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COMMUNICATION
FIRST ASSESSMENT OF BIRD DIVERSITY IN THE UNESCO SHEKA FOREST BIOSPHERE RESERVE, SOUTHWESTERN ETHIOPIA: SPECIES RICHNESS, DISTRIBUTION AND POTENTIAL FOR AVIAN CONSERVATION

Mattias Van Opstal, Bernard Oosterlynck, Million Belay, Jesse Erens & Matthias De Beenhouwer

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FIRST ASSESSMENT OF BIRD DIVERSITY IN THE UNESCO SHEKA FOREST BIOSPHERE RESERVE, SOUTHWESTERN ETHIOPIA: SPECIES RICHNESS, DISTRIBUTION AND POTENTIAL FOR AVIAN CONSERVATION

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Abstract: The Sheka Zone in southwestern Ethiopia is covered by some of the largest remaining forests in the Eastern Afromontane biodiversity hotspot. Owing to the rich biodiversity and a high degree of endemism, it was declared as a biosphere reserve by UNESCO in 2012 and is considered a Key Biodiversity Area. Detailed knowledge on species diversity and distribution in the reserve is, however, severely limited. From February to April 2016, an assessment of the bird diversity and distribution in the reserve was made for the first time through point count transects, camera-trap recordings and opportunistic observations. In total, 244 bird species were identified, of which 19% was only found within the reserve’s designated protected zones. Our study indicates a remarkable bird species richness across the different habitats in Sheka Forest Biosphere Reserve and can be used as a baseline for future monitoring studies and conservation planning.

Keywords: Avifauna, Eastern Afromontane Biodiversity Hotspot, habitat occupation, Horn of Africa, inventory, IUCN.

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Author contribution: MDB and MB designed the study, MVO, BO, JE and MDB collected the data, BO and MDB analysed the data. MVO, JE and MDB wrote the manuscript.

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INTRODUCTION

Ethiopia is recognized among the 35 most biodiverse regions in the world and its biodiversity is renowned for its high percentage of endemism. The highlands in the southwest, where most of the larger forest tracts remain, are part of the Eastern Afrotropical Biodiversity Hotspot (Mittermeier et al. 2011). Natural habitats are highly diverse in this region, where the forest structure changes along a large elevation gradient (Friis 1992), with moist evergreen Afrotropical rainforests presenting the dominant vegetation type, but also including bamboo forests and transitional rainforests leading down to semi-deciduous forests at lower altitudes. In most areas, the forests are interspersed with wetlands or, at higher altitude, moorlands. Ethiopian natural forests are however rapidly disappearing (Dessie & Kleman 2007; Reusing 2000), with approximately 11.4% or 12,499,000ha of total forest cover left (FAO 2015).

The Sheka Zone in southwestern Ethiopia still harbors some of the largest remaining Afrotropical forests in the country (>100,000ha). Nevertheless, the combination of a rising population, ongoing land-allocation to agricultural investors and a lack of land-use planning are increasing pressure on the remaining natural habitats. As such, the deforestation rate within Sheka is one of the highest in Ethiopia, with severe impacts on local economy, culture and environment (Woldemariam & Fetene 2007). Sheka forest is considered a Key Biodiversity Area (Birdlife International 2017) and, in 2012, it was recognized by UNESCO as the Sheka Forest Biosphere Reserve. This recognition has led to the zonation of the area into core-, buffer- and transition zones (Fig. 1). These are, respectively, devoted to long-term protection of intact forests (core zones), participatory forest management and low-intensity production (buffer zones), and sustainable human settlement and agriculture (transition zones) (Gole & Getaneh 2011). The forest furthermore provides an important refuge for the native genetic diversity of wild crop relatives with significant agricultural value. The most prominent example is the indigenous wild coffee *Coffea arabica*, which can still be found in reasonable densities in the broadleaf forest of Sheka, but also other wild crop relatives that are imperative for local food provisioning such as Enset or ‘False Banana’ *Ensete ventricosum* and Ethiopian Cardamom *Aframomum corrorima*. All combined, there are strong incentives to safeguard this forest also from an economic and agricultural perspective (De Beenhouwer et al. 2013; Aerts et al. 2015).

Biodiversity and conservation research has seen a recent increase in southwestern Ethiopia, mainly in relation to agroforestry (e.g., Hundera et al. 2013; Tadesse et al. 2014); however, biodiversity studies in remote forest regions such as Sheka have been very limited thus far, despite the recognition as a UNESCO biosphere reserve and strong ongoing habitat degradation. Detailed insights in the diversity, distribution and abundance of species in the area are hardly available. Likewise, information on the bird diversity in Sheka forest is very scarce, but limited research done in the broader region (e.g., Woldegeorgis & Wube 2012) provides clear indications for a large bird species diversity in remaining forest tracts of southwestern Ethiopia. Here, we present a first comprehensive inventory of the bird diversity in Sheka Forest Biosphere Reserve, discuss our observations in relation to the delineated management zones, and highlight the biosphere reserve as an understudied yet highly valuable area for bird conservation and continued biodiversity studies.

MATERIALS AND METHODS

From Masha (around 7.749°N & 35.471°E; ca. 2,250m), the largest village in the area and capital of the Sheka Zone, we surveyed a variety of core-, buffer- and transition zones across the three districts, or ‘woredas’, situated in the biosphere reserve (Masha, Anderacha and Yeki). Our field expeditions took place from 2 February 2016 until 30 April 2016, and nine different ‘kebeles’ (the smallest administrative division) were visited across the three woredas (Table 1). The humid highlands of southwestern Ethiopia are characterized by a short rainy season from March to April and a long rainy season from June to October, with an average temperature of 18.4°C and yearly precipitation of 1,783mm. Hence, our expeditions were carried out immediately prior to and during the short rainy season. Permission for the field work was granted by the Ethiopian Wildlife Conservation Authority (EWCA) at the national level, the head office of the Sheka Zone and by kebele leaders on the local administrative level. The study was part of a larger expedition to assess the biodiversity in the reserve.

