The 13th African Small Mammal Symposium

Mekelle, Ethiopia

16-21 September, 2019

Programme and Abstract Book

Editors:

BRYJA Josef, MEHERETU Yonas

Organizers:

Institute of Vertebrate Biology of the Czech Academy of Sciences, Brno, Czech Republic

Department of Biology, College of Natural & Computational Sciences, Mekelle University, Mekelle, Ethiopia

Place of the meeting:

College of Natural & Computational Sciences, Mekelle University, Mekelle, Ethiopia

Date of the meeting:

16-21 September, 2019

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Foreword

Dear participants,

It is my great pleasure to welcome you all to the 13th African Small Mammals Symposium (ASMS) 2019, which for the first time found its way to Ethiopia. The ASMS conferences are held once every four years, providing the opportunity for the continent and international scientists, students and others interested in studying African small mammals to meet and exchange ideas. Forty-two years have elapsed since the 1st ASMS was held in Pittsburgh in September 1977 and Ethiopian has become the fifth African Nation to host the conference. We at Mekelle University (MU) feel honored to have given this chance at this point in time as the event coincided with the news that MU has been ranked the 2nd Best University in Ethiopia this year. MU has seen a rapid growth in student population, staff profile and teaching-learning and research facilities, together with tremendous gains in national and international collaborative research and development projects.

The MU community and the city of Mekelle are extremely happy to host the 13th ASMS where about 100 participants from 25 countries will be in attendance. With about 100 oral and poster presentations lining up, the conference offers a range of research perspectives spread across the various fields of research of African small mammals (e.g. ecology and conservation, pest management, public health, phylogeography, evolution, taxonomy and systematics). We intend that the conference will identify gaps in the current knowledge and encourage additional field, museum, and laboratory research to fill those gaps.

Furthermore, I hope that this event will represent a unique opportunity by creating the avenue for exchange of new and exciting scientific ideas and developing new networks and collaborations. I believe that you will also find some time to enjoy the city of Mekelle, the hospitality of the people and some of its tourist attractions, including the iconic martyrs' memorial monument and the castle of Emperor Yohannes IV (now serves as a museum).

Welcome!

Enqua Dehan Metsakum!

Enquan Dehna Metachihu!

Meheretu Yonas

Committees

International Scientific Committee

Josef Bryja (co-chair), *Institute of Vertebrate Biology of the Czech Academy of Sciences, Brno, Czech Republic*
Yonas Meheretu (co-chair), *Department of Biology, College of Natural & Computational Sciences, Mekelle University, Ethiopia*
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Local Organizing Committee

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Gebremeskel Teklehaimanot
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Radim Šumbera
Daniela Mizerovská
Veronika Bartáková

Programme

Sunday, September 15, 2019

Arrival of participants

Monday, September 16, 2019

Chair: Y. Meheretu
9.00-9.15: *Welcome* (Y. Meheretu)
9.15-10.00: *Keynote lecture:* LAVRENCHENKO L.A.: The mammals of Ethiopia: diversity, endemism and conservation
10.00-10.15: BRYJA J., ŠUMBERA R., MEHERETU Y., LAVRENCHENKO L.A.: Annotated checklist, taxonomy and distribution of rodents in Ethiopia
10.15-11.00: *Keynote lecture:* BELMAIN S.R.: Results and lessons from 20 years of Ecologically Based Rodent Management research in Africa

11.00-11.30: Morning tea break

Chair: G. Dobigny
11.30-12.30: *Regular lectures*
AVENANT N.L., SMIT G.N., DU PLESSIS J.J.: Changes in small mammal community structure following open-cast mining in central South Africa: an indicator of ecosystem integrity?
MAMBA M., FASEL N.J., MAHLABA T., AUSTIN J.D., MCCLEERY R.A., MONADJEM A.: Influence of sugarcane growth stages on the population dynamics and community structure of small mammals in a savanna-agricultural landscape
DALECKY A., OBSMICE GROUP* (* members that contributed, in alphabetical order : Artige E., Badou S., Brouat C., Diagne C.A., Dobigny G., Dossou H.J., Etougbétché J., Fossati O., Garba M., Gauthier P., Granjon L., Hima K., Houéménou G., Kane M., Le Fur J., Loiseau A., Mauffrey J.F., Ndiaye A., Niang C.T., Niang Y., Piry S., Sarr N., Stragier C., Tatard C., Thiam M.): ObsMiCE: a monitoring system to assess long-term changes in biodiversity of small mammals and associated parasites in a broad range of West African ecosystems
NIANG C.T., DALECKY A., LAFFONT-SCHWOB I., BAL A.B, RANQUE S., BROUAT C., RIBAS A.S., TATARD C.: Socio-environmental changes, structure and impact of rodent communities and their parasites: the context of major hydro-agricultural schemes in the Senegal River valley

12.30-14.00: Buffet lunch

Chair: C. Denys
14.00-15.00: *Keynote lecture:* KENNERLEY R.: The IUCN SSC Small Mammal Specialist Group's priorities for small mammal conservation across Africa
15.00-15.30: *Regular lectures*
NICOLAS V., FABRE P.-H., DENYS C., MISSOUP A.-D., OLAYEMI A., COLYN M. ,BRYJA J., VERHEYEN E., KATUALA P.G.B., DUDU A.M., KERBIS-PETERHANS J., DEMOS T.: The

phylogeny of the wood mouse (Muridae, *Hylomyscus*) based on complete mitochondrial genomes and five nuclear genes reveals cryptic diversity

HÁNOVÁ A., KONEČNÝ A., MIKULA O., LAVRENCHENKO L.A., MARTYNOV A., ŠUMBERA R., BRYJA J.: Multilocus phylogeny and distribution of the multimammate mice of the genus *Mastomys*

15.30-16.00: Afternoon tea break

Chair: V. Nicolas

16.00-17.30: *Regular lectures*

BRYJA J., MIKULA O., ŠUMBERA R., KONEČNÝ A., VERHEYEN E., NICOLAS V.: Phylogenomics resolves relationships among genera in murid tribes Arvicanthini and Praomyini, representing two major rodent radiations in sub-Saharan Africa

GANEM G., DUFOUR C.M-S., AVENANT N.L., KOTZE L., PILLAY N.: An update on *Rhabdomys* sp. distribution, ecology and behavioural characteristics.

TAYLOR P.J., KEARNEY T.T., DALTON D.L., CHAKONA G., KELLY C.M.R., BARKER N.P.: Rare rats on African sky islands: the case of South African montane laminate-toothed rats (*Otomys*)

RAMBAU R.V., ABRAHAMS D., RUIZ HERRERA MORENO A.: The impact of chromosomal rearrangements on cryptic speciation on the African vlei rats

DIANAT M., NICOLAS V., BRYJA J., DENYS C., KONEČNÝ A.: Diversity and genome-level molecular phylogeny of African giant shrews (*Crocidura olivieri* species complex)

KONEČNÝ A., HUTTERER R., MEHERETU Y., BRYJA J.: New species of *Crocidura* (Mammalia: Soricidae) from Ethiopia, and a review of shrews from the country

18.00-22.00: Welcome ice-breaking party

Tuesday, September 17, 2019

Chair: H. Leirs

9.00-10.00: *Keynote lecture*: ECKE F.: Outbreaks of rodent-borne diseases: drivers of the contact zone between pathogens, rodents and humans

10.00-10.30: Morning tea break

10.30-12.00: *Regular lectures*

GRYSEELS S., MBALA-KINGEBENI P., AKONDA I., ANGOYO R., AYOYUBA A., BAELO P., BUGENTHO E., BUSHMAKER T., BUTEL C., CALVIGNEC-SPENCER S., DELAPORTE E., DE SMET B., DÜX A., FISCHER R., KAHANDI C., KAPETSCHI J., KIMBONDJA S., KOUADIO L., BENDEKE A.M., MANDE C., MDINGI G., MOUDIMBA J., NGOLE E.M., MUKADI D., MUSABA P., MUTOMBO P., NDONG BASS I., NEBESSE C., NGOY S., NDIBU S.P., SEIFERT S., TANZITO J., DUDU A., AMUNDALA N., ARIËN K., GEMBU G.C., LEENDERTZ F., LEIRS H., MUKINZI J.-C., MUNSTER V., MUYEMEBE-TAMFUM J.-J., PEETERS M., VERHEYEN E., AHUKA-MUNDEKE S.: Zoonotic investigations of Zaire Ebolavirus in Likati, Democratic Republic of Congo, 2017

OGOLA J., WEBALA P., KIVISTÖ I., NYAGA P., ANZALA O., VAPALAHTI O., SIRONEN T., FORBES K.M.: An ecosystem approach to investigating coronaviruses at Taita Hills, Southeastern Kenya

KAYALA E.N., EISEB S.J., MULUNGU L.S., SCHAER J., BELMAIN S.R.: Seasonal prevalence of haemoparasites infecting small mammals that occur in Mukwe Constituency, Kavango East Region of Namibia

KESSY S.T., MAKUNDI R.H., MASSAWE A.W.: Rodents and flea ectoparasites diversity in plague active foci in Mbulu district, Tanzania

PAREYN M., KOCHORA A., VAN ROOY L., ELIGO N., VANDEN BROECKE B., LEIRS H., MASSEBO F.: Small mammals and cutaneous leishmaniasis in southern Ethiopia

PETRUŽELA J., BRYJA J., BRYJOVÁ A., KATAKWEBA A., SABUNI C., BAIRD S.J.E., GOÜY DE BELLOCQ J.: Evolutionary history of *Pneumocystis* fungi in Tanzanian rodents

12.00-13.30: Buffet lunch

Chair: S. Belmain

13.30-14.15: *Keynote lecture*: MAKUNDI R.H., MASSAWE A.W.: Rodent population outbreaks and the risk of plague transmission in sub-Saharan Africa under the influence climate change

14.15-15.45: *Regular lectures*

MASSAWE A.W., MAKUNDI R.H.: An Africa Centre of Excellence for Innovative Rodent Pest Management and Biosensor Technology Development (ACE IRPM&BTD) in sub-Saharan Africa

CONSTANT N.L., SWANEPOEL L., SOARIMALALA V., GOODMAN S.M., TAYLOR P.J., BELMAIN S.: A comparative study of the characterisation, impacts and locally-adapted management strategies of rodent pests in rural Afro-Malagasy farming communities

MWANGENGWA L., BAKARI G., KANUYA N., MAX R.: Assessing antifertility effects of *Acacia nilotica* and *Albizia lebbeck* on *Mastomys natalensis*

VAN STEENBERGEN F.W.M., BOSMA W.L., ENGDAYEHU G., TILAHUN T., MEHERETU Y.: Bio-Based Rodent Control Product - shifting to ecological and biological rodent control

ZEWDNEH T., SIMON S., MEHERETU Y., LEIRS H.: Farmers´ perspectives of rodent damage and rodent management in southern Ethiopia are associated with socio-demographics factors

CORREA-CUADROS J.P., CORCORAN D., ESTAY S., BROWN P., LIMA M.: Complex dynamics of Australian mice: Weather and predators as factors of outbreaks

15.45-16.15: Afternoon tea break

Chair: A. Monadjem

16.15-18.00: *Regular lectures*

CHIKHI L., RODRIGUEZ W., GRUSEA S., SANTOS P., CORUJO J., ARREDONDO A., BOITARD S., MAZET O.: Demographic inference, genomic data and endangered species

MATAMBA E., RICHARDS L.R., CHERRY M.I., RAMBAU R.V.: Comparative genetic structure of the forest dwelling *Myosorex cafer* and the generalist *Rhabdomys dilectus* in the Eastern Cape of South Africa.

MIZEROVSKÁ D., MIKULA O., BARTÁKOVÁ V., MEHERETU Y., LAVRENCHENKO L.A., BRYJA J.: Evolution at altitudinal gradient: assessment of the role of genetic and ecological factors in speciation of Ethiopian rodents

BARTÁKOVÁ V., BRYJOVÁ A., BRYJA J.: Mitogenomic analyses of selection for high-altitude adaptation in Ethiopian endemic rats

NENGOVHELA A., SCOTT G., BRAGA J., DENYS C., TAYLOR P.J.: Brain size responses to high altitude living in North American (Cricetidae) and African (Muridae) rodents revealed by 3D morphometric analysis of micro-CT scanned images: preliminary results

BORATYŃSKI Z., BRITO J.C., CAMPOS J.C., MOUTINHO A.F., NOKELAINEN O., SCOTT-SAMUEL N.E., VALKONEN J.K.: Camouflage in Sahara-Sahel rodents

ABIATAR Y.L.N., EISEB S.J., DIRKS A.: Geometric morphometric variation of *Procavia capensis* (Hyracoidea, Procaviidae) occurring in Namibia

Wednesday, September 18, 2019

Mid-conference excursion

Thursday, September 19, 2019

Chair: P. Taylor

9.00-10.00: *Keynote lecture*: MONADJEM A.: The role of molecular biology and old fashioned taxonomy in resolving the identification of cryptic bats in Africa

10.00-10.30: Morning tea break

10.30-12.00: *Regular lectures*

WEBALA P.W., RYDELL J., MUSILA S., PATTERSON B.D.: Echolocation calls of high duty-cycle bats (Hipposideridae and Rhinonycteridae) from Kenya

FALZON M., LEIRS H., MNYONE L., SABUNI C., TEMU R.P.C., KIRKPATRICK L.: Quantifying bat activity and sonotype association with habitats along an urban to rural gradient

ATAGANA P.J., BAKWO F.E.M., KEKEUNOU S.: Diversity pattern of bats in four habitat types in the Dja Biosphere Reserve, south Cameroon

MANDE C., LAUDISOIT A., GEMBU G.-C., CANKENBERGHE V.V., VERHEYEN E.: Afrotropical bat's functional variability as a disturbance impact indicator

RAMANANTSALAMA R.V., ANDRIANARIMISA A., RASELIMANANA A.P., GOODMAN S.M.: Rates of hematophagous ectoparasite consumption during grooming by an endemic Madagascar fruit bat

AKAWA M., VERHEYEN E., MBALITINI G., CAKENBERGHE V.V., TUNGALUNA G.C.G.: The species and quantity of bats sold at the Maele island market (Kisangani, Tshopo province, DRC) and the associated health hazards as perceived by traders and customers

12.00-13.30: Buffet lunch

Chair: R. Makundi

13.30-14.30: *Keynote lecture*: DOBIGNY G.: Rodents and public health in urban areas: are there challenges specific to African cities?

14.30-15.30: *Regular lectures*

BADOU A.S., AGBANGLA C., DOBIGNY G., HIMA K., HOUÉMÉNOU G., BROUAT C.: International trade and rodents bioinvasion: a case study in Cotonou Port Seaport, Benin

DOSSOU D.K.H.J., TENTÉ A.B., HOUÉMÉNOU G., BADOU A.S., ETOUGBÉTCHÉ J., GAUTHIER P., DOBIGNY G., ROSSI J.P.: Characterization of urban landcape and small mammals communities in city of Cotonou

HIMA K., HOUÉMENOU G., BADOU S., GARBA M., DOSSOU J., ETCHOUGBTCHÉ J., FOSSATI O., GAGARÉ, DOBIGNY G., DALECKY A.: Native and invasive small mammals in urban habitats along the commercial axis connecting Benin and Niger, West Africa

SOARIMALALA V., GOODMAN S.M.: Rats in rural areas of eastern and central Madagascar: damage and control systems

15.30-16.00: Afternoon tea break

Chair: S. Goodman

16.00-17.45: *Regular lectures*

DENYS C., MISSOUP A.D., SYLLA M., KOUROUMA F., DOUNO M., KADJO B., JACQUET F., NICOLAS V., LALIS A., ANISKINE V., MONADJEM A.: Update on the rodent diversity and threats from Guinean and Liberian Mount Nimba (West Africa)

BOHOUSSOU K.H., AKPATOU K.B., KADJO B., NICOLAS V.: Terrestrial small mammal diversity and abundance in Taï National Park, Côte d'Ivoire

ADEMOLA OLAOLUWA J., MASSAWE A.W., MAKUNDI R.H.: Small mammal composition, abundance and diversity in Ukaguru Eastern Arc Mountains, Tanzania

SAANYA A., MAKUNDI R., MASSAWE A.: Small mammal species diversity in the Selous Game Reserve ecosystem, Tanzania

VAN DE PERRE F., WILLIG M., PRESLEY S., MUKINZI J.C.I., GAMBALEMOKE S.M., LEIRS H., VERHEYEN E.: Vertebrate diversity patterns in the Congo Basin rainforests

CRAIG E.W., KERBIS PETERHANS J.C., BRYJA J., MEHERETU Y.: The highly endemic small mammal diversity of Simien Mountains National Park, Ethiopia: New species and shifting ranges

MOHAMMED K., AFEWORK B., LAVRENCHENKO L.A.: Diversity and Distribution of Small Mammals of Chilalo-Galama Mountains Range, Southeastern Ethiopia

Friday, September 20, 2019

Chair: A. Ferguson

9.00-10.00: *Keynote lecture*: ŠUMBERA R.: Life and work of an Ethiopian endemic, the giant root-rat *Tachyoryctes macrocephalus*, one of the most peculiar rodents in the world

10.00-10.30: Morning tea break

10.30-12.00: *Regular lectures*

(45 mins) LEIRS H., MARIËN J., BORREMANS B., GUNTHER S., FICHET-CALVET E., SABUNI C.A., MASSAWE A.W., MAKUNDI R.H., and many collaborators: The dynamics of *Mastomys natalensis* and Morogoro arenavirus: a model system for transmission ecology

GRYSEELS S., VAN HOUTTE N., TĚŠÍKOVÁ J., ČÍŽKOVÁ D., MEHERETU Y., LAUDISOIT A., MAKUNDI R., TSEU R., NEVES L., BRYJA J., LEIRS H., GOÜY DE BELLOCQ J.: Diversity of African mammarenaviruses and evolutionary relationships with their rodent hosts at various phylogenetic levels

CUYPERS L.N., BAIRD S.J.E., KATAKWEBA A., LEIRS H., GOÜY DE BELLOCQ et al.: Uncovering a morphologically cryptic *Mastomys natalensis* hybrid zone that shapes arenavirus distribution

KIRKPATRICK L., MARIËN J., LEIRS H.: Disentangling social and spatial drivers of disease transmission in small rodents

12.00-13.30: Buffet lunch

Chair: R. Šumbera

13.30-14.30: *Keynote lecture*: FERGUSON A.: Collecting few to save many: The role of natural history museums in mammalian conservation

14.30-15.30: *Regular lectures*

NGATIA D.K., WEBALA P., BUTYNSKI T., DJONG Y., FERGUSON A.: Distribution of the Egyptian mongoose *Herpestes ichneumon* (Linnaeus, 1758) in Africa, with first records for Laikipia County, central Kenya

STREICHER J.P., RAMESH T., DOWNS C.T.: Effects of land-use on the spatio-temporal ecology of two mongoose species in KwaZulu-Natal, South Africa

MAHLABA T.A.M., MONADJEM A., MCCLEERY R., BELMAIN S.R.: Domestic and wild predators around rural homesteads

IMAKANDO C.I., FERNANDEZ-GRANDON M., BELMAIN S.R.: Diversity of small mammal pests and their predators in agro-ecological landscapes: Implications for rodent pest regulation

15.30-16.00: Afternoon tea break

Chair: V. Soarimalala

16.00-18.00: *Regular lectures*

PARREIRA B., CHIKHI L.: The genetic consequences of social structure

RAMANANKIRAHINA R.: A preliminary study on the activity, diet and exploitation of the forest by a critically endangered primates Mongoose Lemur (*Eulemur mongoz*) within the forestry of Antrema, Madagascar

PLEŠTILOVÁ L., OKROUHLÍK J., BURDA H., SEHADOVÁ H., VALESKY E.M., ŠUMBERA R.: Vascularization of the thermal window in the social African giant mole-rat *Fukomys mechowii*

KHASOHA L.M., GOHEEN J.R.: Does dietary generalism confer fitness advantages in small mammal communities?

