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Birds of isolated small forests in Uganda

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Abstract

This study concerns birds recorded from four small forests in Uganda, three of them being naturally isolated and the fourth being a fragment of the once extensive forests of southern Uganda. Whilst the forest interior birds in the natural forest islands might be considered subsets of those found in larger forests, the fact that the species composition in the three naturally isolated patches are almost completely different from each other, and in one case appear to have changed with time, suggests a major element of chance in which species occur where. There is also a strong indication of species turnover amongst the forest interior birds in these forests. The fact that, together and over time these small forests supported 37 forest interior species, suggests that, collectively, small forests (of which there are many in Uganda) do have conservation value. The evidence of species turnover with time, if confirmed, would increase the numbers of species involved and implies that even interior species do sometimes travel significant distances across other habitats.

Introduction

Uganda has many small forests, most of which are remnants of formerly extensive areas. One such fragment, Ziika, has been studied periodically since 1970. Other small forests appear to be natural, including many on islands in Lake Victoria and along the River Nile, although these have often been degraded or even clear-cut. We examine data from three naturally isolated forests, and compare them with data from Ziika, to evaluate what value such forests—they range from 12 to *c.*700 ha—may have for forest birds. We also look at the stability of the bird communities within these forests.

Previous studies of birds in forest fragments in East Africa, mainly in the Taita Hills (e.g., Githiru *et al*. 2006, Githiru & Lens 2007), showed that the key variables explaining forest species persistence across fragmented landscapes are dispersal ability and tolerance of habitat deterioration (Lens *et al*. 2002). Additionally, it is well-known that the number of species to be found in a particular habitat is proportional to the logarithm of its size (Begon *et al.* 2006). From that it follows that any reduction in the size of the habitat will lead to a reduction in the numbers of species. Very small forests also suffer from 'edge effects' (Dale *et al.* 2000) since essentially they are all edge. Amongst other things, predation of nests is often higher at the edge (but see Carlson & Hartman 2001).

Forest birds are generally considered to be poor dispersers; a study in Brazil

found that few forest dependent species moved between patches that were separated by more than 500 m (Yabe *et al.* 2010). But here we are concerned with much larger distances: for example, there are fewer forest species on Mt Elgon, a relatively young forest in eastern Uganda, than comparable forests in the west, which included Pleistocene refugia (Hamilton 1982). Thus, an assessment of which, and how many, forest bird species occur in isolated patches, could provide insights into their ability to reach isolated patches, and then to persist.

The forests

The three naturally small forest islands are Rubanga, Rabongo and Zoka (Fig. 1, Table 1). They are believed to have been isolated for hundreds, possibly thousands of years, or never connected to larger forests (A. Hamilton pers. comm.). They probably arose as part of the much more general post-Pleistocene spread of forest, often along rivers. All three are surrounded by grassland and woodland, as were some natural forest patches in southern Africa, which showed a marked species-area effect (Wethered & Lawes 2003). In contrast, Ziika, a forest patch of 12 ha, was originally part of a much larger forest along the northern shores of Lake Victoria (Hamilton 1984). It gradually became isolated as forests were cleared over the past few hundred years, and particularly in the twentieth century, partly as a measure against sleeping sickness (H. Osmaston pers. comm.). The exact date of its isolation is not known, but is thought to be about 50 years ago. It has been studied periodically over a period of about 35 years.

Figure 1. Map of Uganda showing the location of the four small forests included in this study. The shaded areas were forested prior to conversion to agriculture (Langdale-Brown *et al.* 1964).

Table 1. Basic characteristics of the four small forests included in this study

Feature	Ziika	Rubanga	Rabongo	Zoka
Size (ha)	12	*c.*20	*c.*200	*c.*700
Altitude (m)	1120	1200	900	950
Annual rainfall (mm)	1500	800	1200	1100
Forest type	Moist evergreen	Riverine	Riverine	Partly riverine
Name (km) of nearest forest >100 ha	Mpanga (20)	Malabigambo (70)	Kaniyo-Pabidi (15)	Budongo (130)

All four forests have closed canopies over most of their area with relatively open understorey. Ziika Forest is a lakeside remnant on the Entebbe peninsula, some 25 km south of Kampala, and owes its survival to the Uganda Virus Research Institute, which owns it and has used it extensively for research, particularly on man-biting mosquitoes. Its birds were first studied in the early 1970s (Okia 1976), and subsequently by Dranzoa (1990, 1997b). It is now included in the national bird-monitoring programme. The other three are in drier areas and are predominantly riverine. An indication of Rubanga's long isolation is the recording there in the 1990s of the Cape Robin Chat *Cossypha caffra* (Katende & Pomeroy 1997), normally a highland species. Rabongo on the other hand may once have been connected to Kaniyo-Pabidi—itself an outlier of Budongo Forest—and to have been separated by the joint effects of fire and elephants (D. Sheil pers. comm.). Rabongo is near, and Ziika is within, the area of original forest in Uganda (Fig. 1).

