Scopus 42(2): 38–50 July 2022

Further surveys of the miombo woodland avifaunas of Mbarang'andu and Kimbanda Wildlife Management Areas, southern Tanzania

Chacha Werema and Cuthbert L. Nahonyo

Summary

Wildlife Management Areas (WMAs) have been thought as being a sustainable model that can promote wildlife conservation while improving the livelihoods of rural communities. Some WMAs in Tanzania have been found to be species-rich with abundant wildlife communities. Such WMAs include Mbarang'andu and Kimbanda WMAs in southern Tanzania which together with Nalika, Chingoli and Kisungule WMAs form a wildlife corridor that connects Nyerere National Park in Tanzania and Niassa Special Reserve in Mozambique. While the mammalian fauna of the Ruvuma landscape is well documented, the avifauna is comparatively poorly known. From 122 1-km transects, this study reports on the bird species found in miombo woodlands in Mbarang'andu and Kimbanda WMAs. One hundred and fifty-six species were observed of which two are globally threatened and 20 were biome-restricted, suggesting that the miombo woodlands in Mbarang'andu and Kimbanda WMAs are important for the conservation of birds in southern Tanzania. We recommend that further avifaunal surveys focus on less sampled areas in our study, including riverine forests and swampy habitats.

Keywords: birds, Tanzania, conservation, miombo woodlands, Wildlife Management Area

Introduction

Wildlife Management Areas (WMAs) are community-based conservation and development areas where several villages set aside land for wildlife conservation in return for some of the tourism revenues from these areas (URT 2012). The local people in these villages have user rights over the wildlife resources in their WMAs, and WMAs have been considered as models with a dual stratergy: to alleviate poverty and to halt overall biodiversity declines (Berkes 2004, Kiss 2004). Thus, WMAs function as a conservation tool and can also be considered as a model to improve livelihoods in rural communities (Kiffner *et al*. 2020). Establishing WMAs is a way of decentralizing wildlife management to the local communities (Lee & Bond 2018) and, as such, natural resource conservation in these WMAs is principally a shared responsibility and local communities must significantly benefit from it (Stolla 2005, URT 2009).

Mbarang'andu and Kimbanda WMAs are part of the extensive miombo woodland system of eastern and southern Africa. The two WMAs form part of the Selous-Niassa wildlife corridor which has been viewed as both an internationally important

wildlife conservation area, and as a biologically important corridor. For example, this corridor is inhabited by globally significant populations of eland *Taurotragus oryx*, Lichtenstein's hartebeest *Alcelaphus buselaphus lichtensteinii*, greater kudu *Tragelaphus strepsiceros*, Roosevelt's sable antelope *Hippotragus niger roosevelti*, and Nyassa wildebeest *Connochaetes taurinus johnstoni* and other wildlife and plantlife (Hofer *et al*. 2004). Thus, the two WMAs occupy an intriguing position biogeographically, and help to maintain connectivity within the formerly unprotected Selous-Niassa wildlife corridor. This is an important transboundary corridor which provides complementary conservation roles which cannot be achieved by the current national parks and game reserves networks alone (Caro *et al*. 2009).

A number of authors have provided broad distributions for birds in this part of Tanzania, including Mackworth-Praed & Grant (1960), Britton (1980), Brown *et al*. (1982), Urban *et al*. (1986, 1997), Fry *et al*. (1988, 2000), Keith *et al*. (1992), Fry & Keith (2004) and Stevenson & Fanshawe (2020). Also, in the Ruvuma landscape (including Mbarang'andu and Kimbanda WMAs), Nkwabi *et al*. (2021) surveyed birds in five different habitats, namely, dense woodland, open woodland, riverine forest, swampy areas and farmlands. However, Nkwabi *et al*. (2021) covered only a small proportion of the existing woodlands, hence there is a need for additional avifaunal surveys. This is important for monitoring purposes, because the existing vegetation cover in the miombo woodlands of the WMAs may change over time due to land use changes as well as habitat fragmentation caused by human activities which include uncontrolled wildfires, collection of fuel wood, charcoal production, tree-felling for timber, cattle grazing and agriculture (Nkwabi *et al*. 2021).

Materials and methods

Study area

Mbarang'andu WMA (2318 km^2; gazetted in 2006) and Kimbanda WMA (2150 km^2; gazetted in 2012) are located in Namtumbo District, Ruvuma Region, southern Tanzania (WWF 2014; Fig. 1). To the east, the Mbarang'andu and Kimbanda WMAs are bordered by Nalika, Chingoli and Kisungule WMAs. Together, these five WMAs comprise the Selous-Niassa Corridor. The area receives an average rainfall of 800–1100 mm per year which falls during a single period from late November to May (Hofer *et al*. 2004).

The landscape where the two WMAs are located consists of plains, valleys, and hills in an undulating topography. The area is mostly covered by miombo woodland and wooded grassland, and there are substantial areas of open savannah, seasonal and permanent wetlands and riverine forests along numerous rivers and streams. The miombo trees are of the Caesalpiniaceae family. The trees in this family were dominated by members of the genera *Brachystegia* and *Julbernardia*. Eight *Brachystegia* species have been identified including *Brachystegia boehmii*, *B. bussei*, *B. floribunda*, *B. longifolia*, *B. microphylla*, *B. spiciformis*, *B. tipulate* and *B. utilis* (Hofer *et al*. 2004). Other tree species include *Pseudolachnostylis maprouneifolia*, *Diplorhynchus condylocarpon*, *Dalbergia nitidula*, *Monotes katangensis*, *Terminalia sericea*, *Uapaca nitida*, *U. kirkiana* and *U. sansibarica*.