MAYAMBA A., VANDEN BROECKE B., LEIRS H., BYAMUNGU R.M., NAKIYEMBA A., ISABIRYE M., KIFUMBA D.; MASSAWE A.W., KIMARO D.N., ISABIRYE B.E., MDANGI M.E., MULUNGU L.S.: Survival and maturation of Multimammate rat (*Mastomys natalensis*) in cultivated field and fallow land habitats in Mayuge district, Eastern Uganda

SADIC BABYESIZA W., MPAGI J.L., MGODE G., SSUUNA J.: Species composition and temporal fluctuations of rodents and shrews inhabiting a degradation gradient in Mabira Central Forest Reserve, Uganda

SSUUNA J., MAKUNDI R.H., MULUNGU L.S., MOSES I., SABUNI C.A., WASWA S.B.: Rodent species composition, relative abundance, and habitat association in Mabira central forest reserve, Uganda

WELEGERIMA K., HAILESELASSIE T.H., GEBRE B., KIDANE D., MASSAWE A.W., MBIJE N.E., MEHERETU Y., MAKUNDI R.H.: Relative abundance and microhabitat use of three rodent species in crop fields and bushland in Ethiopia

18.30-24.00
Conference banquet

Saturday, September 21, 2019

Departure of participants

List of registered posters

ASCHALEW A.K., KATKWEBA A.S., MAKUNDI R.H., MEHERETU Y.: Abundance and diversity of rodents and shrews along altitudinal gradients in Simien mountains national park, Ethiopia

BACHOREC E., HORÁČEK I., HULVA P., KONEČNÝ A., LUČAN R.K., JEDLIČKA P., SHOHDI W.M., ŘEŘUCHA Š., ABI-SAID M., BARTONIČKA T.: Relatedness and roost sharing in a colony of Egyptian fruit bats

BENDA P., KASSO M., NICOLAS V., PLEURDEAU D., STOETZEL E., BEKELE W., BEKELE A., DENYS C.: New data on bats from Dire Dawa region, eastern Ethiopia, with the first record of *Rhinopoma microphyllum* in the country

DU PLESSIS J.J., AVENANT N.L.: Adding ecological significance to the National Museum Mammal Collection by collating the information of small mammal records

DUDU A., GAMBALEMOKE MB., MUSABA A., BAELO, MUKIRANIA, LEIRS H., VERHEYEN E.: The diversity of small mammals (rodents and shrews) in the Yangambi Biosphere Reserve (D.R. Congo)

GAMBALEMOKE M.S., MUKINZI I.J.-C., KATUALA G.-B.P., DUDU A.M.B., LEIRS H., HULSEMANS J., HUTTERER R., VERHEYEN E.: Diversity of shrews (Soricomorpha, Soricidae) in the Congo basin near Kisangani (Democratic Republic of the Congo)

GEMBU T., MUSABA A., MALEKANI B., NGOY S., GAMBALEMOKE MB., NEBESSE M., VERHEYEN E., DUDU A.: Sampling distribution of bats (Chiroptera, Mammalia) in Protected Areas in the hinterland of the Kisangani region, DR Congo

GOÜY DE BELLOCQ J., LAVRENCHENKO L.A.: A new arenavirus in *Mastomys natalensis* mitochondrial matrilineage A-III in Ethiopia

KAISALA L., GEMBU T., KATUALA G.B., NEBESSE M., BAELO, MUSABA A., MALEKANI B., GAMBALEMOKE MB., VERHEYEN E., DUDU A.: Qualitative and quantitative distribution of small mammals (rodents and soricomorphs) in habitats in the hinterland of the city of Aketi (Bas Uélé, D R. Congo)

KIRKPATRICK L., HERRARA OLIVARES I., BERKVENS R., LEIRS H.: ProxLogs: Miniaturised proximity loggers for understanding movement and behaviour

KOMAROVA V.A., KOSTIN D.S., ŠUMBERA R., MEHERETU Y., BRYJA J., LAVRENCHENKO L.A.: Evolutionary patterns and speciation along steep altitudinal gradient: a case study of Ethiopian speckled brush furred mice *Lophuromys flavopunctatus* s. l.

KONEČNÝ A., DIANAT M., NICOLAS V., BUREŠ M., BRYJA J.: Molecular techniques reveal cryptic diversity of African *Crocidura hirta-flavescens* species complex (Eulipotyphla: Soricidae)

MARTYNOV A.A., BRYJA J., MEHERETU Y., LAVRENCHENKO L.A.: Diversity and distribution of multimammate rats of the genus *Mastomys* in Ethiopia

MUKINZI I.J.C., GAMBALEMOKE M.S., KOMBA Y., AKUBOY D., ARAMA O., ATEMBONE L., DUDU A.,VERHEYEN E., LEIRS H.: Diversity of shrews and rodents of disturbed areas in Yoko Forest Reserve and its vicinity: recolonization capacity in a slashed and burned area (Kisangani, DRC).

NEBESSE M., GEMBU T., GAMBALEMOKE MB., VERHEYEN E., DUDU A.: Small mammal wild game in the periphery of the Rubi-Tele Hunting Estate (Bas-Uélé, DRC)

NOROALINTSEHENO LALARIVONIAINA O.S., RAJEMISON F.I., RAMANANTSALAMA R.V., ANDRIANARIMISA A., GOODMAN S.M.: Population size and survival of the Malagasy fruit bat *Rousettus madagascariensis* (Pteropodidae) in Ankarana, northern Madagascar

PASCAL B., GUY-CRISPIN G., VERHEYEN E., LAUDISOIT A., DRAZO A., DUDU A.: Diversity and Ecology of tree Sciuridae (Rodentia, Mammalia) in the Yoko Forest Reserve (Ubundu, DR Congo)

VAN DE PERRE F., CIGAR J., HEUGHEBAERT A., LEIRS H., VERHEYEN E.: African Rodentia becomes African Mammalia

VAN STEENBERGEN F.W.M., BOSMA W.L., ENGDAYEHU G., TILAHUN T., MEHERETU Y.: Bio-Based Rodent Control Product - Shifting to ecological and biological rodent control

VANDEN BROECKE B., MARIËN J., SABUNI C.A., MNYONE L., MASSAWE A.W., MATTHYSEN E., LEIRS H.: Relationship between population density and viral infection: a role for personality?

VEJMĚLKA F., OKROUHLÍK J., LÖVY M., BENNETT N.C., ŠUMBERA R.: Body surface temperature in subterranean rodents. Is social organisation of a species relevant to the pattern and distribution of thermal windows?

VOLOLONA J., RAMAVOVOLOLONA P., GOODMAN S.M.: Diet of *Rousettus madagascariensis* in northern Madagascar

ZEMLEMEROVA E.D., KOSTIN D.S., LAVRENCHENKO L.A.: Genetic diversity of the naked mole-rat (*Heterocephalus glaber*)

Abstracts of oral and poster presentations

(in alphabetical order of first authors´ names)

Geometric morphometric variation of *Procavia capensis* (Hyracoidea, Procaviidae) occurring in Namibia

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Morphological variations can occur within the same population or different populations of the same species found in different geographic areas. The aim of this study was to determine geometric morphometric variation in *Procavia capensis* (Hyracoidea, Procaviidae) from Namibia. Skull specimens of *Procavia capensis*, from different locations in Namibia, were sourced from the Mammal Collection at the National Museum of Namibia and tested for morphometric variation from age effects and sexual dimorphism. A total of 135 skull specimens were collected. *Procavia capensis* skull specimens were divided into sex (males or females) and age categories (based on the degree of tooth wear). Skull images (dorsal and ventral) were taken using a Sony Cyber-Shot (DSC-H5) digital camera. Twenty anatomical landmarks (dorsal-8; ventral-12) were selected to compare the variation in skull shape between the sexes and age classes. A Thin-plate spline relative warps analysis (equivalent to a Principal Component Analysis) of landmark data of OTUs for each of the two views (dorsal & ventral) was computed. Partial weight matrix data (W) for dorsal and ventral views were further subjected to a Discriminant Analysis to test for significant differences in the shape of the skulls within the population. The results of this study indicate presence of sexual dimorphism between adult males and adult females within a single population (males larger than females). It was recorded in previous studies that Procavia males are territorial and competes for females. This implies that sexual selection may act via male-male combats or/and female choice and thus favour bigger male body size. Juveniles differ from adults in size and shape because of differences in growth patterns between these groups. No analysis was done for geographic variation due to sample size limitations. Therefore more sampling is needed from rest of Namibia and southern Africa to compare for variation due to various environmental conditions.

(ORAL PRESENTATION)

Small mammal composition, abundance and diversity in Ukaguru Eastern Arc Mountains, Tanzania

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Conservation of any landscape requires knowledge of the available resources in the area. Ukaguru Eastern Arc Mountains, Tanzania, have received considerable attention in terms of research on plants, amphibians, reptiles and birds. Scarce information exists on the small mammals of these mountains. This study is aimed at providing information on composition, abundance and diversity of the small mammals of this landscape. Habitats sampled include intact and disturbed forests, farmlands, fallow lands and peridomestic areas. Capture-mark-recapture and removal trapping techniques were employed for 3 nights per month. Fourteen species were recorded over a 12-month sampling period at altitudes ranging from 1500 to 1818 m above sea level. These are *Praomys* sp, *Beamys* sp, *Lophuromys* sp, *Grammomys* sp, *Graphiurus* sp, *Mastomys natalensis*, *Mus* spp, *Lemniscomys* sp, *Acomys* sp, *Arvicanthis neumanni*, *Crocidura* sp, *Rattus rattus* and *Xerus* sp. *Crocidura* sp was recorded in all habitats; *Mastomys natalensis* and *Mus* spp in disturbed and farm habitats. *Lophuromys* sp. and *Graphiurus* sp. were present in intact forests but not in disturbed forests. *Praomys* sp. accounted for 92% and 80% of all captures in disturbed and intact forests, respectively. *Mus* spp were dominant in cultivations (54%). The species diversities from both intact forest and cultivations were significantly higher than in disturbed forest ($p < 0.05$). The study suggests that human disturbance is a factor responsible for the observed diversity of small mammals in Ukaguru Mountains.

(ORAL PRESENTATION)

The species and quantity of bats sold at the Maele island market (Kisangani, Tshopo province, DRC) and the associated health hazards as perceived by traders and customers

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In order to identify and quantify the bats exploited as game in Kisangani, to inquire about the level of perception of the health hazard incurred as a result of this exploitation, investigations were carried out at the Maele market from January to December 2013 by direct observation of carcasses, counting and surveys within different social and occupational

groups. The observations revealed 5 species of fruit-eating bats: *Eidolon helvum* (Kerr, 1792), *Hypsignathus monstrosus* H. Allen 1861, *Epomops franqueti* (Tomes, 1860), *Rousettus aegyptiacus* (E. Geoffroy, 1810), *Myonycteris torquata* (Dobson, 1878). Of a total of 3266 carcasses surveyed during the entire period of our study, 92.8% belong to the *E. helvum* and 4.5% to *H. monstrosus*. And an annual income of $ 3180 USD for a body biomass of 607.3 kg. Surveys of social and professional groups revealed that bats are marketed and consumed throughout the year in Kisangani. As for health threats via bats for humans, 46.7% of respondents do not know about them; 16.7% talked about the transmission of the Ebola virus; 12.8% report the risks associated with bites; 9.4% recognize that they can give diseases (without mentioning them by name) to humans.

(ORAL PRESENTATION)

Abundance and diversity of rodents and shrews along altitudinal gradients in Simien mountains national park, Ethiopia

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Abundance, species diversity and distribution of rodents and shrews along altitudinal gradients in Simien mountains national park were studied by using Sherman live traps. Four altitudinal ranges (2800m a.s.l., 3200m a.s.l., 3600m a.s.l. and 4000m a.sl.) in the park and 3100m a.s.l. around human settlements and farmlands were sampled for this study. A total of 68 individuals were captured. Out of these, 59 individuals were rodents and nine individuals were shrews. In total there were eight species of rodents and one shrew species. The relative abundances were *L. simensis* (33.8%), *S. albipes* (22.1%) and *O. typus* (14.7%). *Dryomys nitedula* and *Desmomys harringtoni* had the lowest abundance across the study area (1.47%). The highest species diversity across altitudinal gradients was recorded at 3100m a.s.l. (H'=1.49) around human settlements on the periphery of the park and at 2800m a.l.s. (H'=1.338) inside the national park. The highest species diversity across habitat types was recorded in the forest habitat (H'=1.754). The diversity, abundance and distribution of rodents and shrews varied along altitudinal gradient and habitat types. This study reports for the first time the rodent and shrew diversity and distribution along elevational gradients and habitat types in in the Siemens Mountains in Ethiopia.

(POSTER)

Diversity pattern of bats in four habitat types in the Dja Biosphere Reserve, south Cameroon

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Here we present an assessment of the diversity of Cameroonian bats at four contrasting habitat type (primary forest, secondary forest, plantations and human habitation) in the Dja Biosphere Reserve between June 2018 and March 2019. Using 10 mist nets in each habitat type every night, two hundred and twenty eight individual bats for four families, sixteen genera and twenty species were recorded. *Epomops franqueti* was the most common specie in primary forest (n= 19) and plantation (n= 16) meanwhile *Megaloglossus woermanni* was the most common specie in secondary forest (n= 20) and human habitation (n= 44). The netting effort was equal in the four habitat types. The was more abundance in human habitation followed by plantations, primary forest and secondary forest with 114, 69, 51 et 48 individuals caught respectively. Our results shows that this abundance in betwen the four habitat types does not imply a significant statistical difference (ANOVA = 1,664 ; P= 0,192). Specie richness is higher in primary forest and plantation with 13 species in each habitat. Meanwhile, secondary forest and human habitation zones have eight and nine species respectively. The is no significant statistical difference in this four habitat types species richness (ANOVA = 1,207 ; P= 0,321). However, ANOSIM similarity test show no similarity betwen the four habitat types and consequently forest disturbance in this study site negatively affects bats diversity. Forests managers should thus consider the sensitivity forest fragmentation before authorising the implementation of anthropological activities.

(ORAL PRESENTATION)

Changes in small mammal community structure following open-cast mining in central South Africa: an indicator of ecosystem integrity?

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In southern Africa small mammals (mice, shrews and sengis) are often included in environmental impact assessments, with proving the presence/absence of Red listed species a main objective. Recent studies in southern Africa's Grassland Biome have however suggested the potential use of a number of small mammal variables that, collectively, may be useful as

indicators of ecosystem integrity. In general, small mammal species richness and diversity decline with habitat degradation, generalist species dominates community numbers at low ecological integrity, the number of specialist species increases towards ecological climax, and specific species act as indicators during the successional process. This contribution discusses the complex relationship between small rodents, vegetation, rainfall and dust on an open-cast iron ore mine in the Nama-Karoo Biome. A total of 43 rodent and vegetation transects on the mine and surrounding farms were stratified to be at various distances, as well as along a potential impact gradient radiating from the core mining activities. Transects were sampled annually at the end of the main rodent breeding season over a seven year period. Clear changes were observed in the small rodent communities closer to the mine activities, with significant changes evident within the first year or two after mining commenced. These changes included a decrease in species richness and diversity, a disappearance of specialist species, and an increase in generalist species. Similar changes were less apparent on transects further away from the mining activities. On the furthest, least influenced transects, none of these patters were observed. Our rodent data therefore confirms the hypothesis set following similar studies in the Grassland Biome, demonstrating the potential value of small rodents as ecological indicators also in the Nama-Karoo. For the vegetation the situation was more complex, indicating that plants react differently to the same drivers.

(ORAL PRESENTATION)

International trade and rodents bioinvasion: a case study in Cotonou Port Seaport, Benin

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Trade intensification leads to an increase of biological invasion risk throughout the world. In particular, maritime traffic plays a key role in the worldwide spread of anthropophilic rodents by allowing the import/export of rats and mice at seaports. The Autonomous Port of Cotonou mainly trades with Europe, America and Asia (around 15,000 ships between 2006 and 2016). It is the main contributor to the Benin economy and provides 80-85% of customs incomes as well as about 15% of the GDP. Cotonou harbour is also the closest and safest outlet to serve landlocked countries such as Mali, Burkina Faso, Niger and Chad, which heavily depend on it for both importation and exportion.

In such a context, a close partnership with the Cotonou Seaport authorities was settled in order to monitor rodent communities and associated ectoparasites and pathogens for a better

assessment and management of the problems they may cause (i.e. damages, import and export of zoonotic agents) reach 9.2% of the stored rice.

Besides, we have been conducting longitudinal trapping campaigns since 2015 to characterize the diversity and spatio-temporal dynamics of small mammal communities within the seaport. Our results indicate a spatial species segregation at a very fine scale that is stable over the years.

Furthermore, we have conducted a population genetics study with 18 microsatellite loci of 457 black rats trapped in 40 neighbourhoods of Cotonou City, including the port. The presence of four exclusive alleles in the seaport as well as a few others shared only by the seaport and three neighbouring sites confirms the role of Cotonou Harbour as a major point of involuntary introduction of invasive rats in Benin.

Finally, the serological and molecular screening (qPCR, 16S metabarecoding) of hundreds of small mammals trapped during more than two years within the port demonstrates the circulation of several zoonotic pathogens, some of which some are clearly allochtonous (e.g. Seoul hantavirus).

(ORAL PRESENTATION)

Relatedness and roost sharing in a colony of Egyptian fruit bats

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Roosting habits of bats are influenced by roost diversity and abundance, predation risk, food distribution and abundance, season, as well as by social organization of the species and energy economy. Social roosting and movement between multiple roosts are common traits in many bat species, which encourages information transfer and can generate communal knowledge about roosting or foraging sites. Bats moving among several roosts usually form subgroups which belong to larger stable network. However, there is little knowledge about the potential role of genetic relatedness in roosting associations of bats. In this study we investigated roosting habits of the Egyptian fruit bats (*Rousettus aegyptiacus*) in Dakhla oasis, Egypt. Combination of spatial and genetic data with network analysis allowed us to explore roosting network structure and the possible link between relatedness and roost sharing. Because grouping with kin is reducing numerous costs and having more relatives as roost mates can result in easier access to

information about both roosting and foraging sites, our main goal was to test whether genetic relatedness is a predictor of roost sharing. Our results showed that pairwise roosting associations in Egyptian fruit bats are not dependent on relatedness neither in winter when food was relatively abundant nor spring when food was scarce. Such roosting strategy indicate that fruit bats living in agricultural area with limited roosting sites may benefit from non-kin associations and public information about roosts and foraging sites.

(POSTER)

Mitogenomic analyses of selection for high-altitude adaptation in Ethiopian endemic rats

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Organisms living at high altitude must adapt to environmental conditions with hypoxia and low temperature. Such extreme environment might require changes in the structure and function of proteins, especially those encoded by the mitochondrial genes due to their association with oxidative phosphorylation (OXPHOS) of ADP to ATP. The Ethiopian highlands with the Great Rift Valley and the astonishingly steep elevational gradients (ca 900-4500 m a.s.l) represent the unique mosaic of ecological conditions and provide great opportunity for studies of microevolutionary processes. We analysed the selection potentially working on the mitochondrial OXPHOS genes in murid rodents of the endemic Ethiopian genus *Stenocephalemys*; there are often two to three species present at different elevations of the same mountain range and we asked whether their distribution is associated with functional variability of their mitochondrial genes. We obtained the entire mitogenomes from all six presumable species of the genus and we looked for the signatures of positive selection in sequence data by using dN/dS approach. Phylogenetic analysis of 28 complete mitogenomes (including *Myomyscus* sp. as an outgroup) revealed a well-structured tree with identical topologies in both maximum-likelihood and Bayesian analyses. We verified previously inferred relationships based on cytochrome b, suggesting that the observed cases on mitonuclear inconsistencies are caused by mitochondrial introgression rather than by convergent evolution of cytochrome b. The robust mitochondrial phylogeny guided the analyses of selection.

(ORAL PRESENTATION)

Results and lessons from 20 years of Ecologically Based Rodent Management research in Africa

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The paradigm of ecologically-based rodent management (EBRM) is more than 20 years old, although some experts will certainly argue that rodent researchers were following the principles of EBRM well-before the term was first mentioned in at a rodent workshop in 1996 at the Pest Management Centre, Sokoine University of Agriculture, Tanzania. Particularly after the publication of the book Ecologically-Based Rodent Management in 1998, EBRM became a global term through its adoption by many research teams, most notably in southeast Asia and sub-Saharan Africa. Rodent research in Africa has particularly benefitted from historical ties and bilateral research funds from many European countries, most notably Belgium, France and the UK, besides many others. However, the networking of rodent experts from different African countries, working together, has largely relied European Union funding, which has enabled almost continuous collaboration among some African nations for nearly 20 years. The challenges and opportunities of carrying out empirical applied research on EBRM through these international networks will be summarized, highlighting the successes and failures. In this context, potential future directions of EBRM research in Africa will be discussed.

(KEYNOTE LECTURE)

New data on bats from Dire Dawa region, eastern Ethiopia, with the first record of *Rhinopoma microphyllum* in the country

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A small collection of bats collected in Dire Dawa area, eastern Ethiopia, in November 2017, is presented. The recorded species belong to six species and four families, they represent three various faunas concerning their biogeographic affinities (Afro-tropical, Saharo-Sindian, and Palaearctic/Afro-tropical). Besides three species previously known in the region, *Rousettus aegyptiacus*, *Epomophorus minimus* and *Charephon pumilus*, three bats were newly documented from the area, *Rhinopoma microphyllum*, *R. cystops* and *Scotophilus leucogaster*. *R. microphyllum* is here reported from Ethiopia for the first time. Molecular genetic comparison indicated Ethiopian *R. cystops* to belong to the Arabian lineage, representing a separate

subspecies, *R. c. arabium*, until now unknown from the African continent. The easternmost extent of the Ahmar Mountains, including the Dire Dawa area, is a region of mixing of the faunas of the Afro-tropical savannah bats with the Saharo-Sindian dry scrubland bats. Rather surprisingly, the Saharo-Sindian fauna of the area shows certain affinity also to the Arabian region.

