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Importance Of Urban Green Spaces in Avian Conservation: The Status of Birds at the University of Dar es Salaam Main Campus Thickets After 30 Years, Tanzania

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Abstract

Between 1986 and 1990, 77 species of birds were mist netted at the University of Dar es Salaam main campus thickets, in Dar es Salaam City, Tanzania. Thirty years later, due to various developments which resulted into decline in the overall cover of the vegetation, between 2016 and 2021 we conducted a similar mist netting study to assess whether there have been changes in bird species composition and abundance at the campus thickets. We mist netted 65 species of which 44 were also mist netted between 1986 and 1990, and seven species were new records for the campus thickets. The Sorensen Similarity Index between the two sampling periods was 61% suggesting a moderately high similarity in species composition between the two periods. Seventy-nine species out of 98 (from both studies) did not show any significant differences in probability of occurrence between 1986-1990 and 2016-2021. Our assessment revealed that the remaining thickets have continued to provide a habitat for a number of bird species including forest-dependent ones. Thus, given the ongoing loss of original habitats and urban sprawl in Dar es Salaam, the continued protection of these thickets is recommended as are any other thickets in urban and sub-urban environments in the country.

Keywords: Coastal thickets; forest dependence; University of Dar es Salaam campus urban green space

Introduction

Natural areas in urban areas have been fragmented into smaller patches because of various types of developments. As such, human-induced fragmentation has been considered one of the major causes of the loss of biodiversity particularly due to decrease in habitat size and habitat heterogeneity as well as increase in the degree of isolation (Werema et al. 2019). In general, the species and overall diversity of birds in the urban areas rely on the size, quantity, connectedness and quality of urban green spaces (Beninde et al. 2015). Thus, the distribution of urban birds follows a nested accumulation of species suggesting that large and continuous habitat blocks are more suitable than small ones (Natuhara and Imai 1999). When large and continuous habitat blocks are further fragmented into smaller ones, local extinctions of some species may occur (Werema et al. 2019).

Urban green spaces comprise a range of habitat types across a continuum from intact remnant patches of native vegetation, gardens and yards, to essentially modified patches of vegetation that may or may not be representative of native community associations (Aronson et al. 2017). While urban areas may be considered to have

depauperate flora and fauna dominated by invasive species and homogeneous taxa across regions, it has however, been found that these areas can house a great deal of species both native and non-native to the surrounding region (Lepczyk et al. 2017, John and Kagembe 2022). The urban areas can even support endemic native species and others of conservation concern both at regional and global scales (Aronson et al. 2014, Ives et al. 2016). Urban and peri-urban forests are crucial in maintaining biodiversity, which in turn provides a large number of ecosystem services which human communities depend on (Sanesi et al. 2011). The natural green spaces although declining in urban areas, their remnants provide the more needed resources such as food and breeding locations for many bird species (Dong et al. 2024). Green spaces particularly forests in urban areas can even provide dispersal corridors among different habitat patches (Bolger et al. 2001). Furthermore, these forests can provide refuge for species whose native habitats have been largely lost (Angold et al. 2006), even allowing for the occurrence of dependent species including forest specialists (Bennun et al. 1996) in urban and peri-urban landscapes (Park and Lee 2000). Examples of such forests in the Dar es Salaam urban landscape include Pande Game Reserve (Burgess et al. 1991) and University of Dar es Salaam main campus thickets (Mlingwa 1992). These habitats are of conservation concern as they host significant portion of the bird species found within Dar es Salaam area (Harvey and Howell 1987).

Between 1986 and 1990, Mlingwa (1992) conducted a study on the understorey bird species within the University of Dar es Salaam main campus especially in the thickets. There has been no detailed investigation of the status of avifauna in the area for the last 30 years. With the study site being in an urban landscape, due to various developments at the campus (e.g. increase of buildings), there have been changes in the overall cover of vegetation (Kivuyo and Masao 2020) which may have affected the diversity and abundance of birds. For example, forest cover at the University campus decreased from about 83.1% (during 1986 – 2002) to 50.6% (during 2002 – 2018) (Kivuyo and Masao 2020). As such, almost 30 years after the initial study by Mlingwa (1992), between 2016 and 2021 we used mist nets to catch birds in order to assess whether there have been changes in bird species composition and abundance at the university campus thickets in a span of 30 years. We hypothesized that due to decrease in the overall cover of vegetation in a span of 30 years, (i) there is a change in species composition in the campus thickets, and (ii) there are changes in abundances of bird species at the campus thickets. The results provide an understanding of the importance of the remaining thickets at the campus for continued conservation of birds in an urban landscape.