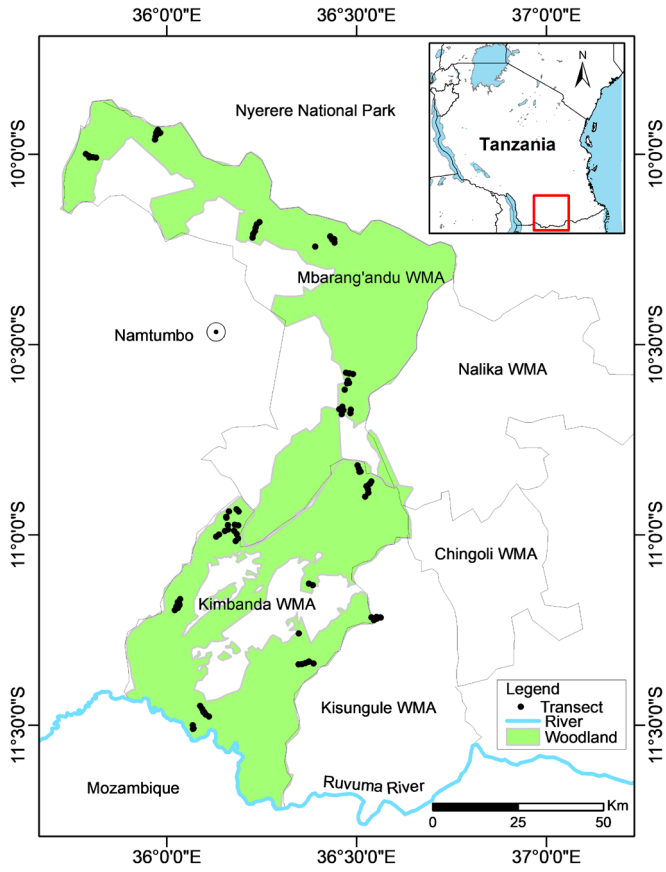

Figure 1. Map of Mbaran'gandu and Kimbanda WMAs showing the locations of transects. Coverage of the woodlands which were set aside by villages forming the two WMAs for conservation are shown in green. Note that Ruvuma River is the border between Tanzania and Mozambique.

Data collection and analysis

Birds were surveyed using the transect method (Bibby *et al*. 2000) and we concentrated our sampling effort on closed-canopy miombo woodland and strips of evergreen riverine forest within these woodlands (Fig. 1). In total, 122 transects were surveyed (62 in Mbarang'andu WMA and 60 in Kimbanda WMA; see Fig. 1 for the location of transects). The total length of transect surveyed was 122 km, an area equivalent to 12.2 km^2. Pre-selected starting points were established for each transect to ensure that coverage of the miombo woodlands in the WMAs was representative and spatially balanced. Transects were accessed through available road networks and trails. Each transect was sampled once and GPS units were used to ensure that our field surveys closely followed transect routes selected beforehand.

The habitats on most of the transects were homogenous and the orientation of each transect varied. Field surveys were conducted from 26 May to 7 June 2021 and from 12 to 27 January 2022 and bird observations started in the early morning (usually at 07:00). For logistical reasons, transects were surveyed throughout the day. Bird

species and numbers were recorded within 50 m of each side of the transect, and for species which were not directly identified in the field, brief notes describing them, or their vocalizations, were recorded to allow for later identification. Birds flying overhead were included if they were specifically associated with the habitat (e.g., swallows and birds of prey actively foraging along the transects).

To assess whether sampling effort was adequate, a sample-based rarefaction curve was generated using the program Paleontological Statistics software–PAST (Hammer *et al*. 2001). To have the percentage of the predicted species, Chao2 species richness estimator was used to estimate species richness (by a set of samples), which has been shown to perform well for bird communities (Walther & Martin 2001). This was produced with the PAST software (Hammer *et al*. 2001). For each species, in every WMA, species occurrence was expressed in terms of its relative frequency (*Rf*) (i.e., as a proportion of the number of transects in which a species was observed: n = 62 for Mbarang'andu WMA and n = 60 for Kimbanda WMA) on the basis of its presence or absence in the transects. *Rf* comprises an index of bird abundance and allowed for a general assessment of the abundance of different species in the WMAs; the higher the *Rf* of the species, the more widely distributed it is in the study area.

Taxonomy and nomenclature follow the IOC world bird list (see Gill *et al*. 2021) except for the following species where we use differing nomenclature: Common Bulbul *Pycnonotus barbatus* was regarded as Dark-capped Bulbul *P. tricolor*, Rufous-bellied Tit *Parus rufiventris* as Cinnamon-breasted Tit *Melaniparus pallidiventris*, Miombo Wren-Warbler *Calamonastes undosus* as Stierling's Wren-Warbler *Calamonastes stierlingi,* African Yellow White-eye *Zosterops senegalensis* as Southern Yellow White-eye *Z. anderssoni* and Spotted Creeper *Salpornis slavadori* as African Spotted Creeper *S. salvadori.*

Results

We recorded a total of 156 species (3487 individuals) of which 92 were observed in both Mbarang'andu and Kimbanda WMAs (Appendix 1). Of the 156 species observed, 111 (1277 individuals) and 137 (2210 individuals) were recorded in Mbarang'andu and Kimbanda WMAs, respectively (Appendix 1). The species accumulation curve approached asymptote suggesting that few species were likely to be recorded on additional transects in the woodlands (Fig. 2). An analysis by Chao2 species richness estimator, showed that we recorded 89% of the expected 175 (s.d. ± 9.12) species that would be recorded from an exhaustive survey.

