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Status, abundance and habitat use of Blue-eyed Cockatoo *Cacatua ophthalmica* on New Britain, Papua New Guinea

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Summary

Most research on cockatoos *Cacatua* outside Australia has focused on species that figure significantly in the pet trade. Here, we examine the status of Blue-eyed Cockatoo *Cacatua ophthalmica*, an extremely poorly known species endemic to the island of New Britain, in three lowland forest types: primary forest, forest that had been commercially logged of selected large trees in the previous eight years, and forest gardens (small-scale mixed agroforests or ''homegardens'' tended by indigenous people). During fieldwork at two lowland study sites on New Britain between December 1998 and April 1999, groups of *C. ophthalmica* were recorded in all forest types (maximum group size = 40), but the species was largely absent from non-forested areas. Estimated cockatoo density in selectively logged forest (64 individuals per km^2) was similar to that in primary forest but densities in forest gardens at both sites (6 and 28 per km^2) were considerably lower than those in primary forest (27 and 73 per km^2). Most active nests found were in large trees in primary forest and the paucity of nests in logged forest, and particularly in forest gardens, is cause for concern given ongoing forest alteration on the island. While we predict that the Blue-eyed Cockatoo population on New Britain is declining, the species remains numerous and the current low levels of trapping and the large area of suitable forest remaining on the island indicate that the taxon is currently of ''Least Concern''. In a wider context, *C. ophthalmica* is considerably more common than most of the traded cockatoos, but the tendency for cockatoo densities to be highest in primary forest, intermediate in human-altered forests and lowest in non-forest areas holds for traded and untraded species alike.

Introduction

Blue-eyed Cockatoo *Cacatua ophthalmica* is endemic to the island of New Britain in the Bismarck Archipelago (Figure 1). There is very little information on status and population changes of the species over the last 20 years, and this is of particular concern as several other non-Australian *Cacatua* species have declined seriously during this period (Marsden 1992, Lambert 1993, PHPA/LIPI/Birdlife International-IP 1998, Snyder *et al.* 2000). In the 1960s, the species was apparently common in lowland rainforest and the foothills, but rarer at higher altitudes (Gilliard and LeCroy 1967, Forshaw 1989). Although numbers of *C. ophthalmica* entering the international pet trade have historically been low (Wilkinson *et al.* 2000), there is some evidence that the species is now being traded in greater numbers, for example, 38 were imported to CITES signatory countries in 1996–