(POSTER)

Terrestrial small mammal diversity and abundance in Taï National Park, Côte d'Ivoire

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Terrestrial small mammal species survey was carried out in Taï National Park using Sherman's live traps and pitfall traps from March to June 2010. The aim of the study was to determine the diversity and distribution of rodents and shrews in three different habitats: primary, secondary and swamp forests. During the study period, 263 terrestrial small mammals belonging to 17 species (six Soricidae species and eleven Muridae species) were captured out of 8,610 trap-nights. For rodents, the most frequent species were *Malacomys edwardsi* (n = 76) followed by *Hylomyscus simus* (n = 53), *Praomys rostratus* (n = 51) and *Hybomys planifrons* (n = 27). For shrews, the most frequent species were *Crocidura buettikoferi* (n = 12) followed by *Crocidura eburnea* (n = 7). The species richness (S) and diversity index (H') were higher in the secondary forest (S = 15; H' = 2.12) than the ones of the primary forest (S = 10; H' = 1.79) and swamp forest (S = 8, H' = 1.74) respectively. In the primary forest, the population of terrestrial small mammals was dominated by four species: *Malacomys edwardsi* (n = 32), *Praomys rostratus* (n = 21), *Hylomyscus simus* (n = 15) and *Hybomys planifrons* (n = 13). In the secondary forest, *Hylomyscus simus* (n = 29), *Malacomys edwardsi* (n = 23) and *Praomys rostratus* (n = 18) were the most abundant. In swamp forest, the most abundant species were: *Malacomys edwardsi* (n = 21), *Praomys rostratus* (n = 12) and *Hybomys planifrons* (n = 11). Of the listed species, two species worthy for conservation, *C. buettikoferi* (NT) and *G. buntingi* (DD) and ten were endemic to the Upper Guinea forests. These results confirm once again the important animal diversity of the Taï National Park, which harbors numerous species endemic to the Upper Guinea forests.

(ORAL PRESENTATION)

Camouflage in Sahara-Sahel rodents

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Deserts are open environments, providing an opportunity to study the evolution of anti-predatory strategies, like camouflage. In the face of fast climatic changes on arid regions animals risk being maladapted in the admixture of their constantly shifting habitats. Phenotype-habitat color match, a classic example of camouflage, offers the opportunity to study the interplay between historical and ecological factors shaping species adaptation. We investigated dorsal fur and habitat coloration in several arid adapted rodent species in North-West Africa (*Gerbillus*, *Jaculus*, *Meriones*, *Pachyuromys* and *Psammomys*). Analyses of calibrated digital and satellite images of animals and their habitats showed that animal-habitat color match is common among Sahara-Sahel rodents. Two often sympatric and phenotypically similar *Jaculus* species showed significant fur-habitat covariation and fur color polymorphism consistently with the genetic divergence. Phenotype-habitat color match among fourteen *Gerbillus* species persisted after accounting for phylogenetic signal, but the camouflage adaptation was acquired/lost multiple times during their diversification. Fur color and pattern of several rodent species accurately matches their habitats at different spatial scales. The persistent match across large spatial scale suggests the prevalence of a generalist strategy, but some species also improved their match to specific habitats. Camouflage accuracy in Sahara-Sahel rodents is a remarkably fine-tuned example of adaptation against both mammalian and bird predators, as suggested by modeling of animals' vision. Predation seems to drive phenotype-environment convergence and a generalist camouflage strategy that, on average, gives the best survival advantage by accurately resembling rich and variable desert environments. Such generalist strategy can promote species survival over past and ongoing fast climatic shifts.

(ORAL PRESENTATION)

Phylogenomics resolves relationships among genera in murid tribes Arvicanthini and Praomyini, representing two major rodent radiations in sub-Saharan Africa

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The tribe Arvicanthini has 18 currently recognized African genera and one Asiatic genus and together with the tribe Praomyini (8 African genera) they represent the most successful groups of African murid rodents. They colonized whole sub-Saharan Africa (with isolated populations even in northern Africa), where they live in very wide spectrum of habitats from lowland humid forests through savannas to semi-deserts and they often represent the most abundant members of small mammal assemblages. African diversification was supposed to start in Late Miocene (TMRCAs of these tribes has been estimated between 12-7 Ma, depending on used markers and calibration points for molecular clock) and the earliest records of modern genera are from the very end of Miocene. Despite intensive efforts and employment of mitochondrial and nuclear markers, the phylogenetic relationships among many lineages (= genera) within these two tribes have remained obscured. In previous studies, many basal nodes on the phylogenetic tree were unresolved or changed their topology according to used markers, which was likely caused by intensive Late Miocene/Early Pliocene radiations of the groups. Furthermore, no previous multilocus analysis contained the representatives of all extant genera. In this study we used the phylogenomic scale data (377 loci, 581 030 bp) to produce the dated species tree for all currently delimited genera of these two tribes. The analysis revealed fully resolved phylogeny, based on which we propose scenarios of historical biogeography and evolution of ancestral traits. The results suggest that both African radiations started early after the colonization of Africa by arvicanthine and praomyine ancestors from Asia during Messinian period, ca. 7 Ma, and was likely linked with fragmentation of pan-African Miocene forest. Some lineages stayed in the forest, but others successfully colonized wide spectrum of more or less open habitats (e.g. savannas or wetlands). We also discuss delimitation of genera in the two tribes (e.g. *Grammomys*, *Praomys*, *Myomyscus* and *Mastomys* are polyphyletic) and propose few taxonomic changes reflecting the results of phylogenomic analysis.

(ORAL PRESENTATION)

Annotated checklist, taxonomy and distribution of rodents in Ethiopia

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We provide an annotated checklist of rodents of Ethiopia. For each species we show a distributional map based on critically revised data from: (1) the literature; (2) museum collections including those records in the Global Biodiversity Information Facility (GBIF); and (3) recent field surveys performed in the last three decades within the Joint Ethio-Russian Biological Expedition (JERBE) and Ethio-Czech Research Projects. The recent material was in most cases analysed in detail by genetic and/or morphometric approaches. In total, the Ethiopian rodent fauna consists of 104 species (40 genera, 10 families). Compared to previous studies we were not able to confirm the presence of 12 species, mostly due to the lack of data from arid lowland areas, however, some of these may be extinct. On the other hand, we report the occurrence of > 40 species that had not been included in the previous checklist published in 1996 (with many of them still requiring formal description). Out of the total number of species, most are Ethiopian endemics (44 species = 42.3%), followed by those living in Somali-Masai (27) and Sudanian (12) savannas. The checklist clearly confirms the disproportionately high value of Ethiopian biodiversity and should serve as a basis for its conservation.

(ORAL PRESENTATION)

Demographic inference, genomic data and endangered species

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Genomic data are becoming increasingly available for endangered species. These data are used to reconstruct the recent history of these species in relation to ancient habitat change. Many of the methods use to infer the demographic history of species assume a panmictic population and they quantify and date population size changes in the history of species. This is for instance the case of the PSMC method of Li and Durbin (2011) whhc only requires the genome of a single diploid individual. At the same time an increasing number of studies have

shown that population structure may generate spurious signals of population size change. In a recent study we introduced a time-and sample-dependent parameter which we called the IICR (inverse instantaneous coalescence rate, Mazet et al (2016)). We have also shown that the PSMC actually estimates the IICR, thus our theoretical framework can be used to interpret PSMC curves in a new way. In this talk we will show how PSMC plots obtained for different species, including small African mammals, can be interpreted in a framework of population structure.

(ORAL PRESENTATION)

A comparative study of the characterisation, impacts and locally-adapted management strategies of rodent pests in rural Afro-Malagasy farming communities

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Rodents generate multiple negative impacts for smallholder farmers in Africa including food security, livestock, and public health. Ecologically Based Rodent Management (EBRM) is an approach that aims to provide sustainable solutions for the mitigation of rodent damage through assessments of rodent population dynamics, agro-ecosystems and socio-cultural contexts. However, consideration of the social and cultural systems of different countries are also important as they influence the ways farmers perceive and conduct rodent management. We adopt a comparative case study approach across South Africa, Tanzania, and Madagascar to characterise the impacts of rodent pests on smallholder farming communities, and local knowledge and beliefs associated with current and future rodent management interventions using focus groups, questionnaires and interviews. Crop damage estimates caused by rodents were high and varied according to the cropping system, harvesting stage and the growth stage of crops. Across the case studies, the application of chemical rodenticides was perceived as reducing the severity of observed rodent damage, and farmers favoured the application of acute poisons and anticoagulants across smallholder farming communities. A lack of support for the implementation of biological control methods in agro-ecosystems was justified by negative cultural perceptions associated with avian and reptilian predators. Local perceptions and behaviours associated with lethal and non-lethal control measures pose a challenge for EBRM. The study points towards a need to adopt a multifaceted and collaborative approach with smallholder farmers, where education initiatives are designed according to the sensitivities of

the socio-cultural context of the farming community, to enhance knowledge and tolerance of biologically sustainable methods for rodent management.

(ORAL PRESENTATION)

Complex dynamics of Australian mice: Weather and predators as factors of outbreaks

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Plague populations usually are kept at low densities, but suddenly they can generate outbreaks that cause economic damages in crops. We analyzed the outbreaks of Australian mice to have irregular dynamics, their economic impact on wheat crops, and the absence of a causal explanatory mechanism. To find the outbreaks factors, we proposed an initial group of hypotheses associated with drastic environmental changes, and a second group that raises the existence of escape thresholds from predators related to the principle of co-operation. To modeling, the population dynamics, we used a time series data from Walpeup, Roseworthy and Darling Downs, with two mathematical models' approach. The first model is a logistic growth including exogenous factors, and the second model is a predator-prey with functional response type III. As a result, the best model of weather approach showed that precipitation and evaporation improve the soil conditions to increase the enemy-free space for mice in the three production sites, explained and predicted more of 45% of mice outbreak. We are evidenced that the weather factors are a driver in the process of outbreaks. On the other hand, the escape threshold approach showed that mammals and birds act like a key factor in the mice dynamics working together with the precipitation and evaporation factors in sites from Victoria, in contrast to Queensland site. This behavior allows the escape from predator regulation, when the weather factors improve the soil conditions to make the burrows and decrease the predator's attack rate, predicting in 90% the outbreaks. According to results, we conclude that mice dynamics are complex and influenced mainly by weather factors along escape from predators, which leads to the dynamics transcend from a low to high-density state quickly. Furthermore, the mechanisms that generate the outbreaks in Australia could be identified, explained and predicted to establish future management measures to reduce their economic impact on wheat crops.

(ORAL PRESENTATION)

The highly endemic small mammal diversity of Simien Mountains National Park, Ethiopia: New species and shifting ranges

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Little is known about the distribution and ecology of small mammals inhabiting Simien Mountains National Park in Ethiopia despite its high proportion of unique and endemic species. In 2015, we conducted an elevational survey to assess the park's small mammal diversity for the first time in nearly a century. All 13 species documented during the survey are endemic to the Ethiopian Plateau, including one potentially new shrew species discovery. To assess the influence of climate change on these small mammal communities we compared our distribution data to those collected by "Chicago Daily News Abyssinian Expedition" led by W.H. Osgood in 1927. Our comparison revealed upward elevational range shifts in four out of the nine species documented by both surveys. We present the first comprehensive reassessment of small mammals in Simien Mountains National Park.

(ORAL PRESENTATION)

Uncovering a morphologically cryptic *Mastomys natalensis* hybrid zone that shapes arenavirus distribution

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Mastomys natalensis, the Natal Multimammate mouse, is one of the most widespread mouse species in Sub-Saharan Africa. There are six distinct mitochondrial lineages occurring in different geographical regions. Gryseels et al. (2017) used 15 microsatellite markers in a line transect and found that two mitochondrial lineages meeting in eastern Tanzania correspond to taxa that are distinct genome-wide. Moreover, each taxon appeared to carry its own arenavirus species.

We developed 88 SNPs to distinguish between the two taxa and typed 650 individuals from a larger geographical region to characterize the contact zone. Next, we screened 960 individuals for arenaviruses to further assess if indeed each taxon carries its own arenavirus species.

The SNP data revealed that the contact zone is a 19 km wide hybrid zone, which can be crossed by some SNP alleles. Other SNPs alleles do not cross the hybrid zone, have a strong deficit of heterozygotes and are strongly correlated, indicating potential barrier regions in the genome. Over all SNP markers, the change in alleles over the hybrid zone is asymmetric. This indicates preferential introgression of genes of one taxon into the other, or movement of the hybrid zone. The *Mastomys natalensis* hybrid zone also appears able to shape the distribution of pathogens it carries: on one side of the hybrid zone only Morogoro mammarenavirus occurs, on the other side only Gairo mammarenavirus, while both have been detected in the hybrid zone.

(ORAL PRESENTATION)

ObsMiCE: a monitoring system to assess long-term changes in biodiversity of small mammals and associated parasites in a broad range of West African ecosystems

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Global changes affect biological diversity, with major consequences on socio-ecological processes Africa is considered as particularly exposed and vulnerable to such changes. In Western Africa, severe drought episodes have occurred since the end of the 1960s, even though the Central Sahel has recorded wetter years from the end of the 1990s. At the same time, West Africa undergoes major changes of land use practices, for instance the extension of irrigated perimeters, as an attempt to mitigate drought effects on food security. Urbanization has also been dramatically increasing in Sub-Saharan Africa where more than 80 urban centres are predicted to reach one million inhabitants by 2025. Following such transformations, good and people exchanges have been increasing in an unprecedented way, thus deeply modifying connectivity patterns.

In many instances, small mammals, particularly rodents, are valuable indicators of these contrasted changes, which may i) deeply impact their distribution ranges, ii) drive abundance changes including outbreaks, and iii) favor biological invasions. ObsMiCE, the West African Observatory on small Mammals as indicators of Environmental Changes, implements long-term environmental monitoring that has been initiated during the 1970s to 2000s according to the sites studied. ObMiCE objectives are i) to document long-term changes in biodiversity of small

mammals and their associated parasites/pathogens in connection to local and global socio-ecological drivers, including climate variability, land use change, urbanization, increasing exchange networks and associated expansion of invasive species; ii) to secure long-term stewardship and repository of database; iii) to move forward an universal and equitable access to data. We will present some examples of the ObsMiCE monitoring activities and results in a broad range of ecosystems: harbors and cities, pastures and cultivated fields as well as natural reserves.

(ORAL PRESENTATION)

Update on the rodent diversity and threats from Guinean and Liberian Mount Nimba (West Africa)

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Situated in the triple frontier zone between Liberia, Ivory Coast and Guinea, Mount Nimba provides strong isolation due to climatic and vegetation changes along an altitudinal gradient. Mount Nimba, (1752 m a.s. l.), is one of the three tallest mountains in West Africa. Mount Nimba harbours several endemic taxa of vertebrates and has been registered as a World Heritage Site by UNESCO. Nevertheless, this ecosystem is highly threatened by intensive human activities. We present here the results of two field surveys in the Guinean side and two in the Liberian side of Mount Nimba conducted between 2008 and 2013. Based on these surveys, a total of 18 rodent species were collected on the Guinean side and 13 species on the Liberian side.Observations of large and arboreal rodents were also recorded. Species were identified by an integrative approach that combined morphology, morphometrics, cytogenetics and molecular barcoding. On the Guinean side, the highest species richness was observed in savannas at 1200 m a.s.l. (10 species), followed by lowland and montane forests below 1200 m a.s.l. (9 species). A few species were restricted to lowland forest whereas other species were recorded in multiple vegetation types up to 1600m a.s.l. We recorded the presence of two synanthropic species of Mastomys in both natural savannas and anthropogenic environments. In Liberia, *Rattus rattus* was also collected in a peri-urban environment. We failed to establish the presence of several

taxa that were recorded in previous surveys in the 1960's and 1970's, but we have added at least five new taxa which brings the rodent diversity of Mount Nimba to a total of 44 rodents.

(ORAL PRESENTATION)

Diversity and genome-level molecular phylogeny of African giant shrews (*Crocidura olivieri* species complex)

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The African giant white-toothed shrews, *Crocidura olivieri* species complex (Eulipotyphla, Soricidae), are one of the most common and abundant insectivorous small terrestrial mammals in sub-Saharan Africa. They inhabit a wide range of habitats (including forests, grasslands, as well as villages and cities) and their size reaches 24 cm of length (including tail) and 65 g of weight, being thus predisposed to play an important ecological role in ecosystems. Despite this importance, their diversity and evolutionary history is only partly understood - especially the evolutionary relationships among genetic lineages in the complex are not resolved and the species are not sufficiently delimited. From previous analyses (based primarily on mtDNA) the species *C. olivieri* seems to be paraphyletic and the whole species complex includes several other valid taxa (*C. flavescens*, *C. fulvastra*, *C. goliath*, *C. somalica* and *C. viaria*) as well as many synonyms. In our contribution we provide a phylogeny based on reduced-genome SNP data (produced by ddRAD sequencing over the whole genome), which helps to disentangle the complex taxonomic situation and provides suggestions for species delimitation and evolutionary history description taking into account the geographical and temporal context.

The research was funded by the French project MNHN - ATM Blanche 2019 and the Czech Science Foundation project No. 18-17398S.

(ORAL PRESENTATION)

Rodents and public health in urban areas: are there challenges specific to African cities?

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Explosive urbanization is one of the major socio-environmental modification that developing countries currently face, especially in Africa where the process is particularly rapid. In many instances, it is characterized by the informal settlement of poor populations within large

unhealthy areas where basic services (eg. sanitation, waste management, access to health care and education, transports, etc.) are weak when not absent. Hygiene is usually very low, thus making board and lodging easily available for rodents which proliferate. In addition to massive damages on infrastructures and food stocks, rodents are responsible for the maintaining, circulation and transmission to humans of a wide range of zoonotic diseases (eg. hantavirus and Lassa haemorragic fevers, leptospirosis, typhus and plague), thus contributing to the already quite heavy infectious load that slum inhabitants have to live with. Despite the obvious importance of urban rodents in terms of public health in developing countries, perception of human/rodent interactions within cities by academics and developers is often biased by the situations observed and studies conducted in European and American towns. Yet, differences with African cities exist and should be taken into account for the implementation of locally adapted rodent control strategies.

We will try to address several of these aspects: which features of the urban environment that underlie urban rodents abundance are common between cities ? What is the impact of History on current and future rodent species assemblages within African towns, and what are the consequences in terms of zoonotic risk? Which of the African urban landscape characteristics favour rodents proliferation and promiscuity with humans? Which organizational structures are in charge with rodent control implementation in Africa? Doing so, we hope to put forward some reflexions that may be useful for improved rodent control in African cities.

(KEYNOTE LECTURE)

Characterization of urban landcape and small mammals communities in city of Cotonou

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African's urban environment is characterized by demographic increase, anarchic installation, and unhealthiness of most areas. This process contibutes to the oubreak of anthropophile small mammals and rodents in particular. This abundance can create environmental situations where humans are in daily interaction with animals, therefore increasing transmission risk of pathogenics. Cotonou, economic capital of Benin is a good example of this kind of proximity. Our study was realized in neighborhoods where the socio-environmental conditions are degraded. It permitted us to highlight important rodents densities

which are associated with the circulation of many pathogenics. The presence of pathogenic leptospires was detected. The flood affecting Cotonou every years causes therfore a major risk of human's contamination.

During this conference, we will talk about the analysis of correlations between urban landscape structure and the small mammals communities structure in Benin's economic capital. We present the small mammals catch protocol in the three neighborhoods, that we used for two years of data collection. The urban landscape and associated uses have been mapped with the Open Street Map's community tools and the data used to build a Geographic Information System. This GIS enabled us to do the structure analysis of the urban landcape using landscape metrics and multivariate analysis. The spatio-temporal data of rodent abundance has been analyzed with partial triadic analysis which came out the existence of a spatial structure of the assemblage of species common to the different sampling dates. The metrics derived from the structure of the urban landscape have been crossed with the pattern of distribution of small mammals common to different dates of the field monitoring.

(ORAL PRESENTATION)

Adding ecological significance to the National Museum Mammal Collection by collating the information of small mammal records

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Museum collections contain records of past species' presence and distributions, and represent a vast pool of genetic information. The Mammal Collection at the National Museum, Bloemfontein, South Africa (NMB) - that is continuously being updated by NMB staff - make an important contribution to a wide range of scientific studies, including taxonomic, phylogeographic, parasite-host, intestinal microbiome-host, conservation, and even anthropological (through paleoenvironment reconstruction) studies, amongst others. A number of factors, such as strategic planning of field excursions, updating sampling strategies, and collecting associated data over the last two decades, have made it possible to update previous checklists based on the NMB collection (e.g. C.D. Lynch's 1983 "The Mammals of the Orange Free State"). In addition, it also add more ecological value to a level not attainable in the past. The observation of small mammal species complexes / community composition and structure (as well as its relation to the more detailed habitat specifics that is now available) in previously unsampled areas in the Free State Province and elsewhere in the southern African Grassland Biome, allow us to make inferences related to ecological integrity and species' indicator status.

