Breeding birds in the tropical rain forests of Kibale National Park, Uganda

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Abstract

A combination of trapping and foot surveys was used to assess the breeding status of birds in unlogged and logged sites in the tropical rain forest of Kibale National Park, Uganda. Breeding of forest edge and gap species was greatly enhanced by logging, whereas crevice and hole nesting specialist breeders were adversely affected. Egg-laying periods corresponded to higher rainfall regimes at the nearby field station. The relevance of these findings to bird conservation is discussed.

Key words: breeding, birds, tropical, rainforest, Kibale, Uganda

Résumé

On a évalué le statut de reproduction des oiseaux dans les sites exploités ou non de la forêt tropicale humide du Parc National de Kibale, en Ouganda, par des observations combinées par piégeage et à pied. La reproduction des espèces de lisières ou de clairières était fortement stimulée par les coupes de bois tandis que celle des espèces nichant dans les crevasses et les trous d'arbres était diversement affectée. Les périodes de ponte correspondaient aux moments de chutes de pluies maximales relevés à la station météorologique la plus proche. On discute de la pertinence de ces observations pour la conservation des oiseaux.

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Introduction

There is little data on the breeding of forest birds in East Africa. Most breeding records have been gathered opportunistically (Brown & Britton, 1980; Baranga & Kalina, 1991; Kalina & Baranga, 1991; Dranzoa & Otim, 1993). Only 28% of the total avifauna of Uganda have definite breeding records (Dowsett & Dowsett-Lemaire, 1993). The paucity of records is because of the difficulty of sighting breeding birds.

Often, conclusions drawn on the persistence of birds in logged areas are based on the observations of their presence in such an area (Johns, 1989; Lambert, 1992), but there is little evidence as to whether populations breed or whether these logged forests are continual sinks for transients from elsewhere. Wong (1985) found that breeding success was lower in logged forest adjacent to unlogged forest. Other studies (Loyn, 1985; Sandstrom, 1992) showed that bird populations which require holes for nesting were reduced in managed forests. These declines in logged forests are partly attributed to reduced nest site availability and fewer nest materials, increased competition for nest sites and nest predation. However, in Amazonia, Johns (1982, 1989) and Thiollay (1992) reported that the diversity of hornbills and woodpeckers increased in logged forests. These differences are a result of resource availability.

The onset of breeding is determined by a number of interacting physiological and environmental factors (Brown & Britton, 1980; Dowsett & Dowsett-Lemaire, 1984), whereas breeding success is influenced by both ecological resources and climatic factors (Brown & Britton, 1980).

The influence of past logging on breeding potential and success differ from species to species. Recher (1991) and Thompson *et al.* (1992) found that the numbers of some species were depressed because of logging, but that certain species had increased breeding densities. The selection pressure acts most on those with special requirements, e.g. hole nesters, specific materials, etc. (Brown & Britton, 1980; Poque & Schnell, 1994). However the quality of nest sites and the nests themselves plays an important role in facilitating breeding success of individual birds, because most birds require specific characteristics of nests (Bollinger & Gavin, 1989; Sandstrom, 1991, 1992; Conner, Jone & Jones, 1994). This study was therefore intended to document the forest bird species and individuals breeding in unlogged and logged areas.

Methods

The study was carried out in two study sites in Kibale National Park, which is located between 0°13′–0°41′ and 30°32′–30°35′ E, western Uganda, at an altitude of about 1100 m. The study sites were located in the northern sector of Kibale (Fig. 1). The logged area was originally similar, but not the same as, the unlogged area. The logged site was selectively pitsawn in 1968, and 21 m^3 of timber per hectare were extracted. However, over 60% canopy openness was created (Kasenene, 1987). The unlogged site was a mature, primary forest charac-