Materials and methods

Study area

The University of Dar es Salaam main campus is about 500 ha (6° 46′ S - 6° 47′ S, 39° 12′ E - 39° 14′ E) (Figure 1) at 40 - 100 m above sea level (Mlingwa 1992). It falls within the east coast biome (Fishpool and Evans 2001). The natural vegetation at the campus was once dominated by forest but most of it disappeared due to clearance for agriculture and buildings in the past (Wingfield 1977). Much of the natural vegetation in form of natural trees and dense thickets remained until 1975 (Mlingwa 1992). During the last quarter, a century the campus has continued to retain its vegetation due to protection from wood collection and cultivation (Senzota 2012). For example, during 1970-1986, the campus forest cover was about 77.6% that increased to about 83.1% during 1986 and 2002. However, at some places the thickets and forests have been cleared (Figure 1) for building offices, hostels, library, lecture rooms and laboratories leading to a decline of forest cover to about 50.1% during 2002 – 2018 (Kivuyo and Masao 2020). To date, there are seven patches of thickets of native tree and shrub species and two patches which have been dominated by an exotic tree *Leucaena leucocephala*. The thicket patches at the

University campus, though varying in size, have stood out as habitat islands in a sea of human settlements, campus buildings (e.g., offices and lecture halls) and road networks (Senzota 2012).

