

OPPENHEIMER GENERATIONS



RESEARCH AND CONSERVATION

11th OPPENHEIMER RESEARCH CONFERENCE

5-7 October 2022



Changing the conversation around conservation

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5-7 October 2022

Randjesfontein Cricket Pavilion,
Midrand



Introduction

The Oppenheimer Research Conference (ORC) showcases cutting edge scientific research and provides a platform for engagement and dialogue. By so doing it contributes African voices to the global conversations on environment and sustainability.

The conference engages researchers in an interdisciplinary and multisectoral manner, and across scale, from the microscopic to the landscape level.

It represents an opportunity to celebrate and explore diverse ways of knowing about Africa's needs, challenges and contributions, and to discuss and reflect on how this knowledge is created and used.

The ORC embraces a community of knowledge builders which includes Oppenheimer-funded researchers and partners, African and global researchers, NGOs, policymakers, land-use decision makers, business, the media and the broader public.

Through this showcase of excellence, ORC offers opportunities to learn and to build new networks to galvanise action based on solid research and asking the right questions.

Research can map out solutions to head off environmental and conservation tipping points, especially in four key areas:

Biodiversity loss – How can we mitigate biodiversity loss in Africa?

Landscape ecology - How do we prioritise ecosystem interventions in Africa? What gets used, protected and rehabilitated?

Climate change – How will climate change affect Africa, on land and along its coastline? What should be done to mitigate or adapt to the massive upheavals already well underway?

Wildlife economies - How do we grow inclusive economies that enable both the use and preservation of ecosystems for future generations?

Global narratives on how to deal with climate change, for example, tend to be led by the global north deriving arguments and recommendations based on research from predominantly Europe, America and Australia. The ORC provides a platform to showcase African research, and to amplify the voices of African scientists to ensure that sustainable solutions are forged, not only for Africa, but for the world.

Day 1: Wednesday, 5 October 2022

Session 1: Chair | Duncan MacFadyen

08:00 – 09:00	Registration/ Networking/ Refreshments
09:00 – 09:05	Welcome
09:05 – 09:15	Introduction by Nicky Oppenheimer
09:15 – 09:25	Keynote address by Minister Barbara Creecy
09:25 – 09:55	What does it mean for an economy to embrace the power of nature? PLENARY by Mavuso Msimang
09:55 – 10:25	The Future of Exploration in the greatest age of exploration Full presentation Lee Berger

10:25 – 10:55 Morning tea

Session 2: Chair | Rendani Nenguda

10:55 – 11:25	Nature's unprecedented decline and pathways to just and sustainable futures Full presentation Luthando Dziba
11:25 – 11:40	Mineral Licks in Conservation: Predation, Hostility and Nutrition Results Presentation Andrew Abraham
11:40 – 11:55	Ecosystem-based approaches to address climate challenges at the agriculture-wildlife interface: experiences from Zimbabwe Results Presentation Olga Kupika
11:55 – 12:10	Mapping woody invasive alien plant species and their impacts in strategic water source areas using freely available satellite imagery and cloud computing Results Presentation Alanna Rebelo
12:10 – 12:25	Lessons from trade in rhino products over three millennia: a systems approach Results Presentation Robert Millar
12:25 – 12:55	The Wildlife Economy in Africa and unlocking its potential Full presentation Sue Snyman

12:55 – 13:10	A savannah protected area and its water sources best conserve bird diversity compared with the surrounding anthropogenically modified mosaic landscape Results Presentation Rion Lerm
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13:10 – 14:00	Lunch
Session 3: Chair Andre Tranquilini	
14:00 – 14:30	Rivers in crisis in South Africa Full presentation Stephen Woodborne
14:30 – 14:45	Mapping the Wildlife Economy Results Presentation Alex Chidakel
14:45 – 15:00	Pilot Project : Bulls infected with <i>Trichomonas foetus</i> Results Presentation Danny Pillay
15:00 – 15:15	Importance of freshwater eels on inland fisheries and livelihood in South Africa Results Presentation Mxolisi Nkomo
15:15 – 15:30	From Enabling Change to Scaling Change: Lessons for Integrating Conservation and Sustainable Livelihoods, 2017-2022 Results Presentation Harriet Croome
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15:30 – 16:00	Afternoon tea
Session 4: Chair Laura Pereira	
16:00 – 17:00	Panel discussion: Post-growth or green-growth – alternative development pathways for Africa Panel Members: Jonathan Oppenheimer Awande Buthelezi Neva Makgetla Vasna Ramasar
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17:00 – 17:30	Break Painted wolf wines – wine tasting
17:30 – 18:00	Movie introduction: Dereck and Beverly Joubert
18:00 – 19:00	Movie Screening: Okavango river of dreams
19:30	Venue close

Day 2: Thursday, 6 October 2022

Session 1: Chair | Peter Makumbe

08:00 – 08:30	Registration/Networking/Refreshments
08:30 – 09:00	Social evolution and population dynamics in mammals PLENARY by Tim Clutton Brock
40 mins	SPEED PRESENTATION SESSION
09:00 – 09:05	The loss of vegetation cover has distinct but short-term impact on multiple vertebrate taxa in a grassland ecosystem Speed presentation Aisha Rifai
09:05 – 09:10	Quantifying glucocorticoids and their metabolites in quills, spines and faecal material from Cape porcupine (<i>Hystrix africaeaustralis</i>) and Southern African hedgehog (<i>Atelerix frontalis</i>) for monitoring responses to stressors Speed presentation Zamekile Bhembe
09:10 – 09:15	Determining potential natural and anthropogenic drivers of adrenocortical activity in African clawless otters (<i>Aonyx capensis</i>) by evaluating faecal glucocorticoid metabolite concentrations Speed presentation Harvey Seete
09:15 – 09:20	Determining potential natural and anthropogenic drivers of adrenocortical activity in African clawless otters (<i>Aonyx capensis</i>) by evaluating faecal glucocorticoid metabolite concentrations Speed presentation Marli Burger
09:20 – 09:25	Spectral detection of weed infestation in maize farms using Sentinel-2 data Speed presentation Yoliswa Mkhize
09:25 – 09:30	The effect of landscape structure and native vegetation on the insect biodiversity of urban green spaces Speed presentation Johann de Beer
09:30 – 09:35	Arthropod response to monoculture timber plantation: a systematic review Speed presentation Thembekile Mthimunye
09:35 – 09:40	Speed presentation group Q&A session

Poster session

09:40 – 11:00	Morning tea and POSTER SESSION in Poster Gallery
10:10 – 10:25	Parallel: Optional VR Screening in Auditorium (100 people max) by Ulrico Grech-Gumbo , Habitat XR
10:40 – 10:55	Parallel: Optional VR Screening in Auditorium (100 people max) by Ulrico Grech-Gumbo , Habitat XR

Session 2: Chair | Dylan Smith

11:00- 11:15	The ecology of snakebite in southern Africa: lessons from trapping studies Results Presentation Bryan Maritz
11:15 – 11:30	Effects of carcass decomposition on spatio-temporal vegetation dynamics in Bankenveld grasslands of South Africa Results Presentation Cate Nkalitshana
11:30 – 12:00	Persistence of wildlife in mosaic urban landscapes- a KwaZulu-Natal perspective Full presentation Colleen Downs
12:00 – 12:15	Rainfall seasonality as a driver of Miombo floristics Results Presentation Mthokozisi Moyo
12:15 – 12:30	River connectivity and fish migration considerations in the management of multiple stressors in South Africa Results Presentation Gordon O'Brien
12:30 – 12:45	Repellents from natural chemical signals to reduce human-carnivore conflict Result Presentation Peter Apps

12:45 – 13:45 Lunch

Session 3: Chair | Prince Ngomane

13:45 – 14:15	Inclusive wildlife economy and CBNRM Full presentation Brian Child
14:15- 14:30	The Achilles Heel of Conservation Results Presentation Merlyn Nkomo

14:30 – 14:45	Microplastics profile in the Vaal River, South Africa Results presentation Dalia Saad
14:45 – 15:00	The olfactory landscape concept: a key source of past, present and future information driving animal behaviour, movement, and decision-making Results presentation Adrian Shrader
15:00 – 15:15	Six years and counting of ant biodiversity research in KwaZulu-Natal: an update Results Presentation Caswell Munyai
15:15 – 15:30	Will Kalahari pangolins cope with a warming world? Results Presentation Wendy Panaino

15:30 – 16:00 Afternoon tea

Session 4: Chair | Polly Carr

16:00 – 17:00	Panel discussion: Conservation: Who owns the conversation? Panel Members: Nolwazi Mbongwa Peter Fernhead Bongani Bingwa George Wamukoya
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17:00 – 17:15	Optional VR Screening in Auditorium (100) people max) by Ulrico Grech-Gumbo , Habitat XR
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17:30 – 18:45	NEW JWO RESEARCH GRANT RECIPIENT AWARD PRESENTATION Jonathan Oppenheimer
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19:00	Cocktail function
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Day 3: Friday, 7 October 2022

Session 1: Chair | Ashleigh Fynn-Munda

08:00 – 08:30	Registration/Networking /Refreshments
08:30 – 09:00	Changing the conversation around conservation PLENARY by Irene Amoke
09:00 – 09:30	Holistic evaluation of elephant management interventions in South Africa Full presentation Rob Slotow
09:30 – 09:45	Climate change and regional tipping points in southern Africa Results Presentation Francois Engelbrecht
09:45 – 10:00	Three Cases of Wildlife Economy Value Chains Results Presentation Reinhard Nyandire

10:00 – 10:30 JWO RESEARCH GRANT Snapshot – 3 years of groundbreaking research

Mobilising Africa's biodiversity experts to put nature on the decision-making map
Hayley Clements

Artificial light as a vector control strategy
Bernard Coetzee

Ecological impact of COVID-19 pandemic: Release of chemical contaminants from facemasks and effects on soil microbial and macrofauna species
Gideon Idowu

10:30 – 11:00 Morning tea

Session 2: Chair | Ranga Huruba

11:00 – 11:15	Interactions between livestock, wildlife, and fire: Lessons from the Kenya Long-term Exclosure Experiment Results Presentation Duncan Kimuyu
11:15 – 11:45	The Protected Area Paradox and the Refugee Species Concept Full presentation Graham Kerley
11:45 – 12:00	Vultures nesting on the Highveld in Zimbabwe Results Presentation Josephine Mundava

12:00 – 12:15	Cooperative building behaviour of the white-browed sparrow weaver (<i>Plocepasser mahali</i>) Results Presentation Maria Tello Ramos
12:15 – 12:45	The Jersey Cow Full presentation Andre Tranquilini
12:45 – 13:00	The nature of the Kalahari Butterfly Migration in some numbers Results Presentation Reinier Terblanche
13:00 – 13:15	Can Private Conservation be Profitable? Maximising net economic returns from conservation at Tswalu Kalahari Results Presentation Arnold Meyer
13:15 – 13:30	Genetic management of African biodiversity Results Presentation Yoshan Moodley
13:30 – 14:00	CONFERENCE AWARDS Nicky Oppenheimer AND CLOSE Duncan MacFadyen
14:00 – 15:00	Lunch
15:00 – 18:00	Weeva's Sustainability Hackathon
15:00 – 15:05	Welcome Overview and problem ideation
15:05 – 15:50	Problem Identification Pulse check
15:50 – 16:50	Ideation of solution Pulse check
16:50 – 17:10	Crafting solution pitches
17:10 – 17:40	Groups present their ideas (one from each group)
17:40 – 17:50	Judges closing statements
17:50 – 18:00	Prize giving

Poster session

Abraham Dabengwa , Sally Archibald, Marion Bamford and Caroline Lehmann	Fine-scale analysis of micro-charcoal particles from modern soils reveal difference in African savanna fire regimes: implications for ecosystem management	1
Adrian John Brink , Ruan Marais, Diane Hardie, Ephifania Geza	Leveraging host genomics to diagnose neurological COVID-19	2
Albert Myburgh , Hannes Botha, Xander Combrink, Jan Myburgh	Terrestrial diet dependance in an unprotected crocodile population	3
Amanda Laura Adlam , Christian Chimimba, Hugo Retief, Stephan Woodborne	In hot water: The fate of southern African freshwater fauna under climate change scenarios	4
Amaurée Jansen van Vuuren , Jan Venter and Herve Fritz	Five small antelope species diets indicate different levels of anthrodependence in the Overberg Renosterveld, South Africa	5
Amukelani Maluleke , Gregor Feig, Christian Brümmer and Guy Midgley	A paired tower approach to compare carbon dioxide and water vapour fluxes between two vegetation types representing Savanna and Nama-Karoo Biomes at the Benfontein Nature Reserve	6
Angelica Kaiser , Stephan Woodborne, Annelize Van der Merwe, Gordon O'Brien	Multiple lines of evidence to evaluate the fish communities in the Limpopo River Basin, southern Africa	7
Anthony Francis Craig , Livio Heath, Jan Ernst Crafford and Robert Swanepoel	Interrelationships of warthogs, Ornithodoros ticks and African swine fever virus in South Africa	8
Antony Emenyu	Accelerating uptake of regenerative agriculture by smallholder farmers in African Landscapes	9
Arlin Viljoen , Bernard Coetzee, Lizette Koekemoer, Megan Riddin and Ashley Burke	The impact of artificial light spectra and intensity on the feeding behaviour of <i>Anopheles gambiae</i>	10
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Bruce Crossey , Andre Ganswindt and Elizabeth Pienaar	Safari-wildlife tourism in Southern Africa: Understanding the effects on observers and the observed	14
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Abstracts and Biographies

Day 1: Wednesday, 5 October 2022

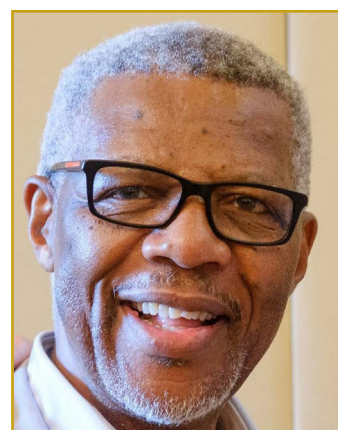
Plenary: Mavuso Msimang

Born in 1941, Msimang left the country for military training in 1963 and rose to the highest ranks of Umkhonto we Sizwe, the military wing of the African National Congress and later served as personal assistant to the ANC President Oliver Tambo.

Msimang obtained his BSc degree as well as an MBA during his time in exile and went on to work for various international development organizations, including the United Nations Agencies UNICEF and the World Food Programme.

On returning to South Africa in 1993, Msimang held several senior positions in public sector organizations, including South African Tourism, South African National Parks and the State IT Agency (SITA) in which he successively served as CEO. He retired from the civil service in 2010 following a three-year stint as Director-General at the Department of Home Affairs.

Msimang is the immediate-past Chairman of Corruption Watch, serves on various civic society, environmental management, and private sector boards. He is an outspoken critic of corruption and maladministration.



Session 1

What does it mean for an economy to embrace the power of nature?

Mavuso Msimang

Private consultant, mavuso.msimang@gmail.com

What does it mean for an economy to embrace the power of nature? I have seen first-hand that more protected areas are not only good for the planet, but also for business. This presentation seeks to demonstrate that, if Africa chooses to unlock the power of nature by embracing wildlife economies, it will create unparalleled business value for the continent. There is evidence of the economic value of nature already being generated by self-sustaining biodiversity initiatives in Africa. Unfortunately, climate change is having unprecedented impact on the continent. Funding mechanisms currently in place need to be revised to hold countries who are the largest emitters accountable for their contribution to global GHG

emissions. These countries should be funding biodiversity gap in partnership with African governments, to mainstream environmental protection within their budget and financial planning. It remains important to balance social equity and rural job creation, ensuring a strong focus on meaningful inclusion of Indigenous Peoples and Local Communities (IPLCs) rights and ownership to intellectual property, land and economic opportunities. In light of this, safeguarding conservation measures will help develop and protect the future of Africa for future generations.

The Future of Exploration in the greatest age of exploration

Lee. R. Berger

University of the Witwatersrand, lrbprivate@gmail.com

Understanding where we come from as a species has been one of the great goals of humankind, exploring the questions of where we come from and why we are here as a species. In this lecture, Professor Lee Berger will explore some of the greatest discoveries of the last two decades in the search for human origins, discoveries he has been instrumental in and intimately involved with. These discoveries have led us to re-evaluate the story of human origins on the continent of Africa. With lessons from what has been described as one of the most challenging sciences on earth, Berger will explore why he believes we are in the midst of the greatest age of exploration and relate the importance of lessons he has learned during his search for understanding human origins that he believes are applicable to all areas of scientific endeavour and to our daily lives.

Session 2

Nature's unprecedented decline and pathways to just and sustainable futures

Luthando Dziba

South African National Parks (SANParks), Luthando.Dziba@sanparks.org

The unprecedented decline in nature has been extensively documented, culminating in a comprehensive Global Assessment Report published by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) in 2019. The report shows that humans are largely responsible for the unprecedented loss of nature through a) changes in land & sea use; b) direct exploitation of organisms; c) climate change; d) pollution and e) invasive alien species. Other reports that have followed since such as the Global Biodiversity Outlook 5 and the WWF Living Planet Report also confirming similar trends. Climate change is projected to compound biodiversity loss and drive accelerated rates of extinction. This report shows that 50,000 wild species meet the needs of billions of people worldwide, 20% of the human population is directly dependent on wild species for income and food, more than 10,000 wild species are harvested for human food and 2.4 billion people (a third) depend on fuel wood for cooking. In light of these findings, I will reflect on implications for policy makers who will be negotiating the approval of the Post2020 Global Biodiversity Framework in December 2022. Is this new deal to secure a new deal between people and nature realistic or even possible considering the unprecedented decline in biodiversity at rates unseen before in human history, further compounded by dire climate change projections? Are there pathways to just and sustainable futures where people live in harmony with nature and what do they demand of us to do today?

Mineral Licks in Conservation: Predation, Hostility and Nutrition

Andrew Abraham¹ and Andrea Webster²

¹Northern Arizona University, Andrew.Abraham@nau.edu

²University of Pretoria

Wildlife reserves often supply anthropogenic salt and mineral licks to offset wildlife nutritional deficits. But how much is the right amount to provide? Too little may result in malnourished individuals raising questions of animal husbandry, while too much may inflate populations beyond the ecosystem carrying capacity. In addition, the artificial creation of nutrient hotspots may alter the interactions and coexistence of species. Here, I explore the impact of anthropogenic salt and mineral licks for altering the dynamics of large mammals 10-2500kg at Tswalu Kalahari Reserve. Tswalu has two sections, each with a different predator guild. This presents a unique opportunity to examine how predators influence wildlife dynamics at lick sites. Where lions are present, herbivores are restricted to using licks during the day, increasing temporal overlap between prey species. Smaller herbivores are generally submissive to larger species at lick sites, resulting in clear body size dominance hierarchies. This influences species use of licks and resulting intake of key nutrients (Na, P, Zn). Together, the manifold impacts of anthropogenic licks may impede attainment of conservation goals.

Ecosystem-based approaches to address climate challenges at the agriculture-wildlife interface: experiences from Zimbabwe

Olga Laiza Kupika

Chinhoyi University of Technology, okupika@cut.ac.zw

Tropical savannah ecosystems provide a wide range of goods and services on which communities rely on for their livelihoods. Climate change, in addition to other multiple stressors poses a threat to the availability of ecosystems-based goods and services. To safeguard tropical savannah's natural wealth and development gains in the face of climate change challenges, communities living on the edge need to strengthen the resilience of their natural and human systems. Communities living on the edge (CLE) of protected areas must also harness opportunities to reduce its contribution to climate change. Ecosystem-based approaches can help CLEs address these challenges by making use of ecosystems and biodiversity to reduce greenhouse gas emissions and to assist people to adapt to a changing climate. This paper documents the current state of CLEs local knowledge and experience on ecosystem-based approaches. It draws upon work from climate change research projects (2014 – 2021) and partner institutions in the Middle Zambezi Biosphere Reserve and the Great Limpopo Transfrontier Conservation Area, Zimbabwe.

Mapping woody invasive alien plant species and their impacts in strategic water source areas using freely available satellite imagery and cloud computing

Alanna Jane Rebelo

Agricultural Research Council, South Africa, RebeloA@arc.agric.za

We are currently in the United Nations 'Decade on Ecosystem Restoration'. This theme was selected because society's well-being depends on healthy nature. In South Africa alone, the value of nature's benefits to people is estimated at R275 billion annually (about 7% of our GDP). One example of degradation,

invasion by alien trees, costs the nation R6.5 billion annually in damages, and government spends over R300 million annually clearing alien trees. However, this clearing has largely been ineffective. One reason for this, is lack of information on alien trees: where they are, and how fast they are spreading. Using freely available satellite imagery, cloud computing and stakeholder engagement, we are developing methods for mapping alien trees in different biomes within the key strategic water source areas of South Africa. In the Fynbos and Grassland Biomes we achieve great success in discriminating woody alien plants from native shrublands and grasslands (~90% accuracy). Data driven alien tree clearing could improve effectiveness, in turn bolstering nature's resilience, which could therefore better absorb shocks and buffer society from long-term changes expected from climate change.

Lessons from trade in rhino products over three millennia: a systems approach

Robert Peter Millar

University of Pretoria, bob.millar@up.ac.za

Illegal wildlife trade threatens biodiversity and ecosystems. Despite considerable resources directed at illegal trade in rhino horn there remains a dire threat of species extinction. Reductionist approaches such as anti-poaching have failed to impact on the trade as they do not consider the complexity of the system driving rhino horn demand. As a result, conservationists increasingly focus on behaviour change intervention to reduce demand. Using historical case studies over three millennia of rhino product use, we show how demand is maintained in societies and identify insights for behaviour change intervention. Rhino horn demand is maintained by complex adaptive systems that span continents, cultures, and socio-economic contexts. Over time, the value rhino horn was transmogrified with changing economic and societal changes. Demand is reinforced by positive feedback loops created by economic incentives and societal values and cannot be halted by simplistic interventions. Rhino horn demand is fuelled by bottom-up and top-down societal influences. Case studies illustrate that it is possible to transition demand away from rhino horn to alternatives that fulfil the needs of consumers.

The Wildlife Economy in Africa and unlocking its potential

Susan (Sue) Snyman

School of Wildlife Conservation, African Leadership University, ssnyman@alueducation.com

The wildlife economy in Africa is multi-faceted and multi-sectoral and has an important role to play in terms of conservation and development across the continent. Based on research conducted by the School of Wildlife Conservation over the past 2.5 years, results will be presented on the State of the Wildlife Economy in a number of countries across Africa, as well as statistics related more broadly to various different wildlife economy activities, including forest products, tourism and hunting, amongst others. Information will be provided on the different facets of the wildlife economy, what is needed to unlock the potential of the wildlife economy and the key steps needed to unlock it. Additionally, information and preliminary results will be provided on the ALU SOWC Wildlife Economy Investment Index and its role in raising awareness about the importance of the wildlife economy in Africa, attracting investment into conservation and wildlife economy activities and resulting in wildlife (fauna and flora) being seen as a key strategic asset and a comparative advantage for Africa.

A savannah protected area and its water sources best conserve bird diversity compared with the surrounding anthropogenically modified mosaic landscape

Rion Elias Lerm¹, David Alan Ehlers Smith², Dave Ian Thompson² and Colleen Thelma Downs²

¹South African Environmental Observation Network (SAEON), re.lerm@saeon.nrf.ac.za

²University of KwaZulu Natal

Protected areas are important in mitigating threats to biodiversity, including land conversion. Some of the largest protected areas are located in biodiverse savannah systems where a mosaic of land-uses exists beyond their borders. In northeastern South Africa, the drivers of the region's bird community composition are mostly unknown in spite of the ecosystem services this taxon provides and a multitude of singleton species studies across the region. We aimed to investigate how various bird diversity metrics differed across the Kruger National Park (KNP) protected area and its adjacent matrix and, whether there were any environmental drivers of bird diversity across the region. Using a citizen science dataset and remotely sensed products, seasonal water was identified as the strongest driver of especially bird phylogenetic diversity and to a lesser extent functional and species richness. When accounting for high elevation, we found that phylogenetic diversity was significantly greater inside KNP emphasizing the importance of protected areas for the conservation of regional biodiversity.