Additional information on, inter alia, species measurements, reproductive activity and output, and cultural uses, further add to the picture. An update of "The Mammals of the Orange Free State" will, therefore, highlight the ecological value of Mammal Collections in general and serve as a valuable reference to researchers, environmental assessment practitioners, wildlife and conservation managers, and decision makers.

(POSTER)

The diversity of small mammals (rodents and shrews) in the Yangambi Biosphere Reserve (D.R. Congo)

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The diversity of rodents and shrews in the Yangambi biosphere rerserve (R.D. Congo) was also highlighted. It was being studied in July-August 2016, we captured 197 specimens, of which 70 were rodents (35.5%) and 127 shrews (64.5%). Among rodents, we found 6 different genera, and among shrews, 4 different genera. Our results confirmed by the Congo River also affect the composition of rodent and shrew species of two rivers of the river and also the lives degree of the disturbance foresters in the region.

But the loss of biodiversity due to deforestation can be partly offset by the supply of secondary forests and plantation forestry. It is important to consider that secondary forest and fallow land can be of great value to biodiversity and support ecosystem functions, especially in successional stages. Nevertheless, it should not be forgotten that there is no substitute for primary forests and their associated faunas and that this response may be different for other taxonomic groups. Future research is needed to focus conservation efforts on functional technologies.

(POSTER)

Outbreaks of rodent-borne diseases: drivers of the contact zone between pathogens, rodents and humans

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Outbreaks of rodent-borne diseases largely rely on successful pathogen transmission among rodents on one hand and among rodents and humans on the other hand. Transmission modes (direct or indirect) explain HOW pathogens are transferred to humans. Contact modes such as synanthropy and occasional synanthropy, viz. rodents occasionally entering human dwellings

explain WHERE transmission might take place. However, neither transmission modes nor contact modes explain the environmental conditions that determine the transfer of pathogens from rodents to humans. Here, I illustrate with a focus on horizontally transmitted hantaviruses, how considering intrinsic (e.g. population density) and extrinsic factors (e.g. weather conditions and food availability) – with the former largely being driven by the latter – helps us to understand outbreaks of rodent-borne diseases. To increase such knowledge is a prerequisite to achieve useful predictions for disease outbreaks as well as to develop successful disease prevention and control.

(KEYNOTE LECTURE)

Quantifying bat activity and sonotype association with habitats along an urban to rural gradient

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Tanzania is home to an estimated 105 bat species, yet despite this diversity relatively little is known about where different species are found. Many presence records are based on a small number of samples or opportunistic records and the habitat preferences of many species is poorly known. In this study, we aimed to better characterise the bat fauna of Morogoro, Tanzania, an area with high variability in different habitat types. Depending on the habitat structure within which bats are moving, and foraging strategy, bat species have characteristic wing morphologies and echolocation pulses which can be used to classify them into broad guilds or "sonotypes".

In this study, we investigated whether there is an association between sonotype and habitat type by recording echolocation calls in ten 4km transects encompassing an urban to rural gradient. We also quantified habitat structure and developed a call library based on trapping data. We recorded over 60 thousand calls with the majority of calls recorded during transects conducted at 10pm in comparison to transects at 7pm. The transect with the most recorded calls was situated in and around a botanical garden, close to a water body. We analysed all calls for 17 acoustic parameters such as the Characteristic Frequency (Fc), Characteristic Slope (Sc), and the duration of a call (Dur), and used a combination of principle component analysis and classification algorithms to classify calls to sonotype, and identify key acoustic features associated with each sonotype. We explored the relationship between sonotype specific activity and habitat features such as elevation, clutter and surrounding land use using generalised linear mixed effect models. This survey is the first of its kind in and around the Morogoro area and has increased knowledge about bat diversity and activity in an under-surveyed region, including

some surprising findings such as the presence of *Rhinolophus clivosus*, *R. eloquens*, and *R. blasii*.

(ORAL PRESENTATION)

Collecting few to save many: The role of natural history museums in mammalian conservation

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Natural history museums (NHMs) function as vital repositories of information for better understanding our Planet. Whether it be through public education, scientific research, or on-the-ground conservation, NHMs are founded on and fueled by one major component: collections. Collections of objects, or specimens for biological material, form the heart and soul of NHMs and are vital to the mission of these institutions. However, conflict often arises around such collections, especially with regard to killing animals, and scientists working in NHMs are increasingly under pressure to both defend and explain why continued collecting is necessary. Moving beyond the moral argument as to whether or not killing animals is acceptable, this talk seeks to explore the positive impacts continued collecting has on the field of mammalogy and how NHMs can augment conservation efforts on a local and global scale.

(KEYNOTE LECTURE)

Diversity of shrews (Soricomorpha, Soricidae) in the Congo basin near Kisangani (Democratic Republic of the Congo)

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In Kisangani and its hinterlands, shrews are relatively little studied. This study combined the genetic tools (mt gene 16S rRNA and nuclear gene ApoB) with anatomical, cranio-dental morphometrics and ecological data to review shrew diversity and taxonomy in the region of Kisangani. The Congo River and its main tributaries were considered as barriers for their distribution. Shrews were trapped on open transects and in a closed area of 1ha, using four types of traps: Pitfall, Sherman, Museum special, and Victor. Shrews were captured in different habitats: primary forest, old secondary forest, old fallow lands, and old palm groves.

This study enabled us develop a new overview of shrew biodiversity along the Congo River and its major tributaries (Maiko, Tshopo, Lindi, Lomami, Aruwimi, Itimbiri, etc.). The

molecular markers allowed to separate 21 "cryptic operational taxonomic units": e.g. *Scutisorex* sp1, (presumed to differ from *S. congicus*, *S. somereni*, *S. thory*), *C.* cf. *olivieri* is split into three distinct populations (*C. olivieri* sp1, *C. olivieri* sp2 and *C. olivieri* sp3) ; the clade *C. littoralis* contains three populations: *C. littoralis* sp1, *C. littoralis* sp2, and *C. littoralis* sp3., etc. Because of these cryptic species, the use of genetic tools, combined with morphological, cranio-dental, and ecological data, as well as the distribution areas in reference to type localities, proved to be usefull for reviewing the taxonomic status of shrews.

(POSTER)

An update on *Rhabdomys* sp. distribution, ecology and behavioural characteristics

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Until recently, the genus Rhabdomys was considered monospecific. Hence the bulk of studies addressing its ecology and behaviour reported population variations, which in light of recent knowledge could be species differences. Indeed, three studies described the phylogeography of the genus, revealing the existence of at least 5 species, occupying distinct environmental niches, although their distribution range and limits are still under investigation. Here we will, first, clarify the distribution of *Rhabdomys* species and, second, report on our ongoing research involving several contact areas between *Rhabdomys* species. Indeed, *Rhabdomys* offers the opportunity to address ecological divergence between species under common garden conditions, and we used this opportunity to investigate the impact of environmental conditions versus species interference on ecological and behavioural divergence within this genus.

(ORAL PRESENTATION)

Sampling distribution of bats (Chiroptera, Mammalia) in Protected Areas in the hinterland of the Kisangani region, DR Congo

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The "Centre de Surveillance de la Biodiversité (CSB/Kisangani) develops research Programs in the Protected Areas of the Kisangani region in order monitoring not only endemic,

rare or endangered species but also their distribution in a perspective of pathogens transmission. The present research concerns the evolution of the sampling of the bats in 7 reserves because the human activities in human agglomerations and exploitation concessions (agricultural, mining, forestry, extraction of the building materials, ...) surrounding these Protected Areas greatly reduce the forested areas of these reserves and probably the possibility for the bats to properly rebuild its population once decimated, to shelter with tranquility or to get enough food energy.

For this, the bats were sampled from 2013 to 2018 using 3 mist nets (6, 9 and 12 meters) for 5 consecutive nights and identified with the keys of Hayman et al. (1966) and Rambaldini (2011). A total of 314 specimens were collected in 105 net nights with an overall success of 3.5 specimens per trap-night. The sampled specimens belong to at least 25 species. It appears from our study that 6 of 25 species are frequently collected in the Protected Areas (almost all the reserves), they are: *Casinycteris argynnis*, *Epomops franqueti*, *Hipposideros caffer*, *Megaloglossus woermanni*, *Myonycteris torquata* and *Scotonycteris zenkeri*. Monitoring of constantly sampled species: *Hipposideros gigas*, *Hipposideros ruber*, *Hypsignathus monstrosus* and *Rousettus aegyptiacus*. Species that are rarely or accidentally caught in mist nets are *Eidolon helvum* and Vespertilionidae (*Glauconycteris* sp, *Pipistrellus* sp, ...). Also, the Protected Areas around Kisangani City (Masako, Mbiye and Yoko) are the most diverse in bats (11 to 18 species collected) than those that are quite distant (Lomami and Fauna in Okapi).

(POSTER)

A new arenavirus in *Mastomys natalensis* mitochondrial matrilineage A-III in Ethiopia

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Mastomys natalensis, the Natal multimammate mouse, is one of the most widespread rodent species in Africa. It is the main reservoir of the Lassa arenavirus, highly pathogenic for humans in Western Africa. Six main mitochondrial matrilineages are recognised in this rodent species, forming two monophyletic clades A and B. So far, at least one arenavirus has been described for each of these matrilineages at the exception of the matrilineage A-III: Lassa virus in A-I, a Mobala-like virus in A-II, Gairo virus in B-IV, Morogoro virus in B-V and Mopeia and Luna virus in B-VI. We screened for arenavirus RNA presence 203 rodent, shrews and bats samples from Dhati-Welel National Park sampled in 2014 and found several positive *Mastomys natalensis* samples. We present preliminary results on the phylogenetic position and the genetic distance of this arenavirus in comparison with arenaviruses from other *M. natalensis* mitochondrial lineages. (POSTER)

Zoonotic investigations of Zaire Ebolavirus in Likati, Democratic Republic of Congo, 2017

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Outbreaks of Zaire Ebola virus (EBOV) in people always start with a spillover event from wildlife. Which animal species constitute the reservoir is still not clear, but there is evidence for the involvement of several species of bat in EBOV ecology. In this study, we aimed to investigate EBOV presence among (small) mammals in the location where the index case of the 2017 EBOV outbreak lived (Kaigbono, Likati, Bas-Uele, Democratic Republic of Congo), 2.5 months after the start of that outbreak. The index case had been exposed to cooked meat of a dead Red river hog (*Potamochoerus porcus*) and grilled meat of a live captured fruit bat, likely a straw-colored fruit bat (*Eidolon helvum*).

A total trapping effort of 5460 terrestrial trap nights and 237 mist netting nights led to specimen collection of 241 rodents, 141 bats, 79 shrews, 5 monkeys and 1 mongoose as well as the molar pulp of the mentioned *P. porcus* remains, and we furthermore collected 97 environmental faeces/urine at a nearby *E. helvum* colony. None of the tested animals were positive for EBOV RNA in a qRT-PCR assay (including *P. porcus* molar pulp), and none of the 272 blood samples and 94 faeces were considered to harbor anti-ebolavirus antibodies on a 10-antigen Luminex assay. Notably, for only 91 individuals (mostly larger bats) was it possible to determine the specimen to the species level with certainty based on morphology only in the field. Sequencing mitochondrial genes for 332 animals revealed at least 47 species in our sample. Except for two species of rodent and two species of bat, most had low (1-20) per-

species sample sizes, indicating it had been easy to miss potential low prevalent EBOV RNA or antibodies in most species.

We conclude that more surveillance with large trapping efforts to reach sufficient per-species sample sizes is necessary to find the natural EBOV reservoir, and that genetic means to confirm small mammal hosts from this region at the species level are necessary.

(ORAL PRESENTATION)

Diversity of African mammarenaviruses and evolutionary relationships with their rodent hosts at various phylogenetic levels

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Mammarenaviruses are RNA viruses that are known to predominantly infect rodents, but some occasionally infect and cause haemorrhagic fever in humans. Like for other zoonotic viruses, it has been proposed that the tight evolutionary relationship between mammarenaviruses and their rodent hosts has determined their current diversity and distribution. On the other hand, also several host switches are known to have occurred during the evolutionary history of mammarenaviruses.

We screened a collection of 4151 dried blood samples from African small mammals, and genetically detect four novel mammarenaviruses from *Mastomys erythroleucus* in Ethiopia, *Arvicanthis neumanni* in Tanzania, *Praomys jacksoni* in the Democratic Republic of Congo and *P. jacksoni* from Kenya. We determine complete genomes of three of these, and of two additional previously partially described mammarenaviruses from *M. awashensis* and *Stenocephalemys albipes* in Ethiopia. With the presently extended dataset of 28 arenavirus taxa found in African rodents, we review African mammarenaviruses phylogeny and evaluate their host fidelity at various phylogenetic levels. We delineate five African mammarenavirus clades consistently at both genomic segments.

We confirmed the strong specificity of African mammarenaviruses for their hosts: most taxa have only been detected in a single rodent species or even a single intraspecific lineage, and eight taxa are circulating in sympatry in distinct hosts. While statistical association of mammarenavirus phylogenetic subclades and rodent genera is weak, on a deeper taxonomic

level we find that most members of the same African mammarenavirus clade are significantly associated with members of the same rodent tribe. These results indicate that African mammarenavirus evolution is not continuously directed by host evolutionary background, but at intermittent intervals constrained by distinct phylogenetic levels of their rodent hosts.

(ORAL PRESENTATION)

Multilocus phylogeny and distribution of the multimammate mice of the genus *Mastomys*

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Murine rodents of the genus *Mastomys* ("multimammate mice or rats") represent one of the most successful groups of indigenous African mammals. These mice inhabit almost the whole sub-Saharan Africa, as well as Morocco. They are very important from human point of view (important agricultural pests and reservoirs of diseases), but they serve also as model taxa for fundamental biological research (speciation, phylogeography, host-parasite co-evolution, etc.). For proper use of *Mastomys* as biological models, the information about their diversity and evolutionary history is necessary. Unfortunately, most available genetic data on this genus are based on mitochondrial DNA, which provides only partial information.

Currently, nine morphologically very similar species are recognized especially on the basis of their karyotypes and mitochondrial sequences. Some of them have large area of distribution, e.g. the most widespread species, *M. natalensis*, or Sudanian savanna specialist *M. erythroleucus*, while the distribution of other species is geographically very restricted (e.g. *M. awashensis* in Ethiopia or *M. shortridgei* in humid habitats of southwestern Africa). Here, we combine both newly produced and already published mitochondrial sequences and describe the most complete distribution of mitochondrial variability of *Mastomys* across the continent. For the first time we use nuclear sequences to reconstruct multi-locus phylogeny of the genus and clarify the relationships among *Mastomys* species. The results show that (i) the genus is not monophyletic - *M. pernanus* should be excluded from *Mastomys*, (ii) M. angolensis clearly belong to the genus, as sister to all other species, (iii) *M. coucha* and *M. shortridgei* are closely related species, potentially still hybridizing, and (iv) the highest species diversity of *Mastomys*, four species, is found in Ethiopia. In addition, we also clarify other questions concerning species delimitation, taxonomy and distribution.

(ORAL PRESENTATION)

Native and invasive small mammals in urban habitats along the commercial axis connecting Benin and Niger, West Africa

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Climate and land use changes, urbanization and increasing international exchanges could affect animal community structure, which is known to be dependent of local environment conditions, historical events and evolutionary processes. They favour invasive species introductions and their spread as it is the case of some rodent species particularly rats and house mice. Their dispersal and colonization capacities are associated with road and river transportation networks, as well as growing urbanization. When established, they caused important damages to crops and food stocks, represent major reservoirs of pathogens and may threaten native biodiversity. Based on compiled small mammal trappings data during the period 2005-2017, the study aims to describe small mammal community assemblage along the commercial axis connecting Benin and Niger countries, from the seaport of Cotonou to the north sahelian hinterland of Niger with a particular focus on invasive species.

Trapping resulted in a total of 3701 captured individuals in 66 sampling sites, including three invasive species: *R. rattus*, *R. norvegicus*, and *M. musculus*, and six native taxa. Invasive species were trapped in most of the sampled sites (73%) and localities (83%). *R. rattus* was detected at almost all southern sites but its frequency decreased northward. *M. musculus* was only detected in the Autonomous Port of Cotonou and the Great Market of Niamey. *R. norvegicus* was restricted to only coastal sites in southern Benin. A median number of 34 small mammal individuals was captured per site. Local species richness ranged between 1 and 4 species, with a mean of 2.2 species. We observed a latitudinal gradient of species richness which decreased significantly northward. Patterns of segregation were also observed between native *M. natalensis* and two invasive species *R. rattus* and *R. norvegicus*.

Overall, results show a spatial pattern of small mammal community assemblage along the axis and the impact of invasive species.

(ORAL PRESENTATION)

Diversity of small mammal pests and their predators in agro-ecological landscapes: Implications for rodent pest regulation

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The diversity and abundance of small mammals and their natural predators within agro-ecosystems is still poorly understood in Zambia. This makes developing ecologically-based rodent management and understanding the ecosystem services provided by small carnivores highly challenging. The current study seeks to assess the effect of habitat type and season on the diversity and abundance of small mammals and their natural predators. We employed camera trapping of small carnivores and removal trapping of small mammals in three different landscapes (maize fields, grassland and natural forest). A total of 266 small mammals representing 12 species of rodents and 3 species of shrews were captured. The highest diversity of small mammals was observed in grassland (13 species, Shannon's diversity index, H' = 1.7), followed by natural forest (6 species, H' = 1.55) and maize fields (6 species, H' = 0.73). Small mammal species diversity increased with increasing cover and less disturbance. Despite having the least species diversity, maize fields stood out for the abundance of *M. natalensis* (94% of total captures) – the main rodent pest in the sub-Saharan Africa. A total of 11 species of small mammal predators was observed in the three habitats. The highest richness of small mammal predators was observed in maize fields (7 species, H' = 1.42), followed by grassland (6 species, H' = 1.19) and natural forest (5 species, H' = 1.42). The observed predators could be at risk of being killed through secondary poisoning if farmers continue using rodenticides. Our results reveal that grasslands in our study site support a diverse community of small mammals and their natural predators. This highlights the importance of grasslands in the conservation of small carnivores that are likely contributing to rodent pest management in nearby agricultural fields. Maintaining natural habitats around croplands has the potential to balance the conservation of these animals and help in crop protection leading to increased yields and food security for small holder farmers.

(ORAL PRESENTATION)

Qualitative and quantitative distribution of small mammals (rodents and soricomorphs) in habitats in the hinterland of the city of Aketi (Bas Uélé, D R. Congo)

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This is a paper, which is a publication of the rodents and soricomorphs of the region, in the context of forest, in a brassing maintenance, and a amplified hearing, also distributing in a perspective plus a large transmission of pathogens.

For this purpose, rodents and soricomorphs were sampled in 7 habitat types from Aboso (September 2017), Wela (February 2018) and Bombongolo (March 2018). We used Sherman, Victor Rat Trap and pitfall (20-liter buckets). We completed our study by using qualitative surveys in order to perceive the risk factors following contact between humans and small mammals. A total of 368 small terrestrial mammal specimens, including 287 rodents and 81 soricomorphs, were sampled over 3132 catch nights success with an overall of 11.75%. These specimens have less than 21 different species, 6 species of Soricomorphs and 15 species of rodents. Habitat degradation has favored some species to thrive at the expense of other species that are rendered in low density habitats. *Nannomys* cfr *grata* and *Praomys jacksoni*, *Praomys* sp and *Crocidura* cfr *olivieri* are known from the collection as well as increasingly abundant in regional habitats and for those who are lost diseases. *Nannomys* has priority habitat of old and cultivated fields where it has a high density. *Praomys* spp thrives best in fallow and best of *Crocidura* cfr *olivieri* thrives secondary forest in primary forest, secondary forest and fallow land. In the three locations surveyed, fallow and secondary forest have almost the same species richness and density of rodents. The density of rodents drops old fallow in primary forest. In Soricomorphs, however, the density does not vary significantly between habitats. The distribution of rodent species between habitats is not uniform.

