

OPPENHEIMER GENERATIONS



RESEARCH AND CONSERVATION

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# 12<sup>th</sup> OPPENHEIMER RESEARCH CONFERENCE

◆ SCIENCE FOR IMPACT ◆



ORC

2023

4-6 October 2023

Cover photo: Valery Phakoago, from the School of Physiology at the University of the Witwatersrand, tracking pangolin at Tswalu Kalahari Reserve, to gain a deeper understanding of their behaviour and dietary overlap between armadillos and ground pangolins in the Kalahari. Photo credit: Marcus Westberg.

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Randjesfontein Cricket Pavilion,  
Midrand



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# Welcome note

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The Oppenheimer Research Conference was initiated in 2010 and has grown into an important, significant event on the global academic calendar. What is unique about this conference is that unlike any other conference it showcases research from various environmental and natural science fields. One of its great successes is this conference's diversity. Usually, one attends a conference focused on single specialisations such as ornithology, entomology, archaeology, however, it all happens here, creating an opportunity for scientists to mix with other scientists from various fields.

The work presented here is cutting-edge, innovative scientific research, that provides a platform to foster engagement and collaboration. By so doing, we are contributing to placing African voices in global conversations on environment, conservation, and sustainability. The conference engages researchers in an interdisciplinary and multisectoral manner, and across scale, from the microscopic, landscape and global level.

The conference is not only about scientists talking to other scientists, but to create a movement for nature in a way that creates sustainable, long-lasting impact. We need to move from pure discussion into translating global challenges and together providing the answers. 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 utilized.

The Oppenheimer Research Conference 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, we offer opportunities to learn and to build new networks to galvanise action based on solid research, creating impact, and asking the right questions. This will guide action towards mapping out solutions to mitigating environmental and conservation tipping points across the continent and beyond.

We are confident that you will be inspired over the next three days by the various cross-cutting presentations and posters, which include topics such as biodiversity loss, reintroduction of critically endangered species, landscape ecology, climate change and wildlife economies, as we work towards understanding the simultaneous equation between man and the environment. Thank you for joining us.

**Nicky and Jonathan Oppenheimer**

# Introduction

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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.

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 encourage action based on solid research and asking the right questions.

Research can provide solutions to mitigate environmental and conservation tipping points, focused on the following four 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, 4 October 2023

## Session 1: Chair | Duncan MacFadyen

08:00 – 09:00	Registration/ Networking/ Refreshments
09:00 – 09:05	Welcome <b>Jane Goodall, DBE</b>
09:05 – 09:15	Introduction by <b>Nicky Oppenheimer</b>
09:15 – 09:25	Keynote address by <b>Minister Naledi Pandor</b>
09:25 – 09:55	Lessons from the dodo PLENARY by <b>Carl Jones</b>
09:55 – 10:25	Nature conservation in South Africa — current and desired states Full presentation <b>Hector Magome</b>

## 10:25 – 10:55 Morning tea

## Session 2: Chair | Rendani Nenguda

10:55 – 11:25	How many black rhino subspecies are there? Full presentation <b>Yoshan Moodley</b>
11:25 – 11:40	Positive tipping points for adaptation and resilience: Opportunities and risks for people and nature in accelerating transitions Results Presentation <b>Tom Powell</b>
11:40 – 11:55	Forensic applications to assess illegal trade in Temminck's ground pangolin ( <i>Smutsia temminckii</i> ) in traditional medicine markets in South Africa Results Presentation <b>Vivienne Williams</b>
11:55 – 12:10	Shifting power to accelerate conservation impact in Africa Results Presentation <b>Salisha Chandra</b>
12:10 – 12:25	Protecting and connecting landscapes stabilises savanna elephant populations Results Presentation <b>Ryan Huang</b>
12:25 – 12:55	Wildlife trade policy and the rhino conservation economy Full presentation <b>Michael 't Sas-Rolfes</b>
12:55 – 13:10	Towards a just energy transition for Africa Results Presentation <b>John Asafu-Adjaye</b>

13:10	Conference Photo
13:20 – 14:00	Lunch
Session 3: Chair   Ashleigh Fynn-Munda	
14:00 – 14:30	Saving Marion Island's seabirds – the world's most important bird conservation project Full presentation <b>Mavuso Msimang</b> and <b>Mark Anderson</b>
14:30 – 14:45	Putting biodiversity on the decision-making map: Building a Biodiversity Intactness Index for Africa Results Presentation <b>Hayley Clements</b>
14:45 – 15:00	Climate change and potential distribution of two South African avian montane grassland specialists, the Drakensberg Rockjumper, and the Mountain Pipit Results Presentation <b>Thobeka Gumede</b>
15:00 – 15:15	Eating wild meat for the restoration of african landscapes and sustainable livelihoods Results Presentation <b>Wiseman Ndlovu</b>
15:15 – 15:30	The five early hominid species of Sterkfontein and Swartkrans Results Presentation <b>Ronald Clarke</b>
15:30 – 16:00	Afternoon tea
Session 4: Facilitator   Jonathan Oppenheimer	
16:00 – 17:00	Panel discussion: Environmental Philanthropy: Learning from the past to inform the future Panel members: <b>Shafika Isaacs</b> <b>Nicky McLeod</b> <b>Irshaad Paruk</b> <b>Robin Woodhead</b>
17:00 – 17:30	Break   Painted Wolf Wines – wine tasting
17:30 – 17:40	Movie introduction: Kim Wolhuter
17:40 – 18:40	<b>Movie screening:</b> Natural World: Cheetahs – Growing Up Fast
19:00	Venue close



# Day 2: Thursday, 5 October 2023

Session 1: Chair | Peter Makumbe

08:00 – 08:30	Registration/Networking/Refreshments
08:30 – 09:00	Harnessing the value of Africa's ecological assets for sustainable development: The case of forests and tree-based landscapes PLENARY by <b>Doris Mutta</b>
<b>40 mins</b>	<b>SPEED PRESENTATION SESSION</b>
09:00 – 09:05	Hybridisation of wild <i>Oreochromis mossambicus</i> populations with the introduced <i>Oreochromis</i> species in the Limpopo, Mpumalanga, and KwaZulu-Natal provinces, South Africa Speed presentation <b>Mahlatse Mashaphu</b>
09:05 – 09:10	The impact of artificial light on mosquito community ecology Speed presentation <b>Layla van Zyl</b>
09:10 – 09:15	The role of brood pheromones in the reproductive dominance of <i>Apis mellifera scutellata</i> workers Speed presentation <b>Goratileone Oepeng</b>
09:15 – 09:20	Spatial competition in the ectoparasite community of small mammals Speed presentation <b>Sian Willoughby</b>
09:20 – 09:25	Seed dispersal and germination of the alien <i>Cotoneaster pannosus</i> in Afromontane grasslands of the eastern Free State Speed presentation <b>Karabo Moloi</b>
09:25 – 09:30	Drought or degradation? Satellite monitoring of rangeland health in relation to rainfall Speed presentation <b>Guy Lomax</b>
09:30 – 09:35	Sedimentary carbon stock variability in <i>Zostera capensis</i> meadows over large and fine spatial scales: Insights from a South African estuary Speed presentation <b>Aidan Bossert</b>
09:35 – 09:40	<b>Speed presentation group Q&amp;A session</b>

## Poster session

09:40 – 11:00 Morning tea and POSTER SESSION in Poster Gallery

### Session 2: Chair | Pumla Dlamini

- 11:00 – 11:15 Certifying wildlife enterprise  
Results Presentation **Francis Vorhies**
- 11:15 – 11:30 The ecology of leopards (*Panthera pardus*) on a privately-owned land: The case of Shangani holistic  
Results Presentation **Moreangels Mbizah**
- 11:30 – 12:00 Evaluating afforestation in Africa for combating global change  
Full presentation **William Bond**
- 12:00 – 12:15 Microhabitat requirements and occupancy of understorey forest – specialist birds in Southern Mistbelt Forests of KwaZulu-Natal, South Africa: the use of camera traps  
Results Presentation **Nasiphi Bitani**
- 12:15 – 12:30 Land use planning for sustainable land management in Zambia and Zimbabwe: Trade-offs, challenges, and opportunities  
Results Presentation **Kudzai Mpakairi**
- 12:30 – 12:45 The wildlife coexistence conundrum – who wants (to) change?  
Result Presentation **Andre Ganswindt**

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### 12:45 – 13:45 Lunch

### Session 3: Chair | Bailey Corder

- 13:45 – 14:15 Integrating deep history into conservation efforts on the African continent: Opportunities, challenges and applications  
Full presentation **Paul Lane**
- 14:15 – 14:30 Grassy ecosystems in the Anthropocene  
Results Presentation **Nicola Stevens**
- 14:30 – 14:45 A roadmap to deliver Africa's natural climate solutions  
Results presentation **Michael Wolosin**
- 14:45 – 15:00 Crime and punishment: International perspectives on wildlife crime in sub-Saharan Africa  
Results presentation **Yolanda Mutinhima**

15:00 – 15:15 Taxonomic analysis of the pouched mouse, *Saccostomus campestris*, reveals ancient populations with little gene flow  
Results Presentation **Nakedi Maputla**

15:15 – 15:30 Rewilding for improved soil carbon sequestration in Africa  
Results Presentation **Matthew Child**

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**15:30 – 16:00**      **Afternoon tea**

Session 4: Facilitator | Cebisa Luzipho

16:00 – 17:00 Panel discussion – Reinventing the future: Youth perspectives  
Panel Members:  
**Antony Emenyu**  
**Savanna Strauss**  
**Sènakpon Tcheton**  
**Terry Achieng**

17:30 – 18:30 2023 JWO RESEARCH GRANT RECIPIENT AWARD PRESENTATION  
**Jonathan Oppenheimer**

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**18:30 for 19:00**      **Cocktail function**

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# Day 3: Friday, 6 October 2023

