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# Gonadosomatic index infers the breeding season of the House Crow *Corvus splendens* in Dar es Salaam, Tanzania

Eligi P. Kimario, Jasson R. John and Harishchandra B. Pratap

## Summary

The House Crow *Corvus splendens* is native to the Indian subcontinent but also has a broad invasive range which includes the coast of East Africa. House Crows (HC and HCs throughout this paper) were introduced in Zanzibar in the 1890s from where they later spread to mainland Tanzania. Their negative socioeconomic and ecological impacts have necessitated the instigation of population control programmes using avicides and trapping. Although knowledge on the reproductive biology of HCs, in particular the breeding status, is important for successful control programmes, little is known about it in Dar es Salaam. To establish the HC breeding status, a total of 83 female and 100 male birds were collected from August 2013 to July 2014 from traps operated by the Ministry of Natural Resources and Tourism population control programme. All birds were euthanized, dissected, and sex determined by gonad examination. The gonadosomatic index (GSI) was determined as the ratio of gonad weight upon total body weight. The GSI, which is an index of gonad development relative to the bird's sexual maturation, peaked from October to December suggesting that this period is the main breeding season. The HC population control could be intensified during the onset of gonad development when the demand for resources is high.

**Keywords** breeding season, gonadosomatic index, House Crow, Dar es Salaam

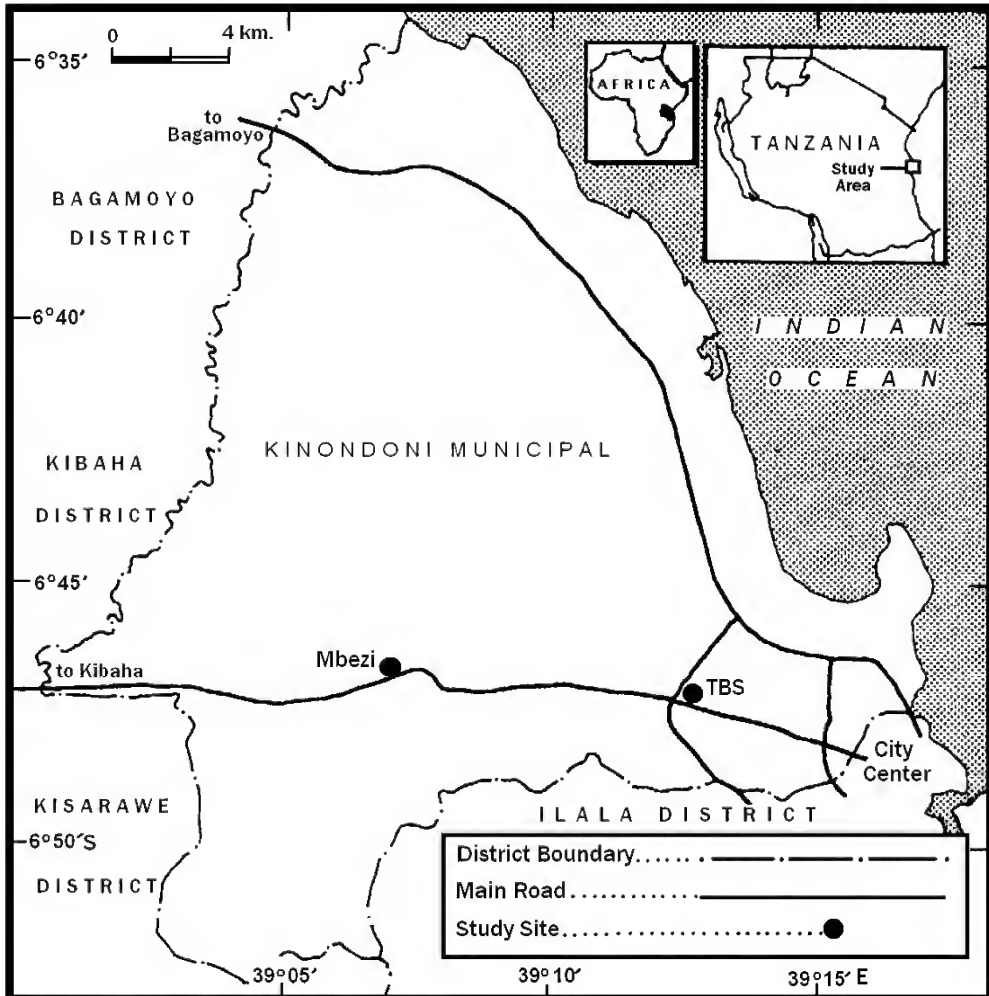
## Introduction

The House Crow *Corvus splendens* is considered to be one of the most intelligent and adaptable birds that exhibit complex social behaviour and is common around human dwellings (Koul & Sahi 2013). It is native to the Indian subcontinent including India, Myanmar, Nepal, Bangladesh and Sri Lanka (Puttoo & Archer 2003; Jackson & Cowburn 2011). House Crows (HCs) were introduced to Zanzibar Island (Tanzania) in 1890s (Finn 1893, Vaughan 1930). The population of HCs grew and spread along the East African coast (Cooper 1996, Jackson & Cowburn 2011). A more recent global assessment of HC spread is provided in Ryall (2016). The HC is considered as an invasive pest especially in its non-native range as it competes with native birds such as Pied Crow *Corvus albus*, Cattle Egret *Bubulcus ibis*, and destroys nests of many local birds. HCs are also known to peck out the eyes of newborn livestock (MNRT 2010). They are shown to be carriers of enteric pathogens including *Salmonella* and *Campylobacter*, and birds infected by Influenza A virus subtype H5N1, which is a human health hazard (Ryall & Meier 2008), have been found in the Far East. The presence of HCs near airports is a potential threat for a bird strike with aeroplanes, especially because of their erratic and unpredictable behaviour when roosting (Ryall & Meier

2008). Based on the ecological and socio-economic negative impacts, they have been subjected to control programmes in many countries including Tanzania, South Africa, Mauritius, Kenya, Yemen, and Singapore by trapping and poisoning using Starlicide DRC#1339 (Puttoo & Archer 2003, Ethekewini Municipality 2007, Ryall & Meier 2008, Suleiman & Taleb 2010). Although knowledge of the breeding cycle is essential for a successful control programme of many invasive species (Dhami 2009), little is known about the HC's breeding season. Understanding the onset of breeding periods allows a control programme to interrupt a pest species' breeding cycle. The development of gonads, quantified using gonadosomatic index (GSI), provides the duration of the breeding season (Williams 1967, Fox 2007). All other breeding behaviours such as pairing, copulation and nesting are triggered by physiological changes in the avian body, the onset of which can be studied by using gonad development indices. This method gives a peak breeding season beyond what is usually observed in the field. The objective of this study was to establish the breeding status of HC in Dar es Salaam using GSI, as an increase in GSI signifies the breeding season for many vertebrates (Williams 1967, Fox 2007).

## Materials and methods

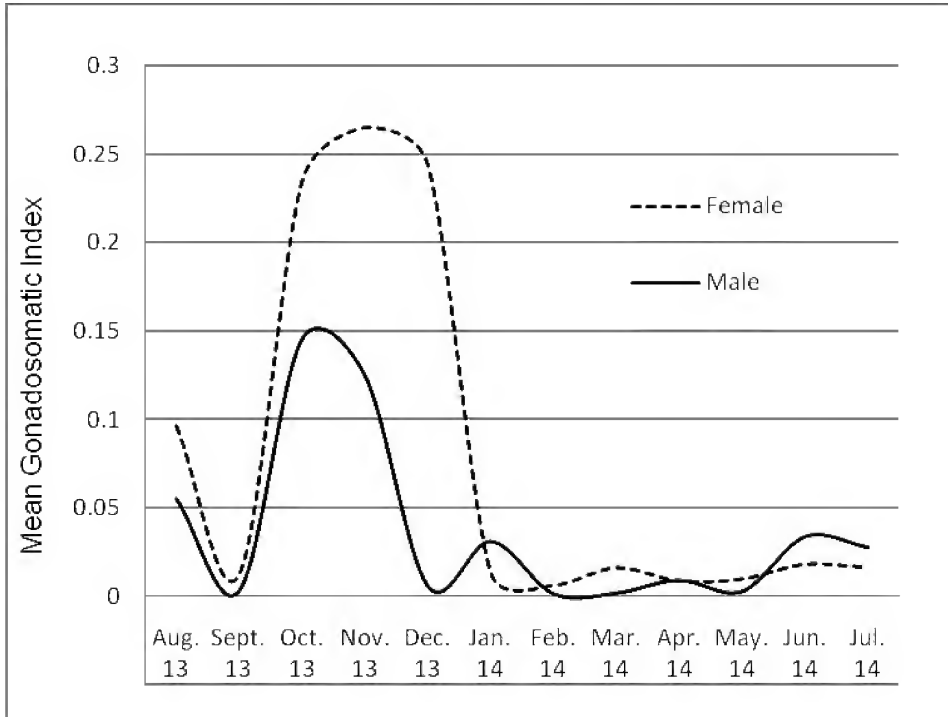
The study was conducted in Dar es Salaam city located (6°48'0'S, 39°17'0'E) on the Tanzanian coast. The study sites, with two traps each, were operated by the Wildlife Division of the Ministry of Natural Resources and Tourism and located at both the Tanzania Bureau of Standards (TBS) (Ubungu ward) and Mbezi Kimara (MK) (Mbezi ward), both located in Ubungu municipality, northwest of Dar es Salaam City (Fig. 1). TBS is both a roosting and foraging site while MK is predominantly a foraging area with ample food from slaughterhouse waste; the roosting sites are also in the same vicinity. Traps were baited with leftover foods and meat scraps and supplied with fresh water. Birds were collected from one of the two traps at MK or TBS alternately every week from August 2013 to July 2014 (note that this study was part of a larger ongoing initiative to control House Crows in Tanzania). Birds were removed from the trap before dawn to avoid deterring other crows. They were taken to the laboratory where they were euthanized by chloroform before dissection. The specimens were dissected using a procedure recommended by Friend and Franson (1999). All ethical guidelines of the University of Dar es Salaam were adhered to during the study. To establish sex, gonads were dissected and weighed separately on a digital balance (Mettler AE 100) to four decimal places. The GSI of adult males and females was used to measure sexual maturity in relation to gonad development. The GSI for each month were calculated by dividing the total gonad weight by total body weight (Fox 2007). Kruskal Wallis (K-W) test was used to compare sex specific GSI between months followed by a Mann-Whitney pair wise comparison test. All tests were two-tailed and factors were considered statistically significant at  $p < 0.05$ .



**Figure 1.** Map of Kinondoni Municipality showing trapping sites at Mbezi Kimara (MK) and Tanzania Bureau of Standards (TBS) in Dar es Salaam.