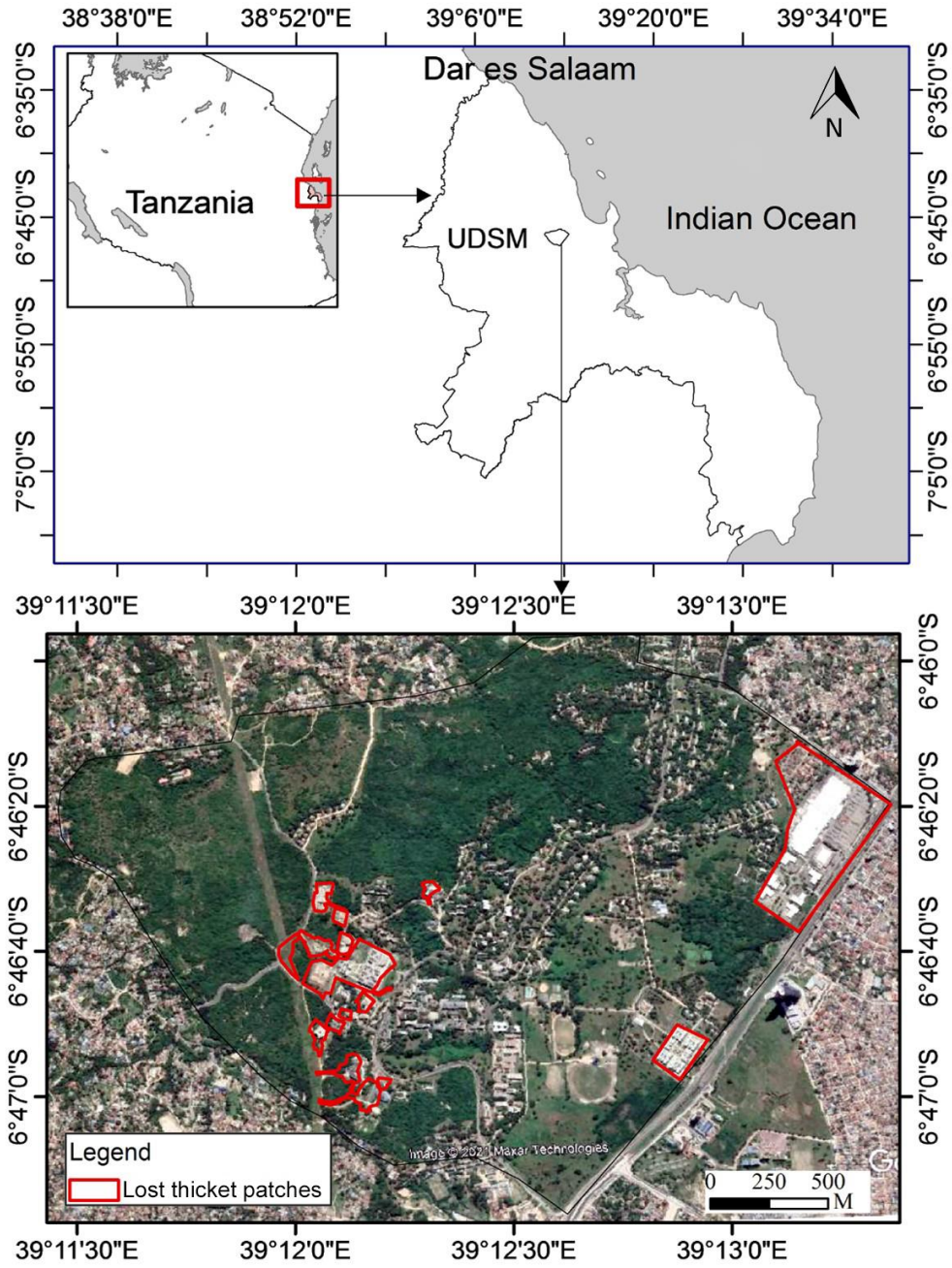

Figure 1: University of Dar es Salaam Main campus environments. Most recently impacted thickets are encircled in red. Thickets are represented by the dark green colour.

Data collection

Similar to the study by Mlingwa (1992) we used mist nets to catch birds. The total mist netting effort was 43,628 metre-net-hours (hereafter, m-n-h) and was conducted during the following periods: October 2016 (864 m-n-h), September 2018 (1400 m-n-h), March 2020 (6048 m-n-h), August 2021 (4032 m-n-h), January 2021 (8856 m-n-h), February 2021 (17712 m-n-h), October 2021 (3276 m-n-h) and December 2021 (1440 m-n-h). Although we targeted mostly thickets similar to the previous study (Mlingwa 1992), our mist netting sites may have differed due to various developments including clearing of some thickets for building purposes. To identify recaptures, birds caught in mist nets were temporarily marked on the right tarsus with black/blue ink and only few birds were metal-ringed. All birds were immediately released. Mist nets were usually opened from 06:00 to 18:30 and they were checked every after 30 to 40 minutes.

Data analysis

Similarity in bird species we mist netted and those mist netted by Mlingwa (1992) was computed using Sorensen Similarity Index (SSI) (Magurran 1988) as follows:

$$SSI = \frac{2a}{b + c}$$

where, a = the common number of species we mist netted and those mist netted by Mlingwa (1992), b = the number of species mist netted by Mlingwa (1992) and c = number of species we mist netted.

The birds in the study area were grouped into: forest-dependent species and forest visitors following Bennun et al. (1996) and John and Kiwango (2021). Forest-dependent species were Forest Specialists (*FF* species) which are birds of the forest interior that are likely to disappear when the forest is modified and Forest Generalists (*F* species) which occur in undisturbed forests but are able to exist in modified and fragmented forests as well as forest edge (Mlingwa et al. 2000). *F* species still depend upon the forest for some of their resources like nesting sites. Furthermore, forest visitors (*f* species), the species which are often recorded in forest, but are not dependent upon it were assessed. These are commonly found in non-forest habitats, where they are most likely to breed (Bennun et al. 1996).

Since sampling efforts between the two survey periods differed, we calculated catch rate of each species (Bennun and Howell 2002). This was expressed as the number of individuals mist netted divided by the mist netting effort per 10^5 m-n-h. The catch rates were subjected to normality test. Since they were not normally distributed, we used Wilcoxon rank sum test to assess whether there was a significant difference in catch rates (of birds) between two survey periods.

Similarly, because of the differing sampling efforts and the fact that different species differ in their vulnerability to changes in habitat, abundance of each species was expressed in terms of its relative abundance. This was calculated by dividing the number of individuals mist netted by the total number of individuals mist netted at each survey period i.e., proportional composition of total captures per survey session. With relative abundance data we used Chi-square (χ^2) analysis to assess whether the probability of occurrence of each bird species differed significantly between our mist netting study and that of Mlingwa (1992). Because sample size must be sufficiently large so that each expected frequency is at least 5 (Glover and Mitchell 2015), analyses were restricted to species whose individuals mist netted were at least 10 (either in the past 30 years or in the current mist netting study). Bird taxonomy follows Gill et al. (2024).