## Session 1: Chair | Dylan Smith

08:00 – 08:30	Registration/Networking/Refreshments
08:30 – 09:00	Man-eating lions in southern Tanzania: Spirit animals or <i>Panthera leo</i> ? PLENARY by <b>Craig Packer</b>
09:00 – 09:30	Financing biodiversity conservation – are we putting our money where our mouths are? Full presentation <b>Odirilwe Selomane</b>
09:30 – 09:45	Investigating potential indicators of rangeland degradation in perennial grass populations along a semi-arid grazing intensity gradient Results Presentation <b>Faith Chambara</b>
09:45 – 10:00	Trace elements in the environment: Is wildlife contamination risk influenced by diet? Results Presentation <b>Andrea Webster</b>

## 10:00 – 10:25 JWO RESEARCH GRANT snapshot – 4 years of groundbreaking research

Microplastics and plastic-derived contaminants in Africa's fresh water and marine environments

**Gideon Idowu**

Cattle corridors: Study designs, rangelands selected and the students to make it happen

**Elizabeth le Roux**

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## 10:25 – 11:00 Morning tea

## Session 2: Chair | André Tranquilini

11:00 – 11:15	Long-term vegetation assessment at vegetation monitoring sites on Shangani Ranch Results Presentation <b>Karin Murwira</b>
11:15 – 11:45	An overlooked carbon sink underfoot: The role of mycorrhizal fungi in African biomes Full presentation <b>Heidi Hawkins</b>

11:45 – 12:00	Soil seed bank dynamics as potential indicators of grazing-induced land degradation threshold in a dryland savanna Results Presentation <b>Ndamonenghenda Hamunyela</b>
12:00 – 12:15	Managing African ecosystems for biodiversity and carbon Results Presentation <b>Guy Midgley</b>
12:15 – 12:45	Spatial ecology and interactions between cheetahs and their prey in the arid Kalahari, and implications for their management and conservation Full presentation <b>Gus Mills</b>
12:45 – 13:00	Space use by elephants in Gonarezhou National Park and their ranging patterns beyond the protected area boundaries Results Presentation <b>Bob Mandinyenya</b>
13:00 – 13:15	Drivers of inter- and intraspecific variation in physiological responses of dominant South African savanna trees to high temperatures across an environmental gradient Results Presentation <b>Kerry-Anne Grey</b>
13:15 – 13:30	Strategic opportunism – what works in Africa: Twelve fundamentals for conservation success Results Presentation <b>Brian Huntley</b>
13:30 – 14:00	CONFERENCE AWARDS <b>Nicky Oppenheimer</b> AND CLOSE <b>Duncan MacFadyen</b>
14:00 – 15:00	Lunch

# Poster session schedule

<b>Admore Mureva</b> , Luke Jimu, Anderson Muchaona and Lovemore Musemwa	Species diversity and biomass variability among different woodland types in Zambezi dry forests	1
<b>Akhabue Enimhien</b> , Andrew Cunliffe, Anna Harper, Karina Williams and Tom Powell	Modelling the resilience of ecosystem service provision in African landscapes	2
<b>Alexander Chidakel</b> and Brian Child	Leveraging technology for transparency: Advancing data quality in southern Africa's trophy hunting sector	3
<b>Amaurée Jansen van Vuuren</b> , Jan Adriaan Venter, Hervé Fritz and Lourens Swanepoel	The effects of spotted hyaena ( <i>Crocuta crocuta</i> ) activity hotspots on the abundance and species richness of smaller predators and small mammal species	4
<b>Antony P. Emenyu</b> , Tom Powell, Andrew Cunliffe and Lorien Jasney	Positive tipping points in regenerative practices in smallholder farming systems in Africa: What drives adoption?	5
<b>Arlin Viljoen</b> , Bernard Coetzee, Lizette Koekemoer and Megan Riddin	The impact of artificial light spectra and intensity on the feeding behaviour of <i>Anopheles gambiae</i>	6
<b>Armand Engelbrecht</b> , Christian Timothy Chimimba and Grant Hall	Stable isotope ratios of murid rodents in Gauteng, South Africa: Comparing invasive and indigenous rodents from historical and modern collections	7
<b>Arno van Niekerk</b> , Louis du Preez, Jeanne Tarrant, Lizanne Roxburgh and Adrian Armstrong	Reproductive behaviour of the Kloof frog ( <i>Natalobatrachus bonebergi</i> ), an endangered South African endemic	8
<b>Ashrah M. Shereni</b> , Rangarirai Huruba, Peter Makumbe, Bright M. Chiremba and Michael Mkwanzani	Understanding cattle forage preferences of holistically managed herds: A herder-friendly approach in determining biomass	9
<b>Azraa Ebrahim</b> , Tobias Wang, Leith Meyer, Gareth Hunter, Jessica Briner and Graham J. Alexander	Habitat use and activity patterns of puff adders ( <i>Bitis arietans</i> ) in the Kalahari	10
<b>Bahle F. Ngcongco</b> and Sindiso C. Nkuna	Plant species and functional diversity between the riparian and upland habitats along the Umgeni River at Wakefield	11
<b>Benjamin Melamdowitz</b> , Francesca Parrini and Wendy Panaino	Temminck's pangolin ( <i>Smutsia temminckii</i> ) spatial ecology in Tswalu Kalahari Reserve	12
<b>Boitumelo Mongale</b> , Alan Barrett, Sellina Nkosi and Leslie Brown	Impala seasonal habitat utilisation and movement patterns in Sourish Mixed Bushveld	13

<b>Bradley C. Matainz</b> , Cobus van Dyk and Lee-Ann Sade Modley	<a href="#">An assessment of the macroinvertebrate assemblage within the Pienaars River downstream and upstream from the Roodeplaat Dam</a>	14
<b>Bruce Crossey</b> and Andre Ganswindt	<a href="#">Correlations between tourist activity and stress-related faecal glucocorticoid metabolite concentrations in wildlife</a>	15
<b>Buster Mogonong</b> , Wayne Twine, Gregor Feig, Jolene Fisher and Helga van der Merwe	<a href="#">The influence of climate on cropland cover change (1984-2022) in former apartheid homelands of South Africa: A case study of the Maputaland Coastal Plain (MCP)</a>	16
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# Abstracts and Biographies

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## Day 1: Wednesday, 4 October 2023

### Keynote address: Minister Grace Naledi Pandor

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Born on 7 December 1953, Dr Pandor is South Africa's current Minister of International Relations and Cooperation.

Dr Pandor became an MP in 1994 and has amassed impressive experience in positions of public office, including Deputy Chief Whip of the ANC in the National Assembly from 1995 to 1998, Deputy Chairperson of the National Council of Provinces in 1998, and its Chairperson from 1999 to 2004.

Dr Pandor's experience in education policy planning led to her welcome appointment as South Africa's Minister of Education in 2004. She has been a member of cabinet ever since, and has served her country in the following portfolios:

- Minister of Education (2004-2009);
- Minister of Science and Technology (2009-2012);
- Minister of Home Affairs (2012-2014);
- Minister of Science and Technology (2014-2018); and
- Minister of Higher Education and Training (2018-2019).

Dr Pandor has a PhD from the University of Pretoria (2019) and honorary doctorates from the Cape Peninsula University of Technology, Stellenbosch University, the University of Lisbon (Portugal) and University College Dublin in Ireland.

Upon Dr Pandor's being awarded Germany's highest federal award, the Grand Cross of Merit, the German Ambassador to South Africa, Walter Lindner, said: "Dr Pandor is for us a symbol of the new South Africa: modern, innovative, dedicated to scientific progress and also outstanding in female leadership."

Dr Pandor is married to Mr Sharif Pandor, and they have four children and six grandchildren.





## Plenary: Carl Jones

Durrell's Chief Scientist and declared disciple of Gerald Durrell has brought back at least nine species from the brink of extinction – including the Mauritius kestrel, pink pigeon, echo parakeet, Rodrigues warbler and Rodrigues fody – and has worked to restore the populations of many more species.

He spent much of his career working in the Mascarene Islands, and as a consequence Mauritius has averted more bird extinctions than any other country. However, Carl's conservation approach includes techniques that can be adapted and scaled for ecosystems in other areas of the world where species are at risk of extinction. His captive breeding and reintroduction programmes now serve as models for what can be achieved elsewhere. Carl also pioneered the conservation technique of using ecological replacements to fulfil the role of extinct species.

In 2016, Carl was awarded the prestigious Indianapolis Prize, the “Nobel Prize” of the conservation world. In Carl's honour, Durrell launched the Carl Jones Scholarship Fund in 2020 to inspire and train the next generation of conservation leaders.



## Session 1

### Lessons from the dodo

#### Carl Jones

Durrell Wildlife Conservation Trust, [Carl.Jones@Durrell.org](mailto:Carl.Jones@Durrell.org)

The Durrell Wildlife Conservation Trust works on the conservation of species and the rebuilding of ecosystems, working closely with local communities. I will consider the development of Durrell's efforts worldwide and focus on the work I have been involved with in Mauritius and Rodrigues. Here we have been successful in restoring five species of birds, namely the Mauritius kestrel, pink pigeon, echo parakeet, Rodrigues fody and Rodrigues warbler, from known populations of twelve or less, to populations of hundreds and thousands of individuals. This work has been done using captive breeding and reintroductions, the management of free-living populations and the restoration of habitats. In addition, we have restored the population of the Rodrigues fruit bat and several populations of reptiles, including three species (Günther's gecko, orange-tailed skink and Round Island boa) that would possibly be extinct without our interventions. I will discuss the nature of our approach and how species restoration can be an effective driver for restoring habitats and rebuilding ecosystems.



## Nature conservation in South Africa: Current and desired states

Hector Magome

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In South Africa, Uzani's prosecution of BP for offences, despite ex post facto authorisations under NEMA's section 24G, highlighted flaws in enforcing environmental laws, allowing serious offenders to evade justice. However, Uzani's actions demonstrated that change is possible with focus, determination and will-power. Other Southern Africa Development Countries (SADC), like Malawi, have successfully combated wildlife crime through state and private sector partnerships, leading to significant progress within four years. In contrast, South Africa has struggled with a surge in rhino poaching and wildlife trafficking in the past decade. A joint study by EWT and WESSA indicated that provincial protected areas are on the verge of collapse, largely due to funding issues. Uzani's revelation of over 2 500 unprosecuted environmental crime cases exposed a lack of will to prosecute such offences, impacting the entire SA landscape with various environmental crimes, including littering and pollution. Although SA once excelled in nature conservation and transboundary PAs, the increasing environmental crimes are putting immense strain on conservation efforts. Funding and skills shortages, along with socio-political challenges, pose major hurdles, but also present opportunities for the private sector and concerned society to improve the situation. Preventing the breaking of the conservation efforts should be a collective responsibility, and decisive action is necessary to protect the environment from further deterioration.

