# NABU's Follow-up Biodiversity Assessment at the Kafa Biosphere Reserve, Ethiopia

Naturschutzbund Deutschland (NABU) e.V.
The Nature and Biodiversity Conservation Union
Charitéstraße 3
10117 Berlin, Germany
www.en.NABU.de



First published in 2020

This assessment has been part of the NABU project 'Community Action in Biodiversity and Forest Conservation and Adaptation to Climate Change in the Wild Coffee Forests (CAFA)'. This project has been supported by the German Federal Ministry for Economic Cooperation and Development (BMZ). The follow-up biodiversity assessment has been supported by NABU International Foundation for Nature.


**This report has been compiled by:**
Svane Bender
Dr Viola Clausnitzer
Dr Klaas-Douwe B. Dijkstra
Andreas Gminder
Dominic Kamau Kimani
Tom Kirschey
Holger Meinig
Ondřej Mikula
Dr Hendrik Müller
Abiy Tadele
Mengistu Wale
Bernhard Walter
Kiros Welegerima
Dr Meheretu Yonas

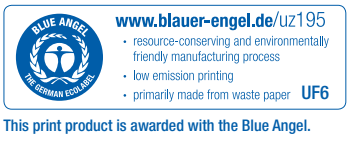
**Revised by:**
Svane Bender, Manja Graham, Stefanie Brandes, Ellen Externbrink

Selected maps have been produced and amended by NABU.

**Proposed citation:**
The Nature and Biodiversity Conservation Union (NABU) (eds.), 2020: NABU's Follow-up Biodiversity Assessment at the Kafa Biosphere Reserve, Ethiopia. Berlin, Addis Ababa.

**Editor's note:**
Although it was part of the overall assessment, the report does not include data on reptiles. As of the date of publication (April 2020), no report has been submitted by the expert in charge.

**Print:**
DBM Druckhaus Berlin-Mitte, a company after the Environmental management system EMAS III validated, produced according to RAL-UZ 195 Blue Angel, printed on 100% recycled paper



This print product is awarded with the Blue Angel.


**Design:**
springer f3, corporate communication, Cologne, Germany

**Photographs cover and back side:**
Cover: Bruno D'Amicis; back side: NABU/Tom Kirschey (frogs), Bernhard Walter (bird), Andreas Gminder (fungi), Viola Clausnitzer, Klaas-Douwe B. Dijkstra (dragonfly)

**Order/ISBN:**
The book is available at NABU's shop www.NABU-shop.de.
ISBN 978-3-925815-31-7

# NABU's Follow-up Biodiversity Assessment at the Kafa Biosphere Reserve, Ethiopia

# Table of Contents

# Participants of NABU's follow-up biodiversity assessment

### International experts

| | | |
|---|---|---|
| Dr Viola Clausnitzer | NABU member | Odonata |
| Dr Klaas-Douwe B. Dijkstra | Private | Odonata |
| Andreas Gminder | NABU member | Fungi |
| Dominic Kamau Kimani | National Museums of Kenya | Birds |
| Tom Kirschey | NABU Headquarters | Amphibians/Reptiles |
| Holger Meinig | NABU member | Mammals |
| Ondřej Mikula | Czech Academy of Sciences | Mammals |
| PD Dr Hendrik Müller | Friedrich-Schiller-University Jena | Amphibians/Reptiles |
| Bernhard Walter | NABU Working Group Africa | Birds |

### Ethiopian experts

| | | |
|---|---|---|
| Zinaw Asaye | Bonga University | Fungi |
| Eskedar Asfaw | Bonga University | Fungi |
| Dr Yodit Ayele | Bonga University | Birds |
| Habtamu Deribe | Bonga University | Fungi |
| Gebre Egzeabeher | Ethiopian Biodiversity Institute | Odonata |
| Abeje Kassie | Ethiopian Biodiversity Institute | Amphibians/Reptiles |
| Manaye Misganaw | Ethiopian Biodiversity Institute | Odonata |
| Seid Muhammad | Bonga University | Odonata |
| Teferi Paulos | Bonga University | Odonata |
| Mintesinot Shetachew | Office of Environment Forest and Climate Change Control | Birds |
| Abiy Tadele | Bonga University | Mammals |
| Woldemariam Tesfahunegn | Ethiopian Biodiversity Institute | Birds |
| Mengistu Walle | Ethiopian Biodiversity Institute | Mammals |
| Kiros Welegerima | Mekelle University | Birds |
| Tariku W/Michael | Office of Environment Forest and Climate Change Control | Amphibians/Reptiles |
| Dr Meheretu Yonas | Mekelle University | Mammals |

### NABU representatives

| | | |
|---|---|---|
| Asaye Alemayehu | NABU Project Office Bonga | Natural Resource Management Officer |
| Stefanie Brandes | NABU Headquarters | Project Coordinator German side |
| Yalemwas Endalkachew | NABU Project Office Bonga | Finance and Administration Officer |
| Yonas Gezahegn | NABU Project Office Bonga | Driver |
| Geremew Legesse | NABU Head Office Addis Ababa | Driver |
| Abdurazak Sahile | NABU Project Office Bonga | Communication Officer |
| Marie Schoroth | NABU Headquarters | Trainee |
| Anteneh Tamirat Bogale | NABU Headquarters | Intern |
| Mesfin Tekle | NABU Project Office Bonga | Senior Local Project Coordinator |

### Field assistants and rangers

| | | |
|---|---|---|
| Mohamed Abamecha | NABU ranger | Birds |
| Admasu Assefa | NABU ranger | Amphibians/Reptiles |
| Wondwosen Bekele | NABU Project Office Bahir Dar | All teams |
| Abebe Belachew | NABU ranger | Fungi |
| Mitiku Gebremariam | NABU ranger | Odonata |
| Abera Hoeto | NABU ranger | Odonata |
| Siraj Hussen | NABU ranger | Mammals |
| Girma Kebede | NABU ranger | Amphibians/Reptiles |
| Wodajo Kebede | NABU ranger | Fungi |
| Nasir Ousiman | NABU ranger | Birds |
| Abdu Siraj | NABU ranger | Mammals |
| 3 drivers | | |

# List of abbreviations

| | |
|---|---|
| **a.s.l.** | above sea level |
| **BMU** | German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety |
| **BMZ** | German Federal Ministry for Economic Cooperation and Development |
| **CAFA** | Community Action for Biodiversity and Forest Conservation and Adaptation to Climate Change in the Wild Coffee Forests |
| **CBD** | The UN Convention on Biological Diversity |
| **CHEG** | A collection of fungi, with members of the Clavariacaeae, Hygrocybe, Entolomataceae and Geoglossaceae |
| **CR** | Critically Endangered |
| **CYTB** | Mitochondrial cytochrome b |
| **DFSC** | Danida Forest Seed Centre |
| **DMDP** | Danida Market Development Partnerships |
| **DMFA** | Danish Ministry of Foreign Affairs |
| **DNA** | Desoxyribonucleic acid |
| **EBI** | Ethiopian Biodiversity Institute |
| **EN** | Endangered |
| **EWNHS** | Ethiopian Wildlife and Natural History Society |
| **FAO** | Food and Agriculture Organization of the United Nations |
| **GRV** | Great Rift Valley |
| **GIZ** | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| **IBA** | Important Bird Area |
| **IBC** | Institute of Biodiversity Conservation |
| **ICRAF** | World Agroforestry |
| **IKI** | International Climate Initiative |
| **IPGRI** | International Plant Genetic Resources Institute |
| **ITS** | Internal Transcribed Spacer |
| **IUCN** | International Union for Conservation of Nature |
| **Kafa BR** | Kafa Biosphere Reserve |
| **KBA** | Key Biodiversity Area |
| **KDA** | Kafa Development Association |
| **MoARD** | Ministry of Agriculture and Rural Development |
| **NABU** | The Nature and Biodiversity Conservation Union |
| **NGO** | Non-Governmental Organisation |
| **NT** | Near Threatened |
| **PFM** | Participatory Forest Management |
| **RFPA** | Regional Forest Priority Area |
| **SAFORGEN** | The sub-Saharan African Forest Genetic Resources Programme |
| **SNNPR** | Southern Nations, Nationalities and Peoples‘ Region |
| **SSC** | Special Survival Commission |
| **UNESCO** | United Nations Educational, Scientific and Cultural Organization |
| **VU** | Vulnerable |
| **WBISPP** | Woody Biomass Inventory and Strategic Planning Project (Ethiopia) |
| **ZFMK** | Zoologisches Forschungsmuseum Alexander Koenig |

# Organisational profile

For 120 years, **NABU (The Nature and Biodiversity Conservation Union)** has been promoting the interests of people and nature, drawing on its unwavering commitment, specialised know-how and the backing of 770,000 members and supporters. NABU is Germany's oldest and largest conservation NGO with its headquarters in the capital and 15 regional branch offices in almost every federal state of Germany. 2,500 volunteer groups around the country support NABU's work.

NABU has clearly defined aims: providing environmental education, preserving habitat and species biodiversity, promoting sustainable agriculture, forestry and water management and enhancing the profile of nature conservation within the society. NABU's work also targets global warming, species conservation, sustainable settlement, sustainable waste and infrastructure management and consumer protection.

NABU is the German partner of BirdLife International and supports partner organisations around the world.

Africa, Asia and Russia form the geographical focus of NABU's international commitment. Offices in several countries in Africa and Asia and in Brussels provide expertise and implement projects to conserve and manage habitat and species diversity. Fostering set up and management of protected areas, in particular UNESCO biosphere reserves, community-based ecosystem restoration and management, sustainable local development in collaboration with green entrepreneurs and farmers as well as adaptation to climate change and capacity development are amongst NABU's international core targets. In Ethiopia NABU runs several offices in the capital and in different parts of the country implementing large projects since 2006.

**Contact:**
Svane Bender
Deputy Head of International Affairs/
Head of Africa Programme
Email: Svane.Bender@NABU.de
www.en.NABU.de

# Acknowledgements

Foremost, NABU would like to express its gratitude to the German Federal Ministry for Economic Cooperation and Development (BMZ) for supporting the project 'Community Action for Biodiversity and Forest Conservation and Adaptation to Climate Change in the Wild Coffee Forests (CAFA)' and thus as part of it, this follow-up assessment.

The assessment has additionally been supported by NABU International – Foundation for Nature.

We also would like to express our thankfulness to the Ethiopian, Czech, Dutch, German and Kenyan experts who contributed to the success of the assessment by participating in the fieldwork in the rainy season, vividly analysing species and findings and producing the reports for this overall assessment report.

Moreover, we would like to sincerely thank our partners for this assessment which are the Ethiopian Biodiversity Institute (EBI) for facilitating data collection and sample permits, the Kafa Zone Administration and Office of Environmental Protection, Forest and Climate Change Control as well as Bonga University and Mekelle University.

We would also like to thank the local communities for their openness to our field study and the welcoming atmosphere they provided to our international teams in the field.

We further convey our utmost thankfulness and appreciation to our NABU teams in Bonga, Addis Ababa and Berlin for preparing, hosting and facilitating this assessment.

*Svane Bender*
*NABU Headquarters*
*Deputy Head of International Affairs/*
*Head of Africa Programme*

# Executive summary

From 30 July to 13 August 2019 NABU hosted the second biodiversity assessment at the Kafa Biosphere Reserve (BR) as follow-up to a first one held in 2014. A team of nine international experts from the Czech Republic, Germany, Kenya and the Netherlands, 16 Ethiopian experts from partnering institutions and science as well as 10 NABU rangers and nine NABU team members conducted intensive field work on amphibians, birds, dragonflies and damselflies, fungi and small- and medium-sized mammals. NABU has been working towards the protection of Kafa's unique environment with national and international partners and support from the German government since 2006. We aim to ensure the conservation and restoration of the Afromontane cloud forests and their wetlands to preserve ecosystem resilience and unique biodiversity, reduce $CO_2$ emissions and sustain ecosystem services for local communities. In cooperation with local communities, ecosystems shall be assessed and restored, secured and transformed into sustainable, participative community management.

The Kafa BR in south-western Ethiopia (Southern Nations, Nationalities and Peoples' Region, SNNPR) combines a distinctive richness of culture and biodiversity, which is unique among paleotropical regions. Up to 2014, however, the immense local biodiversity had not been professionally assessed and documented. This changed with **NABU´s first biodiversity assessment** where 12 taxa were assessed for the first time. This assessment detected a high biological diversity at habitat level and in species per habitat. The identified habitats envisaged a high heterogeneity and were located in only short distances from each other. Particularly outstanding was the discovery of approximately 50 new species to science (mostly insects). Based on experts' knowledge and the subsequent analysis of the results, 29 indicator species and 16 flagship species were selected among the recorded species.

With a **second, follow-up assessment in the rainy season** of 2019, NABU aimed to obtain comparable and new data on the status of biodiversity between years and seasons for specific taxonomic groups. Additionally, the second assessment further developed the capacities of the local authorities which ensures the continuation of regular assessments at the Kafa BR even without initiation and large-scale support by NABU. The gathered data will be analysed and incorporated into the biodiversity monitoring scheme.

This report presents the results of **the follow-up assessment**. The following was found: At least 515 species have been recorded, 31 of which at the minimum are new to science (mainly fungi and one amphibian species) and 276 of which are new to Ethiopia. 29 species are endemic. The highest biodiversity was found in core areas of the biosphere reserve such as Mankira and Komba Forest as well as in natural and semi-natural habitats in general.

The assessment was part of NABU's current project 'Community Action for Biodiversity and Forest Conservation and Adaptation to Climate Change in the Wild Coffee Forests (CAFA)' supported by the German Federal Ministry for Economic Cooperation and Development (BMZ).

# Background and approach

**Svane Bender**

# 1. Introduction

From 30 July to 13 August 2019 NABU hosted a second assessment at the Kafa Biosphere Reserve (Kafa BR) as follow-up to a first one held in 2014. A team of nine international experts from the Czech Republic, Germany, Kenya and the Netherlands, 16 Ethiopian experts from partnering institutions and science as well as 10 NABU rangers and nine NABU team members conducted intensive field work on various taxa. The assessment was part of NABU's project 'Community Action for Biodiversity and Forest Conservation and Adaptation to Climate Change in the Wild Coffee Forests (CAFA)'.

This report presents the results and findings of our second in-depth biodiversity assessment. By highlighting the findings and analysed data of all surveyed taxa except reptiles (amphibians, birds, dragonflies and damselflies, fungi, small- and medium-sized mammals) this report is another step forward in verifying and significantly expanding existing knowledge on species, their habitats and their major threats at the Kafa BR.

The assessment report is structured as follows: The introduction in the first part outlines the objectives of the follow-up assessment as well as its role and merits for NABU's work at the Kafa BR. It is followed by a description of the research area (Chapter 2). The analytical framework of the follow-up biodiversity assessment is outlined in the methodology section (Chapter 3). Subsequently, the overall results of the follow-up biodiversity assessment are highlighted (Chapter 4).

The second part contains the detailed reports of the assessment for the single taxa.

## 1.1 Objectives of the follow-up biodiversity assessment

The Kafa BR in south-western Ethiopia (Southern Nations, Nationalities and Peoples' Region, SNNPR) combines a distinctive richness of culture and biodiversity, which is unique among paleotropical regions. Therefore, the highly specialised and locally adapted fauna and flora occurring in complex habitats are of international conservation value and of immense economic value to both the local communities and the global community. Up to 2014, however, the immense local biodiversity had not been professionally assessed and documented. This changed with NABU's first biodiversity assessment from 3 to 13 December 2014 where 12 taxa were assessed for the first time. The first biodiversity assessment detected a high biological diversity at the Kafa BR. This was reflected by the high diversity at habitat level and in species per habitat. The identified habitats envisaged a high heterogeneity and were located in only short distances from each other. Particularly outstanding was the discovery of approximately 50 new species to science (mostly insects). Based on experts' knowledge and the subsequent analysis of the results, 29 indicator species and 16 flagship species were selected among the recorded species. 13 out of 16 flagship species also served as indicator species. Out of the 29 indicator species, 15 were found for montane, bamboo and floodplain forests (five trees, three birds, two tree frogs, two bats, two fungi and one primate) and 14 are indicators for wetland and river areas (nine birds, four insects and one mollusc).

The overall goal of NABU's follow-up assessment was to repeat the assessment conducted in the dry season of 2014 with some of the taxonomic groups (amphibians, birds, dragonflies and damselflies, fungi, small- and medium-sized mammals) in the rainy season. This was considered essential to obtain comparable and new data on the status of the Kafa BR's biodiversity between years and seasons. As in 2014 the follow-up assessment concentrated on the status of indicator and flagship species and determined their threat status. By repeating the assessment during the rainy season, it was considered very likely to find additional new species. Moreover, the second assessment further strengthens the capacity of the local authorities which ensures the continuation of regular assessments at the Kafa BR even without initiation and large-scale support by NABU. The gathered data will be analysed and incorporated into a biodiversity monitoring scheme. This will help to preserve the area's unique diversity.

NABU highly acknowledges Ethiopia´s efforts and success in biodiversity conservation and the fight against biopiracy. The assessment contributes towards Ethiopia's aims to meet international, national and local targets for biodiversity conservation including international conventions such as the Convention on Biological Diversity (CBD) and the Nagoya Protocol.

## 1.2 NABU's work at Kafa

NABU has worked towards the protection of Kafa's unique environment with national and international partners and support of the German government since 2006. From 2006 to 2010, NABU lead the establishment of the Kafa BR from application up to recognition by UNESCO's Man and the Biosphere Programme in the wider framework of a wild coffee related Public Private Partnership project. The UNESCO concept opened up new opportunities for the region and for the country as a whole: untouched natural core zones, surrounding buffer zones and a large development zone would offer room for conservation, research and development. The process of establishing an appropriate zoning and planning of the biosphere reserve, in order to ensure

the protection of the marvellous forests, took place with the support and involvement of more than 500 governmental representatives of the region. In 2010, the Kafa BR was finally recognised by UNESCO as one of the first biosphere reserves in Ethiopia. In the course of the successful establishment of the Kafa BR, NABU, the former Ministry of Science and Technology of the Federal Democratic Republic of Ethiopia and UNESCO signed a memorandum of understanding to establish further biosphere reserves in Ethiopia, for instance Lake Tana Biosphere Reserve. In order to strengthen the Kafa BR, NABU expanded its activities in the region and initiated a series of large-scale projects supported by the German government as well as smaller interventions with support from private foundations and individuals.

NABU aims to ensure the conservation and restoration of the Afromontane cloud forests and their wetlands in order to preserve ecosystem resilience and unique biodiversity, reduce $CO_2$ emissions and sustain ecosystem services for local communities. In cooperation with local communities, ecosystems shall be assessed and restored, secured and transformed into sustainable, participative community management.

Until point of publication of this report NABU supported the Kafa region through a series of projects:

- *Coffee-novation*: Green diversification of Ethiopia's garden coffee value chain (2019-2023, supported by the Danida Market Development Partnerships (DMDP) programme, Danish Ministry of Foreign Affairs (DMFA)).

- Community Action for Biodiversity and Forest Conservation and Adaptation to Climate Change in the Wild Coffee Forests (CAFA, 2017-2020, supported by the German Federal Ministry for Economic Cooperation and Development (BMZ)).

- Biodiversity under Climate Change: Community Based Conservation, Management and Development Concepts for the Wild Coffee Forests (2014-2017, supported by the International Climate Initiative (IKI) of the German Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)).

- Climate Protection and Preservation of Primary Forests – A Management Model using the Wild Coffee Forests in Ethiopia as an Example (2009-2013, supported by BMU).

- Introduction of Sustainable Coffee Production and Marketing Complying with International Quality Standards using the Natural Resources of Ethiopia (2006-2008, Public Private Partnership supported by GIZ).

**More information at:**
www.en.nabu.de/projects/ethiopia/kafa

# 2. Physical and cultural context of the research area

## 2.1 Geomorphology

Ethiopia's geological and tectonic characteristics are strongly shaped by the Ethiopian magma dome and the development of the East African Rift system. The soils originate from rocks formed during the tertiary period and the subsequent geomorphic processes. They are characterised as deep, red, brown-grey and brown clay soils. The Ethiopian magma dome, shaped by a series of volcanic activity and geological formation in different geological eras, forms the foundation of the Ethiopian Highland (Dennis Moss Partnership, 2009). As a result of these complex geological processes, the Ethiopian landscape is very diverse, ranging from vast plains to Alpine-like mountain ranges. Sometimes referred to as the 'Roof of Africa', the Ethiopian Highlands form the largest continuous area of its altitude on the whole continent, with little of its surface falling below 1,500 m above sea level (m a.s.l.) and peaks of up to 4,550 m a.s.l. The Kafa Zone situated in the western plateau of these highlands is located on the tertiary layers, consisting mainly of sandstone and limestone, and of tertiary volcanic rocks.

The topography of the study area is characterised by a complex system of highlands, steep valleys and large flatlands, which drops to the lowlands in the south. The area's altitude ranges from 1,020 m a.s.l. in the south to 3,350 m a.s.l. in the north-east with its lowest point east of Wacha in the Sherma Plain and its highest mountain range south of Kaka (Angiyo Kolla Mountain Range) (Dresen et al., 2015). The altitudinal variation results in extreme slope gradients, ranging from flat lowlands (e.g. south of Konda in the Gojeb Wetland) to extremely steep (>60°) areas (e.g. Machachi Forest, Latitude 7.190556, Longitude 35.985833) (Figure 1).

About 1.2% (8,360 ha) of the total biosphere reserve's spatial extent is very steep terrain (>35°) covered by tropical Afromontane cloud forest (Whitmore, 1993), plantations (80%) and agriculture (12%). All other steep areas are savannah or are covered by bush land. The most remarkable highlands include the Gurgura Mountains, Shonga Mountains, Yatana Mountains and Gola Mountains, along with Koma Summit and Saja Summit. Alemgono and Gojeb Wetland are the most extensive wetlands (Figure 2).

Mountains and wetlands are connected by numerous fertile valleys and lowlands, which extend mostly through the central part of the biosphere reserve (Figure 3). This great variety of landforms is responsible for highly diverse climate, soil and vegetation. According to the soil map produced by the WBISPP (2004), the dominant soils in the Kafa Zone are dystric nitosols (Nd). Adiyo, the south-western part of Telo and north and north-west of the Gewata Woredas are dominated by orthic acrisols (Ao). In addition, eutric fluvisols (Je), chromic luvisols (Lc), chromic vertisols (Vc) and pellic vertisols (Vp) can be found at the Kafa BR to varying degrees (EWNHS, 2008).

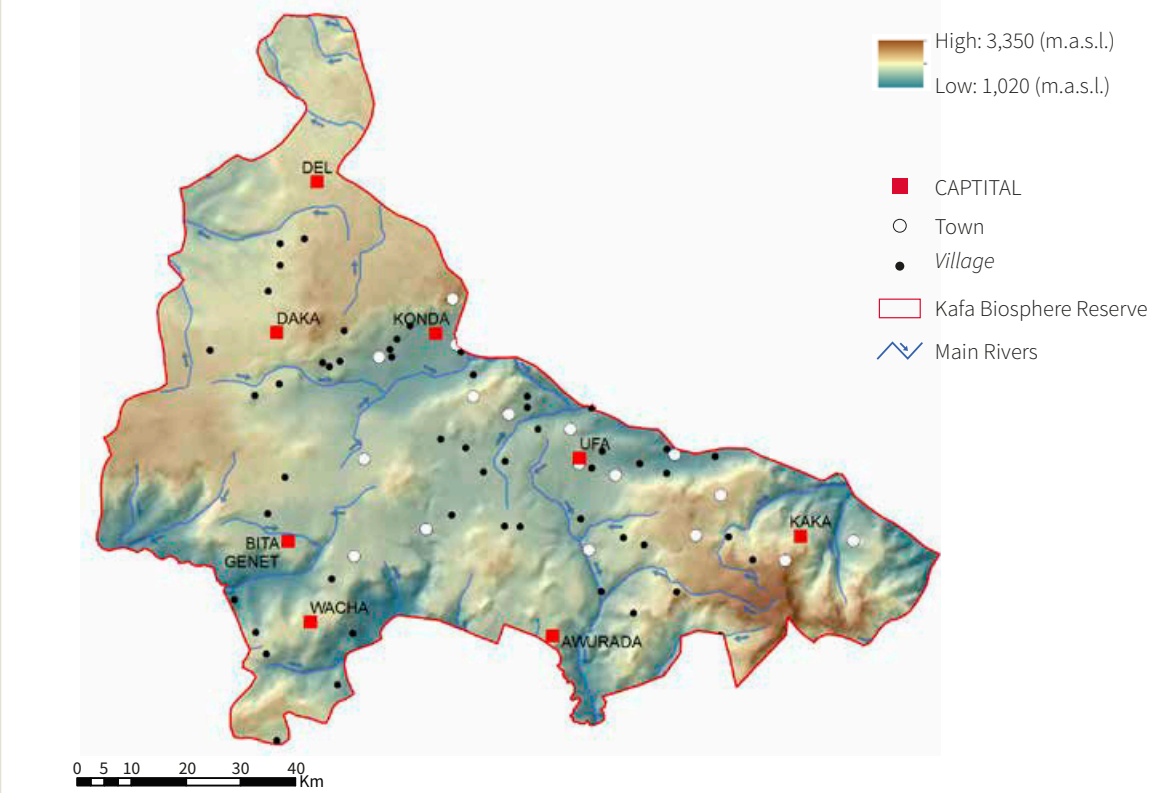



**Figure 1:** Altitudinal range at the Kafa BR (Dresen et al., 2015)



-> back to content

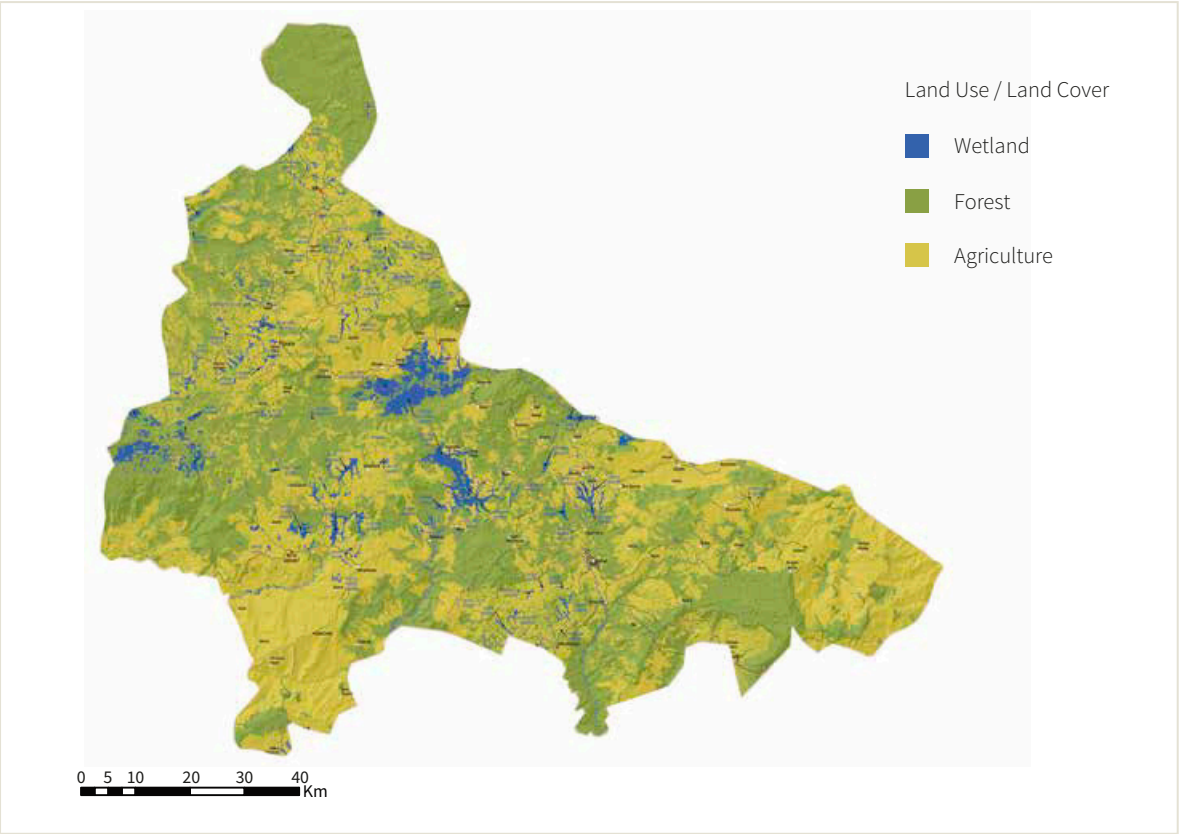



**Figure 2:** Wetlands at the Kafa BR (Dresen et al., 2015)

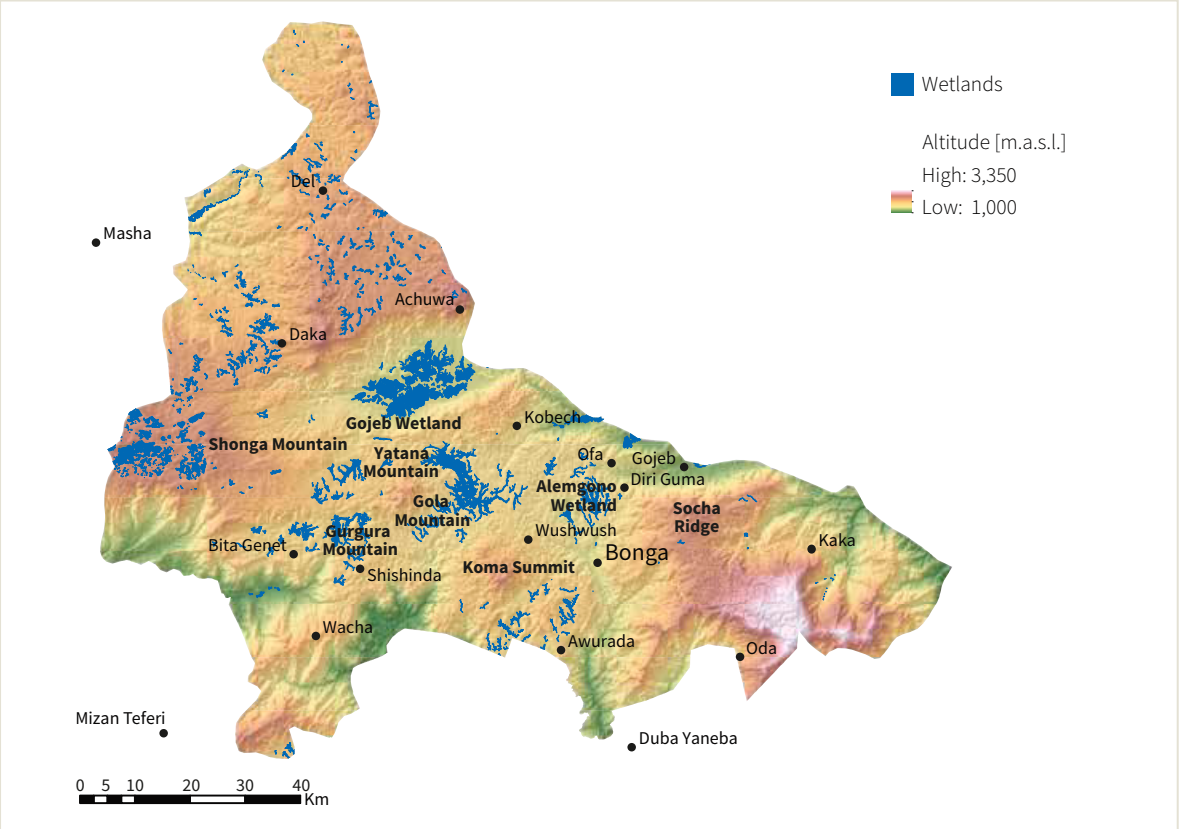



**Figure 3:** Topographic features of the Kafa BR

## 2.2 Climate

In general, the climate is characterised by a bimodal rainfall pattern, with the main rainy season between June and September and a short rainy period from February to April. Kafa receives its rainfall from the south-west monsoon, which reaches its maximum intensity during July and August. The average annual rainfall ranges from 1,500 mm in the lowlands up to 2,000 mm at the highest elevations (EWNHS, 2008). Thus, the Kafa BR is in the most humid part of the country, with only two to four dry months per year. According to Gamachu (1977), annual temperatures vary between 15 and 24°C. Due to the high variety of landscapes and altitudes within the Kafa BR, there are many microclimatic deviations from the usual rainfall patterns. According to Kassahun & Bender (2020) using statistical long-term data from the Climate Explorer Koninklijk Nederlands Meteorologisch Instituut Climate Change Atlas 2018 (accessed in May 2018) the temperatures are increasing significantly (Figure 4), while the precipitation is decreasing (Figure 5).

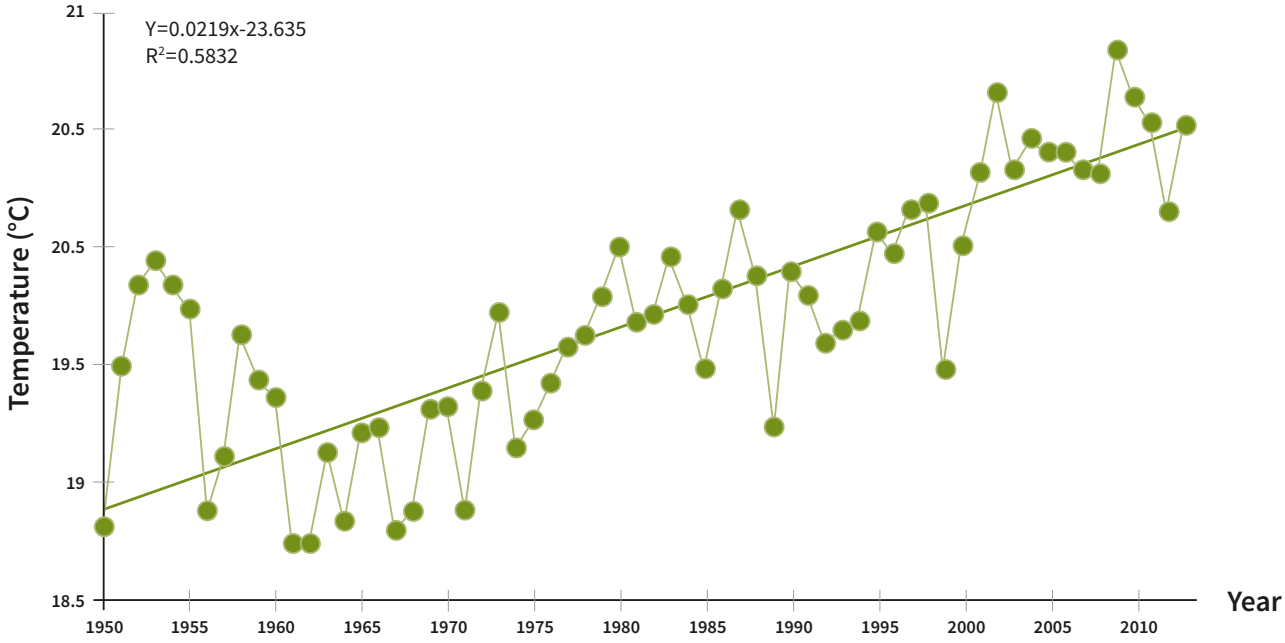



**Figure 4:** Increasing annual average temperatures at the Kafa BR (1950-2013, adapted from Kassahun & Bender, 2020)

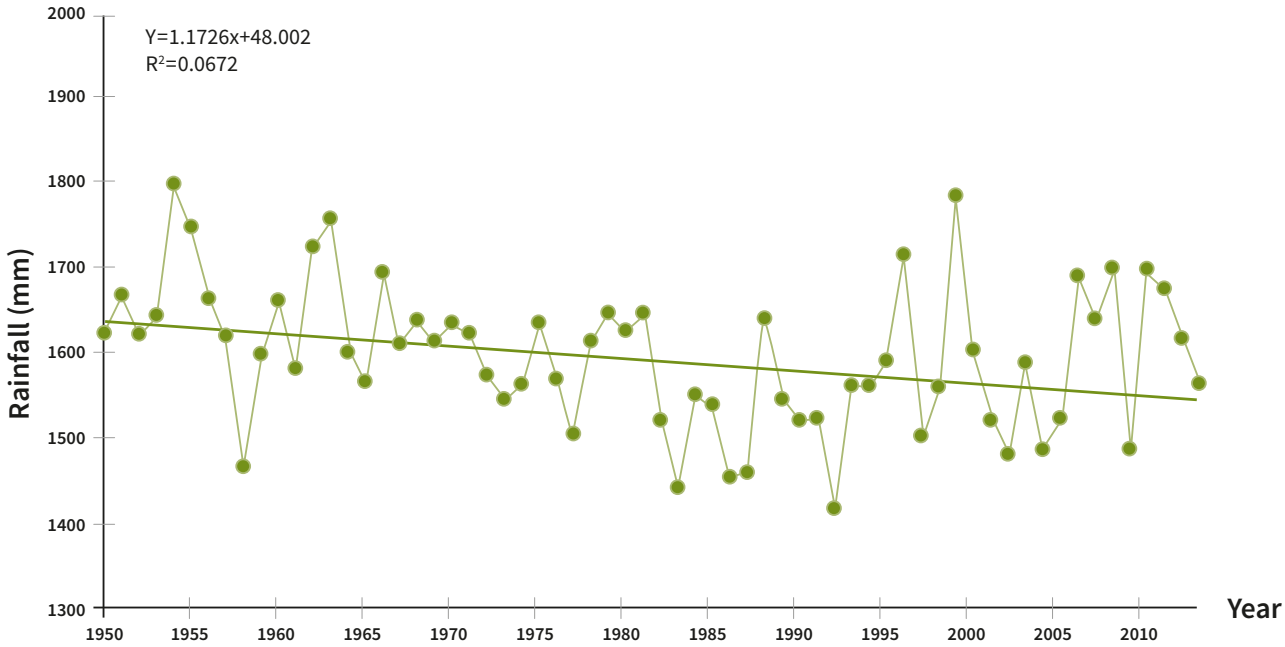



**Figure 5:** Decreasing trend for precipitation at the Kafa BR (1950-2013, adapted from Kassahun & Bender, 2020)

## 2.3 The Kafa Biosphere Reserve

The Kafa BR is located in the south-western highland region of Ethiopia, in the Southern Nations, Nationalities and Peoples' Region (SNNPR, Figure 6). It was designated as UNESCO biosphere reserve in 2010. Its planning and establishment as one of the first biosphere reserves of Ethiopia was a widely appreciated success under the technical guidance of NABU and within the framework of a German Public Private Partnership project (Bender-Kaphengst & Tekle, 2019).

The Kafa Zone has a total area of around 10,000 km² of which the Kafa BR covers more than 7,500 km². 47% of the Kafa BR are covered by forest with 4% (28,172 ha) being core zones serving as a refuge for endemic or endangered species (The Nature and Biodiversity Conservation Union, 2017). The region is characterised by Afromontane cloud forests and rain forests, which contain wild *Coffea arabica*, bamboo forests, grasslands and shrub lands (The Nature and Biodiversity Conservation Union, 2017). Because of its relevance to national biodiversity and as a catchment area, the Ethiopian government has put the area under partial national protection in the form of a Regional Forest Priority Area (RFPA). The area is particularly noteworthy for being the origin and the centre of *Coffea arabica*'s genetic diversity (valued at ~1.5 billion US$) and therefore as a globally significant *in situ* gene bank. The overall economic value of *Coffea arabica* has been estimated at approximately 1.5 billion US$ (Hein & Gatzweiler, 2006).

Different political and demographic factors have driven changes in land use and land cover in the Kafa Zone. In the 1970s, major land redistribution occurred, followed by large-scale resettlement in the 1980s. The 1990s were shaped by the agricultural investment policy and the promotion of cereal production, along with the Ethiopian Forestry Action Plan. Finally, the 2000s were influenced by large-scale agricultural expansion, the establishment of National Forest Priority Areas, participatory forest management (PFM) projects and ultimately the UNESCO biosphere reserve (Tadesse et al., 2014).

The Kafa Zone has a little over 1 million inhabitants. The average population density of the Kafa BR is 130.14 p/km². Administratively, the Kafa BR consists of 11 Woredas, 256 Kebeles and 25 urban towns. According to a background study by Chernet (2008), the ethnic composition of the Kafa Zone is dominated by Kaffecho (81%), followed by Bench (6%), Amhara (6%) and Oromo (2%). The remaining 5% also include marginalised groups like Manja/Mano. The biggest religious group are Orthodox Christians (67%), followed by Protestants (20%) and Catholics (10%). There is also a small Muslim community (3%).

More than 90% of the inhabitants' livelihoods depend on subsistence farming, the sale of coffee (10% forest coffee/65% garden coffee), forest honey and the use of natural resources, e.g. for food, fuel, building material and medicinal plants or spices (SNNPR, 2013). Mainly grain is being cultivated, including the local Ethiopian grain species teff (*Eragrostis tef*), legumes and the locally important Abyssinian banana (*Ensete ventricosum*), whose starch-rich stem is fermented for bread. The most common livestock is cattle (7.5 per household, 2011/2012, local government), followed by poultry, sheep and goats. Wild coffee harvesting has been practised over centuries; complex tenure arrangements and traditions and rites have been developed (Bender-Kaphengst & Tekle, 2019).


**Figure 6:** Location of the Kafa BR at a continental, national and regional scale



-> back to content

Figure 7 shows the distribution of the population at the Kafa BR. Chena is the most densely populated district (Woreda), followed by Tello, Gesha, Gimbo and Adiyo Woredas. Most of the core zones at the Kafa BR are located in these Woredas along with most of its characteristic habitats, such as bamboo forests and wetlands.

UNESCO biosphere reserves have the explicit purpose of reconciling people's needs with nature conservation. Thus, the aim is to bring ecological, social and economic factors together to create sustainable ways of living (Bridgewater, 2002). At the Kafa BR, there are long traditions of using wild plants and animals for various purposes. However, traditional management techniques may no longer be sustainable due to pressures from population growth and resettlement programmes. New technologies and the economic interests of external actors have produced significant changes in land use management with detrimental effects on biodiversity and ecosystem services. Preserving biodiversity requires new land management approaches and techniques. In this sense, it is essential to consider socio-cultural factors when developing feasible conservation strategies and management plans.

While the initiative for the establishment of the Kafa BR was taken by NABU in 2006 in the frame of a German Public Private Partnership project, the Zone's government and the majority of the local population were positive about the reserve's establishment (Bender, 2011). NABU supervised the development of a UNESCO biosphere reserve at Kafa: The concept opened new opportunities for the region and for the country as a whole: untouched core zones of nature, surrounding buffer zones and a large development zone offer room for conservation, research and development. A large-scale biosphere reserve has the potential to increase the population's income through the international export of wild coffee and to provide additional marketing opportunities both for local products and for tourism to the birthplace of coffee. The existing participatory forest management scheme (PFM) could be easily extended and improved.

After an official consultation at regional and community levels, planning workshops were held and governmental staff were trained. Subsequently, demarcation committees were nominated and a time-consuming resource mapping was conducted together with all affected local communities. When all stakeholders had agreed upon a zoning scheme, the actual demarcation began with the support and involvement of more than 500 representatives of the region (Bender, 2011). The official managing entity was planned to be affiliated to the Kafa Zone Department of Agriculture & Rural Development in Bonga town and its related administrative offices in the countryside. In the communities, continuous communication gave people an understanding of the biosphere reserve concept which induced increased confidence building and made them committed multipliers and community representatives for all further activities. Finally, the reserve was accepted into UNESCO's world network of biosphere reserves in 2010 with the following features (see Table 1).

NABU's first biodiversity assessment detected high biological diversity at the Kafa BR, reflected in high diversity at both the habitat level and the species in each habitat. The identified habitats exhibited a high heterogeneity despite the short distance between them. Particularly outstanding was the record of approximately 50 species which are new to science or recorded for the Kafa region for the first time. The species comprised amongst others three fungi species (*Ascocoryne kafai* ined., *Cerinomyces bambusicola* ined., *Coniolepiota kombaensis* ined.), one mollusc species (*Pisidium sp.*), one species of *Hyperoliidae* (genus *Leptopelis*), two beetle species (*Pachysternum sp. nov. Tachinoplesius schoelleri Schülke*, 2016), four fly species (family *Diopsidae*), one bee species (genus *Colletes*) and one species of *Rhinolophus* from the horseshoe bat family. At least 40 further insect species new to science are to be expected. Another important finding was the extremely high rate of endemism. Most of the assessed taxa consisted of about 30% of endemic species. This high degree of endemism can be explained by the isolated vast highlands surrounded by dry lowlands, along with the area's geological and tectonic development. Combined with the exceptionally high rate of endemism, the high diversity at the habitat level and the heterogeneity of landscapes makes the Kafa BR an exceptional area for biodiversity protection.

Based on expert knowledge and the subsequent analysis of the results, 29 indicator species and 17 flagship species were identified from the recorded species. Thirteen out of 17 flagship species also serve as indicator species. Of the 29 indicator species, 15 are indicators for Afromontane, bamboo and floodplain forests (five trees, three birds, two tree frogs, two bats, two fungi and one primate) and 14 are indicators for wetland and river areas (nine birds, four insects and one mollusc). Deforestation was assumed to be the major threat for both indicator and flagship species occurring in forest areas, followed by habitat fragmentation and forest/habitat degradation. Drainage activities, agricultural run-offs, fertiliser and domestic and urban waste were identified as key threats to the biodiversity of river and wetland areas. It was concluded that further research was needed to specify and quantify these threats.

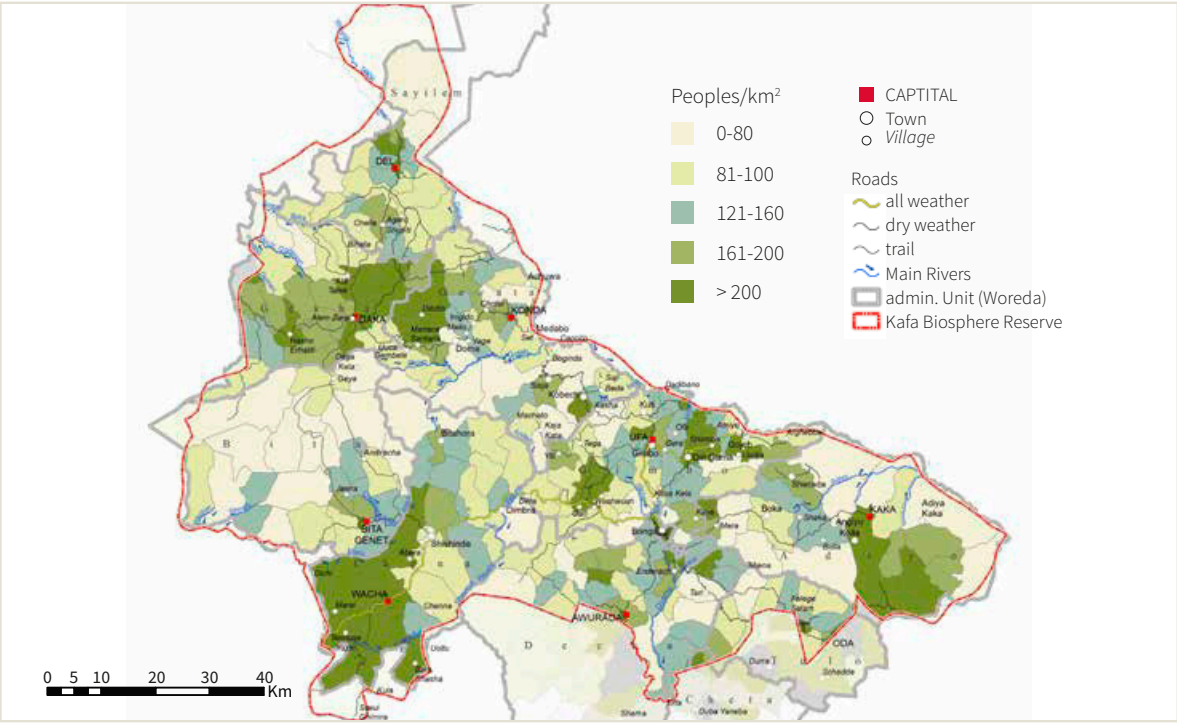



**Figure 7:** Population density at the Kafa BR (adapted from Dresen et al., 2015)

**Table 1:** Zonation of the Kafa BR showing main spatial features and functions (adapted from Dresen, 2011)

| BR zones | Size and percentage | Forest area | Key functions | Priority for the biodiversity assessment |
|---|---|---|---|---|
| Core zone | 28,172 ha (4%) | 28,110 ha | Serves as a refuge for various endemic and/or endangered species and provides opportunities for long- and short-term research and monitoring programmes, as well as non-consumptive use. | High |
| Candidate core zone | 219,130 ha (28%) | 174,482 ha | Contains highly endangered habitats. Candidate core zones should be included into the core zones after feasibility assessment. | Medium to high |
| Buffer zone | 161,351 ha (22%) | 87,487 ha | Connects conservation areas that have been isolated by human activities. Buffer zones should encourage a symbiotic relationship between conservation and nature-related economic activities. | Medium |
| Transition zone | 336,069 ha (46%) | 61,560 ha | Enhances environmental integrity or rehabilitation of unused farmland and plantations. Used to restore and preserve sites and/or features of historical and cultural significance. | Low |
| **Total** | **744,722 ha (100%)** | **351,639 ha** | | |

According to Bender-Kaphengst & Tekle (2019) the natural ecosystems of the Kafa BR are increasingly being degraded. The degradation also endangers important ecosystem functions and subsequently increases the human vulnerability to climate change. Due to climate change, there is a rise in temperatures, changed precipitation patterns, more frequent droughts and a threat of long-term water supply. At the same time, the degradation enforces surface run-off and fosters soil erosion, with negative consequences for soil fertility and water quality through sedimentation and reduced ground-water formation. Besides severe impacts on biodiversity, the loss of forests has also led to freeing a considerable amount of $CO_2$ and impair the forest's function as a carbon sink. Climate change impacts like irregular and heavy rainfall, extreme droughts and heavy frosts as well as proliferation of pests are challenging farmers and ecosystems. In particular, the wild Arabica coffee is at risk (Davis et al., 2012). Although laws and regulations for the protection and utilisation of forests and biodiversity exist in Ethiopia, insufficient capacities of the responsible institutions prevent an effective implementation.

## 2.4 Main habitat types at the Kafa Biosphere Reserve

The Kafa BR is home to the last surviving moist evergreen montane forests in the Eastern Afromontane biodiversity hotspot (Mittermeier et al., 2004). The area is also recognised as a key biodiversity area (KBA). The wild coffee tree, *Coffea arabica*, is indigenous to the understorey of Kafa's natural montane forest. In some areas it is harvested without proper management. In other areas, designated as PFM sites, the wild coffee is harvested in forest fragments, where farmers cut and thin out parts of the upper canopy and annually slash the forest understorey. This form of forest use is known to be structurally sustainable for the natural forest vegetation.

According to the Ethiopian Biodiversity Institute (2005), adapted by Dresen (2014), there are five main habitat types in the Kafa Zone (Figure 8):

- Evergreen montane forest and grassland complex: This complex habitat occurs between altitudes of 1,900 and 3,300 m a.s.l. and covers 52% of the biosphere reserve. It includes many of the highlands located in the buffer area of the biosphere reserve. This habitat occurs in areas which are often densely populated, leading to pressures from expansion of arable land.

- Moist evergreen montane forest: This habitat occurs between 1,500 and 2,600 m a.s.l. and covers 26% of the biosphere reserve. This type of forest is of global conservation significance due to the occurrence of wild *Coffea arabica*. In addition to deforestation for arable land, timber extraction is a major threat to this habitat.

