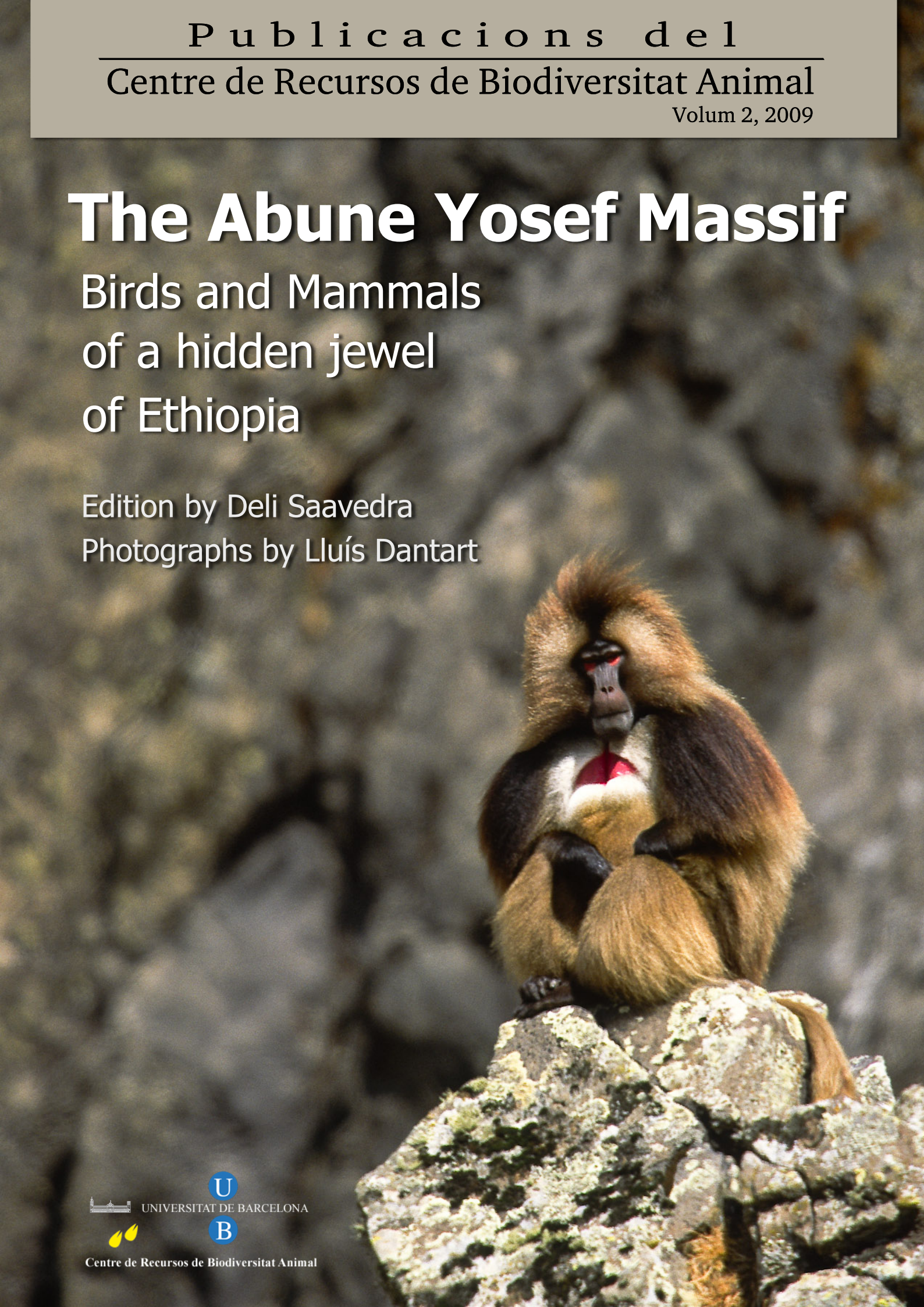
Publicacions del
Centre de Recursos de Biodiversitat Animal
Volum 2, 2009

The Abune Yosef Massif

Birds and Mammals of a hidden jewel of Ethiopia

Edition by Deli Saavedra
Photographs by Lluís Dantart



UNIVERSITAT DE BARCELONA
Centre de Recursos de Biodiversitat Animal

Publicacions del
Centre de Recursos de Biodiversitat Animal
Volum 2, 2009

THE ABUNE YOSEF MASSIF:
Birds and Mammals of a hidden jewel of Ethiopia

Editor: Deli Saavedra
Photographs: Lluís Dantart

UNIVERSITAT DE BARCELONA
Centre de Recursos de Biodiversitat Animal

April, 2009

Published by:

Centre de Recursos de Biodiversitat Animal
Facultat de Biologia
Universitat de Barcelona
Avinguda Diagonal 645
08028 Barcelona
Spain

crba@ub.edu
www.ub.edu/crba

Saavedra, D., et al. 2009. The Abune Yosef Massif. Birds and Mammals of a hidden jewel of Ethiopia. *Publicacions del Centre de Recursos de Biodiversitat Animal,* Volum 2, 131pp

Cover: *Theropithecus gelada*. Photograph by Lluís Dantart

INDEX

PREFACE

I. Foreword i
Antoni Serra
II. Tribute to Lluís Dantart iii

III. Executive summary / Resum / Resumen iv

IV. Contributors vii

CONTENTS

1. Expeditions and surveys 1
Raimon Mariné & Deli Saavedra
1.1. Description of camps 2
1.2. Methods for the study of the main vertebrate groups 5

2. Geographical area 9
Deli Saavedra & Raimon Mariné
2.1. Ethiopia 9
2.2. The Abune Yosef massif 13

3. Vegetation and Habitats 20
Deli Saavedra

4. The Mammals of the Abune Yosef 24
Deli Saavedra, Àngel Such-Sanz, Guillermo Díaz, Raimon Mariné, Íngrid Regalado, Marc López & Lluís Dantart
4.1. Introduction 24
4.2. Relevant species 25
4.3. Discussion 66
4.4. Checklist of the Mammals of the Abune Yosef massif 69

5. The Birds of the Abune Yosef 71
Deli Saavedra, Guillermo Díaz, Raimon Mariné & Oriol Armet
5.1. Introduction 71
5.2. Relevant species 71
5.3. The avifauna composition of the Abune Yosef massif 88
5.4. The importance of the Abune Yosef massif for bird conservation 92
5.5. Bird transects carried out in the Afroalpine ecosystem 93
5.6. Checklist of the Birds of the Abune Yosef massif 95

6. Other groups 100
Deli Saavedra

7. Main threats and conservation proposals 103
Deli Saavedra
7.1. Threats 103
7.2. Conservation proposals 107

8. Acknowledgements 111

9. References 112

I. Foreword

The organization and participation in expeditions to perform zoological studies is part of the scientific ideology of the Centre de Recursos de Biodiversitat Animal of the Facultat de Biologia of the Universitat de Barcelona from its very first origins. In fact, the embryo of the current collections, the historical collection, is formed by birds and mammals from the "Gabinete de Historia Natural", created in 1847 by Dr. Antonio Sánchez Comendador (1823-1888) Chair of Mineralogy and Zoology of the Universitat de Barcelona. This collection includes native specimens as well as many exotic ones that were partly collected during the "Comisión Científica del Pacífico", a Spanish expedition to America that was conducted between 1862 and 1866.

Far more recently, in 1998 and in collaboration with the Fundaçao Florestal de Sao Paulo, the CRBA carried out an expedition to the Brazilian Atlantic Rainforest with the aim of evaluating population densities of reptiles, birds and mammals in the area. The obtained results yielded a set of scientific papers that were published as a book in 2002.

The origins of the study presented in the current book started in 1998, when Guillermo Díaz and Carlos Mariné achieved a Biology degree at the Universitat de Barcelona and decided to climb all Ethiopian peaks above 4,000 m (14 overall). One of these peaks was the Abune Yosef (4,284 m) placed in the Northern area of Ethiopia, near the city of Lalibela. This massif left a deep impression in them both. They were amazed by the large amount of fauna they managed to observe but also by the almost total lack of biological and ecological knowledge of this Afroalpine ecosystem, the most endangered one in Africa.

The magical conjunction of natural and cultural values of great importance in Abune Yosef and Lalibela was the base for an idea that caught on during the following months: establishing a Biosphere Reserve in the area. The MAB (Man and Biosphere) Committee of the UNESCO grants this title to the areas where the conservation of biodiversity is combined with the sustainable development of local communities, jointly with research on their natural and cultural values.
The suggestion was well received by the MAB Committees of Ethiopia and Spain. This last institution sponsored three expeditions to the massif in 1999, 2000 and 2001, all of them carried out by Guillermo Díaz and Carlos Mariné.
In the 2001 expedition, Raimon Mariné and Deli Saavedra, biologists from the Universitat de Barcelona, joined the team. During this trip, new expeditions were planned. The aims of these new surveys would be the completion of an inventory of birds and mammals inhabiting the massif and the performance of a wide photographic report. This would allow the presentation of all the material in a book to publicize the natural and cultural values of the Abune Yosef massif.

This idea, arisen at 4000 metres above sea level, was put forward to the Centre de Recursos de Biodiversitat Animal, which gave a determined support to the initiative from the very beginning and got involved in the planning and execution of new expeditions. Finally, at the request of the CRBA, the Divisió de Ciències Experimentals i Matemàtiques of the Universitat de Barcelona sponsored two new expeditions that were carried out in 2002 and 2004.

This book is the outcome of the combined efforts performed in the Abune Yosef massif during the last years. It intends on becoming a compendium of some of the values of the area and its urgent need for management and conservation.

Antoni Serra
Director
Centre de Recursos de Biodiversitat Animal

II. Tribute to Lluís Dantart

Lluís Dantart i Puig (1962 – 2005), Curator of the Centre de Recursos de Biodiversitat Animal of the Facultat de Biologia of the Universitat de Barcelona, was deeply involved in the organization and performance of the expeditions to the Abune Yosef in Ethiopia.

From an early age, Lluís stood out by his love towards nature. This love made him compile his first collections of fossils and insects, particularly butterflies. Later on, he developed an interest on snails, which led him to publish several scientific works after he achieved a Biology degree at the Universitat de Barcelona. Some time after, he would start a PhD on Polyplacophora molluscs.

His other big passion was photography. His capability to observe and a remarkable sensitivity towards nature were joined with his deep technical and scientific knowledge on photography and fauna to yield a large amount of images. Many of his photographs constitute documents of both aesthetic and scientific value and some have been published in the most prestigious magazines.

In 1999 he became the Curator of the CRBA, where the results of his work still remain: exhibitors, prepared animals, boards, diagrams and exhibitions are good examples. He also promoted the courses and exhibitions of wildlife photography of the CRBA, a legacy that he left jointly with a large image archive.

His participation in the expeditions to the Abune Yosef massif allowed him to actively work on the scientific tasks and, at the same time, to produce a high quality photographic report. A compilation of these photographs was the core of the exhibition "The hidden treasures of the Abune Yosef. An expedition to the mountains of Ethiopia" that was inaugurated in 2003 in the CRBA. The publication of the current book would be, undoubtedly, a source of satisfaction for Lluís. From the very first moment, he believed in the necessity of sharing the obtained results with the scientific community and raising the conscience of society about the need to preserve the values of the Abune Yosef.

Let's consider this book, therefore, a homage to Lluís Dantart and a recognition to the fact that he succeeded in finding in nature and photography his great project for life: communicating knowledge through beauty.

III. Executive summary

The Abune Yosef massif (12º12' N, 39º12' E) is located north of the city of Lalibela, in the Wollo province of Ethiopia. The massif, with a maximum altitude of 4,284 m, is placed in the very extreme of the region known as the Western plateau. The Abune Yosef massif shows a complex mosaic of ecosystems, where bushlands, woodlands, montane dry forests and Afro-alpine grasslands are represented.

All the results provided in this monograph on the Abune Yosef massif birds and mammals were collected *in situ*, during the course of five different expeditions (3 – 7 weeks each), made between the years 1998 and 2004. All five visits to Abune Yosef were made during the dry season (usually from November to December), which probably biased the data collected for some species, but also increases the amount of other vertebrate species observed and made much easier the fieldwork. Some parts of the massif were intensively prospected, especially those located in afroalpine habitats (above 3700 m).

Information on mammals was obtained through transects, viewpoint observations, night drives through the lower areas and interviews to local people. Simultaneous census of Gelada and Ethiopian Wolf were conducted in 2002 from simultaneous viewpoints. For small mammals, the main methods of study were capture using Sherman traps and analyses of raptor pellets. Finally, mist nets were used to capture and identify bats.

Information on birds was obtained through direct observations, interviews to local people, passerine transects and capture of small birds using mist nets. The Bearded vulture was subject to a close monitoring of its numbers, movements and reproductive behaviour.

At least 43 mammal species, from 19 families and 9 orders, have been identified in the Abune Yosef massif. This represents 16% of the species, 49% of the families and 69% of the orders found in Ethiopia (YALDEN *et al.*, 1996). From the 32 endemic species known for Ethiopia and Eritrea (KRUSKOP & LAVRENCHENKO, 2000), 7 have been found in the massif (22%).

A total of 221 bird species, belonging to 48 families and 16 orders, have been identified in the Abune Yosef massif. That represents 24% of the species, 51% of the families and 70% of the orders found in Ethiopia (LEPAGE, 2006). From the 17 endemic species found in Ethiopia, 6 have been found in the massif (35%). Following the data of the Important Bird Areas of Ethiopia work (EWNHS, 1996), the Abune Yosef could be considered to be the second most important bird area in the country.

Abune Yosef is the largest area with afroalpine habitats left in North Wollo, but it is small in terms of carrying capacity and isolation. The main threats for this area are the loss of afroalpine habitats, which are already too small in size, the loss of forests and the overgrazing.

The main conservation measures that could help to preserve this enormous natural and cultural heritage are the development of ecotourism or wildlife tourism - with the use of the Ethiopian wolf and the large diversity of birds to attract visitors -, the promotion among local people of alternatives to the use of firewood, the support to the pastoralists, the protection of the area and the creation of corridors.

Resum

El massís d'Abune Yosef (12º12' N, 39º12' E) es troba emplaçat al nord de la ciutat de Lalibela, a la província etíop de Wollo. El massís, d'una alçada màxima de 4.284 m.s.n.m., se situa a l'extrem de la regió coneguda com a l'Altiplà Occidental. El massís d'Abune Yosef mostra un complex mosaic d'ecosistemes, on estan representats els matollars, les zones forestals, els boscos secs montans i les praderies afroalpines.

Tots els resultats presentats en aquest monogràfic sobre les aus i mamífers del massís de l'Abune Yosef van ser recollits *in situ* durant el transcurs de cinc expedicions diferents (d'entre tres i set setmanes cadascuna) dutes a terme entre els anys 1998 i 2004. Aquestes cinc visites a l'Abune Yosef es van realitzar durant l'estació seca (generalment entre novembre i desembre). Això potser va esbiaixar les dades recollides per algunes espècies però també va incrementar la quantitat total observada d'espècies d'altres vertebrats i va fer molt més fàcil la feina de camp. Algunes àrees del massís van ser prospectades amb intensitat, especialment aquelles situades en hàbitats afroalpins (per damunt dels 3.700 m.s.n.m.).

La informació referent a mamífers va ser obtinguda a través de transectes, observacions des de miradors, conduccions nocturnes a les àrees més baixes i entrevistes als habitants locals. L'any 2002 es van dur a terme censos simultanis de gelades i llops etíops des de miradors. En el cas dels micromamífers, els principals mètodes d'estudi van ser la captura mitjançant trampes de Sherman i l'anàlisi d'egagròpiles de rapinyaires. Finalment, es van utilitzar xarxes japoneses per capturar i identificar ratpenats. Les dades sobre aus es van obtenir mitjançant observacions directes, entrevistes als habitants locals, transectes de Passeriformes i captura de petits ocells fent servir xarxes japoneses. El trencalòs va ser objecte d'un seguiment intensiu del seu nombre, moviments i comportament reproductiu.

Han estat identificades un mínim de 43 espècies de mamífers, pertanyents a 19 famílies i 9 ordres diferents al massís d'Abune Yosef. Això representa el 16% de les espècies, el 49% de les famílies i el 69% dels ordres que es troben a Etiòpia (YALDEN *et al.*, 1996). De les 32 espècies endèmiques d'Etiòpia i Eritrea (KRUSKOP & LAVRENCHENKO, 2000), 7 han estat localitzades al massís (22%).

Un total de 221 espècies d'aus de 48 famílies i 16 ordres diferents han estat trobades al massís d'Abune Yosef. Això representa el 24% de les espècies, el 51% de les famílies i el 70% dels ordres registrats a Etiòpia (LEPAGE, 2006). De les 17 espècies endèmiques d'Etiòpia, 6 han estat identificades al massís (35%). Seguint les dades del treball Important Bird Areas of Ethiopia (EWNHS, 1996), l'Abune Yosef podria considerar-se la segona àrea més important per a les aus del país.

L'Abune Yosef és l'àrea més gran d'hàbitats afroalpins que queda a North Wollo, però és petita en termes de capacitat de càrrega i aïllament. Les amenaces més grans per aquesta àrea són la pèrdua d'hàbitats afroalpins, que són ja massa petits de mida, la pèrdua de bosc i la sobreexplotació de les pastures.

Les principals mesures de conservació que podrien ajudar a preservar aquest magnífic patrimoni natural i cultural són el desenvolupament de l'ecoturisme o turisme de natura –utilitzant el llop etíop i l'enorme diversitat d'avifauna per atraure als visitants -, la promoció entre els habitants locals d'alternatives a l'ús de la llenya, el recolzament als pastors, la protecció de l'àrea i la creació de corredors.

Resumen

El macizo de Abune Yosef (12º12' N, 39º12' E) está emplazado al norte de la ciudad de Lalibela, en la provincia etíope de Wollo. El macizo, con una altura máxima de 4.284 m.s.n.m., se sitúa al extremo de la región conocida como el Altiplano Occidental. El macizo de Abune Yosef muestra un complejo mosaico de ecosistemas, donde están representados los matorrales, las zonas forestales, los bosques secos montanos y las praderas afroalpinas.

Todos los resultados presentados en este monográfico sobre las aves y mamíferos del macizo del Abune Yosef fueron recogidos *in situ* durante el transcurso de cinco expediciones distintas (de entre tres y siete semanas cada una) llevadas a cabo entre los años 1998 y 2004. Estas cinco visitas al Abune Yosef fueron realizadas durante la estación seca (generalmente entre Noviembre y Diciembre). Esto quizás sesgó los datos recogidos para algunas especies pero también incrementó la cantidad total observada de especies de otros vertebrados e hizo mucho más fácil el trabajo de campo. Algunas áreas del macizo fueron prospectadas con intensidad, especialmente aquellas situadas en hábitats afroalpinos (por encima de los 3.700 m.s.n.m.).

La información referente a mamíferos se obtuvo a través de transectos, observaciones desde miradores, conducciones nocturnas en las áreas más bajas y entrevistas a la gente local. En 2002 se llevaron a cabo censos simultáneos de geladas y lobos etíopes desde miradores. En el caso de los micromamíferos, los principales métodos de estudio fueron la captura mediante trampas de Sherman y el examen de egagrópilas de aves de rapiña. Finalmente, se utilizaron redes japonesas para capturar e identificar murciélagos.

Los datos sobre aves se obtuvieron mediante observaciones directas, entrevistas a la gente local, transectos de Paseriformes y captura de pequeños pájaros utilizando redes japonesas. El quebrantahuesos fue objeto de un seguimiento intensivo de su número, movimientos y comportamiento reproductor.

Han sido identificadas un mínimo de 43 especies de mamíferos, pertenecientes a 19 familias y 9 órdenes distintos en el macizo de Abune Yosef. Esto representa el 16% de las especies, el 49% de las familias y el 69% de los órdenes que se encuentran en Etiopía (YALDEN *et al.*, 1996). De las 32 especies endémicas de Etiopía y Eritrea (KRUSKOP & LAVRENCHENKO, 2000), 7 han sido localizadas en el macizo (22%).

Un total de 221 especies de aves de 48 familias y 16 órdenes distintos han sido encontradas en el macizo de Abune Yosef. Esto representa el 24% de las especies, el 51% de las familias y el 70% de los órdenes registrados en Etiopía (LEPAGE, 2006). De las 17 especies endémicas de Etiopía, 6 han sido identificadas en el macizo (35%). Siguiendo los datos del trabajo Important Bird Areas of Ethiopia (EWNHS, 1996), el Abune Yosef podría considerarse la segunda área más importante para las aves del país.

El Abune Yosef es la mayor área de hábitats afroalpinos que queda en North Wollo, pero es pequeña en términos de capacidad de carga y aislamiento. Las mayores amenazas para esta área son la pérdida de hábitats afroalpinos, que son ya demasiado pequeños en tamaño, la pérdida de bosque y la sobreexplotación de los pastos.

Las principales medidas de conservación que podrían ayudar a preservar este magnífico patrimonio natural y cultural son el desarrollo del ecoturismo o turismo de naturaleza –utilizando el lobo etíope y la enorme diversidad de avifauna para atraer a los visitantes -, la promoción entre la gente local de alternativas al uso de leña, el apoyo a los pastores, la protección de la área y la creación de corredores.

IV. Contributors

Oriol Armet
Consorci de les Gavarres
oarmet@gavarres.cat

Lluís Dantart †
Centre de Recursos de Biodiversitat Animal
Facultat de Biologia
Universitat de Barcelona

Guillermo Díaz
Departament de Psiquiatria i Psicobiologia Clínica
Facultat de Psicologia
Universitat de Barcelona

Marc López
Departament de Biologia Animal
Facultat de Biologia
Universitat de Barcelona
mlroig@hotmail.com

Raimon Mariné
rmarine@comsa.com

Íngrid Regalado
Nusos, Activitats Científiques i Culturals
iregalado@nusos.net

Deli Saavedra
deli@solucionat.cat

Àngel Such-Sanz
Departament de Biologia Animal
Facultat de Biologia
Universitat de Barcelona
asuch@wanadoo.es
Forestal Catalana, S.A.
asuch@gencat.cat

From left to right: Lluís Dantart, Deli Saavedra, Raimon Mariné, Belayno Safew, Carles Mariné and Marc López

1. Expeditions and surveys

RAIMON MARINÉ & DELI SAAVEDRA

All the results provided in this monograph on the biodiversity of the Abune Yosef massif were collected *in situ* during the course of five different expeditions (3 – 7 weeks each), performed between the years 1998 and 2004. All five visits to the Abune Yosef were made during the dry season (usually between November and December), which made fieldwork much easier but might bias the data of certain species, increasing the number of some vertebrates. Surveys made during the dry season also provided information about the reproduction of several interesting species such as the Bearded vulture (*Gypaetus barbatus*).

The fieldwork teams were variable in number. They ranged between three (1998, 2000 and 2004) and six members (2001 and 2002), which allowed the intensification of fieldwork, increasing the number of workdays and the whole sampling effort in the massif.

All expeditions began in the city of Lalibela, where the different teams were supplied with food, porters and donkeys to carry the equipment. The trail to the Abune Yosef village begins in Lalibela.

During the trail leading to Abune Yosef (16 Km) and back to Lalibela, all visual records on vertebrates were registered and geographically referenced, and descriptions of vegetation types as well as preliminary locations of the main forests were taken. Pellets, excrements, tracks, signs and other data on vertebrate presence were also collected or recorded during these long hikes.

Car routes around the lower parts of the massif were driven at least once during each expedition, along the only paved road to the airport (Shumshiha area) or the gravel and windy road leading to Bilbala and Yimrihane forest. Car itineraries were followed at night, using spotlighting techniques particularly indicated to detect nocturnal mammals and owls.

Some parts of the massif were intensively prospected, especially localities placed in afroalpine habitats (above 3700 m. of height). Up to five camps were established in the different areas selected for the intensive surveys: Abune Yosef, Zigit, Abi Jacula, Wedebiye Abbo and Yimrihane (see also camp descriptions in Chapter 2). Although fieldwork was conducted during daylight hours, the use of viewpoints, photographic traps and mist nets at night allowed the detection of big mammals, night birds and bats.

Sitting by the fire at the end of the day

1.1. Description of camps

Abune Yosef camp

The first camp was placed in the village of Abune Yosef (1.5 hiking journeys away from Lalibela, 16 km), at 3,580 m. of altitude.. The area, located in the northwestern slopes of the Abune Yosef massif, is highly disturbed by human activities. Its relatively steep slopes are covered by a mosaic of barley cultures and scattered patches of medium sized grasses, shrubs, bushes (mainly *Senecio*) and lobelias. The village is surrounded by several rocky peaks, including the Abune Yosef peak and the highest point of the massif, the Aremgaremg peak. Several small villages are placed near Abune Yosef, and interaction with local people occasionally interfered with fieldwork.

Many interviews with local villagers (some of the expedition members spoke the Amharic language) showed some records of unidentified black cats in the area, and also periodical attacks against domestic cattle. For this reason, viewpoints were established in the highest parts of the area every day at dawn and dusk. Viewpoint techniques were supplemented with photographic traps for mammals and random itineraries in order to locate tracks, scats and latrines. At the same time, several members of the team installed mist nests and

Sherman traps, made observations on a Bearded vulture nest, analysed the number and composition of gelada groups or talked with local people about different species of interest.

Zigit camp

The second camp was installed between the Zigit peaks, at an altitude of 3,910 m. The Zigit camp was placed on the largest afroalpine plateau of the massif, becoming one of the most interesting locations for surveys. Three high peaks surround the area: the Big Zigit (4,080 m), the Small Zigit (4,035 m) and the Aremgaremg (4,284 m), providing impressive views over the afroalpine plateau.

Meteorological conditions in the Zigit camp were extreme, with maximum daytime temperatures close to 40 ºC and minimum temperatures during the night below –5ºC, which made the fieldwork pretty harsh.

The area has a rugged topography. The peak is a large crag surrounded by gorges and very steep slopes, where rocky blocks and stones are scattered all over. High tussocks of *Carex* sp., endemic giant lobelias and globe thistles cover the area. Several streams intersect this small area and provide a relatively high degree of humidity.

This area was subject to a particularly intensive research effort, because of the special interest of northern Ethiopia afroalpine plateaus and the lack of data on such habitats, but also due to the occurrence of several interesting species, especially the Ethiopian Wolf (*Canis simensis*). Field work was focused on the installation of mist nets, photographic traps, Shermann traps, monitoring of the reproduction effort of two Bearded vulture pairs, Geladas censuses, Ethiopian Wolf censuses, random itineraries for mammals tracks and signs, and several bird transects for passerines.

Abi Jacula camp

The third camp was located on the Abi Jacula plateau, at 3,300 m. of height. On the northern slope of the plateau lies the Abi Jacula forest, between 2,950 and 3,300 m of altitude. It is one of the last four woods of the Abune Yosef Massif, characterized by evergreen forest and bushes, *Erica arborea* and *Hypericum revolutum*. The camp was placed above the forest, on the small plateau (27 ha) of grasslands with isolated old-growth *Juniperus* individuals and giant cliffs on both sides. The fieldwork in Abi Jacula was mainly focused on bird and bat trapping with mist nets, but also mice trapping with Shermann traps. Caves and chinks occurring in the cliffs provide shelter to some species of bats, which were easily trapped at the top.

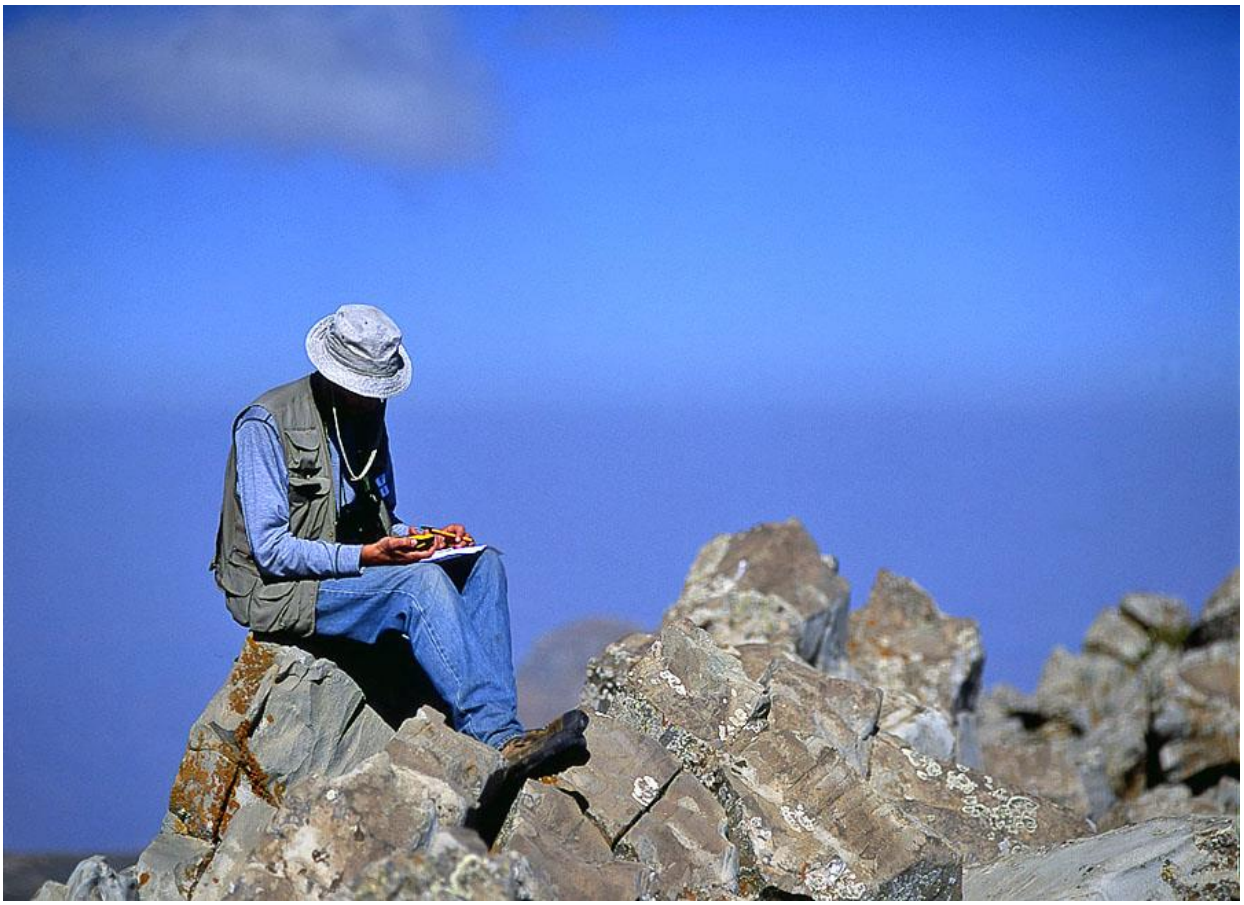
Wedebiye Abbo camp

Occasionally, a camp was set near the Wedebiye Abbo village, being the main interest of this area the presence of moorlands and stonewalls around the Abune Yosef trail. The camp was established for no longer than two days in the course of each expedition, and the main aim of the survey was obtaining information on small mammals (by using Sherman traps) and moorland birds (through mist nets).

Yimrihane camp

The last camp was set yearly in the Yimrihane forest, a few kilometres away from the village of Bilbala, at 2,660 m of height. Yimrihane is an ancient *Juniperus* forest with an extension of 44 ha. The presence of old growth trees and the scarcity of forest patches in the surroundings turn Yimrihane into an extremely interesting study site.

At the same time as fauna studies were performed, the cartography of the remaining forests was produced with the aim of setting the basis for future monitoring and prospecting. Moreover, the area still covered by afroalpine habitat was mapped and the main points of interest georeferred



Taking measurements for the cartography of the area

1.2. Methods for the study of the main vertebrate groups

Large mammals

The main habitats and altitudinal belts of the mountain ecosystems represented in the western side of the massif were visited to establish altitudinal patterns and ecological requirements for the most representative species. Information was obtained from sampling routes and viewpoint observations. Interviews with local authorities and villagers were used to provide additional and complementary data. A system of interconnecting itineraries was previously set, and the different itineraries were repeatedly covered. Surveys were performed between 6.00 and 18.00 h and occasionally until 22.30 by using artificial lighting. The modal time/day was 10 h. Direct observations (with 8x and 10x binoculars and a 20-60x spotting scope) and indirect evidences (e.g. scats, tracks, or bone remains) were recorded jointly with the altitude, type of habitat and local conservation status for each species. Rocky holes and cavities used by Leopards as storage or eating sites were examined for prey remains. *Ad libitum* notes on the animal's behaviour were also made when possible, especially with Gelada baboon groups, Ethiopian wolf and other species occasionally observed.

Direct observations using binoculars

Censuses of Gelada baboons and Ethiopian wolves were conducted during the surveys. Nevertheless, only 2002 data are showed within the results of this report, since the scarcity of available researchers during the first expeditions made results partial. In 1998, 2000, 2001 and 2004, all the observed Gelada baboon groups were counted. In 2002, however, a simultaneous census was conducted by counting individuals in all the known roosting places, especially around cliffs placed in the highest peaks within the massif. Movements and group composition were also analyzed by following the groups during daytime. Other variables related with social behaviour were also recorded. Censuses of Ethiopian wolves were conducted in 2002 from permanent simultaneous viewpoints that allowed a major cover (but still partial) of afroalpine habitats in the massif.

Between three and five photo traps were set in all the altitudinal stages prospected in the 2002 and 2004 expeditions, to obtain any evidence on nocturnal species of mammals.

In different occasions we had the opportunity to carry out night drives through the lower areas, using one spotlighting at each side of the car. Species such as the honey badger *(Mellivora capensis)* were observed only during theses night excursions. In 2004, two night transects covering 53.5 km were carried out with the aim of setting a rough approach to the density of Scrub Hare *(Lepus fagani)* in the lowlands around the Abune Yosef massif.

In order to analyze differences and similarities of the Abune Yosef mammal composition within the North-central massif district, we used ecological and faunistic data from the Simien Mountains. The Simien Mountains are located in the northwestern side of the North-central massif district of the Ethiopian Highlands. It is the best known and most thoroughly explored massif of the Northern Ethiopian Highlands, since it was established as a National Park in 1969. The Simien Mountains range in altitude from 1,500 to 4,500 m., and they contain a large variety of habitat types and montane ecosystems: open, dry bushlands; grasses and acacia woodlands; rocky areas; forests, alpine moorlands and cultivated land (NIVERGELT *et al.*, 1998). Ecologically, both Abune Yosef and Simien Mountains are relatively similar. In addition, we compared the faunal checklists of the Awash and Yangudi Rassa located in the Rift valley depression to obtain a more complete picture of faunal influences.

