



Ostrich

Journal of African Ornithology

ISSN: 0030-6525 (Print) 1727-947X (Online) Journal homepage: <http://www.tandfonline.com/loi/tost20>

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To cite this article: Moreen Uwimbabazi, Amy E Eycott, Fred Babweteera, Eric Sande, Richard J Telford & Vigdis Vandvik (2017): Avian guild assemblages in forest fragments around Budongo Forest Reserve, western Uganda, *Ostrich*, DOI: [10.2989/00306525.2017.1318186](https://doi.org/10.2989/00306525.2017.1318186)

To link to this article: <http://dx.doi.org/10.2989/00306525.2017.1318186>



Published online: 19 May 2017.



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Avian guild assemblages in forest fragments around Budongo Forest Reserve, western Uganda

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Remnant forest fragments provide an opportunity for conservation in fragmented landscapes but some patches are more useful than others. Forest fragments around Budongo Forest Reserve, an Important Bird Area in western Uganda, were surveyed to explore the effects of different aspects of habitat fragmentation on bird guild composition. We recorded 1 128 individuals of 75 bird species over 7 056 net hours. The greatest number of birds and species were recorded in the forest fragments that were large, near to the continuous forest and surrounded by subsistence farmland. However, rarefied species richness was not affected by distance, size or matrix type; instead, forest specialist species were replaced by generalists and visitors with increasing fragmentation. The proportion of forest specialists and of terrestrial insectivores decreased with distance from the main forest, canopy openness and matrix intensity but not with fragment area. The findings show that bird assemblages vary in their response to habitat fragmentation but within guilds the response to fragmentation can be consistent, and can make ecological sense. Forest bird conservation can therefore benefit from information on species ecology when deciding which bird species and which parts of the landscape are to be prioritised for conservation or monitoring purposes.

Les assemblages de guildes aviaires dans des fragments forestiers autour de la réserve forestière de Budongo, Ouest de l'Ouganda

Les fragments forestiers résiduels offrent une opportunité pour la conservation dans les paysages fragmentés, mais certains patchs sont plus utiles que d'autres. Des fragments de forêts autour de la réserve forestière de Budongo, une zone importante pour les oiseaux dans l'ouest de l'Ouganda, ont été étudiés pour explorer les effets de différents aspects de la fragmentation de l'habitat sur la composition en guildes d'oiseaux. Nous avons enregistré 1 128 individus appartenant à 75 espèces d'oiseaux sur 7 056 heures nettes. Le plus grand nombre d'oiseaux et d'espèces ont été enregistrés dans les grands fragments forestiers, localisés près de la forêt continue et entourés de terres agricoles de subsistance. Cependant, la richesse rarefiée en espèces n'a pas été affectée par la distance, la taille ou le type de matrice; en revanche, les espèces spécialistes des forêts sont remplacées par les espèces généralistes et les visiteurs avec l'augmentation de la fragmentation. La proportion en spécialistes forestiers et en insectivores terrestres a diminué en fonction de la distance à la forêt principale, l'ouverture de la canopée et l'intensité de la matrice, mais pas en fonction de la surface fragmentée. Les résultats montrent que les assemblages d'oiseaux varient dans leur réponse à la fragmentation de l'habitat, mais au sein des guildes, la réponse à la fragmentation peut être cohérente et peut avoir un sens écologique. La conservation des oiseaux forestiers peut donc bénéficier d'informations sur l'écologie des espèces pour décider quelles espèces d'oiseaux et quelles parties du paysage doivent être priorisées à des fins de conservation ou de surveillance.

Keywords: forest specialist, fragment size, frugivore, insectivore, isolation, land use, matrix, species richness

Introduction

Forest fragmentation exposes forest species to a range of interrelated negative impacts, including loss of forest cover, increased distance between fragments, reduced fragment size, and also often increased hostility of the matrix landscape surrounding the fragments due to land-use intensification and habitat change (Saunders et al. 1991; Fahrig 2003). Reduction in forest patch area

and the associated resources such as food and physical space are combined with increased exposure to edge effects, i.e. negative impacts of conditions imposed by peripheral ecosystems (Saunders et al. 1991; Laurance 1994; Terborgh 2001). A larger proportion of the forest is modified and disturbance is often greater (Laurance 1994; Terborgh 2001), resulting in higher mortality and lower

reproductive success compared with intact forest (Fahrig 2003; Korfanta et al. 2012). Increased distance from other forest patches decreases the rate of immigration and recolonisation (Fahrig 2003). The effects of distance (or isolation) differ among species depending on their mobility, dispersal mechanism, behavioural response to non-habitat, and interactions with other species (Guldmond and van Aarde 2010).

While most studies highlight the effect of area and distance on biodiversity, the effect of the intervening matrix landscape is often ignored (Korfanta et al. 2012). The impact of fragmentation is also dependent upon species' traits such as habitat specialisation and feeding guild (Newmark 1991; Gascon et al. 1999). Among birds, large species, insectivores, forest specialists and understory birds are particularly vulnerable (Beier et al. 2002; Laurance 2004; Watson et al. 2005). The drivers of such effects vary, for example larger birds seem to be more vulnerable despite their greater potential mobility, and forest specialists may move further than generalists but this may be in response to more stringent requirements for suitable patches (Neuschulz et al. 2013). Loss or decline of specific guild or functional groups such as insectivores may lead to loss or reduction of important landscape-scale processes and services. Sensitive functional groups such as terrestrial insectivores merit particular consideration for the services they provide. Gonzalez and Chaneton (2002) reported that change in species proportions in various functional groups may result in disassembly of ecological communities. Predicting the effect of landscape change will depend on the faunal composition, and how the different guilds will be affected by the different aspects of fragmentation.

