ISSN 0250–4162

SCOPUS

A publication of the
Bird Committee of the
East Africa Natural History Society

Edited by
Darcy Ogada
David Pearson
Graeme Backhurst

Volume 37(2), July 2017

BirdLife INTERNATIONAL

NatureKenya
The East Africa Natural History Society

Scopus 37(2), July 2017

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Diurnal patterns at an autumn migration ringing site near the Sudan Red Sea coast

Gerhard Nikolaus, David Pearson and Bernd Raddatz

Summary

During August to October in 1982 and 1983 large numbers of migrating Palaearctic passerines were trapped and ringed after their early morning arrival in a small watered garden at Khor Arba'at near the Sudan Red Sea coast (Nikolaus 1983). Numbers within this small site varied throughout the day according to a regular pattern, and it was noted that different species peaked in the catch at different times of the morning. In 1984 the site was worked systematically with a constant number of mist-nets over the main migration period, from 17 August to 23 September. Times of capture were noted and the temporal capture profile, from dawn to midday, was determined for each species. Nocturnal migration was also investigated during September 1984 by observing birds crossing the face of the full or near full moon.

Site details and methods

Khor Arba'at (19°42´N, 37°16´E) lies at the foot of the Red Sea Hills, where it provided a water source and pump station for the town of Port Sudan on the coast about 25 km to the southeast. Here, an L-shaped watered garden of some 0.5 ha with date palms and lemon trees formed a small green oasis amid arid surroundings during August–September. The ground outside was completely bare, the small sparse acacia bushes leafless towards the end of the local hot dry season (see Fig. 1). Days and nights were fine throughout August–September 1984, with daily maximum temperatures of 40–44° C during early weeks, falling to 36° C later in September. Two sets of four 12 m x 2.5 m mist-nets were employed throughout, each set across an arm of the L, 96 m of net in all. These were opened each day from before dawn until 12:00 or 13:00, and usually closed during the afternoon. They were sometimes opened and checked throughout the night. Times of capture were routinely noted within half-hour periods. Sunrise was at 05:00–05:15, sunset at 18:00–18:15.

Figure 1. The Khor Arba'at water pump station in September 1984.

To compare the intensity of migration at different times of night, and to estimate direction of flight, birds crossing the disc of a full or near full moon were observed and counted during the four nights beginning 8–11 September. Numbers were recorded within 15-min periods of observation through 10x binoculars, continuously from 19:00 to 21:15, then over the first 15 min of each hour from 22:00 to 02:00. Mean counts per 15-min period were derived by pooling results from different nights. On the first two nights the moon was already up at sunset so that observation could begin from 18:15. On the last two nights the moon was high enough in the sky to allow counts nearer dawn, and these were made within 15-min periods from 03:00 to 04:45. Direction was deduced from points at which birds entered and left the moon's disc, taking account of its position in the night sky. Without knowledge of the birds' height and without correction for the moon's altitude no attempt could be made to assess migration density quantitatively, but moonwatching revealed a consistent nightly pattern of overhead migration traffic.

Daytime in the garden

Remarkable numbers of Palaearctic passerines entered the tiny garden at times. Thousands were present on some days with many hundreds caught and ringed. Although nets were occasionally opened and checked at night practically no birds were caught. But from first light at 04:45 birds descended rapidly into the garden each morning with a whistling wing sound, and this continued over a period of about 20 minutes. Many birds, mainly Thrush Nightingales *Luscinia luscinia*, were then caught in the nets before sunrise. Other species, notably Marsh Warbler *Acrocephalus palustris*, soon joined the catch, but others were scarce in the earliest net round and tended to appear mainly from 08:00 or later. These 'later' species were perhaps entering the garden throughout the morning unnoticed. Catching typically remained very brisk for about five hours, but obvious activity decreased, most birds taking shelter within the date groves and other leafy cover and emerging only to drink from the various puddles and troughs provided. By 12:00–13:00, when the temperature often reached 43° C or higher and a northeasterly wind had got up, the garden would appear quiet, but inspection of the date groves often revealed the rustlings of hundreds of sheltering passerines, and the impression was that full numbers were then still present. Three hours later most of these birds had invariably left the garden, but attempts to observe their departure from its perimeter during the hot afternoon met with little success.

Moonwatching observations

Nocturnal activity as revealed by moonwatching occurred within two separated periods, as illustrated in Fig. 2. It peaked during the first hour after sunset, 18:30–19:30, when the mean hourly count of birds moving across the moon's disc exceeded 40. This initially included some very low flying birds that were assumed to be taking off from the garden. Movement then decreased steadily until finally ceasing around 21:00. It was renewed again after midnight and then continued until first light at 04:30. Peak activity in these early morning hours was recorded between 03:00 and 04:00, a time when many bird calls were heard, notably those of Ortolan Bunting *Emberiza hortulana*. A mean count then of about 20 birds per hour crossing the moon was lower, however, than that recorded after sunset. From their size and flight pattern during a typical one to two second transit of the moon's disc most birds were judged to be small passerines. They all appeared to be following a heading about south to south-southwest.

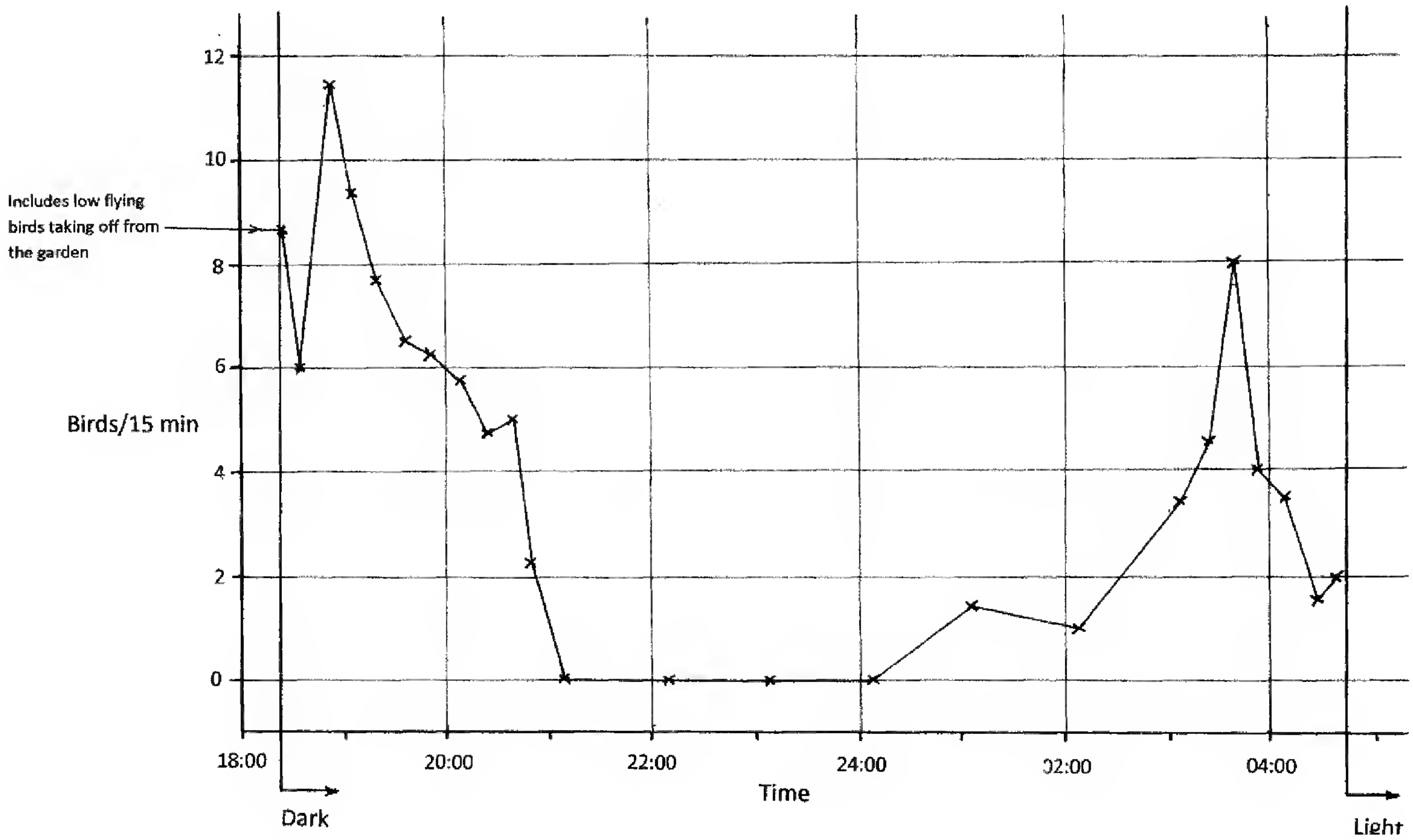

Figure 2. Mean count of birds crossing the moon during each 15-min period.

Hourly capture patterns of individual species

Capture patterns of the main species are shown in Fig. 3, which gives the percentage of the season's overall catch netted within each hourly period of the morning. Birds entered the nets from 05:00, just before sunrise, and continued to do so into the late morning. Activity typically tailed off about midday (12:00) and the nets were usually closed soon after. The first hour of netting was invariably dominated by Thrush Nightingale, and accounted for over 60% of this species' catch. The few Common Nightingales *Luscinia megarhynchos* were also mostly caught soon after dawn. Other early species were River Warbler *Locustella fluviatilis* (with 65% before 07:00) and Common Redstart *Phoenicurus phoenicurus* (60% before 06:00). Marsh Warbler, the principal species overall, made an early appearance, but the main catching period extended from 05:30 to 09:00. A similar temporal pattern was found for Reed Warbler *A. scirpa*ceus and Great Reed Warbler *A. arundinaceus*, but Olivaceous Warbler *Iduna pallida* was caught mainly from 07:00 onwards. There were few *Sylvia* warblers during the early hours, but they became prominent throughout the garden from about 08:00 onwards. Almost half the Garden Warblers *S. borin* and Common Whitethroats *S. communis* were caught between 10:00 and midday, and a similar pattern was found with Blackcap *S. atricapilla*, Lesser Whitethroat *S. curruca* and Barred Warbler *S. nisoria*. Willow Warblers *Phylloscopus trochilus* and Spotted Flycatchers *Muscicapa striata* were scarce before 08:00, but commonly caught from 09:00 until after midday. Golden Oriole *Oriolus oriolus* was another species that appeared in late morning, as were Ortolan and Cretzchmar's Buntings *Emberiza caesia*, both caught mainly after 10:00. All three of the main shrike species, Red-backed *Lanius collurio*, Woodchat *L. senator* and Nubian *L. nubicus*, were very much in evidence from first light and then throughout the morning, undoubtedly following the concentration of small migrants. About half the catch of these shrikes was taken before 07:00. Lesser Grey Shrikes *L. minor*, on the other hand, seemed to arrive later, most being caught between 06:30 and 11:00.

Thus, as evidenced by trapping numbers, the invasion of this tiny 'oasis' at day-break by Thrush Nightingales was followed by the successive appearance of first Marsh Warblers, then Olivaceous Warblers, *Sylvia* species, and finally, in mid morning, Willow Warblers, Spotted Flycatchers, Golden Orioles and others.

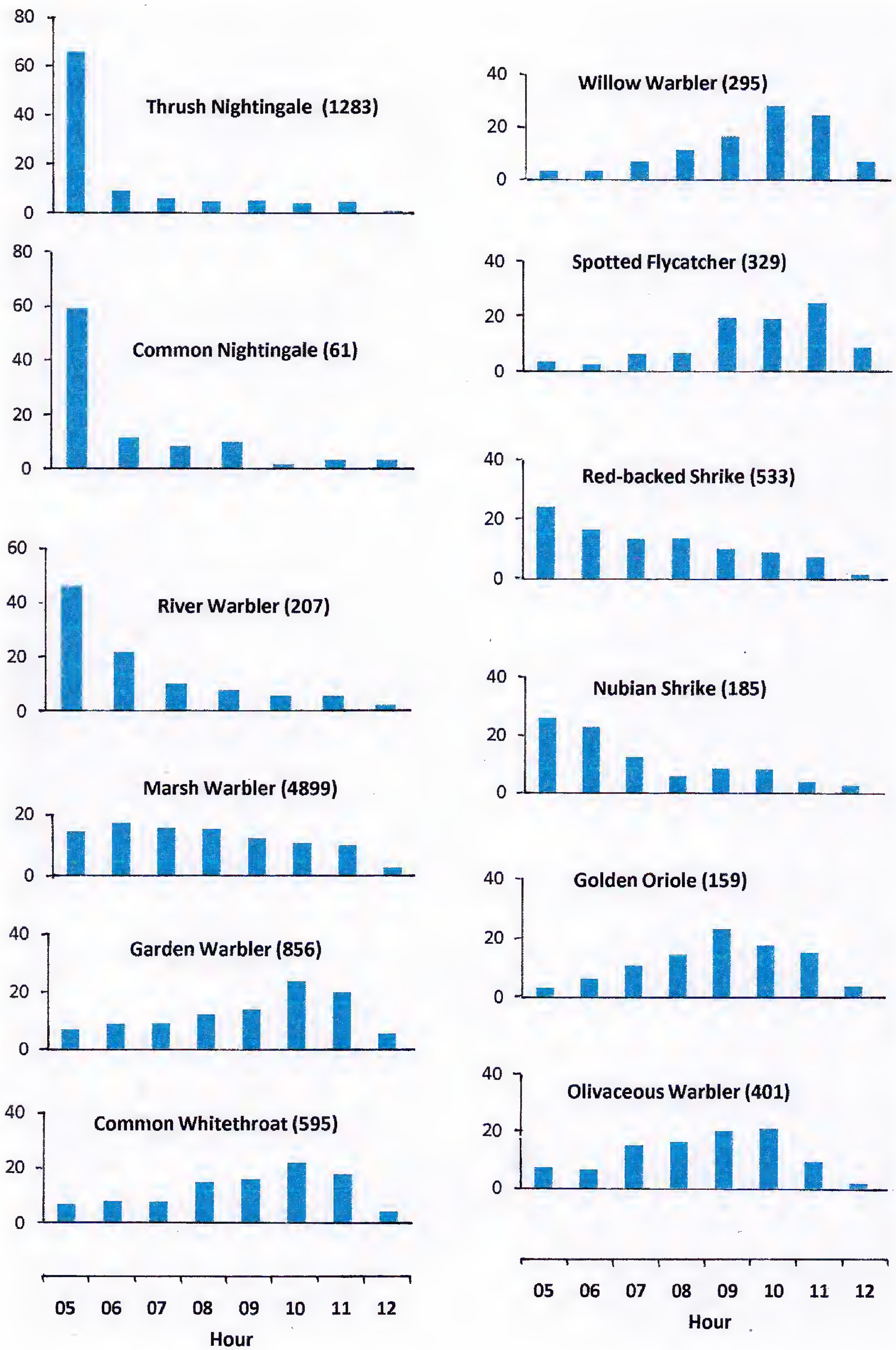

Figure 3. Percentage of the total season's catch of each species caught during hourly periods beginning at the morning times shown. The total catch for each species is given in parentheses.

Discussion

Migration at night

The passerine migrants arriving at Khor Arba'at each morning during August and September were mostly assumed to have crossed the Red Sea on a south to southwesterly heading, having set off the previous evening from northwest Saudi Arabia. The vegetated hills inland from the coast near Yanbu-al-Bahr may well have afforded a suitable transit and takeoff area. Such a flight would involve an oblique sea crossing of some 300–400 km followed before arrival at the ringing site by a shorter transit of the arid coastal Sudan plain, with its sparse littoral and semi-arid vegetation, as indicated in Fig.4. The south to south southwest heading apparent in the birds observed crossing the moon would fit this picture.