Small mammals

During the first years of fieldwork, the trapping effort for small mammals during the surveys was minimal. The reason for this unequal sampling effort is that the main goal of the first two expeditions was the obtaining of an inventory of the large mammals and bird species of the massif. Research on the small fauna was an additional activity to gain preliminary information: it was not systematically conducted but rather limited to the collection of skulls, dentitions and other remains from the floor, scats and pellets. Many species were caught by hand and native people brought some small mammals for our

research. Nevertheless, in 2002 and 2004, a more systematic trapping was performed around the Zigit camp, and our belief is that a reliable representation of the composition of small mammal communities of the afroalpine ecosystem of the Abune Yosef massif was obtained.

Traps were usually placed in the areas where the highest activity of the small mammal was detected (by visual inspection, alert calls). We did not capture using an equidistant network of traps since most of the species occurring in the area are distributed in an aggregated pattern, and we did not mark individuals in order to calculate densities. In fact, the main aim of the small mammal trapping was achieving a representative and accurate checklist of the species living in the afroalpine ecosystem.

Birds

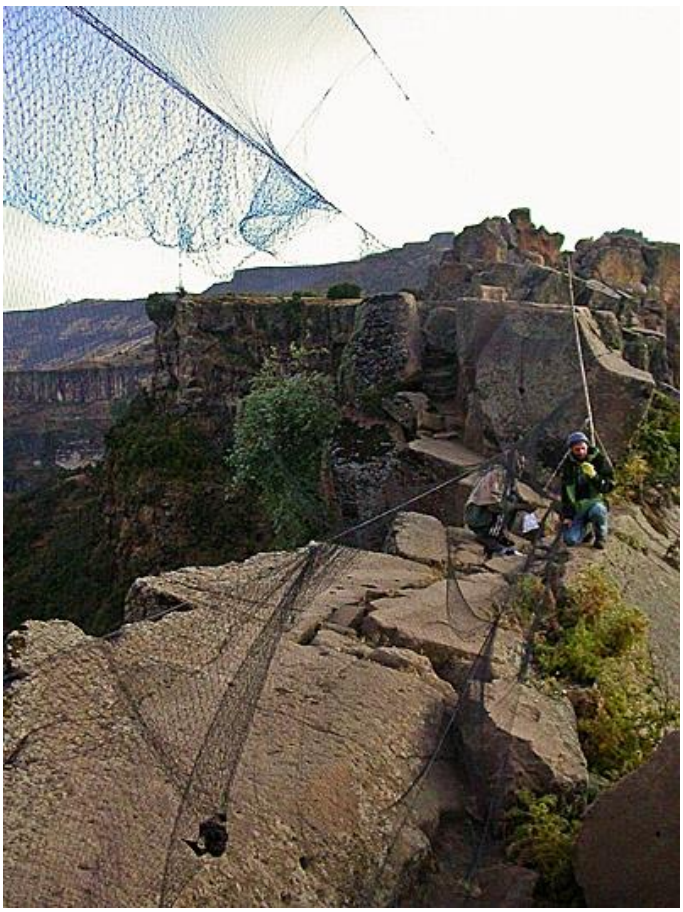
As stated for small mammals, the main goal of the bird study was yielding a representative and accurate checklist of the species occurring in the massif. During the surveys, most of the habitats and altitudinal belts of the Abune Yosef were visited to establish altitudinal patterns and ecological requirements for the most representative bird

Searching for vultures on the cliffs

species. Direct observations (with 8x and 10x binoculars and a 20-60x spotting scope) were recorded with the altitude, type of habitat and local conservation status for each species. Additional information was obtained from interviews to local people in the Amharic language. Mist nets were used to capture small birds, which were identified, measured, weighted, photographed and released again. Some bird transects for passerines were carried out in afroalpine habitats of the Zigit and Aremgaremg sites. Bearded vultures were subject to a close monitoring of its numbers, movements and reproductive behaviour.

Bats

The orographical characteristics of the Abune Yosef massif hinder the examination of caves and chasms. For this reason, the main method to capture bats was the use of mist nets. Capture index was quite low in some of the camps, due to the inexistence of passages or similar places to install the mist nets. Only in the Abi Jacula plateau the captures of bats were numerous and diverse.



Collecting specimens trapped with mist nets

2. Geographical area

DELI SAAVEDRA & RAIMON MARINÉ

2.1. Ethiopia

Physical geography

Ethiopia is located in the horn of Africa between 3º and 18º North latitude, 33º and 48º East longitude, lying within the tropics. It comprises an area of 1,127,127 km^2. The altitudinal variation ranges from 110 m below sea level in the Afar depression to 4,620 m above sea level at Ras Dashen, in the Simien Mountains. The Great Rift Valley runs from the northeast to the southwest of the country and separates the western and southeastern highlands. The highlands on each side of the rift valley give way to extensive semi-arid lowlands to the east, south and west of the country (PLANT GENETIC RESOURCES CENTRE, 1995).

One of the characteristics that distinguish Ethiopia from all other African countries is the extent of its high ground, or land placed at a high altitude. Ethiopia has 50% of all the afrotropical lands above 2,000 m and 80% of all the lands above 3,000 m (YALDEN & LARGEN, 1992).

Ethiopia is subdivided in three physicogeographical regions considering morphostructure, relief, climate, soil and vegetation: the Ethiopian Highland (also referred as the western plateau), the Ethiopian-Somalian Plateau (the eastern plateau) and the Rift valley (SOKOLOV *et al.*, 1997).

The highlands of Ethiopia are a huge volcanic dome formed from eruptions (70 to 5 millions years ago) that deposited a thick layer of basalt, up to 3,000 m deep. During the Pleistocene the high areas were glaciated. The most recent glaciers retreated within the last 10,000 years and in these areas, above 3,700 m, only thin soils have developed after the masses of ice disappeared. Between 3,300 and 3,700 m, the periglacial zone, deeper soils are present in the flatter areas (MALCOLM & TEFERA, 1997).

The Ethiopian Highland is placed in the northwestern part of Ethiopia and accounts for 43% of its territory. It is subdivided in natural orographical districts: the North-central massif, the Tigrean Plateau, the Shewan Plateau, the South-western Plateau, and the Mountain Plains (WOLDE-MARIAM, 1972). These districts have been isolated from each other by deep canyons and they are considered to be natural barriers, which has greatly influenced the development of their respective faunas.

Cliffs in the Abune Yosef massif

Climate

Ethiopia is a tropical country where the altitudinal variation produces varied macro and micro-climatic conditions that affect nature and humans and contribute to the formation of diverse ecosystems, which are inhabited by a large diversity of plant and animal life forms. The average annual rainfall patterns range from 500 mm to 2,800 mm. The climate in the highlands (areas above 1800 m) is mild and the annual precipitation ranges from 800 to 2200 mm. The lowlands are hot with annual rainfall varying from less than 200 to 800 mm; of the total area, 60 percent is reported suitable for agricultural purposes. The natural forest cover is about 2.4 percent of the total area (ENVIRONMENTAL PROTECTION AUTHORITY, 1998).

Ethiopia has diverse physical features that create a great variety of climatic conditions. The various latitudinal, climatic, edaphic and other conditions result in a multitude of agro-ecological zones. The traditional climatic zones and their physical characteristics include *Bereha* (hot arid, altitude below 800 m and rainfall below 200 mm), *Kolla* (warm semi-arid, 800 – 1,500 m of height and rainfall 200 - 800 mm), *Woina Dega* (cool sub-humid, 1,500 – 2,300 m and rainfall 800 - 1200 mm), *Dega* (cool humid, 2,300 – 3,000 m and rainfall

1200 - 2200 mm) and *Wurch* (cold and moist, altitude higher than 3,000 m and rainfall above 2200 mm).

Flora

The Horn of Africa could be designated as a world hotspot, as it holds more than 7000 plants and a high number of endemic plants (1500 species), mammals and birds (VIVERO *et al.*, in press).

The flora of Ethiopia is estimated to comprise between 6,500 and 7,000 species, of which about 10% are considered to be endemic. There are, however, large differences between provinces. Arsi and Shewa are the richest areas in terms of endemisms and Welo has the lowest afroalpine endemic richness. This is odd, since this province has more than 4000 km^2 above 3000 m and three peaks over 4000 m, representing 18% of the total for Ethiopia and Eritrea (YALDEN, 1983). For VIVERO *et al.* (in press), the explanation could be that this apparent coldspot has been overlooked by botanists, but it surely holds an important afroalpine flora yet to be discovered in mountains such as the Abune Yosef, Delanta and Amba Farit, thus further collecting trips are recommended. Recent research in the Abune Yosef has contributed to the taxonomy of afroalpine *Senecio* (ORTIZ & VIVERO, 2005).

Ethiopia is one of the twelve known ancient countries for crop plant diversities in the world. It has valuable reserves of crop genetic diversity and 11 cultivated crops have their centre of diversity in the country.

Fauna

The fauna is also highly diverse. About 277 species of mammals (31 endemics), 861 species of birds (17 endemics), 201 reptile species (over 87 snakes, 101 lizards and 13 tortoises and turtles), 63 species of amphibians, 145 species of freshwater fish and 324 species of butterflies are known from Ethiopia.

The level of endemicity of a country depends on arbitrary political divisions, which generally have nothing in common with biological or ecosystem divisions. But in Ethiopia, political and ecological divisions are somehow related, and the country holds a high degree of endemicity on fauna, with 31 endemic mammals or 17 endemic birds. After Eritrea's independence in 1993, Ethiopia has less endemic species; as for some, the range is now shared by both countries (passing, for example, from 30 to 17 endemic bird species).

People

Ethiopia has an estimated population of approximately 53 million, and about 88 percent of the total population is considered to be rural dwellers. The estimated population growth is about 2.9 percent per annum. The main city is Addis Ababa, the capital, with 2.3 millions of inhabitants. The Ethiopian highlands (above 1,800 m of altitude), which cover 37 percent of the total area, are inhabited by about 77 percent of the population. Hence, the highlands of the country are densely populated, resulting in over-grazing and severe degradation of the vegetation. The lowlands, on the other hand, being affected by insufficient rainfall and high temperatures are sparsely populated.

The main ethnic groups in Ethiopia are the Oromo (35%), the Amhara (30%), the Tigre (6.3%), the Somali (6%), the Sidama (6%) and the Gurage (4%), but there are more than 80 different ethnic groups within Ethiopia. Some of these have as few as 10,000 members. The main religions are Muslim (45%) and Ethiopian Orthodox Christian (45%). In general, most of the Christians live in the highlands, while Muslims and adherents of traditional African religions tend to inhabit lowland regions (US DEPARTMENT OF STATE, 2003).

Countryman labouring in a field

Economy and development

Ethiopia is a developing country, with a per capita income of only 110 US$. The Ethiopian economy is based on agriculture, which contributes 45% to GNP and more than 80% of exports, and employs 85% of the population. The major agricultural export crop is coffee, providing 65%-75% of Ethiopia's foreign exchange earnings.

The rural areas of Ethiopia suffer from inadequate social and economic investment. Education levels are very low, and health facilities are inadequate. Eighty five percent of the rural people are illiterate. Only 10 percent of the rural population has access to potable water, while human waste disposal facilities in the rural areas are non-existent. Low levels of nutrition affect the productivity of the rural populations. For example, the caloric intake of the population is 16 percent lower than the 2,100 Kcal that have been set by the World Health Organization as the minimal acceptable weighted average calorie needs. Besides malnutrition, lack of safe drinking water and poor environmental sanitation are major causes of health problems in Ethiopia, much so in the arid, semi-arid and dry sub-humid parts. Health services are also limited and reach only 46 percent of the population. As a result, infant mortality and overall death rate are high, while average life expectancy at birth is 47 years. There is a limited access to post and telecommunication facilities, while electricity is a luxury not accessible to rural populations. Ethiopia is also one of the countries in Africa that has the lowest road density.

2.2. The Abune Yosef massif

Physical geography

The Abune Yosef massif (12º12'N, 39º12'E) is located north of city of Lalibela in the Wollo province. The massif, with a maximum altitude of 4,284 m, is placed on the very extreme of the northeastern side of the Ethiopian Highland physicogeographical region (also referred to as the western plateau). The Abune Yosef massif is part of the mountainous system surrounding and defining the upper Takezze river, and it is limited to the east by the fault escarpment of the Rift valley depression. The ridge continues northwards to the Tigrean Plateau through lower systems and westwards to the Simien Mountains (4,600 m of height), to which it is connected by a chain of lower mountain systems (1,000–2,000m).

The Abune Yosef massif, as considered in the current work, reaches 2,000 m of altitude in the western part, including Shumshiha (Lalibela airport area) and the area placed around the road Lalibela – Bilbala. Figure 2.1 on page 18 shows a detailed map of the area.

Gelada baboons on the steep cliffs

Climate

The climate of the area can be divided into two main seasons: a wet season from June to early September, and a dry season from mid-September to May. Annual rainfall averages some 2,000 mm, mostly falling between July and September. Short rains might fall in any month of the year, but particularly in March.

Description of most cited localities

Abi Jacula forest. UTM: 509893/1331680 3,100 m

The Abi Jacula forest, located in the southwestern side of the massif, at an altitude between 2,950 m and 3,300 m, corresponds to the upper level of the montane dry forest ecosystem. It is one of the relatively large forested patches that still remain in the massif, but it is under a growing human intervention (wood collection and livestock grazing along the edges). Central parts of the forest are less disturbed because they are densely

vegetated. The dominant species is *Erica arborea,* but also *Hypericum revolutum*, *Rosa abyssinica,* etc. are relatively widespread and common species. The forest, placed on a northwestern slope, densely vegetated and enclosed within the Abi Jacula escarpment, provides a relatively high degree of humidity in relation to the drier surroundings. The forest sustains a large diversity of mammals and birds.

***Abi Jacula plateau*.** UTM: 510055/1331291 3,290 m

This small plateau is situated above the Abi Jacula forest. It consists on two long and narrow plateaus divided by a very narrow pass, and surrounded by medium to high ridges (20 - 80 meters). Both plateaus jointly measure around 27 hectares. The area is covered by grasslands with scattered bushes (mainly *Hypericum revolutum*). The main trail from Lalibela to Abune Yosef crosses the Abi Jacula plateau, having there a difficult pass that was arranged some years ago to facilitate the climbing of the ridge just between the two semi-plateaus.

Mists cover the valleys

Abune Yosef. UTM: 520836/1343983 3,580 m

The area of the Abune Yosef village is on the northwestern slopes of the massif between 3,300 and 3,600 m. The eastern part is entirely cultivated, mainly with barley crops, onions, potatoes and lentils. The western part is relatively untouched because it is dominated by large, vertical cliffs and presents very steep slopes. The degree of humidity is high and there are several streams intersecting the area. Not heavily grazed, it has a relative high ground cover of tall grasses, giant lobelias and different thistles. At 3,300 m the *Erica* timberline has almost entirely disappeared.

Aremgarem. UTM: 520003/1342216 4,284 m

The summit, named Aremgarem, is a large crag with some patches of afro-alpine short-grasses (*Poa* and *Agrostis* species) and scattered with endemic giant lobelias (*Lobelia rhynchopetalum*). The peak is the highest point of the escarpment, which divides dramatically the steep northern slopes and the plain, moderately steep, and largest plateau of the Aremgarem. The plateau is heavily over-grazed.

Astokual. UTM: 519680/1344350 3,600 m

Small forested patch in the northern part of Abune Yosef massif, ranging from 3,450 to 3,700 m and dominated by *Erica arborea*.

Gromail. UTM: 515956/1342885 3,668 m

It forms the biggest forested patch in the Abune Yosef massif, with more than 180 hectares. It is situated in the northwestern part of the massif and ranges from 3,300 to 3,800 m. The vegetation is similar to that of Abi Jacula, but the tree shaped vegetation clearly dominates over the shrubs, with big examples of *Hypericum revolutum*. The proximity of the Gromail forest to the Big Zigit peak confers an enormous landscape value to the whole area.

Wedebiye Abbo. UTM: 513857/1339215 3,625 m

Small plain located on the western slopes of the Kechinababa valley, at an altitude of 3,625 m. The plain is enclosed in its southwestern part by the Wedebiye escarpment and it encounters, to the west, a chain of steep hills about 3,800 m high. To the north, the highest afroalpine plateaus of the massif, the Zigit and the Aremgarem, delimit the area. The area is highly disturbed by human activities. There are small settlements along the

plain, cultivations (particularly barley crops) and overgrazed prairies. Introduced *Eucaliptus* trees and invasive plants have largely replaced natural vegetation.

Koro. UTM: 506544/1330956 2,500 m

Rocky and steep area, with small barley crops between big boulders, in the trail connecting Lalibela with Medage. The area is also used as a quarry, from which rocks are manually extracted for house and road construction.

Lalibela. UTM: 504994/1330724 2,520 m

Lalibela is the second of Ethiopia's holiest cities, only after Aksum. It is known around the world for its 12 monolithic churches, carved in the rock. UNESCO named the churches to its World Heritage List in 1978. Lalibela is the main city in the Abune Yosef area, with more than 15,000 inhabitants in 2005. Population growth is high, since, according to the national census, the city had a population of 8,484 inhabitants in 1994.

Medage. UTM: 507517/1332220 2,500 m

Small village placed 3 km northeast from Lalibela. Medage is set near a small river and it holds a complete and well-maintained system of irrigation that allowed the plantation of hundreds of trees and shrubs. From the top of the ridge, Medage appears as a forested island in the middle of a mosaic of barley cultivations and bushlands. A few relict patches of riverine woodlands still exist along the creeks that descend from Medage to the west.

Shumshisa. UTM: 498820/1325400 2,100 m

Area situated in the lowlands of the Abune Yosef massif. The main landscape is a hilly dry *Acacia* woodland, with some agricultural fields and heavily overgrazed in some areas. The airport of Lalibela is located in this area.

Yimrihane. UTM: 507858/1342004 2,662 m

The last forest with big trees of the Abune Yosef massif is Yimrihane forest, which still remains thanks to its status of sacred forest. At the lower part of the forest, under a big cavern, the beautiful Yimrihane church is located. Imposing *Juniperus*, surely centenaries,

Inside the sacred Yimrihane forest

with trunk diameters over a meter and heights above 30 meters, composes this tree-heather forest. It can be considered a monumental forest, regardless of its reduced size (less than 50 hectares).

Zigit (camp). UTM: 517347/1344321 3,909 m

It is placed at the headwaters of the Zigit creek, which, with other creeks, forms the beginning of the Kechinababa river. It is placed a few meters away from the low escarpment (10 – 30 m) almost continuous (W-E) that ranges from Zigit to the Abune Yosef pass. The main landscape around the camp is an open, flat and moderately grazed mosaic of grass steppe (*Poa* and *Carex*), *Senecio* shrubs and giant lobelias (*Lobelia rhynchopetalum*).

Zigit (Big and Small) Big. UTM: 516640/1345130 4,080 m;
Small. UTM: 516739/1344008 4,035 m

The Zigit area is placed on the northwestern side of the massif. The area has a rugged topography. Both peaks are large crags surrounded by gorges and very steep slopes, where rocky blocks and stones are scattered all over. The area is covered by high tussocks of *Carex* sp. (about 50 cm.), endemic giant lobelias (*Lobelia rhynchopetalum*) and globe thistles (*Echinops giganteum*).

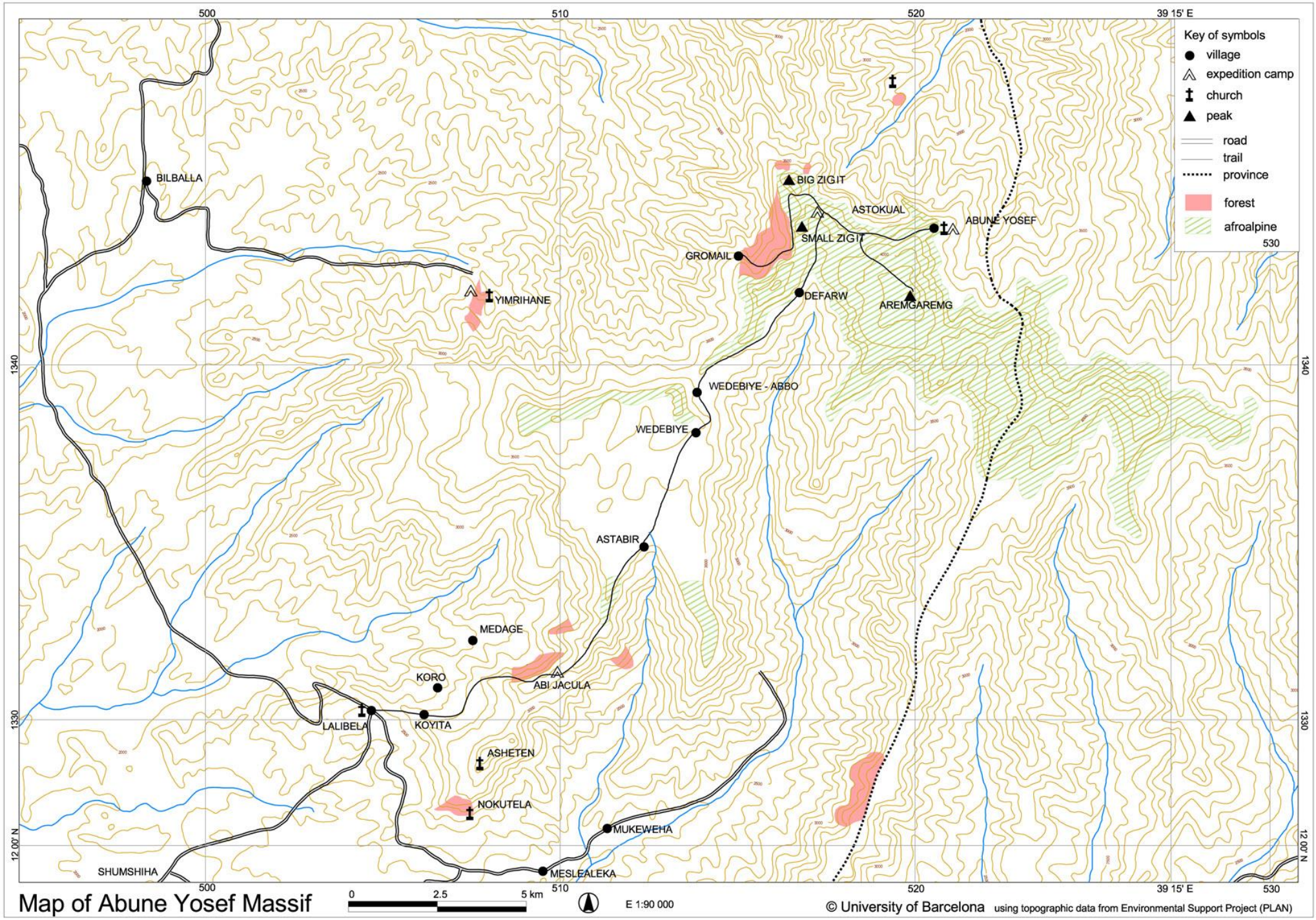


Figure 2.1.- Map of the Abune Yosef Massif made by D. Saavedra and L. Dantart based on topographic data from Plan International.

3. Vegetation and Habitats

DELI SAAVEDRA & GUILLERMO DÍAZ

The Abune Yosef massif shows a complex mosaic of ecosystems where bushlands, woodlands, montane dry forests and afroalpine grasslands are represented. These ecosystems suffer diverse levels of human intervention (mainly agricultural activities and livestock grazing) that have dramatically modified their natural (primary) conditions. The human impact is lower at the highest altitudes, whereas large areas of the middle and lower altitudinal belts are highly modified.

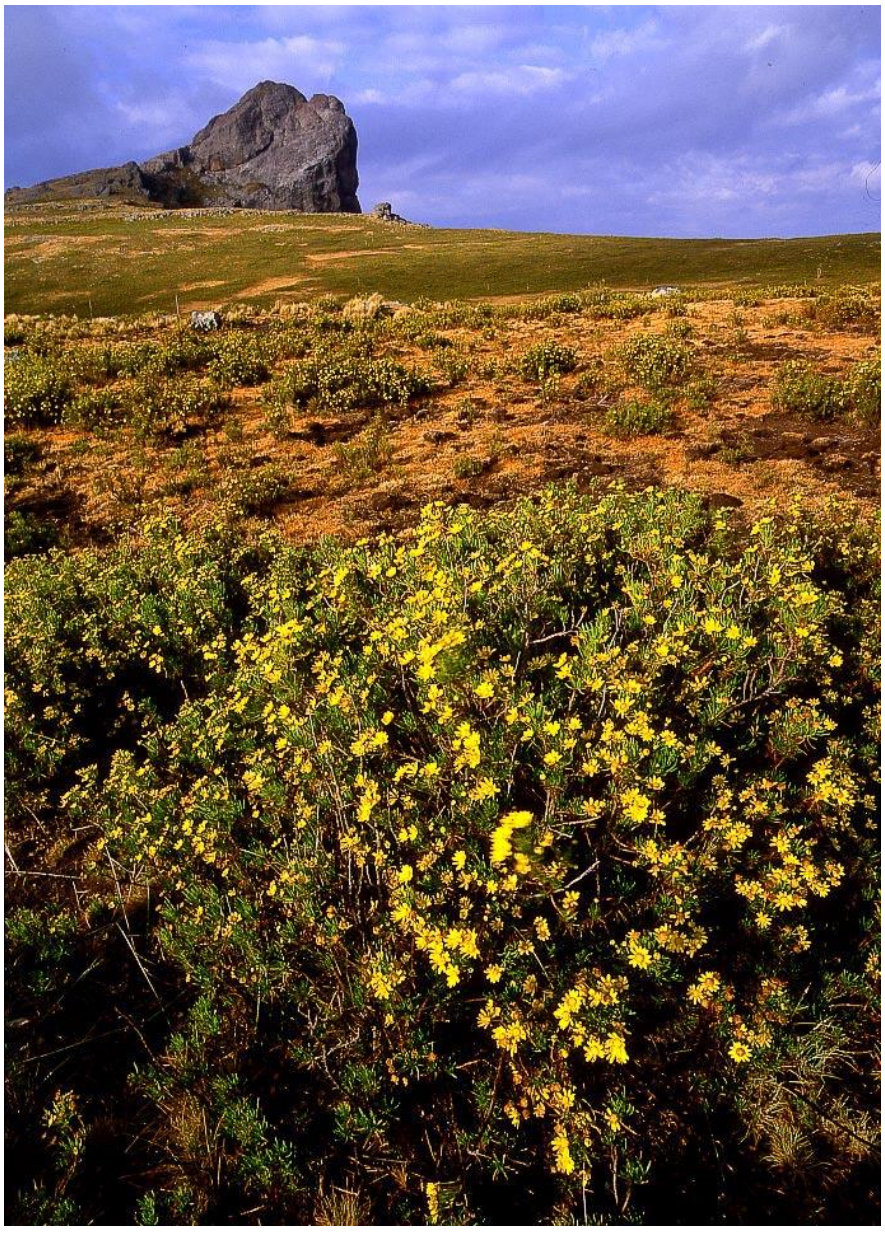
Savannah landscape

Three main ecosystems are represented in the massif: the montane savannah-woodland, the montane dry forest and the afroalpine ecosystem, which are sorted in altitudinal belts ranging from 2,000 to 4,280 m of height (Figure 3.1 on page 22).

The lower altitudinal belt belongs to the ecoclimatic zone known in Ethiopia as Woina Dega. This moderately warm zone is found at elevations between 1,800 and 2,500 m, and it contains the savannah acacia-woodlands and the lower range of the mountain forest

ecosystem. Savannahs are not well represented. The natural vegetation of the acacia-woodland complex is constituted by *Acacia abyssinica*, *Acacia tortilis*, *Croton macrostachys, Cordia abyssinica* and several large grasses. The evergreen forest species are mainly represented by *Juniperus procera, Olea africana*, and *Dodone viscosa*. In fact, the area shows a complex mosaic of bushlands and cultivations with scattered, relatively untouched, woodland (forested) areas.

The most humid and temperate belt, the Dega, is placed between 2,500 and 3,500 m of altitude. Evergreen forests and bushes of *Juniperus procera, Olea africana, Hagenia abyssinica,* and *Euclea schimperi* characterize this zone. At the highest altitudes, juniper thickets gradually give way to *Erica arborea* and *Hypericum revolutum* dwarf forests. In the massif, this is by a long way the most transformed belt. There are a few patches where natural vegetation is still represented (e.g. the Abi Jacula or the Yimrihane *Juniperus* forests).



Senecio shrubs in the afroalpine ecosystem

Above 3,500 m, the Wurch (alpine) zone occurs, represented by the afroalpine ecosystem. The afrosubalpine vegetation is characterized by species of the genera *Alchemilla, Potentilla, Helychrisum, Senecio*, *Carex*, *Poa, Festuca, Agrostis* and the endemic giant Lobelia (*Lobelia rhynchopetalum*).

In the Abune Yosef massif, the afroalpine ecosystem has been reduced over the last decades, as in most of Ethiopian highlands, and it currently remains above 3,700 m only. We have calculated that no more than 5,000 ha of the massif are still covered by the afroalpine ecosystem.

The vegetation of the afroalpine area consists mainly on large extensions of *Senecio* shrubs with scattered patches of grasslands and rocky areas. On the northern slopes, grasslands dominate (with *Poa, Agrostis, Carex, Festuca …)*, most of them with short grasses due to heavy overgrazing. Only some areas, characterized by very steep slopes and a high degree of humidity, have long grasses. The moderately steep and large plateau of the Aremgarem is the only place where the giant Lobelias are abundant, with densities ranging from 800 to 2500 plants per hectare.

Giant lobelias (Lobelia rhynchopetalum) on the Aremgarem plateau

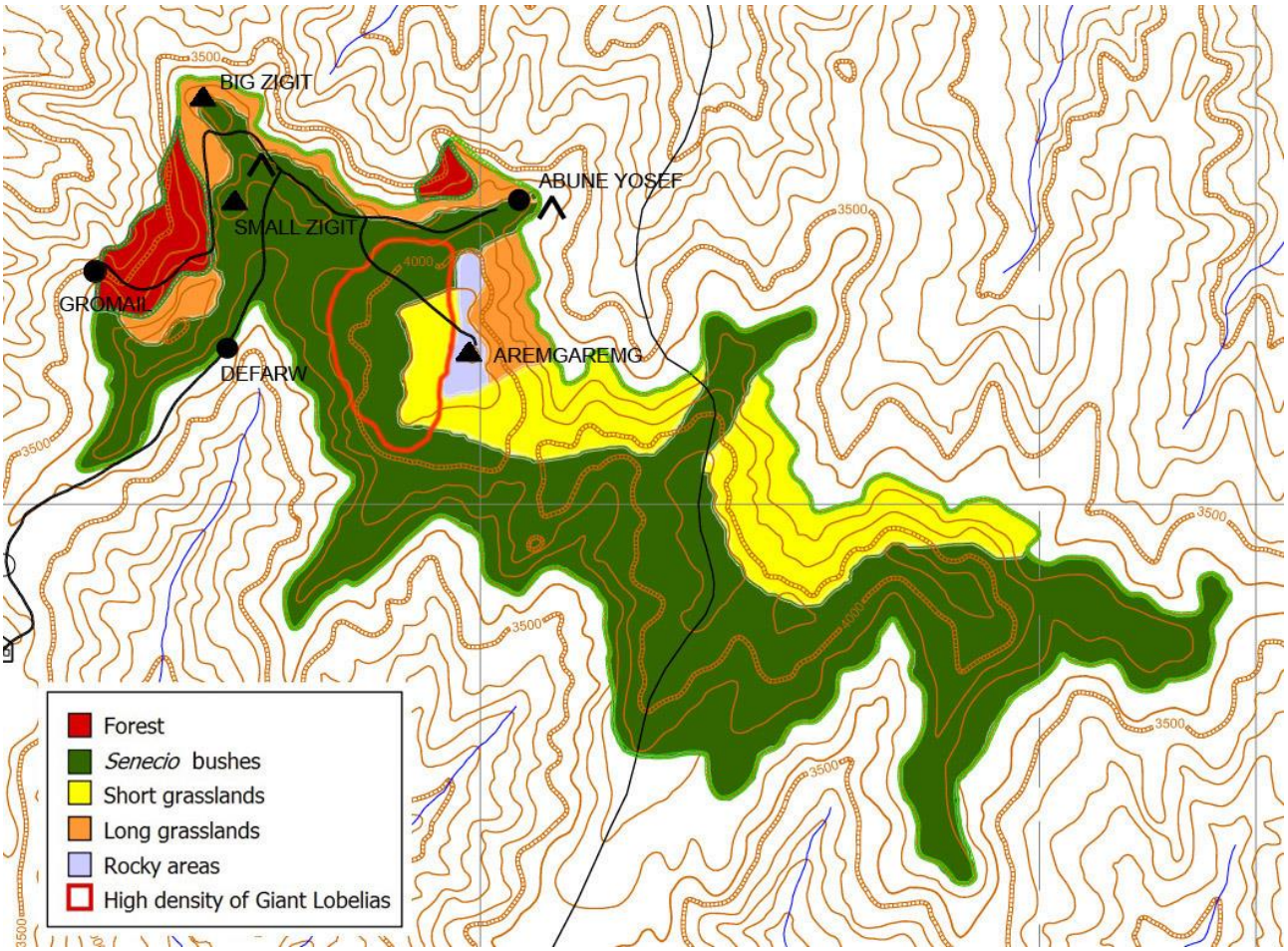


Figure 3.1.- Vegetation structure of the Abune Yosef afroalpine ecosystem. Data were gathered by observing the landscape through binoculars from different lookouts and during the wildlife fieldwork. (*Note: within Senecio areas there are many scattered grasslands or rocky patches that have not been represented in this map*).

4. The Mammals of the Abune Yosef

DELI SAAVEDRA, ÀNGEL SUCH-SANZ, GUILLERMO DÍAZ, RAIMON MARINÉ, ÍNGRID REGALADO, MARC LÓPEZ & LLUÍS DANTART

4.1. Introduction

The variety of ecosystems and complicated topography of Ethiopia provide a wide spectrum of habitat types and ecological niches for many mammal species. Such an ecological complexity is one of the main reasons that explain why Ethiopia holds one of the highest diversities of mammals (277 terrestrial species) and endemicity levels (30 endemic species) in Africa (HILLMAN, 1993).

However, these numbers are still considered to be provisional and the knowledge of the ecology, distribution and conservation of the Ethiopian mammals is fragmentary. Huge areas remain biologically unexplored, particularly in the highlands of Wollo, Begemdir and Shoa (YALDEN & LARGEN, 1992). Past political instability in the region and the difficult access to the remote inland areas have hampered efforts made to complete the scientific knowledge of unique montane and afroalpine ecosystems.