Birds were identified using visual, vocal and camera trap observations. Photo and audio recordings were made to support identification. When recordings of certain species were lacking, only those with double observations were listed. Visual and vocal assessments were done during early morning point transect surveys and on an ad hoc basis in all locations visited throughout
the expedition. Because the delineation between core and buffer zones was not always clear in the field, observations herein were collectively assigned to the 'protected zones' within the reserve. Assessments were carried out covering a wide variety of habitats. These were divided into seven categories for a provisional overview of species' habitat occupation throughout the reserve (Table 2). Early morning point transect surveys consisted of six counts of 10 minutes, interspersed by five minutes of walking in a predetermined direction. All birds seen and/or heard within a perimeter of 25 meters around the observer were noted. In this way, a total of 74 point transect surveys were carried out, with one survey always restricted to the same habitat. Species identification was done using the Helm field guide 'Birds

Table 1. An overview of the locations visited in Sheka Forest Biosphere Reserve during the inventory, highlighting the central areas and field camps around which search efforts were concentrated and their altitude as approximated by GPS readings.

| Woreda    | Location/kebele | GPS                  | Altitude (m) |
|-----------|-----------------|----------------------|--------------|
| Masha     | Masha           | 7.749'N & 35.471'E   | 2293         |
| Ateso     |                 | 7.711'N & 35.450'E   | 2332         |
| Shato forest (north) |     | 7.856'N & 35.506'E   | 1681         |
| Shato forest (south) |    | 7.803'N & 35.551'E   | 1712         |
| Karina    |                 | 7.859'N & 35.339'E   | 2176         |
| Atele     |                 | 7.707'N & 35.407'E   | 2385         |
| Anderacha | Gecha           | 7.562'N & 35.404'E   | 2231         |
| Gandochi  |                 | 7.417'N & 35.425'E   | 2576         |
| Yeki      | Tepi (and Gilo River) | 7.198'N & 35.425'E   | 1097         |

Figure 1. An overview of the Sheka Forest Biosphere Reserve and its location in Ethiopia, showing the proposed zoning into different management zones (see legend; Gole & Getaneh 2011) and camera trapping locations within the reserve. Masha, Gecha and Tepi are the central towns, respectively, in the woredas of Masha, Anderacha and Yeki.
of the Horn of Africa’ (Redman et al. 2011) as a main reference. Occasional unknown sounds were recorded and identified afterwards using the xeno-canto database (http://www.xeno-canto.org).

Camera trap monitoring was done with 16 camera traps in 28 different locations (see Fig. 1) for a total of approximately 510 camera trap days. Camera trap locations were selected based on their potential to monitor mammal diversity, but additional bird observations were made of crepuscular species and analysed as part of the present study.

RESULTS

We recorded a total of 244 bird species from 55 different families in the Sheka Forest Biosphere Reserve (Table 3; Images 1–4). Of the species recorded in the reserve during our fieldwork, 47 species or 19% were only found in the designated protected zones. All other species were found across a variety of management zones. Of the 155 species identified during the point transect surveys, 16 species were observed across all studied habitats, of which Bradypertus cinnamomeus (89.2% of surveys), Turdus (olivaceus) abyssinicus (83.8%), and Zosterops poliogastrus kaffensis (78.4%) were the most common bird species identified during the surveys. Riverine forest was the most species-rich habitat sampled with on average 24.3 species sampled per survey, while bamboo forest was the least species rich habitat with an average of 13.4 species recorded per survey (Table 2). Based on our observations, the main habitat types used by each species are noted, except for the species encountered on migration, for which no habitats could be determined (Table 3).

Eleven bird species that were recorded during the surveys are considered threatened based on the IUCN Red List. With the notable exception of the recorded vultures, these observations largely stem from within the designated protected zones of the reserve. Details on these species and their identification are discussed below:

**Necrosyrtes monachus** (Critically Endangered) (Image 1C)

A smaller brown vulture, identified based on its naked pink head and whitish-grey ‘hooded’ hindneck and nape. It is common and still very abundant around settlements, but rather rare in a variety of other habitats. Like the other African vultures listed below, it is severely threatened by a combination of factors, including land conversion, active persecution as well as secondary poisoning.

**Trigonoceps occipitalis** (Critically Endangered)

A rather large blackish vulture with contrasting white belly and large red-colored bill. Singles and pairs are uncommon but found to be widespread in a variety of habitats including settlements.

**Gyps africanus** (Critically Endangered) (Image 1D)

A typical vulture with a bright brown back, dark brown plumage, dark bill and down feathers on the neck. Seen in groups of up to 20 birds but also often in the presence of other vulture species. Common and widespread in a variety of habitats, most numerous around settlements.

**Gyps rueppellii** (Critically Endangered)

This vulture is similar to *Gyps africanus* but easily distinguished based on its yellow bill and scaled appearance in adult birds caused by bright edges on dark feathers. Rather uncommon, but widespread and present in a variety of habitats including settlements.

| Habitat Description | Surveys | No. of species, survey |
|---------------------|---------|------------------------|
| Riverine forest (Rf) | Broadleaf forest and woodland along waterways. | 9 | 24, 3 |
| Wetland (We) | Open habitat, either permanently or seasonally saturated with water. | 23 | 22, 3 |
| Moorland (Mo) | Open habitat, characterised by low-growing vegetation on acidic soils. | 8 | 16, 1 |
| Broadleaf forest (Br) | Broadleaf forest and woodland. | 22 | 22, 6 |
| Bamboo forest (Bf) | Evergreen forest with bamboo as main vegetation type. | 12 | 13, 4 |
| Settlement (Se) | Villages and surroundings. | - | - |
| Grazing Land (Gr) | Grazing land and all other open areas except for wetland and moorland. | - | - |

**Table 2.** The studied habitat categories, including the number of point transect surveys conducted per habitat and the average number of bird species recorded per survey. Surveys were not focussed on settlements (Se) and grazing lands (Gr), which instead were assessed through opportunistic search efforts and camera trapping.
Image 1. Photographic records of bird species observed in Sheka Forest Biosphere Reserve: A. Anhinga rufa | B. Bostrychia hagedash | C. Necrosyrtes monachus | D. Gyps africanus | E. Buteo augur | F. Stephanoaetus coronatus | G. Pternistis squamatus (camera trap recording) | H. Rougetius rougeti.
**Torgos tracheliotus** (Endangered)
A very large, dark brown vulture with a pink head that shows distinctive skin folds. Pairs and solitary birds were encountered only a limited number of times around smaller settlements and agricultural areas.