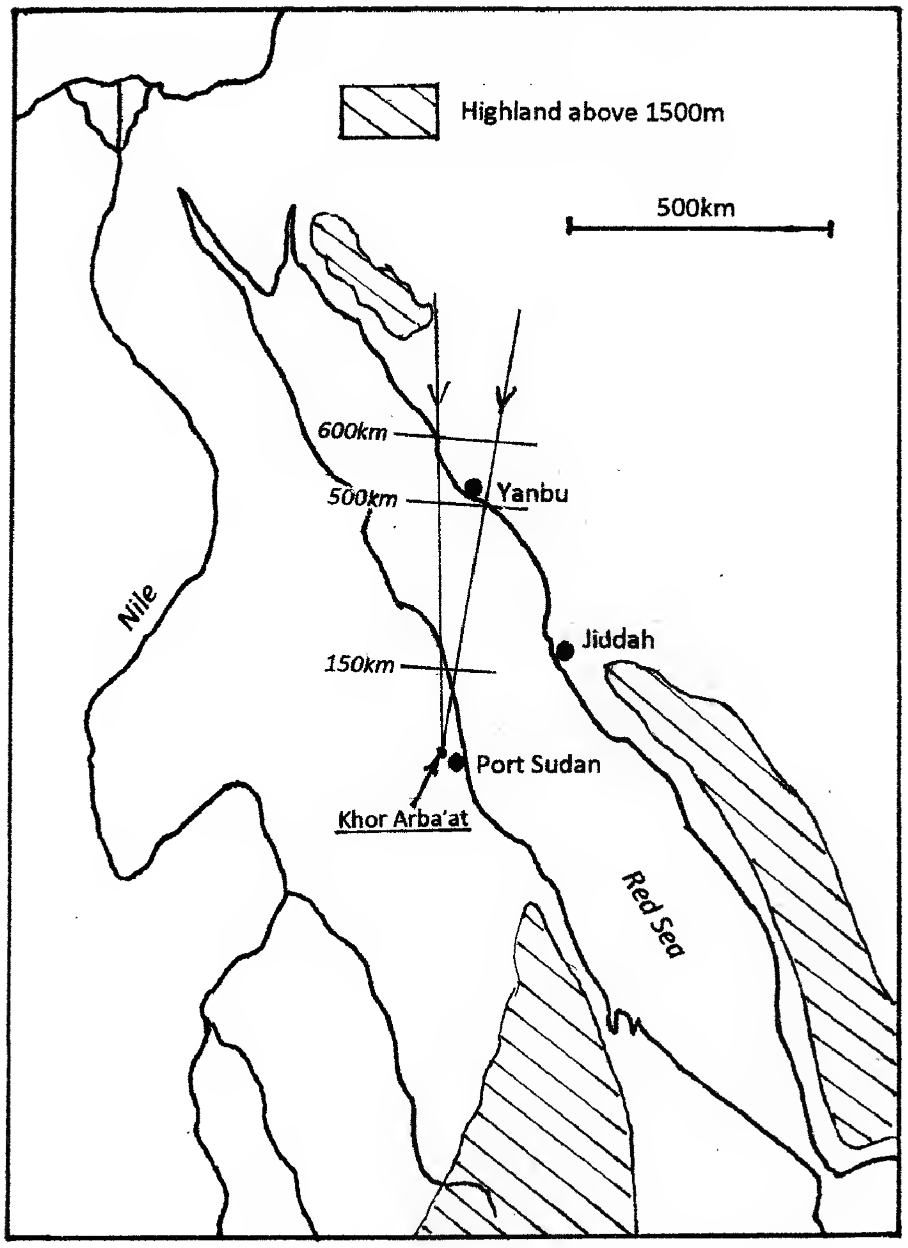

Figure 4. The Red Sea showing the location of Khor Arba'at, and suggesting the likely takeoff area and direction of migration of passerines arriving from Saudi Arabia. Distances from the site are indicated.

In a study of autumn migration across the deserts of northeast Egypt Biebach *et al.* (1991) assumed flight speeds for small passerines of between 15 and 21 m/s. This was based on radar measurements elsewhere, and included an 8 m/s component for the likely tailwind at an altitude of 1000 m. Winds over the northern Red Sea are also typically light to moderate from north to northwest (Edwards 1987), and would probably be stronger at 1000 m altitude. We could therefore assume a similar correction for wind speed as did Biebach *et al.* (1991) and also take likely ground speeds for birds flying from northwest Arabia to coastal Sudan as between about 15 and 20 m/s. Birds taking off in the evening from the Arabian coastal hinterland would then be expected to take some 9–12 h to reach Khor Arba'at about 500–600 km away, arriving shortly before or around dawn. If distance from takeoff or ground speed were outside these assumed ranges birds would arrive earlier before dawn or later into the morning.

Moonwatching at Khor Arba'at revealed two separate periods of nocturnal migration, one over the first three hours of darkness, the second over the last three to four hours of the night. Birds crossing the moon soon after dusk (a few quite close by) were assumed to be moving from the coastal plain shortly after takeoff from nearby sites. Again, assuming ground speeds in the range 15–20 m/s, the continuation of this movement up to 21:00 could account for birds heading from the plain from up to about 200 km to the north. But its cessation at this time indicated that further north–south nocturnal movement along the Sudan coast was minimal. The renewal of activity after midnight probably involved the arrival of the first of the birds to have taken off the previous evening from near the opposite Red Sea coast. Peak moon observations at 03:00–04:00 presumably reflected the main overhead passage of birds from Arabia heading into the Sudan Red Sea Hills and the Nile basin beyond.

Arrivals in the garden

The difference in arrival and capture times of different species in the Khor Arba'at garden was striking. Given their more crepuscular habits, the prominence of *Luscinia* species in the first round catches was to be expected. But the delay of two to three hours before the build up in numbers of some of the warbler species was surprising. One possibility is that species such as Thrush Nightingale and River Warbler were from less distant Arabian takeoff areas, or had faster flight speeds, than say Olivaceous Warbler and Willow Warbler, and so reached Khor Arba'at earlier. But this would imply that the later arrivals were continuing their migratory flight for several hot hours into the morning. It seems much more likely that all overflying migrants were looking for a landing area at first light, and the small green oasis of Khor Arba'at was especially attractive to birds requiring shade and cover such as *Luscinia, Acrocephalus* and *Locustella* species. Others might be able to tolerate landing in less verdant sites better, with Olivaceous Warblers, Willow Warblers and Spotted Flycatchers, for example, more able to feed in drier bush. Their influx into the garden may well have occurred unobtrusively, subsequent to an initial landing in the surrounding area.

Acknowledgements

We thank the Ministry of Wildlife, Khartoum and Mr Asir, the Chief Engineer at the water pumping station, for their help and for allowing us to stay in their Rest House.

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Scopus 37(2): 1–7, July 2017
Received 17 March 2017

Scopus 37(2): 8–23, July 2017

The role of kopjes in bird species' conservation within an agricultural matrix west of the Greater Serengeti Ecosystem, Tanzania

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Summary

This study was conducted in unprotected agricultural land located just west of the Greater Serengeti Ecosystem to assess 1) avian community composition in four different habitat types, and 2) the importance of kopjes found in agricultural areas in conservation of birds. All species recorded during this study have been recorded in the nearby Serengeti Ecosystem suggesting that the study area is a subset of this ecosystem. The density of bird species and individuals were higher in the kopjes than in the surrounding human-impacted habitats. Thus the kopjes in farmland increase regional avifaunal diversity, and this is likely due to the provision of diverse habitats. The kopjes as well as the surrounding habitats are important for bird species conservation even though they are found in agricultural areas.

Introduction

Just west of the Greater Serengeti Ecosystem (GSE), an area defined by movements of migratory wildebeest (see Hopcraft *et al.* 2015), lies agricultural land (hereafter agriculture) under intensive cultivation and animal husbandry. In this area also occur patches of degraded woodlands in hilly areas, riparian vegetation, as well as rocky outcrops (kopjes) that may be of importance for the birds and other fauna. It is assumed that similar natural savanna habitat found inside the present GRE previously extended into this area until agriculture and small holdings took over in the 1950s (Sinclair *et al.* 2002). The underlying assumption is that this area was originally similar in flora and fauna, geology, soil and nutrients and other ecological features to the southwestern and western parts of the existing Serengeti National Park (Sinclair *et al.* 2002).

Kopjes are impressive granite outcrops that protrude like "terrestrial islands" within a sea of the surrounding habitat matrix. They form exceptional habitats because their flora is often rich in species composition that differs from the vegetation in the surrounding areas (Poelchau & Mistry 2006). As evidence of their exceptionality, different species of amphibians, reptiles, birds and small mammals inhabit the kopjes (Sinclair & Arcese 1995, Timbuka & Kabigumila 2006, Trager & Mistry 2003, Byrom *et al.* 2015), as well as rare and endemic species (Porembski 1996, Porembski *et al.* 1996). Some animals take refuge in kopjes to forage during droughts, while others, especially predators may use kopjes as vantage points when hunting (Timbuka & Kabigumila 2006). Thus kopjes contribute considerably to the ecological diversity in the areas where they occur in terms of habitat heterogeneity and through the provision of shelter to a variety of fauna (Hoeck 1975, Anderson *et al*. 2008).

While the avian fauna of the GRE is fairly well known (e.g. Sinclair 1978, Folse 1982, Schmidl 1982, Gottschalk 2001, 2002, 2007, Sinclair *et al*. 2002, Trager & Mistry 2003, Jankowiski *et al*. 2015, Turkington *et al*. 2015), the areas surrounding this ecosystem, particularly agricultureal areas, are poorly known. To the best of our knowledge, the only study that has been carried out in the farmlands is that of Sinclair *et al*. (2002) which compared land under agriculture and protected areas, and found that many more species of birds are confined to the latter than the former.

Among the studied areas in the GSE are the kopjes (within Serengeti National Park), which have been found to differ significantly in bird species composition from those of the surrounding matrices and were of importance to the conservation of birds (Trager & Mistry 2003). For kopjes found in farmlands little or no attention has been focused on them. Using birds as a representative taxon, we assessed the role of the kopjes as habitats for birds in unprotected areas consisting of a matrix of agriculture, riparian vegetation, settlements and degraded shrub lands. The objectives were (i) to compare community composition across the four habitats, (ii) to assess whether or not birds found in the study area were similar to those of the nearby GSE, and (iii) to compare densities of birds (in terms of species and individuals) in the kopjes with the surrounding habitat matrix.

Materials and methods

Study area

The study area (2°27′40″–2°33′40″S, 33°49′13″–34°00′00″E; ~208 km^2, 1100–1140 m) was located at Igaganulwa and Ngasamo to the west of Maswa Game Reserve and Serengeti National Park, about 25 km southeast of Lake Victoria (Fig. 1). Rainfall is bimodal with periods of short rains during November–December and long rains during March–June. There is a long dry season that lasts from July to October and a short dry season in January and February.

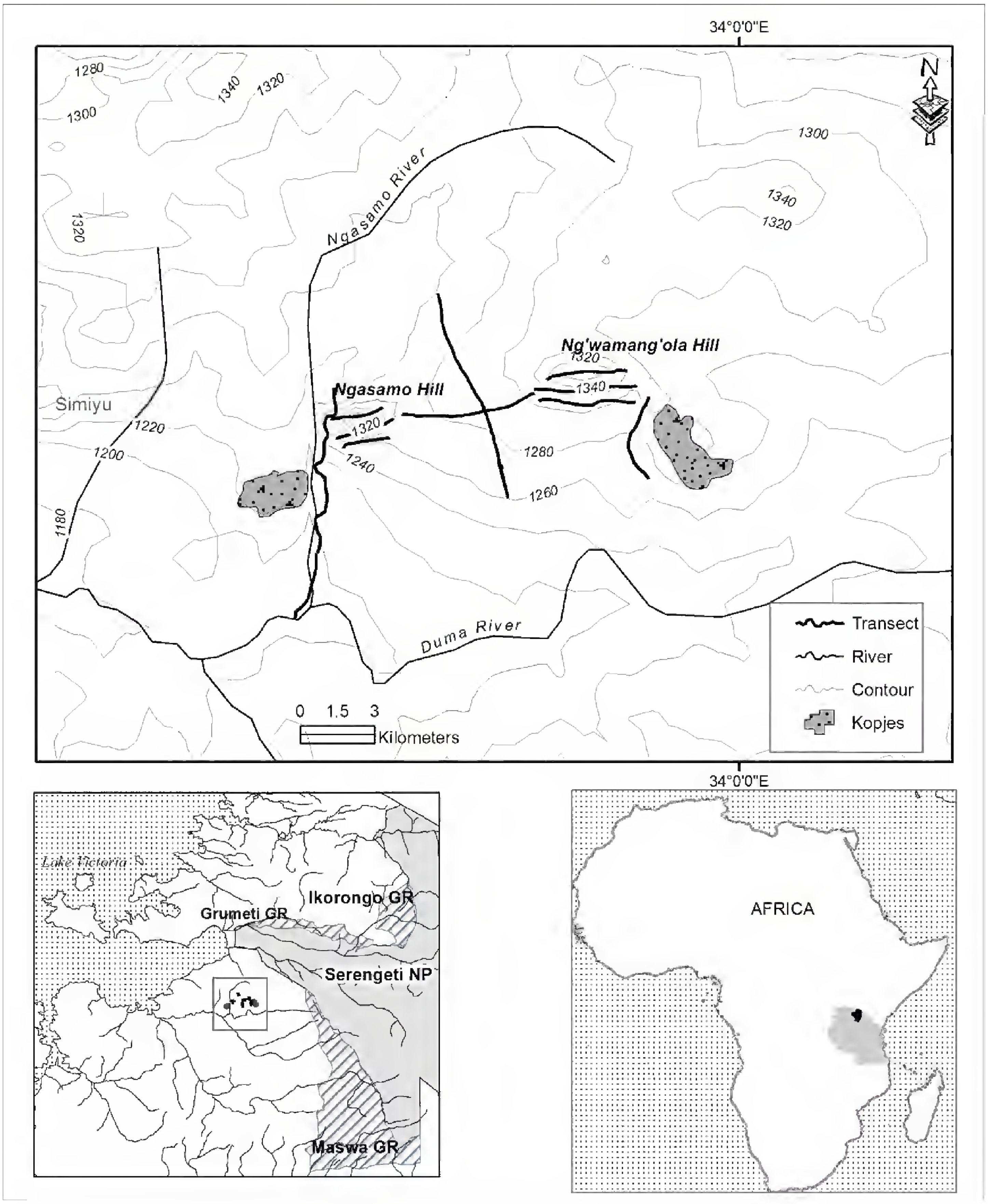

Figure 1. Map of the study area.

The study area consisted of two large groups of kopjes that had shrubs and broad-leaved trees such as *Ficus sycomorus*. The trees and shrubs formed dense thickets by growing among the rocks (Fig. 2; see Byrom *et al.* 2015). For comparison, three other main habitat types present in the study area were surveyed. These were:

1) Degraded woodland (hereafter shrub land) on Ngasamo and Ng'wamang'ola Hills (Fig. 1) and chiefly composed of shrubs with very few trees. The most frequent shrub species were *Acacia seyal, Rhus natalensis, Combretum adenogonium, Lantana camara, Harrisonia abyssinica, Acalypha fruticosa, Ormocarpum kirkii, Grewia microcarpa and A. drepanolobium.*

2) Farmland which consisted of small-scale farms, grazing land and some patches of wooded areas that all had scattered trees with farms around them (Fig. 2). This habitat surrounds the kopjes and hills. In the farmlands the predominant tree species included *Acacia* spp. and *F. natalensis.* The latter was fruiting during the dry season. Some farms were surrounded by hedges consisting of mainly *Acacia* sp. (Fig. 2).

3) Riparian vegetation found along the Ngasamo River that had well developed thickets and disturbed woodland comprised predominantly of *F. sur* and *A. polyacantha* (Fig 2).

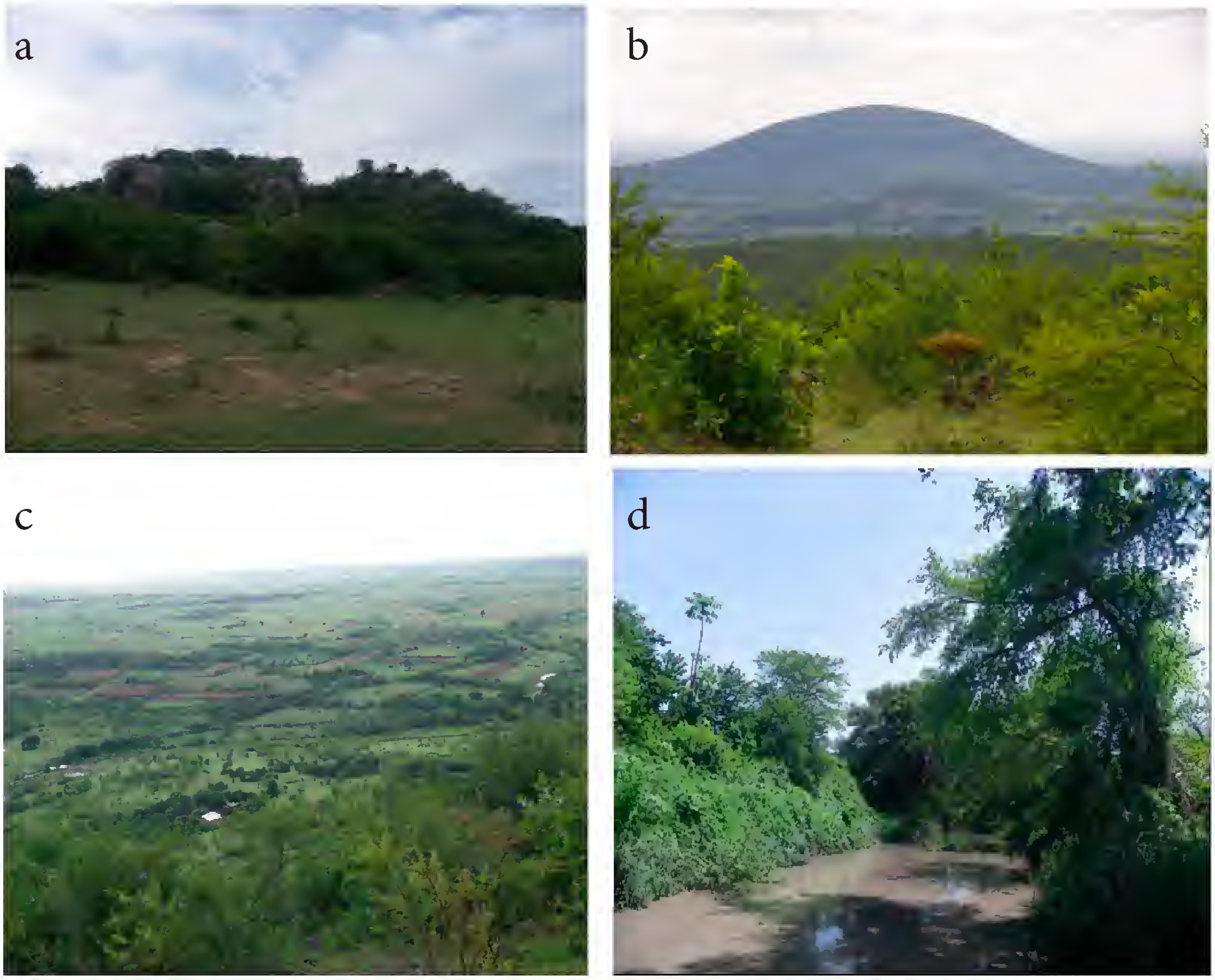

Figure 2. Four habitats composing the study area. (a) kopjes, (b) shrub land, (c) farmland and, (d) riparian vegetation. Photographs were taken during the wet season.