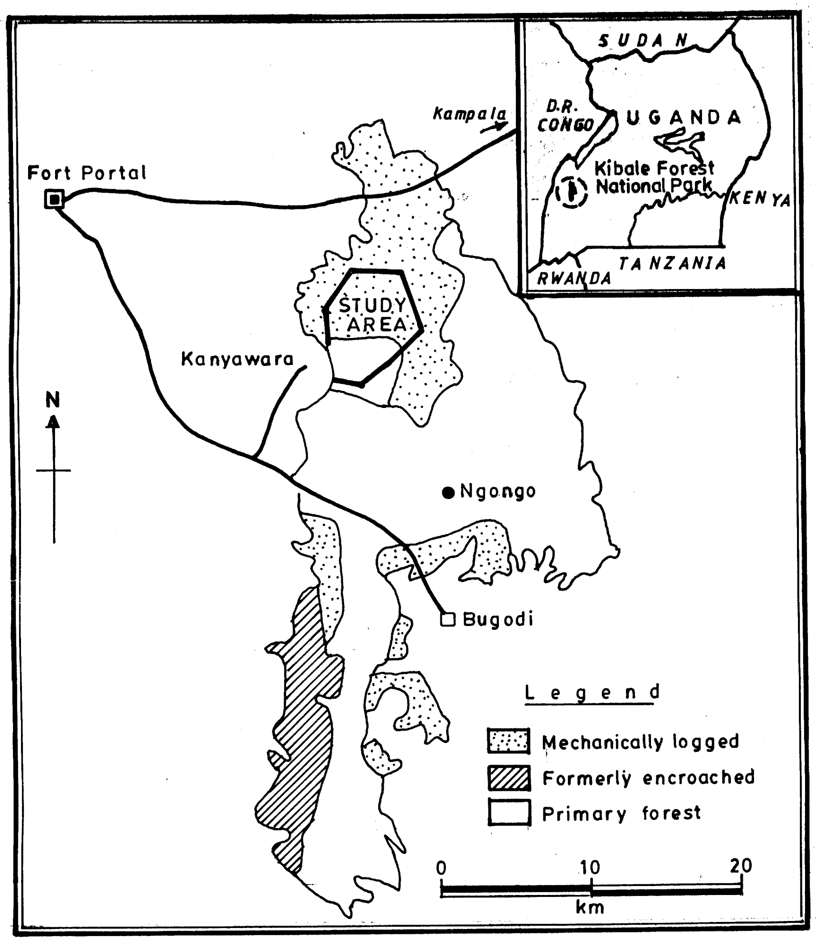

Fig 1 Map of Uganda showing the location of Kibale National Park and location of the study area

terized by large trees and undulating terrain (details are given in Dranzoa, 1998).

Trapped birds

Birds that were caught using standard mist-nets (Dranzoa, 1998) were examined for breeding condition. Each individual captured was examined for presence or absence of brood patch and cloacal protuberance; other measurements were also taken. Individual birds were ringed using either numbered metallic aluminium or coloured plastic rings and released at the site of capture. Mist-netting was carried out for 18 months, from November 1991 to June 1993.

Foot survey/physical search

In an attempt to establish records on individual species, systematic physical searches for breeding birds were carried out from November 1991 to August 1993. Diamond (1974), Crome & Moore (1988) and Brosset (1990) used similar procedures. A 20 m by 5000 m transect was established in each compartment. The search for breeding individuals was carried out monthly. During each search an existing trail system was used as a baseline and each transect was searched for 2–3 days to try and flush out hidden incubating birds. Tree trunks were scanned for crevices and nests. A tag was tied near breeding sites for ease of relocation on subsequent visits. Breeding stages were monitored on a regular basis. Fledglings that were accessible were ringed with metallic aluminium numbered rings before they developed flight feathers.

For each nest, observations on the presence of eggs, incubation of eggs, and delivery of food for the young by adults was treated as a confirmed breeding record. Other conventional signs of breeding, such as collection of nest materials, nest construction and courtship displays, were recorded as unconfirmed but probable signs of breeding.

In general, there was equal effort in terms of metre-net hours of trapping and man hours of nest searching at each study site (Dranzoa, 1995, 1998).

Results

Breeding populations from mist-netted communities

Breeding occurred throughout most of the trapping months but with marked seasonality in percentages of both breeding adults as well as immatures within the population (Fig. 2). Although there was no significant difference in the overall proportion of breeding birds at the two sites, the monthly breeding population was significantly higher in the logged than the unlogged site ($U = 199.5$, $P < 0.001$; Mann–Whitney U-test). However, the mean monthly proportion of the breeding populations of forest interior specialist or 'true' forest birds (Bennun, Dranzoa & Pomeroy, 1996) was higher in the unlogged site (Fig. 2, $U = 130.5$, $P < 0.05$; Mann–Whitney U-test) accounting for 56.9% ($N = 160$) and 26.5% ($N = 381$), whereas the logged site had high proportions of forest generalist immatures and breeding birds.

