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AVIFAUNAL BIODIVERSITY IN PERIL: PRE- AND POST-VEGETATION CLEARANCE SURVEY OF AVIFAUNA IN A FRAGMENTED THICKET IN AN URBAN LANDSCAPE, DAR ES SALAAM CITY, TANZANIA

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ABSTRACT

In contrast to the bird faunas of most protected areas in Tanzania, those found in urban areas have poorly been studied. In December 2009 and May 2010, using mist netting and audiovisual observations, we undertook surveys of birds at *Kituo cha Biomazingira Dar es Salaam* (KIBIDA), a privately owned 6 ha area, as an initial attempt to ascertain which bird species are found there. In 2012 and 2017 this 6 ha area (dominated by thickets) was cleared by unknown people further reducing it to about one-third and one-sixth of the original area, respectively. This led us to further assess whether the birds were negatively affected by habitat reduction after one-third and one-sixth of the study area remained. In both cases we continued to use mist nets augmented by audio-visual observations of birds. We detected a total of 98 species of which 62, 48, 53 and 42 were recorded before wood vegetation in the original 6 ha area was cleared, during clearing, two years and six years after it was cleared, respectively. Some of the species detected were forest-dependent and Palaearctic migrants suggesting that remnant thickets and forest patches in urban landscapes are important for conservation of forest dependent and migrant birds. Twenty-two species that were detected before the wood vegetation in the area was cleared were neither found during the time of clearance nor after clearance suggesting possible emigration or local extinction. Similarly, 44 species that were not found in the study area prior to clearance were either observed or mist netted afterwards as a result of turnover in species composition during the sampling period. The results suggest that there is a

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need to continue to protect KIBIDA and other similar habitats in urban landscapes in order to preserve their avifauna. The results further imply that should such habitats continue to be cleared for provision of settlement, some of the bird species found in them will be lost leading to local extinction. As such, the study recommends conserving thickets and forest patches in urban landscapes as habitats for birds and other fauna.

Keywords: remnant thicket, habitat reduction, urbanization, avifauna, mist netting, Dar es Salaam

INTRODUCTION

Urbanisation is a process of converting wildlands to better meet the requirements and desires of humans (Adams & Lindsay, 2010). It leads to reduction, isolation and degradation of wildlife habitats at local and global scales. Urbanisation has the greatest local effect on wildlife because of its persistence on the landscape (Marzluff & Ewing, 2001). It is a growing global issue with one of its major results being habitat fragmentation and loss (McKinney, 2002), which eventually lead to declines in the number of species (Melles *et al.*, 2003).

Urbanisation creates islands of habitat patches in an urban landscape that vary in size, shape, edge circumference, vegetative make-up, connectivity to other patches and surrounding matrix (Adams & Lindsey, 2010). In some places, these patches have been regarded as biodiversity hotspots in urban landscapes (Zhou & Chu, 2012) and wildlife that inhabits them is a function of patch size, proximity and access to other patches or landscape of the surrounding matrix.

A number of avian studies in urban areas have been conducted in various cities around the world. Some have compared low and highly urbanized areas (Fernández-Juricic & Jokimäki, 2001) while others have tried to assess structural differences in communities (guilds, food consumption, *etc*.) between urban and non-urban settings. Other avian studies have gathered information that allows the comparison of different cities in relation to bird abundance and diversity patterns (*e.g*. Clergeau *et al*., 1998). These studies have generally reported that there are some species that are able to live in altered environment and adapt to the changes in new urban niches while others can decrease in numbers or become locally extinct through a combination of mortality and emigration.

Within Dar es Salaam City, Tanzania, there are a few avian studies available including that of Harvey & Howell (1987) who reported the birds found in the general area of Dar es Salaam. Others are by Mlingwa (1992, 1993) who conducted avian studies in thickets at the University of Dar es Salaam campus and Vikindu Forest Reserve. Further investigations on the avifauna in the Dar es Salaam area have been reported by Burgess *et al*. (1991) and Mlingwa *et al*. (1993) whereby conservation significance of the remnant coastal forests at Pande and Kazimzumbwe was assessed.

While avifauna of the general area of the Dar es Salaam City is generally known (Harvey & Howell, 1987; Burgess *et al*., 1991; Mlingwa, 1992, 1993; Mlingwa *et al*., 1993), the effects of urbanisation on the birds have not been investigated. This study concerns a 6 ha piece of land (that was dominated by thickets) that is privately owned and the owner devoted it to conservation of wildlife, albeit in an urban landscape. To understand the role of this 6 ha

area on conservation of birds, we surveyed the birds in September 2009 and May 2010 using mist netting and audio-visual observations. We also undertook similar avian studies to assess whether the avifauna were impacted by habitat loss in December 2012 and February 2015, after two-thirds of the original 6 ha was cleared. In 2017 further invasion occurred in which the remaining 2 ha thicket was cleared to only 1 ha. To ascertain the effects of this further clearing of the thicket habitat on birds, another study using the same methods was undertaken in February 2019.

Specifically, the main objective of the study was to provide baseline information on bird species richness in one of the fragmented thicket and to assess the impact of habitat loss on birds in an urban landscape.