Session 3

Rivers in crisis in South Africa

Stephan Woodborne¹, Albert Myburgh², Angelica Kaiser³, Annalize van der Merwe³, Hugo Retief⁴, Sharon Pollard⁴ and Eddie Riddel⁵

¹iThemba LABS, sm.woodborne@ilabs.nrf.ac.za

²University of KwaZulu Natal

³University of Mpumalanga

⁴AWARD

⁵SANParks

The 2022 Green Drop report suggests that most wastewater in South Africa, irrespective of the affluence of the region, is discharged in rivers with little or no pre-treatment. Economic development and urbanization are increasing demands on the system. Rivers in South Africa are in an unprecedented crisis that will lead to a loss of ecological functionality (ecosystem services). There is urgent need for buy-in: the science community must provide evidence-based research to inform a policy framework; the regulator must implement the policy; and the community must responsibly handle demand and discharge. Research on crocodile mortalities in the Olifants River elucidates the ecological processes that integrate the entire river catchment. The science crystalises the reason for the crocodile catastrophe, and points to the lack of action by the regulator, but most important: it highlights the priority and value placed on the environment by society. The potential remedy lies in education because the scientists' voice is mute if society is not adequately empowered to hold the regulator to its mandate. Development and conservation are not mutually exclusive of one another.

Mapping the Wildlife Economy

Alexander Chidakel and Brian Child
University of Florida, achidakel@ufl.edu

The economic performance of African protected areas (PAs) varies widely. However, methods to measure the value of tourist spending and its impacts on local and national economies are not well developed for the African context, and thus important information on the economic contributions and return on investment of PAs is missing. Likewise, data on the socio-economic impacts of trophy hunting, especially on communal lands, is rarely consolidated and made available for analysis. This presentation will introduce newly developed methods for measuring the economic impacts of park-tourism at both local and national scales through case studies in Brazil, Zambia, and South Africa. The case studies will not only highlight the methodology, but also reveal how the economic performance of PAs (state-run, private, and communal) is influenced by underlying institutional, governance, and organizational factors. Preliminary data, as well, will be presented on newly consolidated records of the returns to communities from trophy hunting in Zambia and Zimbabwe. This information will be placed in the context of efforts to develop the knowledge management capacity of national CBNRM institutions.

Pilot Project: Bulls infected with *Trichomonas foetus*

Danny Pillay
PCHM, drpillay@icloud.com

Trichomonas foetalis is a venereal disease of cattle caused by a flagellated protozoan that is an obligate parasite of the bovine reproductive tract. It causes genital infections, infertility, early embryonic death and sometimes abortion. Bulls show minimal signs of infection and become asymptomatic carriers. This pilot project looked at the feasibility of using a homeopathic preparation called a nosode in 6 bulls that tested positive for *Trichomonas foetus*.

Importance of freshwater eels on inland fisheries and livelihood in South Africa

Mxolisi Nkomo, Celine Hanzen, Matthew Burnett and Colleen Downs
University of KwaZulu-Natal, mxolisi380@gmail.com

Western Indian Ocean (WIO) freshwater eels (*Anguillid* spp.) are catadromous migratory fishes which spawn in the sea and spend most of their lives in freshwater. There are four known species of anguillids found in the east coast of Africa, flowing into river systems of southern Africa. These species travel to as far as Western Cape up to the East coast of South Africa from Madagascar where they spawn. Larvae drift in currents to rivers entering, estuaries as glass eels (transparent, less than five meters in length). Slightly longer than 5cm are elvers or an elver, a stage where they gain pigment. These light-weight eels can adhere on we surface on river systems, climbing up waterfalls as they migrate in freshwater, first record dating back to the 1st of February 1953. From this stage they then mature to yellow eels, bigger in size and length, fully adapted to freshwater environments, and the last life stage is known as the silver eels. These eels develop big eyes, a bright belly and dark back. It is in this life stage that eels migrate back to the sea to spawn and die, starting the life cycle again.

From Enabling Change to Scaling Change: Lessons for Integrating Conservation and Sustainable Livelihoods, 2017-2022

Harriet Croome

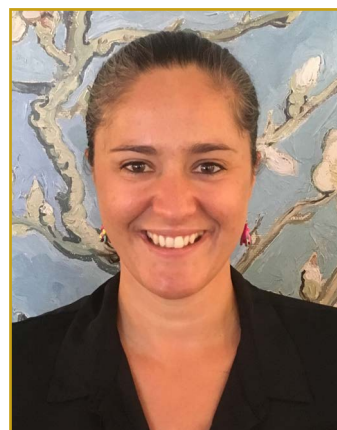
Durrell Wildlife Conservation Trust, harriet.croome@durrell.org

In 2017, Durrell began working with 20 communities across three regions in Madagascar to promote socio-economic development for some of the country's poorest people, alongside conservation for three of the most endangered species on the planet. Our model comprises five pillars: food security, financial independence, reproductive choice, good governance, and research-led conservation. To date, 3,724 farmers are cultivating 981Ha using climate smart agriculture techniques; 95 VSLAs are active; 429 local leaders are enrolled on a bespoke good-governance training programme; and populations of three critically endangered species are stable or increasing. This presentation will share results and lessons learned since 2017, signposting the ways we are scaling the model to reach new communities and species. We recommend a holistic approach, in which multiple project initiatives [each with an explicit development and conservation purpose] support one another. We highlight the need for flexibility in responding to evolving needs of communities and climate unpredictability and reflect on which human and nonhuman species indicators offer the best potential for evidencing cross-sector impact.

Session 4 – Panel Discussion

Laura Pereira

Laura Pereira is the Exxaro Research Chair at the Global Change Institute at Wits University and a researcher at the Stockholm Resilience Centre. She is an interdisciplinary sustainability scientist, having been trained in ecology, law, zoology and human geography. Following her undergraduate at Wits, she went on to complete her DPhil in Geography at Oxford University in 2012, before undertaking post-docs in sustainability science at Harvard's Kennedy School and at the University of Cape Town. She has subsequently worked at Stellenbosch University, City University of London and Utrecht University. She is interested in the interface between traditional knowledge and innovation, the role of futures techniques in enabling transformative change and developing innovative methods for knowledge co-production in Global South contexts. Laura sits on the IPBES Task Force on scenarios and models and is also a member of the Earth Commission's Working Group 4 on Transformations.



Jonathan Oppenheimer

Jonathan Oppenheimer is a South African businessman and social impact investor. He began his career at NM Rothschild & Sons, before moving to Anglo American and subsequently De Beers, where he held several senior management roles in Southern Africa and London over two decades. He completed his

education at Harrow School London and the University of Oxford where he studied Politics, Philosophy and Economics.

As Executive Chairman of Oppenheimer Generations, Jonathan is actively involved in all aspects of the family's private, commercial, and thought leadership activities, including: Oppenheimer Partners, Oppenheimer Generations Asia, Nianova, Shangani Holistic, the Brenthurst Foundation, Oppenheimer Generations Foundation, Oppenheimer Generations – Research & Conservation.

In January 2018, Jonathan joined the Board of Trustees of the Carnegie Endowment for International Peace (CEIP). CEIP is the oldest international affairs think tank in the United States and is committed to advancing the cause of peace through its global network of policy research centres.



Awande Buthelezi

Awande Buthelezi is an organiser and researcher at the Co-operative and Policy Alternative Center (COPAC) and an activist with the Climate Justice Charter Movement. He is also the lead coordinator for the Climate Justice Deal research, to create a comprehensive macroeconomic framework for South Africa built on climate justice principles to meet the environmental and socioeconomic challenges of the country within the shifting context of the crisis. He is also a speaker and climate justice educator, who facilitates workshops and lectures on climate justice for community activists, students and trade unionists. His research interests are in alternative economic systems, economic history, development, political economy, political ecology, and climate justice. Before joining COPAC, Buthelezi was an associate and researcher at the Institute for African Alternatives (IFAA) and an organiser for the Inaugural Re-thinking Economics for Africa Festival. Buthelezi has an MA in Development Studies from the University of the Witwatersrand. His master's dissertation focused on the Green New Deal and is entitled "The Green New Deal as Counter-Hegemony".



Neva Makgetla

Neva Makgetla is a Senior Economist at Trade and Industrial Policy Strategies (TIPS), an economic research institute. She has undertaken extensive research into South African economic issues, published widely, and contributed to a number of national economic policy processes and debates from 1994. She was Deputy Director General for economic policy in the Economic Development Department from 2010 to 2015. Before that, she was Lead Economist for the Development Planning and Implementation Division at the Development Bank of Southern Africa.



She has worked at a senior level in the Presidency and other government departments, and for seven years was head of the Congress of South African Trade Unions (COSATU) Policy Unit. She has a PhD in economics and before 1994 worked for over 10 years as an economics lecturer in Africa and the United States. She is currently a member of the National Minimum Wage Commission.

Vasna Ramasar

Vasna is currently an Associate Senior Lecturer in the Division of Human Ecology, Department of Human Geography and a Research affiliate at the Lund University Centre for Sustainability Studies (LUCSUS) in Sweden. She is also the Programme Director for the Culture, Power and Sustainability international Masters. Dr Ramasar has 10 years research, activism, consulting and teaching experience across southern and eastern Africa, Asia, Europe and north America and is most interested in trying to understand the big picture of how people and planetary dynamics come together, the complexity of these interactions and implications for justice. She supports a resistance to the unsustainable hegemonic system and the creation of radical alternatives is framed within the broad field of critical political ecology and I seek to bring an interdisciplinary perspective to questions of development and sustainability. She is interested in feminist and decolonial approaches to environment and development and finding alternatives to the current destructive development paradigms. Her research has focused on the politics of scale within development and environmental governance in the areas of the energy crisis, health and the environment and water. Dr Ramasar's current research is focused on social and environmental justice looking at just transitions and alternatives to development.



Day 2: Thursday, 6 October 2022

Plenary: Tim Clutton-Brock

Tim Clutton-Brock is a Director of Research in the Department of Zoology at the University of Cambridge and the Emeritus Professor of Ecology and Evolutionary Biology. His research has explored the evolutionary causes and ecological consequences of animal breeding systems and societies and he has published widely on the evolution of reproductive strategies, life histories, social behaviour, the operation of natural and sexual selection as well as on the regulation of animal populations and the consequences of climate change. While he has supervised field studies of insects, fish and birds, his own work has been primarily with mammals. His initial research was on the ecology of Colobus monkeys in Tanzania and Uganda and he has subsequently led long-term, individual-based studies of red deer and Soay sheep (in Scotland), fallow deer (in Sussex, England), banded mongooses (in Uganda) and meerkats and Damaraland mole-rats (in the southern Kalahari). In addition, he has supervised shorter-term studies of puku, lechwe and kob (in Uganda and Zambia). Together with P.H. Harvey, he pioneered the use of quantitative comparative analyses of interspecific differences to test the generality of ecological and evolutionary hypotheses and he has also contributed to theoretical studies of animal communication, the evolution of cooperation, sexual coercion and intrasexual competition in females and males. His books include *Primate Ecology* (Academic Press 1977); *Red Deer: Behavior and Ecology of Two Sexes* (Chicago, 1982); *Reproductive Success* (Chicago, 1988); *The Evolution of Parental Care* (Princeton, 1991); and *Mammal Societies* (Wiley, 2016).



Session 1

Social evolution and population dynamics in mammals

Tim Clutton-Brock
University of Cambridge, UK, thcb@cam.ac.uk

To anticipate the biological consequences of environmental change it is necessary to understand their effects on ecological and evolutionary processes. Many important advances in molecular genetics over the last fifty years were based on research on a small number of 'model' species; many of the most important advances in ecology and evolutionary biology have been based on long-term field studies of a small number of species where it is possible to monitor the development and life histories of large numbers of identifiable individuals across their entire lifespans over periods long enough to measure ecological and evolutionary changes. These long-term, 'individual-based' studies provide insights into the consequences of environmental change that cannot be accessed in any other way, often producing results that are generalisable to related species with similar breeding systems. Drawing on my involvement in two long-term, individual-based field studies of mammals with contrasting breeding systems in contrasting

environments, I show environmental changes lead to changes in growth, survival, breeding success and population size that have ecological and evolutionary consequences.

Spatio-temporal study of apex predator effects, and drought impacts on the variability of primary productivity at Tswalu Kalahari Reserve, using remote sensing

Aisha Salim Rifai, Guy Frank Midgley, Heath Beckett and Kerry-Anne Grey
Stellenbosch University, aisharifai29@gmail.com

In the Kalahari, periods of high rainfall promote higher vegetation productivity, which supports a higher density of grazing herbivores. However, overgrazing has adverse effect on the vegetation. Wherein, irreversible shifts in vegetation from palatable perennial grass to unpalatable grasses and woody shrubs, or dominant annual grasslands are seen. The TKR is split into two distinguished zones; Lekgaba which has a lion population that is restricted within its boundaries, and Korannaberg without any lions creating a contrast in ecosystems. The lions are controlling the herbivore species, and thus the vegetation in the Lekgaba has greater density than the Korannaberg counterpart. This study will inspect the effect lions have on vegetation dynamics through impacts on herbivore behaviour, and thus the role of lions in the Tswalu Reserve. The change in vegetation cover will be studied over a 20-year period via remote sensing. The enhanced vegetation index (EVI) and the Palmer's Drought Severity Index (PDSI) will be used to assess the vegetation changes. It is anticipated that the presence of the lions is influencing herbivore behaviours and thus creating vegetation dynamics at TKR.

The loss of vegetation cover has distinct but short-term impact on multiple vertebrate taxa in a grassland ecosystem

Monday Mdluli¹, Zamekile Bhembe², Duncan MacFadyen³, Leslie Brown⁴, Themb'alilahlwah Mahlaba² and Ara Monadjem²

¹University of Free State, zamekilebhembe@gmail.com

²University of Eswatini

³Oppenheimer Generations

⁴University of South Africa

Changes in vegetation cover may impact the composition of vertebrate communities by altering grassland habitats or perceived predation pressure. So, in this study, we manipulated vegetation cover in a grassland ecosystem at Telperion Nature Reserve and measured its effect on the community structure of birds and small mammals. We established 12 plots which were assigned to three treatments: mowed with cut grass left in situ, mowed with cut grass cleared, and non-mowed. Sampling was done over three sessions: before the treatment, immediately after the treatment, and three months after treatment. We recorded 2,801 bird individuals of 38 species and 98 small mammal individuals of eight species. Species diversity of both taxa was significantly higher in the non-mowed plots than the mowed plots. Birds also showed differences in species composition between treatments immediately after mowing but these differences disappeared three months after mowing. Our study suggests that the mowing of grasslands has short-term effects, but communities rapidly return to pre-loss conditions within a few months. Hence controlled mowing could be an appropriate tool for managing grasslands.

Quantifying glucocorticoids and their metabolites in quills, spines and faecal material from Cape porcupine (*Hystrix africaeaustralis*) and Southern African hedgehog (*Atelerix frontalis*) for monitoring responses to stressors

Harvey Seete, Andrea Webster and Andre Ganswindt

Mammal Research Institute, Endocrine Research Laboratory, University of Pretoria, u201590319@tuks.co.za

Non-invasive hormone monitoring is widely used to assess wildlife responses to environmental stressors. This approach is particularly useful in nocturnal and elusive species. Cape porcupines (*Hystrix africaeaustralis*) and African hedgehogs (*Atelerix frontalis*) both rely on their spiky protrusions for protection, but it is unclear whether these keratinous structures can be used to assess adrenocortical activity in these species. We collected faeces and quills to determine whether these biological materials can be used to non-invasively assess responses to environmental stressors in these species. Preliminary results for porcupines indicate that glucocorticoid (GC) concentrations in the middle part of the quill are significantly lower than the those measured in proximal and distal sections. Additionally, medium thick quills have statistically higher GC concentrations than long thin quills. In porcupines, faecal glucocorticoid metabolite (fGCM) concentrations can be reliably measured up to 36 hours post-defaecation using the 11-oxo-etiocholanolone-I enzyme immunoassay (EIA). The 11-oxo-etiocholanolone-II EIA was deemed suitable for adrenocortical function assessment in hedgehogs.

Determining potential natural and anthropogenic drivers of adrenocortical activity in African clawless otters (*Aonyx capensis*) by evaluating faecal glucocorticoid metabolite concentrations

Marli Burger¹, Andre Ganswindt¹, Andrea Webster¹ and Juan Scheun²

¹University of Pretoria – Mammal Research Institute (MRI), Department of Zoology and Entomology, marli.burger@gmail.com

²University of South Africa (UNISA)

Increasing human populations around the globe and their associated anthropogenic activities are drastically transforming healthy ecosystems. Otters are sensitive to environmental change which makes them an ideal species for monitoring environmental disturbance. How water quality, diet, anthropogenic disturbance, and seasonal variation affect otter stress levels can be examined using non-invasive monitoring approaches, such as examining faecal glucocorticoid metabolite (fGCM) concentrations. In this study we compared fGCM concentrations in African clawless otter spraint, levels of anthropogenic disturbance, diet and water quality in an urban (Rietvlei Nature Reserve; Gauteng), rural (Millstream Farm, Mpumalanga) and natural (Kalkfontein Dam Nature Reserve; Free State) site. We expect an increase in fGCM concentrations as the degree of water pollution and anthropogenic disturbance increase and the diet breadth decrease. Assessing African clawless otter stress physiology in combination with drivers that may contribute to stress in transformed habitats, is essential for mitigation of threats to aquatic environments and the species that rely on them.

Spectral detection of weed infestation in maize farms using Sentinel-2 data

Yoliswa Mkhize

Council for Scientific and Industrial Research (CSIR), ymkhize@csir.co.za

Weeds pose a significant threat to maize growth and its productivity by competing for critical resources such as sunlight, nutrients and water. This emphasizes the need for early detection of weed infestation in maize farms to enable timely management intervention which could reduce possible negative impacts on maize development and yield. Such shortfalls have resulted in a need for automatic, time and cost-effective weed detection methods which can be achieved using Remote Sensing. Considering technological advances occurring in RS, it is hypothesised that satellite data can also be used as primary data to detect weed in maize farms, specifically Sentinel 2. The analysis (to date) focusses on three classes, namely weeds, maize, and a mixed class. Sentinel-2 image bands has been used to test the spectral separability of the different classes prior to model application. A Random Forest model has then been used to predict the occurrence of weeds in maize farms. The separability analysis results show a high degree of weed separability in the red-edge and NIR bands. The results show that weeds can be detected using Sentinel 2 imagery, albeit with low accuracies in mixed pixels.

The effect of landscape structure and native vegetation on the insect biodiversity of urban green spaces

Johann Christiaan de Beer¹, Catherine Lynne Sole¹, Elke Gwynneth Meyer¹, Christina Ida Breed² and Christian Walter Werner Pirk¹

¹University of Pretoria, Department of Zoology and Entomology, u17029989@tuks.co.za

²University of Pretoria, Department of Architecture.

Increased urbanisation is one of the major threats to insect biodiversity due to habitat destruction. With this in mind, the Biodiversity and Ecosystem Services for Tshwane (BEST) project aims to enhance insect biodiversity by creating gardens within urban areas, comprising plant species native to the Tshwane region. We investigated insect biodiversity and abundance between two recently established native plant gardens, three common ornamental gardens, and a native grassland patch. We also investigated how landscape structure affects insect biodiversity in these gardens, by utilising percentage green cover and NVDI indices. Our analyses indicate that overall, insect abundance, richness, Shannon, and Simpson indices were higher in native gardens compared to their ornamental counterparts. In spring, the gardens with a higher percentage green cover within a 200m radius had a positive correlation with increased insect diversity. Those gardens that were most connected and had higher green cover, were shown to be nested in the NMDS analysis and share similar species. This study provides evidence that both landscape structure and vegetation type positively influence insect biodiversity.

Arthropod response to monoculture timber plantation: a systematic review

Thembekile Mthimunya and Caswell Munyai
University of KwaZulu-Natal, thembekile.advice@gmail.com

Anthropogenic disturbance increases the risks of biodiversity loss. How plantations influence invertebrates is not uniform, and the plantation design affects the extent of their environmental impact. This review aimed to determine how arthropod diversity and assemblages globally are affected by *Pinus* and *Eucalyptus* plantations. The studies were selected using PRISMA. Generally, arthropods respond positively to natural vegetation, with rare species found in natural forests. Native forests support more taxonomic and functional diversity, with distinct arthropod communities compared to timber stands. Younger plantations and grasslands have similar functional diversity in most arthropod groups. The *Eucalyptus* forests preserve more diverse arthropods, particularly in the Australian and Nearctic regions. Studies have shown that mixed or unmanaged plantations ameliorated species richness. Forestry practices that generate environmental conditions similar to natural environments could help to conserve species from the natural habitats. On a larger scale, converting native forests into monoculture plantations results in a net positive outcome due to heterogeneous fragments of habitats.

Session 2

The ecology of snakebite in southern Africa: lessons from trapping studies

Bryan Maritz, Emma Buckley, Kurt van Wyk and Riaaz Mohamed
University of the Western Cape, bryanmaritz@gmail.com

Envenomation by snakes poses a significant public health risk in Africa and globally. Despite advances in the treatment of snakebite, there has been little progress in the prevention of snakebite, primarily because our understanding of the animals themselves remains embarrassingly scant. Here, we present ecological data from three field studies in the light of the ecology of snakebite. First, we show that even low measures of detection probability ($p < 0.02$) for a population of Mozambique Spitting Cobras in southeastern Zimbabwe can scale to substantial encounter rates over the course of a summer season. Next, using data from Tswalu Kalahari Reserve, we show that Cape Cobra encounter frequencies can be dramatically impacted by local resource availability. Finally, we show how the activity patterns of Bibron's Stiletto Snakes in the Kalahari are highly variable, but potentially predictable. Each of our studies highlight opportunities for snakebite mitigation, but also emphasize the difficulty of gathering high quality ecological data at broad spatial scales.

Effects of carcass decomposition on spatio-temporal vegetation dynamics in Bankenveld grasslands of South Africa

Resoketswe Cate Nkalitshana, Alan Barrett and Leslie Brown
University of South Africa, cateynkali@gmail.com

Herbivore carcasses play an important role in grassland vegetation dynamics, adding spatial complexity to grassland ecosystems. The amount of nutrients produced by the carcass of a large animal exceeds

most natural processes. Nutrients from a carcass noticeably affect soil chemistry and fertility, even if the carcass is disturbed or scavenged by vertebrates. Even though carcass decomposition has been found to have large impacts on the surrounding soil and vegetation in nutrient-poor ecosystems, so far, no studies have been done in South African grassland ecosystems such as the Bankenveld. The aim of this study was to determine the effects that decomposing adult ungulate carcasses have on vegetation dynamics in Bankenveld grasslands. To achieve this aim; spatial changes in plant species composition and cover, changes to biomass production, veld condition along a spatial gradient from the carcass site, structural and height changes to vegetation were examined. Data was collected in Telperion Nature Reserve, Mpumalanga province, South Africa and was analysed using Excel.

Persistence of wildlife in mosaic urban landscapes- a KwaZulu-Natal perspective

Colleen Downs

University of KwaZulu-Natal, downs@ukzn.ac.za

Anthropogenic changing land use is rapidly transforming natural landscapes with consequences for biodiversity. Case studies of vertebrate species' responses to urban mosaic landscapes in KwaZulu-Natal, South Africa, are presented. Connected habitat mosaics of natural and anthropogenic green spaces are critical for urban wildlife persistence. We present a three-phase framework for vertebrate species persistence in urban mosaic landscapes based on the perspective of our research. Species in suburbia exhibit an initial phase where behavioural and ecological flexibility, life-history traits, and phenotypic plasticity either contribute to their success, or they stay at low numbers. Where successful, the next phase is a rapid increase in populations and distribution; anthropogenic food resources and alternate breeding sites are effectively exploited. The modified third phase is either continued spread, plateau or decline.

Rainfall seasonality as a driver of Miombo floristics

Mthokozisi Moyo, Sally Archibald and Justice Muvengwi

University of the Witwatersrand, mottomoyoza@gmail.com

Rainfall seasonality drives ecosystem dynamics in Africa and it is a significant factor affecting the distribution of plants and animals. The importance of seasonality as an environmental filter is complicated as it co-varies with other environmental factors. β -diversity is used to describe changes in community composition among sites in response to changes in the environment. In order to test whether there are unique species associated with seasonal environments I used maps of seasonality and the SEOSAW regional plot network and tested for nestedness vs turnover across seasonality gradients. I also compared taxonomic and phylogenetic β -diversity in the Miombo woodlands to explore whether unique clades have evolved to capitalise on the seasonal ecosystems that spread in Africa over the Miocene. We also examined which environmental factors influence the diversity of this plant community. There are different vegetation patterns in high and low rainfall seasonality systems. The response to seasonality depended on mean annual rainfall and the soil type. This study shows that species composition can change in response to changes in the environment in this region.

