browner with wear. **UNDERPARTS:** Breast, upper belly and fore-flanks, pale grey (c86) grading to white on vent and undertail-coverts; coverts have well-spaced, dark grey-brown (c121) bars 1–2 mm wide; rear-flanks, grey-white (ne) to white with narrow light-grey (85–84) barring; barring sometimes extends onto vent, but this usually unmarked. **TAIL:** Central feathers (t1), dark brownish-grey (79) to grey-brown (119A), grading to black-brown (119) at edges, which are marked by series of pale triangular spots; spots typically white but sometimes varying tinged buff (223D). Outermost feathers (t5), dark brown (119A) to black-brown (119), broadly barred white. Other feathers intermediate: white barring incomplete, with broad white half-bars along edges (especially inner edges) and smaller white spots near shafts; pale spots are often tinged buff (223D), especially on inner feathers, and grey tinge to ground-colour strongest on inner feathers. In general, closed tail from above looks grey-brown neatly spotted white or buff; from below it appears blackish, broadly barred white. **UPPERWING:** Secondaries and secondary coverts, brownish grey (c79) to grey-brown (c119A), becoming slightly darker on outermost secondary coverts and most secondaries; feathers have varying white fringes, typically narrow and even in width on shortest lesser coverts, and broader and more irregular on longer coverts; on tertials and greater secondary coverts, white fringes usually broken into series of white spots (rarely tinged buff c223D); secondaries have narrow off-white fringes at tips and, usually, especially in very fresh plumages, wavy narrow off-white outer edges, which are sometimes broken into series of small white (rarely, buff 223D) spots on outer edge; outer edges unmarked in some birds. Alula and primary coverts, black-brown (119), narrowly tipped

off-white; small outer marginal coverts beneath alula, white, sometimes exposed as distinct white patch. Primaries, dark brown (119A) to black-brown (119) with narrow off-white fringes at tips that are much reduced with wear and typically lost from p7–p10; inner seven or so primaries (rarely, as few as five or as many as nine) have off-white outer edges, typically very narrow and even in width. In a few, pale outer edges of inner primaries have wavy boundaries, broken to some extent into small discrete white or pale-buff (223D) spots; these birds possibly first basic (see Immature males). **UNDERWING:** Most coverts, cream (54) with varying but fine light-grey (84–85) barring. Greater coverts, pale grey (86), sometimes with off-white or cream (54) barring. Secondaries, uniform brown-grey (ne). Primaries, glossy brownish grey (c79), unmarked on distal third but otherwise with broad white barring on inner webs; on inner primaries, white bars merge as broad white wing-bar bordering coverts. All primaries have dark-grey (83–84) bases; these concealed on most feathers but exposed on outer primaries (about p7–p9) as a dark blotch bordering coverts.

DARK-GREY MORPH: Varies. Differences from light-grey morph: **HEAD AND NECK, UPPERPARTS:** Crown and upperparts tend to be slightly darker and browner (ne). Have a rufous patch of varying size on hindneck, directly below white spot on nape; formed by 1–15 brownish-grey (ne) feathers with broad dark-brown (121) tips that enclose a pair of large rufous-brown (38–136) or buff (39) spots on distal edges. **UPPERWING:** Primaries more often have wavy boundary to pale outer edges. Pale spots on outer edges of secondaries, tertials and greater secondary coverts larger, and often extend onto median secondary coverts (rare in light-grey morph). Pale spots on outer edges of secondaries sometimes have buff tinge (rare in light-grey morph).

RUFIOUS-MORPH: Unlikely that males have a rufous morph (see Sexing); if they do it is identical to rufous morph of adult female.