Results

We mist netted a total of 649 birds of 65 species (Appendix 1). Our results and those of Mlingwa (1992) who mist netted 622 individuals of 77 species make up a total of 98 species using the campus thickets. The overall catch rates for the periods 1986 – 1990 and 2016 – 2021 were 5.35 per 10^5 m-n-h and 15.15 per 10^5 m-n-h, respectively. The catch rates were significantly higher in the sampling period 2016 – 2021 than during the period 1986 – 1990 ($W = 3623$, $p < 0.0001$).

Of the 98 species which have been recorded to use the campus thickets, 12 were forest-dependent and 28 were forest visitors (Bennun et al. 1996, John and Kiwango 2021), the rest were not associated with forest habitats. Species similarity index between the species we mist netted and those mist netted by Mlingwa was 61% suggesting a moderately high similarity in bird species composition between the two periods.

Of the species mist netted in the current study (2016-2021), 10 and 20 were forest-dependent species and forest visitors, respectively (Appendix 1). Among the forest-dependent species were the Olive Sunbird *Cyanomitra olivacea* and Red-throated Twinspot *Hypergos niveogutattus* which were relatively abundant (Appendix 1). Of the forest-dependent species mist netted, four species were new records at the campus thickets. These include the Yellow-rumped Tinkerbird, Eastern Nicator, Black-bellied Starling and Blue-mantled Crested Flycatcher (Harvey and Howell 1987, Mlingwa 1992). For the forest visitors, the Spot-flanked Barbet *Tricholaema lacrymosa,* Singing Cisticola *Cisticola cantans*, Bearded Scrub Robin *Cercotrichas quadrivirgata* were new records at the campus thickets (Harvey and Howell 1987, Mlingwa 1992).

The species with high relative abundances during both sampling periods include Green-backed Camaroptera *Camaroptera brachyura*, Northern Brownbul *Phyllastrephus strepitans* and Red-throated Twinspot *Hypargos niveoguttatus* (Appendix 1, Table 1). Seventy-nine species (*ca*. 80%) out of 98 did not show any significant differences in probability of occurrence between 1986 - 1990 and 2016 - 2021. This suggested that despite the ongoing changes at the University campus, only a few of the bird species have been affected. Moreover, this suggest that the habitats for common and non-habitat specialists have not been severely affected.

Nineteen species (*ca*. 20% of the total species) showed significant differences in abundance between 1986 - 1990 and 2016 – 2021 (Table 1). Of these, seven species had significantly higher abundances in 1986 - 1990 than in 2016 – 2021 while eleven species had significantly higher abundances in 2016 - 2021 than in 1986 – 1990. Of the seven species which had significantly higher abundances in 1986 - 1990 than in 2016 – 2021 only one species, the Red-throated Twinspot, was forest-dependent. The Olive Sunbird was the only forest-dependent species which had significantly higher abundances in 2016 - 2021 than in 1986 – 1990 suggesting that most forest dependent species might have been negatively affected by the habitat changes (Table 1).

T**able 1.** Bird species which showed significant differences in abundance at the University of Dar es Salaam campus during 1986-1990 and 2016-2021. n = number of individuals mist netted per species, FD = Forest dependence, FF = Forest Specialists, F = Forest Generalists, *f* = forest visitors, CR = catch rate, Ra = relative abundance. * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$ and ns = not significant.

