

# The 11<sup>th</sup> African Small Mammal Symposium

*“Africa’s Small Mammal Biologists Tackling Africa’s Big Problems”*

## Scientific Programme and Abstracts



11<sup>th</sup> ASMS  
Department of Biological Sciences, University of Swaziland, Kwaluseni,  
Swaziland  
3-8 August 2011

Francis Makamba  
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1 July 2011

Dear Conference Participants,

The Local Organising Committee (LOC) has great pleasure in welcoming you to the 11<sup>th</sup> African Small Mammal Symposium (ASMS) held at the Kwaluseni Campus of the University of Swaziland (UNISWA), Swaziland. We are particularly proud of the fact that this is the first conference that our department (Biological Sciences) has ever hosted!

We would like to thank you, the delegates, for making the effort to attend this conference. Without your presentations and stimulating after-hour discussions this conference would not exist. We are also grateful to an array of institutions that have provided support, resources or funds that have been channeled into making this conference better for you. In particular we would like to thank E. Oppenheimer and Son and Flemish Inter-University Council (VLIR) for sponsoring scientists from Africa and Europe. The Swaziland Water Corporation provided the water that you will drink during the conference. Finally, thanks to UNISWA for the institutional support that was given to ASMS, without which we would not have been able to successfully host this conference.

We hope that you enjoy your stay here and take some time to explore the beautiful Kingdom of Swaziland during and after the conference.

Yours sincerely,

Prof. Ara Monadjem & Dr. Themba'ahlaba  
On behalf of the Local Organising Committee

### **Local Organising Committee**

Prof. Ara Monadjem, Department of Biological Sciences, UNISWA, Swaziland (Co-chair)  
Dr. Themba'ahlaba, Department of Biological Sciences, UNISWA, Swaziland (Co-chair)  
Dr. Sithembile Kunene, Department of Biological Sciences, UNISWA, Swaziland  
Mr. Francis Makamba, Department of Biological Sciences, UNISWA, Swaziland  
Dr. Steven Belmain, Natural Resource Institute, University of Greenwich, UK  
Prof. Peter Taylor, Department of Ecology & Resource Management, University of Venda, RSA  
Prof Herwig Leirs, University of Antwerp, Belgium  
Dr. Nico Avenant, National Museum, Bloemfontein, RSA  
Dr. Corrie Schoeman, Biological and Conservation Sciences, University of KwaZulu-Natal, RSA  
Mr. Duncan MacFadyen, E. Oppenheimer & Son, Marshalltown, RSA

# Programme

Note: only the presenting author is mentioned in this programme. For the full list of authors, please see the relevant abstract

Sunday 3 July 2011

## OPENING CEREMONY

17:30	<b>Dr. I.S. Kunene</b> (MC) <i>Welcome remarks</i>
17:35	<b>Prof. C.M. Magagula</b> (Vice-Chancellor, University of Swaziland) <i>Official opening</i>
18:00	<b>Dr. R. Thwala</b> (PS, Ministry of Agriculture and Cooperatives) <i>Remarks</i>
18:20	<b>Dr. David Happold</b> <i>How should Africa's small mammal biologists tackle Africa's big problems?</i>
19:00	Dinner

# Programme

Note: only the presenting author is mentioned in this programme. For the full list of authors, please see the relevant abstract

Monday 4 July 2011

Plenary chair: Gary Bronner	
08:25 - 09:15	<b>Galen Rathbun</b> <i>Hose-noses and flute-snoots: The "Nasotheres"</i>
Symposium: AFROTHERIA Chair: Galen Rathbun	
09:20 - 09:45	<b>Gary Bronner</b> <i>Afrotheria: what we know, and where disagreement persists</i>
09:45 - 10:00	<b>Steven Goodman</b> <i>Recent developments in systematic research of Malagasy tenrecs (Family Tenrecidae) and associated conservation programs</i>
10:00 - 10:15	<b>Sarita Maree</b> <i>Evolutionary relationships and conservation of golden moles (Afrosoricida; Chrysochloridae) from sub-Saharan Africa</i>
10:15 - 10:30	<b>Galen Rathbun</b> <i>How many sengi species are there?</i>
10:30 - 11:00	Tea break
11:00 - 11:15	<b>Peter Coals</b> <i>Status of Rhynchocyon in Mozambique</i>
11:15 - 11:30	<b>Nomakwezi Mzilikazi</b> <i>Thermoregulatory physiology within the Afrotheria</i>
11:30 - 11:45	<b>André Ganswindt</b> <i>Take a break - endocrinological indications for embryonic diapause in the Aardvark (Orycteropus afer)</i>
11:45 - 12:00	<b>Mike Perrin</b> <i>The spatial organisation of the four-toed elephant-shrew (Petrodromus tetradactylus)</i>
12:00 - 12:15	<b>David Ribble</b> <i>The genetic mating system of the short-eared sengi (Macroscelides proboscideus)</i>
12:15 - 12:30	<b>Caleb Ofori-Boateng</b> <i>Influence of habitat characteristics on the distribution patterns of aardvarks (Orycteropus afer) in Mole National Park, Ghana</i>
12:30 - 14:00	Lunch
Symposium: DIVERSITY & DISTRIBUTION Chair: Herwig Leirs	
14:00 - 14:15	<b>Jean-Claude Mukinzi</b> <i>Abundance, reproduction and population structure of three African shrews: Sylvisorex cf. ollula Thomas, 1913, Scutisorex somereni (Thomas, 1910) and Crocidura dolichura Peters, 1876 (Soricidae, Mammalia) from the Yoko Forest Reserve (DRC)</i>
14:15 - 14:30	<b>Sintayehu Workeneh</b> <i>Abundance of small mammals in Nechisar National Park, Ethiopia</i>

14:30 - 14:45	<b>Seth Eiseb</b> <i>Systematics and biogeography of the genus Mastomys in Namibia and adjacent countries</i>
14:45 - 15:00	<b>Aubrey Munyai</b> <i>Biodiversity of terrestrial small mammals along an altitudinal transect of Soutpansberg, Limpopo Province, South Africa: A case study of Lajuma</i>
15:00 - 15:15	<b>Tshifhiwa Nemakhavhani</b> <i>Small mammal biodiversity in a complex habitat in Lajuma, Limpopo Province, South Africa</i>
15:15 - 16:00	Poster session & tea break
Symposium: GENERAL ECOLOGY Chair: Nico Avenant	
16:00 - 16:15	<b>David Happold</b> <i>The Mammals of Africa: progress and problems</i>
16:15 - 16:30	<b>Anita Rautenbach</b> <i>Grasslands of fear: positive effects of wooded islands on the foraging behaviour of nocturnal rodents at Phinda Game Reserve</i>
16:30 - 16:45	<b>Duncan MacFadyen</b> <i>The dynamics of small mammal populations in the Rocky Highveld grasslands of Telperion Nature Reserve, Mpumalanga, South Africa</i>
16:45 - 17:00	<b>Rod Baxter</b> <i>Seasonal variation in the diet of Rhabdomys pumilio in Bhisho Bushveld, Eastern Cape, South Africa</i>
17:00 - 17:15	<b>Radim Sumbera</b> <i>Radio-tracking as an effective tool to study the behaviour of free-living subterranean rodents</i>

# Programme

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Tuesday 5 July 2011

Plenary chair: Peter Taylor	
08:25 - 09:25	<b>Steven Goodman</b> <i>The bats of Madagascar: history of colonization, speciation, and measures of species richness and endemism</i>
Symposium: SYSTEMATICS Chair: Steven Goodman	
09:30 - 09:45	<b>Paul Bates</b> <i>Enhancing taxonomic capacity to underpin biodiversity conservation</i>
09:45 - 10:00	<b>Frédéric Veyrunes</b> <i>Accumulation of rare sex chromosome rearrangements in the African pygmy mice (genus Mus, subgenus Nannomys)</i>
10:00 - 10:15	<b>Jean-Francois Cosson</b> <i>Phylogeography of Saharan rodents</i>
10:15 - 10:30	<b>Hana Patzenhauerová</b> <i>Continental islands – the biogeography of the East African forest-dwelling mountain rodent Praomys delectorum</i>
10:30 - 11:00	Tea break
11:00 - 11:15	<b>Vladimír Mazoch</b> <i>Phylogeography of the Red Veld Rat (Aethomys chrysophilus) (Rodentia: Muridae), the role of rivers and potential Pleistocene refugia in south-eastern Africa</i>
11:15 - 11:30	<b>Peter Vallo</b> <i>Taxonomy of the genus Scotophilus (Vespertilionidae) in southern Africa</i>
11:30 - 11:45	<b>Petr Benda</b> <i>Taxonomic revision of the genus Asellia (Hipposideridae)</i>
11:45 - 12:00	<b>Leigh Richards</b> <i>Comparative chromosome painting studies of Chiroptera from Madagascar: chromosomal homologies and genome evolution</i>
12:00 - 12:30	Poster session
12:30 - 14:00	Lunch & posters
Symposium: BAT BIOLOGY Chair: Corrie Schoeman	
14:00 - 14:15	<b>Samantha Stoffberg</b> <i>Population substructure of geoffroy's horseshoe bat in South Africa: what can the patterns tell us?</i>
14:15 - 14:30	<b>Ara Monadjem</b> <i>Bats of Nimba Mountain, Liberia: an African hotspot</i>
14:30 - 14:45	<b>Angel Ngcamphalala</b> <i>The diversity, activity and diet of insectivorous bats in agro-ecosystems in Swaziland</i>
14:45 - 15:00	<b>Bruno Djossa</b> <i>Impact of traditional agriculture practices on plant phenology, implication for food resources availability and population dynamics of fruit bats in Northern Benin, West Africa</i>

15:00 - 15:15	<b>Guy-Crispin Gembu</b> <i>Bat exploitation as game animals in Kisangani and its impact on biodiversity preserving</i>
15:15 - 16:00	Poster session & tea break
Symposium: BAT BIOLOGY Chair: Peter Taylor	
16:00 - 16:15	<b>Corrie Schoeman</b> <i>The relative influence of competition and prey defences on the trophic structure of animalivorous bat ensembles</i>
16:15 - 16:30	<b>Michael Pierce</b> <i>Diversity assessment of bat communities on Kwalata Game Ranch, Gauteng, South Africa, with a view to investigate effects of ecological light pollution</i>
16:30 - 16:45	<b>Joy Coleman</b> <i>The sweet side of life: sugar and concentration preference in Wahlberg's epauletted fruit bat (Epomophorus wahlbergi)</i>
16:45 - 17:00	<b>Colleen Downs</b> <i>Seasonal effects on thermoregulatory abilities of the Wahlberg's epaulette fruit bat (Epomophorus wahlbergi) in KwaZulu-Natal, South Africa</i>

# **Programme**

Wednesday 6 July 2011

## **Mid-conference excursion**



# Programme

Note: only the presenting author is mentioned in this programme. For the full list of authors, please see the relevant abstract

Thursday 7 July 2011

Plenary chair: Rod Baxter	
08:25 - 09:25	<b>Neville Pillay</b> <i>Social flexibility in the four-striped mouse Rhabdomys</i>
Symposium: RODENT BEHAVIOUR Chair: Neville Pillay	
09:30 - 09:45	<b>Tasmin Rymer</b> <i>Parental care in African striped mice (Rhabdomys pumilio): an ontogenetically complex problem</i>
09:45 - 10:00	<b>Megan Mackay</b> <i>Behavioural differences of the two sub-species of Rhabdomys dilectus</i>
10:00 - 10:15	<b>Mbulelo Xalu</b> <i>Activity patterns of bush Karoo rats (Otomys unisulcatus) in the thicket biome of South Africa: preliminary results</i>
10:15 - 10:30	<b>Jenny Lancaster</b> <i>Effects of species removal on the population dynamics and space use of coexisting small mammals</i>
10:30 - 11:00	Tea break
11:00 - 11:15	<b>Nkosinathi Babu</b> <i>Socio-spatial organization of bush Karoo rats (Otomys unisulcatus) in the Albany Thicket Biome: preliminary results</i>
11:15 - 11:30	<b>Siviwe Lamani</b> <i>Resting site ecology of the woodland dormouse (Graphiurus murinus) in a riverine Combretum forest: preliminary results</i>
11:30 - 11:45	<b>Tracy Lötter</b> <i>Are bushveld gerbils group-living?</i>
11:45 - 12:00	<b>Hynek Burda</b> <i>To mate or not to mate? Mate preference and fidelity in monogamous Ansell's mole-rats (Fukomys anelli; Bathyergidae)</i>
12:00 - 12:15	<b>Jan Šklíba</b> <i>Foraging strategies in African mole-rats</i>
12:15 - 12:30	<b>Hynek Burda</b> <i>African mole-rats: "Golden Mine" for the study of magnetoreception in mammals</i>
12:30 - 14:00	Lunch & posters
Symposium: GENERAL Chair: Ara Monadjem	
14:00 - 14:15	<b>Clare Mateke</b> <i>A preliminary assessment of species diversity, distribution and status of the small carnivores in the Lower Zambezi National Park and Chiawa Game Management Area, Zambia</i>
14:15 - 14:30	<b>Chabi Djagoun</b> <i>Small carnivores from southern Benin: Assessment of diversity and hunting pressure</i>
14:30 - 14:45	<b>Herwig Leirs</b> <i>Differential predation by barn owls (Tyto alba) on field rodents in Tanzania: old males</i>

	<i>are more at risk</i>
14:45 - 15:00	<b>Abraham Haim</b> <i>Reproduction in desert adapted populations of the genus Acomys – the role of Integrative physiology</i>
15:00 - 15:15	<b>Emiliano Trucchi</b> <i>Evolutionary response of two African rodent species (Hystrix sp.) to climate changes: studying the past to estimate the future</i>
15:15 - 16:00	Poster session & tea break
Symposium: PEST MANAGEMENT Chair: Themb'a Mahlaba	
16:00 - 16:15	<b>Steven Belmain</b> <i>Case-control studies of ecologically-based rodent management in rural communities of Swaziland, Tanzania and Namibia</i>
16:15 - 16:30	<b>Peter Taylor</b> <i>Cryptic species of agriculturally important and associated non-target rodents in Africa: Implications for ecologically based rodent management, taxonomy and conservation</i>
16:30 - 16:45	<b>Drazo Amundala</b> <i>Farmers' perceptions on rodents as crop pests and practices in rodent pest management in Faradje region in northwest of the DRC</i>
16:45 - 17:00	<b>Themb'a Mahlaba</b> <i>Impact of crop cycle on movement patterns of pest rodent species in southern Africa</i>
19:00	<b>CONFERENCE BANQUET</b>

# Programme

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Friday 8 July 2011

Plenary chair: Ara Monadjem	
08:25 - 09:25	<b>Woody Cotterill</b> <i>Geobiological signatures of African evolution: new opportunities in cross-disciplinary explorations of the tempo and mode of Earth history</i>
Symposium: POPULATION DYNAMICS & CONSERVATION Chair: Woody Cotterill	
09:30 - 09:45	<b>Apia Massawe</b> <i>Spatial and temporal population dynamics of rodents in three geographically different regions: Implication for ecologically- based rodent management</i>
09:45 - 10:00	<b>Loth Mulungu</b> <i>Population dynamics and breeding patterns of Mastomys natalensis Smith 1932 in irrigated rice in Eastern Tanzania</i>
10:00 - 10:15	<b>Georgy Shenbrot</b> <i>Long-term study of population dynamics, habitat selection and interspecific competition of the Negev Desert rodents</i>
10:15 - 10:30	<b>Christopher Sabuni</b> <i>The use of camera traps in the study of the ecology of Black-and-rufous sengi (Rhynchocyon petersi) in Zaraninge coastal forest, Tanzania</i>
10:30 - 11:00	Tea
11:00 - 11:15	<b>Prince Kaleme</b> <i>The Albertine Rift Region of Africa: Evolution and Conservation of small mammals</i>
11:15 - 11:30	<b>Nico Avenant</b> <i>Correlating vegetation and small mammal community structure after fire in a grassland ecosystem, Erfenisdam Nature Reserve, Free State Province, South Africa</i>
11:30 - 11:45	<b>Prince Kaleme</b> <i>Origin and putative colonization routes for invasive rodent taxa in the Democratic Republic of Congo</i>
Symposium: DISEASE Chair: Steven Belmain	
11:45 - 12:00	<b>Elisabeth Fichet-Calvet</b> <i>A preliminary survey of small mammal communities in relation to Lassa fever occurrence within Nigeria</i>
12:00 - 12:15	<b>Elisabeth Fichet-Calvet</b> <i>Lassa serology in Mastomys natalensis: habitat, age and abundance effects</i>
12:15 - 12:30	<b>Sophie Gryseels</b> <i>Landscape genetics of Mopeia virus and its host (Mastomys natalensis) in Morogoro region, Tanzania</i>
12:30 - 14:00	Lunch & posters
14:00 - 14:15	<b>Seth Eiseb</b> <i>Seasonal variation of fleas occurring on rodents in Namibia, Swaziland and Tanzania</i>
14:15 - 14:30	<b>Meheretu Madebo</b> <i>Rodent-ectoparasite associations in the highlands of Tigray, Northern Ethiopia:</i>

	<i>Implications for potential zoonoses</i>
14:30 - 14:45	<b>Rhodes Makundi</b> <i>Rodent populations and associated flea species complex in the plague outbreak foci in the northern wing of the Rift Valley in Tanzania</i>
14:45 - 15:00	<b>Didas Kimaro</b> <i>Community and diversity of potential plague small mammals in different landscapes in West Usambara Mountains, Tanzania</i>
15:00 - 15:15	<b>Didas Kimaro</b> <i>Spatial analysis of vegetation communities with respect to small mammals potential for plague occurrence in Western Usambara Mountains, Tanzania</i>
15:15 - 15:30	<b>Boris Krasnov</b> <i>Gender biased parasitism: patterns, mechanisms, consequences</i>
15:30 - 16:00	Tea
16:00 - 16:30	<b>Closing ceremony</b>

# Abstracts

Listed in chronological order by session

# Opening Ceremony

## How should Africa's small mammal biologists tackle Africa's big problems?

David Happold

*Division of Botany and Zoology, Australian National University, Canberra, ACT 2600, Australia. [David.Happold@anu.edu.au](mailto:David.Happold@anu.edu.au)*

Africa as a whole has many big problems of which poverty, economic viability, political stability and population numbers are perhaps the most important. However, there are many differences between countries and generalisations are often too simplistic. Any mammalian biologist (even though specialization is prerequisite for success in a chosen field) can play a meaningful role in solving or ameliorating these problems. How any of these problems can be solved is debatable and controversial. It is essential that the natural assets of any country of Africa are utilized for the good of every citizen, and that the proceeds derived from these assets are used either for infrastructure now or saved for future generations; balancing these conflicting demands is a major challenge. Small mammal biologists need to be very aware and knowledgeable about these problems and be able to think laterally. There is no easy or simple answer to Africa's problems, but sensible policies and planning are essential in order to ensure a balanced and sustainable environment for all inhabitants of the continent, now and in the future. This presentation will explore some of ways in which small mammal biologists can make a contribution to solving Africa's problems; these include, *inter alia*, active participation in educational programmes, involvement in economic and political debate, and good quality research in fields relevant to the problems.

# Afrotheria

## PLENARY

### **Hose-noses and flute-snoots: The “Nasotheres”**

Galen B. Rathbun

*Department of Birds and Mammals, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118, USA. [grathbun@calacademy.org](mailto:grathbun@calacademy.org)*

Africa includes some of the best and most bizarre examples of well-developed mammal noses in the world – one only needs to consider the African elephant as the ultimate hose-nose. However, not all nasotheres are confined to Africa, as shown by the discovery and documentation by Harold Stumpke in 1967 of the highly unique and diverse Rhinogradentia from a Pacific island. Just as unique and bizarre are several mammals on “Island Africa”, including the Macroscelidea or flute-snoots. All macroscelids share a suite of highly unusual life history traits, but so far the clade has escaped the complete extirpation that befell the rhinogrades. One of the great unanswered questions in nasothere biology is whether the Afrotheria, which includes the Macroscelidea, Tubulidentata, Afrosoricida, and Paenungulata (and yes, nearly all have unique noses), might have affinities to the rhinogrades. Unfortunately, and very predictably, we will never know.

## ORAL PRESENTATIONS

### **Afrotheria: what we know, and where disagreement persists**

Gary N. Bronner

*Department of Zoology, University of Cape Town, P/Bag X03, Rondebosch, 7701 [gary.bronner@uct.ac.za](mailto:gary.bronner@uct.ac.za)*

In 2003, at the 9<sup>th</sup> ASMS (Morogoro, Tanzania), I analogized the relatively new Afrotheria supraordinal grouping concept as “the Cinderella of mammalian systematics”: enigmatic, ethereal, unexpected and, to some die-hard morphologists, simply a fairy tale. Now, eight years on, Afrotheria has ascended to, and is firmly entrenched in, the realm of mammalian systematics. Early doubts about the ontological status of this clade, which was never predicted by morphology, has subsided as overwhelming molecular evidence favouring Afrotheria has accumulated, and some anatomical synapomorphies (albeit often subtle) of both extant and fossil species have been proposed. Afrotheria has even found its way into conservation management and planning, testament that it is now widely accepted in the scientific disciplines other than systematics.

# Afrotheria

While the reality of Afrotheria as a supraordinal clade is now widely accepted, debate and dissent persist but now focus on some of the unresolved details: the proposed Gondwana origin (vs. Eurasian) and sister-group relationships of afrotheres; inter-ordinal relationships, especially within paenungulates, and the affinities of sengis and the aardvark to afrosoricids; the validity of putative synapomorphies, especially with respect to recent fossil finds; and taxonomic disagreements about the correct nomenclature for the tenrec+golden mole clade (either Afrosoricida or Tenrecomorpha).

In this review I summarize the status of current knowledge about the Afrotheria, emphasize aspects that deserve priority research attention, and comment on a serious lack of research on afrotheres within the African scientific landscape.