Adult female (Second and subsequent basic). **DARK-RUFIOUS MORPH:** **HEAD AND NECK:** Forehead and crown, dark brown (121–119), with forehead and forecrown fading to grey-brown (121B) with wear; top of head varying streaked by broad light rufous-brown (39) edges to feathers that are often absent on sides of crown, which thus appears as dark lateral crown-stripe contrasting with pale supercilium and rufous-streaked crown. Small white spot on nape (as adult male) always abuts large rufous and black-brown patch on hindneck. All feathers of hindneck, dark brown (121) to black-brown (119) with broad rufous-brown (136, 38) edges (light rufous-brown [39] when worn) that do not reach bases of feathers and are sometimes shaped as pair of large spots at distal corners of feathers. Depending on pattern of feathers and wear, patch on hindneck varies from rufous-brown with dark streaking to dark with coarse rufous-brown streaking or spots. White supercilium with narrow dark-brown (121) shaft-streaks typically narrow in front of eye (it is sometimes absent and never extends to bill) and broad behind eye; it runs through upper ear-coverts toward sides of upper hindneck, where it grades to buff (c124). Eye-stripe, dark brown (121) to black-brown (119); runs from rear half of lores through lower ear-coverts to sides of neck; latter two areas faintly streaked by light rufous-brown (39) edges to feathers. A thin short dark-brown (119A) moustachial stripe and, in some, a smaller dark-brown (119A) malar stripe, contrast with uniformly pale-grey (c86, browner than grey morphs of males) chin, throat and foreneck. Typically have a partial dark gorget formed by coarse irregular dark-brown (121) barring, most extensive on sides of foreneck but also extending narrowly across centre of lower foreneck and upper breast. In

some heavily marked birds, feathers of gorget also have light rufous-brown (c39, c38) to buff (124) tips and subterminal bars so that throat looks unevenly barred or finely barred; in palest birds, gorget restricted to a few dark-brown (121) subterminal bars on feathers at sides of foreneck. **UPPERPARTS:** Mantle, upper back and scapulars, dark brown (121), densely mottled by rufous-brown (c136) spots on edges and tips of feathers; when worn, ground-colour becomes greyish brown (119B) and rufous-brown spots fade to buff (124) or light rufous-brown (c38). Lower back, rump and uppertail-coverts, brown (c119A, 119B) becoming lighter grey-brown (ne) with wear; in some birds (especially in fresh plumage), rump faintly speckled by buff (c124) or white spots along edges of feathers; uppertail-coverts have series of pale spots along edges and narrow pale fringes at tips, which are usually white, but buff (124) to light rufous-brown (c39) in some. **UNDERPARTS:** Gorget often extends onto sides of breast and can extend narrowly across upper breast but never across lower breast. Rest like adult male except for slightly browner tinge to ground-colour and, often, slightly broader dark barring on rear-flanks and undertail-coverts. **TAIL:** Like adult male, but notches on edges of rectrices more often buff (124) to light rufous-brown (39). **UPPERWING:** When fresh, all secondary coverts like feathers of mantle and scapulars; tend to fade more quickly so that in worn birds coverts often look paler than upperparts. Tertials, dark brown (121) with small light rufous-brown (c39) to buff (124) spots along edges that can be wholly lost with wear, leaving notched feathers. Secondaries, black-brown (119) when fresh, dark brown (121) when worn, with varying series of rufous-brown (136, 39) spots along edges and narrow light rufous-brown (39) fringes at tips; in some, these spots and fringes very narrow and off-white. Primaries, black-brown (119) when fresh, dark brown (121) when worn, with narrow pale fringes at tips extending from p1 to about p7; these typically buff (124) on innermost primaries, off-white on outer primaries. Primaries typically have series of light rufous-brown (39) spots along outer edge, which sometimes connect to form narrow wavy line; appearance then rather like that of immature male, but typically more marked; when worn, these markings become narrower and paler buff (c124) or off-white. **UNDERWING:** Fine light-grey (85) barring on coverts may be broader than adult male.

LIGHT-RUFIOUS MORPH: Intermediate in appearance between dark-grey morph of adult male and dark-rufous morph of adult female; differences from latter given: **HEAD AND NECK:** Top of head has less rufous streaking and is sometimes unmarked (though white nape-spot and rufous patch on hindneck always present). Ground-colour of patch on hindneck typically

Plate 31

Oriental Cuckoo *Cuculus saturatus* (page 653)

1 Adult male; 2 Adult female, grey morph; 3 Adult female, rufous morph; 4 Juvenile male, grey morph; 5 Juvenile female, rufous morph; 6 Immature female, grey morph; 7 Adult male; 8 Adult female, rufous morph

Pallid Cuckoo *Cuculus pallidus* (page 662)