FD	Species	1986-1990			2016-2021			Chi-sq.
		n	CR	Ra	n	CR	Ra#	
	Specked Mousebird *Colius striatus*	13	10.96	2.09	3	6.88	0.46	6.77*
	Striped Kingfisher *Halcyon chelicuti*	13	10.96	2.09	0	0.00	0	13.70***
	Red-fronted Tinkerbird *Pogoniulus pusillus*	6	5.06	0.96	17	38.97	2.62	4.89*
F	Black-throated Wattle-eye *Platysteira peltata*	15	12.65	2.41	30	68.76	4.62	4.55*
	Red-backed Shrike *Lanius collurio*	24	20.24	3.86	0	0.00	0	24.52***
F	Terrestrial Brownbul *Phyllastrephus terrestris*	4	3.37	0.64	15	34.38	2.31	6.00*
F	Northern Brownbul *Phyllastrephus strepitans*	25	21.09	4.02	64	146.69	9.86	16.65***
F	Dark-capped Bulbul *Pycnonotus tricolor*	111	93.62	17.85	3	6.88	0.46	117.55***
	Rattling Cisticola *Cisticola chiniana*	3	2.53	0.48	17	38.97	2.62	9.37**
F	Green-backed Camaroptera *Camaroptera brachyura*	22	18.56	3.54	69	158.16	10.63	24.05***
F	Garden Warbler *Sylvia borin*	38	32.05	6.11	0	0.00	0	40.87***
	White-browed Scrub Robin *Cercotrichas leucophrys*	4	3.37	0.64	13	29.80	2	4.45*
	Spotted Palm Thrush *Cichladusa guttata*	0	0.00	0	13	29.80	2	12.59***
F	Collared Sunbird *Hedydipna collaris*	2	1.69	0.32	48	110.02	7.4	42.06***
FF	Olive Sunbird *Cyanomitra olivacea*	2	1.69	0.32	29	66.47	4.49	22.95***
f	Grey Sunbird *Cyanomitra veroxii*	5	4.22	0.8	24	55.01	3.7	11.93***
	Vittelline Marked Weaver *Ploceus vitellinus*	13	10.96	2.09	1	2.29	0.15	10.93***
	Zanzibar Red Bishop *Euplectes nigroventris*	0	0.00	0	10	22.92	3.69	9.66***
F	Red-throated Twinspot *Hypargos niveoguttatus*	49	41.33	7.88	24	55.01	3.7	10.25***

data for Appendix 1 are inclusive when evaluating Ra.

Discussion

Our results and those of Mlingwa (1992) suggest that despite the secondary nature of the remaining thickets at the campus, several species, some of which are forest dependent as well as forest edge bird species, are supported there. The results suggest that this community is rich in a number of bird species and the present avian community is still a representative of the community which was reported by Mlingwa (1992). With seven new records at the campus, this study and those by Harvey and Howell (1987) and Mlingwa (1992) have contributed to a better understanding of the bird community found at the University of Dar es Salaam campus. Nevertheless, the continued survival of this bird community at the campus thickets would very much depend on the effortful protection of the remaining thickets (albeit disturbed) by the management of the University of Dar es Salaam. Further clearance of the remaining thickets due to the ongoing developments at the campus would lead to local extinctions of a number of bird species particularly forest-dependent birds as it has already happened at one of the fragmented thickets in Dar es Salaam area (Werema et al. 2019).

The thickets are also important for a number of forest visitors. Indeed, the thickets at the campus are important in accommodating intra-African migrants such as the Red-capped Robin-Chat, African Paradise Flycatcher *Terpsiphone viridis* and African Pygmy Kingfisher *Ispidna picta*. Furthermore, these thickets have been well-known "stop-over" or "wintering" sites for Palearctic migrants (Harvey and Howell 1987, Mlingwa 1992). For these reasons, and given the ongoing urban sprawl in Dar es Salaam and the surrounding areas (Magina et al. 2024), the shrinking urban thickets such as the University campus should be protected.

While there was a difference in mist netting effort between the two time periods, we are confident that our results accurately represent the existing avian community composition at the campus thickets. The fact that many species (80%) did not show significant differences in relative abundances between the two sampling periods suggest that their populations have probably remained stable over the years. The fact that some species were mist netted by Mlingwa (1992) but not by us does not mean that they have gone locally extinct. Actually, some of these species e.g. Blue-naped Mousebird *Urocolius macrourus*, Lesser Striped Swallow *Cecropis abyssinica*, Striped Kingfisher *Halcyon chelicuti* and Purple-banded Sunbird *Cinnyris bifasciatus* are still common at the campus especially in more open habitats (John in press) only that we were not able to catch them in mist nets.