Methodology

We used line transects to sample birds because this method covers large areas quickly (Bibby *et al*. 2000). A total of 35 transects whose lengths varied from 1–4 km were surveyed in four main habitats during the wet season (April 2012) and during the dry season (August 2012). The lengths of transects were as follows:

- Kopjes: 16 transects, each 1 km
- Riparian vegetation: 6 transects each 2 km
- Farmland: 4 transects total, three 3-km and one 4-km transect
- Shrub land: 9 transects total, six 1-km transects, two 3-km transects and one 4-km transect

For the kopje transects, we ventured onto the kopjes where the rock structure and vegetation allowed, otherwise we walked around the perimeter. Data were collected by walking slowly along the transects in the mornings (between 06:30–11:00 h) and afternoons (between 16:00–18:00 h) during each season. All birds seen or heard up to 50 m on either side of the transect lines were identified and recorded. Birds seen opportunistically within the study area were also recorded.

Data analysis

To assess whether our sampling effort was adequate, we used rarefaction curves to compare species numbers between habitats because sampling efforts between habitats differed. We calculated density indices to assess whether there were significant differences in densities of species and individuals between and across different habitats. Data were tested for normality using Shapiro-Wilk test. Kruskal-Wallis test was used to assess whether there were significant differences in number of species per kilometre of transect, and densities of birds and species across the four habitat types. Mann-Whitney U-test was used to assess whether the number of species per kilometre of transect, and density of birds and species were significantly higher in the in kopjes than in farmland, riparian vegetation and shrub land habitats. These statistical tests were computed using the software package PAST (Hammer *et al.* 2001). Community composition of birds among different habitat types was assessed using the Sørrensen Disimilarity Index, comparing birds based on presence-absence data. The index is bound between 0 and 1, where 0 means the two sites have the same species composition and 1 means the two sites do not share any species. This analysis was done using the software package Community Analysis Package (CAP) version 4.1.3 (Seaby & Henderson 2007). Species order, taxonomy and common names follow Sinclair & Ryan (2010).

Results

Species richness

A total of 164 avian species were recorded (Appendix 1). Of these, 145 and 19 species were recorded along transects and during ad hoc observations, respectively. In total, 91 species were found in kopjes while more species, (n = 99) were observed in the riparian vegetation (Appendix 1). Eighty-nine and 76 species were recorded in farmlands and shrub land habitats, respectively (Appendix 1). Species accumulation curves for each habitat showed upward trends without reaching an asymptote, although they started to taper off somewhat (Fig. 3). The species accumulation curve for farmland fell below the other three habitats (Fig. 3).

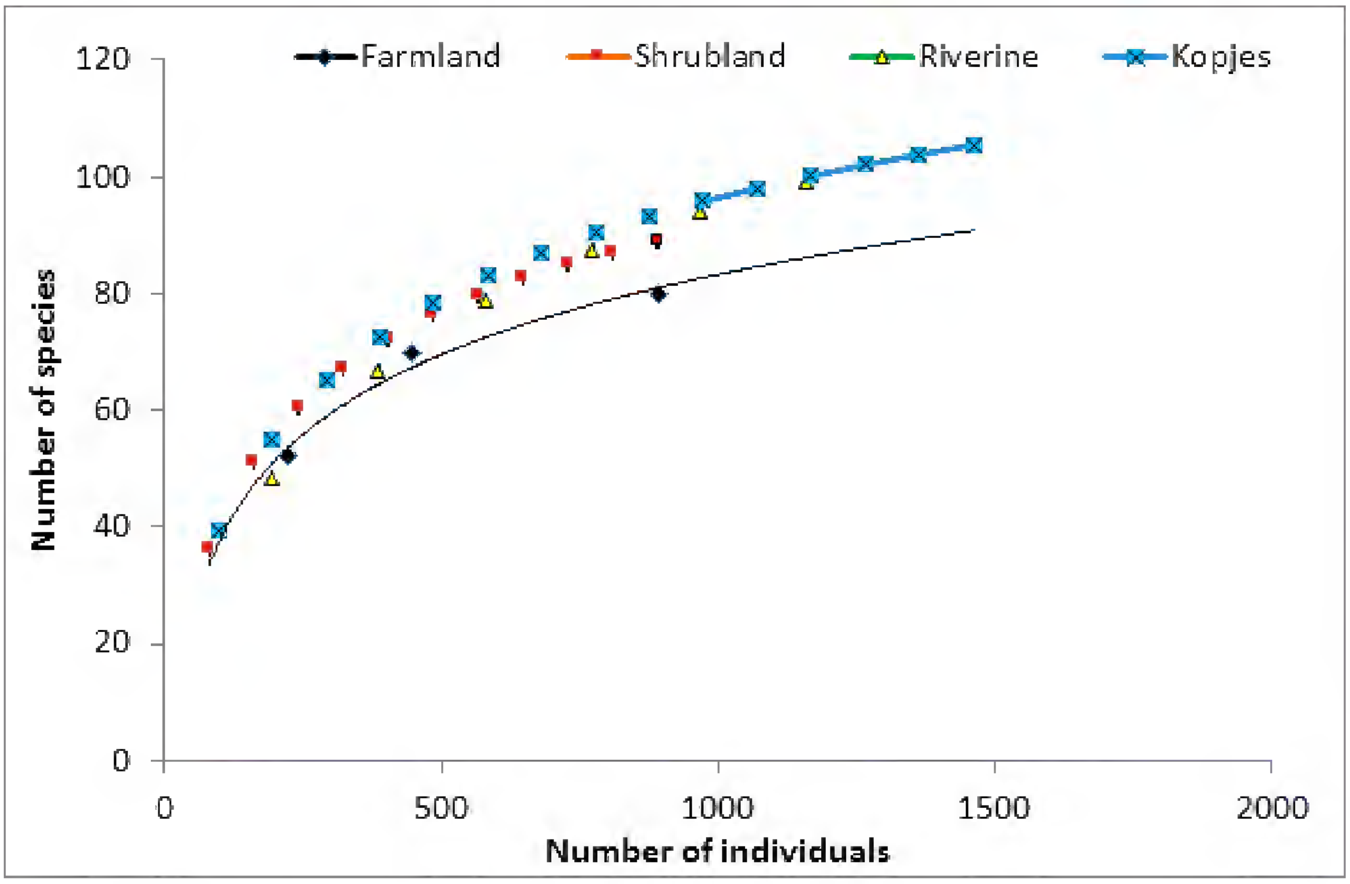

Figure 3. Rarefaction curves for the numbers of species in four habitats. The black line indicates rarefaction curve for the farmland.

Community structure

The bird community of the kopjes was more similar to that found in farmland, and was least similar to that of shrub land (Fig. 4).

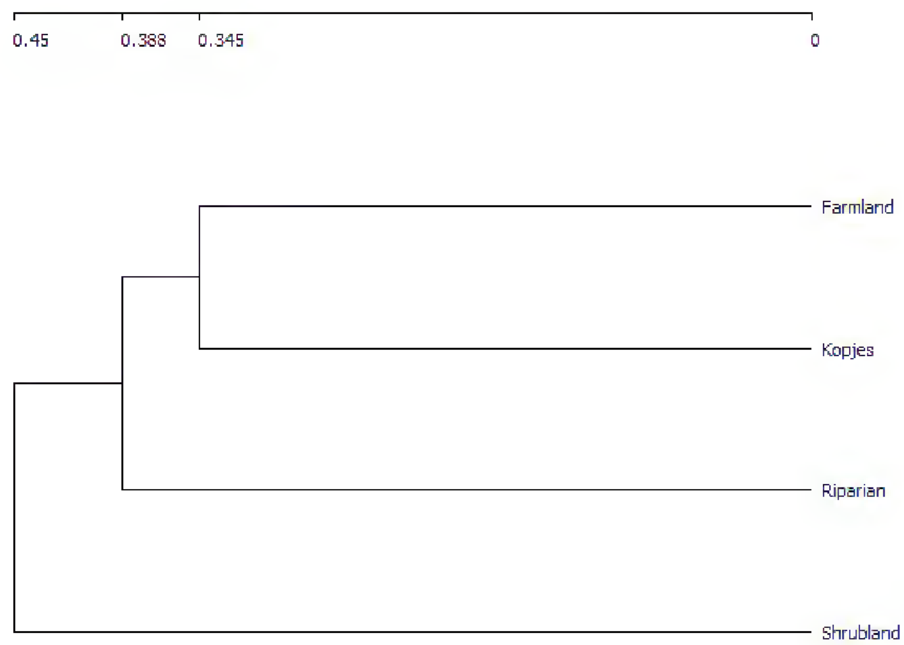

Figure 4. Community structure of birds found in the kopjes compared to those of other habitats.

Density of species and individual birds in the kopjes and surrounding matrix

The mean number of species per km of transect was 17.3 (±1.4). There were significant differences in numbers of species per kilometre between the four habitat types (Kruskal-Wallis test, $\chi^2=20.65$, $p<0.005$; Fig. 5). Mean numbers of species per kilometre were significantly higher in kopjes than in farmland ($U=4$, $p<0.005$), riparian vegetation ($U=18$, $p<0.05$) and shrub land habitats ($U=2.5$, $p<0.0005$).

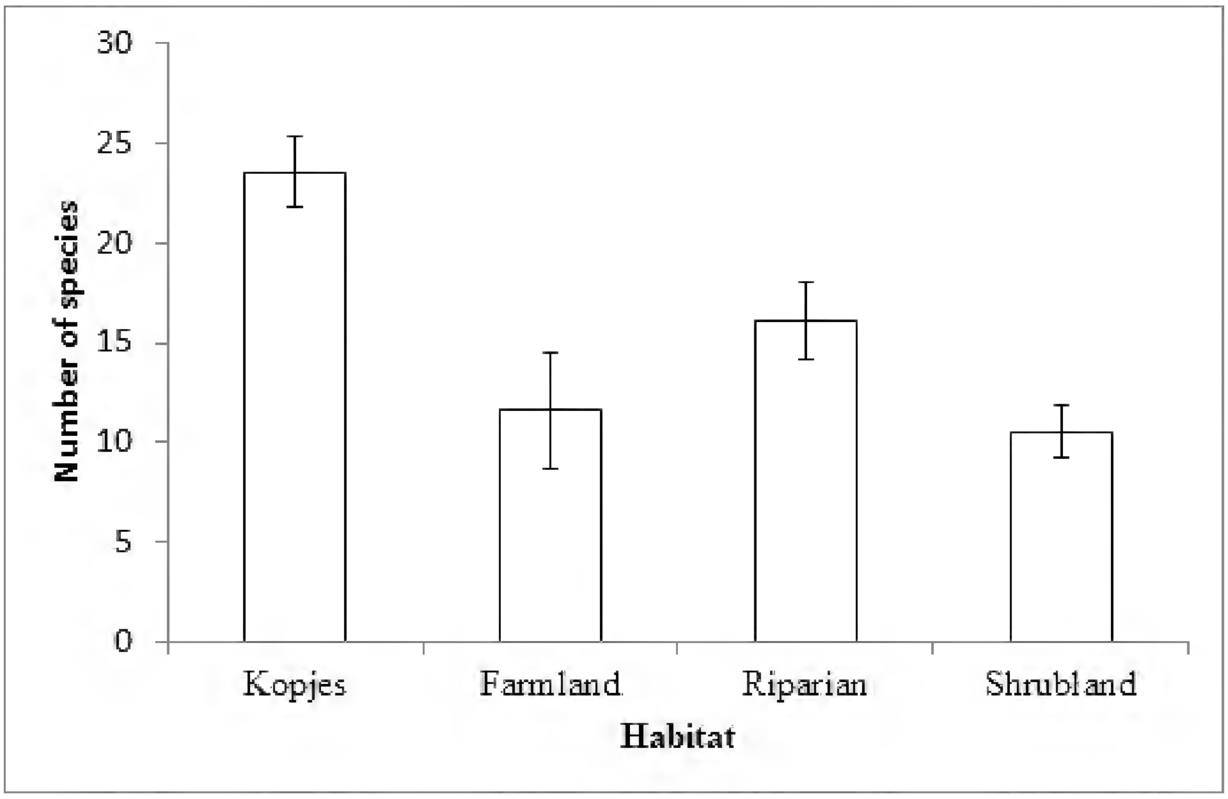

Figure 5. Number of species per kilometre of transect (± standard error).

Mean densities of species per square kilometre varied across the four habitats (Appendix 1). The most abundant were Wattled Starling *Creatophora cinerea* and Speckled Mousebird *Colius striatus,* particularly in farmland and riparian habitats, respectively (Appendix 1). These species were also abundant in the kopjes (Appendix 1).

The mean number of birds per square kilometre was 767.7 (±108.0). There were significant differences in the densities of birds across the four habitats (Kruskal-Wallis test, χ^2=12.05, $p<0.01$; Fig. 6). Kopjes had more birds per square kilometre than shrub land (U=7, $p<0.005$), but not in the farmland (U=23, $p>0.1$) or in riparian vegetation (U=47, $p>0.5$).

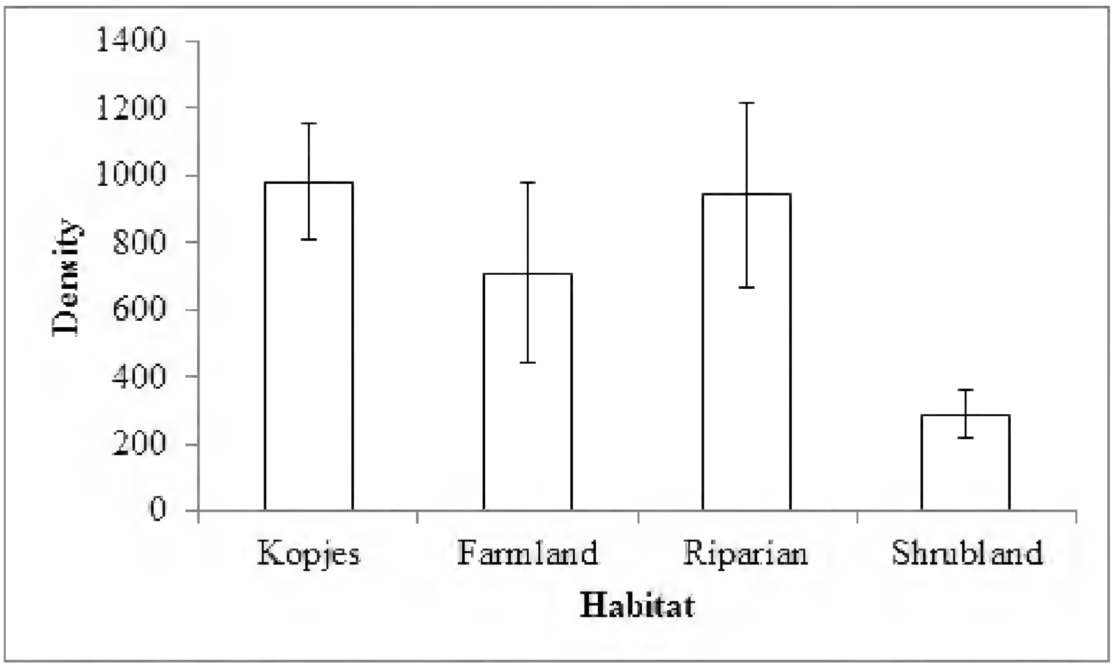

Figure 6. Density of birds per square kilometre (± standard error).

Discussion

Species richness and community structure

One hundred and sixty-four species of birds were recorded which is a quarter of the 617 species that have been found in the entire GRE (Jankowiski *et al.* 2015). The number of species recorded in this study is more than the 131 species that were recorded in kopjes and the surrounding matrix within the Serengeti National Park by Trager & Mistry (2003) of which about 55% (n=72) were detected in the present study. In this study, the availability of different habitats (i.e. shrub land, riparian vegetation, kopjes and farmland) may have created a heterogeneous matrix that attracted different species of avifauna. This agrees with the findings that structural heterogeneity of habitats is correlated with avian species richness (Trager & Mistry 2003, Mulwa *et al.* 2012).