**Aquila nipalensis** (Endangered)
A large eagle with brown upper parts and blackish flight feathers, larger and darker than *Aquila rapax*. Observed and photographed on only one occasion while on migration northwards on 18 April 2016 above a highland moorland at Gandochi.

**Polemaetus bellicosus** (Vulnerable)
A very large brown eagle with white body underparts. Only one sighting in a wetland in the protected zone of Shato where a territorial pair was seen and heard in flight on 24 April 2016.

**Balearica pavonina** (Vulnerable)
An unmistakable crane with predominantly black body plumage and a crown of golden feathers. Limited number of sightings on a single day during a wetland inventory around the town of Masha.

**Terathopius ecaudatus** (Near Threatened)
Easily recognised in flight from below, based on the black body plumage, black and white wings and chestnut tail. Observed only one time at Shato forest (south) and two times in highland moorland at Gandochi, where a male was photographed on 30 March 2016.

**Sarothrura rufa**
Adult males have a chestnut red head and chest with otherwise black plumage with narrow but striking white streaks. Adult males were observed two times during an inventory in a wetland around Shato when flushed from about 5m from the observers in a wet grassland.

**Stephanoaetus coronatus** (Near Threatened) (Image 1F)
Large eagle with crest, giving the head a rather triangular appearance. Barred black and white from below, with chestnut underwing coverts. Widespread and common in the core forested areas, very rare elsewhere. Both juveniles and adults were seen and photographed on several occasions throughout the study.

**Bradypterus alfredi**
Sound recorded at two different locations in highland bamboo forest were uncommon and localized. A rapid series of short notes all at the same pitch “chit-it chit-it chit-it”.

**Halcyon malimbica** (Image 2E)
A striking blue kingfisher, distinguished from *Halcyon senegalensis* based on its blue breast-band and more extensive amount of black on its wings. Rare and secretive, but present around the largest rivers in the area. Often heard in wetland and riverine forest habitat in Shato forest, and one individual was photographed in lowland riverine forest near Tepi.

**Anomalospiza imberbis**
A small finch-like species. Males were recognised based on their black bill and yellow head and underparts. Only observed once in the largest wetland at the side of the Gebba River. A male was seen on 28 February 2018 for approximately 30 seconds sitting on top of a shrub at 15m from the observers during a wetland survey.

**Cinnyris chloropygius**
Males showed a metallic green head, breast and upper parts, a red breast-band and olive belly. Uncommon in open riverine woodland in the lowlands of Tepi, where one territorial male was seen actively foraging during a riverine forest survey by several observers.

Several species that were found in the reserve during the monitoring occur only in a very restricted range in Ethiopia. Although these species are not considered threatened on the IUCN red list nor are endemic, their isolated distribution within Ethiopia and/or occurrence at the extremes of their distribution ranges deserves special conservation attention. Except for *Cinnyris chloropygius*, these species were exclusively found within the protected zones of the reserve.
Image 2. Photographic records of bird species observed in Sheka Forest Biosphere Reserve: A. Actophilornis africanus | B. Turtur tympanistria | C. Poicephalus flavifrons | D. Agapornis taranta | E. Halcyon malimbica | F. Ispidina picta | G. Merops albicollis | H. Merops pusillus.
Table 3. Bird species identified within Sheka Forest Biosphere Reserve, with IUCN conservation status (LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered), predominant habitat occupation (see Table 2, Mi: Migration), the identification method leading to species detection (OO: opportunistic observation; PT: point count transect observation; CT: camera trap observation), and main verification method (PH: photographic recording; AU: audio recording; DO: double observation). Species endemic to the Horn of Africa (Redman et al. 2011) are indicated with †. Species that were only observed in the protected zones are indicated with ‡. IUCN status according to https://www.iucnredlist.org, accessed on 29 September 2018.