The differences in abundances of some species we mist netted and those captured by Mlingwa (1992) could be related to changes in the microhabitats in which they were mist netted and species habitat preferences. Some species may be locally abundant at one thicket compared to the other thickets depending on the available resources and the level of isolation of the thicket. For example, all of our captures of the Terrestrial Brownbul *Phyllastrephus terrestris* came from only two thickets among the several thickets found at the university campus. Differential use of the remaining thickets at the campus by different species of birds has been reported by Werema and Wilson (2022) who found that thickets dominated by native trees and shrubs had significantly higher abundance of some species than those thickets dominated by the exotic *Leucaena leucocephala*. For example, Werema and Wilson (2022) found that the Sombre Greenbul *Andropadus importunus*, Northern Brownbul *Phyllastrephus strepitans* and Terrestrial Brownbul were significantly more abundant in the thickets dominated by native tree and shrub species than in those thickets dominated by the exotic *L. leucocephala*. This could also explain the higher relative abundances of other species such as Collared Sunbird, Grey Sunbird and Zanzibar Red Bishop in the current study compared with that of Mlingwa (1992). Similar reasons could hold for the higher abundances of the other species such as the Dark-capped Bulbul *Pycnonotus tricolor* and Red-throated Twinspot *Hypargos niveogutatus* in the

period 1986 – 1990 (Mlingwa 1992) than in the period between 2016 and 2021.

Compared to the study by Mlingwa (1992) we did not mist net three species of Palaearctic migrants, the Garden Warbler *Silvia borin*, European Nightjar *Caprimulgus europaeus* and Red-backed Shrike *Lanius collurio*. This could probably be associated with loss of vegetation cover at the campus and other areas in vicinity of the campus. As such, since the study by Mlingwa (1992) some trees and shrubs have been cleared leading to more isolated thickets at the campus hence possible less visits by the Palaearctic migrants. The Red-backed Shrike seems to be still wintering in Dar es Salaam area, as it has been mist netted in December 2012 and observed in February 2015 at Salasala area some 15 km from the study area (Werema et al. 2019). Moreover, several other factors including climate change, food supply, predation rates, and other anthropogenic activities, have been noted to influence the distribution, site fidelity and phenology of migratory species (Imlay et al. 2018, Martay et al. 2023) which may also have affected our observations.

Conclusion

Despite the various developments at the University of Dar es Salaam campus, the remaining thickets continue providing habitats for a number of bird species including forest-dependent ones. The results have shown a considerable conservation importance of the thickets and other habitats at the university campus. The continued conservation of these thickets is recommended as are any other thickets in urban and sub-urban environments in Tanzania and elsewhere. Any further clearing of the thickets at the campus should be halted for conservation of birds, and possibly other fauna. We recommend the management of the University of Dar es Salaam to continue to conserve the remaining thickets to avoid possible local extinction of birds. While the biodiversity conservation needs of the remaining patches of forest or thickets in Dar es Salaam area have been previously emphasized, this study calls for designs of urban landscapes including green spaces that are nature friendly. These may include native tree planting along arterial and street roads, public parks and institutions such as hospitals, university and school campuses. Such vegetation will provide stop-over sites and foraging areas for migratory and urban species respectively.

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Appendix 1. Bird species mist netted at the University of Dar es Salaam campus during 1986-1990 and 2016-2021 which had enough observations for comparison and those that did not show significance variation between the two study periods. n = number of individuals mist netted per species, FD = Forest dependence, CR = catch rate, Ra = relative abundance (for interpretation data from Table 1 are inclusive).