Neither Rubanga nor Rabongo has received a detailed bird study, but enough data exist for our present purpose. Both have survived in reasonably intact condition because they are within protected areas, Rubanga in Lake Mburo National Park and Rabongo in Murchison Falls National Park. Rabongo suffered from the very high population of elephants in the 1960s and 1970s, which allowed fires to penetrate the forest edge at various places, so that parts of it are relatively open. The elephant numbers are now low, but occasional fires still reach the forest edge. Zoka lies within the East Madi Wildlife Reserve, which receives a moderate level of protection (Plumptre *et al.* 2008).

The birds

In this paper, we are mainly concerned with forest-dependant bird species. Bennun *et al.* (1996) classified birds of Kenya and Uganda according to their degree of dependence on forests. They recognised three categories, designated by letters, thus:

FF species are forest interior specialists, often uncommon even at the forest edge

F species are generalists in their ecology, occasionally occurring outside forests

f species are sometimes seen in forests, usually at the edge or in large gaps, but are better thought of as forest visitors.

Data sources

In addition to the studies of Ziika by Okia (1976) and Dranzoa (1990), CD also carried out short sessions of mist-netting in 1989 (see Dranzoa 1997b) and 2002 (unpub. data). She also made nine Timed Species Counts (TSCs) (Pomeroy & Dranzoa 1997) in 1989, and since then, another 24 TSCs have been made by various observers, with at least two per year, from 2002 to 2009. The Uganda Forest Department included Ziika in a series of 65 Ugandan forests where biodiversity surveys were made in the 1990s (Davenport *et al*. 1996), using a variety of methods including mist-netting. Further, Carswell (1986) listed a number of records from Ziika.

Five TSCs and some opportunistic observations were made in Rubanga by CW in June and October 2001. Previously, a few species had been recorded there by CD and DP. Andrew Opeta (pers. comm.) provided some additional observations. Rabongo has received a number of visits, but the main observations come from four TSCs and some mist-netting in 1989–94 (CD), with six more TSCs in 2001–02 (DP, CW); opportunistic observations were also made on those and other occasions. Zoka was included in the Forest Department surveys in 1993 (Davenport & Howard 1996), where both mist-netting and opportunistic observations were made. A more recent survey by the Wildlife Conservation Society (Plumptre *et al.* 2008) used point counts. Although data from these forests were collected at various times of year, all forest-specialist (FF) species recorded are believed to be residents (Carswell *et al*. 2005) and hence no significant seasonal differences would be expected.

Results and Discussion

Table 2 summarises the number of species of forest birds found by the various surveys, whilst Appendix 1 lists the actual species in the most important category, the forest specialists. The number of FF species in Ziika during the 1970s, 1989 and since has been 16 in each case (Table 2), although the species composition varied considerably. These numbers partly reflect differences in effort, which complicates interpretation, but are clearly much higher than the corresponding numbers for the three long-isolated forests, Rabongo, Rubanga and Zoka. Though the numbers of FF species in Ziika suggested a decline between 1970s and 1989 (Table 2), sampling effort was considerably higher in the 1970s study. Indeed, the numbers of FF birds recorded by both methods remained relatively constant over the different time periods whilst F-species increased (Table 2).

Table 2. Numbers of forest-related species in relation to sampling effort (Sampling effort refers to no. of counts for TSCs and metre-net-hours (mnh) for mist-netting; Ziika sub-totals comprise species recorded by both methods; FD = Forest Department; details of other data sources are given in the text)

Forest	Data sources	Method	FF	F	f	Sampling effort
Ziika	1970s: Okia	Mist-nets	16	25	23	90 000
	1989: CD	TSCs	12	17	12	9
		Mist-nets	8	10	5	15 960
		1989 Sub-Total	**16**	**21**	**13**	
	1993–4: CD	Mist-nets	6	7	3	6 130
	1994–5: FD	Mist-nets	2	3	5	10 162
	2002–9: various	TSCs	16	37	28	24
		Mist-nets	5	7	3	9 600
		2002–9 Sub-Total	**16**	**38**	**29**	
Rubanga	2002–09: CW, AO	TSCs	7	18	14	5
Rabongo	1989–94	TSCs	4	23	38	3
	2001–02 CW/DP	TSCs	6	19	24	9
Zoka	1993, 2008 various	Mist-nests, point counts	5	7	29	4 140