Afrotropical forests are poorly represented in fragmentation research, despite suffering the highest rate of deforestation (Deikumah et al. 2014). Nevertheless, studies focusing on the impact of forest fragmentation on bird communities in Africa (Manu et al. 2006; Guldmond and van Aarde 2010), particularly East Africa (e.g. Brooks et al. 1999; Otieno et al. 2011; Korfanta et al. 2012), are increasing. The Budongo Forest Reserve (BFR) is a 428 km² continuous forest (Eggeling 1947; Plumptre 1996) in the Eastern Afromontane biodiversity hotspot and a designated Important Bird Area (Opige Odull and Byaruhanga 2010). Agricultural intensification and construction activity around BFR since the 1950s (Mwavu and Witkowski 2008) have left secondary forest fragments on private land (McLennan and Plumptre 2012) – much like the rest of Uganda, where 70% of the forest cover is now found in such small fragments (IRG 2006). The conservation value of such fragments is unclear (Chapman et al. 2007; McLennan and Plumptre 2012; Bulafu et al. 2013); indeed, previous bird studies in the Budongo area have all concentrated on the continuous forest of the BFR (Owiunji and Plumptre 1998; Dale et al. 2000, Ngabo and Dranzoa 2001; Kirika et al. 2008).

We explored the role of unprotected fragments in supporting bird diversity, focusing on the response of understory birds in different guilds to different aspects of fragmentation. Previous studies have shown that understory birds respond to changes in local vegetation structure (Barlow et al. 2002), floristic composition and

availability of resources (Barlow and Peres 2004) and landscape processes (Stouffer and Bierregaard 1995), making them suitable for this study as they are good indicators of disturbance in tropical forests. In addition, guilds are a useful tool for examining community changes in species-rich environments, thus facilitating comparisons between communities that differ in species composition. We predict that the proportion of forest specialists and terrestrial insectivores will decrease in fragments that are small, remote from the continuous forest, and in an intensely used matrix, and that the reverse will be true for forest generalists and frugivorous birds.

Methods

This study was conducted between October 2008 and May 2009 in six forest fragments of sizes ranging between 69 and 430 ha lying south of BFR, and in a 777 ha compartment of the continuous forest of BFR called N15 (428 km²) (Eggeling 1947; Plumptre 1996), used as a control (Table 1, Figure 1a). Located east of Lake Albert in western Uganda (1°35'–1°55' N, 31°8'–31°42' E) at 1 100 m above sea level, BFR is a moist semi-deciduous forest (McLennan and Plumptre 2012). A series of remnant fragments, mostly highly disturbed riverine secondary forests, are found to the east and south of BFR. They are predominantly surrounded by three distinct matrix habitats: bushland, cultivated fields, and sugarcane plantations. We ranked the three matrix habitats according to Gascon et al.'s (1999) filter analogy: the closer the structural similarity of a matrix to the primary forest, the higher the permeability to faunal movement. The bushland matrix, mainly composed of sparse shrubby trees and bushes, was considered least hostile (most permeable). The farmland matrix was mainly composed of mixed, subsistence agricultural crops with scattered fruit trees that provide perching sites as birds connect from one fragment to another and was considered of intermediate hostility. The sugarcane matrix was composed of commercial, extensive monocrop sugarcane plantation and so was considered most hostile. Fragments of three different size classes (c. 50 ha, c. 150 ha and c. 400 ha) were sampled at varying distances from BFR (0–15 km) and in the three different matrix types (Table 1) to represent the broadest available combination of size, distance and matrix types, and there were no significant correlations between the variables distance, size, or matrix type (Spearman rank correlations with dummy coding 1–3 for the three matrix types; $n = 6$). Nevertheless, the fragments we have used represent to some extent the gradient of fragmentation found in this area: from compact, large fragments that are near the forest and surrounded by bushland (trees, shrubs and grasses) to small, elongated fragments that are far from the forest and surrounded by commercial sugar cane plantation. Fragment boundaries were mapped using a GPS (Garmin 12) and ArcMap 10.2.2 (ESRI, Redlands, CA, USA) used to calculate distance to continuous forest and area (Table 1). Canopy cover as a measure of disturbance was measured by canopy densiometer with four (north, south, east and west) readings taken every 50 m along each 400 m transect established (see section below) and the mean reading per transect was calculated.

We used mist nets to sample birds along three 400-m-long transects in each fragment. The transects were established perpendicular to the edge of the forest at the start point and there was at least 200 m between each transect (Figure 1b). Mist nets were set in groups (four 13 m nets or two 18 m nets) perpendicular to the transect approximately every 50 m, with groups set on alternate sides of the transects and groups of different net-lengths also on alternating sides (see Figure 1b). All nets were 3 m deep and had 36 mm mesh size. Total net length per transect was 352 m, so total net area was 1 056 m². On each transect, all 24 nets were opened approximately concurrently, between 07:00 and 14:00 on two days of good weather, with hourly inspection. Only one transect was netted on any one day. All captured birds were recorded, ringed and released close to where they were caught. Sampling was done both in the rainy season (September to early December and March to May) and the dry season (mid-December to February), avoiding the peak of the rainy season, that is mid-November and mid-April. One forest in each of the matrix types was sampled in each season. Bird species were categorised according to their habitat preference (forest specialist, forest generalist or forest visitor) and foraging niche (frugivore, frugivore-insectivore, granivore-insectivore, leaf-gleaning insectivore, terrestrial feeding insectivore, sallying insectivore, and nectarivore) following Owiunji and Plumptre (1998). Mist netting provides a useful standardised technique for comparing understory avifaunal communities, which are mainly composed of non-vocal and secretive species, and the method is not observer biased (Stouffer and Bierregaard 1995; Barlow et al. 2007). However, mist nets are generally less efficient than point counts (Thiollay 1994; Barlow et al. 2007) and tend to result in relatively small sample sizes, as is the case in this study. Nonetheless, mist nets tend to be more effective in more disturbed habitats where birds fly closer to the ground (Barlow et al. 2007).