In addition, this still incompletely known biodiversity richness is seriously threatened. Much of the Ethiopian landscape from sea level up to 4,000 m is altered by agricultural activities, deforestation and overgrazing in order to fit the basic needs of a growing human population (HILLMAN, 1993). This habitat deterioration is particularly menacing the unique afroalpine ecosystems and, as a consequence, the populations of several endemic threatened montane mammals such as the Ethiopian wolf (*Canis simensis*), the walia ibex (*Capra walia*) or the gelada baboon (*Theropithecus gelada*).

For these reasons, studies and conservation of montane and afroalpine mammals are urgently needed. The aim of this work is achieving further knowledge on the species of the Abune Yosef massif and its conservation status in order to facilitate the identification of the conservation priorities for this area. No studies on mammals have been previously carried out in the massif, with the exception of brief surveys on the Ethiopian wolf conducted by Marino and by other members of the Ethiopian Wolf Conservation Programme (MARINO *et al.*, 1999; MARINO, 2003a).

In this text, we follow the same notation as YALDEN *et al.* 1996. For each species, we use the following acronyms to designate its zoogeographic category: E = endemic from Ethiopia; EAM = East African Montane; SA = Somali arid; WAS = West african savanna;

PAS = Pan-african savanna; EAF = East African forest; SS = Saharo-sindian; U = Unclassified. We also use the same names (unless more recent references modify this notation) and taxonomical order.

4.2. Relevant species

At least 43 different mammal species belonging to 19 families and 9 orders have been detected in the Abune Yosef massif. This means 16% of the terrestrial mammal species, 49% of the families and the 69% of the orders found in Ethiopia (YALDEN *et al.*, 1996). From the 32 endemic species known for Ethiopia and Eritrea (KRUSKOP & LAVRENCHENKO, 2000), 7 have been found in the massif (22%).

Order Insectivora

Family Soricidae

Bailey's shrew *Crocidura baileyi* (Heuglin, 1877). (E)

The Bailey's shrew is an endemic species from Ethiopia (YALDEN & LARGEN, 1992; YALDEN *et al.*, 1996), being restricted to the western Plateau in the Simien National Park (DIPPENAAR, 1980; YALDEN *et al.*, 1996).

It is a medium size shrew, characterized by the bicoloured tail, being brown in the dorsal part and whitish in the ventral one (Yalden *et al.*, 1976; YALDEN & LARGEN, 1992). It is not possible to distinguish its cranium from that of *Crocidura fumosa*, since both are of similar size (I^1-M^3: 9.3-10.8 mm) (YALDEN *et al.*, 1976). It can be distinguished from *C. fumosa* by the contrasted bicoloured hair in *C. baileyi* and the little contrasted fur of *C. fumosa* (YALDEN *et al.*, 1976). The description (Figure 4.1) and measures (Table 4.1) of the individuals captured during our survey agree with those previously accounted for the species (YALDEN *et al.*, 1976; YALDEN AND LARGEN, 1992).

Crocidura baileyi is characteristic of high-altitude grassland habitats (YALDEN & LARGEN, 1992), being recorded between 2700 and 3300 m (YALDEN *et al.*, 1996). More recent works

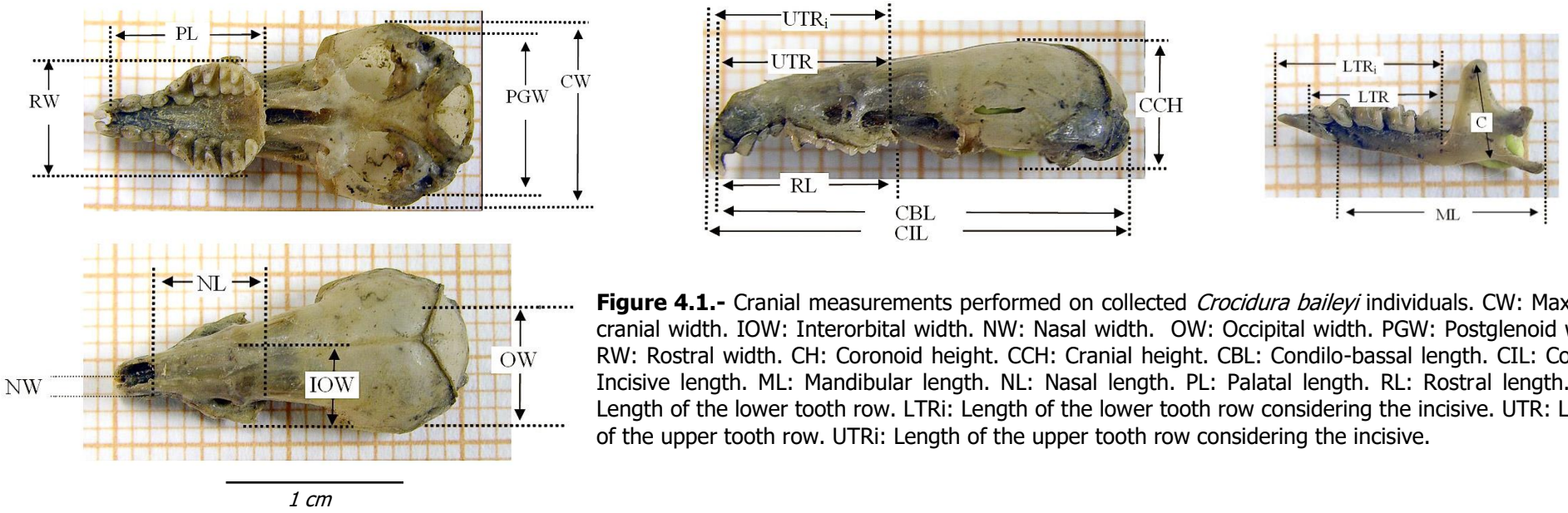


Figure 4.1.- Cranial measurements performed on collected *Crocidura baileyi* individuals. CW: Maximum cranial width. IOW: Interorbital width. NW: Nasal width. OW: Occipital width. PGW: Postglenoid width. RW: Rostral width. CH: Coronoid height. CCH: Cranial height. CBL: Condilo-bassal length. CIL: Condilo-Incisive length. ML: Mandibular length. NL: Nasal length. PL: Palatal length. RL: Rostral length. LTR: Length of the lower tooth row. LTRi: Length of the lower tooth row considering the incisive. UTR: Length of the upper tooth row. UTRi: Length of the upper tooth row considering the incisive.

Table 4.1.- Results of the cranial measurements performed on collected *Crocidura baileyi* individuals. CRBA is the collection number of the specimens deposited at the Centre de Recursos de Biodiversitat Animal of the Universitat de Barcelona. "-" means that the conservation status of the specimen's cranium did not allow its measurement. The Table shows the minimum, the maximum, the mean and the standard deviation. All measures are given in millimetres. Measurements are described in Figure 4.1.

CRBA	Species	CW	IOW	NW	OW	PGW	RW	CH	CCH	CBL	CIL	ML	NL	PL	RL	LTR	LTRi	UTR	UTRi
CRBA340	*C. b.*	9.60	4.40	1.10	7.00	6.40	6.50	5.00	5.90	19.80	20.30	10.50	2.00	8.20	8.60	6.10	7.20	8.40	9.00
CRBA346	*C. b.*	9.83	4.60	1.10	7.45	5.40	6.57	5.10	5.89	19.37	20.87	10.80	-	8.79	7.62	6.43	8.68	8.85	9.53
CRBA347	*C. b.*	9.51	4.53	1.20	7.26	6.41	6.51	5.08	5.91	19.92	20.95	10.59	-	8.31	7.85	6.33	8.64	8.77	9.54
	Min	**9.51**	**4.40**	**1.10**	**7.00**	**5.40**	**6.50**	**5.00**	**5.89**	**19.37**	**20.30**	**10.50**		**8.20**	**7.62**	**6.10**	**7.20**	**8.40**	**9.00**
	Max	**9.83**	**4.60**	**1.20**	**7.45**	**6.41**	**6.57**	**5.10**	**5.91**	**19.92**	**20.95**	**10.80**		**8.79**	**8.60**	**6.43**	**8.68**	**8.85**	**9.54**
	Mean	**9.65**	**4.51**	**1.13**	**7.24**	**6.07**	**6.53**	**5.06**	**5.90**	**19.70**	**20.71**	**10.63**		**8.43**	**8.02**	**6.29**	**8.17**	**8.67**	**9.36**
	SD	**0.17**	**0.10**	**0.06**	**0.23**	**0.58**	**0.04**	**0.05**	**0.01**	**0.29**	**0.35**	**0.15**		**0.31**	**0.51**	**0.17**	**0.84**	**0.24**	**0.31**

found the species on the Gich plateau, at altitudes comprised between 3550 and 3750 m, but not at Dirni Camp, between 2700 and 2850 m, in the Simen Mountains National Park (GÜTTINGER *et al.*, 1998). According to results provided by GÜTTINGER *et al.* (1998) in the Simien Mountains, the species shows a rather strong preference for humid, long-grass covered habitats of the afroalpine plateau, being restricted to natural or seminatural habitats.

Three specimens were captured around Zigit camp, at 3910 m, which slightly increases the upper altitudinal limit of the species.

This species is considered as 'Near threatened' by the IUCN Red List, with an uncertain population trend. The major threats affecting the species are habitat loss/degradation by agriculture practices and its restricted distribution range. Conservation measure proposed by the IUCN is the creation of protected areas (LAVRENCHENKO, 2004c).

Order Chiroptera

Data on bats gathered during the Abune Yosef surveys are still being processed and studied. For this reason, only the name of the species (provisional in some cases) and the data of individuals captured with mist nets are included in this monograph.

Family Rhinolophidae

Horseshoe bat (*Rhinolophus sp.)*

Table 4.2.- Details of the *Rhinolophus* sp. individuals captured during the surveys. Sex: m – male, f – female; FA: forearm length in mm; 3rd: length of the third metacarpal in mm; 5th: length of the fifth metacarpal in mm; Site: place where the specimen was collected; Alt: altitude of the site in m above sea level; Code: expedition code assigned to the specimen.

Sex	FA	3rd	5th	Site	Alt	Code
m	52.62	79.67	66.13	Abi Jacula	3300	02120702
f	52.2	83.92	65.06	Abi Jacula	3300	02120701

Family Vespertilionidae

Pipistrelle (*Pipistrellus sp.)*

Table 4.3.- Details of the *Pipistrellus* sp. individuals captured during the surveys. Sex: m – male, f – female; FA: forearm length in mm; 3rd: length of the third metacarpal in mm; 5th: length of the fifth metacarpal in mm; TrL: tragus length in mm; TrMWd: tragus maximum width in mm; Tail: tail length in mm; Wght: weight of the specimen in gr; Site: place where the specimen was collected; Alt: altitude of the site in m above sea level; Code: expedition code assigned to the specimen.

Sex	FA	3rd	5th	TrL	TrMWd	Tail	Wght	Site	Alt	Code
m	35.13	63.42	42.72	4.38	2.1	1.4		Abi Jacula	3300	02120905
m	34.02	60.62	42.36	4.4	1.98	1.08		Abi Jacula	3300	02121010
f	35.4	61.45	46.1	4.25		2.1		Abi Jacula	3300	02120704
f	33.62	59.6	41.35	3.1	1.98	0.96		Abi Jacula	3300	02121009
f	34.53	61.55	42.88	3.5	2.15	1.08		Abi Jacula	3300	02121011
f	35.53	60.57	45.31	4.65	1.9	1.63		Abi Jacula	3300	02121111
f	35.55	64.32	42.96	3.67	1.65	0.94		Abi Jacula	3300	02121112
f	35.04	62.87	46.51	3.99	2.11	32.12	10	Abi Jacula	3300	04112305B
m	33.57	60.93	45.7	4.39	2.01	26.54	5.5	Abi Jacula	3300	04112308B

Pipistrellus sp. individual captured

Serotine bat (*Eptesicus sp)*

Table 4.4.- Details of the *Eptesicus* sp. individuals captured during the surveys. Sex: m – male, f – female; FA: forearm length in mm; 3rd: length of the third metacarpal in mm; 5th: length of the fifth metacarpal in mm; TrL: tragus length in mm; TrMWd: tragus maximum width in mm; Tail: tail length in mm; Thmb: thumb length in mm; Cl: claw length in mm; Wght: weight of the specimen in gr; Site: place where the specimen was collected; Alt: altitude of the site in m above sea level; Code: expedition code assigned to the specimen.

Sex	FA	3rd	5th	TrL	TrMWd	Tail	Thmb	Cl	Wght	Site	Alt	Code
m	47.44	81.53	49.47	5.47	1.98	4.97				Abi Jacula	3300	02121108
m	49.35	80.3	61.62	6.4	2.32	46.96	5.46	3.06	15	Abi Jacula	3300	04112205B
m	45.67	75.49	53.86	6.52	2.11	41.44	6.04	2.08	16	Abi Jacula	3300	04112207B
m	47.17	79.51	59.41	6.41	2.33	43.84	5.25	1.74	13	Abi Jacula	3300	04112301B

Eptesicus sp. individual captured

Tropical long-eared bat *(Laephotis wintoni)* (EAM)

Table 4.5.- Details of the *Laephotis wintoni* individuals captured during the surveys. Sex: m – male, f – female; FA: forearm length in mm; 3rd: length of the third metacarpal in mm; 5th: length of the fifth metacarpal in mm; TrL: tragus length in mm; TrMWd: maximum width of the tragus in mm; Site: place where the specimen was collected; Alt: altitude of the site in m above sea level; Code: expedition code assigned to the specimen.

Sex	FA	3rd	5th	TrL	TrMWd	Site	Alt	Code
m	43.74	69	52.46	5.88	3.23	Abi Jacula	3300	02120902
f	41.5	76.02	58.22	7.95	3.61	Abi Jacula	3300	02120901
f	41.76	75.68	58.44	8.43		Abi Jacula	3300	02120703

Long-eared bat *(Plecotus balensis)* (E)

Table 4.6.- Details of the *Plecotus balensis* individuals captured during the surveys. Sex: m – male, f – female; FA: forearm length in mm; 3rd: length of the third metacarpal in mm; 5th: length of the fifth metacarpal in mm; TrL: tragus length in mm; TrMWd: tragus maximum width in mm; Tail: tail length in mm; Thmb: thumb length in mm; Cl: claw length in mm; Wght: weight of the specimen in gr; Site: place where the specimen was collected; Alt: altitude of the site in m above sea level; Code: expedition code assigned to the specimen.

Sex	FA	3rd	5th	TrL	TrMWd	Tail	Thmb	Cl	Wght	Site	Alt	Code
m	40.34	70.93	53.65							Abi Jacula	3300	02121008
f	40.33	74.41	54.72							Zigit camp	3900	02120104
m	40.07	66.17	53.38	16.88	5.33	38.05	7.24	2.57	7	Zigit camp	3900	04111501B
m	45.26	73.58	59.26	15.5	4.9	43.04	9.38	2.19	8	Zigit camp	3900	04111801B
m	42.83	73.01	54.05	15.76	5.35	39.4	6.25	1.81	9	Abi Jacula	3300	04112203B

Plecotus balensis individual captured

Plecotus balensis individual captured

Long-fingered bat *(Miniopterus inflatus)* (U)

Table 4.7.- Details of the *Miniopterus inflatus* individuals captured during the surveys. Sex: m – male, f – female; FA: forearm length in mm; 3rd: length of the third metacarpal in mm; 5th: length of the fifth metacarpal in mm; TrL: tragus length in mm; TrMWd: tragus maximum width in mm; Tail: tail length in mm; Thmb: thumb length in mm; Cl: claw length in mm; Wght: weight of the specimen in gr; Site: place where the specimen was collected; Alt: altitude of the site in m above sea level; Code: expedition code assigned to the specimen.

Sex	FA	3rd	5th	TrL	TrMWd	Tail	Thmb	Cl	Wght	Site	Alt	Code
m	49.4	94.98	55.69							Abi Jacula	3300	02121001
m	48.75	91.95	53.79							Abi Jacula	3300	02121002
m	50.62	95.68	55.21							Abi Jacula	3300	02121003
m	49.53	95.31	56.13							Abi Jacula	3300	02121007
m	52.2	95.79	59.78							Abi Jacula	3300	02121109
f	50.39	94.34	55.01							Abi Jacula	3300	02121004
f	50.61	97.18	57.32							Abi Jacula	3300	02121005
f	49.57	96.87	58.64							Abi Jacula	3300	02121006
f	49.29	94.59	58							Abi Jacula	3300	02121110
m	47.74	56.98	38.19	6.19	2.04	47.68	4.92	1.93	14	Abi Jacula	3300	04112206B
m	48.19	91.82	58.72	6.2	2.38	46.82	5.86	2.3	15	Abi Jacula	3300	04112208B
m	49.54	90.55	58.55	4.33	2.11	55.32	5.03	2.43	15	Abi Jacula	3300	04112302B
m	50.4	94.94	60.87	5.17	2.22	55.65	6.13	2.47	15	Abi Jacula	3300	04112303B
f	48.51	95.12	60.08	3.11	1.72	54.96	5.72	2.08	14	Abi Jacula	3300	04112304B
f	51	94.39	57.58	5.25	2.13	54.56	6.12	2.18	16	Abi Jacula	3300	04112307B

Family Molossidae

Guano bat *(Tadarida aegyptiaca)* (U)

Table 4.8.- Details of the *Tadarida aegyptiaca* individuals captured during the surveys. Sex: m – male, f – female; FA: forearm length in mm; 3rd: length of the third metacarpal in mm; 5th: length of the fifth metacarpal in mm; Tail: tail length in mm; Wght: weight of the specimen in gr; Site: place where the specimen was collected; Alt: altitude of the site in m above sea level; Code: expedition code assigned to the specimen.

Sex	FA	3rd	5th	Tail	Wght	Site	Alt	Code
m	50.14	91.63	49.2	15.86		Abi Jacula	3300	02120903
m	47.62	88.49	48.6	14.78		Abi Jacula	3300	02121012
m	48.12	90.72	48.9	20.6		Abi Jacula	3300	02121013
m	52.38	95.61	51.62	20.25		Abi Jacula	3300	02121014
m	50.8	93.74	52.35	22.8		Abi Jacula	3300	02121015
m	50.76	93.7	50.18	22.57		Abi Jacula	3300	02121016
m	47.65	84.03	47.26	22.99		Abi Jacula	3300	02121101
m	49.86	92.51	50.85	23.81		Abi Jacula	3300	02121102
m	48.84	89.5	49.22	23.61		Abi Jacula	3300	02121104
m	49.33	91.06	46.89	22.19		Abi Jacula	3300	02121106
f	50	88.62	48.07	21.86		Abi Jacula	3300	02120904
f	50.04	92.62	50.23	25.7		Abi Jacula	3300	02121103
f	51.68	96.55	53.86	19.26		Abi Jacula	3300	02121105
f	48.84	88.05	48.66	16.87		Abi Jacula	3300	02121107
m	50.88	94.92	51.3	47.57	17	Abi Jacula	3300	04112201B
m	47.59	87.71	47.82	37.55	16	Abi Jacula	3300	04112202B
m	50.45	91.52	51.78	42.1	17	Abi Jacula	3300	04112204B
m	52.61	92.22	54.06	44.97	18	Abi Jacula	3300	04112306B

Tadarida aegyptiaca individual captured

Order Primates

Family Cercopithecidae

Hamadryas baboon (*Papio hamadryas*) 'Netch djindjero' (SA)

The hamadryas baboon is a large cercopithecid, classified as 'Near threatened' because its distribution is restricted to Northeastern Africa and Southwestern Arabia (IUCN, 2003). Hamadryas show a considerable ecological plasticity: although their preferred habitats are rocky areas in arid sub-desert steppes, dry short-grass plains and bushlands, they have occasionally been reported at high altitudes on the plateaus up to 3,300 m (YALDEN *et al.*, 1977; WOLFHEIM, 1983; YALDEN *et al.*, 1996).

We identified two different groups along the southwestern side of the massif. The first group ranged from the Abi Jacula moorlands to the dry steppes of the Astabir escarpment, between 2,900 and 3,500 m of altitude. The second group was observed in the degraded dry bushlands and *Juniperus* forest of the Yimrehana area (2,600 – 2,800 m). Both groups were composed by between 30 and 40 individuals.

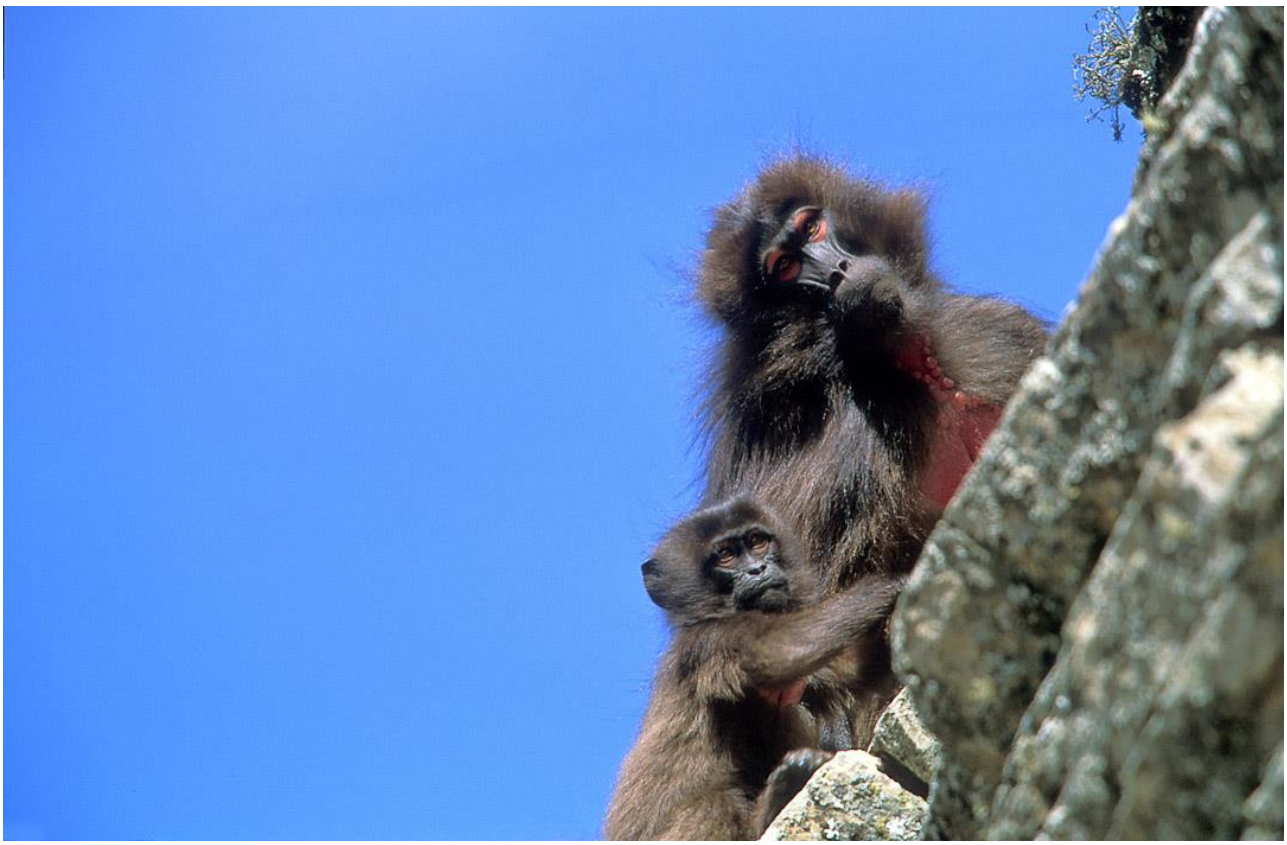
On the 5th of January 2000, about 20 individuals were seen in the eastern part of the Astabir escarpment at an altitude of 3,500 m. This is the highest altitude ever reported for the species. Local villagers explained that hamadryas are regularly seen in this area. Although 3,500 m is theoretically within the altitudinal range of the afroalpine zone, the area, which is southwesterly orientated, is too hot and dry to clearly correspond to such an ecosystem. We found no evidences for the occurrence of this species in the more humid, northern afroalpine areas.

The Astabir-Abi Jacula group was observed inside the heather moorland both in 2000 and 2001, indicating a regular use of this dense, cluttered and humid habitat. The hamadryas may use such forested patch as a day resting shelter to avoid human disturbance and aerial predation. Large areas of the surroundings are inhabited and cultivated. In several occasions, we saw hamadryas entering the moorland running away from local people who were throwing stones, shouting and harassing them in the vicinity or within cultivations, local paths and grazing areas. The area holds Verreaux´s eagles that are known to hunt on baboons (ZINNER & PELÁEZ, 1999) and other large eagle species. At night, the Astabir-Abi Jacula group slept in the vertical cliffs delimiting the forest from above to avoid predators such as leopards, which are common in the area (local villagers reported that occasionally leopards have killed hamadryas). The second group also seemed to regularly use the Yimrihane area.

Group sizes varied between 20 and 40 individuals, a number that corresponds to poor habitat conditions (KUMMER, 1968; WOLFHEIM, 1983). The surveys were carried out during the dry season, when food resources are scarce and sparse. Hamadryas baboons are probably not rare in the Abune Yosef.

Gelada baboon *(Theropithecus gelada)* 'Gelada' (E)

The endemic gelada baboon is a flagship species among Ethiopian mammals. Geladas are cercopithecids highly specialized to prairies and cliffs at high elevations on the plateaus (2,350 - 4,400 m). They have a very restricted distribution in the Central and Northern highlands of the Ethiopian plateau; although there is a small southern population in a very limited area around the Webi-Shebeli river (MORI & BELAY, 1990). With an estimated population of 600,000 individuals (YALDEN *et al.*, 1992, but other estimations as low as 100,000), the species is classified as 'Near Threatened' (IUCN, 2003). The most immediate threat to the gelada's survival comes from farming that increasingly eats up grasslands and other Afroalpine habitats. But the global raising of temperature due to climate change is also threatening geladas: their lower limit for grazing will rise in the next decades, decreasing the surface of the sensitive Afroalpine grasslands where geladas feed.



Theropithecus gelada (Gelada baboons)

Geladas were distributed along the northwestern highlands of the massif, virtually up to the highest peak (4,284 m). A small group of about 60 individuals was seen in the course of three different visits to the southwestern and drier areas of Astabir and Abi Jacula (3,300 – 3,500 m).

Geladas are very abundant in the massif. A simultaneous counting in the northern part of the massif gave a result of 648 individuals in November 2002, and the estimated population is over 1,000 individuals. The Afroalpine zone is currently under human-driven intense modification (mainly agriculture and overgrazing). According to the amount of gelada individuals recorded, though, these activities have not had a negative impact on the species so far. The rugged topography, with steep slopes, gorges and cliffs at different altitudes, guarantees the existence of safe shelters and provides enough grass supply to the population. High densities are only possible under especially favourable habitat conditions (WOLFHEIM, 1983).

Grivet monkey *(Cercopithecus aethiops)* 'Tota' (U)

The grivet monkey is an abundant species all over its distribution area and it shows a large ecological plasticity. It could even be an agricultural pest, although grivets depend on the nearby existence of gallery/riverine vegetation as hiding habitats (WOLFHEIM, 1983; YALDEN *et al.*, 1977).

Several groups were scattered along the western and southern areas of the massif across a variety of habitats under different levels of degradation and between 2,100 and 3,000 m of altitude. Grivet monkeys are confined to areas offering vegetation patches.

According to local reports, the population of grivet monkey is declining in the area. Currently, the upper altitudinal belt of the savannah-woodlands (e.g. Medage, Lalibela or Nokutalab) is completely transformed by agricultural activities, deforestation and livestock grazing. Few relict patches of riverine woodlands still exist in this zone. The amount of individuals in each of the observed groups was slightly lower than the average numbers previously reported for this species (WOLFHEIM, 1983). However, they were still larger than the groups reported from the Simien Mountains (HEGGLIN *et al.*, 1998).

In the Yimrihane area (2,600 – 2,900 m), a resident group has the core of their home range within a remnant *Juniperus* forest.

Local villagers of Wedebiye (above 3,500 m) said that grivets are occasionally found on the plateau during the dry season, particularly in cultivated areas. This information, which will imply an altitudinal extension of range from 3,000 to 3,500 m, should be considered as reliable because local people clearly distinguish the three species of cercopithecids occurring in the massif (geladas, netch djindjeros and tota) from one another.

Although these cercopithecid species are sympatric in the area, there seems to be a marked ecological segregation between them as a result of their different habitat and/or dietary preferences. Geladas were found between 3,200 - 4,280 m, mainly occurring in the higher, more northern, humid and cooler grassy habitats with steep slopes, gorges and escarpments. They fed on the ground layer vegetation, being exclusively granivorous (DUNBAR, 1977). Hamadryas were found on steep slopes of the most temperate, drier montane dry forest ecosystem between 2,500 - 3,500 m. In addition, the dietary preferences of hamadryas are remarkably different to those of the geladas. They more resemble those of other baboon subspecies, with a diet characterized by soft fruits, seeds and leaves of the plant/shrub layer. Their apparent absence below 2,500 m of height might be due to the fact that this species prefers rocky habitats and these areas have no suitable cliffs and escarpments. Grivet monkeys mainly ranged across the entire savannah-woodland ecosystem and the lower and medium level of the montane dry forest ecosystem in an altitudinal range between 2,100 and 3,000 m. Their dietary habits are to some extent similar to those of baboons but mostly concentrated on the tree layer (DUNBAR, 1977).

Group of gelada baboons (Theropithecus gelada)

Despite a potential habitat overlap, there is a marked ecological segregation between geladas and the hamadryas baboons. However, as it has been mentioned above, a gelada troop was observed within the core area of a resident *P. hamadryas* group. In other montane areas such as the Simien Mountains, both species have been observed

intermingled (NIEVERGELT *et al.*, 1998), but in the Abune Yosef massif, no contact or association was observed between both species. On the other hand, the olive monkey (*Papio anubis*) was not detected in the Abune Yosef massif, while the three species have been observed in the Simien National Park (HEGGLIN *et al.*, 1998).

Order Carnivora

Family Canidae

Ethiopian wolf *(Canis simensis)* 'Kai kebero' (E)

The Ethiopian wolf is a highly specialized canid, endemic to the Afroalpine habitat of Ethiopia. Ethiopian wolves live in packs (3-13 adults), communally sharing and defending an exclusive territory. Pack members, though, feed alone during the day, mainly on rodents (GOTELLI & SILLERO-ZUBIRI, 1992; SILLERO-ZUBIRI & GOTELLI, 1994; SILLERO-ZUBIRI & GOTELLI, 1995). It is considered to be the rarest and most endangered canid in the world and it is classified by the IUCN as 'Critically endangered' (IUCN, 2003; SILLERO-ZUBIRI & MACDONALD, 1997). Ethiopian wolf populations are decreasing dramatically due to habitat loss. Nowadays, probably between 500 and 550 individuals survive separated in two different populations in the western and eastern plateaux, with more than half the species' population living in the Bale Mountains National Park (ASH, 2001; KINGDON, 1997; MARINO *et al.*, 1999; SILLERO-ZUBIRI & GOTELLI, 1994). Recent surveys in Wollo Administrative Zone, where the Abune Yosef is located, have confirmed the presence in some areas, with an estimation of 80 wolves divided in populations below 50 individuals (ASH, 2001; MARINO *et al.*, 1999).

Ethiopian wolves were observed in the Afroalpine belt on 13 different days during the visits to this habitat from 1998 to 2002. On November 30th 2002 we counted four different individuals, three in the Aremgarem plateau and another one in a valley east of Aremgarem. They were seen walking and resting in open moorlands and grasslands of the massif, mainly in the Aremgarem plateau (between 3,950 and 4,150 m), but also in the lower, eastern Injafat and Western Zigit at 3,650 m.

Density of wolves in Bale ranged between 0.1 and 1 adult/km^2, positively correlated with density of rodent prey and negatively with vegetation height (SILLERO-ZUBIRI & GOTELLI, 1994). However, lower densities were applied to estimate the potential population (0.1 to 0.3 wolves/ km^2) following recent estimations for Ethiopia (MARINO, 2003). As the extension of Afroalpine grasslands and heathlands in the Abune Yosef massif is of

Canis simiensis (Ethiopian wolf)

approximately only 47 km^2, the potential population of *Canis simensis* could range between 5 and 14 adults. These numbers agree with recent estimations (SILLERO-ZUBIRI *et al.*, 2000; MARINO, 2003) that suggest an amount of wolves ranging between 19 and 23 for three massifs of North Wollo with wolf's presence (Abune Yosef, Aboi Gora and Delanta) totalling 140 km^2 of available habitat.

The northern population of *Canis simensis* is isolated, highly threatened, and at present, only protected within the limits of the Simien Mountains National Park. Nevertheless, its future within this protected area is uncertain in the current conditions of the Park (NIEVERGELT *et al.*, 1998; SILLERO-ZUBIRI & GOTELLI, 1994). Some areas of Amhara Regional State where the species is present are partially managed as community natural resources areas (ASH, 2001). In the massif, the areas used by the Ethiopian wolf are Afroalpine moorlands and grasslands under high grazing pressure. Local herders regard them as a menace to sheep and they try to kill them, although the availability of fire weapons is still low. However, local authorities reported that two individuals were killed by local people in 2001. The species is protected by the national law and since 2003 a ranger from the government patrols the area, mainly supervising that no dogs are brought to the Afroalpine grasslands by herders. It is also important to note that in three different studies in Bale and Simien, no evidence was found of livestock remains in faeces from *Canis simensis* (SILLERO-ZUBIRI & GOTELLI, 1994).

Canis simiensis
(Ethiopian wolf)

Side-striped jackal *(Canis adustus)* 'Bula kebero' (PAS)

C. adustus is a lightly built jackal with a greyish yellow coat, a white stripe from elbow to hip and with a white tip on the tail, which may be absent (KINGDON, 1997). North eastern African *C. adustus* are, to some extent, difficult to distinguish in the field from *C. aureus*. Differences between them mainly rely on the fact that the former lacks the white tail-tip and conspicuous pale lateral stripe, which characterize South-African forms. However a detailed observation of the shape and colour of the ears readily help to distinguish both species. In *adustus* ears are rounded and not pointed out as they are in *aureus,* being in addition of the same grizzled grey-brown colour as the head. In *aureus* ears are ginger or foxy-red, strongly contrasting with the rest of the head colour (YALDEN et al., 1980).

In Ethiopia *C. adustus* is a very rarely recorded species, probably due to the aforementioned *adustus-aureus* identification difficulties (YALDEN *et al*., 1980). However, its geographical range is exceptionally wide, occurring in open habitats, savannas, disturbed vegetation and cultivated montane areas up to 2,700 m (KINGDON, 1997). In Ethiopia, YALDEN et al. (1980) consider that it is perhaps more commonly associated to forested habitats than *C. aureus*.