A total of 37 FF species were recorded across all four forests (Appendix 1). Of these, 28 were in TSCs and 17 from mist-netting: since only eight of the 37 were recorded by both methods, this emphasises the need to use more than one method for a comprehensive result for forest surveys. However, mist-netting is far more time-consuming than TSCs, which produced the greater number of species. To put these figures into perspective, there are about 190 FF species in Uganda (Carswell *et al.* 2005) and 80 in the remaining lakeside forest, Mabira, which is about 300 km^2 (Dranzoa 1990).

We were surprised to see how different the forest bird communities were between the various forests, and over time. Russell (1998, p. 378) defined species turnover as 'the difference in composition between two community censuses' and the term is useful in considering the results in Appendix 1. For example, although all 37 of the species in that table are found in most of the larger forests of Uganda (Howard 1991), it is remarkable that of the 19 found in the three natural forest islands, only one (Olive Sunbird *Cyanomitra olivacea*) was recorded in all three, and only one other (Brown Illadopsis *Illadopsis fulvescens*) occurred in two. At Zoka, the most isolated (but also the largest) forest, neither of the two FF species recorded in 1993 were found in 2008, when three additional FF species were observed. And of the nine FF species recorded from Rabongo, only the Black Cuckoo *Cuculus clamosus* was recorded in both periods. Likewise, of the 26 FF species recorded at Ziika, 11 of them were recorded only once and a further eight only twice, out of a possible seven sampling sessions (Appendix 1). The high turnover rates which those data imply are likely to be lower in reality since many forest birds are hard to detect, and may have been present but not recorded. Others, however, are conspicuous and/or noisy (e.g. Crowned Eagle *Stephanoaetus coronatus*, Black-billed Turaco *Tauraco schuetti*, Shining-Blue Kingfisher *Alcedo quadribrachys*,

Shrike Flycatcher *Megabyas flammulatus*) and these are less likely to have been overlooked, particularly from the two smallest forests.

There was considerable turnover of species in Ziika, both FF and F species (Table 3). Only 7 of 20 (35%) FF, and 16 of 33 (48%) F species were found in both earlier and later periods. Ziika is very small, and some of the species recorded there are easily detected, so it is reasonable to assume that there was a genuine turnover of species, at a surprisingly high rate. However, all but one of the seven FF species which disappeared between the 1970s and 1993–4 were already uncommon in the 1970s, all having capture rates of below 0.020 per 100 mnh by 1989 (see Appendix 1).

Table 3. Number of unique and shared forest species over the two sampling periods at Ziika (n = number of TSC counts)

	1989 (n=9)	2002–9 (n=24)	Both periods
FF-species	5	8	7
F-species	2	15	16
Totals	7	23	23

Dranzoa (1997a) found that only nine of 29 species of forest greenbuls in Uganda occurred in forests of < 350 ha, suggesting a minimum forest size. We recorded four greenbuls in Rabongo (but only one FF), four in Rubanga (no FF), five in Zoka (two FF) and, by 2009 seven in Ziika (three FF). This phenomenon may well apply to other species, as Beier *et al.* (2002) found in West Africa.

Nine of the FF species in Appendix 1 were also amongst the 26 species most commonly caught by Dale *et al.* (2000) in Budongo Forest, to the west of Rubanga. They classified five of these as edge species, but three were commoner in the forest interior, suggesting that large forests offer no clear pattern as to which species are likely to reach or survive in forest fragments. As would have been expected, Rabongo had more FF and F species than Rubanga, since it is larger, less isolated and better-studied. In contrast, the most remote forest, Zoka, had rather few of these species despite being the largest, suggesting an isolation effect. In all, the differences in species composition between the four forests could imply a significant degree of chance as to which species arrive where.