9 Adult male, light-grey morph; 10 Adult female, light-rufous morph; 11 Adult female, dark-rufous morph; 12 Juvenile; 13 Immature male, dark-grey morph; 14 Adult male, light-grey morph; 15 Adult female, dark-rufous morph

paler, light rufous-brown (39) or buff (124). Lack all traces of gorget, and long dark eye-stripe is sharply demarcated from pale-grey chin and throat, often by a streaky line of light rufous-brown (39) or buff (124) lower edges to feathers. Often have a short narrow dark-brown (c119A) moustachial stripe. **UPPERPARTS:** Fewer rufous spots and tips; these markings typically confined to mantle and, in some, isolated scapulars. Pale spots on uppertail-coverts, white. **UNDERPARTS:** As adult male. **TAIL:** Pale spots usually white, seldom buff. **UPPERWING:** On secondary coverts, tertials and secondaries, pale spots and tips smaller and often white, sometimes with buff (c39–124) tinge, but seldom as rufous as in dark-rufous morph. On primaries, pale spots smaller and usually cream (54) to off-white; in some, pale spots along edges of primaries are so narrow they can be wholly lost with wear. **UNDERWING:** As adult male.

GREY MORPH: Thought not to have a grey morph (see Sexing): if they do, it is indistinguishable from adult male.

Nestling No information.

Juvenile HEAD AND NECK: Forehead, lores, chin and throat, dark brown (121) fading to grey-brown (c119B) with wear; feathers of throat have narrow off-white fringes and white to pale-grey (c85) basal edges that may be exposed as coarse streaking. Crown, very dark brown (121–119), coarsely streaked by broad white edges to feathers; these broaden toward rear of head and grade into off-white of hindneck, sides of nape and supercilium, which are coarsely streaked by dark-brown (121) shaft-streaks. Supercilium separated from varying (usually broad), ill-defined white moustachial stripe by dark-brown (119A) ear-coverts, which are streaked white by white upper edges to upper coverts and white lower edges to lower coverts. **UPPERPARTS:** Coarsely streaked dark brown (119A) and white. Feathers of mantle and scapulars, dark brown (119A) grading to darker brown (121) distally, and with off-white fringes that are narrow at tips and broad on edges; pale fringes often tinged buff, especially on mantle and innermost scapulars. Feathers of back and rump similar, but pale fringes much broader and usually without buff tinge; rump looks white with broad dark-brown (119A) shaft-streaks. Uppertail-coverts, dark brown (121) with narrow white fringes; white edges to central feathers have wavy inner boundaries. **UNDERPARTS:** Upper breast, dark brown (121), fading to grey-brown (c119B) with wear, and finely streaked by narrow off-white fringes to feathers. Fringes to feathers of rest broader and cleaner white, so that belly, flanks and lower breast mainly white, streaked by dark-brown or grey-brown shaft-steaks. **TAIL:** Dark brown (121) with pale-brown (223D) shafts and white notches to fringes; notches along inner

edges small on t1 (which has symmetrical pattern), but increasingly broad on outer feathers; on t4 they form half-bars on inner web that almost meet shaft; and t5 is unevenly barred dark brown and white. **UPPERWING:** Greater, median and inner lesser secondary coverts, dark brown (121–119A) with broad white fringes at tips and one or two pairs of very large white spots at sides (so that dark centres look diamond-shaped distally). Primary coverts, alula and outermost lesser secondary coverts, dark brown (121–119A) with narrow white tips. Marginal coverts, dark brown with white edges. When wing folded, only white parts of lesser secondary coverts exposed, and they contrast with scapulars as distinct white band; in some birds, white tips of median and greater secondary coverts are so broad that they look continuous with white areas of lesser coverts and form large, mainly white panel on folded wing. Primaries and secondaries, very dark brown (121–119) with white fringes that are very narrow on outer primaries (but retained till post-juvenile moult). Pale outer edges of outer four or so primaries often have wavy inner boundary. **UNDERWING:** All secondary coverts, white. Lesser and median primary coverts, white, finely barred dark grey-brown (c119A); greater primary coverts, light grey (85) with a few off-white spots or half-bars along outer edges. Remiges, grey (c84) to light grey (c85) with broad white half-bars on inner webs extending from inner edges almost to shafts; half-bars most striking on inner primaries, always absent from distal third of outer primaries and often absent from distal half of all secondaries.