River connectivity and fish migration considerations in the management of multiple stressors in South Africa

Gordon O'Brien¹ and Robin Petersen²

¹University of Mpumalanga, gordon.obrien@ump.ac.za

²South African National Parks

People throughout the world depend on the services we derive from freshwater ecosystems. Human land-use activities often affect the quality, quantity and habitat of freshwater ecosystem, which need to be carefully managed to ensure their integrity and provision of services is sustainable. In South Africa, legislation has established resource-directed measures to attain a sustainable balance between the use and protection of water resources. These procedures have been implemented in most of South Africa's nine water-management areas, resulting in new legislation to protect these resources. Unfortunately, very little protection has been afforded to river connectivity maintenance and fish migrations. For water storage and flow regulation for agriculture and other resource use activities, 610 formal dams and 1430 gauging weirs have been constructed that act a partial or complete barriers to fish migration on river ecosystems. Only 60 fish passage structures have been built, but many are not functional. River connectivity and fish migration management appears to be a shortcoming of the existing management approach for multiple stressors. In this paper we review the drivers affecting.

Repellents from natural chemical signals to reduce human-carnivore conflict

Peter James Apps

Botswana Predator Conservation Trust, peterjapps@gmail.com

Conflict with humans is the biggest threat to predator populations. Throughout Africa, livestock depredation severely impacts rural livelihoods, and predators are killed proactively or in retaliation. There are no sufficiently effective non-lethal solutions to this wildlife conflict. This project investigates airborne repellents derived from carnivore scent-marks as protection for livestock. METHODS; Predator odour components are identified by gas chromatography – mass spectrometry, predator reactions to single components or simple mixtures are recorded with camera traps, and whether the repellents protect livestock is tested on a cattle ranch and at subsistence cattle posts. RESULTS; Compounds with repellent effects in screening tests; black-backed jackal; dimethyl disulfide, dimethyl trisulfide, aldehydes, skatole. Spotted hyaena; dimethyl trisulfide. Leopard; 3-mercapto-3-methylbutanol. Caracal; aldehydes. Honey badger; dimethyl disulfide. When repellent was absent, leopards killed 0.9 calves per month, and 0.2 per month when repellent was present.

Session 3

Inclusive wildlife economy and CBNRM

Brian Child

University of Florida, bchild@ufl.edu

This presentation will assess the current and potential wildlife economy in southern Africa. It will then provide the economic and institutional theory for the sustainable governance of wildlife based on my recent book, sustainable wildlife governance and community based natural resource management. Finally, it will provide a theoretical and practical framework for the community governance needed for communities to fully participate in the wildlife economy.

The Achilles Heel of Conservation

Merlyn Nomusa Nkomo

FitzPatrick Institute of African Ornithology, University of Cape Town, merynomsa@gmail.com

This talk is a reflection on the lived career experiences of a young African woman and first-generation graduate, and also a paper she co-authored calling for transformation entitled: Overcoming racism in the twin spheres of conservation science and practice. Conservation, as it is practised in Africa, has failed to win over the vast majority of people begging the question "Who are we conserving Africa for if the majority, especially the youth, are not part of the solutions?" Unfortunately, in the developing world, the colonial legacy of conservation and systemic racism are ubiquitous. Although much has changed in post-colonial approaches, at the core, they are informed by colonial-era fortress approaches and the unchanging power dynamics between the developing and developed world. Conservation is not inclusive across racial and gender fronts. Conservation careers are alienating for Africans, due to the existence of barriers to entry and a leaky pipeline in academia and practice. Consequently, a lack of representation and diversity means that local communities do not identify with the conservation enterprise, it is a white-people's endeavour. To be effective, conservation in Africa needs a fundamental shift towards people centered models that are context specific and are considerate of the rights and beliefs of indigenous and local communities. This talk is an invitation to continued reflection, learning and steps towards building systems for a sustainable and equitable future in conservation practice.

Microplastics profile in the Vaal River, South Africa

Dalia Saad, Gibbon Ramaremissa, Michelle Ndlovu and Patricia Chauke

University of the Witwatersrand, dalia.saad@wits.ac.za

Microplastics (MPs) pose significant risks to the environment and human health. In South Africa, MP occurrence in freshwater remains largely unreported. This study investigated the abundance, physical characteristics and composition of MPs in surface water, sediment and fish samples from the Vaal River. Samples were undergone digestion, density separation, and filtration prior to physical and chemical analysis. Following the extraction, potential MPs were visually identified under a Nikon stereomicroscope, aided by chemical characterization using Raman spectroscopy. All the samples showed presence of MPs

with average abundances of 0.61 ± 0.57 particles/m³, 463.28 ± 284.08 particles/kg_{dw} and 41.18 ± 52.81 particles/kg for water, sediment and fish, respectively. 80% of MPs were fragments and fibres of less than 2 mm, coloured MPs were more abundant compared to transparent. Polyethylene and polypropylene were most dominant among other polymers. These findings reveal elevated levels of MP contamination within the Vaal from secondary sources. Potential sources include: surface run-off from urban centres, inflow from tributaries, recreational activities and wastewater effluent.

The olfactory landscape concept: a key source of past, present and future information driving animal behaviour, movement, and decision-making

Patrick Finnerty¹, [Adrian Shrader](#)², Clare McArthur¹, Peter Banks¹ and Catherine Price¹

¹School of Life & Environmental Sciences/ The University of Sydney, adrian.shrader@up.ac.za

²Mammal Research Institute/ University of Pretoria

Across landscapes, external factors (physical environment and living organisms) are key drivers of animal behaviour, movement, and decision making. Yet, the information and sensory mechanisms animals use to detect and respond to these factors are seldom discussed. By deconstructing current frameworks of animal behaviour and movement ecology we highlight a gap in our understanding of the information animals use to make decisions – odour. Odour is everywhere, emitted from predators, prey, conspecifics, vegetation, and surface water. Many animals exploit odour to find food, avoid threats, and attract mates. Here, we introduce the concept of an olfactory landscape: real-time dynamic olfactory contours reflecting the patchy distribution of resources and risks, providing a key source of information used by many animals. Incorporating the olfactory landscape into current frameworks of animal behaviour provides a mechanistic link to help answer important questions about where, why, and when animals move. By understanding how animals use the olfactory landscape to make crucial decisions, we can then manipulate the landscape to modify ecological interactions.

Six years and counting of ant biodiversity research in KwaZulu-Natal: an update

[Caswell Munyai](#)

School of Life Sciences, University of KwaZulu-Natal, Pietermaritzburg campus, Munyaic2@ukzn.ac.za

The KwaZulu-Natal province of South Africa is well known for its beautiful beaches, mountains, forests, grasslands, savannas, and various charismatic vertebrate taxa. However, little is known about the invertebrates, the province's most diverse group. In particular, ants (Hymenoptera: Formicidae) have the highest terrestrial biomass among animals. As ecologists, our primary goal is to understand biodiversity patterns. The latter is crucial for community ecology and conservation biology. Here, I (1) present an update on what we know about ants in KwaZulu-Natal. (2) Using data from various recent studies in the province, I answer the question on how ants respond to major land-uses and transforming habitats in the province and (3) I provide updated details and recommendations for future research. Across KwaZulu-Natal, grasslands have the highest diversity, while natural forest has unique ant assemblage. Dominant ants in the genus, *Pheidole*, *Anoplolepis* and *Crematogaster* seem to control assemblages in highly disturbed systems including, sugar-cane plantations and bush encroached systems. The abundant monoculture plantations seem to support higher ant abundance.

Wendy Panaino¹, Francesca Parrini¹, Robyn Hetem¹, Peter Kamerman², Leith Meyer², Duncan Mitchell², Valery Phakoago², Dylan Smith³, Gus van Dyk³ and Andrea Fuller²

¹School of Animal, Plant and Environmental Sciences, and Brain Function Research Group, School of Physiology, University of the Witwatersrand, Johannesburg, wpanaino@gmail.com

²Brain Function Research Group, School of Physiology, University of the Witwatersrand, Johannesburg

³Tswalu Kalahari Reserve, Northern Cape.

Climate change (increased heat and unpredictable rainfall) affects animals by imposing greater heat loads and by altering food resources. Temminck's pangolin (*Smutsia temminckii*) is a mostly nocturnal, myrmecophagous mammal inhabiting parts of Africa, including the southern Kalahari. Understanding how pangolins respond to changes in climate and food availability in a hot and dry environment allows us to predict their responses to environmental change occurring with climate change elsewhere. Using biologging, we investigated the ecophysiological responses of seven pangolins at Tswalu for two years in response to fluctuations in climate and food resources. Pangolins adjusted their diet when food was scarce, but still experienced low energy intake, particularly during winter. The low energy intake resulted in lower than normal 24h minimum body temperatures and pangolins became active earlier during the day. The behavioural and physiological plasticity exhibited by pangolins allowed them to cope with changes in food availability during our study, but the extent to which this plasticity will buffer them against future climate change-induced reductions in food availability is unclear.

Session 4 – Panel Discussion: Conservation: Who owns the conversation?

Polly Carr

Polly Carr is CEO of Oppenheimer Generations Custodian, the entity that represents the global long commercial, philanthropic and family interests of the Jonathan and Nicky Oppenheimer family. Prior to this from 2005 until 2018, she was the group finance director of E Oppenheimer and Sons, the predecessor to Oppenheimer Generations. During this time, she was a member of the De Beers audit committee.

Polly represents Oppenheimer Generations on the boards of Nianova (including Fireblade, Tswalu, Niarra and Weeva), Oppenheimer Partners, the Brenthurst Foundation and Shangani Holistic. She is also involved with Oppenheimer Generations – Research & Conservation, Oppenheimer Generations Philanthropy and Oppenheimer Generations Asia. Prior to joining the Oppenheimer family, Polly was the finance director and a member of the executive and investment committees of Brait private equity, a leading private equity firm in South Africa. She qualified as a chartered accountant at Deloitte in London and became a partner in the financial institutions team at Deloitte in Johannesburg, specialising in private equity. Polly holds a BA in History from the University of Exeter.



Nolwazi Mbongwa

Nolwazi Mbongwa is a PhD student at the Institute of Communities and Wildlife in Africa (University of Cape Town) looking at the Cultural value and sustainability of wildlife trade among traditional healers and muthi traders in South Africa. Nolwazi completed her BSc., BSc. (Hons) (Cum Laude) and MSc. (Cum Laude) at the University of Witwatersrand. In 2014 she accepted her calling to be trained as a Sangoma (diviner), and this inspired her to do research that combines her social experiences with conservation. Thereafter, she did her MSc. in ethnobotany looking at the perceptions, attitudes and knowledge of traditional healers and muthi traders about using cultivated medicinal plants. She has worked for Endangered Wildlife Trust (EWT) and South African National Biodiversity Institute (SANBI) as a muthi market survey intern and a Medicinal Plant Biodiversity Management Plan research assistant, respectively. She is currently a member of the International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC) Southern African Plant Specialist Group. Nolwazi's love for the environment stems from a rural background where nature is not only loved for its aesthetic value, but it also holds cultural significance for its inhabitants. She is passionate about the collaborative work between resource users, scientists and conservationists in achieving the sustainable use of traditional medicine and ensuring that African cultural values are respected and considered in conservation initiatives, so that conflict of interests is avoided, and communities can also take part in conserving the environment.



Peter Fernhead

Peter Fearnhead is the Chief Executive Officer and co-founder of African Parks. He has been involved in formal conservation since the age of 13, where in his native Zimbabwe he developed a 2,000-acre wildlife reserve on the school campus. He graduated with a BSc in Agric Economics from the University of Natal and an MSc in Agric and Resource Economics from the University of Oxford. His professional career started as a management consultant with Deloitte specialising in strategy, before joining South African National Parks (SANParks), where he held a number of positions, including Resource Economist, Advisor to the CEO, and then Head of Commercial Development. Peter has been at the forefront of innovations in conservation for over twenty years particularly where this has involved crowding-in the commercial sector as a conservation strategy. Amongst other initiatives, Peter conceptualised and implemented the commercialization program at SANParks turning the organisation around from near bankruptcy; established a mechanism whereby the South African Government funded land acquisition to expand parks; concluded multiple contract-park agreements which expanded the national conservation footprint; formulated African Parks; and established the African Parks Endowment Fund. Today African Parks manages 20 protected areas in 11 countries, covering 17 million hectares.



Bongani Bingwa

Bongani Bingwa is the host of the Breakfast show on 702. He is the former Afternoon Drive show host. Before joining 702 he was a presenter and journalist on Carte Blanche. For the last ten years, he has been a presenter and journalist for South Africa's longest running investigative television programme Carte Blanche.

He has interviewed thought leaders, senior politicians, and captains of industry, authors, celebrities and highflyers on the global stage. Not a few wrongdoers have come under the glare of his probing questioning for the show. Bongani Bingwa's passion for broadcasting began at a young age in 1993 when he worked as a presenter for children's television on SABC'S TV1. He quickly progressed to hosting adult content on shows like Your Own Business and on DSTV's Channel O.

His career as a journalist began in 2005 on Talk Radio 702 as a News Anchor and quickly progressed to hosting his own show Talk At Nine. He is a recognized industry leader and was highlighted among a select few journalists and media specialists for Vanity Fair's July 2007 Africa feature. He studied politics and holds a Bachelor of Arts degree from UNISA.



George Wamukoya

George has over 30 years experience and expertise in formulation of international, regional and national policies. He is the Team Leader, African Group of Negotiators Experts Support (AGNES) and also serving as the Leadership Program Director. George was among the 11 Co-Facilitators that facilitated negotiations that resulted in the adoption of the Paris Agreement on Climate Change. He is currently co-facilitating UNFCCC negotiations on Nationally Determined Contributions Common Time Frames and lead negotiator on issues related to agriculture. George has served as Climate Change Advisor to the Common Market for Eastern and Southern Africa (COMESA), GIZ-CAADP Support Programme of the African Union Development Agency (AUDA-NEPAD) and DFID funded Regional Programme on Climate Smart Agriculture in Eastern and Southern Africa. For many years George was part of the legal experts that implemented UNEP's Training Programme of Judges, Magistrates and Prosecutors on the implementation of environmental laws in Africa. George was the Joint Secretary to the National Committee on the Implementation of the Environmental Management and Coordination Act (EMCA) which established National Environment Management Authority (NEMA-Kenya). George holds a doctorate degree in law and is a recipient of the Presidential Award of the Order of the Grand Warrior (OGW) for outstanding work in environmental conservation.



Day 3: Friday, 7 October 2022

Plenary: Irene Amoke

A landscape ecologist with over fifteen years of experience in field ecology, GIS, and project management, Irene has worked in academia, government, and the private sector both within and outside Kenya. She worked with the Kenya Wildlife Service (KWS) on human-wildlife co-existence projects, conducted elephant surveys and managed a national elephant mortality database. She led field surveys in private game reserves in South Africa and managed several environmental and sustainability projects under the Department of Environment Food & Rural Affairs (DEFRA), Oxford Brookes University, both in the United Kingdom.



Irene graduated with a BSc in Zoology from the University of Eastern Africa, Baraton, and Kenya holds an MSc in Environmental Assessment & Management and a PhD in Landscape Ecology, both from Oxford Brookes University (UK). Her research focuses on the interface between wildlife, people and emerging land use, looking at practical and sustainable ways to mitigate adverse impacts, particularly in fragile ecosystems. She is passionate about bridging the gap between science and policy formulation in the conservation sector. Irene sits on the Boards and Advisory Councils of several local and international conservation organizations and is a 2022 Eisenhower Fellow.

Session 1

Changing the conversation around conservation

Irene Amoke

Kenya Wildlife Trust, irene.amoke@kenyawildlifetrust.org

'Biodiversity loss, environmental degradation and climate change are global challenges and should be considered everyone's issue. There are however conflicting views on how these issues should be tackled due to the different value systems people choose to adopt in order to protect, manage and even improve the environment. One school of thought argues that approaches involving environmental economic valuations will accelerate habitat and species destruction, while the opposing school of thought claims that traditional conservation approaches are not efficient enough or fast enough to protect biodiversity and that new approaches are required to address these challenges. I believe that conservation can only be successful when; it is driven by the people who live, with and rely on wildlife and wild landscapes and when it provides direct economic benefits to them. For this to happen, conservation needs to be more inclusive and offer more seats around the table to indigenous voices. Admittedly, there are now more African voices in conservation than ever before. However, even more voices, from the grassroots and frontlines of conservation, are needed.

Holistic evaluation of elephant management interventions in South Africa

Rob Slotow, Manqoba Zungu and Enrico Di Minin
University of KwaZulu Natal, antoinette@bteh.org

We document elephant management interventions from literature, surveys and reports by managers, and social media. There is technical ability to implement sophisticated interventions successfully, but effectiveness of indirect interventions (e.g. range expansion is not well understood. Half of reserves believe their elephant population is above carrying capacity, but only 1/3 use monitoring data; less than half would use culling. Challenges were identified with Damage Causing Animal Control (DCA), hunting, and translocation. Managers were concerned about reputational risk from hunting, confirmed through social media analysis – killing elephants raised strong negative sentiment, which can compromise ecotourism. A One Welfare approach (linking animal welfare, human well-being, and environmental health), ranked range expansion and contraception highest, while DCA was worst, followed by fencing, culling, and hunting. Managers identified reserve expansion, in a way that included local communities, as the most important approach to take. Non-interventionist approaches can achieve highest benefits, services, and values from elephants, in the most sustainable manner.

Climate change and regional tipping points in southern Africa

Francois Alwyn Engelbrecht
Global Change Institute, University of the Witwatersrand, Francois.Engelbrecht@wits.ac.za

Southern Africa is a hot and dry region, which under low mitigation climate change futures is likely to become drastically warmer, and likely also generally drier. This renders the region a climate change hot-spot, where climate change adaptation options are limited. The potential exists for the regional climate system to shift into a regime never experienced before, where high-impact and unprecedented climate events can occur, leading to the collapse of certain human or ecosystems. To such events are referred to as climate change induced tipping points. In this talk the potential of four major tipping point events occurring in the southern Africa region will be examined: a 'day zero drought' in Gauteng, the collapse of the maize crop and cattle industry under a future characterized by multi-year droughts and intense heat-waves, unprecedented heat-waves impacting on human mortality, and intense tropical cyclones making landfall as far south as Maputo or Richards Bay.

Three Cases of Wildlife Economy Value Chains

Reinhard Nyandire
African Wildlife Economy Institute, reinbonkenyandire@gmail.com

AWEI is exploring wildlife enterprise value chains from a landscape perspective. The project explores the possibilities for developing potential and existing wildlife enterprises to transform, enhance, and maintain African landscapes. Opportunities for sustainable markets in wildlife products vary and are influenced by such factors as market access, community involvement, wildlife population management, and regulatory frameworks. Using a value chain approach, the project will identify and assess key opportunities and challenges in relation to the enabling environment and enterprise development. A component of the

project to be presented at the ORC will investigate the value chains associated with three species – e.g., eland, kudu, and springbok. This investigation will trace the value chains of the markets for these three species – including game viewing, hunting, meat, and hide – and identify not only where value is added along the chains but also where sustainability outcomes can be enhanced. The insights from this investigation will raise awareness of the economic, ecological, and social contributions of the wildlife enterprises using these species.

JWO RESEARCH GRANT Snapshot – 3 years of groundbreaking research

Mobilising Africa's biodiversity experts to put nature on the decision-making map

Hayley Clements and 201 experts in African biodiversity

Centre for Sustainability Transitions, Stellenbosch University, clementshayley@gmail.com

How do African countries navigate socio-economic growth while still conserving the ecosystems on which people's well-being ultimately depend? Biodiversity and development are fundamentally intertwined yet typically treated as separate in policy and planning. Biodiversity indices need to better capture the elements of biodiversity that matter for ecosystem functioning and thus human well-being, enabling decision-making that accounts for the dependences between people and nature. To address this need, funded by a Jennifer Ward Oppenheimer Research Grant, this project has mobilized 201 biodiversity experts from 26 African countries. A series of structured expert elicitation processes provided insight into how the continent's changing landscapes are impacting the abundance of thousands of vertebrates and plants, and the important ecosystem functions that they provide. The resulting dataset is being used to produce a continental map of 'biodiversity intactness' that aims to be credible and useful to African decision-makers (<https://bii4africa.org/>). In this talk I will share lessons learned from the process of convening a continent-wide expert elicitation, as well as key insights.

Artificial light as a vector control strategy

Bernard Coetzee¹, Kevin Gaston¹, Izak Smit³, and Lizette Koekemoer⁴

¹University of Pretoria, bernard.coetzee@up.ac.za

²Exeter University

³SANPARKS

⁴WITS/NICD

Many medically relevant mosquito species show pronounced biological rhythms that are influenced by light and the artificial disruption thereof. Here we outline and report on our research programme to assess artificial light as an additional vector control strategy. It is based on three tiers – lab-based work, field work and modelling work. The lab work has illustrated a photopic suppression of feeding propensity, which implies that artificial light at night (ALAN), used in the correct times, types and intensities may be used as an additional vector control strategy. The field components are developing and testing novel techniques to measure artificial light at the household scale, to better understand how it can be practically optimized. Finally, the modelling work will better elucidate how artificial light interacts with other

environmental drivers to alter the attraction cascade, to better optimize ALANs use as a control strategy. Taken together, these approaches will help to employ ALAN more holistically to help reduce disease burdens, especially in the developing world.

Ecological impact of COVID-19 pandemic: Release of chemical contaminants from facemasks and effects on soil microbial and macrofauna species

Gideon Aina Idowu

Federal University of Technology Akure (FUTA), Nigeria, gaidowu@futa.edu.ng

An estimated 438 billion medical facemasks have been discarded into the environment as a result of the COVID-19 pandemic. While the use of facemasks may have proved effective in curbing the spread of the virus, their possible ecological consequences have been largely overlooked. Being synthetic polymers of petrochemical origin, the facemasks may release microplastics and organic compounds, which may adversely affect organisms in the natural environment. We have monitored the degradation of medical facemasks on soil environment, under the tropical climatic conditions of Africa, where indiscriminate disposal is common and impact may be most significant. This presentation will provide initial evidence of the release of microplastics, phthalate esters and toxic trace metals by facemasks dumped on soil environment. It will reveal the role of *Acinetobacter* and *Cellulomonas* bacterial species in the biodegradation of facemasks, following attack by environmental abiotic factors. Furthermore, it will reveal the unexpected positive impacts of facemasks in serving as food and breeding 'haven' for some specific soil macrofauna species, thereby contributing to their reproduction and survival.

Interactions between livestock, wildlife, and fire: Lessons from the Kenya Long-term Exclosure Experiment

Duncan Kimuyu¹, Kari Veblen², Corinna Riginos³ and Wilfred Odadi⁴, Lauren Porensky⁵, Grace Charles⁶, Eric La malfa², Ryan L. Sensenig⁷ and Truman Young⁶

¹Karatina University, dkimuyu@gmail.com

²Utah State University

³University of Wyoming

⁴Egerton University

⁵USDA Agricultural Research Services

⁶University of California, Davis

⁷Goshen College

For the last 27 years we have been studying interactions between cattle and wildlife and fire in series of eighteen 4ha plots at the Kenya Long-term Exclosure Experiment (KLEE). The exclosure plots keep away different combinations of herbivores, allowing us to disentangle the complex interactions between livestock, biodiversity, and fire in savanna ecosystems. Key results from this experiment include: 1) Cattle competitively suppress a broad spectrum of wild ungulates, including those that have traditionally been classified as browsers. 2) However, these negative effects of cattle may be mitigated by rainfall, fire, and elephants. 3) Effects of cattle on composition and productivity of herbaceous vegetation are similar to those of a diverse array of wild mammalian ungulates. 4) Cattle and wild ungulates unleash cascades via rodents to disease vectors and pathogens. Overall, cattle management, at moderate stocking densities,

has the potential to be compatible with the maintenance of considerable native biodiversity, although achieving these livestock densities in Africa is increasingly a challenge.