Conclusions for conservation

The data suggest that small forests do support reasonable numbers of forest birds, although the numbers of interior (FF) species remain a small subset of those found in large forests. Observations in Ziika and Rabongo show that even forest-interior species can survive for decades in fragmented patches. The relatively high turnover of species across sites implies that a series of such forests could, collectively, hold a significant number of forest species. This is particularly so where there are other fragments nearby, as is the case with

Ziika (Chamberlain *et al*. 2009). Forest restoration, currently being practiced in larger forests such as Kibale (Struhsaker 2003), could thus also increase the numbers of forest birds in fragments (Aerts *et al*. 2008), and should be a future option.

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Appendix 1. Records of the 37 forest specialist (FF) species, with estimates of relative abundance. For TSC data, a = more than half of counts, b = half or less, but more than one, c = once only. For mist-netting, data are captures per 100 mnh. For Zoka, P/A = presence/absence.

Forest		Rubanga	Rabongo		Zoka	Ziika					
Method		TSC	TSC		P/A	TSC		Mistnet			
Years		2001	1989-94	2002	1993/2008	1989	2002-9	1970	1989	1993-4	1994-5	2002
Crowned Eagle	*Stephanoaetus coronatus*	c[i]										
African Wood Pigeon	*Columba unicincta*		b									
Grey Parrot	*Psittacus erithacus*					c	b					
Black-billed Turaco	*Tauraco schuetti*					b						
Black Cuckoo	*Cuculus clamosus*		c	b								
Dusky Long-tailed Cuckoo	*Cercococcyx mechowi*					c		0.001				
Sabine's Spinetail	*Rhaphidura sabini*		a									
African Dwarf Kingfisher	*Ispidina lecontei F*[ii]			c								
Shining-blue Kingfisher	*Alcedo quadribrachys*		c					0.001				
Blue-throated Roller	*Eurystomus gularis*			c								
Yellow-throated Tinkerbird	*Pogoniulus subsulphureus*						b					
Yellow-spotted Barbet	*Buccanodon duchaillui*					b	b					
Yellow-billed Barbet	*Trachylaemus purpuratus*					c						
Thick-billed Honeyguide	*Indicator conirostris*							0.004				
Buff-spotted Woodpecker	*Campethera nivosa*							0.002	0.013			
Brown-eared Woodpecker	*Campethera caroli*							0.001				
Little Grey Greenbul	*Andropadus gracilis*							0.001				
Plain Greenbul	*Andropadus curvirostris E*		c			c	b	0.027	0.025	0.016		0.021

Forest		Rubanga	Rabongo		Zoka			Ziika				
Method		TSC	TSC		P/A	TSC				Mistnet		
Years		2001	1989-94	2002	1993/2008	1989	2002-9	1970	1989	1993-4	1994-5	2002
Slender-billed Greenbul	*Andropadus gracilirostris*				x		c					
White-throated Greenbul	*Phyllastrephus albigularis I*				x	c	b	0.066	0.18	0.15	0.03	0.083
Red-tailed Bristlebill	*Bleda syndactyla I*						c					
Grey-winged Robin-chat	*Cossypha polioptera*	b										
Fire-crested Alethe	*Alethe diademata I*						c	0.005				
Rufous Flycatcher-thrush	*Stizorhina fraseri*					a	b	0.01	0.019	0.016		
Black-throated Apalis	*Apalis jacksoni*				x							
Buff-throated Apalis	*Apalis rufogularis*	c				c	b					
Grey Apalis	*Apalis cinerea*	b										
Grey-throated Flycatcher	*Myioparus griseigularis*						b	0.012	0.013			
Blue-mantled Crested Flycatcher	*Trochocercus cyanomelas*	a										
African Shrike-flycatcher	*Megabyas flammulatus*					b						
Chestnut Wattle-eye	*Dyaphorophyia castanea E*	b				c	c	0.001	0.025	0.016		0.021
Brown Iladopsis	*Illadopsis fulvescens I*	c		c			c	0.033	0.019			0.01
Green Sunbird	*Anthreptes rectirostris*									0.016		
Little Green Sunbird	*Anthreptes seimundi*						b					
Blue-throated Brown Sunbird	*Cyanomitra cyanolaema*						b	0.001				
Olive Sunbird	*Cyanomitra olivacea E*	c		c	x	b	b	0.078	0.132	0.23	0.049	0.22
Green-backed Twinspot	*Mandingoa nitidula E*				x			0.002	0.006			
Total species		7	5	5	5	12	16	16	9	6	2	5
Total numbers								0.25	0.42	0.42	0.079	0.35

i – seen twice nearby, with a pair on 04 November 2001

ii – common edge (E) and interior (I) species in a Budongo Forest study (Dale et al. 2000)