## Session 2

### How many black rhino subspecies are there?

Yoshan Moodley

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The intraspecies taxonomy of the wide-ranging black rhinoceros (*Diceros bicornis*) has always been contentious. It has drawn the attention of taxonomists, ecologists, wildlife practitioners and, more recently, geneticists. However, despite a wealth of available information, an evidence-based system for defining populations (or subspecies) is still lacking. One of the main obstacles for a fully elaborated intraspecies taxonomy is the relatively low resolution of traditional morphological and molecular markers, making it difficult to define and localise distinct populations. Yet, the need to document the underlying variation within this and many other wildlife species and to understand how this variation has become partitioned in space and time by evolutionary processes is crucial for informing conservation planning and interventions. Without a basic understanding of a species's evolutionary history, it is difficult to know how many populations exist or existed, how these populations arose, and their history of genetic contact with one another, all of which are essential for both local and range-wide conservation management. In this talk, I will present a genome-scale appraisal of genetic.

## Positive tipping points for adaptation and resilience: Opportunities and risks for people and nature in accelerating transitions

Tom Powell<sup>1</sup>, Laura Pereira<sup>2</sup>, Tim Lenton<sup>1</sup>, Antony Emenyu<sup>1</sup>, Thereza Achieng<sup>1</sup>, Thomas Pienkowski<sup>3</sup>, Arundhati Jagadish<sup>4</sup> and Andy Cunliffe<sup>1</sup>

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<sup>3</sup>Imperial College London

<sup>4</sup>Conservation International

Accelerating climate change adaptation and mitigation are urgent global priorities. Human, ecological and climate systems have complex dynamics and can undergo sudden changes between different states if they pass so-called tipping points. Climate tipping points present serious risks, but potential positive tipping points in human societies could lead to a rapid, self-propelling adoption of practices, technologies or behaviours that accelerate adaptation or mitigation, e.g., renewable energy is now cheaper than carbon-based alternatives, and is being rapidly deployed. Rapid transformations in society and ecology can have widespread and unequal impacts, creating both new opportunities and new risks. We draw on a new “Global Tipping Points Report” to explore what opportunities and risks might exist for people and nature in Africa through a time of accelerating change. Using examples from agroecological farming, renewable energy, conservation, climate finance and others, it will explore how rapid transformations might be unlocked, while considering how to prioritise African visions of sustainable and just futures, with the unique heritage and diversity of the continent at their core.

## Forensic applications to assess illegal trade in Temminck's ground pangolin (*Smutsia temminckii*) in traditional medicine markets in South Africa

Vivienne Williams<sup>1</sup>, Vincent Naude<sup>2</sup>, Nolwazi Mbongwa<sup>1</sup>, Marli de Bruyn<sup>3</sup>, Antoinette Kotze<sup>4</sup>, Thibedi Moshoeu<sup>1</sup>, Peter Coals<sup>1</sup> and Andrew Taylor<sup>5</sup>

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<sup>4</sup>University of the Free State

<sup>5</sup>Endangered Wildlife Trust

Pangolins are consistently sought after for traditional medicine. While poaching and confiscations are pervasive and persistent in South Africa, there is a lack of holistic understanding of the dynamics of local trade. We approach this deficit through consideration of socio-economic market factors alongside molecular forensic tools. We conducted trade surveys in four provinces, where we acquired samples and applied forensic techniques to assess the illegal trade and genetic diversity in *Smutsia temminckii* individuals present in muthi markets. While trade in this iconic species is burgeoning, its ubiquity provides an opportunity for developing and refining local trade monitoring and assessment tools. Furthermore, the use of molecular techniques is progressively advancing our understanding of wildlife trade dynamics. The scale and scope of the pangolin trade provides a pertinent case system with wide-reaching and potentially complex challenges relevant to global wildlife trade issues. In particular, we address aspects of market demand, product valuation, species and individual identification, inter- and intra-market comparability, and considerations of provenance and connectivity.

## Shifting power to accelerate conservation impact in Africa

Salisha Chandra, Monicah Mbiba, Fred Nelson and Resson Kantai Duff  
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Addressing climate change, conserving biodiversity, securing indigenous and community land rights, and fostering more resilient livelihoods in rural communities across Africa all depend on action by community-based organisations. Yet these organisations struggle to grow or increase their impact due to inbuilt barriers and challenges in their ability to participate in relevant conversations and dialogue, as well as due to how they are funded. This presentation will shed light on the key barriers and challenges that CSOs face, and will provide insight into effective ways to strengthen African CSOs and improve partnership and funding practices to support these organisations better.

## Protecting and connecting landscapes stabilises savanna elephant populations

Ryan Huang, Celesté Maré, Robert Guldemon, Stuart Pimm and Rudi van Aarde  
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Home to 70% of Africa's savanna elephants, the protected areas in southern Africa are a patchwork of fragments, varying in size, level of protection, and connectivity. Despite elephants being a well-studied species of conservation interest, there is yet to be a synthesis of elephant population growth or influence of protected area spatial characteristics. Here we consider how combinations of protected landscape arrangements and use affect elephant population growth rates. Overall, southern African elephants grew at 0,16% annually in the past quarter century. Larger and more strictly protected populations typically grow faster and are less variable from year to year. Isolated populations show consistently high growth due to active management and lack of emigration. Conversely, buffer areas connected to core and other buffer areas have more variation in growth between sites and between years, likely due to a combination of higher threats and dispersal in the face of such dangers. Such anthropogenic-driven source-sink dynamics within conservation clusters drive stability in core areas and variability in buffers.

## Wildlife trade policy and the rhino conservation economy

Michael 't Sas-Rolfes<sup>1,2</sup>

<sup>1</sup>University of Oxford, tsas.rolfes@gmail.com

<sup>2</sup>African Wildlife Economy Institute

International and domestic wildlife trade policy matters for conservation: sensible trade policy can support it, but misguided policy undermines it. To illustrate this, I share the results of three studies that formed part of recent doctoral research. The first, grounded in political science, analyses what drives wildlife trade policy conflict and identifies three ideologically grounded "policy narratives", based on differing views on what is ethical and what works. The second study draws on a comprehensive database of rhino conservation performance and uses natural experiments and process tracing techniques to identify which of the policy narratives most closely aligns with success. The results demonstrate that policies that empower local actors through the devolution of rights outperform policies that retain centralised control. The third study focuses on Africa's two most successful rhino range states, South Africa and Namibia,

and examines how and why enabling legal hunting and trophy exports from these countries has helped to improve their conservation performance. Combined, the results of the three studies provide clear guidance for future conservation policy.

## Towards a just energy transition for Africa

**John Asafu-Adjaye**

**African Center for Economic Transformation, [jasafuadjaye@acetforafrica.org](mailto:jasafuadjaye@acetforafrica.org)**

Africa has committed to reducing its emissions, even though it has contributed less than 4% of global carbon emissions. As of May 2022, 45 African countries had submitted updated Nationally Determined Contributions (NDCs) with ambitious targets to reduce their GHG emissions by 2030. However, Africans currently face a vast energy access gap that threatens their future prosperity. Although Africa accounts for 17% of the world's population, it only consumes 5.9% of the world's energy supply. In sub-Saharan Africa, more than half of the population (57%) do not have access to electricity, while only 17% have access to clean cooking solutions and must rely on biomass for household thermal energy. The true costs of the net-zero transition go beyond those contained in countries' NDCs. For example, expenditures on energy and land could be as much as 10% of the national GDP in Africa and some Asian countries. The objectives of this study are twofold. It provides an assessment of the readiness of selected African countries to undertake the transition to net-zero (or low) carbon pathways and makes recommendations to assist the transition.

## Session 3

### Saving Marion Island's seabirds – the world's most important bird conservation project

**Mark Anderson<sup>1</sup>, Mavuso Msimang<sup>2</sup> and The Mouse-Free Marion Project team<sup>3</sup>**

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<sup>2</sup> Private

<sup>3</sup> The Mouse-Free Marion Project

Marion Island is an important breeding island for 28 seabird species, including globally significant populations of several threatened species. It is South Africa's only Special Nature Reserve, an Important Bird & Biodiversity Area and a Ramsar site. Amongst the greatest threats to the ecology and conservation of Marion Island are the impacts of invasive house mice. Ongoing increases in mouse densities, linked to the warmer, drier climate, have depleted their main invertebrate prey, driving the mice to attack albatrosses and petrels. The impacts are not limited to seabirds. The Mouse-Free Marion Project, a collaboration between the Department of Forestry, Fisheries & the Environment and BirdLife South Africa, aims to eradicate mice from the island and thereby facilitate the ecological restoration of this globally important site. The project is underpinned by research conducted at Marion Island and elsewhere. In addition to the research, planning for the project must address a wide range of requirements, including financial, logistical, political and legal preparations and stakeholder communications, all of which are vital to create enabling conditions for a successful eradication.

## Putting biodiversity on the decision-making map: Building a Biodiversity Intactness Index for Africa

Hayley Clements and 200 experts in African biodiversity  
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Addressing the pressing need for context-appropriate tools to mainstream biodiversity into decision-making in sub-Saharan Africa, the BII4Africa project mobilised 200 African biodiversity experts to map the Biodiversity Intactness Index (BII). The map depicts the remaining proportion of intact populations of flora and fauna across the region. Importantly, this tool comes from the people who know best – those who work in African landscapes every day and witness the impacts on biodiversity. This talk will share my three-year journey funded by a Jennifer Ward Oppenheimer Research Grant. Highlights include showcasing Africa's biodiversity experts; building a large, standardised dataset of land use impacts on Africa's diverse flora and fauna; producing a user-friendly map; and exploring tipping points as intactness declines. Key insights include the role played by the region's extensive rangelands and near-natural lands in conserving 63% of Africa's remaining intactness, compared with just 6% in protected areas. It is imperative that African countries work with the millions of people in the region's working lands, who are the custodians of the remaining biodiversity on which we all depend.