MATERIALS AND METHODS

Study area

The study area was *Kituo cha Biomazingira Dar es Salaam* (KIBIDA). It is located within the Dar-es-Salaam City along the Western coast of the Indian Ocean (figure 1). It is about 6 ha and the owner devoted it to conserving terrestrial biodiversity in an urban landscape.

Before May 2012 KIBIDA was dominated by thickets with small patches of grassland and scrub (*ca.* 10% of the whole area), however, between May 2012 and February 2013 the woody vegetation was cut by unknown people whose aim was to clear in order to build houses for settlement. In the process, in 2015 *ca.* 66% of the vegetation in the entire area was cleared and houses of different sorts were built to an extent that the study area was composed of squatters (66%) and the remaining bush thickets (34%). In 2017, about half of the remaining thickets was cleared further reducing it to about 1 ha (with a canopy cover averaging 60%). The remaining vegetation is below the minimum park area for birds in urban parks of 10–35 ha (Fernández-Juricic & Jokimäki, 2001) and is surrounded by an "urban ocean" of buildings (urban matrix). Also the surrounding environment has some scattered trees.

The most abundant tree species in the study area (*i.e.* the remaining 1 ha) include *Pteleopsis myrtifolia* (M.A.Lawson) Engl. & Diels., *Azadirachta indica* A.Juss, *Grewia conocarpa* K.Schum., *Leucaena leucocephala* (Lam.) de Wit., *Maerua angolensis* D.C. and *Sideroxylon inerme* L. Other tree species are *Carpodiptera africana* Mast., *Catunaregam obovata* (Hochst.) A.E.Gonç., *Diospyros usambarensis* F.White, *Ehretia amoena* Klotzsch, *Euclea natalensis* A.DC., *Strychnos madagascariensis* Poir., *Tamarindus indica* L., *Terminalia spinosa* Engl. and *Zanthoxylum chalybeum* Engl.

The most abundant shrubs include *Uvaria kirkii* Oliv. ex Hook.f., *Xylotheca tettensis* (Klotzsch) Gilg, *Harrisonia abyssinica* Oliv., *Deinbollia borbonica* Scheff., *Dichrostachys cinerea* (L.) Wight & Arn. and *Ehretia amoena* Klotzsch. Other, less abundant shrubs in the study area include *Albizia petersiana* (Bolle) Oliv., *Blepharis maderaspatensis* (L.) B.Heyne ex Roth., *Capparis tomentosa* Lam., *Carissa spinarum* L., *Cassytha filiformis* L., *Commiphora africana* (A.Rich.) Engl., *Flueggea virosa* (Roxb. ex Willd.) Voigt, *Hibiscus micranthus* L.f., *Lannea stuhlmannii* (Engl.) Engl, *Maerua angolensis* D.C., *Ochna mossambicensis* Klotzsch, *Searsia natalensis* (Bernh. ex C.Krauss) F.A.Barkley, *Uvaria lucida* Benth. and *Jeffreycia hildebrandtii* (Vatke) H.Rob., S.C. Keeley & Skvarla.