## Recent developments in systematic research of Malagasy tenrecs (Family Tenrecidae) and associated conservation programs

Voahangy Soarimalala<sup>1,2</sup> and Steven M. Goodman<sup>1,3</sup>

<sup>1</sup>*Vahatra, BP 3972, Antananarivo 101, Madagascar*

<sup>2</sup>*Département de Biologie Animale, Facultés des Sciences, Université d'Antananarivo, BP 906, Antananarivo 101, Madagascar*

<sup>3</sup>*Field Museum of Natural History, 1400 South Lake Shore Drive, Chicago, Illinois 60605, USA. [vsoarimalala@vahatra.mg](mailto:vsoarimalala@vahatra.mg)*

Over the past 20 years, data on the higher-level systematics and taxonomy of Malagasy tenrecs have considerably expanded as a result of research efforts, including phylogenetic and phylogeographic studies. This is in part associated with broad-scale inventories of previously unknown or poorly known forested areas of Madagascar and the collection of voucher specimens with associated tissue samples for molecular genetic and morphological research. Eight species have been described as new to science, while others with previously unclear taxonomic status have been clarified. As a result of this research, measures of Tenrecidae species richness have increased considerably. Further, for most taxa details are better defined with regards to their distributions, habitat use and levels of micro-endemism. This new information has been paramount in helping to define conservation priorities and even in one case with the creation of a new protected area. Some species serve as biological indicators for improving the management of existing protected areas and conservation management.



# Afrotheria

## Evolutionary relationships and conservation of golden moles (Afrosoricida; Chrysochloridae) from sub-Saharan Africa

Sarita Maree<sup>1, 2</sup>, Gary Bronner<sup>3</sup>, Nigel Bennett<sup>1</sup>, Carel Oosthuizen<sup>2</sup> and Paulette Bloomer<sup>2</sup>

<sup>1</sup> Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria, Pretoria, 0002, South Africa. [smaree@zoology.up.ac.za](mailto:smaree@zoology.up.ac.za)

<sup>2</sup> Molecular Ecology and Evolution Programme, Department of Genetics, University of Pretoria, Pretoria, 0002, South Africa

<sup>3</sup> Department of Zoology, Private Bag X3, University of Cape Town, Rondebosch, Cape Town, 7701, South Africa

Golden moles belong to an ancient Afrotherian clade of placental mammals and represent one of Africa's most enigmatic, elusive and endangered mammalian families according to IUCN Red List criteria (IUCN 2010). The group comprises two subfamilies, nine genera and 21 species. Eleven species are considered threatened yet, the delineation of certain taxa based on morphology and cytogenetic grounds remain unclear. A sound taxonomy forms an essential baseline for conservation planning and within this context we present a comprehensive multi-gene molecular phylogeny for golden moles. The inferred relationships question taxonomic subdivisions in current use as distinct evolutionary lineages are clearly contained within at least two genera and three of 21 recognized species. Molecular data analyzed in combination with discrete morphological characters revealed contradicting evolutionary trends in some characters, suggesting convergent evolution and homoplasy. Due to the novelty of this mammalian family and the insights that the group can offer into the radiation of an old but range restricted clade across the African continent, we used molecular dating to tentatively place the radiation of the family within a temporal and associated biogeographic framework.

## How many sengi species are there?

Galen B. Rathbun and John P. Dumbacher

Department of Birds and Mammals, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118, USA. [grathbun@calacademy.org](mailto:grathbun@calacademy.org)

Since the first descriptions of sengis (or elephant-shrews) by Western scientists, starting in about 1800, the group has presented taxonomic challenges at all levels. In the 1800s, dozens of new species and subspecies were described by many authors, but not until 1968 was the taxonomy of the entire Order addressed by Gordon Corbet and John Hanks, and the 15 species Corbet recognized in 1974 has survived the test of time and genetics. In 2008, however, a new species of *Rhynchocyon* from Tanzania was described, and also a new cryptic species of *Elephantulus* from South Africa. Thus, currently there are 17 species of sengi recognized, in one family, two subfamilies, and four genera. Recent genetic work suggests that *Elephantulus rozeti* from the Maghreb and *Petrodromus* from sub-Saharan Africa will need to be revised at the genus level. In 2010, another giant sengi was discovered in northern coastal Kenya, although it still awaits naming. Currently, we and several colleagues are finalizing the details of a revision of the monospecific genus *Macroscelides*, which will result in the two currently recognized subspecies

# Afrotheria

being elevated to full species, and a third brand new species from northern Namibia described. In the future, it is likely that the monospecific status of *Petrodromus* also will be revised. *Rhynchocyon* also will need revision, which probably will result in changes to the current status of subspecies and species, especially in Mozambique and the Congo Basin. We predict that in the next few years about 8 or 10 additional species will be recognized (mostly revisions, but perhaps a few new taxa). Even with a total of 25-odd species, however, the macroscelids still will be characterized by low species diversity, especially given their antiquity, wide distribution, and diversity of habitats occupied.

## Status of *Rhynchocyon* in Mozambique

Peter Coals<sup>1</sup> and Sophie Scott<sup>2</sup>

<sup>1</sup> Oxford University, Department of Zoology & St Hilda's College, Oxford, OX4 1DY, United Kingdom [peter.coals@st-hildas.ox.ac.uk](mailto:peter.coals@st-hildas.ox.ac.uk)

<sup>2</sup> Mareja Community Reserve, Cabo-Delgado, Mozambique

The first species of giant sengi (*Rhynchocyon*) was described in 1847, with the type locality of Quilimani, Mozambique. This species, *R. cirnei*, was characterized by a pattern of chequers on its back. Three additional *Rhynchocyon* species have subsequently been described, based mostly on pelage colour and patterns, and allopatric distribution. In addition, *R. cirnei* has 6 recognised subspecies. In the seminal and largely definitive sengi taxonomy of Gordon Corbet and John Hanks (1968), *Rhynchocyon* from Mozambique north of Qulimani might represent a new subspecies, but it was not named because of the lack of specimens. In addition, they stated that "The overall pattern of [*R. cirnei*] variation cannot be assessed until more data are available from Mozambique".

Based on a literature survey and preliminary field work, we have a rough idea of the distribution and habitat associations of *Rhynchocyon* in Mozambique. With additional voucher specimens and tissues for DNA analyses, however, we will be able to address the question of the taxonomic status of *Rhynchocyon* in Mozambique. We are exploring two hypotheses: First, giant sengis from northern Mozambique represent the same taxon as *R. cirnei cirnei* from Quilimani. Second, the northern specimens will belong to a different subspecies than *R. c. cirnei*, or perhaps they are a different full species. Because we are working with specimens relatively close to the type for *R. cirnei*, we also may find that the several subspecies of *R. cirnei*, such as *R. c. shirensis* from southwestern Mozambique and Malawi, and *R. c. macrurus* from inland southeastern Tanzania, represent full species, rather than a subspecies of *R. cirnei*.

# Afrotheria

## Thermoregulatory physiology within the Afrotheria

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The ability to reduce metabolic rate and body temperature (heterothermy) in response to environmental challenges is well recorded in mammals. With advances in telemetry and data-logging technology, a number of studies have been investigated heterothermic responses in free-ranging animals. By far the greatest number of known mammalian heterotherms is within the superorder Afrotheria, with representatives from the Macroscelidea, Chrysochloridae and Tenrecidae). Whereas the traditional classification of heterothermy includes daily torpor and hibernation, Afrotherian thermoregulation blurs this distinction, often exhibiting thermoregulatory patterns that are characteristic of both these physiological responses. Minimum body temperatures measured during heterothermy range between 5.1 – 27.4 °C in representatives ranging in mass from 135g. The heterothermic bout lengths range between one hour and four days. Instead of maintaining a constant body temperature with periodic use of heterothermy, some species tend to be primarily heterothermic, with brief periods of normothermy. These observations make the Afrotheria particularly interesting in the context of their phylogenetic placement as they may offer insights into the evolution of endothermy and a glimpse into thermoregulatory mechanisms of early mammals.

## Take a break - endocrinological indications for embryonic diapause in the Aardvark (*Orycteropus afer*)

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The ability to reproduce is one of the key factors influencing species survival, and among the evolutionary strategies that ensure successful reproduction is a phenomenon called *delayed implantation* or *embryonic diapause*. This condition of temporary suspension of mammalian embryo development occurs in about 100 different mammals, and can be divided into two functionally distinct types: facultative and obligate diapause. The occurrence of facultative diapause seems to be associated with metabolic stress for the dam, whereas obligate diapause, which (if existent) is present during every gestation, seems to allow the mother to time the birth with environmental conditions favourable to neonatal survival. Due to the marginal mass gain during the first two months of gestation, it *is conceivable that* embryonic diapause may also occur in Aardvarks, but so far, no endocrinological data exists to support this hypothesis. In this study, we therefore used faecal steroid analysis for monitoring hormone levels in captive Aardvarks to a) describe longitudinal profiles of excreted oestrogen and progesterone metabolites throughout gestation and b) reveal endocrinological evidence for the possible existence of delayed implantation in this unique myrmecophagous mammal. Between October

# Afrotheria

2002 and November 2010, 1232 faecal samples were collected from 3 female Aardvarks, housed at Brookfield Zoo, USA. Following ethanolic extraction, the samples were analysed for immunoreactive oestrogen and progesterone concentrations using enzymeimmunoassays for estradiol (antibody R4972, UC Davis, USA) and progesterone (monoclonal antibody CL425, UC Davis, USA). Collectively, we were able to monitor two successful pregnancies and one stillbirth with gestation length of 239, 238, and 234 days, respectively. During preconception periods, faecal estrogens showed a clear cyclic pattern with an average cycle length of 10-11 days, indicating seasonally polyoestrous. Faecal progesterone levels were only marginally elevated during the first 80-93 days of each monitored pregnancy, suggesting the existence of obligate diapause in the Aardvark.

## **The spatial organisation of the four-toed elephant-shrew (*Petrodromus tetradactylus*)**

Mike Perrin and Katherine Oxenham

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We radio-tracked four-toed elephant shrews intensively for two months in sand forest at Tembe Elephant Park. They occurred as monogamous male-female pairs that defended overlapping home ranges. There was virtually no overlap between the ranges of adjacent pairs, indicating low population density, although not negating avoidance or territorial defence. Home range areas are similar to those reported earlier, although females tended to have smaller ranges. Most males and some females had two separate centres, which may be associated with habitat characteristics. Results are discussed in relation to social behaviour and previous studies.

## **The genetic mating system of the short-eared sengi (*Macroscelides proboscideus*)**

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Elephant-shrews or sengis are a unique clade of mammals that are all suspected to be socially monogamous, yet there are few genetic studies to confirm genetic monogamy. The objective of this study was to examine paternity of offspring in *Macroscelides proboscideus*, the Short-eared sengi from South Africa. Previous field work has confirmed that this species is socially monogamous. Microsatellites were isolated from Short-eared sengi DNA, and polymerase chain

# Afrotheria

reaction primers were designed. Fourteen of these target loci were successfully amplified with fluorescently-tagged primers. Heterozygosity across loci ranged from 0.43 to 0.90, indicating the usefulness of these markers for paternity analysis. Paternity was analyzed using the program Cervus and exclusion analysis. Of 21 offspring from 12 mothers, 13 (62%) were genetically related to the putative fathers identified in the field. Another 8 offspring (38%) were found to be fathered by males other than the suspected father. These surprising results will be discussed relative to the likely ecological factors important in sengi social ecology.

## **Influence of habitat characteristics on the distribution patterns of aardvarks (*Orycteropus afer*) in Mole National Park, Ghana**

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Determining influential factors to species distribution is difficult, yet critical to effective wildlife conservation efforts. Among African mammals, aardvarks (*Orycteropus afer*) are particularly less studied and understood due to their solitary nocturnal behaviour. In West Africa, they also face potential threats from bush meat trade and habitat alteration. As part of a larger effort to develop a conservation action plan for aardvarks in West Africa, this study aimed at determining factors influencing aardvarks' distribution. The study was conducted in Ghana's largest National Park (Mole) located in the northern savannah plains. We recorded the presence or absence of aardvarks from 253 camera traps from 2006-2009 and concurrently collected several habitat data including proximity to watercourses, distance to fringe communities and road networks. We obtained additional data on habitat features (shape files) from the Ghana Wildlife Division. We used logistic regression analyses to assess the influence of habitat variables on aardvark distribution. Results revealed a significant negative association between aardvark presence and distance to park boundaries, watercourses, villages and road networks; variables that also correlates with human presence. This finding is consistent with aardvark life history features, which typically describe aardvarks as being shy and generally quick to flee at any sign of danger. It further supports published findings that aardvarks are discretionary in their site selection behaviours, like for instance in choosing safe but not too far distances from watercourses for digging their burrows.

# Diversity & Distribution

## ORAL PRESENTATIONS

### **Abundance, reproduction and population structure of three African shrews: *Sylvisorex cf ollula* Thomas, 1913, *Scutisorex somereni* (Thomas, 1910) and *Crocidura dolichura* Peters, 1876 (Soricidae, Mammalia) from the Yoko Forest Reserve (DRC)**

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We analyzed seasonal variation of local abundance, reproduction and population structure of three sympatric shrews occurring in undisturbed and disturbed habitats within and around the Yoko Reserve Forest in the North Eastern region of D.R. Congo. During a period of 12 months, 451 shrews (276 *Sylvisorex cf ollula*, 74 *Scutisorex somereni* and 101 *Crocidura dolichura*) were captured using pitfall traps in two phases (January -February ; April- May 2007 and from October 2007 to June 2008, march 2008 excluded) in the goal to assess ecological preferences and reproduction rate of the species under study. Monthly, six transect lines were dug, 3 in disturbed habitat (fallow land) and 3 others in undisturbed habitat. In total, six sites were investigated. Reproductive characteristics were observed only for female individuals while population age classes were done by the mean of molar's tooth wear patterns and the statement of the suture between basioccipital and basisphenoid bones. Reproduction seems continuous throughout the year for some species. The number of shrews collected changes according to habitat: Primary Forest (FP& FPg), Secondary forest (FS), young and old fallow lands and old palm plantation (VPS). On the whole, a high number of adults are present and more male than females occur during a month, during rainy seasons and in disturbed habitats (JJ, JV &VPS). The amount of shrews captured in these undisturbed habitats arises 74%, 69% and 62% respectively for *Scutisorex somereni*, *C. dolichura* and *Sylvisorex cf ollula*. Litter size based on the number of embryos lies between 1 to 3 and 1 to 2 respectively for *S.cf ollula* and *S.somereni* but fewer animals are in gestation during the dry season, especially in January and February.



# Diversity & Distribution

## Abundance of small mammals in Nechisar National Park, Ethiopia

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Ecology of rodents and insectivores were studied in Nechisar National Park, Ethiopia during August 2008 - March 2009. Grassland, *Acacia* woodland, ground water forest, riverine forest, deciduous bush land, Lake Abaya shore and Lake Chamo shore were randomly surveyed. Twenty species of rodents and 5 species of insectivores were recorded from the study area. *Mastomys natalensis* (17.37%), *Arvicanthis dembeensis* (17.09%), *Mastomys erythroleucus* (8.90%), *Stenocephalemys albipes* (8.76%), *A. niloticus* (8.19%), *Acomys cahirinus* (7.34%), *Lemniscomys striatus* (6.92%), *Tetera nigricauda* (6.21%), *Grammomys dolichurus* (3.67%), *T. robusta* (2.12%), *Mus proconodon* (1.98%), *Praoimys natalensis* (1.41%), *Dendromus melanotis* (1.27%), *A. abyssinicus* (1.13%), *Mus musculus* (0.99%), *P. albipes* (0.85%), *Xerus erthrophus* (0.85%), *L. mice* (0.71%), *Mus tenellus* (0.71%) and *Otomys tupus* (0.28%) were the rodents and their relative abundance in the study area. *Crocidura flavescence* (1.41%), *C. fumosa* (0.85%), *C. bicolor* (0.57%), *Elephantulus rufescens* (0.28%) and *C. olivera* (0.14%) were the insectivores recorded and with their respective relative abundance. *M. natalensis* was the most abundant, which constituted 17.37% where as *O. typus* had the lowest percentage abundance (0.14%). Small mammal density varied from 55 to 176/ha, based on the habitat type and season. Biomass estimated varied from 6580.40 g/ha to 9563.00 g/ha, with higher values for the dry season.

## Systematics and biogeography of the genus *Mastomys* in Namibia and adjacent countries

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Systematics of the genus *Mastomys* in southern Africa is unstable and has experienced many changes over years. *Mastomys* species are important reservoir hosts of many diseases affecting humans and they are significant agricultural pests. Hence, there is a need for a more reliable delimitation of species and their geographic distribution. This study aims to determine the number of *Mastomys* species and their geographical distribution in Namibia and parts of Botswana and Angola. A total of 352 specimens were trapped in these countries. The

# Diversity & Distribution

methodological approach included skull morphometrics (396 specimens), karyotypes (64 specimens) and cytochrome-b gene sequences (124 specimens). Results indicate that *M. coucha* and *M. natalensis* have a distinct geographical distribution in Namibia. This seems to be influenced by precipitation: *M. coucha* mainly occurs in the low rainfall areas of central Namibia, whereas *M. natalensis* occurs in higher rainfall areas of north-central and north-eastern Namibia, extending into Angola and northern Botswana. Karyologic data suggest the existence of a third karyomorph (probably *M. shortridgei*), which shares the same diploid number ( $2n = 36$ ) with *M. coucha* but differs in fundamental number: *M. shortridgei* (aFN = 51/52) and *M. coucha* (aFN = 60). Both molecular and karyologic data indicate that *M. coucha* is the closest relative of *M. shortridgei*. The results of this study will improve the current understanding of systematics and biogeography of *Mastomys* in southern Africa.

## **Biodiversity of terrestrial small mammals along an altitudinal transect of Soutpansberg, Limpopo Province, South Africa: a case study of Lajuma**

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This research seeks to investigate the influence of climatic variables by determining the influence of temperature and rainfall on small mammal distribution, abundance and species composition. Different species of small mammals will be identified and their elevational ranges will be determined. The relationship between slope/aspect vegetation structure and the influence of fire on species richness and abundance will be determined. Different sets of data will be collected in the field: small mammal sampling will be done using the capture-mark-recapture method wherein small mammals are trapped using Sherman traps at ten altitudinal sites on north and south facing slopes. Species will be identified using a key based on external characteristics (Newberry, 1999) and vegetation sampling will follow Monadjem (2005). Environmental data (rainfall and temperature) will be collected using rain gauges, iButtons/data loggers. Data analysis will be performed as follows: similarity indices will be calculated to determine levels of similarities at different altitudinal sites using XLSTAT (Addinsoft, 2008). Multiple linear regression analysis and correspondence analysis (CA) will be used to determine associations between species occurrence, relative abundance, habitat type, and environmental variables. The statistical software Estimate S will also be used to generate values for small mammal species diversity at each site. Rarefaction or species accumulation curves will also be calculated for each site.



# Diversity & Distribution

## Small mammal biodiversity in a complex habitat in Lajuma, Limpopo Province, South Africa

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Anthropogenic factors and possibly climate change have a negative impact on habitats in Limpopo Province. These effects can be ameliorated with rational conservation of key habitats. Lajuma is situated in the northern part of South Africa, high up in the Soutpansberg Mountain Range between Makhado and Vivo. Lajuma has a variety of habitat types including montane forests and montane grasslands, clear mountain streams with waterfalls. Lajuma, which falls within the proposed Vhembe Biosphere Reserve, contains a high diversity of plants and animals with strong altitudinal and climatic gradients containing a mosaic of ecosystems from mesic savanna and wetlands on the slopes, to sourveld grassland and mist belt forest on the summits. The research suggests that there is a good relationship between habitat type and small mammal richness, diversity and abundance. The focus of the study is to establish baseline ecological data on small mammal community structure, habitat preferences and population cycles as these allow early detection of subtle changes in the ecosystem. The importance of small mammals is that they live short lives and have a high population turnover, thus allowing cohorts to be followed from natality to mortality in a relatively short time. Data were collected using Sherman traps. Small mammals were trapped and individually marked on permanently marked grids during general survey efforts and community structure and population dynamics was followed over time using capture-mark-recapture method. The research focuses on rodents, shrews, and elephant shrews. The study has indicated that ten small mammal species occur on the plot. Four insectivorous specialists similarly can be expected to indicate changes in insect community structure and over all abundance while the wetland specialist should be good indicators of wetland health.

# General Ecology

## ORAL PRESENTATIONS

### **The Mammals of Africa: progress and problems**

David Happold and Meredith Happold

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“*The Mammals of Africa*” is a six-volume multi-author work that presents detailed profiles of the 1116 species currently recognized as extant on the continent. Two of the volumes, edited by us, are devoted to the small mammals (Orders Rodentia, Lagomorpha, Afrosoricida, Macroscelidea, Erinaceomorpha, Soricomorpha and Chiroptera). These orders collectively comprise about 75% of the species of African mammals. A series of guidelines were produced to ensure that each species profile has the same basic format as well as a pan-African distribution map and a table of standard measurements. In addition there are profiles for every order, family and genus. Each volume is well illustrated and there are many Tables that provide comparative data. During the writing and editing of this work, we were confronted by many problems of special relevance to others who are contemplating writing or editing books about the fauna of particular regions: some of these issues will be discussed in this presentation. All six volumes of “*The Mammals of Africa*” will be published simultaneously in hardback in 2012: later, we hope, they will be issued as a series of DVDs.

### **Grasslands of fear: positive effects of wooded islands on the foraging behaviour of nocturnal rodents at Phinda Game Reserve**

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Forest fragments in grasslands create spatial heterogeneity within landscapes. The resulting habitat fragmentation and edge effects influence wildlife abundance and distribution on broad geographic scales. A population's activity patterns may reveal the value of habitat types and the corresponding edge habitats. Recently, Abu Baker & Brown (2010) found that the rodent, *Rhabdomys pumilio*, perceived the forest fragments in grasslands as habitats with no opportunities and highly risky even when equal opportunities were provided. We used live trapping and giving-up densities (GUDs) to test if nocturnal rodents similarly perceive the distinct ‘islands’ of woody vegetation in the grasslands at Phinda Game Reserve (PGR), KwaZulu-Natal, South Africa. Contrary to expectations, our results suggest that the two most abundant rodent species (*Gerbillus leucogaster* and *Mus minutoides*) perceived the grasslands as more risky than the wooded islands when equal opportunities were simultaneously provided. We also found no evidence for cover effects at the microhabitat scale: GUDs of rodents were similar at open and closed patches in grassland and woody habitats. We suggest that because wooded islands are relatively scarce at PGR, they have positive effects on small, nocturnal rodents by reducing predation risk on a landscape scale. Our data are useful for developing recommendations for managers to improve the quality or amount of edges for wildlife.

