

Distribution, status and natural history of the Bornean Ground Cuckoo *Carpococcyx radiatus*

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Records of the Bornean Ground Cuckoo show it to be or to have been widely and evenly distributed across the island of Borneo, with a total of 49 localities, 10 in Sabah, 15 in Sarawak, four in Brunei, and 11 in East, four in Central and five in West Kalimantan. Although it is normally characterised as a rare species, evidence is accumulating that it is better considered a generally highly secretive but in fact moderately common bird. However, its habitat is clearly mainly primary forest, and it probably favours level areas near rivers, mainly but not exclusively in the lowlands. Rates of loss of such habitat probably cancel any positive effects on its Near Threatened status stemming from improved knowledge of its range and numbers. It subsists chiefly on forest-floor invertebrates, sometimes following bearded pigs *Sus barbatus* or sun bears *Helarctos malayanus*, but its combination of apparent pheasant mimicry and unpalatability is puzzling. Its breeding remains unknown, but the various reports of its vocalisations sort into at least five calls, a deep *thook-torr*, a monotone *koo*, a rolling *torrymmm*, a snarling *ark* or *heh* in alarm, and a bizarre bleating in breeding-related behaviour.

INTRODUCTION

We recently proposed (Collar and Long 1996) that cuckoos of the genus *Carpococcyx* on the Sunda islands are not one polytypic species, as treated throughout the twentieth century, but two monotypic species, Bornean Ground Cuckoo *C. radiatus* and Sumatran Ground Cuckoo *C. viridis*; and we indicated the limited distribution and alarming conservation status of the latter, whose first sighting since 1916 is documented in Zetra *et al.* (2002, this issue). However, the Bornean Ground Cuckoo, while much better known over a much longer period, itself remains one of the most enigmatic of species on its native island, and has also been considered threatened in the recent past, when it was lumped with the Sumatran species (Collar and Andrew 1988, Collar *et al.* 1994). To review its status more clearly, we assembled data from the published and unpublished literature, museums, and personal communication with ornithologists and other fieldworkers.

Abbreviations for museums whose data we use in this review (and which were gathered by ourselves unless otherwise stated) are: AMNH, American Museum of Natural History, New York (data from R. Sloss *in litt.* 1993); BMNH, Natural History Museum, Tring, U.K.; IRSNB, Institut Royal des Sciences Naturels, Bruxelles, Belgium; MNHN, Muséum National d'Histoire Naturelle, Paris (data from C. Voisin *in litt.* 1993); MZB, Museum of Zoology, Bogor, Indonesia (data from S. van Balen *in litt.* 1995); RMNH, Naturalis, Leiden, Netherlands; SMKK, Sabah Museum, Kota Kinabalu (data from F. H. Sheldon *in litt.* 1993); SMK, Sarawak Museum, Kuching (data from F. H. Sheldon *in litt.* 1993); SMTD, Staatliches Museum für Tierkunde, Dresden, Germany (data from S. Eck *in litt.* 1993); SNMS, Staatliches Museum für Naturkunde, Stuttgart, Germany; SNMB, Staatliches Naturhistorisches Museum, Braunschweig, Germany; UMMZ, University of Michigan Museum of Zoology, Ann Arbor, U.S.A.

(data from R. B. Payne *in litt.* 2002); USNM, United States National Museum (Smithsonian), Washington, D.C.; ZMA, Zoologisch Museum, Amsterdam; ZMB, Zoologisches Museum, Berlin (data from G. Mauersberger *in litt.* 1993); ZRCNUS, Zoological Reference Collection, National University of Singapore (data from Yang Chang Man *in litt.* 1995).

DISTRIBUTION

The island of Borneo is divided up into four political territories representing three nations: Sabah and Sarawak are independently governed states within Malaysia, Brunei is a sovereign nation, and Kalimantan is one of the largest segments of Indonesia, itself falling into four provinces, Kalimantan Timur (East), Kalimantan Selatan (South), Kalimantan Tengah (Central) and Kalimantan Barat (West). The records below show that the Bornean Ground Cuckoo is found throughout Borneo, in all four major political divisions and indeed only remains unrecorded in Kalimantan in the province of South Kalimantan (Fig. 1). This confirms the assertion of Büttikofer (1899), based on considerable explorations in the 1890s in which he took a substantial part, that the species was 'spread over the whole island'.

For ease of reference, we group records of the species by the four main political divisions and, within Kalimantan, by province, ranging them in each case roughly from north to south. We map the localities in question (highlighted in bold in the text) according to coordinates given in BirdLife International (2001) or, failing that, GND (1970), Sheldon *et al.* (2001), NIMA (2002), *Times atlas of the world*, and in two cases (Sungai Mahakam and Dingai) by reading off maps; where coordinates appear in the text, these are derived from the source of the record. For consistency, we have converted the word 'river' and 'mount' in certain locality ascriptions to 'sungai' and 'gunung' respectively.