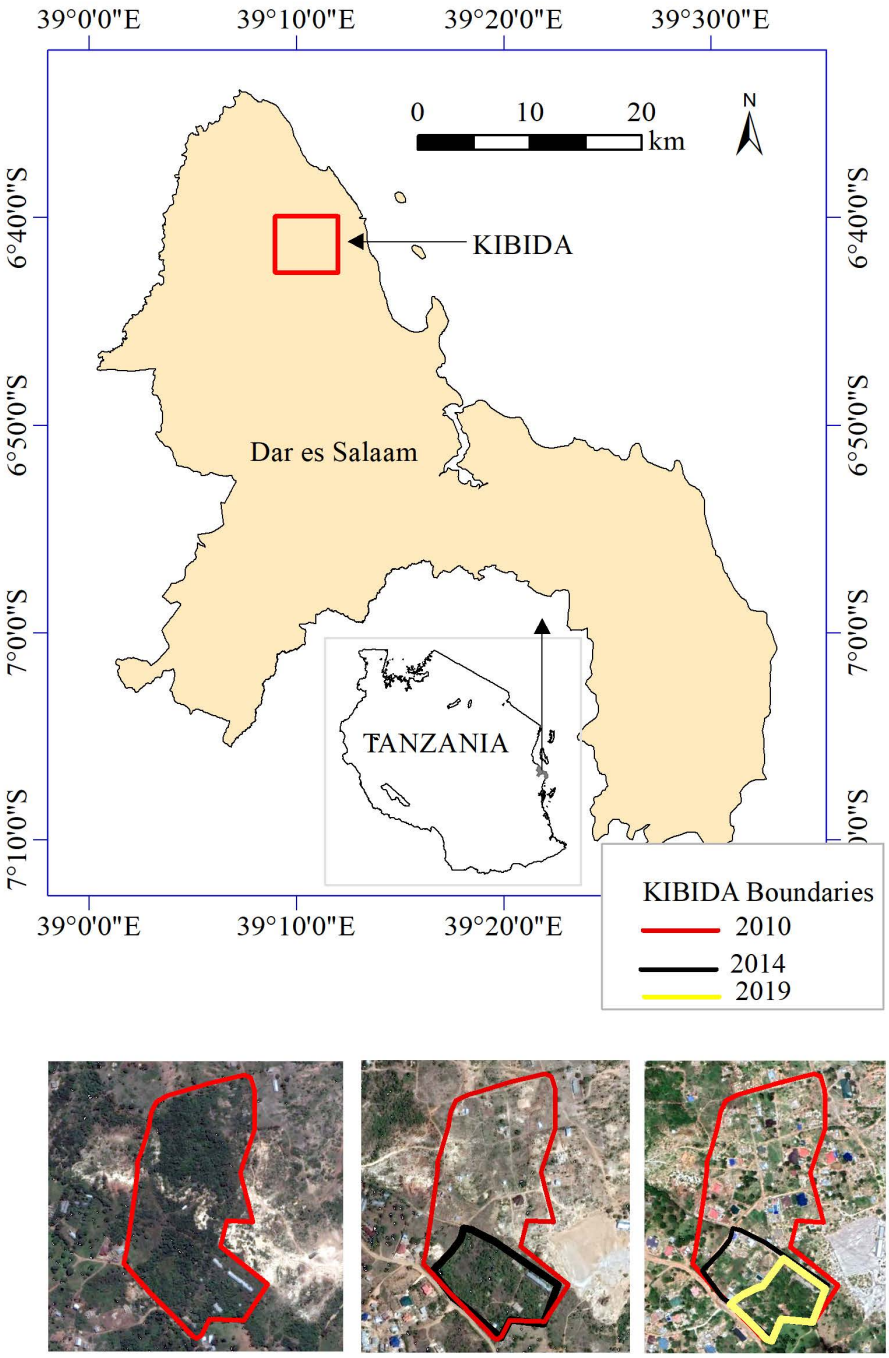

Figure 1. Map of Kituo cha Biomazingira Dar es Salaam (KIBIDA) showing the remaining thicket and cleared land. The original 6 ha and the remaining 2 ha and 1 ha thickets are shown on the bottom the figure. Boundaries (red, black and yellow) are based on the dates when aerial photographs were taken (as per Google Earth maps).

Methods

The studies were conducted in December 2009 before the woody vegetation was cleared; in December 2012 during the clearing and in February 2015, two years after the vegetation was cleared. In February 2019 another study was conducted after the study area was further cleared to 1 ha in order to assess whether habitat reduction had affected the diversity of bird fauna.

We used a combination of mist netting and audio-visual observations. Mist netting was the main method that was used to study birds following Bennun & Howell (2002) because it allows recording of more secretive bird species. Before the vegetation in study site was cleared and during the time of clearing, we used six mist nets (each 12 m long, 2.6 m high, mesh size 30 mm, 4 tiers) for three days (36 daylight hours) to catch birds. The nets were located such that they were randomly distributed in the entire area (6 ha). After two-thirds of the area was cleared, we used 15 mist nets (each 12 m long, 2.6 m high, mesh size 30 mm, 4 tiers, for 42-day light hours) that were randomly scattered throughout the remaining area of 2 ha. Furthermore, after further clearing (in 2017), 15 mist nets (each 12 m long, 2.6 m high, mesh size 30 mm, 4 tiers, for 42-day light hours) were randomly set throughout the remaining area (1 ha) in February 2019. During each mist netting session, the nets were operated from early in the morning before sun rise, usually at 06:00 hours to late evening at sun set usually at 18:00 hrs. Nets were checked frequently at intervals of thirty to sixty minutes to minimize injuries to birds caused by entanglements and to reduce the risks of netted birds being attacked by predators. All birds trapped were carefully removed from mist nets, identified and temporary marked with black ink on one of the tarsi for recognition of recaptures. For security reasons we did not survey the cleared land.

Audio-visual observations took place in the mist-netting points as well as at the entire study area during the sampling period.

Birds in the study area were divided into two groups: forest- and non-forest dependent species following Bennun *et al*. (1996) and Mlingwa *et al*. (2000). Forest species are birds of the interior undisturbed forest and in most cases are found in forest trips, gaps and edges. Non-forest species are birds that are infrequently found in the forest but are not dependent on it for their survival (Newmark, 1991).

The study is mainly qualitative because of differences in mist netting efforts during sampling periods. As such, some statistical analyses were not performed. Based on equal sampling efforts between the 2 ha and the remaining 1 ha thicket, further analyses on short term changes in avifauna in the study area will be presented elsewhere.

Birds mist netted were expressed as number of individuals per 1000 metre-net hours. Sample-based species accumulation curves were generated using a software package, PAST (Hammer, Harper & Ryan, 2001). Agglomerative hierarchical clustering based on the Sørensen dissimilarity index for binary data (on an absence-presence matrix of all species sampled) was used to assess bird community similarity before the vegetation in the area was cleared, during the process of clearing and after about two-thirds and five-sixth of the original 6 ha area was cleared. This was carried out using Community Analysis Package 4 (Seaby & Henderson, 2007).

Bird taxonomy follows Gill & Donsker (2019).