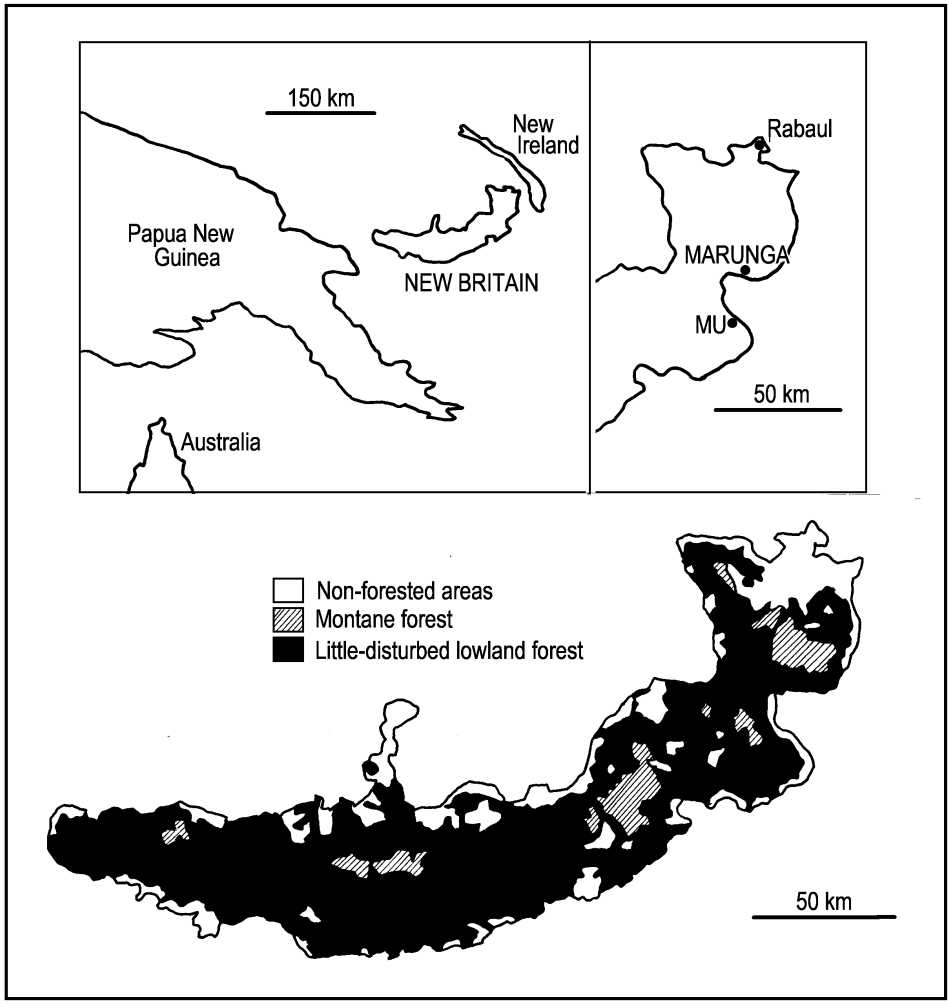

Figure 1. Maps showing the location of New Britain and the study areas. Masarou is situated on the coast 5 km to the west of Marunga. Also shown is a habitat map of New Britain. Areas of little-disturbed lowland forest are those with only slight disturbance as defined by Saunders (1993).

97 alone (WCMC CITES database). An increase in trapping pressure, in conjunction with the impacts of selective logging and other forest alterations on the island, are cause for concern.

Our aim was to assess the current status of *C. ophthalmica* according to the current IUCN threat classification scheme (December 1994). In particular, we aimed to identify the effect of habitat change on cockatoo density in the absence of heavy trapping: densities appear to fall in habitats such as logged forest but it is not known if this is because of habitat change or increased accessibility to trappers (Marsden 1992). We had four objectives: (1) to examine the distribution and broad habitat associations of *C. ophthalmica*; (2) to estimate *C. ophthalmica*

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population densities in different habitats and areas, and therefore estimate its island-wide population; (3) to identify important feeding and nesting resources of the species and relate abundance to present and future land use changes on New Britain; (4) to gather information on the intensity of cockatoo trapping on the island.

Study sites and methods

New Britain (40,500 km^2) is politically part of Papua New Guinea and is located 100 km off the east coast of mainland New Guinea (Figure 1). Fieldwork was undertaken by JDP at two sites around Wide Bay from 22 December 1998 to 30 April 1999, during the local dry season. Initially, work was based around Mu (5°13′ S 152° 02′ E), moving later to the Marunga/Masarou area (Marunga: 4° 59′ S 152° 07′ E). To facilitate within- and between-site comparisons, all work was carried out below 400 m. Wide Bay was chosen for the survey because of its mosaic of habitats. There are extensive lowlands in the north of the bay, but in the south the land rises away quickly from a thin coastal strip to a series of ridges at 200–400 m. Pristine evergreen forest still exists even at low altitudes around Mu in the south and Marunga in the north. This forest has a 40–50 m high canopy dominated by *Elaeocarpus*, *Canarium*, *Myristica* and *Pometia* (Balun *et al.* 1996). Small community-based sawmill projects are selectively cutting areas close to Mu and Marunga, but a large area of industrially logged forest extends from Masarou (5 km west of Marunga) across the island to the northwest coast. Numerous small plantations of coconut *Cocos nucifera* and cocoa *Theobroma cacoa* and small mixed gardens occur throughout the lowlands of Wide Bay. There is now little settlement away from the coastal strip although, before 1918, small villages existed in the coastal hills.

In each area, transects were set up with census stations marked with coloured tape at intervals of 250 paces (approx. 200 m). In all habitat types there were over 40 km of transect. Most stations were positioned along paths that had been cut especially for the survey, the remainder being positioned along existing paths of width < 3 m. In the latter case, every station was positioned 50 m to alternate sides of the transect. This was done in an attempt to reduce bias due to surveying along non-random features such as paths (Jones *et al.* 1995).

The habitat characteristics around each census station were described by JDP at the time of the census. He used this information to allocate each station to one of six broad habitat categories: primary forest, forest that had been selectively logged during the previous eight years, small-scale coconut or cocoa plantation, secondary forest (most usually abandoned forest gardens), and forest gardens currently in use. These categories were later simplified to three habitat types: primary forest, < 8 year-old selectively logged forest and forest gardens, this last category including both plantation types along with currently and formerly used gardens. Altogether, 250 vegetation plots were considered in the analysis (the majority of these plots were surveyed for cockatoos twice giving a total of 448 bird census counts). At Mu, there were 63 vegetation plots in primary forest, and 57 in forest gardens. At Marunga/Masarou there were 49 plots in primary forest, 36 plots in forest gardens, and 45 plots in selectively logged forest.