| Species/family     | Common name          | IUCN  | Habitat | Identification | Verification |
|--------------------|----------------------|-------|---------|----------------|--------------|
| Podicipedidae (1)  |                      |       |         |                |              |
| 1 Tachybaptus ruficollis Little Grebe LC RF, We CT, OO, PT PH |
| Phalacrocoracidae (1) |                    |       |         |                |              |
| 2 Phalacrocorax africanus Long-tailed Cormorant LC RF OO, PT DO |
| Anhingidae (1)     |                      |       |         |                |              |
| 3 Anhinga rufa‡ African Darter LC RF OO, PT PH |
| Helornithidae (1)  |                      |       |         |                |              |
| 4 Podica senegalensis‡ African Finfoot LC RF OO, PT DO |
| Ardeidae (6)       |                      |       |         |                |              |
| 5 Nycticorax nycticorax Black-crowned Night Heron LC RF OO DO |
| 6 Bubulcus ibis Cattle Egret LC Gr OO, PT DO |
| 7 Ardea ralloides‡ Squacco Heron LC Mi OO PH |
| 8 Butorides striata‡ Striated Heron LC RF OO DO |
| 9 Ardea purpurea Purple Heron LC RF OO, PT DO |
| 10 Ardea melanocephala Black-headed Heron LC RF, We OO, PT DO |
| Ciconiidae (5)     |                      |       |         |                |              |
| 11 Ciconia ciconia White Stork LC Mi OO DO |
| 12 Ciconia microscelis African Woollyneck LC RF, We, Gr OO, PT PH |
| 13 Ciconia abdimii Abdim’s Stork LC Gr, Se OO PH |
| 14 Anastomus lamelligerus African Openbill LC Mi OO PH |
| 15 Leptoptilos crumeniferus Marabou Stork LC We, Se OO PH |
| Threskiornithidae (2) |                    |       |         |                |              |
| 16 Bostrychia hagedash Hadada Ibis LC We, Gr, Se CT, OO, PT PH |
| 17 Bostrychia carunculata‡ Wattled ibis LC We, Gr CT, OO, PT PH |
| Anatidae (5)       |                      |       |         |                |              |
| 18 Plectropterus gambensis‡ Spur-winged Goose LC We OO DO |
| 19 Anas undulata Yellow-billed Duck LC RF PT PH |
| 20 Anas sparsa African Black Duck LC RF OO PH |
| 21 Anas crecca‡ Eurasian Teal LC Mi OO DO |
| Accipitridae (28)  |                      |       |         |                |              |
| 22 Milvus migrans Black Kite LC Gr, Se OO, PT PH |
| 23 Milvus (migrans) aegyptius Yellow-billed Kite LC Gr, Se CT, OO, PT PH |
| 24 Haliaeetus vocifer African Fish-Eagle LC RF OO, PT PH |
| 25 Necrosyrtes monachus Hooded Vulture CR Gr, Se CT, PT PH |
| 26 Trigonoceps occipitalis White-headed Vulture CR Gr, Se PT PH |
| 27 Torgos tracheliotus Lappet-faced Vulture CR Gr, Se OO PH |
| 28 Gyps africannus White-backed Vulture CR Gr, Se OO PH |
| 29 Gypaetus barbatus Rüppell’s Vulture CR Gr, Se OO PH |
| 30 Cirroetus pectoralis‡ Brown Snake-Eagle LC Br OO PH |
| 31 Cirroetus cirrocephalus‡ Black-chested Snake-eagle LC Br OO PH |
| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|---------------|-------------|
| 33 Accipiter tachiro | African Goshawk | LC | Br | OO, PT | PH |
| 34 Accipiter rufiventris | Rufous-breasted Sparrowhawk | LC | Br | OO | PH |
| 35 Accipiter minullus† | Little Sparrowhawk | LC | RF | OO | DO |
| 36 Accipiter melanoleucus | Great Sparrowhawk | LC | Br | OO | PH |
| 37 Aviceda cuculoides† | African Cuckoo-Hawk | LC | Br | OO | PH |
| 38 Polyboroides typus | African Harrier-Hawk | LC | Br, Gr, Se | OO, PT | PH |
| 39 Pernis apivorus | European Honey-Buzzard | LC | Mi | OO | PH |
| 40 Buteo augur | Augur Buzzard | LC | Gr, Br | OO, PT | PH |
| 41 Buteo buteo | Common Buzzard | LC | Mi | OO, PT | PH |
| 42 Buteo rufinus† | Long-legged Buzzard | LC | Mi | OO | DO |
| 43 Clanga pomarina† | Lesser Spotted Eagle | LC | Mi | OO | PH |
| 44 Aquila rapax | Tawny Eagle | LC | Gr | OO, PT | PH |
| 45 Aquila nipalensis† | Steppe Eagle | EN | Mi | OO | PH |
| 46 Hieraaetus pennatus† | Booted Eagle | LC | Mi | OD | DO |
| 47 Hieraaetus ayreii | Ayres’s Hawk-Eagle | LC | Br | OO | DO |
| 48 Terathopius ecaudatus† | Bateleur | NT | Gr | OO | PH |
| 49 Lophoetus occipitalis | Long-crested Eagle | LC | Br, Gr | OO, PT | PH |
| 50 Polemaetus bellicosus† | Martial Eagle | VU | We | OO | PH |
| 51 Stephanoaetus coronatus | African Crowned Eagle | NT | Br | OO | PH |

**Falconidae (3)**

| 52 Falco ardosiaceus† | Grey Kestrel | LC | Gr | OO | PH |
| 53 Falco cuvierii† | African Hobby | LC | RF | OO | PH |
| 54 Falco subbuteo† | Eurasian Hobby | LC | Mi | OO | DO |

**Phasianidae (2)**

| 55 Pternistis squamatus† | Scaly Francolin | LC | Br | CT | PH |
| 56 Pternistis castaneicollis† | Chestnut-naped Francolin | LC | Br, Gr | OO | AU |

**Sarothruridae (2)**

| 57 Sarothrura elegans† | Buff-spotted Flufftail | LC | Br | OO | AU |
| 58 Sarothrura rufula | Red-chested Flufftail | LC | We | OO, PT | DO |

**Rallidae (4)**

| 59 Amouranous flavirostra | Black Crake | LC | RF, We | OO, PT | PH |
| 60 Rougetus rougeti† | Rouget’s Rail | NT | RF, We, Mo | CT, OO, PT | PH |
| 61 Rallus caerulescens | African Rail | LC | RF, We | OO, PT | PH |
| 62 Gallinula chloropus | Common Moorhen | LC | RF | OO | DO |

**Gruidae (1)**

| 63 Balearica pavonina | Black Crowned Crane | VU | We | OO | DO |

**Jacanidae (1)**

| 64 Actophilornis africanus† | African Jacana | LC | RF | CT, OO | PH |

**Scopacidae (4)**

| 65 Actitis hypoleucos | Common Sandpiper | LC | RF, We | OO | DO |
| 66 Tringa glareola | Wood Sandpiper | LC | We | OO | DO |
| 67 Tringa ochropus | Green Sandpiper | LC | We | OO | DO |
| 68 Gallinago nigriceps† | African Snipe | LC | We | PT | DO |

**Columbidae (10)**

| 69 Treron calvus | African Green Pigeon | LC | Br | OO, PT | PH |
| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 70            | Treron waalia | Bruce’s Pigeon | LC | Br | OO, PT | DO |
| 71            | Columba guineae | Speckled Pigeon | LC | Se | OO | DO |
| 72            | Columba arquatrix | African Olive Pigeon | LC | Br, Mo, BF | OO, PT | DO |
| 73            | Turtur afer | Blue-spotted Wood Dove | LC | Br | OO, PT | PH |
| 74            | Turtur tympanistria | Tambourine Dove | LC | Br, Gr, Se | CT, PT | DO |
| 75            | Streptopelia vinacea | Vinaceous Dove | LC | Br, Gr | PT | PH |
| 76            | Streptopelia semitorquata | Red-eyed Dove | LC | Br, Gr, Se | OO, PT | DO |
| 77            | Streptopelia lugens | Dusky Turtle Dove | LC | Br | PT | DO |
| 78            | Apileopelia larvata | Lemon Dove | LC | Br | CT, OO | PH |

**Psittacidae (1)**

| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 79            | Poicephalus flavifrons | Yellow-fronted Parrot | LC | Br | PT | PH |
| 80            | Agapornis taranta | Black-winged Lovebird | LC | Br | PT | PH |