C. adustus is considered rare throughout its range, but no direct threat is known (CANID SPECIALIST GROUP WEBPAGE, 1998). It is not listed in any IUCN threat category.

This species might be relatively common in the Abune Yosef massif. Pairs and solitary individuals were observed during the visits in 1998, 1999, 2000 and 2004, in the Zigit area, between 3,550 and 3,900 m of height. All records were obtained during the central

hours of the day. The Zigit area has a remarkably heterogeneous topography and different vegetation types, but jackals were only observed in the open, plain and moderately grazed mosaic of grass (*Poa* and *Carex*) steppe, *Senecio* grasslands and giant lobelias (*Lobelia rhynchopetalum*). Two more individuals were observed at Muja village (2,830 m) and near Bilbala village (2,146 m), both at night.

The record at 3,900 m exceeds in 1,200 m the maximum altitude previously recorded for *Canis adustus* (KINGDON, 1997) and extends its ecological range well into the above level of the Afroalpine ecosystem, where it seems to prefer open, grassy and moorland habitats.

The Abune Yosef population extends northwards the geographical distribution of *C. adustus* in Ethiopia to 12º 12' N, following YALDEN et al., 1980 and YALDEN *et al.*, 1996). This species has not been detected in the well surveyed Simien Mountains (HEGGLIN *et al.*, 1998).

Diurnal activity in *C. adustus* is reported for the first time. This species is regarded as strictly nocturnal, with some dawn and dusk activity (DORST & DANDELOT, 1990; KINGDON, 1997). This behavioural shift may be more likely interpreted as a local adaptive response to prey on the high altitude rodent community (e.g. *Arvicanthis* species), which is, by large, the most abundant food and it has a marked diurnal activity. It must be taken into account that the two lowland observations occurred at night. It would be highly interesting to check the possible competitive overlap for this resource between this jackal and the Ethiopian Wolf (*Canis simensis*), a diurnal rodent specialized canid. In fact, both species were spotted in the very same area (Zigit) at daytime.

C. adustus in Abune Yosef showed a remarkable adaptation and tolerance to human and cattle presence at day time. In two occasions, a pair of individuals was patrolling, for an average of 10 minutes, all over the Zigit plateau, moving among numerous cattle and even coming close to shepherd boys.

Golden jackal *(Canis aureus)* 'Buna kebero' (SS)

This species primarily occurs in dry, open savannas and arid, lowland regions, often around human settlements. In Ethiopia, it also inhabits the Afroalpine area (KINGDON, 1997; YALDEN *et al.*, 1980).

On the 23rd of November 2001, at 13.25h, a pack of three individuals were observed during almost 15 minutes in a hilly dry *Acacia* woodland area at 2,200 m of height. This pack was directly coming from the nearby farmlands of the Shumshiha area. At that time, farmers and shepherds were scattered all over the very same area.

Occurrence of golden jackals in the Afroalpine zone of the Simien and Bale Mountains has been reported (YALDEN *et al*. 1980, NIEVERGELT *et al.*, 1998). We found no evidences of its occurrence in the higher altitudinal belts of the Abune Yosef. At such altitudes, besides our observations of *C. adustus*, interviewed local villagers only recognized the occurrence of greyish jackals. Thus, *C. aureus* range appears to be restricted to the lowland areas.

Family Mustelidae

Ratel or honey badger *(Mellivora capensis)* 'Marbella' (U)

An individual was observed at night, near the road between Shumshiha and Lalibela, at 2,300 m of height. Its unmistakable footprints were found from savannah-*Acacia* woodlands to Afroalpine moorlands between 2,100 and 3,900 m of height. It is probably widespread across all habitats and altitudes. Although first regarded as a lowland species, the presence of the Ratel in Afroalpine habitats, up to 4,100 m, has been already recorded in the Bale Mountains (SILLERO-ZUBIRI, 1996).

Zorrilla or striped polecat *(Ictonyx striatus)* (PAS)

Four sightings were done around Zigit, in Afroalpine moorlands, at 3,900 m, which is an altitudinal record for the species (YALDEN *et al.*, 1980, 1996). A local villager showed us two skins of this species: both animals were killed in a mosaic of barley cultivation and bushlands, one in Medage and the other one in Lalibela, at an elevation of about 2,500 m.

Family Viverridae

Ethiopian genet *(Genetta abyssinica)* 'Mitmat' (U)

The Ethiopian Genet is a cryptic and seldom recorded genet, which occurs along the Horn of Africa. Although formerly regarded as a montane endemic of Ethiopian highlands (DORST & DANDELOT, 1972), additional findings in Sudan, Somalia, Djibouti and Eritrea changed his endemic status and showed that the species has a wide altitudinal and

ecological range (YALDEN *et al*., 1996).

The Ethiopian genet is classified by the IUCN as 'Data Deficient' (IUCN, 2003).

The species was observed in the Abi Jacula forest (3,300 m) in 2001, being the first report of *G. abyssinica* in a forested area. It was also observed in the Zigit Afroalpine rocky grasslands up to 3,850 m of height, exceeding in 350 m the maximum altitude previously recorded (YALDEN *et al*., 1996).

The 15 scats examined during the expedition mainly consisted of rodent hairs and bones (mostly *Arvicanthis* and *Lophuromys*), small quantities of small passerines bones and remarkably small quantities of chitinous remains of insects and plant remains.

The Abi Jacula and Zigit sightings reported for the first time diurnal activity in the Ethiopian Genet. This behaviour could be interpreted as a local adaptive response to prey on the high altitude rodent community, which has a marked diurnal activity. This behavioural shift has also been reported for *Canis adustus* in the Abune Yosef massif (see species account in this chapter).

A longer explanation of records in the Abune Yosef can be found in DÍAZ & VAN ROMPAEY (2002).

African civet *(Civettictis civetta)* 'Tirign' (U)

A piece of a skin of this species was shown to us in Medage village. Several footprints were observed in the vicinities of watercourses along the Medage, Tinchoi and Shumshiha areas between 2,100 and 2,500 m of altitude. This widespread species seems local in the surveyed area.

Family Herpestidae

White-tailed mongoose *(Ichneumia albicauda)* 'Arach' (PAS)

Several white-tailed mongooses were sighted at dawn, dusk and night within urban areas or adjacent riverine galleries and degraded bushlands between 2,100 and 3,600 m of height.

The record of *I. albicauda* in the surroundings of the Abune Yosef village at 3,600 m

extends in about 500 m the previous altitudinal record (at 3,100 m, quoted in YALDEN *et al.*, 1996), and consequently the ecological range of this species up to the Afroalpine zone. Such an extension might be associated to human disturbance of the area, as we found no evidences for the occurrence of this species in relatively untouched habitats of the Afroalpine belt. This individual, who had a very dark, almost black coat and greyish tail, was observed at 6.30h in a mosaic of cultivated land (barley crops) and bushy secondary vegetation with some giant lobelias, *Kniphophia* and *Cardus* species scattered all over.

We observed two territorial fights within Lalibela village, both in November 2001. This species seems very common in the area, showing a marked preference for settled and disturbed areas.

Slender or lion-tailed mongoose *(Herpestes sanguinea)* (U)

The systematics of this highly variable group remains uncertain and still controversial (YALDEN *et al.*, 1980; YALDEN *et al.*, 1996). There is a great variation and among 70 subspecies have been named. Four subgroups have been distinguished, probably incipient or actual species: *sanguinea, ochracea, flavescens* and *swalius* (KINGDON, 1997). In Ethiopia *H. sanguineus* has a high degree of individual and regional variation in colour. YALDEN et al. (1980) have suggested that fur colouration of Slender mongooses varies along a humidity gradient cline. *H. ochraceus* is recognized by some authors as a distinct species in the basis of craniometrical differences (TAYLOR & GOLDMAN, 1993). The geographical distribution and ecology of both taxa still remain obscure, but while *H. ochraceus* appears to be confined to Somalia and south-eastern areas of Ethiopia, *H. sanguineus* seems to be a more widespread species, occupying arid regions as well as mountainous areas of the plateaux (YALDEN *et al.*, 1980; YALDEN *et al.*, 1996). Very dark, almost black, pelages appear to be associated to habitats with a relatively high degree of humidity (e.g. in Lake Tana), while individuals from drier, more arid habitats (e.g. from south-eastern Ethiopia) are generally paler, with rather ginger-agouti pelages. Intermediate colourations appear to be related to different degrees of humidity: e.g. individuals from the Tigray region showed a dark mid-dorsal coat and tail, but paler, olive-agouti flanks and legs. This species is widely distributed across Ethiopia, but it is more common in arid regions than it is in the mountainous plateaux. It has been previously recorded from sea level to 2,700 m (YALDEN *et al.*, 1980; YALDEN *et al.*, 1996).

Four individuals were seen in small open areas of the Abi Jacula forest during different surveys, between 3,000 and 3,300 m of height. A fifth individual was observed in a forested patch of the Medage village at 2,400 m.

The records in Abi Jacula extend the upper altitudinal limits of H. sanguineus in 800 m (KINGDON, 1997), well into the upper limit of the Montane Dry Forest belt.

All individuals were dark forms. On the 9th of October 2001, an individual was clearly observed in the Abi Jacula heathlands while sunbathing at 14.20h on a rocky ledge. It had very dark, almost black, face and tail, and a reddish-brown dorsal coat with paler reddish flanks and legs.

Egyptian mongoose *(Herpestes ichneumon)* (PAS)

This is another uncertain species in the area, from which we have no direct observations.

A track of 7 footprints along a dusty path of the Lalibela village (2,500 m of height) could belong to this species. Some local villagers positively recognized this mongoose by its long and extremely thin tail. However, most of the interviewed people did not recognize this form.

Marsh mongoose *(Atilax paludinosus)* (U)

The relatively large and pointed, distinctive footprints of *A. paludinosus* were observed in several watercourses along the south-western lowland areas, between 2,000 m and 2,300 m of height. Nevertheless, since we could not see any individual, we consider it to be an uncertain species.

Family Hyaenidae

Spotted hyaena *(Crocuta crocuta)* 'Djibb' (PAS)

Several droppings and footprints of this species were found in Shumshiha acacia woodlands at 2,150 m of height, within the Abi Jacula heather forest at 3,100 – 3,300 m and in the Afroalpine rocky slopes of the Zigit, between 3,900 and 4,100 m of altitude. Our highest records agree with those of the Spotted Hyaenas observed in the Bale Mountains, at more than 4,000 m of height (SILLERO-ZUBIRI, 1996).

Authorities as well as local people informed us that hyaenas were once common around Lalibela and other rural villages. Nowadays, this species appears to be more secretive, occupying areas relatively far away from human settlements. Although probably in decline, hyaenas might be relatively common in the whole area due to their ecological plasticity.

Family Felidae

African wildcat *(Felis silvestris, lybica* group) 'Ye-dur dimmet' (U)

The African wildcat is here referred as *Felis silvestris*, *libyca* group (following the taxonomy proposed by the Cat Specialist Group of the IUCN and KINGDON, 1997). African wildcats are lightly built, with a thin, tapering tail. The background colour of its coat ranges from reddish to sandy yellow to tawny brown to grey, and it is typically marked with faint tabby stripes and spots. A characteristic feature is a reddish or rusty-brown tint to the backs of the ears (Cat Specialist Group, 1996). It is the most common and most widespread of all cats and it is not listed in the IUCN list of threatened species.

On the 28th of November 2002, at night (19.30h), an individual was observed during 15 minutes in the Afroalpine *Senecio* moorlands of the Zigit camp, very close to the northern escarpment, at 3,900 m f height. Its colour was buff with darker small spots on the face and back. Its tail had a black tip and three black rings, occupying only the end half of the tail. Legs were long, with two black stripes on the front part of each leg. The animal crossed the plain slowly and silently, following an existing trail.

Two more individuals were observed during the night car transects carried out in the western lowlands in 2004, between 2,000 and 2,200 m of altitude.

A black individual was observed on the 1st of November 1998, at 18.20h, in the Aremgarem peak at 4,200 m of height. During the four minutes of observation, the wildcat tried to hunt twice an Erckeli´s Francolin (*Francolinus erckeli*). Another black individual was observed on the 25th of January 2000, at 18.40h, in the steep escarpments west of the Abune Yosef village. Four latrines, placed in natural rock cavities, were found in this small (about 3 km^2) and rugged area between 3,450 and 3,750 m of altitude. During observations, both wildcats were at a distance of, respectively, about 80 and 50 meters from the observers. Light conditions were rather poor but enough to observe that both individuals were completely black, apparently showing no traces of stripes or spots. Estimated body size for both individuals was around 80 cm without tail, which is slightly larger than the average, but within the range of body size dimensions reported for this species (KINGDON, 1997; DORST & DANDELOT, 1990). Length and width of footprints ranged 38-40 and 37-39 mm, respectively, which is also slightly larger than the 30-35 mm of average length reported (STUART & STUART, 1998). Scats ranged in diameter from 15 to 22 mm., being the average 17 mm. The average reported for this species is 16 mm (STUART & STUART, 1998). It is not known if these observations correspond to a domestic cat or a melanistic wild cat.

On the 12th of October 2001, at dusk, a 'tabby' greyish individual was observed (during 30 minutes) in the bushlands of Medage village, at 2,500 m of height.

The occurrence in the Afroalpine ecosystem up to 3,900 m. are for the first time reported in *Felis silvestris*, *lybica* group. Prior to this finding, the highest altitude ever reported for this species was 3,300 m in the mountains of Kenya, Ethiopia and Algeria (KINGDON 1977, YALDEN *et al.*, 1996). Ecological conditions are severe in the Afroalpine zone. It has an extremely cold weather (temperature ranges between 16ºC in the warmest month and –13ºC in the coldest month), and high rainfall (about 1,800 mm/year). In addition, Afroalpine ecosystems are rather poor in resource diversity and biomass.

Local people reported that black wildcats are rather common at high altitudes, and that there are no black forms at the medium and lower altitudes. The possible melanism on wildcats should not be considered a rare phenomenon, as melanic forms of leopards and serval cats are relatively common in Afroalpine moorlands.

No evidence (sight, track or local report) was found for the occurrence of the serval cat, *Felis serval*. Its apparent absence is difficult to explain considering that this is a widespread species occurring in similar high mountainous areas such as the Bale and the Simien Mountains, even above 4,000 m (HILLMAN, 1993; SILLERO-ZUBIRI, 1996; YALDEN *et al.*, 1996). Strikingly, local people named the 'black' wildcats as "Aner", which is the common word (in Amharic language) used to designate serval cats.

The Abune Yosef lowland population could be in serious decline due to the increasing deforestation of these areas. Local people reported that some decades ago they were fairly common.

Caracal *(Caracal caracal)* 'Delg ambessa' (Local name: 'Afinch') (U)

Several footprints were found along the southwestern area of the massif, mainly in savannah-woodland complexes at elevations between 2,100 and 2,500 m. Based on our data and local reports, this species might be considered relatively common. Local people reported that caracals occasionally prey on sheep and goats, but they are not locally hunted.

Leopard *(Panthera pardus)* 'Nebir' (U)

Although it could still be considered as reasonably numerous in Ethiopia, leopard population seems to decrease all over the country due to habitat loss and illegal skin trade. Leopards are officially protected in Ethiopia.

Leopards occur in a wide range of habitats and altitudes across the massif. On the 8th of October 2001, one individual was seen at dusk in the Aremgaremg plateau at 4,150 m.

During the 2000 and 2001 surveys we heard at dusk rasping calls (up to a dozen) in the Abi Jacula and the Zigit *Erica* heathlands. Several footprints were found and droppings collected, in forests, rocky areas, and Afroalpine meadows from 2,500 to 4,150 m of height.

Although leopards are officially protected, local people in the massif hunt them because they represent a real threat to their livestock and to themselves. Lalibela administration reported that between three and four leopard skins are confiscated per year. The real number of annually killed leopards is expected to be higher than that. As furtives know that it is officially protected, they do not use firearms to kill leopards. Poison and smoke to get them out from their dens are the preferred techniques.

Although leopards generally use the arboreal substrate to eat and store their preys, we found that individuals living in the Afroalpine zone use large rocky holes and cavities as storage and eating sites (probably as a result of the lack of arboreal cover). Remains of domestic livestock, hyraxes, geladas, crested porcupines, and francolins were identified in such sites.

Procavia habessinica (Ethiopian rock hyrax)

Order Hyracoidea

Family Procaviidae

Ethiopian rock hyrax *(Procavia habessinica)* 'Eshkoko'

Rock hyraxes were found across all rocky areas and cliffs in all habitat types between 2,100 and 4,280 m of height. Very common, this species probably plays an important ecological role as food supply to the large number of terrestrial and aerial predators of the poor ecosystems of the highlands.

Order Tubulidentata

Family Orycteropodidae

Aardvark *(Orycteropus afer)* 'Goana' (PAS)

This species has probably been overlooked in Ethiopia due to its strictly nocturnal habits and because it shelters during the day in deep burrows (YALDEN *et al.*, 1986). However, in the Abune Yosef massif, burrows, spade-like scratches and footprints of this species were found in woodlands and cultivations in the southwestern lowlands. Farmers from Lalibela explained how, from time to time, they hunt an Aardvark and use its skin to make tools. In November 2002, a businessman from Lalibela saw an Aardvark crossing the road near Shumshisa.

Order Artiodactyla

Family Suidae

Bushpig *(Potamochoerus larvatus)* 'Ye-dur azama' (EAF)

We observed faeces and muzzle scratches (which we attributed to this species) in a patch

of riverine vegetation in the southwestern lowlands. Authorities and local people confirmed the occurrence of bushpigs. It could be rare or declining in the area due to massive deforestation.

Family Bovidae

Bush duiker *(Sylvicapra grimmia)* 'Midakwa' (PAS)

Four individuals were observed in three different occasions near Shumshiha (around 2,200 m of height.), mostly during the night car transects carried out in 2004. Tracks were found in acacia woodlands, and local people reported that it is relatively common in southern lowland areas. No evidences of this species were found at higher altitudes, probably due to human disturbance. In the Simien and Bale Mountains, common Duikers range up to 3,300 m in montane moorlands (YALDEN *et al.*, 1984).

Klipspringer *(Oreotragus oreotragus)* 'Sassa' (EAS)

Klipspringers were observed across a wide ecological and altitudinal range. Six different pairs were recorded in the southwestern lowland *Acacia* woodlands of the Shumshiha area between 2,100 and 2,300 m of altitude. Two pairs were found in the Abi Jacula montane *Erica* moorland and cliffs between 3,000 and 3,400 m of height. Five individuals were detected in the Afroalpine rocky area of the Zigit between 3,700 and 3,900 m. Footprints and faeces were also recorded in these localities.

This monogamous species typically occurs in low densities due to its marked territoriality, and it is highly sensitive to ecological disturbance. In the Simien Mountains, the Klipspringer's population has dramatically decreased during the last forty years due to habitat loss (NIEVERGELT, 1998). In the Abune Yosef, the highland population seems very small and declining, while in the southern lowlands this species seems to be still relatively common in suitable habitats. Authorities and local people informed us that Klipspringers are occasionally hunted because their tasty meat is much appreciated. It is classified in the IUCN List of Threatened Species as 'Lower Risk/Conservation Dependent' (IUCN, 2003).

Order Rodentia

Family Sciuridae

Striped ground squirrel (*Euxerus erythropus*) (WAS)

Several individuals, tracks and holes were found in the southwestern open lowland areas, between 2,000 and 2,450 m of height. This species seems to show a preference for settled areas.

Family Muridae

(Note: Measures performed on collected specimens are detailed and summarised in Table 4.9 and Figure 4.2 on pages 58 and 59 respectively. Figures 4.3, 4.4, 4.5, 4.6, 4.7 and 4.8 on pages 61 to 64 illustrate some of the studied specimens).

Maned rat (*Lophiomys imhausi*) (U)

(see Figure 4.3 on page 61)

This species presents an unmistakable cranium with a granulated upper surface. Its rather large size (590-920 gr) and its long, bicoloured and bushy tail makes it easily identifiable also externally (YALDEN *et al.*, 1976; MORALES, 2006).

Very little is known about the biology and distribution of *Lophiomys imhausi*. The maned rat seems to inhabit a wide range of habitats. In the southern side of its distribution area it is found in dense forests, but it lives in much more open woodlands in the north side (KOCK AND KUENZEL, 1999). In Ethiopia, it is not confined to forested areas (YALDEN *et al.*, 1976). It has been recorded from sea level up to 3,300 m of height (Yalden *et al.*, 1976; Yalden *et al.*, 1996), and in the eastern and western plateaux of Ethiopia (Yalden *et al.*, 1976; KOCK & KUENZEL, 1999) and other eastern African countries such as Eritrea, Djibouti, Somalia, Sudan, Kenya, Uganda and Tanzania (KOCK & KUENZEL, 1999; MORALES, 2006).

During the current expeditions, one cranium was found in the pellets of *Strix woodfordii* located in the Yimrihane forest, at 2,660 m of altitude. This record is in agreement with the altitudinal range of the species.

The species is considered as Lower risk/Least concern in the IUCN Red List (SCHLITTER & AGWANDA, 2004a).

Groove-toothed rat (*Otomys typus*) (EAM)
(see Figure 4.4 on page 61)

The taxonomic status of *Otomys typus* is uncertain (YALDEN & LARGEN, 1992). Although in 1976 YALDEN *et al.* said that "there is no indication of more than one species of *Otomys* in Ethiopia", more recent works by Yalden himself suggest that *Otomys typus* should be a complex of two or three species, some of which may be endemic to Ethiopia (YALDEN & LARGEN, 1992; YALDEN *et al.*, 1996).

The dentition of this species is very characteristic, with molars showing transversal lamellae and the incisors deeply grooved in their anterior surface (two groves in the lower incisors and one in the upper ones) (YALDEN *et al.*, 1976)

According to YALDEN *et al.* (1976), *Otomys typus* is a species from the plateaux, recorded from 1,800 to 4,000 m of height (up to 4,050 m in YALDEN *et al.* (1996)). YALDEN (1988) considers it to be more frequent between 3800 and 4000 m, and thus an Afroalpine moorland dweller. However, SILLERO-ZUBIRI, TATTERSALL & MACDONALD (1995b) conclude that it is a montane grassland belt species, with abundance decreasing as altitude increases in the Erinaceus and Afroalpine belts. In these kinds of habitats, the species plays the same ecological role as the European genus *Arvicola*, living in tunnels at streamsides (YALDEN *et al.*, 1976). In Dinsho, the species inhabits wetlands with a dense grass cover between 3,200 and 3,500 m of height (DORST, 1972), while in Debra Markos it was collected at 2,500 m of altitude (CORBET & YALDEN, 1972). In the Simien Mountains, the groove-toothed rat has been reported between 3,550 and 3,750 m, in long/short grass steppes, humid heather forests or open areas, but not between 2,700 and 2,850 m (GÜTTINGER *et al.*, 1998). In Meganesha, *O. typus* has been found in open forests with grassy patches and in *Erica* scrub at altitudes between 2,500 and 3,300 m (BEKELE, 1996). It had been previously detected in the Abune Yosef (MARINO, 2003), and it seems to play an important ecological role as a prey for the threatened Ethiopian wolf (*Canis simiensis*) (YALDEN & LARGEN, 1992; MALCOLM, 1997; MARINO, 2003a; ASHENAFI *et al.*, 2005).

A minimum of six and a maximum of ten individuals were found in pellets of *Strix woodfordii* in the Yimrihannne forest, at 2,660 m. This record agrees with the altitudinal range of the species.

The species is considered as 'Least concern' by the IUCN Red List, with a decreasing population trend (LAVRENCHENKO & CORTI, 2004).

East African mole rat (*Tachyoryctes splendens*) 'Filfel' (EAM)
(see Figure 4.5 on page 61)

Two species belonging to the genus *Tachyoryctes* occur in Ethiopia: *T. splendens* and *T. macrocephalus*. *T. splendens* is much smaller than *T. macrocephalus* (200 gr in adults and

M^{1-3} 7,2-11,2 mm for *T. splendens* against 300-930 gr and M^{1-3} 11,1-12,9 mm for *T. macrocephalus*) (CORBET & YALDEN, 1972; YALDEN & LARGEN, 1992). It presents a rather complicated enamel pattern in the molars, similar to that of the genus *Hystrix* (YALDEN *et al.*, 1976). The tail of *T. splendens* is longer than that in *T. macrocephalus* (YALDEN, 1988). The endemic giant mole rat (*T. macrocephalus*) lives in the Bale Mountains in the Eastern Ethiopian plateau (SILLERO *et al.*, 1995b; YALDEN, 1985), but it is uncertain whether it also occurred or occurs in the Western plateau (GÜTTINGER *et al.*, 1998).

The mole rat is a fossorial species that prefers open habitats with loose soil (GÜTTINGER *et al.*, 1998). It has increased its former distribution range thanks to farming practices that modify the soil structure (RUPP, 1980). The mole rat leaves conspicuous signs of its activity in the form of soil piles surrounded by cut grass.

Soil piles made by Tachyoryctes splendens

T. splendens inhabits both the eastern and the western plateau (YALDEN *et al.*, 1976). In 1996, Yalden *et al.* state that "contra YALDEN *et al.* (1976), neither the live animal nor its

burrows have been observed above 3,200 m in the Bale Mountains". Even though YALDEN (1988) quotes some skulls collected in the Urgana Valley, at 3,900 m from pellets of *Asio abissinicus*, those authors suggest that predators would have carried the sample from much lower altitudes. Following YALDEN *et al.* (1996), the altitudinal range of the species is set between 1,220 and 3,200 m. It was recorded in Koffole at 2,500 m. where it was the dominant species (DORST, 1972). GÜTTINGER *et al.* (1998) captured six individuals in the Simien Mountains, which were provisionally classified as *T. splendens* by the authors, although they argue that further examinations were necessary for correct determination.

T. splendens had not been previously detected in the scats of Ethiopian wolves in the Abune Yosef, but it had been recorded as an important prey to this species in other areas of Ethiopia such as Arsi, Bale and the Simien mountains (MALCOLM, 1997; MARINO, 2003). During our surveys, we found soil piles made by *T. spelendens* in the Aremgaremg peak in the Zigit camp at 4100 m of height. This record represents an important increase in the altitudinal range of the species. In addition to this record, the remains of a specimen were found in pellets of *Strix woodfordii* from Yimrihane, at 2660 m. The description (Figure 4.2.) and the craniometric (Table 4.9.) measures of that specimen match values given in literature for *T. splendens* (CORBETT & YALDEN, 1972; YALDEN *et al.*, 1976; YALDEN & LARGEN, 1992). The cranium from Yimrihane is in agreement with the altitudinal range reported for the species.

The species is considered as 'Least concern' by the IUCN Red List, with a steady population trend (SCHLITTER & AGWANDA, 2004b).

Common pigmy mouse (*Mus mahomet*) (EAM)

Although included by YALDEN & LARGEN (1992) in their list of endemic mammals, the authors state that "*M. mahomet* is, taxonomically, one of the least certain of Ethiopia's endemic mammals". In fact, it seems to be present also in Uganda and Kenya, since *M. musculoides emesi* HELLER 1911 has been recognized as a synonym of *M. mahomet* (MUSSER & CARLETO (1993) in YALDEN *et al*. 1996). In the current work, we consider the species to be an East African Montane form, as do YALDEN *et al*. (YALDEN *et al.*, 1996).

The common pygmy mouse has an intermediate size compared to its congeners in Ethiopia. It can be told apart from other *Mus* species by the upper molar row length, which is 3,0-3,6 mm (*M. mahomet*), against 2,6-3,1 mm (*M. tenellus*), 3,0-3,6 mm (*M. setulosus*) or 3,6-4,0 mm (*M. triton*). *M. setulosus* inhabits lower altitudes. The fur of *M. mahomet* mouse is greyish-brown in the dorsal part, and greyish-white in the ventral side, separated by a narrow orange line (YALDEN *et al.*, 1976; YALDEN & LARGEN, 1992).

The species seems to be a semi-commensal species as it is frequently associated to secondary vegetation caused by human activities. It has been previously recorded from

1,500 to 3,200 m. (YALDEN *et al.*, 1976; YALDEN & LARGEN, 1992; YALDEN *et al.*, 1996). It has also been recorded at 1,700 m in grass and in maize fields in Koka (BEKELE & LEIRS, 1997) and in bush and open forest in Meganesha, between 2,200 and 2,580 m (BEKELE, 1996).

During the 2001 survey, a male was captured by hand at dawn (05h30) in the vicinity of the Abune Yosef village, at 3,650 m. The area, located in the north-western slopes of the massif, is highly disturbed by human activities. Its relatively steep slopes are covered by a mosaic of barley cultivations and scattered patches of medium sized grasses, shrubs, bushes (mainly *Senecio*) and lobelias. Measures of the specimen (in mm) were 64 (head-body), 46 (tail), 13 (hindfoot) and 12 (ears). This record substantially increases the altitudinal range of the species.

The species is considered as 'Least concern' by the IUCN Red List, with a steady population trend. The major threats affecting the species are habitat loss/degradation caused by the agricultural practices (small-holder farming) and wood extraction for subsistence (LAVRENCHENKO, 2004a).

Gray-tailed narrow-headed rat (*Stenocephalemys griseicauda*) (E)
(see Figure 4.6 on page 62)

The grey-tailed narrow-head rat is an endemic rodent from Ethiopia, being recorded on both, the western and eastern plateaux (YALDEN & LARGEN, 1992)

It is quite smaller than its congener *S. albocaudata* (upper molar row length 6.5 - 7 mm (7.5) for *S. griseicauda* and 7.4 – 7.9 mm for *S. albocaudata* (PETTER, 1972; YALDEN *et al.*, 1976; SILLERO-ZUBIRI *et al.*, 1995a), although there is some overlap in size. The tail is similarly proportioned in the two species, but it is white in *S. albocaudata*, and dorsally grey in *S. griseicauda* (PETTER, 1972). However, the best distinguishing feature is the rounded shape of the interorbital region in *S. griseicauda*, while in *S. albocaudata* it is squared in cross-section (YALDEN *et al.*, 1976; YALDEN, 1988; YALDEN & LARGEN, 1992).

S. griseicauda is far more common and widespread than *S. albocaudata*, and it lives associated to scrubby, open habitats in the montane grassland (YALDEN & LARGEN, 1992; SILLERO-ZUBIRI *et al.*, 1995b). It has been recorded from 2,400 to 4,000 m (YALDEN *et al.*, 1996) but it is more abundant around 3,000 m of height. At higher altitudes, it seems to be replaced by *S. albocaudata* (YALDEN *et al.*, 1976; FADDA & CORTI, 2000). Even though the altitudinal ranges of both species overlap, they seem to be separated by different habitat preferences. *S. griseicauda* appears to be more associated to the montane grassland, below the *Erica arborea* belt, while *S. albocaudata* seems confined to the afroalpine moorlands, above the *Erica arborea* belt (YALDEN *et al.*, 1976; YALDEN & LARGEN, 1992). This species has not been detected in the scats of *Canis simensis* from the Abune Yosef massif, unlike *S. albocaudata* (MARINO, 2003a).

During the surveys that we performed, a total of 4 individuals were captured at 3,900 m in the Zigit camp, near a burrow zone rounded by the scattered rocky blocks and the high tussocks of *Carex* sp., giant lobelias and globe thistles. Although these records match the altitudinal range of the species, they are in the upper part of this range. The measures and the description for those individuals match those previously described for the species.

S. griseicauda is considered as 'Lower risk/near threatened' by the IUCN Red List, with an uncertain population trend. Major threats affecting the species are habitat loss and degradation caused by agricultural practices (nomadic and small holders), human disturbance, and its restricted distribution range (LAVRENCHENKO, 2004b).

Abyssinian grass rat (*Arvicanthis abyssinicus*) (E)

(see Figure 4.7 on page 63)

The taxonomy of the genus *Arvicanthis* is complex. Up to 10 different forms have been described from East Africa, but, since the 1970's, the occurrence of four *Arvicanthis* species in Ethiopia seems to be accepted: *A. abyssinicus, A. dembeensis, A. blicki* and *A. somalicus*. (YALDEN *et al.*, 1976; RUPP, 1980; ROUSSEAU, 1983).

A. abyssinicus is considered endemic to Ethiopia (YALDEN *et al.*, 1996). It is smaller than *A. blicki* (on average, *A. abyssinicus* weights 95 gr and *A. blicki* weights 128 gr) (YALDEN & LARGEN, 1992; SILLERO-ZUBIRI *et al.*, 1995a). In addition, *A. blicki* is endemic to the south-eastern plateau (YALDEN & LARGEN, 1992). These two species probably diverged during the Pleistocene from a common ancestor (CAPANNA *et al.*, 1996). Measures of the individuals captured during our surveys (length of upper molar row, see Table 4.9.) agree with those stated by CORBET & YALDEN (1972) for the species that they classify as *A. niloticus abyssinicus*. Description and measures are also coincident with *A. abyssinicus* on ROUSSEAU'S (1983) study on *Arvicanthis*. *A. abyssinicus* is very similar to *A. dembeensis* in size and colouring (YALDEN *et al.*, 1996), but both species can be told apart considering their different interorbital width (BEKELE *et al.*, 1993).

According to YALDEN *et al.* (1996), there seems to be a tendency for *A. abyssinicus* to replace *A. dembeensis* above 2,000 m of height, although there is a considerable overlap in their altitudinal ranges. BEKELE *et al.* (1993) only found an altitudinal cline in both species, but no specific replacement. *A. abyssinicus* has been cited from 1,300 to 3,400 m (YALDEN *et al.*, 1996) and it has been captured in the Simien Mountains at 3,700 m of altitude (MÜLLER, 1977; BEKELE *et al.*, 1993; GÜTTINGER *et al.*, 1998). Our findings in the Zigit camp (3,910 m) slightly enlarge its upper altitudinal range.

A. abyssinicus was captured on overgrazed *Senecio* grasslands, with some scattered rocks and boulders. In the Simien Mountains it seems to tolerate a certain grazing impact (GÜTTINGER *et al.*, 1998). It appears to be very abundant on the Abune Yosef afroalpine

ecosystem, which agrees with data published for the Simien Mountains, where it was the most frequently captured small mammal (MÜLLER, 1977; GÜTTINGER *et al.*, 1998).

A. abyssinicus seems to play an important ecological role. It has been documented as an important prey in the diet of *Canis simensis* in the Simien Mountains and in the Abune Yosef (SILLERO-ZUBIRI & MACDONALD, 1997; MARINO, 2003a).

The species is considered as 'Least concern' by the IUCN Red List, with an uncertain population trend (LAVRENCHENKO & CORTI, 2004).

