

Birds of the Kihansi Gorge, south-eastern Udzungwa Mountains

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Introduction

Birds of the Eastern Arc Mountains have received considerable attention in the last two decades. New species and new populations have been discovered in some of the more remote forests (e.g. Jensen 1983, Dinesen *et al.* 1994), and the ecology of many forest birds is becoming better known. The general ecology and distribution of the Udzungwa avifauna has been reported on by several authors (e.g. Stuart *et al.* 1987, Jensen & Brøgger-Jensen 1992, Dinesen *et al.* 1993, Moyer 1993, Fjeldså 1999), and a recent paper (Dinesen *et al.* 2001) evaluates priorities for conservation of biodiversity in most forest patches in the range.

Some of the smaller or remote forest reserves in the Udzungwas still remain largely unexplored. As forest loss and fragmentation continues, there remains a pressing need to inventory biota of such patches to initiate their conservation. Until recently, one of the unexplored forest patches was in the remote Kihansi gorge (35° 52' E, 8° 14' S), which is part of the Njerera Forest Reserve and is now covered by the Lower Kihansi Hydropower Project (LKHP) area. During the course of a three-year environmental monitoring programme to investigate the impact of the LKHP on the flora and fauna of the Kihansi gorge we documented forest species occurring in the area. This study included surveys of threatened and non-threatened bird species in the gorge to determine whether they were susceptible to population declines from environmental changes created by the LKHP.

In this paper, we present and discuss our important findings regarding the distribution of birds in the Njerera FR and environs. We complement our findings with a preliminary ornithological study in this forest in September 1994 (Rahner 1995).

Study area and methods

Njerera FR is a 2834 ha reserve gazetted in 1957 on the south-eastern edge of the Udzungwa Mountains, just below Uhafiwa. It covers the east-facing escarpment and two riverine gorges, those of the Kihansi and Udagaje rivers (Figure 1). The LKHP project, which was initiated in 1994 and completed in 2000, covers an area that includes the Njerera FR, as well as hilly uplands above the escarpment and a section of

escarpment to the south of the reserve. Closed canopy evergreen moist forest occurs in the Kihansi and Udagaje gorges, with a canopy 30–40 m high. The escarpment is covered with Zambebian woodland (*sensu* White 1983) dominated by *Brachystegia* spp. (Miombo woodland).

Kihansi and Udagaje Gorges were the primary sites for our investigations. The Kihansi forest patch was larger and the elevational range greater. As a consequence, more species were found there. Tree species from both gorges are shown in table 1. The mixed forest in Kihansi Gorge (c. 90 ha) is rich in large tree species. A small patch of *Filicium decipiens* occurs next to mixed forest in the upper parts of the gorge (500–600 m). Although this forest is dominated by large trees of *Filicium decipiens* it contains several species also found in the mixed forests. Further details of Kihansi gorge can be found in Lovett *et al.* (1997). Udagaje gorge is about 1.5 km to the east of Kihansi gorge, and the forest (c. 40 ha) is floristically similar to the Kihansi mixed forest (Table 1). Above the gorge, montane forest occurs along the river and above the dam site.

