

BOOK OF ABSTRACTS

“RODENTS IN CHALLENGING ENVIRONMENTS”

THE FARM INN, PRETORIA, 5-6 FEBRUARY 2019

1 PLENARY: Living the high life: integrative physiological mechanisms of high-altitude adaptation in mice **Graham Scott¹**

¹*Department of Biology, Centre for Climate Change, McMaster University, Hamilton, Ontario, Canada, scottg2@mcmaster.ca*

High-altitude environments provide fertile ground for investigating the mechanisms and evolution of physiological systems underlying animal performance. The cold and oxygen-depleted ('hypoxic') environment at high altitudes requires that endotherms sustain high rates of O₂ consumption for thermogenesis and locomotion while facing a diminished O₂ supply. My research examines the ways in which high-altitude natives overcome these challenges, in an effort to elucidate naturally evolved solutions to oxygen deprivation and to provide general insight into the evolution of complex physiological systems. I will present our work on the respiratory mechanisms of high-altitude adaptation in deer mice (*Peromyscus maniculatus*), and discuss some of our recent work to uncover the genetic basis for adaptive variation in respiratory function and hypoxia resistance.

2 PLENARY: Teasing apart the mechanisms of socially-induced infertility in non-reproductive female and male naked and Damaraland mole-rats occurring in harsh arid environments

Nigel C. Bennett

¹*Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria, Pretoria, South Africa, ncbennett@zoology.up.ac.za*

The naked and Damaraland mole-rats are eusocial subterranean mammals that inhabit harsh arid environments. These two species exhibit an extreme reproductive skew with a single reproductive female responsible for procreation. Non-reproductive female colony members are physiologically suppressed while in the confines of the colony and exhibit reduced concentrations of luteinising hormone (LH) and a decreased response of the pituitary, as measured by the release of bioactive LH, to an exogenous dose of gonadotropin releasing hormone (GnRH). Removal of the reproductive female from the colony results in an elevation of circulating plasma LH and an enhanced response of the pituitary to a GnRH challenge in non-reproductive females which is comparable to that of the reproductive female, implying control to reproduction in these individuals by the reproductive female. This renders these two mole-rat species ideal models to investigate the physiological and behavioural mechanism that regulates the hypothalamic-pituitary-gonadal axis. We know less about the control of reproduction at the level of the hypothalamus. The immunohistochemistry of the GnRH system of both reproductive and non-reproductive female Damaraland mole-rats has revealed no significant differences with respect to the morphology, distribution and numbers of immunoreactive GnRH perikarya. However, the GnRH perikarya of non-reproductive females revealed a higher degree of immunoreactivity and the presence of beads of GnRH along the length of the neurons, intimating a block to the release of GnRH. Endogenous opioid peptides are usually implicated in reproductive failure in organisms that undergo stress. We examined whether the endogenous opioid peptide beta-endorphin was responsible for the inhibition of release of the GnRH from the neurons indirectly by measuring LH concentrations in these non-reproductive females following single, hourly and eight hourly injections of the opioid antagonist naloxone. The results imply that the endogenous opioid peptide beta-endorphin is not responsible for the inhibition of GnRH release from the perikarya in non-reproductive females. Preliminary data examining the distribution of kisspeptin immunoreactivity in the hypothalamus of reproductive and non-reproductive females suggest a possible role for this recently discovered neuropeptide that is important in the release of GnRH for the control of reproduction in socially suppressed Damaraland mole-rats. In the non-reproductive female naked mole-rats there is less Kisspeptin expression than their breeding counterparts in the arcuate nucleus suggesting inhibition of manufacture of the neuropeptide. Recent evidence suggests that suppression of reproduction in the naked mole-rat appears to be brought about by the phenomenon of hyperprolactinaemia. The ovaries of females are prepubescent and the testes are azoospermic, which would be indicative of a shut down in the hypothalamic-pituitary-gonadal axis. Various models of reproductive control are discussed.