- Wetlands: A complex system of wetland habitats occurs between 900 and 2,600 m a.s.l. These sensitive ecosystems are of utmost importance for the local communities, for example in providing materials for building shelter, for grazing and freshwater supply. At the same time, wetlands are also increasingly under pressure due to intense grazing and other land uses.

- Combretum-Terminalia woodland: The Ethiopian Biodiversity Institute (2005) has classified some areas of the Kafa BR as Combretum-Terminalia woodland, which were later corrected to bamboo forests by Dresen (2014). Figure 8 shows the older classification (light green), while Figure 9 displays the habitat types distinguished in a land use/land cover map in 2014.

- Sub-Afroalpine habitat: This habitat occurs at altitudes higher than 3,200 m a.s.l. and covers only 0.3% of the total biosphere reserve. This vegetation type is under severe threat due to agricultural expansion. Indigenous tree species such as *Hagenia abyssinica* are under high pressure.

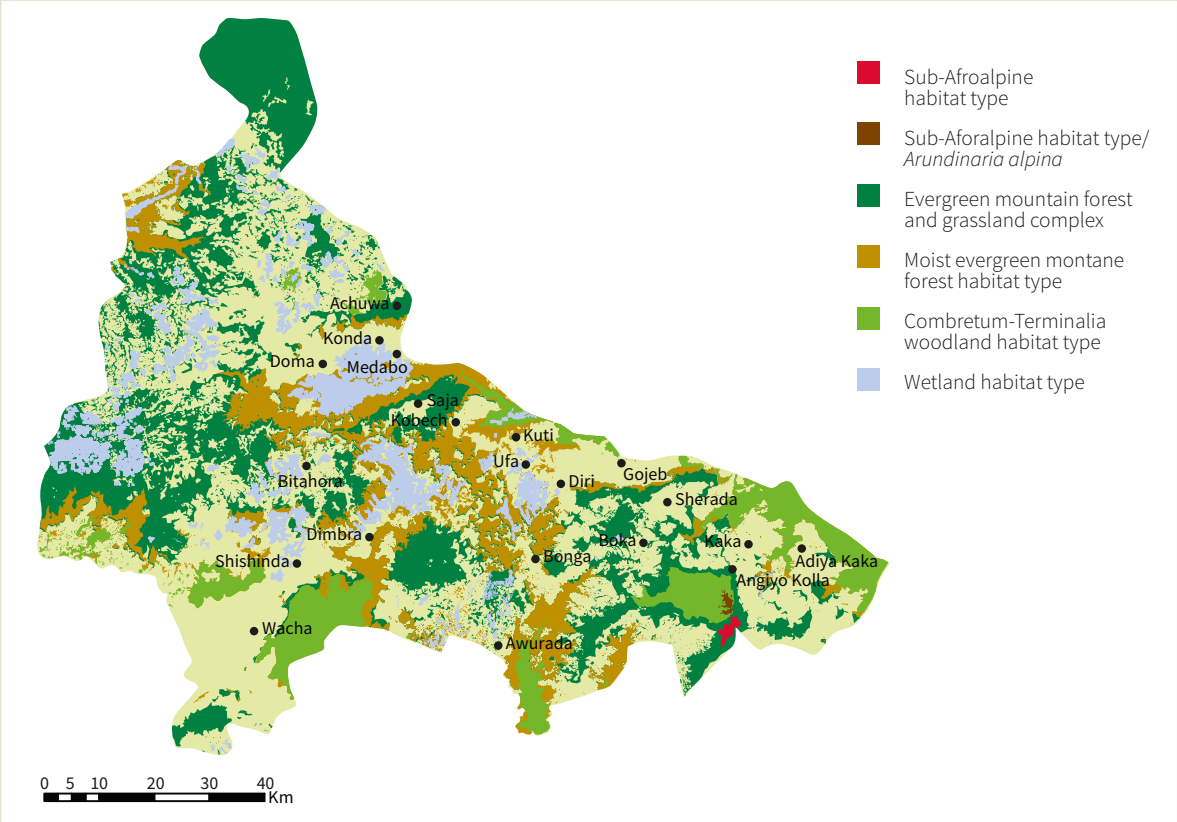



**Figure 8:** Habitat types in the Kafa Zone (IBC, 2005 adapted by Dresen, 2014)

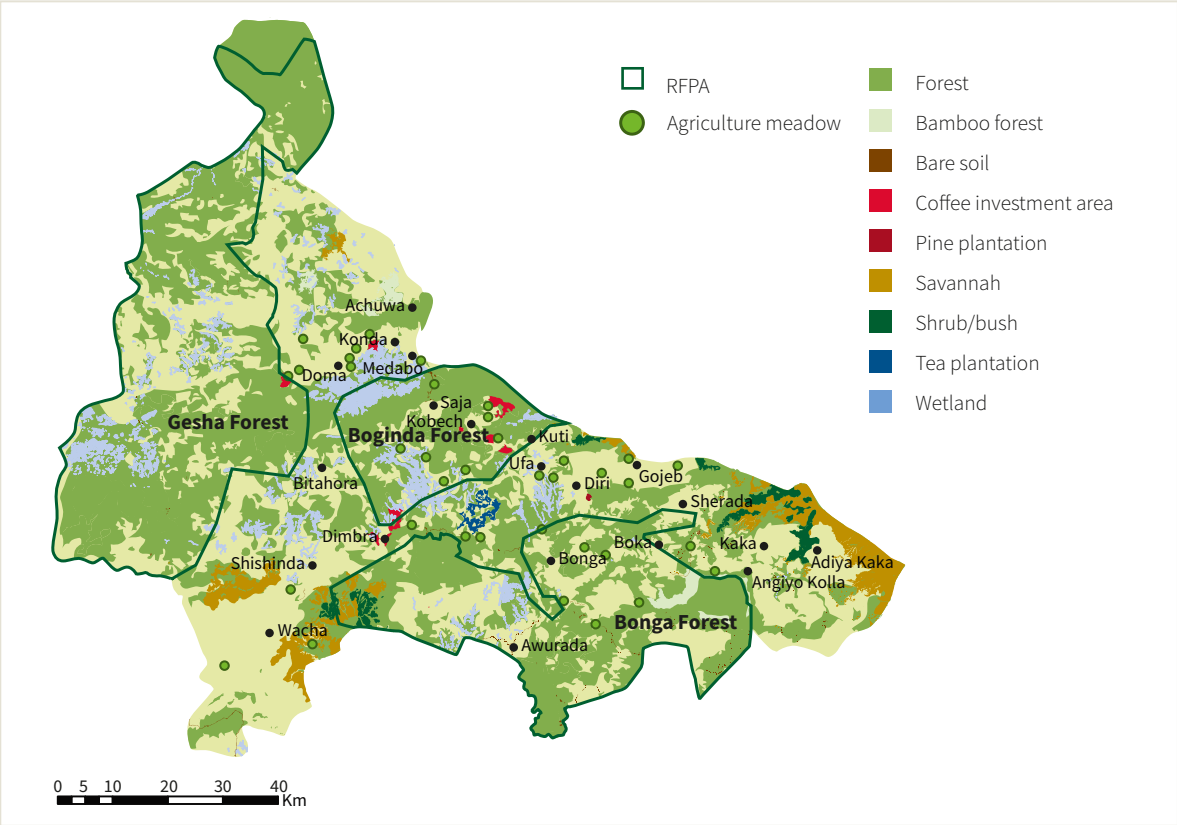



**Figure 9:** Regional Forest Priority Areas according to Million, B & Leykun, B. (2001) (red lines) projected on land use and land cover at the Kafa BR, adapted by: Elisabeth Dresen (2014)

## 2.5 Impression of major habitat types at the Kafa BR

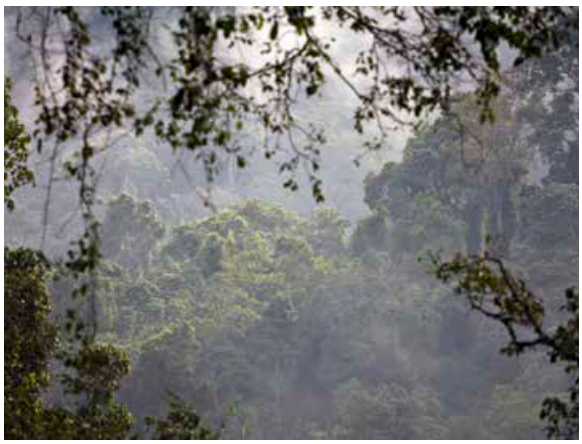


**Figure 10:** Boginda Forest
(photo: Bruno D'Amicis)

**Figure 11:** Komba Forest
(photo: NABU/Svane Bender)

**Figure 12:** Mankira Forest
(photo: Bruno D'Amicis)

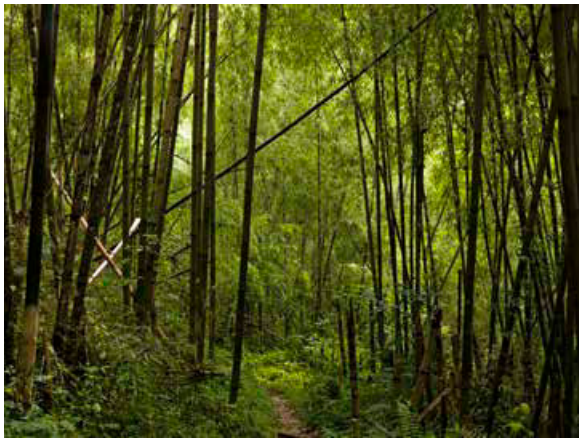


**Figure 13:** Bamboo Forest
(photo: Angelika Berndt)

**Figure 14:** Wetland vegetation
(photo: Bernhard Walter)

**Figure 15:** Riverine vegetation close to God's Bridge
(photo: NABU/Svane Bender)

# 3. Methodological approach

With a second, follow-up assessment in the rainy season of 2019, NABU aimed to obtain comparable and new data on the status of biodiversity between years and seasons for specific taxonomic groups. Additionally, the follow-up survey further developed the capacities of the local authorities, which ensure the continuation of regular assessments at the Kafa BR even without initiation and large-scale support by NABU. The gathered data will be analysed and incorporated into the biodiversity monitoring scheme.

Complex administration was required prior to the fieldwork to ensure compliance with the Ethiopian law. The follow-up biodiversity assessment was conducted in close cooperation with the relevant Ethiopian authorities and research institutions with agreements to use and share the information gained from the assessment.

In total, 25 experts (16 Ethiopian experts from partnering institutions and science and nine international experts from the Czech Republic, Germany, Kenya and the Netherlands) as well as 14 NABU rangers and field assistants and nine NABU team members were involved in the assessment. Five of the Ethiopian experts were delegates of the Ethiopian Biodiversity Institute (EBI).

The experts were assembled into five different teams based on different taxa:

- Amphibians and reptiles
- Birds
- Dragonflies and damselflies
- Fungi
- Small- and medium-sized mammals

The names and current affiliations of each expert and participant are provided in the participants section at the beginning of this report. The experts were supported by NABU's local team and by local field guides where required. Sampling sites were selected based on the first assessment and the needs and requirements of the experts regarding specific habitats of the surveyed taxa.

Logistics and organisational support were provided by staff from NABU Headquarters Germany and NABU Ethiopia, along with several four-wheel drive vehicles and their drivers. In total, 48 people were involved in the assessment. The headquarters of the operation were based at NABU's Project Office Bonga.

## 3.1 Sampling site selection

Sampling sites were selected based on ecological parameters as per surveyed taxon, results and open questions from the first assessment and the core objectives of this follow-up assessment. Many of the sites assessed during the first survey were revisited in order to enrich data with sampling results from the rainy season. The majority of visited sites was selected following criteria such as biodiversity value (core and candidate core zones in forests and wetlands, see Figure 16), coverage of national forest priority areas (Bonga, Boginda and Gesha Forest, see Figure 9) and earlier inventories i.e. NABU's assessment of major wetlands and riverines.

Selection criteria such as access to the sites, distance from Bonga and road conditions during the rainy season as well as security i.e. for overnight field stays were also taken into account for practical reasons.

The chosen study sites can be further divided into those which are of particular ecological importance due to having near-to-intact ecosystems and those which are regularly used by humans. These include different habitats, which are specified below.

**Table 2:** Study areas' priorities

| Area | BR zones | Altitudinal range (a.s.l.) | Priority |
|---|---|---|---|
| Montane forests | Core and core candidate | 1,500-2,600 m | High |
| Wetlands<br>Floodplain forests | Candidate and buffer | 900-2,600 m | High |
| Bamboo forests | Core | 2,400-3,050 m | High |

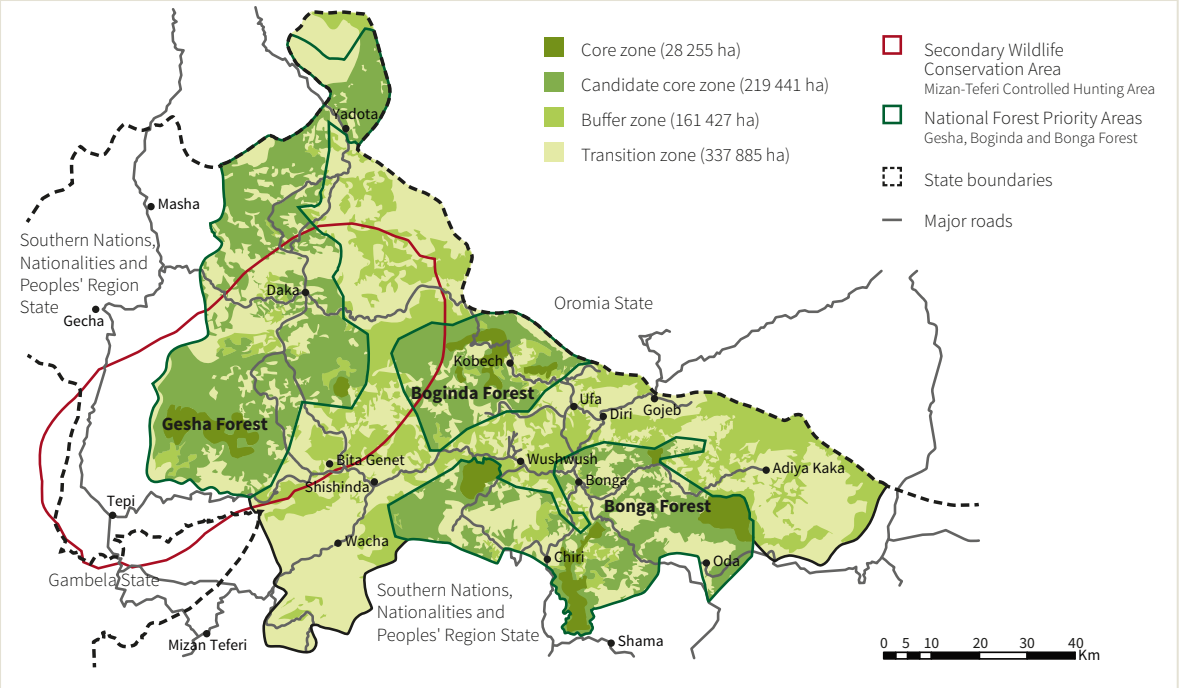



**Figure 15:** Forest priority areas within the Kafa BR including Bonga, Boginda and Gesha Forests (2016)

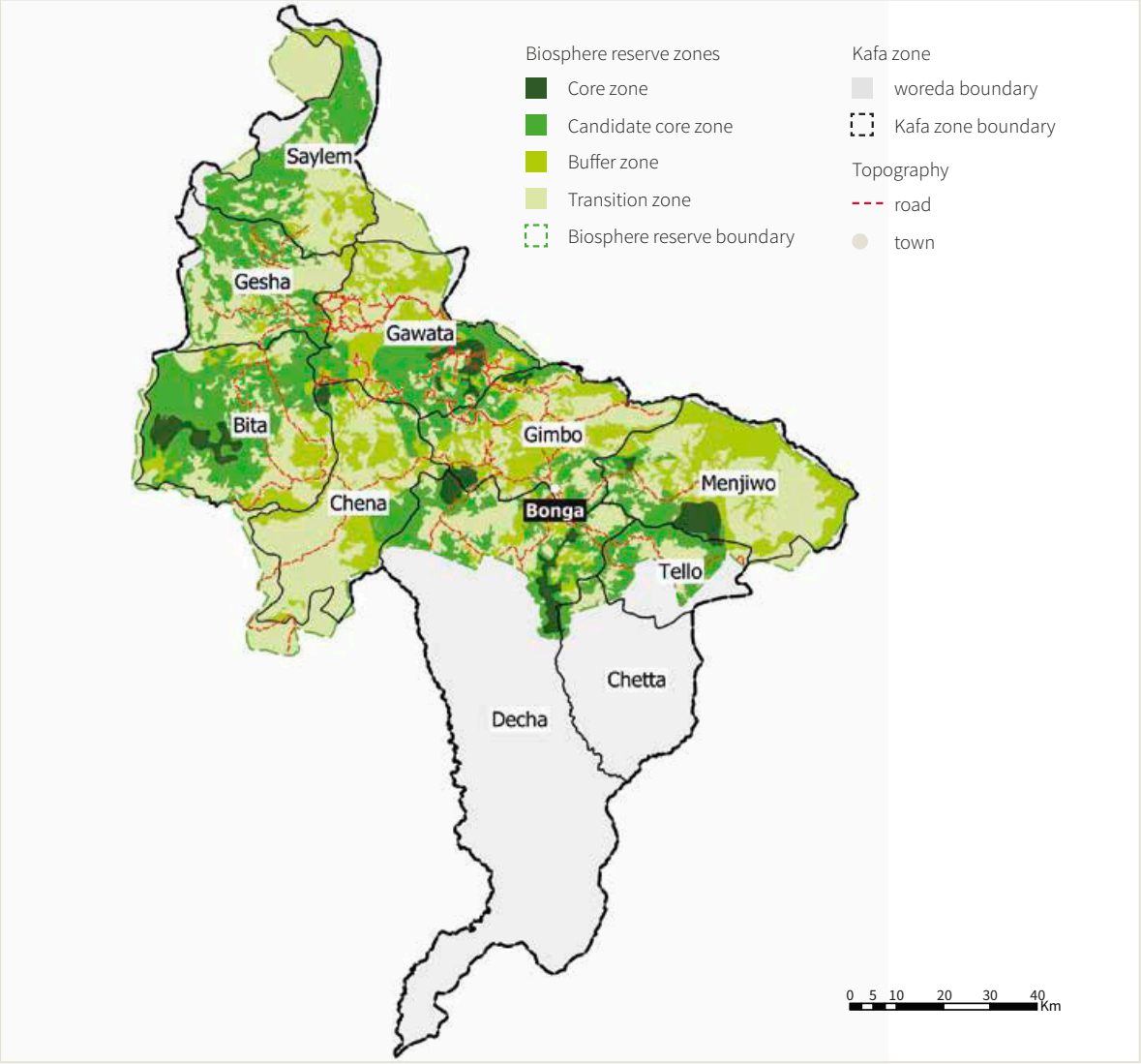



**Figure 16:** Administrative boundaries at the Kafa BR

## 3.2 Areas of particular ecological importance

Bamboo forests: This extensive and unique vegetation at the Kafa BR occurs at altitudes between 2,400 and 3,050 m a.s.l. and is characterised by bamboo undergrowth either in pure stands or mixed with trees, including *Hagenia abyssinica*, *Myrsine melanophloeos* and *Hypericum revolutum* (Bekele, 2003). A huge and unique patch is located at Adiyo Woreda in the eastern part of the Kafa BR.

Afromontane forests: These are characterised by dense vegetation, a complex understorey and distinctive tree layers where the emergent trees reach heights of around 25 m. They occur in hilly areas, shaped by depressions, streams and creeks. Along their altitudinal gradient, these forest areas are divided into two types:

(a) Evergreen montane forest: This type of vegetation occurs between altitudes of 1,900 and 3,300 m a.s.l. and covers 52.1% of the Kafa BR.

(b) Moist evergreen montane forest: This habitat occurs between 1,500 and 2,600 m a.s.l. and covers 26% of the Kafa BR. This type of forest is of global conservation importance due to the presence of wild *Coffea arabica*.

Wetlands: Based on former NABU wetland assessments and community restoration and management programmes, Alemgono, Gojeb and Shorori Wetlands were selected for the assessment. These habitats are complex systems mostly composed of flooded savannahs, forested islands and border zones which are inundated by an average water level of 30 to 60 cm for about three months of the year.

Floodplain forests-riverine areas: Sites which are periodically flooded by the Gummi and Gojeb Rivers were also assessed. These floodplains are temporarily inundated during the rainy season from June to September, but flash floods also occur in the montane rainforest areas. In both cases the inundation period is comparably short (less than a month) and the water level oscillates between 30 cm and 1 m.

For this assessment sampling sites were selected focussing on forests and wetlands/riverines. The sites are listed in Table 3. Further details including geographical location of sampling sites can be found in the individual taxa reports.

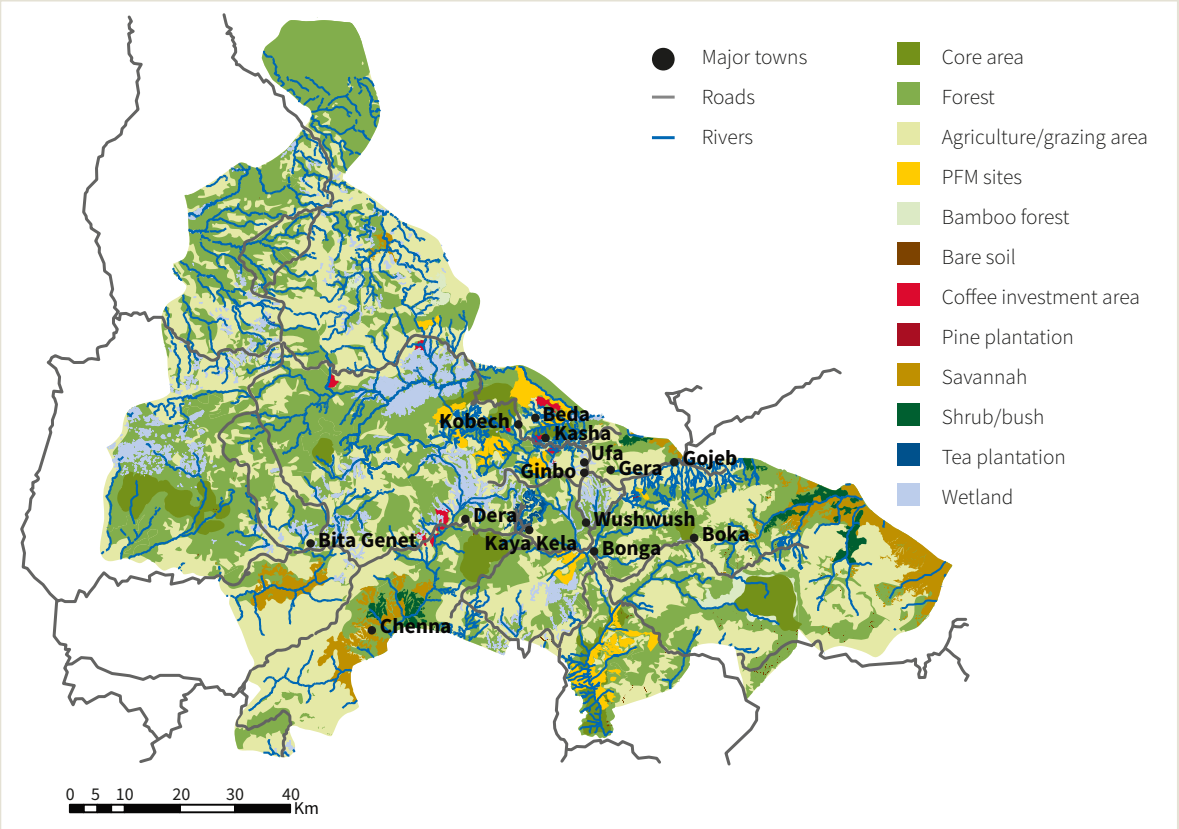



**Figure 17:** Sampling areas



-> back to content

**Table 3:** Major sampling areas of the biodiversity assessment at the Kafa BR (details specified in individual reports)

| Woreda (administrative disctrict) | Area/site name |
|---|---|
| Gimbo | Gojeb Wetland |
| Gimbo | Gojeb River/Arguba Investment Area (River/floodplain forests) |
| Gimbo | Alemgono Wetland/Alemgono Village |
| Gimbo | Shorori Wetland and Quarry |
| Gimbo | Komba Forest (Afromontane) and Quarry |
| Gimbo | Dadiban Hot Springs (direction to Medabo) |
| Gimbo | Yartachi |
| Gimbo | Masha Malo Forest |
| Gimbo | Wushwush |
| Gimbo | Kejaraba |
| Gimbo | Arguba |
| Adiyo | Boka Wetland |
| Adiyo | Boka Forest (Chefahanna; Afromontane) |
| Adiyo | Shaka (Angiyo Kolla) |
| Adiyo | Bamboo Forest, east of Boka |
| Decha | Awurada Valley (Gummi River/Gummi Bridge (Anderach)) (Afromontane forest/riverine vegetation) |
| Decha | Beha |
| Decha | Mankira Forest (Afromontane) |
| Gewata | Boginda Forest (Afromontane) |
| Gewata | Saja Forest (Afromontane) |
| Bonga | KDA Guesthouse |
| Bonga | God's Bridge |
| Bonga | Shera Village |

## 3.3 Data collection and management

Data collection and management were largely based on expert experience and in reference to the first assessment. The data were partially complemented with the limited scientific literature available on Ethiopia and Kafa and information about similar habitats. In general, the data collection methods applied in the fieldwork followed standard protocols commonly used for these kinds of biodiversity assessments. They combine field observations, transect/plot walking and simple field gear like landing nets or collecting containers with modern tools and devices such as high-resolution microscopes or call recordings etc. Most teams worked during the day. Due to the lack of suitable laboratories in Ethiopia, most samples were pre-processed and exported to Europe for specific identification. Each researcher signed an agreement which obligates compliance with a number of criteria for exporting species to another country. Although the data collection and analysis processes differ between each taxon, the content and structure of the individual reports have been standardised for better comparison between the results and comprehensive presentation of the information acquired. Further information on the sampling methods for each taxon can be found in the individual reports.

The experts started systematisation and analysis of the field data for species determination on-site in Bonga, so that only new species or those that were difficult to identify had to be exported. Many species such as fungi are still in the process of determination. During this process the preliminary species determinations were confirmed, rejected or corrected based on literature and (additional) expert knowledge.

In addition to the field data collection, all international experts conducted intense theoretical and practical field training on each taxon for NABU's rangers and other interested participants.

# 4. Summary of results

Through the follow-up assessment in the rainy season of 2019, NABU aimed to obtain comparable and new data on the status of biodiversity between years and seasons for specific taxonomic groups. Additionally, the follow-up assessment further developed the capacities of rangers and the local authorities which shall ensure a continuation of regular biodiversity monitoring at the Kafa BR without initiation and large-scale support by NABU.

Overall, the biodiversity assessment confirmed high biological diversity and an extremely high rate of endemism within the Kafa BR, reflected in high diversity at both the habitat level and the species number in each habitat. The identified habitats exhibit high heterogeneity despite the short distance between them. During the second assessment at least 515 species were recorded, of which at least 31 are new to science (mainly fungi and one amphibian species), and 276 are new to Ethiopia. 29 species were found endemic for Ethiopia. The highest biodiversity was found in core areas of the biosphere reserve such as Mankira and Komba Forests as well as in natural and semi-natural habitats in general.

The gathered data will be analysed and incorporated into the biodiversity monitoring scheme.

Highlights and detailed results of each taxon assessment can be found in the individual reports.

# 5. References

**Bekele, T.** (2003). The Potential of Bonga Forest for Certification: A Case Study. Paper prepared for the National Stakeholders Workshop on Forest Certification. Organized by the Institute of Biodiversity Conservation and Research (IBCR), FARM Africa and SOS Sahel. Addis Ababa, Ethiopia.

**Bender, S.** (2011). Saving the Wild Coffee Forests – Joint Forces for Kafa Biosphere Reserve in Ethiopia. In: Austrian MAB Committee (eds.) Biosphere Reserves in the Mountains of the World. Excellence in the Clouds? 88-92. Austrian Academy of Sciences Press, Vienna.

**Bender-Kaphengst, S. & Tekle, M.** (2019). Community Action for Biodiversity and Forest Conservation and Adaptation to Climate Change in the Wild Coffee Forests (CAFA). In: Leal Filho, W.; Barbir, J. & Preziosi, R. (Eds.). Handbook of Climate Change and Biodiversity. Springer Nature Switzerland AG, Basel.

**Bridgewater, P.B.** (2002). Biosphere reserves: Special places for people and nature. Environmental Science & Policy 5(1), 9-12. Elsevier BV, Amsterdam.

**Chernet, T.** (2008). Land Resources and socio-economic report of Bonga, Boginda, Mankira and the surrounding areas in Kaffa Zone, SNNPRS, Ethiopia. Report for PPP project on the establishment of a Coffee Biosphere Reserve in Bonga Region. Addis Ababa, Ethiopia.

**Davis A.P.; Gole, T.W.; Baena S. & Moat, J.** (2012). The Impact of Climate Change on Indigenous Arabica Coffee (*Coffea arabica*): Predicting Future Trends and Identifying Priorities. PLoS ONE 7(11), e47981.

**Dennis Moss Partnership** (2009). Application for Nomination of Kafa Biosphere Reserve. South Africa (unpublished), Stellenbosch.

**Dresen, E.** (2011). Forest and Community Analysis. Final report. On behalf of NABU's project „Climate Protection and Preservation of Primary Forests – A Management Model using the Wild Coffee Forests in Ethiopia as an Example" (unpublished).

**Dresen, E.; Tegetmeyer, C.; Mundt, F. & Dresen, M.** (2015). Final Report – Mapping and analysis of wetlands and rivers at Kafa Biosphere Reserve. Final report submitted to NABU.

**Dresen, E.** (2014). Map „Habitat Types in Kafa Biodiversity Reserve" produced on behalf of NABU for NABU's biodiversity assessment.

**EWNHS (Ethiopian Wildlife & Natural History Society)** (2008). Rapid Biodiversity Assessment in Kafa Zone: The case of Mankira, Saja and Boka Forest. Prepared for FAO – Kafa Sustainable Land Management Project (SLM), Addis Ababa.

**Gamachu, D.** (1977). Aspects of Climate and Water Budget in Ethiopia. Addis Ababa University Press, Addis Ababa.

**Hein, L. & Gatzweiler, F.** (2006). The economic value of coffee (*Coffea arabica*) genetic resources. Ecological Economics vol. 60, issue 1, 176-185. Elsevier BV, Amsterdam.

**Ethiopian Biodiversity Institute (formerly Institute of Biodiversity Conservation)** (2005). National Biodiversity Strategy and Action Plan. Government of the Federal Democratic Republic of Ethiopia.

**Kassahun, T. & Bender, S.** (2020). Food Security in the Face of Climate Change at Kafa Biosphere Reserve, Ethiopia. In: Handbook of Climate Services, pp 463-479. Springer International Publishing, Cham.

**Million, B. & Leykun B.** (2001). State of Forest Genetic Resources in Ethiopia. Forest Genetic Resources Working Papers, Co-publication of FAO, IPGRI/SAFORGEN, DFSC, ICRAF, Working Paper FGR/21E.

**Mittermeier, R. A.; Robles Gil, P.; Hoffman, M.; Pilgrim, J.; Brooks, T.; Goettsch Mittermeier, C.; Lamoreux, J. & da Fonseca, G. A. B.** (2004). Hotspots revisited. Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions. Mexico City.

**The Nature and Biodiversity Conservation Union (NABU) (eds.)** (2017). NABU's Biodiversity Assessment at the Kafa Biosphere Reserve. Berlin, Addis Ababa.

**SNNPR (Southern Nations Nationalities and Peoples' Regional State)** (2013). Kafa Zone Finance and Economic department (2005) e.c. (2012) zonal statistical abstract. (May, 2006) e.c. (2013).

**Tadesse, G.; Zavaleta, E. & Shennan, C.** (2014a). Coffee landscapes as refugia for native woody biodiversity as forest loss continues in southwest Ethiopia. In: Biological Conservation 169, 384-391. Elsevier BV, Amsterdam.

**Tadesse, G.; Zavaleta, E.; Shennan, C. & FitzSimmons, M.** (2014b). Policy and demographic factors shape deforestation patterns and socio-ecological processes in southwest Ethiopian coffee agroecosystems. In: Applied Geography 54, 149-159. Elsevier BV, Amsterdam.

**WBISPP (Woody Biomass Inventory and Strategic Planning Project)** (2004). Forest Resources of Ethiopia. MoARD, Addis Ababa. In: Bongers, Frans & Tennigkeit, Timm (editors) (2010). Degraded Forests in Eastern Africa: Management and Restoration (Earthscan Forest Library). Taylor & Francis Ltd., Abingdon.

**Whitmore, T.C.** (1993). Tropische Regenwälder – Eine Einführung. Spektrum Akademischer Verlag (SAV), Heidelberg/Berlin.

# 6. Annex

## 6.1 Photos

**Figures 18-21:** Regular briefings and field planning at NABU's Project Office in Bonga

**Figure 18 (photo:** NABU/Abdurazak Sahile)


**Figure 19 (photo:** NABU/Abdurazak Sahile)

**Figure 20 (photo:** NABU/Abdurazak Sahile)

**Figure 21 (photo:** NABU/Abdurazak Sahile)

**Figures 22-27:** Collection of field data and samples by the teams

**Figure 22** (photo: Bernhard Walter)

**Figure 23** (photo: Bernhard Walter)

**Figure 24** (photo: Bernhard Walter)

**Figure 25** (photo: NABU/Abdurazak Sahile)

**Figure 26** (photo: NABU/Abdurazak Sahile)


**Figure 27** (photo: NABU/Abdurazak Sahile)

**Figures 28-33:** Collection of field data and samples by the teams

**Figure 28** (photo: NABU/Abdurazak Sahile)

**Figure 29** (photo: NABU/Abdurazak Sahile)

**Figure 30** (photo: NABU/Abdurazak Sahile)

**Figure 31** (photo: NABU/Abdurazak Sahile)

**Figure 32** (photo: NABU/Abdurazak Sahile)

**Figure 33** (photo: NABU/Abdurazak Sahile)

**Figures 34-37:** Collection of field data and samples by the teams

**Figure 34** (photo: NABU/Abdurazak Sahile)

**Figure 36** (photo: Viola Clausnitzer)

**Figure 35** (photo: NABU/Abdurazak Sahile)

**Figure 37** (photo: Viola Clausnitzer)

# Detailed reports

# Fungi of the Kafa Biosphere Reserve

**Andreas Gminder, Zinaw Asaye, Eskedar Asfaw and Habtamu Deribe**

# Highlights

→ Within 10 sampling days, 350 samples have been collected in six different forests.

→ Approx. 280 species belonging to approx. 50 genera were recorded, most of which have not been reported before for Ethiopia.

→ At the time of publication, approx. 20-30 species are new to science. However, this number is expected to increase when determination of further species will be completed.

→ At Boginda Forest, Komba Forest and Mankira Forest a species community significant for natural forests with long-lasting habitat tradition was found.

→ The highest number of species not yet described seems to be linked to Bamboo Forest, followed by Mankira Forest.

→ The highest biodiversity seems to be found at Komba Forest and Mankira Forest.

→ Species diversity at all sites is high when ground moisture is found, e.g. due to large trees or shrubs and herbs.

# 1. Introduction

The knowledge of fungi in tropical regions is worldwide far from being equivalent to the Mediterranean and to boreal regions of the northern hemisphere. Several scattered inventories of certain countries and areas exist, which usually consist of a commented list of fungi found over a certain period of years. Up to now, there is not a single publication dealing with deeper insights into the ecological needs of tropical fungi or with the decline (or increase) of certain species and the reasons for that. There is, therefore, a considerable need of thorough inventory of fungi in different tropical areas, and this inventory may serve as an important step towards a fundamental knowledge base on fungi in the tropics.

# 2. Materials and methods

## 2.1 Study area

The study sites are listed in Table 1. They include coffee forests (montane forests), bamboo forests and mountain cloud forests in a range between approx. 1,800 and 2,500 m a.s.l. which were visited during a 10-day-period.

## 2.2 Sampling methods

At each site all group members collected all fungi present. A few groups of wood-inhabiting fungi have been collected only selectively, e.g. Corticiaceae and Xylariales, as the aim of this study in the rainy season of 2019 was to focus on the terrestrial fungi, whereas the focus of NABU's first biodiversity assessment was on the wood-inhabiting fungi.

Fruit bodies of the fungi found were collected preferably in young and mature stages. Each collection was wrapped separately in order to avoid mixing and a paper sheet with an identifying number was enclosed.

## 2.3 Collection methods

### Documentation

At the end of each field stay all collections were photographed for the documentation of colour and overall shape. To ensure the correct allocation, an identifier paper sheet for each collection was photographed at least once.

Characteristics that can only be recorded in a fresh and not in a dried state were noted. Such characteristics included colour changing, smell, taste or chemical reactions.

In some cases, microscopic characteristics visible in a vital state only were noted as well (e.g. in inoperculate ascomycetes).

### Preparation

After the documentation the collections were placed on an electric dryer – together with the identifier label – and dried at a temperature of 30°C-40°C for approx. 24 hours.

Dried collections were stored in airtight plastic bags. For most of the agarics and some of the other fungi groups small samples for molecular analyses were stored in Eppendorf tubes (approx. 150 collections).

All collections were divided into two parts, one of which remained with the Ethiopian Biodiversity Institute (EBI).

## 2.4 Data analysis

Following the national regulations of the EBI, samples were properly prepared and exported to Germany, with the main objective to further identify the species and complete the species list.

At the time of publication, the analyses have not been fully concluded yet. Hence, this report gives a first overview of the fungi collected at the Kafa Biosphere Reserve (Kafa BR) during NABU's follow-up biodiversity assessment.

**Table 1:** List of study sites and characteristics

| No. | Code | Area | Woreda | Habitat | Sites | No. of visits |
|---|---|---|---|---|---|---|
| 1 | AW | Bonga | Decha | Riverine vegetation | Awurada Valley | 1 |
| 2 | BA | Bonga | Adiyo | Bamboo Forest with Haggenia | Bamboo Forest | 1 |
| 3 | BK | Bonga | Adiyo | Bamboo Forest | Boka Forest | 1 |
| 4 | BO | Bonga | Gewata | Afromontane Forest, with palm ferns | Boginda Forest | 1 |
| 5 | KO | Bonga | Gimbo | Afromontane Forest | Komba Forest | 3 |
| 6 | MA | Bonga | Decha | Afromontane Forest | Mankira Forest | 2 |
| 7 | SHO | Bonga | Gimbo | Afromontane Forest | Shorori Forest | 2 |

All approx. 150 Eppendorf tubes have undergone molecular analysis by Prof. Dr. Marco Thines at Senckenberg (Frankfurt/Main). The sequences of the internal described spacer (ITS) region had been gained by 10 February 2019, whereafter analysis of the molecular data began.

Morphological analyses have begun in November 2019 and will be continued successively. Determination of Polypores will be done in collaboration with Prof. em. Leif Ryvarden (University of Oslo), determination of corticoid species with Dr. Viacheslav Spirin (University of Helsinki) and determination of Xylariales with Prof. Dr. Marc Stadler (University of Braunschweig). For many other species or species groups the help of specialists will be necessary.

# 3. Results and discussion

## 3.1 Collection methods

### Sampling method

The time schedule for the project allowed only one visit of relevant locations so that the installation of permanent plots was not possible. Convenience sampling was chosen as the sampling method, as this usually produces more data in a shorter time, especially in regions where no or limited data are available (Mueller et al., 2004). This way, approx. 40-50 collections were sampled on each excursion day and most of them were described, photographed and dried afterwards. This resulted in a total of 320 collections. As indicated above, the main focus in 2019 was on collecting terrestrial species, as the wood-inhabiting species had already been sampled intensely during the dry season of 2014.

The very large number of fungal species, especially in the tropics, would require collection in many more different habitats for years in order to get an impression of Ethiopia's fungal inventory.

## 3.2 Habitats

### Bamboo Forest

At Bamboo Forest the main focus was on fungi occurring directly on bamboo culms or leaves. In addition, fungi occurring on dead branches, bark or wood of Hagenia were searched.

The total number of species was lower than in the Afromontane forests, which is above all due to the monotone structure of Bamboo Forest with a much lower number of ecological niches than in other forest types. On the other hand, the number of species occurring here only and in none of the other collecting sites was considerably larger.

Some of the collections have already been identified and found to be identical or very similar to species from Asia. Nevertheless, the molecular data have already shown that at least some of them might be near related species of their own. This raises the idea that the Ethiopian bamboo forests have developed a high proportion of endemic species in fungi or species that are endemic for East Africa at least.

### Afromontane Forests

To some extent, the mountain forests of Komba, Mankira and Shorori had a similar species composition, although each of these forests has its own characteristics.

Besides several interesting species which are probably new to science, a characteristic species composition of natural habitat indicators was found in each of these forests. These so-called CHEG[1] species groups are spread all over the world. Their occurrence in the mountain forests of the Kafa region indicates that their composition is still natural and that they have a long-lasting habitat tradition. The monitoring of the CHEG species can be regarded as a clue to controlling the conservation status of these forests.

## 3.3 Species/groups

When we tried to collect all groups of agarics, no special emphasis was laid on a certain group. As the inventory of fungi at the Kafa BR and for the whole of Ethiopia is just at the beginning, specialising on certain groups will be a task for the future.

A first overview of the established collections suggested that approx. 20-30 species at least are new to science, many are new to Africa. With the exception of the Polypores (Ryvarden, 1980 and later), no inventory of fungi in Ethiopia exists, so that most of the fungi once identified will be mentioned for Ethiopia for the first time.

1 A collection of fungi, with members of the Clavariacaeae, Hygrocybe, Entolomataceae and Geoglossaceae (and sometimes adapted to CHEGD, additionally with Dermoloma) which are a "characteristic of less disturbed, unfertilised grasslands" (comp. Griffith et al., 2013)

# 4. Conclusions and recommendations for conservation and monitoring

## 4.1 Recommendations for conservation

It is mandatory for the conservation of these forests and the fungal flora within them that their resources be used extensively only. Especially the felling of trees and the felling of bamboo are changing the ecosystem considerably. Other threads are changes of the ground water level, which would change the forests completely, and, to a minor degree, grazing of cattle in the forests.

It is recommended to keep the ecosystems as balanced as possible, in particular when it comes to input of nutrients, changes in hydrology and intensified use of forests.

## 4.2 Suggestions for future studies

In order to learn about the richness of the Ethiopian fungal flora, more excursions and collecting trips are required. Above all, the forest ecosystems which are still natural or near natural should be monitored intensively in the next years in order to document the species richness in fungi in this area.

It is of vital importance to have Ethiopian people interested in the fungal flora (and not only in eating mushrooms) and willing to learn how to identify fungi. Therefore, university classes and cooperations are highly suggested.

# 5. References

**Griffith, G.W.; Gamarra, J.G.-P.; Holden, E.M; Mitchel, D.; Graham, A.; Evans, D.A.; Evans, S.E.; Aron, C.; Noordeloos, M.E.; Kirk, P.M.; Smith, S.L.N.; Woods, R.G.; Hale, A.D.; Easton, G.L.; Ratkowsky, D.A.; Stevens, D.P. & Halbwachs, H.** (2013). The International Conservation Importance of Welsh "Waxcap" Grasslands. Mycosphere 4(5), 969-984, doi 10.5943/mycosphere/4/5/10.

**Mueller, G.M.; Schmit, J.P.; Huhndorf, S.M.; Ryvarden L.; O´Dell, T.E.; Lodge, D.J.; Leacock, P.R.; Mata, M.M.; Umaña, L.; Wu, Q.-X. & Czederpiltz, D.L.** (2004). Recommended protocols for sampling macrofungi. In: Mueller, G.M., Bills, G., Foster, M.S. (eds) Biodiversity of Fungi: Inventory and Monitoring Methods. Elsevier Academic Press, San Diego, pp 168-172.