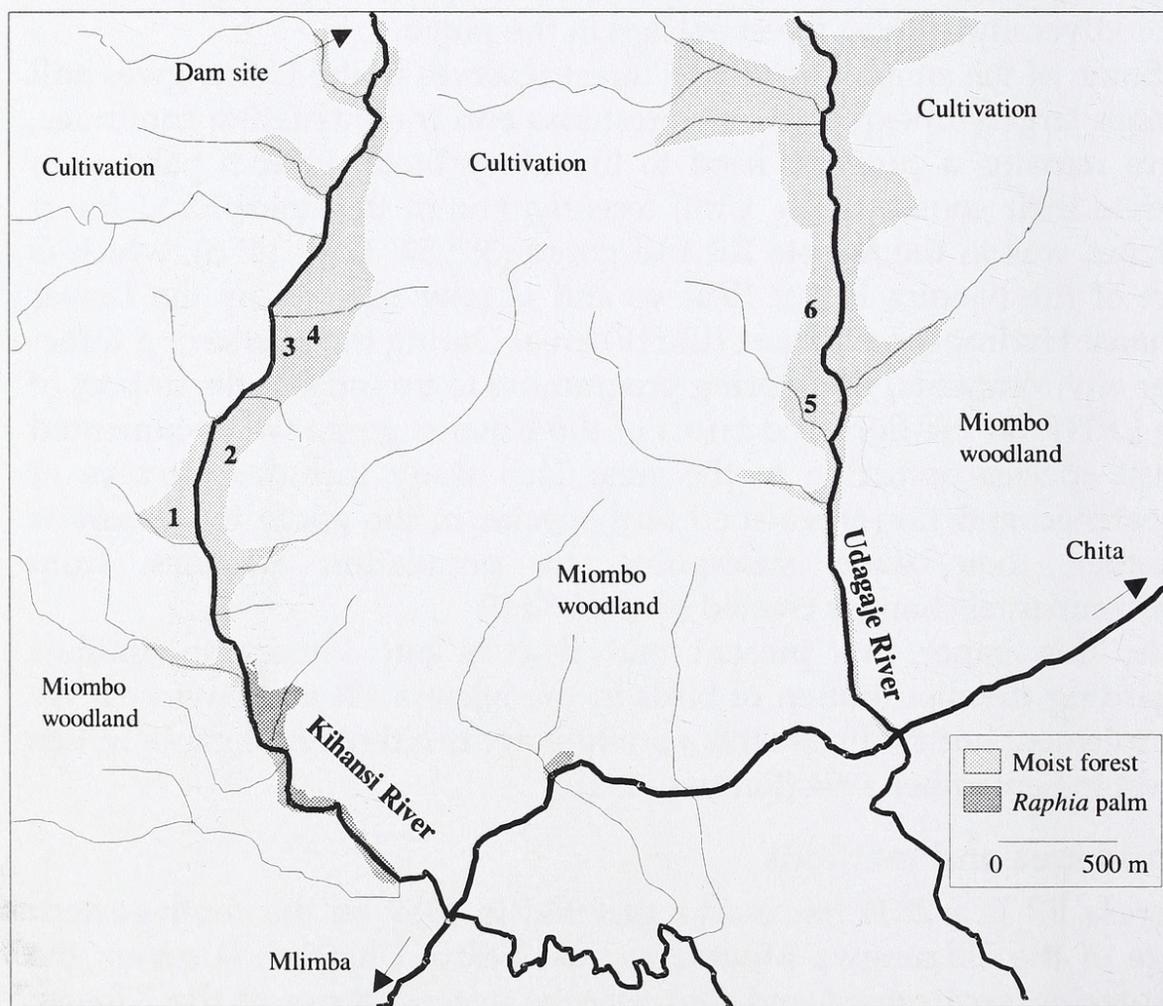


Figure 1. Map showing the extent of moist forest in the Kihansi and Udagaje gorges. Bird sampling stations are marked as follows: 1=520 m; 2=630 m; 3=760 m (moist forest type); 4=820 m (*Filicium* forest type) in Kihansi Gorge; 5=510 m; 6=620 m in Udagaje Gorge.

Table 1. Trees of >20 cm diameter at breast height recorded from the mixed forest of Kihansi Gorge (KM), the *Filicium* forest of Kihansi Gorge (KF) and the Udagaje Gorge (UM). The list is not complete, particularly for Udagaje Gorge.