3 Non-invasive assessment of glucocorticoid and androgen metabolite levels in cooperatively breeding Damaraland mole-rats (*Fukomys damarensis*)

Katarina Medger¹, Nigel C. Bennett^{1,2}, Heike Lutermann¹, Andre Ganswindt^{1,3}

¹*Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria, South Africa, kmedger@zoology.up.ac.za*

²*SARChI Chair of Mammal Behavioural Ecology and Physiology, Department of Zoology and Entomology, University of Pretoria, , South Africa*

³*Endocrine Research Laboratory, Department of Anatomy and Physiology, Faculty of Veterinary Science, Onderstepoort South Africa*

Damaraland mole-rats (*Fukomys damarensis*) occur in some of the most challenging habitats on earth, including the Kalahari desert. Although they are subterranean and appear to be less affected by environmental changes, seasonal climatic changes have a profound effect on their behaviour and physiology. Breeding females of these cooperative breeders exhibit elevated androgen concentrations during the wet season, which may aid to enforce of their breeding monopoly. We evaluated the effects of breeding status on androgen and glucocorticoid (stress hormone) concentrations in

captive Damaraland mole-rats and mole-rats caught during the dry season in the Kalahari, South Africa. We further examined the suitability of using faecal samples for measuring glucocorticoid metabolite (fGCM) and androgen metabolite (fAM) concentrations using enzyme immunoassays for Damaraland mole-rats. Faecal analysis offers additional advantages especially for field studies on this species. Surprisingly, we found very few differences in fGCM and fAM concentrations between breeders and non-breeders. Immunoreactive fGCM concentrations were low in non-breeders and breeding females and comparatively higher in male breeders. There were no differences in fAM concentrations between wild-caught breeding and non-breeding males and females. In captive mole-rats, concentrations of fAMs and fGCMs were similar in males and females. Faecal androgen metabolite concentrations were, however, higher in captive than in wild-caught individuals, which may be related to a higher reproductive activity due to removal from the breeding female. Dispersal opportunities are limited during the dry season resulting in more stable colony structures and less need for aggression by the breeding female towards non-breeders in order to maintain breeding monopoly. This may result in the relatively uniform and low fAM and fGCM concentrations observed in this study indicating low stress levels in Damaraland mole-rat colonies during the dry season.

4 PLENARY: Update on the rodent diversity and threats of west-central African highlands

Denys, Christiane¹

¹*Muséum National d'Histoire Naturelle, Institut de Systématique et Evolution de la Biodiversité, Paris, France. christiane.denys@mnhn.fr*

Tropical African highlands constitute remarkable hotspots of diversity and are known as “continental islands”. The altitudinal zonation of vegetation as well as climatic fluctuations observed through time act in favour of high endemism for many taxa and among them Rodents. Many scenarios have shown that previous quaternary climatic fluctuations have contributed to the modifications of altitudinal montane forest belts and this may be the promotor of diversification of some taxa. After a review of the present knowledge of the rodent diversity in two montane ranges of west (Nimba, Loma Mts) and Central Africa (Cameroon Volcanic Line), we will compare it to that observed in the eastern and southern highlands of tropical Africa. Anthropization and global warming are presently affecting all the environments and through some examples from west-central African highlands rodents studies we will examine the turnover in species composition over time and altitude. We suggest that some of the species that have not been recorded in recent surveys are due to local extinction, and while some of the new species are due to recent colonisation made possible by massive deforestation and forest fragmentation.

5 PLENARY: Rodents in agricultural landscapes – the example of sugarcane plantations

Ara Monadjem^{1,2}

¹*Department of Biological Sciences, University of Eswatini, Kwaluseni, Eswatini, ara@uniswa.sz*

²*Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria, South Africa*

Agricultural landscapes usually represent major transformations of the original native vegetation in terms of habitat structure, food availability and the threat of predation. This is particularly true for wooded habitats that are replaced by fast-growing, irrigated crops. One such example is sugarcane planted in savanna landscapes. For native rodents, the transformation from savanna to sugarcane may signify a whole host of either positive or negative features. In turn, this has impacts on the conservations since rodents have numerous ecosystem functions (such as seed dispersal and providing prey for a host of carnivores). Furthermore, this has implications for sugarcane farmers because rodents can destroy crops. This presentation examines the impacts of sugarcane farming on rodent populations and community structure in Eswatini. Based on 21,564 trap-nights along 12 transects at three different sugarcane estates across Eswatini, we showed major changes to the abundance, species richness and composition of the rodent community. Each transect ran from savanna into sugarcane fields, extending 375 m into each land use. Species richness decreased with increasing distance into the sugarcane. Species composition differed between the two land uses, with the granivorous functional group being practically absent within sugarcane fields. In fact, sugarcane fields were for the most part dominated by a single species, *Mastomys natalensis*. A 12-month of *M. natalensis* in sugarcane fields showed that they have better body condition than conspecifics in savanna habitats, although there were no other demographic differences. However, survival declined significantly in sugarcane fields that were burnt (prior to harvesting). Sugarcane fields, therefore, have large (and predictable) impacts on rodents which in turn have knock-on effects on other taxa.

