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A preliminary account of the forest avifauna of Ihang'ana and Idewa Forest Reserves: 'forest islands' on the Udzungwa Plateau, Tanzania

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Summary

This study reports on the forest avifaunas of Ihang'ana and Idewa Forest Reserves, located on the Udzungwa Plateau, Tanzania, which are undocumented in published literature. Field surveys were conducted between 28 October and 6 November 2020 using the McKinnon species list method. From 185 McKinnon 10-species lists, 40 species were observed in Ihang'ana and 30 in Idewa Forest Reserves, for a combined total of 41 species. Of the species recorded, over 78% (32 species) were forest-dependent birds representative of Eastern Arc Mountains forests. Seven species detected are considered restricted-range species, including Yellow-throated Greenbul *Arizelocichla chlorigula,* which is endemic to the Eastern Arc Mountains of Tanzania. The results suggest that forest birds, including montane species, can survive in isolated areas of suitable habitat even when patch size is small. As such, forests such as Ihang'ana and Idewa forests can still play an important role in the conservation of forest birds.

Keywords: Udzungwa plateau, forests islands, forest birds, conservation

Introduction

Ihang'ana and Idewa Forest Reserves (hereafter, Ihang'ana and Idewa) are situated on the Udzungwa Plateau, within the Udzungwa Mountains in the southern highlands of Tanzania. The Udzungwa Mountains form the southernmost and largest block of the Eastern Arc Mountain chain, which rises from the coastal plain of eastern Tanzania. This mountain chain is comprised of 13 individual mountain blocks that include the Taita Hills (in Kenya), North and South Pare, West and East Usambara, Nguu, Nguru, Ukaguru, Rubeho, Uluguru, Malundwe, Udzungwa and Mahenge (in Tanzania) massifs (Burgess *et al*. 2007). The forests of the Eastern Arc Mountains have been recognized as an Afromontane biodiversity hotspot, being part of the world's 25 biodiversity hotspots (Myers *et al*. 2000). In many places, these forests are now heavily fragmented, and Ihang'ana and Idewa are isolated on the plateau, and no longer connected to the forests found along the main escarpment of the Udzungwas to the east (see Ndangalasi *et al*. 2014).

Avian research in the East Arc Mountains has been extensive. It has included ecological studies such as those of Stuart *et al*. (1987), Romdal & Rahbek (2009) and Werema (2015, 2016), investigating the altitudinal ranges of forest birds, and those of numerous other fieldworkers who have focused on inventorying some of the larger

forest blocks (e.g., Jensen & Brøgger-Jensen 1992, Cordeiro *et al*. 2004, 2006, Fjeldså 1999, Jensen *et al*. 2020). However, the avifauna of many smaller or especially remote forests in the Udzungwa Mountains and Udzungwa plateau, such as Ihang'ana and Idewa, have not been surveyed (e.g., see Cordeiro *et al*. 2004). The condition of the forest at both sites is good and likely to support viable populations of numerous bird species representative of the Eastern Arc Mountains. However, because they exist as forest "islands" in a "sea" of pine plantations, small-scale farms, and settlements, with limited connectivity to larger forests, they are less studied and their usefulness for conservation less well known. As such, an inventory of the species occurring in each forest was required. Avian surveys such as the one reported here may be of use in informing management decisions and in measuring the effectiveness of forest conservation for biodiversity (Bennun & Njoroge 1999).

Materials and methods

Study area

Ihang'ana and Idewa are found in Mufindi District, about 70–75 km east of Mafinga town, and about 22–30 km northwest of the Udzungwa escarpment at Uhafiwa and Ukami villages (Fig. 1). Ihang'ana and Idewa lie between 1800 and 2100 m above sea level. Ihang'ana covers 1207 ha of forest while Idewa has 291 ha of forest (Fig. 1). Currently, the two forests are about 4 km apart, mainly surrounded by pine plantations, and to a lesser extent by croplands and settlements. Of the two forests, Ihang'ana, the larger, is the main catchment and the source of Kihansi River. The two forests are primarily moist with closed canopy, but with some areas of the forest edge having relatively shorter canopies as a result of forest disturbance (Ndangalasi *et al*. 2014). The forest floor is wet and covered with various species of fungi, bryophytes and pteridophytes. The most common tree species in the two forests include *Aphloia theiformis*, *Olea capensis* and *Diospyros whyteana* (Ndangalasi *et al*. 2014).