**Ryvarden, L. & Johansen, I.** (1980). A preliminary polypore flora of East Africa. Fungiflora, Oslo.

# 6. Annex

## 6.1 Appendices

**Appendix 1:** List of collecting sites for species by date

| Date | Code | Area | Woreda | Habitat | Sites |
|---|---|---|---|---|---|
| 30/07/2019 | KO | Bonga | Gimbo | Montane forests | Komba Forest |
| 31/07/2019 | AW | Bonga | Decha | Riverine vegetation | Gumi River |
| 01/08/2019 | BA | Bonga | Adiyo | Bamboo forests | Bamboo Forest |
| 02/08/2019 | SHO | Bonga | Gimbo | Montane forests | Shorori |
| 03/08/2019 | MA | Bonga | Decha | Montane forests | Mankira Forest |
| 04/08/2019 | KO | Bonga | Gimbo | Montane forests | Komba Forest |
| 05/08/2019 | BO | Boginda | Gewata | Montane forests | Boginda Forest |
| 06/08/2019 | BK | Bonga | Adiyo | Montane forests | Boka Forest |
| 07/08/2019 | KO | Bonga | Gimbo | Montane forests | Komba Forest |
| 10/08/2019 | SHO | Bonga | Gimbo | Montane forests | Shorori |
| 11/08/2019 | MA | Bonga | Decha | Montane forests | Mankira Forest |

**Appendix 2:** List of fungi collected at the Kafa BR during the follow-up assessment
("ETH-###" indicates herbarium specimens, "x" indicates presence at the site without collecting)

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Agaricales | spec. 1 | | | | | | ETH-551 | | | | | |
| Agaricales | spec. 2 | | | | | | | | | ETH-599 | | |
| Agaricus | spec. 1 | | | | ETH-446 | | | | | | | |
| Agaricus | spec. 2 | | | | ETH-928 | | | | | | | |
| Agaricus | spec. 3 | | | | ETH-933 | | | | | | | |
| Agaricus | spec. 4 | | | | | ETH-501 | | | | | | |
| Agaricus | spec. 5 | | | | | | ETH-951 | | | | | |
| Agaricus | spec. 6 | | | | | | | | | ETH-595 | | |
| Aphyllophorales | spec. 1 | | | | | | ETH-527 | | | | | |
| Aphyllophorales | spec. 2 | | | | | | ETH-528 | | | | | |
| Aphyllophorales | spec. 3 | | | | | | | ETH-547 | | ETH-604 | | |
| Armillaria | spec. 1 | | | ETH-430 | | | | | | | | |
| Armillaria | cf. fusiceps | | | | | | ETH-517 | | | x | x | |
| Ascobolus | spec. 1 | | | ETH-917 | | | | | | | | |
| Ascocoryne | spec. nov. ined. | ETH-911 | | | | | | | | | | |
| Ascomycetes | spec. 1 | | | ETH-916 | | | | | | | | |
| Ascomycetes | spec. 2 | | | ETH-437 | | | | | | | | |
| Ascomycetes | spec. 3 | | | ETH-438 | | | | | | | | |
| Ascomycetes | spec. 4 | | | | | | | ETH-569 | | | | |
| Ascomycetes | spec. 5 | | | | | | | ETH-570 | | | | |
| Auricularia | brunneotomen-tosa | | | | | ETH-485 | | | | | | |
| Auricularia | delicata | | | | | ETH-529 | x | | | | | |
| Basidiomycetes | spec. 1 | | | ETH-444 | | | | | | | | |
| Bolbitius | spec. 1 | | | | | | | | ETH-575 | | | |
| Botryobasidium | curtisii | | | ETH-480 | | | | | | | | |
| Calathella | spec. 1 | | | | | | | | ETH-576 | | | |

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calocera | spec. 1 | | | ETH-920 | | | | | | | | |
| Campanella | spec. 1 | ETH-420 | | | | | | | | | | |
| Campanella | spec. 2 | | | | ETH-465 | | | | | | | |
| Campanella | spec. 3 | | | | | | ETH-531 | | | | | |
| Campanella | spec. 4 | | | x | | | | | ETH-583 | | | |
| Campanella | spec. 5 | | | | | | | ETH-561 | | | | |
| Chaetocalathus | cf. liliputianus | ETH-403 | | | | ETH-474 | | | | | | |
| Chaetocalathus | aff. liliputianus 1 | | | | | ETH-503 | | | | | | |
| Chaetocalathus | aff. liliputianus 2 | | | | | ETH-506 | | | | | | |
| Chlorophyllum | spec. nov. | | | | | ETH-487 | | | | | | ETH-xxx |
| Clavaria | cf. fragilis | ETH-901 | | | | | | | | ETH-594 | | ETH-xxx |
| Clavaria | spec. 1 | | | | | | | | | ETH-591 | | |
| Clavicipitales | spec. 1 | | | | | ETH-942 | | | | | | |
| Clavulinopsis | spec. 1 | ETH-905 | | | | | | | | | | |
| Clavulinopsis | spec. 2 | | | ETH-439 | | | | | | | | |
| Clavulinopsis | spec. 3 | | | | | | | | | ETH-592 | | |
| Clavulinopsis | spec. 4 | | | | | | | | | ETH-593 | | |
| Clitocella cf. | spec. | | | | | | | ETH-534 | | | | |
| Clitocybe cf. | spec. | | | | ETH-467 | | | | | | | |
| Clitopilus | cf. hobsonii 1 | | | ETH-436 | | | | | | | | |
| Clitopilus | passeckerianus agg. | | | | | ETH-507 | | ETH-961 | | | ETH-xxx | |
| Clitopilus | cf. hobsonii 2 | | | | | | | ETH-542 | | | | |
| Conocybe | spec. | | | | ETH-922 | | | | | | | |
| Cookeina | colensoi | ETH-001 | | | | | ETH-524 | | | x | | |
| Coprinopsis | spec. | | | | ETH-940 | ETH-461 | | | | | | |
| Coprinus | spec. 1 | ETH-414 | | | | | | | | | | |
| Coprinus | cf. disseminatus | x | | | x | ETH-475 | | | | | | |
| Coprinus | cf. micaceus | | | ETH-434 | | | | | | | | |



-> back to content

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coprinus | spec. 2 | | | | | | | ETH-548 | | | | |
| Cordyceps | spec. | | | | | | | | | ETH-967 | | ETH-xxx |
| Corticiaceae | spec. 1 | | | ETH-440 | | | | | | | | |
| Corticiaceae | spec. 2 | | | ETH-488 | | | | | | | | |
| Corticiaceae | spec. 3 | | | ETH-489 | | | | | | | | |
| Corticiaceae | spec. 4 | | | ETH-482 | | | | | | | | |
| Corticiaceae | spec. 5 | | | ETH-483 | | | | | | | | |
| Corticiaceae | spec. 6 | | | ETH-484 | | | | | | | | |
| Corticiaceae | spec. 7 | | | | | ETH-512 | | | | | | |
| Corticiaceae | spec. 8 | | | | | ETH-513 | | | | | | |
| Corticiaceae | spec. 9 | | | | | ETH-514 | | | | | | |
| Corticiaceae | spec. 10 | | | | | ETH-515 | | | | | | |
| Corticiaceae | spec. 11 | | | | | | | ETH-536 | | | | |
| Corticiaceae | spec. 12 | ETH-564 | | | | | | | | | | |
| Corticiaceae | spec. 13 | ETH-566 | | | | | | | x | | | |
| Corticiaceae | spec. 14 | ETH-584 | | | | | | | | | | |
| Corticiaceae | spec. 15 | ETH-585 | | | | | | | | | | |
| Corticiaceae | spec. 16 | ETH-586 | | | | | | | | | | |
| Corticiaceae | spec. 17 | ETH-587 | | | | | | | | | | |
| Corticiaceae | spec. 18 | ETH-588 | | | | | | | | | | |
| Corticiaceae | spec. 19 | ETH-589 | | | | | | | | | | |
| Corticiaceae | spec. 20 | | | | | | | | | ETH-603 | | |
| Crepidotus | spec. 1 | | | | | ETH-490 | | | | | | |
| Crepidotus | spec. 2 | | | | | | ETH-521 | | | | | |
| Crepidotus | spec. 3 | | | | | | | | ETH-581 | | | |
| Cyathus | cf. striatus | | | | | ETH-500 | x | | | | | |
| Cyphellaceae | spec. 1 | | | ETH-481 | | | | | | | | |
| Cyphellaceae | spec. 2 | | | | ETH-453 | | | | | | | |
| Cystoderma | spec. | | | | | | | | ETH-966 | | | |

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cystolepiota | spec. | | ETH-912 | | | | | | | | | |
| Dacrymyces | spec. | | | x | | | | | | | | |
| Deconica | spec. | | | ETH-435 | | | | | | | | |
| Dennisiodiscus cf. | spec. | | | ETH-432 | | | | | | | | |
| Dermoloma | spec. 1 | ETH-909 | | | | | | | | | | |
| Dermoloma | spec. 2 | ETH-910 | | | | | | | | | | |
| Entoloma | spec. 1 | ETH-402 | | | | | | | | | | |
| Entoloma | spec. 2 | x | | | | x | x | | | ETH-600 | | |
| Entoloma | spec. 3 | | | | ETH-924 | | | | | | | |
| Entoloma | spec. 4 | | | | | ETH-473 | | | | x | | x |
| Entoloma | spec. 5 | | | | | ETH-944 | | | | | | |
| Entoloma | spec. 6 | | | | | | | | ETH-965 | | | |
| Favolaschia | thwaithesii | x | | | | | | | | | | |
| Favolaschia | tonkinensis | | | ETH-429 | | | | | | | | |
| Flammulina | spec. 1 | | | | | | ETH-952 | | | | | |
| Flammulina | spec. 2 | | | | | | | | ETH-582 | | | |
| Fomitiporia | cf. caryophylli | | | | ETH-456 | | | | | | | |
| Fomitopsis | carnea | ETH-400 | | | | | x | | x | | | |
| Galerina | marginata agg. 1 | | | | ETH-451 | | | | | | | |
| Galerina | marginata agg. 2 | | | | | | ETH-556 | | | | | |
| Galerina | spec. | | | | | | | ETH-961 | | | | |
| Geastrum | aff. triplex 1 | x | | | | | ETH-517 | ETH-537 | | | | |
| Geastrum | spec. 1 | | | | ETH-921 | | | | | | | ETH-xxx |
| Geastrum | spec. 2 | | | | ETH-454 | | ETH-549 | | | | | |
| Geastrum | cf. javanicum (114) | | | | ETH-455 | x | | | | | | |
| Geastrum | spec. 3 | | | | ETH-932 | | | | | | | |
| Geastrum | aff. triplex 2 | | | | | | | ETH-954 | | | | |
| Geastrum | spec. 4 | | | | | | ETH-956 | | | | | |
| Gerronema cf. | spec. 1 | ETH-906 | | | | | | | | | | |



-> back to content

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gerronema cf. | spec. 2 | | | | | | | ETH-955 | | | | |
| Gloiocephala | spec. | | | | ETH-496 | | | | | | | |
| Glutinoglossum | spec. | ETH-904 | | | x | x | x | | | ETH-605 | x | x |
| Gymnopilus | spec. 1 | | ETH-424 | | | | | | | | | |
| Gymnopilus | spec. 2 | | | ETH-442 | | | | | | | | |
| Gymnopilus | spec. 3 | | | | | ETH-493 | | | | | | |
| Gymnopus | spec. 1 | ETH-401 | | | | | | | | | | |
| Gymnopus | spec. 2 | | | | | | | ETH-538 | | | | |
| Gymnopus | spec. 3 | | | | | | | ETH-541 | | | | |
| Gymnopus | spec. 4 | | | | | | | ETH-546 | | | | |
| Gymnopus cf. | spec. 5 | ETH-419 | | | x | x | x | | | | | |
| Helotiales | spec. | | | | | ETH-509 | | | | | | |
| Hemimycena | spec. 1 | | | ETH-443 | | | | | | | | |
| Hemimycena | spec. 2 | | | | | ETH-494 | | | | | | |
| Hemimycena | spec. 3 | | | | | ETH-498 | | | | | | |
| Henningsomyces | spec. | | | ETH-914 | | | | | | | | |
| Hohenbuehelia cf. | spec. | | | | | ETH-492 | | | | | | |
| Hyaloscyphaceae | spec. | | | ETH-425 | | | | | | | | |
| Hydropus | spec. 1 | ETH-903 | | | | | | | | | | |
| Hydropus | spec. 2 | | | | | | ETH-554 | | | | | |
| Hygrocybe | conica agg. | ETH-410 | | | | | | | | | | |
| Hygrocybe | spec. | | | ETH-913 | | | | | | | | |
| Hymenagaricus | spec. | | | | | ETH-948 | | | | | | |
| Hypholoma | subviride aff. | ETH-406 | | | | x | x | x | | x | | x |
| Hypocreales | spec. | | | | | | | | | ETH-597 | | |
| Hypoxylon | spec. | | ETH-422 | | | | | | | | | |
| Hypoxylon | cf. ticinense | | | | | | | | | | ETH-xxx | |
| Lactocollybia cf. | spec. | | | | ETH-469 | | | | | | | |
| Lentaria | spec. | | | | | | | ETH-532 | | | | |

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lentinus | spec. 1 | | | | ETH-464 | | | | | | | |
| Lentinus | spec. 2 | | | | | ETH-504 | x | x | | | | |
| Lentinus | spec. 3 | | | | | | ETH-526 | x | | | | |
| Lentinus | spec. 4 | | | | | | | | | ETH-602 | | |
| Lepiota | ichthyospora spec. nov. | | | | ETH-447 | | | | | | | |
| Lepiota | spec. 1 | | | | ETH-449 | | | | | | | |
| Lepiota | spec. 2 | | | | ETH-934 | | | | | | | |
| Lepiota | spec. 3 | | | | ETH-935 | | | | | | | |
| Lepiota | viola spec. nov. | | | | ETH-938 | | | | | | | |
| Lepiota | spec. 4 | | | | ETH-939 | | | | | | | |
| Lepiota | spec. nov. aff. fuscovinacea | | | | | | | | | | | ETH-xxx |
| Leptoglossum cf. | spec. | | | | | | | | ETH-571 | | | |
| Leucoagaricus | aff. tangerinus | | | | | | | | | | | ETH-xxx |
| Leucocoprinus | spec. | | | | | | | | | | | ETH-xxx |
| Limacella | spec. nov. | | | | ETH-468 | | | | | | | |
| Lycoperdon | spec. | | | | | | | ETH-543 | | | | |
| Marasmiaceae | spec. 1 | | | | ETH-926 | | | | | | | |
| Marasmiaceae | spec. 2 | | | | ETH-930 | | | | | | | |
| Marasmiellus | spec. 1 | | | | ETH-937 | | | | | | | |
| Marasmiellus | spec. 2 | ETH-562 | | | | | | | | | | |
| Marasmius | spec. 1 | | | ETH-427 | | | | | | | | |
| Marasmius | spec. 2 | | | | ETH-452 | | | | | | | |
| Marasmius | spec. 3 | | | | | ETH-486 | | | | | | |
| Marasmius | spec. 4 | | | | | ETH-947 | | | | | | x |
| Marasmius | spec. 5 | | | | | | | ETH-545 | | | | |
| Marasmius | spec. 6 | | | | | | | | | | ETH-xxx | |
| Melanotus | spec. | | | | | | ETH-523 | | | | | |



-> back to content

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Microglossum | spec. | | | | | | | | | ETH-606 | | |
| Micromphale cf. | spec. | | | | | | | ETH-535 | | | | |
| Micropsalliota | spec. nov. 1 | ETH-418 | | | | | | | | | | |
| Micropsalliota | spec. nov. 2 | | | | ETH-925 | | | | | | | |
| Micropsalliota | spec. nov. 3 | | | | ETH-927 | | | | | | | |
| Micropsalliota | spec. nov. 4 | | | | ETH-466 | | | | | | | |
| Micropsalliota | spec. nov. 5 | | | | | ETH-941 | | | | | | |
| Micropsalliota | spec. nov. 6 | | | | | ETH-943 | | | | | | |
| Micropsalliota | spec. nov. 7 | | | | | | ETH-959 | | | | | |
| Morganella | spec. | | | ETH-915 | | | | | | | | |
| Mucronella | spec. | | | | | | | ETH-559 | | | | |
| Mutinus | zenkeri | x | | | | | x | | | | | |
| Mycena | spec. nov. aff. lazulina | | | ETH-428 | | | | | | | | |
| Mycena | spec. 1 | | | ETH-918 | | | | | | | | |
| Mycena | spec. 2 | | | ETH-919 | | | | | | | | |
| Mycena | spec. nov. aff. lazulina | | | ETH-445 | | | | | | | | |
| Mycena | spec. 3 | | | | ETH-441 | ETH-471 | | | | | | |
| Mycena | pura agg. | | | ETH-476 | | ETH-477 | | | | | | |
| Mycena | spec. 4 | | | | | ETH-945 | | | | | ETH-xxx | |
| Mycena | spec. aff. hetera-cantha (214) | | | | | | | ETH-958 | | | | |
| Mycena | epipterygia agg. | | | | | | | | ETH-578 | | | |
| Mycena | spec. 5 | | | | | | | | ETH-579 | | | |
| Mycena | spec. 6 | | | | | | | | | | | ETH-xxx |
| Mycena | spec. 7 | | | | | | | | | | | ETH-xxx |
| Mycena | spec. 8 | | | | | ETH-946 | | | | | | |
| Ombrophila | spec. | ETH-907 | | | | | | | | | | |

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Omphalotus | spec. | ETH-411 | | | | | x | | | | | |
| Peziza | cf. ampliata | | | | | | | | ETH-963 | | | |
| Phaeomarasmius | spec. | | | | | | | | ETH-580 | | | |
| Physalacria | spec. | | | | ETH-470 | | | | | | | |
| Pleurotus | spec. 1 | | | | ETH-460 | x | | | | | | |
| Pleurotus | spec. 2 | | | | | | | | ETH-568 | | | |
| Pleurotus cf. | spec. 3 | | | | | ETH-505 | | | | | | |
| Pleurotus cf. | spec. 4 | | | | | | ETH-522 | | | | | |
| Pluteus | spec. 1 | ETH-415 | | | | | | | | | | |
| Pluteus | aff. romellii | | | | ETH-923 | | | | | | | |
| Pluteus | spec. 2 | | | | | ETH-502 | xxx | | | | | |
| Pluteus | spec. 3 | | | | | | ETH-957 | | | | | |
| Podostereum | spec. 1 | | | | | | | ETH-962 | | | | |
| Polyporaceae | spec. 1 | | | | | ETH-508 | | | | | | |
| Polyporaceae | spec. 2 | | | | | ETH-516 | | | | | | |
| Polyporaceae | spec. 3 | | | | | | ETH-520 | | | | | |
| Polyporaceae | spec. 4 | | | | | | ETH-950 | | | | | |
| Polyporaceae | spec. 5 | | | | | | | ETH-557 | | | | |
| Polyporaceae | spec. 6 | | | | | | | ETH-558 | | | | |
| Polyporaceae | spec. 7 | ETH-565 | | | | | | | | | | |
| Polyporaceae | spec. 8 | | | | | | | | | ETH-596 | | |
| Polyporaceae | spec. 9 | | | | | | | | | | ETH-xxx | |
| Polyporus | cf. dictyopus | | | | ETH-929 | | | | | | | |
| Postia | spec. | | | | | | ETH-550 | | | | | |
| Protomerulius | africanus | ETH-563 | | | | | ETH-949 | | | | | |
| Psathyrella | spec. 1 | ETH-407 | | | | | | | | | | |
| Psathyrella | spec. 2 | ETH-408 | | | | | | | | | | |
| Psathyrella | spec. 3 | ETH-409 | | | | | | | | | | |

-> back to content

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Psathyrella | spec. 4 | ETH-413 | | | | | x | | | | | |
| Psathyrella | spec. 5 | ETH-421 | | | | | | | | | | |
| Psathyrella | spec. 6 | | | | | ETH-495 | | | | | | |
| Psathyrella | spec. 7 | | | | | ETH-497 | | | | | | |
| Psathyrella | spec. 8 | | | | | | ETH-553 | | | | | |
| Psathyrella | aff. aberdarensis | | | | | | | | ETH-572 | | | |
| Psathyrella | aff. efflorescens | | | | | | | | | | | ETH-xxx |
| Psilocybe | spec. | | | ETH-433 | | | | | | | | |
| Pterula | spec. 1 | | | ETH-431 | | | | | | | | |
| Pterula | spec. 2 | | | | | ETH-472 | | | | | | |
| Pterula | spec. 3 | | | | | | ETH-953 | | | | | |
| Pterula | spec. 4 | | | | | | | | | ETH-598 | | |
| Pycnoporus | sanguineus | | | | x | x | x | | | | | |
| Pyrenomycetes | spec. | | | | | ETH-525 | | | | | | |
| Sarcoscypha | javanense | x | | | | | ETH-555 | | | ETH-xxx | | |
| Sarophorum | spec. | | | | | | | | | ETH-590 | | |
| Schildia | spec. nov. | | | | | | ETH-530 | | | | | |
| Sclerotiniaceae | spec. 1 | ETH-908 | | | | | | | | | | |
| Sclerotiniaceae | spec. 2 | | | | | | | ETH-533 | | | | |
| Scutellinia | spec. 1 | ETH-404 | | | | | | | | | | |
| Scutellinia | spec. 2 | ETH-902 | | | | | | | | | | |
| Scutellinia | spec. 3 | | | | | ETH-510 | | | | | | |
| Scutellinia | spec. 4 | | | | | | ETH-519 | | | | | |
| Scutellinia | spec. 5 | | | | | | | ETH-539 | | | | |
| Scutellinia | spec. 6 | | | | | | | ETH-540 | | | | |
| Scutellinia | spec. 7 | | | | | | | | ETH-577 | | | |
| Scytinopogon | spec. | | ETH-423 | | ETH-450 | | | | | | | |
| Sericeomyces | spec. | | | | | | | | ETH-964 | | | |

| Genus | Taxon | Wushwush KO 1 30/07/2019 | Chiri (Awurada) AW 31/07/2019 | Boka BA 01/08/201 | Gimbo SHO 02/08/2019 | Enderach MA 03/08/2019 | Wushwush KO 2 04/08/2019 | Boginda BO 05/08/2019 | Boka BK 06/08/2019 | Wushwush KO 1 07/08/2019 | Gimbo SHO 10/08/2019 | Enderach MA 11/08/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Steccherinum | spec. | | | | | | | | ETH-573 | | | |
| Stereum | spec. 1 | | | | ETH-457 | | | | | | | |
| Stereum | spec. 2 | | | | ETH-463 | x | | | | | | |
| Stereum | spec. 3 | ETH-567 | | | | | | | | | | |
| Strophariaceae | spec. | ETH-417 | | | | | | | | | | |
| Thelephoraceae | spec. | | | | ETH-459 | | | | | | | |
| Trametes | spec. | | | | ETH-448 | | | | | | | |
| Tremella | spec. 1 | | | | ETH-936 | | | | | | | |
| Tremella | spec. 2 | | | | | | | ETH-544 | | | | |
| Tremellales | spec. | | | | | | | ETH-960 | | | | |
| Trichoglossum | spec. 1 | ETH-405 | | | | | | | | x | x | x |
| Trichoglossum | spec. 2 | | | | | | | | | ETH-607 | | |
| Trichoglossum | spec. 3 | | | | | | | | | ETH-968 | | |
| Trichoglossum | spec. 4 | | | | | | | | | | | ETH-xxx |
| Tricholomopsis | cf. aurea | | | ETH-426 | | ETH-499 | | | | ETH-601 | | |
| Tricholosporum | spec. | | | | | | | | | | | ETH-xxx |
| Trogia | spec. | | | | | | | | | | ETH-xxx | |
| Tubaria | spec. | | | | | | | ETH-560 | | | | |
| Typhula | spec. | | | | ETH-931 | | | | | | | |
| Volvariella | spec. | | | | | ETH-478 | | | | | | |
| Xanthagaricus | spec. | | | | ETH-458 | | | | | | | |
| Xeromphalina | spec. | | | | | | | | ETH-574 | | | |
| Xerorus | spec. | | | | | ETH-491 | | | | | | |
| Xylaria | spec. 1 | ETH-412 | | | | | | | | | | |
| Xylaria | spec. 2 | ETH-416 | | | | | | | | | | |
| Xylaria | spec. 3 | | | | ETH-462 | | | | | | | |
| Xylaria | spec. 4 | | | | | ETH-511 | | | | | | |



-> back to content

## 6.2 Photos

**Figure 1:** *Coniolepiota kafai* (photo: Andreas Gminder)

**Figure 2:** *Calathella digitiformis* aff. at Boka Forest (photo: Andreas Gminder)

**Figure 3:** Komba Forest is one of the surveyed sites with the highest fungi biodiversity at the Kafa BR and for example inhabited by *Campanella* spec. cf. (photo: Andreas Gminder)

**Figure 4:** *Clavaria fragilis* was found at Mankira Forest (photo: Andreas Gminder)

**Figure 5:** Another fungi species which has been found in the biodiverse Mankira Forest: *Coniolepiota kafai* spec. (photo: Andreas Gminder)

**Figure 6:** *Cyanthus* spec. at Mankira Forest (photo: Andreas Gminder)

**Figure 7:** *Entoloma* spec. at Komba Forest
(photo: Andreas Gminder)

**Figure 8:** *Geastrum schweinitzii* at Mankira Forest
(photo: Andreas Gminder)

**Figure 9:** *Geastrum* spec. at Shorori Forest
(photo: Andreas Gminder)

**Figure 10:** *Gymnopus* spec. at Komba Forest
(photo: Andreas Gminder)

**Figure 11:** *Hypoxylon ticinense* cf. at Shorori Forest
(photo: Andreas Gminder)

**Figure 12:** *Leotiomycetes* spec. at Boginda Forest
(photo: Andreas Gminder)

**Figure 13:** A fungi species of the genus *Microglossum*, found at Komba Forest (photo: Andreas Gminder)

**Figure 14:** *Mycena* spec. at Bamboo Forest which seems to be linked to the highest number of fungi species not yet described (photo: Andreas Gminder)

**Figure 15:** *Mycena* spec. at Mankira Forest (photo: Andreas Gminder)

**Figure 16:** *Psathyrella* spec. at Boka Forest (photo: Andreas Gminder)

**Figure 17:** *Ramaria* spec. at Komba Forest (photo: Andreas Gminder)

**Figure 18:** A species of the genus *Trichoglossum*, which has not been fully analysed yet, was found at Komba Forest (photo: Andreas Gminder)

**Figure 19:** *Trigonosporum* spec. cf. at Komba Forest
(photo: Andreas Gminder)

# Dragonflies and damselflies (Odonata) of the Kafa Biosphere Reserve

**Dr Viola Clausnitzer, Gebre Egzeabeher, Manaye Misganaw, Seid Muhammad, Teferi Paulos and Dr Klaas-Douwe B. Dijkstra**

## Highlights

→ A total of 57 Odonata (dragonflies and damselflies, hereafter referred to as "dragonflies") species from nine families was recorded in the two 2014 and 2019 surveys (this represents 53% of the 108 species certain to occur in Ethiopia and 90.5% of the Kafa Biosphere Reserve's confirmed dragonfly fauna). In the 2014 survey just 33 species were found, so the 2019 survey resulted in a further 29 species which could be added to the biosphere reserve's total.

→ The Ethiopian endemic *Crenigomphus denticulatus* was recorded for the first time since 1962 and is thus new to the Kafa Biosphere Reserve. *Pseudagrion sjoestedti* is new to Ethiopia.

→ A total of 63 dragonfly species from nine families has now been recorded at the Kafa Biosphere Reserve, with at least 75 expected in total.

→ Nine of the 12 species known to be endemic to Ethiopia are confirmed to be present at the Kafa Biosphere Reserve (*Pseudagrion guichardi*, *P. kaffinum*, *Crenigomphus denticulatus*, *Notogomphus cottarellii*, *N. ruppeli*, *Paragomphus crenigomphoides*, *Atoconeura aethiopica*, *Orthetrum kristenseni*, *Trithemis ellenbeckii*) as is one subspecies (*Palpopleura jucunda radiata*). Another endemic (*Elattoneura pasquinii*) is almost certain to occur, while suitable habitat may also be present for the final two (*Ischnura abyssinica*, *Crenigomphus abyssinicus*). Among the species that were present and that have a limited distribution outside Ethiopia are *Pinheyschna waterstoni* (also in western Sudan) and *Notogomphus lecythus* (also in western Kenya).

→ Seven species are globally at risk of extinction according to the IUCN Red List of Threatened Species (five Vulnerable, two Endangered), while one is Near Threatened. All of these species except the near endemic *Pinheyschna waterstoni* are confined to Ethiopia.

→ Most endemic species were found in streams, usually flowing from natural bogs or forests, typically at an altitude between 1,600 and 2,600 m a.s.l. *Pseudagrion kaffinum* and *Crenigomphus denticulatus*, however, were found only along or near Gojeb River at about 1,300 and 1,550 m respectively.

→ Lower lying areas, including ponds and rivers, harbour more species but fewer endemics.

→ The Ethiopian Highlander (*Atoconeura aethiopica*), Ethiopian Sprite (*Pseudagrion guichardi*), Cottarelli's Longleg (*Notogomphus cottarellii*) and Rüppell's Longleg (*N. ruppeli*) are used as monitoring species for habitat quality.

→ The results demonstrate the significance of the natural and semi-natural habitats at the Kafa Biosphere Reserve for conserving Ethiopia's biodiversity and endemics.

The Odonata Team (photo: Viola Clausnitzer; Klaas-Douwe B. Dijkstra)

# 1. Introduction

The insect order Odonata includes dragonflies and damselflies (hereafter referred to as "dragonflies" only), which all breed exclusively in freshwater habitats. Many species are sensitive to the disturbance of such sites and, therefore, are considered good indicators of anthropogenic change.

A survey of the Kafa Biosphere Reserve (Kafa BR) in December 2014 recorded only 33 dragonfly species in total, which is just over 30% of the species known from Ethiopia, while closer to 70% were considered likely to be present. The main recommendation of the report of the first biodiversity assessment was therefore to sample during the wet season in the boreal summer, which was done in August 2019.

This report details the results of the follow-up survey, undertaken in the first half of August 2019. Its goals were to (1) complete the list of species present; (2) obtain more data on the distribution and ecology of the localised and threatened species; and (3) provide training in the identification of the species, which are good flagships and indicators for conservation in the region.

Additional details on the research history, diversity, biogeography and ecology of Ethiopia's Odonata are provided in the previous report (Clausnitzer, 2017), as well as by Clausnitzer & Dijkstra (2005) and Consiglio (1978).

# 2. Materials and methods

## 2.1 Study area

The study sites listed in Table 1 cover all types of waters (headwaters, streams, rivers, wetlands, bogs, temporary pools) and landscapes (montane, bamboo, secondary and coffee forests, wooded savannah, grassland, cultivated fields) available in the region from just under 1,300 m altitude to about 2,600 m a.s.l.

## 2.2 Sampling and collecting methods

Adult dragonflies were observed with binoculars and caught with butterfly nets, mostly between 10 am and 4 pm. Adults depend on warmth and sunshine for their activity, but despite frequent rain and often overcast days, we believe the lists for most sites are generally complete. In most cases, adults were identified in the field using Dijkstra & Clausnitzer (2014). Collected adults were put in acetone for a night, dried and then stored in paper envelopes. Dragonfly larvae were caught in the water using a kitchen sieve or scoop net and subsequently stored in alcohol.

The authors were supported by Gebre Egzeabeher Hailay (EBI), Manaye Misganaw (EBI), Abdu Siraj Abagaro (Ranger), Abera Hoeto (Ranger), Mitiku Gebremariam (Ranger), Seid Mohamed (Bonga University), Teferi Phaulos (Bonga University) while a few extra records were provided by Tom Kirschey and Hendrik Müller, members of the herpetological team.

**Table 1:** List of study sites, characteristics and survey dates

| No | Full survey | Position | Site | Date |
|---|---|---|---|---|
| 1 | yes | Between Bonga and Gimbo | Temporary pools in Shorori quarry | 30/07/2019 |
| 2 | yes | Between Bonga and Gimbo | Alemgono Wetland | 30/07/2019 |
| 3 | yes | Between Bonga and Gimbo | Shorori Wetland, stream and forest | 30/07/2019 |
| 4 | yes | Between Mera and Boka | Boka Forest bog and outflow stream | 01/08/2019 |
| 5 | yes | South-east of Boka | River in Bamboo Forest | 01/08/2019 |
| 6 | no | | West of Konda | 02/08/2019 |
| 7 | no | Between Saja and Boginda | Road on descent to Gojeb | 02/08/2019 |
| 8 | yes | Between Medabo/Set and Boginda | Gojeb River and flooded areas | 02/08/2019 |
| 9 | yes | East of Saja | Wetland and stream on edge of Boginda Forest | 02/08/2019 |
| 10 | no | Between Konda and Medabo | Small river | 03/08/2019 |
| 11 | no | East of Enderach (Andracha) | Bridge on Gumi River | 03/08/2019 |
| 12 | yes | Between Konda and Chotio | North side of Gojeb Wetlands | 03/08/2019 |
| 13 | yes | South of Medabo and Set | East side of Gojeb Wetlands | 03/08/2019 |
| 14 | yes | Between Amiyo (Gojeb) and Arguba | Gojeb River and adjacent savannah | 04/08/2019 |
| 15 | yes | Between Dera (Dara) and Dimbra | Wetland and stream on edge of coffee forest | 05/08/2019 |
| 16 | yes | Between Dera (Dara) and Dimbra | Roadside stream | 05/08/2019 |
| 17 | yes | Between Dera (Dara) and Wushwush | Gravel pits in Komba Forest | 05/08/2019 |
| 18 | yes | West of Wushwush | Stream coming from Wushwush Tea Plantation | 05/08/2019 |
| 19 | no | Between Shaka and Kaka | Forest road | 07/08/2019 |
| 20 | no | South-east of Boka | Pool at edge of Bamboo Forest | 07/08/2019 |
| 21 | no | South-east of Tari | Roadside pools and drain | 07/08/2019 |
| 22 | yes | East of Enderach (Andracha) | Bridge on Gumi River | 07/08/2019 |
| 23 | yes | Between Tari and Felege Selam | Tributary of Gumi River | 07/08/2019 |
| 24 | no | Hill above the Guest House | Open-air museum south-east of Bonga | 08/08/2019 |
| 25 | yes | 3 km south-east of Bonga | Forest clearing and swamp | 08/08/2019 |
| 26 | yes | Bonga town | Bonga town | 09/08/2019 |
| 27 | yes | Between Bonga and Awurada (Chiro) | Beha Wetland and its outflow, Kepi River | 11/08/2019 |

## 2.3 Data analysis

Samples were properly prepared and exported in accordance with the national regulations of the Ethiopian Biodiversity Institute (EBI), with the main objective of verifying identifications. Half the material remains at the EBI as a reference, while the exported material will be kept at the Naturalis Biodiversity Center in Leiden, The Netherlands.

Information on point localities and species is stored in an Excel datasheet and all information will be transferred to the Odonata Database of Africa hosted by Jens Kipping. The data will also be added to the IUCN Red List of Threatened Species. Basic analysis was done using functions in Excel.

# 3. Results and discussion

## 3.1 Diversity

The table in Appendix 2 provides details of the 108 dragonfly and damselfly species certain to occur in Ethiopia, with those recorded at or near the Kafa BR during the 2014 and 2019 surveys specified. *Azuragrion nigridorsum* and *Orthetrum brachiale* are best removed from the national list (see Dijkstra & Clausnitzer, 2014) pending confirmation, as they may have been confused with *A. vansomereni* and *O. stemmale*. A total of 57 species was found in the 2019 survey, i.e. 53% of those confirmed for Ethiopia, excluding a possible observation of *Zosteraeschna ellioti* but including larvae of a *Paragomphus* species, a sighting of an unidentified *Phyllomacromia* species, and the finding of wings (without body) of *Gynacantha nigeriensis*. This exceeds the total of 33 species found during the 2014 dry-season survey by 24 species, with 29 species added to the overall Kafa BR list.

The difference between the two surveys is explained partly by the season, as demonstrated by the appearance of species that are presumably widespread at the biosphere reserve like *Africallagma elongatum*, *Anax speratus* and *Pinheyschna waterstoni*, lotic species with a limited flight season like *Notogomphus dorsalis* and *N. lecythus*, and lentic species that need rainfall to form their temporary reproductive habitats like *Pantala flavescens* and *Sympetrum fonscolombii*. Nonetheless, we estimate that about two-thirds of the additions can be explained by the wider exploration of the region in the follow-up survey. Most notably, nine species were added in the relatively low-lying area (1,295-1,375 m a.s.l.) along Gojeb River near Arguba, including river specialists such as *Mesocnemis singularis*, *Pseudagrion gamblesi*, *P. sjoestedti*, *Crenigomphus denticulatus* and *Brachythemis lacustris*, as well as more generalist species like *Ceriagrion suave*, *Pseudagrion hamoni*, *Orthetrum chrysostigma* and *Trithemis aconita*. Indeed, this is the only place where a new species for Ethiopia was found (*P. sjoestedti*).

Other additions to the Kafa region are: *Lestes tridens*, *Phaon iridipennis*, *Azuragrion vansomereni*, *Acisoma inflatum*, *Brachythemis impartita*, *Crocothemis sanguinolenta*, *Diplacodes lefebvrii*, *Diplacodes luminans*, *Orthetrum guineense*, *Orthetrum machadoi*, *Orthetrum monardi*, *Tramea basilaris*, *Trithemis kirbyi*.

The five species definitively found in 2014 only were *Zosteraeschna ellioti*, *Gynacantha villosa*, *Palpopleura jucunda*, *Tetrathemis polleni* and *Zygonyx torridus*. The last two were seen only at the low-lying bottom (1,293 m a.s.l.) of Gumi Valley near Awurada, where it rained during our 2019 visit. Sightings of *Gynacantha villosa* at several sites in 2014 (as well as *G. nigeriensis* at one), demonstrate that adults of this genus are best sought in the dry season, as they only seem present as larvae in temporary pools in the wet.

A total of 63 species is now confirmed for the Kafa BR, but at least 11 more are presumed present based on the proximity of records of the Ethiopian endemic *Elattoneura pasquinii* (see below) as well as the widespread *Africallagma subtile*, *Agriocnemis exilis*, *Anaciaeschna triangulifera*, *Anax ephippiger*, *Gynacantha vesiculata*, *Paragomphus alluaudi*, *Phyllomacromia picta*, *Chalcostephia flavifrons*, *Orthretum hintzi* and *Zygonyx natalensis*. Thus, the total number of species in the region should be at least 75 and possibly even 80 species.

## 3.2 Sites and habitats

By far the highest number of species recorded at any site was the 35 species from lower Gojeb River (site 14). This site is at lower elevation for the most part and has very high habitat heterogeneity of lentic and lotic habitats. Two sites which scored 16 species each were the Gojeb Wetlands (site 8) and temporary pools at Shorori (site 1). For most of the other sites fewer than four species were recorded, but this may partly be because the sampling intensity was different due to time and weather constraints.

Similar to the findings of Dijkstra & Clausnitzer (2005) and Clausnitzer (2017) the high proportion of endemic species is notable. The species number recorded for the Kafa BR could be raised tremendously, something that had already been suspected based on the report from the the first survey (Clausnitzer, 2017). The general pattern of a species-poor but endemic-rich fauna and flora is most likely a result of the area's geological history and present-day isolation. The Ethiopian Highlands have undergone heavy volcanism and climate changes, which might be responsible for the relatively high level of adaptiveness.

## 3.3 Species

The first survey recorded seven of the twelve species unique to Ethiopia, while fieldwork in March 2004 had found an eighth endemic and the follow-up assessment added a ninth.

Nine of the twelve species known to be endemic to Ethiopia are confirmed present at the Kafa BR, as is one subspecies, *Palpopleura jucunda radiata*. Four of these have a similar ecology, favouring (often swift) streams typically near a forest: *Pseudagrion guichardi* and *Atoconeura aethiopica*, both ranked Vulnerable on the IUCN

Red List of Threatened Species, and *Notogomphus cottarellii* and *N. ruppeli*, both considered Endangered. All appear present from just under 1,600 to almost 2,600 m a.s.l. in the region, except *N. ruppeli*, which was not found below 1,900 m, neither there nor elsewhere in Ethiopia. The Near Threatened *Paragomphus crenigomphoides* may belong to this group, too. The only adult record (obtained in 2004) was near Wushwush at 1,845 m a.s.l., although possible larvae were found at 1,580 m a.s.l. in 2019. Recorded between 1,630 and 2,420 m a.s.l. in south-western Ethiopia, *Orthetrum kristenseni* has a similar altitudinal range but favours boggy pools. However, being much scarcer than its congeners *O. caffrum*, *O. julia* and *O. stemmale* at such habitats, it seems more sensitive to the heavy grazing and trampling impacts there, possibly relying on more natural bogs for its survival. Its current listing as Least Concern may therefore be somewhat optimistic.

The Vulnerable *Pseudagrion kaffinum* and Least Concern *Trithemis ellenbeckii* regionally have a lower and narrower altitudinal range, from 1,500 to 1,800 m a.s.l., as their preferred habitat of slower and more open streams and rivers occurs to be lower. Another endemic, the Vulnerable *Elattoneura pasquinii*, may occur with them. While not yet reported at the Kafa BR, it has been found between 1,610 and 1,650 m a.s.l., both to the east and north-west of the region. We are confident that it will be found, for example at Gojeb or its tributaries within the large Gojeb Wetland complex. Finally, multiple individuals of the Vulnerable *Crenigomphus denticulatus* were found among tall grass about 650 m from Gojeb River near Arguba, which flows at 1,295 m a.s.l. here. Although they may have emerged from one of the tributaries, larger rivers (Gojeb is 25 m wide here) are suitable for *Crenigomphus* species. The species was only known from three records in the 19th century and one in 1962 (Pinhey, 1982) and is new to the Kafa BR.

The two remaining species endemic to Ethiopia, the Near Threatened *Ischnura abyssinica* and the Vulnerable *Crenigomphus abyssinicus*, were not found during either survey. Most reliable records of the first are from open pools between 2,000 and 3,000 m a.s.l., so we suspect there is little suitable habitat in south-western Ethiopia. The second species is even more poorly known than *C. denticulatus*, with just a few specimens of mostly uncertain provenance, the last one collected in 1914 (pers. comm. J. Kipping).

Two additional species present at the Kafa BR have very limited ranges outside of Ethiopia. The Vulnerable *Pinheyschna waterstoni* is also known from Jebel Marra of western Sudan and probably occurs in a wide range of faster-flowing waters at the BR, from at least 1,300 to 2,600 m a.s.l. The Least Concern *Notogomphus lecythus* is also known from a small area of western Kenya. It was only recorded along Gojeb, but surveyed at both the lower (1,295 m a.s.l.) and higher (1,560 m a.s.l.) localities.

Ethiopia's endemics appear to be quite tolerant to human impacts, probably because they evolved in response to the highlands' constant climatic and geological changes. Indeed, some of the species may not be as threatened as their current Red List status suggests. Nonetheless, given the pressures on the remaining forests, we recommend monitoring of these endemic species. Furthermore, as observed above for *Orthetrum kristenseni*, species of open habitats may be more sensitive than often believed, due to the increasing pressures of lifestock on such sites.

# 4. Conclusions and recommendations for conservation and monitoring

## 4.1 Recommendations for dragonfly conservation

Deforestation and environmental degradation due to human disturbance, along with an increase in water pollution due to economic growth, even in remote areas, pose a major threat to Ethiopia's environmental health. Much of the natural landscape has been turned into agricultural land. Around 95% of Ethiopia's original forest has already been lost to agriculture and human settlements (Gordon & Carillet, 2003). As explained above, Ethiopia's endemic dragonflies are relatively tolerant to habitat disturbance. Still, even species adaptable to altered landscapes may disappear in the face of ongoing habitat change due to pollution, water extraction and reforestation with eucalypts.

The endemic species which require forested and clear rocky streams or rivers, such as the Ethiopian Sprite (Figure 1a), Cottarelli's Longleg (Figures 3a, b), Rüppell's Longleg (Figure 3c) and Ethiopian Highlander (Figure 4a) are of conservation concern and act as monitoring species for the core zones of the Kafa BR. Since they are easy to see and endemic to the montane habitats, the Ethiopian Highlander (Figure 4a), Ethiopian Skimmer (Figures 5a, b), Ethiopian Sprite (Figure 1a) and Kaffa Sprite (Figure 1b) are considered as flagship species for the Kafa BR.

Conservation efforts at the Kafa BR have thus largely focused on the threatened montane upland habitat, which explains why core zones have not yet been established in the wetlands. The huge wetlands of Gojeb River should be considered as a core zone, as well as the wetlands in the Afroalpine zone, i.e. beyond Boka Forest. Gojeb River especially, and streams draining into the Gojeb in the Arguba investment area, have a very high species diversity and there the endemic Little Talontail (*Crenigomphus denticulatus*) (Figure 2a and b) was recorded for the first time after its description over 60 years ago. This is only the second locality where it is known to occur and it might be considered as a flagship species for the lower habitats at the Kafa BR.

## 4.2 Suggestions for future studies

We currently have good data for the months of August (2019 survey) and December (2014 survey), as well as a few records from the authors' brief visit in March 2004. To complete the seasonal picture we suggest research in (1) April and May, as the start of the rains may be optimal for many of the lotic species; and (2) October, as the end of the rains may be the time when most lentic species emerge.

Concerning areal coverage, large parts of the west and the north of the Kafa BR have never been surveyed. It would be good to visit these regions as well. A detailed survey on the endemic species should be encouraged. This would allow the future monitoring of habitat quality.

# 5. References

*For more reference on the odonatological history of Ethiopia consult Clausnitzer & Dijkstra (2005) and Clausnitzer (2017).*

**Clausnitzer, V. & Dijkstra, K.-D.B.** (2005). The dragonflies (Odonata) of Ethiopia, with notes on the status of endemic taxa and the description of a new species. Entomologische Zeitschrift, Stuttgart. 115:117-130.

**Clausnitzer, V.** (2017). Dragonflies and damselflies (Odonata) at the Kafa Biosphere Reserve, pp.160-189, in: The Nature and Biodiversity Conservation Union (NABU) (2017) NABU's Biodiversity Assessment at the Kafa Biosphere Reserve. Berlin, Addis Ababa.

**Consiglio, C.** (1978). Odonata Collected in Ethiopia by the Expeditions of the Accademia Nazionale Dei Lincei. I Introduction and the Zygoptera. Problemi Attuali di Scienza e di Cultura (III) 243:27-51.

**Dijkstra, K.-D.B. & Clausnitzer, V.** (2014). The Dragonflies and Damselflies of Eastern Africa: Handbook for all Odonata from Sudan to Zimbabwe. Studies in Afrotropical Zoology 298:1-264.

**Gordon, F.L. & Carillet, J.-B.** (2003). Ethiopia and Eritrea. Lonely Planet Publications, Melbourne.

**Pinhey, E,** (1982). Odonata collected in Ethiopia III. Anisoptera. Problemi Attuali di Scienza e di Cultura (III) 252:1-56. Accademia Nazionale Dei Lincei.

# 6. Annex

## 6.1 Appendices

**Appendix 1:** List of collecting sites in 2019 for dragonflies including locality information (see also Table 1)

| No | Position | Survey date | Additional date | Altitude min (a.s.l.) | Altitude max (a.s.l.) | Latitude | Longitute |
|---|---|---|---|---|---|---|---|
| 1 | Between Bonga and Gimbo | 30/07/2019 | 10/08/2019 | 1,690 m | 1,700 m | 7.36371088 | 36.21228409 |
| 2 | Between Bonga and Gimbo | 30/07/2019 | | 1,710 m | 1,720 m | 7.361938 | 36.2219696 |
| 3 | Between Bonga and Gimbo | 30/07/2019 | | 1,620 m | 1,630 m | 7.359440804 | 36.2060318 |
| 4 | Between Mera and Boka | 01/08/2019 | 07/08/2019 | 2,420 m | | 7.294794559 | 36.37634659 |
| 5 | South-east of Boka | 01/08/2019 | | 2,620 m | | 7.240357876 | 36.45194626 |
| 6 | West of Konda | 02/08/2019 | | 1,610 m | | 7.600477695 | 35.99933243 |
| 7 | Between Saja and Boginda | 02/08/2019 | | | | 7.507861614 | 36.05672836 |
| 8 | Between Medabo/Set and Boginda | 02/08/2019 | | 1,560 m | | 7.55403614 | 36.0593605 |
| 9 | East of Saja | 02/08/2019 | | 2,130 m | 2,140 m | 7.501667023 | 36.09070206 |
| 10 | Between Konda and Medabo | 03/08/2019 | | 1,575 m | | 7.573671818 | 36.03019333 |
| 11 | East of Enderach (Andracha) | 03/08/2019 | | 1,575 m | | 7.20290947 | 36.28380585 |
| 12 | Between Konda and Chotio | 03/08/2019 | | 1,580 m | | 7.593741417 | 35.97877121 |
| 13 | South of Medabo and Set | 03/08/2019 | | 1,560 m | | 7.563093185 | 36.05007172 |
| 14 | Between Amiyo (Gojeb) and Arguba | 04/08/2019 | 06/08 and 12/08/2019 | 1,295 m | 1,375 m | 7.409640312 | 36.39720535 |
| 15 | Between Dera (Dara) and Dimbra | 05/08/2019 | | 1,780 m | | 7.320901871 | 35.99799728 |
| 16 | Between Dera (Dara) and Dimbra | 05/08/2019 | | 1,790 m | | 7.319906235 | 36.00978088 |
| 17 | Between Dera (Dara) and Wushwush | 05/08/2019 | | 1,950 m | | 7.310642242 | 36.0759964 |
| 18 | West of Wushwush | 05/08/2019 | | 1,910 m | | 7.307193279 | 36.12187195 |
| 19 | Between Shaka and Kaka | 07/08/2019 | | 1,920 m | | 7.288095474 | 36.48557663 |
| 20 | South-east of Boka | 07/08/2019 | | 2,665 m | | 7.243246555 | 36.4432106 |
| 21 | South-east of Tari | 07/08/2019 | | 2,295 m | | 7.161600113 | 36.33116913 |
| 22 | East of Enderach (Andracha) | 07/08/2019 | 03/08 and 05/08/2019 | 1,575 m | | 7.202408314 | 36.28335953 |
| 23 | Between Tari and Felege Selam | 07/08/2019 | | 1,580 m | | 7.122454643 | 36.38181305 |
| 24 | Hill above the Guest House | 08/08/2019 | | 1,970 m | | 7.253574371 | 36.2634201 |
| 25 | 3 km south-east of Bonga | 08/08/2019 | | 1,940 m | 1,980 m | 7.247397423 | 36.27408981 |
| 26 | Bonga town | 09/08/2019 | | 1,760 m | | 7.262025356 | 36.24902344 |
| 27 | Between Bonga and Awurada (Chiro) | 11/08/2019 | | 1,900 m | | 7.180156708 | 36.20835876 |

**Appendix 2:** List of the Odonata (dragonflies and damselflies) of Ethiopia according to literature studies and surveys by the authors, their Red List status and their occurrence at the Kafa BR; 1: recorded by the authors in 2004, 2014 or 2019, 2: literature record

| Scientific name | Common name | IUCN Red List | Kafa BR | 2014 | 2019 |
|---|---|---|---|---|---|
| **Zygoptera (Selys, 1854)** | | | | | |
| **Lestidae (Calvert, 1901)** | | | | | |
| *Lestes* (Leach, 1815) | True Spreadwings | | | | |
| *Lestes tridens* (McLachlan, 1895) | Spotted Spreadwing | | 1 | | 1 |
| *Lestes virgatus* (Burmeister, 1839) | Smoky Spreadwing | | 1 | 1 | 1 |
| *Lestes pallidus* (Rambur, 1842) | Pallid Spreadwing | | | | |
| **Calopterygidae (Selys, 1850)** | | | | | |
| *Phaon* (Selys, 1853) | African Demoiselles | | | | |
| *Phaon iridipennis* (Burmeister, 1839) | Glistening Demoiselle | | 1 | | 1 |
| **Chlorocyphidae (Cowley, 1937)** | | | | | |
| *Platycypha* (Fraser, 1949) | Dancing Jewels | | | | |
| *Platycypha caligata* (Selys, 1853) | Common Dancing Jewel | | 1 | 1 | 1 |
| **Platycnemididae (Yakobson & Bianchi, 1905)** | | | | | |
| *Elattoneura* (Cowley, 1935) | African Threadtails | | | | |
| *Elattoneura pasquinii* (Consiglio, 1978) | Ethiopian Threadtail | VU | 2 | | |
| *Mesocnemis* (Karsch, 1891) | Riverjacks | | | | |
| *Mesocnemis singularis* (Karsch, 1891) | Common Riverjack | | 1 | | 1 |
| **Coenagrionidae (Kirby, 1890)** | | | | | |
| *Aciagrion* (Selys, 1891) | Slims | | | | |
| *Aciagrion gracile* (Sjöstedt, 1909) | Graceful Slim | | 1 | 1 | 1 |
| *Africallagma* (Kennedy, 1920) | African Bluets | | | | |
| *Africallagma elongatum* (Martin, 1907) | Elongate Bluet | | 1 | | 1 |
| *Africallagma subtile* (Ris, 1921) | Fragile Bluet | | 2 | | |
| *Agriocnemis* (Selys, 1877) | Wisps | | | | |
| *Agriocnemis exilis* (Selys, 1872) | Little Wisp | | 2 | | |
| *Agriocnemis inversa* (Karsch, 1899) | Highland Wisp | | | | |
| *Agriocnemis sania* (Nielsen, 1959) | Nile Wisp | | | | |
| *Azuragrion* (May, 2002) | Sailing Bluets | | | | |
| *Azuragrion nigridorsum* (Selys, 1876) | Sailing Bluet | | | | |
| *Azuragrion somalicum* (Longfield, 1931) | Somali Bluet | | | | |
| *Azuragrion vansomereni* (Pinhey, 1956) | Tiny Bluet | | 1 | | 1 |
| *Ceriagrion* (Selys, 1876) | Citrils | | | | |
| *Ceriagrion glabrum* (Burmeister, 1839) | Common Citril | | 1 | 1 | 1 |
| *Ceriagrion suave* (Ris, 1921) | Suave Citril | | 1 | | 1 |
| *Ischnura* (Charpentier, 1840) | Bluetails | | | | |
| *Ischnura abyssinica* (Martin, 1907) | Ethiopian Bluetail | NT | | | |
| *Ischnura senegalensis* (Rambur, 1842) | Tropical Bluetail | | | | |
| *Proischnura* (Kennedy, 1920) | Fork-tailed Bluets | | | | |
| *Proischnura subfurcata* (Selys, 1876) | Fork-tailed Bluet | | 1 | 1 | 1 |
| *Pseudagrion* (Selys, 1876) | Sprites | | | | |
| *Pseudagrion* (Selys, 1876) (A-group) | | | | | |
| *Pseudagrion gamblesi* (Pinhey, 1978) | Great Sprite | | 1 | | 1 |

| Scientific name | Common name | IUCN Red List | Kafa BR | 2014 | 2019 |
|---|---|---|---|---|---|
| *Pseudagrion guichardi* (Kimmins, 1958) | Ethiopian Sprite | VU | 1 | 1 | 1 |
| *Pseudagrion kaffinum* (Consiglio, 1978) | Kaffa Sprite | VU | 1 | 1 | 1 |
| *Pseudagrion kersteni* (Gerstäcker, 1869) | Powder-faced Sprite | | 1 | 1 | 1 |
| *Pseudagrion salisburyense* (Ris, 1921) | Slate Sprite | | | | |
| *Pseudagrion spernatum* (Selys, 1881) | Upland Sprite | | 1 | 1 | 1 |
| *Pseudagrion* (Selys, 1876) (B-group) | | | | | |
| *Pseudagrion commoniae* (Förster, 1902) | Black Sprite | | | | |
| *Pseudagrion hamoni* (Fraser, 1955) | Swarthy Sprite | | 1 | | 1 |
| *Pseudagrion massaicum* (Sjöstedt, 1909) | Masai Sprite | | | | |
| *Pseudagrion niloticum* (Dumont, 1978) | Nile Sprite | | | | |
| *Pseudagrion nubicum* (Selys, 1876) | Bluetail Sprite | | | | |
| *Pseudagrion sjoestedti* (Förster, 1906) | Variable Sprite | | 1 | | 1 |
| *Pseudagrion sublacteum* (Karsch, 1893) | Cherry-eye Sprite | | | | |
| *Pseudagrion torridum* (Selys, 1876) | Wing-tailed Sprite | | | | |
| **Anisoptera (Selys, 1854)** | | | | | |
| **Aeshnidae (Leach, 1815)** | | | | | |
| *Anaciaeschna* (Selys, 1878) | Evening Hawker | | | | |
| *Anaciaeschna triangulifera* (McLachlan, 1896) | Evening Hawker | | 2 | | |
| *Anax* (Leach, 1815) | Emperors | | | | |
| *Anax ephippiger* (Burmeister, 1839) | Vagrant Emperor | | 2 | | |
| *Anax imperator* (Leach, 1815) | Blue Emperor | | 1 | 1 | 1 |
| *Anax speratus* (Hagen, 1867) | Eastern Orange Emperor | | 1 | | 1 |
| *Gynacantha* (Rambur, 1842) | True Duskhawkers | | | | |
| *Gynacantha nig*eriensis (Gambles, 1956) | Yellow-legged Duskhawker | | 1 | 1 | 1 |
| *Gynacantha vesiculata* (Karsch, 1891) | Lesser Girdled Duskhawker | | 2 | | |
| *Gynacantha villosa* Grünberg, 1902) | Brown Duskhawker | | 1 | 1 | |
| *Pinheyschna* (Peters & Theischinger, 2011) | Stream Hawkers | | | | |
| *Pinheyschna waterstoni* (Peters & Theischinger, 2011) | Ethiopian Hawker | VU | 1 | | 1 |
| *Zosteraeschna* (Peters & Theischinger, 2011) | Highland Hawkers | | | | |
| *Zosteraeschna ellioti* (Kirby, 1896) | Highland Hawker | | 1 | 1 | ? |
| **Gomphidae (Rambur, 1842)** | | | | | |
| *Crenigomphus* (Selys, 1892) | Talontails | | | | |
| *Crenigomphus abyssinicus* (Selys, 1878) | Ethiopian Talontail | VU | | | |
| *Crenigomphus denticulatus* (Selys, 1892) | Little Talontail | VU | 1 | | 1 |
| *Crenigomphus renei* (Fraser, 1936) | Western Talontail | | | | |
| *Ictinogomphus* (Cowley, 1934) | Tigertails | | | | |
| *Ictinogomphus ferox* (Rambur, 1842) | Common Tigertail | | | | |
| *Notogomphus* (Selys, 1858) | Tonglegs | | | | |
| *Notogomphus cottarellii* (Consiglio, 1978) | Cottarelli's Longleg | EN | 1 | 1 | 1 |
| *Notogomphus dorsalis* (Selys, 1858) | Little Longleg | | 1 | | 1 |
| *Notogomphus lecythus* (Campion, 1923) | Northern Longleg | | 1 | | 1 |
| *Notogomphus ruppeli* (Selys, 1858) | Rüppell's Longleg | EN | 1 | 1 | 1 |