Crevice/hole nesters

Amongst the forest birds, some use crevices, flutes, holes and/or clefts made by the buttress roots of trees (Mackworth-Praed & Grant, 1964 and Table 1). The overall relative proportions of breeding birds were higher in the logged forest than in the unlogged. However, numbers of crevice and hole nesters were significantly higher in the unlogged site ($\chi^2 = 5.08$, $P < 0.05$). In the logged forest, crevice nesters contributed about 3.7% ($n = 381$) to the total number of breeding individuals while in the unlogged forest, 17.5% ($n = 160$) of the total breeding individuals captured were crevice nesters. Hole nesters formed 7.5% and 2.4% of the overall breeding birds in unlogged and logged forests, respectively.

Foot survey results

The foot survey results (Table 1) were consistent with those of mist-netting data. Many more nesting records of hole and crevice nesters were obtained in the unlogged site.

The overall breeding records in the two study sites

Combining the data from the unlogged forest with those from the logged forest, there were 65 bird species with breeding records. Fifty-nine species had confirmed breeding records. Definite egg laying of Cameroon sombre greenbul *Andropadus curvirostris*, White-tailed ant thrush *Neoccossyphus poensis*, yellow-white-eye *Zosterops senegalensis* and masked apalis *Apalis*

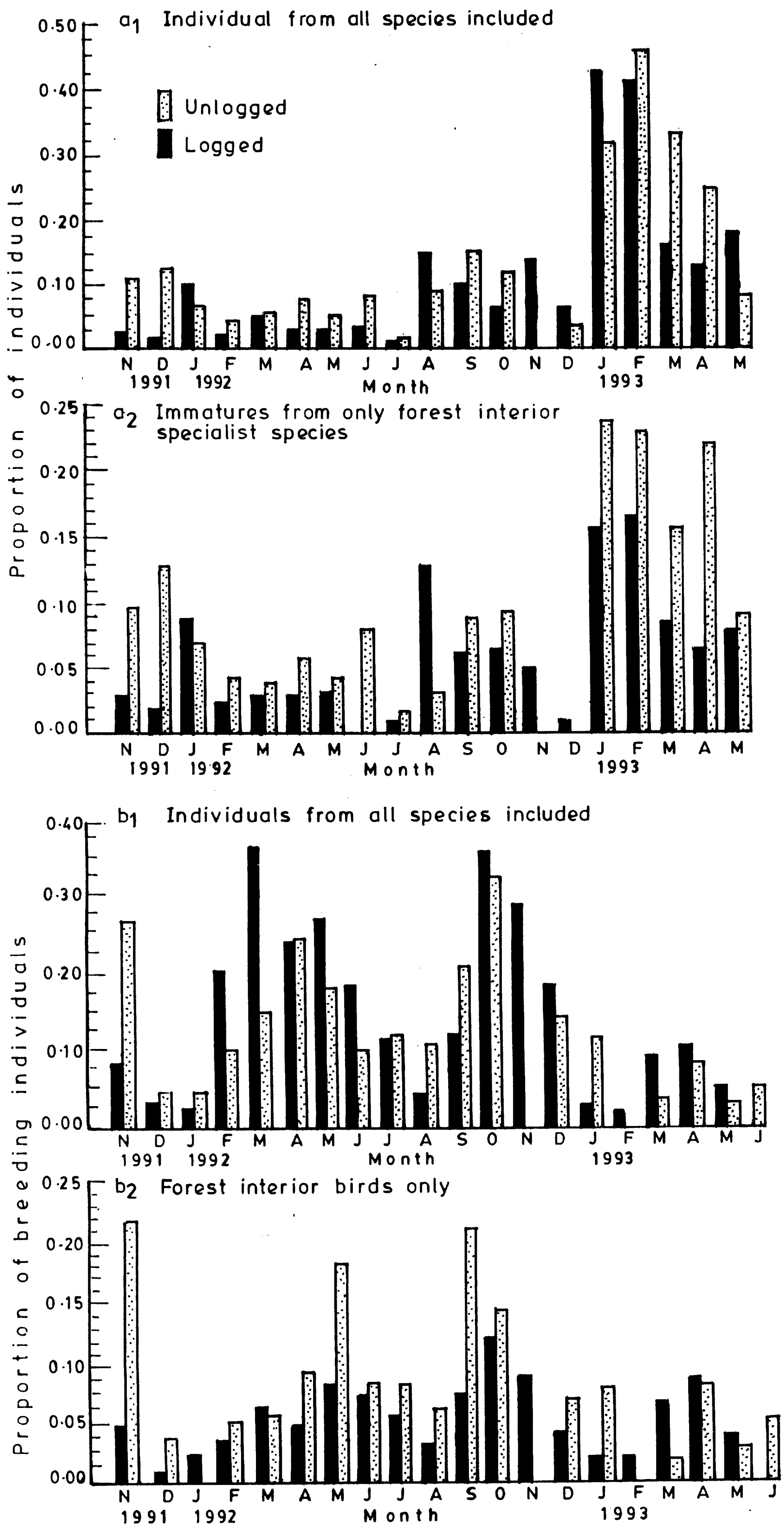

Fig 2 Relationship between the numbers of breeding birds and immatures mist-netted in the two study sites

Table 1 Breeding birds; data obtained from physical searches (nests: Ps) and records from trapped birds (Tr) includes all individuals with brood patches and protruding cloaca

			Individuals			
			Unlogged		Logged	
No.	Status	Species (Common and scientific name)	Ps	Tr	Ps	Tr
135	FF	Crowned Hawk Eagle *Stephanoaetus coronatus*	1	0	0	0
188	F	Crested Guineafowl *Guttera edouardi*	1	0	0	0
344	FF	Afep Pigeon *Columba unicinta*	4	0	4	1
357	F	Tambourine Dove *Turtur tympanistria*	6	0	5	0
384	FF	Black-billed Turaco *Turaco schuetti*	1[a]	0	0	0
401	F	Yellowbill *Ceuthmochares aereus*	0	1	0	0
462	F	Narina's Trogon *Aploderma narina*	0	1	0	0