(POSTER)

Seasonal prevalence of haemoparasites infecting small mammals that occur in Mukwe Constituency, Kavango East Region of Namibia

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Small mammals play an important role in nature as reservoir hosts for many pathogens, including some that can be transmitted to other animals including humans. Infections with zoonotic haemoparasites are widespread in wild small mammals. They include borrelia, trypanosomes, bacilli, plasmodia and coccobacilli. In humans, these pathogens are responsible for many rodent-borne diseases including plague, leptospirosis, toxoplasmosis, leishmaniasis and haemorrhagic fevers, with leptospirosis and plague believed to be widespread in East and Southern Africa. Extrinsic factors such as temperature, humidity and rainfall, as well as intrinsic factors such as gender and age of small mammals affect the prevalence and the abundance of haemoparasites. This study is being carried out in Bagani and Diyogha Villages of the Kavango East Region in Namibia. Live trapping of small mammals has been conducted since December 2018 and is anticipated to be concluded in December 2019. Trapping of small mammals is being carried out inside houses, fallow land and natural (less disturbed) habitat on a monthly basis. The following small mammal species were captured between December 2018 and June 2019: *Mastomys natalensis*, *Gerbilliscus leucogaster*, *Saccostomus campestris*, *Thallomys paedulcus* and *Steatomys pratensis*. Blood smears were made from 144 small mammals that were captured and screening was done on 74 of the 144. However, none of the 74 small mammals tested positive in terms of presence of haemoparasites. Therefore, further screening is going to be done.

(ORAL PRESENTATION)

The IUCN SSC Small Mammal Specialist Group's priorities for small mammal conservation across Africa

KENNERLEY R.

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The SMSG acts as a scientific advisory body for nearly half of the world's mammal species, representing the orders Rodentia, Eulipotyphla, and Scandentia. The group undertakes global research, coordinates global Red List assessments, designs and advises on projects, helps to fund raise, runs action planning workshops, and raises awareness. Amongst these, Red Listing

constitutes a huge aspect. The process and data required for undertaking assessments will be explained, and importantly, how researchers and conservationists can contribute to it will be outlined.

Broadly speaking the group has three main strategies for increasing small mammal conservation: we develop champions for key small mammal species; build conservation capacity in key small mammal regions; and we promote small mammal conservation within the world's leading zoos. Each of these strategies will be discussed and this will include providing examples of some of our recent successes. Crucially, we will explore how these relate to the group's identified priority areas and species across Africa and talk about the resources that the group has available and expand on the opportunities available for people to get involved with the SMSG.

(KEYNOTE LECTURE)

Rodents and flea ectoparasites diversity in plague active foci in Mbulu district, Tanzania

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Plague persistence and transmission are influenced by various factors including multiple vector interaction with the host in the active foci. Present study aimed at determining population diversity of rodents and flea ectoparasites within habitats.

Studies were conducted in Mongahay and Endeshi villages from Nov 2018 - April 2019. Trapping involved forest, farms and inside house habitats. In the farms and forest a removal trapping method was applied using Sherman traps. Inside houses box traps and Sherman traps were used with the addition of light torch hanged 3cm high from the tray filled half water to collect fleas.

Total number of rodents collected was 201 samples. This included 83 from farms and 68 from forest and 50 from inside houses. Rodents collected were *Mastomys natalensis* (45%), *Dasymys* sp. (2.4%), *Grammomys* sp. (6%), *Graphiurus* sp. (2%), *Lemniscomys* sp. (5%), *Lophuromys* sp. (7%), *Mus* sp. (1.4%), *Praomys* sp. (10.4%) and *Rattus rattus* (20.3%). Total number of fleas collected was 237, 23 from farms, 32 from forest and 182 from inside houses. Total flea index collected from rodents is 1.17 and average number of fleas collected from trays per house per day is 5. Flea species collected were, *Ctenocephalides felis* and *Ctenocephalides canis* (21.5%), *Xenopsylla brasiliensis* (28.2%), *Dinopsyllus* sp (13.9%), *Pulex irritans* (32.9%) and *Nosopsyllus incisus* (3.4%). Results supports earlier studied showing multiple host-vector interaction. Also, higher level of flea vector inside houses suggest more studies on flea vector intervention to reduce plague persistence and transmissions.

(ORAL PRESENTATION)

Does dietary generalism confer fitness advantages in small mammal communities?

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Human activities and climate change have triggered shifts in the global distribution of animals. However, within animal communities, species distributions shift at different rates and in different directions, leading to questions about fitness differences that may underlie such differences. Across broad spatial scales, some species are abundant with widespread distributions and some rare with restricted distributions, leading some ecologists to hypothesize that widespread species might enjoy greater fitness. Additionally, common and widespread species are hypothesized to be generalists (capable of using a wide variety of resources), while rare and restricted species are hypothesized to be specialists (that instead use a narrow subset of resources available to them). Together, these two hypotheses predict that generalists should exhibit higher survival rates, higher reproductive output, or both as compared to specialists. I test the idea that the degree of diet generalism - the breadth of foods eaten by individuals - is the main determinant in whether a population is extirpated, persists, or expands its range in the face of human activities and climate change. By quantifying how food input translates to components of individual fitness in small mammal community, I provide a field test of the hypothesis that abundance (numbers of individuals occurring at a site), occupancy (the number of sites occupied), diet generalism, and fitness are correlated positively with one another. I ask if individual´s diet breadth determines reproductive output and survival rates. I hypothesize that dietary generalists will have longer lifespans than that of specialists which is potentially higher reproductive output in a lifespan. Secondly, dietary generalists will be more abundant with higher occupancy compared to specialists. Survival, diet breadth, abundance, and occupancy relationship will be analyzed via generalized linear models.

(ORAL PRESENTATION)

ProxLogs: Miniaturised proximity loggers for understanding movement and behaviour

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Interactions between individuals are central to understanding the mechanisms underpinning behaviour such as competition, predation, sociality or disease. This requires detailed understanding of how individual behaviour differs in space and time, and the resultant consequences for interactions and social network structure. To accurately determine how

population level social structure emerges from highly dynamic individual behaviour, it is essential to gather robust, accurate, high resolution empirical evidence of interaction behaviour. However, systematic, disturbance free observation, particularly of highly mobile, nocturnal or small species, can be extremely challenging.

Until recently, such detailed knowledge of individual behaviour has been restricted to either captive, large or easily visible species. However, by exploiting recent advances in embedded software, chip miniaturisation and battery development, we have developed small (~1g) proximity loggers which record when individuals come within a predetermined distance of each other, the identification of the individuals and the time period over which the interaction occurs. Our loggers, developed in collaboration with the Department of Engineering and the Department of Product Design at Universiteit Antwerpen, are cheap, open source and remotely programmable. Here we present some results from recent experiments with the loggers on birds and rodents. We anticipate that the loggers will have a wide appeal for ecologists working on a range of different species.

(POSTER)

Disentangling social and spatial drivers of disease transmission in small rodents

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Disease transmission between individuals occurs when there is overlap in space and / or time. However, disentangling when transmission is a function of social or spatial behaviour is challenging. This is particularly the case when our ability to determine social contacts is limited to inferred contacts, as often occurs for small mammal species. Most social network approaches focus solely on interactions with other individuals and ignore any spatial component, yet this spatial component is inherently part of the process underlying whether individuals will contact each other.

Here, we use a combination of social network measures which encapsulate how an individual may contact other individuals or contribute to disease transmission and spatiotemporal Bayesian models to determine the extent to which an individuals´ connectivity or spatial behaviour is associated with their likelihood of exposure to disease in the Natal multimammate mouse (*Mastomys natalensis*). We show that the probability of an individual being exposed in the absence of accounting for spatial behaviour is associated with contacts with a small number of individuals overall, but positively associated with contacts with positive individuals. However, these relationships are altered when spatial and temporal correlation are accounted for. This demonstrates the importance of including spatial structure when analysing

the relationship between social network measures and disease prevalence, something which is rarely addressed in most studies considering the role of social contacts in disease transmission.

(ORAL PRESENTATION)

Evolutionary patterns and speciation along steep altitudinal gradient: a case study of Ethiopian speckled brush furred mice *Lophuromys flavopunctatus* s. l.

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Mountain tropics are interesting as regions where processes of local adaptation of species to relatively narrow patches of altitudinal gradient are most pronounced. Repeated shifting of altitudinal ecosystem boundaries during Pleistocene have affected on speciation processes and contributed to interspecific introgression events. In present study, we investigate diversity and evolutionary history of the Ethiopian representatives of speckled brush furred mice *Lophuromys flavopunctatus* s.l. Nine species belonging to the complex are endemics to the country and widespread in various moist habitats of the Ethiopian highlands. Data were collected in 1995-2018 across Ethiopian highlands; in total we genotyped 386 specimens of Ethiopian *Lophuromys*. Phylogenetic analysis was based on the combination of one mitochondrial (cyt *b*) and four nuclear (IRBP, GHR, DHCR24-7, WLS-7) markers. Our results showed substantial discordance between mitochondrial and nuclear phylogenies that could be considered as traces of reticulate processes. Revealed cases of existence of deeply divergent mitochondrial lineages within populations of three species (*L. melanonyx*, *L. simensis*, *L. brunneus*) also could be explained as a result of ancient introgression events. Besides this, we found a couple of presumed recent introgression events in species pairs *L. simensis – L. menageshae* and *L. flavopunctatus – L. brunneus*. Taken together, obtained results allowed to put forward the hypothesis of adaptive introgression of particular mitochondrial genomes. Proposed scenario of Ethiopian *Lophuromys* evolutionary history showed that contemporary species and their genetic diversity were formed under the complex conjunction of divergent and reticulate processes.

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(POSTER)

Molecular techniques reveal cryptic diversity of African *Crocidura hirta-flavescens* species complex (Eulipotyphla: Soricidae)

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White-toothed shrews of the genus *Crocidura* are with almost two hundred species the most diverse mammalian genus. Due to their high diversity, morphological similarity and hiding life-style, *Crocidura* shrews are one of the least known and taxonomically complicated Old World mammals. In our contribution we present molecular phylogeny of the East and South African *C. hirta-flavescens* species complex - an Afrotropical *Crocidura* clade mostly from open habitats, phylogenetically sister to widely distributed sub-Saharan giant shrews of the *C. olivieri* species complex. Based on molecular analysis (maximum likelihood and Bayesian approaches) of mitochondrial and nuclear DNA sequences and SNPs data over the whole genome (produced by ddRAD sequencing) of specimens from Ethiopia to South Africa, we identified several well-differentiated gene pools, potentially corresponding to separate species. *Crocidura flavescens* s. str. is distributed along South African coast, but genetically similar population was found in south-western Zambia, south of the Zambezi River. Their sister lineage is widespread in arid central Tanzania ("Massai steppe"). *Crocidura hirta* has wide distribution in savannah-like habitats of Tanzania, Mozambique and Zambia and consists of three genetically and geographically well separated groups. Specimens from southern Ethiopia and coastal Mozambique formed two significantly distinct lineages, sister to *C. hirta*, and their species status is discussed (including confrontation with morphological data). Despite the fact that taxonomy of this complex will require further work, analysis of its genetic diversity can be very informative about past evolutionary processes in tropics.

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(POSTER)

New species of Crocidura (Mammalia: Soricidae) from Ethiopia, and a review of shrews from the country

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Thanks to a substantial variety of unique habitats (heterogeneity related to presence of the Great Rift Valley and Ethiopian highlands), the country of Ethiopia hosts an outstanding level of biodiversity and endemism. This is true for small mammals as well, including the white-toothed shrews (*Crocidura*), whose diversity is still not understood sufficiently. New species are defined from Ethiopia, based on genetic and morphological data of recently collected specimens (using cytochrome *b* barcoding and skull morphology data). One is a northern representative of *C. lucina*, another is a new species allied to *C. turba*. Comparisons are provided with other species known to occur in the country. A tentative list of 30 species of shrews known from the territory of Ethiopia is provided, 14 of which are currently considered to be endemic to Ethiopia. The endemic shrew fauna consists of forest and montane species known to occur within an altitudinal range of 1200-4050 m a.s.l. The remarkable numbers of endemic *Crocidura* species shows that the Ethiopian Plateau is an important centre of diversity and of an adaptive radiation of the genus. Current molecular data suggest that a majority of endemic *Crocidura* species form a monophyletic clade that diversified in Ethiopia and served as a source for southward colonization of other East African mountains.

(ORAL PRESENTATION)

The mammals of Ethiopia: diversity, endemism and conservation

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The diversity and uniqueness of the Ethiopian fauna can be connected to such specific features of the Ethiopian Plateau as pronounced altitudinal zonation, extremely diverse geomorphology and drastic environmental changes in the past. For over thirty years, we studied diversity and evolution of Ethiopian mammals. The phylogeny of some selected groups of rodents and shrews was reconstructed using analysis of molecular data in the context of the history of the main ecosystems in Ethiopia. The revealed phylogenetic patterns suggest that the evolutionary history of the Ethiopian small mammals was featured by both intensive local

speciation and accumulation of survived evolutionary lineages. Such processes were presumably promoted by ecological vacuum in the local forest communities and forming of high-mountain landscapes at the Pliocene-Pleistocene border. The obtained data revealed that the diversity of the Ethiopian mammals could be far higher than it was suspected before. One order, one family, four genera and 10 species were detected for the first time within the boundaries of Ethiopia. Species rank of seven rodent taxa previously held in taxonomic synonymy was confirmed. Eleven new endemic species were described de novo. In addition, 25 species of small mammals, belonging to 13 genera, have been identified as new to science and await formal description. Totally, according to our obviously incomplete list, the Ethiopian mammal fauna consists of 311 species, and 57 of them are endemic to the country. Many of these species are potentially threatened because of their extremely limited distribution ranges. In view of the fast habitat destruction in the country, taxonomic and evolutionary studies on Ethiopian small mammals are especially important and urgent. There is a high risk that some unknown endemic species will become extinct before they can be described and studied.

This study was supported by the Russian Foundation for Basic Research (project 18-04-00563-a).

(KEYNOTE LECTURE)

The dynamics of *Mastomys natalensis* and Morogoro arenavirus: a model system for transmission ecology

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The Multimammate mouse *Mastomys natalensis* is a common rodent species over a large part of Africa South of the Sahara. These rodents are a serious pest in agriculture and can reach high outbreak densities, triggered by abundant off-season rainfall. They are host for a number of parasites, including a group of different arenaviruses, linked to different subspecific lineages of *M. natalensis*.

The population dynamics of these rodents have been studied in several regions of Africa but the most extensive research has been carried out in Morogoro, Tanzania, including a capture-recapture study with monthly trapping sessions since 1994 and still ongoing. Since 2007, blood samples have been taken from every individual at each monthly capture. Together with removal trappings, field and lab experiments, this has resulted in an understanding of the seasonal and interannual fluctuations of the rodents themselves, but also of the dynamics of Morogoro virus, the arenavirus carried by the *M. natalensis* lineage that is found in that region. Moreover, it has

been possible to develop mechanistic models of the transmission ecology of the virus, taking into account aspects of the viral infection, rodent social networks and behavior and the rodent-virus interaction.

In this talk, an overview will be presented of the results of these studies and how they provide a model system for questions about transmission ecology in general, as well as offer a solid basis for simulating the effects of different rodent-targeted management strategies on the transmission of the virus. The latter is illustrated with a modelling study comparing possible intervention strategies for Lassa fever control in Guinea. The former one shows how African rodent science can reach a level where it can surpass the common idiosyncratic studies. It would be fruitful for African Small Mammal research to further explore that path.

(ORAL PRESENTATION)

Domestic and wild predators around rural homesteads

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Following on a previous study in which we tested, using giving up densities, whether the presence of domestic cats and/or dogs in rural homesteads would affect the foraging behaviour of pest rodents and found that the presence of cats and dogs at the same homestead significantly reduced activity and increased GUDs of pest rodent species. Using camera traps, we collected data on predator (wild and domestic) activity around homesteads. We also set up owl boxes and conducted periodic rodent surveys in grids set up in areas adjacent to the owl boxes. The homesteads were only rarely visited by wild predators, mongooses in this instance. The owl boxes were not occupied implying unsuitable construction or siting or a low owl population in the area. We conclude that there may be other factors impacting rodent populations in this area.

(ORAL PRESENTATION)

Rodent population outbreaks and the risk of plague transmission in sub-Saharan Africa under the influence climate change

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Africa Centre of Excellence for Innovative Rodent Pest Management and bio-sensor Technology Development

Weather affects the dynamics of vegetation, invertebrates and vertebrates populations both locally and regionally. Seasonal rodent population changes are widely studied in sub-Saharan Africa. Rodent outbreaks are often indirectly linked to effect of precipitation on the diet and cover. In active plague foci, weather among other factors, affects vector populations (fleas), host seasonal abundance and plague transmission from reservoir hosts to humans. Therefore we need to understand how climate change might affect the abundance of rodents in agro-ecosystems in Sub-Saharan Africa, and whether such population changes will lead to much more severe pest outbreaks and frequency than the current situation. A clear insight on the effects of weather, in particular extreme changes in temperature, rainfall and humidity, on the distribution and abundance of fleas and how it will impact on the severity of plague epidemics in current active foci in Sub-Saharan Africa is necessary. A major shift in inter annual vegetation cover due to seasonal and inter-annual climatic variations caused by climate changes in sub-Saharan Africa could have a major effect on rodent populations and vectors of plague. Under much drier conditions in some areas such as the Montane rain forests in the Eastern Africa Highlands some rodent species which depend on wet forests for survival are likely to be highly negatively impacted, while under wetter conditions opportunistic pest species such as *Mastomys natalensis* and *Arvicanthis* spp. are likely to become much more serious pests in agro-ecosystems. However in drier areas in Southern, Eastern and Sahel Region of North Africa, induced dryness due to climate changes may negatively impact on the distribution and abundance of rodent species. These impacts will be more severe depending on human induced alterations of vegetation cover (e.g. deforestation, over grazing and land degradation) and human induced climate changes either on local or global scales.

(KEYNOTE LECTURE)

Influence of sugarcane growth stages on the population dynamics and community structure of small mammals in a savanna-agricultural landscape

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Sugarcane production is an economically and ecologically important and growing land use across the wetter savanna regions of southern Africa, yet its effects on small mammal species is poorly known. In particular, the influence of sugarcane growth stages on small mammals has not yet been investigated. The aim of this study was to determine the influence of five different growth stages on the population dynamics and the community structure of small mammals in north-eastern Eswatini. Small mammals were captured in Sherman live traps set in eight separate grids, each consisting of 49 (7 x 7) trap stations. Six grids were established in sugarcane and two in untransformed savanna, the latter acting as a control. A total of twelve monthly trapping sessions were conducted between June 2017 and May 2018, with each grid being trapped for four consecutive nights per session. A total of 970 small mammals comprising eight species were captured. There were significant differences in species richness however overlap in species composition of small mammals between the different growth stages. Furthermore, densities of the numerically dominant *Mastomys natalensis* were higher in sugarcane compared with savanna, and the body condition of individuals was better in the former landscape. Finally, survival of *Mastomys natalensis* declined significantly in sugarcane fields that were burnt (prior to harvesting). These findings reflect the generalist and opportunist character of *Mastomys natalensis* as a pioneer species that takes advantage of resource availability offered by the sugarcane and illustrate that sugarcane fields can have large and predictable impacts on small mammals with ecological consequences on the rest of the communities.

(ORAL PRESENTATION)

Afrotropical bat's functional variability as a disturbance impact indicator

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Bats' morphological trait assemblages are biological indicators of habitat state. This study aims to predict landscape resilience, considering that high potential of bats population flows allows ecological restoration of disturbed areas. Fieldwork was conducted in the Tshuapa-Lomami-Lualaba landscape in the central Congo basin in the Democratic Republic of Congo. Bat monitoring was performed using capture-recapture protocol of aerial insectivores (AIB), shrub frugivores and nectarivores (FNB). Population dispersion mechanism was simulated using morphological variables. During 1296 mnh (one mist net hour "mnh" equivals one 9 m net or one harp trap open for one hour), interspecific comparison of flight parameters showed high aspect ratio (AR) in Hipposideridae and low values in Pteropodidae, Nycteridae or Vespertilionidae. Body mass (M) variability influenced the flight patterns, particularly among *Epomops franqueti* (95 g, 22 km/h) or *Doryrhina cyclops* (28 g, 17 km/h), *Hypsugo musciculus* (4 g, 15 km/h). Generally, AR is negatively correlated to M ($r = -0.96$, $^{**}p < 0.001$), while M correlated significantly to the flight speed ($r = 0.92$, $^{*}p < 0.05$). Horizontal undergrowth visibility (HVI) indicates a significant effect on various bat species presence in any sampled forest ($p < 0.035$). The probability of AIB presence is high in mixed old-growth forest with an HVI around to 30 m. However, FNB presence remains static during efficient leafing season in swamp and secondary forest, regardless of trees density. Our study indicates that bat´s responses are mostly species-specific and vary in their navigation capacities in a broad range of habitat factors affecting movement.