| Scientific name | Common name | IUCN Red List | Kafa BR | 2014 | 2019 |
|---|---|---|---|---|---|
| *Paragomphus* (Cowley, 1934) | Hooktails | | | | |
| *Paragomphus alluaudi* (Martin, 1915) | Highland Hooktail | | 2 | | |
| *Paragomphus crenigomphoides* (Clausnitzer & Dijkstra, 2005) | Ethiopian Hooktail | NT | 1 | | |
| *Paragomphus genei* (Selys, 1841) | Common Hooktail | | | | |
| **Macromiidae (Needham, 1903)** | | | | | |
| *Phyllomacromia* (Selys, 1878) | African Cruisers | | | | |
| *Phyllomacromia pallidinervis* (Förster, 1906) | Pale-veined Cruiser | | | | |
| *Phyllomacromia picta* (Hagen in Selys, 1871) | Darting Cruiser | | 2 | | |
| Phyllomacromia sp. | | | 1 | 1 | 1 |
| **Libellulidae (Leach, 1815)** | | | | | |
| *Acisoma* (Rambur, 1842) | Pintails | | | | |
| *Acisoma inflatum* (Selys, 1882) | Stout Pintail | | 1 | | 1 |
| *Acisoma variegatum* (Kirby, 1898) | Slender Pintail | | | | |
| *Atoconeura* (Karsch, 1899) | Highlanders | | | | |
| *Atoconeura aethiopica* (Kimmins, 1958) | Ethiopian Highlander | VU | 1 | 1 | 1 |
| *Brachythemis* (Brauer, 1868) | Groundlings | | | | |
| *Brachythemis impartita* (Karsch, 1890) | Northern Banded Groundling | | 1 | | 1 |
| *Brachythemis lacustris* (Kirby, 1889) | Red Groundling | | 1 | | 1 |
| *Brachythemis leucosticta* (Burmeister, 1839) | Southern Banded Groundling | | | | |
| *Bradinopyga* (Kirby, 1893) | Rockdwellers | | | | |
| *Bradinopyga strachani* (Kirby, 1900) | Red Rockdweller | | | | |
| *Chalcostephia* (Kirby, 1889) | Inspector | | | | |
| *Chalcostephia flavifrons* (Kirby, 1889) | Inspector | | 2 | | |
| *Crocothemis* (Brauer, 1868) | Scarlets | | | | |
| *Crocothemis erythraea* (Brullé, 1832) | Broad Scarlet | | 1 | 1 | 1 |
| *Crocothemis sanguinolenta* (Burmeister, 1839) | Little Scarlet | | 1 | | 1 |
| *Diplacodes* (Kirby, 1889) | Perchers | | | | |
| *Diplacodes lefebvrii* (Rambur, 1842) | Black Percher | | 1 | | 1 |
| *Diplacodes luminans* (Karsch, 1893) | Barbet Percher | | 1 | | 1 |
| *Hemistigma* (Kirby, 1889) | Piedspots | | | | |
| *Hemistigma albipunctum* (Rambur, 1842) | African Piedspot | | | | |
| *Nesciothemis* (Longfield, 1955) | Blacktails and Peppertails | | | | |
| *Nesciothemis farinosa* (Förster, 1898) | Eastern Blacktail | | 1 | 1 | 1 |
| *Orthetrum* (Newman, 1833) | Skimmers | | | | |
| *Orthetrum abbotti* (Calvert, 1892) | Little Skimmer | | 1 | 1 | 1 |
| *Orthetrum brachiale* (Palisot de Beauvois, 1817) | Banded Skimmer | | | | |
| *Orthetrum brevistylum* (Kirby, 1896) | Three-striped Skimmer | | | | |
| *Orthetrum caffrum* (Burmeister, 1839) | Two-striped Skimmer | | 1 | 1 | 1 |
| *Orthetrum chrysostigma* (Burmeister, 1839) | Epaulet Skimmer | | 1 | | 1 |
| *Orthetrum guineense* (Ris, 1910) | Guinea Skimmer | | 1 | | 1 |
| *Orthetrum hintzi* (Schmidt, 1951) | Dark-shouldered Skimmer | | 2 | | |

| Scientific name | Common name | IUCN Red List | Kafa BR | 2014 | 2019 |
|---|---|---|---|---|---|
| *Orthetrum julia* (Kirby, 1900) | Julia Skimmer | | 1 | 1 | 1 |
| *Orthetrum kristenseni* (Ris, 1911) | Ethiopian Skimmer | | 1 | 1 | 1 |
| *Orthetrum machadoi* (Longfield, 1955) | Highland Skimmer | | 1 | | 1 |
| *Orthetrum monardi* (Schmidt, 1951) | Woodland Skimmer | | 1 | | 1 |
| *Orthetrum sabina* (Drury, 1770) | Slender Skimmer | | | | |
| *Orthetrum stemmale* (Burmeister, 1839) | Bold Skimmer | | 1 | 1 | 1 |
| *Orthetrum trinacria* (Selys, 1841) | Long Skimmer | | | | |
| *Palpopleura* (Rambur, 1842) | Widows | | | | |
| *Palpopleura deceptor* (Calvert, 1899) | Deceptive Widow | | | | |
| *Palpopleura jucunda* (Rambur, 1842) | Yellow-veined Widow | | 1 | 1 | |
| *Palpopleura lucia* (Drury, 1773) | Lucia Widow | | 1 | 1 | 1 |
| *Palpopleura portia* (Drury, 1773) | Portia Widow | | 1 | 1 | 1 |
| *Pantala* (Hagen, 1861) | Rainpool Gliders | | | | |
| *Pantala flavescens* (Fabricius, 1798) | Wandering Glider | | 1 | | 1 |
| *Rhyothemis* (Hagen, 1867) | Flutterers | | | | |
| *Rhyothemis semihyalina* (Desjardins, 1832) | Phantom Flutterer | | | | |
| *Sympetrum* (Newman, 1833) | True Darters | | | | |
| *Sympetrum fonscolombii* (Selys, 1840) | Nomad or Red-veined Darter | | 1 | | 1 |
| *Tetrathemis* (Brauer, 1868) | Elfs | | | | |
| *Tetrathemis polleni* (Selys, 1869) | Black-splashed Elf | | 1 | 1 | |
| *Tholymis* (Hagen, 1867) | Twister | | | | |
| *Tholymis tillarga* (Fabricius, 1798) | Twister | | | | |
| *Tramea* (Hagen, 1861) | Saddlebag Gliders | | | | |
| *Tramea basilaris* (Palisot de Beauvois, 1817) | Keyhole Glider | | 1 | | 1 |
| *Tramea limbata* (Desjardins, 1832) | Ferruginous Glider | | | | |
| *Trithemis* (Brauer, 1868) | Dropwings | | | | |
| *Trithemis aconita* (Lieftinck, 1969) | Halfshade Dropwing | | 1 | | 1 |
| *Trithemis annulata* (Palisot de Beauvois, 1807) | Violet Dropwing | | | | |
| *Trithemis arteriosa* (Burmeister, 1839) | Red-veined Dropwing | | 1 | 1 | 1 |
| *Trithemis dejouxi* (Pinhey, 1978) | Stonewash Dropwing | | | | |
| *Trithemis donaldsoni* (Calvert, 1899) | Denim Dropwing | | | | |
| *Trithemis ellenbeckii* (Förster, 1906) | Ethiopian Dropwing | | 1 | 1 | 1 |
| *Trithemis furva* (Karsch, 1899) | Navy Dropwing | | 1 | 1 | 1 |
| *Trithemis imitata* (Pinhey, 1961) | Copycat Dropwing | | | | |
| *Trithemis kirbyi* (Selys, 1891) | Orange-winged Dropwing | | 1 | | 1 |
| *Trithemis stictica* (Burmeister, 1839) | Jaunty Dropwing | | 1 | 1 | 1 |
| *Urothemis* (Brauer, 1868) | Baskers | | | | |
| *Urothemis assignata* (Selys, 1872) | Red Basker | | | | |
| *Urothemis edwardsii* (Selys, 1849) | Blue Basker | | | | |
| *Zygonyx* (Hagen, 1867) | Cascaders | | | | |
| *Zygonyx natalensis* (Martin, 1900) | Blue Cascader | | 2 | | |
| *Zygonyx torridus* (Kirby, 1889) | Ringed Cascader | | 1 | 1 | |

**Appendix 3:** Record sites of the Odonata (dragonflies and damselflies) at the Kafa BR

| Scientific name/ Site No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Total Sites |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Aciagrion gracile* | | | | | | | | x | | | | | | | | | | | | | | | | | | | | 1 |
| *Acisoma inflatum* | | | | | | | | | | | | | | x | | | x | | | | | | | | | | | 2 |
| *Africallagma elongatum* | | x | | | | | x | x | | | | | x | x | x | | x | x | | | | x | x | x | | | | 11 |
| *Anax imperator* | x | | | | | | | | | | | | x | x | | | x | | | | | | | | | | | 4 |
| *Anax* spec. | | | | x | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Anax speratus* | x | | | | | | | x | | x | | | | x | | | | | | | | | | | | | | 4 |
| *Atoconeura aethiopica* | | | x | x | | | | | | | | | | | | x | | x | x | | | x | x | | x | | | 8 |
| *Azuragrion vansomereni* | | | | | | | | | | | | | | x | | | x | | | | | | | | | | | 2 |
| *Brachythemis impartita* | | | | | | | | | | | x | | | | | | | | | | | | | | | | | 1 |
| *Brachythemis lacustris* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Brachythemis* spec. | | | | | | | | | | | | | | | | | | x | | | | | | | | | | 1 |
| *Ceriagrion glabrum* | x | | x | | | | | x | | | | | x | x | | | x | | | | | | | | | | | 6 |
| *Ceriagrion suave* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Crenigomphus denticulatus* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Crocothemis erythraea* | | | | | | | | | | | | | x | x | x | | | | | | | | | | | | | 3 |
| *Crocothemis sanguinolenta* | | | | | | | | | | | | x | | x | | | | | | | | | | | | | | 2 |
| *Diplacodes lefebvrii* | | | | | | | | | | | | | | | | | x | | | | | | | | | | | 1 |
| *Diplacodes luminans* | x | | | | | | | | | | | | | x | | | | | | | | | | | | | | 2 |
| *Gynacantha nigeriensis* | | x | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Lestes tridens* | x | | | | | | | | | | | | | | | | x | | | | | | | | | | | 2 |
| *Lestes virgatus* | | x | x | | | | | x | | | | | x | | | | x | | | | | | | | | | | 5 |
| *Mesocnemis singularis* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Nesciothemis farinosa* | x | | | | | | | | | | | | | x | | | | | | | | | | | | | | 2 |
| *Notogomphus dorsalis* | | | x | | | | | | | | | | | x | | | | | | | | | x | | x | | | 4 |

| Scientific name/ Site No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Total Sites |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Notogomphus cottarellii* | | | | | | | | | | | | | | | x | | | | | | | | | | x | | | 2 |
| *Notogomphus lecythus* | | | | | | | | x | | | | | | x | | | | | | | | | | | | | | 2 |
| *Notogomphus ruppeli* | | | | x | | | | | | | | | | | | | | | | | | | | | x | | | 2 |
| *Notogomphus* spec. | | | | x | | | | | x | | | | | | | | | x | | | | | | | | | | 3 |
| *Orthetrum abbotti* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Orthetrum caffrum* | | | | | | | | | x | | | x | x | x | | x | | | | | | | | | | | | 5 |
| *Orthetrum chrysostigma* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Orthetrum guineense* | | x | | | | | | | | | | | x | x | | | | | | | | | | | | | | 3 |
| *Orthetrum julia* | | x | x | | | | x | x | | | | x | | x | x | x | | x | x | | | x | x | | x | | | 13 |
| *Orthetrum kristenseni* | | | | | | | | | x | | | | | | | | | | | | | | | | x | | | 2 |
| *Orthetrum machadoi* | | | | | | | | x | | | | | | x | | | | | | | | | | | | | | 2 |
| *Orthetrum monardi* | x | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Orthetrum stemmale* | | x | x | | | | | | | | | | x | | | | | | | | | | | | | | | 3 |
| *Palpopleura lucia* | | x | x | | | | | x | | | | x | x | x | | | x | | | | | | | | | | | 7 |
| *Palpopleura portia* | | x | x | | | | | x | | | | | x | | | | | | | | | x | | | x | | | 6 |
| *Pantala flavescens* | x | | | | | | | | | | | | | x | | | | | | | | | | | | x | | 3 |
| *Paragomphus* spec. | | | | | | | | | | | | | | | | | | | | | | | x | | | | | 1 |
| *Phaon iridipennis* | | | | | | | | x | | | | | | | | | | | | | | | | | | | | 1 |
| *Phyllomacromia* spec. | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Pinheyschna waterstoni* | | | | | x | | | | | | x | | | x | | | | | | | | | x | | x | | | 5 |
| *Platycypha caligata* | | | x | | | | | x | | | | x | | x | | | | x | | | | x | x | | | | x | 8 |
| *Proischnura subfurcata* | | X | x | x | | x | x | | x | | | | x | | x | x | x | x | | x | | x | x | | x | | x | 16 |
| *Pseudagrion gamblesi* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Pseudagrion guichardi* | | | | x | | | | | x | | | | | | | x | | x | | | | | x | | x | | | 6 |
| *Pseudagrion hamoni* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Pseudagrion kaffinum* | | | | | | | | x | | x | | | | | | | | | | | | | | | | | | 2 |



-> back to content

| Scientific name/ Site No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Total Sites |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pseudagrion kersteni* | x | | | | | | | | | | | | | x | | | | | | | | | | | | | | 2 |
| *Pseudagrion sjoestedti* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Pseudagrion spernatum* | x | | x | x | x | x | | | | | | x | | x | x | x | | x | | | | x | x | | x | | x | 14 |
| *Sympetrum fonscolombii* | x | | | | | | | | | | | | x | | | | | | | | | | | | | x | | 3 |
| *Tramea basilaris* | x | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Trithemis werneri* | | | | | | | | x | | | | | | | | | | | | | | | | | | | | 1 |
| *Trithemis aconita* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Trithemis arteriosa* | x | | | | | | | | | | | | | x | | | | | | | | | | | | | | 2 |
| *Trithemis ellenbeckii* | x | | | | | | | X | | x | | | x | | | | | | | | | | | | | | | 4 |
| *Trithemis furva* | | | | | | | | | | | | | | x | | | | | | | | | | | | | | 1 |
| *Trithemis kirbyi* | x | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| *Trithemis* spec. | | | | | | | | | | | | | | | | | | | | | x | | | | | | | 1 |
| *Trithemis stictica* | x | | | | | | | X | | | | x | | | | | | | | | | | | | | | | 3 |
| *Zosteraeschna ellioti* | | | x | | | | | | | | | | | | | | | | | | | | | | | | | 1 |
| Total species per site | 16 | 9 | 12 | 7 | 2 | 2 | 3 | 16 | 5 | 3 | 2 | 7 | 13 | 35 | 6 | 6 | 10 | 9 | 2 | 1 | 1 | 7 | 10 | 1 | 11 | 2 | 3 | |

## 6.2 Photos


Figure 1a


Figure 1b


Figure 1c

**Figures 1a-c:**
The endemic Sprite *Pseudagrion guichardi* (**a**) and *P. kaffinum* (**b**) are the most readily recognisable flagship species at the Kafa BR, as males of both have an orange labrum ('lip') and blue abdomen tip ('tail'). *Pseudagrion guichardi* is much larger than *P. Kaffinum* and occurs in higher elevations along clear and fast streams, while the Kaffa Sprite has been recorded from Gojeb River. Similar is *P. spernatum* (**c**, left species) which almost invariably occurs alongside *Pseudagrion guichardi* (**c**, right species), but is smaller and has no orange face. (photos: Viola Clausnitzer; Klaas-Douwe B. Dijkstra)


Figure 2a


Figure 2b

**Figures 2a, b:**
The endemic *Crenigomphus denticulatus* (left female, right male) was recorded for the first time in 57 years. Its precise habits are unknown, but it may be a flagship species of large rivers like Gojeb. (photos: Viola Clausnitzer; Klaas-Douwe B. Dijkstra)





**Figures 3a-d:** The endemic *Notogomphus cottarellii* (above; female on the left, male on the right) and *N. ruppeli* (below; female on the left, male just after emergence from its larval skin on the right) are indicators of fairly natural streams. While the former is much larger than the latter, they are easily confused with each other and with *N. dorsalis* and *N. lecythus* when not closely examined.
(photos: Viola Clausnitzer; Klaas-Douwe B. Dijkstra)


Figure 4a


Figure 4b

**Figures 4a, b:** The endemic *Atoconeura aethiopica* (**a**) is a flagship species of forested streams and rivers. Mature males are deceptively similar to the abundant *Orthetrum julia* (**b**) although that species will rarely perch on rocks by fast-flowing water (as seen on the left) and never has the thin central yellow line between the forewing bases and the 'neck'.
(photos: Viola Clausnitzer; Klaas-Douwe B. Dijkstra)


Figure 5a


Figure 5b

**Figures 5a, b:** The endemic *Orthetrum kristenseni* is much scarcer at the Kafa BR than some other skimmer species and may thus be an indicator of relatively pristine bogs and wetlands. It should be separated with care from *O. caffrum* in which the second white stripe is usually more pronounced and the first stripe does not lie right against the spiracle, the dot-like opening on the side of the thorax. (photos: Viola Clausnitzer; Klaas-Douwe B. Dijkstra)

# Amphibians of the Kafa Biosphere Reserve

**PD Dr Hendrik Müller, Abeje Kassie, Tariku W/michael and Tom Kirschey**

## Highlights

→ A total of 18 amphibian species from six different families were recorded.

→ Nine of the recorded species of amphibians are endemic to Ethiopia: *Leptopelis* cf. *ragazzi*, *Leptopelis* cf. *vannutellii*, *Leptopelis sp.*, *Hemisus microscaphus*, *Afrixalus clarkei*, *Paracassina obscura*, *Phrynobatrachus minutus*, *Phrynobatrachus inexpectatus*, *Ptychadena erlangeri*.

→ One species of Tree Frog, genus *Leptopelis*, appears to be new to science and narrowly distributed within the Kafa Biosphere Reserve.

→ The previously undescribed tadpoles of *Afrixalus clarkei*, *Conraua beccarii*, *Leptopelis sp.*, *Phrynobatrachus minutus* and *Xenopus clivii* were collected and are being formally described.

→ Besides the already recognized flagship species, Beccari's Giant Frog (*Conraua beccarii*), Largen's Puddle Frog (*Phrynobatrachus inexpectatus*) and Clarke's Banana Frog (*Afrixalus clarkei*), the as yet undescribed Tree Frog, *Leptopelis sp.*, would appear to make an ideal flagship species to highlight conservation needs and efforts at the Kafa Biosphere Reserve.

→ Within the Kafa Biosphere Reserve, Beccari's Giant Frog (Conraua beccarii) seems to be most dependent on forest habitats and would make the most suitable indicator species for forest and stream quality.

→ Wetlands within or close to natural forest and grassland areas showed the highest diversity and should receive conservation priority.

# 1. Introduction

In virtually every respect – biologically, culturally, historically – Ethiopia is a special place in Africa. Almost the entire country falls within two of Africa's eight recognized global biodiversity hotspots (30 in total worldwide). These are the Horn of Africa hotspot, which covers all of Ethiopia's north-eastern, eastern and southern lowlands, and the Eastern Afromontane hotspot, which comprises the Ethiopian highlands east and west of the Great Rift Valley (GRV). From an amphibian perspective, the Ethiopian highlands are by far the most diverse region and although Ethiopia is home to 'only' 72 species of amphibians, a number that seems comparatively small compared to other African countries, over 40% of these are endemic to Ethiopia (Largen & Spawls, 2010). Overall, the true diversity of Ethiopia's amphibian fauna is understood very insufficiently and severely undersampled, which is largely a result of the huge size of the country combined with an infrastructure which has been in a relatively poor state until recently. However, over the last decade, Ethiopia has seen a renewed interest in its amphibian fauna and surveys on a broader geographical scale have uncovered previously unrecognized diversity in several anuran groups (Reyes-Velasco et al., 2018a,b) and new species are being described (Gouette et al., 2019).

At the same time, the Ethiopian highland is one of the most densely settled areas in Africa and the pressure on the environment is immense. Several species have experienced dramatic declines in the Bale Mountains (Gower et al., 2013) and, as a consequence, a number of endemics are critically threatened with extinction. The large-scale habitat modification and destruction, especially the clearing of forests for agriculture, dramatically increases the risk of extinction. This is especially the case in endemics which are distributed quite narrowly and in Ethiopia in particular, we currently run the risk of losing species before their discovery and description. In addition, for many species we lack even the most basic data on their ecology, which makes it in turn difficult to assess their habitat requirements etc., which forms the basis for any informed conservation measure. A case in point are larval anurans – tadpoles – which are unknown for almost half of all known Ethiopian frog species.

In our survey, we addressed these issues by focussing on three main objectives. During the first survey a single specimen of an unusual and presumably undescribed Tree Frog (*Leptopelis sp.*) was discovered (Kirschey, 2017). The single specimen was juvenile, which precluded an assessment of its taxonomic status. Finding and assessing this potentially new species was a main objective of our work. In addition, we targeted larval amphibians in particular. The identities of many Ethiopian tadpoles are unknown. However, tadpoles are often rather conspicuous and easy to sample, which would make them potentially more suitable to target in surveys than adults (Müller, 2019). That potential is currently not realized because of our insufficient knowledge of tadpole identities. In addition, we aimed to collect the little known Ethiopian endemic Caecilian *Sylvacaecilia grandisonae*, which had not been found in recent surveys conducted in south-western Ethiopia.

# 2. Materials and methods

## 2.1 Study area

The study sites are listed in Table 1. The study sites visited during the 12 working days included primarily sites already visited during the first assessment (e.g. coffee forests (montane forests), bamboo forests, secondary forests, riverbanks and wetlands). The field team consisted of Abeje Kassie, Admasu Assefa, Girma Kebede, Tariku Woldemichael and the two authors.

**Table 1:** Study sites and characteristics

| Code | Area | Latitude | Longitude | Habitat | Site |
|---|---|---|---|---|---|
| BK1 | Boka | 7.291778 | 36.375889 | Boka Wetland | Forest and stream within forest |
| BK2 | Boka | 7.291778 | 36.375889 | Boka Wetland | Grassland and swampy sections |
| BK3 | Boka | 7.291778 | 36.375889 | Boka, small roadside clay pit wetland | Waterfilled clay pit next to road, bordering natural fores |
| BK4 | Boka | 7.241139 | 36.452278 | Bamboo Forest, Boka | River and small tributaries in bamboo forest |
| KO1 | Komba | 7.309861 | 36.067722 | Komba Forest | Clear stream and surrounding natural forest |
| KO2 | Komba | 7.310306 | 36.075861 | Komba Forest roadside quarry/clay pit | Small but relatively deep ponds next to the road in a former quarry |
| KO3 | Komba | 7.310306 | 36.075861 | Large forest quarry | Large, partly flooded quarry inside forest, bordering stream and natural forest |
| AL1 | Alemgono | 7.362472 | 36.220556 | Alemgono Wetland | Large, grassy valley bottom with several ponds and swampy sections, surrounded mostly by agricultural areas and degraded woodland |
| SH1 | Shorori | 7.360500 | 36.208444 | Shorori quarry | Number of differently sized, waterfilled quarry and clap pits |
| SH2 | Shorori | 7.360500 | 36.208444 | Shorori Wetland | Large, grassy swamp at valley bottom and surrounding coffee forest with small streams |
| GU1 | Gumi | 7.243306 | 36.409611 | Gumi River near Bonga | Primary forest along the riverbanks and small tributary streams |
| GO1 | Gojeb | 7.563889 | 36.101667 | Meda Abo, Gojeb Wetland | |

## 2.2 Sampling methods

The main sampling methods were visual encounter surveys (VES) where a targeted area and its microhabitats were systematically searched for amphibian and reptile specimens. This included searches of bushes and tree branches, leaf litter and other debris, turning over logs and generally walking through the habitat in search for specimens. Most searches were done during the day, but especially Boka Forest was also searched during the late evening and early night hours using head lamps or hand-held torches. However, due to logistic and administrative restrictions, it was not possible to extend searches beyond about 9.30 pm. This was somewhat unfortunate as most amphibians are most active at night, especially during the breeding season when we visited. For night searches we prioritized Boka in search of specimens of a putative new species of *Leptopelis* (3.1) and to also obtain potential data on its biology. In addition, we used dip netting in aquatic habitat to collect tadpoles and also aquatic species such as African Clawed Frogs (*Xenopus*). To sample burrowing amphibians and reptiles, and especially to sample Caecilians, we also dug the soil in various places in the forest (stream banks, around trees, between tree buttresses, under rotting vegetation/fallen logs) with a hoe. Sampling methods followed standard established practice (Heyer et al., 1994).

## 2.3 Data analysis

Following the national regulations of the Ethiopian Biodiversity Institute (EBI), samples were properly prepared and exported to Germany, with the main objective to further identify the species and complete the species list. Specimens were provisionally identified in the field using standard literature (e.g. Largen & Spawls, 2010; Channing et al., 2012, and references therein) and portable field equipment (Bresser Biorit ICD LL stereo microscope; hand-held magnifying lens). Adult and larval specimens were killed by administering a lethal dose of the anaesthetics MS222 (for larvae) or Orajel (for adults), fixed with formalin, and subsequently transferred to 70% ethanol. Prior to fixation, fresh tissue samples (liver, tail tips) were collected from selected specimen and stored in 99% ethanol for subsequent deoxyribonucleic acid (DNA) analyses. Tadpoles were anaesthetized and photographed using a small aquarium.

Since the specimens were exported to Germany, we have begun with the in-depth examination of the material. Some specimen identifications have been revised following more detailed examination using microscopy (Zeiss SteREO Discovery V12), this work is still ongoing. For selected specimens, DNA will be extracted from collected tissue samples and sequences of the 12S rRNA, COI, and/or 16S rRNA genes amplified and sequenced following standard procedures (Vences et al., 2005; Fouquet et al., 2007). Tadpoles will be staged followed Gosner (1960); standard measurements and labial tooth row formula are taken following Altig and McDiarmid (1999) and description of buccopharyngeal morphology follows Wassersug (1976). Drawings will be prepared with the aid of a camera lucida attached to a Zeiss V12 SteREO Discovery microscope. For inspection of the buccopharyngeal morphology, representative specimens will be dissected, dehydrated and critical point dried (Emitech K850 Critical Point Dryer), sputter coated (Emitech K500) with gold-palladium and investigated using a Phillips XL30 ESEM scanning electron microscope with a digital image capture system.

# 3. Results and discussion

## 3.1 Amphibia

We recorded 18 species of amphibians, although identification is still preliminary for some of them (see below). This represents 25% of the species reported for Ethiopia (72 in total; Amphibiaweb 2019). While this may sound like a comparatively small percentage, one has to bear in mind that Ethiopia is a large country characterized by a great diversity of habitats and strong regional endemism (Largen & Spawls, 2010). Considering south-western Ethiopia, our species tally represents about 70% of the species that could be expected within the forested highlands, which is a reasonable result in line with expectation given the length and nature of the survey.

### 3.1.1 Arthroleptidae

At several localities we collected Tree Frogs of the genus *Leptopelis* that were identified as either *L. ragazzii* or *L. vannutellii* (Figure 2). Both species are variable in coloration but otherwise very similar in their overall meristic and morphometric characteristics, including call and tadpole morphology (Largen, 1977; Channing et al., 2012; Tiutenko & Zinenko, 2019), which complicates a reliable identification. Traditionally, *L. ragazzii* has been considered to be restricted to the east of the GRV, whereas *L. vannutellii* was thought to occur only west of the GRV (Largen, 1977). Over the years, a number of studies have reported *L. ragazzii* also from west of the GRV (e.g. Largen & Spawls, 2010) and it was also reported from the Bonga area during the first assessment. A recent study (Reyes-Velasco et al., 2018b), however, provided well-supported evidence that *L. vannutellii* and *L. ragazzii* are indeed separated by the GRV, with the former restricted to the west and the latter to the east, which highlights the need for an in-depth revision of these two species. At present, we tentatively chose to report both species for the Bonga area, but this is preliminary at best.

**Table 1:** List of recorded amphibians

| No | Species | Family | Status |
|---|---|---|---|
| 1 | *Leptopelis cf. ragazzi* (Boulenger, 1896) | Arthroleptidae | VU, endemic |
| 2 | *Leptopelis cf. vannutelli* (Boulenger, 1896) | Arthroleptidae | VU, endemic |
| 3 | *Leptopelis sp.* | Arthroleptidae | not assessed, probably endemic to Kafa BR |
| 4 | *Conraua beccarii* (Boulenger, 1911) | Conrauidae | LC |
| 5 | *Hemisus microscaphus (*Laurent, 1972) | Hemisotidae | LC, endemic |
| 6 | *Afrixalus clarkei (*Largen, 1974) | Hyperoliidae | EN, endemic |
| 7 | *Hyperolius* cf. *acuticeps* | Hyperoliidae | Unknown |
| 8 | *Hyperolius viridiflavus* s.l. (Duméril & Bibron, 1841) | Hyperoliidae | LC |
| 9 | *Hyperolius sp.* | Hyperoliidae | Unknown |
| 10 | *Paracassina obscura* (Boulenger, 1895) | Hyperoliidae | LC, endemic |
| 11 | *Phrynobatrachus minutus* (Boulenger, 1895) | Phrynobatrachidae | LC, endemic |
| 12 | *Phrynobatrachus inexpectatus* (Largen, 2001) | Phrynobatrachidae | DD, endemic |
| 13 | *Phrynobatrachus* cf. *natalensis* (Smith, 1894) | Phrynobatrachidae | LC |
| 14 | *Ptychadena erlangeri* (Ahl, 1924) | Ptychadenidae | NT, endemic |
| 15 | *Ptychadena mascareniensis* (Duméril & Bibron, 1841) | Ptychadenidae | LC |
| 16 | *Ptychadena neumanni* (Ahl, 1924) | Ptychadenidae | LC |
| 17 | *Ptychadena schillukorum* (Werner, 1907) | Ptychadenidae | LC |
| 18 | *Xenopus clivii (*Peracca, 1898) | Pipidae | LC |

A far more exciting find was an adult specimen and several juvenile and metamorphic frogs as well as several series of tadpoles, of an apparently undescribed species of *Leptopelis* (Figure 1e). This species was already reported during the first assessment, based on a single specimen that was photographed but not collected at the time. The new material supports the first assessment in so far as it likely represented a new species. Unfortunately, despite repeated, systematic searches we only obtained a single adult specimen, which probably indicates a somewhat more cryptic lifestyle compared to the sympatric *Leptopelis* cf. *ragazzii* found at the same site. Morphologically, the putative new species is characterised by very conspicuous epidermal ridges and grooves that run along the dorsal and dorsolateral sides of the body in all examined metamorphosed specimens. In addition, the tadpoles tentatively assigned to this species differ in overall shape and the morphology of the oral disc from the *L.* cf. *ragazzii* found at the same locality (Figures 1d and e).

Moreover, the two species seem to be microspatially segregated in their breeding habitats and tadpoles of the new *Leptopelis* species were only found in small, isolated puddles within the swampy parts of the grassland and forest edge adjacent to the montane forest at Boka. In contrast, tadpoles of *L.* cf. *ragazzi* were restricted to stream habitats. We only recorded this species at two different localities, but fairly close to Boka. Further investigations (morphological and molecular) are currently underway to establish the specific identity of these specimens and describe them as new to science. If these specimens are confirmed as belonging to an undescribed species, which seems likely at present, it will appear to be narrowly distributed and should receive immediate attention and be targeted for conservation measures.

### 3.1.2 Conrauidae

Beccari's Giant Frog or Filfil Slippery Frog (*Conraua beccarii*) is the only member of this genus and family found in Ethiopia, where it occurs from south-western Ethiopia all the way up north to Asmara, Eritrea. Other members of the genus are exclusively found in West and Central Africa and include the well-known Goliath Frog (*Conraua goliath*). *Conraua beccarii* is the second largest species within the genus and also the largest frog known from Ethiopia. This species was only recorded as a tadpole from a stream in Komba Forest. Other streams where this species was collected in 2014 were too fast-flowing to be accessible for sampling. The tadpole of *C. beccarii* is currently undescribed but resembles other known tadpoles of the genus and can thus be unambiguously identified (Figures 1 and 5). It is highly adapted to fast-flowing streams and the presence of such habitats is likely a key requirement for the survival of the species. Beccari's Giant Frog is reportedly widespread (Milto et al., 2015) and common in the general area of Bonga (Largen & Spawls, 2010), and currently listed as Least Concern by IUCN (2013). It should nonetheless be included in future monitoring efforts as it is likely a very important indicator species, given its dependence on forests and especially clear and fast-flowing streams for reproduction and its unlikely tolerance of large-scale forest degradation and deforestation. Species of *Conraua* are furthermore important in the West African bushmeat trade (e.g. Schäfer et al., 2019). At present, it is unknown whether *C. beccarii* are hunted in Ethiopia for human consumption, which may increase their vulnerability. As with other *Conraua*, very little is known about the general biology of this species, which, given its size, might perhaps resemble that of *C. goliath* (Schäfer et al., 2019).

### 3.1.3 Hemisotidae

We recorded several specimens of *Hemisus* from Komba Forest, Meda Abo/Gojeb, the Komba Forest quarry and Alemgono Wetland (from the last two localities only in the form of tadpoles). Two species of *Hemisus* are known from Ethiopia, the endemic *H. microscaphus* and the more widespread *H. marmoratus* (Largen & Spawls, 2010). An initial assessment in the field identified the metamorphosed specimens as *H. marmoratus*, which would have been a substantial range extension, but subsequent closer analysis revealed these to be the Ethiopian endemic *H. microscaphus* (Figure 3), which also fits better with our current understanding of the ecology and distribution of both species (Largen, 1997a). However, it also reveals *H. microscaphus* to be more variable in its meristic and morphometric characters than previously thought. At Alemgono and the roadside quarry in Komba Forest we collected tadpoles and a single metamorphic specimen, which indicates that this species metamorphoses at comparably very large sizes and undergoes only moderate post-metamorphic growth.

### 3.1.4 Hyperoliidae

Clarke's Banana Frog (*Afrixalus clarkei*) is an Ethiopian endemic with a relatively narrow distribution centred in the Bonga area (but perhaps more widespread than currently known, see Mertens et al., 2016; Foquet et al., 2019). As a follow-up to the first survey, we recorded this species from a number of additional localities, including more anthropogenically influenced sites like Alemgono, where it was not recorded in 2014. The tadpole of this species is also currently undescribed, but we obtained a number of specimens from Boka Swamp, where *A. clarkei* was particularly abundant (Figure 1a), and are currently preparing a formal description.

The Tree Frog genus *Hyperolius* is the most species-rich African anuran taxon and *Hyperolius* are found throughout almost the entire sub-Saharan African

continent (Schiøtz, 1999). One common species that we recorded from several localities is *Hyperolius viridiflavus* s.l., which comprises a number of species distributed through much of sub-Saharan Africa. Species delimitation among members of the complex is hampered by the extreme variability shown by members of this group and genetic data will need to be analysed as part of a geographically broader taxonomic revision of this group. The same applies to specimens of *Hyperolius* cf. *acuticeps*, which we recorded from a number of localities. These small Tree Frogs are part of the widespread *nasutus* group, the sole Ethiopian representative of which was until recently considered to be *H. acuticeps*. Channing et al. (2013), however, restricted *H. acuticeps* to Malawi and the status of Ethiopian populations is in need of revision. At the roadside quarry in Komba Forest, we also collected *Hyperolius* tadpoles that are currently undetermined (Figure 1c). These will be barcoded to determine their specific identity.

One species recorded for the first time during the follow-up survey is *Paracassina obscura*, a species and genus endemic to Ethiopia. *Paracassina obscura* is part of a group of ground-dwelling Tree Frogs, and as such is more difficult to sample in surveys as they are usually strictly nocturnal and fairly secretive. However, males emit a very characteristic advertisement call and the species also has very distinct tadpoles (Figure 1g). A record of *Kassina senegalensis* by Milto et al. (2016) might represent a misidentified *Paracassina obscura*. We recorded it from a number of different localities (see Appendix 1) and although it is primarily a forest-dwelling species, it seems to be rather adaptable and was found in a number of habitats which are considerably influenced anthropogenically.

### 3.1.5 Phrynobatrachidae

Puddle Frogs of the genus *Phrynobatrachus* are also found in most of sub-Saharan Africa and occur in a number of different habitats. One widespread species that was recorded at a number of different localities is *Phrynobatrachus natalensis*, a comparatively large and ecologically adaptable species. It was most prominent in Shorori and Alemgono Wetlands. Studies have shown that specimens currently assigned to *P. natalensis* comprise a species complex (Zimkus et al., 2010). Ethiopian populations of *P.* cf. *natalensis* undoubtedly represent an unnamed taxon (Zimkus et al., 2010), especially considering that the type locality of *P. natalensis* is Natal, South Africa.

The most widespread Puddle Frog within the Kafa Biosphere Reserve (Kafa BR) is *Phrynobatrachus minutus*, a small Ethiopian endemic, which was found in considerable numbers in almost all localities visited during this survey. As for many other Ethiopian species, the tadpole of *P. minutus* is currently unknown, but we collected a series of tadpoles that probably belong to this species (Figure 1f). Final confirmation via DNA evidence is currently outstanding. The presence of the second Ethiopian endemic Puddle Frog (*P. Inexpectatus)*, which was reported for the first survey, could not be unambiguously confirmed at present. We collected some specimens at a single locality (a small roadside pond near Boka), which may represent *P. inexpectatus*, but further investigation is necessary to confirm this. The main problem here is the very small adult size of *P. inexpectatus*, which makes them difficult to distinguish from immature *P. minutus*. The recent discovery of a new and very distinct species of *Phrynobatrachus* (Guette et al., 2019) from Gura Ferda, south-western Ethiopia highlights that new species are likely to be discovered through fieldwork and a critical reassessment of specimens, especially in taxa such as Phrynobatrachus.

### 3.1.6 Ptychadenidae

A number of Rocket or Grass Frogs of the genus *Ptychadena* has been reported and described from Ethiopia (Largen, 1997b) and includes species endemic to Ethiopia and species that are far more widespread through other parts of Africa. *Ptychadena* are relatively conservative in their overall morphology, which complicates species identification. Also, several of the more widespread species, like *P. schillukorum* or *P. mascareniensis* are suspected or known to comprise a complex of cryptic species (e.g. Vences et al., 2004) and more revisionary work is needed on this group. We recorded a number of different species of *Ptychadena* that we tentatively assigned to the species recorded during the first assessment.

### 3.1.7 Pipidae

We recorded *Xenopus clivii* from several different localities as both adults and tadpoles (see Appendix 1). Like other species of *Xenopus*, *X. clivii* is strictly aquatic but adult and juvenile frogs are seemingly possible to migrate over considerable distances in order to colonise various aquatic habitats, from forest streams, rivers and wetlands, to a number of manmade ponds and other such structures, which makes it probably the most resilient local amphibian species provided it has access to aquatic habitats. As for other anurans, the tadpole of *X. clivii* has not been described so far. We obtained a number of tadpole specimens (Figure 1h) and a formal description is in preparation. A preliminary investigation revealed it to be very similar to other known tadpoles of *Xenopus*. This preliminary assessment also enabled us to document some natural history observations on the tadpoles of this species, including the first recorded predation by a Fishing Spider (cf. *Nilus sp.*, Pisauridae; Figure 7).

# 4. Conclusions and recommendations for conservation and monitoring

## 4.1 Recommendations for amphibian conservation

The largest threats to Ethiopia's biodiversity appear to be deforestation and environmental degradation due to human disturbance, combined with a drastic increase in water pollution resulting from economic growth. These threats do not evenly affect all areas of the country, but are a factor even in remote areas. Around 95% of Ethiopia's original forest has already been cleared for agriculture and human settlements.

This is also apparent at the Kafa BR, where parts of the natural landscape have been turned into agricultural land. Especially the area around Boka seems largely deforested, and this seems to have occurred rather recently. Forest clearance particularly affects species that are primarily associated with this habitat. Even in areas where stands of forest are left intact, forest endemics are often severely impacted nonetheless because of a decline in water quality of the streams that these species depend on for reproduction.

This is particularly the case in the endemic Beccari's Giant Frog and the forest associated Tree Frog. Other species, such as Clarke's Banana Frog, the Ethiopian Banana Frog, the Ethiopian Dwarf Puddle Frog and Largen's Dwarf Puddle Frog are somewhat less dependent on streams for breeding but still require healthy, unpolluted wetlands for their continued survival. All these species are of conservation concern and could act as monitoring species for the core zones of the biosphere reserve.

Especially the Tree Frogs such as *Leptopelis ragazzii*, *Leptopelis vannutellii* and the newly discovered, undescribed species as well as the two Banana Frog species of the genus *Afrixalus* are relatively conspicuous and easily identified and can therefore act as flagship species for the Kafa BR. Beccari's Giant Frog (*Conraua beccarii*), is shy and difficult to collect, which makes working with this species more difficult. However, these large frogs cannot be confused with other species within the Kafa BR and their presence could simply be visually surveyed. They also have very conspicuous and easily identified tadpoles that should make it easier to monitor this species. Tadpoles might generally be more suitable for surveying at least some of the species of concern here. Tadpole-based surveys could also be carried out during the day, which could potentially increase the efficiency of amphibian survey and monitoring work within the Kafa BR, especially when carried out by local rangers.

Wetlands should be included in any future zonation work within the Kafa BR. If not already done, a protected zone should be established covering the huge wetlands of Gojeb River as well as the wetlands in the Afroalpine zone, e.g. beyond Boka Forest. Smaller, more intensively used wetlands such as Alemgono, however, are also vital for maintaining local amphibian diversity.

Globally, freshwater habitats are being disturbed, polluted and destroyed at an alarming rate, even though access to clean water is essential to human health, with the United Nations declaring it a fundamental human right in 2010. Freshwater habitats are some of the most threatened ecosystems on a global level. Even though wetlands only make up 1% of the Earth's land area, they contain 10% of all known species and provide ecosystem services valued at several trillion USD per year (Butchart et al., 2005). All over the world, more than half of all wetlands have been degraded, and more than two-thirds of our upland watersheds remain unprotected.

In general, protection for terrestrial ecosystems is much better than for wetlands, because conservation efforts mainly focus on large terrestrial mammals. Wetlands and their associated watersheds provide valuable ecosystem services such as water catchment, retention and purification, provide habitats for a large range of specialised flora and fauna and serve as important longitudinal and transversal corridors for dispersal of biota. Freshwater ecosystems and freshwater biodiversity are in great peril, and urgent measures are needed.

Wetlands need to be protected, and their status must be monitored. This is especially true for countries like Ethiopia, where the economy is growing while at the same time systems for wastewater do not exist, thus wetlands and their ecosystem services are significantly affected. Amphibians are among the most threatened taxa groups worldwide. Because of their joint aquatic and terrestrial ecology, amphibians in general are good indicators for freshwater and terrestrial habitats. The Kafa BR is one of the last remnants of Afromontane forest in Ethiopia, and only stronger conservation efforts for the cluster of wetlands and forests can secure a more favourable conservation status of endemic and typical herpetofauna assemblages.

### 4.2 Suggestions for future studies

One clear priority for future studies is the new Tree Frog species of the genus *Leptopelis* from the Boka area, once its status is confirmed. From our work so far, it seems to be associated with montane grassland and not occurring within the neighbouring indigenous forests. Montane grasslands are under particularly strong pressure from cattle grazing and other uses and are also dependent on the surrounding forests for regulating the water table. The new *Leptopelis* seems to be dependent on this type of habitat and we did not find it in other similar habitats outside the Boka area.

At present knowledge, it seems to be only narrowly distributed and would likely qualify for a high conservation status (Vulnerable, Endangered or Critically Endangered) following current IUCN assessment criteria (IUCN 2019). More and more targeted fieldwork is urgently needed to better understand its distribution and basic ecological needs to initiate informed conservation measures. Another priority should be the Aleku Caecilian, *Sylvacaecilia grandisonae*. *Sylvacaecilia grandisonae* is the only species of caecilian known to occur in Ethiopia, is an Ethiopian endemic, and holds a key position in our understanding of the evolution of higher Caecilians (San Mauro et al., 2014; Theska et al., 2019) because of its breeding biology. It was described as a new species by Taylor (1970) as a member of the West African *Geotrypetes* and subsequently transferred to the newly erected genus Sylvacaecilia by Wake (1987). Few additional specimens have been collected since Largen et al. (1972) obtained a series of specimens from a number of localities throughout south-western Ethiopia in the early 1970s. Over the last decade, concerted efforts have been made to relocate the species, but these have so far been unsuccessful (DJ Gower & SP Loader, pers. comm.). Given its singular status, efforts should be made to relocate this species. The most promising area for such efforts would be Komba Forest, which is one of the most extensive remaining stands of natural forest in the area.

Search efforts should include digging for the species in suitable habitats as well as a more people-focussed approach. We did interview people about the presence of *S. grandisonae*, with mixed and somewhat inconclusive results, but a directed search using a public awareness campaign is likely to be the most promising effort to relocate this species. Both *S. grandisonae* and the new Leptopelis would make excellent flag-ship species to raise awareness for and also promote the conservation goals and measures of NABU within the Kafa BR and Ethiopia in general.

## 5. References

**Altig, R. & Mc Diarmid, R.W.** (1999). Body plan – development and morphology. *In* Mc Diarmid, R. W.; Altig, R. (eds.), Tadpoles – the biology of anuran larvae, pp. 24-51. The University of Chicago Press, USA.

**AmphibiaWeb.** (2019). www.amphibiaweb.org University of California, Berkeley, CA, USA. Accessed 14/10/2019.

**Butchart, S.; Dieme-Amting, E.; Gitay, H.; Raaymakers, S. & Taylor, D.** (2005). Ecosystems and human well-being: Wetlands and water. Synthesis. Millennium Ecosystem Assessment. WRI, Washington D.C., p 68.

**Channing, A.; Rödel, M.-O. & Channing, J.** (2012). Tadpoles of Africa – The biology and identification of all known tadpoles in sub-Saharan Africa. Edition Chimaira, Germany.

**Channing, A.; Hillers, A.; Lötters, S.; Rödel, M.-O.; Schick, S.; Conradie, W.; Rödder, D.; Mercurio, V.; Wagner, P.; Dehling, J.M.; du Preez, L.H.; Kielgast, J. & Burger, M.** (2013). Taxonomy of the super-cryptic *Hyperolius nasutus* group of long reed frogs of Africa (Anura: Hyperoliidae), with descriptions of six new species. Zootaxa 3620:301-350.

**Fouquet, A. ; Gilles, A. ; Vences, M. ; Blanc, M. & Gemmell, N.J.** (2007). Underestimation of species richness in neotropical frogs revealed by mtDNA analyses. PLoS ONE 2(10):e1109.

**Foquet, R.; Kassie, A. & De Beenhouwer, M.** (2019). Express Biodiversity Survey in Gura-Ferda Forest, Ethiopia. BINCO Express Report 8.0 Biodiversity Inventory for Conservation. Glabbeek, Belgium, 24 pp.

**Gosner, K.L.** (1960). A simplified table for staging anuran embryos and larvae with notes on identification. Herpetologica 16:183-190.

**Goutte, S. ; Reyes-Velasco, J. & Boissinot, S.** (2019). A new species of puddle frog from an unexplored mountain in south-western Ethiopia (Anura, Phrynobatrachidae, *Phrynobatrachus*). ZooKeys 824:53-70.

**Gower, D.J.; Aberra, R.K.; Schwaller, S.; Largen, M.J.; Collen, B.; Spawls, S.; Menegon, M.; Zimkus, B.M.; de Sá, R.; Mengistu, A.A.; Gebresenbet, F.; Moore, R.D.; Saber, S.A. & Loader, S.P.** (2013). Long-term data for endemic frog genera reveal potential conservation crisis in the Bale Mountains, Ethiopia. Oryx 47:59-69.

**Grandison, A.G.C.** (1978). The occurrence of *Nectophrynoides* (Anura: Bufonidae) in Ethiopia. A new concept of the genus with a description of a new species. Monitore zoologico italiano, N.S. Supplemento XI:119-172.

**Heyer, W.R.; Donelly, M.A.; McDiarmid, R.W.; Hayek, L.-A.C. & Foster, M.S.** (eds.) (1994). Measuring and Monitoring Biological Diversity – Standard Methods for Amphibians. Smithsonian Institution Press, Washington D.C., 364 p.

**IUCN** (2019). The IUCN Red List of Threatened Species. Version 2019-2. www.iucnredlist.org.

**IUCN SSC Amphibian Specialist Group** (2013). *Conraua beccarii*. The IUCN Red List of Threatened Species 2013: e.T58251A18390772. www.dx.doi.org/10.2305/IUCN.UK.2013-2.RLTS.T58251A18390772.en. Downloaded on 18/10/2019.

**Kirschey, T.** (2017). Herpetofauna (Amphibia, Reptilia) at the Kafa Biosphere Reserve. NABU's Biodiversity Assessment at the Kafa Biosphere Reserve. NABU, Berlin, 190-205.

**Largen, M.J.** (1997a). *Hemisus microscaphus* Laurent 1972, a little-known Ethiopian endemic (Amphibia Anura). Tropical Zoology 10:271-285.

**Largen, M.J.** (1997b). Two new species of *Ptychadena* Boulenger 1917 (Amphibia, Anura, Ranidae) from Ethiopia, with observations on other members of the genus recorded from this country and a tentative key for their identification. Tropical Zoology 10:223-246.

**Largen, M.J. & Spawls, S.** (2010). The Amphibians and Reptiles of Ethiopia and Eritrea. Edition Chimaira, Germany.

**Largen, M.J.; Morris, P.A. & Yalden, D.W.** (1972). Observations on the caecilian *Geotrypetes grandisonae* Taylor (Amphibia Gymnophiona) from Ethiopia. Monitore Zoologico Italiano, Nueva Seria Supplemento IV 8:185-205.

**Mertens, J.; Jocqué, M.; Geeraert, L. & De Beenhouwer, M.** (2016). Newly discovered populations of the Ethiopian endemic and endangered *Afrixalus clarkei* Largen, implications for conservation. ZooKeys 565:141-146.

**Milto, K.D.; Pestov, M.K. & Kirschey, T.** (2016). Preliminary data on the batrachofauna of the Kafa Biosphere Reserve. Vestnik of St. Petersburg University Ser. 3 2016/3:100-106.

**Müller, H.** (2019). Description of the Tadpole of the Critically Endangered Ethiopian toad *Altiphrynoides osgoodi* (Amphibia: Anura: Bufonidae). Journal of Herpetology 53:218-223.

**Reyes-Velasco, J.; Manthey, J.D.; Bourgeois, Y.; Freilich, X. & Boissinot, S.** (2018a). Revisiting the phylogeography, demography and taxonomy of the frog genus *Ptychadena* in the Ethiopian highlands with the use of genome-wide SNP data. PloS ONE, 13(2), e0190440.

**Reyes-Velasco, J.; Manthey, J.D.; Freilich, X. & Boissinot, S.** (2018b). Diversification of African tree frogs (genus *Leptopelis*) in the highlands of Ethiopia. Molecular Ecology, 27:2256-2270.

**San Mauro, D.; Gower, D.J.; Müller, H.; Loader, S.P.; Zardoya, R.; Nussbaum, R.A. & Wilkinson, M.** (2014). Life-history evolution and mitogenomic phylogeny of caecilian amphibians. Molecular Phylogenetics and Evolution 73:177-189.