## Climate change and potential distribution of two South African avian montane grassland specialists, the Drakensberg rockjumper and the mountain pipit

Thobeka Gumede  
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Species with small/restricted habitat ranges are most susceptible to environmental change; therefore, it is essential to understand how they can be affected by climate change for management and conservation purposes. We compared the present and future range distribution of two specialist mountain grassland bird species, the *Chaetops aurantius* and *Anthus hoeschi*, using the future climate data from Global Climate Models and climatic variables downloaded from WorldClim. We downloaded Drakensberg rockjumper and mountain pipit occurrence records from SABAP 2. We built the distribution model using the "SDM" package in the R statistical environment. The predictive performance of the model was evaluated using an independent Area Under Curve (AUC) value. Our models performed well in predicting the future distribution and habitat suitability, with AUC of 0,977 and 0,943 for the Drakensberg rockjumper and mountain pipit respectively. Future predictions showed a decreased distribution range for both of our study species, and their suitability had shifted to higher altitude areas. Our results highlighted the decrease in suitable locations because of habitat changes induced by climatic changes.

## Eating wild meat for the restoration of African landscapes and sustainable livelihoods

Wiseman Ndlovu and Francis Vorhies

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

Wild meat is an important source of protein and income for many people in Africa. However, its consumption presents potential negative impacts on wildlife populations and ecosystems. This research explores the potential of wild meat as a sustainable source of food and income for rural communities in Africa, while restoring degraded landscapes and promoting the conservation of wildlife and their habitats. The paper provides insights into an understanding of the global wild meat value chains: who the consumers are, who the producers are, what is being supplied, what is being demanded, what the barriers are and what the opportunities are. The overall project involves conducting field studies and engaging with local communities to assess the role of wild meat in their diets and livelihoods. It also examines the potential of wild meat and its by-products to generate income through sustainable hunting and wildlife-based economic activities. Additionally, it examines the ecological impacts of wild meat harvesting.

## The five early hominid species of Sterkfontein and Swartkrans

Ronald Clarke

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In 1774, Lord Monbodo predicted that if Africa were well searched, several types of human progression might be traced and all varieties of species discovered. In 1924, this became reality with the discovery of the Taung *Australopithecus africanus* skull. From 1936, many fossils followed: two *Australopithecus* species from Sterkfontein and Makapansgat, and *Paranthropus* from Kromdraai and Swartkrans. In 1949, Swartkrans yielded the first *Homo* contemporary with *Paranthropus*. From 1959, similar types of hominids were found in East Africa in stratified deposits with volcanics that could be accurately dated, demonstrating stages of evolutionary progression. South African limestone cave deposits were difficult to date, stratigraphies over-simplified, and some hominids from southern and East Africa wrongly classified. This situation has changed. Cosmogenic dating has produced dates older than previously assumed, stratigraphies are well studied, and fossils are reassigned to correct taxa. Sterkfontein has a significant record of two contemporaneous *Australopithecus* species, and Swartkrans shows the coexistence of *Paranthropus* with two species of early *Homo*, as well as a late surviving form of *A. africanus*.

## Session 4 – Panel discussion

### Environmental Philanthropy: Learning from the past to inform the future

When it comes to enabling environmental research and programmes, there are those seeking resources, and those seeking worthwhile initiatives to support. Both of these groups want to make significant and sustainable impacts. How can their interests and efforts be aligned to maximise and sustain impact?

The strong perception of environmental philanthropy as a black hole, fraught with the risk of failure, is an inhibitor to growing the funding pot. Way too often, the purpose for which the funds are given is not achieved, with a consequent waste of energy and resources. At the same time, programmes need to find the balance between being run like a business – setting, monitoring and managing indicators – and maintaining the human element in often difficult and complex environmental, financial and social contexts.

Through this panel discussion, attention will be given to exploring what environmental philanthropists are really looking for, what successful programmes look like, and where the pitfalls lie between funding requests and tangible outcomes on the ground. We aim to discuss the good, the bad and the ugly of environmental philanthropy – highlighting the importance of grassroots engagement and prioritising Global South-driven programmes to achieve African solutions to African challenges, while overcoming the “hand-out” mindset and really understanding and amplifying what works. Guidance will be given about how to position programmes for philanthropists in creative ways which promote collaborations and act as catalysts for sustained impact.

## Jonathan Oppenheimer – Facilitator

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Jonathan Oppenheimer is a South African businessman, conservation philanthropist 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, the Oppenheimer Generations Foundation, and Oppenheimer Generations Research and 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.



## Shafika Isaacs

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Shafika Isaacs is an AI and education specialist, community builder and professional coach. Her work focuses on inclusion, equity, and social justice in digital and biodiversity ecosystems. She is an Expert Group member of UNESCO's AI Competency Framework for Teachers and as partner via the Lewis Foundation, in the Biodiversity Skills Transformation Strategy in South Africa. She serves on the governing boards of global and local organizations including as Trustee of The Lewis Foundation which promotes nature conservation and animal welfare and as Chair of the Telkom Foundation.





## Nicky McLeod

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Nicky McLeod is co-director of social enterprise NGO, Environmental & Rural Solutions (ERS) based in Eastern Cape. ERS was established in 2002 and provides landscape and livelihood services for rural communities to boost wellbeing and resilience. She has gathered almost 30 years of practical experience fostering collaborative natural resource management in rural areas, designing and managing various livelihood and landscape security-focused development initiatives, including communal land stewardship. By collaborating and building partnerships, ERS can tap into the local value of social capital to restore and secure the area's natural systems. In this way, they put themselves and their communities on the road to a sustainable, self-sufficient future, overcoming a complex set of social, environmental and economic problems.



## Irshaad Paruk

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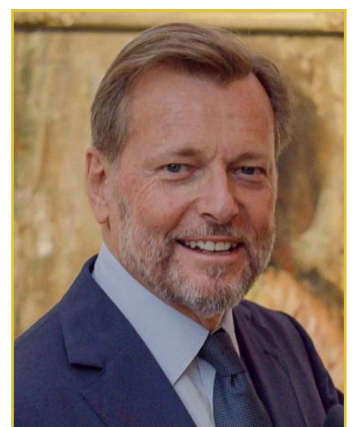
Irshaad Paruk is co-head of corporate finance at Rand Merchant Bank. He is a member of the corporate finance advisory team covering general corporate finance and M&A. Key responsibilities included new business development, execution and project management. Involvement with the development of RMB Natural Capital. He is involved in ensuring a catalytic and innovative driving force for incubating and implementing finance solutions for conservation land and seascapes across Africa.



## Robin Woodhead

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Robin Woodhead is a philanthropist, advisor on philanthropic giving. He has worked for the international art house Sotheby's for over 25 years, rising to CEO and then Chairman of Sotheby's International, where he advised on philanthropic strategy at the highest levels. He is also Deputy Chairman of London's Southbank Centre, a Trustee of the African Arts Trust and Chairman of the David Rattray Foundation UK, an NGO operating locally in South Africa as KHULA Education. As UK Chair, Robin advises on delivering sustainable programming while maximising the donations on which its work relies.





# Day 2: Thursday, 5 October 2023

## Plenary: Doris Mutta

Doris Mutta, PhD, is a Senior Programme Officer at the African Forest Forum and Project Manager for a project on strengthening management and the use of forest ecosystems for sustainable development in Africa.

She earned a PhD degree in environmental studies at the University of Strathclyde, Glasgow, Scotland; an MSc degree in Botany at the University of British Columbia, Canada; and a BSc degree in Forestry at Moi University, Kenya.

She is a forest scientist with over 30 years of progressive professional experience in research and in programmes management for forestry, coastal and marine ecosystems in different institutions in Africa in various capacities.

Her expertise focuses on forestry management, forest-based value chain analysis, forest-based livelihoods and poverty eradication, indigenous knowledge and traditional medicine, and agrobiodiversity.

She has previously worked with the United Nations Environment Programme (UNEP), Kenya Forestry Research Institute (KEFRI) and the African Centre for Technology Studies (ACTS), focusing on science-based management, policy and institutional analyses.



## Session 1

### Harnessing the value of Africa's ecological assets for sustainable development: The case of forests and tree-based landscapes

#### Doris Mutta

African Forest Forum, Kenya, [d.mutta@cifor-icraf.org](mailto:d.mutta@cifor-icraf.org)

Africa is endowed with abundant ecological assets, and its vast forests and diverse tree-based landscapes hold immense potential for sustainable development. The continent is home to the world's second largest tropical rainforest, the Congo Basin, and a wide array of other forest ecosystems, from mangroves and coastal forests to dry forests, and from savanna woodlands to Afromontane forests. Trees outside forests also nourish land and life on farms and are key components of urban areas across the continent. This presentation explores the role these natural resources play in fostering social well-being, environmental sustainability and economic growth across the continent pivotal for achieving sustainable development outcomes. The presentation also examines challenges to and opportunities for harnessing the value, and proposes measures to address the constraining factors.

An Africa-wide scientific assessment and literature review by the African Forest Forum shows that Africa's forest ecosystems provide goods and services that support human survival, even during unexpected adverse events including climate change, global economic shocks and disease pandemics, which have disrupted development pathways in the continent. They contribute a substantial proportion of income

and valuable assets for managing risk, coping with shocks and, in some cases, moving out of poverty for up to 250 million forest-proximate communities. The assets also provide vital ecosystem services such as water regulation, soil protection and climate change mitigation, to support other economic activities like agriculture, livestock, fisheries and nature-based tourism that generate foreign exchange. The forests also contribute to national accounts, although this is underestimated. FAO estimates that 79 million m<sup>3</sup> of wood was harvested as industrial timber in Africa in 2018, but this is a substantial underestimate due to large-scale illegal felling and trade in many countries.

Non-timber forest products have contributed to the development of pharmaceutical, biotechnology and food and beverage industries that generate significant revenue for private companies in Africa and beyond. Carbon trade can be leveraged to generate income for both local communities and governments. Despite the potential, investment in forests and tree-based systems has not matched their importance, with governments spending relatively little of their own funds (e.g., less than 1%) in the forestry sector, and international financing being insufficient to fill the gap. The implication is that these assets are undervalued, and their full potential remains untapped. The sector is marginalised and preference given to other sectors, and forest conversion to other land uses continues unabated, therefore eroding its potential. Harnessing the value of these assets presents a unique opportunity for the continent to balance its economic aspirations with the ecological integrity of its forest ecosystems.