Given the low number of fragments, the data were analysed by Spearman rank correlations, graphical presentation and non-metric multidimensional scaling (NMDS), which we used to explore compositional patterns, using the vegan package 2.09 in R software (Oksanen et al. 2013). The proportion of species was calculated as the number of species in each habitat or feeding guild divided by the total number of species. Rarefaction analyses were carried out using the rarefy function, also in the vegan package, with the sample size set to the same size as the smallest sample (23).

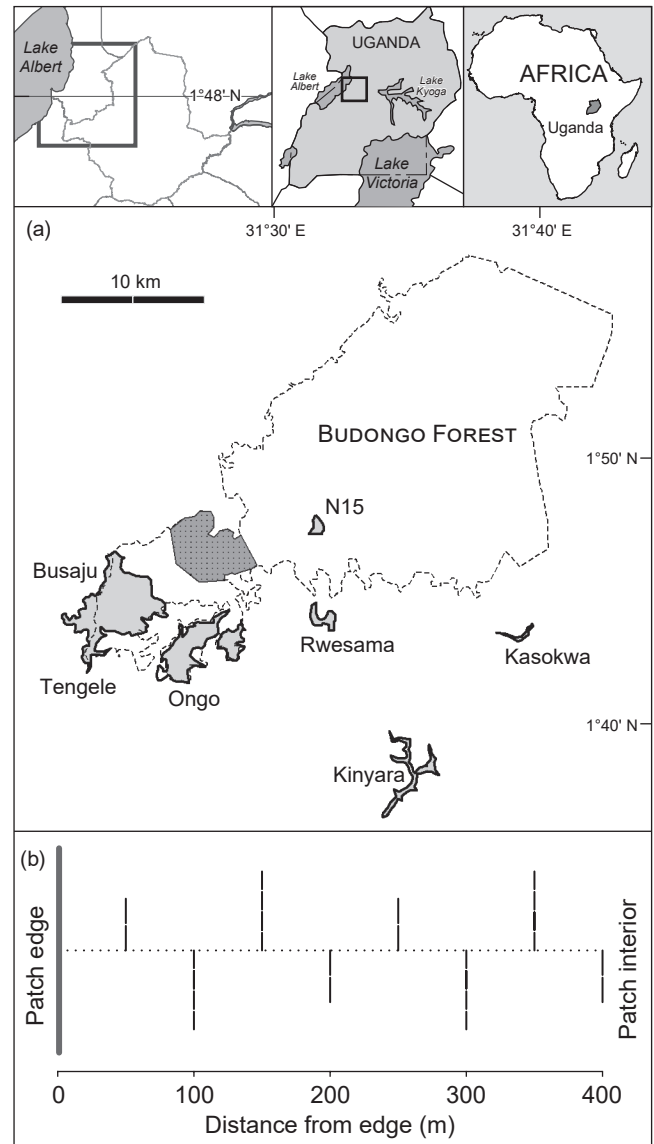


Figure 1: Location of the forest fragments in relation to Budongo Forest and the set-up of each transect. (a) The Budongo Forest Reserve (which includes the fragments Busaju, Ongo and Tengele) is marked with a dashed line. The stippled area indicates an area of recovering forest, which separates these fragments from the main block. The insets show the position of the study area within Uganda. (b) On the diagram of the transect, shorter black lines indicate the 13 m nets while longer lines indicate the 18 m nets

Table 1: Characteristics of the forest fragments sampled around Budongo Forest Reserve, Uganda and the compartment of the continuous forest used as a control. NFA = National Forest Authority

Fragment name	Matrix type	Area (ha)	Distance from main forest block (km)	Ownership	Species richness	Number of captures
Control: N15	Continuous forest	777	0	NFA	25	206
Busaju	Bushland	430	7.0	NFA	35	280
Tengele	Bushland	69	9.2	Local government	23	100
Ongo	Farmland	163	12.4	Private	35	145
Rwesama	Farmland	136	7.4	NFA	32	185
Kinyara	Sugarcane plantation	405	14.1	Private	23	103
Kasokwa	Sugarcane plantation	73	13.5	NFA	29	109

Results

In total, 1 128 birds of 75 species were captured (Appendix). The highest number of birds was captured in the largest forest fragment, followed by the continuous forest; only half as many were captured within small fragments and fragments surrounded by sugarcane (Table 1). There was a significant negative correlation between distance and the number of birds captured (Spearman $\rho = -0.88$, $p = 0.024$; Figure 2) but not between area and the number of birds captured (Spearman $\rho = -0.57$, $p = 0.200$; Figure 2). Large fragments in the least hostile matrix had higher species richness (Table 1) but there were no significant correlations between distance or area and species richness and the correlation coefficients were low, suggesting that even with increased replication we may not have found a particularly strong relationship (distance $\rho = -0.29$, $p = 0.526$; area $\rho = 0.22$, $p = 0.638$). In addition, the results of a rarefaction procedure (Figure 2) suggest that this decrease in species richness is largely explained by the concurrent decrease in number of birds captured. Along

axis 1 of the NMDS, the control forest and the bushland fragments showed similar composition, with the sugarcane fragments being the most dissimilar to control forest (Figure 3). In addition, the bushland and farmland fragments had similar composition compared with the sugarcane fragments. Axis 2 separated the bushland fragments from the control forest.