**Schäfer, M.; Tsekané, S.J.; Tchassem, F.A.M.; Drakulić, S.; Kameni, M.; Gonwouo, N.L. & Rödel, M.-O.** (2019). Goliath frogs build nests for spawning – the reason for their gigantism? – Journal of Natural History 53: 1263-1276.

**Taylor, E.H.** (1970). A new caecilian from Ethiopia. The University of Kansas Science Bulletin 48:849-854.

**Theska, T.; Wilkinson, M.; Gower, D.J. & Müller, H.** (2019). Musculoskeletal development of the Central African caecilian *Idiocranium russeli* (Amphibia: Gymnophiona: Indotyphlidae) and its bearing on the re-evolution of larvae in caecilian amphibians. Zoomorphology 138:137-158.

**Tiutenko. A. & Zinenko, O.** (2019). Tadpole of Leptopelis ragazzii (Boulenger, 1896), Shoa Forest Tree Frog (Anura, Arthroleptidae). Herpetozoa 32:51-55.

**Vences, M.; Kosuch, J.; Rödel, M.-O.; Channing, A.; Glaw, F. & Böhme, W.** (2004). Phylogeography of

*Ptychadena mascareniensis* suggests transoceanic dispersal in a widespread African-Malagasy frog lineage. Journal of Biogeography 31:593-601.

**Wake, M.H.** (1987). A new genus of African caecilian (Amphibia: Gymnophiona) Journal of Herpetology 21:6-15.

**Wells, K.D.** (2007). The Ecology and Behavior of Amphibians. University of Chicago Press, USA.

**Wassersug, R.J.** (1976). Oral morphology of anuran larvae: terminology and general description. Occasional Papers of the Museum of Natural History, the University of Kansas 48:1-23.

**Zimkus, B.M.; Rödel, M.-O. & Hillers, A.** (2010). Complex patterns of continental speciation: molecular phylogenetics and biogeography of sub-Saharan puddle frogs (*Phrynobatrachus*). Molecular Phylogenetics and Evolution 55:883-900.

# 6. Annex

## 6.1 Appendices

**Appendix 1:** Amphibians collected at the Kafa BR during the biodiversity assessment.
*precise localities were not recorded because of unclear species identification

| Family | Genus | Species | Endemic | BK1 | BK2 | BK3 | BK4 | KO1 | KO2 | KO3 | AL1 | SH1 | SH2 | GU1 | GO1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arthroleptidae | *Leptopelis* | *cf. ragazzii* | E | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | *Leptopelis* | *cf. vannutellii* | E | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | *Leptopelis* | *sp.* | E | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Conrauidae | *Conraua* | *Beccarii* | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hemisotidae | *Hemisus* | *Microscaphus* | E | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| Hyperoliidae | *Afrixalus* | *Clarkei* | E | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | *Hyperolius* | *cf. acutus* | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| | *Hyperolius* | *viridiflavus s.l.* | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| | *Hyperolius* | *sp.* | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Paracassina* | *Obscura* | E | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| Phrynobatrachidae | *Phrynobatrachus* | *Inexpectatus* | E | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Phrynobatrachus* | *Minutus* | E | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| | *Phrynobatrachus* | *cf. Natalensis* | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| Ptychadenidae* | *Ptychadena* | *Erlangeri* | E | | | | | | | | | | | | |
| | *Ptychadena* | *Mascareniensis* | | | | | | | | | | | | | |
| | *Ptychadena* | *Neumanni* | | | | | | | | | | | | | |
| | *Ptychadena* | *Schillukorum* | | | | | | | | | | | | | |
| Pipidae | *Xenopus* | *Clivii* | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |

## 6.2 Photos


**Figure 1:** Tadpoles of (**a**) *Afrixalus clarkei*, (**b**) *Conraua beccarii,* (**c**) *Hyperolius sp.*, (**d**) *Leptopelis* cf. *ragazzi*, (**e**) *Leptopelis sp.* Boka, (**f**) *Phrynobatrachus* cf. *minutus*, (**g**) *Paracassina obscura*, (**h**) *Xenopus clivii*, not to scale (photos: Hendrik Müller)

**Figure 2:** *Leptopelis vannutelli*, Komba Forest
(photo: Hendrik Müller)

**Figure 3:** *Hemisus microscaphus*, Gojeb Wetland
(photo: Hendrik Müller)

**Figure 4:** Eggs of *Hyperolius sp.,* Alemgono Wetland
(photo: Hendrik Müller)

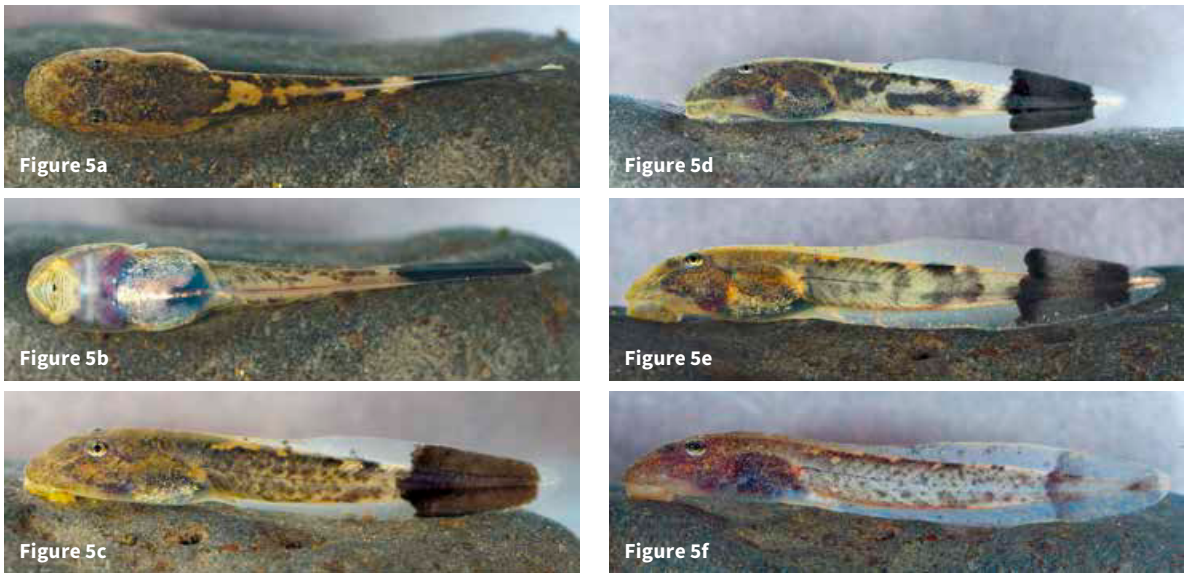



**Figure 5:** Tadpoles of *Conraua beccarii*, dorsal (**a**), lateral (**b**) and ventral (**c**) view of the same tadpole, (**d**) – (**f**) illustrate variation in pigment pattern, not to scale (photos: Hendrik Müller)

**Figure 6:** Eggs of *Ptychadena sp.* (large eggs) and *Phrynobatrachus natalensis* (small eggs), Shorori quarry (photo: Hendrik Müller)

**Figure 7:** Pisaurid spider with its prey, a *Xenopus clivii* tadpole (photo: Hendrik Müller)

**Figure 8:** Amplexus of Hyperolius *viridiflavus* s.l. (photo: NABU/Tom Kirschey)

**Figure 9:** Calling male of Hyperolius *viridiflavus* s.l.
(photo: NABU/Tom Kirschey)

**Figure 10:** *Paracassina obscura*
(photo: NABU/Tom Kirschey)

**Figure 11:** *Afrixalus clarkei*
(photo: NABU/Tom Kirschey)



-> back to content

# Birds of the Kafa Biosphere Reserve

**Bernhard Walter, Kiros Welegerima Gerlass, Woldemariam Tesfahunegn, Dr Yodit Ayele, Mintesinot Shetachew and Dominic Kimani**

# Highlights

→ 179 bird species were recorded.

→ 26 species are restricted to the Afrotropical Highland biome.

→ Two species are restricted to the Somali-Masai biome.

→ Three species are endemic to Ethiopia: Abyssinian Longclaw, Abyssinian Catbird, Yellow-fronted Parrot.

→ Nine species are endemic to Ethiopia and Eritrea.

→ Six species are near endemic.

→ 10 species are listed in the IUCN Red List of Threatened Species.
- Three species are Near Threatened: Crowned Eagle, Rouget's Rail, Abyssinian Longclaw.
- Three species are Vulnerable: Tawny Eagle, Black Crowned Crane, Wattled Crane.
- One species is Endangered: Lappet-faced Vulture.
- Three species are Critically Endangered: Hooded Vulture, White-backed Vulture, Rüppell's Vulture.

→ A breeding place of the critically Endangered Rüppell's Vulture was found.

→ A pair of the Wattled Crane and a larger group of the Black Crowned Crane (58 individuals) were found at Gojeb Wetland.

→ Several flocks of the Yellow-fronted Parrot were found in different areas of the biosphere reserve.

# 1. Introduction

The first biodiversity assessment led by NABU in 2014 had already shown that the Kafa area has a rich birdlife. In only two weeks of investigation 178 bird species were found. The assessment took place in December, which is the dry season in Ethiopia and the time when many migratory birds from the Palearctic come for wintering in the region. The 2019 assessment took place in August, which is the rainy season. The breeding time of many birds like Weavers, Widowbirds and Cuckoos is correlated with this time of the year when mating behaviour and nest-building activities are obvious. Compared to the 2014 assessment shifts in the composition of the avifauna were expected due to seasonality aspects.

# 2. Materials and methods

## 2.1 Study area

The study sites are listed in Table 1. Some of the sites, like Alemgono and Gojeb Wetlands and Bamboo Forest were the same as in the 2014 assessment. In addition, some new, promising places were selected for the current study. We investigated six forest areas, six wetlands and the acacia savannah near Arguba, representing a very different habitat type which is rare in the Kafa region (Table 1). The area around the Kafa Development Association (KDA) Guesthouse, which served as a base camp for most of the time, was included in the assessment.

**Table 1:** List of study sites and characteristics

| Area | Site | Code | Habitat | Altitude (a.s.l.) | Latitude | Longitude |
|---|---|---|---|---|---|---|
| Gimbo | Kejaraba | KJ | Montane forest | 1,879 m | 7.262500 | 36.183333 |
| Boginda | Path to the hot springs | BO | Montane forest | 1,813 m | 7.459167 | 36.187222 |
| Gewata | Gewata | GW | Riverine forest | 1,409 m | 7.473056 | 36.178889 |
| Adiyo | Adiyo | AD | Montane forest | 2,027 m | 7.290556 | 36.475556 |
| Adiyo | Bamboo Forest | BA | Bamboo Forest dominated by *Arundinaria alpina* | 2,590 m | 7.241111 | 36.452222 |
| Adiyo | Chefahanna (Boka Forest) | BK | Wetland surrounded by montane forest | 2,440 m | 7.294722 | 36.378611 |
| Gewata | Saja Forest (Gewata) | SF | Montane forest | 2,139 m | 7.506944 | 36.119444 |
| Gimbo | Alemgono Wetland | AG | Wetland | 1,722 m | 7.361667 | 36.217778 |
| Gimbo | Shoriri Wetlands | SHO | Wetland | 1,615 m | 7.358611 | 36.206389 |
| Gimbo | Yartachi | YA | Farmland (maize); grassland riverine vegetation | 1,327 m | 7.403611 | 36.368889 |
| Gimbo | Gojeb Wetland; Medabo | GOJ | Wetland, grazed and ungrazed areas | 1,566 m | 7.564167 | 36.051667 |
| Bonga | KDA Guest House | KDA-GH | Village, farmland | 1,738 m | 7.250833 | 36.254444 |
| Decha | Decha, Beha | DE | Wetland, riverine forest, coffee plantation | 1,822 m | 7.168889 | 36.220556 |
| Gimbo | Arguba, Gimbo | AR | Grassland with Acacia trees, small riverine forest, Gojeb River | 1,330 m | 7.419722 | 36.395000 |

## 2.2 Sampling methods

The assessment was carried out in the rainy season from 30 July 2019 to 13 August 2019. In determination and naming we followed the field guide by Redman et al. (2009), supplemented by Clark & Davies (2018).

In forests with restricted access, small paths, game trails or roads were taken as transect trails. Most wetland counts were made from the higher ground of the peripheral areas of the wetlands. Whenever possible we also entered the wetlands. Start and end points were recorded using a hand-held Global Positioning System (GPS). For each bird species encountered during a walk, the number of individuals was recorded in order to yield a rough estimate of its frequency in the region. Surveys were conducted between 6 am and 7 pm. Birds were located by visual encounter using binoculars (10 x 40) or by means of their distinctive songs or calls. Unknown songs and calls were checked using recordings made with a mobile phone. Reference songs and calls were taken from www.xeno-canto.org in advance. In a few cases, we checked the identity of an unknown bird species via voice playback.

## 2.3 Data analysis

Information on bird abundance is normally derived from the number of specimens counted over a period of several days, or even weeks (Sutherland et al., 2005). As we visited most of our study sites only once, the methodology did not allow a reliable estimate of abundance. Unlike the first assessment, the current investigation took place in the rainy season, taking our understanding of the avifauna at the Kafa Biosphere Reserve (Kafa BR) a step further.

# 3. Results

## 3.1 Forest sites

We studied six different forest sites: Kejaraba (Table 2), the wooded areas at the path to the hot springs (Table 3), Gewata (Table 4), Adiyo (Table 5), Bamboo Forest (Table 6) and Saja Forest (Table 7). In nearly all the study sites there were clearings, small wetlands, farmland habitats, road edges with scrub or forest edge in addition to the closed forest areas. As a result, besides the forest species like White-cheeked Turaco, African Olive Pigeon or Sharpe's Starling we also encountered bird species that are not bound to forest habitats.

### 3.1.1 Kejaraba

**Date:** 31/07/2019, 6.20 am – 5.05 pm
**GPS position:** Latitude 7.278889 / Longitude 36.213611; 1,646 m a.s.l.
**GPS position:** Latitude 7.262500 / Longitude 36.183333; 1,879 m a.s.l.
**GPS position:** Latitude 7.273333 / Longitude 36.205833; 1,734 m a.s.l.
**Habitat:** forest edge, maize plantation and forest

**Table 2:** List of birds recorded at Kejaraba

| Common name | Scientific name | Counted specimens | Remarks |
|---|---|---|---|
| Hadada Ibis | *Bostrychia hagedash* | 2 | |
| Wattled Ibis | *Bostrychia carunculata* | 1 | |
| Long-crested Eagle | *Lophaetus occipitalis* | 1 | |
| African Green Pigeon | *Treron calvus* | 3 | |
| Tambourine Dove | *Turtur tympanistria* | 10 | |
| Red-eyed Dove | *Streptopelia semitorquata* | 2 | |
| White-cheeked Turaco | *Tauraco leucotis* | 15 | |
| Red-chested Cuckoo | *Cuculus solitarius* | >10 | |
| Black Cuckoo | *Cuculus clamosus* | 2 | |

| Common name | Scientific name | Counted specimens | Remarks |
|---|---|---|---|
| Klaas's Cuckoo | *Chrysococcyx klaas* | 2 | Observation of an immature Klaas's Cuckoo being fed by an African Paradise Flycatcher |
| Speckled Mousebird | *Colius striatus* | 10 | |
| African Pygmy Kingfisher | *Ceyx pictus* | 1 | |
| Crowned Hornbill | *Tockus alboterminatus* | >10 | |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | 8 | |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 5 | |
| Double-toothed Barbet | *Lybius bidentatus* | 5 | |
| Banded Barbet | *Lybius undatus* | 3 | |
| Lesser Honeyguide | *Indicator minor* | 1 | |
| Cardinal Woodpecker | *Dendropicos fuscescens* | 4 | |
| Mountain Wagtail | *Motacilla clara* | 2 | |
| Black Cuckoo-shrike | *Campephaga flava* | 1 | One male |
| Red-shouldered Cuckoo-shrike | *Campephaga phoenicea* | 2 | Two males at different locations |
| Common Bulbul | *Pycnonotus barbatus schoanus* | 5 | |
| Mountain Thrush | *Turdus olivaceus* | 10 | |
| Grey-backed Camaroptera | *Camaroptera brachyura* | >20 | |
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatinus* | 2 | |
| African Dusky Flycatcher | *Muscicapa adusta* | >15 | |
| African Paradise Flycatcher | *Terpsiphone viridis* | 20 | |
| Grey-headed Batis | *Batis orientalis* | 2 | |
| Black-headed Batis | *Batis minor* | 2 | |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | 4 | Recorded at a maize plantation |
| Montane White-eye | *Zosterops poliosgastrus* | >15 | |
| Copper Sunbird | *Cinnyris cupreus* | 1 | |
| Variable Sunbird | *Cinnyris venustus* | 12 | |
| Northern Puffback | *Dryoscopus gambensis* | >20 | |
| Ethiopian Boubou | *Laniarius aethiopicus* | 6 | |
| Abyssinian Oriole | *Oriolus monacha* | 6 | |
| Thick-billed Raven | *Corvus crassirostris* | 1 | |
| Red-billed Oxpecker | *Buphagus erythrorhynchus* | 5 | |
| Sharpe's Starling | *Pholia sharpii* | >15 | One group in canopy |
| Baglafecht Weaver | *Ploceus baglafecht* | 1 | |
| Bronze Mannikin | *Lonchura cucullata* | >10 | |
| Black-and-white Mannikin | *Lonchura bicolor* | 1 | |
| Pin-tailed Whydah | *Vidua macroura* | 1 | |
| African Citril | *Serinus citrinelloides* | 2 | |
| Streaky Seedeater | *Serinus striolatus* | 1 | |

### 3.1.2 Path to the hot springs

**Date:** 01/08/2019, 6.50 am – 12.40 pm
**GPS position along a transect:**
Latitude 7.440278 / Longitude 36.182222; 1,813 m a.s.l.
Latitude 7.456389 / Longitude 36.187222; 1,746 m a.s.l.
Latitude 7.462778 / Longitude 36.185000; 1,463 m a.s.l.

**Habitat:** montane forest, clearing, hot spring, small swamp, river and cultivated land
**Remarks:** a group of Blue Monkeys was observed at a group of Blue Monkeys was observed at Latitude 7.456389 / Longitude 36.187222, a group of De Brazza's Monkeys at Latitude 7.462778 / Longitude 36.185000

**Table 3:** List of birds recorded at the path to the hot springs

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Hadada Ibis | *Bostrychia hagedash* | 13 |
| White-backed Vulture | *Gyps africanus* | 25 |
| African Goshawk | *Accipiter tachiro* | 1 |
| African Green Pigeon | *Treron calvus* | 7 |
| Blue-spotted Wood Dove | *Turtur afer* | 1 |
| Tambourine Dove | *Turtur tympanistria* | 3 |
| Red-eyed Dove | *Streptopelia semitorquata* | 1 |
| Yellow-fronted Parrot | *Poicephalus flavifrons* | 4 |
| White-cheeked Turaco | *Tauraco leucotis* | 5 |
| Red-chested Cuckoo | *Cuculus solitarius* | 2 |
| Blue-headed Coucal | *Centropus monachus* | 1 |
| Speckled Mousebird | *Colius striatus* | 3 |
| Little Bee-eater | *Merops pusillus* | 9 |
| Crowned Hornbill | *Tockus alboterminatus* | 1 |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | 4 |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 1 |
| Eastern Grey-headed Woodpecker | *Dendropicos spodocephalus* | 2 |
| Common Bulbul | *Pycnonotus barbatus schoanus* | >10 |
| Rüppell's Robin-Chat | *Cossypha semirufa* | 4 |
| Mountain Thrush | *Turdus abyssinicus* | 2 |
| Grey-backed Camaroptera | *Camaroptera brachyura* | >20 |
| Northern Black Flycatcher | *Melaenornis edolioides* | 2 |
| African Dusky Flycatcher | *Muscicapa adusta* | 3 |
| African Paradise Flycatcher | *Terpsiphone viridis* | 5 |
| Brown-throated Wattle-eye | *Platysteira cyanea* | 3 |
| Montane White-eye | *Zosterops poliosgastrus* | 6 |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | 1 |
| Variable Sunbird | *Cinnyris venustus fazoqlensis* | >10 |
| Collared Sunbird | *Hedydipna collaris* | 3 |
| Northern Puffback | *Dryoscopus gambensis* | 2 |
| Ethiopian Boubou | *Laniarius aethiopicus* | 3 |
| Black-headed Oriole | *Oriolus larvatus* | 4 |
| Abyssinian Black-headed Oriole | *Oriolus monacha* | 2 |
| Sharpe's Starling | *Pholia sharpii* | >15 |
| Spectacled Weaver | *Ploceus ocularis* | 1 |

### 3.1.3 Way from the hot springs to Kobesh (Gewata)

**Date:** 01/08/2019, 12.50 pm – 4 pm
**GPS position along a transect:** Latitude 7.473056 / Longitude 36.178889
**Habitat:** riverine forest, small wetland and montane forest

**Table 4:** List of birds recorded at the way from the hot springs to Kobesh

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Woolly-necked Stork | *Ciconia episcopus* | 2 |
| Hadada Ibis | *Bostrychia hagedash* | >10 |
| White-backed Vulture | *Gyps africanus* | 36 |
| African Goshawk | *Accipiter tachiro* | 1 |
| Long-crested Eagle | *Lophaetus occipitalis* | 1 |
| African Green Pigeon | *Treron calvus* | 7 |
| Tambourine Dove | *Turtur tympanistria* | 2 |
| Red-chested Cuckoo | *Cuculus solitarius* | 1 |
| Woodland Kingfisher | *Halcyon senegalensis* | 2 |
| Blue-breasted Bee-eater | *Merops lafresnayii* | 6 |
| Wire-tailed Swallow | *Hirundo smithii* | 1 |
| Red-shouldered Coockoo-shrike | *Campephaga phoenicea* | 1 |
| Common Bulbul | *Pycnonotus barbatus schoanus* | 1 |
| Grey-backed Camaroptera | *Camaroptera brachyura* | >10 |
| Ethiopian Cisticola | *Cisticola lugubris* | 1 |
| African Dusky Flycatcher | *Muscicapa adusta* | 1 |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | 1 |
| Variable Sunbird | *Cinnyris venustus fazoqlensis* | 2 |
| Ethiopian Boubou | *Laniarius aethiopicus* | 2 |
| Sharpe's Starling | *Pholia sharpii* | 8 |
| Red-collared Widowbird | *Euplectes ardens* | 1 |
| Red-billed Firefinch | *Lagonosticta senegala* | 6 |

### 3.1.4 Way to the vulture colony in Adiyo (Shaka)

**Date:** 02/08/2019, 7 am – 1 pm
**GPS position along a transect:** Latitude 7.290556 / Longitude 36.475556
**GPS position, view to a vulture colony:** Latitude 7.295000 / Longitude 36.478889
**Habitat:** cultivated land, forest and riverine forest

**Table 5:** List of birds recorded at Adiyo

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Hadada Ibis | *Bostrychia hagedash* | 1 |
| Wattled Ibis | *Bostrychia carunculata* | 5 |
| White-backed Vulture | *Gyps africanus* | 16 |
| Rüppell's Vulture | *Gyps rueppellii* | 33 |
| Augur Buzzard | *Buteo augur* | 12 |
| Chestnut-naped Francolin | *Pternistis castaneicollis* | 5 |

| Common name | Scientific name | Counted specimens |
|---|---|---|
| African Olive Pigeon | *Columba arquatrix* | 1 |
| Lemon Dove | *Aplopelia larvata* | 1 |
| Yellow-fronted Parrot | *Poicephalus flavifrons* | 2 |
| Blue-breasted Bee-eater | *Merops lafresnayii* | 5 |
| Crowned Hornbill | *Tockus alboterminatus* | 1 |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 1 |
| Double-toothed Barbet | *Lybius bidentatus* | 5 |
| Banded Barbet | *Lybius undatus* | 3 |
| Red-throated Wryneck | *Jynx ruficollis* | 2 |
| Abyssinian Woodpecker | *Dendropicos abyssinicus* | 1 |
| Red-rumped Swallow | *Cecropis daurica* | 4 |
| Mountain Wagtail | *Motacilla clara* | 2 |
| Black Saw-wing | *Psalidoprocne pristoptera* | >30 |
| Common Bulbul | *Pycnonotus barbatus* | >10 |
| Rüppell's Robin-Chat | *Cossypha semirufa* | 1 |
| African Stonechat | *Saxicola torquatus* | 1 |
| Mountain Thrush | *Turdus abyssinicus* | 1 |
| Tawny-flanked Prinia | *Prinia subflava* | 2 |
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatinus* | 1 |
| African Dusky Flycatcher | *Muscicapa adusta* | 8 |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | 8 |
| Montane White-eye | *Zosterops poliogastrus* | 25 |
| Thick-billed Raven | *Corvus crassirostris* | 5 |
| Sharpe's Starling | *Pholia sharpii* | 5 |
| Tacazze Sunbird | *Nectarinia tacazze* | 3 |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | 3 |
| Variable Sunbird | *Cinnyris venustus fazoqlensis* | 2 |
| Common Fiscal | *Lanius Collaris* | 2 |
| Black-headed Oriole | *Oriolus larvatus* | 1 |
| Abyssinian Black-headed Oriole | *Oriolus monacha* | 5 |
| Cape Rook | *Corvus capensis* | 2 |
| Thick-billed Raven | *Corvus crassirostris* | 2 |
| Swainson's Sparrow | *Passer swainsonii* | 2 |
| Vitelline Masked Weaver | *Ploceus vitellinus* | 1 |
| Spectacled Weaver | *Ploceus ocularis* | 1 |
| Baglafecht Weaver | *Ploceus baglafecht* | 1 |
| Yellow-bellied Waxbill | *Coccopygia quartinia* | 5 |
| Black-and-white Mannikin | *Lonchura bicolor* | 5 |
| Pin-tailed Whydah | *Vidua macroura* | 1 |
| African Citril | *Serinus citrinelloides* | 3 |
| Brown-rumped Seedeater | *Serinus tristriatus* | 2 |
| Streaky Seedeater | *Serinus striolatus* | 1 |

### 3.1.5 Bamboo Forest

**Date:** 02/08/2019, 1 pm
**GPS position along a transect:** Latitude 7.241111 / Longitude 36.452222; 2,590 m a.s.l.
**Habitat:** bamboo forest, riverine forest

**Table 6:** List of birds recorded at Bamboo Forest

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Black Saw-wing | *Psalidoprocne pristoptera* | 5 |
| Rüppell's Robin-Chat | *Cossypha semirufa* | 1 |
| Cinnamon Bracken Warbler | *Bradypterus cinnamomeus* | 1 |
| Grey-backed Camaroptera | *Camaroptera brachyura* | 1 |
| Montane White-eye | *Zosterops poliogastrus* | 6 |
| Tacazze Sunbird | *Nectarinia tacazze* | 3 |
| Yellow-bellied Waxbill | *Coccopygia quartinia* | 2 |
| Brown-rumped Seedeater | *Serinus tristriatus* | 1 |

### 3.1.6 Saja Forest Gewata

**Date:** 06/08/2019, 8 am – 4.45 pm
**GPS position:** Latitude 7.506944 / Longitude 36.119444; 2,139 m a.s.l.
**Habitat:** intact evergreen montane forest

**Table 7:** List of birds found at Saja Forest

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Woolly-necked Stork | *Ciconia episcopus* | 2 |
| White-backed Vulture | *Gyps africanus* | 6 |
| Rüppell's Vulture | *Gyps rueppellii* | 1 |
| Common Buzzard | *Buteo buteo* | 1 |
| African Hobby | *Falco cuvierii* | 1 |
| African Olive Pigeon | *Columba arquatrix* | 1 |
| Red-eyed Dove | *Streptopelia semitorquata* | 1 |
| Yellow-fronted Parrot | *Poicephalus flavifrons* | 12 |
| White-cheeked Turaco | *Tauraco leucotis* | 4 |
| Red-chested Cuckoo | *Cuculus solitarius* | 4 |
| Black Cuckoo | *Cuculus clamosus gabonensis* | 1 |
| Klaas's Cuckoo | *Chrysococcyx klaas* | 1 |
| Blue-breasted Bee-eater | *Merops lafresnayii* | 8 |
| Broad-billed Roller | *Eurystomus glaucurus* | 1 |
| African Grey Hornbill | *Tockus nasutus* | 1 |
| Crowned Hornbill | *Tockus alboterminatus* | 3 |
| Yellow-fronted Tinkerbird | *Pogoniulus chrysoconus* | 1 |
| Double-toothed Barbet | *Lybius bidentatus* | 1 |
| Lesser Honeyguide | *Indicator minor* | 1 |
| Eastern Grey Woodpecker | *Dendropicos spodocephalus* | 3 |
| Black Saw-wing | *Psalidoprocne pristoptera* | 6 |
| Red-shouldered Cuckoo-shrike | *Campephaga phoenicea* | 1 |
| Common Bulbul | *Pycnonotus barbatus schoanus* | >10 |
| Mountain Thrush | *Turdus abyssinicus* | 1 |
| Cinnamon Bracken Warbler | *Bradypterus cinnamomeus* | 2 |
| Grey-backed Camaroptera | *Camaroptera brachyura* | 7 |
| African Dusky Flycatcher | *Muscicapa adusta* | 3 |
| Black-headed Batis | *Batis minor* | 2 |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | 5 |
| Montane White-eye | *Zosterops poliogastrus* | 3 |
| Variable Sunbird | *Cinnyris venustus* | 2 |
| Northern Puffback | *Dryoscopus gambensis* | 2 |
| Ethiopian Boubou | *Laniarius aethiopicus* | >10 |
| Abyssinian Oriole | *Oriolus monacha* | 7 |
| Thick-billed Raven | *Corvus crassirostris* | 4 |
| Red-winged Starling | *Onychognathus morio* | 30 |
| Sharpe's Starling | *Pholia sharpii* | 5 |
| Village Weaver | *Ploceus cucullatus* | 20 |
| Spectacled Weaver | *Ploceus ocularis* | 2 |
| Yellow-bellied Waxbill | *Coccopygia quartinia* | 5 |



-> back to content

## 3.2 Wetlands

Six wetland areas were investigated: Alemgono (Table 8), Chefahanna (Table 9), Shoriri (Table 10), Yartachi (Table 11), Gojeb (Table 12) and Decha (Table 13).

### 3.2.1 Alemgono

**Date:** 30/07/2019, 6.30 am – 4.45 pm
**GPS position:** Latitude 7.361667 / Longitude 36.217778; 1,722 m a.s.l.
**GPS position wetland:** Latitude 7.356944 / Longitude 36.227500
**GPS position cultivated area:** Latitude 7.352778 / Longitude 36.232778
**Habitat:** transitional area farmland (maize and teff) to wetland (dense stands of *Cyperus latifolius* surrounded by heavily grazed areas, swampy area with *Typha spp.*)

**Table 8:** List of birds found at Alemgono (AG)

| Common name | Scientific name | Counted specimens | Remarks |
|---|---|---|---|
| Wolly-necked Stork | *Ciconia episcopus* | 14 | |
| Hadada Ibis | *Bostrychia hagedash* | >10 | |
| Wattled Ibis | *Bostrychia carunculata* | 2 | |
| Hooded Vulture | *Necrosyrtes monachus* | 8 | |
| White-backed Vulture | *Gyps africanus* | 7 | |
| Great Sparrowhawk | *Accipiter melanoleucus* | 1 | |
| African Harrier Hawk | *Polyboroides typus* | 1 | |
| Augur Buzzard | *Buteo augur* | 2 | |
| Red-chested Flufftail | *Sarothrura rufa* | 8 | |
| Rouget's Rail | *Rougetius rougetii* | 5 | |
| Black Crowned Crane | *Balearica pavonina* | 2 | |
| African Green Pigeon | *Treron calvus* | 7 | |
| Blue-spotted Wood Dove | *Turtur afer* | 6 | |
| Tambourine Dove | *Turtur tympanistria* | 4 | |
| Red-eyed Dove | *Streptopelia semitorquata* | >10 | |
| Laughing Dove | *Streptopelia senegalensis* | 1 | |
| Black-winged Lovebird | *Agapornis taranta* | 4 | |
| Jacobin Cuckoo | *Clamator jacobinus* | 1 | |
| Black Cuckoo | *Cuculus clamosus* | 1 | |
| Blue-headed Coucal | *Centropus monachus* | 4 | |
| Speckled Mousebird | *Colius striatus* | 8 | |
| Little Bee-eater | *Merops pusillus* | >40 | |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | 12 | |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 2 | |
| Brown-throated Martin | *Riparia paludicola* | 1 | |
| Mosque Swallow | *Cecropsis senegalensis* | 2 | |
| Abyssinian Longclaw | *Macronyx flavicollis* | 2 | |
| Grassland Pipit | *Anthus cinnamomeus* | 1 | |
| Common Bulbul | *Pycnonotus barbatus schoanus* | >10 | |
| Mountain Thrush | *Turdus abyssinicus* | 2 | |
| Grey-backed Camaroptera | *Camaroptera brachyura* | >15 | |
| Ethiopian Cisticola | *Cisticola lugubris* | 4 | |

| Common name | Scientific name | Counted specimens | Remarks |
|---|---|---|---|
| Tawny-flanked Prinia | *Prinia subflava* | 1 | |
| African Dusky Flycatcher | *Muscicapa adusta* | 3 | |
| Grey-headed Batis | *Batis orientalis* | 2 | |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | 11 | |
| Abyssinian White-eye | *Zosterops abyssinicus* | 2 | |
| Tacazze Sunbird | *Nectarinia tacazze* | >5 | |
| Copper Sunbird | *Cinnyris cupreus* | 3 | |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | 4 | |
| Variable Sunbird | *Cinnyris venustus* | >10 | |
| Common Fiscal | *Lanius collaris* | >10 | |
| Ethiopian Boubou | *Laniarius aethiopicus* | 6 | |
| Black-headed Oriole | *Oriolus larvatus* | 1 | |
| Cape Rook | *Corvus capensis* | 5 | |
| Red-billed Oxpecker | *Buphagus erythrorhynchus* | 6 | |
| Greater Blue-eared Starling | *Lamprotornis chalybaeus* | >20 | Two flocks, near the grazing cattle |
| Splendid Starling | *Lamprotornis splendidus* | 15 | Flock in a fruiting Fig tree |
| Village Weaver | *Ploceus cucullatus* | 30 | One big breeding colony near the swamp; others in the farmland |
| Spectacled Weaver | *Ploceus ocularis* | 2 | Cultivated area |
| Baglafecht Weaver | *Ploceus baglafecht* | 4 | Cultivated area |
| Black Bishop | *Euplectes gierowii* | 4 | Maize plantation |
| Red-collared Widowbird | *Euplectes ardens* | >10 | |
| Fan-tailed Widowbird | *Euplectes axillaris* | 80 | |
| Red-billed Firefinch | *Lagonosticta senegala* | 2 | |
| Common Waxbill | *Estrilda astrild* | 3 | Near the swamp |
| Bronze Mannikin | *Spermestes cucullata* | >30 | |
| Pin-tailed Whydah | *Vidua macroura* | 2 | |
| Village Indigobird | *Vidua chalybeata* | 1 | |
| African Citril | *Serinus citrinelloides* | 2 | |

### 3.2.2 Chefahanna

**Date:** 03/08/2019, 6.50 am – 12.30 pm
**GPS position:** Latitude 7.294722 / Longitude 36.378611; 2,440 m a.s.l.
**Habitat:** wetland surrounded by montane forest, small meadow stream

**Table 9:** List of birds found at Chefahanna

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Hadada Ibis | *Bostrychia hagedash* | 11 |
| White-backed Vulture | *Gyps africanus* | 7 |
| Rüppell's Vulture | *Gyps rueppellii* | 17 |
| Great Sparrowhawk | *Accipiter melanoleucus* | 2 |
| Augur Buzzard | *Buteo augur* | 1 |
| Chestnut-naped Francolin | *Pternistis castaneicollis* | 1 |
| Rouget's Rail | *Rougetius rougetii* | 2 |
| Blue-spotted Wood Dove | *Turtur afer* | 1 |
| Red-eyed Dove | *Streptopelia semitorquata* | 1 |
| Black-winged Lovebird | *Agapornis taranta* | 7 |
| White-cheeked Turaco | *Tauraco leucotis* | 1 |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 1 |
| Lesser Honeyguide | *Indicator Minor* | 1 |
| Abyssinian Woodpecker | *Dendropicos abyssinicus* | 1 |
| Black Saw-wing | *Psalidoprocne pristoptera* | 8 |
| Common Bulbul | *Pycnonotus barbatus schoanus* | 2 |
| Rüppell's Robin-Chat | *Cossypha semirufa* | 1 |
| Mountain Thrush | *Turdus abyssinicus* | 2 |
| Cinnamon Bracken Warbler | *Bradypterus cinnamomeus* | 5 |
| Grey-backed Camaroptera | *Camaroptera brachyura* | 2 |
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatinus* | 1 |
| African Dusky Flycatcher | *Muscicapa adusta* | 1 |
| Montane White-eye | *Zosterops poliogastrus* | 26 |
| Tacazze Sunbird | *Nectarinia tacazze* | 12 |
| Variable Sunbird | *Cinnyris venustus* | 2 |
| Northern Puffback | *Dryoscopus gambensis* | 2 |
| Ethiopian Boubou | *Laniarius aethiopicus* | 2 |
| Abyssinian Oriole | *Oriolus monacha* | 3 |
| Black-headed Oriole | *Oriolus larvatus* | 3 |
| Cape Rook | *Corvus capensis* | 2 |
| Thick-billed Raven | *Corvus crassirostris* | 6 |
| Baglafecht Weaver | *Ploceus baglafecht* | 2 |
| Yellow-bellied Waxbill | *Coccopygia quartinia* | 5 |
| Black-and-White Mannikin | *Spermestes bicolor* | 5 |
| Streaky Seedeater | *Serinus striolatus* | 2 |

### 3.2.3 Shorori

1) **Date:** 04/08/2019, 6.50 am – 1.30 pm
**GPS position:** Latitude 7.344444 / Longitude 36.191111; 1,685 m a.s.l.
**GPS position:** Latitude 7.346111 / Longitude 36.198333; 1,618 m a.s.l.
**GPS position:** Latitude 7.350278 / Longitude 36.200278; 1,622 m a.s.l.
**Habitat:** big wetland, swampy areas surrounded by montane forest

**Table 10:** List of birds found at Shoriri Wetland

| Common name | Scientific name | Counted specimens | Remarks |
|---|---|---|---|
| Woolly-necked Stork | *Ciconia episcopus* | 1 | |
| Hadada Ibis | *Bostrychia hagedash* | 35 | |
| Wattled Ibis | *Bostrychia carunculata* | 3 | |
| Egyptian Goose | *Alopochen aegyptiaca* | 1 | |
| Yellow-billed Duck | *Anas undulata* | 9 | |
| African Goshawk | *Accipiter tachiro* | 1 | |
| Augur Buzzard | *Buteo augur* | 1 | |
| African Harrier Hawk | *Polyboroides typus* | 4 | |
| Crowned Eagle | *Stephanoaetus coronatus* | 1 | |
| Red-chested Flufftail | *Sarothrura rufa* | 6 | |
| Rouget's Rail | *Rougetius rougetii* | 3 | |
| African Rail | *Rallus caerulescens* | 1 | |
| Black Crowned Crane | *Balearica pavonina* | 15 | |
| African Green Pigeon | *Treron calvus* | 2 | |
| Blue-spotted Wood Dove | *Turtur afer* | 3 | |
| Tambourine Dove | *Turtur tympanistria* | 2 | |
| Red-eyed Dove | *Streptopelia semitorquata* | 2 | |
| White-cheeked Turaco | *Tauraco leucotis* | 5 | |
| Levaillant's Cuckoo | *Clamator levaillantii* | 2 | |
| Red-chested Cuckoo | *Cuculus solitarius* | 4 | |
| Black Cuckoo | *Cuculus clamosus* | 1 | |
| African Palm Swift | *Cypsiurus parvus* | 4 | |
| Speckled Mousebird | *Colius striatus* | 7 | |
| Woodland Kingfisher | *Halcyon senegalensis* | 1 | |
| Striped Kingfisher | *Halcyon chelicuti* | 1 | |
| Broad-billed Roller | *Eurystomus glaucurus* | 2 | |
| Crowned Hornbill | *Tockus alboterminatus* | 3 | |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | 8 | |
| Double-toothed Barbet | *Lybius bidentatus* | 3 | |
| Red-rumped Swallow | *Cecropis daurica* | 6 | |
| Mountain Wagtail | *Motacilla clara* | 2 | |
| Red-shouldered Cuckoo-shrike | *Campephaga phoenicea* | 1 | |
| Common Bulbul | *Pycnonotus barbatus schoanus* | 8 | |
| Mountain Thrush | *Turdus abyssinicus* | 6 | |
| Cinnamon Bracken Warbler | *Bradypterus cinnamomeus* | 2 | |
| Grey-backed Camaroptera | *Camaroptera brachyura* | 4 | |

| Common name | Scientific name | Counted specimens | Remarks |
|---|---|---|---|
| Ethiopian Cisticola | *Cisticola lugubris* | 2 | |
| African Dusky Flycatcher | *Muscicapa adusta* | 2 | |
| African Paradise Flycatcher | *Terpsiphone viridis* | 1 | |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | 5 | |
| Montane White-eye | *Zosterops poliogastrus* | 7 | |
| Copper Sunbird | *Cinnyris cupreus* | 3 | |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | 3 | |
| Variable Sunbird | *Cinnyris venustus* | 1 | |
| Common Fiscal | *Lanius collaris* | 1 | |
| Ethiopian Boubou | *Laniarius aethiopicus* | 4 | |
| Marsh Tchagra | *Tchagra minutus* | 1 | |
| Abyssinian Oriole | *Oriolus monacha* | 5 | |
| Red-billed Oxpecker | *Buphagus erythrorhynchus* | 9 | |
| Greater Blue-eared Starling | *Lamprotornis chalybaeus* | 1 | |
| Swainson's Sparrow | *Passer swainsonii* | 27 | |
| Village Weaver | *Ploceus cucullatus* | 15 | One colony in the cultivated farm |
| Red-headed Quelea | *Quelea erythrops* | 7 | |
| Red-collared Widowbird | *Euplectes ardens* | 1 | |
| Fan-tailed Widowbird | *Euplectes axillaris* | 13 | |
| Red-billed Firefinch | *Lagonosticta senegala* | 5 | |
| Black-and-white Mannikin | *Spermestes bicolor* | 7 | |
| Pin-tailed Whydah | *Vidua macroura* | 13 | |
| African Citril | *Serinus citrinelloides* | 3 | |

### 3.2.4 Yartachi

**Date:** 05/08/2019, 6.50 am – 12.30 pm
**GPS position:** Latitude 7.403611 / Longitude 36.368889; 1,327 m a.s.l.
**GPS position:** Latitude 7.407500 / Longitude 36.376667; 1,317 m a.s.l.
**Habitat:** transitional area farmland (maize) to natural and secondary grassland, more or less wet; riverine vegetation and sparse stands of *Cyperus latifolius* surrounded by heavily grazed areas

**Table 11:** List of birds found at Yartachi

| Common name | Scientific name | Counted specimens | Remarks |
|---|---|---|---|
| Cattle Egret | *Bubulcus ibis* | 3 | The only finding of this species during the assessment |
| Black-headed Heron | *Ardea melanocephala* | 1 | |
| Hadada Ibis | *Bostrychia hagedash* | 30 | |
| Egyptian Goose | *Alopochen aegyptiaca* | 1 | |
| Hooded Vulture | *Necrosyrtes monachus* | 4 | |
| African Harrier Hawk | *Polyboroides typus* | 1 | |
| Augur Buzzard | *Buteo augur* | 2 | |
| Rouget's Rail | *Rougetius rougetii* | 2 | |
| Green Sandpiper | *Tringa ochropus* | 1 | |
| Blue-spotted Wood Dove | *Turtur afer* | 6 | |
| Tambourine Dove | *Turtur tympanistria* | 2 | |
| Red-eyed Dove | *Streptopelia semitorquata* | >10 | |
| Laughing Dove | *Streptopelia senegalensis* | 1 | |
| Klaas's Cuckoo | *Chrysococcyx klaas* | 2 | |
| Blue-headed Coucal | *Centropus monachus* | 4 | |
| Speckled Mousebird | *Colius striatus* | >10 | |
| Woodland Kingfisher | *Halcyon senegalensis* | 1 | Near Gojeb River |
| Striped Kingfisher | *Halcyon chelicuti* | 1 | |
| Crowned Hornbill | *Tockus alboterminatus* | 2 | |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | 2 | |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 2 | |
| Barn Swallow | *Hirundo rustica* | 3 | |
| Wire-tailed Swallow | *Hirundo smithii* | 2 | |
| Black Saw-wing | *Psalidoprocne pristoptera* | 3 | |
| African Pied Wagtail | *Motacilla aguimp* | 2 | |
| Abyssinian Longclaw | *Macronyx flavicollis* | 2 | |
| Grassland Pipit | *Anthus cinnamomeus* | 5 | |
| Common Bulbul | *Pycnonotus barbatus schoanus* | >10 | |
| Rüppell's Robin-Chat | *Cossypha semirufa* | 1 | |
| Grey-backed Camaroptera | *Camaroptera brachyura* | 4 | |
| Croaking Cisticola | *Cisticola natalensis* | 5 | |
| Red-faced Cisticola | *Cisticola erythrops* | 2 | |
| Tawny-flanked Prinia | *Prinia subflava* | 2 | |
| African Paradise Flycatcher | *Terpsiphone viridis* | >10 | |

| Common name | Scientific name | Counted specimens | Remarks |
|---|---|---|---|
| Black-headed Batis | *Batis minor* | 2 | |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | 7 | |
| Montane White-eye | *Zosterops poliogastrus* | 2 | |
| Copper Sunbird | *Cinnyris cupreus* | 15 | |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | 5 | |
| Variable Sunbird | *Cinnyris venustus* | 1 | |
| Common Fiscal | *Lanius collaris* | 2 | |
| Grey-backed Fiscal | *Lanius excubitorius* | 5 | |
| Marsh Tchagra | *Tchagra minutus* | 2 | |
| Cape Rook | *Corvus capensis* | 4 | |
| Red-billed Oxpecker | *Buphagus erythrorhynchus* | 6 | |
| Greater Blue-eared Starling | *Lamprotornis chalybaeus* | 2 | Two flocks, near the grazing cattle |
| Swainson's Sparrow | *Passer swainsonii* | >20 | |
| Village Weaver | *Ploceus cucullatus* | >200 | Three breeding colonies, others in the cultivated farm (maize and Eucalyptus) plantations |
| Compact Weaver | *Ploceus superciliosus* | 4 | |
| Grosbeak Weaver | *Amblyospiza albifrons* | 2 | |
| Black Bishop | *Euplectes gierowii* | 4 | Maize plantation |
| Red-collared Widowbird | *Euplectes ardens* | >10 | |
| Yellow-mantled Widowbird | *Euplectes macroura* | >200 | |
| Red-billed Firefinch | *Lagonosticta senegala* | 4 | |
| Bar-breasted Firefinch | *Lagonosticta rufopicta* | 2 | |
| Bronze Mannikin | *Spermestes cucullata* | 50 | |
| Pin-tailed Whydah | *Vidua macroura* | >10 | |
| African Citril | *Serinus citrinelloides* | >10 | |

### 3.2.5 Gojeb Wetland, Medabo

**Date:** 06.08.2019, 6.10 am – 4.45 pm
**GPS position:** Latitude 7.564167 / Longitude 36.375833; 1,566 m a.s.l.
**GPS position:** Latitude 7.557222 / Longitude 36.051667; 1,549 m a.s.l.
**Habitat:** wetland, grazed and ungrazed areas surrounded by forest and cultivation

**Table 12:** List of birds found at Gojeb Wetland

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Black-headed Heron | *Ardea melanocephala* | 1 |
| Hamerkop | *Scopus umbretta* | 2 |
| Woolly-necked Stork | *Ciconia episcopus* | 5 |
| Hadada Ibis | *Bostrychia hagedash* | >20 |
| Egyptian Goose | *Alopochen aegyptiaca* | 1 |
| Yellow-billed Duck | *Anas undulata* | 3 |
| Black-winged Kite | *Elanus caeruleus* | 1 |
| Hooded Vulture | *Necrosyrtes monachus* | 10 |
| White-backed Vulture | *Gyps africanus* | 15 |
| Rüppell's Vulture | *Gyps rueppellii* | 1 |
| Gabar Goshawk | *Micronisus gabar* | 1 |
| Long-crested Eagle | *Lophaetus occipitalis* | 1 |
| Chestnut-naped Francolin | *Pternistis castaneicollis* | 6 |
| Rouget's Rail | *Rougetius rougetii* | 1 |
| Black Crowned Crane | *Balearica pavonina* | 58 |
| Wattled Crane | *Bugeranus carunculatus* | 2 |
| Blue-spotted Wood Dove | *Turtur afer* | 3 |
| Tambourine Dove | *Turtur tympanistria* | 6 |
| Red-eyed Dove | *Streptopelia semitorquata* | 15 |
| Laughing Dove | *Streptopelia senegalensis* | 2 |
| Dusky Turtle Dove | *Streptopelia lugens* | 1 |
| Lemon Dove | *Aplopelia larvata* | 2 |
| Red-chested Cuckoo | *Cuculus solitarius* | 1 |
| Black Cuckoo | *Cuculus clamosus gabonensis* | 3 |
| African Emerald Cuckoo | *Chrysococcyx cupreus* | 1 |
| Blue-headed Coucal | *Centropus monachus* | 4 |
| Speckled Mousebird | *Colius striatus* | 12 |
| Woodland Kingfisher | *Halcyon senegalensis* | 2 |
| Striped Kingfisher | *Halcyon chelicuti* | 1 |
| African Pygmy Kingfisher | *Ceyx pictus* | 3 |
| Crowned Hornbill | *Tockus alboterminatus* | 2 |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | 12 |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 1 |
| Double-toothed Barbet | *Lybius bidentatus* | 2 |
| Cardinal Woodpecker | *Dendropicos fuscescens* | 1 |
| Barn Swallow | *Hirundo rustica* | 19 |
| Black Saw-wing | *Psalidoprocne pristoptera* | 1 |

| Common name | Scientific name | Counted specimens |
|---|---|---|
| African Pied Wagtail | *Motacilla aguimp* | 2 |
| Abyssinian Longclaw | *Macronyx flavicollis* | 10 |
| Grassland Pipit | *Anthus cinnamomeus* | 2 |
| Black-Cuckoo-shrike | *Campephaga flava* | 1 |
| Red-shouldered Cuckoo-shrike | *Campephaga phoenicea* | 2 |
| Common Bulbul | *Pycnonotus barbatus schoanus* | >15 |
| Rüppell's Robin-Chat | *Cossypha semirufa* | 1 |
| Cinnamon Bracken Warbler | *Bradypterus cinnamomeus* | 1 |
| Grey-backed Camaroptera | *Camaroptera brachyura* | 5 |
| Ethiopian Cisticola | *Cisticola lugubris* | 1 |
| Tawny-flanked Prinia | *Prinia subflava* | 2 |
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatinus* | 2 |
| African Dusky Flycatcher | *Muscicapa adusta* | 4 |
| African Paradise Flycatcher | *Terpsiphone viridis* | 2 |
| Black-headed Batis | *Batis minor* | 2 |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | 6 |
| Montane White-eye | *Zosterops poliogastrus* | 15 |
| Copper Sunbird | *Cinnyris cupreus* | 1 |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | 2 |
| Olive Sunbird | *Cyanomitra olivacea* | 1 |
| Variable Sunbird | *Cinnyris venustus* | 2 |
| Collared Sunbird | *Hedydipna collaris* | 2 |
| Common Fiscal | *Lanius collaris* | 6 |
| Grey-backed Fiscal | *Lanius excubitorius* | 3 |
| Ethiopian Boubou | *Laniarius aethiopicus* | 4 |
| Northern Puffback | *Dryoscopus gambensis* | 2 |
| Abyssinian Oriole | *Oriolus monacha* | 2 |
| Cape Crow | *Corvus capensis* | 2 |
| Thick-billed Raven | *Corvus crassirostris* | 2 |
| Red-billed Oxpecker | *Buphagus erythrorhynchus* | 2 |
| Greater Blue-eared Starling | *Lamprotornis chalybaeus* | 7 |
| Swainson's Sparrow | *Passer swainsonii* | 6 |
| Village Weaver | *Ploceus cucullatus* | 25 |
| Spectacled Weaver | *Ploceus ocularis* | 4 |
| Baglafecht Weaver | *Ploceus baglafecht* | 2 |
| Red-headed Quelea | *Quelea erythrops* | 32 |
| Red-collared Widowbird | *Euplectes ardens* | 30 |
| Fan-tailed Widowbird | *Euplectes axillaris* | 50 |
| Common Waxbill | *Estrilda astrild* | 11 |
| Bronze Mannikin | *Spermestes cucullata* | 20 |
| African Citril | *Serinus citrinelloides* | 7 |