## Results

During the 12 months study period, sex-specific GSI for each month of 83 females and 100 males were calculated. The peak GSI for females was between October 2013 (GSI=0.235) to December 2013 (GSI=0.244) while for males it was between October 2013 (GSI=0.149) to November 2013 (GSI=0.125) (Fig. 2). These findings of high GSI suggest that the period from October to December is the main breeding period.



**Figure 2.** Gonadosomatic index (GSI) for male and female House crows for a one-year cycle from August 2013 to July 2014 in Dar es Salaam.

Over the period of one year, monthly female GSI varied and differed significantly ( $KW=42.34$ ,  $p<0.001$ ). The female mean GSI during the cold dry to short rainy season (June–December) was high ( $GSI=0.104$ ), while it was significantly lower ( $GSI=0.0083$ ) during the hot dry to long monsoon rainy season (January–May) (Mann-Whitney  $U$ -test,  $U=247$ ,  $p<0.001$ ).

The monthly GSI for males differed significantly during the study period ( $KW=29.21$ ,  $p=0.002$ ). Likewise, the mean GSI for males during the cold dry to short rainy season (June–December) was significantly higher ( $GSI=0.057$ ) compared to hot dry to long rainy season (January–May,  $GSI=0.009$ ) (Mann-Whitney  $U$ -test,  $U=579$ ,  $p<0.001$ ).

## Discussion

Animal breeding status can be followed using indices of reproductive development that are directly correlated with cellular and physiological changes occurring concurrently in gonads (Williams 1967). In fish, for example, an increase in GSI suggests spawning season and thereafter it decreases in spent fish (fish that have already spawned) (Fox 2007). Similarly, in birds, indices of reproductive development increase during the breeding season (Williams 1967). The HC GSI for both, females and males in this study differed significantly between different months indicating that HC has a defined breeding season. The wider window of GSI for females as compared to males can be explained by the fact that upon single insemination the sperm is stored in the oviduct tubes prior to egg laying. Thereafter, reproductive activities such as ovulation and fertilization continue to take place even after several weeks of

copulation or sperm insemination (Birkhead & Møller 1993). Therefore, copulation ceases while females are still fertile and eggs will be fertilized throughout the breeding season creating a time lag, which is reflected in the sex-differentiated GSI.

During the short rainy season, the period from October to December 2013, HCs had significantly higher GSI suggesting the main breeding season. This breeding season inferred from GSI overlaps with that reported in Mombasa (Kenya) where nesting activities peaked in November to December (Ryall 1990, Chongomwa 2011). This is likely because of similar climatic conditions as both Mombasa and Dar es Salaam are located on the East African coast. The HC's breeding season in Eastern Africa, including Dar es Salaam, differs from that of its native range. In its native range breeding mainly occurs from June to September during the dry cool season (Lamba 1963, Ali *et al.* 2007, Awais *et al.* 2015). Dry seasons are favourable for easy availability of nesting materials such as dry sticks, twigs and tree branches, which are common nesting materials (Behrouzi-Rad 2010).

Based on these findings, we recommend that HC population control activities especially poisoning and trapping be intensified during the onset of gonad development (Fig. 2) when the demand for resources, food in particular, is high. Trapping and poisoning during this period will be more effective because many HCs need to feed more when preparing for breeding, thus increasing the risks of being trapped or poisoned. Disruption of HCs' breeding will not only eradicate reproductively active birds, but greatly lower recruitment rates and thus control the total population over time.

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# Recent Survey of Birds in Gishwati Forest, Rwanda

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## Summary

We conducted a general avian survey in and around the Gishwati Forest of Rwanda's Gishwati-Mukura National Park between 6 June and 7 August 2019, using stationary point counts and opportunistic observations along approximately 300 km of transects and trails. Of the 155 bird species recorded, one is Critically Endangered (Hooded Vulture *Necrosyrtes monachus*), two are Endangered (Gray Crowned-Crane *Balearica regulorum* and Grauer's Swamp Warbler *Bradypterus graueri*), one is Vulnerable (Tawny Eagle *Aquila rapax*), and two are Near-Threatened (Mountain Buzzard *Buteo oreophilus* and Lagden's Bushshrike *Malaconotus lagdeni*). We recorded three Afrotropical migrants and 20 species endemic to the Albertine Rift (though two of these are only recognized at the subspecies level). Within this avian community, 41 species are forest specialists, 55 are forest generalists, and 25 are forest visitors.

**Keywords** conservation, Gishwati Forest, Gishwati-Mukura National Park, montane forest birds, Rwanda

## Introduction

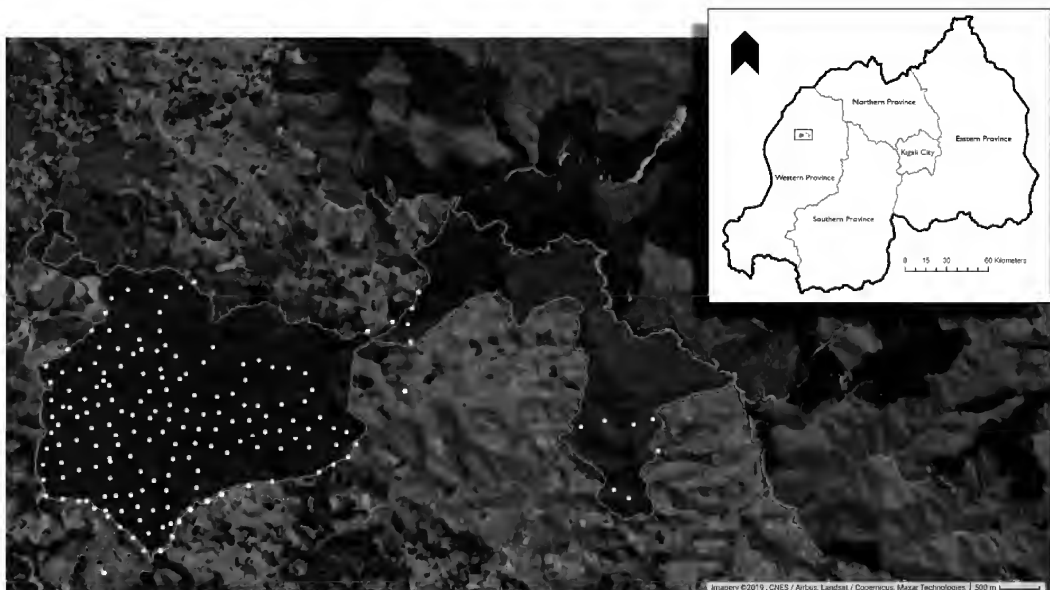
Gishwati Forest (01°49'S, 29°22'E; 2050–2610 m), in northwest Rwanda, is a secondary montane rainforest fragment that lies roughly between Volcanoes National Park to the north and Nyungwe Forest National Park to the south. The forest that included Gishwati in the early 1900s may have been as large as 100 000 ha, although this cannot be confirmed (REMA 2015). In 1984, the protected area that comprised Gishwati was 21 213 ha, but by 2015 it had suffered a 93% reduction in size to 1440 ha (REMA 2015). The majority of forest clearance occurred before 2010. There is now 1570 ha of Gishwati Forest that are gazetted as part of the newly formed Gishwati-Mukura National Park, declared in 2015, after having been a Forest Reserve since 1951 (REMA 2016). Gishwati Forest Reserve was previously an Important Bird Area but was later down-listed by BirdLife International after the area's vast habitat loss (Kanyamibwa 2001).

Vande weghe & Vande weghe (2011) recorded 190 resident species in this forest during observations that were made before 1986 (G. Vande weghe, pers. comm.), which provides the historical baseline for the Gishwati avifauna. This publication has since been updated by Vande weghe (2018), which lists the total avifauna recorded in Gishwati Forest, including migrants, as about 150. There have been other surveys of the birds of Gishwati in the last two decades, though most have never been published or were of short duration (see Nsabagasani & Nsengimana 2009, WCS unpub., Valle unpub., Tuyisingize unpub., REMA unpub.).

Our goal was to conduct a survey of the current avifauna of Gishwati Forest, to provide a much-needed contribution to our understanding of this forest under its present state, as well as the distribution of some endemic, rare, and poorly-known species. It is therefore not historically comprehensive. For example, there were 42 species documented in Vande weghe & Vande weghe (2011) that we did not find during our survey. Some of these may have been missed in the field, but others were likely extirpated by the profound habitat changes and fragmentation of this forest in the 1980s and 1990s. This work was part of a larger project to measure changes in species composition and to conduct a spatial analysis of the remnant avian diversity as it relates to distance from the edge of the park boundaries.

## Methods

Over the course of 40 field days, between 6 June and 7 August 2019, we conducted 180 point counts along approximately 300 km of transects and trails in Gishwati Forest, or within 1 km of its boundary (Fig. 1). This represented over 400h of direct and opportunistic observations while walking between points. After giving birds 60s to settle after our arrival at each point, we documented every individual bird heard or seen for 10min using binoculars and referencing Stevenson & Fanshawe (2002) as necessary. Points were spaced at least 200m apart. Over 86% of the points were surveyed more than once, and 54% of the points were surveyed thrice. We allocated more effort to the core area of relict forest than to the relatively newer and much more degraded habitat to the east, which is a much narrower band of protected area where impacts of edge effects would be more difficult to determine. Surveys were conducted between 06:00 (sunrise) and 12:30, and we delayed surveying during active rain, which rarely occurred.



**Figure 1.** Map of Gishwati forest showing surveyed points and the official Park boundary.

## Results

We detected a total of 155 species (Table 1), 20 of which are endemic to the Albertine Rift (BirdLife International 2019a). Signs of breeding (immature birds or nesting behaviour) were found for 15 species, and three species were intra-African migrants. Four species are on the IUCN Red List, and 2 other species are considered Near-Threatened (BirdLife International 2019b). According to the categorizations established by Bennun *et al.* (1996), 41 were forest specialists, 55 were forest generalists, and 25 were forest visitors, leaving 34 uncategorized species that typically were non-forest species—or were species not included in Bennun *et al.* (1996). In Table 1 we include a very rudimentary proxy of abundance based on how many days a given species was detected, which was of course biased by a given species' behaviour and habitat, as well as our sampling distribution, and as such these values should be considered a rough estimate.

**Table 1.** Bird species recorded in and around Gishwati Forest of Gishwati-Mukura National Park. The list follows Clements *et al.* (2019). R = resident, AM = Afrotropical migrant; B = signs of breeding recorded in this survey; ARE = Albertine Rift endemic; CR = Critically Endangered, E = Endangered, V = Vulnerable, NT = Near-Threatened; Abundance categories: Once = 1, Rare < 5, Uncommon < 10, Common > 10, Frequent > 20, Abundant > 30.