Arvicanthis abyssinicus (Abyssinian grass rat)

Dega rat *(Desmomys harringtoni*) (E)

The systematics of this species is not well understood, and several authors have tended to allocate it within the genus *Pelomys* (DIETERLEN, 1974; YALDEN *et al.*, 1976, YALDEN & LARGEN, 1992). However, in the basis of its ridged, not grooved upper incisors, assignment of this species to the genus *Desmomys* seems more appropriated (MUSSER & CARLETON, 1993, YALDEN *et al.*, 1996; KINGDON, 1997). The endemic *D. harringtoni* is a widespread species with semi-arboreal habits found in an altitude range of 1,800-3,300 m.

Two individuals have been captured by hand in the southwestern slopes of the massif. The first one was sighted crossing a small stream and captured in a relatively forested riverine gallery, in the eastern vicinity of the Medage village at 2,350 m of altitude. The second was in a mosaic of woodland and long grass patch of the Tinchoi area at an altitude of 2,280 m. Measurements are within the reported range of the species: head-body 135 and 120 mm, tail 153 and 140 mm.

Yellow-spotted brush-furred rat (*Lophuromys flavopunctatus*) (EAM)
(see Figure 4.8 on page 64)

Two different species of *Lophuromys* inhabit Ethiopian highlands: *L. melanonyx* and *L. flavopunctatus*. The first species is an Ethiopian endemic known only from the Bale Mountains on the eastern plateau (YALDEN & LARGEN, 1992; BEKELE & CORTI, 1994), although there are two records from west of the Rift Valley (YALDEN *et al.*, 1976; DIETERLEN, 1987). *L. melanonyx* is bigger (Head and body 140-165 mm, M^{1-3} 5,8-6,2 mm) than *L. flavopunctatus* (Head and body 110-133 mm, M^{1-3} 4,8-5,8 mm) (PETTER, 1972; YALDEN *et al.*, 1976; YALDEN & LARGEN, 1992; SILLERO-ZUBIRI *et al.*, 1995a).

The taxonomy of the Ethiopian *L. flavopunctatus* has been described as rather chaotic (LAVRENCHENKO *et al.*, 2001). Seven taxa were described and latter grouped in only one species complex. This species complex shows much morphological variation, especially ventral fur coloration (BEKELE & CORTI, 1994), external measurements (LAVRENCHENKO *et al.*, 1998) and karyotypic variability (CORTI *et al.*, 2004). Recent studies based on genetic analyses revealed the split of the former *L. flavopunctatus* into three taxa with specific ranks: *L. brevicaudus, L. chrysopus* and *L. brunneus* (LAVRENCHENKO *et al.*, 1998). These species are endemic to Ethiopia. The former species is a specialized heatland species, while the latter inhabit lower tropical forests on both sides of the Rift Valley (LAVRENCHENKO *et al.*, 2001).

Craniometric measures identify the individuals captured during our surveys in the Abune Yosef as *L. flavopunctatus brunneus* (LAVRENCHENKO *et al.*, 1998). This taxon corresponds to the species *L. brunneus* in LAVRENCHENKO et al. (2001). Because of its traditional view, we use the *L. f. brunneus* notation. All measures agree with the range given for *L. f. brunneus* except the larger width of nasals (VERHEYEN *et al.*, 2002) (Table 4.9.). We provisionally classify these individuals as *L. f. brunneus*, but further analyses will be needed for final determination.

All individuals were captured around the Zigit camp, at 3,910 m, which agrees with the wide altitudinal range of this species, set between 1,200 and 4,000 m (YALDEN *et al.*, 1996). *L. f. brunneus* is considered to be a forest species, inhabiting at intermediate altitudes between the high-altitude *L. melanonyx*, and the low-altitude *L. chrysopus* (LAVRENCHENKO *et al.*, 1998; LAVRENCHENKO *et al.*, 2000).

Specimens were captured on overgrazed *Senecio* grasslands, with some scattered rocks and boulders, the same microhabitat where *A. abyssinicus* was found. In the Simien Mountains, *L. flavopunctatus* seems to choose long-grass covered habitats, avoiding the disturbed areas where *A. abyssinicus* is found (GÜTTINGER *et al.*, 1998). In the Abune Yosef, the species had been previously recorded in scats of *Canis simensis* (MARINO, 2003a)

The relationship between *A. abyssinicus* and *L. flavopunctatus* in the Abune Yosef is interesting and it is worth further research. Both species were captured in the same microhabitat and the same places, living in colonies built around *Senecio* clumps, and both typically emitted a high-pitched whistling cry as a warning when detecting any danger. This behaviour has been described in the Bale Mountains for mixed colonies of L*. melanonyx* and *A. blicki* (YALDEN, 1988; YALDEN & LARGEN, 1992).

The species is considered as 'Least concern' by the IUCN Red List, with an uncertain population trend (LAVRENCHENKO & CORTI, 2004).

Table 4.9.- Results of the cranial measurements performed on the rodent specimens collected during the surveys. CRBA is the collection number of the specimens deposited at the Centre de Recursos de Biodiversitat Animal of the Universitat de Barcelona. "-" means that the conservation status of the specimen's cranium did not allow its measurement. The Table shows the minimum, the maximum, the mean and the standard deviation. All measures are given in millimetres. Measurements are described in Figure 4.2. In the case of *Lophiomys imhausi*, *Otomys typus* and *Tachyoryctes splendens*, all specimens were found in pellets (thus, several measurements could not be taken).

CRBA	Species	IOW	NW	OW	ZW	CCH	CCHb	CBL	DL	FIL	ML	NL	LTRa	LTRc	UTRa	UTRc
CRBA348	*Lophiomys imhausi*	-	-	-	-	-	-	-	-	-	-	-	12,70	11,70	14,00	12,20
CRBA344	*Stenocephalemys griseicauda*	3.62	4.00	13.13	18.28	9.94	10.92	31.69	10.13	8.74	21.58	15.58	6.70	6.43	7.11	6.72
CRBA345	*Stenocephalemys griseicauda*	3.62	4.05	12.94	17.56	9.74	10.35	30.86	10.09	7.99	20.94	13.82	5.79	5.90	6.64	6.23
CRBA349	*Stenocephalemys griseicauda*	3.82	4.70	13.31	18.40	9.80	12.56	34.42	10.84	9.21	21.20	15.61	6.28	6.37	7.02	6.60
CRBA350	*Stenocephalemys griseicauda*	4.03	4.19	12.63	17.98	9.92	10.62	33.42	9.89	8.55	20.44	15.97	6.22	6.27	7.16	6.46
	Min	**3.62**	**4.00**	**12.63**	**17.56**	**9.74**	**10.35**	**30.86**	**9.89**	**7.99**	**20.44**	**13.82**	**5.79**	**5.90**	**6.64**	**6.23**
	Max	**4.03**	**4.70**	**13.31**	**18.40**	**9.94**	**12.56**	**34.42**	**10.84**	**9.21**	**21.58**	**15.97**	**12.70**	**11.70**	**14.00**	**12.20**
	Mean	**3.77**	**4.24**	**13.00**	**18.06**	**9.85**	**11.11**	**32.60**	**10.24**	**8.62**	**21.04**	**15.25**	**7.54**	**7.33**	**8.39**	**7.64**
	SD	**0.20**	**0.32**	**0.29**	**0.37**	**0.10**	**0.99**	**1.62**	**0.42**	**0.50**	**0.48**	**0.97**	**2.90**	**2.45**	**3.14**	**2.55**
CRBA339	*Arvicanthis abyssinicus*	4.30	3.30	13.00	15.30	9.20	11.30	31.10	8.80	6.90	18.00	12.40	5.90	6.00	6.30	6.10
CRBA342	*Arvicanthis abyssinicus*	4.20	4.10	12.50	18.00	9.70	11.70	31.50	8.80	8.10	18.90	12.90	6.40	6.30	7.00	6.50
	Mean	**4.25**	**3.70**	**12.75**	**16.65**	**9.45**	**11.50**	**31.30**	**8.80**	**7.50**	**18.45**	**12.65**	**6.15**	**6.15**	**6.65**	**6.30**
	SD	**0.07**	**0.57**	**0.35**	**1.91**	**0.35**	**0.28**	**0.28**	**0.00**	**0.85**	**0.64**	**0.35**	**0.35**	**0.21**	**0.49**	**0.28**
CRBA341	*Lophuromys flavopunctatus*	6.20	3.10	13.10	15.10	8.80	10.40	31.00	9.30	7.40	17.50	12.80	5.10	4.90	5.10	5.20
CRBA351	*Otomys typus*	-	-	-	-	-	-	-	5.50	4.60	-	-	7.80	6.70	7.70	6.30
CRBA353	*Otomys typus*	-	-	-	-	-	-	-	-	-	-	-	-	-	8.10	6.50
CRBA356	*Otomys typus*	-	-	-	-	-	-	-	-	-	-	-	7.60	7.20	-	-
CRBA357	*Otomys typus*	-	-	-	-	-	-	-	-	-	-	-	7.40	7.00	-	-
CRBA358	*Otomys typus*	-	-	-	-	-	-	-	-	-	-	-	7.00	7.00	-	-
CRBA359	*Otomys typus*	-	-	-	-	-	-	-	-	-	-	-	7.00	6.30	-	-
CRBA360	*Otomys typus*	-	-	-	-	-	-	-	6.40	5.20	-	-	-	-	-	-
	Min	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5.50**	**4.60**	**-**	**-**	**7.00**	**6.30**	**7.70**	**6.30**
	Max	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**6.40**	**5.20**	**-**	**-**	**7.80**	**7.20**	**8.10**	**6.50**
	Mean	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**5.95**	**4.90**	**-**	**-**	**7.36**	**6.84**	**7.90**	**6.40**
	SD	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.64**	**0.42**	**-**	**-**	**0.36**	**0.35**	**0.28**	**0.14**
CRBA352	*Tachyoryctes splendens*	-	-	-	-	-	-	-	11.50	3.10	-	-	-	-	7.80	7.50

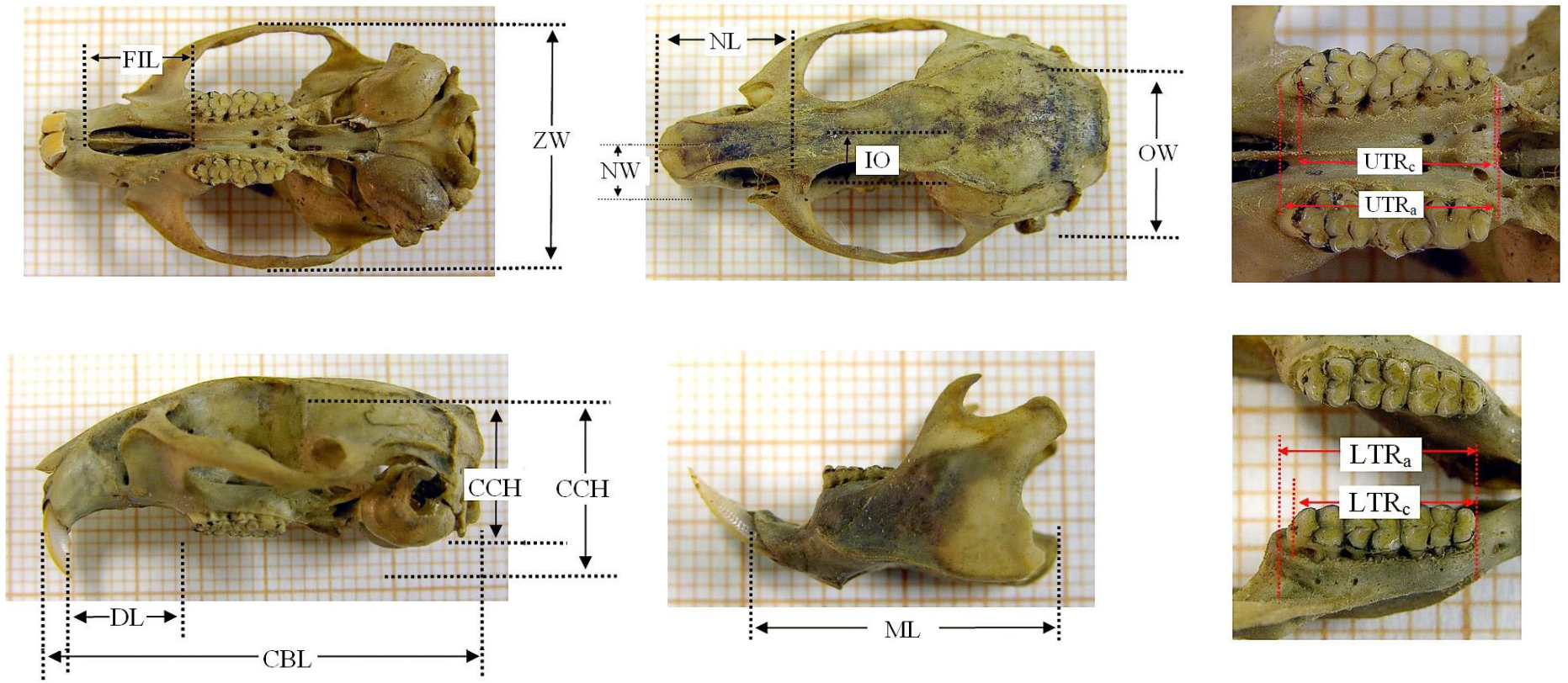
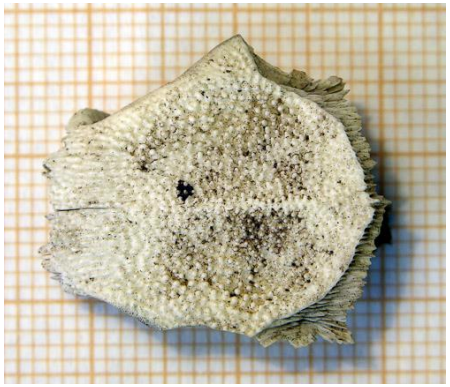
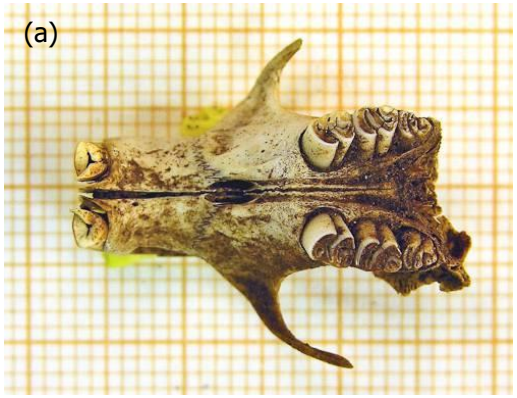


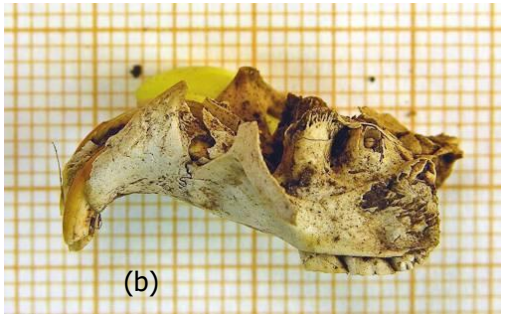
Figure 4.2.- Cranial measurements performed on the rodent specimens collected during the surveys. IOW: Interorbital width. NW: Nasal width. OW: Occipital width. ZW: Zygomatic width. CCH: Cranial height. CCHb: Cranial height from the tympanic bone. CBL: Condilo-bassal length. DL: Length of the diastema. FIL: Length of the incisive foramen. ML: Mandibular length. NL: Nasal length. LTRa: Length of the lower tooth row at the alveolar level. LTRc: Length of the lower tooth row at the crow level. UTRa: Length of the upper tooth row at the alveolar level. UTRc: Length of the lower tooth row at the crown level. (Photographs: CRBA)



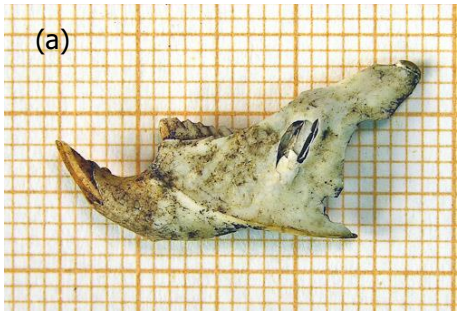
1 cm

Figure 4.3.- Cranial fragment of a *Lophiomys imhausi* specimen (CRBA348) found in a pellet. (Photograph: CRBA)

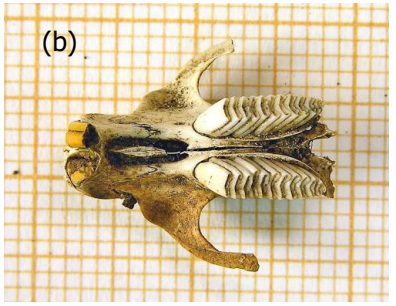




1 cm



1 cm



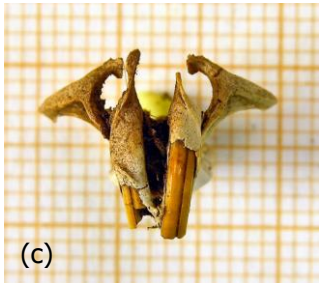


Figure 4.4.- Cranial fragments of an *Otomys typus* specimen (CRBA351) found in a pellet. (a) Mandible lateral view. (b) Ventral view. (c) Frontal view. (Photographs: CRBA)

Figure 4.5.- Cranial fragments of a *Tachyoryctes splendens* specimen (CRBA352) found in a pellet. (a) Ventral view. (b) Lateral view. (c) Frontal view. (Photographs: CRBA)

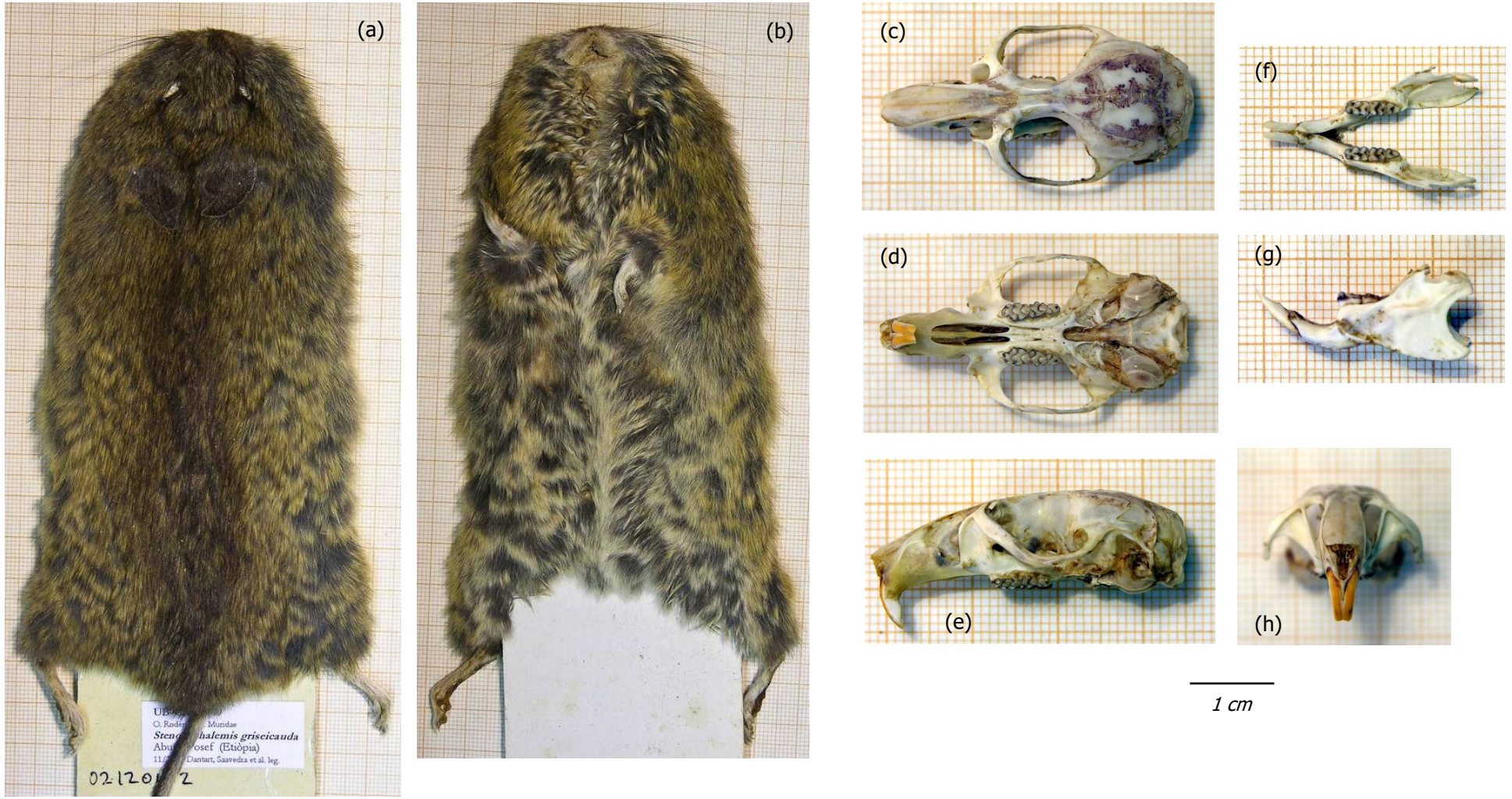


Figure 4.6.- One of the *Stenocephalemys griseicauda* specimens that were examined (CRBA349). (a) Dorsal view. (b) Ventral view. (c) Cranial dorsal view. (d) Cranial ventral view. (e) Cranial lateral view. (f) Mandible dorsal view. (g) Mandible lateral view. (h) Cranial frontal view. (Photographs: CRBA)

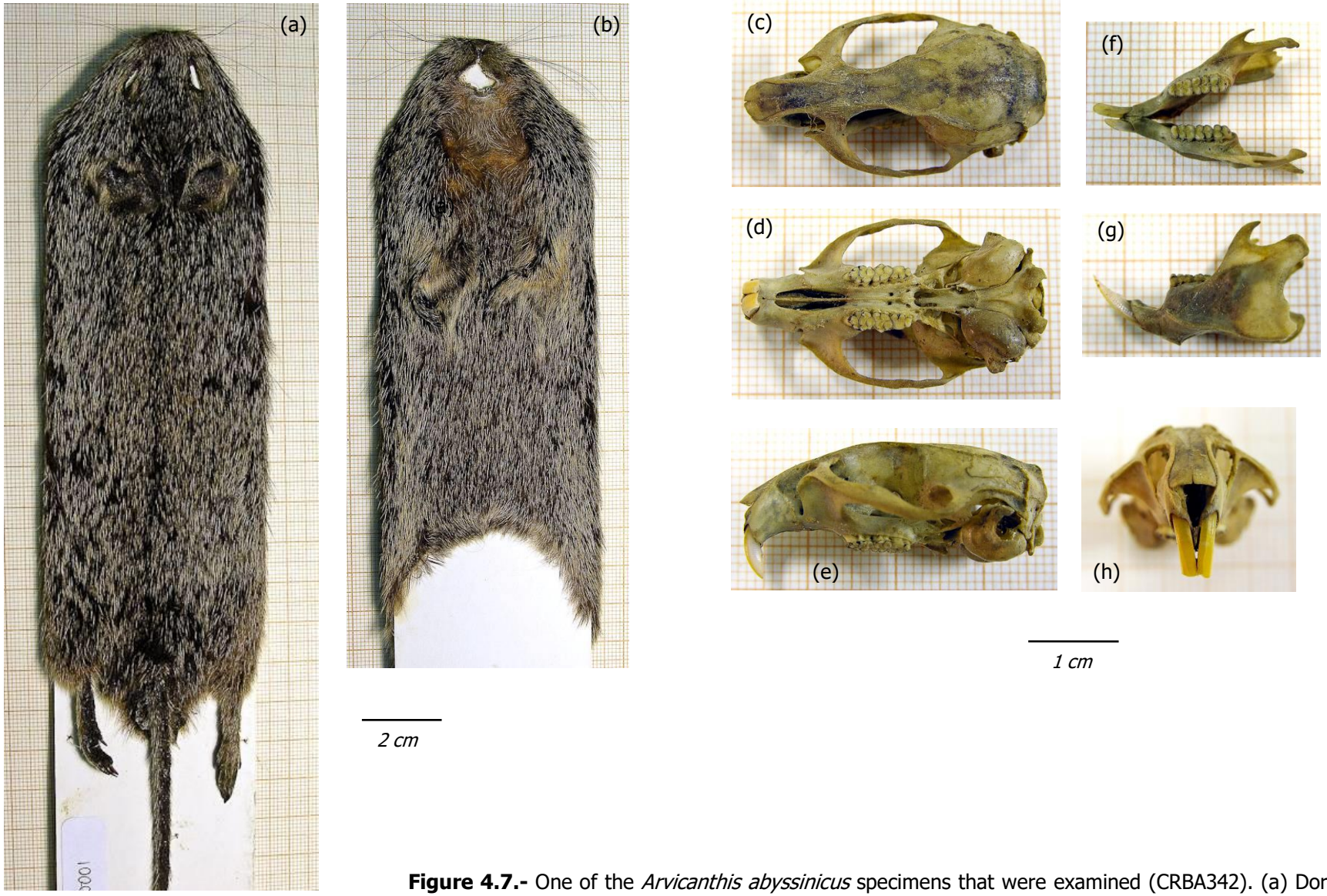


Figure 4.7.- One of the *Arvicanthis abyssinicus* specimens that were examined (CRBA342). (a) Dorsal view. (b) Ventral view. (c) Cranial dorsal view. (d) Cranial ventral view. (e) Cranial lateral view. (f) Mandible dorsal view. (g) Mandible lateral view. (h) Cranial frontal view. (Photographs: CRBA)

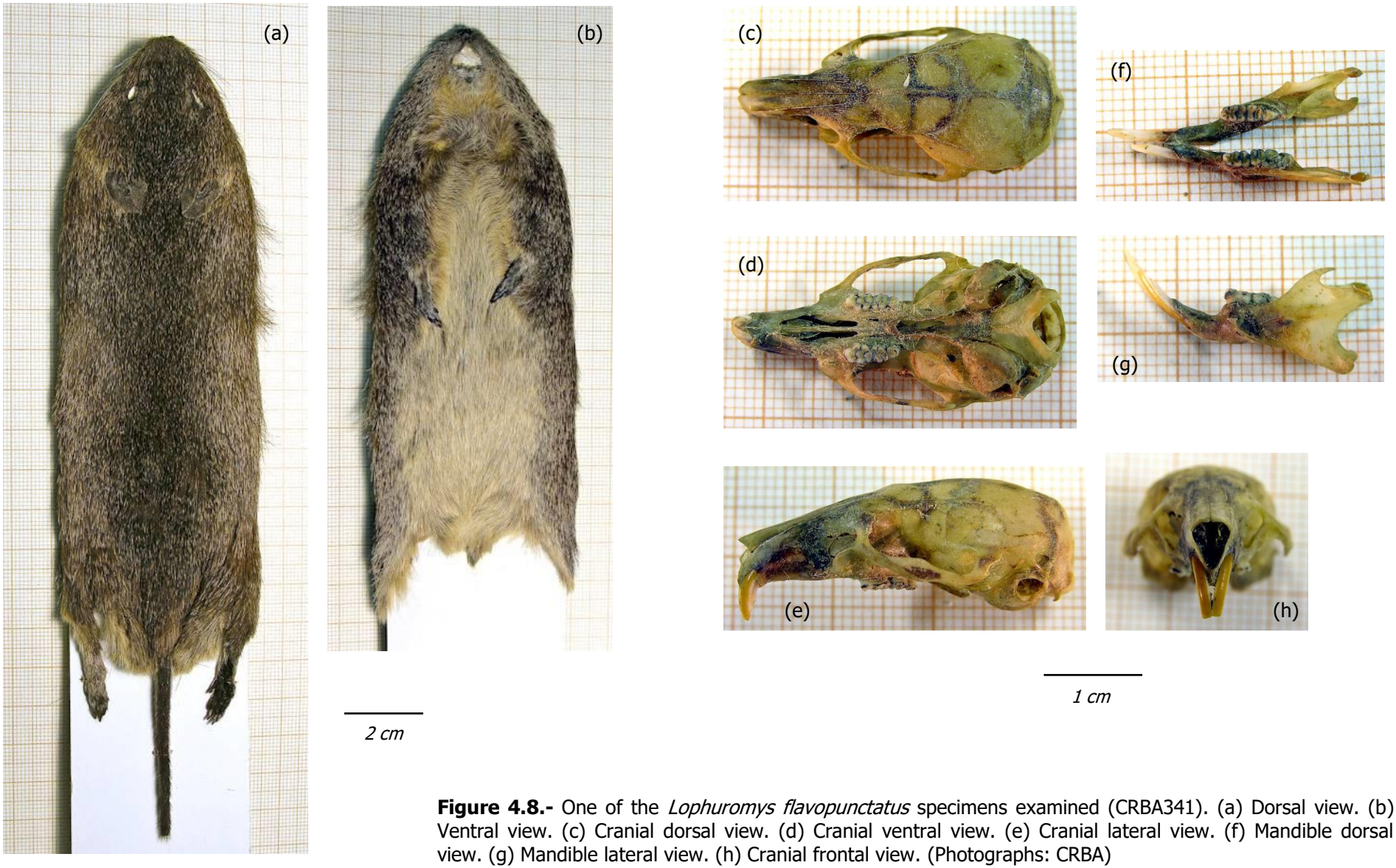


Figure 4.8.- One of the *Lophuromys flavopunctatus* specimens examined (CRBA341). (a) Dorsal view. (b) Ventral view. (c) Cranial dorsal view. (d) Cranial ventral view. (e) Cranial lateral view. (f) Mandible dorsal view. (g) Mandible lateral view. (h) Cranial frontal view. (Photographs: CRBA)

Family Hystricidae

Crested porcupine (*Hystrix cristata*) 'Djarrt' (WAS)

The crested porcupine is classified by the IUCN as 'Least Concern' (GRUBB *et al*. , 2008).

Black and white spines, footprints and faeces were found from lowlands to Afroalpine grasslands up to 3,540 m. A mandible was found in a leopard eating site. Local authorities reported that they have frequently seen porcupines while driving at night along the roads of the area. It seems fairly common.

Order Lagomorpha

Family Leporidae

Scrub hare *(Lepus fagani)* 'Tinchel' (WAS?)

The scrub hare is a common species in the study area. Many individuals were seen in the western and southwestern lowlands, from 2,000 to 2,500 m of height. In 53.5 km of night

Lepus fagani (scrub hare)

transects (by car) through the savannah habitats of the lowlands, 24 groups of hares were observed, totalling 29 individuals (0.54 ind/km).

We also found hare droppings in the Afroalpine zone. The only hare species known to occur at high altitudes is the endemic ***Lepus starcki*** (E) (YALDEN *et al*., 1986; YALDEN & LARGE, 1992). However we have no directly sighted any hare along the Afroalpine meadows, and hare species are not easily distinguished by its droppings. We provisionally leave the hypothetical occurrence of *L. starcki* to be confirmed by further field work.

4.3. Discussion

Ethiopia has a unique orography in its region. As much as 2% of its territory is above 3,000 m of altitude, and 15% is above 2,000 m. This feature implies very hard environmental conditions, particularly climatic ones (YALDEN & LARGEN, 1992). These extreme conditions and the isolation of the Ethiopian highlands from the surrounding areas facilitate and enhance speciation processes (MARINO, 2003b). This leads towards an important endemicity factor (YALDEN *et al*. 1996) with approximately 11% of the existing terrestrial mammal species being endemic to Ethiopia and Eritrea. Currently, 32 endemic mammal species are known from Ethiopia (KRUSKOP & LAVRENCHENKO, 2000). Six of these endemics have been found in the Abune Yosef massif.

Small mammals

Species recorded during our surveys are typical of the Ethiopian high altitude rodent community. This community is formed by species whose distribution range extends above 3,000 m, although some of the species found can live at lower altitudes. At high altitudes, they tend to live in open habitats (grassland-shrubland). At lower altitudes, some of them prefer montane forests.

Our results are similar to those found by MARINO (2003a) in a study on the diet of *Canis simensis*. This author recorded *Otomys typus*, *Arvicanthis abissynicus* and *Lophuromys flavopunctatus,* all of them being an important prey to the Ethiopian wolf in the Abune Yosef*.* She also found *Praomys albipes* and *Stenocephalemys albocaudata* but not *S. griseicauda* in scats of *Canis simensis* in the Abune Yosef.

Our results are also similar to those stated by GÜTTINGER *et al.* 1998 in a high altitude area of the Simien mountains, since they detected the following species: *Crocidura baileyi, A. abyssinicus, L. flavopunctatus, S. griseicauda* and *O. typus*. They also captured six

Tachyoryctes individuals that where provisionally classified as *T. splendens*, finding also *T. splendens* in the scats of *C. simiensis*.

The similarities between the results by MARINO (2003a) and GÜTTINGER *et al*. (1998) and our work could be explained by the fact that all three studies have been performed in the Western Plateau, and at similar altitudes.

On the other hand, our results from the Abune Yosef differ from those obtained by YALDEN (1988) in the Bale mountains. This author detected almost all of the high altitude species that we found in the Abune Yosef (*C. baileyi*, *M. mahomet, S. griseicauda, L. flavopunctatus, O. typus, and T. splendens*) but also some others that we did not find endemics to the Eastern Plateau (*Arvicanthis blicky, Stenocephalemys albocaudata, Lophuromys melanonyx*). SILLERO-ZUBIRI *et al.* (1995) reported similar results from the same area.

The differences between high altitude small mammal communities from the Abune Yosef and the Bale mountains, as well as the similarities between those from the Abune Yosef and the Simien mountains could be explained by biogeographical factors. The Bale Mountains National Park is located on the Eastern Plateau, while the Abune Yosef and the Simien mountains are on the Western Plateau. The Rift Valley separates the two plateaux, acting as a zoogeographical barrier and promoting the isolation and the diversification of the fauna on both sides of the valley (YALDEN & LARGEN, 1992).

From a different point of view, the species we found in the Abune Yosef are important preys to the most endangered canid in the world, *C. simensis*, but very little is known about their ecology or even about their distribution in the Abune Yosef massif. In MARINO (2003a), *O. typus* represents the most common prey consumed by the Ethiopian wolf (40%-50% occurrences). In the Bale mountains, three species of small mammals (*Tachyoryctes macrocephalus*, *Arvicanthis blicki* and *Lophuromys melanonyx*) account for 86.4% of preys consumed by the Ethiopian wolf (SILLERO-ZUBIRI & GOTTELLI 1995), although, in that case, *O. typus* contributed little to their diet. The biogeographical differences between small mammal communities are reflected in the biogeographical patterns found in the diet of the Ethiopian wolf, which in turn reflects prey availability (MARINO, 2003a).