Investments in research, technology, innovation and capacity-building initiatives are crucial to enhancing Africa's ability to utilise its ecological assets sustainably. Supportive policy and institutional frameworks that recognise the key role of forestry in economic contribution and development are proposed.

### Hybridisation of wild *Oreochromis mossambicus* populations with the introduced *Oreochromis* species in the Limpopo, Mpumalanga and KwaZulu-Natal provinces, South Africa

Mahlatse Mashaphu<sup>1</sup>, Colleen Downs<sup>1</sup>, Gordon O'Brien<sup>2</sup> and Sandi Willows-Munro<sup>1</sup>

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<sup>2</sup>University of Mpumalanga

Non-indigenous *Oreochromis* species, such as *O. niloticus*, were introduced in South Africa to benefit the economy through aquaculture, fisheries and pet trading. However, *Oreochromis* species hybridise readily, and now wild populations of native *O. mossambicus* are threatened. Evaluating the extent of these introduced species in the wild will help identify populations of native *Oreochromis* species that are genetically pure and need prioritisation in management, monitoring and conservation plans. *Oreochromis mossambicus* occur naturally in many major river catchments in South Africa, especially in warmer regions. This species is listed as Vulnerable on the IUCN Red List. We used a suite of 14 microsatellite loci to assess the extent of genetic contamination of *O. mossambicus* with the introduced *O. niloticus* and *O. aureus* from major river catchments in the three provinces (KwaZulu-Natal, Mpumalanga and Limpopo). The analyses revealed evidence of genetic contamination with *O. niloticus* in the four populations in Limpopo, two populations in Mpumalanga and one population in KwaZulu-Natal. We recommend that strict measures be implemented to preserve the present genetic integrity.

## The impact of artificial light on mosquito community ecology

Layla van Zyl<sup>1</sup>, Bernard W.T. Coetzee<sup>1</sup>, Mark P. Robertson<sup>1</sup> and Izak P.J. Smit<sup>2</sup>

<sup>1</sup>Department of Zoology and Entomology, University of Pretoria, Pretoria, u19104652@tuks.co.za

<sup>2</sup>Scientific Services, South African National Parks

The use of artificial light at night (ALAN) is expanding globally. The introduction of ALAN can alter mosquito feeding and activity, and so may impact the transmission of vector-borne diseases, like malaria. However, the current methods of measuring artificial light do not capture spectral information at a range of intensities, and so quantifying ALAN for ecological applications remains a challenge. Here, we use the newly described Environmental Light Field method to characterise the artificial light environment both inside and outside houses in rural villages in South Africa, Mozambique, Uganda and Tanzania. We find blue spectrum LED lights predominantly present in rural Africa, which may alter mosquito communities. As the blue light emitted by LED lights has negative impacts on both human and environmental health, the costs and benefits of widespread LED light usage need to be assessed. The quantification of the light environment is essential to understanding the impact of ALAN on mosquitoes and has implications for understanding disease transmission.

## The role of brood pheromones in the reproductive dominance of *Apis mellifera scutellata* workers

Goratileone R. Oepeng, Christian Pirk, Abdullahi Yusuf, Fiona Mumoki and Robin Crewe

Department of Zoology and Entomology, University of Pretoria, u22941330@tuks.co.za

In social insects, communication is aided by the releases carried out mainly using chemical volatiles called pheromones. Honey bee workers were exposed to known components of brood pheromones and queen mandibular pheromones to assess the physiological changes and behavioural changes regarding reproductive hegemony of honey bee workers (*Apis mellifera scutellata*). This was achieved by looking at the glandular secretions produced by workers, the development of their ovaries and hypopharyngeal glands, and the food consumption and survival of the workers. Our preliminary results show that exposing workers to brood pheromones has resulted in increased food consumption and a reduced survival rate, and has affected the size of HPG acini and the ovarian activation stage. This thus means that the presence of the brood in a colony does affect the growth of the colony and discourages the presence of pseudoqueens, and it ensured that the growth of the colony was prolonged through increased food intake and survival when compared with the control.

## Spatial competition in the ectoparasite community of small mammals

Sian Willoughby and Heike Lutermann

University of Pretoria, u19181711@tuks.co.za

The similarities of the locations of preferred feeding sites observed between ectoparasite taxa indicate the possibility of a community being found on a single host. Such parasite communities are likely to experience interspecific competition; however, this has rarely been studied in ectoparasites and never in African species. In this study, we used ectoparasites (i.e., ticks, mites, fleas and lice) from sengis (*Elephantulus*

*myurus*) captured at the Telperion/Ezemvelo Nature Reserve in 2015, to 1) study their spatial distribution on the host and 2) study recolonisation dependent on tick infection. All animals caught were sexed and thoroughly examined for ectoparasites on the head, ears, lower back, chest and extremities. We manipulated tick burden in half of the animals to study recolonisation of the body sections in the presence and absence of ticks. Preferred attachment sites for ticks were the ear ridges (larvae) and the rear of sengis (nymphs), while mites attached mostly to the rear. We will discuss how these shifted in response to our treatment.

### Seed dispersal and germination of the alien *Cotoneaster pannosus* in Afromontane grasslands of the eastern Free State

Karabo T. Moloji<sup>1</sup>, Grant D. Martin<sup>2</sup> and Sandy-Lynn Steenhuisen<sup>1</sup>

<sup>1</sup>University of the Free State, karabomoloi0312@gmail.com

<sup>2</sup>Department of Entomology and Zoology, Rhodes University

Rosaceae shrubs, such as *Cotoneaster pannosus*, have become emerging invasive alien plants in grasslands of South Africa. We explored the seed dispersal and germination of *C. pannosus* that has become established in montane grasslands of the eastern Free State, notorious for forming monocultures which can outcompete natives. This was achieved by seed disperser identification, using observations and remote cameras; and by exploring germination success and the rate at which *C. pannosus* seeds were ingested by birds, in experiments with seeds of three treatments: whole fruits, de-pulped seeds and excreted seeds. Results revealed that indigenous birds and mammals consumed *C. pannosus* fruits. Experiments showed that fruits were eaten whole and germination success was low over all treatments. Germination rates for seeds buried as whole fruits were twice as high as the other treatments. In conclusion, birds were confirmed as consumers and seed dispersers of *C. pannosus*, but unlike with other invasive Rosaceae species, ingestion is not significant for breaking seed dormancy. However, pulp removal improves germination, regardless of whether this is achieved through bird ingestion or manual de-pulping.

### Drought or degradation? Satellite monitoring of rangeland health in relation to rainfall

Guy Lomax<sup>1</sup>, Tom Powell<sup>1</sup>, Andrew Cunliffe<sup>1</sup>, Tim Lenton<sup>1</sup>, Peadar Brehony<sup>2</sup> and Peter Tyrrell<sup>2</sup>

<sup>1</sup>University of Exeter, G.Lomax@exeter.ac.uk

<sup>2</sup>Dascot Ltd

Rangeland degradation is defined as a long-term loss of vegetation productivity in rangelands, especially of those plants that provide forage for grazing. It is a growing problem in African rangelands, driven by a combination of overgrazing, shifting rainfall patterns, changing land use pressures and invasive species. Satellite-derived metrics of vegetation “greenness”, such as the Normalised Difference Vegetation Index (NDVI), have often been used as measures of rangeland health. But they cannot easily distinguish the effects of rainfall or soil from the local impacts of management or grazing pressure. As part of the Oppenheimer Programme in African Landscape Systems (OPALS), we are developing a rangeland degradation monitoring method that can disentangle these factors and identify areas of localised degradation. We use satellite imagery, rainfall data, soil maps and other information to estimate the potential productivity of land, and then use this to map areas of reduced productivity. We are also planning to turn the method into a freely accessible web tool for monitoring rangeland health.

## Sedimentary carbon stock variability in *Zostera capensis* meadows over large and fine spatial scales: Insights from a South African estuary

Aidan Bossert, Andrew Ndhlovu and Sophie von der Heyden

<sup>1</sup>Stellenbosch University, aidanbossert26@sun.ac.za

Understanding the drivers of organic carbon (Corg) stock variability is key to improving the accuracy of seagrass blue carbon assessments and emphasising their role as nature-based solutions to help mitigate climate change. The Berg River Estuary holds South Africa's second largest population (~206 ha) of the seagrass *Zostera capensis*, making it an ideal system to study variability in seagrass Corg stocks. Using sediment coring (15 cm depth), we investigated Corg variability at fine spatial scales (<110 m) and large spatial scales (~17 km) between the distributional limits of the species at the upper and lower reaches of the Berg River Estuary. We found significant differences between the sampling sites, with higher Corg stocks at the lower extent of the estuary ( $7,18 \pm 1,83$  Mg C ha<sup>-1</sup>) compared with the upper extent ( $3,33 \pm 0,70$  Mg C ha<sup>-1</sup>); however, variability of Corg stocks was low with no significant differences at fine scales and between the upper and lower sampling sites. We also found that fine particle size proportion and shoot density were not significantly different at fine scales and between the upper and lower extent of the estuary, with both not significantly correlated to the observed Corg variability.

## Session 2

### Certifying wildlife enterprise

Francis Vorhies

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

"The Kumming/Montreal Global Biodiversity Framework has two key targets on wildlife utilisation – Target 5: "Ensure that the use, harvesting and trade of wild species is sustainable, safe and legal, preventing overexploitation, minimizing impacts on non-target species and ecosystems, and reducing the risk of pathogen spillover ..."; and Target 9: "Ensure that the management and use of wild species are sustainable, thereby providing social, economic and environmental benefits for people ...." These targets set expected outcomes from wildlife use – sustainability, minimal impacts, safety, benefits for people – that can potentially be verified through voluntary certification. This paper reviews existing certification schemes for wildlife enterprise, including Certified Wildlife Friendly for enterprise-based conservation; Climate, Community and Biodiversity for nature-based carbon credits; FairWild for harvesting wild plants; and the Marine Stewardship Council for harvesting wild fish. With a particular focus on the wildlife economy in Africa, opportunities for scaling up the use of current standards are explored; and key gaps, such as certifying wild meat and hunting tourism, are identified.