6 Diversity and distribution pattern of small mammals in different elevations in Mt. Kenya Important Bird Area, Kenya.

Simon Musila¹, Xue-Long Jiang², Richard Yego¹, Zhong Zheng Chen², Bin Zhang², Quan Li², Chang Zhe Pu², Immaculate Muthoni¹ and Samson Omondi¹.

¹*Mammalogy Section, National Museums of Kenya, GPO Nairobi, Kenya; smusila@museums.or.ke; surnbirds@gmail.com*

²*Lab of Mammal Ecology and Evolution, State key Laboratory of Genetic Resources and Evolution, Kunming Institute of Zoology, Chinese Academy of Sciences Kunming, Yunnan, China*

The elevational distributions of small mammals in mountain environments can provide important information on the effect of climate change on shifting the distribution of species. We investigated small mammals in Mt. Kenya, the second largest mountain in Africa, in nine different sampling stations, each in Chogoria and Sirimon side of this mountain. A total of 160 Sherman's, 160 snap traps and 24 pitfalls were used to sample small mammals, for two nights each in each different elevation. A total of 31 small mammal species were captured, including 26 in Chogoria and 19 in Sirimon. Species in genus *Lophuromys* and *Crociodura luna* occurred in all sampling elevations both in sites. There was a significant difference

between the Shannon-Weiner indices of diversity of the two sites. There was no significant difference in the mean species richness in each elevation in both sites. The distribution pattern of species richness with elevation in Chogoria was hump-shaped; while in Sirimon it decreased with increase in elevation. A total of 1932 individuals of small mammals were captured, which included 959 in Chogoria and 973 in Sirimon. More individuals of shrews were captured in Chogoria (206) than in Sirimon (180). There was no significant difference in mean abundance of small mammals in each elevation in both sites. The distribution pattern of small mammal abundance with elevation both in Chogoria and Sirimon was hump-shaped. More surveys are required in different parts of the mountain in future in order to have clear pattern of distribution of small mammals.

7 Diversity, systematics and conservation of rodents from the montane forest of Oku (Cameroon Volcanic Line, Central Africa)

Alain Didier Missoup¹, Violain Nicolas², Guy Martial Ntougwa Ebague¹, Ngartoubam Didier¹, Ernest Kemin Chung³ and Christiane Denys²

¹Zoology Unit, Laboratory of Biology and Physiology of Animal Organisms, Post Graduate School of Fundamental and Applied Sciences, Douala, Cameroon, admissoup@ymail.com

²Institut de Systématique, Evolution, Biodiversité, ISYEB - UMR 7205 - CNRS, MNHN, UPMC, EPHE, Sorbonne Universités

³Kilum-Ijim Forest Project, Kumbo, Cameroon

Mount Oku, in the North-West Region of Cameroon, is a part of Bamenda-Banso Highlands within the so-called Cameroon Volcanic Line (CVL) ecoregion. Second highest mountain of West and Central Africa, it is well known for its exceptional species diversity for animal and plants. Situated in an area with a high human population density, causing a serious damage on natural habitats, the montane forest of Oku is a priority in terms of conservation at a local and continental scale. We present here our updated data on Mount Oku rodents' diversity, systematics and conservation after 12 years of studies, based on integrative methodological approaches. At least 24 rodents' species can be reported to the montane forest of Oku, of which three are endemic at the level of the whole geographic region of Bamenda-Banso Highlands within the CVL, and three others strictly endemic to Mount Oku. Our systematic works, based on the combination of morphological and molecular data, allowed us to validate the taxonomic status of many species previously known from a few number of specimens. These data have also helped to evidence the effect of both volcano-tectonic activities and climatic fluctuations from Late Pliocene to Pleistocene ages, and to propose different diversification scenarios, to explain the original species diversity of rodents in Mount Oku. Finally, our assessment on the effect of trapping activities on rodents' communities of the montane forest of Oku highlighted the high pressure of local trapping on populations of two rodent species with a high conservation importance, considering the International Union for Conservation of Nature's classification. All these data point out the importance of Mount Oku in the knowledge of the afro-tropical rodent's diversity and highlight the need to preserve this very rich and unique montane forest patch for both West and Central Africa.