RESULTS

Species richness

Species recorded during the study period are listed in appendix 1. Species accumulation curves for all sampling periods based on mist netting data showed upward trends without reaching an asymptote, although all curves had started to taper off somewhat, particularly for the overall curve (figure 2). Ninety-eight species of birds in 30 families of which 62, 48, 53 and 42 were detected before the wood vegetation was cleared, during the clearing period, 2 years and 6 years after the vegetation was cleared, respectively. Over 75% of the species detected were caught in mist nets and the rest were observed (appendix 1). Most of the species detected, 91.8% (ninety species) were non-forest dependent species, while 8 (8.2%) were forest-dependent. Five species, the European nightjar *Caprimulgus europaeus*, red-backed shrike *Lanius colurio,* spotted flycatcher *Muscicapa striata,* blackcap *Silvia atricapilla* and Eurasian golden oriole *Oriolus oriolus* were Palaearctic migrants. Two invasive species, the house crow *Corvus splendens* and house sparrow *Passer domesticus* were observed. On overall assessment, sombre greenbul *Andropadus importunus,* spotted morning palm thrush *Cichladusa guttata* and D'Arnauds barbet *Trachyphornus dararnaudii* were the most abundant species mist netted (appendix 1).

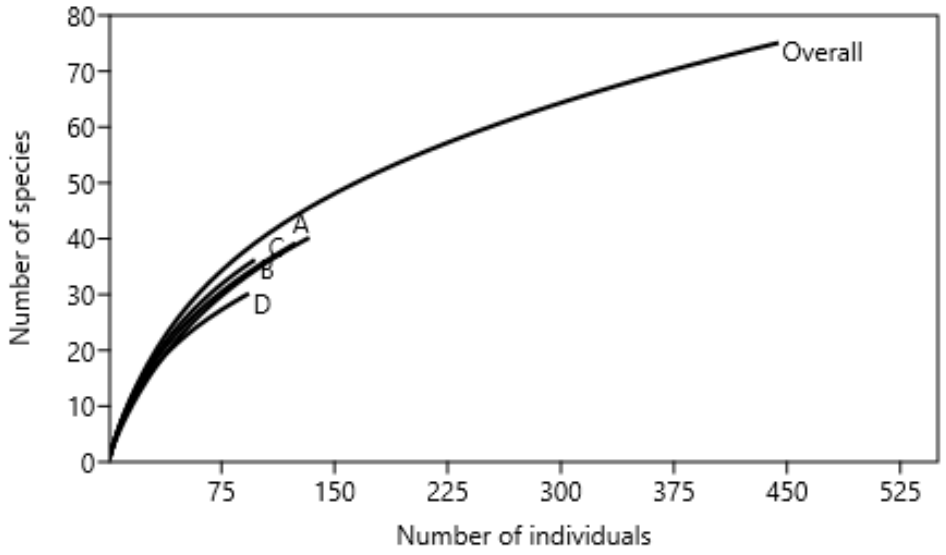

Figure 2. Sample-based species accumulation curve for bird species mist netted at KIBIDA. A, B, C, and D refer to sampling period before the vegetation in the study area was cleared, during clearance, after two-thirds and five-sixths of the vegetation in the study area was cleared, respectively. Overall indicates a curve drawn based on all records of mist netted individuals.

Pre- and post- vegetation clearance comparisons

About one-third of the species detected were found to be present during each sampling session (appendix 1). Twenty-five species (that were detected before the wood vegetation in the study area was cleared) were neither found during the time of clearance nor after clearance. Twenty species have been either mist netted or observed during each survey

period. The clustering showed higher similarity in community assemblage of birds between the period during vegetation clearing in 2012 and 2 years post-clearance (figure 3). The bird community after only 1 ha of the original area remained (6 years after initial vegetation clearing) was well separated from the other three sampling periods (figure 3).

Of the six forest-dependent species detected before the vegetation was cleared, only the brownbul *Phyllastrephus terrestris* and black-throated wattle-eye *Platysteira peltata* were observed after the vegetation in the study area was reduced to 2 ha (appendix 1). None of the forest dependent species that were detected before the vegetation in the original 6 ha area was cleared was either mist netted or observed after the study area was reduced to 1 ha (appendix 1). For the first time, the only forest dependent species that was observed after the area was further cleared to 1 ha was black-bellied starling *Lamprotornis corrusca*.