## The ecology of leopards (*Panthera pardus*) on privately owned land: The case of Shangani holistic

**Moreangels Mbizah, Simbarashe P. Chatikobo and Tapiwa P. Chimbadzwa**  
Wildlife Conservation Action, [moreangelsm@gmail.com](mailto:moreangelsm@gmail.com)

As competition for land heightens, it is largely evident that privately owned land has a central role in the conservation of carnivores. Understanding the ecology of leopards in the different land use type matrixes is essential for their conservation and management. We monitored the ecology of leopards (*Panthera pardus*) in the 450 km<sup>2</sup> Shangani holistic ranch, which is managed for both livestock and wildlife. We made use of GPS collars, camera traps and scat analysis to understand their space utilisation, densities, distribution and diets. We collared and monitored three leopards (two females and one male), we conducted seasonal (early and late dry) camera trapping, we assessed their diets from opportunistically collected scats and kill sites determined from GPS clusters, and individual leopards were identified from their unique rosettes for the estimation of their densities. We found that home range size varied with sex for the leopards, and that male home ranges overlapped with those of several females. We found that the leopards utilised both wild and livestock species from the small-medium size and mainly juveniles from the large classes, and incidences of scavenging were recorded.

## Evaluating afforestation in Africa for combating global change

**William J. Bond**  
Biological Sciences, University of Cape Town, [william.bond@uct.ac.za](mailto:william.bond@uct.ac.za)

Trees are trendy, and planting trees has become a popular strategy to combat global warming. Africa, the grassiest continent, is a major target for tree planting programmes, with the Bonn Challenge alone aiming to plant at least 1 000 000 km<sup>2</sup> by 2030. In this talk, I will consider the arguments for tree planting at continental scales as mitigation for climate change. There is undoubtedly a place for restoration of deforested land by planting indigenous African forest trees. The concern, however, is the extensive areas of savannas that are also being targeted, especially for growing plantations of fast-growing conifers and eucalypts. The potential carbon sequestered is trivial compared with greenhouse gas emissions due to fossil fuel use in industrialised countries. The afforestation programmes appear to be poorly planned, with little consideration of long-term sustainability or the long-term consequences to host countries of tying up land in plantations far into the future. The consequences for Africa's iconic grassy ecosystems are potentially disastrous. Credible alternatives to tree planting are needed which appeal to people who wish to reduce the risk of global warming. Building cities and industries with low dependence on fossil fuels would seem appropriate in Africa's rapidly urbanising future.

## Microhabitat requirements and occupancy of understorey forest-specialist birds in Southern Mistbelt Forests of KwaZulu-Natal, South Africa: The use of camera traps

Nasiphi Bitani, Craig Cordier, David A. Ehlers Smith, Yvette C. Ehlers Smith and Colleen Downs  
University of KwaZulu-Natal, [bitaninasiphi@gmail.com](mailto:bitaninasiphi@gmail.com)

Monitoring species' habitat selection and microhabitat requirements is vital for conservation and management. Camera traps are a valuable technique for studying elusive bird species that are challenging to document using traditional survey techniques. Here, 184 camera traps were installed during the non-breeding and breeding season (2020-2022) to study understorey forest-specialist birds' habitat requirements in 14 selected Southern Mistbelt Forest patches in the Midlands, KwaZulu-Natal, South Africa. We conducted foliage profiles, forest structure surveys and an inventory of tree species richness to characterise forest microhabitats. Over 7 182 trap days, we had 615 detections of ten understorey forest-specialist bird species, most of which were insectivores. We modelled the occupancy of lemon doves, chorister robin-chats, crested guineafowls and red-necked spurfowls to determine microhabitat characteristics that influenced detection probability and occupancy. The main microhabitat characteristics influencing forest-specialist understorey birds were tree species richness, leaf litter and water cover.

## Land use planning for sustainable land management in Zambia and Zimbabwe: Trade-offs, challenges and opportunities

Kudzai S. Mpakairi and Susan Snyman  
African Leadership University, [kmpakairi@alueducation.com](mailto:kmpakairi@alueducation.com)

Land use planning plays a crucial role in achieving sustainable land management practices. Effective planning requires considering the conservation impact, potential health hazards and GHG emissions associated with various land uses to balance development and conservation for long-term resource sustainability. This study examines the environmental and socioeconomic implications of key land use types (agriculture, mining, tourism) in Zambia and Zimbabwe. Using a comprehensive dataset, we analyse their distinct impacts. Agriculture is the primary contributor to GDP and employment, but competition for arable land poses challenges. Mining offers growth opportunities but raises concerns about land acquisition, community displacement and environmental degradation. Tourism promises sustainable development but requires land allocation for infrastructure, while conserving natural and cultural assets. These findings underscore the importance of strategic land use management practices. By optimising the benefits of agriculture, mining and tourism while minimising their adverse effects, these countries can achieve sustainable land management and economic development.

## The wildlife coexistence conundrum – who wants (to) change?

Andre Ganswindt

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Due to a progressing global human population growth connected with an ever-expanding network of altered landscapes and ecosystems, linked to most effective resource utilisation, a dwindling number of wildlife has to coexist in increasingly human-dominated landscapes. Consequentially, examining wildlife well-being has been increasingly recognised as a crucial component in evaluating this development. Especially monitoring responses to stressors has been recognised as playing an important role, as stress is generally regarded as antipathetic to welfare. Quantifying stress-associated hormones is nowadays a primary approach for examining physiological responses in wildlife roaming in transformed landscapes. The presented findings will focus on anthropogenic factors and their stress-associated endocrine responses in wildlife, providing detailed insight into the physiological responses of wild mammals to anthropogenic activities and their ability to adapt to human presence or changing environmental conditions. It underlines the importance of monitoring physiological stress responses to assist wildlife management and impose the question of change for wildlife living in a brave new world.

## Session 3

### Integrating deep history into conservation efforts on the African continent: Opportunities, challenges and applications

Paul J. Lane

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This paper will outline the rationale for including perspectives based on knowledge of the deep histories of human-environment entanglements on the African continent in approaches to wildlife conservation, illustrating the argument with reference to different case studies. A key argument will be on the need to abandon older binaries that make a sharp distinction between “natural” and “cultural” landscapes and many of the incumbent management approaches that this binary has enabled. While this is not arguing for the wholesale abolition of protected areas, a case will be made for better recognition of the complex interplay and deep histories of the historical ecology of African landscapes, and how these have contributed to the current distribution and composition of biodiversity. Case studies from across the African continent pertinent to elephant conservation, marine ecosystems and African savannas that draw on archaeological and historical insights, alongside indigenous ontologies, will be presented.



## Grassy ecosystems in the Anthropocene

Nicola Stevens<sup>1</sup> and William Bond<sup>2</sup>

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<sup>2</sup> University of Cape Town

Humans have long interacted with grassy ecosystems, but they are becoming severely impacted as the Anthropocene advances. Grassy ecosystems are easy to clear and cultivate, poorly protected and poorly defined due to legacies of colonial narratives that can describe them as deforested, wastelands or derived. Climate change, land conversion and the erosion of the processes that have shaped grassy ecosystems for millennia have had cascading and cumulative impacts on grassy ecosystem extent and integrity. Here, I examine how and where these changes are impacting grassy ecosystems, specifically those that fall into ecosystem-uncertain space – climate envelopes where vegetation is not at an equilibrium with climate, and either grassy ecosystems or forests can occur. Within this space, these systems are sensitive to changes in climate, CO<sub>2</sub> and disturbances. Changes in any of these drivers interact to change the distribution and integrity of grassy ecosystems globally. We examine what the loss of these ancient, biodiverse ecosystems means – ranging from a loss of ecosystem services to earth system impacts of altered albedo, carbon and hydrological cycles.

## A roadmap to deliver Africa's natural climate solutions

Michael Wolosin<sup>1</sup>, David Hole<sup>1</sup>, Johan Rockström<sup>2</sup> and Bronson Griscom<sup>1</sup>

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<sup>2</sup> Potsdam Institute for Climate Impact Research

A safe and just climate is out of reach without the rapid reversal of human emissions from land and nature, from 12 gigatons CO<sub>2</sub> emissions per year globally to net zero by 2030 and a 10 gigaton sink by 2050. Africa can provide nearly 20% of this global need, by protecting, restoring, and improving the management of natural and productive ecosystems. The Exponential Roadmap for Natural Climate Solutions (NCS) introduces a new sectoral roadmap for rapidly scaling natural climate solutions to deliver the necessary nature transition. It defines eight NCS “Action Tracks” which specify who can do what, where, and by when to deliver quantifiable and transformative climate gains, thereby linking the policy choices of government officials, corporations, and investors to the practices of communities on the ground (from farmers to foresters to Indigenous Peoples) – and takes a major step forward in guiding the transformative commitments and investments needed for nature. We will present the concept for a new African Continental Roadmap that will quantify how a land-use transition can deliver both climate and biodiversity outcomes, with examples of opportunities for cross-border regional collaborations and new information support tools, and an invitation to collaborate on next steps.

## Crime and punishment: International perspectives on wildlife crime in sub-Saharan Africa

Yolanda Mutinhima<sup>1</sup>, Darragh Hare<sup>2</sup>, Lessah Mandoloma<sup>2</sup>, Lovemore Sibanda<sup>3</sup>, Salum Kulunge<sup>4</sup>, Betty Rono<sup>5</sup>, David Kimaili Mwendwa<sup>6</sup> and Amy Dickman<sup>2</sup>

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<sup>3</sup> Cheetah Conservation Zimbabwe

<sup>4</sup> Sokoine University of Agriculture

<sup>5</sup> Rhodes University

<sup>6</sup> South Eastern Kenya University

Wildlife crimes such as illegally killing wild animals, harvesting resources, or grazing livestock in protected areas can undermine conservation. Punishments for wildlife crimes can be severe, and harsh penalties may generate resentment towards conservation among people who live in or near important wildlife areas. However, research into how different groups of people think about which types of illegal human-wildlife interactions are acceptable or unacceptable, and what punishments are appropriate for different wildlife crimes, is currently lacking. We compare perspectives on wildlife crimes and appropriate punishments among people living in rural areas of Kenya, Tanzania and Zimbabwe, urban areas of sub-Saharan Africa, and rural and urban areas of the UK and USA. We focus on how acceptable or unacceptable it is to kill four different wild animals (lion, hyena, elephant and impala) illegally for six different reasons (to protect people, to reduce damage to crops or livestock, to keep meat, to sell meat, to sell parts other than meat, or to fulfil part of a cultural tradition). We discuss our findings in the context of international debates over coexisting with iconic but harmful wild animals.