513	F	Black and White Casqued Hornbill *Bycanistes subcylindricus*	4	0	1[a]	0
536	F	Yellow-billed Barbet *Trachylaemus purpuratus* (h)	1	0	0	0
538	F	Hairy-breasted Barbet *Lybius hirsutus* (h)	1	0	0	0
548	F	Yellow-rumped Tinkerbird (h) *Pogoniulus bilineatus*	0	7	1	6
553	F	Black-necked Weaver *Ploceus nigricollis*	0	0	0	1
566	F	Lesser Honeyguide *Indicator minor*	2	1	0	0
592	F	Yellow-crested Woodpecker *Mesophycus xanthlophus* (h)	0	1	0	0
596	FF	African Broadbill *smithornis capensis*	1[a]	0	2	3
649	F	Black-headed Oriole *Oriolus brachyrhynchus*	1	0	0	2
674	FF	Scaly breasted Illadopsis *Trichastoma albipectus*	0	17	0	2
675	FF	Brown Illadopsis *Trichastoma fluvecens*	0	4	0	2
697	FF	Cameroon Sombre Greenbul *Andropadus curvirostris*	2	3	0	17
698	FF	Slender-billed Greenbul *A. gracilirostrils*	1[a]	2	3	34
701	F	Yellow-whiskered Greenbul *Andropadus latirostris*	6	36	14	186
705	F	Little Greenbul *A. virens*	0	6	0	10
708	F	Bristlebill *Blenda syndactyla*	7	11	4	8
716	F	Nicator *Nicator chloris*	1	1	1	1
718	FF	White-throated Greenbul *Phyllastrephus albigularis*	0	9	0	0
732	F	Common bulbul *Pycnonotus barbatus*	0	0	1	0
736	FF	Brown-chested Alethe *Alethe peliocephala*	13	14	0	11
750	F	Blue-shouldered Robin Chat *Cossypha cyanocampter*	0	2	4	21
752	F	Red-capped Robin Chat *Cossypha natalensis*	4	4	0	0
772	FF	White-tailed Ant Thrush *Neoccosyphus poensis* (h)	1	4	0	2
785	FF	Equatorial Akalat *Sheppardia aequatorialis* ©	0	9	0	2
790	FF	Rufous Thrush *Stirzorhina fraseri* ©	0	1	0	1
815	FF	Masked Apalis *Apalis binotata*	0	0	1	0
837	F	Grey-backed Camaroptera *Camaroptera brachyura*	0	0	0	1
838	FF	Olive-green Camaroptera *Camaroptera chloronota*	1[a]	2	0	8
889	F	Green *Hylia prasina*	1	6	0	7
900	F	Ashy Flycatcher *Muscapa caerulescens*	0	3	1	5
910	F	Branded Prinia *Prinia bairdii*	0	0	1	8
911	F	White-chinned Prinia *Prinia leucopogon*	0	0	0	3
923	FF	White-browned Crombeck *Sylvietta leucophyrus*	0	0	0	2
957	FF	Jameson's Wattle-eye *Platysteira blisseti*	0	3	0	4
958	FF	Chestnut Wattle-eye *Pletysteira castanea*	0	2	0	2
967	FF	Red-bellied Paradise Flycatcher *Terpsiphone rufiventer*	1	1	0	0
1008	F	Luhders Bushshrike *Laniarius luhderi*	0	0	1	6
1080	F	Collared Sunbird *Anthreptis collaris*	2	0	4	1