The most frequently recorded species include Pale Batis *Batis soror* (*Rf* in the two WMAs combined = 51; i.e. 51 out of 122 transects), Yellow-throated Bush-Sparrow *Gymnoris superciliaris* (46/122), Black-crowned Tchagra *Tchagra senegalus* (44/122), Black-backed Puffback *Dryoscopus cubla* (43/122) and Western Violet-backed Sunbird *Anthreptes longuemarei* (41/122) (Appendix 1). The most abundant species were Orange-breasted Waxbill *Amandava subflava* (180 individuals), Yellow-throated Bush-Sparrow (165), White-crested Helmetshrike *Prionops plumatus* (152), Pale Batis (140) and Violet-backed Starling *Cinnyricinclus leucogaster* (121) (Appendix 1).

Twenty-two forest-dependent species were observed in these woodlands, all of which were forest generalists (Bennun *et al*. 1996, Mlingwa *et al*. 2000; Appendix 1) including the African Broadbill *Smithornis capensis* which is considered a forest generalist in southern Tanzania (Neil Baker, pers. comm) and not a forest specialist *sensu* Bennun *et al*. (1996).

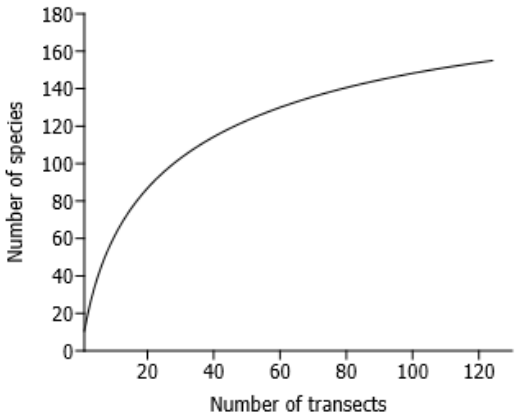

Figure 2. Bird species accumulation curve for transects surveyed in Mbarang'andu and Kimbanda WMAs.

Of the species observed, four and 12 species were Palaearctic and intra-African migrants, respectively (Appendix 1). The latter species are, variably, either breeding or non-breeding visitors to the area.

Twenty biome-restricted species were observed in the woodlands in the WMAs of which three species are restricted to the East African Coastal biome and 17 species that are Zambezian biome species (Table 1; Baker & Baker 2002). Furthermore, seven species recorded in the two WMAs have been regarded as endemic to *Brachystegia* (Benson & Irwin 1966). These are the Pale-billed Hornbill *Lophoceros pallidirostris*, Stierling's Woodpecker, Stierling's Wren-Warbler *Calamonastes stierlingi*, Böhm's Flycatcher *Muscicapa boehmi*, Miombo Rock Thrush *Monticola angolensis*, Shelley's Sunbird *Cinnyris shelleyi* and Black-eared Seed-eater *Crithagra mennelli.*

T**able 1**. Biome-restricted species (Baker & Baker 2002) recorded on transect surveys in Mbarang'andu and Kimbanda WMAs.

Biome	Species
East African Coast biome	Brown-headed Parrot *Poicephalus cryptoxanthus*
	Brown-breasted Barbet *Lybius melanopterus*
	Pale Batis B*atis soror*
	Pale-billed Hornbill *Lophoceros pallidirostris*
	Racket-tailed Roller *Coracias spatulatus*
	Böhm's Bee-eater *Merops boehmi*
	Stierling's Woodpecker *Dendropicos stierlingi*
	Dickinson's Kestrel *Falco dickinsoni*
	Cinnamon-breasted Tit *Melaniparus pallidiventris*
	Long-tailed Cisticola *Cisticola angusticauda*
	Stierling's Wren-Warbler *Calamonastes stierlingi*
Zambezian biome	Kurrichane Thrush *Turdus libonyana*
	Böhm's Flycatcher *Muscicapa boehmi*
	Miombo Rock Thrush *Monticola angolensis*
	Arnott's Chat *Myrmecocichla arnotti*
	Eastern Miombo Sunbird *Cinnyris manoensis*
	Shelley's Sunbird *Cinnyris shelleyi*
	Olive-headed Weaver *Ploceus olivaceiceps*
	Broad-tailed Paradise *Whydah Vidua obtusa*
	Black-eared Seed-eater *Crithagra mennelli*

Records of distributional interest

White-tailed Blue Flycatcher *Elminia albicauda*

We observed this species on four transects in Mbarang'andu WMA. There are also unpublished records held by the Tanzania Bird Atlas (http://tanzaniabirdatlas.net) from about 50 km to the northwest of the study area and records from that area are documented similarly by Urban *et al.* (1997).

Semicollared Flycatcher *Ficedula semitorquata*

Five males were observed on four transects in Mbarang'andu and Kimbanda WMAs. The species was identified based on the half-collar on the neck being more extensive than in the European Pied Flycatcher *F. hypoleuca*. This species is a Palaearctic migrant, and Urban *et al.* (1997) document the closest known range approximately 150 km to the northwest of the study area. Within the study area there is an unpublished record of this species held by the Tanzania Bird Atlas (http://tanzaniabirdatlas.net).

White-bellied Tit *Melaniparus albiventris*

Two single birds individuals were observed in two different feeding parties on two transects in Kimbanda WMA in January 2022. Fry *et al.* (2000) document the closest known population approximately 100 km to the north of the study area. However, there are some unpublished records held by the Tanzania Bird Atlas from our general study area (http://tanzaniabirdatlas.net).