Common Name	Species Name	Status	Abundance
Handsome Francolin	<i>Pternistis nobilis</i>	R, B, ARE	Common
Scaly Francolin	<i>Pternistis squamatus</i>	R	Once
Rameron Pigeon	<i>Columba arquatrix</i>	R, B	Uncommon
Dusky Turtle-Dove	<i>Streptopelia lugens</i>	R	Rare
Red-eyed Dove	<i>Streptopelia semitorquata</i>	R	Uncommon
Blue-spotted Wood-Dove	<i>Turtur afer</i>	R	Once
Tambourine Dove	<i>Turtur tympanistria</i>	R	Rare
African Green-Pigeon	<i>Treron calvus</i>	R	Uncommon
Great Blue Turaco	<i>Corythaeola cristata</i>	R	Uncommon
Black-billed Turaco	<i>Tauraco schuettii</i>	R	Frequent
Rwenzori Turaco	<i>Ruwenzorornis johnstoni johnstoni</i>	R, ARE	Once
Blue-headed Coucal	<i>Centropus monachus</i>	R	Common
Blue Malkoha	<i>Ceuthmochares aereus</i>	R	Rare
Klaas's Cuckoo	<i>Chrysococcyx klaas</i>	R	Rare
African Emerald Cuckoo	<i>Chrysococcyx cupreus</i>	R	Uncommon
Barred Long-tailed Cuckoo	<i>Cercococcyx montanus</i>	R	Rare
Black Cuckoo	<i>Cuculus clamosus</i>	AM	Uncommon
Red-chested Cuckoo	<i>Cuculus solitarius</i>	AM	Abundant
Rwenzori Nightjar	<i>Caprimulgus ruwenzorii</i>	R, ARE subspecies	Rare
Square-tailed Nightjar	<i>Caprimulgus fossii</i>	R	Once
Little Swift	<i>Apus affinis</i>	R	Once
Red-chested Flufftail	<i>Sarothrura rufa</i>	R	Uncommon
Black Crane	<i>Zapornia flavirostra</i>	R, B	Rare
Gray Crowned-Crane	<i>Balearica regulorum</i>	R, E	Once
Black-headed Heron	<i>Ardea melanocephala</i>	R	Rare
Hadada Ibis	<i>Bostrychia hagedash</i>	R	Frequent
African Harrier-Hawk	<i>Polyboroides typus</i>	R	Once
Hooded Vulture	<i>Necrosyrtes monachus</i>	R, CE	Common
Tawny Eagle	<i>Aquila rapax</i>	R, V	Rare

Common Name	Species Name	Status	Abundance
African Goshawk	<i>Accipiter tachiro</i>	R	Rare
Black Goshawk	<i>Accipiter melanoleucus</i>	R	Rare
Black Kite (Yellow-billed)	<i>Milvus migrans parasitus</i>	R	Rare
Mountain Buzzard	<i>Buteo oreophilus</i>	R, NT	Uncommon
Augur Buzzard	<i>Buteo augur</i>	R	Common
Verreaux's Eagle-Owl	<i>Bubo lacteus</i>	R	Rare
Red-chested Owlet	<i>Glaucidium tephronotum</i>	R	Rare
African Wood-Owl	<i>Strix woodfordii</i>	R	Rare
Speckled Mousebird	<i>Colius striatus</i>	R	Rare
Narina Trogon	<i>Apaloderma narina</i>	R	Rare
Bar-tailed Trogon	<i>Apaloderma vittatum</i>	R	Once
White-headed Woodhoopoe	<i>Phoeniculus bollei</i>	R	Common
Crowned Hornbill	<i>Lophoceros alboterminatus</i>	R	Uncommon
Gray-headed Kingfisher	<i>Halcyon leucocephala</i>	R	Rare
Cinnamon-chested Bee-eater	<i>Merops oreobates</i>	R	Common
Yellow-rumped Tinkerbird	<i>Pogonius bilineatus</i>	R	Common
Lesser Honeyguide	<i>Indicator minor</i>	R	Rare
Scaly-throated Honeyguide	<i>Indicator variegatus</i>	R	Common
Elliot's Woodpecker	<i>Chloropicus elliotii</i>	R	Rare
Cardinal Woodpecker	<i>Chloropicus fuscescens</i>	R	Rare
Bearded Woodpecker	<i>Chloropicus namaquus</i>	R	Once
Olive Woodpecker	<i>Chloropicus griseocephalus</i>	R	Common
Tullberg's Woodpecker	<i>Campethera tullbergi taeniolaema</i>	R	Rare
Eurasian Kestrel	<i>Falco tinnunculus</i>	R	Once
Rwenzori Batis	<i>Batis diops</i>	R, ARE	Abundant
Chinspot Batis	<i>Batis molitor</i>	R	Abundant
Northern Puffback	<i>Dryoscopus gambensis</i>	R	Abundant
Lüdher's Bushshrike	<i>Laniarius luehderi</i>	R	Rare
Tropical Boubou	<i>Laniarius major</i>	R	Common
Willard's Sooty Boubou	<i>Laniarius willardi</i>	R	Once
Albertine Boubou	<i>Laniarius holomelas</i>	R	Abundant
Many-colored Bushshrike	<i>Telophorus multicolor</i>	R	Rare
Doherty's Bushshrike	<i>Telophorus dohertyi</i>	R	Abundant
Lagden's Bushshrike	<i>Malaconotus lagdeni</i>	R, NT	Rare
Gray Cuckooshrike	<i>Coracina caesia</i>	R	Common
Black Cuckooshrike	<i>Campephaga flava</i>	R	Rare
Mackinnon's Shrike	<i>Lanius mackinnoni</i>	R	Common
Northern Fiscal	<i>Lanius humeralis</i>	R	Rare
African Golden Oriole	<i>Oriolus auratus</i>	AM, B	Rare
Black-tailed Oriole	<i>Oriolus percivali</i>	R, B	Abundant
African Paradise-Flycatcher	<i>Terpsiphone viridis</i>	R	Abundant
Pied Crow	<i>Corvus albus</i>	R	Common
White-necked Raven	<i>Corvus albicollis</i>	R	Common
Rock Martin	<i>Ptyonoprogne fuligula</i>	R	Rare
Angola Swallow	<i>Hirundo angolensis</i>	R	Common
Red-rumped Swallow	<i>Cecropis daurica</i>	R	Uncommon
White-headed Sawwing	<i>Psalidoprocne albiceps</i>	R	Common
Black Sawwing	<i>Psalidoprocne pristopectera</i>	R	Frequent
White-tailed Blue Flycatcher	<i>Elminia albicauda</i>	R	Rare

Common Name	Species Name	Status	Abundance
Stripe-breasted Tit	<i>Melaniparus fasciiventer</i>	R, ARE	Uncommon
Eastern Mountain-Greenbul	<i>Arizelocichla nigriceps kikuyuensis</i>	R	Frequent
Yellow-whiskered Greenbul	<i>Eurillas latirostris</i>	R, B	Abundant
Yellow-streaked Greenbul	<i>Phyllastrephus flavostriatus</i>	R	Frequent
Common Bulbul (Dark-capped)	<i>Pycnonotus barbatus tricolor</i>	R	Abundant
White-browed Crombec	<i>Sylvietta leucophrys</i>	R	Frequent
Grauer's Warbler	<i>Graueria vittata</i>	R, ARE	Rare
Red-faced Woodland-Warbler	<i>Phylloscopus laetus</i>	R, ARE	Uncommon
African Yellow-Warbler	<i>Iduna natalensis</i>	R	Rare
Mountain Yellow-Warbler	<i>Iduna similis</i>	R	Frequent
African Reed Warbler	<i>Acrocephalus baeticatus</i>	R	Rare
Evergreen-Forest Warbler	<i>Bradypterus lopezi</i>	R	Frequent
Cinnamon Bracken-Warbler	<i>Bradypterus cinnamomeus</i>	R	Abundant
Grauer's Swamp Warbler	<i>Bradypterus graueri</i>	R, ARE, E	Uncommon
Rwenzori Apalis	<i>Oreolais ruwenzorii</i>	R, ARE	Abundant
Green-backed Camaroptera	<i>Camaroptera brachyura aschani</i>	R	Uncommon
Black-throated Apalis	<i>Apalis jacksoni</i>	R	Abundant
Black-faced Apalis	<i>Apalis personata</i>	R, B, ARE	Abundant
Chestnut-throated Apalis	<i>Apalis porphyrolaema</i>	R	Frequent
Banded Prinia	<i>Prinia bairdii</i>	R	Frequent
Black-faced Rufous-Warbler	<i>Bathmocercus rufus</i>	R, B	Abundant
Gray-capped Warbler	<i>Eminia lepida</i>	R	Uncommon
Chubb's Cisticola	<i>Cisticola chubbi</i>	R	Abundant
African Yellow White-eye	<i>Zosterops senegalensis</i>	R	Abundant
Rwenzori Hill Babbler	<i>Sylvia atriceps</i>	R	Abundant
Mountain Illadopsis	<i>Illadopsis pyrrhoptera</i>	R	Abundant
Gray-chested Babbler	<i>Kakamega poliothorax</i>	R	Frequent
Dusky-brown Flycatcher	<i>Muscicapa adusta</i>	R	Common
Yellow-eyed Black-Flycatcher	<i>Melaenornis ardesiacus</i>	R, ARE	Once
White-eyed Slaty-Flycatcher	<i>Melaenornis fischeri</i>	R, B	Common
Archer's Robin-Chat	<i>Cossypha archeri</i>	R, ARE	Abundant
Cape Robin-Chat	<i>Cossypha caffra</i>	R	Rare
White-browed Robin-Chat	<i>Cossypha heuglini</i>	R	Rare
Red-capped Robin-Chat	<i>Cossypha natalensis</i>	R	Rare
White-starred Robin	<i>Pogonocichla stellata</i>	R, B	Abundant
Red-throated Alethe	<i>Chamaetylas poliophrys</i>	R, ARE	Frequent
Equatorial Akalat	<i>Sheppardia aequatorialis</i>	R	Rare
African Stonechat	<i>Saxicola torquatus</i>	R	Common
Abyssinian Ground-Thrush	<i>Geokichla piaggiae tanganjicae</i>	R, ARE subspecies	Once
Abyssinian Thrush	<i>Turdus abyssinicus</i>	R	Common
Slender-billed Starling	<i>Onychognathus tenuirostris</i>	R	Common
Waller's Starling	<i>Onychognathus walleri</i>	R	Uncommon
Sharpe's Starling	<i>Pholia sharpii</i>	R	Rare
Stuhlmann's Starling	<i>Poeoptera stuhlmanni</i>	R	Uncommon
Collared Sunbird	<i>Hedydipna collaris</i>	R, B	Frequent
Green-headed Sunbird	<i>Cyanomitra verticalis</i>	R, B	Common
Blue-headed Sunbird	<i>Cyanomitra alinae</i>	R, B, ARE	Frequent
Olive Sunbird	<i>Cyanomitra olivacea</i>	R	Common
Scarlet-chested Sunbird	<i>Chalcomitra senegalensis</i>	R	Once

