The abundance of birds in Uganda's inhabited areas and the importance of pastoral areas

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Abstract

The Uganda bird-monitoring programme has so far generated more than 18,600 observations from the 37 sites where land birds are monitored annually. Ten of the sites are in farmed area (agroecosystems), thirteen in semi-natural pastoral ecosystems and fourteen in natural ecosystems (mainly national parks). The farms are almost entirely small-scale and very diverse in their land use systems. Monitoring is by Timed Species Counts from which the frequency of recording of each species at each site can be generated (with over 460 species recorded so far, the overall spread sheet contains many zero values). The species numbers overall were the highest at natural sites (375 species), which also had the highest numbers of birds that often use trees, and those which are specialist grassland or aerial species or Palearctic visitors; but numbers of Red Data species are the highest in semi-natural sites. As one would expect, formerly forested areas and moist savannas support most tree birds, whilst Red Data species were most frequently recorded in areas of impeded drainage – typically, these are periodically flooded. Grassland specialists are more common in dry than in moist savannas. Palearctic migrants are nowhere common. Uganda's pastoral areas, on which domestic livestock graze and browse on predominant natural vegetation, are rich in birds and deserve a much more detailed study.

Key words: monitoring, diversity, birds, agroecosystems

Introduction

Amongst a number of biodiversity-monitoring programmes in Uganda are several concerning birds. These are summarized in the reports on *The State of Uganda's biodiversity,* for example Pomeroy & Tushabe (2004). The biggest, and the one which forms the basis for this study, is for landbirds, and began in 1988. However, it was not until 2002 that each of the 37 sites was visited regularly, twice a year; prior to that, different sites were visited in different years. No site has had <13 visits and some had >25 visits.

Three major forms of land use are represented.

- Natural ecosystems (mainly national parks, and predominantly savannas) – fourteen sites.
- Semi-natural ecosystems (pastoral areas) – thirteen sites.
- Agro-ecosystems – ten sites.

All sites have trees, ranging from sparse to quite dense woodland, and the ground flora is predominantly grasses, except where there is active cultivation. One of the natural sites (Ziika) is a small forest.

Study area and data collection methods

Sources of data

The 37 sites cover most of the country (Fig. 1), except the north, and thus the mean annual rainfall – both quantity and distribution – varies too, from about 800 to 1400 mm a year, and from areas with a bimodal pattern (mainly in the south and west) to those with a single longer rainy season, to the north and east.

Data for this study come from Timed Species Counts (TSCs), which are essentially species lists, and we have used them simply for presence–absence analyses. Essentially, each count consists of a list of the species recorded (whether by sight or sound), in the order in which they were detected, within a defined habitat. This information, divided into ten-minute blocks, can also yield more detailed estimates of relative abundance (Freeman, Pomeroy & Tushabe, 2003). Observers are free to move anywhere within the habitat, using an area of up to about a square kilometre.

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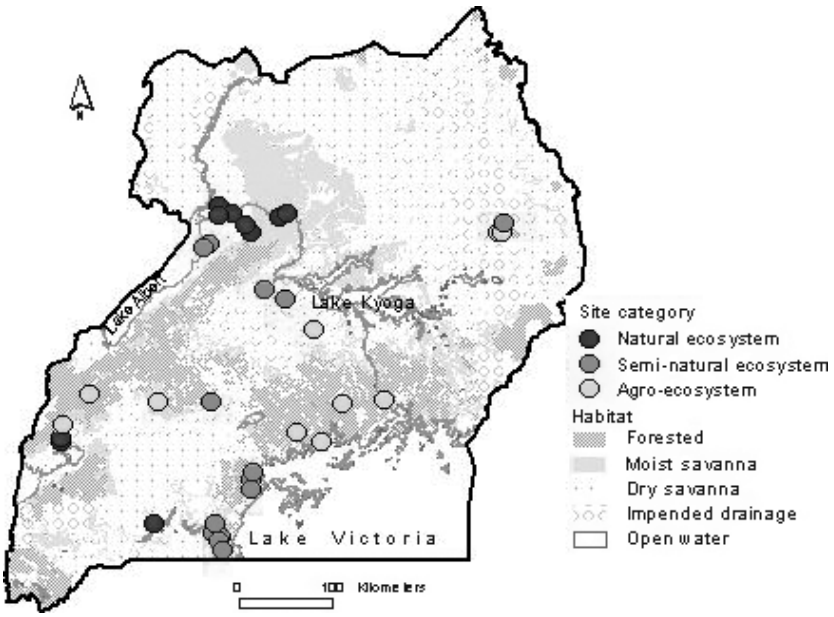