The Protected Area Paradox and the Refugee Species Concept

Graham Kerley

Centre for African Conservation Ecology, Nelson Mandela University, graham.kerley@mandela.ac.za

Protected areas are one of the central pillars of biodiversity conservation and comprise more than 20 million km² of the world's land surface (~15%). Paradoxically, despite this massive and growing investment in PAs, the number of endangered species is rising. One of the mechanisms behind this Protected Area Paradox are attempts to conserve species in suboptimal habitats, reflecting the global bias of PAs to less productive habitats, and shifted baselines of conservation managers. Refugee Species confined to suboptimal habitats suffer lower densities and fitness and achieve poor conservation outcomes. Range loss has occurred in 13% of 4785 mammal species globally, associated with niche shifts towards ecological margins. Identified Refugee Species transcend phylogenetic, geographic and ecological boundaries, and include the giant panda, European bison and gymnosperm trees. South African partial Refugee Species populations include Cape Mountain Zebra in grass-poor habitats and the last Knysna elephant. We urgently need to revise the conservation management of Refugee Species to improve their prospects of persistence and more effectively conserve species in protected areas.

Vultures nesting on the Highveld in Zimbabwe

Josephine Mundava¹, Peter Mundy¹, Ngoni Chiweshe², Rangarirai Huruba³ and Duncan MacFadyen⁴

¹National University of Science and Technology, Zimbabwe, jmundava@gmail.com

²CIRAD

³Shangani Ranch

⁴Oppenheimer Generations Research and Conservation

In southern Africa, vultures are in decline with many species being critically endangered or endangered. Vultures are currently mostly found in protected areas, and in some cases, they can be found on large commercial ranches. Outside of protected areas, human activities present an ever-tightening noose on vultures with increased mortalities threatening the viability of populations. Large livestock and wildlife ranches present a potential haven for breeding and foraging vultures. We explored the use of the holistically-managed Shangani Ranch (Midlands, Zimbabwe) by nesting White-backed Vultures. Results show the Ranch to support more than 30 nesting pairs of vultures over five successive breeding seasons; with numbers increasing each year – and new nesting areas being utilised. This shows the importance of working ranches towards the success of breeding and foraging critically-endangered vultures outside of protected areas. It also shows the importance of holistic management toward conservation success.

Cooperative building behaviour of the white-browed sparrow weaver (*Plocepasser mahali*)

Maria Cristina Tello Ramos¹, Susan D Healy¹, Lauren Guillette² and Andrew Young³

¹University of St Andrews, mctr@st-andrews.ac.uk

²University of Alberta

³University of Exeter

The trees of the Kalahari are filled with structures built by white-browed sparrow weavers (*Plocepasser mahali*). These prolific builders live in large families and like many other animals in the Kalahari, they cooperate to survive. Do these birds also cooperate when building these complex structures? Here we present evidence that the structures built by different families studied at the Tswalu Kalahari Reserve are morphological distinctive. We found that despite multiple birds building a single structure, families build structures with an “architectural signature”. The length of the entrance and exit tubes, the angle between tubes and the total width of the roosts differ between families and thus these roosts may be the result of differences in the decision-making process of the families. To explain this result, we measured the distance between families, temperature and wind speed in the territories of all families, size of the birds of different families as well the genetic relatedness between individuals of different families. We found that the contribution of all these factors is small if not null, suggesting a possible role for socially transmitted “architectural traditions”.

The importance of a traditional Jersey Cow in Smallholder Farming

David Hambrook¹ and Andre Tranquilini²

¹Jersey Island Genetics, estatemanager@walthamplace.com

²Waltham Place Farm

Even though the Jersey breed is the second most numerous dairy breeds in the world, the number containing the original population bloodline is of concern. The original population are smaller in stature and whilst more robust lighter in weight with feed intake still relative to productive output. This is a significant advantage for farmers with limited resources, and the productive efficiency reduces GHG emissions relative to production. We will share recent scientific research providing weight to an increasing volume of evidence that supports the Jersey breed’s value in improving incomes and food security for resource poor smallholder dairy farmers and their families in developing economies and in the UK. By sharing examples and case studies from Jersey, England and African countries including Rwanda, Malawi and Ethiopia, this presentation will highlight the conservation value and importance of the original population of the Jersey dairy cow, aiming to share its relevance in a changing world and looking into future directions.

The nature of the Kalahari Butterfly Migration in some numbers

Reinier Francois Terblanche

Department of Conservation Ecology and Entomology, Stellenbosch University, South Africa,
reinierf.terblanche@gmail.com

Butterfly counts made from January 2014 to January 2022 show that 21 butterfly species migrate in a north-easterly direction in the annual Kalahari butterfly migration across southern Africa. This embodies

the highest number of species taking part in any annual butterfly migration within the region. The main species comprising the migration are *Belenois aurota* and *Catopsilia florella*. The former is the most abundant migrant in the mid-summer and the latter in autumn. The research confirms return flights among partaking butterfly species for the first time, given that sufficient incidences of this phenomenon have been observed. This changes the understanding of the migration. These observations further underscore the advantages of using timed butterfly counts at Pollard walk transects and rectangular sample plots. *Boscia albitrunca* is the main host plant source for the migration of the butterfly *Belenois aurota* in the Kalahari. The presentation will further discuss phenological studies at GPS-marked individual *Boscia albitrunca* trees, within the Tswalu Kalahari Reserve. In conclusion, the presentation posits that the sheer number of butterflies that migrate during the Kalahari butterfly migration embodies one of the most remarkable migration events on the earth.

Can Private Conservation be Profitable? Maximising net economic returns from conservation at Tswalu Kalahari

Emily van der Merwe and Arnold Meyer
Nianova, arnold.meyer@nianova.net

Private conservation and the role of private landowners are key to increasing the size and number of protected areas in South Africa and elsewhere on the continent. Yet, financing is a pressing concern for many private conservation projects and stakeholders. Assuming that private landowners are rational individuals who seek to maximise net returns and maintain the value of their balance sheet, this paper uses Tswalu Kalahari as a case study to test a model for comparing the net returns from cattle farming to various conservation-based land uses, including ecotourism, rare game breeding and trophy hunting. With the incorporation of current and future land restoration and conservation costs into the model, it shows the net balance sheet impact of each of these land use cases from the perspective of the private landowner, as well as some broader societal implications of private conservation. The result is a theoretical model that predicts the “crowding-in” of private funding into conservation, to the benefit of local communities and biodiversity alike.

Genetic management of African biodiversity

Yoshan Moodley
University of Venda, yoshan.moodley@univen.ac.za

The age of evidence-based conservation is upon us. Efficient and appropriate conservation management decisions are increasingly based on scientific research. Genetics is undisputedly an important tool for managing wildlife populations over the long term. This is because, ultimately, it is the evolutionary potential of a species that we wish to conserve, and not just high numbers of a particular species or population within a species. South Africa has a long history in conservation genetics research with several key laboratories across the country. Genetic considerations are also firmly entrenched in national policies on wildlife management. However, there are few examples where active conservation management in South Africa is informed by genetics. Why is the implementation of genetic recommendations on the ground still so challenging? In this talk I will outline this issue and present a range of potential solutions. I will end with a straightforward key for conservation managers, to help determine whether their populations require a genetic intervention, and where best to source potential animals/plants/etc for the intervention.

Poster session abstracts

1. Fine-scale analysis of micro-charcoal particles from modern soils reveal difference in African savanna fire regimes: implications for ecosystem management

Abraham Dabengwa, Sally Archibald, Marion Bamford and Caroline Lehmann
University of the Witwatersrand, abrahamdabengwa@gmail.com

Fires in savanna are an ancient disturbance process whose manipulation by humans is useful for improving forage production and promoting functional heterogeneity in landscapes. Palaeo-ecological studies suggest that fire characteristics or 'regimes' of past environments are indicated by charcoal particle assemblages at depositional environments. However, interpreting charcoal assemblages is difficult because of many systems for quantifying relevant particle sizes and their significance. In this study, we compared micro-charcoal particle concentrations in modern soils from Kruger National Park using five size classes from patches with known fire and grazing histories. We found that at coarse-scale, charcoal concentration separated long-term sites with contrasting fire histories, but that concentrations from recently established combined fire and grazing sites and the frequently burnt site were comparable. Longer disturbance histories corresponded with distinct separation of charcoal particle sizes at fine-scale.

2. Leveraging host genomics to diagnose neurological COVID-19

Adrian John Brink¹, Ruan Marais¹, Diane Hardie¹, and Ephifania Geza²

¹Division of Medical Microbiology, Faculty of Health Sciences, University of Cape Town, adrian.brink@uct.ac.za

²Bioinformatician: Division of Computational Biology, Faculty of Health Sciences, University of Cape Town

Background: Neurological symptoms are found in up to a 3rd of patients with the severe SARS-CoV-2 pneumonia and include convulsions and stroke. The hypothesis for neuro COVID (and long COVID) relate to immune dysfunction. Methods: We leveraged molecular data generated by metagenomic next-generation sequencing of the cerebrospinal fluid of 47 patients admitted to Groote Schuur hospital, Cape Town, to characterize the host response. We analyzed and compared differential expression of host RNA in 2 cohorts, those who were COVID-19 pos versus neg. Results: Relative up- and downregulation of multiple genes, as determined by host RNA sequencing was observed. The differential expression between COVID-19 and non-COVID-19 patients included genes associated with cellular energetics (and inferred cell damage due to hypoxia) and long-noncoding RNA molecules (and inferred induction of inflammatory gene expression). Conclusion: The array of host RNA transcripts (transcriptome) produced in neuro-COVID-19 patients appear to qualitatively and quantitatively differ from Covid neg patients. Host RNA analysis may be a valuable diagnostic tool to facilitate directed treatment for viral infections.

3. Terrestrial diet in an unprotected crocodile population

Albert Myburgh¹, Hannes Botha², Xander Combrink³, and Jan Myburgh¹

¹University of Pretoria, albert.isotopes@gmail.com

²University of Limpopo

³Tshwane University of Technology

Nile crocodile (*Crocodylus niloticus*) populations in South Africa are under threat. Population management is hampered by uncertainties in the feeding ecology of crocodiles. Here, we present data suggesting terrestrial diet dependence in an unprotected Nile crocodile (*Crocodylus niloticus*) population in the country's most threatened freshwater system, the Olifants River, Mpumalanga and Limpopo Provinces, South Africa. Nitrogen stable isotope ratios were obtained from fish and crocodile populations along the length (± 430 km) of the river in South Africa. Incorporation of pollutants in fish elevates $\delta^{15}\text{N}$ values along the river and provides a basis for tracking the trophic levels of crocodiles as a response to that of fish. Crocodiles in this river did not respond to changes in the $\delta^{15}\text{N}$ values of fish populations and predicted dietary components could only be derived from terrestrial sources.

4. In hot water: The fate of southern African freshwater fauna under climate change scenarios

Amanda Laura Adlam¹, Christian Chimimba¹, Hugo Retief², Stephan Woodborne³

¹Department of Zoology and Entomology, University of Pretoria, amanda.adlam@up.ac.za

²Association for Water and Rural Development (AWARD)

³iThemba LABS

Freshwater systems are vital to the persistence of biological life and are arguably the most threatened ecosystem facing a myriad of anthropogenic disturbances including climate change. In this study, we model the response of a freshwater ecosystem in southern Africa to climate change. Modelling techniques simulate daily ($E_f = 0.81$) and monthly ($E_f = 0.95$) water temperature in two South African rivers, using air temperature. Using the validated model under the representative concentration pathway (RCP) 8.5 projections of future air temperatures for the area, our results show that there will be a 3.7°C increase in monthly and a 4.6°C increase in daily average water temperatures by the year 2100. The effects of this increase in water temperature have implications on individual freshwater fish and macroinvertebrate species in southern Africa. Ultimately, climate change may result in both chronic and acute heat stress in freshwater fauna, leading to mass die-offs, local extinctions and disruptions in trophic interdependencies.

5. Five small antelope species diets indicate different levels of anthrodependence in the Overberg Renosterveld, South Africa

Amaurée Jansen van Vuuren¹, Jan Venter¹ and Herve Fritz^{1,2}

¹Nelson Mandela University, s215106210@mandela.ac.za

²University of Lyon

The Overberg, Western Cape, South Africa is highly suitable for agricultural practices and has been severely transformed over the last four centuries. This has created a novel habitat for many wildlife species. The objective was to determine the forage use of five antelope species and thereby assess their level of

anthrodependence in terms of diet. The five species were bushbuck (*Tragelaphus sylvaticus*), Cape grysbok (*Rhaphicerus campestris*), common duiker (*Sylvicapra grimmia*), grey rhebok (*Pelea capreolus*) and steenbok (*Rhaphicerus campestris*). To do this we performed a histological analysis on dung samples collected. Our study indicated a high ratio of crops anthropogenic to natural vegetation in the diets of bushbuck, grey rhebok and steenbok, as anthropogenic vegetation presented a high nutrient food resource which is easily accessible. However, Cape grysbok and common duiker indicated a higher use of natural vegetation. The results indicated that all the species benefit from the resources offered by the altered landscape and that some species may be dependent on these resources while others appear to be more dependent on the pockets of natural vegetation in the landscape.

6. A paired tower approach to compare carbon dioxide and water vapour fluxes between two vegetation types representing Savanna and Nama-Karoo Biomes at the Benfontein Nature Reserve

Amukelani Maluleke¹, Gregor Feig², Christian Brümmer² and Guy Midgley¹

¹Stellenbosch University, amukelanimaleke940806@gmail.com

²SAEON/EFTON

African semi-arid ecosystems are subject to multiple anthropogenic pressures such as climate change and increasing concentrations of atmospheric carbon dioxide, which potentially alter ecosystem and biogeochemical processes and may result in important feedback loops of terrestrial productivity. This study uses paired Eddy Covariance flux towers to improve the quantitative understanding of CO₂, H₂O and energy exchange over diurnal and seasonal dynamics in two distinct vegetation types representing the Savanna and Nama-Karoo biomes over the wet and dry seasons. The towers are located within ~4 kilometres of each other, under closely matched variations in climatic conditions, at the Benfontein Nature Reserve, near the city of Kimberley. Higher GPP and NEE was observed at Savanna than Nama-Karoo while incoming radiation, VPD and air temperature appear to drive GPP with soil moisture being a key variable for productivity at both sites. A higher eWUE is observed at the Savanna site over a daily time scale – fixing more carbon per unit of water than the Nama-Karoo site over a 2-year period.

7. Multiple lines of evidence to evaluate the fish communities in the Limpopo River Basin, southern Africa

Angelica Kaiser¹, Stephan Woodborne², Annelize Van der Merwe¹ and Gordon O'Brien¹

¹University of Mpumalanga, angelica97.ak@gmail.com

²iThemba LABS

Freshwater ecosystems are vulnerable and endangered globally, despite providing valuable and irreplaceable services to human communities. The Limpopo Basin has high aquatic biodiversity, but the water resources of the basin have been heavily used and today it is unclear if the rivers are able to maintain the historical fish communities. Multiple statistical and biotic lines of evidence were used to evaluate the relative shifts in the community structure and potential changes from the historical frequency of occurrence of species. During this study 37 of the expected 77 fish species were collected and significant changes in the fish communities from historical conditions were identified. The fish community structure is in a moderately modified ecological state, with deteriorating water quality, altered flows and habitat

alterations identified as drivers of change of the fish communities. The excessive use of the water resources of the Limpopo River appears to have resulted in changes that may not allow the historic biodiversity to persist in the Basin. Urgent Management actions are required to achieve a sustainable balance between the use and protection of the system.

8. Interrelationships of warthogs, Ornithodoros ticks and African swine fever virus in South Africa

Anthony Francis Craig¹, Livio Heath², Jan Ernst Crafford¹ and Robert Swanepoel¹

¹Department of Veterinary Tropical Diseases, Faculty of Veterinary Science, University of Pretoria, Onderstepoort. af.craig83@gmail.com

²ARC – OVR Transboundary Animal Disease Programme Laboratory (TADL), Onderstepoort

African swine fever virus (ASFV) causes a contagious and lethal disease of domestic pigs. In eastern and southern Africa, the virus circulates between warthogs that develop benign viremic infection and ticks of the Ornithodoros moubata complex. In South Africa, the disease was first seen in the north of the country where domestic pigs had contact with warthogs, ostensibly through consumption of infected tissues or transmission through the intermediary of ticks. Outbreaks elsewhere were initiated by movement of infected pigs or pork products. Consequently, a controlled area was declared in 1935 to include the known distribution of warthogs at the time, and movement of pigs and pork products was regulated. However, from 2016, outbreaks south of the controlled area have occurred with no link to infection from the north. Meanwhile, there has been an increase in informal pig farming in South Africa and widespread translocation of warthogs south of the controlled area. We tested sera from warthogs for the presence of ASFV antibody, and ticks for presence of ASFV and confirmed extension of sylvatic circulation of ASFV beyond the controlled area in South Africa.

9. Accelerating uptake of regenerative agriculture by smallholder farmers in African Landscapes

Antony Emenyu

University of Exeter, emantoph@gmail.com

Smallholder farmers are central in food security within Africa. Unfortunately, due to their low adoptive capacities, operation on highly degraded soils and dependence on rain-fed agriculture, smallholder farmers also bear the full weight of climate change impacts on agriculture thus limiting their potential contribution. Despite a number of well tested interventions like regenerative agriculture being promoted to boost their resilience, the rate of adoption of these interventions is too low to effectively curb climate change impacts. By investigating the success of the Small Group and Tree Planting (TIST) program in East Africa, this study explores the possibility of leveraging the payment of ecosystem services to boost regenerative agriculture adoption rates and scale-up their contribution to climate change resilience. Beyond contributing to the scholarly literature, the findings of this study will be used to inform works of various partners across Africa such as African Parks (AP), UNESCO, Global Ever Greening Alliance and others.

10. The impact of artificial light spectra and intensity on the feeding behaviour of *Anopheles gambiae*

Arlin Viljoen¹, Bernard Coetzee¹, Lizette Koekemoer², Megan Riddin¹ and Ashley Burke²

¹University of Pretoria, u17265704@tuks.co.za

²University of Witwatersrand, Johannesburg

Mosquitoes are important vectors for a wide range of parasites and pathogens which cause severe illnesses in humans. Mosquito blood feeding propensity is defined as the proportion of mosquitoes that successfully blood feed. Our research group has shown that artificial light suppresses mosquito blood feeding. By better understanding the impact of artificial light at night on mosquito blood feeding propensity, artificial lighting that reduces mosquito-borne disease transmission can be implemented. Here we aim to determine what effect light spectra and intensity have on the blood feeding propensity and preference of *Anopheles gambiae*, a major malaria vector across Africa. Under laboratory conditions, we conducted biting assays to measure blood feeding propensity and choice tests to measure blood feeding preference. Preliminary results indicate that blood feeding propensity is reduced under greater intensity LED lights than under lower intensity LED lights. In addition, blood feeding propensity is lower under shorter wavelength LED light than under longer wavelength LED light. These results indicate that artificial light at night could be operationalised as a vector control strategy.

11. Non-Tariff Barriers Inhibiting Inter-Continental Trade in Wildlife Meat: Pertinent Issues Identified in Namibia, South Africa and Tanzania

Biandri Joubert

African Wildlife Economy Institute, biandrijoubert@gmail.com

Wildlife meat should theoretically benefit from the liberalisation of inter-continental trade and the opportunities offered by the Agreement establishing the African Continental Free Trade Area (AfCFTA). The AfCFTA is, however, unable to liberalise the inter-continental trade in wildlife meat on its own. Various actors will interact along the value chain in the application and enforcement of this agreement and its success relies on co-operation and facilitation of agreed upon processes and procedures by member states. Barriers to trade inevitably arise when multiple countries trade with one another. Therefore, a product specific understanding of existing and persistent associated non-tariff barriers (NTBs) is necessary to identify and understand challenges that require National, Regional or Continental level co-operation to resolve NTBs if the AfCFTA is to facilitate mutual economic benefit to parties to the AfCFTA in the trade of wildlife meat. This research primarily aims to evaluate the AfCFTA's NTB mechanism in terms of its accessibility to producers or exporters and its ability to identify and facilitate the elimination of identified NTBs.

12. A preliminary assessment of elephant movement around Gonarezhou National Park to inform spatial conservation prioritisation in the GLTFCA landscape

Bob Mandinyenya

Gonarezhou Conservation Trust, bob@gonarezhou.org

Land has become a limited resource that must fulfil multiple functions and land use strategies require the integration of conflicting demands of society and wildlife on resources. Most animals have become constrained within protected areas and many herbivore populations in Gonarezhou National Park (GNP) are geographically isolated. Through monitoring data from 21 elephants collared since 2016 it has been possible to illustrate elephant movement based on the Landuse systems beyond the park boundary with the goal being to determine the socio-environmental attributes of landscapes which are mostly used by elephant cow herds and bulls when they disperse beyond the park boundary. This study explores data on how much time cow herds and bulls spend outside the protected areas boundary and also, the types of land use systems they utilise once they are outside the boundaries of the park. Five of the 21 collared elephants showed movement into Mozambique, but some continued to return into GNP during the day and at certain times of the year, with males ranging the furthest from the boundary than cow herds. These form the baseline of a study on modelling spatial conservation prioritization.

13. Bridging the gap between morphological and molecular identification of coastal diatoms

Brishan Kalyan¹, Thomas Bornman¹ and Gavin Snow²

¹University of Witwatersrand/ Nelson Mandela University, brishanrhk@gmail.com

²South African Environmental Observation Network

An environment's phytoplankton diversity alters the ecosystem services it provides. Phytoplankton communities are dominated by diatoms, a single-celled algae found in water, the most diverse microalgal taxa providing ecosystem services locally and globally. Using diatoms to infer environmental change may help better monitor coastal waters but few species that are identified by morphology are identified using molecular data. Diatoms were isolated and cultured from samples from Algoa Bay and monocultures obtained from Dr. Majewska. Morphology and molecular data were used to identify cultures then data was uploaded to the Barcode of Life Data Systems. Monocultures were digested using 2 different organic matter digestions for identification and imaged on light and scanning electron microscopes. DNA was extracted on the ribulose-1,5-bisphosphate carboxylase/oxygenase gene and sequenced in both directions by Sanger sequencing. 19 of 24 cultures were identified in this study, 7 to genus and 12 species, with 4 of the 12 only identified by morphology. This study made a small, but significant contribution to the global barcode reference libraries for diatom species identification.

14. Safari-wildlife tourism in Southern Africa: Understanding the effects on observers and the observed

Bruce Crossey, Andre Ganswindt and Elizabeth Pienaar

Mammal Research Institute (MRI), University of Pretoria, bruce.crossey@up.ac.za

We present how electrodermal activity data provide a useful tool to measure tourist's psycho-physiological response to viewing wildlife. Further, we demonstrate how these data have the potential assist in identifying safari-wildlife tourism preferences by investigating how the viewing of different species-interactions, specific behaviours, or variation as a result of viewing different species may trigger varying levels of psychologically arousal for guests engaging in safari-wildlife tourism.

15. Vegetation description around the EFTEON flux tower at Benfontein Nature Reserve, South Africa

Buster Mogonong^{1,2}, Helga van der Merwe², Gregor Feig², Tshililo Ramaswiela² and Amukelani Maluleke³

¹Wits University, b.p.mogonong@gmail.com

²SAEON arid lands node

³Stellenbosch University

We surveyed woody vegetation in five square 1 ha plots while the herbaceous layer was sampled across 105 circular plots following the SEOSAW protocol. We applied SCD methods to describe the woody vegetation around one of the EFTEON flux towers at Benfontein Nature Reserve, Kimberley, South Africa. The herbaceous layer was described by species counts, basal cover quantification, dry biomass measurement, and diversity analysis. We found five tree species to occur in the plots which were dominated by *Vachellia erioloba*. Recruits (trees between 0 and 1 m in height) constituted 95.9% to the overall woody vegetation abundance in the landscape, while only 4.1% of the individuals were large trees (between 1.2 to 9.5 m in height). The population structure of the woody vegetation yielded a Type IIIa curve for all tree species except for *Ziziphus mucronata* which yielded a Type IIIb. The herbaceous layer consisted of 42 species of which 10 were grass and 32 forbs. *Schmidtia pappophoroides* was dominant with a high count of individuals, basal cover and dry biomass. There is a high number of recruits, however, long term data in this reserve is needed to capture woody and herbaceous vegetation interactions.