# General Ecology

## The dynamics of small mammal populations in the Rocky Highveld grasslands of Telperion Nature Reserve, Mpumalanga, South Africa

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The study attempts to answer the question of habitat selection of small mammals to vegetation type and structure in the Rocky Highveld Grasslands of Telperion in Mpumalanga. The project focuses on the influence of different broad habitats (pioneer grasslands, disturbed grasslands, *Burkea* dominated veld, *Protea* dominated veld) on small mammal diversity and the differences and similarities of ecological patterns displayed. This study also focuses on the effect of different management influences (virgin bush, moderate to severely altered areas) on diversity and abundance. These interactions should give an insight into the effect of different management practices in this grassland region. Habitat fragmentation is a major threat to biodiversity worldwide. It may result in the isolation of populations resulting in unviable population sizes due to low recolonization rates and can thus cause a decrease in population numbers of many species, both directly and indirectly. However, fragmentation is not all negative as a patchwork of habitats of different sizes can lead to high faunal diversity if these areas are of a sufficient size. The presentation focuses on habitat selection, species per/ha and interactions with vegetation communities in this threatened habitat type.

## Seasonal variation in the diet of *Rhabdomys pumilio* in Bisho Bushveld, Eastern Cape, South Africa

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Seasonal variation in the diet of *Rhabdomys pumilio* was investigated over a period of twelve months. The annual diet included 34 plant species. Species richness of the diet reflected the heterogeneity of the habitat and plant food formed the largest proportions of the stomach contents. The diet was dominated by the utilization (>40%) of ephemeral, high quality foods (insects, fruit and seeds) from spring to early autumn. This resulted in significant variation in the major components of their seasonal diets. Reproduction in *R. pumilio* appeared to be linked to the presence of high quality food in their diet. The most important components in terms of abundance and frequency of occurrence in the diet were insects, grass seeds, dicot seeds and fruit. These results confirmed *R. pumilio* as an opportunistic omnivore. An increase in bark consumption during dry winter months was evident. Bark consumption peaked with increased density of *R. pumilio* juveniles which tended to eat more bark than adults. The onset of bark consumption appeared to be linked to a marked reduction in the water content of the monocots, which constituted the major food category in winter.

# General Ecology

## Radio-tracking as an effective tool to study the behaviour of free-living subterranean rodents

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A direct observation of free-living subterranean mammals is almost impossible. Apart from short forays above ground, their existence is confined to self-constructed systems of underground burrows. Most of their activities including foraging, searching for mates and reproduction probably occur below ground. The only effective tool how to follow their activity in the field is thus telemetry. In our hitherto carried out studies, we used radio-telemetry in three species of strictly subterranean African mole-rats: the giant mole-rat *Fukomys mechowii*, the Ansell's mole-rat *Fukomys anelli*, and the silvery mole-rat *Heliophobius argenteocinereus*. Based on our results, it is clear that using radio collars (especially if equipped with indicators of activity) can provide us with many valuable information on spatial and temporal activity patterns of subterranean mammals. The advantage of the "subterranean" telemetry is very precise fixing of an animal's position since an observer can approach it very closely without disturbing it seriously. If microenvironmental characteristics are measured, factors determining activity patterns can be tested. If radio-tracking data are collected for a longer period, seasonal trends in activity can be analysed as well. Mapping of a burrow system after radio-tracking of their inhabitants could bring unique information of how subterranean mammals utilise their burrow systems, how they explore underground environment, and finally information related to their role in ecosystems, e.g. burrow excavation and soil transport. Radio-tracking could also reveal contacts between individuals/colonies, or an antipredator behaviour. In social subterranean rodents, radio-telemetry could also document division of labour among colony members or forming of alliances among particular individuals. The research was supported by the grant of the Grant Agency of AS CR IAA601410802

# Systematics

## PLENARY

### ***The bats of Madagascar: history of colonization, speciation, and measures of species richness and endemism***

Steven M. Goodman

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The past decade has seen considerable field research associated with bat inventories across many different areas of Madagascar, which have provided specimen and associated tissue collections for detailed systematic research. The use of molecular genetic techniques at the first level and different morphological studies at the second level have been paramount to understand patterns of colonization, speciation, and identification of cryptic species. In this presentation, these different points are reviewed to approach a synthetic analysis of the bats of the island, including aspects of their biogeographic affinities and levels of endemism.

## ORAL PRESENTATIONS

### **Enhancing taxonomic capacity to underpin biodiversity conservation**

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For the past twelve years, the Harrison Institute and Prince of Songkla University have worked together with colleagues in mainland Southeast Asia to increase taxonomic capacity. Outputs include in-country PhD and MSc students conducting taxonomic research on bats, whilst others are now working on rodents and birds. There have been many faunal surveys, 32 publications, and the description of five bat species new to science. Together, we have hosted training workshops, facilitated staff and student inter-institutional exchanges, and organised and presented at national and international conferences. Currently, we are developing a centre for tropical biodiversity research and training which is based at the Natural History Museum of the Prince of Songkla University in peninsular Thailand. In January, 2011, our team launched the Afro-Asian Taxonomic Network [http://www.harrison-institute.org/afro\\_asian/index.html](http://www.harrison-institute.org/afro_asian/index.html). Targeted at a new generation of young taxonomists and biodiversity specialists, it seeks to promote and facilitate taxonomic research not only in Asia but throughout the Old World tropics. The idea is that the Network offers an opportunity for taxonomists, often working in relative isolation, to become part of a wider international scientific community. It seeks to promote the exchange of ideas and, where possible, provide inter-institutional training and research programmes; greater access to biodiversity literature; and host regional/international taxonomic/biodiversity workshops and conferences.

Although most of our work to date has been in Asia, the first phase of the Network in Africa is about to begin, with the training of an MSc student from the Copperbelt University, Zambia in mammal taxonomy at the Prince of Songkla University. At this Congress, we would welcome any feed-back from the established taxonomic community about the Network. Is it relevant to the needs of Africa and if so what should be its priorities in terms of capacity building, geography and research topics?

# Systematics

## Accumulation of rare sex chromosome rearrangements in the African pygmy mice (genus *Mus*, subgenus *Nannomys*)

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Although sex chromosomes are generally the most conserved elements of the mammalian karyotype, those of African pygmy mice show three extraordinary deviations from the norm: (a) asynaptic sex chromosomes, (b) multiple neo-sex chromosomes, and (c) modifications of sex determination in some populations/species. It is unprecedented that all these features are observed within the same genome. Furthermore, it occurs in very close relatives of the laboratory mouse (same genus), making the African pygmy mice one of the most relevant models to investigate sex chromosome and sex determination evolution in mammals. We will focus on the diversity of neo-sex chromosomes, and on the evolution of a rare case of a novel sex determination system in *Mus minutoides*. In effect, this species is characterized by a very high proportion of XY females from geographically widespread Southern and Eastern African populations. Sequencing of the high mobility group domain of the mammalian sex determining gene *Sry*, and karyological analyses using fluorescence in situ hybridization and G-banding data, suggest that the sex reversal is most probably not due to a mutation of *Sry*, but rather to a chromosomal rearrangement on the X chromosome. In effect, two morphologically different X chromosomes were identified, one of which, designated X\*, is invariably associated with sex-reversed females. The asterisk designates the still unknown mutation converting X\*Y individuals into females. Although relatively still unexplored, such an atypical sex chromosome system offers a unique opportunity to unravel new genetic interactions involved in the initiation of sex determination in mammals.

# Systematics

## Phylogeography of Saharan rodents

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Since the onset of arid conditions, approximately 7 Myr ago, the Sahara desert has experienced drastic changes, alternating humid and arid phases, which rendered its boundaries highly variable. These recurrent and important paleoclimatic shifts have likely affected the geographic distribution and evolution of animal species. We simultaneously studied the phylogeography of three gerbils (*Gerbillus tarabuli*, *G. pyramidum*, *G. gerbillus*) and of the lesser jerboa (*Jaculus jaculus*), which are abundant at the sandy zones of the Sahara. Our phylogenetic analyses, based on the mitochondrial gene of the cytochrome b, indicate for all species, an absence of geographical structuring. The phylogenies also revealed two monophyletic, well differentiated clades in the lesser jerboa, with a mean genetic divergence value ( $K2P = 10.9 \pm 0.01\%$ ), which, suggest that there are two separate species within the currently accepted *J. jaculus* in the Sahara. Various demo-genetics analyses show different patterns of range and demographic contraction/expansion between species, which are related to some important shifts in climatic conditions. This study reveals discordant phylogeographic patterns between these four (five?) Saharan species, which answered each one by different manners to the climatic fluctuations.



# Systematics

## Continental islands – the biogeography of the East African forest-dwelling mountain rodent *Praomys delectorum*

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Mountain forests in Eastern Africa form archipelagos of specific habitats with particular flora and fauna. Fragmented distribution of specialized taxa has important consequences for their genetic structure with the most important effects on the reproductive isolation of populations and allopatric speciation. In present study, we employed morphological and genetic (nuclear microsatellites and the mitochondrial cytochrome *b* sequences) data to review the status of fragmented populations of endemic forest-dwelling rodent *Praomys delectorum* (family Muridae). This species occurs in a long narrow zone of the mountain chains and isolated massifs, from southern Kenya (Taita Hills), northern (Mt. Kilimanjaro) and eastern (Eastern Arc Mountains) Tanzania as far as southern Malawi (Mulanje Massif). Considering the character of distribution of this species it is possible to employ *P. delectorum* as a model for studying interesting biogeographical tasks, e.g. for the reconstruction of the evolution of mountain biota of East Africa or for the testing of the relationship between genetic variation and the population size (i.e. the size of the "forest island"). Genetic data showed significant genetic differentiation of individual populations. The phylogenetic analyses of mtDNA imply the successive splitting of lineages from the south towards north (especially the southernmost populations are very distinct). Microsatellites show slightly different pattern for some populations and suggest the important role of genetic drift during habitat fragmentation. Classical and geometric morphometry again indicate remarkable variation among populations, which is now analysed in relation with predictions of island biogeography.



# Systematics

## Phylogeography of the Red Veld Rat (*Aethomys chrysophilus*) (Rodentia: Muridae), the role of rivers and potential Pleistocene refugia in south-eastern Africa

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Presented are results of the molecular phylogeographic studies of African rodents of the genus *Aethomys* focusing on *Aethomys chrysophilus*. Genus *Aethomys* currently includes nine species, but recent findings suggest the need for a thorough taxonomic revision. Within our collection we identified 5 different species, including recently reclassified *Micaelamys namaquensis*. Material available for *A. chrysophilus* (110 specimens, 40 localities) covers a significant geographic distribution of the selected species complex. Mitochondrial cytochrome b sequences (a fragment of ~1050 bp with 135 parsimony informative sites) were utilized as markers to reconstruct a phylogeography for representative populations. Phylogenetic analyses conducted by maximum parsimony, maximum-likelihood and neighbor-joining methods produced almost matching phylogenetic reconstructions of trees that separated five well supported clades based on geographical origin: (1) Kenya, northern Tanzania, and (2) The central and northern Zambia, Malawi, northern Mozambique, southern Tanzania, (3) Eastern Zambia (4) southern Mozambique, Zimbabwe (5) Surprisingly, well defined species *A. ineptus* was located as an internal group in the phylogenetic tree making *A. chrysophilus* polyphyletic. This spatial structure can be partly explained by the presence of natural barriers as large rivers (Zambezi, Limpopo, Kafue) and their adjacent valleys.

## Taxonomy of the genus *Scotophilus* (Vespertilionidae) in southern Africa

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The Palearctic genus *Scotophilus* is one of the systematically most complicated bat groups in the family Vespertilionidae. Three of the most abundant species in the genus inhabiting sub-Saharan Africa are usually distinguished on the basis of the colouration of their venters as the yellow-bellied *S. dinganii*, the white-bellied *S. leucogaster*, and *S. viridis* which is distinguished from the former two species by greenish tinged fur covering the whole body. Particular populations were assigned to these species rather intuitively and were also often reciprocally synonymized. A recently published study based on genetic sequence data revealed intricate phylogenetic relationships in the genus *Scotophilus* and suggested existence of cryptic species. Here we report on molecular genetic analysis that broadens the current systematic information on the genus. Our

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data suggests that southern African populations fall into three mitochondrial lineages corresponding to three separate species, and confirms the classification of only the yellow-bellied *S. dinganii*. Bats with white to greyish-brown venters, which are currently considered to belong to *S. viridis*, were genetically similar to *S. leucogaster damarensis*. However, *S. l. damarensis* is not closely related to *S. leucogaster* s.str. from the northern hemisphere, and can be regarded as a separate species. On the other hand, the recently discovered cryptic form of *S. dinganii*, tentatively named as *S. mhlanganii*, likely corresponds to the green-tinged *S. viridis* according to the original definition of *S. viridis*.

## Taxonomic revision of the genus *Asellia* (Hipposideridae)

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Two species are currently recognised within the genus *Asellia*, a typical inhabitant of arid areas of northern Africa and southwestern Asia. Most of the distribution range of the genus is covered by the species *A. tridens*, while the other species, *A. patrizii*, is restricted to Ethiopia, Eritrea and several Red Sea islands. We analysed morphological variation in an extensive set of *Asellia* samples covering the whole genus range including most of the available type material. In a representative subset of samples, we employed molecular genetic analysis to infer phylogenetic relationships within the broadly distributed *A. tridens*. Morphological comparisons revealed four distinct morphotypes. Except for the endemic *A. patrizii*, all African *Asellia* belonged to the same morphotype as most of the Middle Eastern specimens. This morphotype was unambiguously identified as *A. tridens*. Two other morphotypes of tentative *A. tridens* could be further delimited based on skull shape differences; one in the southern Arabian region of Dhofar, the other in Socotra. Phylogenetic analysis of complete sequences of the mitochondrial cytochrome *b* gene yielded three main monophyletic groups, which corresponded to revealed morphotypes of *A. tridens*. Significant genetic divergences reaching over 5% and 12%, respectively, were discovered between them. Based on the morphological and molecular data obtained, we propose a split of the current *A. tridens* into three separate species: *A. tridens* in Africa and most of the Middle East, *A. italosomalica* in Socotra and Somalia, and *A. arabica* sp. nov. in southern Arabia. Molecular dating along with available paleontological information and geological history of the Arabian Peninsula supports an Arabian origin of the contemporary *Asellia*. While profound divergence of the Socotran form may be linked with the split of Socotra from the southern Arabian coast in the Middle Miocene, low sequence variation of *Asellia* in most of Africa and the Middle East suggests a relatively recent colonisation of this vast area during Pleistocene. The newly described form from southern Arabia likely represents a relict of aridisation during Miocene/Pliocene transition.

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## Comparative chromosome painting studies of Chiroptera from Madagascar: chromosomal homologies and genome evolution

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Madagascar is home to eight of the 19 recognized families of bats, including the endemic Myzopodidae. While recent systematic studies have contributed to our understanding of the morphological and genetic diversity of the island's chiropteran fauna, little is known about their cytosystematics. We investigated karyotypic relationships among ten species, representing six families of Chiroptera endemic to the Malagasy region using cross-species chromosome painting and GTG-banding. Flow-sorted chromosome painting probes of *Myotis myotis* were used to establish genome-wide homology among chromosomes of the Malagasy species investigated in this study. Our results provide further insights into karyotypic evolution within the two suborders of bats (Pteropodiformes and Vespertilioniformes) and provide further support for the involvement of Robertsonian translocations and predominance of homoplasies in the genome evolution of Chiroptera. Furthermore, we describe novel chromosomal rearrangements in two bat families, Pteropodidae and Myzopodidae, using *M. myotis* whole chromosome probes.

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## ORAL PRESENTATIONS

### Population substructure of geoffroy's horseshoe bat in South Africa: what can the patterns tell us?

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Recent bat research, making use of molecular, morphological or echolocation data keep revealing new taxa. Many of these new taxa were once, on the basis of morphology alone, considered to be members of a single, widely distributed species. Geoffroy's Horseshoe Bat, *Rhinolophus clivosus* is widespread throughout Africa. Roberts (1951) considered three subspecies to occur in South Africa, however there are currently only two subspecies recognised in this region. Here we make use of molecular data (mtDNA) to investigate the variation within *R. clivosus* sampled from South Africa, Mozambique, Kenya, and Egypt. More specifically we investigate the genetic variation within populations from South Africa, encompassing all previously-described subspecies for this region. We find support for the three subspecies, and no haplotypes are shared amongst them. Additional population differentiation is present in the eastern side of South Africa, with individuals from the same localities grouping in separate clades from their conspecifics. Because male-biased dispersal and female philopatry is common among mammals, our on-going research will include microsatellite data to investigate relationships amongst populations and the historical processes influencing them.

### Bats of Nimba Mountain, Liberia: an African hotspot

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Nimba Mountain, straddling Liberia, Guinea and Ivory Coast, has been recognized as a hotspot for mammalian diversity on a continental scale. The bats of Nimba have been extensively surveyed in the past (during the 1970s and 1980s), and 31 species can be vouched for by museum specimens in the former Lamco (now ArcelorMittal) concession on the Liberian side. The Nimba region is coming under increasing pressure from various threats, including mining, deforestation and over-harvesting. However, no recent assessments are available for the bats of the area. The current study was conducted over a four-week period in December 2010 and January 2011 on the Liberian side of Nimba, centred on Yekepa. Standard sampling techniques were employed to capture bats in various habitats, including the use of mistnets, a harp trap and searches for day roosts. During this survey, a total of 32 species of bats were recorded, of which 10 species had not previously been recorded from the Lamco concession area, bringing the total number of species known to occur at Nimba to 50 species. According to most recent IUCN listings, 1 species is Critical, 3 are Endangered, 3 are Vulnerable and 6 are Near-Threatened. A further 2 taxa may represent full species and their conservation status has not yet been evaluated. This highlights the importance of Nimba Mountain for the conservation of African bats.

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## The relative influence of competition and prey defences on the trophic structure of animalivorous bat ensembles

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Deterministic processes such as competition and prey defences should have a strong influence on the community structure of animals such as animalivorous bats that have life histories characterized by low fecundity, low predation risk, long life expectancy, and stable populations. We investigated the relative influence of these two deterministic filters on the trophic structure of animalivorous bat assemblages in southern Africa. We used null models to test if patterns of dietary overlap were significantly different from patterns expected by chance, and multivariate analyses to test the correlations between diet and phenotype (body size, wing morphology and echolocation). We found little evidence that competition structured the trophic niche of coexisting bats. Contrary to predictions from competition, dietary overlap between bats of ensembles and functional groups (open-air, clutter-edge and clutter foragers) were significantly higher than expected by chance. Instead, we found support for the predictions of the allotonic frequency hypothesis: there were significant relationships between peak echolocation frequency and percentage moth in the diets of bats at local and regional scales, and peak echolocation frequency was the best predictor of diet even after we controlled for the influence of body size and phylogeny. These results suggest that echolocation frequency and prey hearing exerts more influence on the trophic structure of sympatric animalivorous bats than competition. Nonetheless, differential habitat use and sensory bias may also be major determinants of trophic structure because these are also correlated with frequencies of bat calls.

## Diversity assessment of bat communities on Kwalata Game Ranch, Gauteng, South Africa, with a view to investigate effects of ecological light pollution

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Considering the value of bats as ecological indicators, baseline diversity assessments are critical if monitoring programs and management plans are to be successful. Furthermore, given the importance of bats from an economic and biodiversity perspective, it is important to elucidate anthropogenic effects on bat communities. We hypothesised that bat diversity would be higher in the riparian and seep-zone vegetation – dominated by *Tambotis* (*Spirostachys africana*) – than in the savannah woodland on Kwalata Game Ranch, South Africa. Using a combination of mist nets, harp traps and acoustic monitoring we assessed bat diversity and community composition within these three distinct vegetation types. We found support for our hypothesis: bat diversity was higher in riparian and seep-zone vegetation than in the savannah woodland. However, because the



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different vegetation types are not equally represented in the reserve, the lower diversity within the savannah woodland may be a result of the dilution effect. Additionally, we measured the proximity of sample sites to a large rural settlement bordering the conservation area. This settlement contains numerous, large spotlights which produce high levels of light pollution at night. The proximity of sample sites to the settlement will be used to determine effects of ecological light pollution on bat community composition. We predict that bat abundance and activity at sample sites will be correlated with distance to the settlement.

## **The diversity, activity and diet of Insectivorous bats in agro-ecosystems in Swaziland**

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Insect pests are of great economic significance in the agricultural industry, resulting in major losses every year. Insectivorous bats are potential biological insect pest control agents but little of this is known in Swaziland and some other African countries. In this study, acoustic methods and conventional methods were used for the detection and capture of bats in four agro-ecosystems (maize, pineapple, sugarcane and pastures) in the Luyengo area while molecular and microscopic methods were used to analyse their diet. An ANABAT II bat detector was used to record bat echolocation calls and these were analysed using ANALOOK software from which the diversity and foraging activity were ascertained. Mist nets were used to capture bats from which faecal pellets and stomach contents were collected and analysed. A total of five bat species (*Chaerephon pumilus*, *Pipistrellus hesperidus*, *Scotophilus viridis*, *Neoromicia nana* and *Miniopterus spp.*) were found to forage in these sites of which *C. pumilus* had the highest activity accounting for 57.6% of the total number of passes recorded. A total of 17 bats were captured and their diet constituted mainly of insects from three orders; Lepidoptera, Coleoptera and Hemiptera. Differences in type of crop grown in each agro-ecosystem did not have any effect on bat foraging activity as there was no significant difference in bat activity in the four agro-ecosystems. This area, however, harbours a significant diversity of bats with a relatively high activity. Microscopic analysis suggests that bats had a high preference for insects from two orders, Lepidoptera and Coleoptera which are the predominant pests of most crops while molecular analysis showed a high preference for insect pests of the order Hemiptera. Based on their activity and their preferred diet, we suggest bats have the potential of acting as biological pest control agents in the agro-ecosystems at Luyengo.