### 3.2.6 Decha (Baha)

**Date:** 11/08/2019, 6.40 am – 1.20 pm
**GPS position:** Latitude 7.168889 / Longitude 36.220556; 1,822 m a.s.l.
**GPS position:** Latitude 7.180000 / Longitude 36.208056; 1,904 m a.s.l.
**Habitat:** wetland, riverine forest, montane cloud forest, coffee plantation and agricultural

**Table 13:** List of birds found at Decha (Baha)

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Hadada Ibis | *Bostrychia hagedash* | >20 |
| Egyptian Goose | *Alopochen aegyptiaca* | 1 |
| African Black Duck | *Anas sparsa* | 2 |
| Augur Buzzard | *Buteo augur* | 1 |
| Common Buzzard | *Buteo buteo* | 1 |
| Crowned Eagle | *Stephanoaetus coronatus* | 1 |
| Chestnut-naped Francolin | *Pternistis castaneicollis* | 1 |
| Red-chested Flufftail | *Sarothrura rufa* | 2 |
| Rouget's Rail | *Rougetius rougetii* | 3 |
| African Rail | *Rallus caerulescens* | 2 |
| Black Crowned Crane | *Balearica pavonina* | 12 |
| African Olive Pigeon | *Columba arquatrix* | 9 |
| Red-eyed Dove | *Streptopelia semitorquata* | 15 |
| Yellow-fronted Parrot | *Poicephalus flavifrons* | 6 |
| Black-winged Lovebird | *Agapornis taranta* | 2 |
| White-cheeked Turaco | *Tauraco leucotis* | 1 |
| Red-chested Cuckoo | *Cuculus solitarius* | 4 |
| Black Cuckoo | *Cuculus clamosus gabonensis* | 2 |
| African Emerald Cuckoo | *Chrysococcyx cupreus* | 1 |
| Blue-headed Coucal | *Centropus monachus* | 5 |
| Speckled Mousebird | *Colius striatus* | 10 |
| Woodland Kingfisher | *Halcyon senegalensis* | 1 |
| Malachite Kingfisher | *Alcedo cristata* | 1 |
| African Pygmy Kingfisher | *Ceyx pictus* | 3 |
| Crowned Hornbill | *Tockus alboterminatus* | 2 |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | 2 |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 1 |
| Double-toothed Barbet | *Lybius bidentatus* | 2 |
| Banded Barbet | *Lybius undatus* | 1 |
| Green-backed Honeybird | *Prodotiscus zambesiae* | 2 |
| Cardinal Woodpecker | *Dendropicos fuscescens* | 1 |
| Abyssinian Woodpecker | *Dendropicos abyssinicus* | 2 |
| Black Saw-wing | *Psalidoprocne pristoptera* | 2 |
| Mountain Wagtail | *Motacilla clara* | 4 |
| Red-shouldered Cuckoo-shrike | *Campephaga phoenicea* | 3 |
| Common Bulbul | *Pycnonotus barbatus schoanus* | 6 |
| Rüppell's Robin-Chat | *Cossypha semirufa* | 6 |

| Common name | Scientific name | Counted specimens |
|---|---|---|
| African Stonechat | *Saxicola torquatus* | 6 |
| Mountain Thrush | *Turdus abyssinicus* | 6 |
| Cinnamon Bracken Warbler | *Bradypterus cinnamomeus* | 8 |
| Little Bush Warbler | *Bradypterus baboecala* | 10 |
| Grey-backed Camaroptera | *Camaroptera brachyura* | 4 |
| Brown Woodland Warbler | *Phylloscopus umbrovirens* | 1 |
| Stout Cisticola | *Cisticola robustus* | 2 |
| Ethiopian Cisticola | *Cisticola lugubris* | 2 |
| Singing Cisticola | *Cisticola cantans* | 5 |
| Tawny-flanked Prinia | *Prinia subflava* | 5 |
| Yellow-breasted Apalis | *Apalis flavida* | 1 |
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatinus* | 12 |
| African Dusky Flycatcher | *Muscicapa adusta* | >10 |
| African Paradise Flycatcher | *Terpsiphone viridis* | 2 |
| Black-headed Batis | *Batis minor* | 1 |
| African Hill Babbler | *Pseudoalcippe abyssinica* | 1 |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | 2 |
| Montane White-eye | *Zosterops poliogastrus* | >20 |
| Tacazze Sunbird | *Nectarinia tacazze* | 2 |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | 1 |
| Olive Sunbird | *Cyanomitra olivacea* | 2 |
| Variable Sunbird | *Cinnyris venustus* | 2 |
| Common Fiscal | *Lanius collaris* | 2 |
| Northern Puffback | *Dryoscopus gambensis* | 1 |
| Ethiopian Boubou | *Laniarius aethiopicus* | 10 |
| Abyssinian Oriole | *Oriolus monacha* | 4 |
| Swainson's Sparrow | *Passer swainsonii* | 10 |
| Spectacled Weaver | *Ploceus ocularis* | 2 |
| Baglafecht Weaver | *Ploceus baglafecht* | >10 |
| Fan-tailed Widowbird | *Euplectes axillaris* | 20 |
| Abyssinian Crimsonwing | *Cryptospiza salvadorii* | 4 |
| Yellow-bellied Waxbill | *Coccopygia quartinia* | 10 |
| Common Waxbill | *Estrilda astrild* | 5 |
| Bronze Mannikin | *Spermestes cucullata* | 10 |
| Black-and-white Mannikin | *Lonchura bicolor* | 20 |
| Pin-tailed Whydah | *Vidua macroura* | 2 |
| African Citril | *Serinus citrinelloides* | >20 |
| Brown-rumped Seedeater | *Serinus tristriatus* | 2 |
| Streaky Seedeater | *Serinus striolatus* | 8 |

### 3.2.7 Arguba

**Date:** 12/08/2019, 7 am – 12.30 pm
**GPS position:** Latitude 7.410556 / Longitude 36.394167; 1,330 m a.s.l.
**GPS position:** Latitude 7.419722 / Longitude 36.545000; 1,285 m a.s.l.
**Habitat:** savannah grassland with Acacia trees; small riverine forest at the side of Gojeb River

**Table 14:** List of birds found at Arguba

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Hamerkop | *Scopus umbretta* | 2 |
| Hadada Ibis | *Bostrychia hagedash* | 10 |
| Egyptian Goose | *Alopochen aegyptiaca* | 4 |
| African Fish Eagle | *Haliaeetus vocifer* | 1 |
| White-backed Vulture | *Gyps africanus* | 6 |
| African Goshawk | *Accipiter tachiro (unduliventer)* | 1 |
| Wahlberg's Eagle | *Aquila wahlbergi* | 2 |
| Long-crested Eagle | *Lophaetus occipitalis* | 2 |
| Common Sandpiper | *Actitis hypoleucos* | 2 |
| African Green Pigeon | *Treron calvus* | 4 |
| Blue-spotted Wood Dove | *Turtur afer* | 2 |
| Tambourine Dove | *Turtur tympanistria* | 4 |
| Red-eyed Dove | *Streptopelia semitorquata* | >20 |
| Eastern Plantain-eater | *Crinifer zonurus* | 2 |
| Red-chested Cuckoo | *Cuculus solitarius* | 2 |
| Klaas's Cuckoo | *Chrysococcyx klaas* | 2 |
| African Emerald Cuckoo | *Chrysococcyx cupreus* | 2 |
| Blue-headed Coucal | *Centropus monachus* | 4 |
| Speckled Mousebird | *Colius striatus* | 12 |
| Woodland Kingfisher | *Halcyon senegalensis* | 1 |
| Striped Kingfisher | *Halcyon chelicuti* | 2 |
| Crowned Hornbill | *Tockus alboterminatus* | 2 |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | 2 |
| Abyssinian Ground-hornbill | *Bucorvus abyssinicus* | 8 |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 1 |
| Double-toothed Barbet | *Lybius bidentatus* | 9 |
| Banded Barbet | *Lybius undatus* | 4 |
| Greater Honeyguide | *Indicator indicator* | 1 |
| Nubian Woodpecker | *Campethera nubica* | 1 |
| Cardinal Woodpecker | *Dendropicos fuscescens* | 1 |
| Brown-backed Woodpecker | *Picoides obsoletus* | 1 |
| Barn Swallow | *Hirundo rustica* | 5 |
| Wire-tailed Swallow | *Hirundo smithii* | 1 |
| Black Saw-wing | *Psalidoprocne pristoptera* | 2 |
| African Pied Wagtail | *Motacilla aguimp* | 4 |
| Mountain Wagtail | *Motacilla clara* | 1 |
| Grassland Pipit | *Anthus cinnamomeus* | 1 |

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Black Cuckoo-shrike | *Campephaga flava* | 1 |
| Common Bulbul | *Pycnonotus barbatus schoanus* | >10 |
| Yellow-throated Leaflove | *Chlorocichla flavicollis* | 2 |
| Rüppell's Robin-Chat | *Cossypha semirufa* | 5 |
| Mountain Thrush | *Turdus abyssinicus* | 8 |
| Grey-backed Camaroptera | *Camaroptera brachyura* | 4 |
| Green-backed Eremomela | *Eremomela canescens* | 6 |
| Buff-bellied Warbler | *Phyllolais pulchella* | 3 |
| Croaking Cisticola | *Cisticola natalensis* | 5 |
| Short-winged Cisticola | *Cisticola brachypterus* | 1 |
| Red-faced Cisticola | *Cisticola erythrops* | 2 |
| Tawny-flanked Prinia | *Prinia subflava* | 2 |
| Yellow-breasted Apalis | *Apalis flavida* | 2 |
| Northern Black Flycatcher | *Melaenornis edolioides* | 1 |
| Pale Flycatcher | *Bradornis pallidus* | 4 |
| African Dusky Flycatcher | *Muscicapa adusta* | 2 |
| African Paradise Flycatcher | *Terpsiphone viridis* | 6 |
| Black-headed Batis | *Batis minor* | 10 |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | 16 |
| White-winged Black Tit | *Parus leucomelas* | 2 |
| Abyssinian White-eye | *Zosterops abyssinicus* | >30 |
| Copper Sunbird | *Cinnyris cupreus* | 4 |
| Variable Sunbird | *Cinnyris venustus* | 1 |
| Collared Sunbird | *Hedydipna collaris* | 1 |
| Grey-backed Fiscal | *Lanius excubitorius* | 6 |
| Cape Rook | *Corvus capensis* | 1 |
| Ethiopian Boubou | *Laniarius aethiopicus* | 4 |
| Swainson's Sparrow | *Passer swainsonii* | >20 |
| Village Weaver | *Ploceus cucullatus* | >200 |
| Spectacled Weaver | *Ploceus ocularis* | 2 |
| Red-collared Widowbird | *Euplectes ardens* | 4 |
| Black Bishop | *Euplectes gierowii* | 2 |
| Yellow-mantled Widowbird | *Euplectes macroura* | >60 |
| Red-billed Firefinch | *Lagonosticta senegala* | 2 |
| Bronze Mannikin | *Spermestes cucullata* | >30 |
| African Citril | *Serinus citrinelloides* | 10 |
| Yellow-rumped seadeater | *Serinus xanthopygius* | 4 |

### 3.2.8 KDA Guest house and surroundings

**Date:** 06/08/2019 – 11/08/2019
**GPS position:** Latitude 7.265000 / Longitude 36.254444; 1,742 m a.s.l.
**Habitat:** nearby village with gardens, lawns, small crop plantations, hedges, small garbage place, edge of the woods

Unlike the other study areas, we compiled a complete list of the species found during the stay at the KDA Guesthouse from 6 August to 11 August 2019. The numbers in the table below represent the maximum number of counted specimens at one observation time.

**Table 15:** List of birds found at KDA Guesthouse

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Hamerkop | *Scopus umbretta* | 1 |
| Woolly-necked Stork | *Ciconia episcopus* | 1 |
| Hadada Ibis | *Bostrychia hagedash* | 4 |
| Wattled Ibis | *Bostrychia carunculata* | 6 |
| Hooded Vulture | *Necrosyrtes monachus* | 5 |
| African Goshawk | *Accipiter tachiro* | 2 |
| Augur Buzzard | *Buteo augur* | 1 |
| Tawny Eagle | *Aquila rapax* | 2 |
| Speckled Pigeon | *Columba guinea* | >30 |
| Blue-spotted Wood Dove | *Turtur afer* | 2 |
| Tambourine Dove | *Turtur tympanistria* | 2 |
| Red-eyed Dove | *Streptopelia semitorquata* | 4 |
| Black-winged Lovebird | *Agapornis taranta* | 3 |
| Red-chested Cuckoo | *Cuculus solitarius* | 2 |
| Black Cuckoo | *Cuculus clamosus gabonensis* | 2 |
| Klaas's Cuckoo | *Chrysococcyx klaas* | 2 |
| African Emerald Cuckoo | *Chrysococcyx cupreus* | 2 |
| Speckled Mousebird | *Colius striatus* | 6 |
| African Pygmy Kingfisher | *Ceyx pictus* | 1 |
| Blue-breasted Bee-eater | *Merops lafresnayii* | 2 |
| Crowned Hornbill | *Tockus alboterminatus* | 2 |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | 12 |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | 1 |
| Double-toothed Barbet | *Lybius bidentatus* | 2 |
| Banded Barbet | *Lybius undatus* | 2 |
| Greater Honeyguide | *Indicator indicator* | 1 |
| Lesser Honeyguide | *Indicator minor* | 1 |
| Cardinal Woodpecker | *Dendropicos fuscescens* | 2 |
| Abyssinian Woodpecker | *Dendropicos abyssinicus* | 2 |
| Black Saw-wing | *Psalidoprocne pristoptera* | 1 |
| Common Bulbul | *Pycnonotus barbatus schoanus* | 8 |
| Rüppell's Robin-Chat | *Cossypha semirufa* | 2 |
| Mountain Thrush | *Turdus abyssinicus* | 4 |
| Grey-backed Camaroptera | *Camaroptera brachyura* | 5 |
| Singing Cisticola | *Cisticola cantans* | 2 |
| Tawny-flanked Prinia | *Prinia subflava* | 4 |

| Common name | Scientific name | Counted specimens |
|---|---|---|
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatinus* | 4 |
| African Dusky Flycatcher | *Muscicapa adusta* | 6 |
| African Paradise Flycatcher | *Terpsiphone viridis* | 2 |
| Black-headed Batis | *Batis minor* | 2 |
| Spotted Creeper | *Salpornis spilonotus* | 2 |
| Montane White-eye | *Zosterops poliogastrus* | 30 |
| Tacazze Sunbird | *Nectarinia tacazze* | 11 |
| Copper Sunbird | *Cinnyris cupreus* | 8 |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | 6 |
| Olive Sunbird | *Cyanomitra olivacea* | 2 |
| Variable Sunbird | *Cinnyris venustus* | 20 |
| Common Fiscal | *Lanius collaris* | 8 |
| Ethiopian Boubou | *Laniarius aethiopicus* | 4 |
| Northern Puffback | *Dryoscopus gambensis* | 2 |
| Abyssinian Oriole | *Oriolus monacha* | 2 |
| Thick-billed Raven | *Corvus crassirostris* | 2 |
| Slender-Billed Starling | *Onychognathus tenuirostris* | 50 |
| Swainson's Sparrow | *Passer swainsonii* | 12 |
| Village Weaver | *Ploceus cucullatus* | 10 |
| Baglafecht Weaver | *Ploceus baglafecht* | 4 |
| Bronze Mannikin | *Spermestes cucullate* | 10 |
| African Citril | *Serinus citrinelloides* | 4 |
| Streaky Seedeater | *Serinus striolatus* | 1 |

# 4. Discussion

The Kafa BR is home to one of the country's last natural montane forests. The high bird diversity reflects its landscape heterogeneity characterised by Afromontane mountain clouds, bamboo forests, many wetlands as well as grass and shrub land and rainforests with wild coffee (*Coffea arabica*). As the area is part of the Eastern Afromontane biodiversity hotspot and has been recognized as a Key Biodiversity Area, it is one of the few regions where many rare and specialized species of birds can be expected to occur.

In the first assessment, 178 bird species were recorded during the dry season (NABU, 2017). In August 2019, we detected 179 species during the rainy season. We recorded 57 species not detected in the 2014 assessment. In both surveys, a combined total of 232 different bird species could be identified at the Kafa BR. Due to the relatively small number of days of investigation during the surveys, we assume that the number of bird species actually living at the Kafa BR is much higher, and this requires further investigation in future studies. We also recorded a number of biome-restricted species in the reserve.

About 26 bird species are restricted to the Afrotropical Highland biome and two species are restricted to the Somali-Masai biome (Table 17). Biome-restricted species are very vulnerable to damage and degradation of their biome and need special attention for conservation. This also applies to endemic species, which are already potentially endangered by their very small distribution area. We found three species that are endemic to Ethiopia (Abyssinian Longclaw, Abyssinian Catbird, Yellow-fronted Parrot), 10 species that are endemic to Ethiopia and Eritrea, and six species that are near endemic (Table 18).

We recorded 10 bird species listed in the IUCN Red List of Threatened Species. Crowned Eagle, Rouget's Rail and Abyssinian Longclaw are listed as Near Threatened. Tawny Eagle, Black Crowned Crane and Wattled Crane are Vulnerable, and the Lapped-faced Vulture is Endangered. Three vulture species are listed as Critically Endangered, the Hooded Vulture, the White-backed Vulture and the Rüppell's Vulture.

There were some hints from locals that there is a vulture breeding place somewhere on the way from Bamboo Forest to Adiyo. With the help of local guides we found the place – a big gorge. Although August is not the main breeding season, we found one breeding Rüppell's Vulture there and another 32 individuals that were resting on the rocks and on a dry tree. In addition to the Rüppell's Vultures we observed 16 individuals of White-backed Vultures at this place. This site should definitely be visited during the main breeding season (presumably December - February) in order to obtain more information on the number of breeding pairs.

The wetlands are the main core sites for the Wattled Ibis, Rouget's Rail, African Rail, Black Crowned Crane and Wattled Crane. On the other hand, these wetlands are the Kafa BR sites most threatened by overgrazing. However, there are neither data indicating how many pairs are breeding nor how successful the breeding is, let alone data about particular threats. Thus, the cranes require our special attention because they are an endangered species and are particularly sensitive to disturbances at the breeding site. We found only one pair of Wattled Crane, at Gojeb Wetland. The Black Crowned Crane is more widespread and has been found in three (Alemgono, Shoriri, Gojeb Wetland) out of six wetlands studied. Although August is not the main breeding season, we were able to observe a breeding pair in Alemgono. At Gojeb Wetland a roosting group of 58 specimens was observed.

Of the species bound to wetlands, only the endemic Rouget's Rail was present at all the six sites studied. The Red-chested Flufftail, very noticeable by its calling activities, was found in the swampy areas of Alemgono, Shoriri and Decha. The endemic Abyssinian Longclaw, which prefers pasture land with areas of short grass, appeared at Alemgono, Yartachi and Gojeb Wetland.

Among the more forest-bound species the White-cheeked Turaco and the Silvery-cheeked Hornbill were found in small groups in fruiting trees in most of the studied areas. The Sharpe's Starling occurred in groups of about 10-15 specimens in the tree tops of the forest sites of Kejaraba, the path to the hot springs and Saja. The Yellow-fronted Parrot was found in groups of 4-12 specimens near the hot springs, in Saja and in Decha. The bird is a forest dweller (Boussekey, 2004) and a common visitor to agricultural areas around human settlements. We found it foraging in gallery forests around Boginda Forest and along riverbanks in Decha. We also detected one individual of the Crowned Eagle in Chefahanna and another one in Decha.

The savannah area near Arguba showed a completely different type of habitat. Compared to the other sites examined, it is drier and lower at an elevation of about 1,300 m a.s.l. only. Here we found some bird species, like the White-winged Black Tit, the Brown-backed Woodpecker and the Abyssinian White-eye, that we detected not at all or only rarely in the other areas. It would be very important to maintain this area in its current state and to restrict agricultural intensification.

# 5. Conclusions and recommendations for conservation and monitoring

## 5.1 Recommendations for conservation and monitoring

The fast-expanding population and inappropriate land use practices are threatening the exceptional Afromontane coffee forest ecosystem, thus leading to the loss of its flora and fauna resources. This problem calls for effective and adaptive land management systems and strategies that address the need of immediate and long-term integrated development, incorporating the interests and requirements of the local communities.

Bird species associated with certain biomes are used as indicators of the biomes of which they are a part. It is highly unlikely that these species can survive outside these biomes. Degradation or alteration of such biomes is of high concern for the conservation of faunal species. Accordingly, there is a need to address anthropogenic pressures, especially those arising from agricultural intensification.

It is important to check and continue to monitor the status and trends of the avian population and at the same time to look for corrective actions against the negative trends that are currently occurring and affecting the overall ecological system and its functions.

The consequences of unscientifically planned and unsustainable use of natural resources are the environmental problems that lead to poverty and loss of the valuable genetic resources. These processes must therefore be stopped and an effective management system, with detailed study of traditional knowledge for sustainable development and stable ecosystem prospects, must be put in place (Berhan, 2008).

Zoning of the prime areas for their biodiversity values with graded limitations of human use and with agreed management objectives would be an option to avoid the threats to wildlife habitat. Encroachment of the wetlands and forest areas could be reversed by marking the boundaries. Movement of people and livestock should be restricted in such areas. Reinforcement should be applied through sufficient deployment of well-trained rangers and community scouts.

Enforcing conservation laws with improved patrolling could also help to halt the decline and to safeguard the dangerously small populations of many, particularly endemic, species and those that are of special conservation interest and concern. It is highly recommended to have a long-term plan for all the wetlands at the Kafa BR and to initiate an overall management and auditing programme which includes the wetlands. This would avoid over- and misuse, and also mitigate the conflicts over the use of water and land resources that are occurring in the area.

The Kafa BR is strategically placed with room for improvement. It is positioned between the northern and the southern road of the tourist circuit. Appropriate market infrastructures and tourism facilities should be developed, as these enterprises have a big potential for bringing in high income through tourism investment and promotion. This, in turn, could boost both the ecotourism development potential and the cultural assets of the Kafa BR. Brooks and Thompson (1999) comment that 'non-consumptive' use of bird resources can be applied successfully, regardless of the irreplaceability of the biodiversity present. This can be achieved through international nature tourism, which can bring large economic benefits in some circumstances (Sweeting, 1999). A classic example of avi-tourism can be seen at Kenya's Arabuko-Sokoke, Karura and Gatamaiyu Forests.

We recommend regular bird walks within the Kafa BR. These could be led by the already trained NABU staff with assistance of the local university. This will help create conservation awareness of critical habitats. Locals will have interest and they are likely to appreciate their rich biodiversity. A good example is Kenya's famous Wednesday Bird Walks; these activities have been going on for over 40 years. This has led to the training of many tour guides and citizen scientists who continue to play a critical role in biodiversity conservation in Kenya and beyond.

There is strong evidence that support of local conservation non-governmental organisations, for example through BirdLife International's Africa partnership, accelerates motivation, transparency and, critically, effective implementation (Hagen et al., 2000). One particularly stimulating activity of those groups is the development of ''Site Support Groups'' consisting of interested locals for Important Bird Areas (IBAs).

The Kafa BR has great potential to be developed into an eco-tourism area. This would be supported by effective training of the bird guides and rangers who could direct the visitors. The following key actions to be undertaken in order to implement avitourism are adapted from Asefa (2015):

- Clearly identify avitourism products and services available along potential IBAs. Lack of awareness about Ethiopia's birding product is the primary reason why birders and channel partners do not visit interesting places like Kafa in Ethiopia. Ethiopia's wealth of endemic and rare bird species is an untapped resource that relevant organizations should highlight to encourage birders to visit and that should be promoted actively.

- Establish birding routes and designate birding sites among the specific birding resources requested by birders at visitor destination areas. The most highly relevant resource appears to be a clearly defined birding route (BirdLife South Africa, 2008; Kruger to Canyons Birding Route, undated). For example, in South Africa there are seven established birding routes in different regions of the country, which are initiated and developed by the Avitourism Division of BirdLife South Africa (BirdLife South Africa, 2008; Biggs et al., 2011; Nicolaides, 2013). The country's 'Birding Route' concept is successful in realizing the role birds play in providing ecosystem services and economic values, which means the need to conserve birds and their habitat, and the role local communities play in conserving birds and their habitats (BirdLife South Africa, 2008; Biggs et al., 2011). The 'Birding Route' model developed by BirdLife South Africa is currently being implemented in several countries worldwide, such as Namibia, Australia and Malaysia (BirdLife South Africa, 2008). Although differences may exist in socio-economic, political and environmental issues, such a model can and could also be replicated in Ethiopia.

*Selection of areas that qualify for meeting the basic conditions for birders is the first step in establishing birding routes*. Selection of routes depends on four main factors which are interlinked (Asefa, 2008; Asefa et al., 2013). These are: (1) The route should encompass some of the areas identified as the country's Important Bird Areas (IBAs) and cover as many different biomes with various habitats as possible, so that the number of species potentially observed is maximised, paying particular attention to endemics, biome or range restricted, rare/elusive and threatened bird species. Meanwhile, identifying and designating birding sites along the birding routes, where birdwatchers can undertake their birding activities, is equally as important as establishing the routes (Asefa et al., 2013). For the most part, it is generally agreed upon that birders prefer visiting areas with high bird species diversity and with little-known and endemic species; (2) Accessibility to birding sites influences the interests of birders to plan their trip to the destination site, as birdwatchers typically wish to cover wide areas within their single trip (OTF GROUP, 2008). Thus, birding sites should be selected along or near the routes and be easily accessible by vehicle and/or on foot; (3) Most bird watchers are people with a reasonable income and so they often require appropriate, if not luxury, accommodation facilities (Sekercioglu, 2002). Suitable accommodation along the routes (e.g. in towns along the route and community/private lodges at birding sites) is crucial for attracting this customer base; and (4) Finally, as is true for any kind of tourism, the safety and security at destination sites is paramount for site selection. As such, changing Ethiopia's overall presumed negative images from the past and the present and publicising its security advantages will be critical in helping to develop avitourism initiatives.

*Developing birding resources*. In developing the most basic of birding resources it is esssential to recognise that almost all birders look for specific resources available at the destination areas when deciding on their booking preferences (Conradie, 2010). The most highly relevant birding resources are clearly defined birding routes, species checklists, maps (showing the routes and birding sites as well as accommodation, facilities and infrastructures), sign boards (BirdLife South Africa, 2008). The Kafa BR must focus on developing the most basic of these birding resources first.

*Promotion and marketing depend on booking methods*. Birders can be categorised into two broad types: direct birders, who plan their trips themselves, and channel birders, who plan their trips with the assistance of channel tour operator partners (international or regional tour operators working in partnership with local/national tour operators in the destination country) (OTF Group, 2008). While websites and word-of-mouth from friends or colleagues are the two most important sources of information used by direct birders to plan their trip, for channel birders, tour operators (first), websites (second) and birding trade fairs (third) are the major sources of information (OTF Group, 2008; Conradie, 2010). It is, therefore, important to undertake a detailed customer analysis and identify which market the country wishes to exploit in order to develop a detailed marketing strategy to target those customers. Thus, primarily focusing on providing website information, targeting bird fairs and serving channel tour operators are key in promoting Kafa as an avitourism destination.

*Launch community bird guide development programmes*. The important role that local communities can play in the conservation of birds of the Kafa region and birds' habitats should be recognized. This has shown to work best when the economic benefits from conservation are maximised for the communities. Avitourism, using community bird guides has the potential to generate significant income for the local communities. Community bird guides provide a source of security and can facilitate logistics on site; however, it is their valuable

information on where elusive and special bird species may be found that will be the main draw for birding enthusiasts (Asefa, 2008).

*Training would be a key component of conserving the biosphere reserve*. Through NABU partnership and local universities, notably Bonga University, it is possible to train and supervise forest guards to watch over the endemic birds and the general biodiversity of the Kafa BR. A two-week training of trainers for the field rangers and scouts is strongly recommended. This will compliment the short training offered to the rangers during the biodiversity assessment.

*Initiate community development and conservation programmes at birding sites*. The rationale of linking conservation and development is to encourage support for conservation among local communities by involving them in management and decision-making, and by providing benefits to offset the costs of protection (Biggs et al., 2011). From a benefit point of view, apart from community guides, local communities living at or around the birding sites/IBAs can be involved in different types of development activities, which are directly linked to avitourism. Offering birders services like a community eco-lodge, local artefact shops, coffee ceremony and traditional dancing is part of the income-generating community development activities that are potentially applicable in most of Ethiopia's IBAs (Asefa, 2008).

*Design and establish systems for monitoring and evaluating the impacts of avitourism activities*. While avitourism can clearly bring enormous economic benefits to individuals, communities and nations, as well as the conservation and management of natural resources, there are drawbacks associated with an influx of relatively wealthy visitors to an area. For example, avitourism overuse can degrade roads and tourist sites, produce waste and litter and cause bird disturbances.

*The management of key montane forests in the Kafa region requires innovative approaches that would serve both development and conservation purposes*. This entails zoning of critical habitats into Core, Buffer and Intensive Use Zones based on different management categories and uses. This is in line with the concept and the principles of UNESCO's Man and Biosphere Programme (Berhan, 2008). Where there are no core areas, such should be introduced. This could be done during critical times, for wetlands it could be during the breeding season of some wetland birds, e.g. the Rouget's Rail. The core areas could be one or more areas where critical environments like the prime forest areas are to be protected, the buffer area could consist of corridors between core areas where the use of resources like wildlife reserves can be controlled and resources can be used sustainably.

We recommend Alemgono and Medabo Wetlands, which are currently found in the buffer zone of the Kafa BR, to be upgraded to the core zone. This was also suggested by Chawaka et al. (2018). These wetlands are heavily disturbed by agricultural intensification and overgrazing. The plan would be to start with these two and continue with others later.

Local communities rely on wetlands for their daily livelihoods in some parts of the Kafa region. In this regard, principles of wise use prevail. This will guarantee successful breeding of endemic and other species of global concern.

*The Kafa BR could also benefit from additional research*. Rodrigues et al. (2018) assert that research should focus on (a) the use of functional diversity and trait approaches to assess bird diversity and the responses to coffee management, (b) the assessment of ecosystem functions and services provided by birds and how these change with coffee management and landscape configuration, (c) understanding the relationships between bird diversity and the production and sustainability of coffee forests.

*There is an increase in development of user-friendly mobile applications*. Examples include *BirdLasser* for monitoring birds and other wildlife. Using these kinds of applications requires additional training for potential users, but involving the public is essential in order to generate the mass of data needed for a well-founded scientific analysis.

*Presentation of the research findings at international conferences would also arouse interest from a wide scientific community*. An example is the Pan-African Ornithological Congress, which takes place in an African country every four years and is solely dedicated to research and conservation in Africa. This would serve as a vehicle for the exchange of information on bird conservation between African scientists and those from abroad.

## 5.2 Suggestions for future studies

The Kafa BR holds a variety of bird species assemblages varying from rare, endemic, resident and migratory species occurring in various habitats. However, rapidly expanding populations, both rural and urban, agricultural expansion into primary forest and overgrazing of wetlands might be the main threat factors for both terrestrial and water bird species at the Kafa BR. These pressures pose serious threats to the sustainability of biodiversity in general and for birds in particular, and counter measures need to be implemented. Effective conservation efforts and detailed study of rare and threatened indicator bird species can provide stepping stones on the way to a stable ecosystem. Conservation and monitoring of these species not only justify the linkages between the biological and socio-economic values at the local level, but they are of strategic importance at national and global levels as well.

For many bird species at the Kafa BR, very little is known about their population size, the distribution of their breeding sites and their breeding success. Furthermore, little is known about the threats these birds are facing, which can be very different for forest species or species of open land. However, this knowledge is crucial in order to contribute to good breeding success and a high survival rate and thereby ensure the survival of a species in the region.

Therefore, further investigations on the population status, monitoring and key threats should be carried out at least for some of the threatened, the indicator and the umbrella species of the biosphere reserve, such as the Abyssinian Longclaw, Wattled Ibis, Wattled Crane, Black Crowned Crane, Rouget's Rail, Lappet-faced Vulture and White-headed Vulture (see the status in Table 16 of the Annex).

We recommend well-resourced, community-based advocacy and awareness-raising actions within the Kafa region, especially for all endemic and IUCN-listed bird species.

### The rails and cranes

#### Rouget's Rail

Rouget's Rail (*Rougetius rougetii*, Guérin-Méneville 1843) in the Rallidae family is an endemic bird to Ethiopia and Eritrea between 1,500 and 4,100 m a.s.l. elevation. The species is listed as Near Threatened in the IUCN Red List of Threatened Species because it is thought to be declining rapidly owing to the modification of its habitats. The bird appears to have maintained its distribution, but to have suffered a reduction in numbers. Therefore, an investigation of the current distribution, population status and breeding success of the species in its natural habitat at the Kafa BR is crucial. Moreover, extensive surveys should be conducted in all potentially suitable habitats in the region, particularly wetlands, high-altitude marsh lands, grasslands, rivers, freshwater marshes, pasture lands and rural gardens, using standard survey methodology.

#### Black Crowned Crane and Wattled Crane

Similarly, cranes are among the world's most threatened groups of birds. Several of the families have come close to the precipice of extinction, and many may now be globally threatened. Diverse threats, including habitat loss and degradation, pollution, exploitation, poisoning and disturbance, beset the cranes. The situation in different crane habitats is highly dynamic, so that even small local changes in certain populations can significantly affect the status of a species as a whole. Thus, an understanding of the biology, ecology, and status of Black Crowned Crane and Wattled Crane at the Kafa BR is fundamental to the success of efforts to conserve these species and the ecosystems within which they exist.

Finally, threat and conservation issues of both rails and cranes should also be assessed for designing possible conservation action plans for the region and later for the rest of the country.

### The vultures

Particular attention should be paid to vultures, which are in sharp decline in the vast majority of their breeding areas. Vultures are highly susceptible to incidences of poisoning. We recommend investigation of the use of various livestock drugs in the area. This may be important in augmenting the effects of changes in the regulation of veterinary drugs toxic to vultures. NABU should lead in the prevention of poisoning through national bans on harmful carbamate pesticides and diclofenac, coupled with education and awareness raising to reduce demand and use of such chemicals. This can be done through consultation workshops, organised at the Kafa BR with relevant stakeholders. A continued Kafa BR vulture programme, coordinated by NABU in multiple sites, is required to support the persistence of Kafa's vulture population as a stronghold of Ethiopian vultures.

Development of single-species action plans for the critically endangered vultures would be a priority to guide conservation. The said species would also serve as umbrella species, helping the conservation of other species in that region. We recommend further study in order to understand the attitude of people towards vultures, especially factors influencing behaviours that support their conservation. This is vital if the decline in vultures is to be slowed down and reversed. Local veterinary officers should be educated on the risks to vultures in the form of various drugs like diclofenac and Furadan. Proper carcass disposal methods should be encouraged to reduce the number of contaminated carcasses available to vultures. Religious leaders should incorporate stewardship of the environment and use their platforms to educate the public on the immense contributions that vultures make in ensuring human well-being. Vultures stand a greater chance of being protected when they are appreciated and their importance in providing key ecosystem functions is understood.

**Thanks to the whole bird team!**

**Figure 1:** The bird team of NABU's follow-up biodiversity assessment (from left to right: special guest Steffi Brandes (NABU Headquarters); Dominic Kimani (National Museums of Kenya); Mintesinot Shetachew (Forest Department Official); Dr. Yodit Ayele (Bonga University); Bernhard Walter (NABU Africa Working Group); Kiros Welegerima Gerlass (Mekelle University); Woldemariam Tesfahunegn (EBI); Mohamed Abamscha (NABU Ranger); Nassir Oshman (NABU Ranger); Wondwosen Bekele (NABU Office Bahir Dar) is missing in this photo (photo: NABU/Marie Schoroth)

# 6. References

**Berhan, L. A.** (2008). Status and Distribution of Faunal Diversity in Kafa Afromontane Coffee Forest. Addis Ababa, 56. Downloaded on 03/10/2019.

**Boussekey, M. & Pelsy, C. & Pelsy, F.** (2002). Preliminary FieldRreport on Yellow-faced Parrot *Poicephalus flavifrons* in Ethiopia. PssitaScene, 52:4-5.

**Brooks, T. & Thompson, H. S.** (2001). Current Bird Conservation Issues in Africa. The Auk, 118(3), 575-582. Downloaded from: www.bioone.org/journals/The-Auk on 01/10/2019 Terms of Use: www.bioone.org/terms-of-use.

**Chawaka, S.N.; Boets, P.; Goethals, P.L.M. & Mereta, S.T.** (2018). Does the protection status of wetlands safeguard diversity of macroinvertebrates and birds in southwestern Ethiopia? Biological conservation, 226, 63-71. Downloaded on 03/10/2019.

**Clark, W.S. & Davies, R.** (2018). African Raptors (Helm Identification Guides).

**Hagen, R.; Trempe, F. & Kasisi, J.-R.** (2000). African NGO-Government Partnerships for Sustainable Biodiversity Action Project RAF/97/G31/1G/31. Mid-term evaluation.

**Rodrigues, P. & Fischer, J.** (2018). Bird Diversity and the Resilience of Southwestern Ethiopian Forests. Tropical Conservation Science, 11, 1940082918781928.

**Sweeting, J.E.; Bruner, A.G. & Rosenfeld, A.B.** (1999). The Green Host Effect, An Integrated Approach to Sustainable Tourism and Resort Development (No. 33545 Caja (551)). Conservation International.

**Asefa, A.** (2015). Avitourism in Ethiopia: Potential Socio-Economic and Environmental Benefits, Current Status and Suggestions for Future Development. Ethiopian Journal of Environmental Studies and Management, 8(2), 983-992.

**Asefa, A.** (2008). Report on experience sharing visit to BirdLife South Africa on Avitourism Development Initiatives. Bale-Dinsho, Ethiopia: Bale Mountains National Park.

**Asefa, A.; Richman, E., Baggallay, T. & Admassu, B.** (2013). Bale Mountains National Park Birding Booklet. Addis Ababa, Ethiopia: Ethiopian Wildlife Conservation Authority.

**Biggs, D.; Turpie, J.; Fabricius, C. & Spenceley, A.** (2011). The Value of Avitourism for Conservation and Job Creation – An analysis from South Africa. Conservation and Society, 9(1):80-90.

**BirdLife South Africa** (2008). A Feathership of Partners. Durban, South Africa: BirdLife South Africa.

**Conradie, N.** (2010). International market potential of avitourism in South Africa. Johannesburg, South Africa: University of South Africa, Pretoria.

**The Nature and Biodiversity Conservation Union** (NABU) (eds.), (2017). NABU's Biodiversity Assessment at the Kafa Biosphere Reserve. Berlin, Addis Ababa.

**Nicolaides, A.** (2013). Promoting Avitourism as a special niche area of Ecotourism in South Africa. African Journal of Hospitality, Tourism and Leisure, 2 (3): 1-16.

**OTF (On the Frontier) Group, Inc.** (2008). Building a winning bird product in Rwanda: target customer and channel partner needs. Kigali, Rwanda: Rwanda Wildlife Authority.

**Redman, N.; Stevenson, T. & Fanshawe, J.** (2009). Birds of the Horn of Africa: Ethiopia, Eritrea, Djibouti, Somalia and Socotra (Princeton Field Guides).

**Sekercioglu, C.H.** (2002). Impacts of birdwatching on human and avian communities. Environmental Conservation, 29(3): 282-289.

# 7. Annex

## 7.1 Tables

**Table 16:** List of birds recorded during NABU's first and follow-up biodiversity assessments at the Kafa BR (Beisenherz et al.)

| Common name | Scientific name | IUCN Status | Status in Ethiopia | 2019 | 2014 |
|---|---|---|---|---|---|
| Little Grebe | *Tachybaptus ruficollis* | | RB | | X |
| Long-tailed Cormorant | *Phalacrocorax africanus* | | RB | | X |
| African Darter | *Anhinga rufa* | | RB | X | |
| Cattle Egret | *Bubulcus ibis* | | RB | X | |
| Striated Heron | *Butorides striata* | | RB | | X |
| Black-headed Heron | *Ardea melanocephala* | | RB | X | X |
| Hamerkop | *Scopus umbrette* | | RB | X | X |
| White Stork | *Ciconia Ciconia* | | NB | | X |
| Abdim's Stork | *Ciconia abdimii* | | MB/NB | X | |
| Woolly-necked Stork | *Ciconia episcopus* | | rb | X | X |
| Hadada Ibis | *Bostrychia hagedash* | | RB | X | X |
| Wattled Ibis | *Bostrychia carunculate* | | RB | X | X |
| Egyptian Goose | *Alopochen aegyptiaca* | | RB | X | X |
| Yellow-billed Duck | *Anas undulata* | | RB | X | |
| African Black Duck | *Anas sparsa* | | RB | X | X |
| Yellow-billed Kite | *Milvus aegyptius* | | RB | | X |
| Black-winged Kite | *Elanus caeruleus* | | RB | X | |
| African Fish Eagle | *Haliaeetus vocifer* | | RB | X | X |
| Hooded Vulture | *Necrosyrtes monachus* | CR | RB,EN | X | X |
| Lappet-faced Vulture | *Torgos tracheliotus* | EN | rb, VU | X | X |
| White-headed Vulture | *Trigonoceps occipitalis* | CR | rb, VU | | X |
| White-backed Vulture | *Gyps africanus* | CR | RB, NT | X | X |
| Rüppell's Vulture | *Gyps rueppellii* | CR | RB, NT | X | X |
| Western banded Snake Eagle | *Circaetus cinerascens* | | RB, | | X |
| Bateleur | *Terathopius ecaudatus* | NT | RB, NT | | X |
| Western Marsh Harrier | *Circus aeruginosus* | | NB | | X |
| Montagu's Harrier | *Circus pygargus* | | NB | | X |
| Gabar Goshawk | *Micronisus gabar* | | RB | X | |
| African Goshawk | *Accipiter tachiro* | | RB | X | X |
| Rufous-breasted Sparrowhawk | *Accipiter rufiventris* | | RB | | X |
| Great Sparrowhawk | *Accipiter melanoleucus* | | RB | X | |
| Augur Buzzard | *Buteo augur* | | RB | X | X |
| Common Buzzard | *Buteo buteo* | | NB | X | X |
| Greater Spotted Eagle | *Aquila clanga* | VU | NB, VU | | X |
| Tawny Eagle | *Aquila rapax* | VU | RB | X | X |
| Steppe Eagle | *Aquila nipalensis* | EN | NB | | X |

Abbrevations: RB – Resident breeder, rb – Mainly resident but partially migratory of or erratic or marginal occurance, MB – Breeding visitor (intra-African migrant), mb – Breeding visitor(sparse occurance), NB – Non- breeding visitors (Palearctic or intra-African migrant), nb – Non-breeding visitor (sparse occurance)

| Common name | Scientific name | IUCN Status | Status in Ethiopia | 2019 | 2014 |
|---|---|---|---|---|---|
| Wahlberg's Eagle | *Aquila wahlbergi* | | NB/mb | x | |
| Ayres's Hawk Eagle | *Hieraaetus ayresii* | | RB | X | X |
| Long-crested Eagle | *Lophaetus occipitalis* | | RB | X | X |
| African Harrier Hawk | *Polyboroides typus* | | RB | X | |
| Crowned Eagle | *Stephanoaetus coronatus* | NT | RB | X | X |
| African Hobby | *Falco cuvierii* | | RB | X | X |
| Common Kestrel | *Falco tinnunculus* | | RB/NB | | X |
| Helmeted Guineafowl | *Numida Meleagris* | | RB | X | X |
| Common Quail | *Coturnix coturnix* | | MB/NB | | X |
| Chestnut-naped Francolin | *Francolinus castaneicollis* | | RB | X | X |
| Scaly Francolin | *Francolinus squamatus* | | RB | | X |
| Red-chested Flufftail | *Sarothrura rufa* | | mb | X | |
| Rouget's Rail | *Rougetius rougetii* | NT | RB, NT | X | X |
| Black Crake | *Amaurornis flavirostra* | | RB | | X |
| African Rail | *Rallus caerulescens* | | rb | X | X |
| Black Crowned Crane | *Balearica pavonina* | VU | RB, VU | X | X |
| Wattled Crane | *Bugeranus carunculatus* | VU | RB, VU | X | X |
| African Finfoot | *Podica senegalensis* | | RB | | X |
| African Wattled Lapwing | *Vanellus senegallus* | | RB | | X |
| Green Sandpiper | *Tringa ochropus* | | NB | X | X |
| Wood Sandpiper | *Tringa glareola* | | NB | | X |
| Common Sandpiper | *Actitis hypoleucos* | | NB | X | X |
| Common Snipe | *Gallinago gallinago* | | NB | | X |
| African Green Pigeon | *Treron calvus* | | RB | X | X |
| Bruce's Green Pigeon | *Treron waalia* | | RB | | X |
| Speckled Pigeon | *Columba guinea* | | RB | X | X |
| African Olive Pigeon | *Columba arquatrix* | | RB | X | X |
| Blue-spotted Wood Dove | *Turtur afer* | | RB | X | X |
| Tambourine Dove | *Turtur tympanistria* | | RB | X | X |
| Red-eyed Dove | *Streptopelia semitorquata* | | RB | X | X |
| Laughing Dove | *Streptopelia senegalensis* | | RB | X | |
| Dusky Turtle Dove | *Streptopelia lugens* | | RB | X | X |
| Lemon Dove | *Aplopelia larvata* | | RB | X | X |
| Yellow-fronted Parrot | *Poicephalus flavifrons* | | RB | X | |
| Black-winged Lovebird | *Agapornis taranta* | | RB | X | X |
| White-cheeked Turaco | *Tauraco leucotis* | | RB | X | X |
| Eastern Plantain-eater | *Crinifer zonurus* | | rb | X | |
| Levaillant's Cuckoo | *Clamator levaillantii* | | rb | X | |
| Red-chested Cuckoo | *Cuculus solitarius* | | RB | X | |
| Black Cuckoo | *Cuculus clamosus* | | MB | X | |

Abbrevations: RB – Resident breeder, rb – Mainly resident but partially migratory of or erratic or marginal occurance, MB – Breeding visitor (intra-African migrant), mb – Breeding visitor(sparse occurance), NB – Non- breeding visitors (Palearctic or intra-African migrant), nb – Non-breeding visitor (sparse occurance)

| Common name | Scientific name | IUCN Status | Status in Ethiopia | 2019 | 2014 |
|---|---|---|---|---|---|
| Klaas's Cuckoo | *Chrysococcyx klaas* | | RB | X | X |
| African Emerald Cuckoo | *Chrysococcyx cupreus* | | RB | X | X |
| Blue-headed Coucal | *Centropus monachus* | | RB | X | X |
| African Wood Owl | *Strix woodfordii* | | RB | X | X |
| Montane Nightjar | *Caprimulgus poliocephalus* | | RB | | X |
| Little Swift | *Apus affinis* | | RB | | X |
| White-rumped Swift | *Apus caffer* | | MB | X | |
| African Palm Swift | *Cypsiurus parvus* | | RB | X | |
| Speckled Mousebird | *Colius striatus* | | RB | X | X |
| Narina Trogon | *Apaloderma narina* | | RB | X | |
| Pied Kingfisher | *Ceryle rudis* | | RB | | X |
| Giant Kingfisher | *Megaceryle maxima* | | RB | | X |
| Woodland Kingfisher | *Halcyon senegalensis* | | RB | X | |
| Half-collared Kingfisher | *Alcedo semitorquata* | | RB | X | X |
| Striped Kingfisher | *Halcyon chelicuti* | | RB | X | X |
| Malachite Kingfisher | *Alcedo cristata* | | RB | X | X |
| African Pygmy Kingfisher | *Ceyx pictus* | | RB | X | X |
| Little Bee-eater | *Merops pusillus* | | RB | X | X |
| Blue-breasted Bee-eater | *Merops lafresnayii* | | RB | X | X |
| White-throated Bee-eater | *Merops albicollis* | | MB/NB | | X |
| European Bee-eater | *Merops apiaster* | | NB | | X |
| Northern Carmine Bee-eater | *Merops nubicus* | | RB | | X |
| Broad-billed Roller | *Coracias glaucurus* | | MB | X | X |
| African Grey Hornbill | *Tockus nasutus* | | RB | X | X |
| Crowned Hornbill | *Tockus alboterminatus* | | RB | X | X |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | | RB | X | X |
| Abyssinian Ground-hornbill | *Bucorvus abyssinicus* | | RB | X | |
| Yellow-fronted Tinkerbird | *Pogoniulus chrysoconus* | | RB | X | X |
| Red-fronted Tinkerbird | *Pogoniulus pusillus* | | RB | X | |
| Double-toothed Barbet | *Lybius bidentatus* | | RB | X | X |
| Banded Barbet | *Lybius undatus* | | RB | X | X |
| Greater Honeyguide | *Indicator indicator* | | RB | X | X |
| Lesser Honeyguide | *Indicator minor* | | RB | X | X |
| Green-backed Honeyguide | *Prodotiscus zambesiae* | | RB | X | |
| Red-throated Wryneck | *Jynx ruficollis* | | RB | X | |
| Eurasian Wryneck | *Jynx torquilla* | | NB | | X |
| Nubian Woodpecker | *Campethera nubica* | | RB | X | X |
| Cardinal Woodpecker | *Dendropicos fuscescens* | | RB | X | X |
| Abyssinian Woodpecker | *Dendropicos abyssinicus* | | RB | X | |
| Brown-backed Woodpecker | *Picoides obsoletus* | | RB | X | |