Survey Methods

Avian species richness was determined using a modified Mackinnon list method (see Fjeldså 1999). This involved slowly walking in the forest while recording birds in lists of 10 species each. Field surveys were conducted between 28 October and 6 November 2020. At 25 pre-planned starting points in both forests, the observers scanned a section of the forest area while recording all the birds seen or heard. Once the first list of 10 species was complete, another list of 10 species was compiled immediately thereafter, and so on. Bird observations were conducted from sunrise to sunset, with brief notes describing unidentified birds or vocalizations, allowing for later adjustments (Fjeldså 1999). In total, 185 10-species lists were compiled: 125 from Ihang'ana and 60 from Idewa.

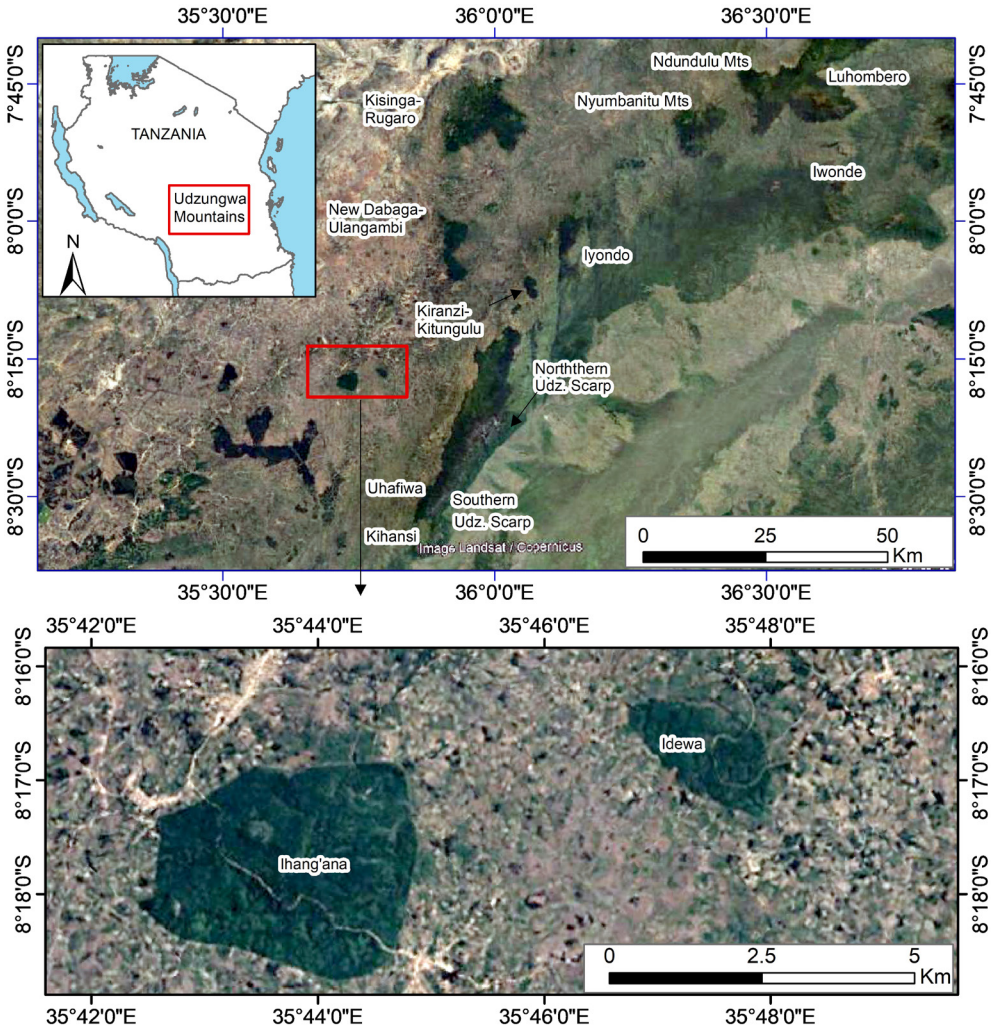

Figure 1. Location of Ihang'ana and Idewa forests on the Udzungwa plateau (Source: Google Earth).