Malaysia: Sabah

Gore (1968) described the species's status as 'uncertain; probably a scarce resident', but in stating that 'the only record' was the one from 1962 at Kalabakan, he overlooked the fact that 'Lumbidan province' (Sharpe 1876-1879) is located in Sabah rather than in Brunei, and also missed four old specimens: the AMNH Kinabalu skin, the 'Teuton' and Mangalong records, and a bird in BMNH taken on 30 October 1877 in 'N. E. Borneo', which may reasonably be assumed to fall within the boundaries of Sabah. There are in fact now ten localities in the state at which the species has been found. The records are:

'Teuton', apparently near **Kudat**, 1895 (specimen in Royal Ontario Museum: Sheldon *et al.* 2001); **Poring**

Hot Springs, where a bird was observed at 500-900 m in December 1976 or January 1977 (K. Phillipps *in litt.* 1995); **Kinabalu**, June-July 1903 (unsexed specimen in AMNH); 5 km upstream (at 5°29'N 118°15'E) on the Sungai Menangel, near **Sukau** on the Sungai Kinabatangan, where one of a pair was filmed on 25 May 1996 (A. Nettelbeck *in litt.* 1997); **Lambidan** ('Lumbidan province'), at an unknown date in the mid-nineteenth century (Sharpe 1876-1879, Sclater and Shelley 1891; unsexed specimen in BMNH); **Sungai Mengalong** ('Mengalong, Brunei'), August 1899 (♀ in SNMB); **Danum Valley**, at least two birds at West 15 South 05 on 21 June 1994, and two birds near the June area, November 1994 (D. Yong *in litt.* 1995), with a further record from Rhino Ridge, June 1998 (I. Mauro



Figure 1. Borneo, showing 500 m contour and localities at which the Bornean Ground Cuckoo *Carpodoccyx radiatus* has been recorded (note sites 50 and 51 are provisional). **Sabah** (1) Kudat; (2) Poring Hot Springs; (3) Kinabalu; (4) Sukau; (5) Lambidan; (6) Sungai Mengalong; (7) Danum Valley; (8) Maliau basin; (9) Baturong Caves; (10) Kalabakan; **Sarawak** (11) Sungai Lawas; (12) Tutoh; (13) Gunung Mulu; (14) Sungai Melinau; (15) Sungai Suai; (16) Baram district; (17) Similajau National Park; (18) Gunung Kalulong; (19) Bintulu; (20) Sungai Mujong; (21) Samunsam Wildlife Sanctuary; (22) Kuching; (23) Tagora; (24) Gunung Gigi; (25) Sadong; **Brunei** (26) Sungai Tutong; (27) Senukoh; (28) Sungai Soga; (29) Kampung Tamada; **East Kalimantan** (30) Bulungan; (31) Kemawen; (32) Sungai Merah; (33) 'Tandjong Seglu'; (34) Sungai Mahakam; (35) Tabang; (36) Dingai; (37) Sungai Kahala; (38) Sungai Wain; (39) Bukit Suharto; (40) Wanariset; **Central Kalimantan** (41) Busang-Kasau; (42) Muarateweh; (43) Lihong Bahaija; (44) Riam; **West Kalimantan** (45) Anjungan; (46) Pontianak; (47) Sungai Sempang; (48) Gunung Palung National Park; (49) Sungai Kendawangan; (50) Pawan area; (51) Nangatayap.

in litt. 1999) and another near the entrance to the Borneo Rainforest Lodge, 1999 (S. Harrap *per* K. D. Bishop *in litt.* 2001); **Maliau basin**, at Camp 2, 880 m in the transition zone between hill dipterocarp and lower montane coniferous forest, May 1988 (D. Yong *in litt.* 1995); **Baturong Caves**, 12 July 1978 and 14 August 1980 (2 unsexed specimens in SMKK; see Habitat), this clearly being the SMKK-derived record from 'Kunak' in Smythies (1981), since Smythies (1957) had no records from Sabah; 12 miles (18 km) north of **Kalabakan**, 20 m, where a single immature male was collected on 7 November 1962 (Thompson 1966; hence Gore 1968).

Malaysia: Sarawak

There are at least 15 localities for the species in Sarawak, as follows:

Sungai Lawas, where a male was collected at an unknown or unspecified time in 1900 (Kloss 1930); **Tutoh**, uncommon in February 1965 (Fogden 1976); **Gunung Mulu**, September 1893 (♀ in SNMS), September–December 1893, 300 m (Sharpe 1893–1894); **Sungai Melinau** at Camp 5, mid-April 1978 (Davison 1979); **Sungai Suai**, 14 May 1958 (♂ in SMK); **Baram district**, July 1888 and August 1891 (2♂♂ in BMNH, MNHN; hence Sclater and Shelley 1891), with further, often dataless (but mostly and probably all C. Hose) specimens (AMNH 1, IRSNB 1, RMNH 1, SMK 2 [both dated 1891], SMTD 1; also Everett 1889, Hose 1893, Forbes and Robinson 1898); **Similajau National Park** at Sungai Likar, western edge of the park at 3°22'N 113°10'E, 13 September 1995 (M. I. Evans verbally 1995, Duckworth *et al.* 1996); **Gunung Kalulong**, 'not... at any great height', c.1890 (Sharpe 1893–1894); **Bintulu**, mid-1870s (Sharpe 1876–1879, Everett 1889); probably the **Sungai Mujong**, 13 July 1910 (unsexed specimen in AMNH collected by W. Beebe and assessed for likelihood of provenance by D. R. Wells *in litt.* 1995); **Samunsam Wildlife Sanctuary**, Kuching division, one observation some time around 1986 (E. L. Bennett *in litt.* 1993) and one in June 1987 (K. Phillipps *in litt.* 1995); **Kuching**, 1891 (unsexed specimen in SMK), 1902 (unsexed specimen in SMK), and on the Matang road, 25 September 1924 (unsexed specimen in SMK), and again on the Matang road, 28 July 1925 (2 unsexed specimens in SMK, ZRCNUS); **Tagora**, eight miles (14 km) south of Bau, unknown date in the nineteenth century (Everett 1889); Gunung Gilly (here presumed to be **Gunung Gigi**), 15 November 1880 (imm♂ in ZMB); **Sadong**, 1900 (unsexed specimen in SMK), and at 'T. Paoh', in 'old jungle', 10 February 1958 (♂, ♀ in SMK).