Common Name	Species Name	Status	Abundance
Purple-breasted Sunbird	<i>Nectarinia purpureiventris</i>	R, B, ARE	Common
Bronze Sunbird	<i>Nectarinia kilimensis</i>	R	Uncommon
Malachite Sunbird	<i>Nectarinia famosa</i>	R	Once
Stuhlmann's Sunbird	<i>Cinnyris stuhlmanni</i>	R, ARE	Uncommon
Northern Double-collared Sunbird	<i>Cinnyris reichenowi</i>	R	Frequent
Regal Sunbird	<i>Cinnyris regius</i>	R, ARE	Frequent
Variable Sunbird	<i>Cinnyris venustus</i>	R, B	Common
Cape Wagtail	<i>Motacilla capensis</i>	R	Uncommon
Mountain Wagtail	<i>Motacilla clara</i>	R	Once
African Pied Wagtail	<i>Motacilla aguimp</i>	R	Rare
African Pipit	<i>Anthus cinnamomeus</i>	R	Uncommon
Yellow-fronted Canary	<i>Crithagra mozambica</i>	R	Rare
Western Citril	<i>Crithagra frontalis</i>	R	Rare
Streaky Seedeater	<i>Crithagra striolata</i>	R	Common
Thick-billed Seedeater	<i>Crithagra burtoni</i>	R	Uncommon
Yellow-crowned Canary	<i>Serinus flavivertex</i>	R	Uncommon
Golden-breasted Bunting	<i>Emberiza flaviventris</i>	R	Rare
Baglafaecht Weaver	<i>Ploceus baglafaecht</i>	R	Common
Strange Weaver	<i>Ploceus alienus</i>	R, B, ARE	Frequent
Holub's Golden Weaver	<i>Ploceus xanthops</i>	R	Once
Brown-capped Weaver	<i>Ploceus insignis</i>	R	Once
Yellow-bellied Waxbill	<i>Coccyzygia quartinia</i>	R	Uncommon
Dusky Crimsonwing	<i>Cryptospiza jacksoni</i>	R, ARE	Uncommon
Fawn-breasted Waxbill	<i>Estrilda paludicola</i>	R	Rare
Crimson-rumped Waxbill	<i>Estrilda rhodopyga</i>	R	Once
Common Waxbill	<i>Estrilda astrild</i>	R	Uncommon
Black-crowned Waxbill	<i>Estrilda nonnula</i>	R	Uncommon
Kandt's Waxbill	<i>Estrilda kandti</i>	R, B	Common

## Discussion

We are fairly confident that we detected a significant majority of the birds that were present during our limited field season. It is possible that certain species were consistently silent or cryptic during our field season, which had aberrant rainfall. Anecdotally, the rainy season appeared to be delayed for much of Rwanda in 2019; Shinehouse Gishwati Research Station recorded only about 5680 mm of rain between 1 January and 31 May 2019, compared to the previous 3-year average of 9050 mm (R. Chancellor & A. Rundus, pers. comm.).

We identified ten species that had never previously been reported in Gishwati: African Reed Warbler *Acrocephalus baeticatus*, Crimson-rumped Waxbill *Estrilda rhodopyga*, Yellow-fronted Canary *Crithagra mozambica*, Grauer's Swamp Warbler *Bradypterus graueri*, Gray-headed Kingfisher *Halcyon leucocephala*, Many-colored Bushshrike *Telophorus multicolor*, Olive Sunbird *Cyanomitra olivacea*, Red-chested Flufftail *Sarothrura rufa*, Verreaux's Eagle-Owl *Bubo lacteus*, and Willard's Sooty Boubou *Laniarius willardi*—CN saw this species briefly once, and G. Vande weghe may have seen it in 2017 (REMA unpub.), but efforts should be made to photograph the species in Gishwati given its range restrictions in the Albertine Rift (see Voelker *et al.* 2010).

In contrast, we failed to find over 30 resident species previously reported during the last twenty years. This could be due to birds' behaviour or movements that are impossible to quantify, as well as to potential transcription or identification errors by previous surveys. As our survey dates did not include the Palearctic migration, we undoubtedly missed species that are frequent visitors to Gishwati at other times of the year. Nevertheless, it is surprising that one species reported for the first time, Grauer's Swamp Warbler, is both endangered and an Albertine Rift endemic, which makes it a target species sought by expert birders and ornithologists alike (for some history on this species in Rwanda, see Vande weghe 1983). We recorded four individuals by sight on two occasions and detected this species on five different days during the course of our survey. All observations were in the swampy section of the park where the Pfunda River flows out to the northwest (roughly 2050 masl), which is also where Willard's Sooty Boubou was observed. Perhaps these few individuals are new visitors to Gishwati Forest given habitat loss elsewhere; this swampy section should be monitored more closely. Another Albertine Rift endemic with the same namesake, Grauer's Warbler (*Graueria vittata*), had only been reported twice previously, once in 1990 by Robert Dowsett (R. Dowsett, pers. comm.), and again in 2004 by WCS surveyors (WCS unpub.); we heard it on four separate days. Similarly, our four observations of Elliot's Woodpecker *Chloropicus elliotii* are only matched by the 2004 WCS survey (unpub.), and our four observations of Lüdher's Bushshrike *Laniarius luehderi* are only matched by Dowsett's 1990 visit to Gishwati (pers. comm.), indicating that there may be fluctuations in species presence, and more methodical visits to the Forest will be valuable.

## Conclusion

While we conducted our research at a time suitable to assess resident species of Gishwati Forest, the brevity of our effort leaves other important times of the calendar year unsurveyed. It is imperative to survey at all times to document passage migrants that may use this habitat, as well as other seasonal visitors from elsewhere in Africa or further afield. We encourage further study during the winter months of the northern hemisphere, as well as more targeted and published ornithological surveys in Rwanda. In particular, monitoring the arm of the Park that bends out to the east, known as Nduruma and Kinyenkanda, would be worthwhile, as this includes both the highest elevation of the protected area, as well as the narrowest band of the contiguous forest cover. This region is being actively restored and reforested (World Bank 2019), and therefore might come to host a different suite of bird species in the future. We believe that reassessing the Gishwati Forest component of Gishwati-Mukura National Park under the criteria for the newer IUCN Key Biodiversity Area system might be worthwhile, given the number of endemic and Red-listed species found here. In addition to the birds above, Gishwati Forest is also home to chimpanzees *Pan troglodytes*, Endangered, golden monkeys *Cercopithecus mitis kandti*, Endangered, Great Lakes bush vipers *Atheris nitschei*, Albertine Rift endemic, and other species that display the conservation utility of this protected area as an island of biodiversity in the middle of a heavily human-altered landscape of cattle pasture and agriculture (REMA unpub.).

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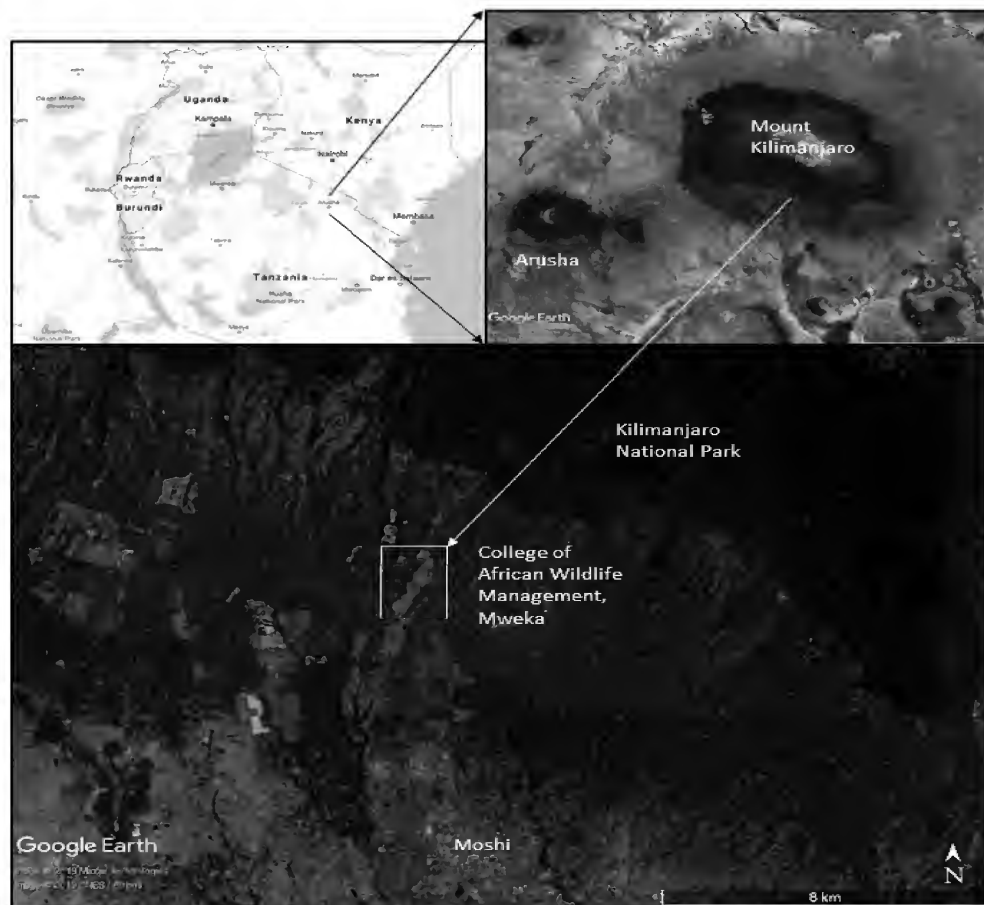
## Short communications

### Birds of the College of African Wildlife Management, Mweka, Tanzania

The College of African Wildlife Management, Mweka (often simply 'Mweka College'; hereafter 'Mweka') has been an important institution for training wildlife and tourism professionals since the early 1960s. Many students get their first introduction to formal ornithology at Mweka. The objective of this paper is to serve this constituency with a description of the avifauna of the site. The list should also be useful to residents of the area and the many ecotourists who visit Kilimanjaro via Mweka.