## Taxonomic analysis of the pouched mouse, *Saccostomus campestris*, reveals ancient populations with little gene flow

Nakedi Maputla<sup>1</sup>, Christian Chimimba<sup>2</sup> and Willem Ferguson<sup>2</sup>

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<sup>2</sup> University of Pretoria

The pouched mouse, *Saccostomus campestris*, shows a high degree of karyotypic variation with up to 16 variants, causing taxonomic uncertainty. We used cranial morphology, cytogenetics and partial sequences from cytochrome b and 16S rRNA to investigate the karyotypic variation further. Morphometric comparisons showed no discernible differences between karyotypes. Cytogenetics revealed autosomal Robertsonian fusions, explaining karyotypic differences and showing a westward reduction in diploid numbers. At least three X-chromosome variants arose from a single pericentric inversion and genetic material addition. Phylogenetic analysis revealed a lineage from the North-East Dune Forest, isolated long ago, with a small population size, and another comprising numerous inland populations of western and eastern sub-lineages. The western sub-lineage covers a single large, semi-arid geographical area. The eastern sub-lineage consists of smaller distinct clusters, with small population sizes and smaller estimates of between-population migration. This indicates very low dispersal rates between patches of suitable habitats, resulting in the genetic isolation of newly established populations.

Matthew Child, Farai Chikomba, Sarah Schumann and Tyron Fouche  
Rewild Capital, [matthew@rewildcapital.com](mailto:matthew@rewildcapital.com)

Nature-based solutions are key to mitigating climate change and conserving biodiversity. Restoring grassland ecosystem functions is estimated to sequester in the range of 0,2 to 0,5 tonnes of carbon dioxide in soils per ha per year. Considering the scale of African rangelands, this could equate to an annual drawdown of 420 million tonnes. However, the current carbon credit methodologies can be inappropriate for African rangelands, in that 1) most carbon projects focus on above-ground carbon, where planting trees can undermine grassland ecosystem functioning and reduce potential for inclusive economic development, and 2) the potential soil carbon sequestration from rewilding trophic complexity and natural disturbances (such as fire) is not reflected in existing models. These two issues can result in conflation of bush encroachment with positive carbon gains, and of viewing restoration of biodiversity as a co-benefit rather than an integral process itself to unlock carbon credits. Here, we develop a decision tree for land use changes that optimise both carbon and biodiversity credits from baseline conditions, and suggest pathways for mainstreaming this into international standards.

## Session 4 – Panel discussion

### Reinventing the future: Youth perspectives

Africa is expected to surpass Asia in becoming the world's fastest-growing region. However, climate change poses a substantial risk to the continent, capable of undermining development and erasing progress unless we find a suitable and robust response. The focus of this panel is to delve into the pivotal question of how we can effectively strategise for the well-being of people, places, and the planet, while pursuing our developmental ambitions. We highlight the unique perspectives of youth, who are expected to inherit the socio-ecological outcomes that stem from the decisions we enact today. We also explore opportunities for change that will shape sustainable socio-economic and socio-ecological trajectories.

### Cebisa Luzipho – Facilitator

Cebisa Luzipho is a seasoned PR Manager, whose career in the communications industry has been marked by an array of brand campaigns, and she has collaborated with global companies such as Unilever, Tiger brands, Bacardi Limited, L'Oréal and Diageo.

Cebisa is currently the PR Account Director at Orchard on 25 for Oppenheimer Generations Research and Conservation, where she leads a team in Reputation Management.

Cebisa's portfolio boasts a rich tapestry of achievements, notably including her role as an Account Lead for prestigious brands such as L'Oréal



Professionnel, Dark and Lovely, Don Julio, Makwa IT, Icelandic Glacial and J&B Whisky. She extends her influence across key regions, managing media relations in southern Africa, West Africa and East Africa.

Beyond her professional accomplishments, Cebisa exemplifies a commitment to corporate values, advocating inclusivity and diversity within her team and the broader organisation. Her proactive approach to crisis management, underpinned by the utilisation of social listening tools and media training, has fortified her reputation as a meticulous and forward-thinking PR professional.

In essence, Cebisa Luzipho is a trailblazer in the realm of PR and communications, wielding her expertise to amplify brand narratives, foster partnerships and shape compelling narratives that resonate globally.

## Antony Emenyu

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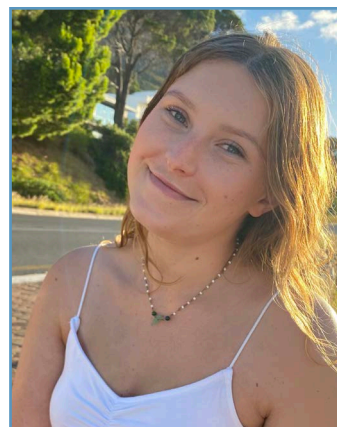
Antony Philip Emenyu is an Oppenheimer-Turvil doctoral scholar at the University of Exeter. His research interests span food security, sustainable system level transitions and rural-urban transformations in sub-Saharan Africa. Currently, his research is aimed at identifying small interventions that could cause quick and big impacts in the resilience of African small-holder farming systems to climate change shocks, particularly focusing on regenerative agriculture. Over the course of his career, Antony has worked with the public sector in Uganda and on projects implementing various sustainable and just transitions targeting smallholder farmers. Now, his focus is on developing solutions to accelerate such transitions.



## Savanna Strauss

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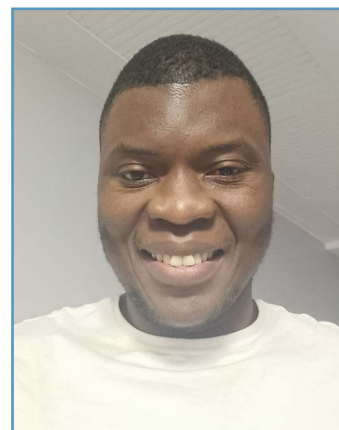
Savanna Strauss is a passionate advocate for nature preservation. Growing up in the heart of Kruger National Park, her connection to the environment ignited an unwavering commitment to safeguard it for generations to come. Savanna is currently perusing her Honours in Environmental Management at Stellenbosch University. She has first-hand conservation experience through working with the Jock Environmental Monitoring Unit, which gave her insights into the grim reality of wildlife poaching and heightened her determination to shield endangered species. She also perused an internship at Sanbona Wildlife Reserve in the Klein Karoo, where she gained greater insights into the delicate interplay between conservation and sustainable development. Her commitment to change brought her to the African Wildlife Economy Institute (AWEI), where she undertakes pivotal research roles encompassing diverse wildlife economy subjects. As well as being involved in the new wildlife magazine, *Rewilding Southern Africa*, Savanna actively works to raise awareness on crucial conservation matters. Through her contributions, she strives to create impactful content that underscores the imperative of shielding Africa's wildlife and natural habitats.



## Sèankpon Tcheton

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Sèankpon Tcheton is an environmental social scientist with global trans-disciplinary interests in the ways societies relate to the natural environment and deal with contemporary sustainability challenges. He graduated in 2021 with an Erasmus Master of Science in Sustainable Territorial Development at the University of Padova in Italy, and is now affiliated to the Global Change Institute of the University of the Witwatersrand, South Africa. He is also interested in the interface between indigenous knowledge and marine ecosystems sustainability, working with the Oppenheimer Generations Future Ecosystems for Africa (FEFA) programme. He has a background in protected areas management, coupled with years of extensive fieldwork experience in wildlife conservation in West Africa.



## Terry Achieng

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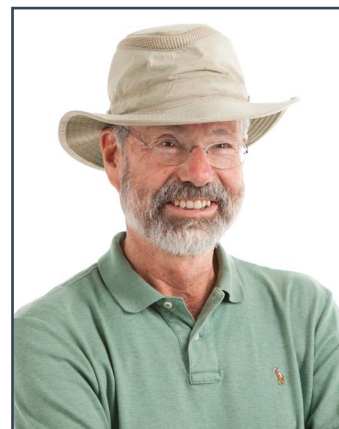
Terry Achieng is a PhD candidate at the University of Exeter with a background in geography (Geographic Information Systems and Remote Sensing), sustainable development and social-ecological systems thinking, which inspired her research pursuits in interconnected systems. She is currently on a PhD journey (supported by OPALs), exploring just tipping points for African social-ecological systems. Her research engagement seeks to understand just tipping points in social-ecological systems (protected areas) in East and southern Africa, towards better transformations. Prior to joining the University of Exeter, she worked with the Kenya Forestry Research Institute as a Research Assistant in the GIS/RS unit. She also holds a master's from Stellenbosch University, where she conducted research in a social field, investigating regime shifts and their implications for human well-being in Amakhala Game Reserve, Eastern Cape.



# Day 3: Friday, 6 October 2023

## Plenary: Craig Packer

Craig Packer is Distinguished McKnight University Professor in the Department of Ecology, Evolution and Behavior at the University of Minnesota. His first book, *Into Africa*, won the John Burroughs Medal in 1995, and he was elected a Fellow of the American Academy of Arts and Sciences in 2003 and the American Association for the Advancement of Science in 2019. During his 40 years of research in Tanzania, he served as an official member of the Tanzanian delegation to CITES, founded an NGO (Savannas Forever) to measure the effectiveness of foreign aid projects in rural Africa, and established a large-scale citizen-science project (Snapshot Safari) to measure the population status of wildlife in dozens of parks across Africa. He has published over 200 scientific papers, and his second book, *Lions in the Balance: Man-Eaters, Manes and Men with Guns*, was published in 2015. He was named Wildlife Conservationist of the Year by the Cincinnati Zoo in 2017 and received the Dawkins Award in Conservation from Balliol College in 2018. His latest book, *The Lion: Behavior, Ecology and Conservation of an Iconic Species*, was published by Princeton Press in March 2023. He currently serves as the Scientific Director of the Mara Predator Conservation Programme in Kenya, and he advises research projects in Botswana, Namibia and South Africa.