Brunei

There are at least four localities for Brunei. It should be noted that the old record given as 'Brunei (Ussher)' by Everett (1889) refers to the specimen above from Lambidan, Sabah. Records are:

Sungai Tutong, October and November 1897 (2♂♂ in BMNH, 1♀ in AMNH); **Senukoh** (Semungkoh), 22 February 1980 (Mann 1987), with two shot near there, in low swampy forest, in the 1950s (J. R. Howes *in litt.* 1995, also in Mann 1988)—these records apparently being the basis for the assertion that the

species is known from Batu Apoi Forest Reserve near the Kuala Belalong Field Studies Centre (Wheatley 1996), although C. F. Mann (*in litt.* 2002) did not find it in over a year's intensive study at this site; **Sungai Soga**, 'in the uninhabited sub-montane forests of Ulu Belait', August 1968 (Holmes 1969, Mann 1987, D. A. Holmes *in litt.* 1993); **Kampung Tamada** along the Sungai Semaba in swampy riverine forest, where one was collected alive for Bangar Zoo, 8 October 1986 (Mann 1988; see plates 1–3 in Collar and Long 1996).

Indonesia: Kalimantan

There are at least 11 localities for East Kalimantan, four for Central and five for West, making 20 in all for Indonesia. A tentative record from Lempunah, East Kalimantan, referred to in Smythies and Davison (1999) as *in press*, did not appear in the published version and was presumably considered too uncertain to enshrine in print. Records are:

(EAST): **Bulungan** (CIFOR research forest), several birds heard and one seen in primary forest, September–October 1998 (S. van Balen *in litt.* 2002); **Kemawen**, August–October 1969 (4♂♂, 1♀, 1 imm♀ in ZMB); **Sungai Merah**, April 1914 (2 unsexed specimens in USNM); **Tandjong Seglu** (0°48'N 117°55'E: J. P. Angle *in litt.* 1995), August 1913 (female in USNM); **Sungai Mahakam**, at the confluence of the Blu and Bluve (Long Bloe) rivers, 200 m, October 1896 and November 1899 (Finsch 1901, 1905; specimens in RMNH), and along the Mahakam and Ratah rivers, January–July and November 1996 (R. Sözer in Holmes 1997); **Tabang**, 11 September 1956 (♀ in ZMB); **Dingai** (Dingey), on the upper sungai 'Long Bloe', where an adult female was collected on 8 October 1896 (Büttikofer 1899; ♀ in RMNH); **Sungai Kahala** (tributary of Danau Semayang in East Kalimantan), where two birds were trapped in January 1996 (R. Sözer in Holmes 1997); **Sungai Wain**, near Balikpapan, multiple sightings, including eight observations of a pair in the first half of 2000 (G. Fredriksson *in litt.* 2000–2002, F. R. Lambert *in litt.* 2002, S. van Balen *in litt.* 2002); **Bukit Suharto**, four birds calling in forest regenerating (after being burnt in 1998), June 2002 (S. van Balen *in litt.* 2002); **Wanariset**, at Samboja, a single bird in a forest fragment of less than 50 ha 'amidst burnt but regenerating forest', June 2002 (S. van Balen *in litt.* 2002);

(CENTRAL) **Busang-Kasau** (Kasso), where two birds were collected, March–April 1916 (Voous 1961; ♂ in ZMA); **Muarateweh** (Moera Teweh), in the mid-1870s (Brüggemann 1877; hence Everett 1889); **Lihong Bahaija** east of the lower Barito River, where two individuals were found, January 1882 (Blasius 1884, 1896, Grabowsky 1885; ♀ in SNMB); **Riam**, by the Sungai Kotawaringin, November–December 1935 (Mayr 1938; 5♂♂, 1♀ in AMNH, ♂ and imm♀ in MZB);

(WEST) **Anjungan**, 29 April 1932 (♂ in MZB); **Pontianak**, the type-locality, around 1830 (Temminck 1832; also Everett 1889), and where three specimens were collected in 1892, January 1893 and 1894 (Blasius 1896); **Sungai Sempang**, where four males, three females and one unsexed bird were collected in June–August 1907 (4♂♂, 3♀♀, 1 unsexed specimen in USNM); **Gunung Palung National Park** at the Cabang Panti Research Site, 1°36'S 110°06'E, 1994–

1995 (Laman *et al.* 1996, 1997); **Sungai Kendawangan**, August–September 1908 (3♂♂ in USNM).