Mweka lies on the south slope of Mount Kilimanjaro at about 1400 m elevation (3°14'S, 37°19'E, Fig. 1). The site receives about 1700 mm of annual rainfall, and has a mean temperature of 18.7°C (<https://en.climate-data.org/africa/tanzania/kilimanjaro/mweka-205889/#temperature-graph>). The Mweka entrance to Kilimanjaro National Park (KNP) is about 2.5 km north of campus at 1650 m elevation. Forest is protected within KNP, and this montane forest once extended to Mweka. Presently, forest patches persist mostly on steeper slopes. Land use around the Mweka campus includes an adjacent village to the north, small *shambas* (mixed agriculture with bananas, coffee, maize, and vegetables), several larger maize fields and pastures, and coffee agriculture. The largest stream in the area runs along the west border of campus, eventually connecting to the Karanga River. A small swampy area east of campus provided the only standing water within the study area in 2014–2015. In addition to the main road from Moshi to KNP, a network of footpaths provides access beyond campus.

Data presented here derive mainly from observations submitted to eBird ([www.ebird.org](http://www.ebird.org)), with about 80% of the observations during my residency at the college from August 2014 to July 2015. Most observations were from unstructured walks within <1 km from campus. We also mist netted birds on campus several times throughout the year. I compiled all observations through December 2019. These eBird data, including photographs and audio recordings, can be viewed at the eBird hotspot for the College of African Wildlife Management (<https://ebird.org/hotspot/L3028880>). Two other bird lists from Mweka were also considered (Hassan *et al.* 1997, Wambura 2009), as were unpublished observations contributed by Norbert Cordeiro. Data from a variety of sources are aggregated at the Global Biodiversity Information Facility (GBIF; [www.GBIF.org](http://www.GBIF.org)) and VertNet ([www.vertnet.org](http://www.vertnet.org)), from which I gleaned additional records. Stefan Ferger's contributions to GBIF were especially useful.



**Figure 1.** The College of African Wildlife Management, in the village of Mweka, north of Moshi, Tanzania. Protected forest at the border of Kilimanjaro National Park (KNP) appears dark green. The road from Moshi to KNP passes through campus and enters KNP at the Mweka Gate.

Codes in the list (Table 1) provide details for each species. Families, common names, and scientific names follow the International Ornithological Community World Bird Names 9.2 checklist (Gill & Donsker 2019). Taxonomy and family sequences have changed considerably since publication of Stevenson & Fanshawe (2006), the most important field guide for the region. Abundance, habitat, and sociality codes refer to the range of habitats within about 1 km of campus. Abundant species (a) are likely to be found on campus on most outings. Common species (c) can be found regularly, but might occur in more specialized habitat or at a particular time of year. Uncommon species (u) have multiple records, and may pass through in significant numbers, but are not regularly found even in the appropriate habitat or season. Rare species (r) have few records, probably representing mostly wanderers or migrants. Casual or historical species (x) have only historical records or a single recent record in eBird. I used summary resources to assign movement patterns and elevational affinities (e.g., Moreau & Sclater 1935, Moreau & Moreau 1939, Lamprey 1965, Britton 1980, Cordero 1994, Zimmerman *et al.* 1996, Dulle *et al.* 2016, Baker 2019). Elevational affinity

indicates species that are at the high or low end of their elevational range at Mweka, based mostly on distribution in the Kilimanjaro region. In general, species with lower affinities do not occur in montane forest, and species with higher affinities are mostly found in montane forest or other montane systems.

Across all data available, 202 species have been recorded at Mweka (Table 1). These include 20 abundant resident species, 45 additional common species, and 67 uncommon and rare species. The 70 casual or historical species (abundance code x) should be viewed as tentative, as most of these have no documentation. The previous lists included some obvious misidentifications that I removed, but there may be identification errors, especially for difficult groups such as *Coturnix* spp. or *Euplectes* spp. in basic plumage. Regardless of their veracity, species with abundance code x are probably not part of the regularly occurring avifauna of Mweka.

**Table 1.** Birds recorded at the College of African Wildlife Management, Mweka, Tanzania. Plate refers to the plate in Stevenson & Fanshawe (2006). Abundance codes: a=abundant; c=common; u=uncommon; r=rare; x=casual or historical. Habitat codes: a=agriculture; c=campus; f=forest; o=overhead; s=forest streams; w=standing water. Elevational affinities: h=higher elevation; l=lower elevation. Migration: a=Intra-African; pp=Palearctic passage migrants; pw=Palearctic winter residents; Sociality: s=small single-species flocks; ss=large single-species flocks; m=mixed-species flocks. See text for more details on classifications.

English name	Scientific name	Plate	Abundance	Habitat	Elevation	Migration	Sociality
<b>Phasianidae</b>							
Scaly Francolin	<i>Pternistis (Francolinus) squamatus</i>	47	x	f,a	h		s
Hildebrandt's Francolin	<i>Pternistis (Francolinus) hildebrandti</i>	49	c	a			s
Common Quail	<i>Coturnix coturnix</i>	51	x	a	h		
Harlequin Quail	<i>Coturnix delegorguei</i>	51	x	a			
<b>Apodidae</b>							
Scarce Swift	<i>Schoutedenapus myoptilus</i>	109	r	o	h		s,m
African Palm Swift	<i>Cypsiurus parvus</i>	109	c	o	l		s
Alpine Swift	<i>Tachymarptis (Apus) melba</i>	107	r	o	h		s,m
Mottled Swift	<i>Tachymarptis (Apus) aequatorialis</i>	107	r	o			s,ss,m
Common Swift	<i>Apus apus</i>	108	x	o		pp,pw	s,ss,m
Nyanza Swift	<i>Apus niansae</i>	108	x	o			s,ss,m
Little Swift	<i>Apus affinis</i>	107	u	o			ss,m
White-rumped Swift	<i>Apus caffer</i>	107	r	o		a?	s,m
<b>Musophagidae</b>							
Hartlaub's Turaco	<i>Tauraco hartlaubi</i>	92	c	f,s	h		
<b>Otididae</b>							
Black-bellied Bustard	<i>Lissotis (Eupodotis) melanogaster</i>	58	x	a			
<b>Cuculidae</b>							
White-browed Coucal	<i>Centropus superciliosus</i>	98	c	f,c,a			
Green Malkoha	<i>Ceuthmochares australis</i>	97	x	f,c,a	l	a?	
Levaillant's Cuckoo	<i>Clamator (Oxylophus) levaillantii</i>	94	r	f,c		a	
Diederik Cuckoo	<i>Chrysococcyx caprius</i>	97	c	f,c	l		
Klaas's Cuckoo	<i>Chrysococcyx klaas</i>	97	c	f,c			
African Emerald Cuckoo	<i>Chrysococcyx cupreus</i>	97	c	f,c	l		
Black Cuckoo	<i>Cuculus clamosus</i>	96	x	f,c	l	a	

English name	Scientific name	Plate	Abundance	Habitat	Elevation	Migration	Sociality
Red-chested Cuckoo	<i>Cuculus solitarius</i>	96	c	f,c		a?	
<b>Columbidae</b>							
Speckled Pigeon	<i>Columba guinea</i>	84	x	c			s
African Olive Pigeon	<i>Columba arquatrix</i>	84	c	f,c,a	h		ss
Eastern Bronze-naped Pigeon	<i>Columba delegorguei</i>	83	x	f	h		s
Lemon Dove	<i>Columba (Aplopelia) larvata</i>	87	x	f	h		
Red-eyed Dove	<i>Streptopelia semitorquata</i>	86	a	c,a			
Ring-necked Dove	<i>Streptopelia capicola</i>	86	r	a,c	l		s,ss
Emerald-spotted Wood-Dove	<i>Turtur chalcospilos</i>	85	u	f,c,a	l		
Blue-spotted Wood-Dove	<i>Turtur afer</i>	85	x	f,c,a	l		
Tambourine Dove	<i>Turtur tympanistria</i>	85	c	f,c,a			
African Green-Pigeon	<i>Treron calvus</i>	83	c	f,c			ss
<b>Rallidae</b>							
African Crake	<i>Crex egregia</i>	53	x	a,w	l	a	
Black Crake	<i>Amaurornis (Zapornia) flavirostra</i>	54	x	w,a			
<b>Turnicidae</b>							
Common Buttonquail	<i>Turnix sylvaticus</i>	51	x	a	l		
<b>Ciconiidae</b>							
Abdim's Stork	<i>Ciconia abdimii</i>	14	x	a	l	a	ss
White Stork	<i>Ciconia ciconia</i>	13	x	a	h	pp,pw	ss
Marabou Stork	<i>Leptoptilos crumenifer</i>	15	x	c,a	l		s,ss
<b>Threskiornithidae</b>							
African Sacred Ibis	<i>Threskiornis aethiopicus</i>	16	r	a,o	l		s,ss
Hadada Ibis	<i>Bostrychia hagedash</i>	16	a	a,c,f,s			s
<b>Ardeidae</b>							
Grey Heron	<i>Ardea cinerea</i>	12	x	w,s			
Black-headed Heron	<i>Ardea melanocephala</i>	12	u	a,w			
<b>Scopidae</b>							
Hamerkop	<i>Scopus umbretta</i>	13	c	w,s			
<b>Accipitridae</b>							
Black-winged Kite	<i>Elanus caeruleus</i>	24	x	a			
African Harrier-Hawk	<i>Polyboroides typus</i>	34	r	a,f			
Palm-nut Vulture	<i>Gypohierax angolensis</i>	25	r	f,s,o	l		
Crowned Eagle	<i>Stephanoaetus coronatus</i>	40	r	f,o			
Long-crested Eagle	<i>Lophaetus occipitalis</i>	39	x	a,f,c			
Wahlberg's Eagle	<i>Hieraaetus (Aquila) wahlbergi</i>	36	r	c,f	l	a	
African Hawk-Eagle	<i>Aquila (Hieraaetus) spilogaster</i>	38	x	a,f,o	l		
Lizard Buzzard	<i>Kaupifalco monogrammicus</i>	30	r	c,a,f	l		
African Goshawk	<i>Accipiter tachiro</i>	32	u	f,c,a			
Little Sparrowhawk	<i>Accipiter minullus</i>	33	u	f,c			
Rufous-breasted Sparrowhawk	<i>Accipiter rufiventris</i>	32	x	f,c	h		
Black Sparrowhawk	<i>Accipiter melanoleucus</i>	33	u	f,c			
Black Kite	<i>Milvus migrans</i>	24	r	c,a,o	l	pw?	
Common Buzzard	<i>Buteo buteo</i>	35	r	o,a,f		pp,pw	s
Mountain Buzzard	<i>Buteo oreophilus</i>	30	x	o,f	h		
Augur Buzzard	<i>Buteo augur</i>	35	c	c,f,a			