## **Impact of traditional agriculture practices on plant phenology, implication for food resources availability and population dynamics of fruit bats in Northern Benin, West Africa**

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The phenology of five native woody plant species on which forage fruit bats was studied in farmed lands of village territories surrounding the Biosphere Reserve of Pendjari (BRP) located in north-western Benin. Three of these woody plants, *Vitellaria paradoxa* (Sapotaceae), *Tamarindus indica*

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(Caesalpiniaceae) and *Diospyros mespiliformis* (Ebenaceae) were well preserved and directly utilized by local human populations whereas *Detarium microcarpum* (Caesalpiniaceae) and *Sarcocephalus latifolius* (Rubiaceae) that are not directly utilized by the same populations were more or less absent in farmed lands. We hypothesized that a reduction in food resources availability due to change in phenology will have high and positive correlation with fruit bats population dynamics. Fruits production was assessed for one year on these five targeted woody plants to explain the population fluctuation pattern obtained from the monitoring of fruit bats population on permanent plots from 2004 to 2009 with standardized method. Higher production of fruits was reported on *T. indica*, *D. mespiliformis* and *V. paradoxa* in farmed lands compared with protected areas (BRP) whereas *S. latifolius* and *D. microcarpum* showed comparable fruits production in farmed lands and protected areas (BRP). 1644 fruit bats captured showed different population dynamics pattern in farmed lands compared with protected areas (BRP). High abundance always coincides with pick production of food resources periods in the two zones. Land use therefore affects food resources availability with direct influence on fruit bats communities' conservation.

## Bat exploitation as game animals in Kisangani and its impact on biodiversity preserving

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The hunting speed in tropical forest regions is frightening, and Kisangani, a city located in the heart of the tropical forest (0°31'N and 25°11'E, 396m), is not spared from this scourge. In order to increase their low income, the resident population, who normally practice traditional fishing, is falling back on the exploitation of bats in urban and rural quarters since to them, the ancient activity of hunting has no more been profitable for two decades. In order to make an inventory of bat species eaten by men and marked in Kisangani, we have also identified different sites of bat game animal stock in Kisangani and counted them so as to show how this exploitation affects biodiversity preserving in the region forest regions of Kisangani. So, 6862 specimens of megabats have been identified during 12 monthly expeditions from March to August 2010 (72 expeditions at 6 months). Morphological characters such as the wool dye, the height and teething of the animals helped us to identify them, using different keys of determination. Manual count of sold carcasses and interview with sellers and hunters in conformity with a questionnaire prepared in advance for this purpose, have helped us to bring our investigation to a successful conclusion. As a result, big and middle-sized fruit bats are the most exploited for men's consumption in Kisangani: *Eidolon helvum* (3577 specimens, that is, 52.11%), *Hypsignathus monstrosus* (2462 specimens, that is, 35.87%), *Epomops franqueti* (677, that is, 9.86%), and *Myonycteris torquata* (148, that is 2.16%). Quarters situated along the Congo River are the main capture and market sites of these small mammals and provide the citizens necessary animal protein from bats. This arises the indication of the exploitation of bats during the whole year and in defiance of legal texts related to hunting, yet these animals have a particular reproduction pattern (long and only one gestation). And this harms the biodiversity of this fauna. If the interaction bats-mice and forest is broken, biodiversity preserving too is affected because this mammal plays a major role in natural reconstitution of forests.

# Bat Biology

## The sweet side of life: sugar and concentration preference in Wahlberg's epauletted fruit bat (*Epomophorus wahlbergi*)

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Fruit consumed by groups of frugivores portray patterns in their sugar composition, suggesting preference for sugars that are dominant in their food items. These sugars are often a key reward to facilitate dispersal of these fruits. Compared with other frugivores, few sugar preference experiments have been conducted with frugivorous or nectarivorous bats. Only one study has been conducted on sugar preference in Old World frugivorous bats, and this involved captive-born bats on a single concentration diet. Consequently, we investigated sugar preference in Wahlberg's epauletted fruit bat, *Epomophorus wahlbergi* over a range of equicaloric sucrose and hexose solutions. Based on the sugar composition of fruits taken by Old World frugivorous bats, we predicted that fruit bats would show preference for hexose sugars over sucrose. Irrespective of sugar type or concentration, bats appeared to regulate daily energy intake, with increased intake rates at lower concentrations. Despite increased intake rates, energy balance on the most dilute diet (5%) was not maintained. In contrast to our expectations, bats preferred hexoses only when offered dilute (5%) solutions. In addition, we examined the effect of concentration on preference when offered only one sugar type. Bats did not show a preference for a particular concentration irrespective of sugar type. We discuss these results in terms of physiological limitations and consider the implications for fruit dispersal.

## Seasonal effects on thermoregulatory abilities of the Wahlberg's epaulette fruit bat (*Epomophorus wahlbergi*) in KwaZulu-Natal, South Africa

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Seasonal variations in ambient temperature require changes in thermoregulatory responses of endotherms. These responses vary according to several factors including taxon and energy constraints. Despite a plethora of studies on chiropteran variations in thermoregulation, few have examined African species. In this study, we used the Wahlberg's epaulette fruit bat (*Epomophorus wahlbergi*) to determine how the thermoregulatory abilities of an Afrotropical chiropteran respond to seasonal changes in ambient temperature. Mass specific Resting Metabolic Rates (RMR<sub>Ta</sub>) and Basal Metabolic Rate (BMR) were significantly higher in winter than in summer. Furthermore, winter body mass was significantly higher than summer body mass. A broad thermoneutral zone (TNZ) was observed in winter (15°C- 35°C) compared with summer (30°C). This species exhibited heterothermy during the day (rest-phase) and had a low tolerance of high ambient temperatures. Overall, there was a significant seasonal variation in the thermoregulatory abilities of Wahlberg's epaulette fruit bats. The relative paucity of data relating to the seasonal thermoregulatory abilities of Afrotropical bats suggest further work is needed for comparison and possible effects of climate change, particularly extreme hot days.



# Rodent Behaviour

## PLENARY

### **Social flexibility in the four-striped mouse *Rhabdomys***

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Environmental change is unquestionably influencing the biology of many living organisms. While many species will succumb to the effects of rapid environmental changes, those that survive are of interest. The resilience of a species to change depends on its ability to respond adaptively. My research has focused on how the four-striped mouse *Rhabdomys* modifies its social behaviour in response to prevailing and changing environments. For the past decade, my research group has integrated behavioural, ecological and physiological studies to understand both ultimate and proximate causes of sociality in *Rhabdomys*. Populations of *Rhabdomys* across its wide distribution in South Africa display extraordinary geographic variation in sociality. *Rhabdomys* in the semi-arid regions is group-living. Groups consist of up to 30 individuals, in which (i) a dominant male displays paternal care and mates with the 2-3 adult females in the group simultaneously, and (ii) philopatric young are helpers at the nest. In the moist grasslands, males and females have intrasexually non-overlapping home ranges in nature but are tolerant of same-sex strangers in captivity. Although grassland males do display paternal care in captivity, paternal care is critical for offspring survival and development in arid but not grassland *Rhabdomys*. Long term studies in the semi-arid succulent karoo, South Africa indicate that *Rhabdomys* demonstrates social flexibility, whereby individuals of both sexes change reproductive tactics facultatively in response to fluctuating environmental conditions, leading to changes in the social system (i.e. switching from group-living to solitary-living). Switches accompany changes in population density and are regulated by (neuro-)endocrine mechanisms. Social flexibility is an adaptation to unpredictably changing environments, selecting for high phenotypic plasticity based on a broad reaction norm and not on genetic polymorphism for specific tactics. *Rhabdomys* is an appropriate model to test how small rodents respond to changing environments.

## ORAL PRESENTATIONS

### **Parental care in African striped mice (*Rhabdomys pumilio*): an ontogenetically complex problem**

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Organizational effects create permanent changes in neural substrates underlying behaviour during early critical periods, while activational effects modify neural activity to alter behavioural state in adulthood. The development and expression of parental care behaviour in African striped mice *Rhabdomys pumilio* suggests a greater level of complexity than the classic organizational-activational dichotomy. When striped mice are raised under different treatments ((i) both parents; (ii) mothers alone; or (iii) mothers alone but in close proximity to the father), the expression of paternal care behaviour in sons appears activated: mothers that raise young alone have sons that subsequently show higher levels of paternal care when adult. As adult male behavioural state changes depending on prevailing environmental and social conditions, activational effects, possibly in the form of hormone upregulation by the presence of pup olfactory cues, trigger the paternal

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care pathway. In contrast, the expression of maternal care behaviour in daughters appears organised: daughters show high levels of care when adult, regardless of the treatment in which they were raised, suggesting the behaviour is set at a critical period of development. However, females decrease care as they gain parenting experience, in particular in response to increased motivation of their mates to provide paternal care. This suggests that activational effects also modify neural activity within the organisationally sculpted maternal care pathway. Thus, organizational and activational effects should be seen to function in tandem to influence the expression of parental care behaviour.

## Behavioural differences of the two sub-species of *Rhabdomys dilectus*

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The role of phylogeny and environmental influences on behaviour were investigated in two sub-species of *Rhabdomys dilectus*: *R. d. chakae* and *R. d. dilectus*. I compared populations of the two sub-species that occur about 70 km apart in superficially similar grasslands, south of Johannesburg (Walkers Fruit Farms) and at Irene in Gauteng Province, South Africa. I studied the maintenance (non-social) and social behaviour of the sub-species in captivity. Three maintenance behaviours were studied: diel activity in an open arena, activity in an enclosed maze and in a modified plus maze. Social behaviour was studied by investigating the stress response of juvenile males after removal from their family groups and being placed in a plus maze, and the tolerance of unfamiliar same-sex consub-specifics in staged dyadic encounters. Both sub-species displayed similar activity profiles (diurnal and crepuscular) and similar levels of activity in an enclosed maze. However, *R. d. dilectus* showed high levels of anxiety in an open arena and in a plus maze. The sub-species showed similar social behaviours: males of both sub-species that were removed from their family groups at the onset of weaning showed a lower stress response compared to the group-living sister species *R. pumilio*. Same-sex intra-sub-specific social interactions were mostly similar between the sub-species but there were slight discrepancies in behaviour associated with mating. Surprisingly, there were higher levels of amicability in all dyads than predicted by the solitary lifestyle of the two sub-species in nature. Behavioural differences (anxiety response) may be due to divergence in allopatry because of differences in vegetation characteristics between the localities, most notably in the amount of cover. The similarities in activity profile and social behaviours could be explained by phylogenetic inertia or by similar selection pressures in similar environments.

## Activity patterns of bush Karoo rats (*Otomys unisulcatus*) in the thicket biome of South Africa: preliminary results

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The Bush Karoo rat (*Otomys unisulcatus*) is a Southern African endemic confined to the semi-arid Karoo regions, occurring marginally in the south-west Cape zone. Little is known about the ecology bush Karoo rats, and more specifically about their activity patterns. Herein, we present the preliminary results of an ongoing project investigating their activity rhythms in the Sam Knott Nature Reserve (Eastern Cape, South Africa). Data were collected from August 2010 to March

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2011 by means of monthly live trapping using PVC traps and radio-tracking. Overall, 28 animals were fitted with activity-monitoring radio-collars and tracked; these were 15 adult males and 13 adult females. In order to avoid influencing animal activities, activity monitoring was carried out from a car, taking fixes every 5 minutes over 11-13 hour-sessions (daytime and night-time). On average, individual bush rats were tracked for  $4.8 \pm 3.4$  days (min = 0, max = 12) and  $4.6 \pm 2.8$  nights (min = 0, max = 10). We recorded 27,380 activity fixes, on average  $1,432 \pm 34$  per hourly period. Throughout the 24-hour cycle, rats showed an average activity of  $22 \pm 8\%$ , with no difference between males and females. Bush rats exhibited a bimodal 24-hour activity cycle, with a first peak in the morning (from 05:00-07:00; 34% of activity) and a second one late afternoon (17:00-19:00; 31-35% of activity). However, we recorded high inter-individual differences in the percentage of activity displayed by animals. The average variation amounted  $19 \pm 11\%$  during daytime, with an average of  $8.2 \pm 2.0$  individuals tracked simultaneously ( $n = 15$  sessions). Values were similar during night-time ( $17 \pm 7\%$  variation), when an average of  $8.8 \pm 2.5$  rats were monitored concurrently ( $n = 13$  sessions). Further data will be collected from April to July 2011. We intend to evaluate the possible influences of weather conditions on the activity, as well as to highlight potential seasonal variations in the activity patterns of bush Karoo rats.

## Effects of species removal on the population dynamics and space use of coexisting small mammals

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Although competition and space use are normally invoked as factors promoting coexistence and structuring of communities, recently, differences in life history traits and behaviour have gained attention as possible explanatory factors. The Namaqua rock mouse *Micaelamys namaquensis* and the Rock sengi *Elephantulus myurus* coexist on rocky outcrops in the higgeld region of South Africa. This study aimed to establish the effect of removal of either *M. namaquensis* or *E. myurus* on ecology of the remaining species. Seven permanent 70m x 70m grids were trapped, of which two grids each were for *M. namaquensis* or *E. myurus* removal and three served as control grids. The density of *E. myurus* was higher on control and *M. namaquensis* removal grids than on *E. myurus* removal grids. There were distinct breeding seasons, with more reproductively active *M. namaquensis* individuals present on removal grids during the early rainy season compared to control grids. Both species had greater juvenile recruitment on removal grids and per capita recruitment of *M. namaquensis* was high on grids from where it was removed. There were no home range or range span differences between grids. Female *M. namaquensis* did not travel as far on *E. myurus* removal grids as they did on control grids. Hence, *E. myurus* is probably restricted in terms of space use by *M. namaquensis* but *E. myurus* may restrict resource acquisition by *M. namaquensis*. These species do compete, probably for resources such as space and food, which in turn affects various population characteristics.

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## Socio-spatial organization of bush Karoo rats (*Otomys unisulcatus*) in the Albany Thicket Biome: preliminary results

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In this paper, we present the preliminary results of an ongoing project investigating the socio-spatial organization of the bush Karoo rat (*Otomys unisulcatus*) in the Sam Knott Nature Reserve (Eastern Cape, South Africa). Data were collected from August 2010 to March 2011 by means of a monthly live trapping programme and radio-telemetry. Locations were obtained by means of random sampling and continuous 11-13 hour tracking sessions conducted at daytime, taking bearings every 30 minutes. Overall, 28 animals were equipped with radio-collars and tracked, but so far sufficient data were obtained for 19 of them (7 adult males and 12 adult females). We collected 4,762 locations, with an average of  $251 \pm 173$  (min = 33, max = 543) per animal. Average maximal home range size was  $403 \pm 251 \text{ m}^2$  (min =  $75 \text{ m}^2$ , max =  $1,000 \text{ m}^2$ ), with male home ranges ( $513 \pm 298 \text{ m}^2$ ) being significantly larger than female home ranges ( $329 \pm 194 \text{ m}^2$ ). Social units (i.e. individuals sharing from one to four nests) were composed of one male, one or two females, two to three subadults of both sexes and the young of the last litter. However, in some units subadults and young were absent, and one case with only two adult females cohabiting was recorded. Home range overlap between male and female pairs averaged  $56 \pm 31\%$  ( $n = 14$ ), while the overlap between cohabiting females reached  $74 \pm 26\%$ . Both males and females of different social units appeared to use exclusive areas, considering that home ranges of males overlapped by only  $7 \pm 8\%$  with those of neighbouring males, and female home ranges overlapped by only  $7 \pm 12\%$  with those of neighbouring females. Overlap between males and neighbouring females averaged  $14 \pm 16\%$  (min = 0%, max = 67%), suggesting that males may visit and mate with those females to increase their reproductive success.

## Resting site ecology of the woodland dormouse (*Graphiurus murinus*) in a riverine *Combretum* forest: preliminary results

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The resting site ecology of the woodland dormouse (*Graphiurus murinus*) was studied in a riverine *Combretum* forest (Great Fish River Reserve, Eastern Cape, South Africa). Dormice were captured using Sherman aluminium traps and eighty wooden nest boxes, and were marked by ear-tattooing. Twenty one woodland dormice were radio-tracked during two periods: hibernation (June–August) and mating season (October–November). A total of 156 resting sites were identified during the study: 47.4% were nest boxes ( $n = 74$ ), 30.1% were inside branches ( $n = 47$ ), 21.8% were inside trunks ( $n = 34$ ) and only one site (0.6%) was located underground. The trees used for resting were predominantly *Combretum caffrum* (86.5%). Several *Ziziphus* trees (7.7%) were also used. *Rhus pyroides* (1.9%), *Olea europea* (1.9%), *Acacia karroo* (1.3%) and *R. longispina* (0.6%) were only used sporadically. The mean height of resting sites used by dormice was  $209 \pm 119 \text{ cm}$  (min = 0 cm, max = 7 m), the mean circumference was  $86 \pm 40 \text{ cm}$  (min = 22 cm, max = 214 cm) and the mean percentage of usage of individual sites was  $11.1 \pm 12.5\%$  (min = 2%, max = 68%). Dormice showed a higher resting site fidelity in the hibernating season ( $81 \pm 11\%$ ) compared to the mating period ( $49 \pm 24\%$ ). Nest boxes used by dormice were located at the same height as cavities they use to rest/nest in trunks. Females used more natural sites (84%) in winter than nest boxes (16%)

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and nest box use (56%) increased during the mating season. Males ( $12.6 \pm 5.0$ ) generally used more resting sites than females ( $7.4 \pm 3.8$ ) and exhibited a lower resting site fidelity ( $41 \pm 29\%$ ) than females ( $70 \pm 20\%$ ) during the mating season.

## Are bushveld gerbils group-living?

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We studied sociality in mainly captive, but also free-living, bushveld gerbils *Gerbilliscus leucogaster* from South Africa. Although they are generally regarded as communal and tolerant of conspecifics, our fieldwork indicated that most burrows were occupied singly. Male home ranges sometimes overlapped, suggesting a lack of territoriality, while female ranges did not overlap; home ranges could overlap with multiple members of the opposite sex. Male ranges were generally larger than those of females. In captivity, social interactions in different temporal and spatial contexts were investigated through dyadic encounters and observations of mother-offspring groups. Tolerance between strangers was generally low regardless of sex. However, while male–female dyads displayed overall low tolerance levels throughout a 7-day study period, tolerance between same-sex partners, particularly females, increased over time. Spatial data tentatively supported a lack of territoriality, particularly in males. In male–female interactions, females initially appeared to be cautious of males, but later became aggressive towards them. Male–female interactions were investigated further during pregnancy and lactation, and females continued to be intolerant of their male partners, which may function to reduce potential infanticide risk. Pair-bonding is unlikely, at least during breeding, and both our field and laboratory data support a promiscuous mating system. Observations of groups of mothers and their weaned juveniles revealed high tolerance levels, at least when no other litter was present, indicating that philopatry is possible. We suggest that the discrepancies between the literature and our field and laboratory data are best explained by a flexible social system, whereby individuals live alone at times (e.g. when density is low) but are able to tolerate one another under other conditions (e.g. high population density). Such social plasticity would allow bushveld gerbils to respond to fluctuating environmental/demographic conditions.

## To mate or not to mate? Mate preference and fidelity in monogamous Ansell's mole-rats (*Fukomys anselli*; Bathyergidae)

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Ansell's mole-rats (*Fukomys anselli*) are subterranean rodents living in multigenerational families, where only the founder pair breeds and their offspring remain in the natal burrow system as helpers. Burda (1990) hypothesized that the female alone is not able to raise her (first) offspring which implies that her mate has to be socially faithful. Since in Ansell's mole-rats, repeated copulations over a longer period of cohabitation are necessary for ovulation and fertilization (Burda 1999), the fidelity of the male partner is expected. Here we tested this prediction and addressed the related question whether or not presentation of a new female provokes enhanced sexual interest in males (Coolidge Effect).



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We performed behavioral partner preference tests where a breeding male (king) chose between two females but had no direct access to them. The kings spent significantly more time sniffing an unrelated (and unfamiliar) female than on their own mates. If given the choice between an unfamiliar unrelated queen and her respective non-reproductive daughter, the kings preferred the queen. In contrast, queens did not differentiate between own mate and unfamiliar breeding or non-breeding males.

In a test on fidelity we allowed the males to access the compartment of an unfamiliar female while their respective families stayed in adjacent compartments (separated by a grid). Only the non-reproductive adult males seized the chance for copulation whereas the kings remained faithful. In reversed test conditions (i.e. females had access to an unfamiliar unrelated male), aggressiveness of the males impeded sexual encounters in most cases. We recorded only three copulations, all of them between queens and non-reproductive males. The reproductive status is apparently crucial for reproductive decisions. We postulate that the maintenance of Ansell's mole-rats' families depends strongly on the faithfulness of the kings.