Unconfirmed but seemingly very probable records in Kalimantan come from the south Pawan area of West Kalimantan (1°15'S 110°30'E), late 1981 (Holmes 1982), and Nangatayap, 1°32'S 110°34'E, where calls thought to be this species were heard, date unspecified (Holmes and Burton 1987).

STATUS

The view that the Bornean Ground Cuckoo is a rare animal has always and understandably prevailed. Hose (1893), who collected a fair number of specimens of the species around the Baram River in Sarawak, judged it to be a 'very rare bird' (although only 'rather rare' in retrospect: Hose 1929), and Finsch (1905) referred to it as 'rare'. Fogden (1976) identified it as one of a suite of ground-haunting species that 'appear to be rare everywhere in Sarawak'. In their summary of the species on Borneo, MacKinnon and Phillipps (1993) described it as 'rather rare and patchy in distribution, but recorded from all parts'; Smythies and Davison (1999) likewise called it 'rather rare'. It is considered 'rare' in Gunung Palung National Park, Kalimantan (Laman *et al.* 1996), where it appears to be both very wary and present at low densities; thus, even in relatively good habitat, three observers had only six encounters with the species in seven field-years (Laman *et al.* 1997). This seems to be a widespread experience among fieldworkers in Borneo: many distinguished ornithologists with months and even years of experience in the island's forests have failed to find it, or have found it only once, and consider it rare and patchily distributed. C. F. Mann (*in litt.* 2002) never found it in 10 years netting in forests in Brunei despite common use of (a) ground-level nets and (b) playback in response to unfamiliar calls, a strategy which yielded Coral-billed Ground Cuckoo *Carpococcyx renauldi* within a short time at Khao Yai, Thailand. The facts that we can trace only 49 localities for a species as large as a mid-sized pheasant, that 24 (50%) of these produced one-off encounters with single birds, and that the span of observer records covers 170 years, 1832–2002, with 27 of the localities hosting records before 1950 and, despite the more intensive coverage, only 24 of them doing so after that date (two localities in both periods), are all evidence consistent with very considerable rarity.

Nevertheless, it is also evidence consistent with very considerable evasiveness, and recent fieldwork by R. Sözer in pursuit of the even more enigmatic Bornean Peacock Pheasant *Polyplectron schleiermacheri* (for this species and R. Sözer's results see BirdLife International 2001) uncovered, as a by-product of interviews with native forest-dwellers, new evidence that the rarity of the cuckoo is indeed a reflection of its highly retiring behaviour. On the basis of the regularity with which birds were caught by Dayaks in the snares they set for galliforms, the cuckoo was concluded to be a 'widespread and common though secretive species in

primary and secondary lowland forests' in the upper Mahakam region (R. Sözer in Holmes 1997 and verbally 1999). Local people interviewed about pheasants reported that they often removed them from traps and, because they considered them unpalatable (see below), released them back into the forest (R. Sözer in BirdLife International 2001). This view of the species tends to be indirectly supported by Banks (1935), who long ago reported that he 'often had this bird alive' but that 'it proved dull and uninteresting', suggesting—in part by the sheer nonchalance of the comment—that it was not particularly rare or exceptional in the part of Sarawak where he lived. Moreover, if the calls heard 'commonly' in Brunei in 1968 (Holmes and Burton 1987) were indeed the ground cuckoo, as they appear to have been (see Voice), and as long as the word 'commonly' does not imply mere repetition from a single source, we have a further hint that we are dealing with a particularly low-profile animal.

It is, of course, a trait of terrestrial forest birds—in Asia, for example, most pheasants Phasianidae, pittas Pittidae, Rail Babbler *Eupetes macrocerus*, various thrushes *Turdus* and *Zoothera*, robins *Luscinia* and shortwings *Brachypteryx*—that they are often exceptionally discreet and elusive in their habits, and most usually revealed by their calls, when they frequently prove to be considerably more abundant than many human observers would readily credit. The vocalisations of the Bornean Ground Cuckoo have in recent years been taped and made available to a new generation of birdwatchers, and it may well be that the species will prove to be at least moderately common in areas where its presence had not previously been registered. The species is currently listed as Near Threatened (BirdLife International 2001), and this status may require reconsideration if records based on vocalisations do indeed reveal that its level of abundance and patchiness of distribution, as mentioned by MacKinnon and Phillipps (1993), are an artefact of its visual unobtrusiveness.

New evidence will also perhaps resolve the difficulty that exists over the habitat of the species. It is to be expected that naturalists might seek to explain instances of rarity by reference to habitat specialisation, and this was the case with the Bornean Ground Cuckoo (Collar *et al.* 1994). However, it is evidently an oversimplification to consider the species confined to level lowland primary forest, and there are consequently grounds for optimism that it may be able to survive in areas upslope of those at present experiencing such devastating losses (for which see BirdLife International 2001: 943–947). On the other hand, the fact that such devastation is occurring throughout areas known to hold the species is enough to convince us that, in all probability, its current Near Threatened status should be maintained irrespective of the security that may be represented by new localities, higher numbers or upslope populations. Moreover, the species may react unfavourably to forest fragmentation: Fogden (1976) thought that it was this widespread phenomenon (for which see Lambert and Collar 2002, this issue) that caused the species to be absent from his study site at Semengo, Sarawak.