Forest specialists accounted for the highest percentage (63%) of all birds captured, followed by forest generalists (26%) and forest visitors. More than 80% of birds recorded in the continuous forest were forest specialists, compared with 65% and 35% in the bushland and sugarcane fragments, respectively (Table 2). The number of forest specialists in the forest fragments decreased with distance from the continuous forest and with canopy openness (Figure 4), with a negative impact of matrix intensity (farmland and sugarcane) superimposed over this. Rarefied species richness of smaller fragments was maintained by the substitution of specialist with generalist species.

Frugivores and frugivore-insectivores account for the highest proportion of species in all fragments (25–60%)

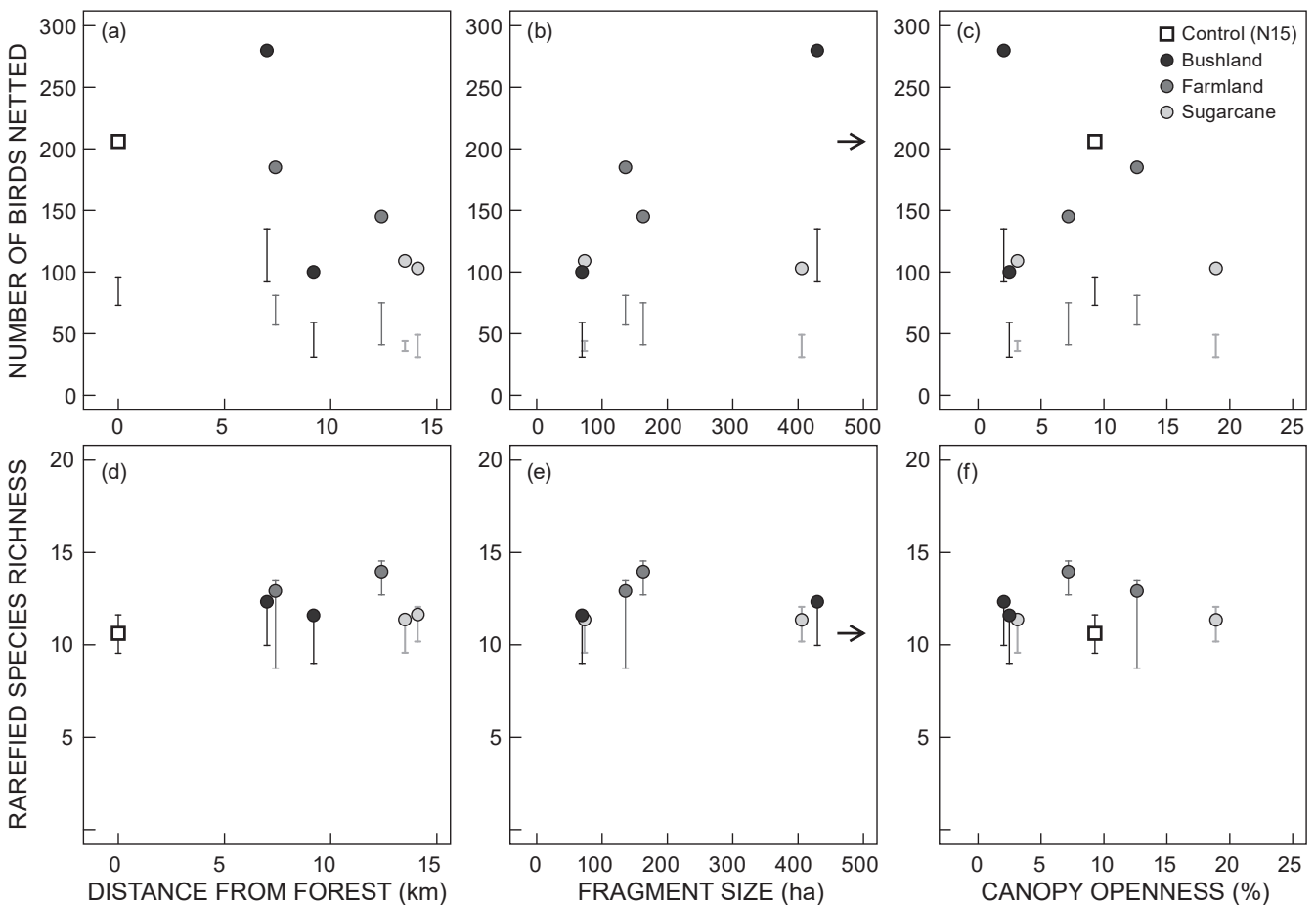


Figure 2: Relationship between fragment characteristics and measures of birds in fragments around Budongo Forest Reserve. The square black point is the ‘control’ (N15) and the circular points are fragments, with shade representing matrix type: dark points are bushland, medium-grey points are farmland and light-grey points are sugarcane. The range of values for the separate transects in each fragment/control are given in the same shade as for the point (note that this is not an error bar; as the top three panels are bird captures, individual transect values are lower than the value for the whole fragment). Given that the control plot is in a large forest, the y-position of the control plot on the figure for ‘fragment size’ is indicated by a black arrow

but not the continuous forest, where terrestrial insectivores dominated (33% as compared with 5–19% in fragments; Table 2). Eleven of the 13 terrestrial insectivore species recorded were classified as forest specialists. The proportion of terrestrial insectivores was highest in the continuous forest and lowest in the two distant forest fragments, which are both surrounded by sugarcane (Figure 4). Granivores and gleaners – the remaining guilds represented by more than 10 species – were more balanced between forest generalist and forest specialist species. This was reflected along NMDS axis 1, where granivores (which comprised a high proportion of species in the fragments) had high scores and terrestrial insectivores had low scores (Figure 3).