All the species observed during this study have been recorded in the nearby GRE. These results imply that the study area is a subset of the entire GRE, except that it is under heavy human pressure. Of the birds detected, ten species were Palaearctic migrants that either used the study area as a wintering ground or as a habitat to move through during migration.

Results of the species accumulation curves suggest that the study was by no means an exhaustive survey of birds in the area. While more species were recorded in the riparian vegetation, about 55% of species found in the study area were recorded in the kopjes.

The bird community of the kopjes is most similar to that of farmlands. This could be due to the fact that the kopjes are surrounded by farmland and the birds could be moving freely between either habitat. The bird community in the kopjes was more similar to that found in riparian vegetation compared to that found in shrub land. This implies that the birds found in the shrubs (on the hills) were somehow distinct from those of the other habitats. In the other habitats there were more trees than there were on the hills, which were dominated by shrubs. For example, the absence of herons, ibises and storks in the shrub land habitat suggests that it was probably because this habitat was located on the hills where there were few resources (such as water) that could have been attractive to these birds.

Density of species and individuals

The higher density of both species and individuals in the kopjes compared to the other habitats could be a result of the presence of diverse and abundant vegetation both among the rocks and around the kopje edges. The kopjes form a distinct habitat that harbours diverse communities (Poelchau & Mistry 2006), probably due to minimal anthropogenic disturbance. It is likely that the high local habitat heterogeneity on the kopjes (see Poelchau & Mistry 2006, Poembski & Bathlott 2000) led to a higher density of bird species and individuals compared to the other habitats. The trees and shrubs found in the kopjes likely provide resources such as food, nesting sites and protection compared to the other habitats. For example, the presence of fruiting *F. sycomorus* in the kopjes attracted Speckled Pigeon *Columba guinea* and White-fronted Barbet *Lybius leucocephalus*, which were observed feeding on fruits of this tree. In addition, the rocks provided appropriate habitat for the Rock Martin *Ptyonoprogne fuligula*, which was only observed in the kopjes. Furthermore, large trees such as *F. sycomorus* likely provided potential nesting sites that were rarely found in the surrounding farmland. Large species such as Marabou Stork *Leptoptilos crumeniferus* and Hamerkop *Scopus umbretta* were nesting on the trees found only in the kopjes. Similarly, the kopjes provided perches, and refuge for the large-sized bird species such as Hamerkop, Hadeda Ibis *Bostrichia hagedash*, Marabou Stork, Bateleur *Terathopius ecaudatus*, Augur

Buzzard *Buteo augur*, Lesser Spotted Eagle *Aquila pomarina*, Tawny Eagle *Aquila rapax* and Spotted Eagle Owl *Bubo africanus*. The higher densities of species and individual birds in the kopjes implies that the kopjes represent local hotspots of avian diversity similar to the results of Trager & Mistry (2003).

Conclusion

Our findings suggest that kopjes have a high conservation value that needs to be recognized. Kopjes increase regional avifaunal diversity by providing unique microhabitats and abundant resources within an agricultural landscape. Thus, kopjes provide landscape level heterogeneity as has been proposed by Trager & Mistry (2003). Similar to kopjes found in the GSE, those found in unprotected areas should be recognised as important for the conservation of biodiversity and as potentially fragile habitats that merit protection. While it has been found that farmland has lower avian species richness compared to protected areas in the Serengeti (Sinclair *et al.* 2002, Jankowiski *et al.* 2015), the findings of this study demonstrate that the kopjes increase regional avifaunal diversity. We recommend further studies in other farmland surrounding the GSE in order to have a better understanding of how agriculture has shaped bird communities neighbouring this ecosystem.

Acknowledgements

We would like to thank B. Tindebwa and A. Macha for logistical support. We thank A.R.E. Sinclair and D. Ogada for helpful comments on a draft of this manuscript.

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Scopus 37(2): 8–23, July 2017
Received 5 April 2017

Appendix 1. List of birds observed in the kopjes and in the surrounding habitats. Abbreviations are as follows: d = mean density (individuals per km^2), s.e. = standard error, * = Palaearctic migrants and x = *ad hoc* observations (species not observed during transect surveys).

Species name	English name	Kopjes		Riparian		Agriculture		Shrubland	
		d	s.e.	d	s.e.	d	s.e.	d	s.e.
Scopus umbretta	Hamerkop	3.75	1.55	0.83	0.83	0.63	0.63		
Ardea cinerea	Grey Heron			x					
Ardea melanocephala	Black-headed Heron			0.83	0.83	1.67	0.96		
Bubulcus ibis	Cattle Egret					x			
Ardeola ralloides	Squaco Heron			0.83	0.83				
Butorides striata	Green-backed Heron			1.67	1.67				
Nycticorax nycticorax	Black-crowned Night Heron			0.83	0.83				
Bostrychia hagedash	Hadeda Ibis	1.25	1.25	3.33	2.11	0.83	0.83		
Leptoptilos crumeniferus	Marabou Stork	5.63	5.63						
Anastomus lamelligerus	African Openbill			2.50	2.50				
Ciconia abdimii	Abdim's Stork					64.55	6.55		
Mycteria ibis	Yellow-billed Stork			0.83	0.83				
Milvus migrans	Black Kite	1.88	1.88	0.83	0.83				
Circaetus pectoralis	Black-chested Snake-Eagle			0.83	0.83	0.63	0.63		
Macheiramphus alcinus	Bat Hawk			1.67	1.67				
Teraphopius ecaudatus	Bateleur	0.63	0.63	0.83	0.83				
**Circus macrourus*	Pallid Harrier					x			
Polyboroides typus	African Harrier Hawk					x		x	
Kaupifalco monogrammicus	Lizard Buzzard					0.83	0.83		
Melierax metabates	Dark Chanting Goshawk	0.63	0.63			1.88	1.88		
Accipiter minullus	Little Sparrowhawk	1.25	0.85						
Buteo augur	Augur Buzzard	6.88	1.98	1.67	1.05				
**Aquila pomarina*	Lesser Spotted Eagle	0.63	0.63					0.91	0.91
**Aquila rapax*	Tawny Eagle			2.50	2.50				
Numida meleagris	Helmeted Guineafowl	1.88	1.88					0.61	0.61
Peliperdix coqui	Coqui Francolin					0.63	0.63		

Species name	English name	Kopjes		Riparian		Agriculture		Shrubland	
		d	s.e.	d	s.e.	d	s.e.	d	s.e.
Pternistis hildebrandti	Hildebrandt's Francolin	1.88	1.01					0.61	0.61
Amaurornis flavirostra	Black Crake			1.67	1.05				
Ardeotis kori	Kori Bustard					1.25	1.25		
Burhinus capensis	Spotted Thick-knee							x	
Charadrius tricollaris	Three-banded Plover			1.67	1.67				
Vanellus lugubris	Senegal Lapwing							0.61	0.61
**Actitis hypoleucos*	Common Sandpiper			5.00	4.08				
Columba guinea	Speckled Pigeon	1.25	1.25						
Streptopelia semitorquata	Red-eyed Dove	6.88	2.70	11.67	9.80	1.25	1.25		
Streptopelia decipiens	African Mourning Dove	4.38	2.03	4.17	2.39	6.67	6.67	1.21	0.93
Streptopelia capicola	Ring-necked Dove	50.00	17.09	30.83	25.31	2.29	1.57		
Streptopelia senegalensis	Laughing Dove	70.63	28.34	48.33	21.24	14.38	8.51	18.79	8.12
Treron calvus	African Green Pigeon	10.63	9.38	0.83	0.83				
Turtur chalcospilos	Emerald-spotted Wood-Dove	6.88	2.18	6.67	2.47	0.63	0.63	3.03	2.71
Turtur tympanistria	Tambourine Dove			0.83	0.83				
Oena capensis	Namaqua Dove			0.83	0.83	1.67	1.67	3.03	1.93
Agapornis fischeri	Fisher's Lovebird	46.88	30.71	43.33	35.93	3.33	1.92		
Chrysococcyx caprius	Diderick Cuckoo	3.75	1.55	1.67	1.05	5.63	4.83	5.00	2.47
Chrysococcyx klaas	Klaas's Cuckoo	0.63	0.63						
Clamator jacobinus	Jacobin Cuckoo			0.83	0.83				
Clamator levaillantii	Levaillant's Cuckoo			1.67	1.67				
Cuculus solitarius	Red-chested Cuckoo			x				x	
Centropus grillii	Black Coucal	0.63	0.63	0.83	0.83				
Centropus superciliosus	White-browed Coucal	3.13	1.20	3.33	1.67	0.83	0.83	0.45	0.45
Bubo lacteus	Verreaux's Eagle-Owl						x		
Bubo africanus	Spotted Eagle-Owl	1.25	1.25			0.83	0.83		
Caprimulgus fosii	Square-tailed Nightjar	0.63	0.63					2.12	1.21
Caprimulgus tristigma	Freckled Nighjar	x							
Colius striatus	Speckled Mousebird	83.75	24.05	315.00	131.33	23.75	7.95	48.18	19.24

Species name	English name	Kopjes		Riparian		Agriculture		Shrubland	
		d	s.e.	d	s.e.	d	s.e.	d	s.e.
Urocolius macrourus	Blue-naped Mousebird	23.13	21.87	1.67	1.67	27.50	27.50	6.67	3.92
Rhinopomastus minor	Abyssinian Scimitarbill					x			
Alcedo cristata	Malachite Kingfisher			2.50	1.71				
Ispidina picta	African Pygmy-Kingfisher	3.75	2.02	6.67	2.47	2.92	1.72	0.91	0.91
Halcyon leucocephala	Grey-headed Kingfisher	3.75	1.80			2.29	1.57		
Halcyon senegalensis	Woodland Kingfisher	0.63	0.63	1.67	1.67				
Eurystomus glaucurus	Broad-billed Roller			x					
Coracias naevius	Rufous-crowned Roller							1.82	1.82
Coracias caudatus	Lilac-breasted Roller					x			
Merops pusillus	Little Bee-eater	7.50	2.81	1.67	1.67	5.00	5.00	2.42	1.86
Merops superciliosus	Madagascar Bee-eater					0.63	0.63	10.91	10.91
**Merops apiaster*	European Bee-eater			6.67	4.77	5.00	5.00		
Tockus nasutus	African Grey Hornbill	0.63	0.63						
Pogoniulus pusillus	Red-fronted Tinkerbird			1.67	1.67	0.83	0.83	0.91	0.91
Lybius leucocephalus	White-headed Barbet	0.63	0.63						
Trachyphonus darnaudii	D'Arnaud's Barbet			1.67	1.67	4.17	2.50	7.88	3.12
Indicator minor	Lesser Honeyguide	0.63	0.63	1.67	1.05	0.83	0.83	2.73	1.26
Campethera nubica	Nubian Woodpecker					0.83	0.83		
Dendropicos fuscescens	Cardinal Woodpecker			x					
Mirafra africana	Rufous-naped Lark							3.94	1.67
Mirafra rufocinnamomea	Flappet Lark	0.63	0.63					8.71	5.39
Eremopteryx leucopareia	Fisher's Sparrow Lark			8.33	6.54	18.33	17.24	11.36	8.04
Ptyonoprogne fuligula	Rock Martin	40.63	17.09						
**Hirundo rustica*	Barn Swallow	3.75	3.75	1.67	1.67			100.91	82.14
Hirundo smithii	Wire-tailed Swallow	13.13	12.47						
Cercropis abyssinica	Lesser Striped Swallow	10.00	4.74	2.50	2.50	2.50	2.50		
Motacilla aguimp	African Pied Wagtail	0.63	0.63	14.17	6.11	2.29	1.57		
Anthus cinnamomeus	African Pipit							0.91	0.91
Coracina pectoralis	White-breasted Cuckoo-shrike			0.83	0.83				

Species name	English name	Kopjes		Riparian		Agriculture		Shrubland	
		d	s.e.	d	s.e.	d	s.e.	d	s.e.
Dicrurus adsimilis	Fork-tailed Drongo	2.50	1.94			2.72	1.72		
Corvus albus	Pied Crow			0.83	0.83				
Oriolus auratus	African Golden Oriole	0.63	0.63						
Oriolus larvatus	Black-headed Oriole	0.63	0.63	x					
Turdoides rubiginosa	Rufous Chatterer	1.88	1.88	10.83	7.12	4.17	4.17	4.55	3.66
Pycnonotus tricolor	Dark-capped Bulbul	33.75	5.39	35.0	16.68	6.04	2.13	17.80	6.10
**Monticola saxatilis*	Rufous-tailed Rock-Thrush	8.13	3.44	1.67	1.67			0.91	0.91
Cossypha natalensis	Red-capped Robin-Chat			0.83	0.83				
Cossypha heuglini	White-browed Robin-Chat	21.25	6.12	12.50	5.88	3.96	2.13	0.23	0.23
Cichladusa guttata	Spotted Palm-Thrush	8.75	2.87	8.33	2.79	8.34	3.09	3.33	1.96
Erythropygia leucophrys	White-browed Scrub Robin	3.13	1.51	1.67	1.05	2.08	1.25	16.36	5.92
Cercomela familiaris	Familiar Chat			x				2.73	1.95
Oenanthe pileata	Capped Wheatear							3.03	2.22
Thamnolaea cinnamomeiventris	Mocking Cliff-Chat	12.50	3.71	x					
**Phylloscopus trochilus*	Willow Warbler							1.82	1.82
**Sylvia borin*	Garden Warbler			1.67	1.05			3.64	2.44
Cisticola chiniana	Rattling Cisticola	10.63	3.92	8.33	3.33	8.33	6.31	31.44	9.22
Cisticola marginatus	Winding Cisticola	1.88	1.88	3.33	2.11	0.83	0.83		
Apalis flavida	Yellow-breasted Apalis	1.88	1.36	1.67	1.67				
Prinia subflava	Tawny-flanked Prinia	17.50	4.52	1.67	1.67	2.50	1.60	0.30	0.30
Eminia lepida	Grey-capped Warbler	0.63	0.63	19.17	8.00				
Sylvietta whytii	Red-faced Crombec	1.88	1.36	3.33	1.67	0.63	0.63	3.94	2.41
Camaroptera brevicaudata	Grey-backed Camaroptera	23.13	4.54	10.00	5.48	4.79	2.21	8.03	5.59
Bradornis microrhynchus	African Grey Flycatcher	2.50	1.12			7.71	2.83	7.88	5.01
Empidornis semipartitus	Silverbird	1.25	1.25	1.67	1.67	2.08	1.25	1.59	1.08
Muscicapa aquatica	Swamp Flycatcher			45.00	14.78				
Terpsiphone viridis	African Paradise-Flycatcher	6.25	2.72	14.17	6.25	6.67	2.36	1.82	1.82
Batis molitor	Chinspot Batis	3.75	2.72			4.79	3.01	6.36	2.36
**Lanius collurio*	Red-backed Shrike	0.63	0.63						

Species name	English name	Kopjes		Riparian		Agriculture		Shrubland	
		d	s.e.	d	s.e.	d	s.e.	d	s.e.
Lanius collaris	Common Fiscal			1.67	1.05	2.50	1.60	2.73	2.73
Dryoscopus cubla	Black-backed Puffback	1.88	1.01	5.00	3.16	0.63	0.63	0.23	0.23
Laniarius funebris	Slate-coloured Boubou	26.88	6.50	5.83	3.27	10.63	4.19	19.24	9.58
Laniarius erythrogaster	Black-headed Gonolek			13.33	5.58	1.25	1.25		
Tchagra australis	Brown-crowned Tchagra	3.75	1.55	3.33	1.67	1.67	0.96	6.89	3.56
Tchagra senegalus	Black-crowned Tchagra	0.63	0.63	0.83	0.83	0.63	0.83		
Lamprotornis purpuropterus	Rüppell's Starling			4.17	2.71				
Lamprotornis superbus	Superb Starling					5.42	2.84	10.61	6.11
Cinnyricinclus leucogaster	Violet-backed Starling	15.61	5.08	30.83	30.83	0.63	0.63	1.82	1.82
Onychognathus morio	Red-winged Starling	5.63	5.00	1.67	1.67				
Creatophora cinerea	Wattled Starling	102.50	93.57	15.00	15.00	295.00	290.56	13.33	10.01
Drepanorhynchus reichenowi	Golden-winged Sunbird			0.83	0.83				
Chalcomitra senegalensis	Scarlet-chested Sunbird	5.63	2.88	2.50	1.71	2.50	2.50	2.73	1.95
Anthreptes orientalis	Eastern Violet-backed Sunbird	5.00	2.24			4.38	1.71		
Hedydipna collaris	Collared Sunbird	6.88	2.99	0.83	0.83	1.25	1.25	0.61	0.41
Cinnyris venustus	Variable Sunbird	6.88	2.99	1.67	1.67			5.45	5.45
Cinnyris pulchellus	Beautiful Sunbird	3.75	2.72	2.50	1.71	2.08	1.25		
Passer rufocinctus	Kenya Rufous Sparrow					x			
Passer suahelicus	Swahili Sparrow	1.88	1.36			8.13	3.09		
Passer eminibey	Chestnut Sparrow							0.91	0.91
Sporopipes frontalis	Speckle-fronted Weaver					7.50	4.79	5.45	3.66
Pseudonigrita arnaudi	Grey-capped Social Weaver					6.67	6.67	1.21	1.21
Ploceus ocularis	Spectacled Weaver	1.25	1.25	2.50	1.71				
Ploceus cucullatus	Village Weaver			5.83	3.27	46.88	43.61	0.91	0.91
Ploceus vitellinus	Vitelline Masked Weaver	9.38	4.75					4.55	4.55
Ploceus intermedius	Lesser Masked Weaver	1.25	1.25			5.00	5.00		
Ploceus nigricollis	Black-necked Weaver							x	
Amblyospiza albifrons	Grosbeak Weaver			0.83	0.83				
Ploceus jacksoni	Golden-backed Weaver					x			