(ORAL PRESENTATION)

Diversity and distribution of multimammate rats of the genus *Mastomys* in Ethiopia

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The multimammate rats of the genus *Mastomys* are widespread in sub-Saharan Africa and occur in wide spectrum of open habitats. Representatives of the genus are the most common African rodents, the main vertebrate agricultural pests and vectors of some human pathogens. In

Ethiopia, biogeographically most complex eastern African country, *M. natalensis*, *M. erythroleucus* and *M. awashensis* can occur, but their distribution was not specified because of similar morphology and co-existing in sympatry. We summarized all known records of genetically identified *Mastomys* species in Ethiopia. The genus inhabits large part of the country, but obviously avoids the highest mountains and very dry areas. For the first time in Ethiopia, we documented *M. kollmannspergeri* from a single locality. *M. awashensis* was found at 18 localities, *M. erythroleucus* at 32 localities and *M. natalensis* at 13 localities. Analysis of cytb gene sequences revealed that only one of the six phylogroups of *M. natalensis* and one of the four phylogroups of *M. erythroleucus* are represented in Ethiopia. Using presence records, we constructed the species distribution models for *M. natalensis*, *M. erythroleucus* and *M. awashensis*. Obtained predictions of the *Mastomys* species distributions demonstrated some overlap. The most overlap is observed between the *M. awashensis* and *M. natalensis* models (0.748). This is in accordance with available information on the distributions of these species, which are co-existing in four localities. There is medium level of overlap between the *M. natalensis* and *M. erythroleucus* models (0.537). Both species are co-existing in two localities. Smaller overlap is observed between the *M. awashensis* and *M. erythroleucus* models (0.467). Nevertheless, these species are co-existing in two localities with average level of suitability.

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(POSTER)

An Africa Centre of Excellence for Innovative Rodent Pest Management and Biosensor Technology Development (ACE IRPM&BTD) in sub-Saharan Africa

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An Africa Centre of Excellence for Innovative Rodent Pest Management and Biosensor Technology Development (ACE IRPM&BTD) was established in 2016/2017, based in Tanzania. The ACEIRPM&BTD shall enhance scientific knowledge (taxonomy, ecology, zoonotic diseases, pest management, biosensor using rats), technology and innovations (STI) on rodent pest management in Africa. ACEIRPM&BTD is currently focusing on two major activities (i) Postgraduate training (32 registered PhD candidates undertaking studies in Tanzania, Uganda and Ethiopia). Sixteen MSc. candidates embarked on research activities in 2018/2019. (ii) Curriculum development for MSc. programmes to train potential candidates for

PhD studies on rodents. About 35 PhD and 80 MSc candidates will enroll in the next five years. Studies already being undertaken include:

(i) Landscape ecology and population dynamics of rodents in Afro-alpine ecosystems, Ethiopia. (ii) Diversity and population dynamics of rodents and associated ectoparasites in Mt. Elgon ecosystem, Uganda. (iii) Prevalence and diversity of haemoflagelates and filarial worms in rodents and shrews in Uganda. (iv) Habitat disturbance, population dynamics and community structure of rodents in forest reserves, Uganda. (v) Ectoparasites and gastrointestinal helminthes diversity in rodents and shrews in Semiens Mountains, Ethiopia. (vi) Prevalence of *Leptospira* in rodents, shrews and humans in Uganda.(vii) Community ecology of rodents in the Selous ecosystem, Tanzania. (viii) Ecology of rodents and flea ectoparasites in plague endemic foci in the Rift Valley, Tanzania. (ix) Biosensor technology development using the African giant pouched rats, *Cricetomys gambianus* (5 studies in pipeline). x) Fifteen newly enrolled PhD students have embarked on proposal development also covering a wide range of studies but predominantly ecology on a wide range of landscapes in East Africa.

The ACEIRPM&BTD will support high impact research on rodents in Africa and welcomes collaboration with scientists from all over the world.

(ORAL PRESENTATION)

Comparative genetic structure of the forest dwelling *Myosorex cafer* and the generalist *Rhabdomys dilectus* in the Eastern Cape of South Africa

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The Eastern Cape forests in South Africa contain high floral and faunal species diversity including habitat specialist and generalist taxa. Due to historical climate fluctuations these forests have become fragmented and broadly consist of the scarp forest, coastal forest and Afromontane mistbelt forests. In this study we hypothesise that these three forest groups may have shaped the population genetic structure of fauna inhabiting them. To test this hypothesis we compared the genetic diversity of two species: the dark-footed forest shrew, *Myosorex cafer* (forest specialist), and the four-striped mouse, *Rhabdomys dilectus* (generalist). Mitochondrial data comprising COI (630 bp), cyt b (1100 bp) and a portion of the control region (450 bp) was generated from R. dilectus (N=58) and M. cafer (N=56) collected from localities within the three forests. Demography analysis revealed recent population size expansions (*M. cafer*: Tajima's D: -1.53683, $P < 0.10$; *R. dilectus*: Tajima's D: -1.38123, $P < 0.05$). However, concatenated data retrieved 26 haplotypes for the striped mouse (haplotype diversity,

Hd=0.9605±0.00013) that are distributed among forests and they are separated by shallow sequence divergences ranging from 0.002 - 0.03 (Kimura 2-parameter model) resulting in low Fst values (Fst =0.19602). On the other hand, *M. cafer* contains 21 haplotypes (Hd=0.9754±0.00023) with high site fidelity; ony one haplotype was shared among the three forest groups. Sequence divergences among the haplotypes ranged from 0.002 - 0.013 and high Fst values (Fst=0.53185). *Myosorex* data from the three forests data strongly suggests that the species comprises metapopulations with limited gene flow between forests while *R. dilectus* data retrieved no genetic structure possibly due to higher connectivity between demes. The data from these two species confirm that forest dependent species are more highly impacted by forest fragmentations than generalist species.

(ORAL PRESENTATION)

Survival and maturation of Multimammate rat (*Mastomys natalensis*) in cultivated field and fallow land habitats in Mayuge district, Eastern Uganda

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A 2.5 years study was conducted in order to understand the relationship between survival and maturation rates of *Mastomys natalensis* with environmental predictors. The study was conducted in Mayuge district in Eastern Uganda with Capture Mark Recapture technique. Survival, maturation and capture probability were estimated using multi-event capture-recapture models. Survival rates were higher after high rainfall in the previous month and increased with increasing population density of the animals. On the other hand, maturation rate was not significantly influenced by rainfall, sex and habitat. This could be as result of the mixed cropping system in the study areas, resulting in food availability throughout the year, or because of the low numbers of recapture, which is thought to have limited attainment of clear differences. The results of the study have important implications for the timing of application strategies, i.e. control efforts should be enforced during the rainfall seasons to prevent population outbreak in the succeeding seasons.

(ORAL PRESENTATION)

Evolution at altitudinal gradient: assessment of the role of genetic and ecological factors in speciation of Ethiopian rodents

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Speciation process is affected by the combination of genetic, ecological and geographical factors and its understanding is important for efficient protection of biological diversity. In our project we focus on mechanisms forming high genetic diversity of endemic Ethiopian rodents. Ethiopian highlands, known as one of the most important centers of endemism on Earth, are divided by the Great Rift Valley into two main mountain massifs with steep ecological gradients along different elevations. Ethiopian rodents provide an excellent opportunity to study microevolutionary processes, especially to disentangle the roles of ecological and geographical factors in speciation. In this study we focused on the endemic Ethiopian murid genus *Stenocephalemys*, which has complex and unresolved taxonomy. Using the most comprehensive sampling across Ethiopian highlands, we reconstructed its phylogeny using complete mitogenomes and ca 400 genomic fragments across nuclear genome. Morphological variation was assessed by 2D geometric morphometry of 160 skulls analyzed from dorsal, ventral and lateral view. We confirmed six major gene pools corresponding to four described species (*S. albipes*, *S. albocaudata*, *S. ruppi* and *S. griseicauda*) and two taxa not yet formally named (*S.* sp. A and *S.* "*pseudogriseicauda*"). We also evidenced the presence of the "reticulate" evolution, manifested by several events of ancestral or recent mtDNA introgression (so the use of mtDNA barcoding for species identification can be misleading). Morphological variation was primarily affected by the ecological gradient along mountain slopes.

The study was supported by the Czech Science Foundation, project no. number 18-17398S.

(ORAL PRESENTATION)

Diversity and Distribution of Small Mammals of Chilalo-Galama Mountains Range, Southeastern Ethiopia

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A study on diversity and distribution small mammals was conducted in Chilalo-Galama Mountains Range from August 2013 to December 2016. The main objective of this research was to make ecological assessment on diversity, distribution, relative abundance and habitat association of small mammals. A total of 40 grids from eight representative habitats were selected. A 5x5 Sherman Live trapping grid with 15 m spacing was employed for three consecutive days per each intensive grid. Overall, 230 mist net net-nights were employed during 60 nights. Sherman live traps, mist nets and mole rat traps were used to capture small mammals. Overall 36 species of small mammals were recorded of which at least 20 species or 55.56% were endemic to Ethiopia. Trap success ranged from 27% to 85.71% with overall trap success of 44.6%. Out of the 4302 captured individuals 4074 were rodents and 228 were shrews. In addition, 219 bats were captured of which 197 (89.95 were new captures, 16 (7.31%) were recaptures and the 6 (2.74%) were unidentified. The overall netting success and capture rate were 0.95 bats/net-night and 0.83 bats/net-h, respectively. The highest relative abundance was recorded for *L. brevicaudus* (21.36%) followed by *S. griseicauda* (17.50%) and *S. albipes* (16.44%). The least relative abundance was recorded for *D. nikolausi* and *M. imberbis*. Capture per trap night was highest (55) for moorland habitat and least (16) in plantation habitat. Small mammals showed variation in distribution and abundance along altitudinal zonation. Results on chromosomal and molecular analysis of the representative species show similarity with its previously described from different parts of the country and showed close affinity with the Bale Mountains. As Chilalo-Galama Mountains Range had high diversity of fauna and flora, proper conservation measures have to be implemented.

(ORAL PRESENTATION)

The role of molecular biology and old fashioned taxonomy in resolving the identification of cryptic bats in Africa

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Research on African small mammals has mostly focused on rodents, with bats receiving far less attention. However, bats are the second most diverse order of mammals with well over 250

species occurring in Africa and associated islands. Furthermore, bats play a wide range of ecosystem services including pollination, seed dispersal, and in agroecosystems, pest suppression.

Correct species identification is important for many disciplines including conservation of biodiversity. However, cryptic species make identifications difficult, a problem familiar to bat biologists, particularly those working in the tropics. I start by highlighting the importance of systematic and taxonomic studies which I illustrate using the example of Mt Nimba, West Africa. Over the course of three short surveys that I participated in, the number of bats increased from 32 to 59 species, including at least four new species to science. Furthermore, the endemic Hipposideros lamottei had been misdiagnosed in the original species description leading to much confusion in the literature over the past 30 years.

Traditionally, cryptic bat species were resolved by careful examination of specimens including detailed analyses of inter alia teeth, skulls and noseleafs; a practice requiring the sacrificing of specimens as vouchers. Advances in molecular techniques have allowed for species identification based on tiny tissue samples (typically wing punches in bats) that do not call for the taking of voucher specimens. This has led some bat workers to call for an end in the taking of specimens. I end the talk, by discussing how an approach that relies entirely on molecular sequencing for species identification (without vouchers) can lead to serious problems and confusion; particularly in an African context where new species are continuously being described. I illustrate this with examples based on my own experience.

(KEYNOTE LECTURE)

Diversity of Shrews and Rodents of disturbed areas in Yoko Forest Reserve and its vicinity: recolonization capacity in a slashed and burned area (Kisangani, DRC)

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We investigated rodents and shrews in three habitats of the Yoko Forest Reserve and surroundings to compare their composition and structure, and to assess their sequence of recolonization after slash and burning.

Six trap sessions were simultaneously carried out in three permanent plots of 16 ha (fallow land, old palm plantation and primary forest) from 2011 to 2012. Before the third trap session the fallow land plot was slashed and burned and then sampled one week after burning.

We combined Pitfall and Sherman traps in each plot, at the rate of two lines per location (in the center, at each diagonal side: 25m and 75m of the border).

We recorded 14 of shrews and 13 species and rodents in 40800 trap nights. In general, no difference was noted in the distribution of shrews species among habitats types, contrary to rodents for which higher abundances occurred in fallow land. Comparison of small mammals diversity before and after burning, show slight changes: lower species richness for shrews (S= 9 before vs 6 after, pi=7.1 vs 5,7 diversity index D=0.58 vs 0.51; H'= 0.97 vs 1.03 ; e=0.44 vs 0.57) against the highest relative abundance for rodents (4.78 vs 12.9: S=7 vs 5, s= with diversity index D=0.22 vs 0.31; H'=1.68 vs 1.32; e=0.86 vs 0.82). *Crocidura* cf *ludia* and *Praomys* cf *minor* are the most dominant species.

Some species like *Paracrocidura schoutedeni* are captured only at the edge (at 25m) of the fallow grid, close to remnant forests while others like *Dendromus mystacalis* appears later, two month after burning. Globally, when homogenous forest habitats are closer to the disturbed area, rodents and shrews´ community structure seem little affected by disturbance due to slash and burning practice.

(POSTER)

Assessing antifertility effects of *Acacia nilotica* and *Albizia lebbeck* on *Mastomys natalensis*

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The antifertility potential of medicinal herbs was investigated in male *Mastomys natalensis*. Stem bark and pods from *Albizia lebbeck* (AL) and *Acacia nilotica* (AN) respectively were initially processed. Crude extracts in distilled water and 70% methanol were obtained for AN and AL, respectively, after 72 hours. Extract from AN was concentrated in water bath at 400C. AL extract was concentrated in vacuumed rotor evaporator at 800C and water bath at 460C. Test animals (n=30) were randomly sorted into 3 groups of 10 and treated daily with 100mg of the plant´s crude extracts in 8g of broiler mash for 60days as follows: Group1: AN, Group2: AL, Group3 control: plain diet. Body weight was recorded at baseline and at day 60. Weights of reproductive organs, histology of the testis and sperm cells parameters were assessed at day 60. Rats on AN and AL displayed marked reduced mean body weights, testis, epididymis and seminal vesicles compared to the control. No sperm cells were observed in the AL treated rats. For the AN treated rats, no progressive motile sperm cells was observed and total sperm cells motility was significantly lower compared to the control. Sperm cells viability assessment indicated no sperm cells in the AL treated. Live sperm cell number was significantly lower in

AN treated compared to the control. Histomorphometry of seminiferous tubules indicated marked increase in lumen size and significant reduction in size of germinal epithelium layer. Histologically, seminiferous tubules indicated extensively loosened germinal epithelium, intraepithelial vacuolation, giant cells formation and halted spermatogenesis in the AN and AL treated compared to the control. The study indicates that, crude extracts from AN and AL may cause suppression of fertility in male *M. natalensis*.

(ORAL PRESENTATION)

Small mammal wild game in the periphery of the Rubi-Tele Hunting Estate (Bas-Uélé, DRC)

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The imbalance in the supply of large and medium-sized game mammals in local markets over the past two decades is leading to a rush to exploit small mammals. Previously, small mammals, considered in most of them to be the object of food taboos reserved for certain age categories (the elderly) or social categories (the chiefs), have now become the potential target for human consumption and for marketing.

A huge quantity of small mammals (746, 19 Kg) is collected by Rubi Tele residents not only for subsistence but also for financial gain. The small mammal hunt mainly concerns the group of rodents (Gambia rats, porcupines and squirrels) at 94.5% and the group of small carnivores (genets, mongooses, palm killer civet and Congo otter) at 5.5%. The markets for these small game hunted in Rubi Tele Wildlife Reserve are growing and expanding in communities farthest from it, and the survey shows that it is the gold and diamond mining centers in Banalia territory in the neighboring Tshopo Province that are the main takers/consumers of Rubi Tele wildlife, including Mangi (76.5%), Bongoza (8.42%) and Kole (6.62%). Thus, the important part of this consumption is on the left bank of the Aruwimi River (91.54%) and the little (8.46%) that remains serves the right bank with Banalia (5.1%), Kisangani (2.8%) and Belgika (0.56) as consumption locations.

From this research, it is clear that markets for small mammalian game are more in small rural areas and not in large urban centers such as Kisangani, which leaves out information on the specific wealth and quantity of game sold in urban markets considered by researchers to be ideal

reference sites for this type of research, given their regional representativeness. It also suggests that particular attention should be paid to small mammals, a group of over-exploited game animals that are "anonymously" overexploited and could suffer the same fate as large mammal species, which are becoming increasingly rare in the region.

(POSTER)

Brain size responses to high altitude living in North American (Cricetidae) and African (Muridae) rodents revealed by 3D morphometric analysis of micro-CT scanned images: preliminary results

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In order to better understand functional morphological adaptations to high elevation life in both North American and African montane-associated rodents, we used a 3D morphometric approach to acquire 3D images of the endocranial (brain) volumes of 51 crania of low-elevation and high-elevation populations of North American deer-mice (*Peromycus*) as well as low-medium elevation (*Praomys hartwigi* and *Stenocephalemys albipes*) and high elevation (*S. albocaudatus*, *S. griseicaudata*) species of African rodents of the Tribe Praomyini (Murinae) as well as populations of Sloggett´s Ice Rat (*Otomys sloggetti*) from medium and high elevations in South Africa. Micro-Computed Tomography (CT) scanning at 15-23 µm resolution was conducted to build 3D composite images and further analysis was done with AVISO, ENDEX and R-studio software. We expected brain volume to scale with skull size to the mammalian constant allometric slope of 0.75, and to be greater in high elevation populations in deer-mice to compensate for brain-swelling associated with altitude sickness at high elevations. Our results showed that brain volume and skull length were not significantly different between highland and lowland *Peromyscus* populations but the allometric slope of brain volume with skull length in highlanders was half that of lowlanders (slope =0.37 cf 0.70 respectively). The former is close to intraspecific values obtained for myomorph rodents while the latter is close to the hypothesized power constant for all mammals proposed for all taxonomical levels. On the other hand, we found no allometric response of brain volume to cranial size but a strong positive correlation between brain volume and elevation in *O. sloggetti* from the Drakensberg Range of South Africa.

(ORAL PRESENTATION)

Distribution of the Egyptian mongoose *Herpestes ichneumon* (Linnaeus, 1758) in Africa, with first records for Laikipia County, central Kenya

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The paucity of studies of the Egyptian mongoose *Herpestes ichneumon* in Africa highlights the need for presenting baseline information on the geographic distribution of this species and factors that may determine distribution across the continent. This study utilized the opportunity presented by confirmed localities of *H. ichneumon* in Laikipia County, central Kenya, to address questions on distribution of H. ichneumon in Africa, with a prediction of the environmental suitability of Laikipia. We used 3,926 georeferenced locality records of *H. ichneumon* to generate distribution maps and conduct ecological niche modelling. Only about 10% of all records occur in continental Africa, with but 88 records for Kenya. Despite past extensive field research and predicted suitability, *H. ichneumon* has only been listed in the Laikipia mammal list (Thouless, 2011) and has hitherto not been sighted in Laikipia County. Our niche models, however, predicted Laikipia to be environmentally suitable for H. ichneumon. Our five records of *H. ichneumon* in well-studied Laikipia County underscores the limited knowledge of this species' distribution and environmental requirements in Africa.

(ORAL PRESENTATION)

Socio-environmental changes, structure and impact of rodent communities and their parasites: the context of major hydro-agricultural schemes in the Senegal River valley

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Ecosystems are increasingly exposed to global changes of anthropogenic origin, which include climate, biodiversity, or land use. These global changes may be the cause of major agricultural problems via deforestation, an increase of crop pests, an impact on crop yields. These changes may also have severe direct or indirect health consequences via animal populations acting as reservoirs of zoonoses.

Parasitism is increasingly considered as an important potential factor affecting the response of species to global change. Parasites can regulate the abundance of their host population, influence the structure and composition of communities, and affect the composition of ecosystems.

In Senegal, rice production is still insufficient to cover household consumption needs despite the availability of arable land and a river in the North. As part of the national program of self-sufficiency in rice and large irrigation projects in the Senegal River Valley, agricultural development programs aimed at increasing production and stocks have been implemented. These changes are accompanied by an increase in the food resources and water around which human populations, livestock, rodents and associated parasites / pathogens concentrate and meet, with expected consequences in terms of health and food security.

It is in this context that our thesis will be implemented. falls in order to determine the rodent communities (identification of species) pests of culture present in the valley of the Senegal River. But also to characterize the species of parasites that they shelter (gastrointestinal helminths and dermatophytes fungi), and which could be source of diseases, but especially to impact the dynamics of these populations of rodents. This thesis will also make it possible to estimate the damage caused to the fields and the stocks by these rodents, so as to be able to alert but also to take adequate measures for a fight against these pests of cultures.