**Musophagidae (1)**

| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 81            | Tauraco leucotis | White-cheeked Turaco | LC | Br, BF | OO, PT | AU |

**Cuculidae (7)**

| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 82            | Cuculus canorus | Common Cuckoo | LC | Mi | OO | DO |
| 83            | Cuculus satiotarius | Red-chested Cuckoo | LC | Br, Se | OO, PT | PH |
| 84            | Cuculus clamomosus | Black Cuckoo | LC | Br | PT | AU |
| 85            | Chrysococcyx klaas | Klaas’s Cuckoo | LC | Br, Se | OO, PT | AU |
| 86            | Chrysococcyx cupreus | African Emerald Cuckoo | LC | Br, Se | PT | PH |
| 87            | Centropus senegalensis | Senegal Coucal | LC | Br | CT, OO, PT | PH |
| 88            | Centropus monachus | Blue-headed Coucal | LC | Rf, We, Mo | OO, PT | PH |

**Strigidae (2)**

| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 89            | Strix woodfordii | African Wood Owl | LC | Br | OD | AU |
| 90            | Bubo cinereascens | Greyish Eagle-Owl | LC | Br, Se | OD | DO |

**Apodidae (3)**

| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 91            | Tachymarptis melba | Alpine Swift | LC | Mi | OO, PT | DO |
| 92            | Apus apus | Common Swift | LC | Gr, Se | OO, PT | DO |
| 93            | Apus niansae | Nyanza Swift | LC | Gr, Se | OO, PT | DO |

**Coliidae (1)**

| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 94            | Colius striatus | Speckled Mousebird | LC | Se | CT, OO, PT | PH |

**Trogonidae (1)**

| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 95            | Apaloderma marina | Narina Trogon | LC | Br | PT | AU |

**Alcedinidae (8)**

| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 96            | Ceryle rudis | Pied Kingfisher | LC | Rf | OO, PT | PH |
| 97            | Megaceryle maxima | Giant Kingfisher | LC | Rf | PT | PH |
| 98            | Halcyon senegalensis | Woodland Kingfisher | LC | Rf, Br | PT | PH |
| 99            | Halcyon malimbica | Blue-breasted Kingfisher | LC | Rf | PT | PH |
| 100           | Halcyon chelicut | Striped Kingfisher | LC | Br | OD | PH |
| 101           | Alcedo semitorquata | Half-collared Kingfisher | LC | Rf | OO, PT | PH |
| 102           | Corythornis cristatus | Malachite Kingfisher | LC | Rf | OO, PT | PH |
| 103           | Ispidina picta | Pygmy Kingfisher | LC | Rf, We | OD | PH |