Large mammals

The high diversity of large mammal species and the unique mammalian composition of the Abune Yosef massif are due to its geographical emplacement between two distinct physico-geographical regions such as the Ethiopian highland and the Rift valley. The large mammal fauna composition of the Abune Yosef (Table 4.10) is, to some extent, similar to that of the Simien mountains (HEGGLIN *et al*., 1998). Nevertheless, the virtual absence of the Viverridae, Herpestidae, Orycteropodidae and Sciuridae families from the Simien, and

the absence of the serval cat and the walia ibex from the Abune Yosef are somehow striking. They clearly indicate distinct ecological and/or historical characteristics for each one of these massifs. Four out of the nine Abune Yosef species that are not found in the Simien mountains occur in the close Rift valley, so, the occurrence of these species might be explained through geographical proximity and/or historical or recent extensions of their distribution ranges.

Table 4.10.- Comparison between checklists of the large mammals of the Abune Yosef massif (AY) and the Simien Mountains National Park (SM). "X" indicates occurrence of the species in the area.

Family	Scientific name	English name	AY	SM
Cercopithecidae	*Theropithecus gelada*	Gelada	X	X
	Papio hamadryas hamadryas	Hamadryas baboon	X	X
	Papio anubis	Anubis baboon		X
	Cercopithecus aethiops aethiops	Grivet monkey	X	X
Colobidae	*Colobus guereza*	Black-and-white colobus		X
Hystricidae	*Hystrix cristata*	Crested porcupine	X	X
Canidae	*Canis simensis*	Ethiopian wolf	X	X
	Canis adustus	Side-striped jackal	X	
	Canis aureus	Golden jackal	X	X
Mustelidae	*Mellivora capensis*	Ratel	X	X
	Ictyonix striata	Zorrilla	X	
Viverridae	*Genetta abyssinica*	Ethiopian genet	X	
	Civettictis civetta	African civet	X	
Herpestidae	*Ichneumia albicauda*	White-tailed mongoose	X	
	Herpestes sanguinea	Slender mongoose	X	
	Herpestes ichneumon	Grey mongoose	X	
Hyaenidae	*Crocuta crocuta*	Spotted hyena	X	X
Felidae	*Panthera pardus*	Leopard	X	X
	Caracal caracal	Caracal	X	X
	Felis sylvestris	African wildcat	X	
	Felis serval	Serval		X
Orycteropodidae	*Orycteropus afer*	Aardvark	X	
Procaviidae	*Procavia habessinica*	Ethiopian rock hyrax	X	X
Suidae	*Potamochoerus larvatus*	Bushpig	X	X
Bovidae	*Oreotragus oreotragus*	Klipspringer	X	X
	Silvicapra grimmia	Common duiker	X	X
	Tragelaphus scriptus	Bush buck		X
	Capra ibex walie	Walia ibex		X
Total			**23**	**19**

Eight species of large mammals are reported to have their highest altitudinal records in the Abune Yosef massif. Factors underlying this phenomenon are not clear and could be diverse. Geographical proximity to the Rift valley could influence the climatology of the massif, moderating temperature, rainfall and humidity, but information is yet unavailable.

4.4. Checklist of the Mammals of the Abune Yosef massif

Mammal species occurring in the Abune Yosef massif are summarised in Table 4.11.

Theropithecus gelada (Gelada baboon)

Table 4.11. ***(following page)-*** Checklist of the Mammals of the Abune Yosef massif. "Zoog.Cat." indicates Zoological Category according to YALDEN *et al.* 1996. "Remarks" state T for species of threatened status in the world (see species text for category), "?" when presence is uncertain and maximum altitude records for species found at higher altitudes than previously reported.

Order / Family	Scientific name	English name	Amharic name	Zoog. Cat.	Remarks
Order Insectivora					
Soricidae	*Crocidura baileyi*		Ait Megot	E	
Order Chiroptera					
Rhinolophidae	*Rhinolophus sp.*	Horseshoe bat			
Vespertilionidae	*Pipistrellus sp.*	Pipistrelle			
	Eptesicus sp.	Serotine bat			
	Laephotis wintoni	Tropical long-eared bat		EAM	
	Plecotus balensis	Long-eared bat		E	
	Miniopterus inflatus	Long-fingered bat		U	
Molossidae	*Tadarida aegyptiaca*	Guano bat		U	
Order Primates					
Cercopithecidae	*Papio hamadryas*	Hamadryas baboon	Netch Djindjero	SA	T 3,500m
	Theropithecus gelada	Gelada	Gelada	E	T
	Cercopithecus aethiops	Grivet monkey	Tota	U	3,500m
Order Carnivora					
Canidae	*Canis simensis*	Ethiopian wolf	Kai Kebero	E	T
	Canis adustus	Side-striped jackal	Bula Kebero	PAS	3,900m
	Canis aureus	Golden jackal	Buna Kebero	SS	
Mustelidae	*Mellivora capensis*	Ratel	Marbella	U	
	Ictyonix striata	Zorrilla	Faro	PAS	3,900m
Viverridae	*Genetta abyssinica*	Ethiopian genet	Mitmat	U	T 3,850m
	Civettictis civetta	African civet	Tirign	U	
Herpestidae	*Ichneumia albicauda*	White-tailed mongoose	Alach	PAS	3,600m
	Herpestes sanguinea	Slender mongoose	Alach	U	3,300m
	Herpestes ichneumon	Grey mongoose	Alach	PAS	
	Atilax paludinosus	Marsh mongoose	Alach	U	?
Hyaenidae	*Crocuta crocuta*	Spotted hyena	Djibb	PAS	
Felidae	*Felis sylvestris lybica*	African wildcat	Ye-dur Dimmet	U	3,900m
	Caracal caracal	Caracal	Delg Ambessa	U	
	Panthera pardus	Leopard	Nebir	U	
Order Hyracoidea					
Procaviidae	*Procavia habessinica*	Ethiopian rock hyrax	Eshkoko	PAS	
Order Tubulidentata					
Orycteropodidae	*Orycteropus afer*	Aardvark	Goana	PAS	
Order Artiodactyla					
Suidae	*Potamochoerus larvatus*	Bushpig	Ye-dur Azama	EAF	
Bovidae	*Silvicapra grimmia*	Common duiker	Midawka	PAS	
	Oreotragus oreotragus	Klipspringer	Sassa	EAS	T
Order Rodentia					
Sciuridae	*Euxerus erythropus*	Striped ground squirrel	Bukakta	WAS	
Muridae	*Lophiomys imhausi*	Crested or maned rat		U	
	Otomys typus	Groove-toothed rat		EAM	
	Tachyoryctes splendens	Mole rat	Filfel	EAM	4,000m
	Mus mahomet	Common pigmy mouse		EAM	3,650m
	Stenocephalemys griseicauda	Narrow-headed rat		E	
	Arvicanthis abyssinicus	Unstriped grass rat		E	3,910m
	Desmomys harringtoni	Dega rat		E	
	Lophuromys flavopunctatus	Harsh-furred rat		EAM	
Hystricidae	*Hystrix cristata*	Crested porcupine	Djarrt	WAS	T
Order Lagomorpha					
Leporidae	*Lepus fagani*	Scrub hare	Tinchel	WAS	
	Lepus starcki	Starck's hare	Tinchel	E	?, T

(Checklist of the Mammals of the Abune Yosef massif)

5. The Birds of the Abune Yosef

DELI SAAVEDRA, GUILLERMO DÍAZ, RAIMON MARINÉ & ORIOL ARMET

5.1. Introduction

Ethiopia holds one of the highest diversities (more than 800 species) and endemicity levels (16 endemic species, 30 including Eritrea) of birds in Africa (EWNHS, 1996). However, these numbers and all ecological, distributional and conservational data on Ethiopian birds are still considered to be provisional. Huge areas remain to be biologically explored, particularly in the highlands of Wollo, Begemdir and Shoa (YALDEN & LARGEN, 1992). Difficult access to the remote inland areas hampers efforts to complete scientific knowledge on these unique montane ecosystems.

In addition, this large biodiversity is seriously threatened (HILLMAN, 1993). Much of the Ethiopian landscape from sea level up to 4,000 m is altered by agricultural activities, deforestation and over-grazing in order to fit the basic necessities of a growing human population. This habitat deterioration is particularly menacing the montane ecosystems and, as a consequence, species are being depleted before scientific information about them is obtained.

For these reasons, the study and conservation of montane wildlife and ecosystems are urgently needed. The vertebrate inventory of the Abune Yosef massif (scientifically, an almost unknown montane area) has brought out new data about the distribution and composition of the avifauna of the Ethiopian Northern Highlands (ENH). As stated elsewhere in this book, the information will facilitate the identification of the conservation priorities for these ecosystems and it is hoped that it will help in the declaration of a Biosphere Reserve in the area.

5.2. Relevant species

221 bird species, from 48 families and 16 orders, have been identified in the Abune Yosef massif (see check-list at the end of this chapter). That means 24% of the species, 51% of

the families and 70% of the orders found in Ethiopia (LEPAGE, 2006). From the 17 endemic species found in Ethiopia, 6 have been found in the massif (35%) (Table 5.1).

Table 5.1.- Species endemic to Ethiopia found in the Abune Yosef massif.

Scientific name	**English name**
Poicephalus flavifrons	Yellow-fronted parrot
Calandrella erlangeri	Erlanger's lark
Macronyx flavicollis	Abyssinian longclaw
Paroplasma galinieri	Abyssinian catbird
Serinus nigriceps	Black-headed siskin
Serinus ankoberensis	Ankober serin

Calandrella erlangeri (Erlanger's lark)

Ethiopia holds 36 Threatened species (BIRDLIFE INTERNATIONAL, 2000), 2 Endangered, 14 Vulnerable, 16 Near Threatened and 4 Data Deficient. In the Abune Yosef massif 9 Threatened species have been found (25% of the species found in the country), one Endangered, 3 Vulnerable, 4 Near Threatened and one Data Deficient (Table 5.2).

Table 5.2.- Globally threatened species found in the Abune Yosef massif.

Scientific name	English name	Category
Cyanochen cyanopterus	Blue-winged goose	Near threatened
Torgos tracheliotus	Lappet-faced vulture	Vulnerable
Aquila clanga	Greater spotted eagle	Vulnerable
Circus macrourus	Pallid harrier	Near threatened
Falco naumanni	Lesser kestrel	Vulnerable
Macronyx flavicollis	Abyssinian longclaw	Near threatened
Cercomela dubia	Sombre rock chat	Data deficient
Serinus ankoberensis	Ankober serin	Endangered
Emberiza cineracea	Cinereous bunting	Near threatened

In the following pages, details are given about some species that are considered to be relevant because they are globally threatened, endemic to Ethiopia or new to the studied area.

Order Anseriformes

Family Anatidae

Blue-winged goose (*Cyanochen cyanopterus*)

Very rare. It was observed only once in the massif, flying over the Afroalpine area. Status unknown.

The blue-winged goose is an endemic species to Ethiopia, classified in the category of "Lower Risk Species" as Near Threatened (BIRDLIFE INTERNATIONAL, 2000), due to the possible decline of an estimated population of between 5,000 and 15,000 individuals. Although it is not threatened by hunting, as it is not eaten for religious reasons, it is surely under pressure due to the degradation of wetlands and grasslands caused by the rapidly expanding human population.

Order Accipitriformes

Family Accipitridae

Bearded vulture (*Gypaetus barbatus*)

The bearded vulture is one of the biggest necrophagous raptors in the world. It formerly occupied most of the mountain areas in the Iberian Peninsula, the Alps, southwestern Europe, central Asia, China, northern Africa mountains, east Africa and South Africa. Between the late 19th century and the first half of the 20th century, the species became extinguished from most of its former distribution area, mainly due to the use of poison and direct hunting by humans. Thus, the distribution area of the bearded vulture in Europe was restricted to the Pyrenees and Sierra de Cazorla (in southern Spain). This last population disappeared in 1985.

The bearded vulture is the only raptor species in the world that feeds almost exclusively on bones. It shows extraordinary adaptations in the digestive track, with very thick and elastic oesophagic walls. The stomach shows a large proportion of gastric acid secreting

Gypaetus barbatus (Bearded vulture)

cells. Another major characteristic of the bearded vulture is the possession of highly isolating feathers. Bearded vultures in the Himalayas have been seen flying above 8,000 m at very low temperatures (below –40º C).

Two different subspecies of bearded vultures have been described, being their distribution areas separated by the Red Sea:

Gypaetus barbatus barbatus is distributed to the North of the Tropic of Cancer and it is quite large, 5-7 Kg of weight and 2.5-2.8 m of wingspan.

Gypaetus barbatus meridionalis is found in Egypt, Sudan, Ethiopia, Eritrea, Uganda, Kenya, Tanzania and South Africa. It is smaller than the former (3-4 Kg), with lower tarsus unfeathered and it lacks black markings and feathers on cheeks and crown.

Ethiopia holds the largest population of *Gypaetus barbatus meridionalis* in the world, with an estimate of 1,430 pairs (TERRASSE, 2001). Further South, Marsabit, Elgon, Mount Kenya, Aberdares, Kilimanjaro and Ngorongoro hold a total of 50 pairs of the species. In South Africa, between Natal and Lesotho, 200 pairs have been calculated. (DEL HOYO *et al.*, 1994).

In Ethiopia, the large amount of breeding pairs could be related to the fact that it is the most mountainous country in Africa, with more than 80% of its territory situated above 3,000 m (YALDEN & LARGEN, 1992).

The Abune Yosef bearded vulture population

During the course of the different surveys conducted in the Abune Yosef, three territories of bearded vultures have been identified (with a possible fourth territory in the eastern part of the massif). It is remarkable that all three territories were placed on afroalpine habitat, using around 1,000 ha/territory.

In November 2004, a specific survey on bearded vultures was performed. 270 hours were dedicated to look for individuals on the different altitudinal stages (2,500 – 4,300 m). Simultaneous observations of two people during half a day in different occasions and territories were also carried out.

Most of the observations were made on afroalpine habitat (above 3,700 m in the Abune Yosef massif) which represents only 15% of all the massif extension (35,000 ha above 3,000 m). From the 18 individuals identified, 13 were observed on afroalpine habitat, for a similar survey effort above and under 3,700 m (Table 5.3).

Table 5.3.- Bearded vulture individuals observed in the Abune Yosef massif in 2004.

	Confirmed		Probable	
	> 3,700m	<3,700m	>3,700m	<3,700m
Adults (phase 3) (*)	5	-	1	4
Subadults (phase 2.2) (*)	1	-	1	-
Young (phase 1.2) (*)	2	-	1	-
Young (phase 1.1) (*)	2	-	-	1

(*) Criteria of identification of the bearded vulture considering age and characteristics of the plumage (unpublished information from R. HEREDIA, M. RAZIN, A. MARGALIDA, J.F. SEGUIN, R. ANTOR, S. XIROUCHAKIS and C. CLEMENTE). Phase 1.1. One-year-old, 1.2. Two-years-old, 2.2. Four-years-old and 3 more than Seven-years-old.

Only one of the reproductive units studied in 2004 was already incubating. The nest was found on the 15th of November on a northern-northeastern cliff placed at 4,000 m of height. On the same dates, a second pair was moving around Aremgaremg (at almost 4,300 m of altitude), and 12 copulations were noted on 22 hours of observation. Finally, the third territory was occupied by a solitary individual. In the 2002 expedition a pair had been recorded in the area, thus, most probably, one of the adults died at some point during the previous two years.

On the 21st of November 2002, a very rare observation was made in a bearded vulture nest close to the Zigit camp. Two bearded vulture chicks were observed in the same nest while being fed by an adult individual. Several visits to the nest surroundings confirmed the observation (see image on the next page). At the same time, other bearded vulture pairs sighted in the vicinity were still on the incubation period, as it is usually cited in literature. The rearing of two youngsters in a bearded vulture nest has only been documented once in the Bale mountains (also in Ethiopia) in 1996 (BARRAU *et al.*, 1997). For several years the assumption was that only one of the two eggs hatched, then it was suggested that cainism might exist between the chicks, as in most raptor species. Finally, MARGALIDA *et al.* in 2004 recorded and confirmed cainism in this species.

During the study, five different ossuaries were found in the afroalpine habitat. Distances between them varied between 1 and 5 km, with an average of 3,207 m.

The density of bearded vultures in the Abune Yosef and other Ethiopian massifs is probably the consequence of trophic availability and low mortality. Precisely, Ethiopia is mainly a farming and stockbreeding society, distributed across virtually the whole territory,

Two bearded vulture chicks (Gypaetus barbatus) in a nest, near the Zigit camp

and the bearded vulture has no natural predators. Mortality caused by humans is low, as this species is not prosecuted, most people do not possess firearms and the use of poison does not seem to be a common practice. Besides, the density of power lines is extremely low and the species has a high availability of breeding sites.

Thus, Ethiopian highlands are probably one of the best habitats for bearded vultures in the world. Nevertheless, the extension of the afro-alpine ecosystem in the country is diminishing very fast, with a percentage of remaining habitats of 41% in 2000 (MARINO, 2003). The extension of this most endangered African habitat could range between 3,000 and 5,000 km^2 (MARINO, 2003; SILLERO-ZUBIRI & MCDONALD, 1997). Taking into account densities found in the Abune Yosef (1 pair/10 km^2), which can be considered as high, the total Ethiopian population living in afro-alpine habitats would range between 300 and 500 individuals. Obviously, the species also uses other habitats, but the Ethiopian population could be in a far worse situation than stated at the beginning of the nineties, when 1,400 – 2,200 pairs were estimated for all Eastern Africa (MUNDY *et al.*, 1992).

Lappet-faced vulture (*Torgos tracheliotus*)

Rare. It has been observed only in a few occasions in the lower areas of the massif (Lalibela, Shumshiha). Perhaps it is a resident species, but without available data.

The lappet-faced vulture is classified in the category of "Globally Threatened Species" as Vulnerable (BIRDLIFE INTERNATIONAL, 2000), due to the decline of an estimated population of 8,500 individuals. Widespread accidental poisoning and disturbance are main threats in their general range, but we do not know the main problems affecting the species around the study area.

Pallid harrier (*Circus macrourus*)

This species is common as a migrant and wintering. It occurs in a wide range of habitats and altitudinal belts along the massif, from the lowlands at 2,000 m of height to the cold highlands at 3,900 m. It has been recorded in all of the surveys (1998 – 2004). These birds were observed from solitary individuals (adults of both sexes and immatures) up to small flocks of six individuals in open cultivated or non-cultivated areas, steep valleys, escarpments and Afroalpine meadows.

The pallid harrier is classified in the category of "Lower Risk Species" as Near Threatened (BIRDLIFE INTERNATIONAL, 2000), due to the marked declines and range contractions shown. Its primary threats are the destruction and degradation of grasslands and the intensification of agriculture. Extensive habitat loss and persistent persecution, mostly in its breeding territories, are the main causes of these declines.

Greater spotted eagle *(Aquila clanga)*

Rare. It was observed only in three occasions in the massif, flying over the Afroalpine area. It is probably a migrant and/or it winters in the area.

The greater spotted eagle is classified in the category of "Globally Threatened Species" as Vulnerable (BIRDLIFE INTERNATIONAL, 2000), due to the rapid decline of the small population of this species. Extensive habitat loss and persistent persecution, mostly in its breeding territories, are the main causes of the decline.

Golden eagle (*Aquila chrysaetos)*

Adults and juveniles of this species were observed in three consecutive years (2000-2002), both in the village of Lalibela and surroundings (2,200 - 2,500 m of height) and in Zigit area (3,900 – 4,000 m of altitude).

The Abune-Yosef massif, together with the Bale mountains (EWNHS, 1996), hold the two only known populations of this species in all sub-saharan Africa. The Abune Yosef is the only area of the Ethiopian Northern Highlands where the species has been recorded. The golden eagle's northern and southern (Bale) populations are approximately 800 km apart. Frequent observations of adults (flying alone or in pairs) and juveniles were made during mid dry season and at the end of the wet season, which suggests that they probably belonged to an established population rather than being winter visitors to the area.

Order Falconiformes

Family Falconidae

Lesser kestrel (*Falco naumanni*)

Uncommon. A solitary male was sighted in a cultivated area in the vicinity of Medage village at 2,500 m of altitude in September 2000. A pair was observed in the escarpment separating Wedebiye from Wedebiye Abbo, at 3,550 m of height, in November 2001. The area is almost completely cultivated. Finally, an individual was observed in the Zigit afroalpine meadows, at 3,900 m of height, in November 2001 and 2002. Records in September and November probably indicate that these birds were in the autumn passage.

The lesser kestrel is classified in the category of "Globally Threatened Species" as Vulnerable (BIRDLIFE INTERNATIONAL, 2000), due to the rapid decline undergone both in its breeding and wintering grounds. Agricultural intensification, intensive pasture management and the use of pesticides are the main causes of this decline.

Order Columbiformes

Family Columbidae

White-collared pigeon (*Columba albitorques*)

Very common. This species, endemic to Ethiopia, is ecologically the most widespread of all the Columbidae species in the study area. It occurs from 2,100 to 4,200 m of altitude in open shrubby areas, savannah *Acacia* woodlands, cultivations, rural and urban settlements, heather and *Juniperus* forests and Afroalpine habitats. Probably more than a hundred birds inhabited the Zigit cliffs. From there, they descended to the *Erica* forests to feed and they are regularly chased by peregrine and lanner falcons.

Columba albitorques (White-collared pigeon)

Order Coraciiformes

Family Phoeniculidae

Black-billed wood hoopoe (*Phoeniculus somaliensis*)

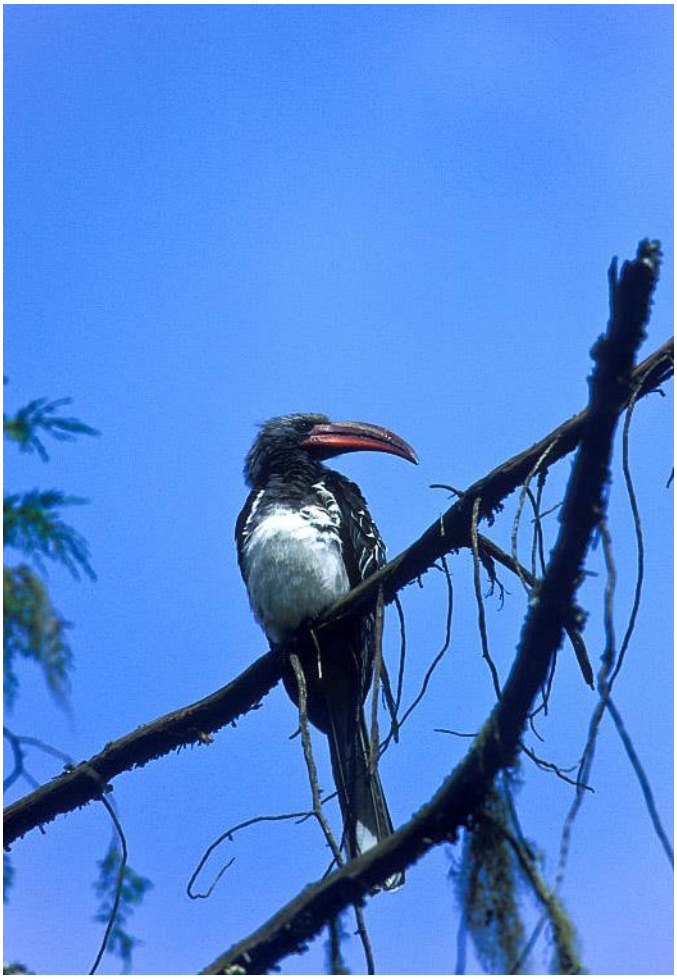
Rare. All sightings are from the Yimrihane forest (2,600 m of altitude), which represents the highest record for the species (DEL HOYO *et al.*, 2001).

Family Bucerotidae

Hemprich's hornbill (*Tockus hemprichii*)

Uncommon. Solitary individuals were recorded in the Bilbala, Shumshiha and Lalibela

areas (2,000 - 2,500 m of height) in October, November and December 2001. In December 2002, a bird was repeatedly observed carrying food to a ravine in the Abi Jacula escarpment (3,300 m of altitude).



Tockus hemprichii (Hemprich's hornbill)

Order Passeriformes

Family Hirundinidae

Crag martin (*Ptyonoprogne rupestris*)

Very common. Although the individuals observed during the first visit were considered to be rock martins (*P. fuligula*), the capture of an individual with a mist net gave the opportunity to correctly identify it. The throat had a dusky and diffuse streak, the characteristic underwing pattern was present, with pale brown-grey remiges and

constrating sooty-black coverts, and the tail feathers showed small white 'windows', all three characteristics from *P. rupestris* (SVENSSON *et al.*, 1999).

Once we started to look closely to martins, we discovered that all the groups happened to be crag martins, from above the Yimrihane forest (2,800 m of height) to the top of Aremgaremg (4,284 m), through Abi Jacula (3,300 m), Astabir (3,500 m) and Wedebiye Abbo (3,600 m).

We captured a total of 10 individuals using mist nets. The first one, captured in the Zigit camp (3,900 m of altitude) on the 28th of November 2002, was completely moulting (rectrices and primaries) so it was not considered as a migrant, but a resident population. The other 9 individuals, captured on the 21st and 22nd of November 2004, were 4 adults and 5 juveniles. Three adults were completely moulting and three juveniles presented

Ptyonoprogne rupestris (*Crag martin*) individuals captured using mist nets

commissures, which would indicate that the reproduction of this population occurs in the Abune Yosef massif. Although *P. rupestris* breed between May and August in Europe, *P. fuligula* is reported to breed between October and December in Ethiopia (DEL HOYO *et al.*, 2004).

Family Motacillidae

Abyssinian longclaw (*Macronyx flavicollis*)

Rare. A pair was recorded in November 2002 in the Afroalpine meadows near the Zigit camp at 3,800 m of altitude. In November 2004, four individuals (a group of three and a solitary individual) were observed during bird transects, and one bird was captured with the mist nets. All individuals were observed in the Afroalpine areas of Zigit and Aremgaremg.

Macronyx flavicollis (Abyssinian longclaw)

The Abyssinian longclaw is endemic to Ethiopia and it is classified in the category of "Lower Risk Species" as Near Threatened (BirdLife International, 2000). Although the species is widespread, it was described as uncommon in all the sites where it was recorded during a survey of Important Birds Areas (EWNHS, 1996). There are no data available, but the species could be declining due to the increasing levels of cultivation and grazing, another consequence of the continuing expansion of Ethiopia's human population.

Family Turdidae

Rüeppell´s chat (*Myrmecocichla melaena*)

Endemic to Ethiopia. It is rare but locally not uncommon in suitable areas. These birds were observed in small numbers (two to five individuals) in shrubby, bushy and grassy stony ground areas, small cliffs and ravines in the surroundings of the Lalibela, Medage, Koro and Abi Jacula areas, from 2,300 to 3,300 m of altitude.

Myrmecocichla melaena (Rüepell's chat)

Sombre rock chat (*Cercomela dubia*)

Very rare. Only one individual has been recorded in the open, dry bushlands of the Tinchoi area at 2,200 m of height, in September 2001. This area is highly modified by agricultural activities, deforestation and livestock grazing.

The sombre rock chat is a scarcely-known species from Ethiopia and Somalia. It is classified in the category of "Other Species" as Data Deficient. It seems to favour rock and scrub, but there are only a few records from Ethiopia and only one from Somalia (BIRDLIFE INTERNATIONAL, 2000).

Family Sturnidae

Somali chestnut-winged starling (*Onychognathus blythii*)

It is a fairly common species in the massif. Pairs to large flocks up to 40 individuals were found in a wide altitudinal and ecological range, from degraded shrubby open areas at 2,200 m of height to the Afroalpine rocky meadows up to 3,700 m. In the Afroalpine zone this species shares the same habitat niche (rocky steep slopes with giant lobelias and steppe of *Carex* and *Festuca* grasses) with the endemic white-billed starling (*Onychognathus albirostris*), but only once both species were found in mixed flocks.

Family Corvidae

Chough (*Pyrrhocorax pyrrhocorax)*

The Ethiopian population of chough is the most southern in the world and the only population living in the Afroalpine ecosystem. It has been defined as a separate subspecies, *Pyrrhocorax pyrrhocorax baileyi* and the entire population of Ethiopia has been estimated to be between 800 and 1,300 individuals (DELESTRADE, 1998).

This species was found to be very common in the western (the Zigit) and north-central (the Abune Yosef village and Aremgarem) rocky areas from 3,200 to 4,300 m of altitude.

Choughs were usually seen feeding in alpine grasslands, cultivated lands and escarpments, both in pairs and in large flocks of up to 150 individuals.

The chough population of the Abune Yosef is one of the three known in Ethiopia (DELESTRADE, 1998). The nearest sub-population occurs in the Simien Mountains National Park, 150 km to the northwest, and the other population in the Bale National Park, 800 km apart. Choughs are suspected to occur in other mountains of the Wollo province, but this presence is yet to be confirmed (DELESTRADE, 1998).

Pyrrhocorax pyrrhocorax (Choughs)

Family Fringillidae

Ankober serin (*Serinus ankoberensis)*

This species was found to be common in all rocky areas of the northwestern and north-central highlands of the massif, from 3,300 up to 4,280 m of height. The area has large,

vertical cliffs, rocks and steep extensions of grasslands (*Festuca* and *Carex*) with endemic giant lobelias (*Lobelia rhynchopetalum*) scattered all over (Afroalpine ecosystem). The species was seen in pairs or small flocks of up to a 65 individuals. Only around Zigit we estimated a number higher than 100 individuals. It feeds mainly on short-grazed pasture, but perches often on rocks in a Petronia-like behaviour.

The endemic Ankober serin is a small, heavily-streaked serin with greyish-brown wings and tail and a fine and pointed bill. It is a relatively little-known finch discovered in 1976 in a north-face cliff of the town of Ankober. For several years, the species was considered to be endemic to this very small area of the central highlands of the Shoa province (CLEMENT *et al.*, 1993). It is classified in the category of "Globally Threatened Species" as Endangered (BIRDLIFE INTERNATIONAL, 2000).

Serinus ankoberensis (Ankober serin)

The Abune Yosef massif holds the fifth known population of this endemic, highly-restricted and endangered species. Prior to this report, the species was only known from four locations in the Amhara Regional State: around Ankober, in Deneba Wereda, in a very small area within Guassa Reserve and near the Simien National Park (BIRDLIFE INTERNATIONAL, 2000). The species is treated as endangered due to its very small range,

but more populations might be found in the future in other highlands of the Amhara Regional State and Tigray.

Family Emberizidae

Cinereous bunting (*Emberiza cineracea*)

Uncommon. Solitary birds and small numbers were seen in grassy valleys under moderate human impact in the Lalibela and Medage areas between 2,400 and 2,500 m of height. It was recorded in September 2000 and October-November 2001.

The cinereous bunting winters in Ethiopia and it is classified in the category of "Lower Risk Species" as Near Threatened. Although there is no obvious decline in range or numbers, the species estimated population is small, between 700 and 7,350 pairs (BIRDLIFE INTERNATIONAL, 2000).

5.3. The avifauna composition of the Abune-Yosef Massif

In order to seek differences and similarities on distribution and composition of the Ethiopian Northern Highlands (ENH) avifauna, we compared the Abune-Yosef (AY) checklist to those of the Simien mountains, Awash and Yangudi Rassa.

The Simien mountains (SM), located in the northwestern side of the ENH, make up the best known and most thoroughly explored massif of the ENH, since it was established as a national park in 1969. To date, 169 bird species have been recorded (NIEVERGELT *et al.*, 1998; FALCH, 2000), a number that increased remarkably during the late 90s: in 1993 only 125 species had been recorded (HILLMAN, 1993). The SM range in altitude from 1,500 to 4,500 m and contain a large variety of habitat types and montane ecosystems: open, dry bushlands; grasses and acacia woodlands; rocky areas; forests, alpine moorlands and cultivated land (NIEVERGELT *et al.*, 1998).

On the other hand, the Abune Yosef massif, located in the northeastern side of the ENH, is only 150 km away from the Rift Valley's semi-desert and savannah lowlands. We surveyed

areas in the AY from 2,100 to 4,200 m of altitude and we think it is safe to say that this massif as a whole has relatively similar montane habitat types and ecosystems to those of the Simien mountains.

Comparison of bird species ecology between both massifs is shown in Table 5.4. Results show that, despite the great disproportion on exploration time and efforts between the two massifs, and especially between altitudinal ranges and habitat types in the AY, they show similar relative percentages in number of species for every ecological category. This pattern allows for comparison of the two montane areas in order to provide possible explanations for the distributional and compositional differences found.

Table 5.4.- Comparison of the avifauna of the Simien mountains (SM) and the Abune Yosef massif (AY), using the relative percentages in number of species in the main ecological categories, classified as far as possible, according to their main ecological preferences.

Ecological categories	**% number sps.**	
	AY	**SM**
1. Open areas: semi-deserts, bush-grasslands, acacia woodlands, etc.	35	36
2. Highland (all different habitat types)	20	21
3. Medium altitudinal wooded areas and forests	5	8
4. Inland, rocky cliffs	10	6
5. Variety of habitats	5	4
6. Other: watered areas, winter visitors, swifts and martins, etc.	25	25

The AY´s checklist was also compared with the Rift Valley avifauna composition because, despite general ecological differences between these areas, they are geographically close. The avifauna composition of the Awash NP and the Yangudi Rassa NP are well known (HILLMAN, 1993), and consequently they were selected as representative areas for the main ecological habitats found in the western part of the Rift Valley; dry savannah woodlands and semi-desertic bushlands respectively.

Results show that Abune Yosef massif shares 77 species with the Simien mountains (73% of its avifauna) and that it holds 30 bird species (27% of its avifauna) that have never been recorded in the SM, most of them found in lowlands areas of the massif. On the other hand, the AY shares 80 species with the Awash: 75% of its avifauna, a little more than for the SM. Moreover, 20 of those AY-Awash shared species belong to the AY assemblage of 30 species that are not found in Simien (70% of the variation). In addition, 50% of those species not found in the SM do also occur in the Yagudi Rassa NP, a mainly semi-desertic area. Therefore, this AY´s particular assemblage of species seems to be mainly related to geographical-historical causes (the proximity of the Rift Valley) rather

than to local ecological factors. It is important to note that the absence in the AY of species present in the SM could be due to several reasons, such as compositional differences due to the proximity with Sudan, but it could also be due to the disproportion between time and methods used in the surveys of the two massifs.

Thus, composition of the AY's avifauna seems to comprise a particular mix between a relatively typical assemblage of montane highland species and an atypical montane lowland assemblage, which is partially composed of typical Rift Valley species. Other mountainous areas of the eastern side of the EHN may well share this pattern of avifauna composition, which differs from the typical northwestern (and probably central) ENH pattern. Since exploration of AY's lowland areas remains poor, it is even possible that new surveys see an increase in the percentage of species in ecological category 1 (open areas) in the massif, which may well contain other typical lowland species found in the ENH as well as the Rift Valley.