English name	Scientific name	Plate	Abundance	Habitat	Elevation	Migration	Sociality
<b>Tytonidae</b>							
Western Barn Owl	<i>Tyto alba</i>	99	x	c,a,f			
<b>Strigidae</b>							
Spotted Eagle-Owl	<i>Bubo africanus</i>	101	x	c,f,a			
Verreaux's Eagle-Owl	<i>Bubo lacteus</i>	101	x	c,f			
African Wood Owl	<i>Strix woodfordii</i>	99	r	f,c			
Pearl-spotted Owlet	<i>Glaucidium perlatum</i>	102	x	a,c			
<b>Coliidae</b>							
Speckled Mousebird	<i>Colius striatus</i>	110	a	c,a			ss
<b>Upupidae</b>							
Eurasian Hoopoe	<i>Upupa epops</i>	120	x	a	l	pw?	
<b>Phoeniculidae</b>							
Green Wood Hoopoe	<i>Phoeniculus purpureus</i>	119	x	f,c			s
<b>Bucorvidae</b>							
Southern Ground Hornbill	<i>Bucorvus leadbeateri</i>	125	x	a	l		s
<b>Bucerotidae</b>							
Crowned Hornbill	<i>Lophoceros (Tockus) alboterminatus</i>	122	c	c,f,a			s
Silvery-cheeked Hornbill	<i>Bycanistes brevis</i>	124	a	c,f			s
<b>Coraciidae</b>							
European Roller	<i>Coracias garrulus</i>	118	r	a,c	l	pp,pw	s
Broad-billed Roller	<i>Eurystomus glaucurus</i>	117	x	a,c,f	l	a	
<b>Alcedinidae</b>							
Grey-headed Kingfisher	<i>Halcyon leucocephala</i>	111	r	c,f,a		a?	
Brown-hooded Kingfisher	<i>Halcyon albiventris</i>	111	c	c,f,s,a	l		
Striped Kingfisher	<i>Halcyon chelicuti</i>	111	x	a,c			
African Pygmy Kingfisher	<i>Ispidina picta</i>	113	r	a,f	l	a?	
Malachite Kingfisher	<i>Corythornis (Alcedo) cristatus</i>	113	x	s,w			
Giant Kingfisher	<i>Megaceryle maxima</i>	111	x	s,w			
<b>Meropidae</b>							
Little Bee-eater	<i>Merops pusillus</i>	114	x	a			
Cinnamon-chested Bee-eater	<i>Merops oreobates</i>	114	u	f,c	h		s
Olive Bee-eater	<i>Merops superciliosus</i>	116	x	o	l	a	s,ss
European Bee-eater	<i>Merops apiaster</i>	116	u	o		pp,pw	ss
<b>Lybiidae</b>							
White-eared Barbet	<i>Stactolaema leucotis</i>	127	c	c,f	l		s
Moustached Tinkerbird	<i>Pogoniulus leucomystax</i>	127	r	f,c	h		
Spot-flanked Barbet	<i>Tricholaema lacrymosa</i>	128	x	a,f,c	l		s
Brown-breasted Barbet	<i>Lybius melanopterus</i>	129	c	c,f	l		s
<b>Indicatoridae</b>							
Green-backed Honeybird	<i>Prodotiscus zambesiae</i>	134	u	c,f	l		
Pallid Honeyguide	<i>Indicator meliphilus</i>	133	u	f,c			
Scaly-throated Honeyguide	<i>Indicator variegatus</i>	132	r	f,c,a			m
Greater Honeyguide	<i>Indicator indicator</i>	132	x	c,a,f			
<b>Picidae</b>							
Nubian Woodpecker	<i>Campethera nubica</i>	136	x	a,c,f			
Golden-tailed Woodpecker	<i>Campethera abingoni</i>	136	c	f,c			
Bearded Woodpecker	<i>Chloropicus (Dendropicus) namaquus</i>	138	x	f,c			

English name	Scientific name	Plate	Abundance	Habitat	Elevation	Migration	Sociality
Cardinal Woodpecker	<i>Dendropicus (Chloropicos) fuscescens</i>	137	r	c,a,f			
Eastern Grey Woodpecker	<i>Dendropicos spodocephalus</i>	138	u	c,f,a			
<b>Falconidae</b>							
African Hobby	<i>Falco cuvierii</i>	43	x	f,c,a		a?	
<b>Platysteiridae</b>							
Chin-spot Batis	<i>Batis molitor</i>	209	c	c,f			s
Black-throated Wattle-eye	<i>Platysteira peltata</i>	211	x	c,f			m
<b>Malaconotidae</b>							
Grey-headed Bushshrike	<i>Malaconotus blanchoti</i>	238	x	f,c,a	l		
Orange-breasted Bushshrike	<i>Chlorophoneus (Malaconotus, Teleophorus) sulfureopectus</i>	238	x	c,a,f			m
Brown-crowned Tchagra	<i>Tchagra australis</i>	237	c	a,c			
Black-backed Puffback	<i>Dryoscopus cubla</i>	236	a	c,a,f			m
Tropical Boubou	<i>Laniarius major</i>	234	a	c,a,f			m
<b>Vangidae</b>							
White-crested Helmetshrike	<i>Prionops plumatus</i>	240	x	c,a			
<b>Campephagidae</b>							
Black Cuckooshrike	<i>Campephaga flava</i>	154	r	c,a,f	l	a?	m
<b>Laniidae</b>							
Red-backed Shrike	<i>Lanius collurio</i>	233	u	a		pp,pw	s
Lesser Grey Shrike	<i>Lanius minor</i>	232	r	a		pp	s
Northern Fiscal	<i>Lanius humeralis</i>	231	a	c,a			
<b>Oriolidae</b>							
African Golden Oriole	<i>Oriolus auratus</i>	244	x	f,c	l	a	m
Black-headed Oriole	<i>Oriolus larvatus</i>	243	u	f,c			m
<b>Monarchidae</b>							
African Paradise Flycatcher	<i>Terpsiphone viridis</i>	212	c	c,f,a			m
<b>Corvidae</b>							
Pied Crow	<i>Corvus albus</i>	242	a	c,a,f			s
White-necked Raven	<i>Corvus albicollis</i>	242	r	f,c,o	h		s
<b>Pycnonotidae</b>							
Dark-capped Bulbul	<i>Pycnonotus tricolor</i>	156	a	c,a,f			s,m
Mountain Greenbul	<i>Arizelocichla (Andropadus) nigriceps</i>	156	r	f,s	h		m
Stripe-faced Greenbul	<i>Arizelocichla striifacies</i>	157	r	f,s	h		m
Little Greenbul	<i>Eurillas (Andropadus) virens</i>	156	c	f,s	l		
Cabanis's Greenbul	<i>Phyllastrephus cabanisi</i>	159	r	f,s	h		s,m
<b>Hirundinidae</b>							
Black Saw-wing	<i>Psalidoprocne pristoptera</i>	148	c	c,f,a	h		s
Banded Martin	<i>Riparia cincta</i>	145	x	a,o			s
Barn Swallow	<i>Hirundo rustica</i>	147	r	c,a,o		pp,pp	ss,m
Wire-tailed Swallow	<i>Hirundo smithii</i>	147	r	c,a,o			s
Rock Martin	<i>Ptyonoprogne (Hirundo) fuligula</i>	145	c	c,f,a,o	h		s
Common House Martin	<i>Delichon urbicum</i>	145	x	o		pp,pw	s,ss,m
Lesser Striped Swallow	<i>Cecropis (Hirundo) abyssinica</i>	146	c	c,a			s
Mosque Swallow	<i>Cecropis (Hirundo) senegalensis</i>	146	r	o			s
Red-rumped Swallow	<i>Cecropis (Hirundo) daurica</i>	146	r	c,a	h		s

English name	Scientific name	Plate	Abundance	Habitat	Elevation	Migration	Sociality
<b>Phylloscopidae</b>							
Willow Warbler	<i>Phylloscopus trochilus</i>	184	c	c,f,a		pw,pp	m
Brown Woodland Warbler	<i>Phylloscopus umbrovirens</i>	185	u	f,c,a	h		m
<b>Acrocephalidae</b>							
Marsh Warbler	<i>Acrocephalus palustris</i>	179	r	c,a,w		pp	
Mountain Yellow Warbler	<i>Iduna (Chloroptera) similis</i>	178	x	c,f	h		
Eastern Olivaceous Warbler	<i>Iduna (Hippolais) pallida</i>	182	x	c,a	l	pw	
<b>Locustellidae</b>							
River Warbler	<i>Locustella fluviatilis</i>	180	x	s		pw,pp	
Evergreen Forest Warbler	<i>Bradypterus lopezi</i>	181	x	f	h		
<b>Cisticolidae</b>							
Tawny-flanked Prinia	<i>Prinia subflava</i>	198	a	c,a,f			s
Yellow-breasted Apalis	<i>Apalis flavida</i>	200	c	c,f,a			m
Black-headed Apalis	<i>Apalis melanocephala</i>	201	x	f,c			m
Green-backed Camaroptera	<i>Camaroptera brachyura</i>	199	a	c,a,f			m
<b>Leiotherichidae</b>							
Arrow-marked Babbler	<i>Turdoides jardineii</i>	216	c	a,c,f			s
<b>Sylviidae</b>							
African Hill Babbler	<i>Sylvia (Pseudoalcippe) abyssinica</i>	215	r	f,s	h		m
Eurasian Blackcap	<i>Sylvia atricapilla</i>	183	c	c,a,f	h	pw,pp	m,s
Garden Warbler	<i>Sylvia borin</i>	183	c	c,a,f		pw,pp	m,s
Common Whitethroat	<i>Sylvia communis</i>	183	c	c,a,f		pw,pp	m,s
<b>Zosteropidae</b>							
Pale White-eye	<i>Zosterops flavilateralis</i>	220	x	c,f,a	l		s
Broad-ringed White-eye	<i>Zosterops eurycricotus</i>	220	r	c,f,a	h		s,m
<b>Sturnidae</b>							
Violet-backed Starling	<i>Cinnyricinclus leucogaster</i>	249	a	c,f			ss
Red-winged Starling	<i>Onychognathus morio</i>	246	a	c,f			s
Waller's Starling	<i>Onychognathus walleri</i>	246	r	c,f	h		s
Kenrick's Starling	<i>Poeoptera kenricki</i>	245	c	c,f	h		s,m
<b>Turdidae</b>							
Abyssinian Thrush	<i>Turdus abyssinicus</i>	168	x	f,c	h		m
<b>Muscicapidae</b>							
White-browed Scrub-Robin	<i>Cercotrichas leucophrys</i>	176	x	a,c	l		
White-eyed Slaty-Flycatcher	<i>Melaenornis fischeri</i>	204	a	c,f	h		m
Southern Black Flycatcher	<i>Melaenornis pammelaina</i>	204	x	c,f	l		m
Pale Flycatcher	<i>Melaenornis (Bradornis, Agricola) pallidus</i>	206	x	a,c,f			
Spotted Flycatcher	<i>Muscicapa striata</i>	206	r	c,a,f		pw,pp	
Ashy Flycatcher	<i>Muscicapa (Fraseria) caerulescens</i>	206	x	f,c,s	l		
African Dusky Flycatcher	<i>Muscicapa adusta</i>	207	c	c,f,a	h		
Cape Robin-Chat	<i>Cossypha caffra</i>	166	r	f,c,a	h		
Rüppell's Robin-Chat	<i>Cossypha semirufa</i>	166	c	f,c,a	h		
White-browed Robin-Chat	<i>Cossypha heuglini</i>	166	r	c,a			
White-starred Robin	<i>Pogonocichla stellata</i>	163	r	f	h		m
Spotted Palm Thrush	<i>Cichladusa guttata</i>	177	x	c,a	l		
Common Nightingale	<i>Luscinia megarhynchos</i>	175	u	a,c	l	pw,pp	