Species of conservation concern

Two species of conservation concern were observed: Stierling's Woodpecker *Dendropicos stierlingi* and Olive-headed Weaver *Ploceus olivaceiceps* which are both Near-Threatened according to the IUCN RedList of Threatened Species (IUCN 2022). Stierling's Woodpecker was observed in 18 out of 122 transects in both Kimbanda and Mbarang'andu WMAs, usually in singles, which is an unexpectedly high density for this species (N. Baker pers. comm.). Meanwhile, we observed seven individuals of Olive-headed Weaver on four transects in Mbarang'andu WMA, where they (both pairs and single birds) were observed actively foraging in the high canopy.

Discussion

With 156 species recorded in the miombo woodlands, including *Brachystegia* endemic species (see Benson & Irwin 1966), this study further reinforces the recognition of the woodlands found in Mbarang'andu and Kimbanda WMAs as important habitats for the conservation of birds. Ninety-two species recorded in the current study were also reported by Nkwabi *et al*. (2021) who conducted avian surveys in Mbarang'andu, Kimbanda, Nalika, Chingoli and Kisungule WMAs in the Ruvuma landscape. In addition to the results presented by Nkwabi *et al*. (2021), the present study expands the list by adding 64 more species.

A number of species recorded in the two WMAs are widespread in distribution. For example, approximately 87% (135 out of 156) of the species recorded in these WMAs have been observed in the Katavi-Rukwa ecosystem, southwestern Tanzania (Engilis *et al*. 2009). Further to the east, 85 species observed have been reported in the woodlands in southeastern Tanzania (Tottrup *et al*. 2005) and 87 species by Wegner *et al*. (2009) in the coastal forests of Mtwara, southeastern Tanzania. Furthermore, 134 species occurring in the study area have been reported in Vwaza Marsh Wildlife Reserve in Malawi, southwest of the study area (Engel *et al*. 2012).

Of the species recorded, there were 17 Zambezian Biome restricted species out of a country total of 40 species (Fishpool & Evans 2001, Baker & Baker 2002). This demonstrates that Mbarang'andu and Kimbanda WMAs, despite being village lands, support a relatively high percentage of species in this biome. This number is slightly more than that of the former Selous Game Reserve (whose size has been reduced to form Nyerere National Park and the existing smaller Selous Game Reserve—Government of Tanzania 2019) with 14 Zambezian biome restricted species (Baker & Baker 2002) in the same ecosystem. All the 14 Zambezian biome restricted species found in Nyerere National Park were observed in Mbarang'andu and Kimbanda WMAs.

While most species were more or less equally abundant in each of the two WMAs, there were some species which were missing in one WMA in comparison with the other. However, for most species the abundances were not strikingly different. The Violet-backed Starling *Cinnyricinclus leucogaster* was abundant in Kimbanda WMA but none was observed in Mbarang'andu WMA. It was recorded only in Kimbanda WMAs in January 2022 and not in May–June 2021. This pattern could be explained by the fact that this species is known to have complex movements (Britton 1980) and most populations make partial migratory movements (Fry *et al*. 2000). The Eastern Miombo Sunbird *Cinnyris manoensis* was abundant in the woodlands in Mbarang'andu WMA but none was recorded in Kimbanda WMA. Our records of this species match well with the distribution shown by additional unpublished records from this general area (www http://tanzaniabirdatlas.net/TZmap_squarelists.html), as well as with other isolated populations found in southern Tanzania (Fry *et al*. 2000).

The presence of riverine forests and some closed *Brachystegia* woodlands at some sites possibly increased habitat diversity in the study area, supporting 22 forest-dependent bird species (Bennun *et al*. 1996). Similar findings have been reported by Wegner *et al*. (2009) who recorded forest-dependent bird species in small patches of dense *Brachystegia* woodland and riverine forest in southern Tanzania. To the north-east of the study area, similar to the findings of this study, Stjernstedt (1969) reported a number of forest birds in lush and dense *Brachystegia microphyllum* vegetation. Of the 22 forest-dependent species observed during the current study, 14 were also recorded by Nkwabi *et al*. (2021) in the Ruvuma landscape. Similar to the findings of this study, out of 14 forest-dependent species observed by Nkwabi *et al.* (2021), six were recorded solely in the riverine forest, while the rest were recorded both in the riverine forest and miombo woodlands.

Conclusion

Our findings highlight Mbarang'andu and Kimbanda WMAs to be of great conservation importance for the miombo avifauna. This is justified by the records of bird species endemic to the *Brachystegia* (Benson & Irwin 1966) biome-restricted species and forest-dependent species. Similarly, since the two WMAs are still village lands, the presence of two Near-Threatened species emphasizes their conservation importance. Despite the present study and the study by Nkwabi *et al*. (2021), the number of species recorded in the woodlands during this study is not likely to be complete. Due to the importance of the two WMAs and the entire landscape as a corridor connecting Nyerere National Park and Niassa Special Reserve, we encourage additional surveys in the miombo woodlands in these WMAs, and in the other three WMAs in the Selous-Niassa Corridor.

Acknowledgements

We wish to thank the Directorate of Research and Publications, University of Dar es Salaam for financial support. The Vice-Chancellor, University of Dar es Salaam is thanked for granting us permission to conduct research in Mbarang'andu and Kimbanda WMAs. Ruvuma region and Namtumbo district administrations through the Namtumbo district's Land, Natural Resources and Environment Department are thanked for granting us permission to work in Mbarang'andu and Kimbanda WMAs. We specifically thank Simon Sambalu and Prisca Msuha for helping with logistics during fieldwork. We are also grateful to James Nchimbi, Hassan Waziri Nkonde and Issa Ndombondo for assistance during fieldwork. We also thank Village Game Scouts for their assistant during the fieldwork. We wish to thank Makemie Mabula for having prepared the map of the study area. We are very grateful to Jasson John, Neil Baker and Neil Stronach for their insightful comments that greatly improved the manuscript.