Fig 1 Location of landbird monitoring sites in Uganda

Sites were also categorized by their original natural vegetation, which was described in the 1960s by Langdale-Brown, Osmaston & Wilson (1964). It has changed little since then in the natural and semi-natural landscapes; of course, the changes are considerable in the ten agricultural sites, although these too retain remnants of the original vegetation, especially in those areas where the agriculture is less intense. Langdale-Brown *et al.* (1964) recognized 20 main vegetation categories, which they designated by letters from A to Z. The ones which concern us here have been grouped as follows: B to F are (or were) areas of forest or forest-savanna mosaic, G to K are moist savannas, L to V are dry savannas and W is used for areas that are subject to occasional flooding, characterized by impeded drainage. For each of these four categories, we had sites with the three types of land use described above (Fig. 1) except that, unsurprisingly, we found no agricultural site in areas of impeded drainage.

Because there are so many species, the birds can also be grouped in various ways. Here we use these categories.

- *Red Data species* (*birds of conservation concern*), which includes those classified by IUCN (http://www.iucn.org) as threatened or near-threatened; and those of regional concern (Bennun & Njoroge, 1996).
- *Migrants*. Uganda has many species, which are migratory; here we consider only those which breed in the Palearctic Region, where many are declining (Sanderson *et al.*, 2006).
- *Habitat specialists*. There is much concern with the process of deforestation, rampant in Uganda (Pomeroy & Tushabe, 2004) as in most tropical countries. We recognize the *forest species* as such (those designated forest specialists (FF) and generalists (F) by Bennun, Dranzoa & Pomeroy, 1996) and *nonforest tree species* (those which commonly use trees for nesting, roosting or feeding, and which Bennun *et al.*, 1996 called f-species). We suspect that natural grasslands are rapidly disappearing outside national parks, and so we also recognize a set of *grassland species* and finally, we looked at *aerial species*, which are a rather special set of insectivores.

Some birds belong to more than one category – thus the Barn Swallow *Hirundo rustica* is a Palearctic migrant, and an aerial feeder, whilst the Red-faced Barbet *Lybius rubrifacies* is a Red Data species and a forest generalist. Such birds were included in both categories for our analyses.

Data analysis

Timed Species Counts data for each species in the 37 sites were organized in a species-by-visit table and used to calculate the percentage frequency of recording using the formula below:

$$\text{Percentage frequency of recording} = \frac{\text{number of times when the species is observed}}{\text{total number of visits}} \times 100$$

Each of these percentage values was transformed to its arcsine (that is the angle whose sine is √p) so that the resulting data would have an underlying distribution that is nearly normal as opposed to the binomial distribution for most percentages (Zar, 1999). In Microsoft Excel, the arcsine is calculated for numbers between −1 and +1 and the returned angle is given in radians in the range from −pi/2 to pi/2. To express the arcsine in degrees, the resulting radians were multiplied by 180/pi.

The arcsine data from all 37 sites were merged into three files by land use, that is natural, semi-natural and agroecosystems, and by vegetation category, before the calculation of mean arcsine values. Finally, the mean arcsine values were retransformed into percentages. Thus, to take one example from Table 1, the percentage occurrence of the group of birds categorized as FF or F, which were recorded from sites in the forest biome, was, on average, 7.28; and so on.

Table 1 Mean percentage occurrence of species in various categories by biome of original vegetation

Category of birds	Vegetation type[a]	Natural	Semi-natural	Agroecosystems
Forest specialists and forest generalists	Forest	7.286	0.659	0.760
	Moist savanna	0.101	1.719	1.406
	Dry savanna	0.041	0.083	0.088
	Impeded drainage	0.068	0.031	No site
	Mean	0.184	0.273	0.454
Forest visitors	Forest	2.977	6.704	4.695
	Moist savanna	4.590	8.871	9.086
	Dry savanna	2.673	2.633	3.636
	Impeded drainage	5.864	1.934	No site
	Mean	3.826	3.706	4.617
Red Data species (Regional & Global)	Forest	0.003	0.464	0.171
	Moist savanna	0.280	0.295	0.027
	Dry savanna	0.215	0.048	0.132
	Impeded drainage	0.598	0.613	No site
	Mean	0.294	0.493	0.136
Grassland	Forest	0.020	3.799	0.106
	Moist savanna	0.715	0.662	0.412
	Dry savanna	2.180	1.197	0.408
	Impeded drainage	0.001	2.020	No site
	Mean	1.220	1.492	0.233
Palaearctic migrants	Forest	0.047	2.667	0.188
	Moist savanna	0.331	1.272	0.804
	Dry savanna	1.024	0.999	0.506
	Impeded drainage	0.001	1.263	No site
	Mean	0.742	1.267	0.349
Aerial	Forest	1.299	13.430	2.545
	Moist savanna	1.899	5.265	4.073
	Dry savanna	2.431	3.586	2.264
	Impeded drainage	2.826	4.366	No site
	Mean	2.261	4.841	2.565
All species combined	Forest	2.1231	3.1874	1.3048
	Moist savanna	1.1816	2.9620	2.6542
	Dry savanna	1.1224	1.1128	0.8905
	Impeded drainage	1.6847	1.0232	No site
	Mean	1.3155	1.5596	1.2360

Data for individual species were transformed to arcsine values and averaged. Figures in the table are mean percentage values (after retransformation).