## Foraging strategies in African mole-rats

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African mole-rats (Bathyergidae) are a rodent family unique for strictly subterranean life and diversity of social systems ranging from solitary to highly cooperative ones. Cooperative foraging of the social species is considered to be an efficient strategy reducing a risk of starvation under harsh ecological conditions (sparse or widely dispersed food resources combined with hard soil). However, there are many other foraging strategies and adaptations improving foraging success of subterranean rodents which are not necessarily connected with a particular social system. 1) Food generalism. Since subterranean food resources are energetically costly to obtain, food generalism is expected to be common in all subterranean mammals. 2) Food storing is a strategy used by most subterranean rodents. Mole-rats select an optimal size of food items to store, whereas they consume other items preferably *in situ*. The amount of stored food probably reflects the actual abundance of the optimal-sized food items. 3) Geophyte farming consists in utilization of food resources, such as large tubers, which after partially eaten, are left *in situ* to regenerate and then consumed again. This strategy was detected in some social mole-rats. 4) Area restricted search means concentration of burrowing activity in an area where food has been found in the past. It is thought to be common in subterranean rodents. On the contrary, captive mole-rats tend to abandon areas where food has been encountered and start to burrow elsewhere, presumably in search for another food-rich area. 5) So-called kairomone (plant odour) - guided food location was evidenced experimentally in several subterranean rodents but evidences from the field are rare. 6) Increased ability to store body fat is expected in solitary mole-rats, but the evidences are anecdotic from both field and captivity. The study was funded by MSMT (6007665801) and GAAV (KJB601410826 and IAA601410802).

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## African mole-rats: "Golden Mine" for the study of magnetoreception in mammals

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Ansell's mole-rats (*Fukomys ansellii*) from Zambia were the first mammals in which magnetoreception and magnetic compass orientation has been unambiguously experimentally evidenced in the laboratory (Burda et al. 1990) and further characterized as a polarity-, light-independent compass (Marhold et al. 1997, Thalau et al. 2006). The experimental paradigm (nesting preference) developed for this species has been successfully applied in subsequent studies of other rodent species. *Fukomys ansellii* was also the first mammalian species, in which processing of magnetic sensory information in the brain (in the superior colliculus) was demonstrated (Nemec et al. 2001) and the effects of magnetic field conditions upon neuronal activity in the brain navigation circuit were described (Burger et al. 2010). In this species also, for the first time in animals, involvement of the cornea in magnetoreception was demonstrated (Wegner et al. 2006).

In our contribution we review the hitherto achievements and point out the perspectives of further study of magnetoreception in African mole-rats as well as other small African mammals. In particular, we advocate the necessity of field and laboratory studies which should be done in Africa and we suggest the experimental designs for these studies and explain respective hypotheses behind them. Acknowledgement: The study is partly supported by the Grant Agency of the Czech Republic (project. nr. 506/11/2121).

# General

## ORAL PRESENTATIONS

### **A preliminary assessment of species diversity, distribution and status of the small carnivores in the Lower Zambezi National Park and Chiawa Game Management Area, Zambia**

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Very little research has been done on Zambian small carnivores. We obtained preliminary data on the distribution and status of small carnivores in two adjacent protected areas of central Zambia, Lower Zambezi National Park and Chiawa Game Management Area (GMA). Over a period of 4 weeks in 2009 we interviewed 57 people working in the area, including tour guides, lodge managers, boat drivers and anti-poaching patrol officers. Nineteen species of small carnivore were recorded. Among these was the rare Meller's Mongoose, not previously recorded in the area, which we personally saw and photographed. Four other previously unrecorded species, Selous' Mongoose, Bushy-tailed Mongoose, Small-spotted Genet and Spotted-necked Otter were also reported but remain unconfirmed. We provide information about habitat, active times, perceived rarity and population stability, as well as perceived human-carnivore conflict issues. The results show a high diversity of small carnivores in the area, although further research is required to confirm the presence of some of the rarer species not previously recorded.

### **Small carnivores from southern Benin: Assessment of diversity and hunting pressure**

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We conducted a study on a nine-week period between August 2007 and June 2008 in southern Benin with the aim to assess small carnivoran diversity and the hunting pressure to which they are subject through interviews, surveys of local markets and occasional direct observations. We provide an 'Index of Rarity' (IR), expressed as the number of times a species is identified as 'rare' by interviewees / the number of time it is mentioned. Nine species or taxa (*Genetta* spp.) were identified through 86 interviewed hunters, representing a total 333 mentions. Genets, *Crossarchus obscurus* and *Herpestes ichneumon* were from far the most sighted, the prevalence of such ecologically versatile species confirming that southern Benin constitutes a disturbed "ecosystem". Other species were *Hydrictis maculicollis*, *Atilax paludinosus*, *Ichneumia albicauda*, *Civettictis civetta*, *Mungos gambianus* and *Nandinia binotata*. Direct observations allowed us to confirm the presence of *G. pardina/maculata*, *C. obscurus*, *H. ichneumon* and *H. maculicollis*. The ubiquitous *C. civetta* was considered the rarest species (IR = 0.89), followed by *H. maculicollis* (0.72) and *I. albicauda* (0.69), whereas *C. obscurus* (0.01) was the commonest small carnivoran. Hunting techniques were mostly traditional guns, accompanied by dogs, and jaw traps. Small carnivorans are likely to represent a fair source of income for hunters, body parts being sold to fetish markets in 47% of the cases. Mean incomes range between US\$ 2.5 and 5.4 per animal, with the notable exception of *C. civetta* (US\$ = 14.6) and heads of *H. maculicollis*, reaching US\$ 33.7.



# General

## Differential predation by barn owls (*Tyto alba*) on field rodents in Tanzania: old males are more at risk

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Predation is an important major mortality factor for many small mammals. Our earlier studies showed that also in populations of the multimammate mouse, *Mastomys natalensis*, predation affects behavior and demography, although the population dynamics effects seem to be limited. A major predator of these rodents is the barn owl, *Tyto alba*. Here, we investigate whether the individual risk of being predated, varies between species, sexes and age/size classes of the rodents. We analysed owl pellets of barn owls, collected over a three year period in a field-fallow mosaic landscape in Morogoro Tanzania. Using skull characters, tooth wear patterns, lower jaw size and pelvis measurements, we assigned skeleton fragments in the owl pellets to prey items in different categories (being well aware of the uncertainty associated to some of these allocations). We compared the proportions of these categories with information obtained during capture-mark-recapture studies in the same area in the same period and found that the preys contained relatively more males, more older animals and more larger animals. The data were too sparse to thoroughly investigate seasonal variation in this differential predation. We will discuss several hypotheses to explain the observed patterns, as well as the possible consequences for population dynamics.

## Reproduction in desert adapted populations of the genus *Acomys* – the role of Integrative physiology

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In ecosystems out of the tropics photoperiod is the main environmental signal for reproduction. However, in deserts when water input into the system is limited and unpredictable while reproduction is a highly energy demanding function, a more reliable signal on the ecosystem quality is demanded. We have been studying environmental signals for reproduction in two desert adapted populations of spiny mice (*Acomys*) namely the golden spiny mouse *A. russatus* and the common spiny mouse *A. cahirinus*. The results of these studies revealed that in both species photoperiod is the initial environmental signal for reproduction. However, for the ultimate activation of system information on water availability is necessary and it is regulated by the secretion levels of the anti diuretic hormone (ADH). Bearing in mind that time after the last rain episode will result in increasing aridity, reflected in increased particles concentrations thus increasing ADH secretion. Receptors for this hormone were discovered in the testis. Leptin also plays a role in reproduction of spiny mice. The fact that ADH has a dual function: on the one hand reabsorb water in the distal parts of the nephron and the collecting tubes while on the other it regulates reproduction is of great interest. These results support earlier ideas that photoperiod cannot be the only signal for reproduction in desert adapted rodents. As reproduction in desert adapted rodents is depended on

# General

water availability small mammals as rodents with high metabolic rates may face a problem as they will be years when they will not reproduce. Reduced metabolic rates, in such species, is an important adaptation for increasing longevity enabling such species to reproduce under favorable conditions.

## **Evolutionary response of two African rodent species (*Hystrix* sp.) to climate changes: studying the past to estimate the future**

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Evidences of ongoing global warming set the study of the reactions of species and ecosystems to climate change as one of the main issues of Conservation Biology and the development of accurate and reliable predictive models as crucial. To date, such models are principally based on projecting climatic variables that characterize the current distribution of species on modeled future climatic scenarios (Ecological Niche Modeling). Accuracy and reliability of such predictions are currently debated thus negatively affecting long-term conservation policy. This modeling tool may also be used to obtain paleodistribution models for target species according to the available information about past climates. In this case, a different approach (phylogeography) can be implemented to study the signature of past dynamics of populations and species and coherence between the two methods can be tested. In our study, phylogeographic analysis of past range dynamics of two African Rodent species (*Hystrix cristata* and *Hystrix africaeaustralis*) will be used to assess the accuracy of Ecological Niche Modeling predictions testing paleodistribution models by statistical phylogeography. We are currently implementing the recent developments of high-throughput sequencing in population genetics taking advantage of contemporary as well as museum collected specimens. Methods and early results of our approach will be shown. As the importance of Ecological Niche Modeling predictions on future climate as a Conservation Biology tool is widely recognized, the analysis of their accuracy, by validating projections on the past through a phylogeographic approach, may provide scientists and policy-makers with a reliable tool to plan timely and effective conservation strategies.

# Pest Management

## ORAL PRESENTATIONS

### Case-control studies of ecologically-based rodent management in rural communities of Swaziland, Tanzania and Namibia

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A case-control study was implemented within rural agricultural communities in Namibia, Swaziland and Tanzania as part of a larger project on the development and implementation of ecologically-based rodent management (EBRM) in southern Africa ([www.nri.org/ecorat](http://www.nri.org/ecorat)). Continuous, daily removal trapping with kill traps was carried out in two communities (intervention) per country and compared to two similar communities following their traditional practice of adhoc poison use (non-intervention). Intensive trapping consisted of dividing communities into four equally-sized quadrants. Trapping took place for seven days in a quadrant, with traps rotated through successive quadrants each week. Individual households trapped with 2-5 traps depending on compound size and complexity for one week out of every month. An evaluation of trap efficacy, impact on rodent population dynamics and rodent damage levels were analysed over a 12 month period to assess changes caused through the trapping programme in comparison to what communities traditionally do to manage rats. Monitoring of rodent populations with kill traps and tracking tiles was done over four consecutive trap nights each month in a subset of households (n=10) in intervention and non-intervention communities. Using the same case-control study design, post-harvest losses were measured in a subset of houses (n=10) across intervention and non-intervention communities. Known quantities of grain were placed within houses to evaluate the impact of the case-control study on rodent damage, contamination and loss to household stored grain. Results showed that households practicing intensive trapping significantly reduced rodent numbers, the incidence of damage caused and maintained these lower rodent populations over the duration of the study. *Rattus rattus* was the dominant species in Tanzania and *Rattus tanezumi* was dominant in Swaziland; however, no *Rattus spp.* were found in the Namibian study site where *Mastomys natalensis* was the dominant species trapped. The use of tracking tiles proved an effective passive monitoring tool to monitor changes in the relative abundance of rodent populations as well as human behaviour with regards to trap setting.

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## Cryptic species of agriculturally important and associated non-target rodents in Africa: Implications for ecologically based rodent management, taxonomy and conservation

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Rodent pests can have severe impacts on crop production, particularly in monocultures where one or two rodent pest species dominate. But in more heterogeneous mosaic crop/fallow/bush subsistence agro-ecosystems in Africa, a surprising species richness of both pest and non-pest species may occur in crop and fallow fields and in and around houses. As part of the ECORAT Project, we aimed to provide baseline information on rodent and shrew species composition, taxonomy and habitat use in agro-ecosystems in three African countries so as to better inform ecologically-based rodent management in Africa (EBRM). We used removal-trapping in a variety of agro-ecological habitats coupled with accurate specimen identification using morphological and molecular (sequencing of cytochrome-b) approaches to produce accurate small-mammal species lists. Intensive kill-trapping by communities was monitored by live-trapping and footprint tracking tiles to test the effect of this intervention on rodent numbers and the levels of post-harvest damage to stored grain. Rodenticides are generally not appropriate in Africa; our study clearly demonstrated the efficacy of alternative community trapping methods to reduce rodent numbers and crop damage in three African countries. Recorded differences in species richness and community structure have potentially important implications, both for conservation of biodiversity and for EBRM. The continuing rapid rate of habitat transformation for rural agriculture in sub-Saharan Africa may increase the risk of extinction of cryptic, un-described, range-restricted endemic rodent species through loss and degradation of their habitats and competition from introduced pest species, particularly in Namibia and Tanzania. Management of pest rodents in rural agro-ecosystems should be cognisant of such non-target species; in this respect community trapping is advocated as an efficient, sustainable, environmentally friendly and low cost alternative to the currently widespread practice of indiscriminate use of rodenticides. Differences in rodent species richness and composition between different African agroecosystems have management implications. For example, in Namibia where commensal *Rattus rattus* was absent, typically non-commensal or semi-commensal species such as *Mastomys natalensis*, *Saccostomus campestris*, *Thallomys nigricauda*, and *Gerbilliscus leucogaster* were frequently observed in houses. Many of these species are zoonotic reservoirs. However, at all sites studied, intensive community trapping in houses was shown to be effective in reducing rodent populations and reducing damage to stored crops.

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## Farmers' perceptions on rodents as crop pests and practices in rodent pest management in Faradje region in northwest of the DRC

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A survey was conducted, to obtain information about the nature and extent of rodent damage to crops, farmers' perceptions as crop pests and practices to their management in Faradje region. The study was carried out in six localities (Logo Bagela, Logo Doka, Logo Lolia, Logo Obeleba, Logo Mondo and Logo Ogambi) out of the nine which constitute Faradje Territory. We have used a probabilistic opinion and the interview method. Maize and rice are the major crops, both for food and for sale. Other crops are: sorghum, groundnut and millet. The study showed that farmers in Faradje region are well aware of rodent related problems, and considered them to be the very pest. Rodent related problems are recurrent, and maize and rice were the most affected crops. Damage are important at every crop stage. After sowing, *Mastomys* and *Xerus* caused the most damage, and during others stages *Thryonomys* are the major rodent pests. Damage can reach 100% if farmers do not take care of crops. Different rodent control techniques are practiced; farmers prefer using trapping barrier (73.7%) followed by clearing around fields (45%). Only 35% of farmers go out after rain to look after their crops in fields at night. Farmers are responsible for rodent control activities on their own fields. Nearly 25% of farmers think that crop damage is linked with a mystical phenomenon. In granaries farmers use a cat for crop safety, but once the crop season is past, they eat this cat. Finally, lack of multiple rodent management methods and adequate knowledge of appropriate and sustainable techniques appeared to be the main reasons for the over dependence on trapping barrier though *Thryonomys* gnaw the woods placed as a barrier.

## Impact of crop cycle on movement patterns of pest rodent species in southern Africa

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Rodent pests can have severe impacts on crop production. *Mastomys natalensis* is a known pest of agricultural crops in Southern and East Africa. Both its population ecology and breeding biology have been studied in agricultural and natural habitats. Its numbers erupt after years of good rainfall and may reach plague proportions, especially in agricultural settings where it may become a serious pest. However, the ecology of this species is not well known within the context of human settlement. It may occasionally enter houses, but the degree to which it does so and the factors influencing this movement are not known. We followed 40 *M. natalensis* mice in Swaziland and

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Namibia by radio-telemetry. Mice were captured in maize fields within 50m of a homestead and fitted with radio-transmitters at three different times corresponding to different stages of crop development: pre-harvest, post-harvest and pre-planting. Mice remained in the fields during the entire study in Swaziland, but entered buildings in Namibia during the post-harvest stage which may represent a period of food shortage for these mice.



# Population Dynamics & Conservation

## PLENARY

### **Geobiological signatures of African evolution: new opportunities in cross-disciplinary explorations of the tempo and mode of Earth history**

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This paper argues for a geobiological research strategy - termed geocodynamics - to study Earth history. Geocodynamics integrates evolutionary sciences in their broader sense: namely geology, genomics and biogeography, which are informed by palaeoecology, phylogeography and systematics. Within the framework of evolving landscapes, its cross-disciplinary syntheses of evolutionary history integrate details of biodiversity dynamics (speciation events and other major demographic changes) with tectonic and climatic events. These syntheses are founded on the recently realized ability to decipher the genomic record of Earth history. Additional to refining narratives of biotic evolution – depicted as TimeTrees of Life - deciphered signatures in the genomic record can quantify the more cryptic of geomorphological events, whose subtle nature lies beyond the fidelity of conventional geological methods. It means that patterns and processes of landscape evolution are shifted into the ambit of biology. So the genomic record can be viewed as the wellspring that links the Earth and life sciences into novel associations, for this geobiological context makes it feasible to quantify the tempo and mode of evolutionary dynamics in space, time and form. This has radical implications in changing entrenched divisions between sciences, which pioneering progress suggests will be transmogrified in fundamental ways; not least, integrating the genomic record with conventional geochronological records blurs divisions between biology and geology. The novel usage of biotic evidence to decipher origins of abiotic entities is driving this groundshift. Conferring unique insights into palaeo-environments, this integration of abiotic and biotic archives can reconstruct finer-scaled details of Earth history. This is where the spatio-temporal fidelity of the genomic record opens new windows on to previously unreadable phenomena.

Focusing on African biodiversity and landscapes, our examples illustrate how the core concepts and methods of geocodynamics unify traditionally isolated sciences into a comprehensive research strategy. Geocodynamics offers the best means of answering longstanding questions about the origins of Africa's mammal diversity, where speciose clades of small mammals hold special interest. There are important reasons why Africa is the ideal continent to explore how its mammal fauna responded to climatic changes and geomorphological dynamics since Gondwana break up. We know remarkably little about the causes of the radiations represented in Soricidae, Afrotheria, Chiroptera, Bovidae, Rodentia, Primata (and indeed nearly all the principal mammal clades), so here we see rich opportunities to reconstruct evolutionary histories, which account for their ancient dispersals, speciation events and adaptations. Geocodynamics opens up a line of attack to solve such problems in Earth history that currently hold the status of mysteries.

Geocodynamics extends the framework of landscape mosaics - familiar to landscape ecologists - into new conceptual territory, as it enables studies of landscape patterns across macroevolutionary scales. This is thanks to its ability to quantify salient events that shaped the coevolving tenures of landforms and their dependent species. Signatures of evolutionary events preserved in genomes of extant species constitute the historical archives that inform geocodynamics, and burgeoning progress in computational biology and genomics is rapidly improving the insights obtained from DNA sequence data. Refinements in molecular clocks and spatial phylogeography exemplify the progress toward improving spatio-temporal precision obtained for reconstructed evolutionary events. So these developments confer immense analytical power on phylogeography and phylogenetic systematics to reconstruct where and when formative events shaped the histories of not only species but the physical landscape. These species can be studied as biotic indicators of

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evolving landscapes, and their integral palaeoenvironments. The ability to quantify phylogeographic records of species reveals the spatio-temporal attributes of major demographic events that shaped their histories in evolving landscapes; here niche parameters are critical to restrict a species' tenure to particular landforms. So it follows that narrow niches of stenotopes enhance the fidelity of their phylogeographic records, as the most sensitive biotic indicators of landscape evolution. Moreover, syntheses of abiotic and biogeographical history reveal what caused evolutionary events, represented in shared evolutionary histories of species and landforms. This resolution confers the means to constrain synergistic responses of particular landforms and species to singular formative events (eg tectonism). It follows that reciprocal illumination of abiotic and biotic attributes of palaeo-environments extends the study of biodiversity dynamics into the domain of geomorphology. Geomorphological concepts and methods have a keystone role in this quest to quantify interlinked tenures of species and landforms in dynamic landscapes. It opens up an unprecedented spectrum of palaeo-environmental phenomena to scrutiny, within the scope defined by the fidelity of phylogeographic records of biotic indicators. Pioneering results reveal that this refined spatio-temporal resolution, obtained by geocodynamics, is set to refine our understanding of the tempo and mode of evolutionary dynamics.

As judged by pioneering research in geocodynamics, participating scientists face interesting challenges. The cross-disciplinary breadth of geocodynamics shifts biologists into unfamiliar academic terrain, especially in demanding close attention to intricacies of Earth science. One example of a revolutionary conceptual switch resides in appreciating that we can now study biodiversity dynamics as an earth surface process. This is implicit when cast in the framework of evolving landscapes, where biotic patterns are linked to episodes of tectonism and palaeoclimates. Equally, Earth scientists are challenged to understand how nuances of ecological and genomic theory quantifies the genomic record. Nevertheless, cross-disciplinary collaboration is a prerequisite if we are to integrate biological evidence into time series comprising geochronological, geomorphological and palaeoclimatological datasets; all bring complementary insights to the quest to understand how palaeo-environmental events played out across Earth's dynamic surfaces.

In summary, geocodynamics aims to characterize the origin, turnover and stasis of landforms and species; its overarching research objective seeks to reconstruct how these causally interrelated entities evolved in the landscape mosaic. Progress obtained to date in geocodynamics emphasizes that studies of multiple taxa reap rich dividends in congruent signals, which endorses a tried and tested *modus operandi* in biogeographical reconstruction. This message from studies of different taxa is clear. It endorses comparative phylogeography - to decipher narratives of biodiversity dynamics in focal landscapes. Histories of multiple biotic indicators confer the important lesson that biodiversity dynamics played out across a spectrum of niches - on shared landforms - provides congruent evidence; their synthesis reveals consilient insights to constrain the more subtle of events that altered palaeo-environments. For example, herpetofauna, birds, fishes, small mammals, and the better known arachnid and insect groups, are informing such syntheses. It follows that such reciprocal illumination will refine our understanding of the tempo and mode of mammalian evolution in radical respects.

We forecast that geocodynamics will aid and abet the simultaneous extension of evolutionary biology to explore the palaeo-environmental and genomic realms of Earth history. This emerging synthesis will reinvigorate the science of natural history in profound respects, especially when one acknowledges that organismal biology constitutes the fulcrum for endeavours that seek to reconstruct how geobiological complexes evolved in dynamic landscapes. Geocodynamics is set to launch natural history into its belated golden age.