**Meropidae (4)**

| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|-------------|
| 104           | Merops pusillus | Little Bee-eater | LC | Gr | OD | DO |
| 105           | Merops (variegatus) hirsutirostris | Blue-breasted Bee-eater | LC | Br, Gr | OD | PH |
| Species/family | Common name                      | IUCN | Habitat | Identification | Verification |
|---------------|----------------------------------|------|---------|---------------|--------------|
| 106           | Merops apiaster                   | LC   | Gr      | PT            | DO           |
| 107           | Merops albicollis                 | LC   | Rf, Br  | PT            | PH           |
| Coraciidae (1) |                                  |      |         |               |              |
| 108           | Eurydactylus glaucus              | LC   | Rf      | OO, PT        | DO           |
| Bucerotidae (1) |                               |      |         |               |              |
| 109           | Tockus alboterminatus             | LC   | Br      | OO, PT        | AU           |
| Bucorvidae (2) |                               |      |         |               |              |
| 110           | Bycanistes brevis                 | LC   | Br      | OO, PT        | PH           |
| 111           | Bucorvus abyssicus                | LC   | We, Gr  | OO, PT        | DO           |
| Lybiidae (4)  |                                  |      |         |               |              |
| 112           | Pogonitis chrysoconus             | LC   | Br      | OO, PT        | PH           |
| 113           | Pogonitis pusillus                | LC   | Br      | PT            | AU           |
| 114           | Lybius bidentatus                 | LC   | Br      | OO            | PH           |
| 115           | Lybius undatus†                   | LC   | Br      | OO            | DO           |
| Indicatoridae (4) |                              |      |         |               |              |
| 116           | Indicator indicator†              | LC   | Rf      | PT            | PH           |
| 117           | Indicator variostriatus†          | LC   | Rf      | PT            | AU           |
| 118           | Indicator minor                   | LC   | Rf, Br  | OO            | AU           |
| 119           | Prodotiscus zambesioides†         | LC   | Rf      | OO            | DO           |
| Picidae (5)   |                                  |      |         |               |              |
| 120           | Jynx torquilla                    | LC   | Mi      | OO            | DO           |
| 121           | Campethera nubica                 | LC   | Br      | PT            | DO           |
| 122           | Dendropicos fuscescens            | LC   | Br      | OO, PT        | PH           |
| 123           | Dendropicos abyssinicus†          | LC   | Br      | PT            | PH           |
| 124           | Dendropicos spodocephalus         | LC   | Gr      | OO            | DO           |
| Hirundinidae (12) |                             |      |         |               |              |
| 125           | Myiopagrus fuligula               | LC   | Se      | OO, PT        | DO           |
| 126           | Riparia paludicola schaenii       | LC   | Gr      | OO            | DO           |
| 127           | Delichon urbicum                  | LC   | Gr, Se  | OO, PT        | DO           |
| 128           | Cecropis daurica                  | LC   | Gr, Se  | OO, PT        | DO           |
| 129           | Cecropis senegalensis             | LC   | Gr, Se  | OO, PT        | PH           |
| 130           | Cecropis abyssinica               | LC   | Gr      | OO            | DO           |
| 131           | Pseudhirundo griseopyga           | LC   | Mi      | OO            | DO           |
| 132           | Hirundo rustica                   | LC   | Gr, Se  | OO, PT        | DO           |
| 133           | Hirundo lucida                    | LC   | Gr      | OO, PT        | DO           |
| 134           | Hirundo smithii                   | LC   | Gr, Se  | PT            | PH           |
| 135           | Hirundo aethiopica                | LC   | Se      | OO            | DO           |
| 136           | Psalidophorus pristoptera         | LC   | We, Gr  | OO, PT        | PH           |
| Motacillidae (9) |                             |      |         |               |              |
| 137           | Motacilla flavipes (flava)        | LC   | Gr, Se  | OO, PT        | DO           |
| 138           | Motacilla aguimp                  | LC   | Rf      | CT, OO, PT    | PH           |
| 139           | Motacilla clara                   | LC   | Rf      | OO, PT        | PH           |
| 140           | Motacilla alba                    | LC   | Mi      | OO            | DO           |
| 141           | Anthus cinnamomeus                | LC   | We, Gr  | CT, DO        | PH           |
| Species/family       | Common name                        | IUCN | Habitat | Identification | Verification |
|---------------------|------------------------------------|------|---------|----------------|--------------|
| 142 Anthus leucophrys omoensis | Plain-backed Pipit | LC   | Gr      | OO             | PH           |
| 143 Anthus similis  | Long-billed Pipit                 | LC   | Gr      | OO             | PH           |
| 144 Anthus cervinus | Red-throated Pipit                | LC   | Mi      | PT             | PH           |
| 145 Anthus trivialis | Tree Pipit                        | LC   | Mi      | OO             | DO           |
| Campephagidae (2)  |                                    |      |         |                |              |
| 146 Campephaga phoenicea | Red-shouldered Cuckoo Shrike   | LC   | Br      | PT             | PH           |
| 147 Cercopipus caesioides | Grey Cuckoo Shrike          | LC   | Rf, Br  | OO             | DO           |
| Pycnonotidae (2)   |                                    |      |         |                |              |
| 148 Pycnonotus barbatus schoanus | Common Bulbul                  | LC   | Br, Mo, Gr, Se | CT, OO, PT | PH           |
| 149 Atimastillas flavicollis | Yellow-throated Leaflove       | LC   | Br      | PT             | DO           |
| Muscicapidae (20)  |                                    |      |         |                |              |
| 150 Cossypha semirufa | Rüppell's Robin-Chat             | LC   | Br, Gr | CT, OO, PT    | PH           |
| 151 Cossypha heuglini | White-browed Robin-Chat          | LC   | Rf      | OO             | DO           |
| 152 Phoenicurus phoenicurus | Common Redstart                  | LC   | Mi      | DO, PT         |              |
| 153 Saxicola (torquatus) albicollis | African Stonechat           | LC   | We, Gr  | OO, PT         | PH           |
| 154 Saxicola rubetra | Whinchat                          | LC   | We, Gr  | OO, PT         | DO           |
| 155 Genetta oenanthe | Northern Wheatear                | LC   | Mi      | OO             | PH           |
| 156 Cercomela sordida | Moorland Chat                   | LC   | We, Mo, Se | OO, PT   | PH           |
| 157 Psophocichla litsitsirupa | Groundscraper Thrush           | LC   | Se      | OO, PT         | PH           |
| 158 Monticola saxatilis | Common Rock Thrush              | LC   | Mi      | OO, PT         | DO           |
| 159 Turdus (olivaceus) abyssinicus | African Mountain Thrush         | LC   | Br, Gr, Se | CT, PT   | PH           |
| 160 Turdus pelios   | African Thrush                    | LC   | Gr, Se  | OO             | DO           |
| 161 Zootoca pisanga | Abyssinian Ground Thrush        | LC   | Br      | CT, PT         | PH           |
| 162 Melaenornis philippinus | Abyssinian Slaty Flycatcher   | LC   | Br, Gr, Se | OO, PT   | PH           |
| 163 Melaenornis edolioides | Northern Black Flycatcher        | LC   | Gs, Se  | OO             | PH           |
| 164 Bradornis micropterus | African Grey Flycatcher         | LC   | Br      | OO             | DO           |
| 165 Bradornis pallidus | Pale Flycatcher                 | LC   | Se      | OO             | DO           |