[a]Vegetation types follow Langdale-Brown *et al.* (1964)– see text for details.

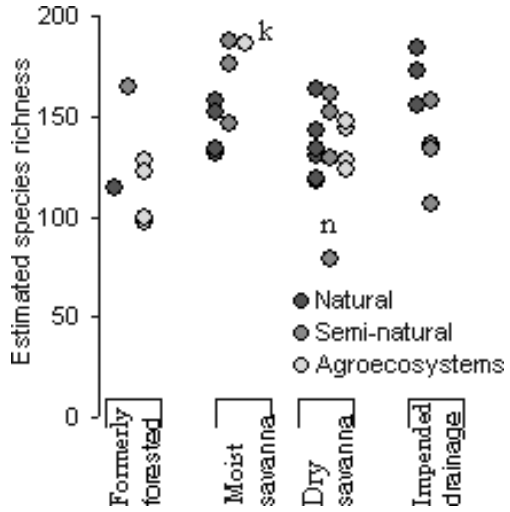

Fig 2 Jack 1 estimates of species richness (in relation to original vegetation types at each site) (sites n and k are referred to in the text)

Overall species richness was estimated by the Jackknife 1, a first-order Jackknife estimator that employs the number of species that occur only in a single sample. However, as Jack-knife estimates increase with the number of replicates (Magurran, 2004), we standardized their calculation at the 15th count at each site (for the few cases with <15 counts so far, we extrapolated from the observed totals).

Results and discussion

By the end of 2005, 18,689 records had been obtained, covering 45% (463) of the 1007 species currently listed from Uganda (Carswell *et al.*, 2005). The results that are presented in Fig. 2 and Table 1 show considerable differences between the various categories that we considered. To begin with, the combined data for all species (bottom of Table 1) show that the occurrence of any one species is, on average, almost equally likely in any of the three land-use categories, although the semi-natural sites have slightly higher values (Table 2). The total number of species is significantly higher between natural and agroecosystems ($t = 3.548$, d.f. = 6, $P < 0.02$) as well as between semi-natural and agroecosystems ($t = 4.959$, d.f. = 6, $P < 0.01$).

Species richness also shows large variations between sites (Fig. 2). Bearing in mind that there was only one semi-natural site in a formerly forested area, only one cultivated site in a moist savanna area (Kyegegwa West – k on Fig. 2) and no cultivation in the areas of impeded drainage, we can still detect some provisional trends, thus:

- Areas of impeded drainage are particularly rich when they retain their natural vegetation.
- For semi-natural areas, moist savannas had the most species.
- In dry savannas, where comparisons are most easily made, all three forms of land use have rather similar numbers of species. Indeed, the average values for species richness across all sites regardless of their original vegetation, are remarkably similar: (mean, SD of $\hat{S}$) areas with natural vegetation – 146, 21; semi-natural vegetation – 144, 29; and for agroecosystems – 129, 28.
- The unexpectedly high species number at Kyegegwa West (Fig. 2, k) is likely to be a result of there still being a considerable amount of natural vegetation in the area. In contrast, Nabugabo grassland, a virtually treeless area, has rather few species (Fig. 2, n).
- As predicted, the pastoral areas (semi-natural) and the natural sites are far more important for grassland species than are the agricultural areas. Similarly, aerial species are most frequent at semi-natural sites as, less expectedly, are the Palearctic migrants. Red Data species are generally sparse, and particularly so in agroecosystems.

Table 2 The total number of species in various categories by biome of original vegetation

	Total number of species		
Category of birds	Natural	Semi-natural	Agricultural
Forest specialists	17	14	7
Forest visitors	73	77	73
Red data species	35	38	24
Grassland species	49	42	26
Palaearctic species	37	36	22
Aerial species	23	23	20

Conclusion

Agricultural sites support many birds, particularly those that need trees, including the two categories of forest birds. Most agriculture occurs in areas that were formerly forested, so the probable explanation for this result is that some forest birds survive outside forest. However, for all other categories, the birds of agroecosystems occur less frequently than in natural and semi-natural habitats.

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