5.4. The importance of the Abune Yosef massif for bird conservation

To evaluate the relative importance of the Abune Yosef massif for birds, available ornithological data have been processed with the same methodology used to establish the Important Bird Areas (IBA) of Ethiopia (EWNHS, 1996). Thus, the criterion and categories of BirdLife International have been applied to the Abune Yosef and the results have been compared with the main Ethiopian IBAs covering mountainous regions.

Category A1: Globally threatened species

The criterion for this category is that the site must regularly hold significant numbers of a globally threatened species, or other species of global conservation concern. This criterion has been difficult to document, as bird information in the Abune Yosef relates more to the presence or absence of a species, and data are lacking about its numbers or its regular presence.

The only Ethiopian globally threatened species with the status of 'Endangered' found in Abune Yosef is the Ankober serin (*Serinus ankoberensis*), with a quite large population of probably some hundreds of individuals. Two species have been found with the status of 'Vulnerable': the great spotted eagle (*Aquila clanga*) and the lesser kestrel (*Falco naumanni*), although both can be considered as wintering and/or migrant species. With

the status of 'Near Threatened', two more species have been found: the pallid harrier (*Circus macrourus*), common as migrant and wintering species, and the endemic Abyssinian longclaw (*Macronyx flavicollis*), which seems to hold a small population in the area.

Category A2: Restricted range species

The criterion for this category is that the site must hold a significant component of a group of species whose breeding distributions define an Endemic Bird Area or Secondary Area, which are defined as places where two or more species of restricted range occur together. Ethiopia has three globally recognized Endemic Bird Areas within it: the Central Ethiopian Highlands, the South Ethiopian Highlands and the Juba and Shebeelle Valleys, and one Secondary Area (the Awash National Park).

Two of the three species belonging to this category for the Central Ethiopian Highlands are found in the Abune Yosef massif: the Rüeppell´s chat (*Myrmecocichla melaena*) and the Ankober serin (*Serinus ankoberensis*). The 'significant component' term in the criterion must be established in an overall network of sites, so for the Abune Yosef it can only be added that both species are relatively common in the study area.

Category A3: Biome-restricted assemblages

The criterion for this category is that the site must hold a significant component of the group of species whose distributions are largely or wholly confined to one biome. This category is useful for delimiting IBAs in a regional scale in places such as deserts or woodlands, where it is particularly difficult. It is necessary to look at the overall list of sites to choose the IBAs for a biome, so in this exercise we only list the bird species present in the Abune Yosef and included in the biome assemblage species. Ethiopia has birds from three biome assemblages: the Afrotropical Highland Biome, the Somali-Masai Biome and the Sudan and Guinea Savannah Biome.

The Afrotropical Highland Biome has 48 species of which 7 are endemics. The Abune-Yosef holds at least 36 Highland Biome species, 75% of the Afrotropical Highland Biome assemblage species found in Ethiopia. The richest site for this biome assemblage is the Bale Mountains National Park, with 88% of the species represented.

The Abune Yosef holds also five species belonging to the Somali-Masai Biome (Black-billed Wood Hoopoe, Hemprich's Hornbill, Sombre Chat, White-headed Buffalo Weaver and Somali Chestnut-winged Starling), due to its geographical proximity to the Rift Valley.

Five endemic bird species have been so far detected, 31% of the Ethiopian endemics

(following for comparison the list from EWNHS 1996). Again, the IBA with the maximum number of endemics is Bale Mountains NP, with 6 endemics (38%).

Data obtained reveal the importance of the Abune Yosef massif for birds. No other mountainous area of the Ethiopian Northern Highlands (ENH) has a larger presence in categories A1 (6 species) and A2 (2 species), representing 75 % of the Afrotropical Highland Biome assemblage of species found in Ethiopia (Table 5.5). Together with the amount of endemic species and following data published in the Important Bird Areas of Ethiopia (EWNHS, 1996), the Abune Yosef could be considered as the second most important area of the country for birds (Figure 5.1).

This fact makes the Abune Yosef massif worthy of conservational efforts, also taking into account the small area of Afroalpine habitats left and the various threats that soar above the overall ecosystem.

Table 5.5.- Comparison between the avifauna of the Abune Yosef massif and five other mountain areas declared as Important Bird Areas of Ethiopia, using the categories proposed in EWNHS (1996) and explained in this chapter.

Site	**Cat. A1**	**Cat. A2**	**Cat. A3**
Abune Yosef	*Aquila clanga** *Circus macrourus** *Falco naumanni** *Macronyx flavicollis* *Serinus ankoberensis* *Emberiza cineracea*	*Myrmecocichla melaena* *Serinus ankoberensis*	36 AHB sps (75%) 5 endemics
Simien	*Circus macrourus* *Macronyx flavicollis*	*Myrmecocichla melaena*	33 AHB sps (69%) 4 endemics
Bale	*Aquila clanga* *Aquila heliaca* *Falco naumanni* *Bugeranus carunculatus* *Circus macrourus* *Rougetius rougetii* *Macronyx flavicollis*		42 AHB sps (88%) 6 endemics
Ankober	*Serinus ankoberensis*	*Myrmecocichla melaena* *Serinus ankoberensis*	24 AHB sps (50%) 3 endemics
Choke	*Macronyx flavicollis*		16 AHB sps (33%) 3 endemics
Mugo	*Macronyx flavicollis*	*Myrmecocichla melaena*	28 AHB sps (58%) 4 endemics

* wintering or migrant species

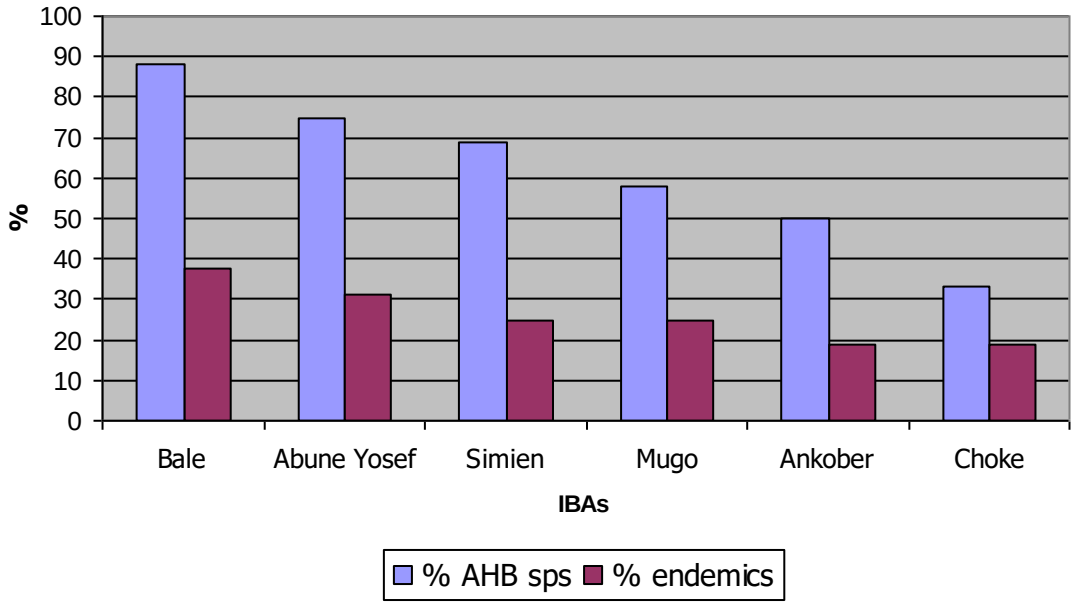


Figure 5.1.- Comparison of the percentage of species represented in the Afrotropical Highland biome assemblage (AHB) and percentage of Ethiopian endemic species (17) between the avifauna of the Abune Yosef massif and five other Ethiopian mountain areas declared as IBA.

5.5. Bird transects carried out in the Afroalpine ecosystem

Three bird transects were carried out in afroalpine habitats around the Zigit and Aremgarem areas during the second half of November 2002 and 2004 (Table 5.6).

Table 5.6.- Characteristics of bird transects carried out in afroalpine habitats of the Abune Yosef.

Name	Repeat	Length (m)	Altitude (m)	Characteristics
Camp1	4	1,000	3,850 – 3,900	Mainly flat afroalpine moorland with scattered Lobelias and some rocky areas
Camp2	5	2,000	3,900 – 3,950	Flat afroalpine moorland without Lobelias and some rocky areas
Aremgaremg	4	1,000	3,950 – 4,100	Steep afroalpine moorland with Lobelias

During the transect, all the birds situated in a 50 metres wide band on both sides of the observer were identified and counted. The speed was constant and around 3 km/h. The path and the speed were controlled using a GPS.

Table 5.7.- Species detected during the bird transects.

Scientific name	**English name**
Galerida theklae	Thekla lark
Calandrella erlangeri	Erlanger's lark
Anthus cervinus	Red-throated pipit
Anthus campestris	Tawny pipit
Macronyx flavicollis	Abyssinian longclaw
Cercomela sordida	Alpine chat
Oenanthe isabellina	Isabelline wheatear
Oenanthe oenanthe	Northern wheatear
Oenanthe hispanica	Black-eared wheatear
Oenanthe pleschanka	Pied wheatear
Psophocichla litsitsirupa	Groundscraper thrush
Cisticola brunnescens	Pectoral-patch cisticola
Cisticola galactotes	Winding cisticola
Serinus nigriceps	Black-headed siskin
Serinus tristiatus	Brown-rumped serin
Serinus ankoberensis	Ankober serin
Onycognathus albirostris	White-billed starling

A total of 17 species were detected during the transects (Table 5.7) and only seven species were recorded at least six times. The density results were calculated for these seven species with a higher number of data (Table 5.8).

Table 5.8.- Densities found in 13 bird transects carried out in afroalpine habitats of the Abune Yosef.

Species	**Densities (ind/ha)**			**Mean density**
	Camp 1	**Camp 2**	**Aremgaremg**	
G. theklae	0.45	0.57	0.30	0.45
C. erlangeri	0.10	0.17	0.05	0.11
A. cervinus	0.45	0.24	0.30	0.32
O. pleschanka	0.08	0.08	0	0.05
O. oenanthe	0.10	0.02	0.03	0.05
C. sordida	0.15	0.36	0.68	0.39
S. nigriceps	0	0.04	0.58	0.19

Although the transect effort is too small to find general patterns of Afroalpine habitats occupation by passerines, some comments can be added to the field data. The Thekla lark was the most abundant species, with high densities in all three transects, the same pattern as that of the red-throated pipit. On the other hand, the Alpine chat and the black-headed siskin were more abundant on the higher Aremgaremg slope, with a high density of giant lobelias.

5.6. Checklist of the Birds of the Abune Yosef massif

Bird species occurring in the Abune Yosef massif are summarised in Table 5.9.

Table 5.9.- Checklist of the Birds of the Abune Yosef massif. Remarks - "E": species endemic to Ethiopia; "T": globally threatened species (see Table 5.2); "RR": restricted ranges species from endemic areas (see Section 5.4); "AHB": Afrotropical highland biome assemblage of species found in Ethiopia (see Section 5.4); "SMB": Somali-Masai biome assemblage of species found in Ethiopia (see Section 5.4); "U": presence uncertain, only one record; "N": nest, fledgings or other signs of breeding. Maximum altitude records are noted for species found at higher altitudes than previously reported.

Order / Family	**Scientific name**	**English name**	**Remarks**
Order Ciconiiformes			
Scopidae	*Scopus umbretta*	Hammerkop	N
Ciconiidae	*Ciconia nigra*	Black stork	
	Ciconia abdimii	Abdim´s stork	
	Ciconia ciconia	White stork	
Threskiornithidae	*Bostrychia carunculata*	Wattled ibis	AHB
Order Anseriformes			
Anatidae	*Cyanochen cyanoptera*	Blue-winged goose	T, AHB, U
	Alopochen aegyptiacus	Egyptian goose	
	Anas sparsa	Black duck	
Order Accipitriiformes			
Accipitridae	*Pernis apivorus*	Honey buzzard	
	Elanus caeruleus	Black-shouldered kite	
	Milvus migrans	Black kite	
	Gypaetus barbatus	Bearded vulture	N
	Neophron percnopterus	Egyptian vulture	
	Necrosyrtes monachus	Hooded vulture	
	Gyps fulvus	Griffon vulture	
	Gyps rueppellii	Rüppell´s griffon	
	Torgos tracheliotus	Lappet-faced vulture	T
	Circaetus gallicus beaudouinii	European short-toed snake-eagle	

	Polyboroides typus	African harrier hawk	
	Circus macrourus	Pallid harrier	T
	Circus pygargus	Montagu's harrier	
	Melierax metabates	Dark chanting-goshawk	
	Melierax poliopterus	Eastern chanting-goshawk	
	Accipiter nisus	Eurasian sparrowhawk	
	Accipiter brevipes	Levant sparrowhawk	
	Accipiter tachiro	African goshawk	
	Accipiter rufiventris	Rufous-breasted sparrowhawk	N
	Buteo buteo	Common buzzard	
	Buteo rufinus	Long-legged buzzard	
	Buteo rufofuscus	Augur buzzard	N
	Aquila pomarina	Lesser spotted eagle	N
	Aquila clanga	Greater spotted eagle	T
	Aquila rapax	Tawny eagle	
	Aquila nipalensis	Steppe eagle	
	Aquila wahlbergi	Wahlberg´s eagle	U
	Aquila verreauxii	Verreaux´s eagle	
	Aquila chrysaetos	Golden eagle	
	Hieraaetus pennatus	Booted eagle	
	Hieraaetus spilogaster	African hawk-eagle	N
	Polemaetus bellicosus	Martial eagle	N
Pandionidae	*Pandion haliaetus*	Osprey	
Order Falconiformes			
Falconidae	*Falco naumanni*	Lesser kestrel	T
	Falco tinnunculus	Common kestrel	
	Falco eleonorae	Eleonora's falcon	
	Falco cuvieri	African hobby	
	Falco biarmicus	Lanner falcon	
	Falco peregrinus	Peregrine falcon	
	Falco pelegrinoides	Barbary falcon	U
Order Galliformes			
Phasianidae	*Francolinus erckelii*	Erckel´s francolin	AHB
	Francolinus psilolaemus	Moorland francolin	AHB
Numididae	*Numida meleagris*	Tufted guinea-fowl	
O. Charadriiformes			
Charadriidae	*Charadrius tricollaris*	Three-banded plover	
Scolopacidae	*Actitis hypoleucos*	Common sandpiper	
	Xenus cinereus	Terek sandpiper	
Order Columbiformes			
Columbidae	*Columba albitorques*	White-collared pigeon	T, AHB
	Columba guinea	Speckled pigeon	3,600 m
	Aplopelia larvata	Lemon dove	
	Streptopelia semitorquata	Red-eyed dove	
	Streptopelia vinacea	Vinaceous dove	
	Streptopelia lugens	Pink-breasted dove	AHB
	Streptopelia senegalensis	Laughing dove	
	Oena capensis	Namaqua dove	
	Treron waalia	Bruce´s green pigeon	
Order Psittaciformes			
Psittacidae	*Poicephalus flavifrons*	Yellow-fronted parrot	E
	Agapornis taranta	Black-winged lovebird	AHB
Order Cuculiformes			
Musophagidae	*Tauraco leucotis*	White-cheeked turaco	AHB
	Crinifer zonurus	Eastern grey plantain-eater	

Order Strigiformes			
Strigidae	*Otus scops*	Eurasian scops-owl	3,300 m
	Bubo capensis	Cape eagle-owl	
	Bubo lacteus	Verreaux´s eagle-owl	
	Bubo cinerascens	Greyish eagle-owl	
	Athene noctua	Little owl	
	Strix woodfordii	African wood-owl	
	Asio abyssinicus	Abyssinian long-eared owl	AHB; 3,900 m
O. Caprimulgiformes			
Caprimulgidae	*Caprimulgus poliocephalus*	Abyssinian nightjar	AHB
Order Apodiformes			
Apodidae	*Schoutedenapus myioptilus*	Scarce swift	AHB
	Tachymarptis melba	Alpine swift	
	Tachymarptis aequatorialis	Mottled swift	
	Apus apus	Common swift	4,000 m
	Apus niansae	Nyanza swift	AHB, 4,000 m
	Apus horus	Horus swift	
Order Coliiformes			
Coliidae	*Colius striatus*	Speckled mousebird	
	Urocolius macrourus	Blue-naped mousebird	
Order Coraciiformes			
Alcedinidae	*Corythornis cristata*	Malachite kingfisher	
	Ceryle rudis	Pied kingfisher	
Meropidae	*Merops pusillus*	Little bee-eater	2,700 m
	Merops apiaster	European bee-eater	
Coraciidae	*Coracias naevia*	Rufous-crowned roller	
Upupidae	*Upupa epops*	Hoopoe	2,500 m
Phoeniculidae	*Phoeniculus somaliensis*	Black-billed wood-hoopoe	SMB, 2,700 m
Bucerotidae	*Tockus nasutus*	Grey hornbill	
	Tokus erythrorhynchus	Red-billed hornbill	
	Tockus hemprichii	Hemprich´s hornbill	SMB,N,3,300m
	Bucorvus abyssinicus	Abyssinian ground hornbill	2,450 m
Order Piciformes			
Capitonidae	*Lybius guifsobalito*	Black-billed barbet	
	Lybius undatus	Banded barbet	AHB
	Pogoniulus pusillus	Red-fronted tinkerbird	
	Trachyphonus margaritatus	Yellow-breasted barbet	
Picidae	*Jynx torquilla*	Wryneck	
	Picoides obsoletus	Brown-backed woodpecker	
	Mesopicos goertae	Grey woodpecker	
Order Passeriformes			
Alaudidae	*Mirafra africanoides*	Fawn-coloured lark	
	Eremopterix leucotis	Chestnut-backed sparrow-lark	
	Calandrella erlangeri	Erlanger's lark	E
	Galerida theklae	Thekla lark	4,150 m
Hirundinidae	*Riparia paludicola*	African sand martin	3,900 m
	Riparia riparia	Sand martin	
	Ptyoprogne rupestris	Eurasian crag martin	4,300 m
	Hirundo aethiopica	Ethiopian swallow	
	Hirundo daurica	Red-rumped swallow	
	Psalidoprocne pristoptera	Black saw-wing	
	Delichon urbica	House martin	
Motacillidae	*Anthus richardi*	Richard´s pipit	4,150 m
	Anthus campestris	Tawny pipit	
	Anthus leucophrys	Plain-backed pipit	
	Anthus similis	Long-billed pipit	

	Anthus trivialis	Tree pipit	
	Anthus cervinus	Red-throated pipit	4,000 m
	Macronyx flavicollis	Abyssinian longclaw	E, T, AHB
	Motacilla flava	Yellow wagtail	
	Motacilla cinerea	Grey wagtail	
	Motacilla clara	Moutain wagtail	
Pycnonotidae	*Pycnonotus barbatus*	Black-capped bulbul	
Turdidae	*Cossypha semirufa*	Rüppell´s robin-chat	AHB
	Irania gutturalis	White-throated robin	
	Phoenicurus phoenicurus	Common redstart	
	Cercomela dubia	Sombre rock-chat	U, T, SMB, RR
	Cercomela sordida	Alpine chat	AHB
	Saxicola rubetra	Whinchat	
	Saxicola torquata albofasciata	Common stonechat	
	Myrmecocichla cinnamomeiventris	Mocking cliff chat	
	Myrmecocichla semirufa	White-winged cliff chat	AHB, 3800m
	Myrmecocichla albifrons	White-fronted black chat	U
	Myrmecocichla melaena	Rüppell´s black chat	AHB,RR,2,900m
	Oenanthe isabellina	Isabelline wheatear	
	Oenanthe bottae	Red-breasted wheatear	
	Oenanthe oenanthe	Northern wheatear	3,900 m
	Oenanthe pleschanka	Pied wheatear	
	Oenanthe hispanica	Black-eared wheatear	
	Oenanthe lugubris	Schalow's wheatear	
	Oenanthe deserti	Desert wheatear	
	Monticola solitarius	Blue rock thrush	4,280 m
	Monticola rufocinerea	Little rock thrush	AHB
	Psophocichla litsitsirupa	Groundscraper thrush	
	Turdus pelios	African thrush	
	Turdus olivaceus	Olive thrush	
	Turdus philomelos	Song thrush	
Sylviidae	*Bradypterus cinnamomeus*	Cinnamon bracken warbler	
	Cisticola cantans	Singing cisticola	
	Cisticola galactotes	Winding cisticola	
	Cisticola brunnescens	Pectoral-patch cisticola	
	Prinia subflava	Tawny-flanked Prinia	
	Spiloptila rufifrons	Red-fronted warbler	
	Sylvietta whytii	Red-faced crombec	
	Sylvia curruca	Lesser whitethroat	
	Sylvia atricapilla	Blackcap	
	Phylloscopus umbrovirens	Brown warbler	AHB
	Phylloscopus collybita	Chiffchaff	
Muscicapidae	*Muscicapa striata*	Spotted flycatcher	
	Muscicapa adusta	Dusky flycatcher	
	Melaenornis chocolatinus	Abyssinian slaty flycatcher	AHB
	Bradornis semipartitus	Silverbird	
Monarchidae	*Tersiphone viridis*	Paradise flycatcher	
Timaliidae	*Parophasma galinieri*	Abyssinian catbird	E, AHB
	Turdoides leucopygius	White-rumped babbler	
	Turdoides leucocephalus	White-headed babbler	3,300 m
Paridae	*Melaniparus leuconotus*	White-backed black tit	AHB
Nectariniidae	*Nectarinia senegalensis*	Scarlet-chested sunbird	
	Nectarinia venusta	Variable sunbird	
	Nectarinia tacazze	Tacazze sunbird	AHB
Zosteropidae	*Zosterops senegalensis*	Yellow white-eye	
	Zosterops poliogaster	Montane white-eye	AHB

Oriolidae	*Oriolus larvatus*	Black-headed oriole	
	Oriolus monacha	Black-headed forest oriole	AHB
Laniidae	*Tchagra senegala*	Black-headed bush-shrike	
	Laniarius aethiopicus	Tropical boubou	
	Lanius isabellinus	Isabelline shrike	
	Lanius collaris	Common fiscal	
	Lanius senator	Woodchat shrike	
Corvidae	*Pyrrhocorax pyrrhocorax*	Chough	
	Corvus albus	Pied crow	
	Corvus capensis	Cape rook	
	Corvus riphidurus	Fan-tailed raven	
	Corvus crassirostris	Thick-billed raven	AHB
Sturnidae	*Onychognathus morio*	Red-wing starling	
	Onychognathus blythii	Somali chestnut-wing starling	SMB
	Onychognathus tenuirostris	Slender-billed starling	AHB
	Onychognathus albirostris	White-billed starling	AHB
	Lamprotornis chalybaeus	Blue-eared glossy starling	
	Lamprotornis purpuropterus	Rüppell´s long-tailed starling	
Buphagidae	*Buphagus erythrorhynchus*	Red-billed oxpecker	
Passeridae	*Passer motitensis*	Rufous sparrow	U
	Passer griseus	Grey-headed sparrow	
	Passer swainsonii	Swainson´s sparrow	AHB
	Petronia pyrgita	Yellow-spotted petronia	
	Sporopipes frontalis	Speckle-fronted weaver	
Ploceidae	*Dinemellia dinemelli*	White-headed buffalo-weaver	SMB
	Plocepasser mahali	White-browed sparrow-weaver	
	Plocepasser superciliosus	Chestnut-crowned Sparrow-weaver	
	Ploceus baglafecht	Baglafecht weaver	AHB, 3,460 m
	Ploceus cucullatus	Black-headed weaver	
	Euplectes ardens	Red-collared widow-bird	
	Euplectes capensis	Yellow bishop	3,900 m
Estriididae	*Vidua macroura*	Pin-tailed whydah	
	Hypochera chalybeata	Indigo-bird	
	Amadina fasciata	Cut-throat	
	Lagonosticta senegala	Red-billed firefinch	
	Lagonosticta rubricata	African firefinch	
	Uraeginthus bengalus	Red-cheeked cordon-bleu	
	Estrilda melanotis	Yellow-bellied waxbill	
	Estrilda paludicola	Fawn-breasted waxbill	
Fringillidae	*Serinus canicollis*	Yellow-crowned canary	
	Serinus citrinelloides	African citril	AHB
	Serinus nigriceps	Black-headed siskin	E, AHB
	Serinus striolatus	Streaky serin	AHB
	Serinus tristriatus	Brown-rumped serin	AHB
	Serinus ankoberensis	Ankober serin	E, T, AHB, RR
	Serinus xanthopygius	White-throated serin	AHB
Emberizidae	*Emberiza tahapisi*	Cinnamon-breasted bunting	
	Emberiza cineracea	Cinereous bunting	T
	Emberiza hortulana	Ortolan bunting	

6. Other groups

DELI SAAVEDRA

The fauna inventory carried out in the Abune Yosef massif was focussed, as seen in previous chapters, in birds and mammals. However, during the expeditions, two different species of reptiles were found in the highlands of the Abune Yosef massif (above 3,000 m of height).

Order Squamata

Family Agamidae

Eritrean rock Agama (*Acanthocerus annectans*)

The Eritrean rock Agama is big and stocky, with strong legs and bright colours. The displaying males show bright blue heads and throats that thy move up and down.

Acanthocerus annectans (Eritrean rock Agama)

This species is common in the rocky areas or even cultivated areas with big boulders and rocks. It was detected around Lalibela and Koro (2,500 m of altitude), climbing p to the Abi Jacula plateau, at 3,300 m of height, much higher than previously reported by other authors (SPAWLS *et al.*, 2002).

Family Scincidae

Mabuya sp.

On the 18th of November 2004, a small lizard was found running between short grass and senecio plants in the southern slope of the Small Zigit, at 3,857 m of height. It was our first and only observation of a lizard in the Afroalpine ecosystem.

Mabuya sp. individual captured

Mabuya sp. individual captured

This small skink (it could be a juvenile) had several shades of brown above, from golden to dark brown, giving the appearance of four dark stripes. A white flank stripe ran from the upper lip to the hindlimb. Beneath, another white stripe ran from the mouth to the hindlimb, both separated by an almost black stripe. The underside was pinkish on tail and hindlimb area and whitish on the rest, with ten fine black bars on the throat, between ventral scales.

Mabuya is a diverse group of small to large skinks that includes about 90 species, 13 of which occur in East Africa (SPAWLS *et al.*, 2002). Most of them are diurnal, and occupy a wide range of habitats and altitudes. Although there are some species that inhabit highlands, the maximum altitude reported so far is 3,600 m for the variable skink (*Mabuya varia*). The specimen from the Abune Yosef was found at a higher altitude, although it is probably not abundant at such ranges.

7. Main threats and conservation proposals

DELI SAAVEDRA

Ethiopian montane and afroalpine ecosystems are unique among the African highlands. The major factors probably determining their composition are the isolating role of the Great African Rift along the Ethiopian highlands, the dynamics of cold and warm periods since, at least, the Pleistocene, and the biogeographical role as a corridor played by the Nile and Takezze rivers. These factors have brought about the current blending of species from different regions (Palaearctic, Tropical and Sub-sahelian) in a unique faunal composition.

Two National Parks, Bale and Simien Mountains, hold half of the afroalpine habitats left in Ethiopia (MARINO, 2003), but they are not exempt from conservation problems. The Simien Mountains for example, although worldwide recognized as a Human Heritage Site by the UNESCO, and despite being protected as a National Park from 1969, are facing severe conservation problems (NIEVERGELT *et al.*, 1998; FALCH, 2000). This fact makes the protection of all the other areas with remaining montane and Afroalpine habitats (mostly much smaller than Bale and Simien) an urgent priority in order to contribute to the preservation of these Ethiopian ecosystems as well as to preserve its own particular ecological environments.

The Abune Yosef is the largest area left in North Wollo, but it is small in terms of carrying capacity and isolation. In this chapter we discuss the threats that it is facing and the conservation measures that could help to preserve this enormous natural and cultural heritage.

7.1. Threats

Loss of afroalpine habitats

Afroalpine habitats were geographically widespread during the Pleistocene. During the colder periods of the glaciations, the treelines in the mountains were 1,100 – 1,500 m lower than they are now (YALDEN & LARGEN, 1992). In the last 15,000 years, these habitats have decreased and fragmented due to a gradual warming of the African continent. This

natural process is believed to have reduced the available habitat for all Afroalpine species by at least one order of magnitude (GOTTELLI & SILLERO-ZUBIRI, 1992).
The natural process has been accelerated by the loss of habitat due to high altitude subsistence agriculture and livestock overgrazing all across Ethiopia. It is necessary to take into account that the population growth in Ethiopia has brought one of the highest rural densities in all Africa, with 47 hab/km^2 regarded as typical (WOLDE-MARIAM, 1972).

Barley, wheat and tej cultivation occurs continuously below 3,300 m and reaches up to 3,600 m in some areas of Ethiopia, such as the Simien mountains (MALCOLM & TEFERA, 1997). In the Abune Yosef, cereals are cultivated even higher, with land ploughed above 3,600 m. This agriculture maybe ends up failing in some areas, but the afroalpine habitat has already disappeared. Nowadays, the line of 3,700 m contains the overall afroalpine ecosystem of the Abune Yosef massif, and only a few small patches of degraded senecio moorlands remain below this altitude.

The loss and fragmentation of the habitats affect all species, but the largest ones, such as the Ethiopian wolf, with requirements of big extensions of afroalpine habitat, are most affected.

Finally, the loss of afroalpine habitats will be increased by climatic change. Global warming can be expected to have an impact on agriculture, allowing more intensive cultivation at higher altitudes (DUNBAR, 1998). In the Abune Yosef, the agricultural land would be extended above 3,700 m, constraining even more the afroalpine habitats and the species that live only in these habitats, such as the gelada.

Loss of forests

In the Abune Yosef massif forested areas are scarce, only present in some rugged slopes, with reduced extension and relatively out of the way from human settlements. Generally, the few forested patches still present are protective forests (with high erosion risk) or placed in sites considered as sacred, around or close to a church or monastery. This fact applies to most of the Ethiopian highlands.

The main threat for the Abune Yosef forests is the collection of firewood for fuel production. The Abi Jacula forest, for instance, even with a clear character of protective forest, is suffering from a strong deforestation process. Each day, the Lalibela market receives dozens of people (mainly women) coming from the Abi Jacula forest carrying firewood (mainly branches and twigs) in an unstoppable process with little perspective of change in the short term.

People selling firewood in the market

Forests placed far away from Lalibela do not suffer from such an intense exploitation, as they only cover the fuel necessities of small villages nearby.

In the Yimrihane forest, the most important forested patch of the massif (see chapter 6), the biggest problem is the null regeneration due to overgrazing. Trees are not cut down because of their sacred status, but cattle and other livestock graze continuously and intensively under the trees, which are mainly very tall and old specimens. The no regeneration can bring about, in the long run, the disappearance of this old forest.

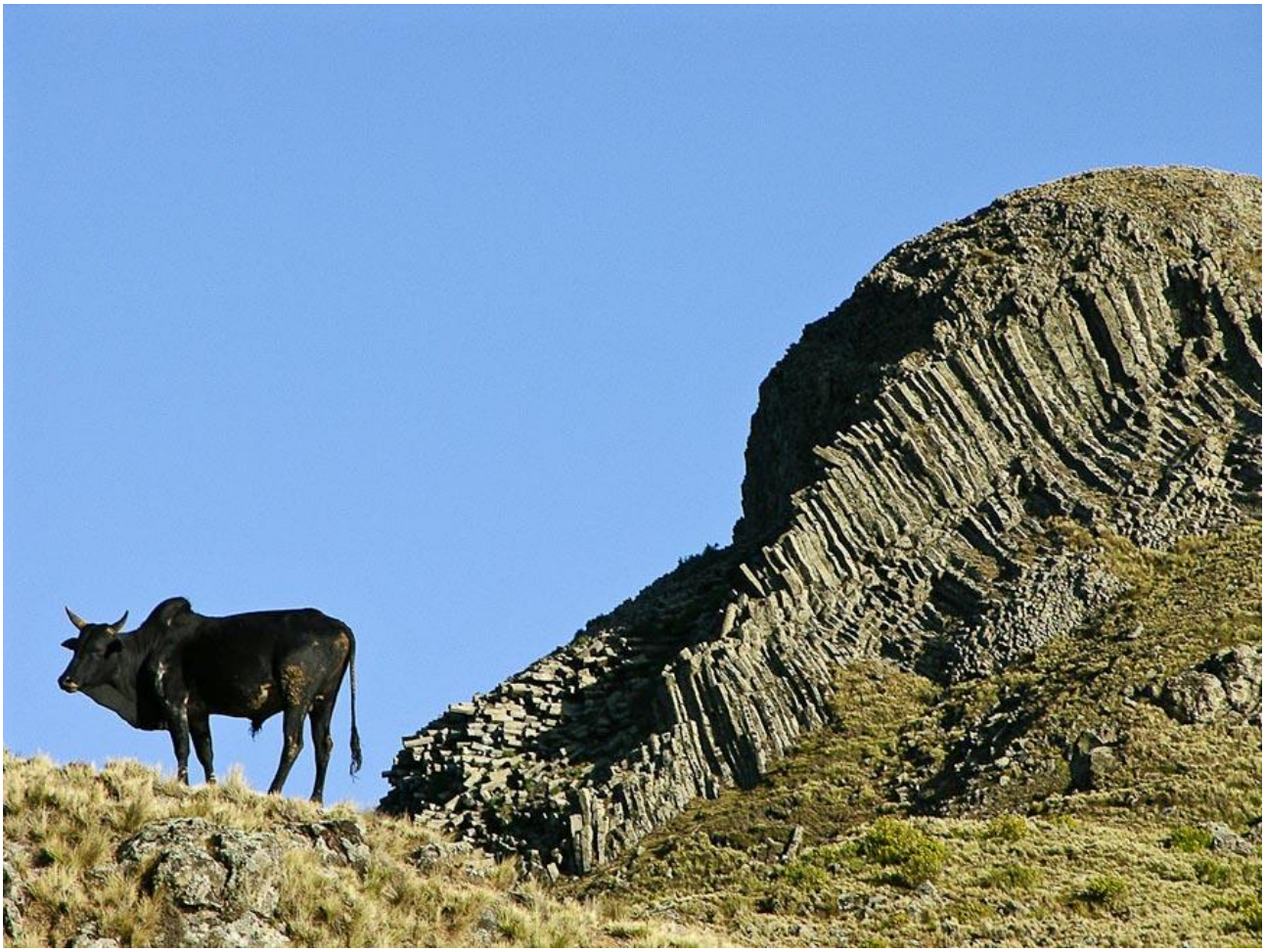
Overgrazing

Extensive overgrazing by livestock may have a significantly unfavourable impact on rodent populations, although a moderate presence of livestock could not interfere and can maintain similar densities of rodents (SILLERO-ZUBIRI & MACDONALD, 1997).