FD	Species	1986-1990			2016-2021			Chi-sq.
		n	CR	Ra	n	CR	Ra	
	European Nightjar *Caprimulgus europaeus*	1	0.84	0.16	0	0.00	0	
	Mozambique Nightjar *Caprimulgus fossii*	0	0.00	0	1	2.29	0.15	
	White-browed Coucal *Centropus superciliosus*	1	0.84	0.16	1	2.29	0.15	
	Diederik Cuckoo *Chrysococcyx caprius*	2	1.69	0.32	0	0.00	0	
f	Klaas's Cuckoo *Chrysococcyx klaas*	2	1.69	0.32	0	0.00	0	
F	Green Malkoha *Ceuthmochares australis*	6	5.06	0.96	1	2.29	0.11	
f	Red-eyed Dove *Streptopelia semitorquata*	2	1.69	0.32	0	0.00	0	
f	Emerald-spotted Wood Dove *Turtur chalcospilos*	6	5.06	0.96	3	6.88	0.46	
	African Green Pigeon *Treron calvus*	1	0.84	0.16	0	0.00	0	
	Blue-naped Mousebird *Urocolius macrourus*	1	0.84	0.16	0	0.00	0	
	Brown-hooded Kingfisher *Halcyon albiventris*	6	5.06	0.96	15	34.38	2.41	3.54^{ns}
	Mangrove Kingfisher *Halcyon senegaloides*	2	1.69	0.32	0	0.00	0	
f	African-Pygmy Kingfisher *Ispidina picta*	10	8.43	1.61	4	9.17	0.62	2.87^{ns}
	Malachite Kingfisher *Corythornis cristatus*	0	0.00	0	2	4.58	0.31	
	Little Bee-eater *Merops pusillus*	4	3.37	0.64	9	20.63	1.39	
f	White-throated Bee-eater *Merops albicollis*	0	0.00	0	1	2.29	0.15	
F	Yellow-rumped Tinkerbird *Pogoniulus bilineatus*	0	0.00	0	2	4.58	0.31	
	Spot-flanked Barbet *Tricholaema lacrymosa*	0	0.00	0	1	2.29	0.15	
f	Brown-breasted Barbet *Lybius melanopterus*	1	0.84	0.16	2	4.58	0.31	
	d' Arnaud's Barbet *Trachyphonus darnaudii*	8	6.75	1.29	2	4.58	0.31	
f	Lesser Honeyguide *Indicator minor*	5	4.22	0.8	0	0.00	0	
	Eastern Black-headed Batis *Batis minor*	1	0.84	0.16	2	4.58	0.31	
	Grey-headed Bushshrike *Malaconotus blanchoti*	1	0.84	0.16	0	0.00	0	

FD	Species	1986-1990			2016-2021			Chi-sq.
		n	CR	Ra	n	CR	Ra	
f	Orange-breasted Bushshrike *Chlorophoneus sulfureopectus*	10	8.43	1.61	4	9.17	0.62	2.87^{ns}
	Brown-crowned Tchagra *Tchagra australis*	3	2.53	0.48	5	11.46	0.77	
	Black-headed Tchagra *Tchagra senegalus*	1	0.84	0.16	0	0.00	0	
f	Black-backed Puffback *Dryoscopus cubla*	4	3.37	0.64	2	4.58	0.31	
f	East Coast Boubou *Laniarius sublacteus*	8	6.75	1.29	8	18.34	1.28	
f	Black Cuckooshrike *Campephaga flava*	4	3.37	0.64	2	4.58	0.31	
f	African Golden Oriole *Oriolus auratus*	2	1.69	0.32	0	0.00	0	
f	Eurasian Golden Oriole *Oriolus oriolus*	2	1.69	0.32	0	0.00	0	
FF	Blue-mantled Crested Flycatcher *Trochocercus cyanomelas*	0	0.00	0	1	2.29	0.15	
f	African-Paradise Flycatcher *Terpsiphone viridis*	1	0.84	0.16	2	4.58	0.31	
F	Eastern Nicator *Nicator gularis*	0	0.00	0	3	6.88	0.46	
	Flappet Lark *Mirafra rufocinnamomea*	1	0.84	0.16	0	0.00	0	
	Sombre Greenbul *Andropadus importunus*	51	43.02	8.2	60	137.53	9.24	0.44^{ns}
F	Yellow-bellied Greenbul *Chlorocichla flaviventris*	28	23.62	4.5	29	66.47	4.47	0.00^{ns}
FF	Fischer's Greenbul *Phyllastrephus fischeri*	2	1.69	0.32	0	0.00	0	
	Eurasian Swallow *Hirundo rustica*	1	0.84	0.16	0	0.00	0	
	Lesser Striped Swallow *Cecropis abyssinica*	1	0.84	0.16	0	0.00	0	
	Red-faced Crombec *Sylvietta whytii*	0	0.00	0	3	6.88	0.46	
	Great Reed Warbler *Acrocephalus arundinaceus*	1	0.84	0.16	0	0.00	0	
	Moustached Warbler *Acrocephalus melanopogon*	1	0.84	0.16	0	0.00	0	
	Eurasian Reed Warbler *Acrocephalus scirpaceus*	3	2.53	0.48	0	0.00	0	
	Singing Cisticola *Cisticola cantans*	0	0.00	0	1	2.29	0.15	
f	Tawny-flanked Prinia *Prinia subflava*	3	2.53	0.48	5	11.46	0.77	
	Yellow-breasted Apalis *Apalis flavida*	1	0.84	0.16	2	4.58	0.31	
	Rufous Chatterer *Argya rubiginosa*	2	1.69	0.32	0	0.00	0	
	Arrow-marked Babbler *Turdoides jardineii*	2	1.69	0.32	0	0.00	0	
F	Black-bellied Starling *Notopholia corusca*	0	0.00	0	1	2.29	0.15	