English name	Scientific name	Plate	Abundance	Habitat	Elevation	Migration	Sociality
African Stonechat	<i>Saxicola torquatus</i>	173	c	a	h		
<b>Nectariniidae</b>							
Collared Sunbird	<i>Hedydipna collaris</i>	229	c	c,a,f			m
Olive Sunbird	<i>Cyanomitra olivacea</i>	226	u	c,f	h		m
Amethyst Sunbird	<i>Chalcomitra (Nectarina) amethystina</i>	225	a	c,f,a			
Bronzy Sunbird	<i>Nectarinia kilimensis</i>	221	c	c,f,a	h		
Malachite Sunbird	<i>Nectarinia famosa</i>	222	x	c,a,f	h		
Eastern Double-collared Sunbird	<i>Cinnyris mediocris</i>	223	r	c,f,a	h		
Beautiful Sunbird	<i>Cinnyris pulchellus</i>	228	x	c,f,a	l		
Variable Sunbird	<i>Cinnyris venustus</i>	229	a	c,a,f			
<b>Passeridae</b>							
House Sparrow	<i>Passer domesticus</i>	251	a	c			s
Kenya Sparrow	<i>Passer rufocinctus</i>	251	r	c,a	h		s
Northern Grey-headed Sparrow	<i>Passer griseus</i>	252	a	c,a			s
<b>Ploceidae</b>							
Thick-billed Weaver	<i>Amblyospiza albifrons</i>	257	x	w,a			s
Baglafaecht Weaver	<i>Ploceus baglafaecht</i>	257	a	c,f,a	h		
Spectacled Weaver	<i>Ploceus ocularis</i>	256	c	c,f,a			m
Village Weaver	<i>Ploceus cucullatus</i>	255	x	c,a,o			s
Chestnut Weaver	<i>Ploceus rubiginosus</i>	257	r	a	l		ss
Red-headed Weaver	<i>Anaplectes rubriceps</i>	263	c	c,f,a	l		
Red-billed Quelea	<i>Quelea quelea</i>	263	x	a			ss
Southern Red Bishop	<i>Euplectes orix</i>	268	x	a,o	l		s
Yellow Bishop	<i>Euplectes capensis</i>	267	c	a,c			s
White-winged Widowbird	<i>Euplectes albonotatus</i>	267	x	a,c,w	l		s,m
<b>Estrildidae</b>							
Red-billed Firefinch	<i>Lagonosticta senegala</i>	275	c	c,a			s
African Firefinch	<i>Lagonosticta rubricata</i>	275	u	c,a,f			s
Red-cheeked Cordon-bleu	<i>Uraeginthus bengalus</i>	274	r	a,c			s
Yellow-bellied Waxbill	<i>Coccyzygia (Estrilda) quartinia</i>	276	x	a,c	h		s,m
Common Waxbill	<i>Estrilda astrild</i>	276	r	a,c,w			s,ss,m
Bronze Mannikin	<i>Lonchura (Spermestes) cucullata</i>	279	c	c,a			ss,m
Black-and-white Mannikin	<i>Lonchura (Spermestes) bicolor</i>	279	c	c,a,f			ss,m
<b>Viduidae</b>							
Village Indigobird	<i>Vidua chalybeata</i>	281	u	a,c			s,m
Pin-tailed Whydah	<i>Vidua macroura</i>	280	r	a,c			s,m
<b>Motacillidae</b>							
Grey Wagtail	<i>Motacilla cinerea</i>	149	r	s		pw,pp	
Mountain Wagtail	<i>Motacilla clara</i>	149	x	s,f	h		
African Pied Wagtail	<i>Motacilla aguimp</i>	149	a	c,a,s			
Tree Pipit	<i>Anthus trivialis</i>	153	r	a	h	pp,pw	s
<b>Fringillidae</b>							
Southern Citril	<i>Crithagra (Serinus) hyposticta</i>	283	c	a,c			s
Yellow-fronted Canary	<i>Crithagra (Serinus) mozambica</i>	282	c	a,c			s
Thick-billed Seedeater	<i>Crithagra (Serinus) burtoni</i>	282	r	a,c,f	h		s
<b>Emberizidae</b>							
Golden-breasted Bunting	<i>Emberiza flaviventris</i>	286	r	a			

Campus was the most frequently used habitat, indicated for 101 species (excluding abundance code x). Forest and agricultural areas were used by many species, often in combination with campus habitat. The limited aquatic habitat was important for multiple species, with streams and the riparian corridor providing key habitat for forest species such as Hartlaub's Turaco *Tauraco hartlaubi*, African Hill Babbler *Sylvia abyssinica*, and multiple greenbuls. The overhead habitat category included species found well above even the tallest trees, often in transit. As expected, these species included mostly swifts, swallows, raptors, and migrating bee-eaters.

Elevational affinities were meaningful for 53 species, again excluding species with abundance code x. Mweka hosted more species from higher elevation (32), than from lower elevation (21). The species at the lower end of their elevational distribution were mostly birds associated with montane forest (26 of 32 with habitat code f). Some of the most common resident species at Mweka, including Hartlaub's Turaco, Rüppell's Robin-Chat *Cossypha semirufa*, African Dusky Flycatcher *Muscicapa adusta*, White-eyed Slaty-Flycatcher *Meleornis fischeri*, Kenrick's Starling *Poeoptera kenricki*, and Bronzy Sunbird *Nectarinia kilimensis*, do not occur much lower on Kilimanjaro. Species nearing their upper elevational limits at Mweka also included forest species, such as Diederik Cuckoo *Chrysococcyx caprius*, African Emerald Cuckoo *C. cupreus*, and Little Greenbul *Eurillas virens*, as well as species using agricultural habitats.

Mweka's avifauna includes a mix of resident and migratory species. About 22 species are Palaearctic migrants, including mostly passerines. Four of these are common species at Mweka during the northern winter (Willow Warbler *Phylloscopus trochilus*, Eurasian Blackcap *Sylvia atricapilla*, Garden Warbler *S. borin*, and Common White-throat *S. communis*). Most Palaearctic migrants are probably also passage migrants through Mweka, although only Lesser Grey Shrike *Lanius minor* and Marsh Warbler *Acrocephalus palustris* have a winter distribution entirely south of northern Tanzania.

Intra-African migrants include 15 species, mostly non-passerines. Conspicuous large-scale patterns are only evident for seven species, including two that come to our region in their non-breeding season (Abdim's Stork *Ciconia abdimii*, African Golden Oriole *Oriolus auratus*), and five that come to the area to breed (Levaillant's Cuckoo *Clamator levaillantii*, Black Cuckoo *Cuculus clamosus*, African Crake *Crex egregia*, Olive Bee-eater *Merops superciliosus*, and Broad-billed Roller *Eurystomus glaucurus*). Seven species are reported to include individuals or populations that migrate, but their status at Mweka is not clear (migration status a?). Other species make local movements that sometimes bring them to Mweka (e.g. Chestnut Weaver *Ploceus rubiginosus* and Red-billed Quelea *Quelea quelea*). With more data some of these patterns may become predictable, such as movements down the mountain in the cold months of June–August or use of ploughed fields in the rainy season.

Although the avifauna of Kilimanjaro has been well described (e.g. Moreau & Sclater 1935, Moreau & Moreau 1939), the focus has been on the montane avifauna, mostly at higher elevation, rather than making a more complete assessment at a site below the extensive protected forests of KNP. With the emerging importance of climate change as a driver of distribution shifts up tropical mountains (Freeman & Freeman 2014; Dulle *et al.* 2016), even semi-quantitative information like this list from Mweka may be useful for designing more comprehensive studies or providing future ornithologists with a point of comparison.

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## The breeding of the Woolly-necked Stork *Ciconia episcopus* in Tanzania

This species occurs in all months with no obvious seasonality (Table 1) suggesting that, for the most part, it can be considered resident, although individual birds in border areas presumably wander to neighbouring countries to some extent. Nesting in Tanzania is not mentioned in Brown & Britton (1980) and Dowsett & Dowsett-Le-maire (1993) could not trace any breeding records. Harvey (1972) suspected that this species was nesting close to Dar es Salaam, but was unable to prove breeding, although he watched them displaying in early December. Elliott (1973) reports this species nesting on 15 August 1948 in a baobab on the north bank of the Ruvu River southwest of Bagamoyo. This constitutes the first breeding record for Tanzania and had been overlooked by later authors. More recently, Jiri Haureljuk (pers. comm.) located a nest on 2 September 2016 in mangroves to the north of Saadani National Park close to Kijongo Bay Beach Resort (Fig. 1). On 24 January 2017 he found a further three storks in the same mangroves along the Msangasi River. There is a more or less resident flock of 20 to 30 birds in this general area.



**Figure 1.** Nest of Woolly-necked Stork in Saadani National Park, Tanzania (photo: Jiri Haureljuk).

On 22 September 2016 we found an active nest in a totally unexpected locality and situation. This nest was built on top of a small (but old) tree growing out of a cliff face in hilly miombo woodland north of Songea (1017 m, co-ordinates available from author), a long way from any significant wetland habitat or any other records of this species (Fig. 2).

**Figure 2.** Woolly-necked Stork nest on a tree growing out of a cliff face north of Songea, Tanzania (photo: Neil Baker).



	Presence	Breeding season
January	119	3
February	87	
March	74	
April	46	
May	48	
June	74	
July	93	
August	65	1
September	70	3
October	84	1
November	67	
December	71	1

**Table 1.** Seasonality of records in the Tanzanian Bird Atlas. Although there are few nest records it appears that this species breeds towards the end of the dry season and into the short rains. The majority of records are coastal in Climatic Zone D8. The Songea record is in Climatic Zone C7 in Brown & Britton (1980).

There are 905 records on the Tanzania Atlas database with occupancy in 120 Atlas squares (34%). Although there are records in every month for only four Atlas squares. Whilst never common, flocks of up to 50 birds have been reported.

#### Acknowledgement

We thank Jiri Haureljuk for records from the mangroves of the Msangasi River.