Discussion

Matrix habitat appeared to exacerbate the negative effect of decreasing fragment size and increasing distance from the continuous forest on the number of birds captured and the proportion of specialist of birds in the forest fragments. The rarefied species richness in forest fragments around Budongo Forest was similar to that of the continuous forest, with the observed decline in absolute richness patterns with increasing fragment isolation largely explained by the concurrent decrease in the number of birds captured. However, a large proportion of birds in the continuous forest were forest specialists, whereas forest fragments contained more forest generalists, forest visitors and other

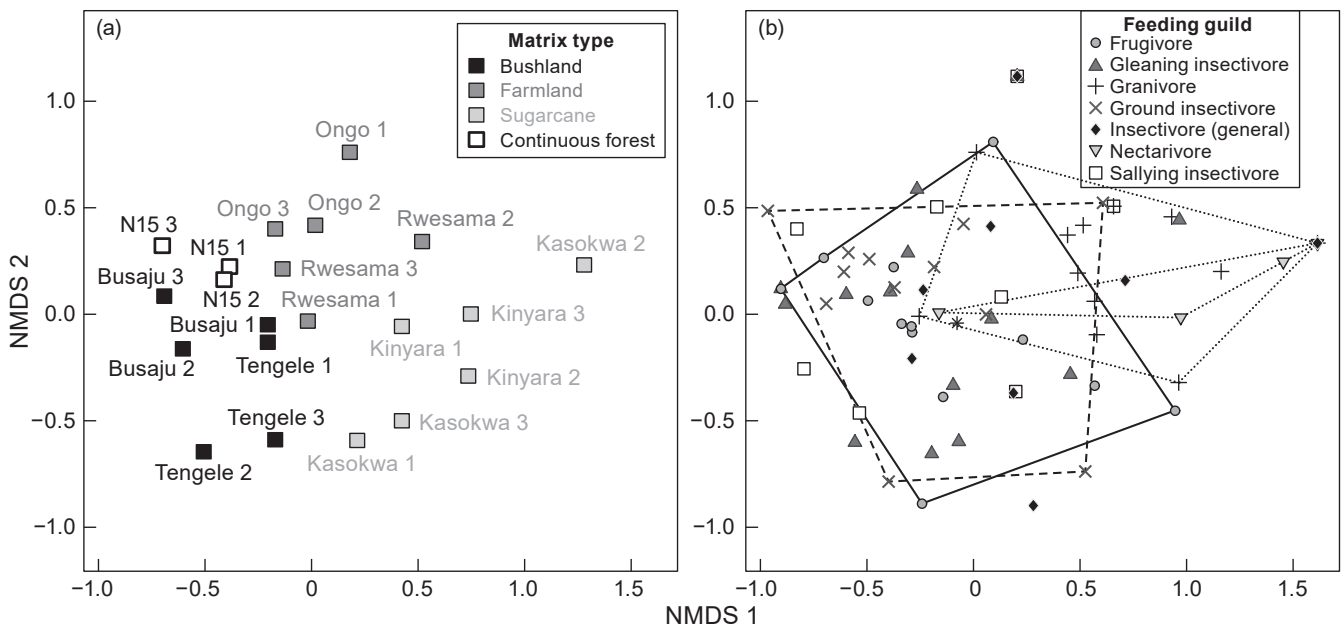


Figure 3: Non-metric multidimensional scaling (NMDS) ordination plot of (a) forest transects and (b) bird species classified by feeding guild. The frugivores (outlined by a dashed line) and ground/terrestrial insectivores (solid line) overlap in position on the ordination, with the higher axis 1 scores characterising the granivores and nectarivores (both dotted lines)

Table 2: Percentage distribution of bird species in the sampled forests according to habitat specialisation and feeding guilds (following Owiunji and Plumpton 1998)

Guild	Control	Bushland		Farmland		Sugarcane	
	N15	Busaju	Tengele	Ongo	Rwesama	Kinyara	Kasokwa
Habitat guild							
Forest specialist	88	71	68	59	55	23	38
Forest generalist	11	25	27	23	26	47	35
Forest visitor	0	4	5	15	13	27	24
Non forest bird	0	0	0	2	6	3	4
Feeding guild							
Terrestrial insectivore	33	16	11	19	11	10	5
Nectarivore	17	7	10	8	14	6	19
Gleaning insectivore	9	15	12	12	9	13	16
Frugivore	36	50	30	37	41	40	39
Sallying insectivore	3	5	35	5	8	7	7
Insectivore (general)	2	1	2	6	5	1	2
Granivore	0	4	0	6	2	6	6
Not classified	0	1	0	8	12	18	7