# Population Dynamics & Conservation

## ORAL PRESENTATIONS

### **Spatial and temporal population dynamics of rodents in three geographically different regions: Implication for ecologically- based rodent management**

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As part of a three years study to develop ecologically-based rodent management (EBRM) in southern Africa, a Capture-Mark-Recapture study was carried out in Tanzania, Namibia and Swaziland to establish the demographic patterns and population dynamics of rodents. Ten species of rodents and one shrew (*Crocidura* sp.) were identified in study areas in Tanzania. The rodent species consisted of *Mastomys natalensis*, *Aethomys chrysophilus*, *Avicanthis neumanni*, *Gerbilliscus vicina*, *Acomys spinnosissimus*, *Lemniscomys griselda*, *Lemniscomys zebra*, *Rattus rattus*, *Graphiurus* sp. and *Mus minutoides*. *Mastomys natalensis* was dominant and contributed more than 70% of the captures. In Namibia, five species were captured, namely *Mastomys natalensis*, *Gerbilliscus leucogaster*, *Saccostomus campestris*, *Mus minutoides* and *Steatomys pratensis*. *Mastomys natalensis* contributed about 50% of the captures. In Swaziland only *M. natalensis* was captured in the study grids. There was a clear pattern in the population dynamics, with breeding confined to the wet seasons in the three countries. *Mastomys natalensis* was the dominant pest species, for which EBRM should focus on. The highest population density of *M. natalensis* occurred during and after the rains, which coincided with the most susceptible phenological stage of crops. The breeding seasonality and density fluctuations observed in the three countries conform to observations made elsewhere in Africa, which support the hypothesis that rainfall events promote primary productivity on which murid rodents depend. Development of EBRM in these countries will be determined by the local conditions and how they influence the breeding patterns and population dynamics of the rodent populations. A workable EBRM solution in southern Africa needs to focus on strategies to manipulate these habitats to reduce their carrying capacity for rodents. Removing refuge habitats and regular weeding would reduce the primary productivity available for rodents during and after the rains, thus lowering survival and recruitment of new individuals into the population.

# Population Dynamics & Conservation

## Population dynamics and breeding patterns of *Mastomys natalensis* Smith 1932 in irrigated rice in Eastern Tanzania

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The population dynamics and breeding patterns of the Multimammate rat, *Mastomys natalensis*, were investigated in irrigated rice in Eastern Tanzania in 2010/2011. Population abundance varied with habitat and crop growth stages. In both rice fields and fallow land, the highest population peak was observed during the dry season from July to October. The results show that *M. natalensis* is sexually active throughout rice cropping season in the study area, although it reaches the highest level at maturity stage of crop growth. Breeding occurred in the dry and wet seasons, and suggests that it was highly influenced by the presence of a rice crop in both seasons. More juvenile individuals were recorded at transplanting stage in each season and few in the subsequent crop growth stages in all habitats. Breeding therefore, was not seasonal and seemed not to be associated with rainfall patterns. Sex ratio of *M. natalensis* was not skewed to either males or females.

## Long-term study of population dynamics, habitat selection and interspecific competition of the Negev Desert rodents

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Population fluctuations of 13 rodent species were monitored for 18 years in the central Negev Desert, Israel, in an area 110 sq. km in different habitat types. Densities of most rodent species in the late summer, after the end of reproduction, were determined mainly by total precipitation during the previous rainy season. Rodent densities in the winter, before the reproductive season, were determined mainly by their densities in the previous season. Rodent populations in dry river beds (wadi) demonstrated either no or negative correlations with total rainfall, suggesting episodes of population crash due to flash winter flooding. For all species occurring in more than one habitat, densities, at least in some habitats, were correlated with their contemporary densities in other habitats. For these species, processes of density-dependent habitat selection were indicated using isodars analysis. Significant negative interspecific interactions were recorded by analysis of census data in three species pairs and only in 25% of analyzed seasons. The results of field experiments with food addition supported these observations but demonstrated higher sensitivity of experimental approach in indicating of competitive relationships comparing with observational approach. Interspecific competition affected species distribution at the micro-habitat scale but had no effect on population dynamics at the macro-habitat scale. Generally, population dynamics of desert rodents were determined by the complex interactions of extrinsic (rainfall) and intrinsic mechanisms but were modified by density-dependent habitat selection.

# Population Dynamics & Conservation

## The use of camera traps in the study of the ecology of Black-and-rufous sengi (*Rhynchocyon petersi*) in Zaraninge coastal forest, Tanzania

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The ecology of species of the genus *Rhynchocyon* with exception to *R. chryopygus* is limited, and yet many factors relating to their distribution, abundance and reproduction are essential requirements for conservation. We are in the process of performing a range of studies on the ecology of Black-and-rufous sengi (*R. petersi*) in and around Saadani National Park, Tanzania. Here, we report preliminary results on the use of camera traps as a method to investigate the behaviour of *R. petersi* and provide suggestions on how to proceed.

## The Albertine Rift Region of Africa: Evolution and Conservation of small mammals

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The study aimed to assess the effects of historical and human induced fragmentation on the distribution and taxonomy of *Praomys jacksoni* [complex] in the Albertine Rift using a combination of morphological and molecular data. Individuals from twelve sites in the montane forests and four in lowland forest in the Albertine Rift, central-east Africa, were sampled. Analyses of mitochondrial sequence variation were performed from fragments of the control region and cytochrome b and revealed significant genetic structure for the taxa examined. This pattern was confirmed by a nuclear gene (7<sup>th</sup> intron of the Fibrinogen gene and the microsatellites) and (traditional and geometric) morphometrics. Four species were retrieved of which, one species has never been reported in the region. There was also a clear phylogeographic structuring of populations, confirmation of *P. degraaffi* in the region using genetic data and the possible existence of two cryptic *Praomys* species in the DRC. Our data suggest that past climatic fluctuation, habitat fragmentation created by the lake and river systems in combination with volcanic activity in the Virunga region could have played a key role in the structuring and diversification of species in the region. Estimation of the divergence times within each species suggests that the separation of the major clades occurred during the mid to late Pleistocene. The results also give evidence of hybridization and introgression for *Praomys* within the Albertine Rift.

# Population Dynamics & Conservation

## Correlating vegetation and small mammal community structure after fire in a grassland ecosystem, Erfenisdam Nature Reserve, Free State Province, South Africa

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The grassland biome is one of South Africa's most threatened. Nevertheless, the recovery of grassland ecosystems and sub-ecosystems after disturbances, such as fire, stays relatively unstudied. Fire is a natural disturbance factor in this biome and the comment is often made that the plant and faunal communities have adapted to this natural fire regime. This study investigates the changes in small mammal populations and communities over five years in relation to vegetation recovery after controlled fire in a part of the Erfenis Dam Nature Reserve, central Free State Province, South Africa. All rodent species, except *Mastomys coucha*, disappeared from the transects immediately after the fire. Densities and species richness of both vegetation and small mammals then increased with succession, conforming to Tilman's curve in the pre-climax phase. Some small mammal species, such as the Vulnerable *Mystromys albicaudatus*, also appeared and later disappeared as succession progressed, while indicator statuses for others were confirmed in the Free State grasslands. These results add to those of earlier studies that have suggested that small mammal communities can be effective indicators of habitat integrity in grassland ecosystems.

## Origin and putative colonization routes for invasive rodent taxa in the Democratic Republic of Congo

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House mice and rats are the most common invasive species known in Africa. The invasion success of both species is largely attributed to their close association with humans. Both species are known as a threat to biodiversity in ecosystems they have colonized. Here we document the extent of occurrence of the two species in the DRC, reconstruct the colonization history of the species using mitochondrial DNA data and historical records and assess the taxonomic (species / subspecies) status of the populations. Tissue samples of mice and rats were collected from five localities in the DR Congo. Four additional mice samples were obtained from Belgium and five rat samples from Tanzania. All the specimens were sequenced for the control region using normal protocols. Trees were constructed using neighbour joining and MrBayes. Our results confirmed the presence of *Mus musculus domesticus* at Kinshasa in the western DRC; *R. norvegicus* at Kisangani as well as *Rattus rattus* in all the sampled localities. Comparing the DNA profile of our samples with those available from GenBank, it appears that our individuals were introduced from the UK and Western Europe, notably Belgium, France and Germany. This is confirmed by historical data on explorations and colonization.

# Disease

## ORAL PRESENTATIONS

### **A preliminary survey of small mammal communities in relation to Lassa fever occurrence within Nigeria**

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Lassa fever is a deadly disease infecting up to 3 million people annually in West Africa. In Nigeria, the dynamics of how the Lassa virus is transmitted from the rodent *Mastomys natalensis* to humans have not been investigated on a significant scale. In this paper, we report our findings on various rodent and shrew communities surveyed across key ecological zones within Nigeria. The compositions of these small mammal communities are discussed in relation to ecological zonation, habitat, and whether the small mammal communities are located in areas endemic for Lassa fever or not. The relative proportion of *Mastomys natalensis* within each of these communities at the different scales investigated and how this is associated with the risk of transmission of Lassa fever to humans is also discussed.

### **Lassa serology in *Mastomys natalensis*: habitat, age and abundance effects**

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Lassa fever is a hemorrhagic fever, due to an Arenavirus, and affects 150-300,000 persons per year in West Africa. During our previous studies in Guinea, we demonstrated that *Mastomys natalensis* was the only host of the Lassa virus. By a longitudinal survey in high endemic area, we also demonstrated that the overall Lassa virus prevalence was 14%, and varied seasonally, being 2 to 3 times higher in rainy season. Using the same collection done between 2003 and 2004 in three villages, Bantou, Gbetaya, and Tanganya, we investigated the Lassa serology in the rodent population. A standardized trapping was conducted in different habitats: houses, cultivations and forest. The rodents were identified morphologically and molecularly, and sexual status was recorded. The screening of antibodies IgG was done by using the indirect immunofluorescence assay, with the strain Bantou 289 as antigen. The overall seroprevalence was 27% (108/396). Several logistic regressions revealed that the seroprevalence varied significantly according to village, habitat, host age, host abundance and host fecundity. The major effect was due to the age:

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the high seroprevalence (50%) in the oldest animals suggests a high horizontal transmission of Lassa virus within the *M. natalensis* population.

## Landscape genetics of Mopeia virus and its host (*Mastomys natalensis*) in Morogoro region, Tanzania

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Many African rodents harbour arenaviruses. The West-African Lassa virus of *Mastomys natalensis* is the most notorious as it can also infect and kill humans. In East-Africa *M. natalensis* carries closely related arenaviruses, but no human cases have been reported here. Hence, the Morogoro virus in Tanzania poses a convenient model system to study arenaviruses in nature. With mutation rates of about a million times higher than that of mammals, the interaction between the evolution and epidemiology of RNA viruses is very close. Therefore, in order to understand the epidemiology of RNA virus infections one must have a good understanding of their evolutionary processes.

In this study we wanted to distinguish whether viruses evolve together with the genetic divergence of their host, or whether the hosts' spatial ecological patterns determine virus evolution. We trapped *M. natalensis* along a 180km transect in the Morogoro region, Tanzania, where two distinct matrilineages of *M. natalensis* occur. We crossed landscapes of varying quality for *M. natalensis* (a semi-commensal species whose optimal habitat is an agricultural field), which could allow varying effective densities of this host. We determined the hosts' matrilineage through sequencing of cytochrome b, and sequenced several genes of Morogoro virus.

The topology of the viral phylogenetic tree did not seem to match that of the host tree of cytochrome b. On the other hand, Morogoro virus did not vary genetically through an isolation-by-distance pattern along our transect. Viruses that originated from localities whose agricultural fields were spatially interconnected were clustered together in well-supported phylogenetic lineages. Furthermore, sequences that originated from poor agricultural areas clustered with sequences from the nearest extensive agricultural area. We presume that the virus is likely to die out occasionally in low-density areas, only to be re-introduced by infected *Mastomys* migrants originating from high-density areas, and that large low-host-density areas can pose barriers for viral gene flow.



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## Insight into Arenavirus evolution and transmission at a local scale: Mopeia Virus in Morogoro, Tanzania

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Links between epidemiologic processes and pathogen evolution within and among hosts are poorly understood. Because their polymerases do not proofread, RNA viruses have the highest mutation rates in all biology. RNA viruses such as arenaviruses allow us to explore the interface between evolutionary and ecological dynamics, because their epidemiological and population genetic processes occur on a similar time scale. In 2009 a hot spot of arenavirus circulation was described in Morogoro, Tanzania. In order to gain insight into the transmission and evolution of the Mopeia arenavirus in its natural host, the multimammate mouse, *Mastomys natalensis*, we investigated the spatial genetic structure of Mopeia strains at grid and regional scales: 15 grids of 1ha set within a 90km<sup>2</sup> region around Morogoro city. 511 blood samples of *M. natalensis* were tested for presence of antibodies against Mopeia virus by indirect immunofluorescent antibody (IFA) assay and for the presence of the virus by RT-PCR. For RT-PCR positive samples, parts of the viral glycoprotein, nucleoprotein and L protein genes were amplified and sequenced. At the same time the genetic structure of the host was investigated using microsatellite markers. At the grid scale (1 ha) the distribution of the antibody positive individuals and viral strains are highly clustered with a maximum distance between two individuals carrying the same viral strain of 64 m. No strains are shared between grids. At the regional scale distinct strain clusters occur in arable land to the Northeast versus Southwest of Morogoro city. Contrasting these results with the host genetic structure allows us to investigate how host relatedness and dispersal affect the spatial distribution of Mopeia strains. In conclusion, a host/viral density trough in the city's urban area may act as a barrier to Mopeia transmission.

# Disease

## Prevalence of haemoparasites, leptospire and cocobacilli with potential for human infection in the blood of rodents and shrews from selected localities in Tanzania, Namibia and Swaziland

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An examination of haemoparasites, leptospire and cocobacilli with potential for human infections in the blood of rodents and shrews from Tanzania, Namibia and Swaziland was made. Haemoparasites were examined in blood smears of rodents and shrews from selected sites in the three countries, while screening for different serogroups of leptospira was based on rodents and shrews from Tanzania only. Serological tests for antibodies against the F1 antigen of *Yersinia pestis* were carried out using the enzyme linked immunosorbent assay (ELISA) using rodent and shrew sera from Tanzania and Namibia. We examined 950 blood smears from Tanzania out of which 297 (31.26 %) had haemoparasites consisting of *Trypanosoma lewisi* (72.73 %), *Bacillus spp.* (25.59 %), *Borrelia sp.* (0.006 %) and bipolar cocco-bacilli (0.01%). Twenty six smears from Namibia had no haemoparasites whereas only one (1.33 %) out of 75 samples from Swaziland had *T. lewisi*. Three hundred and fifty samples from Tanzanian species of rodents and shrews were screened for different serogroups of *Leptospira interrogans*. Thirty six (10.29 %) were positive for serogroup Icterohaemorrhagiae, 10 (2.86 %) for Pomona, 4 (1.14 %) for Hardjo, 3(0.86 %) for Bullum, 5 (1.43 %) for Grippotyphosa and 4 (1.14 %) for Canicola. Only two samples (3.77%) of sera originating from *Rhabdomys pumilio* and *Gerbilliscus leucogaster* from the Kavango region in Namibia were positive for antibodies against the F1 antigen of *Yersinia pestis*, indicating an enzootic plague activity. There was no enzootic plague activity found in rodents in Central Tanzania. These results indicate a potential risk of zoonotic disease infections in humans in the study localities in Tanzania, Namibia and Swaziland.



# Disease

## Seasonal variation of fleas occurring on rodents in Namibia, Swaziland and Tanzania

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Fleas are important vectors of human and wildlife diseases, most notably plague *Yersinia pestis*. Taxonomic knowledge of rodent fleas is very limited in the southern African region. Most studies have only targeted fleas associated with domestic animals. Data for this study were collected under the ECORAT research project which was carried out in Namibia, Swaziland and Tanzania from May 2007 to August 2009. The data were collected to determine and compare species composition of fleas occurring on rodents and also to clarify seasonal dynamics of flea species and rodent host associations. Trapping of rodent hosts was carried out in various habitats namely: crop fields, inside/outside of houses, and community centers. A combined total of 917 fleas were sampled from 1122 rodent hosts representing 20 rodent species. More than 10 species of fleas were identified with *Xenopsylla philoxera* being the most dominant flea species. The multimammate mouse, *Mastomys natalensis* was the most dominant rodent species in Namibia, Swaziland and Tanzania. Flea loads and percentage infested hosts were high during the wet/hot months (Jan-Mar) in Swaziland and (Nov-Feb) in Tanzania, whereas flea loads and percentage infested hosts were high during the dry/warm month (Dec) in Namibia.

# Disease

## Rodent-ectoparasite associations in the highlands of Tigray, Northern Ethiopia: Implications for potential zoonoses

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We studied associations between rodents and their arthropod ectoparasites in crop fields and household compounds in three hamlets in the highlands of Tigray, Northern Ethiopia. Ectoparasite infestation indices such as percent infestation, mean abundance, prevalence and host preferences were calculated for each species. In total, 172 and 97 rodents belonging to three species, *Mastomys awashensis* (Lavrenchenko, Likhnova & Baskevich) (88 and 44), *Arvicanthis dembeensis* (Ruppel) (63 and 37) and *Acomys* sp. (21 and 16), were trapped from crop fields and household compounds, respectively. A total of 558 arthropod ectoparasites (belonging to 11 species) and 296 (belonging to 6 species) were recovered from the respective rodents. Coinfestations were observed on the majority of the infested rodents, 42% in crop fields and 74% in household compounds. The most common ectoparasites recovered were the spiny rat mite *Laelaps* sp. (64.9% and 29%) and the rat flea *Xenopsylla* sp. (20.6% and 50.3%) in the crop fields and household compounds, respectively. Our study revealed that crop fields and household compounds in the highlands share similar rodents and several ectoparasite species. Furthermore, at least one of the rodent species and some of the ectoparasites identified in this study were reported to have posed medical and veterinary threats in other parts of Ethiopia.

# Disease

## Rodent populations and associated flea species complex in the plague outbreak foci in the northern wing of the Rift Valley in Tanzania

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We conducted a vector and reservoirs surveillance in the plague outbreak foci in two districts of the Rift Valley in northern Tanzania, aiming to establish the risks of plague infection in humans. Twelve species of rodents (*Mastomys natalensis*, *Lophuromys* sp., *Grammomys dolichurus*, *Rattus rattus*, *Lemniscomys zebra*, *Mus* sp., *Praomys delectorum*, *Graphiurus* sp. *Arvicanthus niloticus*, *Otomys* sp., *Gerbilliscus leucogaster*, *Acomys wilsoni*) were captured in various types of habitats (forest, cultivated fields, fallow/bush land and peridomestic areas). *Mastomys natalensis*, *Mus* sp., *P. delectorum*, *Lophuromys* sp., *R. rattus*, *Otomys* sp. and *L. zebra* tested positive for specific plague antibodies against the Fraction 1 antigen of *Yersinia pestis* by the Enzyme-Linked Immunosorbent Assay technique. Rodent were associated with ten species of fleas, namely *Ctenophthalmus calceatus calceatus*, *Ctenophthalmus* sp., *Dinopsyllus grypusus*, *Dinopsyllus lypusus*, *Hypsophthalmus campestris*, *Litropsylla basilewsky*, *Nosopsyllus incisus*, *Pulex irritans*, *Xenopsylla brasiliensis* and *Ctenophthalmus dongobeshi*. *Dinopsyllus lypusus* and *X. brasiliensis* are confirmed vectors of *Y. pestis* and were the most abundant flea species in the plague outbreak foci. The two species were predominantly found on *M. natalensis*. *Dinopsyllus grypusus* were more common on *P. delectorum* while *Lophuromys* spp. carried all the flea species except *X. brasiliensis*. Three flea species (*Nosopsyllus incisus*, *C. calceatus* and *X. brasiliensis*) were found on *R. rattus*. The most encountered flea species on *Crocidura* spp. was *Hypsophthalmus campestris*, where as *D. lypusus* and *Litropsylla basilewsky* were found on *Mus* sp. The existence of diverse plague reservoir populations in wild rodents and a complex of associated flea species, have important public-health implications for plague transmission among the rodents and the subsequent risk of human infections. Both the rodents and associated flea species fluctuate in numbers and when sufficiently abundant, these rodent species and fleas can spread epizootics that can cause plague outbreaks in humans in the Rift Valley districts in Tanzania.

# Disease

## Community and diversity of potential plague small mammals in different landscapes in West Usambara Mountains, Tanzania

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Studies conducted on small mammals' diversity indices in Tanzania investigated mainly the relationship between small mammals and vegetation to provide information about the species composition in a community for general conservation and management. None of these studies have specifically attempted to link small mammals' diversity indices with landscape factors in the plague foci. Therefore, a study was conducted in Western Usambara Mountains, Tanzania to assess the community and diversity of small mammals across different plague landscape foci. Remote sensing and GIS techniques and field survey were used to identify small mammals trapping locations on different landscape types. Forty one trapping units were located where about 188 animals were captured in 4905 trap nights. The captured animals were identified to species level following guidelines described by Kingdon, (1997). The collected data were compiled in excel software and analysed statistically using Costat. Diversity index was computed using Shannon-Wiener index. Thirteen small mammals species were identified whereby *Praomys delectorum* and *Mastomys natalensis* comprised 50% of all the animals trapped. In the study area trap success increased with altitude. Majority of the small mammals trapped were in the plateau landscape commonly dominated by cultivation, plantation forest and shrubs. In terms of species diversity, plantation forest ranks first followed by shrub in the plateau. Further research on vegetation-small mammals' relationship vis-à-vis plague hot spots on the landscape is recommended.

# Disease

## **Spatial analysis of vegetation communities with respect to small mammals potential for plague occurrence in Western Usambara Mountains, Tanzania**

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Many studies have been conducted to determine the relationship between vegetation communities and small mammals potential for different viral diseases. However, little information is known about the vegetation pattern, and small mammals with respect to plague. Therefore, a study was conducted in Western Usambara Mountains, Tanzania to assess spatial distribution of vegetation communities in relation to small mammals' potential for plague occurrence. GIS and Remote sensing techniques coupled with field survey were used to identify vegetation communities. Small mammals were trapped from the mapped vegetation communities. Forty one trapping units were located where about 188 animals were captured in 4905 trap nights. The captured animals were identified to species level following guidelines described by Kingdon, (1997). The collected data were compiled in excel software and analysed statistically using Costat in GIS environment. In total six vegetation communities were identified and mapped. Results show that cultivation (annual crops: maize, beans and potatoes) occupied 24% of the total study area followed by plantation forest (19%), shrub (18%), natural forest (17%), and the rest including herbaceous vegetation and horticulture (22%). There was significant difference ( $p \leq 0.05$ ) among the cover of the dominant vegetation communities. Plantation forest, natural forest and horticulture comprised the highest cover (>60%). About 188 small mammals comprised of 13 species potential for plague were trapped where *Mastomys natalensis* dominated in cultivations (80%) while *Praomys delectorum* were dominant in natural forest (60%). The study demonstrated that vegetation communities varied spatially on different landscapes which influence small mammals' abundance.