8 Challenged by ecological pressure and shrouded in unresolved taxonomy: status of endemic and endangered *Otomys barbouri* on Mt Elgon Alpine Zone

Bernard Risky Agwanda¹

¹Mammalogy Section, Zoology Department, National Museums of Kenya, Kenya; benrisky@gmail.com

Typically authorities place conservation priority on species identified as threatened of extinction. In such process a species specific Conservation action plan is developed based on, first taxonomic knowledge and second ecological. Despite occurring in on the Alpine zone of Mt Elgon protected by Uganda forest Authority and Kenya wildlife and Forest Services, the status of endangered and endemic Vlei's rat, *Otomys barbouri* is far from conservation and scientific knowledge safety. The species in this genus *Otomys* has been subject of protracted scientific debate and revisions for nearly a century. Because *O. barbouri* sympatrically occurs with at least two other conspecifics, the unclear external diagnostic features and confounded taxonomy is likely to be masking underlying ecological threats. Here we review recent data on vegetation, rainfall, temperature, elevation shift, other rodent species to explore ecological challenges facing *O. barbouri*. We have also interrogated some of the historical taxonomic debates surrounding this species to advance practical routes towards addressing knowledge gaps that would aide conservation efforts.

9 Introducing ecologically based rodent management to smallholder farmers in Gauteng Province, South Africa.

Emil F. von Maltitz¹, Phanel S. Malebana¹, Frikkie Kirsten¹

¹Agricultural Research Council - Plant Protection Research Institute, Pretoria South Africa, VMaltitzE@arc.agric.za

An ecologically based approach for rodent pest management is increasingly viewed as more sustainable and cost-beneficial. However, such an approach requires a good understanding of the rodent species, their behaviour, breeding potential, and habitat utilisation in a given area. Unfortunately, these factors are often poorly understood for pest rodent species in smallholder and peri-urban farming communities in South Africa.

In 2011 a study was initiated in the Gauteng Province with the main objectives to gather baseline knowledge necessary for ecologically-based rodent pest management, and to conduct on-farm rodent control demonstration trials, in rural/peri-urban mixed farming systems. Results from a knowledge, attitude, and perception survey indicate that respondents question the efficacy of rodenticides and traps; they believe acute poisons are more effective, and the majority felt that rodents are too clever to be trapped, or to feed on rodenticides. Farmers from three municipal districts volunteered to participate in rodent data collecting, and in on-farm demonstrations of rodent control trials. Rodent trapping started in September 2011

and continued at 6-weekly intervals over one year. Results indicate that the rodent numbers decreased during November to February, followed by an increase during March and April. In all study areas, *Rattus rattus* was the dominant species in feed stores, chicken houses and pigsties, and *Mastomys coucha* was dominant in vegetable gardens and garden edges. A significant overlap in habitat utilisation between all the species was found in all localities, but species diversity differed considerably between the three localities. The breeding cycles of the two dominant species *R. rattus* and *M. coucha* differ: the former shows no distinct breeding peak, while the latter peaks in September/October and in late to end summer, March/April.