Tree species	KM	KF	UM	Tree species	KM	KF	UM
<i>Albizia gummifera</i>	✓			<i>Macaranga capensis</i>			✓
<i>Allanblackia stuhlmanni</i>	✓			<i>Milicia excelsa</i>	✓		✓
<i>Antiaris toxicaria</i> var. <i>usambarensis</i>	✓			<i>Milletia oblata</i> ssp. <i>intermedia</i>	✓		✓
<i>Bombax rhodognaphalon</i>	✓			<i>Mimusops kummel</i>	✓		
<i>Carpolobia goetzei</i>	✓			<i>Monodora grandidieri</i>	✓	✓	
<i>Celtis zenkeri</i>			✓	<i>Multidentia crassa</i>			✓
<i>Cephalosphaera usambarensis</i>	✓			<i>Newtonia buchananii</i>	✓	✓	✓
<i>Cola greenwayi</i>	✓			<i>Olea capensis</i>	✓	✓	
<i>Cola microcarpa</i>	✓			<i>Parinari excelsa</i>	✓	✓	✓
<i>Cola scheffleri</i>	✓	✓		<i>Paramacrolobium coeruleum</i>	✓		
<i>Croton sylvaticus</i>			✓	<i>Polysphaeria braunii</i>	✓		
<i>Cussonia zimmermannii</i>	✓			<i>Pouteria alnifolia</i>	✓		
<i>Cylicomorpha parviflora</i>	✓			<i>Pterocarpus mildbraedii</i>	✓		✓
<i>Cynometra</i> sp.	✓			<i>Rhus longipes</i>	✓		
<i>Drypetes usambarica</i> var. <i>usambarica</i>	✓	✓	✓	<i>Ricinodendron heudelotii</i> ssp. <i>africanum</i>	✓		
<i>Englerophytum natalense</i>	✓	✓	✓	<i>Rinorea ferruginea</i>	✓		
<i>Erythrina abyssinica</i>	✓			<i>Rinorea ilicifolia</i> var. <i>ilicifolia</i>	✓		
<i>Erythroxylon emarginatum</i>	✓			<i>Rothmannia manganjae</i>	✓		✓
<i>Fernandoa magnifica</i>	✓			<i>Rothmannia urcelliformis</i>	✓	✓	✓
<i>Ficus exasperata</i>			✓	<i>Sapium ellipticum</i>	✓		✓
<i>Ficus lutea</i>	✓			<i>Sorindeia madagascarensis</i>	✓	✓	✓
<i>Ficus mucoso</i>	✓			<i>Sterculia</i> sp.	✓		
<i>Ficus vallis-choudae</i>	✓			<i>Strombosia scheffleri</i>	✓	✓	
<i>Filicium decipiens</i>	✓	✓	✓	<i>Synsepalum brevipes</i>	✓	✓	✓
<i>Garcinia buchananii</i>	✓	✓		<i>Synsepalum cerasiferum</i>	✓		✓
<i>Garcinia semseii</i>	✓	✓	✓	<i>Tabernaemontana pachysiphon</i>	✓	✓	✓
<i>Haplocoelium foliolosum</i>	✓			<i>Tetrapleura tetraptera</i>	✓		
<i>Haplocoelopsis africana</i>	✓		✓	<i>Tricalysia allocalyx</i>	✓		
<i>Holarrhena pubescens</i>			✓	<i>Tricalysia pallens</i>	✓	✓	
<i>Isolona heinsenii</i>	✓	✓		<i>Trichilia dregeana</i>	✓		
<i>Lagynias pallidiflora</i>	✓	✓	✓	<i>Trilepisium madagascariensis</i>	✓		✓
<i>Lecaniodiscus fraxinifolius</i>	✓			<i>Uvariadendron gorgonis</i>	✓		
<i>Leptactina platyphylla</i>	✓			<i>Vangueria infausta</i>	✓		
<i>Leptonychia usambarensis</i>	✓	✓		<i>Vepris nobilis</i>	✓	✓	✓
<i>Lettowianthus stellatus</i>	✓			<i>Vepris stoltzii</i>	✓		✓
<i>Ludia mauritiana</i>	✓	✓		<i>Zanthoxylum usambarense</i>	✓	✓	

To document the avifauna, and assess abundance of understory forest birds, we conducted audio-visual surveys and mist-net sampling. The loud noise from the waterfalls prior to dam completion prevented quantitative assessments using point counts of the entire avifaunal community. We conducted *ad hoc* observations of birds in microhabitats across elevations at each of these sites, and made a brief foray into the forest above the dam site. We sampled understory birds for 3456 net-metre-hours (nmh) at four stations in Kihansi (altitudes 520, 630, 760 and 820 m) and two stations in Udagaje gorges (altitudes 510 and 620 m) in three sampling season (June 1998, February 1999 and July 2001). In Kihansi gorge, we compared upper level forest (760 m) with the *Filicium*-dominated patch (820 m) to determine if species richness and composition and capture rates varied between the two habitats. Capture rates are expressed as the number of individuals captured divided by

the mist-net effort pooled over all seasons. Taxonomy follows Zimmerman *et al.* (1996).