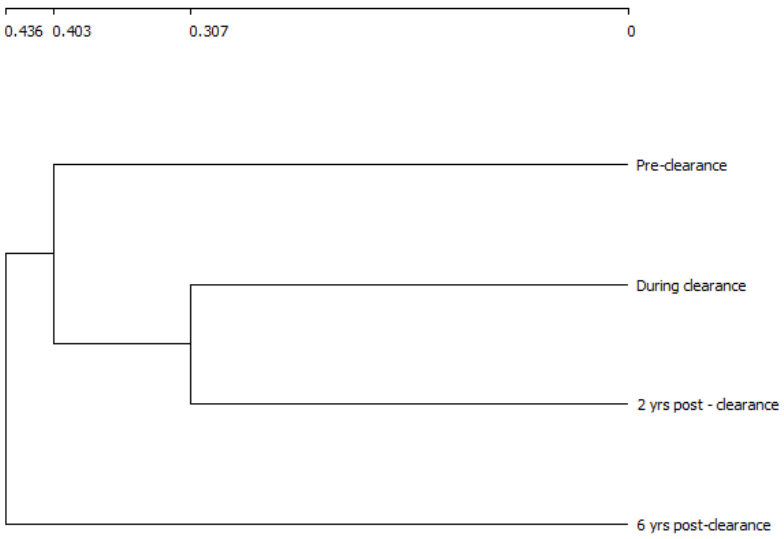

Figure 3. Dendrogram based on a matrix of occurrence of bird species by sampling sessions using Sørensen dissimilarity index. Pre-clearance, during clearance, 2 years post-clearance and 6 years post-clearance refer to sampling period before the vegetation in the study area was cleared, during clearance, after two-thirds and five-sixth of the vegetation in the study area was cleared.

DISCUSSION

Bird species richness

With 98 species, KIBIDA has been supporting diverse avian species some of which are known to inhabit thickets and forests. This number of species is high considering that KIBIDA has been small and its size is below the minimum park area for birds in urban landscapes (see Fernández-Juricic & Jokimäki, 2001).

There were more non-forest dependent species than those that are forest dependent perhaps due to human disturbance during the past and the study area is mostly surrounded by settlements. Such findings concur with those of Adams & Lindsey (2010) who reported that specialists tend to decline in urban areas while generalists increase in numbers. The low proportion of forest dependent species (8.2% of total species) two years, and the presence of only one forest dependent species (*ca.* 1%)

six years after the vegetation was cleared reflect that the area is small and disturbed and unsuitable for inhabitation by most of the forest dependent species. The lack of most of the forest dependent species (except *L. corrusca*) after 83% of the study area was cleared suggests local extinction of these species after the area was reduced to only 1 ha. The starling (*L. corrusca*) seemed to visit the study area temporary. Thus, it is possible that reduction of the study area has led to the loss of some species including the forest dependent species. Similar findings have been reported in Dar es Salaam area in Vikindu Forest Reserve by Mlingwa (1993). This is in contrast to the other nearby and relatively larger forest areas that have been found to have more forest-dependent species. For example, at the University of Dar es Salaam thickets, an area of about 500 ha, Mlingwa (1992) recorded 26 forest-dependent species. In relatively larger protected areas such as Pande (1100 ha; Burgess *et al*. 1991), Kazimzumbwe (3500 ha; Mlingwa *et al*., 1993) and Vikindu (1000 ha; Mlingwa 1993) forests, more forest-dependent species have been recorded. The results of the present study are in agreement that smaller forests support fewer forest birds as was found by Burgess & Mlingwa (1993).

The remaining thicket, albeit now very small (1 ha) and disturbed, forms an "island" in an "urban ocean" of buildings and provides a wintering or stop-over habitat for some Palaearctic migrants. The presence of these Palaearctic migrants further supports the observations of Mlingwa (1992) that they winter in the Dar es Salaam area. Should habitat clearance continue, the study area will not be used by these migrants as a wintering and stop over habitat.

Comparisons of avifauna before, during and after clearing of the wood vegetation in the study site

Cluster analysis separated bird community detected before the vegetation was cleared from bird communities both during clearance and post clearance sampling sessions. The bird community after the original area was further cleared to 1 ha was also well separated from the other sampling periods. This situation suggests distinct avian communities when the study area was 6 ha compared to when it was further reduced to 1 ha. This could partly be due to the absence of some species including the forest dependent species (that were in fact detected before the vegetation was cleared) after five-sixths of the vegetation in the area was cleared. For example, of the forest-dependent species that were detected before the area was cleared, only *P. terrestris* and *P. peltata* were observed after two-thirds of the study area was cleared. These species were neither mist netted nor observed after five-sixths of the study area was cleared. It is therefore possible that due to loss of vegetation cover, some forest-dependent species including tambourine dove *Turtur tympanistria*, black cuckoo *Cuculus clamosus*, red-caped robin chat *Cossypha natalensis* and red-throated twinspot *Hypargos niveoguttatus* that were detected before the area was cleared may now be extinct at KIBIDA. A similar situation may have happened to other non-forest species that were detected before the vegetation in the original area was cleared but not thereafter. Alternatively, these species may have made local movements to the surrounding urban environment. A good example could be the spotted eagle owl *Bubo africanus*. Two individuals of this species were resident in the study area, always roosting in one big tree. However, after the tree was cut in 2017, these individuals have not been observed since.

Prior to vegetation clearance, the study area had some very small patches of grassland and scrub (*ca*. 10% of the total area) that were appropriate habitats for flappet lark *Mirafa rufocinnamomea*, African pipit *Anthus cinnamomeaus* and yellow-throated longclaw *Macronyx croceus*. The absence of these species both during the time when the vegetation was being cleared and post clearance period is likely because of the loss of grassland patches that were converted to settlement.