To assess whether sampling effort was adequate, sample-based rarefaction curves were generated using the program PAST (Hammer *et al*. 2001). Observed species were divided into two groups on the basis of forest dependency: forest specialists (*FF* species) and forest generalists (*F* species) following Bennun *et al*. (1996) and Mlingwa *et al*. (2000). *FF* species are birds of the interior undisturbed forest, "true" forest birds which are likely to disappear if the forest is modified to any great extent. *F* species are species of the forest edge that depend upon the forest for some of their resources, and are less affected by forest modification. Furthermore, we followed Jensen *et al*. (2020) in identifying restricted-range montane forest species, which are defined as birds that are limited in range to Eastern Arc forests, as well as those found in only one or two forest areas outside the Eastern Arc Mountains, typically in Tanzania and/or mountain patches in northern Mozambique/Malawi.

The English and scientific names of species follow the IOC world bird list (www.worldbirdnames.org (see Gill *et al*. 2021)).

Results

We recorded 41 species from the two forests. Species accumulation curves for each of the two forests showed a steady increase approaching asymptote, indicating that most of the species expected for each forest were detected (Fig. 2). Of the species we recorded, 51.2% (21 species) were *FF* species and 26.8% (11 species) were *F* species (Appendix 1). Forty-four percent (18 species) of the species observed were montane forest birds of which seven are restricted-range species. These include Dark Batis *Batis crypta*, Fülleborn's Boubou *Laniarius fuelleborni*, Shelley's Greenbul *Arizelocichla masukuensis*, Yellow-throated Greenbul *Arizelocichla chlorigula*, Chapin's Apalis *Apalis chapini*, Kenrick's Starling *Poeoptera kenricki* and Forest Double-collared Sunbird *Cinnyris fuelleborni*. Among the species recorded, only one species, the Mountain Buzzard *Buteo oreophilus,* is Near Threatened (BirdLife International 2016).

Forty and 30 species were recorded in Ihang'ana and Idewa, respectively, and 29 species were shared by the two forests. For the species recorded at Ihang'ana, 21 (52.5%) were *FF* species and 11 (27.5%) were *F* species, while at Idewa, 16 (53.3%) were *FF* species and nine (30%) were*F* species. With the exception of Black Cuckooshrike *Campephaga flava*, all species recorded in Idewa were also found in Ihang'ana.

Six species were common to abundant and were recorded in over half of the McKinnon lists in both forests: Moustached Tinkerbird *Pogoniulus leucomystax*, Fülleborn's Boubou *L. fuelleborni*, White-tailed Crested Flycatcher *Elminia albonotata,* Yellow-throated Greenbul *A. chlorigula*, Southern Yellow White-eye *Zosterops anderssoni*, and White-starred Robin *Pogonocichla stellata* (Appendix 1).

Of the species observed, 17 are known to be altitudinal migrants in the Eastern Arc Mountains (Appendix 1), and some or all individuals of these species may move to lower elevations during the cold season from April to September.

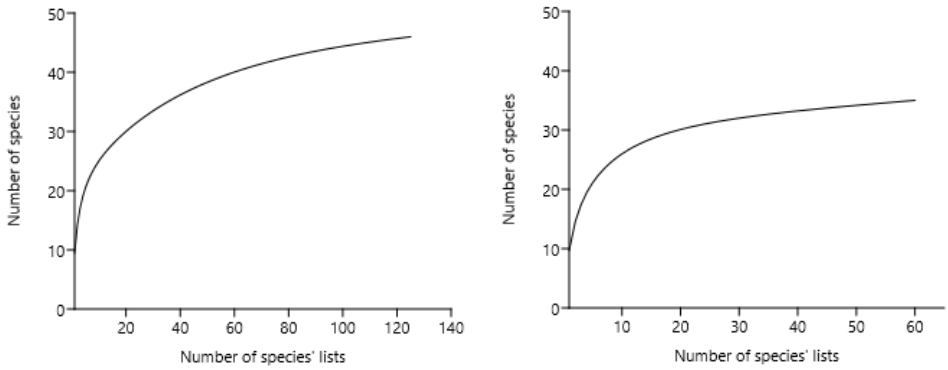

Figure 2. Species accumulation curves for Ihang'ana (left) and Idewa (right) forests.