10 PLENARY: Life and strife in a (semi) desert: the success of *Rhabdomys pumilio*

Neville Pillay

School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, South Africa. Neville.Pillay@wits.ac.za

Deserts are demanding environments for non-desert specialists, particularly during drought conditions. Droughts are expected to become common and unpredictable. The resilience of a species to such challenges depends on the ability of constituent individuals to respond adaptively. Evolutionary (genetic) change is too slow to provide solutions. Instead, adaptive phenotypic plasticity, involving alteration of some aspect of the phenotype in response to prevailing environmental conditions, can increase an individual's fitness. We study the four-striped mouse *Rhabdomys pumilio* in the semi-desert Succulent Karoo, which experiences pronounced and unpredictable weather variation seasonally and annually. *R. pumilio* is diurnal and facultatively grouping living. We have been studying this non-desert specialist continuously for approximately 18 years, each year representing a new generation. Each generation is likely to experience different environmental conditions, either favourable (short dry season with sufficient food) or unfavourable (long, hot dry season, food shortage, heat stress). High ambient temperature and food availability are associated with high survival but severe unfavourable conditions lead to die-off. The species shows behavioural and physiological flexibility in a number of traits to cope with change. For example, thyroid hormone levels, resting metabolic rate, daily energy expenditure and activity all decrease in the dry season than in the wet season. Nonetheless, the health (assessed from blood chemistry) of individual mice before the dry season was a key determinant of their survival, regardless of physiological responses. Interestingly, cognition was not associated with variation in natural food availability, supporting the cognitive resilience hypothesis. Behaviourally, the extended family groups of *R. pumilio* defend a territory and obtain benefits of social huddling and basking. Reproductive competition is a large cost, however, so a declining population size encourages solitary living and breeding, even when physiological costs of living alone are high. Switching social tactics (group vs solitary living) are accompanied by variations in endocrine and neuropeptide hormones, which are triggered by environmental conditions and not predicted by inherent qualities of individuals. We maintain that phenotypic flexibility is a toolkit for survival under challenging environments, enabling *R. pumilio* to out-live other co-existing small rodents in the Succulent Karoo. The evolution of flexible traits depends, possibly, on selection for exaptations, repeated exposure to unpredictable conditions, and requires the necessary energy-demanding machinery to facilitate phenotypic changes. However, there is no bottomless pit of traits that can be altered flexibly when the need arises. For example, we did not find any morphological flexibility in *R. pumilio*.

11 Influence of environmental factors on the circadian activity of ice rats

Maria K Oosthuizen

Department of Zoology and Entomology, University of Pretoria, South Africa, moosthuizen@zoology.up.ac.za

Ice rats are rodents that occur at high altitudes in Southern Africa. They have been described as diurnal in the field, however laboratory studies under controlled conditions have not been performed on these animals. In this study, ice rats were subjected to a series of different light and temperature schedules to firstly characterise their activity rhythms and secondly to assess how a variety of environmental factors would influence the circadian activity of the rats. In the laboratory, ice rats displayed locomotor activity during both the day and night. When a temperature cycle was added, the animals were more active during the day. When the temperature cycle was inverted to have cooler temperatures during the day, a large spike in day-time activity was observed. However, they ran on their wheels almost exclusively during the dark phase of all light and temperature cycles. When the completely dark phase of the light cycle was shortened by the addition of a dawn-dusk simulation, the wheel running activity was also truncated. The nocturnal wheel activity may indicate that the animals in the field are more active during the night than previously thought, they may be active in their tunnels rather than above ground. Locomotor activity of the ice rat appears to be highly dependent on ambient temperature. This behavioural plasticity may be the key to survival in their challenging environment.

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

Peter John Taylor¹, Aluwani Nengovhela^{1,2}, Graham Scott³, José Braga², Christiane Denys⁴

¹SARCHI Chair on Biodiversity Value & Change & Core Team member of C-I-B, University of Venda, South Africa, peter.taylor@univen.ac.za

²Paul Sabatier University of Toulouse, France

³Department of Biology, Centre for Climate Change, McMaster University, Hamilton, Ontario, Canada

⁴Muséum National d'Histoire Naturelle, Institut de Systématique et Evolution de la Biodiversité, Paris, France