References

Baker, N.E. & Baker, E.M. 2002. *Important Bird Areas in Tanzania: A first inventory*. Dar es Salaam: Wildlife Conservation Society of Tanzania.

Bennun, L., Dranzoa, C. & Pomeroy, D. 1996. The forest Birds of Kenya and Uganda. *Journal of East African Natural History* 85(1): 23–48.

Benson, C. W. & Irwin M.P.S. 1966. The Brachystegia avifauna. *Ostrich* 37: 297–321.

Berkes, F. 2004. Re-thinking Community-based conservation. *Conservation Biology* 18(3): 621–630.

Bibby, C.J., Burgess, N. D., Hill, D.A., & Mustoe, S.H. 2000. *Birds census techniques*. London: Academic Press.

Britton, P.L. (Ed). 1980. *Birds of East Africa: Their habitat, status and distribution*. Nairobi: East Africa Natural History Society.

Brown, L.H., Urban, E.K. & Newman, K. (Eds). 1982. *The Birds of Africa*. Vol. I. London: Academic Press.

Caro, T., Gardner, T.A., Stoner, C., Fitzherbert E. & Davenport, T.R.B. 2009. Assessing the effectiveness of protected areas: Paradoxes call for pluralism in evaluating conservation performance. *Diversity and Distributions* 15(1): 178–182.

Engel, J.I., Bates, J.M., Weckstein, J.D. & Gnoske, T. P. 2012. Avifauna of Vwaza Marsh Wildlife Reserve, Malawi. *Journal of East African Natural History* 101(2): 223–240.

Engilis, A., Lalbhai, P.S. & Caro, T. 2009. Avifauna of the Katavi-Rukwa ecosystem, Tanzania. *Journal of East African Natural History* 98(1): 95–117.

Fishpool, L.D.C. & Evans, M.I. (Eds). 2001. *Important bird areas in Africa and associated islands: Priority sites for conservation*. Newbury and Cambridge, UK: Pisces Publications and BirdLife International (BirdLife Conservation Series No. 11).

Fry, C.H. & Keith, S. (Eds). 2004. *The birds of Africa*. Vol. VII. London: Academic Press.

Fry, C.H., Keith, S. & Urban, E.K. (Eds). 1988. *The Birds of Africa*. Vol. III. London: Academic Press.

Fry, C.H., Keith, S. & Urban, E.K. (Eds). 2000. *The birds of Africa*. Vol. VI. London: Academic Press.

Gill, F., Donsker, D. & Rasmussen, P. (Eds). 2021. IOC World Bird List (v11.1). doi:10.14344/IOC.ML.11.1https://www.worldbirdnames.org. Accessed on 12th October 2021.

Government of Tanzania 2019. Proclamation of Nyerere National Park, Made under Section 3, National Parks Act, (Cap. 282). Government Notice No. 923, published on 29/11/2019.

Hammer, Ø., Harper, D. A. T., & Ryan, P. D. 2001. PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica*, 4(1): 1–9.

Hofer, H., Hildebrandt, T.B., Göritz, F., East, M.L., Mpanduji, D., Hahn, R., Siege, L. & Baldus, R.D. 2004. *Distribution and Movements of Elephants and other Wildlife in the Selous-Niassa Wildlife Corridor, Tanzania*. Eschborn: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

HTTP://Tanzaniabirdatlas.Net/TZmap_squarelists.html. Accessed on 26 May 2022.

IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3. <https://www.iucnredlist.org> Accessed on 5 June 2022.

Keith, S., Urban, E.K. & Fry, C.H. (Eds). 1992. *The birds of Africa*. Vol. IV. London: Academic Press.

Kiffner, C., Thomas, S., Speaker, T., O'connor, V., Schwarz, P., Kioko, J. & Kissui, B. 2020. Community-based wildlife management area supports similar mammal species richness and densities compared to a national park. *Ecology and Evolution* 10: 480–492.

Kiss, A. 2004. Is community-based ecotourism a good use of biodiversity conservation funds? *Trends in Ecology and Evolution* 19(5): 232–237.

Lee, D.E. & Bond, M.L. 2018. Quantifying the ecological success of a community-based wildlife conservation area in Tanzania. *Journal of Mammalogy* 99(2): 459–464.

Mackworth-Praed, C.W. & Grant C.H.B. 1960. *African Handbook of Birds. Series I, Vols. 1 and 2. Birds of Eastern and Northern-Eastern Africa*. 2nd edition. London: Longman.

Mlingwa, C.O.F., Waiyaki, E.M., Bennun, L.A. & Burgess, N.D. 2000. Birds in: Burgess, N.D. & Clarke, G.P. (Eds.). *Coastal forests of Eastern Africa*. Gland: IUCN.

Monadjem, A. 2002. Population densities and community structure of birds in Acacia savannah in the lowveld of Swaziland. *Ostrich* 73: 11–19.

Nkwabi, A.K., Bukombe, J.K., Kija, H.K., Liseki, S.D., Ndimuligo, S. A. & Kavana, P.Y. 2021. Avifauna in Relation to Habitat Disturbance in Wildlife Management Areas of the Ruvuma Miombo Ecosystem, Southern Tanzania. In: Mikkola, H., *Birds – Challenges and Opportunities for Business, Conservation and Research*. IntechOpen. pp. 1–20.