FD	Species	1986-1990			2016-2021			Chi-sq.
		n	CR	Ra	n	CR	Ra	
	Bearded Scrub Robin *Cercotrichas quadrivirgata*	0	0.00	0	1	2.29	0.15	
f	White-browed Robin-Chat *Cossypha heuglini*	12	10.12	1.93	20	45.84	3.08	1.72^{ns}
F	Red-capped Robin-Chat *Cossypha natalensis*	9	7.59	1.45	17	38.97	2.62	2.18^{ns}
	Nightingale *Luscinia megarhynchos*	1	0.84	0.16	0	0.00	0	
	Scarlet-chested Sunbird *Chalcomitra senegalensis*	7	5.90	1.13	2	4.58	0.31	
f	Purple-banded Sunbird *Cinnyris bifasciatus*	2	1.69	0.32	0	0.00	0	
	House Sparrow *Passer domesticus*	0	0.00	0	3	6.88	0.46	
	Northern Grey-headed Sparrow *Passer griseus*	1	0.84	0.16	0	0.00	0	
f	Thick-billed Weaver *Amblyospiza albifrons*	4	3.37	0.64	2	4.58	0.31	
f	Spectacled Weaver *Ploceus ocularis*	10	8.43	1.61	6	13.75	0.92	1.19^{ns}
	Eastern Golden Weaver *Ploceus subaureus*	0	0.00	0	8	18.34	1.28	
f	Orange Weaver *Ploceus aurantius*†	5	4.22	0.8	0	0.00	0	
	Village Weaver *Ploceus cucullatus*	3	2.53	0.48	0	0.00	0	
	Black-winged Red Bishop *Euplectes hordeaceus*	0	0.00	0	1	2.29	0.16	
	Yellow Bishop *Euplectes capensis*	2	1.69	0.32	2	4.58	0.32	
F	Green Twinspot *Mandingoa nitidula*	1	0.84	0.16	0	0.00	0	
	Bronze Mannikin *Spermestes cucullata*	3	2.53	0.48	3	6.88	0.46	
f	Black-and-White Mannikin *Spermestes bicolor*	0	0.00	0	2	4.58	0.31	
	Common Waxbill *Estrilda astrild*	0	0.00	0	2	4.58	0.31	
	Red-cheeked Cordonbleu *Uraeginthus bengalus*	0	0.00	0	1	2.29	0.15	
	Southern Cordonbleu *Uraeginthus angolensis*	2	1.69	0.32	7	16.04	1.08	
	Green-winged Pytilia *Pytilia melba*	7	5.90	1.13	6	13.75	0.62	
	Orange-winged Pytilia *Pytilia afra*	0	0.00	0	1	2.29	0.15	
	Red-billed Firefinch *Lagonosticta senegala*	2	1.69	0.32	6	13.75	0.92	
	African Firefinch *Lagonosticta rubricata*	1	0.84	0.16	0	0.00	0	
	Village Indigobird *Vidua chalybeata*	0	0.00	0	1	2.29	0.15	
	Pin-tailed Whydah *Vidua macroura*	6	5.06	0.96	4	9.17	0.62	
	Long-tailed Paradise Whydah *Vidua paradisaea*	1	0.84	0.16	0	0.00	0	
	Yellow-rumped Seed-eater *Crithagra xanthopygia*	2	1.69	0.32	0	0.00	0	

FD	Species	1986-1990			2016-2021			Chi-sq.
		n	CR	Ra	n	CR	Ra	
	Total (individuals)	**622**	524.63		**649**	1487.58		
	Total (species)	**77**			**65**			

†The Orange Weaver *Ploceus aurantius* which was mist netted by Mlingwa (1992) could be an escapee of the live bird trade in Dar es Salaam.