| 166 Muscicapa audax | African Dusky Flycatcher        | LC   | Br, Mo, Bf, Se | PT    | PH           |
| 167 Muscicapa striata | Spotted Flycatcher               | LC   | Mi      | OO             | DO           |
| 168 Terpsiphone viridis | African Paradise Flycatcher     | LC   | Br, Gr, Se | CT, OO, PT | PH           |
| 169 Myioparus plumbeus | Lead-coloured Flycatcher        | LC   | Br      | PT             | PH           |
| Locustellidae (6)  |                                    |      |         |                |              |
| 170 Bradypodius baboecola | Little Rush Warbler            | LC   | Rf, We  | OO, PT         | AU           |
| 171 Bradypodius cinnaeus | Cinnamon Bracken Warbler       | LC   | Br, Mo, Bf | PT             | PH           |
| 172 Bradypodius alfredi | Bamboo Warbler               | LC   | Bf      | OO, PT         | AU           |
| 173 Acrocephalus baeticus | African Reed Warbler           | LC   | Rf      | OO, PT         | AU           |
| 174 Acrocephalus schoenoeca | Sedge Warbler                  | LC   | Mi      | OO             | DO           |
| 175 Chloropeta natalensis | African Yellow Warbler         | LC   | We, Gr  | PT             | PH           |
| Cisticoliidae (8)  |                                    |      |         |                |              |
| 176 Camaroptera brevicaudata | Grey-backed Camaroptera   | LC   | Br, Mo  | OO, PT         | AU           |
| 177 Eremomela concolor | Green-backed Eremomela        | LC   | Br      | OO             | DO           |
| 178 Cisticola (galactotes) lagubris | Ethiopian Cisticola | LC   | Rf, We, Mo | OO, PT     | PH           |
| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|--------------|
| 179 Cisticola erythrops | Red-faced Cisticola | LC | RF | OO | DO |
| 180 Cisticola cantans | Singing Cisticola | LC | Gr, Se | PT | DO |
| 181 Prinia subflava | Tawny-flanked Prinia | LC | Gr, Se | PT | PH |
| 182 Apalis flavida | Yellow-breasted Apalis | LC | Br, Gr, Se | PT | DO |
| **Phylloscopidae (3)** | | | | | |
| 183 Phylloscopus trochilus | Willow Warbler | LC | Br, Gr, Se | OO, PT | DO |
| 184 Phylloscopus collybita | Common Chiffchaff | LC | Br, Gr, Se | OO, PT | AU |
| 185 Phylloscopus umbroviros | Brown Woodland Warbler | LC | Br, Mo, Bf | OO, PT | PH |
| **Sylviidae (5)** | | | | | |
| 186 Sylvia atricapilla | Blackcap | LC | Br, Gr, Se | OO, PT | PH |
| 187 Sylvia borin | Garden Warbler | LC | Mi | OO, PT | AU |
| 188 Sylvia abyssinica | African Hill Babbler | LC | Br, Mo | PT | PH |
| 189 Turdoides leucopygia | White-rumped Babbler | LC | Br | OO, PT | PH |
| 190 Paraphasma galinieri | Abyssinian Catbird | LC | Mo, Bf | OO, PT | AU |
| **Platysteiridae (2)** | | | | | |
| 191 Batis erlangeri | Western Black-headed Batis | LC | Br | PT | AU |
| 192 Platysteira cyanea | Brown-throated Wattle-eye | LC | Br | OO, PT | AU |
| **Zosteropidae (2)** | | | | | |
| 193 Zosterops poliopterus | Montane White-eye | LC | Br, Bf | OO, PT | DO |
| 194 Zosterops abyssinicus | Abyssinian White-eye | LC | Br | OO, PT | DO |
| **Nectariniidae (6)** | | | | | |
| 195 Nectarinia tacazze | Tacazze Sunbird | LC | Br, Mo, Gr, Se | PT | PH |
| 196 Cinnyris cupreus | Copper Sunbird | LC | Br, Gr, Se | OO, PT | DO |
| 197 Cinnyris venustus | Variable Sunbird | LC | Br, Gr, Se | PT | PH |
| 198 Cinnyris chloropygius | Olive-bellied Sunbird | LC | RF | OO | DO |
| 199 Chalcomitra senegalensis | Scarlet-chested Sunbird | LC | Br | PT | AU |
| 200 Cyannomitra olivacea | Olive Sunbird | LC | We, Br, Gr | PT | PH |
| **Laniidae (3)** | | | | | |
| 201 Lanius humeralis | Northern Fiscal | LC | We, Gr, Se | PT | PH |
| 202 Lanius excubitor | Great Grey Shrike | LC | Mi | OO | DO |
| 203 Lanius collurio/isabellinus | Red-backed/Isabelline Shrike | LC | Mi | PT | DO |
| **Malacoctidae (3)** | | | | | |
| 204 Laniarius aethiopicus | Ethiopian Boubou | LC | Br, Gr, Se | CT, OO, PT | PH |
| 205 Dryoscopus cubla | Northern Puffback | LC | Br, Gr, Se | OO, PT | AU |
| 206 Tchagra senegalus | Black-crowned Tchagra | LC | Br | OO | DO |
| **Oriolidae (3)** | | | | | |
| 207 Oriolus oriolus | Eurasian Oriole | LC | Mi | OO, PT | PH |
| 208 Oriolus larvatus rolleti | Black-headed Oriole | LC | Br | OO, PT | DO |
| 209 Oriolus monacha | Abyssinian Oriole | LC | Br, Bf | OO, PT | PH |
| **Corvidae (3)** | | | | | |
| 210 Corvus capensis | Cape Crow | LC | Se | PT | PH |
| 211 Corvus rhipidurus | Fan-tailed Raven | LC | Se | PT | PH |
| 212 Corvus griseirostris | Thick-billed Raven | LC | Gr, Se | CT, OO, PT | PH |
| Species/family | Common name | IUCN | Habitat | Identification | Verification |
|---------------|-------------|------|---------|----------------|--------------|
| *Buphagidae* (1) | | | | | |
| 213 | Buphagus erythrorynchus | Red-billed Oxpecker | LC | Gr | OO | PH |
| *Sturnidae* (8) | | | | | |
| 214 | Poeoptera stuhlmanni | Stuhlmann’s Starling | LC | Br | OO, PT | PH |
| 215 | Onychognathus morio | Red-winged Starling | LC | Br | OD | DO |
| 216 | Onychognathus tenuirostris | Slender-billed Starling | LC | Br, Gr | PT | DO |
| 217 | Lamprotornis chalybeus | Greater Blue-eared Starling | LC | Br, Gr, Se | OO, PT | PH |
| 218 | Lamprotornis splendidus | Splendid Starling | LC | Br, Gr | OO, PT | DO |
| 219 | Lamprotornis purpuroptera | Rüppell’s Starling | LC | Gr | OO, PT | AU |
| 220 | Pholia sharpii | Sharpe’s Starling | LC | Br, Gr | OO, PT | PH |
| *Passeridae* (1) | | | | | |
| 221 | Passer swainsoni | Swainson’s Sparrow | LC | Gr, Se | OO, PT | PH |
| *Ploceidae* (7) | | | | | |
| 222 | Ploceus cucullatus abyssinus | Village Weaver | LC | Se | OO, PT | DO |
| 223 | Ploceus ocularis | Spectacled Weaver | LC | Br, Gr, Se | OO, PT | DO |
| 224 | Ploceus nigricolis | Black-necked Weaver | LC | Br | OO | PH |
| 225 | Ploceus baglafecht | Baglafecht Weaver | LC | Br, Gr, Se | OO, PT | DO |
| 226 | Amblyospiza albifrons | Grosbeak Weaver | LC | Br, We | PT | PH |
| 227 | Anaplectes rubriceps | Red-headed Weaver | LC | Br | OO | DO |
| *Viduidae* (5) | | | | | |
| 228 | Anomalospiza imberbis | Cuckoo Finch | LC | Br, We | OO | DO |
| 229 | Euplectes axillaris | Fan-tailed Widowbird | LC | Br, We | PT | DO |
| 230 | Euplectes albonotatus | White-winged Widowbird | LC | Br, We | PT | DO |
| 231 | Vidua macroura | Pin-tailed Whydah | LC | Gr, Se | OO | DO |
| 232 | Vidua chalybea | Village Indigobird | LC | Gr, Se | OO | PH |
| *Estrildidae* (8) | | | | | |
| 233 | Mandingoa nitidula | Green Twinspot | LC | Br | OO | DO |
| 234 | Cryptospiza salvadorensis | Abyssianian Crispwing | LC | Br, Bf | PT | AU |
| 235 | Lagonosticta senega | Red-billed Firefinch | LC | Gr, Se | OO, PT | PH |
| 236 | Coccopygia quitonia | Yellow-bellied Waxbill | LC | Br, Gr, Se | OO, PT | PH |
| 237 | Estrilda astrild peasei | Common Waxbill | LC | Gr, Se | CT, OO, PT | PH |
| 238 | Estrida (Paludicola) ochrogaster | Abyssianian Waxbill | LC | Gr, Se | OO, PT | DO |
| 239 | Lonchura cucullata | Bronze Mannikin | LC | Gr, Se | OO | DO |
| 240 | Spermestes bicolor poensis | Black-and-white Mannikin | LC | Br, Gr | PT | PH |
| *Fringillidae* (4) | | | | | |
| 241 | Serinus mozambicus | Yellow-fronted Canary | LC | Gr | OO | DO |
| 242 | Serinus citrinelloides | African Citril | LC | Gr, Se | OO, PT | PH |
| 243 | Serinus tristriatus | Brown-rumped Seedeater | LC | Gr, Se | OO, PT | PH |
| 244 | Serinus striolatus | Streaky Seedeater | LC | Gr, Se | PT | PH |
Image 3. Photographic records of bird species observed in Sheka Forest Biosphere Reserve: A. *Lybius bidentatus* | B. *Hirundo smithii* | C. *Anthus cervinus* | D. *Saxicola* (torquatus) albofasciatus | E. *Turdus* (olivaceus) abyssinicus | F. *Zoothera piaggiae* (camera trap recording) | G. *Myioparus plumbeus* | H. *Bradypterus cinnamomeus*
Twelve of the bird species observed inside the reserve are considered endemic to the Horn of Africa. All of these endemic species were encountered regularly within suitable habitat. Details on species identification are listed below (except for *Rougetius rougetii*, already discussed above):