Stevenson, T. & Fanshawe, J. 2020. *Birds of East Africa: Kenya, Tanzania, Uganda, Rwanda and Burundi*. 2nd Ed. London: Helm.

Stolla, F. 2005. *Wildlife Management Areas: A Legal Analysis*. www.tnrf.org

Stjernstedt, R. 1970. Birds in *Brachystegia microphyllum* in southern Tanzania. *Bulletin of British Ornithologists' Club* 90: 28–31.

Tøttrup, A.P., Jensen, F.P. & Christensen, K.D. 2005. The avifauna of two woodlands in southeast Tanzania. *Scopus* 25: 23–36.

United Republic of Tanzania (Urt). 2009. *The Wildlife Conservation Policy of Tanzania. Ministry of Natural Resources and Tourism*. Dar es Salaam, Tanzania.

United Republic of Tanzania (Urt). 2012. The wildlife conservation (wildlife management areas) regulations. Ministry of Natural Resources and Tourism, Government Printer, Dar es Salaam, United Republic of Tanzania.

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

Urban, E.K., Fry, C.H. & Keith, S. (Eds). 1997. *The birds of Africa*. Vol. V. London: Academic Press.

Walther, B.A. & Martin, J. 2001. Species richness estimation on bird communities: how to control for sampling effort. *Ibis* 143: 413–419.

Wegner, G., Howell, K.M., Davenport, T.R.B. & Burgess, N.D. 2009. Forgotten 'coastal forests of Mtwara, Tanzania: a biologically impoverished and yet important ecosystem. *Journal of East African Natural History* 98(2): 167–209.

Whelan, C. 2000. Foliage structure influences foraging insectivorous forest birds: an experimental study. *Ecology* 82: 219–231.

Willson, M.F., De Santo, T.L., Sabag, C. & Armesto, J.J. 1994. Avian communities of fragmented south-temperate rainforests in Chile. *Conservation Biology* 8: 508–520.

World Wide Fund For Nature (WWF) 2014. *Tanzania's Wildlife Management Areas: A 2012 Status Report*. Dar es Salaam: WWF.

Chacha Werema
Department of Zoology and Wildlife Conservation, College of Natural and Applied Sciences, University of Dar es Salaam, P.O. Box 35064, Dar es Salaam, Tanzania. Email: cwerema@yahoo.co.uk

Cuthbert L. Nahonyo
Department of Zoology and Wildlife Conservation, College of Natural and Applied Sciences, University of Dar es Salaam, P.O. Box 35064, Dar es Salaam, Tanzania

Scopus 42(2): 38–50, July 2022
Received 9 April 2022

Appendix 1. Number of transects in which a species was observed (relative frequency) of bird species observed in miombo woodlands in Mbarang'andu and Kimbanda WMAs. Shown in parentheses are the total number of individuals of each species recorded in the transects in each WMA. FF = forest specialists, F = forest generalists (Bennun et al. 1996, Mlingwa et al. 2000), n = number of transects. Sequence and nomenclature follow Gill et al. (2021). PM and IM indicate species which are Palaearctic and intra-African migrants, respectively.

Species	Relative frequency	
	Mbarang'andu (n = 62)	Kimbanda (n = 60)
Helmeted Guineafowl *Numida meleagris*	0(0)	2(4)
Coqui Francolin *Peliperdix coqui*	2(8)	4(6)
Red-necked Spurfowl *Pternistis afer*	0(0)	4(12)
[F]Fiery-necked Nightjar *Caprimulgus pectoralis*	1(1)	0(0)
Square-tailed Nightjar *Caprimulgus fossii* IM	1(1)	4(4)
Pennant-winged Nightjar *Caprimulgus vexillarius*	0(0)	2(3)
Purple-crested Turaco *Gallirex porphyreolophus*	3(5)	7(7)
White-browed Coucal *Centropus superciliosus*	0(0)	2(3)
[F]Red-chested Cuckoo *Cuculus solitarius* IM	1(1)	2(2)
Red-eyed Dove *Streptopelia semitorquata*	8(10)	5(9)
Ring-necked Dove *Streptopelia capicola*	16(25)	22(46)
Emerald-spotted Wood Dove *Turtur chalcospilos*	17(24)	18(33)
[F]Tambourine Dove *Turtur tympanistria*	0(0)	1(1)
[F]African Green Pigeon *Treron calvus*	1(1)	7(52)
Hamerkop *Scopus umbretta*	1(2)	0(0)
Palmnut Vulture *Gypohierax angolensis*	1(1)	0(0)
Brown Snake-Eagle *Circaetus cinereus*	0(0)	1(1)
[F]Bat Hawk *Macheiramphus alcinus*	0(0)	1(1)
Ayres's Hawk Eagle *Hieraaetus ayresii*	1(1)	0(0)
African Hawk Eagle *Aquila spilogaster*	0(0)	1(1)
Lizard Buzzard *Kaupifalco monogrammicus*	4(4)	3(3)
Dark-chanting Goshawk *Melierax metabates*	0(0)	1(1)
Common Buzzard *Buteo buteo* PM	1(1)	0(0)
Pearl-spotted Owlet *Glaucidium perlatum*	1(1)	0(0)
African Barred Owlet *Glaucidium capense*	0(0)	1(1)
Speckled Mousebird *Colius striatus*	1(2)	4(18)
African Hoopoe *Upupa africana*	0(0)	5(17)
Green Wood Hoopoe *Phoeniculus purpureus*	0(0)	2(4)
Common Scimitarbill *Rhinopomastus cyanomelas*	7(13)	12(19)
Southern Ground Hornbill *Bucorvus leadbeateri*	1(1)	1(4)
Crowned Hornbill *Lophoceros alboterminatus*	0(0)	6(11)
Pale-billed Hornbill *Lophoceros pallidirostris*	1(6)	0(0)
[F]Trumpeter Hornbill *Bycanistes bucinator*	1(2)	1(2)
Racket-tailed Roller *Coracias spatulatus*	2(4)	6(12)
Broad-billed Roller *Eurystomus glaucurus* IM	0(0)	5(18)
Grey-headed Kingfisher *Halcyon leucocephala* IM	1(1)	2(2)
Brown-hooded Kingfisher *Halcyon albiventris*	0(0)	1(1)
Striped Kingfisher *Halcyon chelicuti*	1(1)	11(13)
Woodland Kingfisher *Halcyon senegalensis* IM	0(0)	3(7)
African Pygmy Kingfisher *Ispidina picta* IM	0(0)	1(1)
Little Bee-eater *Merops pusillus*	1(3)	3(7)
Böhm's Bee-eater *Merops boehmi*	1(4)	3(6)