Forty-four species that were not found in the study area prior to clearance were either observed or mist netted afterwards as a result of turnover in species composition during the sampling period. For example, species such as lesser honeyguide *Indicator minor*, yellow-breasted apalis *Apalis flavida* and *L. corrusca* were either mist netted or observed only after the vegetation in the remaining study area was reduced to 1 ha. It is possible that these species came from the neighbouring areas and perhaps found the study area suitable for habitation. This suggests that these species were possibly visitors. Another explanation could be that we were possibly not able to detect some of the species as it is easier to prove presence of a species than to confirm its absence. In a situation like this, where there were immigrants and emigrants, the study was by no means an exhaustive survey of all birds (as it was revealed by species accumulation curves).

CONCLUSION AND CONSERVATION IMPLICATIONS IN AN URBAN LANDSCAPE

Our study presents baseline data and has addressed the importance of one of the remnant thickets in Dar es Salaam City in the conservation of birds.

It has thus contributed to an understanding of the role of remnant thickets found in urban areas in conservation of birds. Although the current size of KIBIDA is below the minimum park area for birds in urban areas (see Fernández-Juricic & Jokimäki, 2001), it nevertheless supports a number of birds that would otherwise lack such a habitat. The results suggest that conservation of birds in remnant thickets and forests in urban areas is important. For instance, if populations of birds can be established in urban areas, there would be a decrease in chances of species extinctions both at local and regional levels. Also the aesthetic value of thickets and forested parts in urban areas would be enhanced. The protection and conservation of KIBIDA is recommended and further invasion and habitat clearance should be stopped. Moreover, biodiversity conservation in urban areas is important for the future generations. It is a challenge to city planners and managers who are planning new towns to think of setting out large remnant patches in the urban landscape in order to preserve the biodiversity that depend on these forest patches or thickets.

The results of this survey are a first step in quantifying the value of KIBIDA in terms of bird species conservation. It is thus a suitable bird watching site. The survival of the remaining bird species will definitely depend on the protection of the remaining 1 ha, albeit small and disturbed, from further clearance. We propose future monitoring to be done to address pending possible local extinction of the remaining birds at the study site. The survival of the studied birds need the protection of any remaining natural or secondary vegetation at KIBIDA.

Though the biodiversity conservation needs of remaining forest patches in the Dar es Salaam area have been emphasized by Howell (1981) and Harvey & Howell (1987), there seems to be little effort to control the harmful human activities taking place due to urbanization. We suggest that this problem can be controlled only if conservation education is given to whoever lives in the Dar es Salaam area. This education could involve planting of native trees by all landowners of Dar es Salaam.

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*Appendix 1. Bird species recorded at KIBIDA before the vegetation was cleared (pre-clearance), during clearance and after 2 and 6 years post-clearanc Numbers indicate catch rates in mist nets (number of individuals per metre-net-hours). * = forest-dependent species, ** = Palaearctic migrant, Obs. = bir observed but not mist netted.*

	Survey session			
Family & Species	Pre-clearance	During clearance	2 years post - clearance	6 years post-clearar
Family Numididae: Guineafowls				
Helmeted guineafowl *Numida meleagris* (Linnaeus 1758)	Obs.	Obs.	0.40	
Phasianidae: Quails, Francolins				
Coqui francolin *Peliperdix coqui* (Bates, 1928)	Obs.			
Crested francolin *Dendroperdix sephaena* (Hartlaub, 1866)	Obs.			
Accipitridae: Vultures, Eagles, Hawks etc.				
Black kite *Milvus migrans* (Boddaert, 1783)	Obs.			
Culumbidae : Pigeons, Doves				
Red-eyed dove *Streptopelia semitorquata* (Ruppell 1837)	Obs.	Obs.	Obs.	Obs.
Ring-necked dove *Streptopelia capicola* (Sundevall 1857)	Obs.	Obs.	Obs.	
Emerald spotted wood-dove *Turtur chalcospilo*s (Wagler 1827)	0.39	0.39	Obs.	0.40
*Tambourine dove *Turtur tympanistria* (Temminck 1809)	Obs.			
Namaqua dove *Oena capensis* (Linnaeus, 1766)	0.19			
Cuculidae: Cuckoos, Coucals				
White-browed coucal *Centropus superciliosus* Hemprich & Ehrenberg, 1829	Obs.	Obs.	0.13	Obs.
Jacobin cuckoo *Clamator jacobinus* Sparrman, 1786)	Obs.			
Diederik cuckoo *Chrysococcyx caprius* (Stephens, 1815)			Obs.	
Klaas's cuckoo *Chrysococyx klaas* Shelley, 1880		0.39		Obs.
*Black cuckoo *Cuculus clamosus* Lafresnaye, 1853	Obs.			