Discussion

Our investigation of the birds of Ihang'ana and Idewa provides baseline data on the avian assemblage of these two isolated forests on the Udzungwa plateau. The data suggest that these forests, despite their isolation, do support an important representation of forest birds found in the Udzungwa Mountains (see Romdal & Rahbek 2009, Jensen *et al*. 2020), the wider Eastern Arc Mountains and beyond. These include the 17 species which are known to be seasonal altitudinal migrants in the Eastern Arc Mountains (Burgess & Mlingwa 2000, Werema 2015, 2016; Appendix 1) while the remainder have not been documented to make such movements and are assumed to be sedentary residents. As such, despite the past fragmentation, the results suggest that forest birds, including montane species, can survive in small forest patches in fragmented landscapes, as has been demonstrated elsewhere in sub-Saharan Africa (Dowsett-Lemaire 1989, Jensen *et al*. 2020).

Compared with other montane forests of equivalent size, however, the forest bird communities in Ihang'ana and Idewa are somewhat impoverished. For example, Ihang'ana, with 12.06 km^2 of montane forest, had 32 forest species, which is much less than smaller forest patches in the Udzungwa Mountains. For example, Kisinga-Rugaro (9.4 km^2 of closed forest), and Ukami (5 km^2 of closed forest) at similar elevations in the Udzungwa Mountains, support 55 and 58 forest species respectively (Jensen *et al*. 2020). Similarly, Idewa forest (2.91 km^2) is also impoverished in that it supports only 25 forest species in comparison to the smaller-sized, and more isolated Kitemele forest (1.2 km^2 of closed forest in the Udzungwa Mountains), which supports 31 species (Jensen *et al*. 2020).

The avifaunal impoverishment of both Ihang'ana and Idewa was expected because they are both small and isolated forests. This is particularly evident in the relatively small number of montane bird species in comparison to other forests in the Eastern Arc Mountains, and particularly those from the Udzungwa Mountains to the northeast of Ihang'ana and Idewa (see Jensen *et al*. 2021). These results are in line with studies by Newmark (1991) in the Usambara Mountains, Burgess & Mlingwa (1993) in the coastal forests of eastern Africa, and Jensen *et al*. (2020) in the Udzungwa Mountains, showing that smaller forests support depauperate assemblages of species. The fact that some small forests in the Udzungwa Mountains, such as Kiranzi-Kitungulu and Kitemele, support more forest bird species than the relatively larger Ihang'ana forest could possibly be due to more recent separation of these forests from larger forest areas (see Jensen *et al*. 2020).

Of the two forests, Ihang'ana (the larger-sized) had more species than the smaller-sized Idewa and almost all species recorded in the former were a subset of those observed in the latter, except Black Cuckooshrike. However, the two forests had almost equal proportions of forest-dependent species suggesting that both of them are important in conservation of forest birds. Ihang'ana forest, the larger, supported all seven restricted-range species detected, while Idewa forest supported only five, suggesting that the larger forest offers a wider range of habitats, with a slower rate of species extirpation (e.g., see Jensen *et al*. 2020).

The seven restricted-range species recorded in this study are widespread in the forests found in the Udzungwa Mountains, particularly the larger tracts (Jensen *et al*. 2020). They include Yellow-throated Greenbul, which is endemic to Tanzania and was found to be common at both study sites, as was a second species, Fülleborn's Boubou. Chapin's Apalis and Kenrick's Starling, by contrast, were present at low rel-

ative abundances and were only recorded in Ihang'ana. Chapin's Apalis is endemic to the Malawi Rift Mountains and Eastern Arc Mountains north to the Nguru Mountains, and Kenrick's Starling has been considered to be rare and very local in the Kenyan highlands and Eastern Arc Mountains (North Pare, Usambaras, Nguu, Nguru, Uluguru, Udzungwa and Iringa highlands to Mdandu Forest, Njombe; Fjeldså *et al*. 2010).

In conclusion, Ihang'ana and Idewa support a diminished assemblage of forest species typical of the Eastern Arc Mountains. Nevertheless, they still comprise important refuges for a subset of representative species. In comparison to other forests found in the Udzungwa Mountains, some of which are relatively smaller, Ihang'ana and Idewa are impoverished, likely because of a longer period of isolation from larger forest areas. The overall impoverishment of the avifauna in these forests suggests that further reduction of the size would lead to additional local extirpations (Dowsett-Lemaire 1989, Newmark 1991, Dami *et al*. 2013, Jensen *et al*. 2020), and the fact that forest patches that are more isolated support fewer species over time.