Species	Relative frequency	
	Mbarang'andu (n = 62)	Kimbanda (n = 60)
Olive Bee-eater *Merops superciliosus* IM	0(0)	1(8)
[F]Yellow-rumped Tinkerbird *Pogoniulus bilineatus*	2(2)	11(14)
Yellow-fronted Tinkerbird *Pogoniulus chrysoconus*	6(6)	6(6)
Black-collared Barbet *Lybius torquatus*	0(0)	3(5)
Brown-breasted Barbet *Lybius melanopterus*	1(1)	0(0)
Lesser Honeyguide *Indicator minor*	1(1)	1(1)
Scaly-throated Honeyguide *Indicator variegatus*	2(3)	0(0)
Greater Honeyguide *Indicator indicator*	5(5)	2(2)
Speckle-throated Woodpecker *Campethera scriptoricauda*	4(4)	2(3)
[F]Golden-tailed Woodpecker *Campethera abingoni*	0(0)	9(21)
Bearded Woodpecker *Chloropicus namaquus*	5(8)	1(1)
Cardinal Woodpecker *Dendropicos fuscescens*	2(2)	1(1)
Stierling's Woodpecker *Dendropicos stierlingi*	11(18)	7(9)
Dickinson's Kestrel *Falco dickinsoni*	0(0)	3(5)
[F]Brown-headed Parrot *Poicephalus cryptoxanthus*	6(20)	6(26)
[F]African Broadbill *Smithornis capensis*	0(0)	3(4)
Chinspot Batis *Batis molitor*	10(36)	3(7)
[F]Pale Batis *Batis soror*	24(80)	27(60)
[F]Black-throated Wattle-eye *Platysteira peltata*	0(0)	1(1)
Grey-headed Bush-shrike *Malaconotus blanchoti*	3(3)	6(6)
Orange-breasted Bush-shrike *Chlorophoneus sulfureopectus*	1(1)	5(6)
Brown-crowned Tchagra *Tchagra australis*	1(1)	3(3)
Black-crowned Tchagra *Tchagra senegalus*	16(21)	28(40)
[F]Black-backed Puffback *Dryoscopus cubla*	19(39)	24(55)
Tropical Boubou *Laniarius major*	4(5)	12(20)
Brubru *Nilaus afer*	13(22)	9(10)
White-crested Helmet Shrike *Prionops plumatus*	4(52)	6(100)
Retz' Helmetshrike *Prionops retzii*	3(34)	3(26)
White-breasted Cuckoo-Shrike *Ceblepyris pectoralis*	8(17)	11(20)
Black Cuckoo-shrike *Campephaga flava* IM	2(2)	1(3)
Red-backed Shrike *Lanius collurio* PM	2(2)	0(0)
Southern Fiscal *Lanius collaris*	0(0)	1(1)
Black-headed Oriole *Oriolus larvatus*	15(18)	24(46)
African Golden Oriole *Oriolus auratus* IM	0(0)	3(3)
[F]Square-tailed Drongo *Dicrurus ludwigii*	5(11)	6(18)
Fork-tailed Drongo *Dicrurus adsimilis*	10(22)	25(66)
African Paradise Flycatcher *Terpsiphone viridis* IM	6(13)	21(52)
[F]White-tailed Blue Flycatcher *Elminia albicauda*	4(7)	0(0)
White-bellied Tit *Melaniparus albiventris*	0(0)	2(2)
Cinnamon-breasted Tit *Melaniparus pallidiventris*	13(44)	5(16)
Grey Penduline-Tit *Anthoscopus caroli*	1(2)	1(3)
[F]Eastern Nicator *Nicator gularis*	0(0)	3(4)
Flappet Lark *Mirafra rufocinnamomea*	0(0)	7(8)
Dark-capped Bulbul *Pycnonotus tricolor*	18(48)	20(50)
[F]Little Greenbul *Eurillas virens*	1(1)	0(0)
[F]Yellow-bellied Greenbul *Chlorocichla flaviventris*	2(2)	6(17)
Black Saw-wing *Psalidoprocne pristoptera*	1(6)	1(2)