NATURAL HISTORY

Habitat

The Bornean Ground Cuckoo is a bird of the forest floor, and very many specimens in museums have been taken in native snares (see above). Wells (1985) listed it as an extreme lowland specialist in both Borneo and Sumatra, although the ascription for the latter island (referring to *Carpococcyx viridis*) is now known to be strongly mistaken (BirdLife International 2001, Zetra *et al.* 2002, this issue). Nevertheless, in Sabah Sheldon *et al.* (2001) found that records come from primary forest and possibly also forest growing on limestone soils, and they suspected the Bornean Ground Cuckoo to be an inhabitant of very low-elevation flat primary forest, a habitat almost gone from the state. At the opposite end of the island, in Gunung Palung National Park, Laman *et al.* (1997) recorded the species mainly or entirely close to a river or on adjacent floodplain areas of lowland dipterocarp forest, specifically in the strip of lowland dipterocarp forest on alluvial terraces near the river, and they regarded this as supporting Wells's view that it is an extreme lowland forest specialist.

Other authors, while not extrapolating their observations, provide supporting evidence of the importance of lowland and indeed riverine forest for this species. Thus, a bird in the Samunsam Wildlife Sanctuary in 1986 was in low vegetation on a steep riverbank; the forest type was primary lowland riverine forest, some 9 km inland from the sea and at around the upper limit of brackish water (E. L. Bennett *in litt.* 1993). Another there in 1987 was in level lowlands about 7 km from the river mouth, in nipah/mangrove with some larger trees and kerangas behind (K. Phillipps *in litt.* 1995). On the Sungai Melinau two birds were trapped in dry level 'empran' (*Parashorea*-dominated alluvial) forest (Davison 1979, G. W. H. Davison *per* C. F. Mann *in litt.* 1995), this being expressed later as 'lowland closed canopy forest over dry ground and alluvial terraces' (Smythies and Davison 1999). A bird in eastern Brunei (in Brunei Museum) was taken in low swampy riverside (perhaps secondary) forest dominated by *Macaranga* species (J. R. Howes *in litt.* 1996). Moreover, there are records above from a large number of rivers—Menangel and Mengalong (Sabah), Lawas, Suai and Mujong (Sarawak), Tutong, Soga and Semaba (Brunei), Merah, Mahakam, Kahala and Wain (East Kalimantan), 'Long Bloe' (Central Kalimantan) and Sempang, Kotawaringin and Kendawangan (West Kalimantan)—strongly suggesting a close ecological link with riverine fringes and floodplains throughout the island.

Even so, it is perhaps unwise to use the existing fragmentary record to discriminate genuine habitat preferences, given that there must be an inherent bias in human observation based on the use of rivers for transport in exploration, and that we are dealing with a cryptic, retiring bird in difficult terrain on a very poorly explored island. Also present in the evidence are records in Sabah from Poring Hot Springs at 500–900 m, 'Kinabalu' (although possibly at the base) and the Maliau basin at 880 m, and in Sarawak on Gunung Mulu, Gunung Kalulong and Gunung Gigi (although again possibly at the base and explicitly at no great height

on Kalulong). The record from Sungai Soga, Brunei, was, in fact, in submontane forest (Holmes 1969), and this has resulted in the generalised attribution of 'lowland and hill forest in Brunei' (Payne 1997). What may be happening here is that the upper elevational records could refer to flat-bottomed valleys within steeper landscapes, so that there really is a tie-up between the species and rather damp, flat substrates, but that this tie-up is not exclusively a lowland phenomenon.

Payne (1997) also mentioned 'primary forest on limestone soils in Sabah', but in Sheldon *et al.* (2001), as noted above, this was qualified as an as yet unproven preference; research is needed to determine whether there are indeed significant differences in the type or relative abundances of invertebrate prey in different substrates that might influence and render patchy the distribution or abundance of their predators (Azure-breasted Pitta *Pitta steerii* uses limestone substrates, possibly related to a greater abundance of snails in such habitat: BirdLife International 2001). It is certainly true that birds have been found in 'primary forest' (Grabowsky 1885, Thompson 1966), but it is not clear that this condition is obligatory. There is a footnote by E. B. Poulton in Shelford (1916) reporting no less an authority than C. Hose that '*Carpococcyx*, like *Centropus*, frequents open spaces of cleared land, and is seldom met with in the forest', and while this is a plain (and bizarre) error it is worth noting that one record from Danum, although inside primary forest, was from 'a huge wind-gap, i.e. the area seemed to have been opened up by much natural treefall, and had a dense regenerating undergrowth cover' (D. Yong *in litt.* 1995).