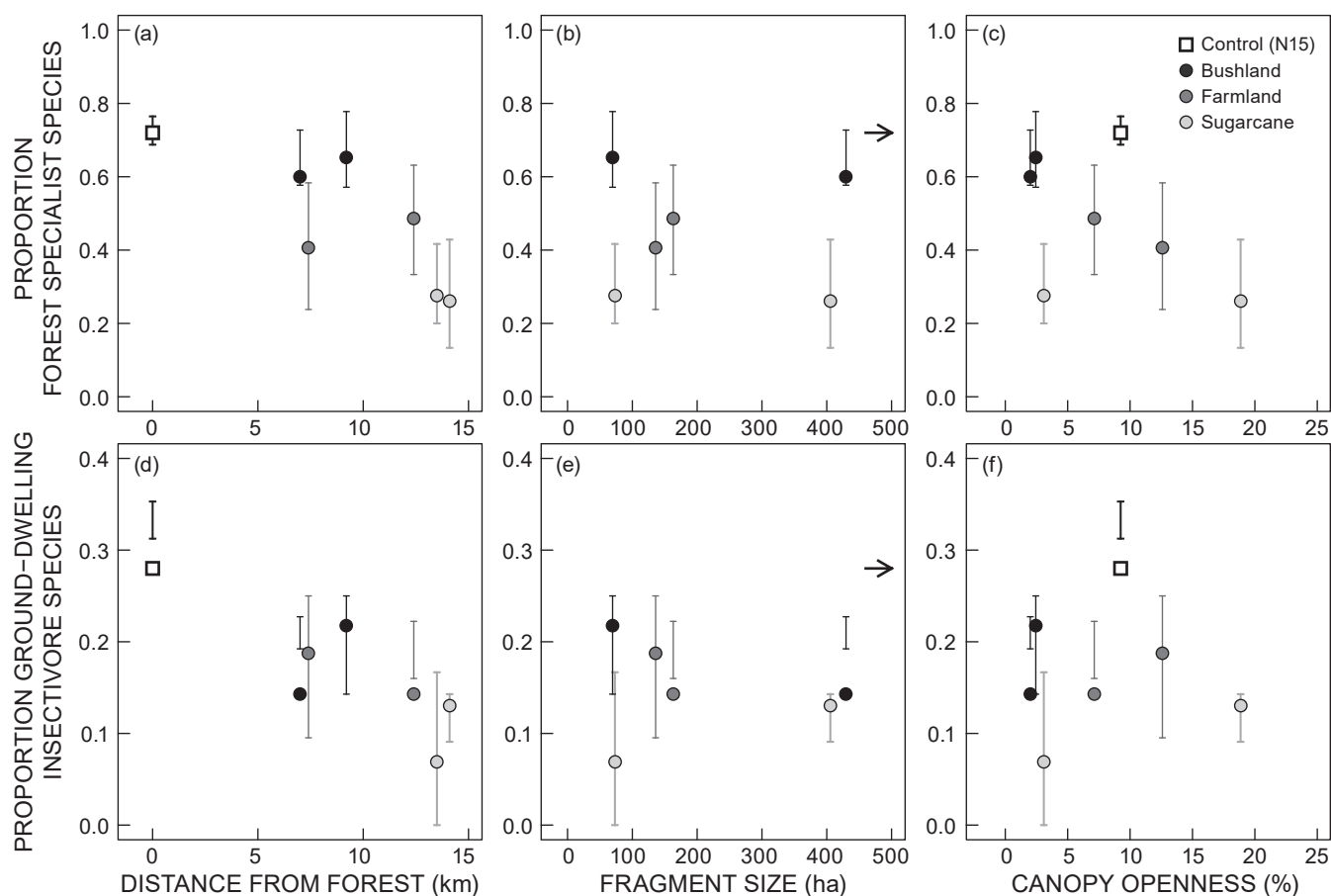


Figure 4: Proportions of forest specialist species and ground-dwelling insectivore species in relation to measures of habitat fragmentation and disturbance. The square black point is the 'control' and the circular points are fragments, with shade representing matrix type: dark points are bushland, mid-grey points are farmland and light-grey points are sugarcane. The range of values for the individual transects in each fragment/control are given in the same shade as for the overall proportion (note that this is not an error bar; please see Discussion for why these range bars do not overlap with the main points). Given that the control plot is in a large forest, the y-position of the control plot on the figure for 'fragment size' is indicated by a black arrow

non-forest birds in addition to forest specialists. Low sample size, and the tendency for bushland fragments to lie closer to the forest with sugarcane forests lying further away, limit analytical power (a test of power suggested double the number of forests would be required to find a significant difference between farmland and sugarcane fragments; data not shown).

Previous studies of the impact of Afrotropical forest fragmentation on birds (Saunders et al. 1991; Beier et al. 2002; Wethered and Lawes 2003) have reported that larger fragments or areas of similar size in continuous forest normally contain more bird species than smaller fragments. Although most of the large-sized fragments in this study had higher avian density and species richness, the large fragment in the sugarcane matrix (Kinyara) had fewer birds and bird species than many of the smaller fragments, which we attribute to the combined effects of increased distance and the hostility of the matrix habitat to forest bird movement – together these may be termed 'isolation'. The distance effect is well documented across almost all biomes and taxa (Prugh et al. 2008). Matrix effects, while also

well documented, are more subtle and species-dependent (Eycott et al. 2012), but for forest birds there is a clear preference to move through matrix types with more woody cover (e.g. Castellón and Sieving 2006; Aben et al. 2012; Magrach et al. 2012). The bushland matrix type was mainly comprised of shrubby trees and bushes, approaching the structure of a young secondary forest. In addition, most of the farmlands surrounding the forest fragments contained scattered large trees that are likely to provide perching sites, feeding resources or escape from predators when birds are moving between forests (Gonzalez and Chaneton 2002; Laurance 2004; Otieno et al. 2011). A matrix habitat that is structurally similar to the original habitat will also suppress fragment edge effects (Gascon et al. 1999), permitting small patches to support larger populations. Such features were not present in sugarcane plantations and this probably explains the similarity in bird composition for the bushland and farmland fragments.

Forest specialists are defined by their habitat requirements but are also characterised by large area requirements and edge avoidance (Dale et al. 2000; Wethered and

Lawes 2003), with an unwillingness to cross large inter-patch distances, especially in areas lacking familiar landscape elements (Lees and Peres 2009). Forest specialists in this study seem not to be particularly sensitive to fragment size, instead showing a strong isolation (distance and/or matrix) effect. If they are extremely limited in movement, forest specialist species recorded in fragments could even be remnant populations (Brooks et al. 1999). In contrast, forest generalists are characterised by small area requirements, tolerance of disturbed forests and low edge-sensitivity (Owiunji and Plumptre 1998), which are all more pronounced in small fragments, so forest generalists comprise a greater proportion of birds in fragments than in continuous forest. This also shows that forest remnants, however small, support bird diversity in situations where indigenous forests are threatened (Munyekenye et al. 2008).