(ORAL PRESENTATION)

The phylogeny of the wood mouse (Muridae, *Hylomyscus*) based on complete mitochondrial genomes and five nuclear genes reveals cryptic diversity

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Woodmice of the genus *Hylomyscus* are small-sized rodents belonging to the family Muridae. They are geographically restricted to tropical Africa, where they are abundant in lowland and montane rainforests. Based on external and craniodental morphology, *Hylomyscus*

species were separated into six species groups: aeta, alleni, anselli, baeri, denniae and parvus. Within these species groups, *Hylomyscus* species are morphologically similar and, as a result, the taxonomy is still a subject of debate. We obtained genetic data (complete mitochondrial genome and five nuclear genes) from 141 *Hylomyscus* specimens, representing the six known species groups. This study is thus the most complete phylogeny of the genus to date both in term of geographical, taxonomic and genomic coverage. It confirms the monophyly of the genus and of the six previous species groups. Our species delimitation analyses suggest the presence of 24 candidate species in our dataset, 9 of which being cryptic, unrecognized species. Integrative species delimitation approaches including morphometrics, ecology, and distributional data are now needed to confirm their validity and to formally describe them. Diversification events within the genus occurred during the last 5.7 My and are linked to the evolutionary history and past connections among African forests. The first split is linked to the fragmentation of the African Miocene forest into the current Guineo-Congolese and East Africa forests at this time. The Early Pliocene marks a renewal of hotter and more humid climates, and possibly reconnected these forest blocks. The most intensive radiation of *Hylomyscus* is dated into the period 3.5-1.4 Mya and seems to be linked to several prolonged periods of strong wet-dry variability. The last period of diversification occurred during the period of climatic instability dated from 1.1 to 0.9 Mya.

(ORAL PRESENTATION)

Population size and survival of the Malagasy fruit bat *Rousettus madagascariensis* (Pteropodidae) in Ankarana, northern Madagascar

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Population size and survival are crucial factors to understand population dynamics of a given species, especially those that have long life spans and delayed sexual maturity, such as Pteropodidae bats. We studied the population size and apparent survival of individuals at a day roost site of an endemic cave-dwelling Malagasy fruit bat, *Rousettus madagascariensis*, in relation with age and sex. 1,801 individuals were captured and tagged over the course of four years in the Grotte des Chauves-souris, Réserve Spéciale at Ankarana, northern Madagascar. The Cormack-Jolly-Seber model and the POPAN model in the program MARK was used to analyze mark-recapture data and to estimate apparent individual survival and population size.

The apparent survival of individuals ranged from 0.46 to 0.60, but exhibited significant variability associated with age, sex, and time. Apparent survival is lower in adults compared to sub-adults (Φ adult = 0.49; Φ sub-adult = 0.63). For adults, the apparent survival of males was higher (Φ male = 0.50; Φ female = 0.47), and conversely for sub-adults, it was in favor of females (Φ male = 0.55; Φ female = 0.70). Population size ranged from 1,245 (CI: 268-3,050) to 5,868 (CI: 3,520-10,601) and was significantly higher during the wet season as compared to the dry season. The survival rate in this population is strongly influenced by mortality and secondarily by dispersal. We found that the apparent survival of individuals has a positive impact on population growth but less than birth rate. Thus, the health and sustainability of the population relies heavily on individual survival.

(POSTER)

An ecosystem approach to investigating coronaviruses at Taita Hills, Southeastern Kenya

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Small mammals especially bats and rodents are known reservoirs of a suite of viral pathogens including coronaviruses. Many of these viruses have spilled over to humans mainly due to increased contact between humans and small mammals caused by human encroachment into wildlife habitat and small mammal movement into urban areas following habitat loss. The objective of this study was to evaluate the diversity and host relationships of coronaviruses at the Taita Hills, southern Kenya. Coronaviruses are a diverse virus group that infects a wide variety of mammal species. However, due to most studies focusing on one or few closely related species little is understood regarding how coronaviruses are maintained at an ecosystem-level.

Fecal and intestine samples were collected from various bat (280) and rodent (150) species in the area, and fecal samples were also collected from livestock including cattle (64), sheep (18), goats (50), donkeys (41) and camels (62). Samples were screened using pan-coronavirus RT-PCR assay and coronavirus positives samples were sequenced to evaluate their phylogenetic relationship to each other and hence the level of cross-species transmission.

Screening is ongoing, and will be completed by early summer 2019. Preliminary results based on bat screening demonstrate that *Mops condylurus* carries both Alpha and Betacoronavirus. This study, and its multi-species approach, will help to understand how

potentially dangerous pathogens are maintained in complex natural systems, and may help guide interventions aimed at preventing potential human disease outbreaks.

(ORAL PRESENTATION)

Small mammals and cutaneous leishmaniasis in southern Ethiopia

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Cutaneous leishmaniasis is a neglected disease that is endemic in the highlands of southern Ethiopia. Here, *Leishmania aethiopica* protozoa are transmitted by a bite of female sandflies. These inhabit rocky crevices and live in close proximity to hyraxes (*Heterohyrax brucei*), which were assigned in 1973 as reservoirs of *L. aethiopica*. In this complex zoonotic transmission setting, it is important to establish all infection sources to accomplish efficient control programs.

This study aimed to investigate the feeding behavior of sandflies to get an indication of potential Leishmania hosts and assess whether hyraxes are still the only reservoirs or whether rodents could also contribute to transmission.

The source of sandfly blood meals from different habitats was identified by sequencing of the Cytochrome B (CytB) gene. The biting preference of the vector was further investigated in an experimental set-up, where field captured sandflies were allowed to take a blood meal from an exposed human hand or a hyrax. The blood meal was later determined by CytB sequences. To assess the *Leishmania* prevalence in rodents and hyraxes, skin biopsies were screened for the presence of kinetoplast DNA (kDNA).

This study found that sandflies mainly bite humans and hyraxes inside caves, while the feeding preference experiment showed that sandflies have a significant preference for hyraxes. Overall, 7% of the blood meals were acquired from spiny mice (*Acomys* spp.). Eight rodent species were captured, but spiny mice were not found. One single African pigmy mouse and 20% of *H. brucei* were found kDNA positive.

Overall, we found that hyraxes show a high infection prevalence and are preferred by sandflies for a blood meal. Their transmission efficiency should be determined to assess whether they are a source of infection or a protective factor. Sandflies appear to bite spiny mice, suggesting that these should be tested for the presence of *Leishmania*.

(ORAL PRESENTATION)

The genetic consequences of social structure

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Many mammalian species are structured in the form of social groups. These are far from being sparse aggregations, within groups individuals coordinate activities, cooperate and mate according to complex strategies. Yet, population geneticists have tended to ignore social structure and envision social groups as relatively small random-mating units. Thus, many group-living species are believed to be subjected to significant genetic drift, inbreeding and inbreeding-depression effects. Although inbreeding depression has been reported in many population genetics studies, behavioral ecologists find outbreeding, rather than inbreeding in many species and ecologists often invoke inbreeding-avoidance strategies as an important mechanism to prevent inbreeding-depression effects. During the past years we have developed new software to simulate genetic and demographic data under some of the most common mating strategies found in primates. In this framework social groups consist of small age-structured units where a limited number of individuals monopolize reproduction and mate according to more or less complex strategies. Simulations under this model have shown that social groups are surprisingly efficient in maintaining genotypic diversity in the form of outbreeding without inbreeding-avoidance mechanisms. This contradicts the belief that small groups are necessarily subject to strong genetic drift and at high risk of inbreeding depression. We apply this framework to an endangered lemur species (*Propithecus tattersalli*) restricted to a small region in Northern Madagascar. An empirical study reports strong outbreeding for this species, a pattern associated to sex-biased dispersal and mate choice to avoid kin. However, we recover the outbreeding patterns measured in nature even though we do not model explicit inbreeding avoidance behaviours. This suggests that demonstrating the existence of active inbreeding avoidance mechanisms may be more difficult than usually assumed.

(ORAL PRESENTATION)

Diversity and ecology of tree Sciuridae (Rodentia, Mammalia) in the Yoko Forest Reserve (Ubundu, DR Congo)

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Tropical forest ecosystems host a high biological diversity, but are severely degraded by human activities (Katuala, 2005). However, according to Katuala (2009), the taxonomy of small mamma species and their distribution are still poorly known in tropical Africa. The Yoko Forest Reserve (YFR) in the DRC is not immune to these gaps in knowledge of wildlife inventories or threats to ecosystems and forest degradation.

For more than three decades, the Faculty of Science at the University of Kisangani has been studying small mammals diversity but focused mostly on terrestrial species. As such the diversity, distribution, species population dynamics and ecological preferences of Sciuromorphic Rodents in the region are still poorly known (Baelo et al., 2016). Describe Sciuridae specific richness taking into account the spatio-temporal dynamic of trapping success according to habitat type and strata (sub-canopy).

We caught in total 123 squirrels in 8775 trap nights (trapping success=1,4) and inventoried six species (*Funiscisurus anerythrus*, *F. bayonii*, *F. congicus*, *Heliosciurus rufobrachium*, *Paraxerus boehmi* and *Protoxerus stangeri*). *F. anerythrus* was the most abundant species in the collection and in fallow land. Number of non-sampled species is higher in Jc (R=4 and Chao1=6±0.24). The sampling coverage rate provides homogeneous values between habitats; FP (ACE=5.26±1.19), FS (ACE=5.84±1.15) at Jc (ACE=6.7). FS is more diversified (H'=1.49 and 1-D=0.7149) than FP (H'=1.257 and 1-D=0.687) and Jc (H'=0.569 and 1-D=0.2936). Habitat type influences trapping succes with more species caught in fallow land ($F = 13{,}042$; ddl = 2 ; $p < 0{,}0001$). Mature, reproductive individuals were 2 times more abundant than immatures of the same sp. The sex ratio was balanced for both groups. The reproduction rate in *F. anerythrus* is 0.75. This first study shows the relevance of systematic inventories and phylogenetics of this poorly studied taxonomic group.

(POSTER)

Evolutionary history of *Pneumocystis* fungi in Tanzania rodents

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Pneumocystis are yeast-like fungi parasitizing the lungs of a wide range of mammal species. A recent study on Asiatic murids showed that several *Pneumocystis* lineages/species are shared by different host species or genera in the Rattini and Murini tribes, challenging the patterns of strong specificity and co-speciation previously reported for these fungi in other mammalian groups. To test if the lack of specificity observed in Asiatic rodent tribes is a special case resulting from the high diversification rates of these rodent tribes or if it is a common features of *Pneumocystis* in rodent hosts, we screened 27 species of Tanzanian rodents from five families for the presence of *Pneumocystis* DNA. We detected *Pneumocystis* in all but seven screened host species, with prevalence ranging from 5.9 to 100%. Using reconstructed multi-locus phylogenies of both hosts and parasites, we tested the hypothesis of their co-evolution. The co-phylogenetic signal was highly significant. We found multiple co-speciations, sorting events and two host-shift events, which occurred between Murinae and Deomyinae hosts. Comparison of genetic distances suggests higher substitution rates at mtDNA for Pneumocystis relative to the rodent hosts on neutral positions and slower rates on selected ones. We discuss life-history traits and population dynamics factors which could explain the observed results.

(ORAL PRESENTATION)

Vascularization of the thermal window in the social African giant mole-rat *Fukomys mechowii*

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Giant mole-rats (*Fukomys mechowii*) as other members of the family of African mole-rats (Bathyergidae) are subterranean rodents which spend their whole lives in self-constructed burrow systems. Digging and maintaining of burrows is physically demanding and produces large amount of metabolic heat, potentially leading to body overheating. Heat dissipation

underground is constrained by limited ventilation and high humidity in burrows. Moreover, mole-rats lack body appendages, such as long legs, auricles or tails, which could enhance body surface and be used for heat dissipation. The most efficient way to dissipate surplus heat seems to be conduction, i.e. pressing specialized body parts to burrow walls. Relatively high thermal conductance found in subterranean rodents suggests that conduction is indeed a most efficient way for thermoregulation in these animals.

Body parts with the most prominent thermal exchange, the so-called thermal windows, were described in many mammalian species. Thermal windows are well vascularized, less haired areas, with a negligible hypodermis layer. Skin morphology of thermal windows was studied mainly in marine mammals, and it was concluded that the key adaptation for heat exchange is vascularization involving dense network of arteriovenous anastomoses.

Our previous study on *Fukomys mechowii* using IR-thermography identified a thermal window on the body ventrum, having shorter and less dense fur compared to dorsal body part. Here, we describe skin morphology (thickness of skin and its layers, thickness and connectivity of fat tissue and vascular network density and number of arteriovenous anastomoses) in the putative ventral thermal window and compare these traits with those at the body dorsal side and discuss the possibilities of thermal conduction via pressing the belly to the burrow ground.

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(ORAL PRESENTATION)

A preliminary study on the activity, diet and exploitation of the forest by a critically endangered primates Mongoose Lemur (*Eulemur mongoz*) within the forestry of Antrema, Madagascar

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The study of animal behaviour can make a significant contribution to conservation. The focus of my study was to investigate possible behavioural adaptations of Mongoose Lemur (*Eulemur mongoz*) with respect to (I) seasons and (II) habitat types (dry forest on dune and dry forest on soil clay). The study was carried out in northwestern of Madagascar at the forestry station of Beankama (dry forest on dune) and Ankoririaka (dry forest on soil clay) between February-March and April-May 2003. We focused on three aspects of the behaviour of these animals: their activity, diet and habitat use. The scan sampling method was used to record the activities of all the individuals composing the group every 5 minutes. A change of activity were observed between dry and rainy season. *E. mongoz* increased their resting time (up to 80%) during the dry season. 26 plant species were used as food resources. *E. mongoz* fed substantially

fruit than leaf. The favoured plant species varied between season and habitat. *E. mongoz* exploited mainly the middle part of the forest independent of the season. Our findings were preliminary, but ours results provided information for subsequent ecological studies of *E. mongoz* since 2003.

(ORAL PRESENTATION)

Rates of hematophagous ectoparasite consumption during grooming by an endemic Madagascar fruit bat

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Few details are available on the consumption of ectoparasites, specifically bat flies (Diptera: Nycteribiidae and Streblidae), by their chiropteran hosts while grooming. Such details are important to document consumption rates of ectoparasites by their bat host and provide informations on the dynamics of host-parasite interactions. We present data on ectoparasite consumption rates for an endemic Malagasy fruit bat (Pteropodidae: *Rousettus madagascariensis*) occupying a cave day roost colony in northern Madagascar. Using quantified behavioral analyses, grooming and associated ingestion rates were measured from infrared videos taken in close proximity to day-roosting bats. The recorded individual bats could be visually identified to age (adult, juvenile) and sex (male, female), allowing analyses of the proportion of time these different classes allocated to consuming ectoparasites via auto-grooming (self) or allo-grooming (intraspecific) per 10 min video recording session. These figures could then be extrapolated to estimates of individual daily consumption rates. Based on video recordings, adults spent significantly more time auto-grooming and allo-grooming than juveniles. The latter group was not observed consuming ectoparasites. Grooming rates and the average number of ectoparasites consumed per day did not differ between adult males and females. The mean extrapolated number consumed on a daily basis for individual adults was 37 ectoparasites. When these figures are overlaid on the estimated number of adult Rousettus occurring at the roost site during the dry season, the projected daily consumption rate was 57,905 ectoparasites. The details presented here represent the first quantified data on bat consumption rates of their ectoparasites, specifically dipterans. These results provide new insights in host-parasite predation dynamics. More research is needed to explore the mechanism zoonotic diseases isolated from bat flies might be transmitted to their bat hosts.

(ORAL PRESENTATION)

The impact of chromosomal rearrangements on cryptic speciation on the African vlei rats

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The African endemic vlei rat, *Otomys irroratus* has a wide distribution in Southern Africa. Due to extensive variation in diploid number (2n=23-32), the species represents an excellent model for evaluating the role of chromosome speciation (chromosome sterility model vs chromosome suppression model). Within one of the recognized mitochondrial clades there is extensive chromosomal rearrangements including heterozygous pericentric inversions and Robertsonian fusions, all of which were identified using standard cytogenetics (G-banding). Given that some of these chromosomal rearrangements are negatively heterotic (according to the chromosome sterility model) we used immunofluorescence to target proteins of the lateral elements of the synaptonemal complex and centromere proteins to study meiotic configurations among specimens. Two main groups were compared: standard karyotypes (no rearrangements, N=13) and those characterised by rearrangements (pericentric inversions and Robertsonian fusions, N=17). All these specimens were barcoded using the COI (660bp) and cyt b (1137 bp), and analysed with the broad sequence data that has been accumulated over the past two decades (N=127). The immunofluorescence results with the SYCP3 antibody revealed no inversion loops, even in specimens carrying inversions (N=30). In addition, two centromeric signals per chromosome were detected in one specimen (all the other had one centromeric signal). Immunostaining results from all karyotyped specimens (with rearrangement and those without rearrangement) demonstrate that normal pairing of chromosomes occurred during meiosis. MtDNA sequence data was congruent with the immunostaing data, i.e. specimens harbouring rearrangements were equally divergent from specimens without rearrangements (mtDNA sequence divergence 0.3 - 1.1%). In effect the two datasets suggest that inversions and Robertsonian fusions are not linked to mtDNA divergence (i.e. incomplete lineage sorting).

(ORAL PRESENTATION)

Small mammal species diversity in the Selous Game Reserve ecosystem, Tanzania

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This study aimed at investigating the diversity and distribution of small mammals in Selous ecosystem, Tanzania. Four sites; Nyamambi/Matambwe mountain, Sable forest, Matambwe seasonal riverine and Rufiji riverine forest/thicket, were selected and in each two grids of 70m x

70m were established and marked using Global Positioning System (GPS). Two methods were used: Capture Mark Recapture (CMR) and random placement of Havahart traps in the selected sites. All the captured animals were marked by toe clipping and released at the site of capture. Between July 2018 and May 2019, a total of 361 individuals from 15 species belonging to seven (7) families were made in 12 936 trap nights with three (3) percent trap success. The species include; *Acomys wilsoni*, *Aethomys chrysophilus*, *Cricetomys gambianus*, *Grammomys dolichurus*, *Lemniscomys rosalia*, *Mastomys natalensis*, *Mus minutoides*, *Paraxerus flavovittis*, *Paraxerus palliatus*, and *Rattus rattus*. Other species include *Crocidura hitra*, *Petrodromus tetradactylus*, *Genetta genetta*, *Mungos mungo* and *Otolemur garnetti*. Nyamambi/Matambwe Mountain had the highest species abundance while Rufiji riverine forest/thicket had the least. Abundance differed significantly between habitats (F=22.064 df=3 p=0.0000001) but not across seasons. *Acomys wilsoni* had the highest relative abundance (33 percent), while *R. rattus* was the least with only one individual. *Lemniscomys rosalia* and *A. wilsoni* were the most distributed species occurring in all habitats, while *C. gambianus* and *R. rattus* were the rarest species and were restricted in only MSR habitat. Sable forest had the highest species diversity (0.79) while Rufiji riverine had the least (0.47) and the variation was significantly different between habitats (F=7.607 df=3 p=0.006) and across seasons (F=2.611, df=6, p=0.043).

(ORAL PRESENTATION)

Species composition and temporal fluctuations of rodents and shrews inhabiting a degradation gradient in Mabira Central Forest Reserve, Uganda

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This study investigated rodent and shrew species structuring along a habitat degradation gradient in Mabira Central Forest Reserve´s (MCFR) (33°1'1.22"E, 0°22'53.76"N), Uganda. Live trapping of animals using Sherman traps set along transects of 200 meters in three habitat strata was conducted. The strata were habitats adjacent to forests, degraded forest edge and primary intact forest. Trapping was conducted intermittently with a break every after two months. A total of 720 rodents and shrews were captured between August 2018 to March 2019 representing 24 species. Species diversity was highest in adjacent forest habitats followed by degraded forest edges and least in primary intact forest. *Hylomyscus stella* was the most abundant species in degraded forest and primary intact forest followed closely by *Praomys* sp. *Lemniscomys zebra* was the most abundant in the adjacent habitats followed by *Lophuromys aquilus*. *Lophuromys aquilus* was the only species recorded from the three habitat strata. Most species showed varying levels of association with certain microhabitats, although *Mastomys*

natalensis, *Hybomys univittatus* and *Scutisorex somerini* showed statistical significance in the association. Temporal fluctuations in abundance for three most abundant species indicates two peaks for *H. stella* and *Praomys* sp. but when the population of *Praomys* sp. was at peak that of *H. stella* was lowest. In adjacent forest habitats, *L. zebra* showed two peaks while *L. aquilus* showed three peaks with alternation in dominance over time. The primary intact forest has some habitat specialists such as *Malacomys longipes* and *Deomys ferrugeneus*, while along the degraded forest edge only adaptive habitat generalist species were recorded. More species were captured in adjacent fallows and along the degraded forest edge suggesting adaptation to disturbed habitats. However specialized species have higher chances of being out competed by the generalist species and being eliminated.