Family & Species	Survey session			
	Pre-clearance	During clearance	2 years post - clearance	6 years post-clearar
Strigidae: Owls				
Spotted eagle-owl *Bubo africanus* (Temminck, 1821)	Obs.	Obs.	Obs.	
Caprimulgidae: Nightjars				
** Eurasian nightjar *Caprimulgus europaeus* Linnaeus, 1758		0.39		
Slender-tailed nightjar *Caprimulgus clarus* Hartlaub, 1857			0.13	
Square-tailed nightjar *Caprimulgus fossii* Hartlaub, 1857	Obs.	Obs.		0.40
Apodidae: Swifts				
White-rumped swift *Apus caffer* (Sharpe, 1904)	Obs.			
Coliidae: Mousebirds				
Speckled mousebird *Colius striatus* Vieillot, 1817	0.39	0.39	0.13	Obs.
Alcedinidae: Kingfishers				
Grey-headed kingfisher *Halcyon leucocephala* (Lesson, R, 1830)	0.77	0.39	0.26	0.13
Brown-hooded kingfisher *Halcyon albiventris* (Scopoli, 1786)			Obs.	0.26
African pygmy kingfisher *Ispidina picta* (Boddaert, 1783)	0.39	0.39		
Meropidae: Bee-eaters				
Little bee-eater *Merops pusillus* Statius Müller, PL, 1776	0.58	0.77	0.40	0.13
White-fronted bee-eater *Merops bullockoides* Oustalet, 1882	Obs.			
Lybiidae: Barbets and Tinkerbirds				
Red-fronted tinkerbird *Pogoniulus pusillus* (Heuglin, 1862)	0.19	0.39	0.66	0.13

Family & Species	Survey session			
	Pre-clearance	During clearance	2 years post - clearance	6 years post-clearar
Brown-breasted barbet *Lybius melanopterus* (Cuvier, 1816)			Obs.	
Crested barbet *Trachyphonus vaillantii* Reichenow, 1887				Obs.
D'Arnaud's barbet *Trachyphonus darnaudii* (Prévost & Des Murs, 1847)			0.93	1.85
Indicatoridae: Honeyguides				
Lesser honeyguide *Indicator minor* Neumann, 1908				0.13
Picidae: Woodpeckers				
Cardinal woodpecker *Dendropicos fuscescens* Malherbe, 1849			Obs.	
Platysteiridae: Batises, Wattle-eyes and allies				
Eastern black-headed batis *Batis minor* Erlanger, 1901	Obs.	Obs.	Obs.	0.26
*Black-throated wattle-eye *Platysteira peltata* Oberholser, 1905	0.58	1.54	0.26	
Malaconotidae: Bushshrikes				
Orange-breasted bush-Shrike *Chlorophoneus sulfureopectus* (Lesson, R, 1831)	0.19			
Brown-crowned tchagra *Tchagra australis* (Sharpe, 1882)	0.19		0.13	
Black-crowned tchagra *Tchagra senegalus* (Temminck, 1840)			0.13	
Tropical boubou *Laniarius major* (Hartlaub, 1848)		0.77	Obs.	0.40
Laniidae: Shrikes				
** Red-backed shrike *Lanius collurio* Linnaeus, 1758		0.77	Obs.	
Oriolidae: Orioles				
Eurasian golden oriole *Oriolus oriolus (Linnaeus, 1758)*				0.13

Family & Species	Survey session			
	Pre-clearance	During clearance	2 years post - clearance	6 years post-clearar
Monarchidae: Paradise Flycatchers				
African paradise flycatcher *Terpsiphone viridis* (Statius Müller, PL, 1776)	0.19	0.77		0.66
Corvidae: Crows				
House crow *Corvus splendens* Vieillot, 1817	Obs.	Obs.	Obs.	Obs.
Alaudidae: Larks				
Flappet lark *Mirafra rufocinnamomea* (Salvadori, 1865)	Obs.			
Pycnonotidae: Bulbuls				
Common bulbul *Pycnonotus barbatus* (Desfontaines, 1789)	0.19	1.93	0.93	0.53
Sombre greenbul *Andropadus importunus* (Vieillot, 1818)	8.29	3.47	2.91	1.06
*Terrestrial brownbul *Phyllastrephus terrestris* Swainson, 1837	0.19	Obs.	0.13	
Northern brownbul *Phyllastrephus strepitans* (Reichenow, 1879)	1.35	3.09	0.53	
Macrosphenidae: Crombecs and allies				
Red-faced crombec *Sylvietta whytii* Shelley, 1894	0.39			0.13
Acrocephalidae: Warblers				
Sedge warbler *Acrocephalus schoenobaenus* (Linnaeus, 1758)	0.19			
Moustached warbler *Acrocephalus melanopogon* (Temminck, 1823)			0.13	
Cisticolidae: Cisticolas, Apalises, Camaropteras etc.				
Red-faced cisticola *Cisticola erythrops* (Hartlaub, 1857)			0.13	
Rattling cisticola *Cisticola chiniana* (Smith, A, 1843)	0.19	0.77	0.13	0.13
Tiny cisticola *Cisticola nana* Fischer, GA & Reichenow, 1884			0.13	