Bird surveying

A point count distance sampling method (Jones *et al.* 1995, Marsden 1999) was used to estimate cockatoo population densities in the three habitat types. Census work was restricted to the periods 06h30–11h00 and 13h30–18h00. No surveying was done in rain, heavy mist, or strong wind. Cockatoos were counted at each census station for a period of six minutes. Search effort was restricted to within 50 m of the plot's central point and only birds that were actually perched when first detected were recorded. However, when approaching a census station, if any birds were flushed from ''within'' the plot, these were recorded as being present, and the distance from the central point to the bird's take-off point was estimated. For each bird encounter, the distance (to the nearest metre) from the recorder to the bird contact was estimated. For groups of birds, the distance to the ''centre of gravity'' of the group was estimated. Immediately after the six minutes had passed, the recorder walked around the census plot for up to a further 10 minutes checking for birds that were present but undetected during the main count period. The number of individuals in each encounter was recorded if known. For any contacts where birds were heard only, it was usually not possible to assess the group size involved. In such cases, the mean of the known group sizes for that species (i.e. for contacts where birds were seen) was substituted for the unknown groups.

Data were analysed using the DISTANCE 3.5 program (http://www.ruwpa.stand.ac.uk/distance). Separate detection functions were calculated for primary forest in each of the two areas but data from logged forest were combined with those from forest gardens at both sites to produce a single detection function. Bird groups were entered as clusters and in ungrouped format. All key functions and series expansions were considered and choice of model dictated by Akaike's information criterion. Data in some instances were right-hand truncated to remove outliers, but because search effort was restricted to within 50 m of the recorder, truncation was sometimes unnecessary and at most 10% of the furthest records were excluded. Actual values for truncation and subsequent grouping of records into distance bands were decided following visual inspection of detection histograms and checking of standard errors for density estimates under different analysis conditions.

Nesting and feeding ecology data collection

If cockatoos were observed feeding on fruit or flowers during the count period, or on walks between census stations, the tree species in which birds fed was recorded. No details of the plant part (e.g. fruit pulp or seed kernel) actually ingested or the amount of material taken per feeding bout were recorded. An active search for nest sites within 30 m of census points was made at each of the 250 vegetation plots immediately following the first bird-counting period. This period of up to 10 minutes was also spent looking for fruiting trees and for ''skulking'' birds that were present but not detected during the main count period. Nest sites were also searched for while walking between census stations and at other times when no formal census was undertaken. Confirmation that a

cavity was an active nest was very difficult unless eggs or young were located or adult birds could be observed around the cavity for an extended period. In this study, we classed cavities as being nests if cockatoos were present either at the cavity entrance or were close by exhibiting behaviour characteristic of a nesting pair (most usually alarm-calling). We appreciate that cockatoos may have occupied cavities while not actually nesting so nest sites described here should be seen as being potential nest sites, not necessarily active at the time of the survey.

Cavities that could not be confirmed as cockatoo nests because the occupiers were not present in or near the cavity entrance, were excluded from the analysis. For each cavity located, information was recorded on tree species, nest tree height and girth, cavity length and width, cavity height above the ground, and angle to the vertical of the cavity entrance.

Results

Distribution and abundance

Cacatua ophthalmica was recorded at census stations in each of the habitat types at both sites (Table 1). Away from the formal surveys it was recorded in similar habitats, but was never recorded in or over the island's capital (Rabaul/Kokopo), or nearby plantations or grassland/scrub. The highest altitudinal record was at 1,000 m (around the highest point reached), but they are expected to occur at higher altitudes. The largest group recorded was 40 birds recorded early one morning in selectively logged forest near Masarou. Cockatoos were recorded near small settlements in the early morning, but tended to avoid them, or visit them stealthily, later in the day when human disturbance was greater. Altogether, there were 46 encounters with cockatoos at census stations, recorded at a rate of just over one encounter per 10 point counts. Density estimation to a reasonable level of precision was possible in most habitats (standard errors averaged < 50% of the actual density estimate in the five estimates presented). Density estimates were generally higher at Marunga/Masarou than at Mu (Table 1). In both areas, densities in primary forests were greater than in forest gardens. The density estimate for logged forest at Marunga/Masarou was similar to that in primary forest at the same site.

Feeding and nesting ecology

Cacatua ophthalmica was recorded eating fruits of coconut *Cocos nucifera*, *Melanolepis multiglandulosa* and an unidentified fig *Ficus* sp., as well as the flowers of *C. nucifera*, *Eucalyptus deglupta* and an unidentified *Cryptocarya* sp. *Cocos nucifera* and, to a lesser extent, *E. deglupta* were common in forest gardens and both species were seen to be used by cockatoos as well as other parrots, such as Eastern Black-capped Lory *Lorius hypoinochrous* and lorikeets *Charmosyna* spp.