In order to better understand functional morphological and sensory adaptations to high elevation life in both North American and African montane-associated rodents, we used a 3D morphometric approach to acquire 3D images of the

nasal capsules and endocranial (brain) volumes of 51 crania of low-elevation and high-elevation populations of North American deer-mice (*Peromyscus*) as well as low-medium elevation (*Praomys hartwigi* and *Stenocephalemys albipes*) and high elevation (*S. albicaudatus*, *S. griseicaudata*) species of African rodents of the Tribe Praomyini (Murinae). Micro-Computed Tomography (CT) scanning at 23 μm resolution was conducted to build 3D composite images and further analysis was done with AVISO, ENDEX and MatLab software. Results presented concentrate on deer-mice, with samples of African murines still awaiting analysis of brain vase volumes. We expected that high elevation populations and species would have enhanced respiratory versus olfactory turbinal surfaces to counter hypoxia. We expected brain volume to scale with skull size to the mammalian constant allometric slope of 0.75, and to be greater in high elevation populations in deer-mice to compensate for brain-swelling associated with altitude sickness at high elevations. Our results showed that respiratory surfaces were greater than olfactory in high-elevation deer mice only in the rostral part of the nasal capsule, the reverse was true for the caudal section; future work needs to model airflow in the nasal passages of different populations. On the other hand, nasal capsules of both low-medium and high elevation African murines showed significantly greater domination by olfactory compared to respiratory surfaces compared to both low and high-elevation populations of deer-mice, probably reflecting phylogenetic constraints. Brain volume and skull length were not significantly different between highland and lowland *Peromyscus* populations (African murines remain to be analysed) but the allometric slope of brain volume with skull length in highlanders was half that of lowlanders (slope =0.37 cf 0.70). The former is close to intraspecific values obtained for myomorph rodents while the latter is close to the hypothesized power constant for all mammals proposed for all taxonomical levels. Future work to distinguish genetic versus environmental effects will work on progeny of deer mice from different elevations raised in “common garden” experiments.

13 Associated tympanic bullar and cochlear hypertrophy define adaptations to true deserts in African gerbils and laminate-toothed rats (Muridae: Gerbillinae and Murinae)

Aluwani Nengovhela^{1,2} Jose Braga^{1,3} Christiane Denys⁴ Frikkie de Beer⁵ Christophe Tenailleau⁶ and Peter J. Taylor^{2,7,8}

¹Laboratoire d'Anthropologie Moleculaire et Imagerie de Synthèse, UMR 5288 CNRS, Université de Toulouse (Paul Sabatier), Toulouse, France, alu.nengos@gmail.com

²South African Research Chair in Biodiversity and Change and Centre for Invasion Biology, School of Mathematical and Natural Sciences, University of Venda, Thohoyandou, South Africa

³Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg, South Africa

⁴Institut de Systématique, Evolution, Biodiversité, UMR 7205, CNRS, MNHN, UPMC, EPHE, Sorbonne Universités, Paris, France

⁵South African Nuclear Energy Corporation, Pelindaba, North West Province, South Africa

⁶Centre Inter-Universitaire de Recherche et d'Ingénierie des Matériaux, UMR 5085 CNRS, Université de Toulouse (Paul Sabatier), Toulouse, France

⁷Core Team Member of the Centre of Invasion Biology, Stellenbosch University, Stellenbosch, South Africa

⁸School of Life Sciences, University of KwaZulu-Natal, Durban, South Africa

Hearing capabilities in desert rodents such as gerbils and heteromyids have been inferred from both anatomical and ecological aspects and tested with experiments and theoretical models. However, very few studies have focused on other desert-adapted species. In this study, a refined three-dimensional morphometric approach was used on three African rodent tribes (Otomyini, Taterillini and Gerbillini) to describe the cochlear and tympanic bullar morphology, and to explore the role of phylogeny, allometry and ecology to better understand the underlying mechanism of any observed trends of hypertrophy in the bulla and associated changes in the cochlea. As a result, desert-adapted species could be distinguished from mesic and semi-arid taxa by the gross cochlear dimensions, particularly the oval window, which is larger in desert species. Bullar and cochlear modifications between species could be explained by environment (bulla and oval window), phylogeny (cochlear curvature gradient) and/or allometry (cochlear relative length, oval window and bulla) with some exceptions. Based on their ear anatomy, we predict that *Desmodillus auricularis* and *Parotomys brantsii* should be sensitive to low frequency sounds, with *D. auricularis* sensitive to high-frequency sounds, too. This study concludes that in both arid and semi-arid adapted laminate-toothed rats and gerbils there is bulla and associated cochlea hypertrophy, particularly in true desert species. Gerbils also show tightly coiled cochlea but the significance of this is debatable and may have nothing to do with adaptations to any specific acoustics in the desert environment.