16. An updated catalogue and review of Afrotherians (Afroplacentalia) Mammals in the Amathole Museum Collection, Eastern Cape, S. A.

Buyiswa Mahala-Nobomvu

Amathole Museum, sheshisa@yahoo.com

The Mammalogy Collection of the Amathole Museum is one of the most comprehensive mammal collections in Africa, with a specialisation in southern African fauna. It was accumulated over almost 100 years, in some instances from areas that no longer support sustainable populations of wildlife. The collection, therefore, is irreplaceable. A museum collection is only as good as its accessibility to students and researchers for it to perform its functions as a biodiversity archive. Accessibility, in turn, depends on up-to-date taxonomy and classification; good curation practices; public awareness of the collection; and electronic access to the details of the collection's composition. The higher-level taxonomy of the Class

Mammalia has undergone extensive changes since the adoption of molecular systematic techniques. Phylogenetic reconstructions based on large DNA sequence databases consistently group placental mammals into four superorders: Laurasiatheria (carnivores, bats, ungulates, whales); Euarchontoglires, a super-clade that includes primates (apes, monkeys and allies), rodents (mouse, rat and guinea pig), lagomorphs, (rabbit and hares), dermopterans (flying lemurs or colugos).

17. Integrating trophic level with the niche variation hypothesis: A comparison of individual niche variation between mammal herbivore and carnivore populations

Chanel Lewis, Runè van der Merwe and Daryl Codron
University of the Free State, chanellewis11@gmail.com

Individualization of niches is an important mechanism where animals are thought to mitigate the effect of competition for resources in limiting environments. We collected data for within-population niche variation amongst different mammalian carnivore and herbivore species, based on stable carbon and nitrogen isotope analysis. These data represent both cross-sections through populations derived from faeces collected at the same time, and longitudinal histories of individuals derived from hair profiles. Analysis of ellipses in isotopic bi-space and a set of community-wide metrics on cross-sectional data, indicates more individual separation in populations of carnivores than in herbivores, even accounting for species-level differences in isotopic niche breadths. Analyses of within-individual variation from time series data also indicate more individual niche separation in carnivore populations. Herbivores, by contrast, display relatively more niche variation within individuals. These results correspond to predictions of a model, based on differences in nutritional and ecological constraints, that indicated individualization should be more prominent amongst carnivores than herbivores.

18. The impacts of climate change on meerkats and ground squirrels at Tswalu Kalahari Reserve

Chanel Rampartab¹, Andrea Fuller¹, Tobias Wang², and Edward Snelling³

¹University of the Witwatersrand, chanel.rampartab@gmail.com

²Aarhus University

³University of Pretoria

Hotter and drier weather resulting from climate change is already exerting a negative influence on fitness and survival of mammals. This impact is exacerbated in resource- scarce semi-arid habitats where small mammals are particularly vulnerable given their high mass-specific metabolism and limited ability to store food and water. In my poster, I will present my PhD research protocol to investigate how climate change-induced fasting and dehydration affect the behaviour and physiology of two small diurnal mammal species, the meerkat and the Cape ground squirrel, in the semi-arid Tswalu Kalahari Reserve in the Northern Cape. I will measure changes in environmental conditions and monitor the behavioural, physiological, and reproductive performance responses of both species. The PhD will form part of the Kalahari Endangered Ecosystem Project and involve a collaboration between teams at the University of the Witwatersrand, University of Pretoria, Copenhagen Zoo and Aarhus University in Denmark.

19. Mass conservation translocations and introductions of Southern White Rhino (*Ceratotherium simum simum*) as a conservation strategy to reduce the threat of extinction. With particular focus on the recent large translocation and introductions into Akagera National Park, Rwanda

Charli Pretorius and Simon Naylor

andBeyond Phinda Private Game Reserve, charli.devos@andbeyond.com

Effective field protection of rhino populations coupled with biological management decision-making aimed at managing rhino populations for rapid population growth has been critical for the persistence of southern white rhino. This has resulted in surplus animals been translocated to set up new populations. In November 2021, andBeyond and African Parks undertook the largest translocation of southern white rhino from Phinda Private Game Reserve in KwaZulu-Natal, South Africa to Rwanda's Akagera National Park. The objective of the translocation and introduction was to create a new population of the species which would in time become one of global significance. Akagera National Park was not part of the historical range and distribution of the species or sub species and therefore a conservation introduction according to the IUCN. Assisted colonisation is the intentional movement of an organism outside its indigenous range to avoid extinction of populations of the focal species. This talk will be a visual and informative presentation into the objectives, planning, logistics, implementation and translocation of the 30 animals from Phinda Private Game Reserve to Akagera National Park.

20. Applying resilience thinking to increase the inclusion of women in environmental sustainability in communities adjacent to protected areas in South Africa and Tanzania

Claire Fordred and Kevin Mearns

University of South Africa (UNISA), cfordred@gmail.com

Africa is a continent filled with many cultural values and traditions which play a major role in gender-related activities, especially for women. This research explores two case studies of communities adjacent to protected areas in South Africa and Tanzania. It has been recognised in the Tanzanian context that women are to abide by household duties more so than in the South African context. Gender inequality is an obstacle to maintaining a socio-ecological system. Addressing these discrepancies could open many future opportunities in the diversity and adaptation of communities and gender roles. Qualitative research was applied through interactions and conducting interviews. Collected data, representing variations in the involvement of women in sustainable environmental practices and how this influences the livelihoods of communities. Community women are open to opportunities for learning and practicing environmental approaches, which will empower them and improve the livelihoods of their communities. By applying resilience thinking of diverse adaptable approaches, future doors are open to women being more actively involved in sustainable environmental activities.

21. Conservation partnerships for conservation action: 15 years of growing the Northern Cape conservation estate

Conrad Geldenhuys, Johan Jonk, Elsabé Swart, Malebo Manyala, Ralph van der Poll and Mandy Schumann
Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform, conradgeldenhuys@gmail.com

As public custodian for biodiversity protection in the province, the Northern Cape Department of Agriculture, Environmental Affairs, Rural Development and Land Reform follows legislative and policy instruments to expand the provincial conservation estate. For an extended period either side of the turn of the century the expansion of conservation areas outside of National Parks had stagnated in the Province. It was only during the last 15 years that renewed impetus was given to conservation action through the compilation of supporting planning frameworks, institutional capacity generation, the establishment of public-private partnerships and landowner enthusiasm. The recent implementation of biodiversity offsets or “producer must pay” sustainable development principles is an additional facility for conservation estate expansion. These active and passive expansion drivers are a positive development for biodiversity conservation. Additional pressures are however placed on government resources through the screening of proposed conservation sites, facilitating the declaration processes, assisting with conservation area management planning and monitoring, extension services, and audit

22. A causal link between individual variation and the maintenance of biodiversity in multispecies communities

Daryl Codron, Rune van der Merwe, Chanel Lewis and Aileen van der Mescht
University of the Free State, CodronD@ufs.ac.za

Many populations are non-randomly structured because individuals occupy distinct portions of the total niche space. This individual niche variation (INV) likely evolved as a strategy to reduce competitive niche overlaps and promote overall population fitness. To study the fitness consequences of INV, we introduce individual stochasticity to a well-known model of multispecies competition. We show that INV reduces not only intra- but also inter-species competition intensity. However, although the additional niche differences should improve fitness, species' competitive abilities are also increased, so that elevated INV does not necessarily prevent exclusion. Coexistence potential is only improved in mixed communities where species have different levels of INV. Here, populations with low INV experience less competitive niche overlap from populations with high INV, but also encroach on the niche space of the latter. INV can therefore be seen as a frequency-dependent evolutionary game in which the benefits are offset by the strategy adopted by other members of the community. This trade-off likely biases perceptions of the functional role of species in many wildlife preservation areas.

23. Soil *Fusarium* survey in the Tswalu Kalahari Reserve

Eduard Venter¹, Adriaana Jacobs², Brett A Summerell³ and Rian Pierneef²

¹University of Johannesburg, eduardv@uj.ac.za

²Agricultural Research Council

³Australian Institute for Botanical Science, Royal Botanic Gardens and Domain Trust, Australia

The fungal genus *Fusarium* hosts a large amount of species that are plant and human pathogens. Unfortunately, the natural distribution of *Fusarium* has not been well studied. Species in the genus *Fusarium* are characterised by significant variation in morphological characters that are routinely used in species identification. However, some species proved difficult to identify morphologically, requiring the development of extensive phylogenetic protocols to aid in species identification. The *Fusarium* soil survey assesses the biodiversity of *Fusarium* species from soils with low anthropological disturbance in the different biomes of South Africa. The survey has been expanded to include the arid regions of South Africa and a survey of the Tswalu Kalahari Reserve has contributed ca. 300 isolates to the survey. This survey contributes towards establishing the natural range and diversification of species in this important genus and contributes towards the National Collections of Fungi (NCF). This strengthens the capacity to form South Africa's national and international legislation regarding mycology and to predict the development of new pathogens on crops in South Africa.

24. The effect of biodiversity garden age on insect assemblages

Elke Gwynneth Meyer, Catherine Lynne Sole, Johann Christiaan de Beer, Christina Ida Breed and Christian Walter Werner Pirk

University of Pretoria, Department of Zoology and Entomology, u17018732@tuks.co.za

The projected increase and accelerated urbanisation in Sub-Saharan Africa threaten biodiversity. Insects are essential for food security and ecosystem services but are undergoing a critical decline due to anthropogenic activity. The introduction of urban green infrastructure can be used to provide refugia for various animals. This is the aim of the Biodiversity and Ecosystems in Tshwane project. Two gardens comprising of plants native to Tshwane have been established, the one at the Future Africa Research Complex and the other at the Javett Art Centre. These gardens differ in age by three months. This study aims to see whether these differences affect the insect assemblages. Insects were collected and identified. The biodiversity of the insects was calculated and compared across gardens and ages (per season). The assemblages in the two gardens were compared to an undisturbed grassland and a monocotyledonous garden on the University of Pretoria grounds. The results indicate that garden age and different seasons have an effect on insect assemblages. More studies need to be done to look at other effects such as edge effects, disturbance and microclimates on these insect assemblages.

25. Chemical communication of drones of *Apis mellifera scutellata* (Lepeletier)

Eloise Sarah Butcher, Abdullahi Ahmed Yusuf and Christian Pirk

Social Insects Research Group, Department of Zoology and Entomology, University of Pretoria, eloise.sarah@gmail.com

Honeybees, *Apis mellifera* (Lepeletier), are responsible for pollinating 33% of crops and can be kept in hives making them the ideal choice to supplement areas of low natural pollinator populations. Honeybees

are eusocial thus the hive must be cohesive to reduce their vulnerability to threats. A hive has a single reproductive queen and multiple female workers, whereas males (drones) are only produced for reproduction in spring/summer. Much research has been conducted on the communication amongst workers and the queen, but little is known about drone communication. It is known that drones communicate with workers within the hive, with other drones and virgin queens at drone congregation areas and again with workers when returning to a hive after an unsuccessful mating attempt. We aimed to determine the chemical signals used by to communicate. The cuticular hydrocarbons of savannah honeybee drones (*A. m. scutellata*) were analyzed using gas-chromatography mass-spectrometry methods to determine the composition and quantities of the drones' communication signals. The results were compared between age stages to determine if ontogenic changes occur and if communication differs between hives.

26. Reptile community responses to an avian ecosystem engineer

Emma Buckley and Bryan Maritz

University of the Western Cape, emma.e.buckley@gmail.com

In the Kalahari, Sociable Weavers (*Philetairus socius*) build huge, communal nests. Although Kalahari Tree Skinks (*Trachylepis spilogaster*) are known to preferentially utilize trees that host such colonies, the degree to which other reptiles use these trees is not fully understood. We trapped reptiles at Tswalu Kalahari Reserve to assess the impact of Sociable Weaver colonies on selected reptile populations. We tested the hypothesis that reptile species under trees with colonies have different abundance and diversity than nearby control trees without colonies. We trapped reptiles for 11 days at 24 sites (12 colony trees, 12 control trees) which resulted in 450 total detections of 11 reptile species, including 94 recaptures. On average, species richness was 2.5 times higher at colony trees than control trees. N-mixture modelling revealed that *T. spilogaster* were 3.2 times more abundant on colony trees, while Royal-Nichols modelling revealed that *P. capensis* were 25 times more abundant on colony trees, and that *N. nivea* were 13 times more abundant on colony trees. Our work reveals that colonies play an important role in structuring reptile communities through non-exclusive mechanisms.

27. Modelling the resilience of ecosystem service provision in African landscapes

Enimhien Akhabue

University of Exeter, enimhien_akhabue@uniport.edu.ng

African ecosystems provide various essential services such as food and water. Due to urbanization, climate change, and population growth, African ecosystems have been under more strain, particularly in recent decades. Understanding the resilience of these services can help inform their sustainable utilisation to support development benefiting people in Africa. Numerical models are important tools for understanding the present condition and likely future state of landscapes and the services they provide. This poster introduces a new PhD project examining the resilience of African ecosystem by application of the Joint UK Land Environment Simulator (JULES) land surface model. This will include simulation of ecosystem services, the collation of new data and model development to improve the relevance of land surface models for these landscapes. This will improve the value of JULES for decision makers in Africa as a tool to design and implement sustainable land management strategies.

28. The Influence of Carcass Decomposition on Soil Nutrient Composition and its Effects on Growth of *Gazania rigens* (L.)

Erika Anne Kullander, Miranda Susan Deutschlander and Veronica Mpode Ngole-Jeme
University of South Africa (UNISA), 53109627@mylife.unisa.ac.za

This research project forms part of the Department of Nature Conservation, Unisa's: Death in the long grass project. The aim of project was to develop an understanding of the ecological dynamics associated with decomposition of blue wildebeest (*Connochaetes taurinus*) carcasses in a grassland ecosystem as nutrient islands. This project investigated the effect of liquid influx from decomposing blue wildebeest carcasses on soil nutrient content at various stages of decomposition, and the effect thereof on growth of indigenous plants *Gazania rigens* (L.). Ten blue wildebeest carcasses, five caged and five pegged, were placed at suitable localities in grasslands at Telperion Nature Reserve, to assess the influence of soil nutrient inputs on plant growth, 120 five-week-old *G. rigens* seedlings were planted in the soils collected around each carcass before placement of carcasses, and at three-week intervals during the decomposition process. Noticeable differences were observed between plants grown in soils collected from decomposing carcasses, compared to those grown in soils collected before placement of carcasses, especially in the number of leaves, leaf lengths, fresh and dry leaf weight.

29. Genetic diversity in free-ranging and captive black-footed cat (*Felis nigripes*) populations from South Africa

Erin Davis, Armanda Bastos and Adrian Tordiffe
University of Pretoria, u17120854@tuks.co.za

The black-footed cat (BFC) is a small, rare felid species found in southern Africa, with fewer than 10 000 adult individuals remaining in the wild. Despite being listed as vulnerable in the IUCN Red List, genetic data are limited. This study aimed to address this data deficit by characterising two mitochondrial gene regions of 27 BFCs from four sampling localities and two provinces in South Africa. Individual and concatenated gene phylogenies of the ND5 and cyt b gene regions, recovered two genetically discrete clades but no evidence of phylogeographical structuring. Six haplotypes were recovered using ND5 sequences, 9 using cyt b sequences and 11 for the ND5-cyt b concatenated dataset. In addition, through sequencing of both the nuclear-mitochondrial DNA (numt) copy of the cyt b gene and the actual mitochondrial copy, we were able to exclude the possibility of numts in datasets. This study established reliable genetic marker protocols for development of a phylogeographical framework to guide conservation of BFCs.

30. Mining historical datasets to align current improved technologies to gain an understanding for conservation

Ernest Charles James Seamark, Angela Curtis, Nadia Hansa, Teresa Kearney, Leon Labuschagne, Dikobe Molepo, Steven Tucker, Menging Wei and Victor Van Cakenberghe
African Bats NPC, Ernest.Seamark@africanbats.org

The Transvaal Museum Bat Banding committee was formed in 1958, after bat banding had started in 1957. Records indicate banding continued until 1979. Thirteen species of bats were banded, with the majority being the migratory Natal Long-fingered Bat (*Miniopterus natalensis*). Even though various

studies worldwide show negative effects of wing bands, these bands are still in use today. Between 1957 and 1979, over 31,000 bats were reported to be banded, with a recapture rate of 8.6%, including 34 dead (0.11%). Analyses provided interesting observations especially concerning the various species' movements/migration in relation to where they were banded. This is important for *M. natalensis* and *Myotis tricolor* (Tricoloured bat), where unreported migratory links between caves/mines in Limpopo, Gauteng and KZN are revealed, including international movement between Botswana and South Africa. These historical data are providing a scaffold to focus on the use of advanced technology (RFID tags). It can also verify if these sites are still used and assess if tagged bats are present at sites without the need to (re)capture, by using a RFID reader system deployed at roost entrances.

31. An integrated landscape modelling approach to facilitate leopard (*Panthera pardus*) conservation in the Western Cape, South Africa

Eugene Greyling¹, Kathryn Williams¹, Alison J Leslie¹ and Wendy Annecke²

¹Stellenbosch University / Cape Leopard Trust, eugene@capeleopard.org.za

²Cape Research Centre, SANParks

Leopards (*Panthera pardus*) are the last terrestrial apex predators to naturally persist in the Western Cape province, South Africa. Leopards of the Cape occupy territories up to ten times larger than their savannah counterparts. Land transformation fragments connectivity between suitable leopard habitats and genetic clustering of local sub-populations have been detected. Research and conservation efforts for leopards of the Cape has historically been conducted through a piecemeal approach. A broader scale conservation strategy is however required to ensure leopard survival across fragmented and changing landscapes. Our study employed province wide questionnaires to assess leopard occupancy, used a robust dataset of leopard distribution points to model leopard habitat suitability, and integrated these data into a landscape permeability model to accurately identify ecological corridors and inform connectivity. Results are intended to guide a large-scale conservation strategy that will ensure species survival across the fragmented landscape. We also provide a spatial baseline for future research on, and applied conservation of, leopards of the Cape.

32. The effect of diet on the development of pheromone signals in *Apis mellifera scutellata* workers

Esther Elizabeth du Rand, Christian Walter Waldo Pirk, Olabimpe Okosun and Abdullahi Ahmed Yusuf

University of Pretoria, ezette.durand@up.ac.za

A honeybee queen is reproductively dominant and produces pheromonal signals that suppress reproduction in worker bees. In the absence of a queen, workers compete to gain pheromonal and reproductive dominance over nest mates. Reproductive status and age-related changes modulate pheromone composition in queenless workers and pheromone status (being worker- or queen-like) influences diet. But it's unknown to what extent diet can modulate pheromone status in these workers. We present evidence of the role of diet in gaining pheromonal dominance in workers when the queen is absent. Workers were fed carbohydrate/protein-rich diets for 25 days. The mandibular secretions were analyzed using gas chromatography and ovary activation evaluated. A clear link between diet and pheromone profiles were observed, workers fed protein-rich diets produced mandibular gland profiles more typical

of queens. Though mandibular gland profiles were queen-like with high proportions of 9-HDA, 9-ODA levels were in the range of nonproductive workers and the ovaries were not fully activated. Suggesting that diet can prime queenless workers to become false queens, but don't trigger transformation into false queens.

33. Contrasting agents of topkill in African savannas

Fezile Mtsetfwa and Sally Archibald

University of the Witwatersrand, School of Animal Plant & Environmental Sciences, fezile.mtsetfwa@wits.ac.za

The importance of fire as a disturbance selecting for resprouting abilities in tropical tree species is well recognized, but cyclones, elephant toppling, drought, frost, lightning, and human harvesting are other common above-ground disturbances that can result in topkill. The relative importance of these as selective forces on tropical tree species has not been properly assessed. Moreover, research has focused mostly on sapling recruitment, and less is known about how large adult trees of different species respond. Here, we map the regional extent of different "topkill agents" in the African savannas, and contrast these in terms of their frequency, extent, and the size-class of trees that is most affected. We use this to set up hypotheses regarding the type of resprouting response that would be selected for across different African ecosystems and evaluate how human harvesting may differ from other topkill agents. These results will improve understanding of resprouting as a key regenerative process and how it defines tree species assemblages and will help assess the degree to which human harvesting regimes deviate from what trees evolved with.

34. Telperion – Termitaria & Termites

Frances Cornelius¹, Duncan MacFadyen² and Haemish Ian Melville¹

¹University of South Africa (UNISA), maraisf.fm@gmail.com

²Oppenheimer Generations Research and Conservation

Termites influence ecosystems on both a micro and macro level, impacting spatial heterogeneity and ecosystem processes. Research on smaller termitaria like those on Telperion Nature Reserve in Mpumalanga, has been neglected. Sampling from three plant communities was undertaken to determine termitarium distribution, density, and termite diversity. Despite the variability in density, termitaria in all three vegetation communities displayed a clustered distribution. Termites were collected from 264 termitaria on the property from 13 March 2021 to 9 May 2021. Termites collected were stored in 70 % ethanol and sent to the ARC-PHP: South African National Collection of Insects, Biosystematics Division for identification. All termites identified were from the family termitidae (higher termites). Cubitermitinae, Termitinae and Nasutermitinae subfamilies could be identified. The species *Trinervitermes trinervoides* was identified from the subfamily Nasutermitinae and *Microcerotermes* sp. from the subfamily Termitinae. Should more precise identification to species level be required, DNA barcoding should be considered.

35. Voluntary standards and certification schemes for the wildlife economy

Francis Vorhies

African Wildlife Economy Institute, Stellenbosch University, wfv@sun.ac.za

In 2011, the CBD Secretariat in partnership with UNEP WCMC released a Review of the Biodiversity Requirements of Standards and Certification Schemes. The study reviewed the biodiversity requirements of thirty-six standards to understand how these standards enable businesses to demonstrate their biodiversity performance to investors, consumers, and other stakeholders. Building on the findings of this review, our research explores the type of standards and certification schemes needed to demonstrate the sustainability outcomes of wildlife-based enterprises. We revisit some of the standards in the CBD review that are particularly relevant to the wildlife economy – notably CCB, FairWild, FSC, MSC, Plan Vivo, and UEBT. We also investigate several standards that have emerged more recently or are under development. Whereas the CBD review focused on biodiversity requirements, we also explore requirements for climate resilience, livelihoods, and community well-being. We investigate the usefulness of existing relevant standards to demonstrate the sustainability outcomes of wildlife-based enterprises and make recommendations for strengthening these standards. We also make recommendations for developing new standards where they are lacking. The aim of our study is to support further development and use of voluntary standards and certification schemes for the wildlife economy that will provide assurance to investors, consumers, and other stakeholders of the sustainability outcomes of wildlife-based enterprises.

36. Shallow metagenomics of faecal samples allows fine-scale diet characterization of myrmecophagous mammals in two South African reserves

Rémi Allio¹, Frédéric Delsuc¹, Marie-Ka Tilak¹, Rachid Koual¹, Nora Weyer², Wendy Panaino², Andrea Fuller², Nico L. Avenant³ and Lionel Hautier¹

¹CNRS – Université de Montpellier, remi.allio@inrae.fr

²University of the Witwatersrand

³National Museum

High-throughput sequencing technologies have made molecular barcoding approaches more practical. We first used a shotgun sequencing approach to construct a mitogenomic reference database from more than 300 samples of ants and termites collected at Tswalu Kalahari and Tussen Die Riviere natural reserves. We then used shallow metagenomic sequencing of 119 field-collected fecal samples to assess the diet of four myrmecophagous mammal species: the armadillo (*Orycteropus afer*), the ground pangolin (*Smutsia temminckii*), the armadillo (*Proteles cristatus*), and the black-backed jackal (*Canis mesomelas*). Using our mitogenomic reference database to map shotgun reads obtained from field-collected fecal samples, we provide a first molecular assessment of their diet that fits very well with more classical studies based on classical macroscopic observations of fecal samples. Our metagenomic approach has the potential to provide a fine-scale characterization of the diet of these elusive mammals by allowing the identification of their prey at the species level. This information might be crucial for their conservation in the current context of rapid global environmental change.