Species name	English name	Kopjes		Riparian		Agriculture		Shrubland	
		d	s.e.	d	s.e.	d	s.e.	d	s.e.
Anaplectes melanotis	Red-headed Weaver					x		x	
Quelea erythrops	Red-headed Quelea							2.42	2.42
Quelea quelea	Red-billed Quelea			14.17	14.17				
Euplectes orix	Southern Red Bishop	x		x		x			
Euplectes hordeaceus	Black-winged Bishop	36.25	21.52	1.67	1.67	0.83	0.83		
Euplectes albonotatus	White-winged Widowbird					0.83	0.83		
Pytilia melba	Green-winged Pytilia	6.25	2.21			1.25	1.25	7.27	5.48
Lagonosticta senegala	Red-billed Firefinch	18.75	7.85	24.17	10.83	10.63	6.16		
Ortygospiza fuscocrissa	African Quail-Finch							0.61	0.61
Spermestes cucullata	Bronze Mannikin	28.75	12.28	31.67	16.16	8.33	5.00	23.33	14.65
Odontospiza griseicapilla	Grey-headed Silverbill	3.13	3.13					0.91	0.91
Uraeginthus bengalus	Red-cheeked Cordonbleu							2.73	2.73
Uraeginthus cyanocephalus	Blue-capped Cordonbleu	14.38	7.85	41.67	13.21	31.04	14.36	10.00	7.01
Granatina ianthinogaster	Purple Grenadier	14.38	4.38			11.46	5.68	13.03	5.40
Estrilda astrild	Common Waxbill			0.83	0.83				
Vidua chalybeata	Village Indigobird					x			
Vidua fischeri	Straw-tailed Whydah					1.88	1.88		
Vidua hypocherina	Steel-blue Whydah							0.91	0.91
Vidua paradisaea	Long-tailed Paradise-Whydah	x		x		x		x	
Crithagra mazambica	Yellow-fronted Canary	20.00	6.77	10.00	2.89	3.54	2.05	13.94	7.20
Crithagra reichenowi	Reichenow's Seed-eater	2.50	2.50	1.67	1.67	5.00	5.00	10.91	7.32
Emberiza tahapisi	Cinnamon-breasted Bunting	1.25	0.85			0.63	0.63	3.64	3.64

Scopus 37(2): 24–31, July 2017

Effects of human activities on birds and their habitats as reported by forest user groups in and around North Nandi Forest, Kenya

Mark Cheruiyot Bett, Muchane Muchai and Catherine Waweru

Summary

Species-rich tropical forests are becoming increasingly fragmented, degraded and are declining due to human activities, threatening the survival of avian species that depend on them. We assessed the detrimental effects of human activities on birds and their habitats in and around North Nandi Forest. A semi-structured questionnaire survey was used to collect data on human activities affecting birds and their habitats among forest users and forest protectors in North Nandi Forest. Habitat destruction (70%) was the main detrimental human activity on avifaunal habitats, while hunting of birds for subsistence use (10%) only affected certain bird species. The age group between 20 and 40 years used the forest most frequently and most activities were undertaken in indigenous forest habitat. Significantly, men undertook timber extraction and livestock grazing, while women undertook collection of firewood and medicinal herbs. Illegal forest exploitation should be curbed in order to ensure future survival of avifaunal diversity in North Nandi Forest.

Introduction

Forest cover has been estimated to exceed 4 billion hectares or 31% of the global land surface (FAO 2010). Forest cover is largely lost through human activities such as land conversion, timber extraction and minimally through natural events such as fire and drought. Even though afforestation, reforestation and natural regeneration have reduced the net loss of forest cover (FAO 2011), ecosystem services and the conservation value of remnant forests continues to decline, at least in the short term (FAO 2010).

Habitat fragmentation is a paradigm of three main effects: degradation of habitat quality and extent; separation of habitat fragments by anthropogenic matrix (e. g. pasture lands and settlements) and increased intensity of edge effects (Saunders *et al.* 1991, Forman 1995). Habitat changes particularly affect less abundant and range-restricted birds, rainforest specialists, and altitudinal migrants (Bett *et al.* 2016, Brooks *et al.* 1999, Raman 2001). The main effect of habitat fragmentation and degradation is a reduction of avian population size and increased vulnerability to extinction (Simberloff 1994). This exposes risks to many tropical avian species, as they are narrowly distributed and do not tolerate conditions outside of the forest (Turner 1996).

The majority of forest reserves in Kenya are jointly managed by government parastatals in conjunction with local communities (Musila 2011). North Nandi Forest Reserve and its surrounding modified habitats are facing an imminent threat from encroachment and human activities: uncontrolled logging, charcoal burning and firewood collection, while intense pressure from cattle-grazing is affecting the structure and regeneration of this forest (Ng'weno *et al.* 2005; Musila, *et al.* 2004; Bennun & Njoroge 1999). With the accelerating population growth rate around this forest reserve, human activities are likely to significantly reduce or locally exterminate populations of avian species that are highly sensitive to habitat disturbance. This study assessed potential threats facing avifauna and their habitats in indigenous forest (undisturbed), forest edge (disturbed), exotic tree plantations and small scale farmlands adjacent to the North Nandi Forest Reserve. Understanding the effects of humans on birds and their habitat will help in devising strategies to ameliorate these detrimental activities.

Materials and methods

North Nandi Forest is in Nandi County (34°51′E, 0°33′N; 1700–2130 m) and receives annual precipitation between 1200 and 2000 mm. Precipitation is bimodal, with a main wet season between March and June, and an auxiliary wet period in September–October (KFS 2010).

The forest was first gazetted in 1936 as a Trust Forest covering 11 850 ha. Since gazettement, a total of 1343 ha have been excised. An additional 410 ha have been converted to tea plantations under Nyayo Tea Zone. Out of the present gazetted forest area (10 500 ha), approximately 8000 ha is indigenous closed-canopy forest, while the remainder consists of scrub, grassland, exotic monoculture tree plantations, cropland and tea (Blackett 1994).

Site selection

The eastern part of North Nandi Forest Reserve was chosen for this study due to its accessibility and proximity to the local community. Community members who consistently utilized forest resources were targeted along four habitat strata: indigenous forest (*c.* 8000 ha), disturbed forest (*c.* 1500 ha), plantation forest (*c.* 1000 ha) and farmlands (*c.* 500 ha). To evaluate the current threats facing forest habitats, questionnaires were administered to community members from four villages that were 1 km from the tea buffer zone. These four villages, namely, Kapkuto, Ngatatia, Kipsamoite and Kapchepkok, allowed for replication of the data collected (Fig. 1).

Sampling procedure

Questionnaires targeted two groups, forest users from the local community and forest protectors, who consisted of staff from the Kenya Forest Service (KFS) and Community Forest Associations (CFA).

Data from forest users were collected using semi-structured questionnaires administered to respondents from selected households. A systematic random sampling technique was used to select respondents where every fifth household was selected. A total of 100 households (25 per village) were selected from a total of 507 households in the study area. Questionnaires relating to the use of various forest habitats were used to gather information on anthropogenic activities in the forest and avifaunal decline. Respondents (15 years old and above) who actively used these forest habitats were targeted (Kothari 2004). Respondents were divided into three age structures: 15–20 years, 20–40 years, and >40 years. Age structure was compared with frequencies of forest use (daily, weekly and monthly). Human activities in the forest habitats based on gender were also compared.

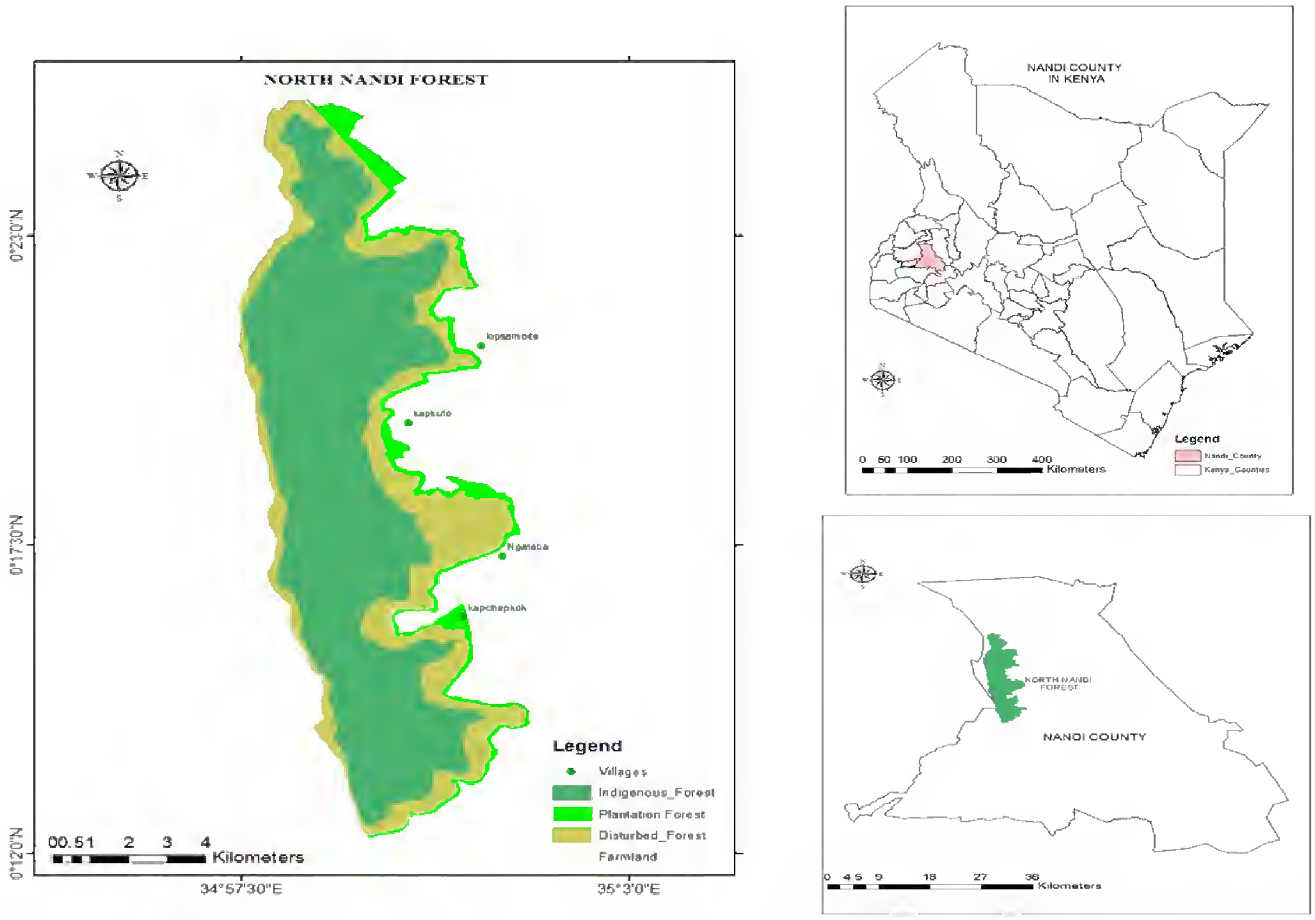

Figure 1. Map of North Nandi Forest, Kenya showing the various study habitats: indigenous forest, disturbed forest, plantation forest and farmland, and the location of study sites designated as villages.

Data were collected from 25 forest protectors, ten KFS officers stationed at three posts within the forest and 15 CFA officials. Respondents answered questions on security patrols in the forest, human activities and bird conservation activities. Analyses were done using Pearson chi-square with a 5% significance level.

Results

Responses of community members to forest exploitation and avifaunal decline

Habitat destruction consisting of the clearing of wetlands and bushes for farming was reported by 70% of respondents and was the main reason reported for the disappearance of birds in and around North Nandi Forest. The other reasons suggested for bird disappearance were changes in climatic conditions (20%), and hunting of birds for subsistence use (10%).

Respondents aged between 20 and 40 years used the forest most frequently — daily or weekly — while those over 40 years old used the forest on a monthly basis (χ^2 =19. 485, df=4, p=0. 0001; Fig. 2). There was no significant difference between a respondent's age and the habitat they used within the forest. Indigenous forest was used the most, while plantation forest was the least used habitat. Almost all age categories participated in similar activities within indigenous forest habitat. However, the collection of medicinal herbs was done mostly by those aged 20 years and above. Livestock grazing and firewood collection were the dominant activities across all age categories. Activities within the forest were gender specific (χ^2=57. 622, df=5, p=0. 0001). Only men participated in timber extraction, and significantly more men participated in livestock grazing as opposed to women. Women collected firewood and medicinal herbs (Fig. 3).

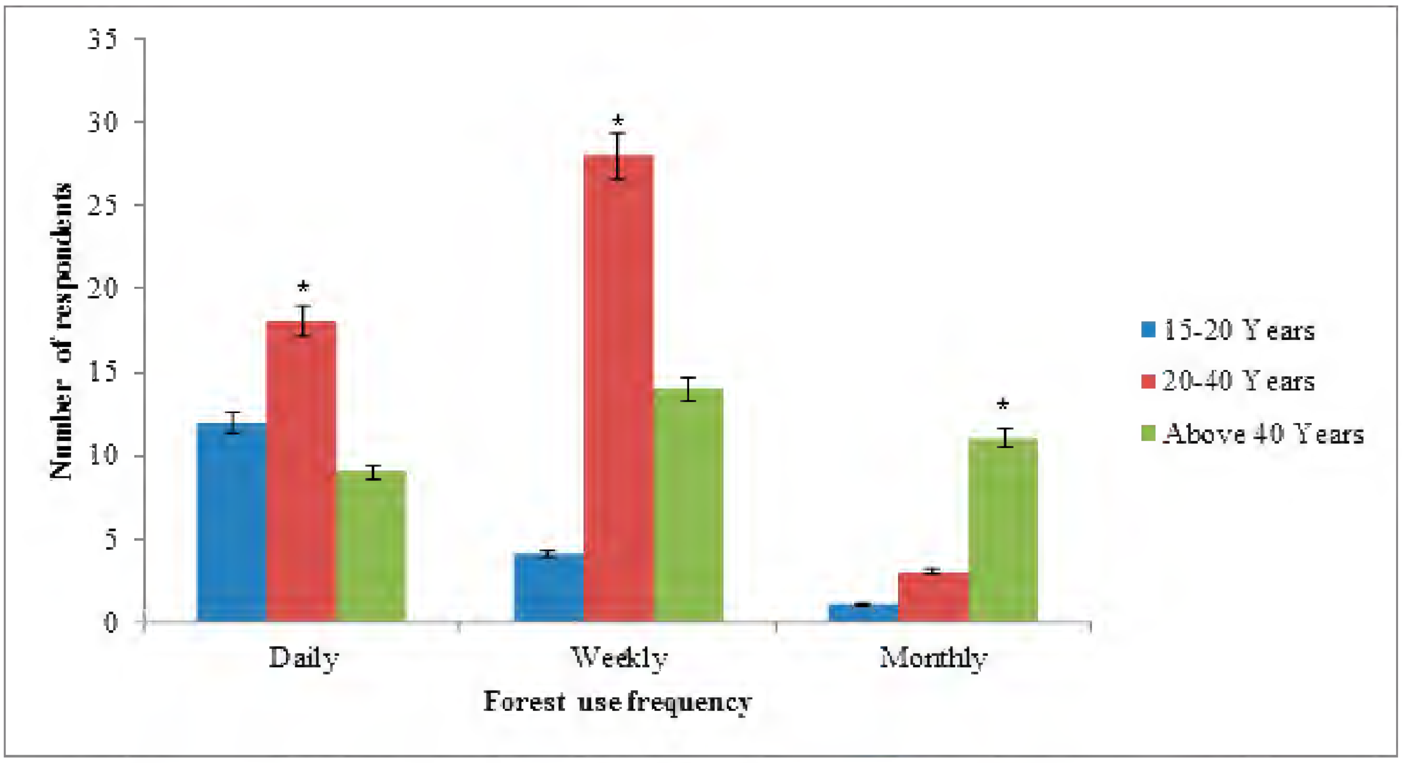

Figure 2. Forest use frequency by community members around North Nandi Forest.