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## Breeding of the Giant Kingfisher *Megaceryle maxima* at Lake Naivasha, Kenya

Lake Naivasha, once described as the Jewel in the Crown of all the East African lakes, has in recent decades been subjected to a series of devastating human pressures, not least the establishment of a vast horticulture and agriculture industry along its shorelines, but also the ever-increasing inflows of nutrients from siltation, sewage and other effluents emanating from a lakeside human population now approaching a million people (Turner 2016). In addition, years of illegal fishing practices by hundreds of licensed and unlicensed fishermen, coupled with a series of alien crayfish 'invasions' that have almost totally eliminated the underwater flora of the lake, have all directly contributed to the steady decline of all waterfowl populations over the past twenty years (Turner 2016, Rift Valley Waterbird Counts 1997–2019).

However, one bird, the Giant Kingfisher *Megaceryle maxima*, has steadily increased its numbers at the lake from around 2 or 3 pairs in the early 1960s (N. Carnelly pers. comm.) to an estimate today of around 50–60 individuals (Madindou *et al.* 2019). This population feeds almost entirely on an abundance of the introduced Common Carp *Cyprinus carpio*, but also on the large numbers of tilapia that are available in the lake today following the regular 'stocking of fingerlings' by the Fisheries Department.

While the Giant Kingfisher is typically found on highland rivers, streams and lakes above 1500 m (Zimmerman *et al.* 1996), particularly those in close proximity to trout farms, its presence at Lake Naivasha is of particular interest because there are few if any suitable hole nesting sites around the entire lakeshore. The breeding of a pair from July through to late September 2019 therefore offered an ideal opportunity to study in detail their activities during both the incubation and fledging periods. Here we document this unusual record and share some details of the nesting site and breeding behaviour that we observed.

In recent years, large numbers of cattle, sheep and goats have overgrazed extensive areas of bush and grassland around the lake, and with the loss of the lake's all-important papyrus belt have directly contributed to the high levels of silt and other nutrients entering the lake, also to the alarming levels of soil erosion taking place throughout the district (Turner 2010). As a result, the emergence of many eroded gullies, gorges and ravines now offer ideal sites for many hole-nesting birds such as White-fronted Bee-eater *Merops bullockoides*, Rufous-crowned Roller *Coracias naevius* and Anteater Chat *Myrmecocichla aethiops* (D. Gachucha, pers. obs.).

On or around 20 July 2019 a pair of Giant Kingfishers was observed daily flying inland from the lake, and on 26 July were observed at a nest hole in an eroded gully some 1.5 km from the lakeshore (Fig. 1). Incubation was clearly in progress because the incubating bird was observed being fed by its mate. Daily observations from then on confirmed that incubation was being undertaken by both sexes for 24 h at a time, with changeover taking place between 06:30 and 07:00 each morning for the entire incubation period. The nest hole (16.5 cm × 27 cm) was high in a vertical sandy bank 4 m from the floor of the gully and 1 m from the top. The nest tunnel itself was 1.9 m in length.



**Figure 1.** Adult close to nest hole with large tilapia for young (photo: Gabriel Benson).

First indications of hatching were around 12–13 August when both adults were observed taking small earthworms *Limnodrilus* sp. and fish into the nest tunnel. Later, the size of fish taken to the young ranged from 4 to 9 cm in length, and largely consisted of tilapia fingerlings that were readily available along the lakeshore. The first young bird (an almost fully fledged female) left the nest hole early on 22 September (some 40 days after hatching) and immediately accompanied the adult female all the way to the lakeshore; a few hours later it returned with the female to the nest, but it stayed outside while the female was inside with the other two young. The two remained together for the remainder of that day at or near the lakeshore.

Meanwhile, the second and third chick (a male and a second female) left the nest hole two days later (24 September) and all three continued to be fed by the parent birds for at least 7–10 days afterwards.

Brown & Britton (1980) had no breeding data from any of the Rift Valley lakes, and while this may be the first East African record of a Giant Kingfisher breeding so far from water, a similar case was documented in South Africa back in the early 1930s (Johnson 1932).

A few days after these observations, an additional family of four Giant Kingfishers was observed nearby, a clear indication that the Lake Naivasha population of Giant Kingfishers continues to increase.

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## An active nest of the Karamoja Apalis *Apalis karamoja* from Tanzania

In the evening of 20 August 2004, we were camped on the edge of the Wembere floodplain 2 km east of the main highway that crosses the floodplain (1052 m, contact author for coordinates). The habitat is sparse *Acacia drepanolobium* thicket on black cotton soil with large swathes of open grassland grazed by cattle belonging to the local Wanyaturu people. The following morning we located four pairs of Karamoja Apalis exhibiting both display and song. Following an individual bird EMB located an active nest close to camp (Fig. 1). On examination, there were two eggs, but these were not removed to photograph them due to the fragile nature of the nest and our reluctance to unduly disturb the birds.

The nest was about 2.5 m above the ground in a medium-sized *Acacia drepanolobium* and was quite easy to see once found (Fig 2). It was domed and made entirely from a fine plant material that we did not identify and reassembled that of a Penduline Tit *Anthoscopus* sp., with a small side entrance hole rather than the open cup nest of a Yellow-breasted Apalis *Apalis flavida*, the only other apalis nest with which we were familiar.



**Figure 1.** Nest of Karamoja Apalis *Apalis karamoja* built into the twigs and thorns of an *Acacia drepanolobium* tree (photo N.E. Baker).



**Figure 2.** The nest was built into the tree pictured. The open habitat is shown, and the person gives scale to the tree (photo N.E. Baker).

On 23 July 2016 we found another nest, but again did not wish to disturb it during the known breeding season (contact author for coordinates). At less than 2 m above the ground, it was placed lower in the *Acacia drepanolobium* than the earlier nest, but otherwise appeared identical.

A nest from the Ugandan population in Opige & Skeen (2011) appears identical to those found on the Wembere Steppe.

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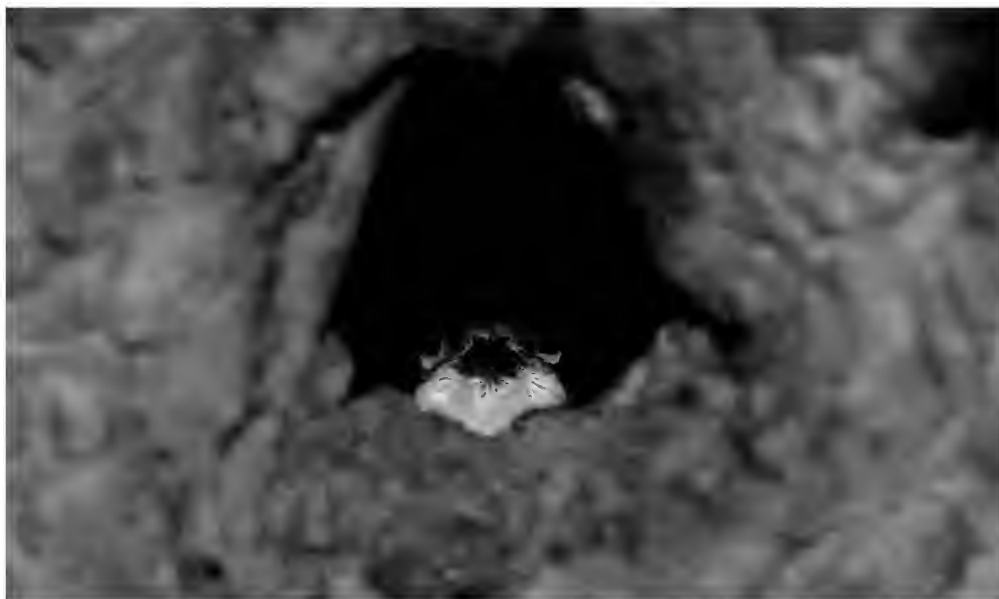
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## Ashy Starling *Lamprotornis unicolor* a new host for Greater Honeyguide *Indicator indicator*

Magambua (5°09'S, 35°18'E at 1300m) is a small rural community on the road east-southeast of Singida, 15km northwest of Kwa Mtoro, and 20km due west of Swaga Swaga Game Reserve, Tanzania. The natural habitat is dominated by baobabs *Adansonia digitate* and *Acacia tortilis*, although miombo woodland dominates Swaga Swaga Game Reserve and the escarpments closer to Singida.

In April of 2013, my husband Jon and I observed a pair of Ashy Starlings *Lamprotornis unicolor* that were active in a nearby tree hole about 1.5 m from the ground in the main trunk of a miombo tree *Brachystegia* sp. They were obviously feeding young. We could clearly hear chirping from within the nest hole while standing a metre away. On April 24, I succeeded in photographing the young. Imagine my surprise when I realized that the single chick was not an Ashy Starling. At first I thought it was a Great Spotted Cuckoo *Clamator glandarius*, but it was later confirmed to be a Greater Honeyguide *Indicator indicator* by Neil Baker and Adam Scott Kennedy, by the distinctive shape of the nostrils. About a month later, I photographed a juvenile Greater Honeyguide in a nearby tree, possibly the same one raised by the Ashy Starlings.



Juvenile Greater Honeyguide *Indicator indicator* in an Ashy Starling nest (photo: Melissa Eager).

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## Silvery-cheeked Hornbill *Bycanistes brevis* in Kenya

The range of the Silvery-cheeked Hornbill *Bycanistes brevis* is almost entirely east of the Rift Valley from the Ndotos and the Mathews Range, south through the Mt Kenya and Aberdare highlands to Thika, Nairobi, Kibwezi, Ol Donyo Orok (Namanga Hill), the Chyulus, and Taita-Taveta District, including the Taita Hills forests. It also occurs in coastal forests from the Arabuko-Sokoke and Gede forest reserves south to the Shimba Hills, Mrima Hill, and Shimoni forests. Meanwhile, wanderers from northern Tanzania appear seasonally in the Nguruman and Loliondo forests astride the Kenya-Tanzania border. It occurs alongside Trumpeter Hornbill *Bycanistes bucinator* in some inland areas and most coastal forests south of Malindi including the Arabuko-Sokoke Forest Reserve.

The lack of Kenya breeding records is due, at least in part, to paucity of suitable nesting sites, and it should be pointed out that all references to an October 1965 breeding record from Molo are unfortunate, as the record itself (Start & Start 1978) actually referred to the breeding of a pair of Black-and-white Casqued Hornbills *Bycanistes subcylindricus* that were resident on the Start property at that time. DAZ frequently visited the Start family at Molo during the 1960s, and he obtained several photographs of the hornbills there until the forest was destroyed in the 1970s.

While there have been a few breeding attempts in the Nairobi suburbs, to date none has been successful, and the only confirmed breeding record in Kenya would appear to be that documented by Guarnieri *et al.* (2018) from Nyeri District in central Kenya.

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