Immature male (First basic). Very similar to adult and not always separable. Both light-grey and dark-grey morphs occur (i.e. no evidence for rufous feathering in hindneck being indicative of immaturity, *contra* Disney 1977). Most differ in retaining worn secondaries from juvenile plumage; these are contrastingly more worn and bleached than newer secondaries, and distinctly narrower, with rather rounded outer corner (cf. rather square in older birds; similar difference in shape is illustrated in text on Oriental Cuckoo [q.v.]). Fresh (first basic) primaries and secondaries also useful in ageing: pale outer edges of primaries often more buff than in adults, and typically broader, with wavy boundaries that may be broken into series of spots along edge. Spotted edges of secondaries and greater secondary coverts typically larger and with stronger buff tinge, often extending onto median secondary coverts; this difference seems fairly reliable feature for ageing in light-grey morph but less effective in dark-grey morph.

Immature female (First basic). Very similar to adult females, and light-rufous and dark-rufous morphs occur. At least some retain juvenile secondaries, which are contrastingly more worn and bleached than newer secondaries, and distinctly narrower, with rather rounded outer corner (see Immature male). However, differences from adults less obvious than in males, as immature and adult females typically have broader pale fringes to secondaries, and these are reduced with wear, so it becomes hard to assess original shape of feather.

Plate 32

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

BARE PARTS Based on photos (Flegg & Longmore 1994; Aust. RD; NZRD; Strahan; unpubl.: J.N. Davies), museum labels (HLW, MV, QVM, SAM, TMAG, WAM), and Hall. **Adults, Immatures** Bill, black (89) to grey-black (82), typically with slightly paler base, most extensive on lower mandible, and variously described as greyish, brown, green or yellow-brown. Palate and gape, orange (16) to dark orange (116); yellow gape recorded on one label. Iris, brown (121B) to black-brown (119); hazel and deep red-hazel reported (labels), and said often to have whitish or yellow outer ring (Hall). Orbital

ring, yellow (55) to pale yellow (157). In all photos, feet, cream (54, 92) with light-grey (c85) scutes on tops of toes and dark-grey (83) to grey-black (82) claws; also said to be grey, dark olive-green, dull black, purplish olive and brownish olive (labels); not known if post-mortem discoloration involved in apparent variation. **Nestling** No information. **Juvenile** Bill, grey (84) grading to off-white on cutting edges, tip and gape (pale areas tinged pinkish or yellowish in youngest birds). Iris, brown (c119A–121B), sometimes with distinct grey (c86) tinge. Orbital ring, pale yellow (c157) to pale olive-green (–); very narrow and perhaps absent in youngest individuals. Legs and feet: at first, pale pink (pale 7) with pale-grey (86) tinge in centre of scutes on tops of toes; similar to adults by time of post-juvenile moult.

MOULTS Based on skins of 150 adults and 63 younger birds (ANWC, HLW, MV, QVM, SAM, TMAG, WAM) and Stresemann & Stresemann (1961, 1966). **Adult post-breeding** (Second and subsequent pre-basic). Usually complete, exceptionally retain a secondary or 1–2 primaries. Mainly in late summer, starting primaries in Jan. and usually finishing about Apr.; 10 of 11 examined in May had finished moult, but one in final stages of moult of primaries recorded as late as 22 June. Moult of body begins earlier than primaries, usually in Dec.–Jan. but, in a few, as early as Sept.; finishes at about same time as primaries. Most moult occurs in N: six records of active moult of primaries in temperate regions of s. Aust., all in early stages (PMS 1–19); 19 records of active moult from tropical Aust. showed broader range of moult scores (PMS 4–48), but only three had PMS <20. Seems likely that many s. birds migrate N with moult of primaries suspended, though only two examined had suspended moult. Sequence of moult of primaries complex; moult alternating primaries, with growing feathers always separated by at least one fully grown feather; 1–4 feathers can grow concurrently. Thought primaries moulted in two groups, p1–p4 and p5–p9: outer group in sequence (p9 and p7)–p5–p8–p6; inner group in sequence (p1 and p4)–p2–p6 (Stresemann & Stresemann 1961). Data collected in this study consistent with this model or differ only slightly (e.g. p2 and p3 transposed); moult of p10 occurred at same time as that of p6 or p8; inner and outer groups of primaries moulted at about same time, with inner group of primaries tending to finish moult before outer group. A few differed markedly from this model, starting with p3, p6 or p8 (i.e. feathers which should be moulted last); not known if these were birds in second pre-basic moulting retained juvenile feathers out of ordinary sequence, as has been reported for Oriental Cuckoo (q.v.). Sequence of moult of rectrices also complex and not understood; moult starts when PMS is c. 10, and some have finished moult of tail by the time PMS 40. Secondaries also begin when PMS c. 10; finish at about same time as moult of last primary. **Post-juvenile** (First pre-basic). Complete or nearly so. Many retain a few juvenile secondaries, most often s2–s4; a few also retain a few juvenile primaries (usually 1–3, rarely as many as seven) or median upperwing-coverts. Moult begins in body, usually only just before start of primaries, though some have moulted much of body before primaries begin; moult of body finished before moult of primaries and secondaries. Most moult occurs in late summer and early autumn while still in breeding areas, with most birds starting about Feb. when PMS 12 (8–16; 6). Timing of start of moult varies markedly; earliest record of moult of primaries was from sw. Aust. in Aug. (PMS 20), but this exceptionally early. Most birds finish moult at some time between Mar. and May; one from NSW was still moulting in June (PMS 37).