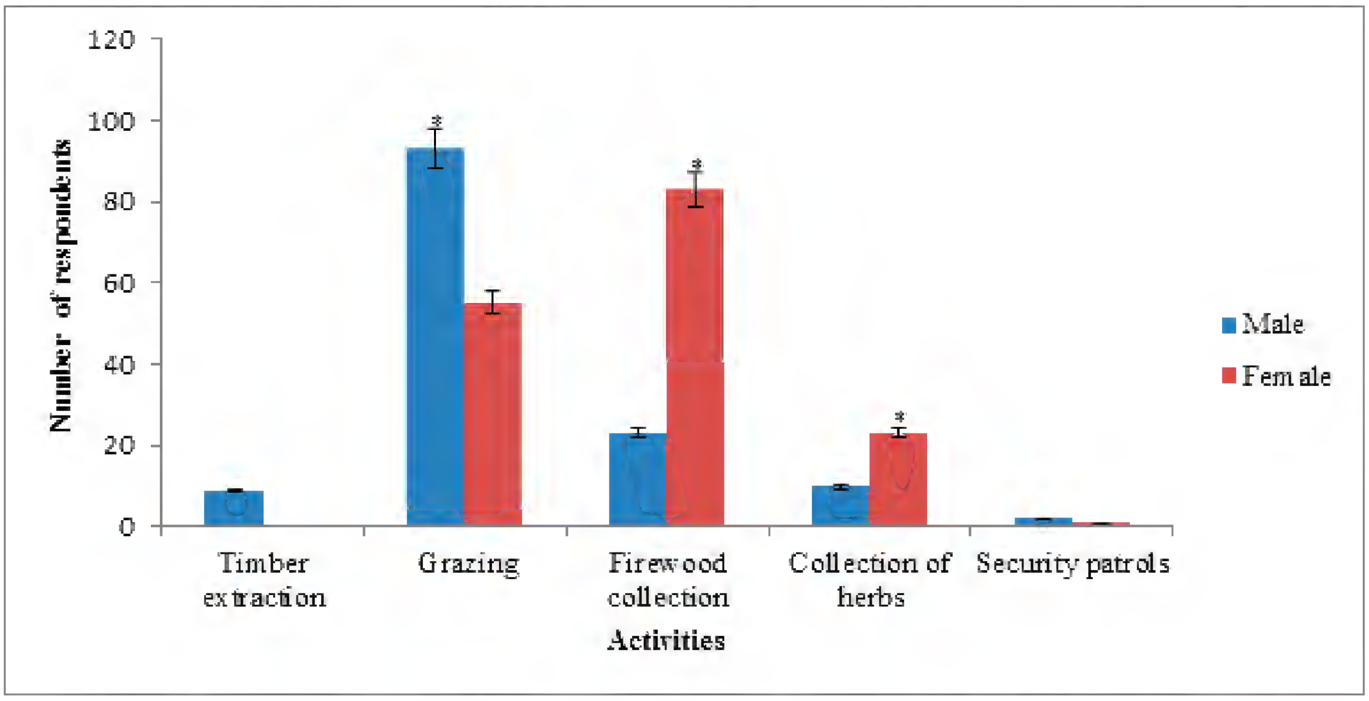

Figure 3. Gender roles versus activities in North Nandi Forest.

Responses of Kenya Forest Service rangers and Community Forest Association officials to forest exploitation and avifaunal decline

KFS rangers reported that they conducted forest patrols as part of their mandate to protect it from exploitation. Of the total respondents, daily patrols were made 60% of the time, weekly patrols 32%, and monthly patrols 8%. There were more patrols conducted in indigenous forest (76%), followed by disturbed forest (16%) and plantation forest (8%).

Human activity that had the greatest negative effect on forested habitats was timber extraction (60%), followed by livestock grazing (20%), firewood collection (15%), and charcoal burning (5%) according to KFS and CFA officials. Indigenous forest (76%) was the most adversely affected habitat, followed by disturbed forest (20%) and finally, plantation forest (4%).

The only activity geared towards bird conservation was the provision of security for local and international researchers. According to respondents, the main threats affecting forest and bird conservation in and around Nandi North Forest were habitat destruction (64%), lack of initiatives to conserve birds by relevant conservation authorities (24%), and subsistence hunting of birds (12%)—especially gamebirds such as Crested Guineafowl *Guttera pucherani*.

Discussion

Detrimental impacts of human activities on birds and their habitats

Habitat destruction and subsistence hunting of birds were the main human activities reported that could negatively impact birds and their habitats in and around North Nandi Forest. Human activities with the greatest impact on the forested habitat were timber extraction or illegal logging, firewood collection and charcoal burning. These activities change the vegetation structure of habitats, thus affecting bird diversity (Musila 2011). The most adversely affected habitats were indigenous forest, followed by disturbed forest and lastly plantation forest. Firewood collection has been revealed as the major threat to wildlife habitat in developing countries (Masanja 2014).

Firewood collection was regulated through the issuance of permits by KFS and the cutting of fallen trees is permitted by KFS rangers. No restrictions are placed on collection of medicinal herbs. Debarking of trees for herbal medicine, especially *Fagaropsis angolensis* and *Tabernaemontana stapfiana*, was rampant, leading to these species dying and being removed for firewood. Continuous removal of dead wood by the surrounding community may affect the density and distribution of cavity-nesting bird species (e.g. woodpeckers) due to the decline in quantity of holes (Veiga *et al.* 2013) and for food (Waiyaki 1995).

Livestock grazing in the indigenous forest has led to the further opening up of undergrowth vegetation and thickets, likely affecting understorey and skulking bird species. Uncontrolled livestock grazing in the forest continues as earlier observed by Musila *et al.* (2010), thus it is likely interfering with the rate of forest regeneration. This happens through feeding and trampling on germinating tree seedlings and saplings by grazing animals. Vegetation alteration from grazing-associated activities leads to changes in avian diversity with protected ungrazed sites having higher diversity compared to unprotected grazed sites (Mamo *et al.* 2016).

Subsistence hunting was observed at Kipsamoite where community members had laid several traps on a trail used by Crested Guineafowl. This activity may significantly reduce local populations of this species because it is currently restricted to forest habitat due to severe hunting in farmlands, in a scenario similar to that reported by Perveen & Khan (2010) for cranes in northern Pakistan.

Based on age structure, those aged 20–40 years used forest habitats most frequently, on a daily basis, and this may be a reflection of their high population as opposed to the younger and older age groups. Unemployment in this age group may be a significant factor that drives them to exploit free and easily accessible forest resources such as firewood, timber and pasture for domestic animals. Similarly, unemployment and low education levels have also been shown to negatively influence the degree of awareness of biodiversity conservation held by local communities (Mehta & Heinen 2001).

Based on gender roles, both men and women used forest habitats in relatively equal amounts, but they differed in terms of their activities in these habitats. Timber extraction for fencing poles and construction was solely done by men, who mainly targeted indigenous forest and disturbed forest. Effects of logging on bird diversity ranges from changes in feeding guild structure, decreases in species richness, and loss of corridors and sink habitats (Bett *et al.* 2016, McCarthy 2012). *Syzygium guineense*, a fruiting canopy tree, was targeted for fencing poles and has been seriously logged to a point that it is only found in the indigenous forest. This tree is important to frugivorous canopy birds such as turacos and Black-and-white Casqued Hornbill *Bycanistes subcylindricus*. Collection of firewood and medicinal herbs was mainly done by women.

Appropriate conservation strategies for birds and their habitats

Based on this study, the main conservation strategies to mitigate detrimental human activities on birds and their habitats in and around North Nandi Forest were to intensify security patrols in indigenous forest by carrying out more daily patrols. Increased security patrols would allow for regeneration of trees and provide a more suitable habitat for birds as outlined in the North and South Nandi Forests Strategic Ecosystem Management Plan (KFS 2015). This is currently being done by KFS rangers and CFA scouts.

In disturbed forest, reforestation of open patches using indigenous tree seedlings was identified as a key conservation strategy that would create more bird nesting sites and feeding sites. Afforestation in empty plantation forest patches is important in creating sink and dispersal habitats for forest birds. Agro-forestry in farmland creates extended habitats for birds, especially non-forest species. A study by Fahrig *et al.* (2008) in Kakamega Forest demonstrated that plantations with a mixture of indigenous tree species can have high conservation value for avifauna.

Community-based organizations engaged in the planting of both exotic and indigenous tree seedlings may increase forest cover. Farmers should be educated on the need to practice agro-forestry to eliminate overdependence on forest resources and improve their livelihoods thus protecting birds and their habitats (KFS 2015). Illegal forest exploitation should be curbed in order to ensure future survival of avifaunal diversity in North Nandi Forest.

Detrimental human activities may play a major role in the disappearance and local extinction of birds in and around North Nandi Forest. The indigenous forest is fast-changing to a disturbed forest, further worsening the status of forest-dependent bird species. However, some conservation strategies currently in place such as reforestation at the forest edge by KFS and CFA may slowly reverse this trend.

Acknowledgements

We gratefully acknowledge the funding support of National Commission of Science and Technology (NACOSTI/RCD/ST&I 6th CALL MSc/038). We also thank the Kenya Forest Service rangers at North Nandi Forest Station and the local community for their excellent guidance and provision of a conducive atmosphere for carrying out this fieldwork. Ian Gordon provided constructive comments that greatly improved the manuscript.

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Scopus 37(2): 24–31, July 2017
Received 16 January 2017

Scopus 37(2): 32–37, July 2017

Preliminary comparison of birds inhabiting exotic *Acacia* and native bushland habitats in semi-arid east-central Tanzania

Chacha Werema

Introduction

In East Africa, studies have found that exotic plantations have negative impacts on birds, causing declines in abundance (Calson 1986, Pomeroy & Dranzoa 1998) and low nesting potential (John & Kabigumila 2007). Further studies on the effects of exotic plantations on birds have shown that the plantations can be appropriate habitats if they are properly designed and managed (John & Kabigumula 2011) and can provide critically needed habitat for birds (Werema & Howell 2016). Despite these studies, there is limited research on the effects of exotic plant species on local biodiversity in Tanzania, yet this understanding is crucial for conservation.

In 1980s an exotic *Acacia insulae-iacobi* (hereafter exotic *Acacia*) was grown at Godegode Village, Mpwapwa District (Dodoma Region) found in east-central Tanzania (6°30′– 6°34′S, 36°32′ – 36°34′E) as a means of afforestation. Since then this exotic *Acacia* has been preferred by villagers at Godegode because of its high growth rate as well as its tolerance of arid areas. Villagers use this tree species as a wind break, for fuelwood, for building material, as fodder, for plot/household fencing and for shade. In addition, the tree helps to control soil erosion and land degradation, and acts as a means of soil and environmental conservation. Currently, at Godegode Village, this tree has established itself in some small valley floodplains in stands of thickets or bushland.

While the exotic *Acacia* is preferred by villagers at Godegode, its effects on local biodiversity are not known. I undertook this preliminary study to assess the effects of the exotic *Acacia* on avian biodiversity, by comparing bird species composition and density in areas of exotic *Acacia* with areas of degraded native bushland. The latter are composed mainly of native *Acacia* spp., *Commiphora* spp. and baobab *Adansonia digitata* trees. I predicted that native bushland would have higher bird abundance and species richness compared to exotic *Acacia* habitats.

Methods

Between 2 and 9 December 2015, I conducted 37 and 32 point counts in native and exotic *Acaci*a bushland habitats, respectively. Each point was located at least 150 m from its nearest neighbour. At each point, I recorded all birds seen or heard within a 50 m radius over 10 min, with an initial 2 min allotted for birds to settle. Birds were surveyed during non-rainy days between 06:00 and 11:00, and between 16:00 and 18:00, corresponding to the periods of high bird activity. Birds that flew from behind the observers and those that flew over the study area were excluded.

Data analysis

EstimateS software was used to assess whether most of the species in the two bushland habitats were sampled by drawing species accumulation curves for each of the two habitats and using the number of point counts as sampling effort.

Mean values of bird abundance and richness were used to extrapolate the number of individuals and species per hectare (ha). Prior to analyses, variables were examined for deviations from normality using the Shapiro–Wilk test. Because the data were not normally distributed, the Mann-Whitney U-test was used to assess whether there were significant differences in the number of species and individuals per hectare between the native and exotic *Acacia* bushlands. The African Openbill *Anastomus lamelligerus* was excluded from analyses because only one very large flock was detected. Species order, taxonomy and common names follow Sinclair & Ryan (2010).

Results

In total 71 species (most of which were resident breeders) were recorded in both native and exotic *Acacia* habitats (Appendix 1). All species observed were found in the surrounding native bushlands and about one-third (n=25) were observed in the exotic *Acacia* habitat, suggesting that species found in the latter habitat were a subset of those found in the former (Appendix 1). Species accumulation curves for the two study sites appeared to reach asymptote, indicating that most of the species were recorded (Fig. 1). There were higher densities of birds (both species and individuals) in the native bushland habitat compared to the exotic *Acacia* bushland (number of species per hectare: Mann-Whitney $U_{32,37}=104$, $p<0.0001$; individuals per hectare: Mann-Whitney $U_{32,37}=221$, $p<0.0001$) (Appendix 1; Fig. 2). Densities of most species were relatively higher in the native bushland compared to the exotic *Acacia* bushland (Appendix 1). Most species in the exotic *Acacia* bushland were at lower density, except the Laughing Dove *Streptopelia senegalensis* (Appendix 1).

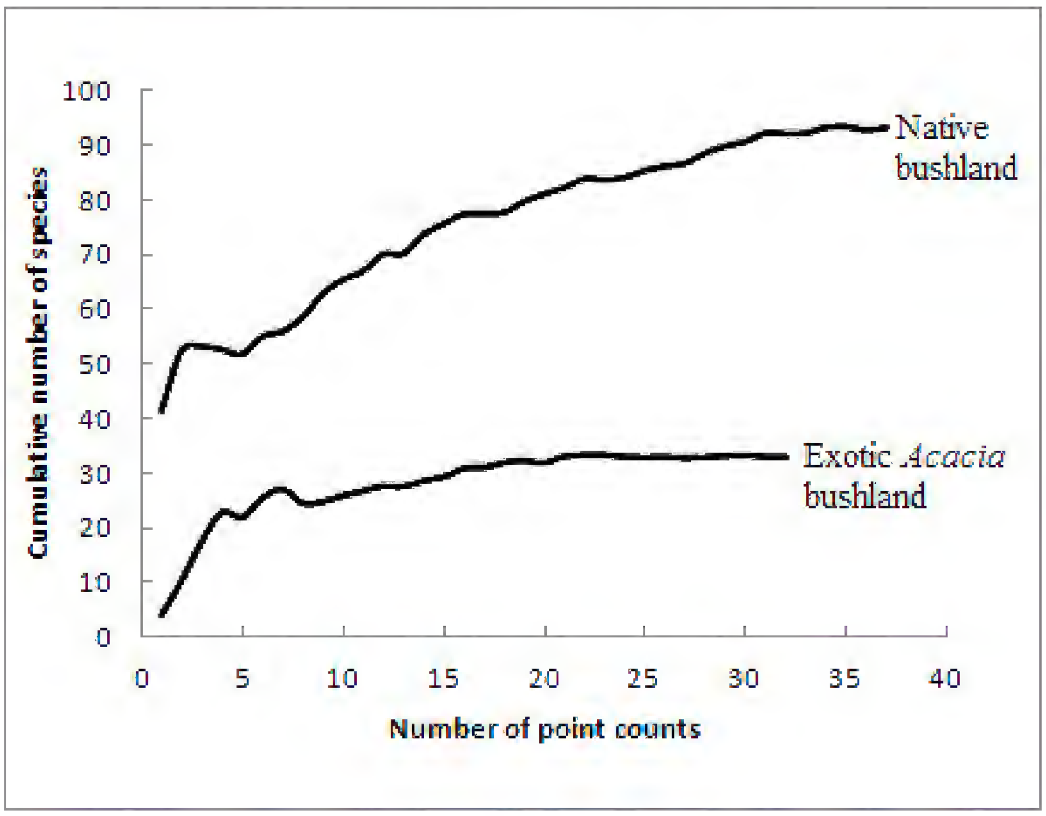

Figure 1. Species accumulation curves for the native and exotic *Acacia* bushlands.