# Disease

## Gender biased parasitism: patterns, mechanisms, consequences

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In this talk, we will consider patterns, mechanisms and consequences of gender bias in parasite infestation using rodents and their ectoparasites as a model host-parasite association. Regarding patterns and using fleas harboured by rodents in the Negev desert, we will show that parasite abundance, prevalence and species richness is often host male-biased, but it may also be female-biased or absent. Then, we will demonstrate that manifestation and strength of gender-biased parasitism may differ inter- and intraspecifically. In particular, the expression of gender-biased parasitism with the same host species may vary temporally (e.g., seasonally), spatially and in dependence of a parasite taxon. Using an example of a South African rodent host (*Rhabdomys pumilio*), we found that spatial variation in gender differences in parasite infestation was affected by parasite-, host- and environmental factors, although the set of factors affecting gender differences in infestation differed among higher taxa of ectoparasites. Gender differences in infestation by fleas and lice were affected mainly by parasite-related factors, whereas gender differences in infestation by ticks and, in part, by mites were affected mainly by host-related and environmental factors. Second part of our talk will deal with one of the mechanisms of gender-biased parasitism. Using data from laboratory experiments on fleas *Xenopsylla ramesis* exploiting rodents *Meriones crassus*, we will show that, in general, fleas perform better on male rodents. In particular, when feeding on male as compared to female hosts, fleas took more blood, digested it faster, produced more eggs and larger male offspring. In addition, female (but not male) fleas appeared to be able to distinguish between male and female hosts presumably by odour clue and select male hosts in Y-maze trials. Finally, we will consider consequences of gender-biased parasitism and will demonstrate that male rodent hosts drive infracommunity structure of their flea parasites.

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### **A new species of *Mus* (Linnaeus, 1758) genus in Kisangani region (Democratic Republic of Congo)**

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We have conducted a taxonomical study on the *Nannomys* subgenus (*Mus* genus) which is one of the most abundant group captured on crop fields in Kisangani region, and which is also recognised by farmers in Kisangani as a rodent pest on fields and in granaries. We used three 100 X 100m grids. Those three grids were placed in experimental fields. At the two first sites, we captured for two consecutive years, but at the third site, captures lasted one year. We used a capture-mark-recapture technique to capture *Nannomys* individuals during all different crop stages. One hundred traps, baited with palm nut pulp, were placed in each grid at ten meters distance each. In total, we have captured 285 individuals which constitute 42% of our data and 48 samples, belonging to the three grids which have been sequenced. After data collection by capture-mark-recapture on fields, we have caught 45 individuals, whose skull was extracted. Canonical analysis of skull measurements was used to evaluate whether our sample was monospecific, and to compare it with others species. Mitochondrial cytochrome b sequences were aligned using the Mega5 computer program, and these sequences were used to construct a phylogentic tree. The study has showed that *Nannomys* of Kisangani region is monospecific, and that it is a new species which is close to *Nannomys grata* of Kenya.

### **Reproduction and residential status of *Lophuromys dudui* (W. Verheyen, Hulselmans, Dierckx and E. Verheyen, 2002) on crop fields and fallow land of Kisangani hinterland ( Democratic Republic of Congo).**

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Reproduction and residential status of *Lophuromys dudui* individuals was studied on mixed experimental fields in comparison with fallow land at three different localities around the city of Kisangani (D.R. C). On each experimental field and fallow land, a one-hectare grid-layout was made, using 100 Sherman live traps. The fields were weeded one month after sowing as upkeep. At two sites, we captured for two consecutive years; at the third site, captures lasted only one year. We used capture-mark-recapture to capture *Lophuromys dudui* individuals during all different crop stages. One hundred traps baited with palm nut pulp are placed in each grid at ten meters distance each. At each grid and during each crop stage, a capture session of five consecutive days was organised. The numbers of pregnant females and sexually active adult males were presented



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according to the crop stages and months. There seems to be a male-biased sex-ratio; and the population structure is stable on both crop fields and fallow land. Males are resident at all crop stages. The proportion of resident adult males varied between 60 and 80% during growth stage, but between 30 and 50% on fallow land during the whole season on fallow land. However, the proportion of pregnant females resident in the fields varied between 0 and 40% during all crop stages. The reason for this is that during sowing and growth, subadults are mostly non-resident 60 and 90% of the individuals captured and residents are nonexistent during these stages.

## **The impact of small mammals on caracal ranging behaviour and animal damage control practises**

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Caracal *Caracal caracal* is one of the major stock slayers in Southern Africa today. Together with black-backed jackal *Canis mesomelas*, caracal are accused of causing annual estimated direct losses of R1.4 billion in South Africa, while individual farmers are claiming to lose between 30 and 75% of their annual increase to these two predators. Still, no management plan is available to assist the small stock industry. Although the scientific community has made contributions aimed at problem animal control and management in southern Africa, it has not been enough to instigate control programs. The current study correlates prey (small mammal) availability with caracal diet, activity and home range use in two distinct areas, the West Coast Strandveld and the southern Free State Grassland>Nama-karoo. It indicates the vital role that the incorporation of knowledge on small mammal community dynamics and structure can play in farm management practises and, therefore, assist in animal damage control programmes. Research conducted in the West Coast Strandveld showed that territorial cats move directly from one high density prey area to the next, patrol these areas and in affect limit the movement of non-territorial cats inside their home ranges. Another significant find was that female cats rearing young switched to larger prey such as antelope due to raised energetic demands. Being an opportunist some of these cats are likely to switch to livestock when energetically stressed, such as in the case of females rearing young, when natural prey (especially rodents) densities drop seasonally or due to conflict and competition with other caracal. As in the West Coast Strandveld social behaviour will be investigated in the Free State study area and results interpreted in the context of small mammal community densities and structure.



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## New data on the bats from Nubia, Sudan

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Data on bats from Nubia were gathered relatively early, oldest reports came from 1830 and 1863, respectively. However, most of the reports of bats from Nubia brought just isolated records. The only systematic research of bats was carried out in 1901–1904 by Baron Rothschild, his trips resulted in the distribution data on seven bat species. After more than a century, I tried to revise the fauna of bats in the Nile section of the Sudanese Nubia. Considering all records in the vast area of Sudan to north of 17°N, the bat fauna is composed of 12 species. The fauna represents a typical Saharan community of bats, in which the most dominant and common species are *Rhinopoma cystops*, *Asellia tridens*, *Taphozous perforatus*, and *T. nudiventris*. Very rarely found Nubian species are *Hypsugo ariel*, *Otonycteris hemprichii* and *Plecotus christii*. As accessory elements, to the fauna also belong sub-Saharan savanna bats (*Rousettus aegyptiacus*, *Rhinolophus clivosus*, *Nycteris thebaica*, and *Pipistrellus rueppellii*) as well as one Mediterranean form, *Pipistrellus kuhlii* (incl. *P. deserti*). The former group of accessory species recognises the narrow Nile valley as an inhabited corridor between fertile areas of sub-Saharan Africa and the Mediterranean, which enabled them to colonise the Levant and adjacent parts of western Asia. For *Pipistrellus kuhlii* Nubia represents the southernmost projection of its Mediterranean range.

## Diet of the yellow mongoose (*Cynictis penicillata*) in the Thicket Biome of South Africa: project presentation

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The dietary habits of the yellow mongoose (*Cynictis penicillata*) will be studied in the Albany Thicket Biome (Great Fish River Reserve, Eastern Cape, South Africa), which is characterized by dense thickets and clumps of thorny and succulent shrubs. The main aims of this study are 1) to investigate the seasonal variations in the diet of the yellow mongoose, 2) to evaluate the possible differences in the diet between different groups or families of mongooses (intergroup variation), 3) to determine if there are interannual variations in the diet, and 4) to assess whether seasonal variations are determined by variations in main prey availability (arthropods and small mammals). The diet will be investigated through the analysis of over 1,000 scats that have been collected near latrine sites throughout the different seasons of the year from 2005–2007, as well as additional scats that will be sampled from July 2011 to June 2012. Scat samples have been/will be stored in a freezer until they are further analysed in the laboratory. There, scats will be dried in an oven for a period of 24 hours at 50 °C. Dried scats will then be weighed and analysed under a dissecting microscope in order to determine which food items (or rather their remains) are present in the scats of the yellow mongoose. The results will be expressed as percentage occurrence (PO), *i.e.* [the number of scats in which a prey item occurred/total number of scats] × 100, relative percentage occurrence (RPO), *i.e.* [the number of occurrences of a prey category/total number of occurrences of all categories] × 100, and the mean relative volume (RV), expressed as a percentage, of the

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remains of each prey item in the scats. In addition, comparisons and overlaps between sampling categories (seasons, years, groups) will be evaluated in calculating 1) the Shannon-Wiener diversity index ( $H'$ ), 2) Levin's standardised niche breadth ( $BA$ ), and 3) Pianka's diet overlap ( $\alpha$ ).

## Taxonomic and phylogenetic inference of South African pygmy mice from museum specimens: preliminary data

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The African pygmy mice (*Mus*, subgenus *Nannomys*) are a group of small-sized rodents (<8gr) widespread throughout sub-Saharan Africa. Chromosomal studies have uncovered extensive karyotypic diversity within this group and have demonstrated that karyotypes are a very useful taxonomic marker. This is notably the case for *Mus minutoides* populations in South Africa where not only are two different cytotypes (2n=34, 2n=18) present, but most remarkably, a modification of the sex determination system exists due to the presence of a Y chromosome in some of the females.

There are four species of *Nannomys* recorded in South Africa: *M. indutus*, *M. minutoides*, *M. neavei*, and *M. orangiae*, the morphological determination of which is not always easy. Previous cytochrome b analyses allowed us to discriminate *M. indutus* and *M. minutoides*, as well as the two different *M. minutoides* cytotypes. To extend the geographic coverage for this species, we collected tissue samples from 6 South African museums. Of the 127 samples processed so far, 46% were successfully amplified with specific cytochrome b gene primers (first 400bp). The analysis of the sequencing results showed that 3 species could be identified: *M. minutoides*, *M. indutus* and a third as yet unidentified taxon. The *M. minutoides* museum samples fell into three different clades: the two cytotypic groups previously identified in South Africa, and an East African clade (one specimen from Zambia). The high resolution of our preliminary results is extremely promising for both species identification of museum specimens and within species phylogeographical surveys. This study will be completed by i) processing the remaining specimens, and ii) testing for the presence of the SRY gene in *M. minutoides* females to identify the occurrence and distribution of the XY females throughout the species' range.

## Transmission of Mopeia virus in controlled populations of *Mastomys natalensis*

Borremans Benny<sup>1</sup>, Jonas Reijnders<sup>1</sup>, Sophie Gryseels<sup>1</sup>, Stephan Günther<sup>2</sup>, Abdul Katakweba<sup>3</sup>, Rhodes Makundi<sup>3</sup>, Christopher Sabuni<sup>3</sup>, Herwig Leirs<sup>1,4</sup>

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For many infections, theory predicts that transmission is dependent on the density of the host population. It has however been proven hard to observe this influence of density in natural or experimental conditions. Through a unique experimental setup, we want to investigate the correlation between density and transmission for Mopeia virus, an East-African arenavirus that is carried by the multimammate mouse (*Mastomys natalensis*). We hypothesize that virus transmission will increase with density through an increase of the absolute number of contacts between individuals. During the coming years, we will perform a series of transmission experiments in controlled multimammate mouse populations. In each of 4 fenced field plots of 0.5ha, one infected individual will be released in a population of susceptible individuals, after which the transmission of the infection is followed up in 2-week intervals for each individually marked mouse, for several months. A range of population densities between 10/ha and 100/ha will be used in order to estimate the minimum host population density necessary for virus transmission. Additionally, a contact experiment will be carried out on these populations, for which a number of mice in each population will be covered with fluorescent pigment powder that is transferred to other individuals in the case of direct contact. As we expect that direct contact is an important mode of transmission for Mopeia virus, we will be able to relate the contact rate to virus transmission. The results of these experiments will then be analyzed using individual-based mathematical models of infection.

## **Home range size and overlap of *Mastomys natalensis*.**

Borremans Benny<sup>1</sup>, Vincent Sluydts<sup>1</sup>, Jonas Reijniers<sup>1</sup>, Abdul Katakweba<sup>2</sup>, Loth Mulungu<sup>2</sup>, Christopher Sabuni<sup>2</sup>, Rhodes Makundi<sup>2</sup>, Herwig Leirs<sup>1,3</sup>

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Calculation of home ranges based on capture-mark-recapture (CMR) data usually suffers from a limited number of observations per individual, making it difficult to detect statistically significant differences. Technically more demanding methods like telemetry produce numerous observations per individual, but only a limited number of individuals can be followed, which means the number of study questions is limited. Here we want to take advantage of a huge CMR database to see if we can overcome these limitations using a large number of observed individuals. Here we study home range size and overlap in a population of *M. natalensis* in Morogoro, Tanzania, using CMR data (36425 separate captures of 15471 individuals in 212700 trap nights). Every individual that was captured during at least 2 different months was retained for home range estimation, which was done using the minimum convex polygon method. The average estimated home range size was  $405 \pm 6 \text{m}^2$ , ranging from  $71 \text{m}^2$  to  $10711 \text{m}^2$ . Consistent with existing literature, male and female home range sizes were not different ( $385 \pm 8 \text{m}^2$  and  $386 \pm 8 \text{m}^2$ , respectively). Adults have a significantly larger home range than subadults ( $465 \pm 15 \text{m}^2$  vs  $363 \pm 6 \text{m}^2$ , resp). Overlap area was not different between functional categories. There was a significant interaction between age (adult/subadult) and density, where subadult (but not adult) home range size decreases with increasing density. Overall, home ranges were significantly smaller with higher densities. These results confirm previously suggested trends, and for the first time allow insight into the effects of density on home range sizes.

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## A baseline survey of bats in the Simandou Range, Guinea

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We conducted a baseline survey of bats in the Forêt Classée de Pic de Fon, Simandou, Guinea, as part of the environmental studies of the Simandou iron ore project. Sampling took place at the end of the dry season from February to March 2008 and at the end of the rainy season in December 2008. Bats were assessed in different habitat types using ground level and stacked mist nets. The study confirmed the presence of 24 bat species from five families. The survey revealed one bat species, *Rhinolophus guineensis*, classified on the IUCN 2010 Red List as Vulnerable and three bat species, *Eidolon helvum*, *Hipposideros jonesi* and *Miniopterus [schreibersi] villiersi*, classified as Near Threatened. Our bat survey results combined with those of the 2002 Conservation International Rapid Assessment Program (RAP) at Pic de Fon were used to determine diversity levels, conservation concerns, and habitat requirements for conservation priority species (CPS). Results are also compared with other surveyed sites in southeastern Guinea to determine regional (gamma) diversity levels.

## IUCN Red list establishment for the small carnivore species of Benin: A useful tool for the sustainable management and conservation

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While poaching of large animals has been controlled in the national parks, pressure on small animals that can be transported unseen by guards has increased. Small predators are thus abusively hunted for human consumption and for medicinal and mythical purposes. Considering that a recently project has been initiated to establish the Red List for some species in Benin which include the small carnivores as well. The approach use here is based on the literature computing and the organization of several meeting with local experts to validation the document. Only species of less than 20 kg are treated as small carnivore species in this Red list establishment for the Benin. Based on the limitation of 20 kg, a total of 23 species belonging to the families: Herpestidae (6 species), Mustelidae (4 species), Viverridae (6 species), Canidae (3 species), Felidae (3 species) and Nandiniidae (1 species) are treated. Most of species treated are targeted to be vulnerable and near threatened. The African clawless otter (*Aonyx capensis*) targeted by IUCN red list to be less concern are listed as endangered species in Benin. We conclude that each country should complete their own red list because some species may not be threatened in a worldwide view, but may be crucial for local village communities in tropical countries, especially in wide areas of the West African country, where local people are living in poor conditions.

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## Small mammal abundance, diversity and richness in the Andries Vosloo Kudu Nature Reserve (Eastern Cape, South Africa)

Emmanuel Do Linh San<sup>1</sup>, Linchay Arnolds<sup>2</sup>, Tembisa Matolengwe<sup>1</sup>, Akhona Mbatyoti<sup>1</sup>, Aviwe Nqinana, Lisa Buwa<sup>2</sup> and Zimkitha Madikiza<sup>1</sup>

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We present the results of a study aimed at assessing potential inter-habitat differences and seasonal variations in small mammal abundance, diversity and richness in the Andries Vosloo Kudu Nature Reserve (Eastern Cape, South Africa). Sampling was conducted by means of live-trapping (6 x 10 grids with 10 m-spacing between traps) at five different sites, representing the main habitat types, over the four seasons in 2009. During each session, traps were left open for five days and checked early mornings and late afternoons. Trapped animals were ear-marked to allow for abundance estimation. Overall, we made a total of 466 captures of 275 different individuals. Trapping success varied between 3.2% (summer) and 5.5% (winter), for an annual average of 4.3% (n = 5,400 trap-days). Ten rodent and one Macroscelidae species were caught, with an average ( $\pm$  SD) of  $5.4 \pm 1.8$  species per habitat type. The highest small mammal richness was found in the Riverine *Combretum* Forest (8 species), while the Medium *Portulacaria* Thicket was the poorest habitat (3 species). The pouched mouse (*Saccostomus campestris*) was trapped in all five habitats, but in very low numbers. In contrast, the four-striped mouse (*Rhabdomys dilectus*) was only found in two, similar habitat types, but was very abundant. The western rock sengi (*Elephantulus rupestris*) and the bush Karoo rat (*Otomys unisulcatus*) were rare and each caught in a single habitat type. Small mammal diversity, assessed through the evenness of representation index (*E*), was highest in the Riverine *Combretum* Forest (*E* = 0.56) and in the Short *Euphorbia* Thicket (*E* = 0.51), whereas the Dense Rocky Bushclump site exhibited an extremely low species diversity (*E* = 0.03). Clear seasonal variations were observed, with a higher small mammal richness and diversity in spring and higher animal numbers in winter.

## Predator-prey interactions involving small mammals, black-backed jackal and caracal: implications for human-wildlife conflict management

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Predators form an integrate part of many ecosystems and through their interactions with other predators or with prey play a very important role in ecosystem functioning. They may directly suppress prey numbers, or they may suppress other predators indirectly resulting in lesser consumption of prey species. There is currently, however, limited scientific evidence on the ecological interactions between damage-causing black-backed jackal *Canis mesomelas*, caracal

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*Caracal caracal*, and small mammals in South African ecosystems. There is some evidence suggesting that black-backed jackal and caracal may control rock hyrax *Procapra capensis* and springhare *Pedetes capensis*. It is important that more scientific studies be conducted on the role of black-backed jackal and caracal in controlling and structuring small mammal communities in a diversity of South African habitats. Such information could contribute to predict more accurately the impact of different human-wildlife conflict management strategies in South African habitats.

## Ecological data based on trapping success, and habitat preferences: the Case of *Crocidura olivieri* (Lesson, 1827), and *Scutisorex somereni* (Thomas, 1910) from the Democratic Republic of Congo

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We collected *Crocidura olivieri*, and *Scutisorex somereni* using four types of traps: Pitfall [PF] buckets, Sherman [SH], Victor [VT], and Museum Special [MS]. The analysis was based on 248 shrews. We captured 27 shrews at Maiko, 11 at Yelenge, 23 in Masako Forest Reserve, 21 in Yoko Forest Reserve, 25 at Djabir-Bolinga, 23 at Baliko, 56 at Bomane (right and left banks of Aruwimi River), 31 during the Congo River Expedition 2009 (five localities: Langa-Langa, Eleko, Monze, Basoko, and Yaekama), and 31 at Kasugho. Shrews were captured on old fallow land (JV), in old palm plantation (VP), in old secondary forest (FS), and in primary forest (FP). Systematically, results on trapping success from different localities indicate that [PF] (trapping effort TE = 10,080 trap-nights TN, 139 shrews, 4 species, trapping success TS = 1.38%) are the most efficient traps (both in trapping success and diversity) to capture shrews while [SH] (TE = 18,265 TN, 65 shrews, 2 species, TS = 0.36%), [VT] (TE = 8,880 TN, 23 shrews, 1 species, TS = 0.26%), and [MS] (TE = 8,560 TN, 10 shrews, 1 species, TS = 0.12%), are more less efficient to capture shrews. For *C. olivieri*, the TS gradient of traps used responds to this equation [PF] > [SH] >> [VT] >>> [MS]. *Scutisorex somereni*, *S. congicus*, and *Scutisorex nov\_sp*, are better captured in [PF] buckets. Then, the TS gradient follows this equation [PF] >> [SH] >>> [VT] >>>> [MS]. Results about the habitat preferences show that *C. olivieri* might be a "Forest-nondependent species". The trapping success responds to this equation VP [TS = 0.67%] > JV [TS = 0.57%] > FS [TS = 0.38%] > FP [TS = 0.24%]. These results also show that *Scutisorex somereni*, *S. congicus*, and *Scutisorex sp* might be a "Forest dependant species". The trapping success responds to this equation FP [TS = 0.22%] > JV [TS = 0.16] > FS [TS = 0.10%] ≈ VP [TS = 0.10%].