(ORAL PRESENTATION)

Rats in rural areas of eastern and central Madagascar: damage and control systems

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A semi-directive survey of farmers was conducted in six villages in the central and eastern areas of Madagascar to investigate the problems caused by introduced rodents. The surveys focused mainly on the importance of introduced rodents, farmers´ perceptions of the causes of rodent related crop loss, and methods used to control rats. About 600 farmers were surveyed and rats are a regular problem for villagers. Of the three introduced rodent species to Madagascar, they reported that *Rattus rattus* (51% of respondents) and *R. norvegicus* (49%) are the most common and associated with the greatest amount of damage, followed by *Mus musculus* (8%). Rice is the most severely damaged crop (98% of respondents), followed by cassava (70%), and different fruits (e.g., pineapple and banana). Other types of damage indicated damage include rats gnawing holes into clothes or damaging different types of household utensils. Further, the interviewees were aware of possible exposure to bubonic plague after being bitten by rat fleas, as well the transmission of other diseases. The methods most widely employed by farmers to control rats include the clearing of vegetation in and around crop fields and the use of rat poison. The damage caused by rats poses a considerable resource burden on villagers, particularly given their difficult economic situation, loss of food resources to rat deprivation, and the need to purchase items damaged by these animals. In any case, because of limited financial means, most villagers have limited capacity to combat rats. Different means of rat control are proposed, such as rodenticides and traps and critically following the advice of agricultural agents, particularly to

avoid poisoning of non-target animals, as well as the dispersal of fleas associated with plague. The use of introduced domestic cats might be a useful mechanism to reduce rat populations.

(ORAL PRESENTATION)

Rodent species composition, relative abundance, and habitat association in Mabira central forest reserve, Uganda

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A study was conducted from September, 2018 to May, 2019 in Mabira Central Forest Reserve (MCFR), Uganda to determine rodent species composition, relative abundance, and habitat association. Data were collected using Sherman traps in 6 permanent grids, each 70 x 70 m in three different habitats. A total of 855 captures of 370 individual animals belonging to 14 rodent species were made in 7938 trap nights (10.8% trap success). Rodent species recorded include: *Lophuromys aquilus* (24.9%), *Hylomyscus stella* (15.7%), *Mastomys natalensis* (11.9%), *Praomys* sp. (15.1%). *Lophuromys sikapusi* (5.1%), *Lemniscomys zebra* (8.9%), *Aethomys* sp. (5.7%), *Mus* sp. (9.2%), *Gerbilliscus kempi* (0.3%), *Deomys ferrugineus* (1.9%), *Gramomys* sp. (0.3%), *Hybomys* sp. (0.3%) and *Xerus* sp. (0.3%). Overall, *L. aquilus* was the dominant species followed by *Hylomyscus* sp., *H. stella* while the least observed were *Hybomys* sp. and *Gramomys* sp. Temporal fluctuations in abundance for the four dominant species indicated two major peaks for *L. aquilus* and two for *H. stella* in September and December, and November and April, respectively. Seasons significantly affected rodent abundance ($F= 8.53$; $p=0.002$), while type of habitat did not. Both the Renyi diversity curves and the Simpson diversity index indicated that species diversity was highest in regenerating forest followed by depleted forest and lowest in intact forest. The sex ratio showed that the rodent population in the study area is male dominated with 57.3% males and 42.7% females. All age groups were represented in the population of the captured species, with 88.1% adults, 9.2% sub-adults, and 2.7% juveniles. The regenerating forest had the highest number of animals (40.8%), followed by undisturbed forest (33.5%) and least in depleted forest (25.7%). The results suggest human activity is influencing rodent species distribution and diversity in MCFR.

(ORAL PRESENTATION)

Effects of land-use on the spatio-temporal ecology of two mongoose species in KwaZulu-Natal, South Africa

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The spatial ecology of the Herpestidae family remains relatively poorly studied across southern Africa. Small carnivore species, like mongoose, can provide models of how mesocarnivores persist with anthropogenic land-use change. We are investigating how this land-use change affects aspects of the ecology, especially spatial habitat and temporal use, and movements, of two co-inhabiting mongoose species (water: *Atilax paludinosus*, large grey: *Herpestes ichneumon*). Individuals of these two species were trapped, collared and tracked using Global Positioning System (GPS)-Ultra high frequency (UHF) transmitters to study their activity, home range size and habitat use across a land-use gradient from the fragmented natural and farmland mosaic of the KwaZulu-Natal Midlands to urban areas of the greater eThekwini Durban Metropolitan Open Space System (D'MOSS). Home ranges, and habitat use showed great individual variation. This highlights how the behavioral plasticity and generalist nature of these species contributes to their persistence in anthropogenically transformed landscapes.

(ORAL PRESENTATION)

Life and work of an Ethiopian endemic, the giant root-rat *Tachyoryctes macrocephalus*, one of the most peculiar rodents in the world

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Colonising harsh environments is frequently the reason for evolution of unusual morphological, behavioural and physiological adaptations allowing animal survival in such conditions. An Ethiopian endemic species from the Bale Mountains, the giant root-rat *Tachyoryctes macrocephalus*, is one of the most enigmatic members among more than 2000 recognised rodent species. It is a large fossorial rodent living in the Afroalpine zone in altitudes above 3 000 m, where it can be found in surprisingly high population densities. Similarly to other fossorial rodents, it has important ecosystem functions, because it modifies remarkably the landscape by extensive burrowing and feeding on Afroalpine vegetation. It is also the principal prey for many predators including the most endangered canid in the world, the Ethiopian wolf. In my presentation, I will review hitherto information about the species including new results from our study carried in 2014-15. Attention will be paid to its taxonomical position, ecology, spatial and circadian activity, dispersal and its ecological role including the root-rat influence on

a rodent community. I will also briefly comment uniqueness of its natural habitat and threats, which the Afroalpine zone of the Bale Mountains faces at the beginning of 21st century.

(KEYNOTE LECTURE)

Rare rats on African sky islands: the case of South African montane laminate-toothed rats (Otomys)

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Recent systematic revisions of Afromontane rodents have revealed hitherto-undocumented patterns of extensive speciation associated with historical Pleistocene geomorphological and paleoecological changes. Such patterns are prevalent in laminate-toothed rats of the genus *Otomys* (Family Muridae, Subfamily Murinae, Tribe Otomyini). Cytochrome b gene sequences and craniometric variables were used to investigate evolutionary relationships of six putative *Otomys* taxa occurring in montane regions of the southern Drakensberg Range of South Africa. A total of 18 specimens of three putative species (*O. auratus*, *O. sloggetti* and *O.* cf. *karoensis*) were added to data obtained from GenBank. We incorporated a further 28 sequences from a shorter segment of 407 bp of cyt b obtained from a recently published study. The amalgamated data set was analysed phylogenetically. We analysed craniodental and craniometric characters of 94 adult skulls from localities from which individuals had been sequenced or karyotyped herein or previously. Phylogenetic, morphometric and biogeographical analyses revealed the existence of a well-supported unique species lineage of *O.* cf. *karoensis* Sp. 1 (named herein) from the Sneeuberg Centre of Floristic Endemism in the southern Drakensberg Range. We documented a southern range extension of a genetically-distinct clade of Sloggett´s ice rat, *O. sloggetti* to the Sneeuberg Mountains. Up to three species of *Otomys* co-occur in the Sneeuberg Mountains, making this an exceptional hotspot of rodent diversity and endemism.

(ORAL PRESENTATION)

African Rodentia becomes African Mammalia

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The availability of online databases has become key in the advancement of taxonomy and conservation. The African Rodentia database contains extensive specimen and tissue collections of the Royal Museum for Central Africa (RMCA), the Royal Belgian Institute of Natural Sciences (RBINS) and the University of Antwerp (UA). Since its launch in 2007 the African Rodentia database has become an important reference with 100 unique visitors per month, about 50,000 page views/year and more than 150 registered users. Part of its popularity is thanks to its unique combination of taxonomical, ecological, geographical and genetic data, as well as data on parasitic and viral infections. While rodents, and in particular murids, still make up the largest part of the specimen collections, recent research has increasingly focussed on other mammal taxa like shrews and bats. Because of its proven usefulness for the diffusion of data on African rodents the African Rodentia database will therefore expand its taxonomical range to include all African mammal orders. Like its predecessor, African Mammalia maximizes its effectiveness by allowing users to query all fields, so not only on species names, but also on the collector, the locality, date of collecting, habitat, type of infection, availability of measurements, morphological and DNA sequence information. These same reasons that set apart African Rodentia from GBIF and other global databases, will allow African Mammalia to become in important reference for mammalogists working on the African continent.

(POSTER)

Vertebrate diversity patterns in the Congo Basin rainforests

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One of the most widely recognized patterns in ecology is the increase in species richness from poles to tropics. Literature suggest that the Congolian lowland rainforest does not follow this pattern: The Central Congolian forest (CCLF), south of the Congo river, is thought to harbor fewer vertebrate species and endemics than the Northeastern (NELF) and Northwestern lowland rainforest (NWLF) north of the Congo river. We used data from the Global Biodiversity Information Facility (GBIF) database on terrestrial vertebrates (mammals, birds, and reptiles), to

test whether differences in sampling effort caused the irregular biodiversity pattern in this region. Our results show that even though the diversity within the Congolian lowland rainforests remains to be fully mapped, current differences in richness are unlikely to be caused by undersampling alone. We argue that the lower vertebrate richness in the CCLF is due to both its relatively small area size and isolated position: Forest cover fluctuated throughout the history of the Congo Basin due to climatic variability, reducing speciation and increasing extinction, while immigration towards the CCLF is limited due to the barrier effect of the Congo river. This implies that diversity differences among Congolian lowland forests are mostly due to forest-associated taxa with limited dispersal capacities. Indeed, we found that local shrew biodiversity was consistently lower in the CCLF, the less species-rich biogeographic region, from taxonomic and functional perspectives. Moreover, we found no evidence that variation in local shrew species composition or biodiversity were related to differences in local interspecific interactions or anthropogenic disturbances. In contrast, the species pool hypothesis received strong support, suggesting that the historic biogeographic differences between regions continue to influence contemporary spatial patterns of biodiversity.

(ORAL PRESENTATION)

Bio-Based Rodent Control Product - Shifting to ecological and biological rodent control

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For many years there has been no innovation in rodent control methods, while chemical products are losing their effectiveness. Therefore this research is undertaken to study the effectiveness and practicality of a novel way of rodent control, using botanical products. The objective is to create an off-the-shelf bio-based product, based on the active plant ingredients. The product is to be accessible for smallholder farmers to reduce damage caused by rodents. This damage is massive in many areas - globally 5-15% (Meerburg, Singleton, and Leirs 2009). The bio-based rodenticide will make a major contribution to increased and improved food crop production at primary levels for the vast amount of smallholder farmers in sub-Sahara Africa. The potential of these botanicals and their working mechanisms were not proven before. The feasibility study tested a range of botanical products in different mixes and in different form (powder/liquid) under scientific protocols, with encouraging results. During the field and lab experiments it is determined that the selected botanicals have the capacity to kill rodents. In the field dead rats within and nearby the experimental fields were observed showing signs of

sickness without outside injuries. Lab experiments with pure treatments have shown a rate of 18.2% (8/46) and 21.8% (10/46) rats respectively becoming sick and dying. With mixed treatments of 2 botanicals, the mortality rate increased to 83% (20/25). Further experiments are underway to single out most effective botanicals, and prototypes are being developed. The feasibility study also documented the occurrence of rodents in Ethiopia as well as other countries, the patterns and control methods in use currently, and the products for sale, their market mechanism and regulatory requirements. Biological rodent control fits within the emerging paradigm of Ecologically Based Rodent Management (EBRM) methods and the larger consciousness of safe sourcing of agricultural commodities.

(POSTER)

Relationship between population density and viral infection: a role for personality?

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Conspecific density and animal personality (consistent between individual differences in behaviour) may both play an important role in disease ecology. Nevertheless, both factors have rarely been studied together but may provide insightful information in understanding pathogen transmission dynamics. In this study, we investigated how both personality and density affect viral infections both direct and indirectly, using the multimammate mice (*Mastomys natalensis*) and Morogoro arenavirus (MORV) as a model system. Using a replicated semi-natural experiment, we found a positive correlation between MORV antibody presence and density, suggesting that MORV infection is density-dependent. Surprisingly, slower explorers were more likely to have antibodies against MORV compared to highly explorative individuals. However, exploration was positively correlated with density which may suggest a negative, indirect effect of density on MORV infection. We have shown here that in order to better understand disease ecology, both personality and density should be taken into account.

(POSTER)

Body surface temperature in subterranean rodents. Is social organisation of a species relevant to the pattern and distribution of thermal windows?

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The subterranean ecotope presents a challenge for thermoregulation of its mammalian inhabitants. The most important way to heat transfer is through conduction via contact with the cooler soil. Based on a study of two species of subterranean rodent in the African mole-rats (Bathyergidae), it has been suggested that the social organisation of a particular species influences the heat dissipation, and specifically, the distribution of the thermal windows of that species. Social species are predicted to be able to dissipate body heat easily due to larger thermal windows and generally shorter and less dense fur; whereas solitary species having smaller thermal windows on the chest, should dissipate body heat less effectively because of the dense and long fur. To test this relationship, we analysed body surface temperature in seven underground-dwelling rodent species from three phylogenetic lineages (Bathyergidae, Octodontidae, Spalacidae) representing different degrees of social organisation as well as geographical distribution using infrared thermography. The main thermal windows were found to be the ventral body region and feet for all species studied. As predicted, social species dissipated body heat more efficiently than solitary species. Interestingly, the pattern of ventral thermal windows does not differ between the rodents tested with different levels of sociality.

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(POSTER)

Diet of *Rousettus madagascariensis* in northern Madagascar

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Old World fruit bats (Pteropodidae) are known for their important function within tropical forest ecosystems. Madagascar´s fruit bats, all endemic and including *Pteropus rufus, Eidolon dupreanum* and *Rousettus madagascariensis*, play at least two different roles in plant and forest ecology -- pollination of flowers and dispersal of seeds. Although fruit and pollen are known to be consumed by these bats, little information is available on this aspect for *R. madagascariensis*, the smallest of the three. To examine dietary aspects of *R. madagascariensis*, this study was

conducted during the dry (September and November 2016) and wet (February and April 2017) seasons in the Réserve Spéciale de l´Ankarana. Two methods were evaluated: analysis of pollen within feces of captured bat and analysis of fruit remains and seeds from fecal matter collected in bat cave. In total, 15 plant species were identified, including four introduced taxa. Among these, four plant species were recorded for the first time in the diet of Malagasy pteropodids: *Capurodendron ankaranense* (Sapotaceae) and *Crotalaria berteroana*, *Parkia madagascariensis* and *Senna ankaranensis* (Fabaceae). Plant species consumed by *R. madagascariensis* at Ankarana include the pollen of nine taxa and the fruit of six other taxa. These bats show a preference for the pollen of an endemic plant - *P. madagascariensis* (39.0%) and an exotic plant - *Ceiba pentandra* (17.1%), as well as the fruit of the exotic *Solanum mauritianum* (31.0%) and native *Ficus polita* (24.1%). This result suggest that *Rousettus madagascariensis* is generalist that feeds both on flowers and fruits of an endemic and exotic plant. These bats thought to be an effective pollinator and disperser of the plant consumed, which include native and non-native species.

(POSTER)

Echolocation calls of high duty-cycle bats (Hipposideridae and Rhinonycteridae) from Kenya

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We describe the echolocation calls of six species of Hipposideridae: *Doryrhina camerunensis*, *Hipposideros beatus*, *H. caffer*, *H. ruber*, *Macronycteris gigas*, and *M. vittata* and two species of Rhinonycteridae: *Cloeotis percivali* and *Triaenops afer*. The recordings were made in Kenya during 2013-2018, using Pettersson D500X and D1000X real time, full spectrum bat detectors. All species used high intensity constant-frequency echolocation of high duty-cycle. Most of them separate clearly in the constant-frequency component of the echolocation calls and can be recognized based on that feature alone. This study provides the first description of the echolocation calls of *D. camerunensis*, whereas those of *H. beatus*, *H. ruber*, and *C. percivali* from Kenya are also described for the first time. Additionally, call frequencies for some of these species differ from those of other parts of their range, demonstrating the need for collection and publication of more local call libraries from tropical regions.

(ORAL PRESENTATION)

Relative abundance and microhabitat use of three rodent species in crop fields and bushland in Ethiopia

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Relative abundance and microhabitat use of three rodent species (*Stenocephalemys albipes*, *Arvicanthis dembeensis* and *Mastomys awashensis*) were investigated in four different habitats: two rainfed crop fields differing in stone bund density, irrigated crop field and bushland, in semi-arid Ethiopia, using Capture-Mark-Recapture and removal trapping techniques. Microhabitat characterizations were made using quadrants (1x1m) centered at each trap station for each successful trap. A total of 444 individual small mammals belonging to six rodents: *Acomys caharinus*, *A. dembeensis*, *Gerbilliscus robustus*, *M. awashensis*, *Mus proconodon* and *S. albipes*, and one shrew (*Crocidura olivieri*) were recorded. Of these, 230 individuals, ~52% belonged to the three target species: *S. albipes* (65%), *M. awashensis* (25%) and *A. dembeensis* (10%). Total numbers of rodents recorded were highest in the early-dry season compared to the rainy season. Overall, the bushland supported the highest small mammal abundance (64%) compared to the crop fields (27%). Bushland was the most favored habitat type by *S. albipes* (74%) and *M. awashensis* (25%). While *A. dembeensis* favored irrigated crop field (42%) compared to the other habitats. Redundancy Analysis showed that 26% (R^2adj = 0.261) of environmental variation explained, at microhabitat level, was correlated with the three species. *S. albipes* was strongly associated with percentage vegetation ground cover (R^2Adj = 0.065, $P < 0.001$) while *M. awashensis* (R^2Adj = 0.111, $P < 0.001$) and *A. dembeensis* (R^2Adj = 0.147, $P = 0.014$) were associated with ground cover type. The result shed light on the relative co-occurrences of the three rodent species in crop fields and bushland and on their microhabitat use in these habitats. Such studies reveal essential information on how the species respond in abundance and microhabitat use in different habitats, potentially providing vital clues for ecologically based rodent pest management and conservation options.

(ORAL PRESENTATION)

Genetic diversity of the naked mole-rat (*Heterocephalus glaber*)

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The naked mole-rat *Heterocephalus glaber* is widespread in arid and semi-arid areas of northeast Africa. It is the endemic for the Somali-Masai biome and has a number of unique characteristics of its biology. *H. glaber* currently recognized as a sole representative of the family Heterocephalidae. It is a model species for a number of costly medical-biological studies. It is one of two known eusocial species of vertebrates, resembling in this respect social insects. Obviously, this could influence the structure of its genetic diversity, which is not enough studied. For the first time we conducted the comparative analysis of two mitochondrial genes (cyt b and D-loop) and six nuclear genes (A2ab, BRCA1, GHR, RAG1, vWF, IRBP) of naked mole-rats (n= 52) from localities covering most of the species distribution range. As a result, a similar tree topology for both combined mitochondrial genes and combined nuclear genes was found. Our results showed that *H. glaber* demonstrates strong phylogeographic structure. Two deeply divergent clades (K2P-distance between them ~ 11% for cyt b) were revealed: the eastern one (lowlands from the both sides of the Chercher Mts) and the southern one (southern Ethiopia and Kenya). Such separation could be related to the geographical isolation of their habitats by the Somalian plateau and the valleys of the Genale and Wabi Shebele rivers. The naked mole-rats from eastern Ethiopia form two subgroups (K2P-distance between them ~ 2.3%) divided by the Chercher Mts. The southern clade is also divided into subgroups with the distance between them from 1% to 4%, but they have been supported only by the analysis of mtDNA. There are probably several deeply divergent lineages of *H. glaber*, which taxonomic status is unclear now. Cytogenetic analysis showed that the karyotypes of different groups and subgroups of the *H. glaber* are similar (2N = 60, NF = 98).

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(POSTER)

Farmers´ perspectives of rodent damage and rodent management in southern Ethiopia are associated with socio-demographics factors

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A survey was conducted in mosaic smallholder farming system in Chano, Southern Ethiopia, to investigate rodent damage and rodent management from the farmers´ perspectives. Farmers (n=384) were interviewed using a semi-structured questionnaire. Farmers (51%)

identified pests as the major production constraints of cereal crops followed by shifting to cash crops (20.6%), water logging of farmlands (15.6%), reduced soil fertility (8.6%) and insufficient rains (4.2%). Majority (83%) of the farmers experienced rodent swarms and recognized maize (98%) as a crop that is most susceptible to rodent damages. Being male (OR=2.82, P =0.016) and years spent in farming (OR = 1.131, P < 0.01), increase farmers´ experience to rodent swarms. Emergence to the first few leaf stages of maize were identified as the stages most susceptible to rodent damages (64.8%) followed by harvesting (19.3%) and maturity (15.9%) stages. Farmers´ estimate of average annual maize yield loss to pre-harvest rodent damage was varied with Kebele, age group and education. Years spent in farming as an occupation decreases farmers´ estimate of % annual maize yield loss to pre-harvest rodent damage by the coefficient of 0.043 (P < 0.05), other factors adjusted for. Own experience (86.5%) and village kiosks (83%) were the major sources of advice and inputs, respectively for rodent management. Rodenticide was the most frequently used (76%) rodent management method and applied individually (91.4%). We recommend awareness creation and extension support to the farmer community to reduce the reliance on toxic rodenticide and shift to integrated rodent management approaches.

(ORAL PRESENTATION)

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