Abbrevations: RB – Resident breeder, rb – Mainly resident but partially migratory of or erratic or marginal occurance, MB – Breeding visitor (intra-African migrant), mb – Breeding visitor(sparse occurance), NB – Non- breeding visitors (Palearctic or intra-African migrant), nb – Non-breeding visitor (sparse occurance)

| Common name | Scientific name | IUCN Status | Status in Ethiopia | 2019 | 2014 |
|---|---|---|---|---|---|
| Eastern Grey Woodpecker | *Dendropicos spodocephalus* | | RB | X | X |
| Common Sand Martin | *Riparia riparia* | | NB | | X |
| Brown-throated Martin | *Riparia paludicola* | | RB | X | |
| Banded Martin | *Riparia cincta* | | rb | | X |
| Red-rumped Swallow | *Cecropis daurica* | | RB | X | |
| Mosque Swallow | *Cecropis senegalensis* | | RB | X | |
| Lesser Striped Swallow | *Cecropis abyssinica* | | RB | X | X |
| Barn Swallow | *Hirundo rustica* | | NB | X | X |
| Wire-tailed Swallow | *Hirundo smithii* | | RB | X | X |
| Black Saw-wing | *Psalidoprocne pristoptera* | | RB | X | X |
| Yellow Wagtail | *Motacilla flava* | | NB | | X |
| African Pied Wagtail | *Motacilla aguimp* | | RB | X | X |
| Mountain Wagtail | *Motacilla clara* | | RB | X | X |
| Grey Wagtail | *Motacilla cinereal* | | NB | | X |
| Abyssinian Longclaw | *Macronyx flavicollis* | NT | RB/NT | X | X |
| Grassland Pipit | *Anthus cinnamomeus* | | RB | X | X |
| Red-throated Pipit | *Anthus cervinus* | | NB | | X |
| Black Cuckoo-shrike | *Campephaga flava* | | rb | X | |
| Red-shouldered Cuckoo-shrike | *Campephaga phoenicea* | | RB | X | |
| Grey Cuckoo-shrike | *Coracina caesia* | | RB | | X |
| Common Bulbul | *Pycnonotus barbatus schoanus* | | RB | X | X |
| Yellow-throated Leaflove | *Chlorocichla flavicollis* | | RB | X | |
| Rüppell's Robin-Chat | *Cossypha semirufa* | | RB | X | X |
| Red-capped Robin-Chat | *Cossypha natalensis* | | NB | | X |
| Snowy-headed Robin-Chat | *Cossypha niveicapilla* | | RB | | X |
| African Stonechat | *Saxicola torquatus* | | RB | X | X |
| Whinchat | *Saxicola rubetra* | | NB | | X |
| Pied Wheatear | *Oenanthe pleschanka* | | NB | | X |
| Abyssinian Ground Thrush | *Zoothera piaggiae* | | RB | | X |
| Mountain Thrush | *Turdus olivaceus* | | RB | X | X |
| African Thrush | *Turdus pelios* | | RB | | X |
| Cinnamon Bracken Warbler | *Bradypterus cinnamomaeus* | | RB | X | X |
| Little Bush Warbler | *Bradypterus baboecola* | | RB | X | |
| Dark-capped Yellow Warbler | *Chloropeta natalensis* | | RB | | X |
| Willow Warbler | *Phylloscopus trochilus* | | NB | | X |
| Common Chiffchaff | *Phylloscopus collybita* | | NB | | X |
| Brown Woodland Warbler | *Phylloscopus umbrovirens* | | RB | X | X |
| Blackcap | *Sylvia atricapilla* | | NB | | X |
| Lesser Whitethroat | *Sylvia curruca* | | NB | | X |
| Grey-backed Camaroptera | *Camaroptera brachyura* | | RB | X | X |

Abbrevations: RB – Resident breeder, rb – Mainly resident but partially migratory of or erratic or marginal occurance, MB – Breeding visitor (intra-African migrant), mb – Breeding visitor(sparse occurance), NB – Non- breeding visitors (Palearctic or intra-African migrant), nb – Non-breeding visitor (sparse occurance)

| Common name | Scientific name | IUCN Status | Status in Ethiopia | 2019 | 2014 |
|---|---|---|---|---|---|
| Green-backed Eremomela | *Eremomela canescens* | | RB | X | |
| Buff-bellied Warbler | *Phyllolais pulchella* | | RB | X | |
| Stout Cisticola | *Cisticola robustus* | | RB | X | X |
| Croaking Cisticola | *Cisticola natalensis* | | RB | X | |
| Short-winged Cisticola | *Cisticola brachypterus* | | RB | X | |
| Ethiopian Cisticola | *Cisticola lugubris* | | RB | X | X |
| Singing Cisticola | *Cisticola cantans* | | RB | X | X |
| Red-faced Cisticola | *Cisticola erythrops* | | RB | X | |
| Tawny-flanked Prinia | *Prinia subflava* | | RB | X | X |
| Yellow-breasted Apalis | *Apalis flavida* | | RB | X | |
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatinus* | | RB | X | X |
| Northern Black Flycatcher | *Melaenornis edolioides* | | RB | X | X |
| Pale Flycatcher | *Bradornis pallidus* | | RB | X | |
| African Dusky Flycatcher | *Muscicapa adusta* | | RB | X | X |
| African Paradise Flycatcher | *Terpsiphone viridis* | | RB | X | X |
| Grey-headed Batis | *Batis orientalis* | | RB | X | |
| Black-headed Batis | *Batis minor* | | RB | X | X |
| Brown-throated Wattle-eye | *Platysteira cyanea* | | RB | X | X |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | | RB | X | X |
| White-winged Black Tit | *Parus leucomelas* | | RB | X | |
| Abyssinian Catbird | *Parophasma galinieri* | | RB | X | X |
| Spotted Creeper | *Salpornis spilonotus* | | RB | X | |
| Montane White-eye | *Zosterops poliogastrus* | | RB | X | X |
| Abyssinian White-eye | *Zosterops abyssinicus* | | RB | X | X |
| Tacazze Sunbird | *Nectarinia tacazze* | | RB | X | X |
| Copper Sunbird | *Cinnyris cupreus* | | RB | X | X |
| Scarlet-chested Sunbird | *Chalcomitra senegalensis* | | RB | X | X |
| Olive Sunbird | *Cinnyris olivacea* | | RB | X | X |
| Variable Sunbird | *Cinnyris venustus fazoqlensis* | | RB | X | X |
| Collared Sunbird | *Hedydipna collaris* | | RB | X | |
| Common Fiscal | *Lanius collaris* | | RB | X | X |
| Grey-backed Fiscal | *Lanius excubitorius* | | RB | X | |
| Northern Puffback | *Dryoscopus gambensis* | | RB | X | X |
| Ethiopian Boubou | *Laniarius aethiopicus* | | RB | X | X |
| Marsh Tchagra | *Tchagra minutus* | | RB | X | |
| Black-crowned Tchagra | *Tchagra senegalus* | | RB | X | |
| Black-headed Oriole | *Oriolus larvatus* | | RB | X | |
| Abyssinian Oriole | *Oriolus monacha* | | RB | X | X |
| Cape Crow | *Corvus capensis* | | RB | X | X |
| Thick-billed Raven | *Corvus crassirostris* | | RB | X | X |

Abbrevations: RB – Resident breeder, rb – Mainly resident but partially migratory of or erratic or marginal occurance, MB – Breeding visitor (intra-African migrant), mb – Breeding visitor(sparse occurance), NB – Non- breeding visitors (Palearctic or intra-African migrant), nb – Non-breeding visitor (sparse occurance)

| Common name | Scientific name | IUCN Status | Status in Ethiopia | 2019 | 2014 |
|---|---|---|---|---|---|
| Red-billed Oxpecker | *Buphagus erythrorhynchus* | | RB | X | X |
| Stuhlmann's Starling | *Poeoptera stuhlmanni* | | RB | X | X |
| Red-winged Starling | *Onychognathus morio* | | RB | X | X |
| Slender-billed Starling | *Onychognathus tenuirostris* | | RB | X | X |
| Greater Blue-eared Starling | *Lamprotornis chalybaeus* | | RB | X | X |
| Splendid Starling | *Lamprotornis splendidus* | | RB | X | |
| Violet-backed Starling | *Cinnyricinclus leucogaster* | | RB | | X |
| Sharpe's Starling | *Pholia sharpii* | | RB | X | X |
| Swainson's Sparrow | *Passer swainsonii* | | RB | X | X |
| Village Weaver | *Ploceus cucullatus* | | RB | X | X |
| Vitelline Masked Weaver | *Ploceus vitellinus* | | RB | X | |
| Spectacled Weaver | *Ploceus ocularis* | | RB | X | X |
| Compact Weaver | *Ploceus superciliosus* | | RB | X | |
| Baglafecht Weaver | *Ploceus baglafecht* | | RB | X | X |
| Grosbeak Weaver | *Amblyospiza albifrons* | | RB | X | |
| Red-headed Quelea | *Quelea erythrops* | | RB | X | |
| Black Bishop | *Euplectes gierowii* | | RB | X | |
| Red-collared Widowbird | *Euplectes ardens* | | RB | X | X |
| Fan-tailed Widowbird | *Euplectes axillaris* | | RB | X | X |
| Yellow-mantled Widowbird | *Euplectes macroura* | | RB | X | |
| Red-cheeked Cordon-bleu | *Uraeginthus bengalus* | | RB | | X |
| Red-billed Firefinch | *Lagonosticta senegala* | | RB | X | X |
| Bar-breasted Firefinch | *Lagonosticta rufopicta* | | RB | X | |
| Yellow-bellied Waxbill | *Coccopygia quartinia* | | RB | X | X |
| Common Waxbill | *Estrilda astrild* | | RB | X | X |
| Crimson-rumped Waxbill | *Estrilda rhodopyga* | | RB | | X |
| Bronze Mannikin | *Lonchura cucullata* | | RB | X | X |
| Black-and-White Mannikin | *Lonchura bicolor* | | RB | X | X |
| Pin-tailed Whydah | *Vidua macroura* | | RB | X | X |
| Village Indigobird | *Vidua chalybeata* | | RB | X | X |
| African Citril | *Serinus citrinelloides* | | RB | X | X |
| Yellow-fronted Canary | *Serinus mozambicus* | | RB | X | X |
| Yellow-rumped Seedeater | *Serinus xanthopygius* | | RB | X | |
| White-rumped Seedeater | *Serinus leucopygius* | | RB | | X |
| Streaky Seedeater | *Serinus striolatus* | | RB | X | X |
| Brown-rumped Seedeater | *Seinus tristriatus* | | RB | X | X |

Abbrevations: RB – Resident breeder, rb – Mainly resident but partially migratory of or erratic or marginal occurance, MB – Breeding visitor (intra-African migrant), mb – Breeding visitor(sparse occurance), NB – Non- breeding visitors (Palearctic or intra-African migrant), nb – Non-breeding visitor (sparse occurance)

**Table 17:** List of biome-restricted species

| Common name | Scientific name |
|---|---|
| **Afrotropical Highland Biome** | |
| Chestnut-naped Francolin | *Francolinus castaneicollis* |
| Rouget's Rail | *Rougetius rougetii* |
| Dusky Turtle Dove | *Streptopelia lugens* |
| Yellow-fronted Parrot | *Poicephalus flavifrons* |
| Black-winged Lovebird | *Agapornis taranta* |
| White-cheeked Turaco | *Tauraco leucotis* |
| Banded Barbet | *Lybius undatus* |
| Abyssinian Longclaw | *Macronyx flavicollis* |
| Rüppell's Robin-Chat | *Cossypha semirufa* |
| Abyssinian Ground Thrush | *Zoothera piaggiae* |
| Cinnamon Bracken Warbler | *Bradypterus cinnamomeus* |
| Brown Woodland Warbler | *Phylloscopus umbrovirens* |
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatinus* |
| Abyssinian Catbird | *Parophasma galinieri* |
| Montane White-eye | *Zosterops poliogastrus* |
| Tacazze Sunbird | *Nectarinia tacazze* |
| Abyssinian Oriole | *Oriolus monacha* |
| Thick-billed Raven | *Corvus crassirostris* |
| Stuhlmann's Starling | *Poeoptera stuhlmanni* |
| Slender-billed Starling | *Onychognathus tenuirostris* |
| Sharpe's Starling | *Pholia sharpii* |
| Swainson's Sparrow | *Passer swainsonii* |
| Baglafecht Weaver | *Ploceus baglafecht* |
| White-rumped Seedeater | *Serinus leucopygius* |
| Brown-rumped Seedeater | *Serinus tristriatus* |
| Streaky Seedeater | *Serinus striolatus* |
| **Somali-Masai Biome** | |
| White-rumped Babbler | *Turdoides leucopygia omoensis* |
| Abyssinian White-eye | *Zosterops abyssinicus* |

**Table 18:** List of endemic and near endemic birds

| Common name | Scientific name | Endemism (Redman et al., 2019) |
|---|---|---|
| Wattled Ibis | *Bostrychia carunculata* | E* |
| Chestnut-naped Francolin | *Francolinus castaneicollis* | NE |
| Rouget's Rail | *Rougetius rougetii* | E* |
| Yellow-fronted Parrot | *Poicephalus flavifrons* | E |
| Black-winged Lovebird | *Agapornis taranta* | E* |
| White-cheeked Turaco | *Tauraco leucotis* | NE |
| Banded Barbet | *Lybius undatus* | E* |
| Abyssinian Woodpecker | *Dendropicos abyssinicus* | E* |
| Abyssinian Longclaw | *Macronyx flavicollis* | E |
| Ethiopian Cisticola | *Cisticola lugubris* | E* |
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatinus* | E* |
| White-rumped Babbler | *Turdoides leucopygia omoensis* | NE |
| Abyssinian Catbird | *Parophasma galinieri* | E |
| Ethiopian Boubou | *Laniarius aethiopicus* | NE |
| Abyssinian Oriole | *Oriolus monacha* | E* |
| Thick-billed Raven | *Corvus crassirostris* | E* |
| Swainson's Sparrow | *Passer swainsonii* | NE |
| Yellow-rumped Seedeater | *Serinus xanthopygius* | E* |
| Brown-rumped Seedeater | *Serinus tristriatus* | NE |

E – endemic to Ethiopia, E* – endemic to Ethiopia and Eritrea, NE – near endemic

## 7.2 Photos

**Figure 2:** The Abyssinian Longclaw (*Macronyx flavicollis*) is endemic to Ethiopia. Breeding pairs were found in the wetlands of Alemgono, Yartachi and Gojeb. (photo: Bernhard Walter)

**Figure 3:** The Abyssinian Slaty Flycatcher (*Melaenornis chocolatinus*) is endemic to Ethiopia and Eritrea. This highland species inhabits forests, forest edge and nearby farmland habitats. (photo: Bernhard Walter)

**Figure 4:** The Crowned Eagle (*Stephanoaetus coronatus*) is a typical species of extensive forest areas with old trees. The main prey of this powerful predator is monkeys, hyraxes and larger birds. (photo: Bernhard Walter)

**Figure 5:** The African Emerald Cuckoo (*Chrysococcyx cupreus*), well camouflaged between the green leaves. (photo: Bernhard Walter)

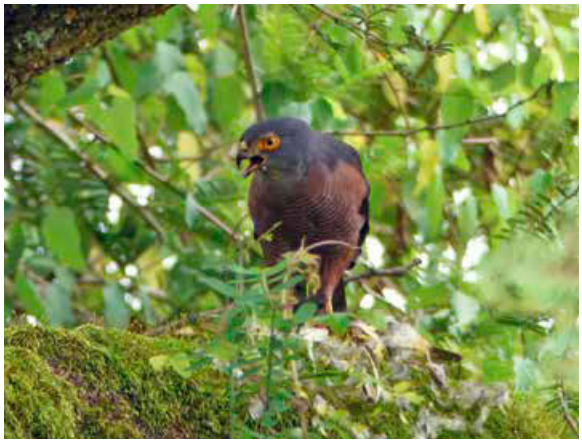


**Figure 6:** The Ethiopian subspecies of the African Goshawk (*Accipiter tachio unduliventer*) is now considered to be a full species called Ethiopian Goshawk (*Accipiter unduliventer*) (Clark & Davies 2018). (photo: Bernhard Walter)

**Figure 7:** The African Olive Pigeon (*Columba arquatrix*) is a species inhabiting the canopy of highland forest. (photo: Bernhard Walter)

**Figure 8:** The Blue-headed Coucal (*Centropus manachus*) is a common resident in marshy areas of the Kafa Biosphere Reserve. (photo: Bernhard Walter)

**Figure 9:** A large group of 58 individuals of the Black Crowned Crane (*Balearica pavonina*) was found in the Gojeb wetland, probably a place for the night roost. (photo: Bernhard Walter)

**Figure 10:** The Chestnut-naped Francolin (*Pternistis castaneicollis*), endemic to Ethiopia and NW-Somalia, inhabits forest clearings and forest edges. We found this species in Adiyo, Chefahanna, Gojeb, and Decha. (photo: Bernhard Walter)

**Figure 11:** The Cattle Egret (*Bubulcus ibis*) is a widespread and common species in Ethiopia. This species is rare at the Kafa Biosphere Reserve, possibly because of the lack of large lakes here. (photo: Bernhard Walter)

**Figure 12:** The Wattled Crane (*Bugeranus carunculatus*) is one of the rarest breeding birds of the Kafa Biosphere Reserve. Further investigations are needed to get more information on the number of breeding pairs and their breeding places within the reserve. (photo: Bernhard Walter)

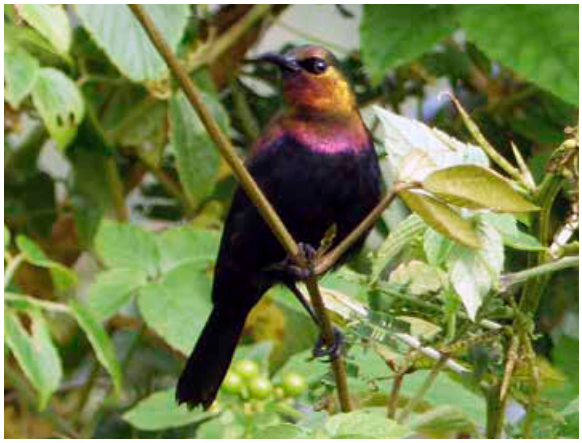


**Figure 13:** The Copper Sunbird (*Cinnyris cupreus*) occurs in lightly wooded areas and the shrub layer on the edge of swampy areas. (photo: Bernhard Walter)

**Figure 14:** The Pin-tailed Whydah (*Vidua macroura*) is common in farmland with shrubs and a variety of bush country. (photo: Bernhard Walter)

**Figure 15:** We found flocks of the Fan-tailed Widowbird (*Euplectes axillaris*) in the wetlands of Alemgono, Shoriri, Gojeb and Decha. (photo: Bernhard Walter)

**Figure 16:** The Red-chested Cuckoo (*Cuculus solitaries*) was one of the most obvious species during this assessment because of its high calling activities ("it will rain"). (photo: Bernhard Walter)

**Figure 17:** We found the African Fish-Eagle (*Haliaeetus vocifer*) resting on a tree on the banks of the Gojeb River. (photo: Bernhard Walter)

**Figure 18:** The only observation of a pair of Spotted Creeper (*Salpornis spilonotus*) was made in the plot of the KDA Guesthouse. (photo: Bernhard Walter)

**Figure 19:** At the KDA Guesthouse many individuals of the Slender-billed Starling (*Onychognathus tenuirostris*) showed a yellow throat spot, probably caused by the pollen of tree blossoms (photo: Holger Meinig).

**Figure 20:** The Silvery-cheeked Hornbill (*Bycanistes brevis*) is found in the Kafa region in all forest sites with old trees. (photo: Bernhard Walter)

**Figure 21:** *Scopus umbretta* foraging in a shallow water pond at Gojeb Wetland (photo: Bernhard Walter)

**Figure 22:** "KD" Dijkstra gave us some good hints on the occurrence of bird species in certain areas. Thanks for that! (photo: Bernhard Walter)

**Figure 23:** A walk through the wonderful wetland of Chefahanna, with the assessment's bird team looking and listening for birds (photo: Bernhard Walter)

**Figure 24:** It was a rainy day when we went down to the hot springs (from left to right: Woldemariam Tesfahunegn, Kiros Welegerima Gerlass, Mohamed Abamscha, Nasir Ousiman) (photo: Bernhard Walter)

**Figure 25:** View from the way to the vulture colony near Adiyo (photo: Bernhard Walter)

# Small- and medium-sized mammals of the Kafa Biosphere Reserve

**Holger Meinig, Dr Meheretu Yonas, Ondřej Mikula, Mengistu Wale and Abiyu Tadele**

# Highlights

→ Eight species of rodents and one species of Soricomorpha were found.

→ Five of the rodent species (*Tachyoryctes sp.3 sensu* (Sumbera et al., 2018)), *Lophuromys chrysopus* and *L. brunneus, Mus (Nannomys) mahomet* and *Desmomys harringtoni*) are Ethiopian endemics.

→ The Ethiopian White-footed Mouse (*Stenocephalemys albipes*) is nearly endemic; it also occurs in Eritrea.

→ Together with the Ethiopian Vlei Rat (*Otomys fortior*) and the African Marsh Rat (*Dasymys griseifrons*) that were collected only during the 2014 survey, seven endemic rodent species are known to occur in the Kafa region, which supports 12% of the known endemic species of the country.

→ The occurrence of the widespread Lesser Cane Rat (*Thryonomys gregorianus*) for the Kafa region was confirmed. For Ethiopia there are only very few records for this species.

→ The Gambian Epauletted Fruit Bat (*Epomophorus gambianus pousarguesi*) was found for the first time at the Kafa Biosphere Reserve.

# 1. Introduction

Ethiopia's geographical location, altitude range, rainfall patterns and soil variability have resulted in immense ecological diversity and a huge wealth of biological resources (Kassa & Bekele, 2008). Ethiopia is also notable for containing 50% of the Afrotropical region's land above 2,000 m a.s.l. (Yalden, 1983). This unique situation is due to repeated glaciations and tectonic events. In eastern Africa, rodents account for 28% of the total mammalian fauna (Kingdon, 1989). The insectivore fauna, particularly shrews, is also incredibly diverse, with 140 species (Hutterer & Yalden, 1990).

Ethiopia's fauna and flora include many species endemic to the country and there are probably also many species yet to be described. The real wealth of species in Ethiopia has not yet been fully assessed, due to a lack of studies in many regions. For example, the Kafa region in south-western Ethiopia has seen very few studies providing reliable data on small mammals (summarised in Berhan, 2008).

Most small mammal species are only rarely observed, but they play a crucial role in their ecosystems. They are the base of food chains for small- and medium-sized carnivores, as well as birds of prey such as raptors and owls. They are responsible, to a certain degree, for the dispersal of plant species through selective feeding, spreading of seeds and concentration of nutrients by using latrines. They also promote ventilation and bioturbation of soil and drainage after rainfall. On a more negative note, they are important vectors for diseases and can become pests in agriculture.

The diversity of small mammals depends on the habitat type (Glennon & Porter, 2007; Garratt et al., 2012), where habitats with higher floral diversity and ground cover support more diversity than those with lower floral diversity and ground cover (Mulungu et al., 2008; Pearson et al., 2001). Hence, the assessment of small mammals is an important component of broader assessments of ecosystem diversity because mammals are strong indicators of habitat conditions.

The first assessment of small mammals at the Kafa BR was carried out during the dry season, between 3 December and 12 December 2014, in different types of habitats and altitudinal ranges. We expected different species compositions in different kinds of habitats (different types of forests, arable land, moister and drier stands). The short study period resulted in an incomplete species list for each sampling site, making comparisons with long-term studies of other small geographical areas (e.g., Habtamu & Bekele, 2008; Kassa & Bekele, 2008; Yonas et al., 2014) impossible.

The follow-up biodiversity assessment was carried out between 30 July and 13 August 2019 during the wet season. Again, different types of habitats were sampled, but predominantly forest stands were investigated.

Since the first assessment in 2014 (Meinig et al., 2017) a lot of systematic and taxonomic work concerning Ethiopian small mammals has been done, based mostly on genetic methods. Most prominent in this field are the working groups of Josef Bryja (Institute of Vertebrate Biology, Czech Academy of Sciences), Leonid Lavrenchenko (Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences), and Meheretu Yonas (Department of Biology and Institute of Mountain Research and Development, Mekelle University, Ethiopia). Many new insights concerning the borders of species that formerly were lumped into species complexes were gathered (e.g. Lavrenchenko & Bekele, 2017). In 1996, Yalden et al. counted 277 mammal species in Ethiopia. In 2017, 311 species were recognized (Lavrenchenko & Bekele, 2017), 57 of which are endemic (Lavrenchenko, 2019). These new findings also make it necessary to re-evaluate the findings of the first assessment in 2014 taxonomically.

# 2. Materials and methods

## 2.1 Study area

Systematic trapping was conducted in the Komba Forest near Wushwush, near Boginda (edge of primary forest), in the Masho Malo Forest, near Alemgono (forest patch, edge of cropland, and wetland), in the forest around God's Bridge near Bonga, in Shera village near Bonga (forest and private gardens) and in the area around the KDA Guesthouse in Bonga. Locals from near the village Gono (Ufdo Kebele) brought two animals of *Tachyoryctes*. In addition, members of other teams of the biodiversity assessment accidentally found animals which were also collected and observations were registered.

## 2.2 Sampling methods

Small mammals were sampled using mouse- and rat-sized snap traps and Sherman LFA live traps (7.5 x 9.0 x 23.0 cm, H.B. Sherman Traps, Inc., Tallahassee, USA) baited with peanut butter mixed with canned fish. Sampling was performed in two to three lines per locality; in each line the three types of trap were set by alternating one after the other in lines up to 400 m long. A variety of traps was used following the suggestion that trap type and size can determine the types of small mammals captured (Thompson & Macauley, 1987; Slade et al., 1993; Lee, 1997). Each trapping line held 50-75 traps (depending upon the habitat condition), each five metres apart. Traps were set before dusk (between 5 and 6 pm) and inspected early in the morning (between 7 and 8 am) to prevent ant damage.

## 2.3 Data analysis

Before skinning, the standard external morphological measurements (body mass, head-body, tail, hind foot and ear lengths) were recorded for each specimen and the reproductive status of the animals determined (see Table 1). The carcasses were then preserved in alcohol for a later skin and skull/skeleton study. Spleen and kidney samples as well as other organs were taken and preserved in 96% ethanol for genetic analyses, and blood samples were collected on calibrated, prepunched filter paper (LDA 22, Ploufragan, France) for later serological and/or molecular screening for RNA viruses.

Following the national regulations of the Ethiopian Biodiversity Institute (EBI), samples were properly prepared and exported to Germany (Material Transfer Agreement from 9 August 2019), with the objective of further identifying the species and completing the species list. Sequences of the mitochondrial cytochrome b (CYTB) gene were obtained from a representative selection of the captured specimens in the laboratory of J. Bryja (Institute of Vertebrate Biology, Brno, Czech Republic).

To maximise the information gathered, skulls and skeletons will be cleaned using the larvae of dermestid beetles (Dermestidae) to prevent damage of delicate structures that might occur through using faster but rougher cleaning methods (procedure ongoing).

We were supported by Rainer Hutterer, the retired former head of the mammal collections at the Alexander Koenig Research Museum (Zoologisches Forschungsmuseum Alexander Koenig ZFMK), Bonn during the first steps of species determination, who also provided us with new and rare literature. Taxonomy follows Wilson et al. (2009-2018) and Bryja et al. (2019).

# 3. Results and discussion

The taxonomic status and ecological requirements of the species recorded during the survey in 2019 are described below.

## 3.1 Soricomorpha

### African Giant Shrew (*Crocidura olivieri*)

Six individuals from a single shrew species were collected in Alemgono Wetland. No shrews were obtained at any other sampling site. The species is a dark brown colour morph of the widespread African Giant Shrew, which occurs in almost every part of sub-Saharan Africa and the Upper Nile Valley in Egypt, except in the very South of the continent. The species was formerly known as *C. flavescens*, a name now restricted to a smaller species occurring in South Africa (Churchfield & Hutterer, 2013). It is also possible that this shrew is the species described as *C. fulvastra* in the species list of the faunal diversity study of the Kafa Afromontane Coffee Forest by Berhan (2008). The population in the study area was previously described under the name of *C. olivieri* ssp. *hansruppi* by Hutterer (1980), who studied six individual animals from four different sites in the Kafa region, because of their long and densely haired tails and their unusual coloration compared to other samples of the species from Ethiopia. Jacquet et al. (2015) demonstrated the species' continent-wide distribution with a pronounced phylogeographic structure. The individuals captured in this survey belong to clade IV, which occurs from the Central African Republic to the Ethiopian Highlands. Although the known colour morphs do not represent subspecies or species (Churchfield & Hutterer, 2013), it is notable that one of the captured individuals is very black. One out of three females had active mammae (7 August 2019), two were pregnant (2/2 embryos, 2/1 embryos). The testes of the two male specimens were inactive.


**Figure 1:** Distribution of *C. olivieri* in Africa (Source: Kingdon et al., 2013)

## 3.2 Rodentia

### East African Root Rat (*Tachyoryctes splendens s.l.*)

The taxonomy of this subterranean rodent is still not clear. Provisionally, 11 species from this complex (*Tachyoryctes*) confined to higher altitudes of East African montane grasslands have been recognised (e.g. Musser & Carleton, 2005), but 10 of them are sometimes lumped into *T. splendens* s.l., to the exclusion of the distinctive *T. macrocephalus* from the Bale mountains (e.g. Wilson et al., 2017). According to genetic and cytogenetic studies (Lavrenchenko et al., 2014; Šumbera et al., 2018), *T. splendens* s.l. contains four species in Ethiopia. Animals from the Kafa region most likely belong to *T. splendens* sp. 3 *sensu* (Šumbera et al., 2018), which occurs west of the Rift Valley and south and east of the Blue Nile. For animals from the Kafa region the name *Tachyoryctes pontifex* is probably the oldest one

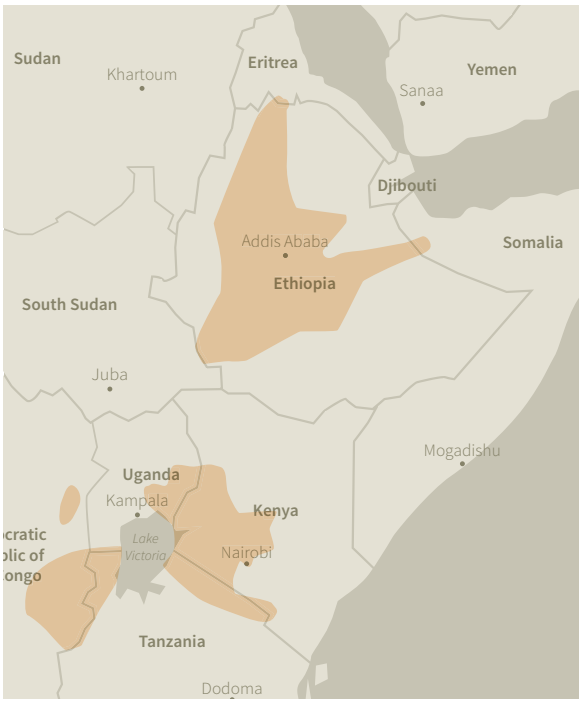



**Figure 2:** Geographic range of *Tachyoryctes splendens* s.l. (Source: Kingdon et al., 2013)

available. The species was described in 1928 by Neumann & Rümmler (1928) based on material collected in 1901 near a village called Buka in the Kafa region. The species should be regarded as endemic to Ethiopia.

Subterranean mammal species occurring in grasslands are often endangered through intensification of agriculture, as was recently shown by Csorba et al. (2015) for a European species complex of Blind Mole Rats (genera *Spalax* and *Nannospalax*), a group closely related to *Tachyoryctes* of the Spalacidae family, with very similar ecological requirements. The replacement of extensive livestock farming and pasture farming with intensive monocultures will lead to the decline, fragmentation and, in many cases, complete eradication of grasslands. Root Rats, today sometimes regarded as a plague, will become endangered. The species feeds on grass and dicotyledonous plants (Yalden, 1975 for *T. macrocephalus*), so a decline in the richness of grassland plant species can also be assumed to harm Root Rat populations. As long as the species limits of the *Tachyoryctes* group remain provisional, and the geographical distribution and limits of the taxa are insufficiently investigated, it will be difficult to judge whether a form is endangered or not.

The species is persecuted by locals like a pest because it consumes root crops, particularly the staple Enset plant or False Banana (*Ensete ventricosum*), widely cultivated as a food plant in the area.

Two individuals (one male, one female) were caught by locals from Ufdo Kebele near Gono village when using snares (Figure 26) set in the species' running paths. *Tachyoryctes splendens* occasionally moves to the surface during the night in order to feed. The male had active testes (9.5 x 7 mm), the female is entirely black (melanistic).

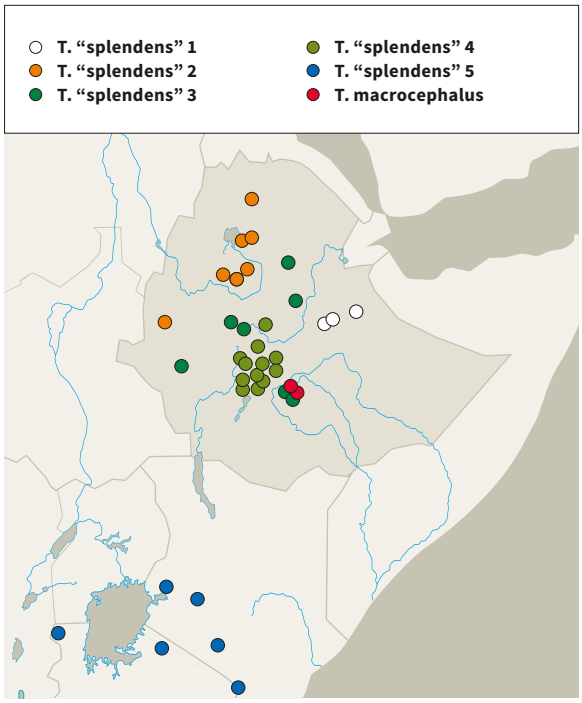



**Figure 3:** Occurrence of six lines (species) of *Tachyoryctes* in East Africa (Source: Šumbera et al., 2018)

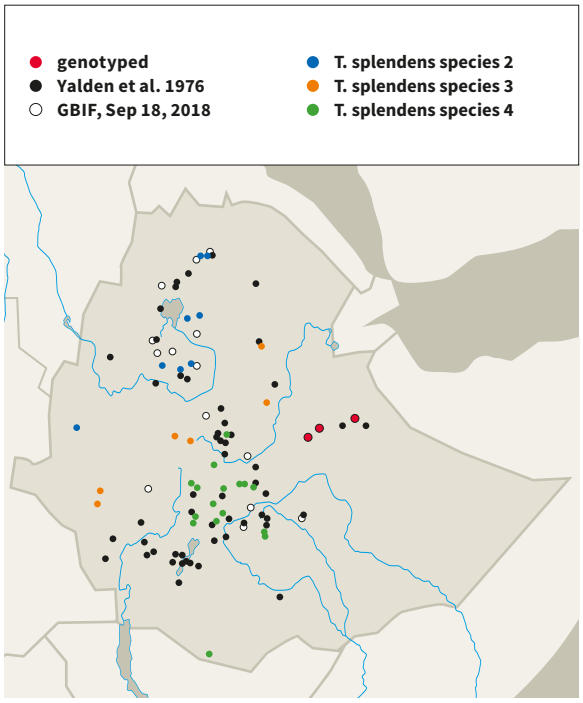



**Figure 4:** Occurrence of four lines (species) of *Tachyoryctes splendens* s. l. in Ethiopia (Source: Bryja et al., 2019)

### Brush-furred Mouse
(*Lophuromys chrysopus* **and** *L. brunneus*)

According to a study by Lavrenchenko et al. (2007), *Lophuromys* is the rodent genus with the maximum number of Ethiopian endemics: nine in total. Some of the species can be readily recognised on morphological grounds (e.g. *L. brunneus* and *L. brevicaudus*, see Figure 28), whereas in others diagnostic traits are not well established. Nevertheless, geographic distribution of the species bears clear signs of ecological differentiation. Some species are replacing each other as the vegetation changes on the mountain slopes. In other cases pairs of species commonly co-exist at the same sites, which also indicates niche differentiation (see Bryja et al., 2019). The specimens obtained during the first assessment therefore were regarded as *Lophuromys flavopunctatus* s. l. In the meantime a lot of genetical analyses have been done (see Bryja et al., 2019), so that the animals from the Kafa region can now be determined as members of the two Ethiopian endemics *L. chrysopus* and *L. brunneus* (Figure 29 and 30), whose co-existence is already known from some locations in south-western Ethiopia (Bryja et al., 2019).

Members of the species mostly feed on insects (ants are preferred). The specimens were caught in different localities: Komba Forest near Wushwush, near Boginda, Masho Malo Forest, forest near Alemgono, and near God´s Bridge (Bonga).

### Ethiopian Vlei Rat (*Otomys fortior*)

This species was not caught during the 2019 assessment; the three specimens existing were trapped during the 2014 assessment. The Vlei Rat is believed to be a species complex consisting at least of six species (Taylor et al., 2008). In Ethiopia, Vlei Rats are recorded in montane areas of the highlands (1,900 to 4,100 m a.s.l.) (Taylor et al., 2008). The species inhabit mesic grassland, montane grasslands and alpine heaths. They occur in grasslands and heaths of the highlands of Ethiopia, Kenya, Malawi, Tanzania and Uganda from 1,800 m a.s.l. upwards (Taylor et al., 2008). Habitats like these were not sampled during the 2019 assessment. The current determination of the three *Otomys* specimens collected near the Bamboo Forest camp (2) and in the Gojeb Wetland (1) in 2014 is based on DNA analysis. As had been supposed formerly (Meinig et al., 2017) the specimens represent the taxon *Otomys fortior*, a name used for specimens collected in the Charada Forest (in the Kafa region) and near Jimma (Taylor et al., 2011). The species is endemic to Ethiopia (see Bryja et al., 2019).

The species complex as a whole has been evaluated as Least Concern by the IUCN, although it is believed to be dwindling (Taylor et al., 2008). As there are several species subsumed under the name *O. typus*, species limits and the area that each species covers should be properly investigated to decide whether any species are more threatened than others and to develop strategies to protect endangered species.


**Figure 5:** Distribution of *Lophuromys flavopunctatus* (Source: IUCN Red List of Threatened Ethiopian Lophuromys Species 2014)

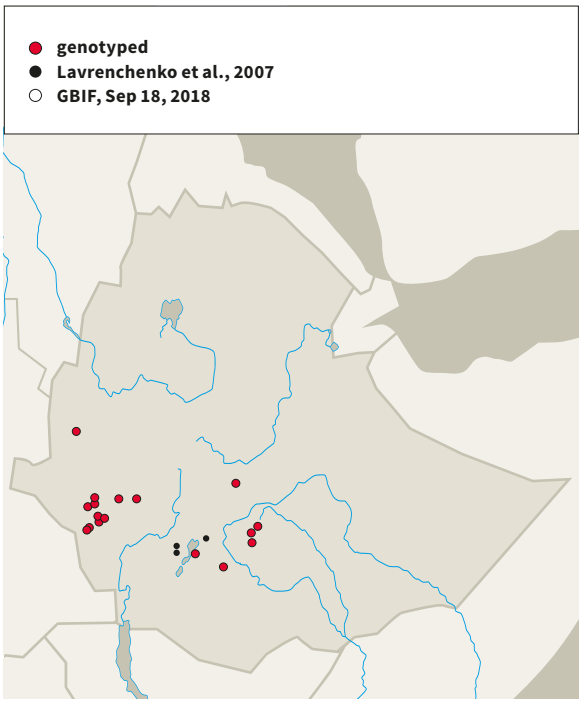



**Figure 6:** Distribution of *Lophuromys chrysopus* in Ethiopia (Source: Bryja et al., 2019)

### Ethiopian white footed mouse
### (*Stenocephalemys albipes*)

The genus *Stenocephalemys* is almost endemic to Ethiopia; the only species that also occurs outside Ethiopia (in neighbouring Eritrea) is *Stenocephalemys albipes* (Figure 10). There are currently six species recognised in this genus (Brya et al., 2019), which belongs to the Praomyini tribe with genus *Myomyscus brockmani* and *M. yemeni* as its closest relatives (Lecompte et al., 2008). *Stenocephalemys albipes* was the most abundant species in the study area. Of the 102 rodents, 70 were *S. albipes*. The species was caught at all sites except the area around the KDA Guesthouse in Bonga. Although able to colonise mosaic habitats, they are most typically associated with the forest stands, which could be seen in two of the Alemgono sites. At the forest patch site the species was very common, whereas at the wetland site with no continuous forest nearby, only a small number of individuals was captured.

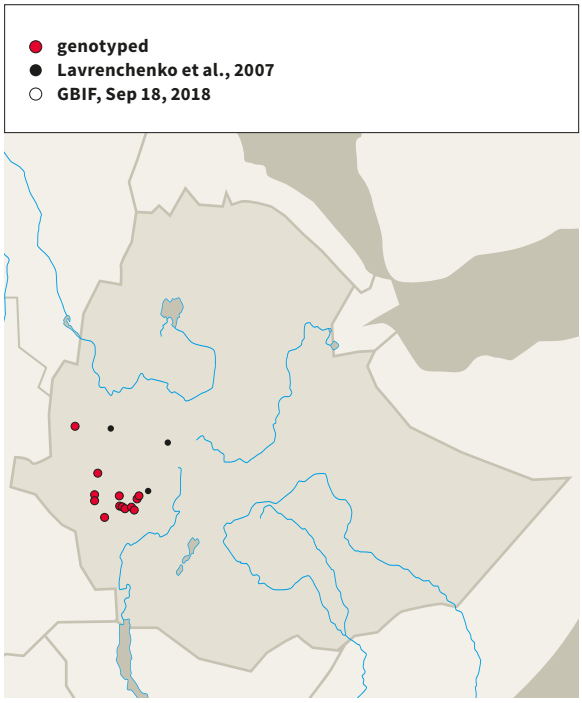



**Figure 7:** Distribution of *Lophuromys brunneus* in Ethiopia (Source: Bryja et al., 2019)

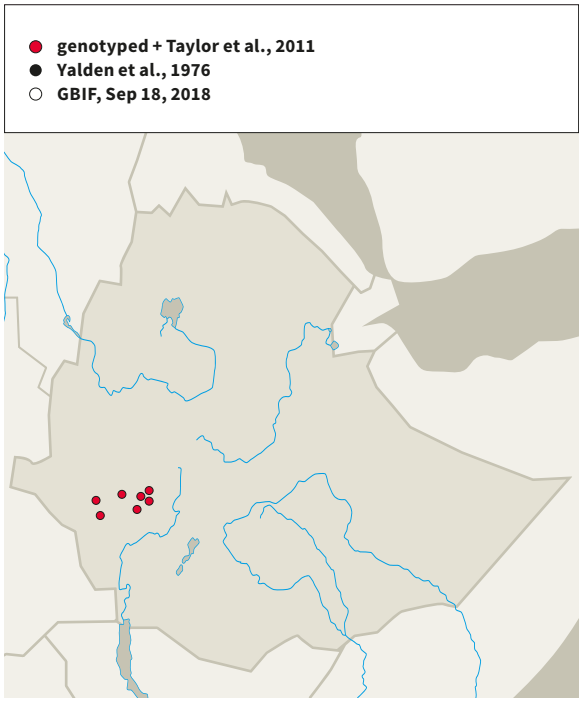



**Figure 9:** Occurrence of *Otomys fortior* (Source: Bryja et al., 2019)


**Figure 8:** Geographic range of *Otomys* cf. *typus* (Source: IUCN Red List of Threatened Species 2014)

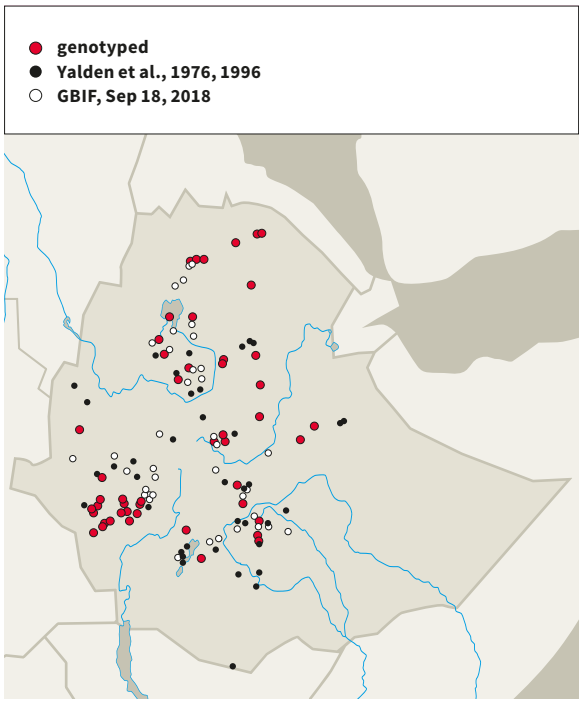



**Figure 10:** Geographic range of *Stenocephalemys albipes* in Ethiopia (Source: Bryja et al., 2019)

### African Pygmy Mouse (*Mus (Nannomys) mahomet*)

Mice of the subgenus *Nannomys* are widespread throughout Africa. According to the recent study by Bryja et al. (2014), eight different forms of the subgenus occur in Ethiopia, six of which are endemic to the country. Among these is *Mus mahomet*, which is restricted to the Ethiopian Plateau and not conspecific with Pygmy Mice from Kenya and Uganda as previously supposed (e.g. Musser & Carleton, 2005). This study includes material from Bonga and Jimma (Figure 33); hence, the determination of the animals sampled during our assessment is supported by genetic data from the same area. 10 individuals were trapped during our assessment. The species occurs in grasslands and forest edges. *Mus mahommet* might be the species mentioned by Berhan (2008) under the name *M. triton*.

### African Marsh Rat (*Dasymys griseifrons*)

This species was not caught during the 2019 assessment; the only specimen existing was trapped during the 2014 assessment. The genus *Dasymys* is widespread throughout sub-Saharan Africa and follows a savannah distribution (Mullin et al., 2005). Its natural habitats are moist savannah, seasonally wet or flooded lowland grassland and swamps. One individual of this species group, a subadult (M3 was just breaking through in both the lower and the upper jaw) female, was trapped in the Gojeb Wetland (11 December 2014). We were unable to identify the specimen morphologically in the field, even to the genus level, but preliminary DNA analysis indicated the specimen's identity. The animal has very dense, soft fur, a relatively long tail (longer than in *Arvicanthis* and shorter than in *Stenocephalemys*), very hairy ears and black sole markings (Figure 35).

Further confirmatory determination will follow using genetic analysis combined with a skull and tooth investigation. Mullin et al. (2005) reported that two chromosomal forms of *Dasymys* (*Dasymys* cf. *incomtus*: 2n = 40, NF = 44 from the Bale Mountains and 2n = 38, NF = 44 from the Harenna Forest) and one distinct morphological form (*D. griseifrons*, known only from Lake Tana and Jigga) occur in Ethiopia. According to the authors all of them differ distinctly from the nominate *incomtus* material from South Africa. The Ethiopian endemic *Dasymys griseifrons* (see Bryja et al., 2019) was lumped formerly in with *Dasymys* cf. *incomptus*.

*Dasymys* populations have been decreasing since the 1960s in southern Africa due to desiccation and destruction of wetlands (Mugo et al., 1995). Ethiopian populations are also likely to be sensitive to these factors.

### Harrington's Scrub Rat (*Desmomys harringtoni*)

The genus *Desmomys* is endemic to Ethiopia and it consists only of two species. A single specimen (Figure 38)


**Figure 11:** Geographic range of the former *Dasymys* cf. *incomtus* (Source: IUCN Red List of Threatened Species 14)

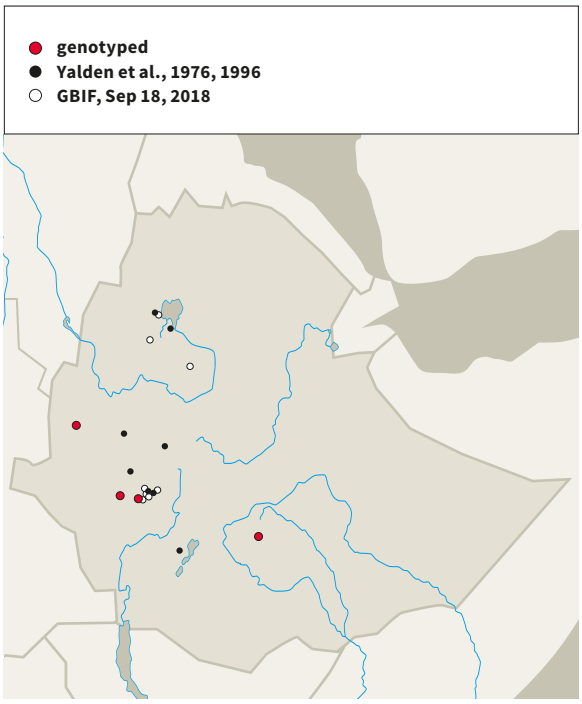



**Figure 12:** Occurrence of the Ethiopian endemic *Dasymys griseifrons* (Source: Bryja et al., 2019)

of the more frequent species *D. harringtoni* was caught 12 August 2019 near Shera village (Bonga) in a private garden in grassland (Figure 39). In western Ethiopia habitats of the species are described as marshes (Bekele, 1996). In the KDA Guesthouse a mouse, to all appearances *D. harringtoni* was observed several times by O. Mikula, H. Meinig and M. Yonas) on 13 August 2019 between 7 and 11 am crossing a small path. Structures were very similar (Figure 40) to those at the trapping site near Shera village. The mouse had not been observed before on that path even though it was used frequently by the observers. The observation could be related to three conditions: (i) the day before the grass was mown left and right of the path leaving the hedge plant of about 0.5 m, (ii) during the night before there was a heavy swarming of termites, and (iii) the night before there was constant rain between 10 pm and 8 am. These factors may have triggered the change in the animal's daily activity that led to the multiple observations. On the other hand, all the other animals caught on the same day as *D. harringtoni* (12 August 2019) in Shera village were wet and damaged (partly eaten) by ants. The single *D. harringtoni*, however, was dry and undamaged by ants, suggesting that the species is active during the day and less active during the hours of darkness.

### Lesser Cane Rat (*Thryonomys gregorianus*)

The genus *Thryonomys* consists of two species. On 12 August 2019 the ornithological assessment group found a roadkill of a Cane Rat in the very east of the study area between Diri Goma (near Gojeb town) and Jimma. Based on body proportions, it was a Lesser Cane Rat (Figure 41), the only *Thryonomys* species genetically confirmed for Ethiopia to date (see Bryja et al., 2019). With the skull totally smashed and the carcass already decomposing, no part of the specimen was secured. Cane Rats are nocturnal, strictly herbivorous, feeding mainly on grass. *Thryonomys gregorianus* occupies moist savanna at higher altitudes (Wilson et al., 2017).