Species	Relative frequency	
	Mbarang'andu (n = 62)	Kimbanda (n = 60)
Wire-tailed Swallow *Hirundo smithii*	0(0)	1(2)
Lesser Striped Swallow *Cecropis abyssinica*	2(20)	0(0)
Moustached Grass Warbler *Melocichla mentalis*	0(0)	2(4)
Red-faced Crombec *Sylvietta whytii*	15(28)	6(12)
Red-faced Cisticola *Cisticola erythrops*	0(0)	7(29)
Rattling cisticola *Cisticola chiniana*	0(0)	13(37)
Croaking Cisticola *Cisticola natalensis*	1(1)	3(10)
Neddicky *Cisticola fulvicapilla*	23(56)	17(43)
Tawny-flanked Prinia *Prinia subflava*	1(3)	9(24)
Yellow-breasted Apalis *Apalis flavida*	1(3)	2(2)
Green-backed Camaroptera *Camaroptera brachyura*	2(7)	8(21)
Stierling's Wren-Warbler *Calamonastes stierlingi*	8(16)	8(14)
Yellow-bellied Eremomela *Eremomela icteropygialis*	1(2)	4(8)
[F]Green-capped Eremomela *Eremomela scotops*	6(19)	7(13)
Arrow-marked Babbler *Turdoides jardineii*	1(5)	1(1)
Southern Yellow White-eye *Zosterops anderssoni*	1(6)	7(59)
[F]Yellow-bellied Hyliota *Hyliota flavigaster*	5(19)	6(29)
African Spotted Creeper *Salpornis salvadori*	5(9)	3(5)
Miombo Blue-eared Starling *Lamprotornis elisabeth*	0(0)	1(6)
Violet-backed Starling *Cinnyricinclus leucogaster* IM	0(0)	15(121)
Kurrichane Thrush *Turdus libonyana*	5(7)	6(8)
Bearded Scrub-Robin *Cercotrichas quadrivirgata*	1(3)	0(0)
White-browed Scrub-Robin *Cercotrichas leucophrys*	5(6)	7(9)
Grey Tit-Flycatcher *Myioparus plumbeus*	1(1)	0(0)
Southern Black Flycatcher *Melaenornis pammelaina*	4(7)	7(12)
Pale Flycatcher *Melaenornis pallidus*	2(2)	8(20)
Spotted Flycatcher *Melaenornis striata* PM	1(2)	5(8)
[F]Ashy Flycatcher *Muscicapa caerulescens*	3(7)	2(2)
[F]African Dusky Flycatcher *Muscicapa adusta*	2(4)	1(1)
Böhm's Flycatcher *Muscicapa boehmi*	0(0)	1(1)
White-browed Robin-Chat *Cossypha heuglini*	1(1)	5(6)
[F]Red-capped Robin-Chat *Cossypha natalensis* IM	1(1)	0(0)
Semicollared Flycatcher *Ficedula semitorquata* PM	2(2)	2(3)
Miombo Rock Thrush *Monticola angolensis*	2(3)	0(0)
Arnott's Chat *Myrmecocichla arnotti*	5(11)	12(30)
Familiar Chat *Oenanthe familiaris*	0(0)	1(2)
Western Violet-backed Sunbird *Anthreptes longuemarei*	21(42)	20(43)
Collared Sunbird *Hedydipna collaris*	4(9)	1(2)
Amethyst Sunbird *Chalcomitra amethystina*	11(28)	10(19)
Scarlet-chested Sunbird *Chalcomitra senegalensis*	1(2)	7(15)
Eastern Miombo Sunbird *Cinnyris manoensis*	22(66)	0(0)
Shelley's Sunbird *Cinnyris shelleyi*	6(19)	3(4)
Yellow-throated Bush-Sparrow *Gymnoris superciliaris*	25(85)	21(80)
White-browed Sparrow-Weaver *Plocepasser mahali*	0(0)	2(4)
Holub's Golden Weaver *Ploceus xanthops*	2(7)	2(2)
Village Weaver *Ploceus cucullatus*	0(0)	2(19)
Olive-headed Weaver *Ploceus olivaceiceps*	4(7)	0(0)

Species	Relative frequency	
	Mbarang'andu (n = 62)	Kimbanda (n = 60)
Red-headed Weaver *Anaplectes rubriceps*	1(1)	2(5)
Black-winged Red Bishop *Euplectes hordeaceus*	2(4)	1(2)
Yellow-Bishop *Euplectes capensis*	2(10)	12(35)
Green-winged Pytilia *Pytilia melba*	0(0)	1(2)
Red-billed Firefinch *Lagonosticta senegala*	0(0)	2(5)
African Firefinch *Lagonosticta rubricata*	1(1)	5(16)
Blue Cordonbleu *Uraeginthus angolensis*	1(5)	5(17)
Common Waxbill *Estrilda astrild*	0(0)	1(12)
Orange-breasted Waxbill *Amandava subflava*	0(0)	3(180)
Bronze Mannikin *Spermestes cucullata*	2(6)	1(12)
Black-and-White Mannikin *Spermestes bicolor*	2(14)	1(6)
Village Indigobird *Vidua chalybeata*	0(0)	1(2)
Pin-tailed Whydah *Vidua macroura*	1(7)	2(10)
Long-tailed Paradise Whydah *Vidua paradisaea*	0(0)	1(1)
Broad-tailed Paradise Whydah *Vidua obtusa*	1(1)	1(1)
Yellow-throated Longclaw *Macronyx croceus*	0(0)	1(2)
Yellow-fronted Canary *Crithagra mozambica*	12(22)	10(50)
Black-eared Seed-eater *Crithagra mennelli*	2(3)	5(25)
Golden-breasted Bunting *Emberiza flaviventris*	1(1)	3(5)
Cabanis's Bunting *Emberiza cabanisi*	3(4)	4(9)