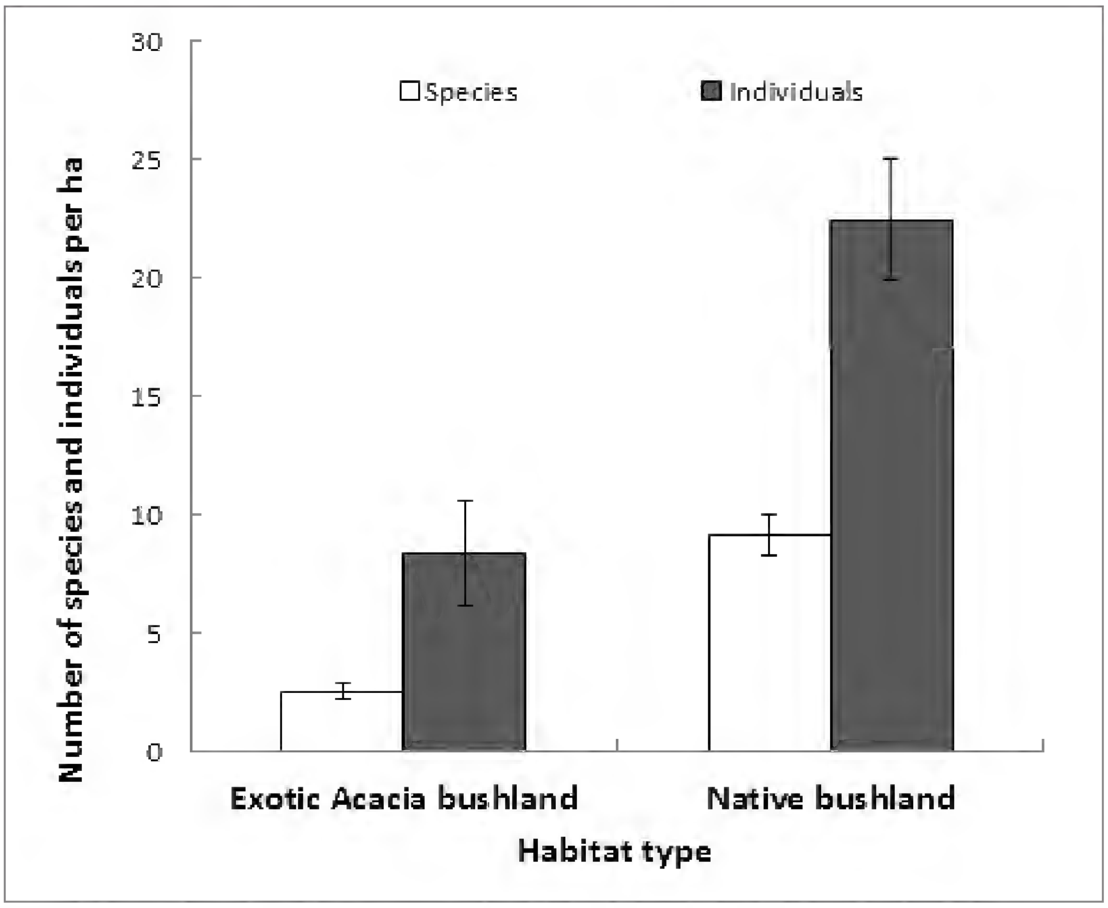

Figure 2. Mean (± SE) number of species and individuals in the native and exotic *Acacia* bushlands.

Discussion

The prediction that native bushlands would have higher bird abundance and species richness compared to exotic *Acacia* bushland was confirmed. Although preliminary due to the brief study period, my results suggest that replacing native vegetation with a monoculture of exotic *Acacia* leads to decreased bird species richness and abundance. Higher species richness and density of birds in native bushlands could be due to the higher diversity and availability of resources in native habitats (see Jacoboski *et al.* 2016).

Lower species richness and abundance in the exotic *Acacia* bushland could be due to a lack of plant species heterogeneity, i.e. simplification of vegetation structure and composition that greatly influences bird communities (see Marsden *et al.* 2001). This suggests that there is a reduced availability of resources, which act as environmental filters, in the exotic plantations than in the native bushlands (Jacoboski *et al.* 2016). Therefore, further growth of the exotic *Acacia* trees at Godegode village is incompatible with bird conservation compared to allowing natural regrowth of native tree species.

Most species in the exotic *Acacia* were at lower density. Only the Laughing Dove was found at higher densities because it visited the River Mkondoa to drink, particularly during the afternoon hours.

While the exotic *Acacia* is preferred by the villagers of Godegode village its spread throughout the entire village landscape and elsewhere needs to be controlled. This tree should only be allowed to grow in a scattered manner amongst the other native trees as a means of increasing vegetation diversity instead of allowing it to form monocultures. Should the entire landscape be dominated by this exotic tree species, the bird fauna (and probably other taxa) will be negatively affected. The conservation of the existing native vegetation is critical for the ecological conditions required by birds at Godegode village and elsewhere. Despite the small area that was studied, my results suggest that there is a need to discourage further spread of this exotic *Acacia* as the best way of maintaining the biodiversity of this region.

Acknowledgements

I thank JSB Envidep Ltd. for logistical support. I am grateful to the villagers of Godegode for information they provided regarding the exotic *Acacia*. I thank J.V. Lyakurwa for assistance in the field. F. Mbago is thanked for identification of the vegetation types in the study area including the exotic *Acacia insualae-iacobi*. I thank K.M. Howell, H.V. Lyaruu, L. Dinesen and D. Ogada for helpful comments on a draft of this manuscript.

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Scopus 37(2): 32–37, July 2017

Received 15 December 2016

Appendix 1. Densities of species observed in the native and exotic *Acacia* bushlands. Densities of species were expressed as mean number of individuals per hectare.

English name	Species name	Native bushland	Exotic *Acacia* bushland
African Openbill	*Anastomus lamelligerus*	4.96	0.00
Hadeda Ibis	*Bostrichia hagedash*	0.03	0.00
Helmeted Guineafowl	*Numida meleagris*	0.64	0.00
Coqui Francolin	*Peliperdix coqui*	0.07	0.00
Red-necked Spurfowl	*Pternistis afer*	0.33	0.00
Small Button-Quail	*Turnix sylvaticus*	0.03	0.00
Water Thick-knee	*Burhinus vermiculatus*	0.13	0.00
Red-eyed Dove	*Streptopelia semitorquata*	0.50	0.08
Ring-necked Dove	*Streptopelia capicola*	0.07	0.00
Laughing Dove	*Streptopelia senegalensis*	2.68	3.98
Emerald-spotted Wood Dove	*Turtur chalcospilos*	0.36	0.04
Tamborine Dove	*Turtur tympanistria*	0.03	0.00
Namaqua Dove	*Oena capensis*	0.07	0.04
Brown Parrot	*Poicephalus meyeri*	0.03	0.00
Fisher's Lovebird	*Agapornis fischeri*	0.33	0.08
Diderick Cuckoo	*Chrysococcyx caprius*	0.13	0.00
Red-chested Cuckoo	*Cuculus solitarius*	0.10	0.00
White-browed Coucal	*Centropus superciliosus*	0.06	0.04
Speckled Mousebird	*Colius striatus*	0.66	0.40
Blue-naped Mousebird	*Urocolius macrourus*	1.32	0.00
African Pygmy-Kingfisher	*Ispidina picta*	0.00	0.04
Brown-hooded Kingfisher	*Halcyon albiventris*	0.03	0.00
Little Bee-eater	*Merops pusillus*	1.02	0.12
Rufous-crowned Roller	*Coracias naevius*	0.07	0.00
Lilac-breasted Roller	*Coracias caudatus*	0.07	0.00
Tanzania Red-billed Hornbill	*Tockus ruahae*	0.03	0.00
Red-fronted Tinkerbird	*Pogoniulus pusillus*	0.03	0.00
Spot-flanked Barbet	*Tricholaema lacrymosa*	0.23	0.00
Fappet Lark	*Mirafra rufocinnamomea*	0.07	0.00
Fisher's Sparrowlark	*Eremopterix leucopareia*	0.26	0.00
Barn Swallow	*Hirundo rustica*	0.10	0.00
Lesser-stripped Swallow	*Hirundo abyssinica*	0.50	0.00
Mosque Swallow	*Hirundo senegalensis*	0.26	0.00
Fork-tailed Drongo	*Dicrurus adsimilis*	0.23	0.00
Pied Crow	*Corvus albus*	0.06	0.00
Dark-capped Bulbul	*Pycnonotus tricolor*	1.16	0.52
Northern Brownbul	*Phyllastrephus strepitans*	1.13	0.28
Sombre Greenbul	*Andropadus importunus*	0.10	0.11
Yellow-bellied Greenbul	*Chlorocichla flaviventris*	0.03	0.16
Kurrichane Thrush	*Turdus libonyanus*	0.03	0.00
White-browed Robin Chat	*Cossypha heuglini*	0.17	0.16
Spotted Palm-Thrush	*Cichladusa guttata*	0.10	0.00
White-browed Scrub Robin	*Cercotrichas leucophrys*	0.30	0.12

English name	Species name	Native bushland	Exotic *Acacia* bushland
Rattling Cisticola	*Cisticola chiniana*	0.52	0.00
Tawny-flanked Prinia	*Prinia subflava*	0.10	0.12
Grey-backed Camaroptera	*Camaroptera brevicaudata*	0.36	0.32
African Grey Flycatcher	*Bradornis microrhynchus*	0.33	0.00
Chinspot Batis	*Batis molitor*	0.07	0.00
Black-backed Puffback	*Dryoscopus cubla*	0.36	0.08
Brubru	*Nilaus afer*	0.13	0.00
Tropical Boubou	*Laniarius major*	0.13	0.00
Slate Coloured Boubou	*Laniarius funebris*	0.76	0.48
Orange-breasted Bush-Shrike	*Chlorophoneus sulfureopectus*	0.03	0.00
Brown-crowned Tchagra	*Tchagra australis*	0.20	0.12
Nothern-white Crowned Helmet Shrike	*Eurocephalus rueppelli*	0.03	0.00
Ashy Starling	*Cosmopsarus unicolor*	0.36	0.08
Superb Starling	*Lamprotornis superbus*	0.17	0.00
Violet-backed Starling	*Cinnyricinclus leucogaster*	0.00	0.00
Scarlet-chested sunbird	*Chalcomitra senegalensis*	0.03	0.12
Western Violatet-backed Sunbird	*Anthreptes longuemerei*	0.17	0.00
Variable Sunbird	*Cinnyris venustus*	0.40	0.00
Beautiful Sunbird	*Cynnyris pulchella*	0.06	0.00
African Yellow White-eye	*Zosterops senegalensis*	0.36	0.07
Red-billed Firefinch	*Lagonosticta senegala*	1.06	0.16
Swahili Sparrow	*Passer suahelicus*	0.20	0.16
Village Weaver	*Ploceus cucullatus*	1.16	0.32
Vitelline Masked Weaver	*Ploceus vitellinus*	0.83	0.00
Green-winged Pytilia	*Pytilia melba*	0.10	0.00
Blue-capped Cordonbleu	*Uraeginthus cyanocephalus*	0.40	0.00
Purple Glenardier	*Granatina ianthinogaster*	0.06	0.00
White-bellied Canary	*Crithagra dorsostriata*	0.60	0.00
Reichenow's Seed-eater	*Crithagra reichenowi*	0.03	0.16

Scopus 37(2): 38–41, July 2017

Group-size effect on scanning behaviour of Maasai Ostrich *Struthio camelus massaicus*

Flora J. Magige

Summary

Scanning behaviour enables birds to collect information important for their survival, such as detecting predators (anti-predatory strategy) and searching for food. The scanning behaviour of the Common Ostrich *Struthio camelus* was investigated by determining the scanning duration (total seconds during 5-min periods that a bird's head was raised) and scanning rate (number of times an individual raised its head per minute) among different group sizes in late 2006 in Serengeti National Park, Tanzania. A total of 14 males and 20 females were observed. Scanning duration was a function of group size where individuals in small groups scanned for longer times than individuals in large groups. However, increasing group size did not have a significant effect on the scanning rate among the groups. Individual vigilance among ostriches is influenced by group size, whereas individual scanning rate may be influenced by factors other than group size, such as body size and habitat type. Higher scanning duration in small groups is attributed to anti-predatory behaviour.

Introduction

Vigilance is an important behavioural trait in many animal species. Animals, including some birds, are continuously scanning their environment to secure their safety. Scanning behaviour in birds is considered an antipredator behaviour (Pulliam 1973, Caro 2005) and it has been shown to increase with increasing predation risk (Edmunds 1974). Avoiding predation is important for survival and reproduction in birds. Body posture has been used as a measure of anti-predator scanning (Caro 2005). Birds have been assumed to be scanning for predators when individuals' heads are up. But when heads are down, for example when searching for food or foraging, they cannot obtain any visual information through scanning (Lima 1987). Birds with laterally placed eyes, like ostriches, could obtain some information through their wide fields of view (Martin 2007, Fernández-Juricic *et al.* 2008) to the extent that they can gather information laterally even when their heads are down (Bednekoff & Lima 2005, Fernández-Juricic *et al.* 2005). However, their ability to detect a predator is only about 30% of their vision when the head is down (Lima & Bednekoff 1999, Tisdale & Fernández-Juricic 2009) and vigilance with a raised head is therefore still important.

The Common Ostrich is the world's largest flightless, herbivorous bird, and is found in a variety of open habitat types (Brown *et al.* 1982). The Maasai Ostrich *S. c. massaicus* is native to East Africa.

Although scanning behaviour has been studied in ostriches (Bertram 1980), little effort has been devoted to the study of intraspecific variation of scanning duration and scanning rate. Changes in vigilance behaviour in ostriches have usually been attributed to variation in predation risk (Bertram 1980). The main predators of adult ostriches are spotted hyenas *Crocuta crocuta* and lions *Panthera leo* (Bertram 1992). While

Egyptian vultures *Neophron percnopterus* s crack ostrich eggs by dropping large stones on to them (Thouless *et al.* 1989). In northern Tanzania, most of these predators are confined to Serengeti National Park or to regions otherwise remote from human activity (Nyahongo 2004). Ostriches inside the park are speculated to be highly vigilant and form groups as an anti-predatory strategy. The aim of this study was to investigate the influence of group size on scanning duration and scanning rate in ostriches.

Methods

The study was conducted in the central and southern part of the Serengeti National Park (14763 km^2, 1°15'–3°30'S, 34°–36°E). The study area is composed of savanna with mainly thorny woodland trees, with species of *Acacia*, *Commiphora*, *Ficus*, *Combretum* and *Podocarpus*, and extensive grass plains (Herlocker 1976). Neither human settlements nor consumptive activities are permitted except ecotourism and photographic tourism.

Data were collected during November and December 2006 for 16 days on 34 individual ostriches (20 females and 14 males). A focal sampling method was used to sample ostrich scanning behaviour. Focal adult subjects were arbitrarily selected from a group or as single individuals, and were followed for five minutes. During each 5-min period, group size scanning frequency, scanning duration and scanning behaviours were recorded. All occurrences of scanning behaviour (stationary or walking while the head is elevated) were recorded. Birds were considered scanning when they raised the tip of their beak to eye level or higher (Hogstad 1988). The bird was considered feeding when it was stationary or walking actively searching for food while its head was at or below body level. Scanning surveys were conducted in the mornings (07:00–12:00) when birds were actively feeding. Ostriches were sampled over a large area, and in order to avoid sampling the same bird twice, sections of the area were sampled once, where only one focal bird per group was identified and monitored. Scanning duration was considered as the total amount of seconds during 5-min periods that the bird's head was raised, while scanning rate was the number of times an individual raised its head per minute.

Analyses were performed using SPSS 20 for Windows. A general linear model (GLM) was used to determine the effects of the predictor variables on dependent variables. In the models, scanning duration and scanning rate were included as dependent variables with group size as the predictor (independent) variable.

Results

A total of 34 behavioural records over a duration of 5 min each was obtained. On average, individual scanning duration decreased with group size whereas scanning rate remained more or less unchanged with group size. A negative relationship between individual scanning duration and group size (Fig. 1) was further supported by multivariate analysis that revealed an effect of group size ($F_{6,27}=3.712$, $p=0.008$) on the scanning duration of ostriches. However, there was no effect of group size on the scanning rate of ostriches ($F_{6,27}=0.595$, $p=0.731$).

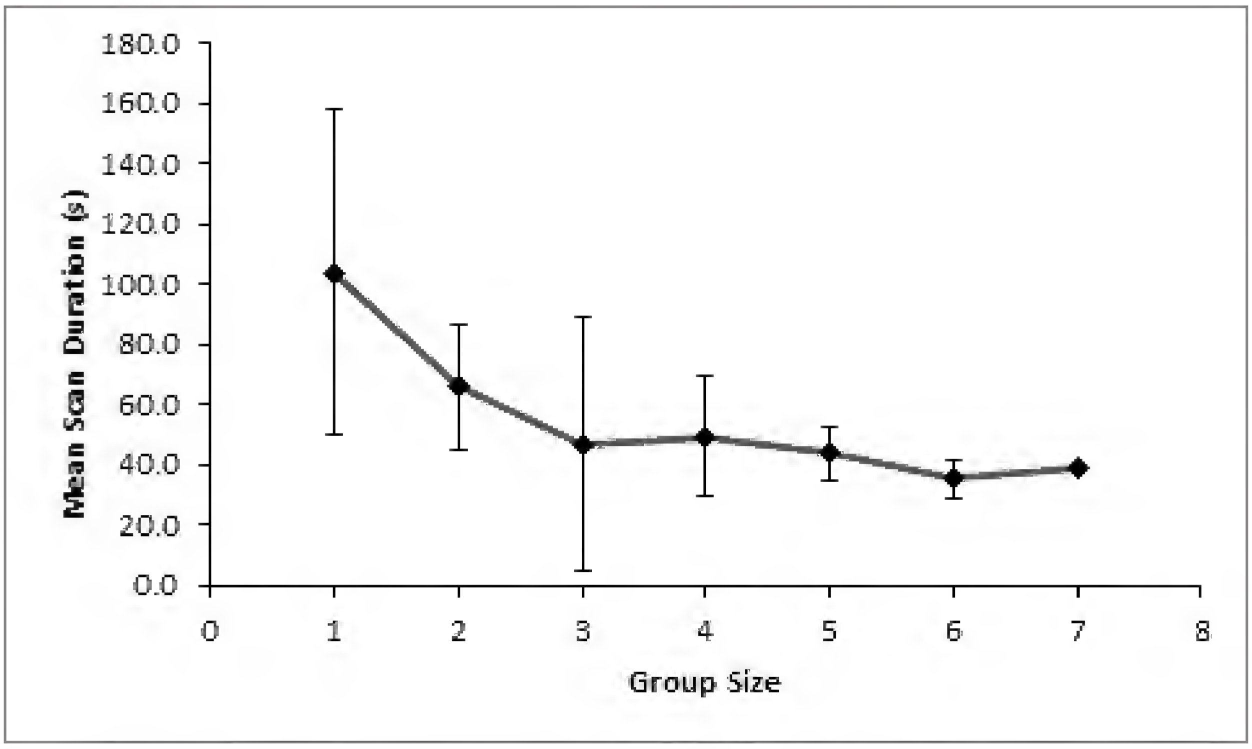

Figure 1. Variation of scanning duration (Mean ± SD) for the different categories of group sizes of ostriches in the Serengeti National Park, Tanzania, November–December 2006.