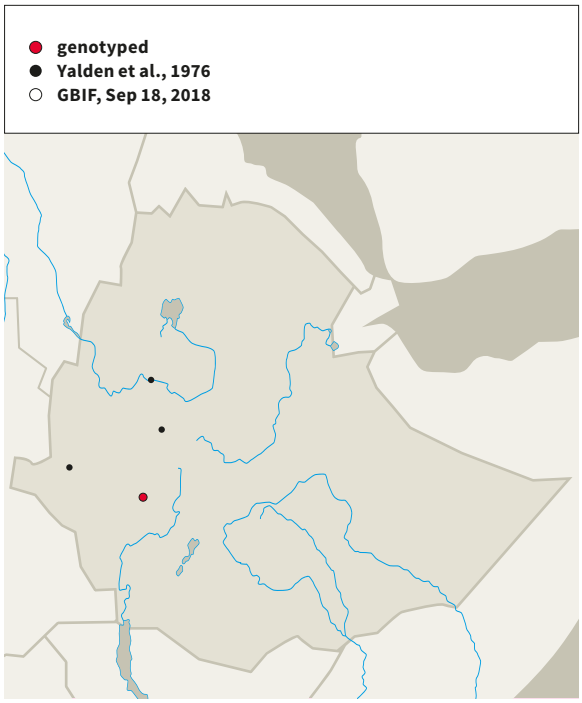



**Figure 14:** *Thryonomys gregorianus* occurrence in Ethiopia (Source: Bryja et al., 2019)

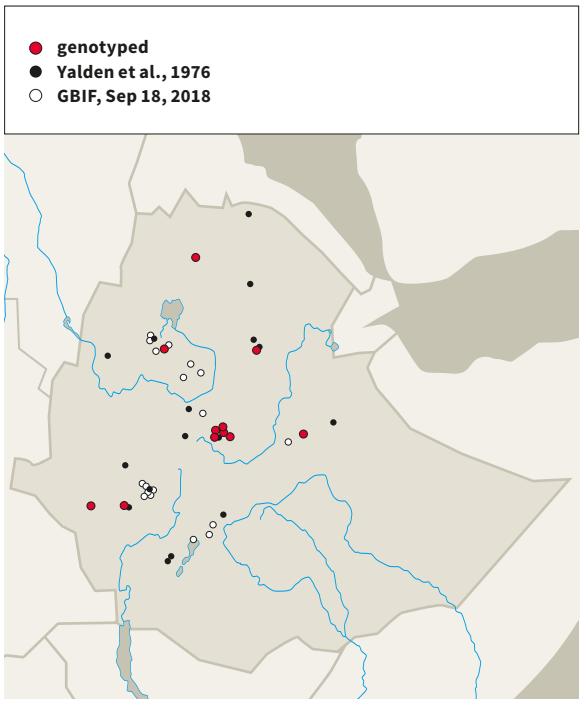



**Figure 13:** Occurrence of *Desmomys harringtoni* (Source: Bryja et al., 2019)

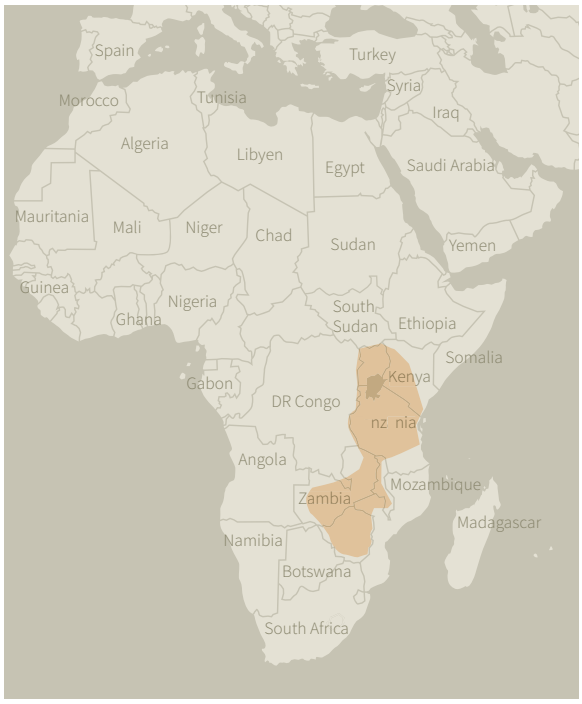



**Figure 15:** Occurrence of *Thryonomys gregorianus* in Africa. From Ethiopia there are only very few records (Source: Kingdon et al., 2013)



-> back to content

## 3.3 Records of mammal species other than Soricomorpha or Rodentia

### Egyptian Fruit Bat (*Rousettus aegyptiacus leachi*)

On 31 July 2019 a group of at least 50 Egyptian Fruit Bats was observed under God´s Bridge near Bonga (Figure 42). The occurrence of a *Rousettus* species in this place had already been reported by Kaipf et al. (2017), but without any further determination. In contrast to the 2014 assessment in the same place no Microchiroptera were observed during the 2019 visit.

### Gambian Epauletted Fruit Bat (*Epomophorus gambianus pousarguesi*) and another small Epauletted Fruit Bat (*E. labiatus* vel *E. minimus*)

During the visit to the Coffee Museum in Bonga on 10 August 2019, some 38 individuals of Epauletted Fruit Bats were observed under the roof of the Museum (counting K.-D. B. Dijkstra). On 12 August 2019 some 25 animals were observed again (own data H.M.). The majority of the animals could be determined as Gambian Epauletted Fruit Bats (E. gambianus pousarguesi) based on external body measurements. While the nominate form is a lowland species occurring below 500 m a.s.l., the current subspecies in Ethiopia may be found up to 2,000 m a.s.l. (van Cakenberghe 2019). One of the animals observed obviously was smaller and hanging a little bit further from a group of *E. gambianus* (Figure 43). This animal was either a Little Epauletted Fruit Bat (*E. labiatus*) or a Least Epauletted Fruit Bat (*E. minimus*). The two species cannot be distinguished without closer examination. This is probably the species mentioned by Berhan (2008) for the Kafa region under the name *E. anurus* that was synonymized under *E. labiatus* by Claessen & De Vree (1990).

**Supplementary to Kaipf et al. 2017**

On the basis of morphological measurements and comparison with voucher specimens in the Museum Koenig Bonn (det. Dr. R. Hutterer + H. M.) the two small Vespertilionid bats (field no. 3 + 4) caught around Bamboo Forest on 4 December 2014 and 5 December 2014 should be Dusk Pipistrelles (*Pipistrellus hesperidus*).

### African Civet (*Civettictis civetta*)

A road kill of the African Civet found on 5 August 2019 near Wushwush. During the 2014 assessment two road kills and an individual that had been poached were also found. This widely distributed African carnivore species seems to be relatively abundant in the study area.

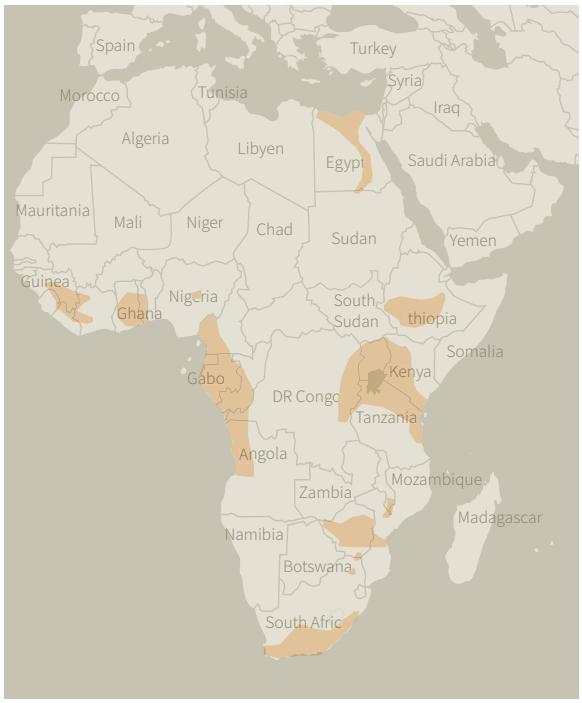



**Figure 16:** Distribution of *Rousettus aegyptiacus* in Africa (Source: Kingdon et al., 2013)


**Figure 17:** Geographic range of *Epomophorus gambianus* (Source: Kingdon et al., 2013)

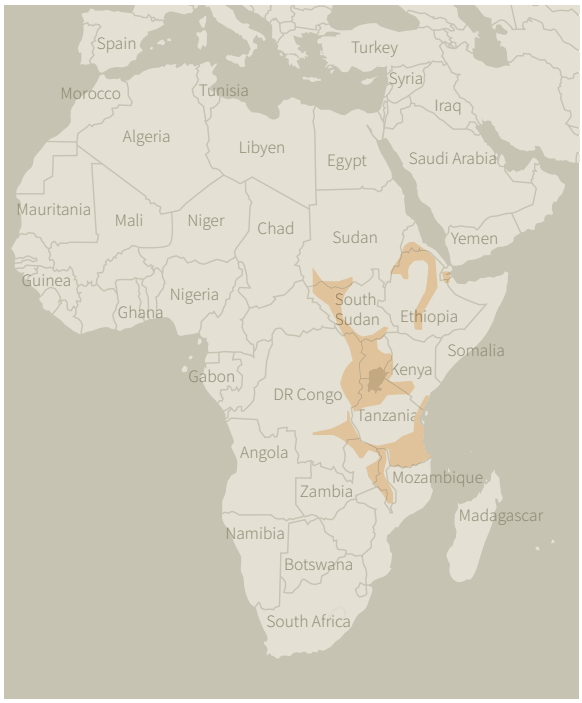



**Figure 18:** Known geographic range of *Epomophorus labiatus* (Source: Kingdon et al., 2013)


**Figure 20:** Geographic range of *Pipistrellus hesperidus* (Source: Kingdon et al., 2013)


**Figure 19:** Known geographic range of *Epomophorus minimus* (Source: Kingdon et al., 2013)


**Figure 21:** Geographic range of *Civettictis civetta* (Source: Kingdon et al., 2013)



-> back to content

### White-tailed Mongoose (*Ichneumia albicauda*)

In the quarry area of Shoriri the upper skull of a viverrid species was found on 10 August 2019. Morphological measurements and comparison with museum specimens at the Museum Koenig, Bonn revealed that the skull belonged to a White-tailed Mongoose, a widespread carnivore in sub-Saharan Africa.

### Bushpig (*Potamochoerus larvatus*)

A group of Bushpigs was observed by the ornithological assessment group on 2 August 2019 at about 1.5 km west of the Bamboo Forest Camp. The species is widely distributed in eastern Africa, its occurrence in the study area was already known from previous studies (e.g. Berhan, 2008; Bauer, 2017).

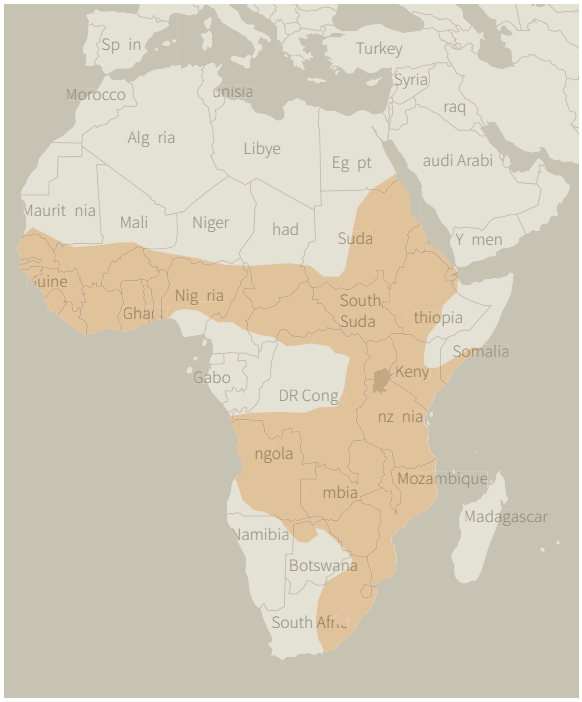



**Figure 22:** Geographic range of *Ichneumia albicauda* (Source: Kingdon et al., 2013)

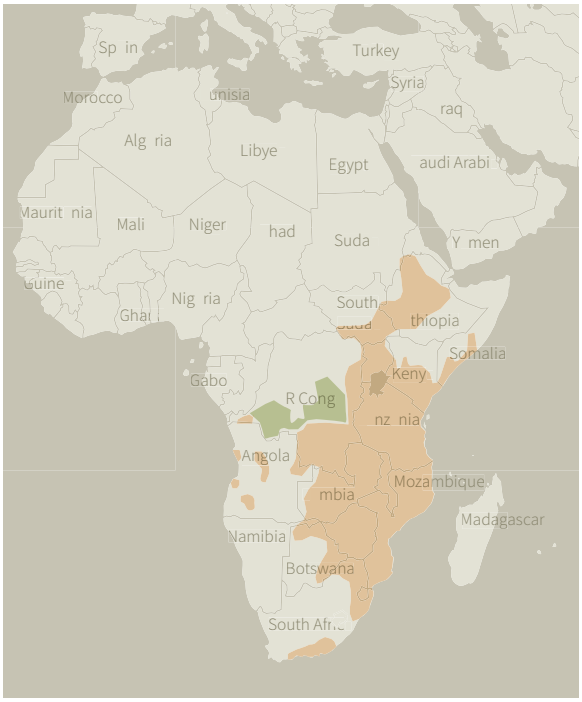



**Figure 23:** Geographic range of *Potamochoerus larvatus* (Source: Kingdon et al., 2013)

Possible intergradation with P. porcus

# 4. Evaluation of survey results

The most abundant species with 70 individuals was the Ethiopian White-footed Mouse (*Stenocephalemys albipes*), a typical species of forest stands. It usually occurs together with Brush-furred mice (*Lophuromys chrysopus* and *L. brunneus*) (19 individuals). In more open habitats with grassy patches the African Pygmy Mouse (*Mus (Nannomys) mahomet*) occurs frequently; we obtained 10 animals. Specimens of White-footed Mouse, Brush-furred Mouse, and African Pygmy Mouse were caught in most locations. This seems to be the regular species composition throughout the Kafa BR.

In open habitats single animals of Harringtons's Scrub Rat (*Desmomys harringtoni*) and Lesser Cane Rat (*Thryonomys gregorianus*) were found.

Six African Giant Shrews (*Crocidura olivieri*) were caught around Alemgono in a wetland. Shrews prefer moister habitats because of the higher densities of insects as food, compared to drier habitats.

The list of species is shorter than expected. Long-term studies would likely have yielded more species (e.g. further shrew species, Multimammate Rats (*Mastomys*) or Zebra Mice (*Lemniscomys*)). Maybe future studies should concentrate to a higher degree on open habitats. A change in the trapping protocol could also be useful to enable more species to be found (e.g. four traps at each trapping place that are controlled every four hours between sunset and sundown).

# 5. Conclusions and recommendations for conservation and monitoring

This short-term study of small- and medium-sized mammals during the wet season yielded only a fraction of the results needed to fully understand the species composition of different habitat types. Future studies should concentrate on more open habitats and less on forest stands. In addition, another protocol for setting and controlling the traps may also be useful for increasing the number of species found.

Except on some very rare occasions (e.g. the Giant Root Rat (*Tachyoryctes macrocephalus*) in Bale National Park) small mammals are unsuited as flagship species, because they are rarely seen in normal conditions. In addition, many people consider rodents to be pests. However, they should be kept in mind during monitoring, as they play an important role in ecosystems. Small mammals are sensitive to overgrazing and pollution by insecticides and herbicides as well as to the intensification of agriculture in general. Where they vanish, many other species that depend on them as a food source will decline, or they will switch to other endangered species such as the Abyssinian Longclaw (*Macronyx flavicollis*) or Plovers (*Vanellus*) for food.

The endemic *Dasymys griseifrons* may be affected by the desiccation and destruction of wetlands, as well as by the pollution of streams and ponds by detergents and pesticides.

To overcome problems caused by intensified land use, regulations governing the extent and type of land use should be implemented and controlled in certain areas. Sewers should be constructed and maintained for villages in the wetlands and near streams to protect water-bound habitats from destruction by fertilizer, detergent, and pesticide pollution.

# 6. Acknowledgements

We would like to thank Dr Josef Bryja (Institute of Vertebrate Biology, Czech Academy of Sciences, Brno) for rapidly processing first DNA samples and Dr Rainer Hutterer (Alexander Koenig Research Museum, Bonn) for his help with species determination. Bernhard Walter (Borgholzhausen) provided photos and data concerning the observation of Bushpigs.

# 7. References

**Bauer, H.** (2017). Medium (esp. Carnivora and Artiodactyla) and large mammals at the Kafa Biosphere Reserve. In: The Nature and Biodiversity Conservation Union (NABU) (eds.): NABU´s Biodiversity Assessment at the Kafa Biosphere Reserve, Berlin, Addis Ababa: 318-328 pp.

**Bekele, A.** (1996). Rodents of the Menagesha State Forest, Ethiopia, with an emphasis on the endemic *Praomys albipes* Rüppell 1842. Tropical Zoology 9: 201-212.

**Berhan, L. A.** (2008). Status and Distribution of Faunal Diversity in Kafa Afromontane Coffee Forest. Addis Ababa. 56 pp + annexes.

**Bryja, J.; Mikula, O.; Šumbera, R.; Meheretu, Y.; Aghova, T.; Lavrenchenko, L. A.; Mazoch, V.; Oguge, N.; Mbau, J. S.; Welegerima, K.; Amundala, N.; Colyn, M.; Leirs, H. & Verheyen, E.** (2014). Pan-African phylogeny of *Mus (subgenus Nannomys)* reveals one of the most successful mammal radiations in Africa. BMC Evolutionary Biology 14. 20 pp.

**Bryja, J.; Meheretu, Y.; Šumbera, R. & Lavrenchenko, L. A.** (2019). Annotated checklist, taxonomy and distribution of rodents in Ethiopia. Folia Zool. – 68 (3): 117-157.

**Cakenberghe, V. van** (2019). African Chiroptera Report 2019. AfricanBats NPC, Pretoria. i-xv + 8297 pp. doi: 10.13140/RG.2.2.27442.76482.

**Churchfield, S. & Hutterer, R.** (2013). *Crocidura olivieri* African Giant Shrew (Mann´s musk shrew, Euchareena´s musk shrew). In: Happold, M.; Happold, D. C. D. (eds.). Mammals of Africa, Volume IV: Hedgehogs, Shrews and Bats, Bloomsbury, London: 118-199.

**Claessen, C. J. & De Vree, F.** (1990). Systematic and taxonomic notes on the *Epomophorus anurus-labiatus-minor* complex with the description of a new species. Senckenbergiana Biologica 71: 209-238.

**Csorba, G.; Krivek, G.; Sendula, T.; Homonnay, Z. G.; Hegyeli, Z.; Sugár, S.; Farkas, J.; Nikola Stojnić, N. & Németh, A.** (2015). How can scientific researches change conservation priorities? A review of decade-long research on Blind Mole Rats (Rodentia: Spalacinae) in the Carpathian Basin. Therya 6. 103-121.

**Garratt, C. G.; Minderman, J. & Whittingham, M.J.** (2012). Should we stay or should we go now? What happens to small mammals when grass is mown, and the implications for birds of prey. Ann. Zool. Fenn. 49. 113-122.

**Glennon, J. & Porter, F.** (2007). Impacts of Land-use Management on Small Mammals in the Adirondack Park, New York. Northeast Nat. 14. 323-342.

**Habtamu, T. & Bekele, A.** (2008). Habitat association of insectivores and rodents of Alatish National Park, Northwestern Ethiopia. Tropical Ecology 49. 1-11.

**Happold, D.C.D.** (ed.) (2013). Mammals of Africa. V. III: Rodents, Hares and Rabbits. Bloomsbury Publishing, London.

**Hutterer, R.** (1980). Zur Systematik und Verbreitung der Soricidae Äthiopiens (Mammalia; Insectivora). Bonner zool. Beitr. 31. Heft 3-4. 217-247.

**Hutterer, R. & Yalden, D. W.** (1990). Two new species of shrews from a relict forest in Bale Mountains, Ethiopia. In: Peters, G.; Hutterer, R. (eds.): Vertebrates in the Tropics – Proceedings of the International Symposium on Vertebrate Biogeography and Systematics in the Tropics. Mus. A. Koenig, Bonn. 63-72.

**Jacquet, F.; Denys, C.; Verheyen, E.; Bryja, J.; Hutterer, R.; Kerbis Peterhans, J. C.; Stanley, W. T.; Goodman, S. M.; Couloux, A.; Colyn, M. & Nicolas, V.** (2015). Phylogeography and evolutionary history of the *Crocidura olivieri* complex (Mammalia, Soricomorpha): from a forest origin to broad ecological expansion across Africa. BMC Evolutionary Biology 15, 71.

**Kaipf, I.; Rudolphi, H. & Meinig, H.** (2017). Bats and fruit bats at the Kafa Biosphere Reserve. In: The Nature and Biodiversity Conservation Union (NABU) (eds.) (2017). NABU´s Biodiversity Assessment at the Kafa Biosphere Reserve, Berlin, Addis Ababa: 206-229 pp.

**Kassa, D. & Bekele, A.** (2008). Species composition, abundance, distribution and habitat association of rodents of Wondo Genet, Ethiopia. Ethiopian J. Science 31. 141-146.

**Kingdon, J.** (1990). Island Africa: The Evolution of Africa's Rare Animals and Plants. Academic Press, Princeton. 287.

**Kingdon, J.** (2001). The Kingdon Field Guide to African Mammals. Academic Press, San Diego. 476.

**Kingdon, J.; Happold, D.; Hoffmann, M.; Butynski, T.; Happold, M. & Kalina, J.** (ed.) (2013). Mammals of Africa. Bloomsbury London.

**Lavrenchenko, L. A.** (2019). The mammals of Ethiopia: diversity, endemism and conservation. The 13th African Small Mammal Symposium, Mekelle, Ethiopia, September 16-21 2019, Programme and Abstract Book. 50-51.

**Lavrenchenko, L. A. & Afework Bekele** (2017). Diversity and conservation of Ethiopian mammals: What have we learned in 30 years? Ethiopian Journal of Biological Sciences, 16 (Supplementary): 20.

**Lavrenchenko, L. A.; Mengistu, S.; Bulatova, N. S.; Bekele, A.; Potapov, S. G.; Nadjafova, R. S. & Belay, G.** (2014). Genetic and cytogenetic variation of African root-rats *Tachyoryctes splendens* (Mammalia: Rodentia) from Ethiopia. Russ. J. Theriol. 13. 109-118.

**Lavrenchenko, L. A.; Verheyen, W.N.; Verheyen, E.; Hulselmans, J. & Leirs, H.** (2007). Morphometric and genetic study of Ethiopian *Lophuromys flavopunctatus* Thomas, 1888 species complex with description of three new 70-chromosomal species (Muridae, Rodentia). Bull. Inst. Roy. Sci. Nat. Belgique, Biologie 77: 77-117.

**Lecompte, E.; Aplin, K.; Denys, C.; Catzeflis, F.; Chades, M. & Chevret, P.** (2008). Phylogeny and biogeography of African Murinae based on mitochondrial and nuclear gene sequences, with a new tribal classification of the subfamily. BMC Evolutionary Biology 8, 199.

**Lee, L. L.** (1997). Effectiveness of Live Traps and Snap Traps in Trapping Small Mammals in Kinmen. Taipei, Taiwan. Acta Zool. Taiw. 8, 79-85.

**Maddalena T.** (1990). Systematics and biogeography of Afrotropical and Palearctic shrews of the genus *Crocidura* (Insectivora: Soricidae): An electrophoretic approach. In: Peters, G.; Hutterer, R. (eds): Vertebrates in the tropics. Mus. A. Koenig, Bonn. 297-308.

**Meheretu, Y.; Sluydts, V.; Welegerima, K.; Bauer, H.; Teferi, M.; Yirga, G.; Mulungu, L.; Haile, M.; Nyssen, J.; Deckers, J.; Makundi, R. & Leirs, H.** (2014). Rodent abundance, stone bund density and its effects on crop damage in the Tigray highlands, Ethiopia. Crop Protection 55. 61-67.

**Meinig, H.; Meheretu, Y. & Hermes, N.** (2017). Small- and medium-sized mammals (Soricomorpha, Lagomorpha, Rodentia, Procavidae) at the Kafa Biosphere Reserve. In: The Nature and Biodiversity Conservation Union (NABU) (eds.) (2017). NABU´s Biodiversity Assessment at the Kafa Biosphere Reserve. Berlin, Addis Ababa. Berlin, Addis Ababa: 296-317 pp.

**Mugo, D. N.; Lombard, A. T.; Bronner, G. N.; Gelderblom, C. M. & Benn, G.A.** (1995). Distribution and protection of endemic or threatened rodents, lagomorphs and macrosceledids in South Africa. South African J. of Zoology 30. 115-126.

**Mullin, S. K.; Pillay, N. & Taylor, P. J.** (2005). The distribution of the water rat *Dasymys* (Muridae) in Africa: a review. South African J. of Science 101. 117-124.

**Mulungu, L.S.; Makundi, R.H.; Massawe, A.W.; Machang'u, R.S. & Mbije, N.E.** (2008). Diversity and distribution of rodent and shrew species associated with variations in altitude on Mount Kilimanjaro, Tanzania. J Mammal 72: 178-185.

**Musser, G. G. & Carleton, M. D.** (2005). Superfamily Muroidea. In: Wilson, D. E.; Reeder, D. M. (eds.) 2005. Mammal Species of the World: A Taxonomic and Geographic Reference.- 3rd Edition, The Johns Hopkins University Press, Baltimore. 894-1531.

**Neumann, O. & Rümmler, H-J.** (1928). Beiträge zur Kenntnis von *Tachyoryctes* Rüpp. Z. Säugetierkunde 3: 295-30.

**Pearson, D.E; Ortega, Y.K.; McKelvey, K.S. & Ruggiero, L.F.** (2001). Small Mammal Communities and Habitat Selection in Northern Rocky Mountain Bunchgrass: Implications or Exotic Plant Invasions. Northwest Sci. 75: 107-117.

**Slade, N.A; Eifler, M.A.; Gruenhagen, N.M. & Davelos, A.L.** (1993). Differential Effectiveness of Standard and Long Sherman Livetraps in Capturing Small Mammals. J. of Mamm. 74, 156-161.

**Šumbera, R.; Krásová, J.; Lavrenchenko, L. A.; Mengistu, S.; Bekele, A.; Mikula, O. & Bryja, J.** (2018). Ethiopian highlands as a cradle of the African fossorial root-rats (genus *Tachyoryctes*), the genetic evidence. Molecular Phylogenetics and Evolution 126: 105-115 pp.

**Taylor, P. J.; Lavrenchenko L. A.; Carleton M. D.; Verheyen, E.; Nigel, C. Bennett, N. C.; Oosthuizen, C. J. & Maree, S.** (2011). Specific Limits and Emerging Diversity Patterns in East African Populations of Laminate-Toothed Rats, Genus *Otomys* (Muridae: Murinae: Otomyini): Revision of the *Otomys typus* Complex. Zootaxa 3024. 66 pp.

**Taylor, P.J.; Maree, S.; Lavrenchenko, L. A.; Kerbis Peterhans, J. & Chitaukali, W.** (2008). *Otomys typus*. The IUCN Red List of Threatened Species. Version 2014.3. www.iucnredlist.org. Downloaded on 13/02/2015.

**Thompson, I.D. & Macaulay, A.L.** (1987). Comparative Efficiency of New and Old Style Museum Special Traps in Capturing Small Mammals. Can. Field Nat. 101, 608-610.

**Wilson, D. E. & Reeder, D. M.** (eds.) (2005). Mammal Species of the World: A Taxonomic and Geographic Reference (Smithsonian Series in Comparative Evolutionary Biology).- 3rd Edition, The Johns Hopkins University Press, Baltimore. 2142 pp.

**Wilson D.E.; Lacher T.E. Jr. & Mittermeier R.A.** (2017). Handbook of the Mammals of the World, Vol. 7. Rodents II. Lynx Edicions, Barcelona.

**Yalden, D. W.** (1975). Some Observations on the Giant Mole Rat *Tachyoryctes macrocephalus* (Rüppell, 1842) (Mammalia Rhizomyidae) of Ethiopia. Monitore Zoologico Italiano. Supplemento, Volume 6. 275-303.

**Yalden, D. W.** (1983). The extent of high ground in Ethiopia as compared to the rest of Africa. Ethiopian J. Science 6. 35-38.

**Yalden D.W., Largen M.J., Kock D. & Hillman J.C.** (1996). Catalogue of the mammals of Ethiopia and Eritrea. Revised checklist, zoogeography and conservation. Trop. Zool. 9. 73-164.

# 8. Annex

## 8.1 Tables

**Table 1:** List of small- and medium-sized mammal species recorded during the follow-up assessment at the Kafa BR

| ID | Scientific name | Barcoded | Date capture | Locality | Latitude | Longitude | Altitude (a.s.l.) | HB | TL | HF | EL | Sex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ETH2181 | *Stenocephalemys albipes* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 137.0 | 152.0 | 26.0 | 22.0 | M |
| ETH2182 | *Stenocephalemys albipes* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | - | - | 27.0 | 24.0 | F |
| ETH2183 | *Stenocephalemys albipes* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 122.0 | 157.0 | 28.0 | 22.0 | M |
| ETH2184 | *Stenocephalemys albipes* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 128.0 | 164.0 | 27.0 | 22.5 | M |
| ETH2185 | *Stenocephalemys albipes* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 124.0 | 163.0 | 26.5 | 20.0 | F |
| ETH2186 | *Stenocephalemys albipes* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 127.0 | 167.0 | 27.0 | 23.0 | F |
| ETH2187 | *Stenocephalemys albipes* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 107.0 | 119.0 | 26.0 | 21.5 | M |
| ETH2188 | *Lophuromys chrysopus* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 142.0 | 53.0 | 23.0 | 19.0 | F |
| ETH2189 | *Lophuromys brunneus* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | - | - | 21.0 | 17.0 | F |
| ETH2190 | *Stenocephalemys albipes* | yes | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 117.0 | 172.0 | 29.0 | 21.5 | M |
| ETH2191 | *Stenocephalemys albipes* | yes | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 100.0 | 144.0 | 25.0 | 19.0 | F |
| ETH2192 | *Stenocephalemys albipes* | yes | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 124.0 | 170.5 | 28.0 | 24.5 | F |
| ETH2193 | *Stenocephalemys albipes* | yes | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 129.0 | 173.0 | 30.0 | 19.0 | M |
| ETH2194 | *Mus mahomet* | yes | 31/07/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | 72.0 | 59.0 | 16.0 | 11.5 | F |
| ETH2195 | *Mus mahomet* | | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | - | 55.0 | 15.5 | - | M |
| ETH2196 | *Mus mahomet* | | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | 73.0 | 51.0 | 14.5 | 11.0 | M |
| ETH2197 | *Mus mahomet* | | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | - | 53.0 | 15.0 | 11.5 | - |
| ETH2198 | *Mus mahomet* | | 02/08/2019 | Boginda | 7.5511 | 36.0621 | 1,524 m | 74.0 | 56.0 | 15.0 | - | F |
| ETH2189 | *Lophuromys brunneus* | | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | - | - | 21.0 | 17.0 | F |
| ETH2190 | *Stenocephalemys albipes* | yes | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 117.0 | 172.0 | 29.0 | 21.5 | M |
| ETH2191 | *Stenocephalemys albipes* | yes | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 100.0 | 144.0 | 25.0 | 19.0 | F |
| ETH2192 | *Stenocephalemys albipes* | yes | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 124.0 | 170.5 | 28.0 | 24.5 | F |

M – male, F – female, HB – head and body, TL – tail, HF – hind foot, EL – ear length. All measurements in millimetres.
Field-IDs are those of the collection of Ethiopian mammals at the Institute of Vertebrate Biology, Brno.



-> back to content

| ID | Scientific name | Barcoded | Date capture | Locality | Latitude | Longitude | Altitude (a.s.l.) | HB | TL | HF | EL | Sex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ETH2193 | *Stenocephalemys albipes* | yes | 31/07/2019 | Komba Forest | 7.3085 | 36.0869 | 1,990 m | 129.0 | 173.0 | 30.0 | 19.0 | M |
| ETH2194 | *Mus mahomet* | yes | 31/07/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | 72.0 | 59.0 | 16.0 | 11.5 | F |
| ETH2195 | *Mus mahomet* | | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | - | 55.0 | 15.5 | - | M |
| ETH2196 | *Mus mahomet* | | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | 73.0 | 51.0 | 14.5 | 11.0 | M |
| ETH2197 | *Mus mahomet* | | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | - | 53.0 | 15.0 | 11.5 | - |
| ETH2198 | *Mus mahomet* | | 02/08/2019 | Boginda | 7.5511 | 36.0621 | 1,524 m | 74.0 | 56.0 | 15.0 | - | F |
| ETH2199 | *Lophuromys brunneus* | yes | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | 114.0 | 59.0 | 22.0 | 16.0 | F |
| ETH2200 | *Stenocephalemys albipes* | yes | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | 115.0 | 168.0 | 28.0 | 21.0 | F |
| ETH2201 | *Stenocephalemys albipes* | | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | 123.0 | 168.0 | 27.0 | 20.5 | M |
| ETH2202 | *Stenocephalemys albipes* | | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | 105.0 | 162.0 | 27.5 | 20.5 | F |
| ETH2203 | *Stenocephalemys albipes* | | 02/08/2019 | Boginda Forest | 7.5511 | 36.0621 | 1,524 m | 127.0 | 165.0 | 27.0 | 22.0 | F |
| ETH2204 | *Lophuromys chrysopus* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 89.0 | 73.0 | 20.5 | 16.5 | M |
| ETH2205 | *Lophuromys chrysopus* | yes | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 134.0 | 94.0 | 22.5 | 19.0 | M |
| ETH2206 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 112.0 | 138.0 | 26.0 | 21.0 | F |
| ETH2207 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 140.0 | - | 29.0 | 22.0 | M |
| ETH2208 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 118.0 | 174.0 | 25.5 | 23.0 | F |
| ETH2209 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 126.0 | 168.0 | 27.0 | 21.0 | M |
| ETH2210 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 124.0 | 155.0 | 26.5 | 21.0 | M |
| ETH2211 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 132.0 | 175.0 | 28.0 | 23.0 | M |
| ETH2212 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 125.0 | 154.0 | 28.0 | 23.0 | F |
| ETH2213 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 121.0 | 156.0 | 27.5 | 22.0 | F |
| ETH2214 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 76.0 | 102.0 | 21.0 | 18.0 | M |
| ETH2215 | *Lophuromys chrysopus* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 109.0 | 77.0 | 21.0 | 17.0 | F |
| ETH2216 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 126.0 | 161.0 | 25.0 | 21.0 | F |
| ETH2217 | *Stenocephalemys* | | 03/08/2019 | Masha Malo | 7.6916 | 35.9850 | 1,730 m | 109.0 | - | 25.0 | 22.0 | F |

M – male, F – female, HB – head and body, TL – tail, HF – hind foot, EL – ear length. All measurements in millimetres.
Field-IDs are those of the collection of Ethiopian mammals at the Institute of Vertebrate Biology, Brno.

| ID | Scientific name | Barcoded | Date capture | Locality | Latitude | Longitude | Altitude (a.s.l.) | HB | TL | HF | EL | Sex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ETH2218 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 111.0 | 145.0 | 27.0 | 19.0 | F |
| ETH2219 | *Stenocephalemys albipes* | yes | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 124.0 | 158.0 | 26.0 | 22.0 | F |
| ETH2220 | *Lophuromys chrysopus* | yes | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 111.0 | 82.0 | 21.0 | 15.0 | M |
| ETH2221 | *Lophuromys chrysopus* | yes | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 111.0 | 80.0 | 21.0 | 18.0 | M |
| ETH2222 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 95.0 | 131.0 | 23.5 | 21.0 | M |
| ETH2223 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 88.5 | 115.5 | 24.0 | 18.5 | M |
| ETH2224 | *Stenocephalemys albipes* | | 03/08/2019 | Masha Malo Forest | 7.6916 | 35.9850 | 1,730 m | 119.5 | 167.5 | 27.0 | 22.0 | F |
| ETH2225 | *Mus mahomet* | yes | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 81.0 | 51.0 | 14.5 | 12.0 | M |
| ETH2226 | *Lophuromys brunneus* | yes | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 139.0 | 76.0 | 26.0 | 18.0 | F |
| ETH2227 | *Lophuromys chrysopus* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | - | - | 23.0 | 15.5 | F |
| ETH2228 | *Lophuromys chrysopus* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 107.0 | 69.0 | 24.0 | 17.0 | M |
| ETH2229 | *Lophuromys chrysopus* | yes | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 113.0 | 80.0 | 23.0 | 17.5 | F |
| ETH2230 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 143.0 | 158.0 | 27.0 | 22.0 | M |
| ETH2231 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 137.0 | 189.0 | 28.0 | 20.5 | M |
| ETH2232 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 150.0 | 178.0 | 29.0 | 24.5 | M |
| ETH2233 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 140.0 | 173.0 | 24.5 | 22.5 | F |
| ETH2234 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 137.0 | 186.0 | 28.0 | 23.0 | M |
| ETH2235 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 132.0 | 166.0 | 27.0 | 22.0 | F |
| ETH2236 | *Stenocephalemys* | | 05/08/2019 | Alemgono | 7.3586 | 36.2130 | 1,707 m | 126.0 | 164.0 | 27.5 | 23.5 | M |
| ETH2237 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 142,0 | 169.0 | 27.0 | 23.0 | M |
| ETH2238 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 144.0 | 166.0 | 28.0 | 23.5 | M |
| ETH2239 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 142.0 | 182.0 | 28.5 | 24.0 | F |
| ETH2240 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 119.0 | 162.0 | 27.0 | 22.0 | M |
| ETH2241 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 96.0 | 107.0 | 24.5 | 18.5 | M |

M – male, F – female, HB – head and body, TL – tail, HF – hind foot, EL – ear length. All measurements in millimetres.
Field-IDs are those of the collection of Ethiopian mammals at the Institute of Vertebrate Biology, Brno.



-> back to content

| ID | Scientific name | Barcoded | Date capture | Locality | Latitude | Longitude | Altitude (a.s.l.) | HB | TL | HF | EL | Sex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ETH2242 | *Mus mahomet* | yes | 05/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | - | 45.0 | 14.0 | - | M |
| ETH2243 | *Lophuromys brunneus* | yes | 05/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 145.0 | 75.0 | 23.0 | 18.0 | F |
| ETH2244 | *Civettictis civetta* | | 05/08/2019 | Wushwush | 7.3090 | 36.1197 | - | - | - | - | - | F |
| ETH2245 | *Crocidura olivieri* | | 05/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 120.0 | 86.0 | 20.0 | 11.5 | F |
| ETH2246 | *Crocidura olivieri* | | 05/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 108.5 | 86.5 | 21.0 | 11.5 | M |
| ETH2247 | *Stenocephalemys albipes* | yes | 05/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 126.0 | 147.0 | 26.0 | 21.0 | M |
| ETH2248 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 140.0 | 161.0 | 27.0 | 23.0 | M |
| ETH2249 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 133.5 | 174.5 | 27.0 | 23.0 | F |
| ETH2250 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 120.0 | 160.0 | 28.0 | 21.0 | F |
| ETH2251 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 116.0 | 185.0 | 28.0 | 23.5 | F |
| ETH2252 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 97.5 | 122,2 | 26.0 | 21.0 | M |
| ETH2253 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 148.0 | 180.0 | 29.0 | 24.0 | M |
| ETH2254 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 134.0 | 177.0 | 29.0 | 21.5 | F |
| ETH2255 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 143.0 | 178.0 | 29.0 | 21.0 | M |
| ETH2256 | *Mus mahomet* | yes | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 79.0 | 51.0 | 15.5 | 13.5 | F |
| ETH2257 | *Crocidura olivieri* | yes | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 112.0 | 85.0 | 20.5 | 11.0 | M |
| ETH2258 | *Lophuromys chrysopus* | yes | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 118.0 | 74.0 | 21.0 | 17.5 | F |
| ETH2259 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 139.0 | 183.0 | 28.0 | 23.5 | M |
| ETH2260 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 88.0 | 126.0 | 25.5 | 21.0 | F |
| ETH2261 | *Lophuromys chrysopus* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 137.0 | - | 24.0 | 18.5 | F |
| ETH2262 | *Lophuromys chrysopus* | yes | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 116.5 | 78.0 | 20.0 | 16.0 | F |
| ETH2263 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 112.0 | 174.0 | 26.0 | 23.0 | F |
| ETH2264 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 116.0 | - | 26.0 | 20.5 | F |
| ETH2265 | *Lophuromys* | yes | 05/08/2019 | Alemgono | 7.3586 | 36.2130 | 1,707 m | 117.0 | 78.0 | 21.0 | 18.0 | F |
| ETH2266 | *Lophuromys brunneus* | yes | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 130.0 | 68.0 | 22.5 | 17.5 | F |

M – male, F – female, HB – head and body, TL – tail, HF – hind foot, EL – ear length. All measurements in millimetres.
Field-IDs are those of the collection of Ethiopian mammals at the Institute of Vertebrate Biology, Brno.

| ID | Scientific name | Barcoded | Date capture | Locality | Latitude | Longitude | Altitude (a.s.l.) | HB | TL | HF | EL | Sex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ETH2267 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 118.5 | 162.5 | 28.5 | 22.0 | M |
| ETH2268 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 127.0 | 187.0 | 28.0 | 23.0 | F |
| ETH2269 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 122.0 | 187.0 | 28.5 | 23.5 | F |
| ETH2270 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 119.0 | 167.0 | 29.0 | 22.0 | M |
| ETH2271 | *Stenocephalemys albipes* | | 05/08/2019 | Alemgono village | 7.3586 | 36.2130 | 1,707 m | 104.0 | 119.0 | 26.0 | 19.0 | M |
| ETH2272 | *Crocidura olivieri* | | 07/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 124.5 | 74.5 | 19.0 | 10.0 | F |
| ETH2273 | *Crocidura olivieri* | yes | 07/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 110.0 | 81.0 | 19.0 | 10.5 | F |
| ETH2274 | *Crocidura olivieri* | yes | 07/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 129.5 | 87.5 | 20.0 | 12.5 | M |
| ETH2275 | *Stenocephalemys albipes* | | 07/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 127.5 | 164.0 | 26.0 | 23.5 | F |
| ETH2276 | *Stenocephalemys albipes* | | 07/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 149.0 | 164.0 | 26.5 | 22.0 | M |
| ETH2277 | *Stenocephalemys albipes* | | 07/08/2019 | Alemgono village | 7.3633 | 36.2239 | 1,716 m | 154.0 | 182.0 | 29.0 | 25.0 | M |
| ETH2278 | *Mus mahomet* | yes | 07/08/2019 | Bonga, KDA Guest-house | 7.2501 | 36.2546 | 1,756 m | - | 53.0 | 14.0 | 11.0 | F |
| ETH2279 | *Mus mahomet* | yes | 11/08/2019 | God's Bridge | 7.3636 | 36.2122 | 1,562 m | 73.5 | 49.0 | 14.0 | 12.0 | F |
| ETH2280 | *Lophuromys chrysopus* | yes | 11/08/2019 | God's Bridge | 7.3636 | 36.2122 | 1,562 m | - | 8.,0 | 23.0 | 20.0 | M |
| ETH2281 | *Stenocephalemys albipes* | | 11/08/2019 | God's Bridge | 7.3636 | 36.2122 | 1,562 m | 131.0 | 175.0 | 28.0 | 21.5 | M |
| ETH2282 | *Stenocephalemys albipes* | | 11/08/2019 | God's Bridge | 7.3636 | 36.2122 | 1,562 m | 105.0 | 127.0 | 25.5 | 21.5 | F |
| ETH2283 | *Stenocephalemys albipes* | yes | 11/08/2019 | God's Bridge | 7.3636 | 36.2122 | 1,562 m | 130.5 | 172.0 | 27.0 | 22.5 | F |
| ETH2284 | *Tachyoryctes splendens* | | 11/08/2019 | Ufdo area, Gono village | 7.3634 | 36.2184 | 1,729m | 230.0 | 67.0 | 34.0 | 15.0 | F |
| ETH2285 | *Tachyoryctes splendens* | | 12/08/2019 | Ufdo area, Gono village | 7.3634 | 36.2184 | 1,729 m | 253.0 | 62.0 | 32.0 | 18.0 | M |
| ETH2286 | *Desmomys harringtoni* | | 12/08/2019 | Shera village | 7.2779 | 36.1835 | 1,840 m | 119.5 | 120.5 | 27.0 | 17.5 | F |
| ETH2287 | *Stenocephalemys albipes* | | 12/08/2019 | Shera village | 7.2779 | 36.1835 | 1,840 m | - | - | - | - | - |
| ETH2288 | *Stenocephalemys albipes* | | 12/08/2019 | Shera village | 7.2779 | 36.1835 | 1,840 m | 122.5 | 153.5 | 28.5 | - | F |
| ETH2289 | *Stenocephalemys albipes* | yes | 12/08/2019 | Shera village | 7.2779 | 36.1835 | 1,840 m | 146.0 | 190.0 | 28.0 | 25.5 | F |

M – male, F – female, HB – head and body, TL – tail, HF – hind foot, EL – ear length. All measurements in millimetres.
Field-IDs are those of the collection of Ethiopian mammals at the Institute of Vertebrate Biology, Brno.



-> back to content

## 8.2 Photos

**Figure 24:** Specimens of male *C. olivieri* from Ethiopia (left: Gojeb Wetland, 11/12/2014, right: the more widespread savannah colour morph from Bahir Dar, Lake Tana, 07/04/2011) (photo: Holger Meinig)

**Figure 25:** *Tachyoryctes splendens* s.l. from the Bamboo Forest, 06/12/2014 (photo: Holger Meinig)

**Figure 26:** Snare for catching *Tachyoryctes*, Bamboo camp, 06/12/2014 (photo: Holger Meinig)

**Figure 27:** A melanistic and a normally coloured specimen of *Tachyoryctes splendens* s. l. from Ufdo Kebele near Gono village, 11/08/2019 (photo: Holger Meinig)

**Figure 28:** Comparison of body proportions of Ethiopian *Lophuromys*. Left: female *L. brunneus* from Bamboo Camp, 06/12/2014, right: male *L. brevicaudus* from Wahoro village, Bale Mts., 04/04/2010 (photo: Holger Meinig)

**Figure 29:** Specimens of *Lophuromys chrysops* (left) and *L. brunneus* (right) from Komba Forest, dorsal view (photo: Holger Meinig)

**Figure 30:** Specimens of *Lophuromys chrysops* (left) and *L. brunneus* (right) from Komba Forest, ventral view (photo: Holger Meinig)

**Figure 31:** *Otomys helleri* (formerly *O.* cf. *typus*) (Source: the Sanetti Plateau, Bale Mts. 14/04/2010) (photo: Holger Meinig)

**Figure 32:** *Stenocephalemys albipes* from the Bale Mts. near Dodola, 09/04/2010 (photo: Holger Meinig)

**Figure 33:** *Mus mahomet* from the Bamboo Forest Camp, 05/12/2014 (photo: Holger Meinig)

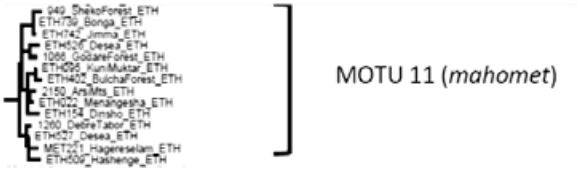



**Figure 34:** Section of samples identified as *M. mahomet* from the phylogeny of the Nannomys group by Bryja et al. (2014), among others, presenting material from the study area (Bonga, Jimma)

**Figure 35:** *Dasymys griseifrons* from the Gojeb Wetland, 11/12/2014 (photo: Holger Meinig)



-> back to content

**Figure 36:** Body proportions of *Stenocephalemys albipes* (above) and *Dasymys griseifrons* (below) (photo: Holger Meinig)

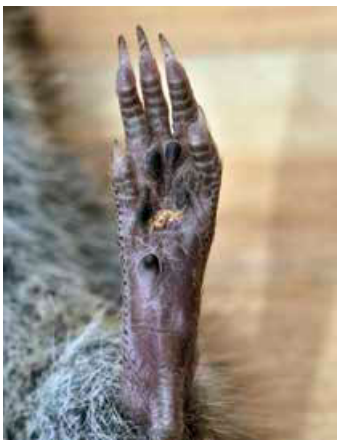


**Figure 37:** Characteristic black sole markings of *Dasymys griseifrons* from the Gojeb Wetland, 11/12/2014 (photo: Holger Meinig)

**Figure 38:** *Desmomys harringtoni* from Shera village, 12/08/2019 (photo: Holger Meinig)

**Figure 39:** Trapping site of *Desmomys harringtoni* near Shera village, 12/08/2019 (photo: Meheretu Yonas)

**Figure 40:** The small path at the KDA Guesthouse in Bonga that was crossed several times by a mouse, to all appearances *D. harringtoni* (photo: Holger Meinig)

**Figure 41:** Records of *Thryonomys gregorianus* from between Diri Goma and Jimma, 12/08/2019 (photo: Holger Meinig)

**Figure 42:** *Rousettus aegyptiacus leachi* under God's Bridge near Bonga (photo: Holger Meinig)

**Figure 43:** Group of seven *Epomophorus gambianus pousarguesi* (2 males and 5 females under the roof of the Coffee Museum in Bonga and a member of a smaller *Epomophorus* species (*E. labiatus* or *E. minimus*), bottom left side, 12/08/2019 (photo: Holger Meinig)

**Figure 44:** Road kill of *Civettictis civetta* from near Wushwush (photo: Holger Meinig)

**Figure 45:** Skull of *Ichneumia albicauda* from Shoriri (lateral view) (photo: Holger Meinig)

**Figure 46:** Skull of *Ichneumia albicauda* from Shoriri (dorsal view) (photo: Holger Meinig)

**Figure 47:** *Potamochoerus larvatus* with young near the former Bamboo Forest Camp (photo: Bernhard Walter)


Participants of the follow-up biodiversity assessement after a theoretical training at NABU's Project Office Bonga (photo: NABU/Abdurazak Sahile)

Members/staff of the Ethiopian Biodiversity Institute, the Bonga University, the Office of Environment, Forest and Climate Change Control and NABU after an interim feedback session at the KDA Guesthouse (photo: NABU/Abdurazak Sahile)

The arrival of experts and NABU staff at Jimma Airport (photo: NABU)

NABU, The Nature and Biodiversity Conservation Union, hosted a second biodiversity assessment at the Kafa Biosphere Reserve as follow-up to a first one held in 2014. A team of nine international experts from the Czech Republic, Germany, Kenya and the Netherlands, 16 Ethiopian experts from partnering institutions and science as well as 10 NABU rangers and nine NABU team members conducted intensive field work on amphibians, birds, dragonflies and damselflies, fungi, small and medium-sized mammals and reptiles.

The Kafa Biosphere Reserve in south-west Ethiopia (Southern Nations, Nationalities and Peoples' Region) combines a distinctive richness of culture and biodiversity, which is unique among paleotropical regions. Up to 2014, however, the immense local biodiversity had not been professionally assessed and documented. This changed with NABU's first biodiversity assessment in 2014 where 12 taxa were assessed for the first time. With a second and follow-up assessment in the rainy season of 2019, NABU aimed to obtain comparable and new data on the status of biodiversity for specific taxonomic groups.

This book is a major step forward in significantly expanding existing knowledge on species and their habitats at the Kafa Biosphere Reserve. Particularly outstanding is the record of 31 species which are new to science (mainly fungi and one amphibian species) and 276 species which are new to Ethiopia. In total, 515 species have been recorded of which at least 29 species are endemic.

NABU, The Nature and Biodiversity Conservation Union, has promoted the interests of people and nature for more than 120 years drawing on its unwavering commitment, specialised expertise and the backing of its 770,000 members and supporters. The NGO is the largest of its kind in Germany. NABU has been working towards the protection of Kafa's unique environment with national and international partners and support from the German government since 2006. NABU aims to ensure the conservation and restoration of the Afromontane cloud forests and wetlands to preserve ecosystem resilience and unique biodiversity, reduce $CO_2$ emissions and sustain ecosystem services for local communities.




The assessment was part of NABU's project 'Community Action for Biodiversity and Forest Conservation and Adaptation to Climate Change in the Wild Coffee Forests (CAFA)' supported by the German Federal Ministry for Economic Cooperation and Development (BMZ).

**NABU e.V.**
Charitéstraße 3
10117 Berlin
Germany
Africaprogramme@NABU.de
www.en.nabu.de

**NABU Ethiopia**
Trade Path International P.L.C.
Urael Street, Woreda 17/18
P.O. Box 62483
Addis Ababa
Ethiopia

german cooperation
DEUTSCHE ZUSAMMENARBEIT

ISBN 978-3-925815-31-7