37. The rational application of clinical metagenomics to central nervous system infections South Africa

Gert Marais, Ziyaad Valley-Omar, Diana Ruth Hardie, Adrian Brink, Kate McMullen, Kathleen Bateman, Diederick van der Westhuizen, Moepeng Maseko and Suzaan Marais
University of Cape Town, ruan.marais1590@gmail.com

Background Diagnosing central nervous system (CNS) infections is challenging as they often present with indistinguishable syndromes. Current CNS diagnostics rely on culture and directed molecular testing, both of which have significant limitations. **Methods** We evaluated the diagnostic performance of clinical metagenomic sequencing (CMS), for the 1st time in a clinical setting in Africa, on 47 patients with suspected CNS infection. We also compared expenditure versus standard diagnostic testing (SDT) for included participants. **Results** CMS was found to have a sensitivity of 84% (95% confidence interval (CI): 62%-94%), relative to a composite standard, for actionable results, compared to 42% (95% CI: 23%-64%) for SDT alone. For CMS the cost per sample was approximated to be R5 000.00. The median cost of SDT per patient was R2 734.00 (Interquartile range (IQR): R948.00–R 4 111.00) for all participants and R4 045.00 (IQR: R2 787.00–R6 163.00) for immunocompromised patients. **Conclusion** We propose the expansion of CMS use in immunocompromised patients with presumed CNS infections, considering the comparable cost and poor relative performance of conventional investigations.

38. The potential for microhabitats to buffer arid-zone organisms in a changing world

Grace Warner, Graham Alexander and Andrea Fuller
University of the Witwatersrand, gmwarner14@gmail.com

Aridification is predicted to accelerate under climate change, with dire consequences for existing arid areas and indigenous fauna. Yet, microhabitats, as sheltered spaces in the environment, may provide a buffer for organisms against the changing macroclimate. Currently, there are few data on microhabitats in African environments. In this study, we provide data on the distribution, abundance, and thermal buffering capacity of five distinct microhabitat types (burrows, nests, rock crevices, tree hollows and vegetation), across three landscapes (dunes, plains and mountains) in the Kalahari. The highest abundance of microhabitats was found in the plains, with shrub vegetation being the most abundant microhabitat type across all three landscapes. Topographic factors were found to have a significant effect on microhabitat distribution only in the mountain landscape. Temperatures within all assessed microhabitats were less variable than the macroclimatic temperatures over the diel cycle, especially in burrows, which showed the least variation in temperatures over the 24-hour cycle. We highlight the need for microclimatic data to better predict the impact of climate change on arid zones.

39. The Effects of Bioclimatic Variables, Topographic Structure and Ungulate Carcass Sites on the Chiropteran Assemblage of Telperion Nature Reserve, South Africa

Gregory Jan de Jong¹, Leigh Richards² and Haemish Melville¹

¹University South Africa (UNISA), gregjdejong@gmail.com

²Durban Natural Science Museum

Insectivorous bats provide ecosystem services vital for maintaining ecosystem health. Grasslands cover ca. 29 % of South Africa's surface, yet the associated bat biodiversity is understudied. Telperion Nature Reserve (TNR) is a grassland- reserve on the Mpumalanga – Gauteng border. Using active and passive techniques, an insectivorous bat inventory and echolocation call library, for TNR, were compiled. The effects of habitat, season, bioclimatic variables, and carcass presence, on species richness and diversity were investigated. Seven bat families comprising 21 species were identified. A *Rhinolophus* cf. simulator species was detected that vocalized at a unique and characteristic frequency (79 kHz). Bat activity varied between habitat types, watercourses were associated with the highest species diversity and anthropogenic sites with highest activity. Bat activity was highest in spring and summer. Wind speed negatively correlated with bat activity and species diversity, while temperature and humidity positively correlated with activity and species diversity. Bat activity was highest near caged carcasses and feeding buzzes were recorded at all carcass sites.

40. Reintroduction Range Establishment and Movements of Spotted Hyenas on Tswalu Kalahari Reserve

Haemish Melville¹ and Nichola Knox²

¹University South Africa (UNISA), melviha@unisa.ac.za

²Department of Architecture and Spatial Science, Namibia University of Science and Technology

Top predators are vital to the functioning of ecosystems. Where such organisms have been excluded, reintroduction is one of the tools available to reinstate their vital ecosystem functions. Despite being integral to the Kalahari, spotted hyenas had been absent from the Tswalu Kalahari Reserve (TKR) since its inception. In concert with a planned reintroduction in 2020 and 2021, we collared five (two in 2020 and three in 2021) of nine spotted hyenas that were reintroduced to the TKR. We investigated the colonisation of the reserve by the first cohort and the difference in colonisation behaviour in the second cohort. We compared home range establishment at monthly intervals using an unconstrained (kernel density estimation -kde) vs a constrained (movement based kde – mkde) approach to assess the home range restrictions placed on hyaena due to being constrained within a fenced reserve. Within four months of release the area of home ranges stabilised, but hyenas still displayed sporadic forays indicative of ongoing exploration. Individual monthly 95% home ranges all intersect with the reserve boundaries indicating that hyaena movements are constrained, even within the TKR.

41. Personality, Competition, Predation and the Quest for Food

Tasha Oosthuizen and Heike Lutermann

University of Pretoria, u15004938@tuks.co.za

Successful foraging is essential for the survival and reproductive success of animals. Foraging decisions can be modified by a number of endogenous (e.g. personality, satiation) and exogenous factors (e.g. conspecifics, predators). In this study we evaluated the effects of conspecifics and predator cues on Namaqua rock mice (*Micaelamys namaquensis*) foraging behaviour and differing in satiation level. After the assessment of their personality and a training period, 24 wild-caught mice were allowed to explore a Y-maze with control, conspecific and predator scent at different levels of satiation. Foraging was not significantly affected by either personality or conspecific cues but mice avoided predator cues. In addition, hungry mice entered the maze faster and showed less avoidance of predator cues. Hence, neither animal personality nor competition seem to play an important role while the satiation level is a key determinant of foraging and risk-taking behaviour in Namaqua rock mice.

42. Unravelling the *Scarabaeolus bohemani* (Harold, 1868) (Coleoptera: Scarabaeidae: Scarabaeinae) species complex in southern Africa, with the description of two new species

Jacomien Zaayman, Catherine Sole and Christian Deschodt

University of Pretoria, u18018689@tuks.co.za

The purpose of this study was to use both morphology as well as molecular techniques to resolve the *Scarabaeolus bohemani* Harold, 1868 (Coleoptera: Scarabaeidae: Scarabaeinae) species complex. Various authors have noticed a variation in the punctures on the elytra of *S. bohemani* specimens collected at different locations across South Africa, Namibia and Botswana. After observing the morphology, we concluded that the species complex consists of four species, two of which were still undescribed. For the molecular component, sampling was mainly unsuccessful, and we were only able to create a molecular phylogeny comparing *S. bohemani* and one of the undescribed species. The results of this phylogeny did however support the morphological conclusion that it is indeed an undescribed species. As a result of this study, we were able to describe two new species belonging to the genus *Scarabaeolus*.

43. Behavioural response of mammals to Kalahari pulse events

Jade Tarryn Harris¹, Tim Hofmeester², Jan Adriaan Venter¹, Herve Fritz¹ and Joris Cromisgt²

¹Nelson Mandela University, s224753150@mandela.ac.za

²Swedish University of Agricultural Sciences

To determine the behavioural response of mammals to the Kalahari pulse events, we used 88 camera traps placed in Kgalagadi Transfrontier Park, Tswalu Kalahari Reserve, and Khomani San Community Land. Our survey period stretched from 2018 to 2020. To observe the timing of the pulse events, we used camera trap images to identify the weekly greenness index, per camera. We identified the correlation coefficient between cameras within a site, as well as between sites to determine the level of synchrony of onset of plant “green up” (pulse events). Subsequently, we determined how different mammal functional

groups responded to these events with relative abundance indices derived from camera trap data. Our results show a good correlation of pulse events between cameras within sites, while a low correlation occurred between sites indicating the spatiotemporal patchiness of green pulses in the system. Some functional groups, such as large herbivores, responded to the events first while others showed no obvious response. These results offer knowledge mammal responses to pulse events in the Kalahari, and thus offer clues in mammals' response in future climate change scenarios.

44. The in vitro and in vivo effect of amitraz treatment on Cape honeybee drone sperm quality

Janice Murray¹, Christina Kotze¹, Gerhard van der Horst¹ and Mike Allsopp²

¹University of the Western Cape, 3567716@myuwc.ac.za

²Agricultural Research Council

Varroa destructor is the major pest threat to Western honeybees, therefore, many countries treat colonies using acaricides. Amitraz is effective in Varroa destructor management, however, owing to suspected mite resistance, beekeepers have applied greater dosages, which may adversely affect honeybee reproductive biology, particularly drone sperm. The aim of this study was thus to investigate the in vitro and in vivo effect of amitraz on sperm quality of sexually mature Cape honeybee (*Apis mellifera capensis*) drones. For determining amitraz's in vitro effect, semen samples were exposed to three different amitraz concentrations. In the in vivo study, drones were exposed to in-hive amitraz treatment (Avipar®) as pupae and adults at the recommended commercial dosage. Sperm quality was determined using functional and structural tests. In vitro exposure decreased sperm vitality while sperm structure was unaffected. In vivo exposure only had minor effects. Drones from treated colonies were heavier compared to controls. Direct administering of very high amitraz doses negatively affects sperm quality, but in-hive chronic exposure to recommended dosages may not affect sperm quality.

45. Soil erosion by water assessments in South Africa – Revisited

Jussi Baade¹, Kevin Zoller¹, Christoph Glotzbach² and Jay le Roux³

¹Department of Geography, Friedrich Schiller University Jena, Germany, jussi.baade@uni-jena.de

²Department of Geosciences, Eberhard Karls University Tübingen, Germany

³Natural and Agricultural Sciences, University of the Free State, Bloemfontein, South Africa

Land degradation by soil erosion has been an issue in South Africa for over a century. At the mid of the last century measures to combat soil erosion by water have been established nationwide. In 2008, the first assessment using the Revised Universal Soil Loss Equation (RUSLE) indicated an average soil loss from arable land of about 13 t ha⁻¹ yr⁻¹, a value exceeding what is often considered the natural soil formation rate (SFR) of 5 t ha⁻¹ yr⁻¹. But, recent studies on cosmogenic nuclides indicate that long-term, steady state denudation and soil formation rates are ~ 0.1 t ha⁻¹ yr⁻¹, only, indicating far from sustainable land use in crop production. At the same time, an initial reassessment of soil erosion by water using the RUSLE with new, Earth observation based, high resolution input data indicates that the previous exercise might have provided an order of magnitude too high soil loss values. Here, we will present the results of the reassessment based on six 100 x 100 km study sites across South Africa, compare the results with the

previous findings and discuss the uncertainties as well as research needs in order to foster guidelines for sustainable crop production.

46. The ambivalence of custodial conservation at living heritage sites: the case of Kruger Cave

Justin Bradfield and Matt Lotter

University of Johannesburg, justinb@uj.ac.za

Contemporary occupation of archaeological sites is fraught with challenges and conflicting priorities. Prevailing opinion on heritage management recognises the fluid and continuous nature of archaeological site formation, yet the role of present-day communities as agents of archaeological palimpsests is inadequately acknowledged. Contemporary communities, often unrelated to the autochthonous inhabitants, occasionally use these sites and landscapes in similar or different ways to how they were used in the past. Their use of these sites, while potentially damaging to the archaeology, simultaneously adds to and is part of, the life history of the site, of which the excavated material and rock art are but pictures in time. Squatters who appropriate archaeological heritage sites constitute ambiguous communities under current heritage legislation. Yet, their role as contributing agents to archaeological sites is no less real. I offer some thoughts around the nuances of negotiating and reconciling archaeological preservation and living heritage management via the case study of Kruger Cave, a Later Stone Age rock art site in the Magaliesberg, currently inhabited by a lay Christian pastor.

47. Habituation or sensitisation: Are South African impala (*Aepyceros melampus*) thriving or just getting by?

Kara du Plessis, André Ganswindt, Bruce Crossey and Mmatsawela Ramahlo

Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria,
u17129622@tuks.co.za

Land transformation is a major driver of global biodiversity loss. The rapid growth of the human population has prompted investigations of wildlife responses to urbanisation. As such, non-invasive monitoring methods (such as faecal analysis) are effective when assessing potential deviations in the welfare of wildlife in response to urbanisation. Impala are a relatively abundant antelope species found in a variety of habitats, with an increasing presence being noted in urban and peri-urban environments. Our study is aimed at determining the effects of land-use and anthropogenic disturbance on the behaviour, body condition, and stress-related faecal glucocorticoid metabolite (fGCM) concentrations of impala. More specifically, we investigate five different sites ranging from highly disturbed (JHB Zoo and a golf estate), to relatively pristine (Telperion). Field observations indicate more competition and poorer body condition in impala found at smaller, more anthropogenically disturbed sites. Following fGCM concentration analysis this study will indicate to what extent a seemingly resilient and ubiquitous antelope species copes with varying levels of urbanisation and human presence.

48. Evaluating determinants of wire-snare poaching risk in the Boland Mountain Complex of South Africa

Tamar Kendon¹, [Kathryn Williams](#)², Jessica Comley³, Anita Wilkinson², Michiel Grobler², Willem Nieman⁴, Alison Leslie⁴, M. Justin O'Riain¹ and Vincent N. Naude⁵

¹Institute for Communities and Wildlife in Africa (iCWild), University of Cape Town, tamar@carsmarts.co.za

²Cape Leopard Trust

³Wildlife and Reserve Management Research Group, University of Mpumalanga,

⁴Department of Conservation Ecology and Entomology, University of Stellenbosch

⁵Institute for Communities and Wildlife in Africa (iCWild), University of Cape Town

Wire-snare poaching for bushmeat is a global threat to biodiversity. Yet, studies evaluating the extent and dynamics of bushmeat poaching are limited. This study conducted on private agricultural properties bordering protected areas in the Boland Mountain Complex in South Africa, characterised snaring and compared interview and patrol reported incidence to quantify the influence of socioeconomic and biophysical determinants of bushmeat poaching, and spatially predicted poaching risk in the region. In total, 671 snares were located during 96 bi-annual patrols across 112 private properties. Despite dissimilar factors affecting interview-reported snaring and patrol-reported snaring, incidence did not differ significantly ($P = 0.186$) between interviews ($n = 307$) and patrols ($n = 180$). High risk areas for snaring were predicted 2.2–5.8 km from the nearest public street, 1.5–2.2 km from the nearest settlement, at elevations of 300–500 m, 1.8–2.5 km from the nearest protected area and 0.5–3.2 km from the nearest river. This study's interdisciplinary approach to understanding bushmeat poaching adds applied conservation value by optimising current monitoring and law enforcement efforts.

49. Developments in the case study of the quiver tree as a climate change sentinel: investigating biogeography using population genomics

[Kayleigh Murray](#)¹, Guy Franklin Midgley¹, Wendy Foden², Kerry-Anne Grey¹, Olwen Grace³ and Juan Viruel³

¹Stellenbosch University, kmurray@sun.ac.za

²South African National Parks

³Royal Botanic Gardens Kew

Research in South Africa must focus on detecting and predicting climate change-linked ecosystem degradation by studying likely indicator species for ecosystem change, modelling their bioclimatic niche, testing physiological tolerances and understanding population dynamics. The long-term study of the quiver tree (*Aloidendron dichotomum*) is an example of this. Developing genomic sequence data will set a global standard for species-climate association studies. Population declines observed in *A. dichotomum* have been attributed to CC related increases in temperature and SDMs predict an impossible range shift to track suitable climate by 2070. A mechanistic study of *A. dichotomum*'s biogeographic history is needed to understand declines and establish whether migration to projected habitat is possible. I would like to present my current research using genomic sequences from across the range of the quiver tree to simulate its historical and future phylogeography. This project will genetically inform conservation interventions, providing evidence for prioritisation of current and future potential habitat and ex situ conservation needs to prevent population extinctions.

50. Hot dogs: Climate change impacts in an endothermic predator

Keafon Jumbam¹, Andrea Fuller¹, Robyn Hetem¹ and Rosie Woodroffe²

¹University of the Witwatersrand, keafon.jumbam@wits.ac.za

²Zoological Society of London

The African wild dog is an endangered species estimated to exist in only 7% of its historical range. Studies show that climate change poses a major threat to its declining population, with high adult mortality and few surviving pups at high ambient temperatures. Little is known about the physiological responses of wild dogs to climate change. We report preliminary data on body temperatures in free-living wild dogs, from implanted data loggers in three wild dogs at Hluhluwe iMfolozi Park. Body temperature of the three individuals were $38.6 \pm 0.5^\circ\text{C}$; $38.3 \pm 0.4^\circ\text{C}$ and $38.6 \pm 0.5^\circ\text{C}$ (mean \pm SD) with the amplitude of the 24-h body temperature rhythm ranging between $2.5 - 2.7^\circ\text{C}$. The highest body temperature recorded for each dog were 40.5°C (on 2 April), 41.7°C and 42.9°C (both on 30 November 2021). Corresponding black globe temperatures derived from shaded areas of the park varied between $20 - 24^\circ\text{C}$, suggesting non-climatic factors may have played a role in triggering such high body temperatures. These are the first records of biologging data on the endangered wild dog biology that can help us make a start with better predictions about the vulnerability of this species to climate change.

51. Improving measures of population genetic diversity: the long and the short of it in buffalo (*Syncerus caffer*)

Keaton Rea and Amanda Bastos

University of Pretoria, u18020004@tuks.co.za

Numerous population genetic studies use mitochondrial DNA (mtDNA) data to guide wildlife management decisions, even though mtDNA represents only a small fraction of an organism's total genomic content. This is primarily because mtDNA markers have several characteristics that make them comparatively simpler to analyse than their nuclear counterparts. With the advent of Next-Generation Sequencing (NGS) technologies, the possibility of generating entire mitochondrial genomes has been broadly embraced and applied without due pause as to whether complete genomes are absolutely necessary. In this study, we outline a fixed-cost, a priori approach in which the benefits of sequence length are balanced against sample size with the aim of realising the optimal levels of population genetic resolution. We demonstrate this by using published whole mtDNA genome data for East African buffalo (*Syncerus caffer*) populations and by applying the optimised approach to two South African buffalo populations.

52. The impact of climate change on body condition of a Kalahari predator

Kim Scholtz¹, Thilo Beck², Graham Alexander², Robin Maritz¹ and Bryan Maritz¹

¹University of the Western Cape, 3571589@myuwc.ac.za

²University of the Witwatersrand

Periods of reduced rainfall are known to impact the body condition and thus fitness of many organisms. However, these relationships have rarely been studied in snakes. We examined the impact of rainfall on the body condition of Cape cobras (*Naja nivea*) from Tswalu Kalahari Reserve over a period of five years. We measured the mass and body length of 108 cape cobras, 66 of which were also recaptured, and

calculated a body condition index (BCI) for each observation (N = 174). Next, we tested the hypotheses that (1) BCI is impacted by deviations from expected rainfall in the preceding months, and (2) the BCI of mating season snakes (September to November) is impacted by rainfall in the preceding summer. We found that sex (lower BCI in females than males) and the amount of rain in the preceding four weeks (positive relationship) had significant effects on body condition. Moreover, BCI of cobras during mating season was positively correlated with rainfall in the previous summer. Our results indicate that prolonged droughts, or increased frequency of droughts in the future, will have detrimental effects on cobra populations in the Kalahari.

53. Challenges in identifying Afrotropical horse flies of the genus *Atylotus*

Kirstin Williams¹ and Louwtjie Snyman²

¹KwaZulu-Natal Museum, kwilliams@nmsa.org.za

²University of Saskatchewan

Tabanids (horse flies) are known vectors of pathogens including viruses, bacteria, protozoans and filarial nematodes. This makes them of medical/veterinary and by extension, economic importance. The Afrotropical horse fly genus, *Atylotus* has previously shown little differentiation into species groups using the barcode gene COI. This study analysed all available *Atylotus* COI sequences from GenBank and BOLD to determine if COI is suitable for delimiting species of this genus. Morphological assessments of the different Afrotropical species were done to determine if these species have been accurately identified in recent publications. The results show that COI does not separate the species of this genus into species clades and these species are often misidentified in the literature. This is of concern as species of this genus are known vectors of pathogens and misidentifications have serious implications for management practices. Additional genes need to be used in future molecular studies to differentiate species.

54. Comparative analysis of the environmental, social and economic contribution of different land-use types in Zambia

Kudzai Mpakairi and Susan Snyman

African Leadership University, kmpakairi@alueducation.com

Optimally managed land use can support socio-economic activities and protect the environment. However, conflicting government policies and the growing demand for economic productivity might make land-use optimisation more difficult. Our study, therefore, aims at comparatively analysing the environmental, social, and economic contributions of agriculture, mining, tourism, and ecotourism in Zambia. We demonstrate the contribution of these land-use types using multi-source data gathered from private and public repositories. Our results show that mining contributes the most towards GDP (9.90 %) and agriculture contributes the least (2%). Although agriculture contributes the least, it accounts for ~50% of employment in Zambia whilst mining only employs 2.4% of the population. On the other hand, ecotourism remains underdeveloped, and government policies supporting and enabling private sector investment are needed to unlock the full potential of ecotourism in the country. Our results are novel and among the first to analyse the macro-level contribution of different land-use types, as well as the trade-offs between land uses, and can be helpful for policymakers and land-use managers.

55. Does *Anopheles funestus* feeding frequency increase under artificial lights used in households?

Layla van Zyl¹, Bernard W.T. Coetzee¹, Lizette L. Koekemoer² and Ashley Burke²

¹University of Pretoria, laylafouche113@gmail.com

²Wits Research Institute for Malaria, University of the Witwatersrand

Anopheles funestus mosquitoes act as primary malarial vectors in Sub-Saharan Africa. Understanding the impact of household lights on mosquito feeding behaviour is important as it has direct implications for malarial transfer. This study investigated how exposure to different household lights (namely compact fluorescent lights, light-emitting diodes and incandescent lights) during night-time alters the feeding frequency of *Anopheles funestus*. Mosquito colonies maintained in a 12:12 light:dark cycle were exposed to a light treatment starting one hour after complete darkness set in, followed immediately by a blood feeding assay. All three household lights result in a reduction in the percentage of females taking a blood meal, with mosquitoes exposed to incandescent light showing the greatest reduction in feeding of 23.3% relative to mosquitoes not exposed to light. Provisional results suggest that exposure to household lights during the night may have an immediate inhibitory effect on feeding. These results may provide insight necessary to design household lights that minimize feeding, and so transmission opportunities, in an attempt to reduce malarial incidence.

56. Seed dispersal by frugivores and germination success of the Invasive alien shrub *Pyracantha angustifolia* in the eastern Free State Province, South Africa

Lehlohonolo Donald Adams¹, Grant Martin^{2,3}, Colleen Downs¹, Sandy-Lynn Steenhuisen³, Islamiat Abidemi Raji¹, Vuyisile Thabethe¹ and Vincent Ralph Clark³

¹University of KwaZulu-Natal, adams2165@gmail.com

²Rhodes University

³University of the Free State

Invasive alien plants can use animal-plant interactions to increase their invasiveness. This study investigated the role of frugivorous birds in seed dispersal, germination success and germination time of the alien plant *Pyracantha angustifolia* (Franch.) C.K. Schneid. (Rosaceae) in South African high elevation grasslands. We monitored which bird species fed on the fruit of the invasive *P. angustifolia* in farms in the Free State Province using timed-focal and opportunistic observations, and camera traps aimed at fruiting branches and fallen fruits on the ground. Nine bird species visited *P. angustifolia* shrubs to perch or feed on fruits, but only one (Speckled Mousebird) fed on the fruits during timed-focal observations. Camera trap footage and opportunistic observations revealed a further three bird species (African Pied Starlings, Crested Barbets, Red-eyed Barbets), domestic horses and goats, and two rodent species feeding on fruits. To assess the effect of ingestion by avian frugivores on *P. angustifolia* germination success and time, *P. angustifolia* fruits were fed to captive birds and germination assessed

57. Dietary flexibility of bat-eared foxes in the semi-arid Kalahari

Letsema Molete¹, Andrea Fuller¹ and Aliza le Roux²

¹School of Physiology, University of the Witwatersrand, Johannesburg. Mahlatsemolete@gmail.com

²Department of Zoology and Entomology, University of the Free State, Qwaqwa Campus, Phuthaditjhaba.