14 PLENARY: Predation in rodent pest control: Underutilized ecosystem service or unrealistic expectation?

Lourens H Swanepoel¹, Corrie M Swanepoel², Mark Keith³, Steve Belmain⁴, Reimund R Roetter⁵, Munir P Hoffmann⁵, Peter J Taylor⁶ & Sam Williams¹

¹Department of Zoology, University of Venda, Thohoyandou, South Africa, lourens.swanepoel@univen.ac.za

²Institute for Soil, Climate and Water, Agricultural Research Council, Pretoria, South Africa

³Eugène Marais Chair of Wildlife Management, Mammal Research Institute, University of Pretoria, Pretoria, South Africa

⁴National Resources Institute, University of Greenwich, Medway Campus, Central Avenue, Chatham Maritime, Kent, UK

⁵Department of Crop Sciences, Tropical Plant Production and Agricultural Systems Modelling Georg-August-Universität Göttingen, Göttingen, Germany

⁶South African Research Chair on Biodiversity Value & Change & Core Team Member of the Centre for Invasion Biology, School of Mathematical & Natural Sciences, University of Venda, Thohoyandou, South Africa

Rodents remain a key pest of grain crops globally. However, the use of chemical control to manage rodent populations is problematic due to increased rodenticide resistance in rodents and negative environmental effects. This has sparked interest in ecologically based rodent control (EBRM). Predation is a key component of EBRM that is often neglected. In this presentation I will aim to address the issues surrounding biological control of rodent pests. This will include the underutilized potential of mammalian and avian predation, as well as the constraints involved in predation as a control

method in rodent pests. Using crop simulation models (APSIM) to estimate the effect of varying plant densities (which act as a proxy for varying rodent densities) on crop yields, I show that grain damage is impacted by rainfall, planting density and rodent seed predation. The greatest impact of rodent seed damage (2-40% yield decline) occurred under high rainfall and densities of 10-30 rodents/ha. However, under low rainfall, crop damage was less prevalent since available soil water seems to drive crop yields. This suggests that reducing or maintaining rodent densities around 10-30/ha should limit crop damages. Then, based on literature, I will present mammalian and avian predator diets to highlight the importance of rodents in their diet. Here, for example mammalian carnivores often detected on crop lands can incorporate up to 80% of rodents in their diet. Avian predator diets include up to 95% of rodents and combined with mammalian predators they can remove a substantial number of rodents per season. I then will present some results from field studies where we investigated mammalian and avian predators in cropping landscapes. Using camera trapping we consistently find that cropping areas often yielded high diversity of mammalian carnivores of which several species are rodent specialists. From drive transects we also show that cropping landscapes have large avian predator communities. Combined these results show that there is an untapped potential of predation on rodent pests. Finally, I will discuss some shortcomings and key challenges related to predation in rodent pest control. These include human wildlife conflict, asynchrony of predation and crop damage, challenges in treatment control studies and unrealistic expectations of zero rodent damage. I will finish with some of our current studies to address some of these issues.

15 Domestic cats and dogs create a landscape of fear for pest rodents around rural homesteads

Themb'allahlwa A. M. Mahlaba^{1*}, Ara Monadjem^{1,2}, Robert McCleery³, Steven R. Belmain⁴

¹*Department of Biological Sciences, University of Eswatini, Kwaluseni, Eswatini*, tammahlaba@gmail.com

²*Mammal Research Institute, Department of Zoology & Entomology, University of Pretoria, Pretoria, South Africa,*

³*Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, United States of America,*

⁴*Natural Resources Institute, University of Greenwich, Chatham Maritime, Kent, United Kingdom*

Using domestic predators such as cats to control rodent pest problems around farms and homesteads is common across the world. However, practical scientific evidence on the impact of such biological control in agricultural settings is often lacking. We tested whether the presence of domestic cats and/or dogs in rural homesteads would affect the foraging behaviour of pest rodents. We estimated giving up densities (GUDs) from established feeding patches and estimated relative rodent activity using tracking tiles at 40 homesteads across four agricultural communities. We found that the presence of cats and dogs at the same homestead significantly reduced activity and increased GUDs (i.e. increased perception of foraging cost) of pest rodent species. However, if only cats or dogs alone were present at the homestead there was no observed difference in rodent foraging activity in comparison to homesteads with no cats or dogs. Our results suggest that pest rodent activity can be discouraged through the presence of domestic predators. When different types of predator are present together they likely create a heightened landscape of fear for foraging rodents.