**Bostrychia carunculata**
A dark ibis with white shoulder patches and a small wattle hanging from its throat. Common and abundant around highland wetlands and grasslands.

**Pternistis castaneicollis**
A large francolin with black forehead and creamy white belly. Uncommon but widespread in a variety of open woodland and forest edges, where often identified by its early morning call. On one occasion a large group (six birds) was seen in a tea plantation near the Gebba River.

**Poicephalus flavifrons** (Image 2C)
A medium-sized green parrot, identified by the presence of yellow colouring on the head. Common in a wide variety of forest and woodland, rare around farmland.

**Agapornis taranta** (Image 2D)
A bright green lovebird with green rump and red forehead. Common in highland woodland, rather rare in a variety of other habitats.

**Lybius undatus**
A barbet with red forecrown and barred plumage. Rare in open highland forest but common in lowland forest areas near Tepi.

**Dendropicos abyssinicus**
Small woodpecker with green back, heavily barred wings and bright red rump. Common in a variety of highland forest where identified and photographed on several occasions during the study.

**Melaenornis chocolatinus**
A large, dark grey-brown highland flycatcher with conspicuous yellow eye. Very common around settlements and a wide variety of other highland
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(habitats.

**Cisticola (galactotes) lugubris**

A cisticola with black and grey streaked mantle and rufous crown. Extremely common and abundant around wetland, highland moorland and big rivers.

**Parophasma galinieri**

A distinctive grey bird with whitish forehead and orange-red undertail coverts. Common in highland bamboo forest, where recorded in high densities in forest edges around moorlands, very rare elsewhere.

**Oriolus monacha** (Image 4B)

A large black-headed oriole with grey wing panel. Very common in a wide variety of highland habitats, not restricted to forests.

**Corvus crassirostris**

A large raven with white patch on nape and very large bill. Common and abundant around settlements and farmland, rare around wetlands and open forest and not recorded from the core zones.

**DISCUSSION**

This study highlights the importance of the Sheka Forest Biosphere Reserve for globally threatened and Ethiopian endemic bird species, and in particular raptors and vultures. The results not only emphasize a high species richness in the reserve, but also indicate the importance of the proposed zonation, with increased control and protection, for bird conservation. Our findings are comparable to other recent ornithological studies in Ethiopia (e.g., Engelen et al. 2017; Rodrigues et al. 2018), showing a structurally diverse landscape, mostly in traditional low-intensity use, supporting a diverse range of bird species, and with undisturbed forest habitats and wetlands presenting a central refuge for vulnerable range-restricted and specialist bird species.

Our inventories were nevertheless confined to the short Ethiopian rainy season, as well as a subset of kebeles and transition-, buffer-, and core zones. Additional bird species, including seasonally present migrants, can undoubtedly be recorded during future studies in different periods and subregions. For instance, two endemic red-listed species, expected to occur in the reserve based on distribution maps, were not found (*Macronyx flavicollis* and *Cyanochen cyanoptera*).

More extensive surveys, specifically during the long rainy season and in the vast moorlands in the eastern highlands of Anderacha woreda might still indicate their continued presence. In addition, point transect surveys were mainly conducted to map species diversity and distributions across habitats, but were inadequate to accurately characterize the relative abundance of species in the reserve. Thus, our study provides a first indication of bird species richness in Sheka forest, and is a baseline that needs complementary monitoring studies to provide more detailed insights in its species composition, population sizes and dynamics. Our study also showed the added value of camera trapping to record crepuscular species, with *Pternistis squamatus* and *Zoothera piaggiae* only being visually observed through camera trap observations.

The large elevation and climatic differences that are present in the reserve add up to a large habitat variation and exceptionally rich bird diversity, underlining the protected status assigned to Sheka forest and the urge to safeguard its habitats from ongoing degradation. Our observations furthermore emphasize the understudied nature of this remote biosphere reserve and the importance of continued biodiversity studies to inform conservation planning. The forests of Sheka provide innumerable services to local communities and many people are directly relying on forest resources for their subsistence. As a result, the forests have been sustained through a long tradition of natural resource management (Woldemariam & Fetene 2007), making Sheka Forest Biosphere Reserve an ideal subject for directed long-term and community-based initiatives to conserve some of the largest remaining Afromontane rainforests.

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