Food, palatability and mimicry

All the evidence indicates that, although it steps up onto logs and perches low in trees, often to call (see Smythies and Davison 1999), the Bornean Ground Cuckoo forages exclusively on the terrestrial substrate, and most of the evidence indicates that it takes animal and in particular invertebrate food. Collected specimens held invertebrate prey from the forest floor: one was full of beetles (Sharpe 1876–1879), another held fragmented staphylinid and carabid beetles plus giant ants (Davison 1979)—in Smythies and Davison (1999) this appears to be revised as 'carabid beetles; chrysomelid beetles; small seeds'—and a third contained beetles and other insects ('von Berchtold' in Büttikofer 1899, hence Smythies 1981), while the earliest report spoke of the species taking worms (Temminck 1832). Indeed, the stomach of a bird shot by a local hunter (at Senukoh, Brunei) was reported by him to have contained 'worms', but also frogs and a small snake (J. R. Howes *in litt.* 1995). Evidence from captivity is largely inadmissible, but at least of interest. A bird that lived in London Zoo (see below) for 18 years 'fed mostly on a vegetable diet with a little scraped raw meat intermixed... occasionally insects... and a dead mouse every other day' (Beddard 1901). Other captive birds were seen 'taking cockroaches willingly and other insects generally' (Banks 1935), and one was even sustained on fish (Brüggemann 1877).

Three interesting features of this species in relation to its feeding ecology and survival are its use of mammals as sources of disturbance and disclosure of food, its

possible use of generally distasteful food as a means of rendering itself in turn distasteful, and its apparent behavioural or morphological mimicry of pheasants. On one occasion an adult and a juvenile were observed very closely following a young bearded pig *Sus barbatus*, repeatedly snatching arthropods from the turned-up earth as the pig rootled in loose sand and detritus on a riverbank (Laman *et al.* 1996). This observation tends to confirm native lore and names, which associate the bird with pigs (three of five names from East Kalimantan translate as 'pig bird': Smythies and Davison 1999), and the habit may have been much stronger in the days when large herds of pigs moved round lowland Borneo in pursuit of fallen fruit (R. Sözer verbally 1999). It is certainly a trait it shares with the morphologically convergent but phylogenetically rather distant *Neomorphus* ground cuckoos of the Neotropics (see, e.g., Hilty and Brown 1986), with local names of Banded Ground Cuckoo *N. radiolosus* translating as 'guide of the wild pigs' and 'companion of wild boar' (Collar *et al.* 1992). However, G. Fredriksson (*in litt.* 2000) also reported that a colleague who was following a foraging sun bear *Helarctos malayanus* found that they were both themselves accompanied by a pair of ground cuckoos, probably taking termites in the wake of the bear's predations. Payne (1997) mentioned that the species sometimes follows army ants, but the source for this is untraced, and there are no real equivalents of such ants in Borneo (C. F. Mann *in litt.* 2002).

The matter of the palatability of the ground cuckoo and its consequences is engaging but highly speculative. Banks (1935) found that birds he kept in captivity 'used to make no attempt to run away even when loose, just sitting and stinking, for they do give off a peculiar and not particularly pleasant smell'. This character is well known in many members of the Cuculidae (see, e.g., Weldon and Rappole 1997) and is associated with the family's exploitation of invertebrate food often too unpalatable for other predators to consume (Payne 1997). Selection of such food may, presumably (in some species at least), be prompted by the need for protection as much as for nutrition, and the need for protection also bears on the question of mimicry. Wallace (1863) made an aside of some interest: 'Cuckoos..., which are certainly among the weakest and most defenceless of birds, imitate several other groups, especially Gallinae, —for example, *Centropus phasianus* in Australia, and *Carpococcyx radiatus* in Borneo, which latter is terrestrial in its habits, and much resembles the *Euplocami* [firebacks *Lophura*] of the same island'. He was still making the point a decade later—'Mr Wallace tells me that when alive this bird closely mimics a Pheasant in appearance and gait' (Sharpe 1873)—and Sclater (1882), commenting on a live specimen at London Zoo (he stated it was from Sumatra, but the dimensions given by Beddard [1901] indicate that it was, predictably, a Bornean Ground Cuckoo: R. B. Payne *in litt.* 2002), bore him out: 'the gait and actions of this remarkable Ground-Cuckoo remind one more of a Gallinaceous bird or a Gallinule than of any of its arboreal relatives of the same family'. (Sclater had clearly not seen the bird in a state of alarm, for it bounds off very rapidly with long hops of its powerful legs [Temminck 1832, Davison 1979], a most un-pheasant-like mode of locomotion.) Later, perhaps basing himself

on these comments, Chasen (1935) adopted the name 'pheasant-cuckoo' for the genus *Carpococcyx* (see discussion of this in Collar and Long 1996).

The odd thing here, of course, is that the mimicry is the wrong way round: an apparently unpalatable species ought not to be mimicking a palatable one. A possible or partial explanation might be that palatability varies with food, and that there may be seasons at which noxious food becomes scarce, leaving the species to depend on food such as fruit that renders it palatable and defenceless. The English name given to *Carpococcyx radiatus* by Sclater (1882) and used again by Beddard (1901), 'radiated fruit-cuckoo', presumably referred to an observed or reported habit of taking fallen fruit, but there appears to be no published record of this. The only indirect evidence seems to be that the specimen in Brunei Museum from Senukoh was snared in a trap baited with *Macaranga* fruit designed to entice Emerald Dove *Chalcophaps indica* (J. R. Howes *in litt.* 1996). Even so, it still remains unclear what selective advantage may lie in a (temporarily) palatable species mimicking another palatable species.