A total of 13 confirmed nest holes were located, eight of which were found at census stations (Table 2). Ten of the 13 nests located were in primary forest. Of the eight nests located at census stations, seven were found in primary forest

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Table 1. Population parameters for *Cacatua ophthalmica* in different habitats at the two study sites on New Britain, Papua New Guinea, 1998–99

	k	*n*	*n*/*k* (± SE)	DE (± SE)
Mu				
Primary	120	12	0.10 ± 0.03	27 ± 12
Garden	103	4	0.04 ± 0.02	6.0 ± 3.5
Marunga/Masarou				
Primary	78	13	0.17 ± 0.05	73 ± 24
Garden	68	3	0.04 ± 0.03	28 ± 20
Logged	79	14	0.18 ± 0.05	64 ± 24

k, number of point counts; *n*, number of bird groups recorded; *n*/*k*, encounter rate (bird groups per count); DE, density estimate (number of individuals per square kilometre); (± SE), ± standard error.

(0.62 per 10 plots), one in logged forest (0.22 per 10 plots) and none in 93 plots in forest gardens. Nests were recorded in 10 tree species, with two trees each containing two nests. Nests were located at heights of 13–50 m and were usually located in large trees: nest tree heights averaged 41 m.

Extent of capture and trade

A total of 38 individuals were imported to CITES signatory countries in 1996–97, while in 1996, approximately 15 (mostly adult) *C. ophthalmica* were found on sale at a market in Kokopo, New Britain (Wilkinson *et al.* 2000). During the fieldwork, four *C. ophthalmica* (priced at US$8 each) along with 14 Eclectus Parrots *Eclectus roratus* (US$8–10) and a single Rainbow Lorikeet *Trichoglossus haematodus* (US$4) were observed at Kokopo market on 19 December 1998. The birds were apparently all caught by placing glue on tree branches in the Bainings area of East New Britain. Elsewhere, single captive *C. ophthalmica* were seen in Guma (a village just south of Mu) and in Port Moresby, mainland Papua New Guinea. Individual birds were also recorded captive at several logging company settlements on New Britain. Anecdotes of local people indicated that *C. ophthalmica* and other parrot species are traded regularly in small numbers for illegally

Table 2. Characteristics of confirmed *Cacatua ophthalmica* nests on New Britain, Papua New Guinea, 1998–99

Nest characteristic	Mean ± SD	CV	Range
Height of nest tree (m)	41 ± 15	37%	25–78
Dbh of nest tree (cm)	89 ± 26	29%	57–140
Height above ground (m)	27 ± 10	37%	13–50
Entrance length (cm)	35 ± 9	26%	18–52
Entrance width (cm)	22 ± 7	32%	14–38
Angle (°)	11 ± 22	200%	–16–+55

Nests found in the following trees (numbers of nests found follow species names): *Bischofia javanica* 2*, *Dracontomenum dao* 1, *Endiandra* sp. 2*, *Eucalyptus deglupta* 1, *Homalium foetidum* 1, *Octomeles sumatrana* 1, *Planchonella obovoidae* 1, *Pometia pinnata* 2, *Pometia* sp. 1, *Pometia tomentosa* 1. For nest holes *n* = 13, for nest trees *n* = 11 as two trees each contained two nests (marked *). CV, coefficient of variation; dbh, diameter at breast height. Negative values for angles indicate overhanging nest entrances (0 = vertical nest entrance).

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imported goods but no further information could be gleaned as to possible export of birds from New Britain.

The species has recently appeared more frequently in international trade. In 1999, 13 adults and three chicks were listed for sale by a bird farm in Mallorca for around US$4,000 each, and Bird Finders Inc. (USA) offered a single male on the internet for US$ 8,500. A year later a pair were offered for sale by a dealer in the U.K. for US$23,000 (M. Curzon, pers. comm.). These current high prices reflect the fact that the species is still being traded in low numbers. In conclusion, we believe that the number of *C. ophthalmica* currently being caught and kept captive within Papua New Guinea is probably small and there is little evidence to suggest that international trade in this species is significant.