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Appendix 1. Birds recorded in Ihang'ana and Idewa forests. FD = Forest dependence categories: FF = forest specialist and F = forest generalist. Montane species are shown in bold. Max. freq. = highest frequency at which a species was recorded in the McKinnon lists in each forest, Ra = Relative abundance. * = altitudinal migrants, and † = restricted-range species. Relative abundance of each species in each forest reserve was calculated by dividing the maximum detections of a species (i.e., the maximum number of McKinnon lists into which a species was recorded) by the total number of McKinnon lists (i.e., 125 in Ihang'ana forest and 60 in Idewa forest). The English and scientific names of species follow Gill et al. (2021).

		Forest Reserve			
		Ihang'ana		Idewa	
Species	FD	Max. freq.	Ra	Max. freq.	Ra
Livingstone's Turaco *Tauraco livingstonii*	F	65	52.00	12	20.00
*Barred Long-tailed Cuckoo *Cercococcyx montanus*	FF	26	20.80	7	11.67
*African Olive Pigeon *Columba arquatrix*	FF	25	20.00	5	8.33
*Lemon Dove *Columba larvata*	FF	34	27.20	0	0.00
Tambourine Dove *Turtur tympanistria*	F	2	1.60	5	8.33
African Goshawk *Accipiter tachiro*	F	7	5.60	8	13.33
Little Sparrowhawk *Accipiter minullus*		1	0.80	0	0.00
Mountain Buzzard *Buteo oreophilus*	FF	2	1.60	3	5.00
Bar-tailed Trogon *Apaloderma vittatum	FF	1	0.80	1	1.67
Crowned Hornbill *Lophoceros alboterminatus*		5	4.00	4	6.67
Moustached Tinkerbird *Pogoniulus leucomystax*	FF	93	74.40	55	91.67
Greater Honeyguide *Indicator indicator*		1	0.80	0	0.00
Olive Woodpecker *Dendropicos griseocephalus	FF	3	2.40	0	0.00
†Dark Batis *Batis crypta*	FF	59	47.20	26	43.33
*Black-fronted Bushshrike *Chlorophoneus nigrifrons*	FF	62	49.60	14	23.33
Black-backed Puffback *Dryoscopus cubla*	F	3	2.40	7	11.67
†Fülleborn's Boubou *Laniarius fuelleborni	FF	66	52.80	46	76.67
Tropical Boubou *Laniarius major*		1	0.80	0	0.00
Black Cuckooshrike *Campephaga flava*		0	0.00	3	5.00
White-tailed Crested Flycatcher *Elminia albonotata	FF	95	76.00	32	53.33
Common Bulbul *Pycnonotus barbatus*		10	6.4	5	8.33
†Shelley's Greenbul *Arizelocichla masukuensis	FF	28	22.40	12	20.00
†Yellow-throated Greenbul *Arizelocichla chlorigula	FF	107	85.60	52	86.67
*Little Greenbul *Eurillas virens*	F	28	22.40	3	5.00
Placid Greenbul *Phyllastrephus placidus*	FF	18	14.40	13	21.67
White-headed Saw-wing *Psalidoprocne albiceps*		2	1.60	0	0.00
*Evergreen Forest Warbler *Bradypterus lopezi*	FF	41	32.80	18	30.00
Cinnamon Bracken Warbler *Bradypterus cinnamomeus*	F	3	2.40	5	8.33
Bar-throated Apalis *Apalis thoracica*	FF	57	45.60	25	41.67
†Chapin's Apalis *Apalis chapini*	FF	7	5.60	0	0.00
Brown-headed Apalis *Apalis alticola*	F	37	29.60	31	51.67
African Hill Babbler *Sylvia abyssinica	FF	32	25.60	14	23.33
Southern Yellow White-eye *Zosterops anderssoni*		63	50.40	34	56.67
Waller's Starling *Onychognathus walleri	FF	6	4.80	0	0.00
†Kenrick's Starling *Poeoptera kenricki	FF	2	1.60	0	0.00

Species	FD	Forest Reserve			
		Ihang'ana		Idewa	
		Max. freq.	Ra	Max. freq.	Ra
African Dusky Flycatcher *Muscicapa adusta*	F	4	3.20	8	13.33
Cape Robin-Chat *Cossypha caffra*		7	5.60	12	20.00
White-starred Robin *Pogonocichla stellata	F	110	88.00	39	65.00
Collared Sunbird *Hedydipna collaris*	F	1	0.80	0	0.00
†Forest Double-collared Sunbird *Cinnyris fuelleborni*	FF	62	49.60	34	56.67
Red-faced Crimsonwing *Cryptospiza reichenovii	F	4	3.20	0	0.00