Family & Species	Survey session			
	Pre-clearance	During clearance	2 years post - clearance	6 years post-clearar
Tawny-flanked prinia *Prinia subflava* (Gmelin, JF, 1789)	0.58	0.77	0.13	Obs.
Yellow-breasted apalis *Apalis flavida* (Strickland, 1853)				0.13
Red-winged warbler Prinia *erythropterus* (Jardine, 1849)			0.13	
Grey-backed camaroptera *Camaroptera brevicaudata* (Vieillot, 1821)	1.16	0.39	0.13	0.26
Leiothrichidae: Babblers				
Rufous chatterer *Turdoides rubiginosa* (Rüppell, 1845)		0.39	0.26	
Arrow marked babbler *Turdoides jardineii* (Smith, A, 1836)	0.19			
Sylviidae: Warblers				
**(*) Blackcap *Sylvia atricapilla* (Linnaeus, 1758)			0.13	
Zosteropidae: White-eyes				
African yellow white-eye *Zosterops senegalensis* Bonaparte, 1850	0.19	Obs.	0.13	
Sturnidae: Starlings				
*Black-bellied starling *Notopholia corrusca* Roberts, 1922				Obs.
Muscicapidae: Thrushes, Robins, Flycatchers etc.				
White-browed scrub robin *Cercotrichas leucophrys* (Vieillot, 1817)		0.77		0.13
Pale flycatcher *Melaenornis pallidus* (von Müller, JW, 1851)		0.39		
African grey flycatcher *Melaenornis microrhynchus* (Reichenow, 1887)			0.66	
** Spotted flycatcher *Muscicapa striata* (Pallas, 1764)	0.19			0.13

Family & Species	Survey session			
	Pre-clearance	During clearance	2 years post - clearance	6 years post-clearar
White-browed robin chat *Cossypha heuglini* Hartlaub, 1866	0.19			Obs.
*Red-caped robin chat *Cossypha natalensis* Smith, A, 1840	0.19			
Spotted palm thrush *Cichladusa guttata* (Heuglin, 1862)	0.39	1.54	0.53	1.19
Nectariniidae: Sunbirds				
Purple-banded sunbird *Cinnyris bifasciatus* (Shaw, 1812)	0.19	0.39		
Variable sunbird *Cinnyris venustus* (Shaw, 1799)			0.13	
Scarlet-chested sunbird *Chalcomitra senegalensis* (Linnaeus, 1766)		0.39	1.98	0.26
Passeridae: Sparrows				
House sparrow *Passer domesticus* (Linnaeus, 1758)	0.19	Obs.	Obs.	Obs.
Northern grey-headed sparrow *Passer griseus* (Vieillot, 1817)	0.19	1.16	Obs.	Obs.
Ploceidae: Weavers, etc.				
Thick-billed weaver *Amblyospiza albifrons* (Vigors, 1831)		0.77		
Spectacled weaver *Ploceus ocularis* Smith, A, 1828	0.77	0.39	0.40	
Eastern golden weaver *Ploceus subaureus* Smith, A, 1839			0.13	
Lesser masked weaver *Ploceus intermedius* Rüppell, 1845			0.40	
Vitelline masked weaver *Ploceus vitellinus* (Lichtenstein, MHK, 1823)	0.77	2.70	0.79	
Village weaver *Ploceus cucullatus* (Statius Müller, PL, 1776)	1.35	0.77		0.13
Red-billed quelea *Quelea quelea* (Linnaeus, 1758)		5.40	0.13	

Family & Species	Survey session			
	Pre-clearance	During clearance	2 years post - clearance	6 years post-clearar
Zanzibar red bishop *Euplectes nigroventris* Cassin, 1848				0.13
Yellow bishop *Euplectes capensis* (Linnaeus, 1766)	0.39	Obs.	0.26	0.40
Estrildidae: Waxbills.				
Green-winged pytilia *Pytilia melba* (Linnaeus, 1758)	1.16	1.54	0.40	0.53
*Red-throated twinspot *Hypargos niveoguttatus* (Peters, W, 1868)	Obs.			
Red-billed firefinch *Lagonosticta senegala* (Linnaeus, 1766)	0.77	0.39		1.06
Blue waxbill *Uraeginthus angolensis* (Linnaeus, 1758)		0.39		0.79
Red-cheeked cordon-bleu *Uraeginthus bengalus* (Linnaeus, 1766)	0.39	0.39	0.53	0.13
Bronze mannikin *Spermestes cucullata* (Swainson, 1837)	0.39	1.16	0.26	
Black-and-white mannikin *Spermestes bicolor* (Fraser, 1843)	Obs.			
Viduidae: Wydahs, Indigobirds, Parasitic weaver				
Village indigobird *Vidua chalybeata* (Statius Müller, PL, 1776)				0.13
Pin-tailed whydah *Vidua macroura* (Pallas, 1764)	0.19			
Long-tailed paradise whydah *Vidua paradisaea* (Linnaeus, 1758)	0.39			
Broad-tailed paradise whydah *Vidua obtusa* (Chapin, 1922)	0.19			
Cuckoo-finch *Anomalospiza imberbis* (Cabanis, 1868)			0.13	
Fringillidae: Canaries, Seedeaters, Allies				
Yellow-fronted canary *Crithagra mozambica* (Statius Müller, PL, 1776)		0.39		Obs.

Family & Species	Survey session			
	Pre-clearance	During clearance	2 years post - clearance	6 years post-clearar
Family Motacillidae: Wagtails, Pipits and Longclaws				
African pipit *Anthus cinnamomeus* Rüppell, 1840	Obs.			
Yellow-throated longclaw *Macronyx croceus* (Vieillot, 1816)	Obs.			
Emberizidae: Old World Buntings				
Cinnamon-breasted bunting *Emberiza tahapisi* Smith, A, 1836	Obs.			
Total number of species	62	48	53	42