Discussion

There have been few recent visits by biologists to New Britain, but information available to us suggests that *C. ophthalmica* is widespread on the island. There are recent records from both the extreme west (around Mt Talawe) and the extreme east of the island on the Gazelle Peninsula (J. Clay unpubl. data 1994). The species has been recorded in plantations and forest both on the south (J. van Oosten unpubl. data 1993) and north coasts (LeCroy and Peckover 1983), and is present in at least part of the Nakanai mountain range. We conclude, therefore, that the species ranges over much of New Britain's 40,500 km^2 land area. Furthermore, the cockatoo's presence, usually in good numbers, in most habitat types on New Britain indicates that its area of occurrence is considerable – for example, in 1996, at least 19,200 km^2 of forest remained on New Britain (Filer 1997) and we suggest that a large proportion of this forest is of sufficient quality to hold reasonable densities of *C. ophthalmica*. We therefore suggest that the extent of occurrence and area of occupancy of the species should exceed the thresholds of 20,000 km^2 and 2,000 km^2 respectively that would, along with other criteria, qualify it for ''Threatened'' status according to IUCN classification.

We are cautious in extrapolating the population figures from our two study areas to the island as a whole. One reason is that there was considerable variability in cockatoo abundance between the two study sites. A second reason is that psittacines are well known to make altitudinal and seasonal migratory movements (e.g. Smith and Moore 1992, MacNally and Horrocks 2000). Some proportion of the *C. ophthalmica* population may move around the island (our data were collected during the dry season only), so we cannot assume that the densities encountered at the two study sites were not inflated due to seasonal immigration, or deflated due to emigration.

However, if we use the lower of the two primary forest estimates (26 per km^2) as being the average density of cockatoos over the remaining forest area (19,200 km^2), then the total population might be in the order of 499,000. Being suitably cautious and using our lowest density estimate of just six per km^2 (that for forest garden at Mu), the total population estimate is still in the order of 115,000 individuals. Notwithstanding the fact that a number of these will be immature birds, we have little doubt that the actual population of mature individuals on New Britain exceeds the 10,000 threshold that might qualify the species for ''Threatened'' status.

Without baseline population figures for *C. ophthalmica* it is impossible to give a ''longitudinal'' prediction as to the recent population trend (that is one that is based on two surveys in the same area separated by a discrete time period). However, we can make a ''latitudinal'' estimate by considering the species' response to habitat alteration in different areas at the same time. According to Filer (1997), 485 km^2 or 1.2% of New Britain's land area was cleared of forest in the period 1975–1996. If we assume that all cockatoos have disappeared from this cleared area then the population might have fallen by 1.2% over a period of 20 years: less steeply than a decline of 20% over three generations that would qualify the taxon for threatened status, given its large population size. Probably more detrimental to many species has been the logging of 11,459 km^2 (28%) of New Britain's land area during the same 20 year period (Filer 1997). Our cockatoo density estimate in logged forest was similar to that in primary forest, suggesting that this habitat alteration has probably not caused a dramatic decline in the number of cockatoos using the habitat at least. However, there is likely to be a reduction in the density of nest sites in human-altered forest, as found elsewhere (Nelson and Morris 1994, Marsden and Jones 1997) and this may affect the breeding population of cockatoos to an unknown degree.

While the above analysis suggests strongly that the cockatoo population on New Britain is declining, the taxon is still common, due to a combination of the absence of heavy trapping pressure and the large area of little-disturbed forest remaining on the island. Taken together, our results strongly suggest that the taxon is currently of ''Least Concern''. In the wider context of cockatoo conservation, it is noteworthy that *C. ophthalmica* is considerably more common than most of the heavily traded cockatoo species in Indonesia and Philippines: typical densities for these species are 5–15 birds per km^2 or even lower (Marsden 1992, Lambert 1993, 1994, Jones *et al.* 1995). One exception is the heavily traded *C. goffini* on the Tanimbar islands, with densities in forest reported to be as high as 100 birds per km^2 (Cahyadin *et al.* 1994). Abundances vary considerably between taxa, but the rank order of habitats ''preferred'' by untraded and traded species are similar: densities are highest in primary forest, intermediate in logged and other human-altered forests, and lowest in agricultural lands and non-forested areas: this holds for traded and untraded species alike (Marsden 1992, Lambert 1993, Cahyadin *et al.* 1994, Jones *et al.* 1995, this study). It is therefore unsurprising that the heavily traded species, *C. sulphurea* and *C. haematuropygia*, that occur in the much-reduced, fragmented and degraded forests of the Lesser Sundas and Philippines have suffered considerably worse declines (Lambert 1994, Jones *et al.* 1995, PHPA/LIPI/Birdlife International-IP 1998) than have the Moluccan cockatoos whose habitat remains far less disturbed (Marsden 1992, Lambert 1993, Cahyadin *et al.* 1994).

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