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### **Resting site ecology and microhabitat use of the Mozambique thicket rat (*Grammomys cometes*) in a riverine *Combretum* forest: project presentation**

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The current study is focused on determining the types, distribution and usage patterns of resting sites of the Mozambique thicket rat (*Grammomys cometes*). It will also be looking to determine the microhabitat use of this species during the nocturnal phase of activity. Field work will take place between June 2010 and May 2011 in the western section of the Great Fish River Reserve complex (Eastern Cape Province, South Africa; 33°04'–33°09' S and 26°37'–26°49' E). The actual site for the study will be a stretch of riverine *Combretum* forest (length x breadth ca. 500 x 100 m) located in the western section of the conservation area. Potential seasonal variations and inter-individual variations in microhabitat use will be determined by conducting 6-day trapping sessions in the first month of each season. A grid of 100 stations (20 x 5) will be set at the study site, with pairs of Sherman traps placed at 10-m intervals, one on the ground and one above the forest-floor in tree branches. Several variables describing microhabitat structure will be recorded at each station. Trapped animals will be weighed, anaesthetized and ear-marked using single-digit spiked numbers and permanent tattoo-ink. The age, sex and reproductive status will also be determined. Microhabitat data will be analysed with logistic regression models (absence vs presence, males vs females, adults vs juveniles, ground vs aboveground). In addition, 10-12 adult animals will be equipped with radio-collars weighing between 1.6 and 2.6 g (i.e. < 5% of the target animal's body mass). Resting sites will be determined on a daily basis in the framework of two 2-week field sessions that will take place during each season of the year (i.e. animals will be tracked for one month during each season). Characteristics of resting sites will be recorded and potential seasonal and inter-individual variations investigated.

### **Biogeography and evolutionary history of hantaviruses and arenaviruses in Africa. Call for participation**

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Understanding the evolution and epidemiology of RNA viruses in their natural hosts is essential for disease emergence prediction and control. Arenaviruses and hantaviruses are respectively rodent-borne and rodent/insectivore-borne RNA viruses causing hemorrhagic fevers and neurological disorders in humans. They are well studied in Europe and the Americas but understudied in Africa despite recent discoveries indicating high African diversity. Based on previous data, it has been assumed that both groups of viruses have had long co-evolutionary histories with their hosts. However, this has not been adequately tested for African arenaviruses, and a recent study of hantaviruses instead suggests a very short co-history of preferential host switching, which has massive implications for viral emergence and control. Our project intends to fill the gap in scientific knowledge of these viruses in Africa by investigating their biodiversity, biogeography and evolutionary history in relation to their hosts. For this purpose we need samples covering as widespread across Africa as possible. In the past three years we have put together a network of collaborators that has gathered small mammal blood samples from Tanzania, Kenya, Democratic Republic of the Congo, Ethiopia, and Zambia. This poster describes the goals of the project and how anyone who wishes to be involved can contribute suitable samples from geo-referenced live caught small mammals.

## **The diet of rodents in agro-ecosystems: a study in maize, pineapple and sugar cane plantations**

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Rats and mice are usually present in low numbers in natural habitats. However, their numbers may increase drastically in agricultural ecosystems due to increased food supply, and they may have significant impacts on crop production. Maize, pineapple and sugarcane are important contributors to the Swazi economy; despite this, no thorough investigations of the impacts of rodents on these crops has been undertaken. In this study the diet of rodents from such farms in the Luyengo-Malkerns area was investigated. The diet of rodents from maize, pineapple, sugarcane fields and an uncultivated pasture was studied from November 2010 to March 2011. The stomach contents of 185 rodents were analysed using microscopic methods. Rodent species analysed (and sample size) are: *Mastomys natalensis* (170), *Mus minutoides* (5), *Rhabdomys pumilio* (4), *Otomys irroratus* (3), and *Tatera leucogaster* (2). Six diet categories were identified: 1) vegetation alone; 2) pineapple alone; 3) vegetation and pineapple; 4) vegetation and insects; 5) grain; 6) unidentified. An Analysis of Variance showed that vegetation is an important part of the diet of rodents in the study area. The rodents that were collected from the pineapple fields had pineapple as part of their diet, with 50% of them feeding on pineapple alone. For all the rodents collected grains and insects made up 17% and 14% of the diet respectively. From the results it is evident that rodents are pests in these crops, and methods of control need to be developed and carried out.



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## Light conditions in damaged foraging tunnel in Ansell's mole-rat (*Fukomys anelli*)

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African mole-rats (Bathyergidae, Rodentia) are strict inhabitants of large lightless system of underground burrows. Because of the lack of an overt behavioural reaction to light, they have been considered to be virtually blind for a long time. However, neuroanatomical studies demonstrated unexpected conservation of retina with S-cones dominance (sensitive to blue part of light spectrum). Among mammals, this phenomenon has been described only in mole-rats so far. At the same time, recent behavioural experiments suggest that photopic vision is conserved and that low acuity residual vision plays an important role in predator avoidance and tunnel maintenance when damaged. In this study we present first light conditions measurements of damaged foraging tunnel in Ansell's mole-rat (FA) in natural habitat in comparison with measurements in laboratory conditions. The measurements suggest low propagation of short wavelength light and higher of middle-to-long wavelengths in natural and artificial tunnel as well. On the basis of results we discuss recent hypothesis of adaptable value of unique dominant short wavelength perception in mole-rats in a context of congenital hypothyroidism.

## Spatio-temporal ecology of spotted genets (*Genetta* spp.) in the Great Fish River Reserve (Eastern Cape, South Africa): a preliminary analysis

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In this paper, we present preliminary results of a study focusing on the spatial ecology and activity patterns of spotted genets (*Genetta* spp.) in a xeric conservation area (Great Fish River Reserve, Eastern Cape, South Africa). Data were collected through radio-tracking from March to December 2006 and from October 2010 to March 2011. Locations and activity fixes were obtained by means of continuous day- and night-tracking sessions, taking bearings every 30 minutes, as well as through random and semi-continuous sampling. Overall, data were collected for 7 small-spotted genets (*G. genetta felina*; 5 males and 2 females) and 1 male large-spotted genet (*G. tigrina*). Genets were essentially nocturnal and crepuscular. Diurnal activity was only marked in the large-spotted genet, and was restricted to short movements near to the diurnal resting site at any time of the day. Genets started nocturnal activity on average at 17h58 (min = 16h27, max = 19h23; n = 162) and ceased at 03h53 (min = 22h25, max = 07h19; n = 60). The duration of the nocturnal activity period varied between 4 h 55 min. and 13 h 34 min., with an average of 9 h 57 min (n = 47). Genets were active in 93% (min = 57%, max = 100%) of the activity period, although nocturnal resting (up to 10 resting bouts) took place in as much as 78% of complete tracking nights (n = 36). The total distance travelled at night varied between 1,700 and 7,860 m (mean = 3,600 m), with genets moving at an average ( $\pm$  SD) speed of  $0.40 \pm 0.14$  km/h. Future analyses will include data

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collected between April and August 2011 and focus on nightly and total individual home range sizes.

## **Activity patterns of the yellow mongoose (*Cynictis penicillata*) in the Great Fish River Reserve (Eastern Cape, South Africa): a preliminary analysis**

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Very little is known of the temporal ecology of most small African carnivores. Here, we present a preliminary analysis of data collected in the framework of a detailed study of the activity patterns of the yellow mongoose *Cynictis penicillata* (Herpestidae). The research was carried out from September 2005 to April 2011 in the Great Fish River Reserve (Eastern Cape, South Africa). Data were gathered through 73 continuous tracking sessions (63 during the day and 10 at night) of 11 radio-collared individuals (7 males and 4 females). For some analyses, activity was then evaluated by classifying 5-min blocks or fixes as either active or inactive. Yellow mongooses were strictly diurnal and crepuscular. Activity levels averaged 58% between 06h00 and 17h59 ( $n = 6,640$  fixes) and only 12% between 18h00 and 05h59 ( $n = 1,669$  fixes). Nocturnal activity only occurred at dusk and at any time of the night in burrows. Yellow mongooses emerged from their burrows on average ( $\pm$  SD)  $75 \pm 48$  min. after sunrise (min =  $-11$  min., max =  $+309$  min.) and returned  $3 \pm 68$  min. before sunset (min =  $-148$  minutes, max =  $+225$  minutes). The duration of the daily activity period (i.e. time spent outside the burrow) varied between 6 h 47 min. and 15 h 36 min., with a mean of 10 h 9 min. Diurnal resting, with up to 11 bouts per activity period, occurred in 100% of activity periods. The longest resting periods occurred early in the morning and late afternoon (sunbathing) and at midday, during the hottest period of the day. Overall, yellow mongooses were active during  $67 \pm 16\%$  of the time spent outside the burrow. Further analyses will incorporate data collected between May and August 2011, and focus on possible intersexual differences, seasonal variations and effects of weather conditions on yellow mongoose activity patterns.

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### Differences in diet between two rodent species of *Mastomys natalensis* and *Gerbilliscus vicinus* in fallowland habitat of central Tanzania

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Differences among rodent species living together in the same habitat usually result from differences in the use of three resources: space, time and food or some combination of these three. However, differences in resource utilization among animal species may simply reflect their specific ecological needs rather than competitive pressures. In this study, the diet of two rodent pest species of *Mastomys natalensis* and *Gerbilliscus vicinus* coexisting in the fallow land in Central Tanzania were studied in order to assess the degree of diet differentiation among them. Niche breadth proved greater in diet consumed by *G. vicinus* than those consumed by *M. natalensis* in all maize cropping calendar. The studied rodent species overlapped considerably in the food items consumed ranging from  $O_{jk} = 0.77 - 0.89$ . The grains and invertebrates contributed high in the diet used by both two rodent species. In addition to the two food categories, plant materials also contributed highly for the diet of the *G. vicinus*. Differences in amount of plant materials consumed by *G. vicinus* could be therefore contributed to differences in the diet partition by these two rodent species which may, in turn, facilitate their coexistence in fallow land.

### Commensal rodents and Lassa fever risk in Ghana

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Lassa virus causes a viral hemorrhagic fever unique to West Africa. It has been described most often in Nigeria and Sierra Leone, but is presumed to occur throughout West Africa. In 2000 a case was reported in a traveler to Ghana due to a strain (AV) different from those found in Nigeria and Sierra Leone. Geographically limited serology studies found seroprevalence in Ghana of around 4%. In order to better understand the epidemiology of Lassa fever, we investigated the rodent community in two villages in southern Ghana, Ehiawenwu (06°27.02'N; 00°51.14'W), and

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Ankaakur (06°10.559'N, 01°47.557' W). Traps were set three consecutive nights in the houses (indoors) and in the surrounding maize, cassava and yam fields, cocoa plantation and forest (outdoors), totaling 1856 trapping nights. The animals were identified morphologically on the field by standard measurements, and the sexual status was recorded. Several biopsies were also performed for future virological investigations. In all, 175 small mammals were captured: 116 *Praomys daltoni*, 27 *Mus (Nannomys) spp*, 11 *Mastomys natalensis*, 10 *Crocidura spp*, 4 *Rattus rattus*, 3 *Lophuromys sikapusi*, 2 *Lemniscomys striatus* and 2 *Praomys sp*. The commensal community was dominated by *P. daltoni* (96%, 114/119 indoors), which displaced *M. natalensis* (18%, 10/56) outdoors. Conversely, the pygmy mice were very abundant outside (48%, 27/56). In the framework of Lassa epidemiology, the quasi absence of the reservoir *M. natalensis* inside in the tropical forest regions of southern Ghana, could explain the low Lassa seroprevalence in humans.

## Helminth community of *Mastomys natalensis* in different agricultural patches in Morogoro, Tanzania

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*Mastomys natalensis*, the multimammate mouse, is a widely distributed African murid, a pest causing agricultural damage and acting as a reservoir of several human pathogens. Because some helminths can regulate host populations, they could be used as potential biological control for rodent pests. So far, the helminth community of *Mastomys natalensis* is still poorly known and has only been sporadically investigated across the continent. In order to gain insight into the ecology of the helminth community of *M. natalensis*, we sampled six localities evenly distributed along a 100 km transect between Morogoro and Berega, Tanzania, in December 2009. We crossed various agricultural patches that could potentially support different densities of *Mastomys*. Major agricultural areas are likely able to support a larger effective density of *Mastomys* than small patch scattered among dry bush land. In total, 329 individuals were dissected and screened for helminths. In this talk we present the results of the effect of host density and host intrinsic factors (sex, age, genetic, body mass index) on the composition and load of the *Mastomys*' helminth community. We also test for the potential interactions between Mopeia arenavirus and helminth parasites.

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### ***Trichuris makundii* and *Paraconcinnum leirsi*, two new helminth species in Tanzanian rodents**

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The helminth community of African rodents is still poorly known and has only been investigated in a fragmented way across the continent. During a 2008-2009 survey of the helminth community of several rodent species in the Morogoro region, Tanzania, we found a whipworm in the multimammate mouse, (*Mastomys natalensis*), which differs from previous recorded species of the genus *Trichuris* in African rodents. Morphological, metric and genetic data support the erection of this as a new species of nematode, for which we propose the name *Trichuris makundii* (Nematoda: Trichuridae). The analysis of partial ITS1-5.8S-ITS2 sequences shows that *T. makundii* clearly differs from the cosmopolitan whipworm, *Trichuris muris*, found in Murinae. During the same survey, examining *Gerbilliscus vicinus* and *Acomys* sp. in Maguha village, we discovered a new trematode species taxonomically keyed to genus *Paraconcinnum*. The species was not found in sympatric *Mastomys natalensis* and *Aethomys* sp. individuals. Sequencing of partial 18S rRNA gene shows the trematode is clearly a Dicrocoelid and falls in a cluster with genus *Concinnum*. We propose the species name *Paraconcinnum leirsi* (Digenea: Dicrocoeliidae) for this trematode. These two new helminth descriptions illustrate the wealth of natural diversity as yet undiscovered inside African rodents.

### **Cranial size and shape variation in Afro-Malagasy *Otomops* (Chiroptera: Molossidae): resolving species limits**

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The taxonomy and morphological diversity of the Old World molossid genus *Otomops* is unresolved. Twelve craniometric characters and 14 dorsal landmarks were used to investigate patterns of morphological variation within Palaeotropical giant mastiff bats. Multivariate analyses of

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craniometric and dorsal landmark data sets show significant size and shape divergence between *Otomops* from Asia and the Afro-Malagasy region. Our data supported the recent recognition of three Afro-Malagasy *Otomops* clades: *O. madagascariensis* from Madagascar; *O. martiensseni* from southern, eastern, central and western Africa; an undescribed taxon from northeast Africa and the Arabian Peninsula. Morphological diversity and cranial size was strongly associated with altitude and seasonality. Based on available data on the morphological diversity and molecular divergence estimates, we suggest that speciation within *Otomops* from Africa and Arabia may have occurred in response to the fluctuating palaeoclimate of the Pleistocene and the increased aridity and seasonality of north-eastern Africa.

## Status of Black-and rufous Sengi (*Rhynchocyon petersi*) in Zaraninge Coastal Forest, Tanzania

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Establishing abundance and density of giant sengis have been estimated mainly using nests transect counts. This method is employed again in this study as a base line information on understanding the status of Black-and rufous Sengi (*Rhynchocyon petersi*) for the ongoing studies of *R. petersi* in coastal forests in and around Saadani National Park, Tanzania. Twenty one transects with lengths ranging from 200m to 1000m were cut through the centre of the forest. Some long transects crosses the road which path through the forest. Number of Sengis nests within 3m on each sides of transect from the middle were observed and recorded including both old and new nests. The density of Black-and rufous Sengi in Zaraninge forest was estimated to be 85.5 per km<sup>2</sup> (SE= 9.4). Habitat preference for Sengis nests placement in this forest are further discussed.

## Ecological characteristics in habitats of two African mole-rat species with different social systems in an area of sympatry

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African mole-rats (Bathyergidae) are subterranean rodents with diverse social systems which range from solitary to highly cooperative ones. We examined ecological characteristics in habitats occupied by two mole-rat species with different social systems in an area of sympatry in the Nyika Plateau, Malawi. Whereas the solitary silvery mole-rat *Heliophobius argenteocinereus* occurs there in high-elevated afro-montane grasslands, the social Whyte's mole-rat *Fukomys whytei* is bound to



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lower miombo woodlands. The habitat of *F. whytei* was characterized by a lower food supply and harder soil. The niche segregation of the two species in the Nyika Plateau probably consists in an inability of the larger solitary species to survive under harsh ecological conditions. Absence of *F. whytei* in higher altitudes may consist in its less effective thermoregulation, competitive exclusion by *H. argenteocinereus*, or other unknown factors. The study was funded by MSMT (6007665801), GAAV (KJB601410826) and GAJU (04-136/2010/P).

## **Home range size, movements and activity patterns of *Aethomys namaquensis* (Smith 1834) under the influence of grazing**

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Savannah ecosystems in Southern Africa are strongly affected by cattle and game farming but the influences of the different grazing regimes are still not clearly understood. In order to measure these differences, the ranging behavior of *Aethomys namaquensis* (Smith 1834) was investigated by using radiotracking on a game farm and a cattle farm bordering the Etosha National Park in Namibia. Nine individuals were collared with radio transmitters at the end of the dry season from September to November 2006 to collect data on range areas, habitat use and activity patterns. Our study revealed that *A. namaquensis* exhibits home range areas from 380-2000 m<sup>2</sup> (Minimum Convex Polygon=MCP 95 %; Kernel 95 %). Males tended to have greater home ranges than females. The individuals on both areas avoided open grass, clearly preferred bushes and trees and even showed arboreal behavior.

Vegetation cover, shelter and food availability for *A. namaquensis* and other small mammals were significantly reduced on the cattle farm. This reduction in habitat quality resulted in enlarged home ranges of *A. namaquensis* on the cattle farm compared to the same species on the game farm. Core areas of individuals on the cattle farm exceeded the core areas on the game farm by three (MCP) to six times (Kernel). In addition, individuals on the cattle farm showed an increase in distances of migratory behavior up to 45 % in comparison to individuals on the game farm. Therefore, our results clearly indicate, that *A. namaquensis* is an applicable indicator to demonstrate different effects of grazing to savannah ecosystems by cattle or game.

## **Diversity, abundance and habitat use of small mammals reflect ecological disturbances – valuable information for the management of farm systems and the protected area network in Southern Africa**

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In the last ten years land use has remarkably shifted from cattle to game farming in Southern Africa. This recent change in land use requires management strategies for sustainable game farming, e.g. composition and abundance of species, spatial arrangements of waterholes, fences and others. In order to provide scientific data to support and measure the sustainability of this kind of land use we propose small mammals as bioindicators. Small mammals are known to be sensitive to disturbances because of their central position in the trophic network of savannah



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ecosystems. They can indicate ecosystem functions (e.g. herbivory, insectivory, bioturbation, and others) on a small scale. Those ecosystem functions need to be assessed and monitored for a sustainable management of game. We investigated small mammal population dynamics and behavior on a game farm (Kaross) adjacent to the Etosha National Park on 1 ha plots following a gradient with distances of 50 m and 1000 m from an artificial waterhole. On each plot 100 Sherman live-traps were set in a grid. 9 individuals of *Gerbilliscus leucogaster* were equipped with radio-collars in order to investigate their spatial behavior. Along this gradient we detected differences in species diversity, abundance, evenness and behavior. The number of species was highest close to the waterhole where game species accumulate probably because of grazing effects on the vegetation cover and arthropod abundance. In addition, home range size of *Gerbilliscus leucogaster* was larger close to the water hole compared to the other plot in more distance. Small mammal species composition, population dynamics and behavior clearly indicate the influence of large herbivores on game farms. Research on population dynamics, behavior, and ecology of small mammals is important for the assessment of habitat quality and management of semi-arid savannah ecosystems.

## Identity of Arabian *Scotophilus* (Vespertilionidae)

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The yellow-bellied *Scotophilus dinganii* is the only African house bat species occurring in the Arabian Peninsula. Formerly, the Arabian house bats were referred to similarly looking white-bellied *S. leucogaster*, from which it differs by the colour of ventral pelage. We explored house bats from southwestern Yemen using molecular genetic and morphological analysis in order to assess their proper taxonomic assignation. Two groups of revealed cytochrome *b* haplotypes clustered within two distantly related lineages of African *Scotophilus*: East African *S. aff. dinganii* and *S. leucogaster*. Differences in external and cranial measurements also indicated both groups as distinct taxa. Due to similarity of Yemeni and Ethiopian populations to the type specimen of *S. nigrata colias*, we suggest the name *S. colias* for the East African lineage of *S. dinganii*. Based on environmental differences of Yemeni localities of origin, *S. colias* appears to be ecologically delimited to mountainous habitats, while *S. leucogaster* to harsh lowland deserts. This is consistent with known habitats of African populations of both species. Comparison of pelage colouration in Yemeni specimens neglected the assumption on specific difference in colour of ventral pelage, since yellow was recorded also in one specimen of white-bellied house bat *S. leucogaster* from southern Yemen.

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## **Intra- specific skull morphometrics of the Cistugid bat species, *Cistugo lesueuri*, an endemic species to South Africa and Lesotho**

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Lesueur's hairy bat, *Cistugo lesueuri*, is a species endemic to South Africa and Lesotho. Very little is known about the basic biology of this small Cistugid bat. *Cistugo lesueuri* has a disjunct distribution with a population in the north-eastern Free State and Lesotho and a population in the south-western Cape. One specimen was sampled at the Karoo National Park, Western Cape. The question is whether the individuals from the two areas are morphometrically similar. A total of 52 museum specimens were examined and grouped in tooth wear classes. Tooth wear classes 2 and 3 were lumped during analyses minimizing variation. Seventeen skull measurements were recorded on each skull. The Multi Dimensional Scaling, Cluster Analysis and Principal Component Analysis sub-routines in PRIMER were used to analyze the data. All the results indicated that the animals from the Free State, Karoo National Park and Lesotho tend to group together. The four specimens from the Western Cape grouped separately. The eigen values from the PCA describing the most variation were mainly length measurements. Three different biomes *ie* Grassland, Karoo and Fynbos are occupied by the species. The first two biomes have a different climate regime than Fynbos. The small sample from the south-western Cape prohibits us to make definitive conclusions. A possible scenario is the existence of a cline, with smaller animals in the south-west and larger one's in the north-east of the country.