Certainly the Bornean Ground Cuckoo is a strikingly large bird. Payne (1997) gave no weights for it, and it seems that such information is scarce. In MZB three specimens possess weight data: an adult male, August, 455 g; an adult male, October, 260 g (but this was supplied by a bird trading company, so may have been starved at death); and an adult female, September, 540 g. Discounting the probably starved bird, the mean value of 500 g is roughly half the weight of a Crestless Fireback *Lophura erythrophthalma* but about equal to that of a small *Polyplectron* such as Bornean Peacock Pheasant. It shares its dark blue glossy head and upperparts with several sympatric *Lophura* taxa, and its chestnut rump with one of them (Crested Fireback *L. ignita*), but there is no other compelling point on which to base an argument of plumage mimicry, except perhaps for the baffling case of the type specimen being described (and illustrated) with a bare red face (reviewed in Collar and Long 1996), which would put it more in line with Crestless Fireback; but this seems most likely to have been an error.

Breeding

Very little indeed is known about reproduction in the Bornean Ground Cuckoo. It can be safely inferred from knowledge of the congeneric Coral-billed Ground Cuckoo that it builds its own platform nest in a tree, and raises its own young (see Payne 1997). Indeed, it was reported to make its own nest by Shelford (1916), although there is no clear evidence that a nest has ever been found or described by a naturalist. The 'Old Collection' in BMNH held an egg of the species (Oates and Reid 1903) but, as this was dismantled in 1837 (M. P. Walters verbally 2002) and as the species was only described in 1832, it seems very possible that the identity of the egg was mistaken. Schönwetter (1964) mentioned this egg and (at least) a further 16 captive-laid eggs in BMNH. These latter were, however, laid by an apparently unmated female, although it is of considerable incidental interest that they were laid in (for the most part) a remarkably steady sequence: (1896) 26 July; (1897) 8 January, 6 March, 7 April, 15 May, 14 June, 5 September (two), 29 September, 27 October, 8

November, 25 November, 26 December; (1898) 14 January, 5 March, 5 April; (1899) 4 February, 14 October (Munt undated). The significance of such regularity (at one stage 15 eggs over 16 months) is unclear. The bird in question was possibly the one received in London Zoo in 1882 (Munt is not thought to have kept birds, but rather to have petitioned birdkeepers for eggs: M. P. Walters verbally 2002), but no records exist even as to the sex of that bird (M. Palmer *in litt.* 2002).

Evidence of seasonality is also extremely tentative. Laman *et al.* (1997) reported an immature in close company with an adult in August; however, these two were following tightly behind a pig, so their proximity to each other was probably a circumstance of foraging opportunity rather than of strong dependence; the young bird could have been 2–8 months old, hence the egg laid January–May (the key evidence in this observation is that parental care does indeed appear to be shown). There is an immature female from Riam, December, which on plumage (plain brown shading to off-white below, brownish chin and throat) might be 3–4 months old (hence egg laid July–August), and there is another almost adult-plumaged immature female with a whitish chin and throat and rufous-suffused breast, stemming from October, Kemawen, which might be 5–6 months old (hence egg laid March–April) (specimens in MZB; judgement by NJC). There are two records of immature birds from November (Kalabakan, Sabah, and Gunung Gigi, Sarawak); if the assumed age of the almost-adult-plumaged female from Kemawen is used as a guide, then these two birds would perhaps have hatched at mid-year. On this basis the period February–July may very tentatively be identified as one in which breeding activity appears to concentrate. This is consistent with the observation reported below under ‘Voice’ of what seems to have been breeding-related interactions at Sungai Wain in April 2000; with a bird in almost complete primary moult in October (Smythies and Davison 1999); fairly so with a male from Gunung Mulu whose testes were in regression (3×8 mm) in mid-April (Davison 1979), and indeed which was moulting wing and tail feathers (Smythies and Davison 1999); and with the general circumstance in which rainforest birds in Borneo breed towards and following the end of the ‘wet’ monsoon (which spans November–April), as insects reach their peak abundance (Fogden 1972, MacKinnon *et al.* 1996).

Voice

Vocalisations of this species have been somewhat variously reported, but a general pattern has emerged in recent years. In the following account, the information from D. Yong represents his descriptions and transcriptions of tape-recordings of observed individuals.

Main self-advertisement call The main call is a deep, low, far-carrying, hornbill-like *thook-torr*, the first note rising slightly and second falling slightly, lasting c.1 second and given in series at c.4-second intervals; a variant of this is a very throaty *aaw-oo*, in which both notes fall slightly (D. Yong *in litt.* 1995). Holmes (1969) had heard ‘a deep *pooppoo*, the first note rising and the second falling slightly’, which was hesitantly—but in the light of the foregoing apparently correctly—attributed

by Ibans to the Bornean Ground Cuckoo. This anecdote was repeated in Holmes and Burton (1987), who further described the call (from elsewhere) as ‘two loud notes, of dove or barbet quality, the first rising and the second falling’. In similar fashion, native people told Davison (1979) that it was Bornean Ground Cuckoo which was responsible for ‘a ringing two-note *Koohoo* repeated four or five times in a series, and of similar volume to the calls of *Argusianus argus*, very like the greatly amplified call of a Koel *Eudynamis scolopacea*’; again the attribution appears correct. Although Payne (1997) and Smythies and Davison (1999) understandably treated ‘*tock-tor*’ and ‘*koohoo*’ as two different calls (in the latter case because a description from D. Yong of a ‘repeated, eerie, low boom’ omitted the crucial point that it is a double note), it would appear that the description of the (main) call of the species as ‘*boot-boooooo*, *boot-boooooo* or *tok-terrr*’ (R. Sözer in Holmes 1997) represents alternative transcriptions of the same call, as we suggest above.