MEASUREMENTS From skins (AM, ANWC, HLW, MV, QVM, TMAG, SAM, WAM): (1–3) Mainland Aust.: (1) Adults; (2) Juveniles; (3) Immatures, 4–12 months old, with first-basic primaries. (4) Tas., adults.

		MALES	FEMALES	
WING	(1)	193.0 (5.07; 179–204; 69)	191.5 (5.15; 182–204; 48)	ns
	(2)	181.6 (4.05; 174–190; 16)	181.5 (7.07; 170–198; 11)	ns
	(3)	189.8 (8.14; 180–199; 4)	188.6 (8.01; 178–198; 5)	ns
	(4)	196.3 (5.29; 186–205; 9)	194.2 (5.85; 186–204; 9)	ns
TAIL	(1)	163.4 (5.90; 151–177; 69)	160.6 (6.41; 151–178; 45)	*
	(2)	155.3 (6.40; 143–168; 15)	156.7 (8.81; 148–178; 10)	ns
	(3)	163.4 (2.07; 161–166; 5)	159.0 (8.60; 150–168; 5)	ns
	(4)	166.9 (3.95; 158–171; 9)	161.6 (7.99; 152–178; 9)	ns
BILL S	(1)	26.9 (1.32; 23.8–29.3; 61)	26.8 (1.02; 24.8–29.1; 47)	ns
	(2)	24.9 (1.86; 21.4–27.5; 17)	26.4 (0.99; 25.2–28.0; 10)	*
	(3)	25.7 (1.51; 23.5–27.7; 5)	26.6 (1.14; 25.5–28.3; 5)	ns
	(4)	26.8 (0.95; 25.8–28.3; 9)	26.6 (1.11; 25.3–28.5; 9)	ns
BILL N	(1)	16.6 (0.75; 14.9–18.4; 62)	16.6 (0.71; 15.6–18.3; 46)	ns
	(2)	14.9 (1.43; 12.8–17.7; 17)	15.5 (1.11; 14.0–17.0; 10)	ns
	(3)	16.6 (0.82; 15.3–17.5; 5)	16.4 (0.75; 15.6–17.2; 5)	ns
	(4)	16.4 (0.67; 15.0–17.2; 9)	16.5 (0.72; 15.6–17.6; 8)	ns
TARSUS	(1)	21.9 (1.39; 19.5–25.3; 24)	22.2 (1.57; 20.2–25.7; 21)	ns
	(2)	19.8, 21.7	22.2, 22.6	
	(3)	21.7 (0.66; 21.0–22.4; 4)	22.6	
	(4)	22.7 (1.69; 20.8–25.6; 6)	22.2 (1.12; 20.8–23.3; 6)	ns
TOE C	(1)	26.2 (1.05; 24.3–27.3; 12)	26.7 (1.85; 24.7–29.9; 13)	ns
	(2)	23.7, 25.3	27.4	
	(3)	26.4, 26.8	–	
	(4)	26.4 (1.06; 25.0–27.5; 4)	26.7 (2.06; 24.7–29.5; 5)	ns

Sexes similar; females possibly slightly smaller than males (significantly so for Tail on mainland) but differences far less marked than in other *Cuculus*. Juveniles have significantly shorter Wing, Tail and Bill than adults; have apparently attained adult size by time of post-juvenile moult, as measurements of adults do not differ significantly from those of immatures.