Results

Forest birds

We located 69 species of birds that are associated with forest habitats (Table 2). During our sampling period, we failed to detect only one species, Chapin's apalis *Apalis chapini*, which had previously been reported from forest close to the dam site (Rahner 1995). Three species

Table 2. List of forest bird species occurring in the Kihansi and Udagaje forest patches within Njerera FR. Nomenclature follows Zimmerman *et al.* (1996) and forest status broadly follows Bennun *et al.* (1996) with the exception of species marked with a cross (†).

Species	Mist netted	Udzungwas* (m)	Njerere FR (m)	Threat status**
African Black Duck <i>Anas sparsa</i>				
African Goshawk <i>Accipiter tachiro</i>				
Mountain Buzzard <i>Buteo oreophilus</i>		1300–1900	>500	
African Crowned Eagle <i>Stephanoaetus coronatus</i>				
Black Sparrowhawk <i>Accipiter melanoleucus</i>		1700–1800	>700	
Crested Guineafowl <i>Guttera pucherani</i>				
African Finfoot <i>Podica senegalensis</i>				
African Green Pigeon <i>Treron calva</i>				
Tambourine Dove <i>Turtur tympanistria</i>	✓			
Livingston's Turaco <i>Tauraco livingstonii</i>				
Yellowbill <i>Ceuthmochares aereus</i>				
African Wood Owl <i>Strix woodfordii</i>				
Narina Trogon <i>Apaloderma narina</i>				
Bar-tailed Trogon <i>A. vittatum</i>		800–1800	>700	
African Pygmy Kingfisher <i>Ispidina picta</i> †	✓			
Crowned Hornbill <i>Tockus alboterminatus</i>				
Trumpeter Hornbill <i>Bycanistes bucinator</i>				
Silvery-cheeked Hornbill <i>B. brevis</i>				
Moustached Green Tinkerbird <i>Pogoniulus leucomystax</i>		1300–1850	>700	
Yellow-rumped Tinkerbird <i>P. bilineatus</i>				
Scaly-throated Honeyguide <i>Indicator variegates</i> †				
Cardinal Woodpecker <i>Dendropicos fuscescens</i> †				
Olive Woodpecker <i>D. griseocephalus</i>		1400–1830	>750	
African Broadbill <i>Smithornis capensis</i>				
Black Rough-wing <i>Psalidoprocne holomelas</i> †				
Little Greenbul <i>Andropadus virens</i>	✓			
Shelley's Greenbul <i>A. masukuensis</i>	✓	900–1900	>700	
Stripe-cheeked Greenbul <i>A. milanjensis</i>	✓	800–1900	>500	
Cabanis's Greenbul <i>Phyllastrephus cabanisi</i>	✓	750–1900	>700	
Fischer's Greenbul <i>P. fischeri</i>				
Yellow-streaked Greenbul <i>P. flavostriatus</i>				
African Hill Babbler <i>Pseudalcippe abyssinica</i>		1400–1900	>700	
Eastern Nicator <i>Nicator gularis</i>	✓			
White-starred Forest Robin <i>Pogonocichla stellata</i>	✓			
Sharpe's Akalat <i>Sheppardia sharpei</i>	✓	600–1850	>600	RR
Red-capped Robin-chat <i>Cossypha natalensis</i>	✓			
White-chested Alethe <i>Alethe fuelleborni</i>	✓			
Orange Ground Thrush <i>Zoothera gurneyi</i>	✓			
Olive Thrush <i>Turdus olivaceus</i>				
Dusky Flycatcher <i>Muscicapa adusta</i>				

Table 2 cont.