Variant main call Apparently related to the main call is a monotone *koo* repeated at several-second intervals (tail raised with each call) (Laman *et al.* 1997). This appears to be the call heard (as one of a medley of three) by birds showing breeding-related behaviour (see below). It also appears to be the first of two calls heard in late 1981 by Holmes (1982), who considered them very like those he had been told were ground cuckoos in 1969: (a) ‘a slightly di-syllabic barbet-like note uttered about one per second (but variable speed)’, and (b) ‘a more distinct double note *cup cwoo* (rising then falling)’, this latter apparently being the standard main call.

Roll call A third call is a one-note *torrrrrrrrr*, forceful at the start and with a rolling quality towards the end, lasting less than a second, given in a series a second or so apart in response to tape playback (D. Yong *in litt.* 1995). There appear to be no other reports of such a call.

Alarm call A sharp snarling *ark*, occasionally sounding like *herk* or *hark*, is given in alarm, with synchronous flirting and dipping of the tail (D. Yong *in litt.* 1995). This is fairly consistent with the account by Laman *et al.* (1997) of an ‘apparent alarm’, a repeated harsh *khaaa*, lasting c.1 second, repeated every 2–3 seconds, with a very metallic vibrating quality (wings jerked down and partly out with each call, in typical cuckoo fashion). It also seems to square with the ‘coughing alarm call *heh, heh, heh...*’ from a bird being released back into the wild (Davison 1979), although Smythies and Davison (1999) considered this to be a distinct vocalisation from the *khaaa* note.

Apparent breeding-related calls At 07h10 on a day in early April 2000, at Sungai Wain (but in an area of swamp near to low hills, some 4 km south of where she had had previous sightings of the species), G. Fredriksson (*in litt.* 2000) heard a series of vocalisations involving three different calls: ‘a harsh persistent call; a melodious dove-like descending cooing; and a lamb-like bleating (a really bizarre sound)’. The calls came from one of two birds in the immediate vicinity; this bird sat on a low branch giving the first call, ‘swaying the tail up with each call’, being answered by the second bird (which gave all three calls, but much less frequently), and occasionally giving the second and even more rarely the third. Over the course of the following hour and a half

the two birds, which only differed in that the less frequent caller seemed brighter white on the breast, moved about on the ground in the small area of swamp, calling and approaching each other and retreating (G. Fredriksson *in litt.* 2000). It seems possible that the first call was the alarm call, the second the variant main call, and the third a previously undescribed call associated with close-range interactions between either aggressive or courting birds. It is worth noting that the Coral-billed Ground Cuckoo performs duets (Payne 1997), described by one experienced observer as 'bizarre antiphonal calls' that 'are quite simply unlike any other bird I have yet heard' (J. C. Eames *in litt.* 1995); it is conceivable that the interactions reported above were a disorganised form of duetting in an unestablished pair.

Local names and a short story

Although we are unable to translate them, it seems worth collating the various local names for the species. The most frequently cited is *toktor*, used by the Ibans and clearly imitative of the call (Banks 1935, Holmes 1969); the local Malay name in Sarawak is *kapua* (Banks 1935). In eastern Brunei the name *ayam ayama* was used (J. R. Howes *in litt.* 1995), *ayam* meaning chicken in Bahasa (C. F. Mann *in litt.* 2002). In interior Kalimantan various names exist, including *ruwai hutan* (on the label of a bird from Anjungan in MZB, meaning 'forest argus' [*ruwai* being onomatopoeic] *fide* C. F. Mann *in litt.* 2002), *bubut meong* (on the label of a bird from Kemawen in MZB), *bubut lai* (Blasius 1884), and *kebahon vavui*, *manuk babui*, *manuk babi*, *bubut tanah* and *bubut juhung* (R. Sözer in Holmes 1997). The last of these is evidently what Brüggemann (1878) reported (after a false start in Brüggemann 1877) as *boemboek tje hong*. Smythies and Davison (1999) give some of these names and attribute them to particular ethnic groups, sometimes different from the above ('*kopua*' [*sic*] as an Iban name, *bubut tanah* as the Malay name), and giving an extra name, *buat bati*.

The last name we can find, *kruai manang* (Hose 1893), in which *kruai* looks like a version of *ruwai* above, has a translation provided in a story by Hose (1929):

The Argus Pheasant comes into another story with another cuckoo, a beautiful and rather rare bird which lives chiefly on the ground, and has a gorgeous purple-blue plumage on its back, while the chest feathers are barred with stripes of grey and white; its legs are of a bright jade-green. This bird is known to the natives as *Kruai Manang*, which means the Doctor of the Argus Pheasant; for he is said to have removed the curse of sickness which befell the Argus Pheasant after his scurvy treatment of the *Bubut* [reneging on an agreement to tattoo the *bubut*—the coucal—after the *bubut* had tattooed the pheasant]. *Kruai Manang* holds a high position in the Bird Aristocracy, according to legend; and by his beauty he certainly deserves it.

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