During the 2004 expedition, simultaneous counts of domestic livestock were done in the afroalpine core area (Aremgaremg plateau, Zigit camp valley, Astokual valley) in an extension of approximately 1,000 hectares. These censuses indicated the following densities: 174 goats and sheep, 22 cattle and 5 donkeys per square kilometre. As a mean

of comparison, in the Web valley (Bale Mountains National Park), regular livestock censuses showed an average density of 22 head of cattle, horses and donkeys per km^2, (SILLERO-ZUBIRI & MACDONALD, 1997).

It is difficult to estimate whether these numbers can be considered as an average for all of the Abune Yosef afroalpine area and it is unknown which are the variations in numbers throughout the year. However, they give an idea that overgrazing is a threat in the Abune Yosef massif, and it probably seriously affects rodent populations in some areas.



Cattle grazing in the afroalpine area

Small size of the afroalpine ecosystem

The afroalpine grasslands and ericaceous heathlands that form the afroalpine zone cover about 5,000 km^2 in Ethiopia (SILLERO-ZUBIRI & MCDONALD, 1997). In the Abune Yosef massif, the afroalpine zone covers only around 5,000 ha, which means 1% of Ethiopian's afroalpine habitats.

The potential area, calculated as the land above 3,200 m (MARINO, 2003), is 26,000 ha, but as stated earlier on, almost all of the land between 3,200 and 3,700 m has been already used for agriculture. Thus, the afroalpine area left is only about 20% of the estimated potential area.

For some species, the extension of the Abune Yosef afroalpine habitat is not enough to maintain a viable population, and they will face a possible extinction in a near future.

7.2. Conservation proposals

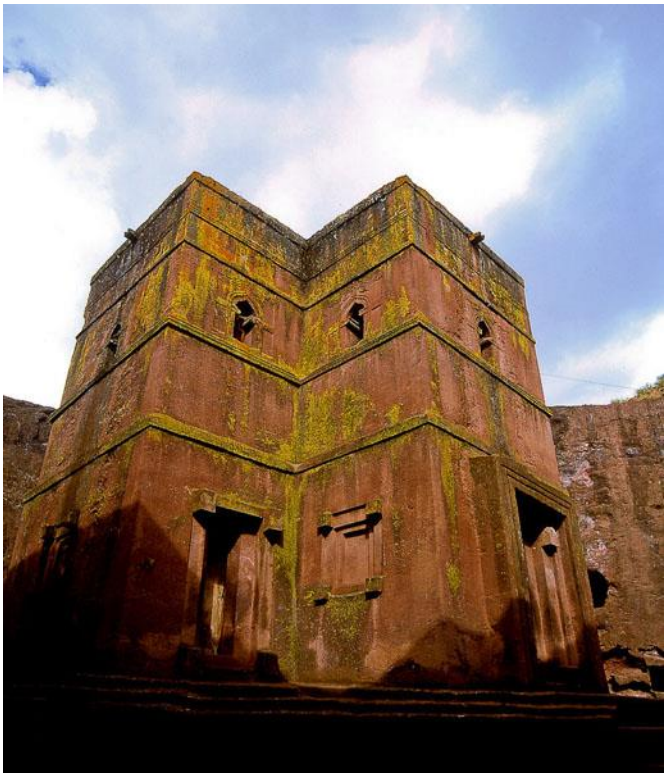
Two main trends will operate in Ethiopia in the following years and taking them into account is important before designing any conservation program for the area. First, human populations will continue on growing and expanding and, second, human standards of living must increase (MALCOLM & TEFERA, 1997). The creation of protected area is desired, but in too many occasions they only consist of areas marked in maps. The real challenge is achieving the translation of written declarations and marked maps into actions that benefit humans and nature.

How can this goal be achieved? The only way is involving local communities, through actions at different socio-economic and organizational levels. Here we point out some of the actions that could be implemented in the Abune Yosef massif:

(i) Development of ecotourism or wildlife tourism

In the city of Lalibela, placed on the western slope of the Abune Yosef massif, tourism is already developed, as the area holds one of Ethiopia's top attractions: the rock-hewn churches. The 13 churches excavated during the 12th and 13th centuries on the soft volcanic rock rank among the greatest historical sites of the Christian world. Although the only comfortable way to arrive to Lalibela is by plane (as the car trip from Addis Ababa still takes one and a half days), about 10,000 tourists visit the town every year.

With this background, organizing some tourism into the Abune Yosef could be relatively easy. As the priority is that tourism into the massif benefits mountain communities, some kind of sleeping infrastructure or selling of food and products could be set up in different places inside the massif, following an organized trekking proposal.



Betagiorgis, one of the rock hewn churches in the area

(ii) Using the presence of the Ethiopian wolf and the diversity of birds to attract wildlife tourism

The few remaining Ethiopian wolfs are not so easy to spot as in the Bale mountains, but they are still possible to see. In the meantime, if the local communities have a benefit from the tourists, they will start to see the wolf as a positive species to have in their land and they will stop persecutions. It is widely accepted that the Ethiopian wolf must be promoted as a flagship species for Ethiopian fauna and the afroalpine ecosystem (SILLERO-ZUBIRI & MACDONALD, 1997), and this must be also done in areas with small populations of the species, even if they are close to extinction.

Similarly, the diversity of birds can attract birdwatchers to the Abune Yosef, an area that does not appear in the Important Bird Areas catalogue for Ethiopia (EWNHS, 1996) but that holds an impressive list of species that sets the massif as the second most important area of the country for birds, and the first one of the Ethiopian Northern Highlands (see Section 5.4). In this case, it would be interesting to combine the visit to the afroalpine habitats with the survey of the savannah habitats in the lowlands.

(iii) Promotion of alternatives to the use of firewood

The pressure of firewood collection is so high and the remaining forests so small that the Abune Yosef is threatened by the total destruction of its forest in the medium or long

term. In the main city, Lalibela, cooking alternatives exist (for example, electricity), but it is too expensive for most of the population, who continue on buying firewood day after day. In the small villages scattered around and inside the massif, firewood is the only option, but in some places is so scarce that people use Senecio plants and dung.

The main alternative in the Abune Yosef are solar cookers. Solar cooking is the simplest, safest, most convenient way to cook food without having to walk for miles to collect wood or spend much of their meagre incomes on fuel or electricity. It can be used during most of the year, as the wet season in Wollo lasts only about three months. Cooperation projects based on the introduction of solar cookers already exist in other Ethiopian regions, and it would be an excellent idea to do something similar in the Abune Yosef.

Woman cooking with a solar cooker

(iv) Support to the pastoralists

One of the reasons for the high number of animals in the family herds is the high rate of mortality and the poor conditions of the animals. As MALCOLM & TEFERA (1997) clearly explain, the provision of veterinary services, herd improvement with artificial insemination

and the provision of mineral supplements could help local people to reduce the amount of animals needed to secure a livelihood, thus possibly reducing the impact of the stock in the afroalpine ecosystems. If the wildlife and agriculture authorities can provide this kind of help to the pastoralists, negotiations over stocking rates and areas of exclusion are more likely to succeed.

(v) Protection of the area

Seeking the support at all levels to the declaration of the Abune Yosef massif and Lalibela as a Biosphere Reserve, where the conservation and management of natural and cultural heritage can be combined. Support must come from the national and regional administration but also from the local communities. This idea is not in contradiction, but complementary, with the proposal to create a regional conservation area in the afroalpine areas left in Wollo, as proposed in SILLERO-ZUBIRI & MACDONALD (1997). International protection can probably bring investment for conservation and visitors to implement ecotourism, while the regional conservation area can be more effective in terms of conservation and management.

(vi) Creation of corridors

The Abune Yosef, Aboi Gara and Delanta (Figure 7.1) are the three areas in North Wollo where afroalpine habitats still exist and where small populations of Ethiopian wolf still persist (MARINO, 2003). The Abune Yosef and Aboi Gara are almost connected, and creating a corridor between both areas would be a priority. Delanta is 20 km apart from the other two areas, but it would be interesting to study the possibilities of connection, especially for the sake of the Ethiopian wolf.

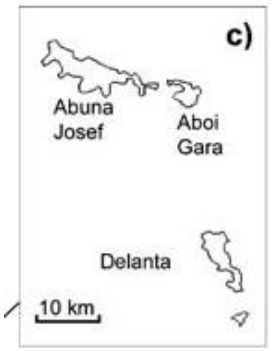


Figure 7.1.- The three afroalpine areas in North Wollo, taken from MARINO (2003).

8. Acknowledgements

We are thankful to the Ethiopian federal authorities of EWCO, ESTC and IBCR, the Amhara Regional State and the Lalibela local authorities for the constant support and official permits for the fieldwork.

We wish to thank also the Spanish Committee of the Man and Biosphere Program (MaB) of UNESCO that financed the surveys of 1999, 2000 and 2001, as well as the Universitat de Barcelona that gave financial support to the expeditions carried out in 2002 and 2004. The adventure shops Barrabés and Uka-uka donated diverse camping and clothing material.

We want to acknowledge the help provided by Christian Boix, Javier Castroviejo, José Luis Copete, Núria López Mercader, Jorgelina Marino, Ramon Martínez, Jacint Nadal, J. Domingo Rodriguez-Tejeiro, Patricia Rovira and José Luis Vivero in Barcelona. We are thankful to Belaynu Sefew, Solomon Birhane, Solomon, Ababo, Abelay, Alebbi, and all the friends that helped us in Lalibela as well as in the Abune Yosef.

We are grateful to Antoni Serra, from the Centre de Recursos de Biodiversitat Animal of the Universitat de Barcelona for his help. Víctor Gómez, Manager of the former Divisió III of the Universitat de Barcelona and all the staff in the Accounts Department provided kind support.

Finally, we thank Pablo Garcia for his help with the making of the Abune Yosef map.

9. References

AFEWORK BEKELE; CAPANA, E.; CORTI, M.; MARCUS, L.F. & SCHLITTER, D.A. (1993). Systematics and geographic variation of Ethiopian *Arvicanthis* (Rodentia, Muridae). *J. Zool. Lond.,* 230: 117 – 134.

ASH, N.J. (2001). Expansion of Ethiopian Wolf conservation to Northern Ethiopia. *Canid News*, 4: 2.

ASHENAFI, Z. T., COULSON, T., SILLERO-ZUBIRI, C., & LEADER-WILLIAMS, N. (2005). Behaviour and ecology of the Ethiopian wolf (*Canis simensis*) in a human-dominated landscape outside protected areas. *Animal Conservation* 8: 113-121.

BARRAU, C.; CLOUET, M. & GOAR, J.L. (1997). Deux jeunes Gypaetes barbus *Gypaetus barbatus meridionalis* a l'envol dans un aire des monts du Bale (Éthiopie). *Alauda*, 65(2): 199-201.

BEKELE, A. (1996). Rodents of the Menagesha State Forest, Ethiopia, with an emphasis on the endemic *Praomys albipes* Ruppell 1842. *Tropical Zoology* 9(1): 201-212

BEKELE, A. & CORTI, M. (1994). Multivariate morphometrics of the Ethiopian populations of harsh-furred rat (*Lophuromys*: Mammalia, Rodentia). *J Zool, (London)* 232(4): 675-689.

BEKELE, A. & LEIRS, H. (1997). Population ecology of rodents of maize fields and grassland in Central Ethiopia. *Belgian Journal of Zoology* 127(SUPPL.): 39-48.

BEKELE, A.; CAPANNA, E.; CORTI, M.; MARCUS, L.F. & SCHLITTER, D.A. (1993). Systematics and geographic variation of Ethiopian *Arvicanthis* (Rodentia, Muridae). *Journal of Zoology,* 230: 117-134.

BIRDLIFE INTERNATIONAL (2000). *Threatened birds of the world*. Lynx edicions and BirdLife International. Barcelona & Cambridge.

BROWN, L.H.; URBAN, E.K. & NEWMAN, K. (1982). The birds of Africa. Vol I. Academic Press. London & New York.

CAPANNA, E.; BEKELE, A.; CAPULA, M.; CASTIGLIA, R.; CIVITELLI, M.V.; CODJIA, J.T.C.; CORTI, M. & FADDA, C. (1996). A multidisciplinary approach to the systematics of the genus *Arvicanthis* (Rodentia, Murinae). *Mammalia,* 60 (4): 677-696.

CAPULA, M.; CIVITELLI, M.V.; CORTI, M.; AFEWORK, B. & CAPANNA, E. (1997). Genetic divergence in the genus *Arvicanthis* (Rodentia: Murinae). *Biochemycal Systematics and Ecology,* 25 (5): 403-409.

CLEMENT, P. (1993). Finches and Sparrows: An identification guide. Princeton University Press. 514 pp.

CORBET, G.B. & YALDEN, D.W. (1972). Recent records of mammals (other than bats) from Ethiopia. *Bulletin of the British Museum (Natural History), Zoology,* 22: 213-252.

CORTI, M., CASTIGLIA, R., & VERHEYEN, W. N. (2004). A note on three new cytotypes of *Lophuromys flavopunctatus* sensu lato (Rodentia, Muridae) from Tanzania 44. *Mammalia* 68(1): 69-74.

CRAMP, S. (ed.). Handbook of the Birds of Europe, the Middle East and North Africa. The birds of the Western Paleartic. Oxford University Press 1988. Vols: I-VIII.

DELESTRADE, A. (1998). Distribution and status of the Ethiopian population of Chough (*Pyrrhocorax pyrrhocorax baileyi*). *Bull. B.O.C.*, 118: 101 – 105.

DEL HOYO, J.; ELLIOTT, A. & SARGATAL, J. EDS. (1994). Handbook of the Birds of the World, vol. 2. New World Vultures to Guineafowl. Lynx Edicions. Barcelona.

DEL HOYO, J.; ELLIOTT, A. & SARGATAL, J. EDS. (1999). Handbook of the Birds of the World, vol. 2. Barn-owls to Humminbirds. Lynx Edicions. Barcelona.

DEL HOYO, J.; ELLIOTT, A. & SARGATAL, J. EDS. (2001). Handbook of the Birds of the World, vol. 6. Mousebirds to Hornbills. Lynx Edicions. Barcelona.

DEL HOYO, J.; ELLIOTT, A. & CHRISTIE, D.A. EDS. (2004). Handbook of the Birds of the World, vol. 9. Cotingas to Pipits and Wagtails. Lynx Edicions. Barcelona.

DÍAZ-BEHRENS, G. & VAN ROMPAEY, H. (2002). The Ethiopian genet, *Genetta abyssinica* (Carnivora, Viverridae): Ecology and phenotypic aspects. *Small Carnivore Conservation, IUCN* , 27: 23-28.

DIETERLEN, F. (1974). Bemerkungen zur systematik der gattung *Pelomys* (Muridae, Rodentia) in Äthiopien. *Z. Säugetierk,* 39: 229-231.

DIETERLEN, F. (1987). Neue Erkenntnisse über afrikanische Bürstenhaarmäuse, Gattung *Lophuromys* (Muridae, Rodentia). *Bonner Zoologishe Beitraege* 38 (3): 183-194.

DIPPENAAR, N. J. (1980). New species of *Crocidura* from Ethiopia and Northern Tanzania (Mammalia: Soricidae). Annals of the Transvaal Museum 32: 125-154.

DORST, J. (1972). Notes sur quelques rongeurs observes eb Ethiopie. Mammalia 36(2): 182-192.

DORST, J. & DANDELOT, P. (1990). A Field Guide to the Larger Mammals of Africa. Ed. Collins, London.

DUCROZ, J.F.; VOLOBOUEV, V. & GRANJON, L. (1998). A molecular perspective on the systematics and evolution of the genus *Arvicanthis* (Rodentia, Muridae): Inferences from complete cytochrome b gene sequences. *Molecular Phylogenetics and Evolution,* 10 (1): 104-117.

DUNBAR, R.I.M. (1977). The gelada baboon: status and conservation: 363-383. In: HSH Prince Rainier III & Bourne, G. *Primate Conservation*. Academic Press. New York.

DUNBAR, R.I.M. (1998). Impact of global warming on the distribution and survival of the gelada baboon: a modelling approach. *Global Change Biology*, 4: 293-304.

ENVIRONMENTAL PROTECTION AUTHORITY (1998). Federal Democratic Republic of Ethiopia: National Action Programme to combat Desertification. Addis Ababa. 158 pp.

EWNHS (1996). Important Bird Areas of Etiopía: a first inventory. Ethiopian Wildlife and Natural History Society. Addis Ababa, Ethiopia.

FADDA, C. AND CORTI, M. (2000). Three dimensional geometric morphometric study of the Ethiopian *Myomys-Stenocephalemys* Complex (Murinae, Rodentia). *Hystrix* 10 (2): 131-143.

FALCH, F. (2000). Simien Mountains National Park Management Plan. Austrian Ministry for Foreign Affairs.

FRY, H & KEITH, S. EDS. (2000) The birds of Africa. Vol VI. Academic Press. London & New York.

FRY, H.; KEITH, S. & URBAN, C. (1988). The birds of Africa. Vol III. Academic Press. London & New York.

GIBBS, D.; BARNES, E. & COX, J. (2001). Pigeons and Doves. Pica Press. Sussex.

GOTTELLI, D. & SILLERO-ZUBIRI, C. (1992). The Ethiopian Wolf - An endangered endemic canid. *Oryx,* 26 (4): 205-214.

GRUBB, P., AMORI, G., DE SMET, K. & BERTOLINO, S. 2008. *Hystrix cristata*. Downloaded on 22 April 2009. Dowloaded on 22 April 2009. 2008 IUCN Red List of Threatened Species. 2008.

GÜTTINGER, R.; LEUMANN, L.; GETAHUN, M.; SIMMEN, J. & WÜST, M. (1998). The actual situation of several small mammal species in the park area: 64-73. In: A survey on the flora and fauna of the Simen Mountains National Park, Ethiopia. Nievergelt, B.; Good, T. & Güttinger, R. eds. Walia 1998 (Special Issue). University of Zurich (Switzerland).

HARRIS, T. & FRANKLIN, K. (2000). Shrike and Bush-shrikes: An identification guide Christopher Helm Publishers.

HEGGLIN, D.; GOOD, T.; GADJON, G.; AAMARA, G.; GEBREMEDHIN, B.; IMFELD, S.; LUSTENBERGER, J. & NIEDERBERGER, J. (1998). Larger Mammals and Birds in the Lowlands and the Plateau of the Park: 52-63. In: Nievergelt, B.; Good, T. & Güttinger, R. eds. (1998). A Survey on the Flora and Fauna of the Simen Mountains National Park, Ethiopia. *Walia* 1998 (Special Issue). University of Zurich (Switzerland).

HILLMAN, J.C. (1993). Ethiopia: Compendium of Wildlife Conservation Information. The Wildlife Conservation Society International and Ethiopian Wildlife Conservation Organization, New York.

IUCN (2003). IUCN Red List of Threatened Species. http://www.redlist.org (accessed August 2003).

JUCH, P. (2000). Habitat preferences of small mammals on Mount Elgon, Uganda. *Bulletin de la Societe des Naturalistes Luxembourgeois,* 100: 83-96.

KINGDON, J. (1974). East African Mammals. An Atlas of Evolution in Africa. Vol. II, part B (Hares and Rodents): 615-616. Academic Press, London, New York.

KINGDON, J. (1997). The Kingdon Field Guide to African Mammals. Academic Press, London. 212 pp.

KOCK, D. & KUENZEL, T. (1999). The maned rat, *Lophiomys imhausii* Milne-Edwards, 1867, in Djibouti, NE-Africa (Mammalia: Rodentia: Lophiomyinae). *Zeitschrift fuer Saeugetierkunde* 64(6): 371-375.

KRUSKOP, S. V. & L. A. LAVRENCHENKO (2000). A new species of long-eared bat (Plecotus; Vespertilionidae, Mammalia) from Ethiopia. *Myotis*. 30: 5-17.

KUMMER, H. (1968). Social organization of Hamadryas Baboons. In: Primates: Studies in adaptation and variability. Ed. Jay, P.C. Holt, Rinehart and Winston, New York: 293-313.

LARGEN, M.J. (2001). Catalogue of the amphibians of Ethiopia, including a key for their identification. *Tropical Zoology,* 14: 307-402.

LAVRENCHENKO, L. A. *Mus mahomet*. 2007 IUCN Red List of Threatened Species. Dowloaded on 25 February 2008. 2004a.

LAVRENCHENKO, L. A. *Stenocephalemys griseicauda*. Dowloaded on 25 February 2008. 2007 IUCN Red List of Threatened Species. 2004b.

LAVRENCHENKO, L. A. *Crocidura baileyi.* In: 2006 IUCN Red List of Threatened Species. 2007 IUCN Red List of Threatened Species. Dowloaded on 25 February 2008. 2004c.

LAVRENCHENKO, L. A. & CORTI, M. *Arvicanthis abyssinicus*. Dowloaded on 25 February 2008. 2007 IUCN Red List of Threatened Species. 2004.

LAVRENCHENKO, L. A., MILISHNIKOV, A. N., & WARSHAVSKY, A. A. (2000). Allozymic phylogeny: Evidence for coherent adaptive patterns of speciation in Ethiopian endemic rodents from an isolated montane massif. *Bonner Zoologische Monographien* (46): 245-253.

LAVRENCHENKO, L.A.; POTAPOV, S.G.; LEBEDEV, V.S. & RYSKOV, A.P. (2001). The phylogeny and systematics of the endemic *Lophuromys flavopunctatus* species complex based upon random amplified polymorphic DNA (RAPD) analysis. *Biochemical Systematics and Ecology,* 29: 1139 – 1151.

LAVRENCHENKO, L.A.; VERHEYEN, W.N. & HULSELMANS, J. (1998). Systematic and distributional notes on the *Lophuromys flavopunctatus* Thomas 1888 species-complex in Ethiopia (Muridae, Rodentia). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique. Biologie*, 68: 199-214.

LEPAGE, D. (2006). Avibase. Bird checklists of the world. BirdLife International. http://www.bsc-eoc.org/avibase/

MALCOLM, J. (1997). The diet of the Ethiopian wolf (*Canis simensis* Rüppell) from a grassland area of the Bale Mountains, Ethiopia. *African Journal of Ecology* 35: 162-164.

MALCOLM, J.R. & TEFERA, Z. (1997). Conservation of Afroalpine habitats: 61-63. In: Sillero-Zubiri, C. & Macdonald, D.W. (1997). The Ethiopian Wolf - Status, Survey and Conservation Action Plan. IUCN, Gland, Switzerland.

MARGALIDA, M.; BERTRAN, J.; BOUDET, J. & HEREDIA, R. (2004). Hatching asynchrony, sibling aggression and cannibalism in the Bearded Vulture *Gypaetus barbatus. Ibis*, 146 (3): 386–393.

MARINO, J. (2003a). Spatial ecology of the Ethiopian wolf *Canis simiensis*. 1-227. 2003. Linacre College, University of Oxford.

MARINO, J. (2003b). Threatened Ethiopian wolves persist in small isolated Afroalpine enclaves. *Oryx*, 37(1): 62–71.

MARINO, J.; LAURENSON, K. & SILLERO-ZUBIRI, C. (1999). Status of the Ethiopian Wolf: Habitat availability, population estimates and threats. Report to the National Geographic Society. Ethiopian Wolf Conservation Programme, Bale, Ethiopia.

MORALES, S. *Lophiomys imhausii* (On-Line). Animal Diversity Web. 2006.

MORI, A. & BELAY, G. (1990). The distribution of baboon species and a new population of Gelada Baboons along the Wabi-Shebeli River, Ethiopia. *Primates*, 31 (4): 495-508.

MÜLLER, J.P. (1977). Populationsökologie von *Arvicanthis abyssinicus* in der Grassteppe des Semien Mountains National Park (Äthiopien). *Z. Säugetierkunde,* 42: 145 – 172.

MUNDY, P.; BUTCHARD, D.; LEDGER, J. & PIPERS, S. (1992). The vultures of Africa. Academic Press. London. 460 pp.

MUSSER, G.C. & CARLETON, M.D. (1993). Order Rodentia: family Muridae. Pp: 501-755. In: Mammal species of the world: a taxonomic and geographic reference. Wilson D.E. & Reeder. D.M. eds. Smithsonian Institution Press. Washington.

NIEVERGELT, B. (1998). Observations on the Walia Ibex, the Klipspringer and the Ethiopian Wolf: 44-51. In: Nievergelt, B.; Good, T. & Güttinger, R. eds. (1998). A Survey on the Flora and Fauna of the Simen Mountains National Park, Ethiopia. *Walia* 1998 (Special Issue). University of Zurich (Switzerland).

NIEVERGELT, B.; GOOD, T. & GÜTTINGER, R. (1998). Biodiversity, Synthesis and Conservational Aspects: 84-93. In: Nievergelt, B.; Good, T. & Güttinger, R. eds. (1998). A Survey on the Flora and Fauna of the Simen Mountains National Park, Ethiopia. *Walia* 1998 (Special Issue). University of Zurich (Switzerland).

NIEVERGELT, B., GOOD, T., AND GÜTTINGER, R. (1998). A survey on the flora and fauna of the Simen Mountains National Park, Ethiopia. *Walia* 1998 (Special Issue). University of Zurich (Switzerland).

NOWAK, R.M. (1991). Walker´s Mammals of the World. Vol. II. The John Hopkins University Press. Baltimore & London, 1991.

ORLOV, V.N.; BASKEVICH, M.I. & BULATOVA, N.S. (1992). Chromosomal sets of rats of the genus *Arvicanthis* (Rodentia, Muridae) from Ethiopia. *Zoologeski Zhurnal,* 71: 103-112.

ORTIZ, S. & VIVERO, J.L. (2005). New species and new combination in the Afroalpine *Senecio nanus – Senecio schultzii* complex (Asteraceae, Senecioneae). *Blumea*, 50: 191 – 195.

PETTER, F. (1972). Deux rongeurs nouveaux d'Ethipie: *Stenocephalemys griseicauda* sp. nov. et *Lophuromys melanonyx* sp. nov. *Mammalia* 36(2): 171-181.

PLANT GENETIC RESOURCES CENTER (1995). Ethiopia: Country Report to the FAO International Technical Conference on Plant Genetic Resources. Addis Abeba. 51 pp.

ROUSSEAU, M. (1983). Étude des *Arvicanthis* du Muséum de Paris par analyses factorielles (Rongeurs, Muridés). *Mammalia*, 47 (4): 525 – 542.

RUPP, H. (1980). Beiträge zur Systematik, Verbreitung un Ökologie äthiopischer Nagetiere Ergebnisse mehrerer Forschungsreisen. *Säugetierk Mitt* 28: 81-123.

SCHLITTER, D. A. & AGWANDA, B. *Lophiomys imhausi*. IUCN. 2007 IUCN Red List of Threatened Species. Dowloaded on 25 February 2008. 2004a.

SCHLITTER, D. A. & AGWANDA, B. *Tachyoryctes splendens*. Dowloaded on 25 February 2008. 2007 IUCN Red List of Threatened Species. 2004b.

SHORE, R.F. & GARBETT, S.D. (1991). Notes on the small mammals of the Shira plateau, Mt. Kilimanjaro. *Mammalia,* 55 (4): 601-607.

SILLERO-ZUBIRI, C. (1996). Records of Honey Badger *Mellivora capensis* in Afroalpine habitats, above 4,000 m. *Mammalia*, 60: 323-325.

SILLERO-ZUBIRI, C. & GOTTELLI, D. (1994). *Canis simensis*. *Mammalian Species*, 485: 1-6.

SILLERO-ZUBIRI, C. & GOTTELLI, D. (1995). Spatial organization in the Ethiopian Wolf (*Canis simensis*): large packs and small stable home ranges. *J. Zool. Lond.,* 237: 65-81.

SILLERO-ZUBIRI, C.; TATTERSALL, F.H. & MACDONALD, D.W. (1995a). Morphometrics of endemic rodents from the Bale Mountains, Ethiopia. *Journal of African Zoology,* 109 (4): 387-391.

SILLERO-ZUBIRI, C., TATTERSALL, F. H., & MACDONALD, D. W. (1995b). Bale mountains rodent communities and their relevance to the Ethiopian wolf (*Canis simiensis*). *African Journal of Ecology* 33: 301-320.

SILLERO-ZUBIRI, C.; TATTERSALL, F.H. & MACDONALD, D.W. (1995c). Habitat selection and daily activity of giant mole rats *Tachyoryctes macrocephalus*: significance to the Ethiopian Wolf *Canis simensis* in the Afroalpine ecosystem. *Biological Conservation,* 72: 77-84.

SILLERO-ZUBIRI, C. & MACDONALD, D.W. (1997). The Ethiopian Wolf - Status, Survey and Conservation Action Plan. IUCN, Gland, Switzerland. 123 pp.

SILLERO-ZUBIRI, C.; MALCOLM, J.R.; WILLIAMS, S.; MARINO, J.; TEFERA, Z.; LAURENSON, K.; GOTTELLI, D.; HOOD, A.; MACDONALD, D.W.; WILDT, D. & ELLIS, S. EDS. (2000). Ethiopian wolf conservation strategy workshop. Final Workshop report. IUCN/SSC Canid Specialist Group and Conservation Breeding Specialist Group, 61 pp.

SOKOLOV, V.E.; NERONOV, V.M. & MILANOVA, E.V. (1997). Natural conditions and regional features of the mammal fauna in Ethiopia. Pp: 6-23. In: Ecological and faunistic studies in Ethiopia. Part I. Fauna, Ecology and Systematics of Vertebrates. Joint Ethio-Russian Biological Expedition, Addis Ababa.

SPAWLS, S.; HOWELL, K.; DREWES, R. & ASHE, J. (2002). A field guide to the Reptiles of East Africa. Academic Press. London.

STEVENSON, T. & FANSHAWE, J. (2002). Field Guide to the Birds of East Africa. T. & A.D. Poyser, London.

STUART, C. & TILDE, C. (1998). A Field Guide to the Tracks and Signs of Southern and East African. Wildlife Southern Book Publishers.

SVENSSON, L.; GRANT, P.J.; MULLARNEY, K. & ZETTERSTRÖM, D. (1999). Collins Bird Guide. HarperCollins. London.

TAYLOR, M.E. & GOLDMAN, C.A. (1993). Tha taxonomic status of the African mongooses, *Herpestes sanguineus, H. nigratus, H. pulverulentus and H. ochraceus* (Carnivora: Viverridae). *Mammalia*, 57: 375-391.

TERRASSE, J.F. (2001). Le gypaéte barbu. Ed. Delachaux et Niestlé. 208 pp.

URBAN, C.; FRY, H. & KEITH, S. EDS. The birds of Africa. Vol II (1986); Vol IV (1992); Vol V (1997). Academic Press. London & New York.

VERHEYEN, W.; HULSELMANS, J.L.J.; DIERCKX, T. & VERHEYEN, E. (2002). The *Lophuromys flavopunctatus* Thomas 1888 s.l. species complex: a craniometric study, with the description and genetic characterization of two new species (Rodentia – Muridae – Africa). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique. Biologie*, 72: 141 – 182.

VIVERO, J.L. (2001). A guide to the endemic birds of Ethiopia and Eritrea. Shama books. Addis Ababa.

VIVERO, J.L.; KELBESSA, E. & DEMISSEW, S. *in press.* Progress on the Red List of plants of Ethiopia and Eritrea: conservation and biogeography of endemic flowering taxa.

WILLIAMS & ARLOT (1995). Birds of Africa. Collins Field Guide. Harper & Collins Publishers.

WOLDE-MARIAM, M. (1972). An introductory geography of Ethiopia. Addis Ababa. 215 pp.

WOLFHEIM, J.H. (1983). Primates of the World: Distribution, Abundance and Conservation. University of Washington Press, Seattle.

YALDEN, D.W. (1983). The extent of high ground in Ethiopia compared to the rest of Africa. *Sinet: Ethiopian Journal of Science* 6: 35–39.

YALDEN, D.W. (1985). *Tachyoryctes macrocephalus*. *Mammalian Species* 237: 1-3.

YALDEN, D.W. (1988). Small mammals of the Bale Mountains, Ethiopia. *African Journal of Ecology,* 26 (4): 281-294.

YALDEN, D.W.; LARGEN, M.J. & KOCK, D. (1976). Catalogue of the mammals of Ethiopia. 2. Insectivora and rodentia. *Monitore Zoologico Italiano,* 1: 1-118.

YALDEN, D.W.; LARGEN, M.J. & KOCK, D. (1977). Catalogue of the mammals of Ethiopia. 3. Primates. *Monitore Zoologico Italiano,* n.s. supplemento IX, 1: 1-52.

YALDEN, D.W.; LARGEN, M.J. & KOCK, D. (1980). Catalogue of the mammals of Ethiopia. 4. Carnivora. *Monitore Zoologico Italiano,* n.s. supplemento XIII, 8: 169-272.

YALDEN, D.W.; LARGEN, M.J. & KOCK, D. (1984). Catalogue of the mammals of Ethiopia. 5. Artiodactyla. *Monitore Zoologico Italiano,* n.s. supplemento XIX, 4: 67-221.

YALDEN, D.W.; LARGEN, M.J. & KOCK, D. (1986). Catalogue of the mammals of Ethiopia. 6. Perissodactyla, proboscidea, hyracoidea, lagomorpha, tubulidentata, sirenia and cetacea. *Monitore Zoologico Italiano,* n.s. supplemento XXI, 4: 31-103.

YALDEN, D.W. & LARGEN, M.J. (1992). The endemic mammals of Ethiopia. Mammal Rev. 22 (3-4): 115-150.

YALDEN, D.W.; LARGEN, M.J.; KOCK, D. & HILLMAN, J.C. (1996). Catalogue of the mammals of Ethiopia and Eritrea. 7. Revised checklist, zoogeography and conservation. *Tropical Zoology,* 9: 73-164.

YOM, T.Y. (1993). Size variation in Rhabdomys pumilio: A case of character release? *Zeitschrift fuer Saeugetierkunde,* 58 (1): 48-53.

ZIMMERMAN, D.A.; TURNER, D.A. & PEARSON, D.J. (1996). Birds of Kenya and Northern Tanzania. Christopher Helm Publishers.

ZINNER, D. & PELÁEZ, F. (1999). Verreaux´s eagles (*Aquila verreauxii*) as potential predators of hamadryas baboons (*Papio hamadryas hamadryas*) in Eritrea. *Am. J. Primatol*., 47: 61-66.

UNIVERSITAT DE BARCELONA

Centre de Recursos de Biodiversitat Animal