Species	Mist netted	Udzungwas* (m)	Njerere FR (m)	Threat status**
Ashy Flycatcher <i>M. caerulescens</i>	✓			
Yellow-throated Woodland Warbler <i>Phylloscopus ruficapilla</i>		800–1900	>600	
Evergreen Forest Warbler <i>Bradypterus lopezi</i>		1300–1900	>750	
Green-backed Camaroptera <i>Camaroptera brachyura</i> †	✓			
Black-headed Apalis <i>Apalis melanocephala</i>				
Chapin's Apalis <i>A. chapini</i> +		1100		VU/RR
White-winged Apalis <i>A. chariessa</i>		1000–2000	750	VU/RR
Bar-throated Apalis <i>A. thoracica</i>		1400–1900	700	
Yellow White-eye <i>Zosterops senegalensis</i>				
Blue-mantled Crested Flycatcher <i>Trochocercus cyanomelas</i>	✓			
African Paradise Flycatcher <i>Terpsiphone viridis</i> †				
Forest Batis <i>Batis mixta</i>	✓			
Black-throated Wattle Eye <i>Platysteira peltata</i>				
Black-fronted Bush-shrike <i>Malaconotus multicolor</i>				
Fuelleborn's Boubou <i>Laniarius fuelleborni</i>				
Black-backed Puffback <i>Dryoscopus cubla</i>				
Grey Cuckoo-shrike <i>Coracina caesia</i>				
Square-tailed Drongo <i>Dicrurus ludwigii</i>				
Waller's Starling <i>Onychognathus walleri</i>				
Slender-billed Chestnut-winged Starling <i>O. tenuirostris</i>				
Black-bellied Starling <i>Lamprotornis corrucus</i>				
Uluguru Violet-backed Sunbird <i>Anthreptes neglectus</i>				
Collared Sunbird <i>A. collaris</i>	✓			
Olive Sunbird <i>Nectarinia olivacea</i>	✓			
Dark-backed Weaver <i>Ploceus bicolor</i>				
Red-face Crimson <i>Cryptospiza reichenowii</i>	✓	900–1830	>700	
Green-backed Twinspot <i>Mandingoa nitidula</i>	✓	750–1000	>600	
Peter's Twinspot <i>Hypargos niveoguttatus</i>	✓			
Oriole Finch <i>Linurgus olivaceus</i>				

* Altitudinal distributions in Udzungwas from Jensen & Brøgger-Jensen (1992) and updated by Dinesen *et al.* (2001).

** Globally threatened status after Collar *et al.* (1994): VU=vulnerable, RR=restricted range, indicating a global range of less than 50 000 km².

† Species not included as forest residents in Bennun *et al.* (1996), but which either reside in rivers traversing through forest or in forest within their Tanzanian range.

+ Only recorded by Rahner (1995).

(Sharpe's Akalat *Sheppardia sharpei*, Chapin's Apalis & White-winged Apalis *A. chariessa*) are globally threatened or range-restricted (range < 50 000 km², Collar *et al.* 1994).

Mist-net captures

We captured 269 individuals of 22 species of birds during the three sampling periods over a combined total of 62 208 nmh. This represents an overall capture rate of 44 birds per 10 000 nmh. Species that were most frequently captured overall were Little Greenbul *Andropadus virens* (29% of total captures), Olive Sunbird *Nectarinia olivacea* (19%), Red-capped Robin Chat *Cossypha natalensis* (8%), Stripe-cheeked Greenbul *Andropadus milanensis* (7%) and Forest Batis *Batis mixta* (6%).

Filicium-dominated forest

Species richness (defined here as number of species), absolute number of individuals captured and species composition were similar between the *Filicium* and Upper Kihansi sites. No significant differences were found in the capture rates between the Upper Kihansi (median=2, 25–75% quartiles=0 and 4 per 10 000 nmh) and *Filicium* (median=2, 25–75% quartiles=1 and 6 per 10 000 nmh) sites (Wilcoxon signed-ranks test, $n=15$, $Z=0.72$, $p=0.47$). This habitat was frequented by mixed-species flocks; many canopy-foragers of the adjacent forest were also seen in large mixed-species flocks in the *Filicium* tree canopies. This habitat appeared particularly important for Uluguru Violet-backed Sunbird *Anthreptes neglectus* and Square-tailed Drongo *Dicrurus ludvigii*.