16 Ecological Based Rodent Management for Sustainable Agriculture and Food Security in Africa (EcoRodMan), Namibia

Laina Abiatar¹, Seth J. Eiseb¹, Steven R. Belmain²

¹*Department of Biological Sciences, University of Namibia, Windhoek, Namibia*, i.abiatar20@gmail.com

²*Natural Resources Institute, University of Greenwich, Kent, UK*

Rodent pests are one of the key factors affecting small holder farmer production. In many parts of Africa large population outbreaks of rodents occur and leads to crop loss. Rodent management in agriculture remains a major challenge in developing countries where resource-poor farmers are ill equipped to deal with pest species. Ecologically based rodent management (EBRM) is recommended as the way forward for rodent management in Africa. EBRM relies on understanding the ecology of pest species and formulating this knowledge into management programs. The overall objective of the project is to improve scientific and technological research on rodent ecology and management in order to enhance food, nutrition and financial security through the development of sustainable agricultural practices that can limit the impact of rodent pests on African livelihoods, reducing hunger and improving well-being. This will be done by developing fertility control instead of mortality control, using contraceptive hormones quinestrol and levonorgestrel on the breeding biology of rodent pest species. Field comparison trials of fertility control vs mortality control on the population dynamics of rodent pest species and subsequent impact on crop damage will be carried out. Secondly by optimising ecosystem services and biological control of rodents through predation by determining whether and to what extent biological control with predators, can reduce numbers and damage levels in small farming systems. Thirdly, innovating technology to sustainably protect post-harvest damage and contamination of food value chains by developing cost-effective and socially acceptable adaptations that make traditional granaries more capable of preventing rodent access. Expected results are ecological intensification approaches which optimise the use of ecosystem services to reduce the impact of rodents on food production in cost-beneficial ways. These actions will help reduce the use of poisons that are dangerous to humans, other animals and the environment.

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

Ester N. Kayala¹, Seth J. Eiseb¹, Loth S. Mulungu² & Steven R. Belmain³

¹*University of Namibia, Windhoek, Namibia*, esterkayala@yahoo.com

²*Sokoine University of Agriculture, Morogoro, Tanzania*

³*Natural Resources Institute, University of Greenwich, Kent, UK*

Small mammals play an important role in nature as reservoir hosts for many pathogens, including some that can be transmitted to other animals including humans. Infections with zoonotic haemoparasites are widespread in wild rodents. They include borrelia, trypanosomes, bacilli, plasmodia and coccobacilli. In humans, these pathogens are responsible for many rodent-borne diseases including plague, leptospirosis, toxoplasmosis, leishmaniasis and haemorrhagic fevers, with leptospirosis and plague believed to be widespread in East and Southern Africa. Extrinsic factors such as temperature, humidity and rainfall, as well as intrinsic factors such as gender and age of small mammals affect the prevalence and the abundance of haemoparasites. This study is going to be carried out in Bagani and Popa village in the Kavango East region of Namibia. This region receives annual average rainfall of 565 mm making it quite humid compared to other regions of the country. Data loggers will be deployed at the trapping sites for temperature and relative humidity reading, whilst rainfall data will be obtained from the Bagani weather station. Live trapping of small mammals will be conducted from November 2018 to November 2019. Trapping of small mammals will be carried out at uncultivated land surrounding rural houses, as well as at peridomestic land. This will allow data to be collected during all four seasons. Blood smears will be collected from small mammal spleen, liver, kidney and heart and screened for haemoparasites. In addition, polymerase chain reaction (PCR) will be performed on similar tissues for better identification of haemoparasites. The prevalence of haemoparasites can be compared between species, sex, seasons and habitat using the General Linear Model of the program SPSS and a Kolmogorov-Smirnov test will be used to test the data for normality. However, to determine the diversity of haemoparasites infecting different host species, the Simpson index will be used.

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