Table 1 *continued*

			Individuals			
			Unlogged		Logged	
No.	Status	Species (Common and scientific name)	Ps	Tr	Ps	Tr
1112	FF	Olive Sunbird *Nectarinia olivacea*	1	3	1	7
1130	F	Green-headed Sunbird *Nectarinia verticalis*	1	0	1	1
1133	F	Yellow-white eye *Zosterops senegalensis*	0	0	1	4
1155	FF	Red-headed Malimbe *Malimbus rubricollis*	1[a]	0	0	0
1161	F	Dark-backed Weaver *Ploceus bicolar*	2[a]	0	3	2
1175	F	Vieillot's Black Weaver *Ploceus nigerrimus*	0	0	0	1
1223	F	Red-faced Crimsonwing *Crytospiza reichenovii*	0	0	0	2
1230	F	Black-crowned Waxbill *Estrilda non-nula*	1[a]	1	0	0
1242	FF	Green-backed Twinspot *Mandigoa nitidula*	0	0	0	1
1246	F	Grey-headed Negrofinch *Nigrita canicapilla*	0	1	0	1
1247	F	White-browned Negrofinch *Nigrita fusconota*	2	0	3	0
1252	FF	Red Fronted Antpecker	0	1	0	1
1259	F	Red-headed Blue Bill *Spermaphaga ruficapilla*	1	3	0	3
		Unidentified species	3	0	2	0
		No. of species	21	31	22	40
		Number of individuals with confirmed breeding records	67	160 (839)	59	381** (2412)
		Number of individual crevice nesters	17**	28* (196)	0	14 (210)
		Number of individual hole nesters	7	12 (52)	0	9 (70)

Figures in parentheses are sample size of adult individuals trapped in each category. A chi-squared test was used to compare the relative percentages in each category, *$P < 0.05$; **$P < 0.01$.
The scientific names of all bird species, nomenclature, numbers and category follows Britton (1980) and Bennun *et al.* (1996).
(c), crevice nesters; (h), hole nesters; [a], unconfirmed record. Status: FF, forest interior specialist; F, forest generalist; f, forest visitors.

binotata were new records for Uganda (Dowsett & Dowsett-Lemaire, 1993); 62% ($n = 126$) of the individuals with confirmed egg-laying records were found in the unlogged forest compartment (Table 1). Although egg laying occurred all year round (Fig. 3), peaks were found, corresponding to the rainy seasons.

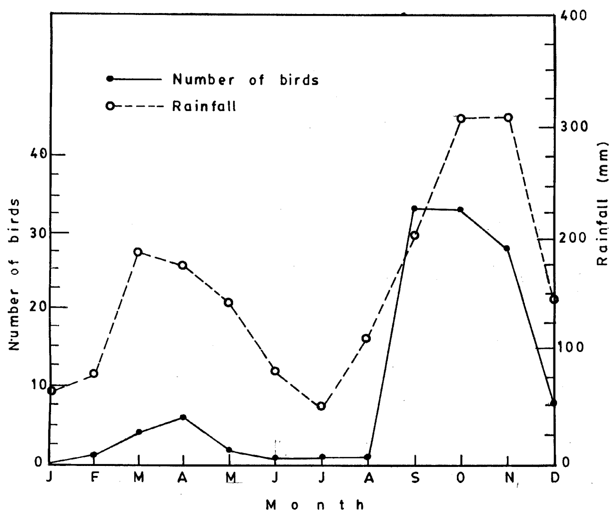

Fig 3 Egg-laying period in relation to monthly rainfall in Kibale National Park (1992)

Discussion

Breeding is one of the crucial ecological aspects of bird population dynamics and yet is the most difficult to evaluate (Johnson, 1979). There is no single satisfactory method that can be used to assess breeding and the potentials of most forest birds. This is because breeding birds are very secretive in their behaviour. The effectiveness of each method is subject to the field experience acquired by the researcher and the breeding behaviour of individual species. Biases may however, be offset by a combination of methods. This study relied on evidence from active nesting records, data on trapped individuals with brood patches and cloacal protuberance.