Forest birds at lower elevations and cold season movements

Several typically submontane and montane forest birds were resident at or above 500 m in the forest of both Kihansi and Udagaje gorges (Table 2). These included Mountain Buzzard *Buteo oreophilus*, Black Sparrowhawk *Accipiter melanoleucus*, White-chested Alethe *Alethe fuelleborni*, Sharpe's Akalat, African Hill Babbler *Pseudalcippe abyssinica*, Orange Ground Thrush *Zoothera gurneyi*, White-starred Robin *Pogonochila stellata*, Cabanis's Greenbul *Phyllastrephus cabanisi*, Shelley's Greenbul *Andropadus masukuensis*, Stripe-cheeked Greenbul, Yellow-throated Woodland Warbler *Phylloscopus ruficapilla*, Black-fronted Bushshrike *Malaconotus multicolor* and Red-faced Crimsonwing *Cryptospiza reichenowii*. The following species were only recorded below 700–750 m in the 1998 and 2001 cold seasons, but not the 1999 hot season: Olive Woodpecker *Dendropicos griseocephalus*, Moustached Green Tinkerbird *Pogoniulus leucomystax*, White-chested Alethe, White-starred Robin, White-winged Apalis, Bar-throated Apalis *Apalis thoracica*, Evergreen Forest Warbler *Bradypterus lopezi*, Grey Cuckoo-shrike *Coracina caesia*.

Other notable records

African Black Duck *Anas sparsa*

Numerous singles and pairs were seen above the dam site along the Kihansi River in February 1999 (1100 m), but it was rarely observed in the upper parts of the Kihansi gorge (800–1000 m). This species is generally noted from above 1800 m in the Udzungwas (Jensen & Brøgger-Jensen 1992).

African Finfoot *Podica senegalensis*

Quite commonly observed as singles or threes in rapids above the dam site on the Kihansi River. A total of about seven birds were seen on 26 February 1999, at 1100 m, along a 1 km stretch of river.

Eurasian Hobby *Falco subbuteo*

Approximately 40–50 of these raptors, together with other unidentified falcons, were observed on 26 February 1999. They were foraging on

swarming termite alates at dusk and late into the evening hours by the light of large work spotlights at the dam site.

Half-collared Kingfisher *Alcedo semitorquata*

This species was regularly encountered along all small streams and rivers below 600 m.

African Pygmy Kingfisher *Ispidina picta*

Regularly observed and/or netted in forest habitats in the cold seasons of 1998 and 2001, but also infrequently observed in the hot season of 1999.

Moustached Green Tinkerbird *Pogoniulus leucomystax*

There is only one previous record of this tinkerbird species occurring at low elevations, namely at 450 m in Kwenhondwe forest, West Usambaras (Stuart & Jensen 1981). To this we add our records of presumed cold seasonal movements down slope at Njerere FR.

Cliffchat *Thamnolea cinnamomeiventris*

A pair of these birds was seen courting in very rocky terrain at 350 m, at the base of Udagaje gorge in July 2001. This represents the lowest altitudinal record for the species in eastern Africa (lowest reported is 600 m, Britton 1980).

White-winged Apalis *Apalis chariessa*

At least two birds identified clearly in a large mixed species flock at Udagaje gorge on 14 June 1998. As it regularly occurs at 1000–1500 m in the Udzungwas, our record at 750 m is probably the lowest for this mountain range.

Uluguru Violet-backed Sunbird *Anthreptes neglectus*

Not uncommon in mixed species flocks at all elevations in Udagaje and Kihansi gorges.

Black-bellied Starling *Lamprotornis corrucus*

Four observed once only at 650 m in forest at Udagaje Gorge. There are few records of this species in the Udzungwa foothills (<http://tanzaniabirdatlas.com/atlas.htm>).