Owiunji and Plumptre (1998) and Dale et al. (2000) report that insectivores in BFR are sensitive to edge effects and logging. We find comparable patterns with feeding guild and fragmentation: terrestrial insectivores are strongly associated with continuous forest, whereas frugivores comprise a higher proportion of the community in fragments. Terrestrial insectivores showed lower turnover between transects (in other words, lower beta-diversity or a smaller species pool) than other guilds, so the proportion of terrestrial insectivores in the whole fragment was lower than for individual transects (see Figure 4 for proportions). For example, five of the seven terrestrial insectivore species recorded in N15 were recorded in all three transects, whereas fewer than half of the bird species from other guilds were found in all three transects there. Among the fragments, terrestrial insectivores are sensitive to distance (in agreement with Deikumah et al. 2013). Fragment-size effects in terrestrial insectivores are frequently related to reduced invertebrate biomass due to increased canopy disturbance, increased edge effects or lower canopy richness (Turner 1996; Zanette 2000), but has also been ascribed instead to distance effects (Şekercioğlu et al. 2002). A decline in terrestrial insectivores may result in increased leaf damage or seed predation, further inhibiting tree regeneration in fragments (Perfecto et al. 2004).

Frugivorous birds show little or no sensitivity to fragment size or distance from the continuous forest, as suggested by their tolerance of disturbance (Owiunji and Plumptre 1998; Dale et al. 2000). Frugivorous birds are adapted to feeding on patchy resources (de Longh and van Weerd 2006), being relatively mobile (Neuschulz et al. 2013) and consuming a wide variety of fruit. They comprise a somewhat higher proportion of species in the farmland and bushland fragments (around 50%), where they presumably exploit fruit crops not available in the closed forest.

Other differences between individual avian species, such as differences in habitat associations, food plant specialisation, behaviour and ecological requirements (Lens 2002), were ignored as a result of categorising species into fairly broad categories of feeding guilds. Moreover, previous single-site studies have suggested that species of different sizes but from the same guild respond differently to disturbance (Renjifo 1999). This could explain the inconsistency of some feeding guilds such as granivore-insectivores in their response to the effects of fragmentation.

This study adds to the growing evidence for the importance of small fragments within agricultural landscapes (e.g. Daily et al. 2001; McLennan and Plumptre 2012; Bulafu et al. 2013), although fragments cannot compensate adequately for intact forest (Hulme et al. 2013). The exacerbating influence of matrix intensification on area and distance effects is highlighted by our results: bushland and farmland matrix types may support birds in forest fragments more effectively compared with the monocrop such as sugarcane matrix type. Despite their size, large fragments in sugarcane landscapes do not contain a high proportion of forest specialists, which we attribute to the combined effect of distance and matrix hostility. Nevertheless, the presence of at least some forest specialists in all fragments suggests that even small fragments can play a role in supporting forest specialists, provided that the matrix conditions do not impinge upon the patch interior; even poor fragments are better than no fragments at all.

Acknowledgements — The research was supported by the Budongo Conservation Field Station, Norwegian Research Council FRIMUF MATRIX project (184787/F10), and the Makerere–Bergen University Collaboration. We are grateful to the Ugandan National Forest Authority for permits to work in Budongo.

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Appendix: Number of records of each bird species in each fragment. N15 is the control plot, in the approximate centre of Budongo Forest. FF = forest specialist, F = forest generalist, f = forest visitor, NF = non-forest species, INGR = terrestrial insectivore, INGLL = leaf-gleaning insectivore, INSA = sallying insectivore, FR = frugivore, FRIN = frugivore-insectivore, GRIN = granivore-insectivore, NECIN = nectarivore-insectivore, IN = general insectivore