WEIGHTS (1–3) Aust., from museum labels (ANWC, MV, QVM, SAM, TMAG, WAM): (1) Adults; (2) Juveniles; (3) Immatures.

		MALES	FEMALES	
ADULTS	(1)	89.5 (13.3; 64–118; 22)	85.6 (12.5; 63–106; 18)	ns
JUVENILES	(2)	71.9 (15.20; 46.5–90.0; 12)	75.0 (13.40; 50–90; 9)	ns
IMMATURES	(3)	85.2 (19.5; 43–105; 8)	93.5, 100	

Sexes similar; juveniles significantly lighter than adults. No obvious seasonal variation apparent from available data, but some variation might be obscured through difficulty in distinguishing migrating, non-breeding and breeding birds. Other weights are presented by Brooker & Brooker (1989).

STRUCTURE Wing long and narrow, pointed. Ten primaries: p8 longest; p10 54–62 mm shorter, p9 2–10, p7 6–13, p6 22–26, p5 37–43, p4 48–57, p3 60–67, p2 70–75, p1 76–86. Outer webs of all primaries taper slightly toward tip. Ten secondaries, including three tertials (one of which is very small and perhaps better considered an inner greater secondary covert). Tail long and graduated; ten rectrices, t1 40–54 mm longer than t5. Further information on pterylography in Parsons (1968). Bill slightly smaller and more slender than in Oriental Cuckoo (q.v.), looking less deep and slightly more decurved because it tapers more gradually. Outer hindtoe, c. 87% length of outer front; inner front, c. 59%, innerhind c. 38%; rest of structure similar to that of Oriental Cuckoo (q.v.).

SEXING Although early authors (e.g. S.A. White 1915; Gould; Mathews) recognized that plumages of adult males and females differ markedly, subsequent works (e.g. Disney 1977; Pizey 1980; Simpson & Day 1984; Slater *et al.* 1989; Aust. RD) have treated the rufous morphs of adult female plumage as immature stages, without adequate explanation. Of adult and immature (first basic) specimens examined in this study, 86 (96%) of those sexed as males (n=90) were light-grey or dark-grey morphs, and 48 (83%) of those sexed as females (n=58) were light-rufous or dark-rufous morphs. Label details were scanty for the few rufous individuals sexed as males (n=4, 4%) and grey individuals sexed as females (n=10, 17%): they all lacked descriptions of gonads and many of them were collected in the non-breeding season (when gonads regressed and inconspicuous). It is likely that all of these last specimens were incorrectly sexed; at best, grey-morph females and rufous-morph males are extremely rare.

GEOGRAPHICAL VARIATION Negligible in Aust. (Mayr 1964; Hall). WA birds were once considered a slightly smaller subspecies than those of e. Aust., but their measurements do not differ: e.g. Wing in adult males from WA, 192.9 (4.59; 21) cf. 193.1 (4.84; 32) in e. Aust. (Vic. and NSW). Tas. birds possibly longer-winged and longer-tailed than those of mainland (see Measurements), though differences only significant for tail of males.

Status in Wallacea not known; it has been suggested that records from Timor and w. Flores may represent a resident population rather than vagrants (White & Bruce 1986).

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Oriental Cuckoo *Cuculus saturatus* (page 653)

1 Adult male; 2 Adult female, grey morph; 3 Adult female, rufous morph; 4 Juvenile male, grey morph; 5 Juvenile female, rufous morph; 6 Immature female, grey morph; 7 Adult male; 8 Adult female, rufous morph

Pallid Cuckoo *Cuculus pallidus* (page 662)

9 Adult male, light-grey morph; 10 Adult female, light-rufous morph; 11 Adult female, dark-rufous morph; 12 Juvenile; 13 Immature male, dark-grey morph; 14 Adult male, light-grey morph; 15 Adult female, dark-rufous morph