Discussion

Despite intense coverage of all six sites in the two gorges, mist-netting capture rates were much lower in Njerera FR than in other Eastern Arc forests at similar elevations. For example, Evans and Anderson (1992) report a capture rate of 130 birds per 10 000 nmh from similar elevations in Mtai Forest Reserve, East Usambaras, which was both considerably larger and wetter than Njerera. The low capture rates can be attributed to the drier forest floor in Njerera FR (where productivity is probably not very high), the small size of the two forests, steepness of terrain, and habitat disturbance. The latter was particularly noticeable in Udagaje gorge and the upper levels of Kihansi where fires have encroached on the forest in the past.

Few globally threatened or restricted-range species occurred in this reserve. Of those that did, all occurred at very low abundances as

judged from capture rates or frequency of encounters. Probably as a result of their low abundances, two such species (Uluguru Violet-backed Sunbird and Sharpe's Akalat) were missed by Rahner (1995) but were added by us in 1998 and consistently recorded thereafter. Low abundances of threatened and restricted-range species may be explained by the same factors as discussed above; specifically, poor habitat quality and small forest size (Newmark 2002). However, rarity of these species may be compounded by the fact that the forest is below their optimal altitudinal ranges in the Udzungwas (Table 1).

We found no differences in understory bird species composition and abundance between the Upper Kihansi forest and the *Filicium*-dominated patch. Our result differs from that of Fjelds  (1999), in which he found that disturbed habitats (in which *Filicium*-dominated forest is included) adjacent to primary forest in the Udzungwas held lower abundances of forest understory specialists, as well as some larger canopy insectivores. We found that the *Filicium* habitat at Kihansi seems to be important for most bird species, including a few forest-interior and understory species. While our data are too limited to assess the abundance of forest understory specialists in disturbed versus undisturbed tracts, the presence of mixed-species flocks in the upper canopy of *Filicium* trees at Kihansi is different to Fjelds 's (1999) study in which he noted that mixed-feeding parties were absent or very infrequent in disturbed habitats. Two flocking species, Square-tailed Drongo and Uluguru Violet-backed Sunbird, commonly foraged in this habitat in both seasons at Kihansi. It is possible that the proximity of *Filicium* forest to the mixed forest in Kihansi allowed forest specialists to 'spill over' and enrich this disturbed forest type in comparison to Fjelds 's study sites in which a broader array of disturbed vegetation types was sampled.

A notable feature of Njerera was the presence of typical submontane and montane birds resident at low abundances from 500 to 800 m. Lovett *et al.* (1997) found upper elevation trees, for example *Olea capensis*, *Allanblackia stuhlmannii* and *Cephalosphaera usambarensis*, in the Kihansi gorge and attributed this to the cool microclimate caused by spray from waterfalls. Elsewhere in the Eastern Arc, in the East Usambaras, moisture from the ocean is augmented by orographic rainfall and is therefore high at lower elevations, such that submontane trees and birds associated with this forest type occur lower down than is typical (Moreau 1966, Stuart 1983). Njerera FR is similar, except that orographic rainfall is augmented by mist from the large waterfalls, capturing sufficient moisture in the gorges to encourage growth of submontane and montane plants. The unique local climate could thus influence the presence of some submontane forest birds.

Small forest patches such as those in Njerera FR that form outliers along the Udzungwa scarp and other Eastern Arc Mountain ranges may maintain low abundances of forest birds due to their small size and

drier forest conditions, among other factors. Nonetheless, these forests are important as they could serve as potential stepping-stones for dispersal between larger patches, and as many are often in the adjacent lowlands, they could serve as important post-dispersal sites for montane species (Burgess & Mlingwa 2000). The presence of several submontane species in the cold but not the hot season, and the presence of these taxa below 700 m in the cold season only, indicates that low-lying forests like Njerera FR may be important cold season refuges. There are numerous such forests throughout the Eastern Arc Mountains that remain to be explored ornithologically, and we therefore recommend future workers to visit these remote patches in different seasons to evaluate what species occur there and whether or not they are important cold season refugia for highland birds.

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