The overall breeding populations of all adult birds caught through mist-netting, 16% ($N = 839$) in unlogged and 13% ($N = 2412$) in logged sites, were lower than the 20% reported by Dowsett-Lemaire (1985) and Dowsett & Dowsett-Lemaire (1993) in Malawi. This low level of breeding appears to be a phenomenon of tropical forest birds (Brosset, 1989).

The open crevice nesters and hole nesters commonly breed in the unlogged sites rather than the logged forest compartment. The pattern of low numbers of these birds clearly corresponds to the nest resource partitioning in the two sites. In the same study, Dranzoa (1995) found that the available nest sites for this particular group of crevice nesters was depressed by over 50% by logging. This may explain the relatively low breeding populations of crevice and hole nesters in the logged forest. It is still unclear where the large populations of crevice nesters in the selectively logged forest came from (Dranzoa, 1998). Dranzoa (1995) also demonstrated local intersite movements. It could be that some of these birds were moving from the surrounding forest compartments. Such a pattern in movement could prove important in aiding genetic variation in a disturbed habitat (Huston, 1994).

Many of the species that occurred in gaps (gap lovers), such as the blue-shouldered robin chat *Cossypha cyanocampter*, plus forest edge or generalist birds such as the yellow-whiskered greenbul *A. latirotris*, have their breeding potential greatly enhanced by logging. This could be attributed to the lush and dense undergrowth vegetation (Dranzoa, 1995), which provided abundant nest materials and sites for these open nesters.

In Gabon, Brosset (1982) reported yellow-whiskered greenbul as a 'lekking' species in primary forest, i.e. males congregate at breeding sites and sing to attract females with whom they mate; after mating the females disperse from the site. The lekking system confers a comparative advantage to that of the congeners; hence their relatively high populations in logged study sites (Dranzoa, 1998).

Although some species of ant followers were missing from the logged compartment, large populations of brown-chested alethe *Alethe poliocephala* and white-tailed ant thrush *N. poensis* still persisted. However, unlike the unlogged forest, there was no definite proof of breeding (from egg-laying records) for these birds. This may suggest that most of the populations of these species come from the surrounding unlogged forest, and that the logged site may only be a sink for them. Therefore, the primary forest and other lightly disturbed forests in the surrounding area may be important as source areas from which birds disperse into suboptimal logged forest sites (Dranzoa, 1998). This view is supported by the presence of large populations of immatures in logged sites. Relationships between immature and breeding populations in both sites reflect the patterns of dispersal of immatures after the breeding season.

On the other hand, the absence of active nesting of some of the birds might be due to predation pressure, which is a common phenomenon in small forest patches (Askins *et al.*, 1987), as well as to a lack of adaptation to microclimatic features that prevail in logged forest.

Breeding of East African tropical forest birds has always been regarded as non-seasonal (Britton, 1980) whereas avifaunas from other habitats have seasonal patterns of breeding (Diamond, 1974; Dowsett & Dowsett-Lemaire, 1984). These patterns of seasonality are influenced principally by resource availability, which seems to be a direct function of rainfall. However, there was a protracted egg-laying period in 1992, corresponding to the rainfall pattern (peaking during the longer rainy season). Mlingwa (1996) showed a similar pattern in Tanzanian forests.

Conclusion

Management based on numeric abundance alone may not serve the conservation purpose of many different species. Because the breeding potential of forest generalists and forest gap lovers appeared to be enhanced within the logged site it is possible that logging may be compatible with maintaining the breeding individuals of these groups. However, the specialized hole/crevice/cavity nesters bred in low numbers in the logged site, although significant populations still persist. Crevice/hole nesters decreased, species preferring dense undergrowth increased and colleagues were not greatly affected.

Logging therefore lowers the value of forests to birds with highly specialized breeding requirements. The long-term conservation of this group of birds will continue to depend on availability of mature, old and senescent trees within protected forests. The protracted egg-laying period found in this study is relevant to management activities such as tree felling. This study suggests that the months from September to November are when many species start laying eggs. Based on this information, timber felling should be avoided during this period so as not to disrupt breeding.

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