Discussion

Scanning behaviour of ostriches varied with group size. The inverse relationship between group size and scanning duration could be a function of shared vigilance. Other studies (Elgar & Catterall 1981, Elcavage & Caraco 1983) have shown a similar relationship. According to Pulliam's 'many-eyes' hypothesis (Pulliam 1973), animals in groups can rely on the vigilance of their group mates to increase the probability of detecting predators and so avoid predation (Robinette & Ha 2001). The risk of predation to an individual in small groups is high, and that is probably the reason why birds are more vigilant in small groups, as observed by Bertram (1980) and also other bird studies (Lima *at al.* 1999). However, Lima *et al.* (1999) reported that decreased vigilance in large groups is not always because of a reduced predation risk, but rather because in areas with scarce resources, animals will tend to compete for the resources and consequently reduce vigilance.

Detailed studies are recommended with a longer survey duration, a larger sample size, and over a longer timeframe to determine the trend of scanning rate with factors other than group size, such as body size and habitat type, incorporated.

Acknowledgements

Thanks to the Tanzania Wildlife Research Institute (TAWIRI) and Tanzania National Parks (TANAPA) for research permits. I also thank Ragna K. Sortland, G. Mwakalebe, N. Masawe, J. Kabondo and O. Mwakabejela for the excellent field assistance. Thanks are due to Dr Frode Fossøy, Prof. Eivin Røskaft and anonymous reviewers for constructive comments on the manuscript. The study was funded by the World Bank who sponsored the Lower Kihansi Environmental Management Project.

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Scopus 37(2): 38–41, July 2017
Received 30 January 2017

Short communications

Striped Pipit *Anthus lineiventris*—overlooked in Uganda?

Introduction

The Striped Pipit *Anthus lineiventri* is a large, distinctive pipit of southern African where it inhabits rocky hills and slopes well covered with trees and shrubs. It is readily identifiable, if seen well, being large, boldly striped and having distinctive yellow-edged wing feathers. There are no published records for Uganda. This paper reports on two birds at Mihingo Lodge adjacent to Lake Mburo National Park, Uganda in November 2016, a single bird at Rwakobo Rock Lodge nearby in May 2017 and some previously unpublished records from the same locations. We suggest that Striped Pipit may be a low-density, overlooked species in suitable habitat in southwest Uganda and adjacent northwest Tanzania.

Published distribution

The main range is southeast Africa from southern Kenya through eastern and southern Tanzania, Malawi, southeast Democratic Republic of Congo (DRC), southeast Zambia, southeast and northeast Botswana, Zimbabwe, western Mozambique and northeast and eastern South Africa. A second population occurs in Angola and a third disjunct population occurs in western and northwest Tanzania from about Kasanga in Rukwa Region north to Gombe National Park in Kigoma Region and in adjacent Burundi and Rwanda (Tyler 2017).

There are no records in the Tanzania Bird Atlas from the Kagera Region of north-west Tanzania, but a sighting from Rusumo Falls, Rwanda in October 2009 was only 300 m from the Tanzanian border. eBird has one record from Uvubu National Park, Burundi (March 1994), but no records from northwest Tanzania or Rwanda (eBird 2012). Britton (1980) reported no records for Uganda and only one for western Tanzania (Kibondo, March 1961). Clancey (1990) did not mention western Tanzania, Burundi or Rwanda as included in the range of this species.

Subspeciation

Clancey (1990) recognized four subspecies, but none in the vicinity of the Albertine Rift that would include northwest Zambia, western Tanzanian, Burundi and Rwandan birds. The most likely of the four is *A.l. angolensis* Bocage 1870 about which he stated "*Range: Western Angola from Huambo and Malanje, south to the escarpment of Huila, but precise limits and status uncertain. Clearly uncommon*". This is the form considered to be in Zambia (Dowsett *et al.* 2008).

The Handbook of the Birds of the World recognizes two subspecies, *A.l. lineiventris* Sundevall 1850 in southeast Botswana to northeast South Africa and Swaziland, and *A.l. stygium* Clancey 1952 elsewhere (Tyler 2017). The IOC does not recognize any subspecies (Gill & Donsker 2017).

The Royal Museum for Central Africa, Tervuren, Belgium has three Striped Pipit specimens from the DRC and one from Zambia. These are not categorized to subspecies level, but are all considered to be the same as birds from eastern DRC, western Tanzania, Burundi and Rwanda.

Records for Uganda

Two pipits were seen by SC at Mihingo Lodge, Western, Uganda (0°36′S, 31°03′E, 1330 m) on the thatched roof of the dining room on the morning of the 13 November 2016. They flew down to forage in the natural grass/rock area around the swimming pool. Distant photographs indicated their identity as Striped Pipit as the yellow tint to the folded wings was clearly visible (Fig. 1). Later that afternoon no pipits were in evidence, but playback of a recording of their call from the eGuide to Birds of East Africa (2014) immediately resulted in one bird emerging from cover and close photographs were obtained. The record was submitted to eBird in November 2017 and to the East African Rarities Committee (EARC) in February 2017. This record has been fully accepted by the EARC, which formally puts this species on the Ugandan list.

Subsequently, a single bird was seen by SC on the lodge roof at Rwakobo Rock Lodge (0°31′S, 31°00′E, 1290 m) on the late afternoon of 8 May 2017 (Fig. 2). It responded to playback, but stayed on the roof. There was no sign of the bird the next morning. This record has been submitted to the EARC for consideration.

Figure 1. Striped Pipit, Mihingo Lodge, Western Uganda, 13 November 2016. Photo S. Clark.

Figure 2. Striped Pipit, Rwakobo Rock Lodge, Western Uganda, 8 May 2017. Photo S. Clark.

Subsequently it has been found that eBird has records from Mihingo Lodge (3 August 2013) and Rwakobo Rock Lodge (0°31′S, 31°00′E, 1290 m; 10 October 2016). Both records were of single birds. Admittedly neither of these records have been vetted by the EARC, but they are from the same localities as the November 2016 and May 2017 records. The lodges are both just outside the boundaries of Lake Mburo National Park, which has many similar rocky hills. It is not permitted to get out of your vehicle in the park and this restriction might contribute to the species being overlooked. It is also possible that the recent records represent a range expansion from the south or west. Both Crested Barbet *Trachyphonus vaillantii* and Black-collared Barbet *Lybius torquatus* have been recorded in the park in recent years and their nearest recognised occurrences would be northwest Tanzania or Rwanda respectively.

Conclusion

The Striped Pipit can now be said to occur in Uganda—at least in the vicinity of Lake Mburo National Park. It extends to the north and east the range of the population that occurs in Zambia, the DRC, western Tanzania, Burundi and Rwanda. It should be looked for in other well-vegetated rocky slopes and hilltops in southwest Uganda and northwest Tanzania.

Acknowledgements

We wish to thank Michel Louette and Alain Reygel at the Royal Museum for Central Africa, Tervuren, Belgium for examining specimens of Striped Pipits in their collection, also to Bob Dowsett for his comments concerning current subspecific divisions within this species. Thanks also to Neil Baker who provided information from the Tanzania Bird Atlas project and Jason Anderson who gave details of his Rwandan sightings from 2009.

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Scopus 37(2): 42–44, July 2017
Received 12 May 2017

Green-capped Eremomela *Eremomela scotops kikuyuensis* in Nairobi

The little known Kenya endemic race *kikuyuensis* of the Green-capped Eremomela was collected by van Someren in November 1916 (believed to have been from the western Nairobi suburbs), but was not described until 1931 (van Someren 1931). Today, it remains extremely localized in the Meru, Embu, Thika, Kiambu and Nairobi districts, but records from Nairobi are both sparse and poorly documented in the last twenty or even thirty years, with the only known dated records being one from east of Kabete in January 1982 (J. Bradley, pers. comm.) and three or four sightings near the Main and Langata Gates of Nairobi National Park between 1997 and 1999 (S. Easley pers. comm.).

On the morning of 5 March 2017, I was birding along the Mbagathi River/Ololua Forest edge below Mbagathi Ridge. Quite unexpectedly, I got a very good view of a Green-capped Eremomela feeding in a Newtonia tree. I noted the yellow underparts becoming pale yellow on the lower half, and in particular I was able to see the black line running from the base of the bill to the darkish eye and the bright yellow supercilium.

Given that this species seems to be a rarity now in Nairobi, I hope that this note will encourage others to record the date and location of any sighting of this species. It should also prompt us all to keep an eye on the status of Ololua Forest and the Mbagathi River and encourage their continued protection.

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Scopus 37(2): 45, July 2017
Received 13 March 2017

East African Rarities Committee (EARC) Rarities Report

David Fisher (Chairman) and Nigel Hunter (Secretary) on behalf of the EARC

The East African Rarities Committee assesses records of new and very rare birds occurring in Kenya, Tanzania, Uganda, Rwanda and Burundi. This includes up to the fifth record of any species from each of the five countries. Sightings of species for which there are fewer than five records for a country should be submitted to the EARC Secretary: Nigel Hunter, P.O. Box 24803, Karen 00502, Nairobi, Kenya. Email: nigelhunter@timbale.org. Please contact the Secretary to obtain clarification of whether a record requires a submission and for guidance on what details to include in the submission. Past records of rare species are also sought in order to bring the EARC database up to date.

1. Since the Committee's last report published in 2016 (*Scopus* 36(2): 57–64) the following records have been Accepted:

Lesser Frigatebird *Fregata ariel*

Fourth record for Kenya. One adult female grounded at Kilifi on 6 October 2016 and photographed. Bird died the following day. Measurements of wing, culmen, tail and weight were taken and the specimen provided to the National Museums of Kenya (S. Alleyne and L. Kirau).

Lesser Frigatebird

Photo: S. Alleyne

Red-throated Bee-eater

Photo: R. Schmitt & A. Nyambacha

Dusky Long-tailed Cuckoo *Cercococcyx mechowi*

Third record for Tanzania but thought to be resident in Minziro Forest (north-western Tanzania). The bird was observed and photographed at Mwanza on 7 February 2016 (G. Long).

Red-throated Bee-eater *Merops bulocki*

First record for Tanzania. First observed on 7 August 2016 and then fairly regularly up to 17 August 2016 in the same location, which was 3.5 km south-southwest of

Fort Ikoma on the banks of the Grumeti River in Serengeti district. Good quality photographs were obtained during that period (A. Nyambacha and R. Schmitt).

Greater Short-toed Lark *Calandrella brachydactyla*

First record for Tanzania. Observed and photographed in short grassland on the northeastern shore of Lake Eyasi (northern Tanzania) on 14 February 2016 (C. & N. Schemling).

Wood Warbler *Phylloscopus sibilatrix*

Second record for Tanzania. Observed at Musoma Town, Mara Region on 28 November 2004. Good description provided (I. Shanni).

Lesser Whitethroat *Sylvia curruca*

First record for Kenya and the East African Region. Observed and photographed visiting a drinking point between 14:30 on 25 February and 08:00 on 26 February 2016 at the Turkana Basin Institute (4°17′N, 36°15′E), Ileret, northern Kenya (D. Burgas, M. Cabeza, S. Fraixedas, Á. Fernández-Llamazares).

Lesser Whitethroat

Photos: D. Burgas *et al.*

Chestnut-winged Starling *Onychognathus fulgidus*

First record for Tanzania. The report with relevant details of a small party in forest on Ukerere Island, Lake Victoria, Tanzania in May 1956 was accepted as new for Tanzania. This report was published by N.R. Fuggles-Couchman in *Scopus* in 1983, but had not been previously considered by the EARC.

Paradise Whydah *Vidua paradisaea*

First and second record for Rwanda. Bird photographed from the roadside near Ibanda-Makera Forest, Kirehe District, Eastern Province on 15 May 2016 and photographed from the roadside near Akagera National Park, Eastern Province on 3 and 5 June 2016; these were accepted as the first two records for Rwanda (J. Hogg, J. de Groot and S. Love).

Dusky Indigobird *Vidua funerea*

Second record for Kenya. Given the ample proof provided in print (Payne *et al.* 1992) and on CD (Chappuis 2000) this species was accepted for inclusion on the Kenya list (EANHS 2009). On 1 March 2012, a male and several female birds were observed and photographed in the Kerio Valley. In addition, the male song was recorded and sonograms prepared (J. & D. Bradley). The report was also reviewed and accepted by an independent expert familiar with indigobird species.

2. The following records were Rejected due to insufficient details to establish identification with certainty:

Black-shouldered Nightjar *Caprimulgus pectoralis nigriscapularis* at Akagera National Park, Rwanda on 14 June 2016.

Kretschmer's Longbill *Macrosphenus kretschmeri* at Gwassi Hills, Western Kenya based on four visits between 2011 and 2015.

Yellow-vented Eremomela *Eremomela flavicrissalis* close to Ndutu Safari Lodge, Northern Tanzania on 3 October 2015.

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Acknowledgements

We are very grateful to all the members of the EARC who commented on the above records; Neil Baker, Nik Borrow, Brian Finch, Colin Jackson, David Pearson, David Moyer, Nigel Redman, Itai Shanni, Roger Skeen, Terry Stevenson and Don Turner. We are also very grateful to Françoise Dowsett-Lemaire for sharing her expertise with us.

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An indigobird *Vidua* sp. puzzle in Uganda

Three species of firefinches occur in Uganda where they represent potential hosts for indigobirds *Vidua* spp. These are Red-billed Firefinch *L. senegala*, host for the Village Indigobird *V. chalybeata*; African Firefinch, *L. rubricata*, host for the Dusky Indigobird *V. funerea*; and Black-bellied Firefinch *L. rara*, together with African Firefinch, thought to be a host for the Cameroon Indigobird, *V. camerunensis*. Neither Dusky nor Cameroon Indigobird has yet been confirmed as occurring in Uganda, despite their hosts being present. However, Dusky is reported to have occurred at Bukoba in north-western Tanzania just across the border from southern Uganda, and Cameroon is known from western South Sudan and north-eastern Democratic Republic of Congo, just across the border from northern Uganda.

In December 2016, RS was undertaking a bird survey in Kihihi near Ishasha (Queen Elizabeth National Park) in Kanungu District, Uganda. He noted that African Firefinches were present, and observed an indigobird associated with these. He further observed that the song closely matched the one on his 'app.'(Stevenson, T., Fanshawe, J. & Finch B.W. 2014. *eGuide to Birds of East Africa*. www.mydigitalearth.com) recording of Dusky Indigobird (Stevenson *et al*. 2014) and differed from that of Village Indigobird. He managed to get some photographs, but was unsuccessful in getting a recording of the bird he was observing. Because Cameroon Indigobird is not known to the East African region, RS concluded that he had a record of Dusky Indigobird (see *Bulletin of the African Bird Club*, March 2017, 24: 121, where it is referred to as Variable Indigobird — a less widely used English name for *V. funerea*) and submitted it as such for consideration by the East African Rarities Committee (EARC). Knowing the difficulty in identifying indigobirds, expert advice was sought. This advice brought to the fore the possibility of the bird being Cameroon Indigobird as the Sudanian ecosystem does occur in Uganda, and it was further suggested that the photographs indicated plumage more akin to Cameroon Indigobird. As a consequence, RS resubmitted the record to the EARC as Cameroon Indigobird.

After further consideration, the EARC concluded that it was not possible to accept the record as being beyond all doubt, either Cameroon or Dusky Indigobird, bearing in mind that the location was in fact thought to be south of the Sudanian ecosystem, that no audio recordings were available for analysis, and that deciding on plumage alone was unwise. The EARC recommended that further study be undertaken, not just at Kihihi, but elsewhere where African and Black-bellied Firefinches occurred with indigobirds present. In particular, they urged that audio recordings be obtained whenever possible as well as photographs. The audio recordings could be significant, because whilst Dusky Indigobird only parasitizes African Firefinch, Cameroon Indigobird is thought to parasitize the two firefinches as well as Brown Twinspot *C. monteiri*, and Dybowski's Twinspot *Euschistospiza dybowskii*. The song of Cameroon Indigobird may therefore include mimicry of all four possible hosts.

It is hoped that this note will encourage the collection of information regarding the unresolved indigobird identity in Uganda, which can be sent to NH, using the following email address: nigelhunter@timbale.org.

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Scopus 37(2): 49, July 2017
Received 22 June 2017

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Urban, E.K., Fry, C.H. & Keith, S. (eds) 1986. *The birds of Africa*. Vol. 2. London: Academic Press.

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