Scientific name	Habitat/feeding guild	N15	Busaju	Tengele	Ongo	Rwesama	Kasokwa	Kinyara
<i>Alethe diademata</i>	FF/INGR	18	17	2	11	6	0	0
<i>Alethe poliocephala</i>	FF/INGR	0	0	0	0	1	0	0
<i>Amandava subflava</i>	NF	0	0	0	0	0	1	0
<i>Androadus latirostris</i>	F/FRIN	5	10	0	0	1	0	0
<i>Andropadus gracilirostris</i>	FF/FRIN	0	0	1	0	0	0	0
<i>Andropadus gracilus</i>	FF/FRIN	0	1	0	0	0	0	0
<i>Andropadus virens</i>	F/FRIN	9	35	14	15	24	26	29
<i>Anthreptes collaris</i>	F/NECIN	0	0	0	0	0	0	1
<i>Apalis rufogularis</i>	FF/INGLL	0	0	0	2	0	0	0
<i>Bleda syndactyla</i>	FF/FRIN	10	19	13	9	17	1	2
<i>Cameroptera brachyura</i>	f/INGLL	0	1	1	4	4	10	4
<i>Cameroptera chloronota</i>	FF/INGLL	9	10	1	1	0	0	0
<i>Cameroptera superciliaris</i>	FF/INGLL	0	0	0	1	0	0	0
<i>Campethera caroli</i>	FF/INGLL	2	1	2	1	3	2	1
<i>Campethera nivosa</i>	FF/INGLL	3	1	0	2	3	0	0
<i>Cercococcyx mechowi</i>	FF/INGLL	0	1	0	0	0	1	0
<i>Clytospiza monteiri</i>	f/GRIN	0	0	0	1	2	4	1
<i>Cossypha cyanocamper</i>	F/INGLL	0	1	0	0	0	0	0
<i>Cossypha natalensis</i>	F/INGLL	0	7	4	0	0	1	0
<i>Cossypha niveicapilla</i>	F/INGR	0	0	0	0	0	1	0
<i>Criniger calurus</i>	FF/INGLL	2	4	0	1	0	1	0
<i>Estrilda nonnula</i>	f	0	1	0	0	5	0	0
<i>Halcyon badia</i>	FF/INGR	2	0	0	0	0	0	0
<i>Halcyon malimbica</i>	F/IN	1	0	0	4	3	0	1
<i>Halcyon senegalensis</i>	NF	0	0	0	2	0	0	0
<i>Hippolais languida</i>	NF	0	0	0	1	0	1	3
<i>Hylia prasina</i>	F/INGLL	3	8	3	3	6	1	8
<i>Illadopsis pyrrhoptera</i>	FF/INGR	1	0	0	0	1	0	0
<i>Ispidina lecontei</i>	FF/INSA	1	7	4	0	0	0	0
<i>Ispidina picta</i>	f/INSA	1	4	4	2	5	7	4
<i>Lagonosticta rubricata</i>	NF	0	0	0	0	5	0	0
<i>Lagonosticta senegala</i>	NF	0	0	0	0	2	0	0
<i>Lonchura bicolor</i>	f	0	1	0	0	3	0	0
<i>Lonchura cucullata</i>	f	0	0	0	0	4	1	0
<i>Lybius hirsutus</i>	F/FR	0	0	0	0	0	0	1
<i>Macrosphenus concolor</i>	FF/IN	0	0	0	1	0	1	0
<i>Malimbus rubricollis</i>	FF/FRIN	0	1	0	0	0	0	0
<i>Mandingoa nitidula</i>	FF/GRIN	0	10	0	1	0	0	0
<i>Merops albicollis</i>	f/INSA	0	0	0	0	1	0	0
<i>Muscicapa caerulea</i>	F/IN	0	0	0	0	0	1	0
<i>Myioparus griseigularis</i>	FF/FRIN	1	2	2	3	2	0	0
<i>Myioparus plumbeus</i>	F/INSA	0	0	0	1	0	0	0
<i>Nectarinia chloropygia</i>	F/NECIN	0	0	0	0	0	3	1
<i>Nectarinia olivacea</i>	FF/NECIN	34	19	10	12	25	17	4
<i>Nectarinia verticalis</i>	F/NECIN	0	0	0	0	0	1	0
<i>Neocossyphus poensis</i>	FF/INGR	0	3	0	0	0	0	0
<i>Neocossyphus rufus</i>	FF/INGR	0	0	2	0	0	0	1
<i>Nesocharis capistrata</i>	f	0	0	0	0	0	0	1
<i>Nicator chloris</i>	F/INGLL	0	0	0	1	0	0	0
<i>Nigrita canicapilla</i>	F/FRIN	0	0	0	3	0	0	0
<i>Phyllastrephus flavoatriatus</i>	FF/FR	48	67	22	23	30	14	8
<i>Phyllastrephus icterinus</i>	FF/INGLL	0	9	0	0	0	0	0
<i>Phyllastrephus xavieri</i>	FF/INGLL	0	0	1	0	1	0	0
<i>Phylloscopus trochilus</i>	f	0	0	0	0	0	1	0
<i>Platysteira blissetti</i>	FF/INSA	3	0	0	0	0	0	0
<i>Platysteira castanea</i>	FF/INSA	0	1	0	3	0	0	0
<i>Ploceus nigerrimus</i>	f/GRIN	0	0	0	7	0	0	0
<i>Ploceus nigricollis</i>	f	0	2	0	8	2	2	13
<i>Ploceus ocularis</i>	f/GRIN	0	0	0	0	0	2	5
<i>Ploceus superciliosus</i>	f/GRIN	0	0	0	0	1	0	0

Appendix: (cont.)

Scientific name	Habitat/feeding guild	N15	Busaju	Tengele	Ongo	Rwesama	Kasokwa	Kinyara
<i>Pogoniulus subsulphureus</i>	FF/FRIN	1	1	0	0	0	0	0
<i>Pycnonotus barbatus</i>	f	0	0	0	0	1	1	0
<i>Pyrenestes ostrinus</i>	F/GRIN	0	0	0	1	0	0	2
<i>Sarothrura elegans</i>	FF/INGR	0	0	0	0	2	0	0
<i>Sarothrura pulchra</i>	F/INGR	0	0	0	1	0	0	1
<i>Spermophaga ruficapilla</i>	F/IN	4	3	1	3	6	1	0
<i>Stiphornis erythrothorax</i>	FF/INGR	25	15	2	4	0	0	0
<i>Stizorhina fraseri</i>	FF/IN	0	0	1	0	0	0	0
<i>Sylvietta virens</i>	F/INGLL	0	0	0	1	0	1	0
<i>Terpsiphone rufiventer</i>	F/INSA	1	2	4	1	8	1	3
<i>Terpsiphone viridi</i>	F/INSA	0	1	0	0	0	0	0
<i>Trichastoma albipectus</i>	FF/INGR	6	7	1	2	0	0	0
<i>Trichastoma fulvescens</i>	FF/INGR	3	0	0	0	4	0	0
<i>Trichastoma rufipennis</i>	FF/INGR	13	4	4	9	6	4	8
<i>Turtur tympanistria</i>	F/FR	0	4	1	0	1	1	1