Bat-eared foxes (*Otocyon megalotis*) are considered to be obligate termite feeders, but they are less specialized in their diet than are other ant- and termite-eating (myrmecophagous) mammals such as the armadillo and ground pangolin. Over the past five years, the number of ants and termites readily available to myrmecophagous mammals at Tswalu in the Kalahari has decreased substantially, particularly in winter, with consequences for armadillo and pangolin welfare. We investigated the diet of bat-eared foxes in the same environment over one year, to determine whether they still were able to access termites or whether they shifted their diet to other items when termites were not readily available. Data were collected from April 2019 to March 2020, using pitfall traps to determine prey availability every second month, and scats from four different locations of the reserve for dietary analysis. We show that bat-eared foxes were able to access termites, even winter when termite numbers were low, but had a varied arthropod diet. Our research supports the idea that dietary flexibility will buffer bat-eared foxes against changing dietary resource availability associated with climate change.

58. Quantifying drought strategies in C4 perennial, Southern African grasses

Londiwe Mokoena¹, Sally Archibald¹, Caroline Lehmann² and Anabelle Cardoso³

¹University of the Witwatersrand, londiwemokoena5@gmail.com

²University of Edinburgh

³University at Buffalo

Plants have a range of strategies for surviving drought associated with a safety-efficiency trade-off. C4 grasses above-ground biomass cures annually over a dry season. There is little research on drought strategies on grasses. We describe and quantify drought responses and recovery patterns of thirteen perennial C4 grasses. An experiment was undertaken where grasses were grown and then exposed to a drought for 3 months. Physiological drought tolerance was measured as the leaf water potential when stomatal conductance fell below a threshold of 50mmol/m²/s-1. Post-drought, grasses were watered for eight days and recovery monitored. Results suggest varied drought strategies in C4 grasses can be linked to safety-efficiency trade-off previously demonstrated in woody species. We suggest a framework identifying key traits (Stomatal sensitivity/regulation, Osmotic adjustment, curing rate and recovery) describing grass physiological performance during and after drought. Our framework suggests grasses with low stomatal control (efficient) cured faster than those with a high stomatal control (safety) at the end of the dry season, which could result in longer dry and more flammable seasons.

59. Predicting hotspots of southern white rhinoceros, *Ceratotherium simum simum*, from their movement patterns in Kruger National Park

Lorenzo Ruaro

University of Stellenbosch, lorenzo.ruaro.93@gmail.com

The conservation status of the southern white rhino (*Ceratotherium simum simum*) is currently classified as Near Threatened and the ongoing poaching for their horns is expected to degrade their populations in the near future. Ultimately, the resulting consequences of increased death rates and decreased birth rates have forced white rhino numbers in Kruger into a downward trend. In essence, poaching pressure creates “ecological traps” within the home range of white rhinos, i.e., areas that white rhinos preferentially select, but consequently these areas also harbour increased risks of mortality. Park anti-poaching initiatives seek to identify these areas to prioritize ranger presence. To help accomplish this, we use a Step Selection Function (SSF) approach and an extensive database of rhino collar data (2016-2018) held by SANParks. The SSF model investigates the finer scale (spatial and temporal) dynamics of rhino movement to predict future movement patterns based on their preference for different environmental variables. We provide a synopsis of our preliminary results and explore how these findings can predict rhino distributions in the future and aid conservation efforts.

60. The current status of DNA barcode reference databases for native and introduced freshwater fish in South Africa: Foundational knowledge for future eDNA applications

Mahlatse Fortunate Mashaphu¹, Sandi Willows-Munro¹, Colleen Downs¹ and Gordon O'Brien²

¹University of KwaZulu-Natal, fortunate.mashaphu@gmail.com

²University of Mpumalanga

DNA barcoding play a vital role in rapid species identification. In freshwater research, it has been used to identify and monitor fish species (native and introduced) using environmental DNA (eDNA) approaches. However, such methods rely on a DNA barcode library linking DNA sequences to species descriptions. South Africa is well-known for biologically diverse ecosystems and eDNA methods could rapidly accelerate species discovery and monitoring. We review the availability of DNA barcode data for all native and introduced South African freshwater fish on BOLD and GenBank. For each species we noted the availability of the two main molecular markers used for fish eDNA research: the cytochrome oxidase I (COI) and 12S ribosomal RNA (12S rRNA). Of the 180 fish species (159 native species and 21 introduced species), COI data is available for 96 native species and 20 for introduced species. Much less 12S rRNA data was available, with reference sequences only available for 40 native and 20 introduced species. Efforts should be directed to developing a complete DNA barcode library for both markers, this will aid in monitoring both native and introduced species in the region using eDNA methods.

61. Dietary overlap between aardvarks and ground pangolins in the Kalahari

Makabudi Valery Phakoago¹, Wendy Panaino¹, Shane K. Maloney² and Andrea Fuller¹

¹University of the Witwatersrand, valeryphakoago@gmail.com

²University of Western Australia

Aardvarks (*Orycteropus afer*) and ground pangolins (*Smutsia temminckii*) are myrmecophagous mammals, feeding on ants and termites. Previous research in the Kalahari indicated that the diets of aardvarks and pangolins in the same habitat did not overlap. However, the research on each species was conducted at different times, and our long-term data reveals substantial fluctuations in ants and termites over time. We, therefore, collected faecal samples of aardvarks and pangolins at the same time over two years in the Kalahari. Aardvarks predominantly preyed on *Trinervitermes* termites in winter (44%), spring (89%) and summer (43%), and *Hodotermes* termites in autumn (51%). In contrast, pangolins primarily fed on *Crematogaster* ants in winter (50%) and spring (62%), and *Anoplolepis* ants in summer (60%) and autumn (41%). Despite their respective preferences, there was some dietary overlap, particularly with both mammals feeding on *Hodotermes* termites in summer in addition to their preferred prey. A decline in prey availability associated with hotter and drier conditions, which are becoming more common with climate change, may lead to increased competition for limited resources.

62. Resurrecting an Elephant Migration Route

Marc Sherratt¹ and Sean Hensman²

¹Sustainability Architects (MSSA), marc@marcsherratt.com

²Rory Hensman Conservation and Research Unit

This research and development project led by Marc Sherratt, Sustainability Architects (MSSA) restores the extinct ability of the African Savanna Elephant (*Loxodonta africana*) to migrate across the Limpopo Province of South Africa. This approximately 1000 km wildlife migration corridor links existing conservation areas that already house over-populated herds of elephant. This route uses elephant's sophisticated infrasonic communication as a method to "call" the animal along this route. This project has been designed to support rural communities by increasing food security and economic resilience while at the same time reversing global warming. The project has currently implemented its proof of concept, an Artificial Intelligence (AI) driven, automatic gate and camera system and an infrasonic elephant communication tower in partnership with the Rory Hensman Conservation and Research Unit in Limpopo. In combination this system allows wild elephants to transverse between electrified conservation areas without direct human interference using a uniquely developed, ecologically sensitive, infrasonic "language".

63. Honey bee's Communication: From the continent to the island

Marjorie Tournut, Christian Walter Werner Pirk and Abdullahi Ahmed Yusuf

University of Pretoria, marjorie.tournut@gmail.com

Social cohesion is very important in eusocial insect societies such as those of honeybees. In the Western honeybees *Apis mellifera*, this is achieved through chemical communication using pheromones produced by exocrine glands. Each caste presents a different array of pheromones used to pass on information to

conspecifics. Hence, communication among individuals is important for the colony to function effectively particularly when faced with unpredictable events. Our study focuses on the mandibular gland pheromones of worker bees which is central to regulating reproductive dominance. We sampled honeybees across three provinces of South Africa, as well as five sites in Reunion Island located in the Indian Ocean and analysed the mandibular gland pheromones using gas chromatography. Our results show significant differences across countries, as subspecies differ between the continent and the island. But some differences in pheromones were also observed across sites in each country. We will discuss our results and the potential factors that can explain the differences of pheromone composition in the context of honeybee diversity and conservation.

64. The Swartkrans early hominid site: its fossils and early archaeology

Kathleen Kuman¹, Travis Rayne Pickering², Matthew Caruana³, Laurent Bruxelles⁴, Jason Heaton⁵, Dominic Stratford¹, Rosa Moll¹, Ronald Clarke¹ and C.K. Brain⁶

¹University of the Witwatersrand, kathleen.kuman@wits.ac.za

²University of Wisconsin, Madison

³University of Johannesburg

⁴CNRS & INRAP, France

⁵Birmingham Southern College

⁶Ditsong Museum

Swartkrans belongs to South Africa's Cradle of Humankind World Heritage Site, declared by UNESCO in 1999. Since 1948, it has yielded fossils of the earliest species of our own genus (*Homo habilis* and *Homo ergaster*), numerous fossils of our ancestral cousin *Paranthropus robustus*, fauna that both hunted and was hunted by the hominids, and the earliest stone tools in southern Africa belonging to the Oldowan industry. In 2005, we renewed excavations and dating work as the Swartkrans Palaeoanthropological Research Project, building upon over two decades of work by C.K. Brain and the early discoveries by Robert Broom and John Robinson. This historically key site is still productive. We have been able to: 1) date the Oldowan stone tools to ~2.2 million years; 2) identify and excavate a new deposit with even older stone tools ~2.4 million years; 3) excavate more complete fossils from the deposit worked by Broom and Robinson; 4) revise and clarify stratigraphic interpretations that will resolve the long-debated age of the earliest *Homo* and *Paranthropus* fossils from the site; and 5) propose that one mandible previously published as *Homo* actually should be identified as *Australopithecus*.

65. A comment on the potential for the recapitulation of the *Bradypodion* phylogeny by their symbiotic bacterial communities

Matthew Grant Adair¹, Jessica da Silva², Krystal Tolley², Bettine Jansen van Vuuren¹ and Devon Main

¹University of Johannesburg, mattgadair@gmail.com

²South African National Biodiversity Institute

The digestive tracts of animals are a ubiquitous home to a wide assortment of bacterial species. This symbiotic relation displays its own unique and myriad assortment of characteristics. One such is phylosymbiosis; where the host phylogeny is replicated in the microbial diversity of their symbiotic inhabitants. This is well documented in mammalian literature, however, examination in reptiles remains far from extensive. Here two potential outcomes pertaining to the potential for phylosymbiosis in the genus *Bradypodion*

(dwarf chameleons) are conveyed: 1) an expected result if phylosymbiosis is present; and 2) an expected result if absolutely no phylosymbiosis is present. This study is currently ongoing so new perspectives are being examined as to how the two outcomes could be interpreted in terms of the ecology of chameleons.

66. Assessing androgen cycles in male southern right whales (*Eubalaena australis*) through baleen analysis

Meghan Calista van Zyl¹, Andre Ganswindt¹, Kathleen Hunt², Alejandro Fernández Ajó³ and Els Vermeulen¹

¹Mammal Research Institute, University of Pretoria, u17147311@tuks.co.za

²Smithsonian-Mason School of Conservation

³Marine Mammal Institute, Oregon State University

In recent years, reproductive success of South African southern right whales (SRWs) has dropped, possibly linked to reduced food availability in their original high latitude feeding grounds. As capital breeders, SRWs have to accumulate sufficient energy during foraging for successful reproduction. Very little is known about SRW reproduction, including male reproductive cycles. In this study, male SRW reproductive histories were assessed through quantification of baleen androgens, while carbon isotope cycles were used to link movement patterns with androgen cycles. Baleen plates of three male SRWs, all of which stranded on the South African coast between 1994-2020, were sampled at 2cm intervals. Contrary to prior assumptions, results indicate androgen cycles peak while male SRWs are still at their high latitude feeding grounds. These preliminary insights into androgen concentrations in male SRWs suggest mating (and subsequent conception) may occur away from the South African coast.

67. Other Effective area-based Conservation Measures (OECMs) - testing a framework to recognise and report South Africa's conservation estate outside of protected areas

Melissa Whitecross¹, Bronwyn Maree¹, Giselle Murison¹, Sarah Hulley², Kevin McCann² and Daniel Marnewick³

¹BirdLife South Africa, melissa.whitecross@birdlife.org.za

²Conservation Outcomes

³International Union for Conservation of Nature (IUCN)

The draft 2030 Global Biodiversity Framework targets have proposed a new area-based target to replace Aichi Target 11 that aims to see 30% of the world's natural surface conserved by 2030. This will be achieved through a network of protected areas and the expansion of the conservation estate through an ecologically representative and well-connected network of 'other effective area-based conservation measures' (OECMs). OECMs are a conservation designation for areas that are achieving long-term, effective in-situ conservation of biodiversity outside of protected areas. They will be a crucial mechanism for South Africa and the global community to achieve the new CBD 2030 Target 2. The identification of OECMs in South Africa will require both spatial planning and in-field assessments that will likely align strongly with the expansion of the biodiversity stewardship mechanism to ensure safeguarding of potential OECMs in the future. BirdLife South Africa with Conservation Outcomes, CapeNature and collaborators are testing this framework across the Western Cape to effectively roll-out OECMs in South Africa going forward and help meet the Convention on Biological Diversity targets.

68. The status of arboreta in South Africa and the taxa they contain

Michael David Cheek¹, John Wilson¹, David Richardson² and Şerban Procheş³

¹South African National Biodiversity Institute, KZN herbarium, Durban, South Africa, m.cheek@sanbi.org.za

²Centre for Invasion Biology, Department of Botany and Zoology, Stellenbosch University, Stellenbosch, South Africa

³School of Agriculture, Earth and Environmental Sciences, Discipline of Geography, University of KwaZulu-Natal, Durban, South Africa

Arboreta are collections of living trees and are important sites for conservation, silvicultural research and as sentinel sites for monitoring pests and diseases. Arboreta can also be the source of propagules for biological invasions. From 2012 to 2022 a survey was undertaken to assess the status of South African arboreta and the taxa they contain, the first such assessment since 1986. At least 172 arboreta have been present in South Africa, but 51 of these are no longer present, with the total number of arboreta peaking around 1980. Arboreta have been lost mostly because of conversion of sites to other land-uses. Most of the remaining 121 arboreta are on municipal or forestry land. The extant arboreta house 2309 taxa from 158 plant families: of these 128 taxa are listed as Vulnerable, Endangered, Critically Endangered or Extinct in the Wild under the 2020 IUCN Red List; and 400 taxa have been listed as invasive somewhere in the world. Biogeographic regions relatively well represented are the East African Steppe, Sino-Japanese, West African Rainforest, North-eastern Australian and Caribbean, making the arboreta valuable sources of germplasm for taxa from these regions.

69. Kalahari mammal activity patterns: weighing up environmental heat load, predation risk and resource availability

Mika Vermeulen¹, Herve Fritz¹, Maartin Strauss², Robyn Hetem³ and Jan Venter⁴

¹Nelson Mandela University, mikaverm@gmail.com

²University of South Africa

³University of the Witwatersrand

⁴Nelson Mandela University

We investigated the seasonal activity patterns of a mammal community in relation to environmental heat load in the Tswalu Kalahari Reserve. The Snapshot Safari camera traps recorded the 24h activity patterns of 16 mammal species and, through the simultaneous deployment of miniature black globe thermometers, we recorded the heat loads under which the species were active in two sites with different predator guilds. Our GLM showed that herbivores generally were active under significantly higher heat loads, ranging from 1-15°C higher, in Lekgaba where lions are present, than in Korannaberg (no lions). The pattern of activity under higher heat loads in the presence of lions was recorded during spring especially. This pattern likely reflects the need for increased foraging at the end of the dry season to meet nutritional requirements, with reduced activity during the cooler times of the day (early morning/late afternoon/evening) due to higher predation risk. Our results indicate that 67% of herbivores considered are foraging under significantly higher heat loads during spring and summer in the presence of lions, an approach that likely will become untenable in the face of climate change.

70. Co-occurrence of mesocarnivore with large carnivore inside and outside protected areas western Zimbabwe

Mlamuleli Mhlanga¹, Colleen Downs², Thamarlinham Ramesh² and Hilary Madri³

¹Lupane State University, mmhlanga@lsu.ac.zw

²University of KwaZulu-Natal

³Zimbabwe Parks & Wildlife Management Authority

Anthropogenic induced habitat changes on ecosystems catalyse consequent changes in the behaviour of wild animals. Such behaviour change includes spatiotemporal use of the habitat. We used camera traps to investigate spatiotemporal dynamics of the habitat and co-occurrence of the spotted hyena with serval, black-backed jackal and African civet across a hunting area, ranch and national park in western Zimbabwe, during the wet and dry season. We tested for co-occurrence and temporal overlap between species pairs alongside habitat, conspecific and anthropogenic variables. Detection probability of serval and African civet increased with presence of spotted hyena while that of the black-backed jackal decreased across the three land uses. Temporal coefficients of overlap were high for all pairwise comparisons, implying that they were more likely to be co-detected at the same sites but not necessarily at the same site hence changes in land management should consider how that would affect intraguild interactions

71. Investigating stress-related fGCM concentrations in free-ranging diurnal and nocturnal southern African mice (*Lemniscomys rosalia* and *Mastomys coucha*) in response to seasonal variation and land-use transformation

Mmatsawela Ramahlo, Andre Ganswindt and Michael Somers

University of Pretoria, jawi.ramahlo@up.ac.za

Global anthropogenic land transformations lead to reduced natural habitats and increased human-wild-life conflicts in many ecosystems. Our study quantified faecal stress hormones of two bio-indicator rodent species (*Lemniscomys rosalia* and *Mastomys coucha*), across dry and wet seasons within five differently transformed landscapes in Magaliesberg, Northwest province, South Africa. Faecal samples were collected from live-trapped mice and analysed to measure fGCM concentrations using a 5 α -pregnane-3 β ,11 β ,21-triol-20-one enzyme immunoassay. Seasonal differences were observed, with *L. rosalia* showing elevated [fGCM] in the dry season compared to the wet, and vice versa for *M. coucha*. Landscape variations were also observed, with *L. rosalia* showing elevated [fGCM] on intensively transformed agricultural land, while the generalist *M. coucha* showed similar [fGCM] across sites. We found that seasonal variation leads to stress-related responses in both species, which may become exacerbated by global climate change. Land transformation appears not to elicit strong stress responses in generalist, synanthropic species, but may threaten specialists and non-commensal species over time.

72. An impact assessment of alien invasive plants in South Africa generally dispersed by native avian species

Nasiphi Bitani

University of KwaZulu-Natal, bitaninasiphi@gmail.com

Invasive alien plant species have been identified as a major threat to biodiversity and the relationship with native avian dispersers may increase their invasion potential. The impact of invasive plant species needs to be quantified using comparable assessment tools across different habitats and species to allocate limited resources to high-priority species. Here, we used the Generic Impact Scoring System (GISS) to assess the impacts of 16 fleshy-fruited alien invasive plant species in South Africa generally dispersed by native avian species. The results showed that fleshy-fruited invasive species have both environmental and socio-economic impacts. The cumulated impact scores for lantana (*Lantana camara*) and the tree of heaven (*Ailanthus altissima*) were the highest, with scores of 42 and 32, respectively. Some species, such as white mulberry (*Morus alba*), camphor tree (*Cinnamomum camphora*), American bramble (*Rubus cuneifolius*) and Brazilian pepper tree (*Schinus terebinthifolius*), had low overall impact scores of 8, 18, 14 and 16, respectively, but scored the maximum impact of 5 for certain mechanisms. Environmental impacts of fleshy-fruited invasive plant species had a high impact magnitude through effects on the ecosystem and vegetation.

73. Increases in subsistence farming due to land reform have negligible impact on bird communities in Zimbabwe

Stephen Pringle², Ngoni Chiweshe¹ and Martin Dallimer²

²Private consultant, chiweshengoni@gmail.com

²Sustainability Research Institute, School of Earth and Environment, University of Leeds, Leeds, UK

Land use change is a major driver of African biodiversity losses. In Zimbabwe, we studied the avian response to abrupt habitat modification associated with a land reform programme that converted part of the Debshan ranches savannah to subsistence farming. Starting a decade after land use change occurred, we monitored bird communities during 2012-2020 across 45 transects in newly-farmed and unchanged ranches land. In 2012, species richness was 8.8% higher in the farmed area. Over the study period, species richness increased in both the ranches (+12.3%) and farmed (+6.8%) areas. There were increased abundances in birds of most sizes, and in all feeding guilds. New species did not add new functional traits, and no species with distinctive traits were lost in either area. As a result, species diversity reduced, and functional redundancy increased by 6.8% in ranches land. By 2020, the two bird communities had both changed, and became more similar. The broadly benign impact on birds of land conversion is attributed to the low level of agricultural activity in the farmland.

74. A virtual framework for designing 3D photogrammetry configurations for measuring animals

Nicolas Derek Prinsloo, Heather Woollon, Martin Postma and Nico de Bruyn

Department of Zoology and Entomology; University of Pretoria, nicolas.prinsloo@up.ac.za

Multi-camera setups synchronously photograph animals for non-intrusive 3D photogrammetric measurement in monitoring condition and growth. Their development takes considerable trial and error, due to their technological complexity, remoteness, and environmental challenges. Virtual photogrammetry, processing 'photographs' simulated from digital 3D scenes, bypasses such obstacles for testing and improving the measurement accuracy of these setups prior to actualisation. We simulated various configurations, existing and yet to be built, to determine their accuracy for measuring volume of various terrestrial animals. Newly designed camera configurations improved on previous ones. Additionally, we determined the accuracy in estimating bird flight height using three cameras varying in spacing, and distance from the subject. There is a decline in accuracy along with previously determined declines in precision with distance. Virtual photogrammetry provides a means to testing new camera configurations and novel photogrammetric approaches on animals prior to real application. Notoriously infeasible volume accuracies for photogrammetric measurement can be determined for digital animal models.

75. A Tale of Two Caves: investigating palaeo-environmental conditions at Kromdraai and Sterkfontein's Jacovec Cavern using fossil micromammals

Nompumelelo Maringa¹, Sara Rhodes¹, Pierre Linchamps², Raphaël Hanon¹, Dominic Stratford³, Jose Braga⁴ and Christine Steininger¹

¹GENUS Palaeosciences/University of the Witwatersrand, mpumi.maringa@gmail.com

²Muséum National d'Histoire Naturelle, Paris

³School of Geography, Archaeology & Environmental Studies, University of the Witwatersrand,

⁴Centre for Anthropobiology & Genomics of Toulouse, Université de Toulouse, Université Paul Sabatier

New investigations of micromammal fossils from two Plio-Pleistocene sites from the Cradle of Humankind are producing significant discoveries relevant to the study of hominin and non-hominin evolution and our understanding of palaeo-environments. Here we present the first micromammal study conducted on recently recovered assemblages from both deposits. Kromdraai Unit P (KW-Unit-P, ~2.0 Ma) and the Jacovec Cavern in the Sterkfontein caves system (JC-STK, ~ 3.6 Ma) have yielded a rich collection of micromammal material stratigraphically associated with hominins. Due to their small home ranges linked to their preferred habitat, these species greatly inform our understanding of local palaeo-environments and habitat reconstructions associated with early hominins. Craniodental elements were analysed to identify taxa which are then correlated to precise (i.e. local) habitat preferences based on modern comparative references. Ongoing analyses reveal a rich list of micromammal species from both localities, and their habitats as well as their implications on our understanding of early hominin environments are explored. Thus enhancing habitat reconstructions associated with hominins.

76. Optimising artificial insectary lighting to increase mating success in colonised *Anopheles funestus*

Paul Calist Mrosso¹, Lizette Koekemoer¹, Ashley Burke² and Bernard W.T. Coetzee³

¹University of Witwatersrand, 2633873@students.wits.ac.za

²National Institute for Communicable Diseases Division of National, Health Laboratory Services

³University of Pretoria

Malaria vector control research has benefited from the rearing of *Anopheles* mosquitoes. Recently, malaria vectors in the *Anopheles funestus* group have been of great interest due to their role in active and residual malaria transmission in Africa. Mastery of the biology and ecology of *An. funestus* is limited owing to the difficulty in rearing them due to their low mating success under insectary conditions. In nature, mating of malaria vectors depends on photoperiods – a fact that has been mimicked by use of artificial lights in insectaries. Since light regulates a range of physiological and behavioral responses and different species respond uniquely to light properties, this study seeks to evaluate the impact of artificial lights on the mating success of *An. funestus* by manipulating adult mosquitoes holding cages environment with black cloth coverings and light contrasting markers. Initial data show that putting black covering material or light contrasting marker on top of adult cage boosts *An. funestus* mating. Success in this study will benefit malaria vector control interventions such as sterile insect technique and gene drive which require insectary mass production of vectors.

77. Genetic assessment of a Burchell's (*Equus quagga burchelli*) and a Hartmann's zebra (*Equus zebra hartmannae*) population in the Tswalu Kalahari Reserve

Paulo Ribeiro, Kelsey L. Glennon, Jason P. Marshal and Francesca Parrini

School of Animal Plant and Environmental Sciences – University of the Witwatersrand,
ribeiro.pauloh@gmail.com

The Equid family comprises seven species, spread over Africa and Asia, and among them, there are three species of zebras, all of them living in Africa. Two of the three extant zebra species can be found in South Africa: the Burchell's plains zebra (*Equus quagga burchelli*) and the Hartmann's mountain zebra (*Equus zebra hartmannae*). The two species differ in chromosome numbers, being 32 for Hartmann's mountain zebra and 44 for Burchell's plains zebra. However, the two species can interbreed and produce hybrid offspring. This study provides a molecular assessment of both Burchell's and Hartmann's zebra populations living in the Tswalu Kalahari Reserve. Hair and tissue samples were collected from both species (27 from Hartmann's zebra and 14 from Burchell's zebra) during the annual game captures in May 2021. DNA was extracted from the samples using a QIAGEN Blood and Tissue Kit®, following the "User-developed protocol".

78. Fisherman's friend or foe: alien tapeworms from invasive carp infecting native yellowfish

Annemarië Avenant-Oldewage and Quinton Marco Dos Santos

University of Johannesburg, aoldewage@uj.ac.za

The presence of invasive organisms in the freshwater systems of southern Africa has become a topic of growing concern, but the secondary introduction of parasites is often overlooked. Recently, unfamiliar

cestodes were recovered from native yellowfish species in the Vaal and Crocodile River systems. To identify and determine the effect of these parasites on their hosts, light and scanning electron microscopy, DNA Barcoding, and histopathological analyses were used. The cestodes from *Labeobarbus aeneus* in the Vaal River were identified as *Atractolytocestus huronensis*. This cestode did not appear to cause severe pathology to the host, but mostly immature specimens were detected. The cestode from *Labeobarbus marequensis* in the Crocodile River was identified as *Archigetes sieboldi*. While *A. huronensis* has been recorded from Africa before, neither cestode species has been recorded from native fish. This study is the first record of *A. sieboldi* from Africa. Both cestodes are tapeworms of the popular but invasive common carp, *Cyprinus carpio*. The apparent host switching of invasive cestodes to native fishes is concerning and needs to be monitored, alongside their impact on native species.

79. From where have all the forams come – Extension of the Tertiary sea

Raymond Davies and Alan Webster Davies

Talmora Diamond Inc. rayal.davies@sympatico.ca

At the 8th conference we questioned “where had all the garnets gone” and concluded that kimberlitic garnets were destroyed by tropical weathering in the Melville Hills of Canada’s NWT. In 2019 we drilled kimberlite targets at Seahorse Lake and encountered thick sequences of clay. Concentrates from bulk clay samples contain kimberlite indicator minerals that survive tropical weathering but also foraminifera that indicate marine conditions. Since 2020 we have answered the question “from where have all the forams come”. They result from contamination of weathered mantle rocks by overlaying marine clays during drilling. The marine clays lie in the southeast of a flat plain with no outcrop, mapped as Ordovician rocks covered by glacial drift and characterized by remnants of Cretaceous rocks projecting above the plain. The area was twice submerged beneath Cretaceous seas but is south of a known arm of a Tertiary Sea. Tropical weathering that destroyed the garnets was Eocene (55 Ma) so overlaying sediments containing forams are younger extending the Tertiary Sea south to Seahorse Lake. Without contamination there would be no Tertiary Sea extension or possibility of marine diamonds.

80. Securing and protecting the habitats for the African Grass Owls in the Highveld coal belt area of South Africa

Tselane Rebotile Rachuene¹, Gareth Tate¹ and Gerhard Nortjie²

¹Endangered Wildlife Trust (EWT), tselaner@ewt.org.za

²University of South Africa

The Grass Owl is a rare ground-nesting species. This habitat specialist is found outside protected areas in the Highveld Grasslands of South Africa. Opencast coal mines, agrarian and developments are major drivers behind the loss and fragmentation of the species’ already diminishing habitat. It breeds in the fragmented grass patches within the wetlands. This study aimed to secure/recover the habitats while raising awareness. From various land-use and agricultural management styles, six viable habitats of different area sizes were secured from well-known threats (fires, livestock trampling). Protection strategies were applied and tested over 24 months period. Habitat protection improved significantly by reducing over 90% of threats. While livestock trampling and uncontrolled burning are continuing threats – management guidelines must be developed. Fragmented habitats are still essential to maintain a population

of this species and are worth protection by establishing corridors, servitudes or habitat connectivity. Community education/awareness is critical to connecting people with species appreciation. Over 900 persons from communities have been reached out about the species/habitat

81. Ecomorphological analysis of fossil bovids from the Plio-Pleistocene Hominin-bearing deposits at Kromdraai, Sterkfontein, and Swartkrans caves, South Africa

Recognise Sambo¹, Dominic Stratford¹, Jose Braga², Mari Arriaza Carmen Dorado³, Raphael Hanon¹, Christine Steininger¹, Mathew Caruana¹, Kathleen Kuman¹ and Travis Rayne Pickering⁴

¹University of the Witwatersrand, recsambo95@gmail.com

²University of Toulouse

³University of Alcalá

⁴University of Wisconsin

The site of Kromdraai, Sterkfontein and Swartkrans, dating between 3.4 and 1.5 Ma, have yielded significant fossil hominins and diverse faunal assemblages used to elucidate early hominin evolutionary history and reconstruct past environments. Here, bovid ecomorphology was applied as a novel, taxon-free palaeoenvironmental analysis. Discriminant function models were constructed using linear measurements of astragali and phalanges to compare morphologies of fossil bovids at Kromdraai (Unit-P), Sterkfontein (Member 4 and Member 5 East, Oldowan Infill) and Swartkrans (Member 1 Lower Bank and Member 2), and those of modern bovids. The aim was to determine their ability to accurately predict habitat affiliation from a four-habitat-grouping scheme: open, light cover, heavy cover, and forest. Results revealed that morphologically, bovids from these sites have varied adaptations to mosaic habitats, mainly dominant in open and light cover habitats and less in heavy cover and forest settings. These deposits accumulated during the time of gradual environmental shift from closed to open environments associated with the expansion of grasslands and major events of hominin and faunal evolution.

82. The impact of woody encroachment on Kalahari reptile populations

Riaaz Mohamed and Bryan Maritz

University of the Western Cape, riaazm94@gmail.com

Woody encroachment has emerged as a major threat to African open grassland systems. The lack of robust reptile population data, as a consequence of the inherent low detection probability associated with reptile surveillance, has resulted in reptiles being notoriously overlooked in conservation planning. With the aim of understanding the impacts of woody encroachment on reptile populations, we conducted four 18-day reptile surveys along a woody encroachment gradient at Tswalu Kalahari Reserve. We estimated the relative abundance of six lizard and three snake species by using multi-season N-mixture models, applied to repeated count data of unmarked animals. Abundance was modelled against two woody encroachment indices: (1) canopy cover and (2) number of trees > 2 m. With varying responses across species, we found encroachment indices to be important positive predictors of abundance for four species and negative predictors for two species. Based on our results, we expect reptile species richness to remain stable, but forecast changes in community composition with increasing encroachment.

83. Adaptive foraging drives animal movement in heterogeneous resource landscapes

Richard Gibbs, Pietro Landi¹, Gus Mills², Sandra MacFadyen¹ and Cang Hui¹.

¹Stellenbosch University, rgibbs@sun.ac.za

²Scientific Services, SANParks

The foraging behaviour of animals consistently influences their spatial distributions by affecting movement, habitat choice and social behaviour (cooperation and territoriality). Traditionally, foraging activities have been approximated as static behavioural rules that optimise energy budgets and minimise risks. However, these do not adequately capture the external and internal drivers of decision-making. These drivers are intrinsically ephemeral and, therefore, must lead to adaptive behaviour in real-world foragers. Using agent-based models, reinforcement learning and social games, we show how heterogeneous resource distributions favour adaptive foraging behaviour and learning in spatial landscapes. Adaptive behaviour is also shown to ameliorate the effects of temporal heterogeneity. We discuss the potential to demonstrate this adaptive behavioural model using diet choice and space use of cheetah in the Kalahari National Park from 2006 to 2011. Once parameterised, this model has the potential to predict the space use and home range of predatory foragers in protected areas, making it an important tool for future conservation planning.

84. Assessing the Response of Mesopredators to Different Apex Predator Regimes in the Tswalu Kalahari Reserve

Roxanne Natasha Ungerer and Haemish Alan Melville

University of South Africa, roxanneungerer@gmail.com

Mesopredator release is the theory that in the absence of apex predators, mesopredators respond functionally by increasing their populations. The Tswalu Kalahari Reserve provides a unique opportunity to test this hypothesis in a Kalahari setting as it has two separate sites within the reserve under two different predator management regimes. At the time of my study Korannaberg supported wild dogs and cheetah as top predators (no lions), and Lekgaba supported lions (no wild dogs or cheetah). Both areas support similar assemblages of mesopredators, and their prey species. I compared mesopredator, large and small ungulate, small mammal and bird relative abundance, seasonally, between the two sites. I assessed relative abundance of mesopredators and ungulates using camera traps, small mammals using live trapping transects and birds using modified point counts. I detected no significant differences in relative abundances, of the mesopredators ($P = 0.908$), ungulates ($P > 0.05$), small mammals ($P = 0.200$), or birds ($P > 0.05$), between the two sites. This supports the increasing body of knowledge suggesting that mesopredator release may not be a ubiquitous phenomenon.

85. Studying the gut microbiota of ant- and termite-eating mammals to understand convergent dietary adaptations

Sophie Teullet¹, Marie-Ka Tilak², Amandine Magdeleine², Roxane Schaub³, Nora M Weyer⁴, Wendy Panaino⁵, Andrea Fuller⁶, W Jim Loughry⁶, Nico L Avenant⁷, Benoit de Thoisy⁸ and Frédéric Delsuc²

¹CNRS, University of Montpellier, sophie.teullet@umontpellier.fr

²ISEM, Univ Montpellier, CNRS, IRD, Montpellier, France

³CIC AG/Inserm 1424, Centre Hospitalier de Cayenne Andrée Rosemon, Cayenne, French Guiana

⁴Brain Function Research Group, School of Physiology, University of the Witwatersrand, Johannesburg, South Africa

⁵Centre for African Ecology, School of Animals, Plant, and Environmental Sciences, University of the Witwatersrand, Johannesburg, South Africa

⁶Department of Biology, Valdosta State University, Valdosta, GA, United States

⁷National Museum and Centre for Environmental Management, University of the Free State, Bloemfontein, South Africa

⁸Institut Pasteur de la Guyane, Cayenne, French Guiana

In mammals, 22 species are specialized in ants and termites consumption (myrmecophagy) including the armadillo, anteaters, armadillos, pangolins, and armadillos. These species have independently evolved toward this diet, which raises the question of whether the same adaptive mechanisms were involved in these convergent species. For instance, taxonomic analyses have revealed convergence in the composition of the gut microbiota in myrmecophagous species suggesting a role of microbial symbionts in prey digestion. Still, questions remain regarding the functions carried by those symbionts, especially their role in the digestion of the insects' chitinous exoskeleton. Here, we sequenced metagenomes from 31 field-collected fecal samples of nine myrmecophagous and insectivorous species collected in French Guiana, South Africa, and the USA. We compared their taxonomic composition and were able to reconstruct more than 200 bacterial genomes from which we identified a diversity of chitinase genes. These results highlight a potential role of the gut microbiota of myrmecophagous species in prey digestion through chitin-degradation pathways.

86. Effect of *Seriphium plumosum* densification on grassland biodiversity in the Mpumalanga Province of South Africa

Susannah Cleo Graham¹, Hanneline Smit-Robinson², Alan Barrett¹ and Leslie Brown¹

¹UNISA, patrosc@unisa.ac.za

²Bird Life SA

Mesic Highveld Grassland is important for biodiversity; however, it is threatened by densification of *Seriphium plumosum*. This indigenous encroacher spreads rapidly, outcompeting other herbaceous species. This study investigated the effect of different *S. plumosum* densities on grassland biodiversity, species composition and vegetation structure within Telperion, Mpumalanga, South Africa. An assessment of the vegetation, small mammals and birds within three grassland sites were undertaken. The results indicate that *S. plumosum* at high densities negatively affect diversity of small mammals and birds together with vegetation composition and structure. Certain bird and small mammal species were found to prefer or avoid dense *S. plumosum*. Generalist species may exploit the altered habitat, whilst specialised species will decline in number. The presence of *S. plumosum* at low densities is considered an integral part of the environment. It is however, important that areas where *S. plumosum* occurs are monitored. An increase

in density of *S. plumosum* as a result of degradation, could negatively affect the biodiversity, species composition and structure of the habitat.

87. Challenges and Opportunities for integrating wildlife conservation and livestock farming on privately owned land: Case of Shangani Holistic Ranch

Tapiwa Prosper Chimbadzwa

Wildlife Conservation Action, info@wildlifeconservationaction.org

The integrated management of wildlife and livestock can simultaneously improve livestock production, human health and wildlife conservation. But for many, biodiversity conservation and livestock ranching typically have been portrayed as conflicting uses of African savannas, since herbivores and livestock compete for grazing land, where as carnivores have been persecuted for killing livestock. However, there is enough room for coexistence between livestock and wildlife. To achieve the benefits of a holistic approach to rangeland management, it is necessary to carefully balance local concerns in order to ensure the long-term recovery, distribution and management of large carnivore populations while also balancing human viability and welfare. Using data collected from kraal assessments, reports on depredation incidents, and investigating kill sites. The study examined the relationship between livestock predation and husbandry practices as well as the ecology of African leopards (*Panthera pardus*), which are mostly responsible for livestock predation at Shangani Ranch. The findings offered a general assessment of the ecology of large carnivores and their interactions with other mammals.

88. Monitoring tree growth rates in Zimbabwe's Teak woodlands: 30 years of experience

Tatenda Gotore¹, Anderson Muchawona², Sally Archibald¹, Casey Ryan³, Lorena Benitez³ and Penelope Mograbi¹

¹University of the Witwatersrand, tatendagotore@gmail.com

²Forestry Commission Zimbabwe

³Edinburgh University

Tree growth rates determine ecosystem structure, community interactions, sustainable harvesting rates and provide insight into likely responses to global change. We analyse tree growth data from eleven permanent increment plots in the teak woodlands of Zimbabwe to establish growth rates of *Baikaea plurijuga* and *Guibourtia coleosperma* and review thirty years of monitoring these plots. Results show a mean (\pm SEM) growth rate of 0.1 ± 0.01 cm⁻¹ across sampling sites. Diameter growth rates differ significantly ($P < 0.001$) with site and species. Assuming linear growth approximately 350 years would be required to reach a harvestable size of 35 cm in tree diameter, which is slightly longer than the regional average. Long-term permanent plots are important in understanding tree growth rates which informs sustainable timber harvesting. Lessons from the past 30 years show that it requires a large investment to maintain and regularly collect data from these plots and that use of standardised data collection protocols enables local data to be comparable with similar data at the regional and global scale.

89. Longitudinal variation in cave roosting species (excluding *Miniopterus natalensis*), at Madimatle Cave in South Africa

Teresa Catherine Kearney¹, Mark Keith², Victor Van Cakenberghe³ and Wanda Markotter²

¹DNMNH/AFRICANBATS NPC, teresacatherinekearney@gmail.com

²University of Pretoria

³University of Antwerp

Madimatle Cave, besides being an important maternity roost for *Miniopterus natalensis*, is utilized by eight other cave roosting species. Part of a wider interdisciplinary collaborative project, the aim was to understand how occupancy of species changed over time, not only in relative abundance, but also differences in sex ratio, age structure, and reproductive classes. Bats were caught over six years (2013 – 2018). Only male *Rhinolophus smithersi* have been caught, whereas both sexes of all the other species have been present. *Rhinolophus clivosus* has been recorded twice. Fewer *Myotis tricolor*, *Rhinolophus smithersi*, and *Hipposideros caffer* have been caught than *Rhinolophus blasii*, *Rhinolophus simulator*, *Nycteris thebaica* and *Cloeotis percivali*. Sex ratios vary between species and over time. With the exception of *R. smithersi* and *R. clivosus* all other species have been observed using the cave as a maternity roost. *Myotis tricolor*, *R. clivosus* and *R. smithersi* have not been observed at the cave in the driest, coldest months. We now have a better understanding of seasonal occupancy of Madimatle Cave by the different species, and additional information regarding their life histories.

90. Four new species of the sac spider genus *Planochelas* Lyle and Haddad, 2009 (*Araneae*, *Trachelidae*) from central and southern Africa

Thembile Khoza¹ and Robin Lyle²

¹South African National Biodiversity Institute, T.Khoza@sanbi.org.za

²Agricultural Research Council – Plant Health and Protection

Four new species of the sac spider genus *Planochelas* Lyle & Haddad, 2009 (*Araneae*, *Trachelidae*) from central and southern Africa the genus *Planochelas* Lyle & Haddad, 2009 is endemic to the Afrotropical region. Members of the genus are very small, arboreal sac spiders. They are mainly collected by canopy fogging in tropical forest and savanna. In this study, four new species of *Planochelas* are described: *P. brevis* sp. nov., *P. jocquei* sp. nov. (Democratic Republic of the Congo) and *P. haddadi* sp. nov., *P. neethlingi* sp. nov. (South Africa). An updated key to the genus is provided, and the new species are illustrated by photographs and drawings. A distribution map for the genus is provided. This paper increases the number of species in the genus to seven. Keywords Afrotropical, arboreal sac spider, South Africa, canopy/tree fogging, endemic species, *Trachelidae*.

91. The thermal quality of the Kalahari from the perspective of an actively foraging snake

Thilo Beck¹, Bryan Maritz² and Graham Alexander¹

¹University of the Witwatersrand, thilo.florian.beck@web.de

²University of the Western Cape

Snakes produce only small amounts of metabolic heat and rely primarily on thermal exchange with the environment to regulate body temperature. Characteristics of the thermal environment differ seasonally

and can prevent snakes from performing certain physiological processes. We defined environmental thermal quality as the difference between operative and target body temperatures. We implanted free-ranging cape cobras with temperature loggers to examine the relationship between body temperature and the thermal quality of the habitat. Operative temperatures were recorded every 30 min. using probes placed in the environment. The temperature loggers inside the snakes recorded body temperatures at the same interval. We found significant differences in thermal quality on spatial and temporal scales, which impacted cobra behaviour and physiology. For example, low winter underground temperatures prohibit effective digestion; during summer, high surface temperatures limit the duration of foraging bouts. Additionally, our results show that thermal quality is not a one-dimensional feature in a thermally heterogeneous environment and should be assessed as a range across available microclimates.

92. The influence of forest characteristics on avian species richness and functional diversity in Southern Mistbelt Forests of South Africa

Thobeka Silindile Gumede, David Alan Ehlers Smith, Samukelisiwe Ngcobo, Mbalenhle Sosibo and Colleen Downs

University of KwaZulu-Natal, thobekagumede123@gmail.com

Natural habitat modifications, changes in vegetation structure and habitat characteristics have resulted in decreased species richness and functional diversity in wildlife populations. We aimed to determine the influence of vegetation structure, patch size and isolation distance on avian communities in Southern Mistbelt Forests in the provinces of KwaZulu-Natal and Eastern Cape, South Africa, across a variety of forest patches during the breeding and non-breeding seasons. We conducted fixed-radius point-count surveys to determine avian species richness and functional diversity and quantified the vegetation foliage profile in 54 distinct forest patches across three study areas. Multivariate analyses showed significant differences in vegetation structure among forest patches and subsequent variation in avian species richness and functional diversity across the study areas during the non-breeding season. Avian beta diversity was significantly driven by the reduction in forest patch size and habitat structural complexity. Reduction in forest size and complexity reduced avian species richness and functional diversity. Increasing isolation distance negatively influenced avian diversity.

93. Drivers and facilitators of the illegal killing of elephants across 64 African sites

Timothy Kuiper¹, and EJ Milner-Gulland²

¹University of Cape Town, timothykuiper@gmail.com

²University of Oxford

Poaching for ivory continues to threaten African elephants. To help inform responses to this threat we (1) used criminology theory and literature evidence to generate hypotheses about factors that may drive, facilitate, or motivate poaching, (2) identified datasets representing these factors, and (3) tested those factors with strong hypotheses and sufficient data quality for empirical associations with poaching. Using standardised monitoring data on 10,286 illegally killed elephants detected at 64 sites in 30 African countries (2002-2020), we found strong evidence to support the hypotheses that the illegal killing of elephants is associated with poor national governance, low law enforcement capacity, low household wealth and health, and global ivory prices. We found only weak evidence that armed conflict may increase the illegal

killing of elephants, and no evidence for effects of site accessibility, vegetation density, elephant population density, precipitation, or site area (km²). Reducing poaching must inevitably involve addressing wider systemic challenges of corruption, human development, and consumer demand.

94. Genome sequencing of historical Encephalomyocarditis viruses from South Africa reveals a link between Mastomys-associated viruses and savannah elephant outbreak strains

Vanessa van Meer¹, Janusz Paweska² and Armanda Bastos¹

¹University of Pretoria, u18016392@tuks.co.za

²NICD

An outbreak of encephalomyocarditis virus (EMCV) occurred in 1993/4 in free-ranging African elephants in the Kruger National Park (KNP). The outbreak, which was characterised by male-biased mortalities, coincided with a rodent population irruption. *Mastomys* rodents were implicated as the reservoir host based on EMCV neutralizing antibodies and PCR. However, as virus isolations were only made from elephants and not from rodents, and as the rodents of this cryptic species complex were not typed, the true reservoir host remains undetermined. Here, we generate the first reference sequences for viruses isolated from two *Mastomys* individuals and one *Mastomys*-associated mite, *Laelaps muricola* in 1961 in SA. The full viral genome was characterised for these historical virus isolates through PCR amplification and sequencing. Phylogenetic analyses revealed that the near-identical *Mastomys*-associated viruses were most closely related to KNP elephant outbreak strains, with high levels of nodal support. These results implicate *Mastomys* rodents as EMCV reservoirs, but it remains to be determined which of the two species, *M. coucha* or *M. natalensis*, plays a role in virus maintenance and spillover

95. Establishing a non-invasive method for monitoring adrenocortical function in roan antelope (*Hippotragus equinus*)

Vanessa Wandja Kamgang¹, Tshepiso Majelantle¹, Nigel Bennett¹, Annemieke van der Goot² and Andre Ganswindt²,

¹Mammal Research Institute, Department of Zoology and Entomology, University of Pretoria, Tshepiso.majelantle@zoology.up.ac.za

²Lapalala Wilderness Nature Reserve

Nowadays, the avoidance of stress is recognised to be a crucial component when managing wildlife. The present study set out to establish a non-invasive method to monitor faecal glucocorticoid metabolite (fGCM) concentrations as a measure of stress and determine fGCM concentrations in relation to male reproductive activity and female reproductive status in the roan antelope (*Hippotragus equinus*), a popular game ranching herbivore in southern Africa. We performed an adrenocorticotrophic hormone (ACTH) stimulation test, using an adult male and female individually housed at Lapalala Wilderness, South Africa, to assess the suitability of five enzyme immunoassays (EIAs) to measure alterations in faecal glucocorticoids metabolite (fGCM) concentrations as a stress-associated biomarker. An 11-oxoaetiocholanolone I EIA performed best, revealing an up to 20-fold increase in study animals, detected 12-17 hours post-administration. Further, a comparison of the female reproductive status revealed an up to 1.2-fold increase in fGCM concentrations, in pregnant compared to non-pregnant females. These findings can be used to support management decisions in conservation breeding facilities.