## Session 1

### Man-eating lions in southern Tanzania: Spirit animals or *Panthera leo*?

Craig Packer<sup>1</sup>, Hadas Kushnir<sup>2</sup> and Dennis Ikanda<sup>3</sup>

<sup>1</sup> University of Minnesota, [packer@umn.edu](mailto:packer@umn.edu)

<sup>2</sup> USAID

<sup>3</sup> WWF – Tanzania

Cases of man-eating lions have been reported throughout Tanzania for well over a century. But two exceptionally large outbreaks, each involving over a thousand victims being attacked or killed, took place first in the 1940s and again in the late 1990s and early 2000s. Precise numbers are not available from the 1940s, and any estimates are complicated by the simultaneous murders of hundreds of people, which were commissioned by criminal elements who hired “lion-men” to kill their enemies. But genuine lion attacks were certainly widespread at the time, and the extents of both the lion-men killings and the man-eating outbreak itself were exacerbated by widespread belief in “spirit lions”. Our investigations into the 1995-2004 outbreak revealed that lion attacks arose from the loss of the lions’ normal prey and a concomitant increase in the vulnerability of rural farmers, as also likely occurred in the 1940s for entirely different reasons. But since these chains of causality were not obvious to local people, the affected communities often resorted to supernatural explanations, allowing the man-eating outbreaks to persist far longer than would have occurred otherwise.



## Financing biodiversity conservation – are we putting our money where our mouths are?

Odirilwe Selomane<sup>1</sup>, Michelle Fourie<sup>2</sup>, Sally Archibald<sup>3</sup> and Laura Pereira<sup>3</sup>

<sup>1</sup> University of Pretoria, [odirilwe.selomane@gup.ac.za](mailto:odirilwe.selomane@gup.ac.za)

<sup>2</sup> uBoomi

<sup>3</sup> University of the Witwatersrand

There is now a lot of momentum to “bend the curve” of biodiversity loss towards positive biodiversity outcomes. This comes after several assessments, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), concluded that biodiversity loss has been increasing over the past several decades, and with this has come a multitude of contributions to society. One of the targets emerging out of the most recent iteration of the conference of parties in Montreal in 2022 was the intention to protect 30% of the planet by 2030. Achieving this target will require a substantial increase in financing for biodiversity. Currently, the required investments are estimated to be \$800 billion annually, compared with the current actual investment of \$100 billion – a \$700 billion shortfall in investment. As part of the Future Ecosystems for Africa Project funded by Oppenheimer Generations Research and Conservation, this work aims to characterise the nature of investments in terms of priorities for so-called “nature-positive” and “nature-negative” investments, and to explore alternative ways for financing the 30 by 30 agenda. Our starting point is exploring current investments.

## Investigating potential indicators of rangeland degradation in perennial grass populations along a semi-arid grazing intensity gradient

Faith Chambara<sup>1</sup>, Mark C. Bilton<sup>1</sup>, Lisa-Maricia Schwarz<sup>2</sup>, Wellencia C. Nesongano<sup>1</sup> and Anja Linstädter<sup>3</sup>

<sup>1</sup> University of Namibia, [rutendomunyebyu@yahoo.com](mailto:rutendomunyebyu@yahoo.com)

<sup>2</sup> University of Bonn

<sup>3</sup> University of Potsdam

Various factors, such as overgrazing, may shift rangelands from a healthy to a degraded condition; however, the use of herbaceous vegetation attributes that can easily be measured to detect possible rangeland degradation have not been adequately accounted for. For this reason, this study sought to establish and compare the spatial arrangements and demographic patterns of six pre-selected perennial grass species using density, basal area, height, cover and seedling recruitment. Sampling was conducted in freehold and communal rangelands, which are the two main land use systems in east-central Namibia. At each site, two transects representing a grazing intensity gradient were laid out, radiating away from a cattle water point. Along each transect, nine plots of 10 m x 10 m were demarcated with nested 1 m x 1 m quadrats. All vegetation attributes differed between the two land use systems ( $p < 0,001$ ). Cover and height of an increaser species, *Aristida congesta*, seem to be responsive to grazing. Despite the lack of definite pointers along a gradient, species that suddenly either increase or decrease towards grazing pressure could be useful as potential indicators of rangeland degradation.

Andrea Webster<sup>1</sup>, Nigel Bennett<sup>1</sup>, Andrew Abraham<sup>2</sup> and Andre Ganswindt<sup>1</sup>

<sup>1</sup> Mammal Research Institute, University of Pretoria, [andrea.webster@tuks.co.za](mailto:andrea.webster@tuks.co.za)

<sup>2</sup> Aarhus University

Quality control of the environment is inextricably linked to ecosystem management, conservation and restoration. Historical and current anthropogenic activities have modified soil horizons and contribute to the presence of harmful residues and contaminants in the environment. Unless obvious signs of pollution are evident, assessment of potentially toxic elements (PTEs), their impact on wildlife endocrine function and their effects on ecosystem integrity are seldom undertaken. Previous research indicates that PTEs in the environment were highest in sediment. In herbivores, grazers show higher concentrations than browsers or mixed feeders, and insectivores show higher concentrations than obligate carnivores. Our results highlight that how animals forage may be equally important as, if not more important than, what they eat. This study is the first to show that ground foraging and fossorial species may be at greater risk of PTE contamination in the wild and highlights the need for further research.

## JWO Research Grant snapshot – four years of groundbreaking research

### Microplastics and plastic-derived contaminants in Africa's freshwater and marine environments

Gideon A. Idowu

Federal University of Technology Akure, Nigeria, [gaidowu@futa.edu.ng](mailto:gaidowu@futa.edu.ng)

Plastic wastes are a key driver of nature deterioration and biodiversity loss. Due to the indiscriminate disposal of plastics in Africa as a result of the lack of enforcement of environmental laws, the continent contributes significantly to the over 8 million tonnes of plastics reaching the ocean yearly. Not only do microplastics (MPs) on their own constitute hazards to organisms, but they also adsorb toxic substances from the environment and serve as vectors to carry them into the organisms. Furthermore, chemical substances incorporated into plastics as functional additives get released as the plastics degrade gradually in the environment. Many of these chemicals are endocrine-disrupting compounds (EDCs), which possess the ability to interfere with hormonal functions and impair reproduction in species. While the need to protect biodiversity is the main motivation for investigating MPs and EDCs in developed nations, Africa has the additional responsibility to protect its rural-dwelling humans, some of whom depend on waters contaminated with MPs and EDCs. In this presentation, I will share results and insight from JWO-funded investigation of MPs and EDCs from all regions in Africa.



## Cattle Corridors: Study designs, rangelands selected and the students to make it happen

Elizabeth le Roux<sup>1</sup>, Zibanani Seletlo<sup>2</sup> and Bakari Mtili<sup>2</sup>

<sup>1</sup> Aarhus University, [eleroux@bio.au.dk](mailto:eleroux@bio.au.dk)

<sup>2</sup> University of Botswana

The increasing isolation of small pockets of protected wildlife populations is a growing concern. With global change and shifts in land use and management practices, wildlife populations face mounting pressure to relocate to more suitable habitats. Such movement necessitates connectivity and habitats that, while not necessarily pristine, are sufficiently conducive to facilitating movement. Last year, I provided a broad outline of a programme supported by JWO (Cattle Corridors) that aims to assess the attributes of rangelands and the strategies employed in their management, to enhance ecological connectivity within these landscapes. This year, I am pleased to introduce two Ph.D. students who are poised to embrace this challenge. Together, we will outline a comprehensive roadmap for implementing this programme, describing the key questions to be asked and presenting the rangeland systems in which we mean to ask them. By presenting a more detailed study design, we aspire to identify potential synergies between our planned research and that of other participants, thereby fostering invaluable collaborations in support of both wildlife conservation and the promotion of thriving rangelands.

## Session 2

### Long-term vegetation assessment at vegetation monitoring sites on Shangani Ranch

Karin Murwira<sup>1</sup>, Christopher Chapano<sup>2</sup>, Farai Matawa<sup>1</sup> and L. Munyaradzi<sup>1</sup>

<sup>1</sup> Scientific and Industrial Research and Development Centre, [kmurwira@sirdc.ac.zw](mailto:kmurwira@sirdc.ac.zw)

<sup>2</sup> National Herbarium and Botanic Garden of Zimbabwe

Shangani Ranch is monitoring the impact of their holistic ranging method by conducting rangeland assessment, part of which is a long-term vegetation survey that was started in 2013. The protocol of the vegetation survey is described in a vegetation monitoring report of 2013 and is based on the recording of grass species richness, frequency and relative abundance, according to the method first proposed by Walker in 1976. Rangeland condition is consequently calculated using the weighted grazing value. This is a report of the results of the vegetation survey for 2023, with 30 quadrats laid out along each of the 27 60-metre-long permanent monitoring transects on Shangani Ranch. The forb and grass species composition and weighted grazing value contributes valuable evidence for enhancing the management decisions in a rangeland where the land is used for both livestock production and wildlife conservation.

## An overlooked carbon sink underfoot: The role of mycorrhizal fungi in African biomes

Heidi-Jayne Hawkins

Conservation International, [hhawkins@conservation.org](mailto:hhawkins@conservation.org)

Carbon sequestration via plant-soil pathways involves an important group of organisms called mycorrhizal fungi, which have been largely overlooked in their potential role for so-called natural climate solutions (NCSs). Thus, we analysed nearly 200 datasets to provide the first global quantitative estimates of carbon allocation from plants to the mycelium of various types of mycorrhizal fungi. We found that there are large amounts of carbon flow from plants to these fungi per year (overall 13,12 Gt CO<sub>2</sub>e; DOI:10.1016/j.cub.2023.02.027). This equates to a staggering ~36% of annual CO<sub>2</sub>e emissions from fossil fuels. However, it was also clear that there are major uncertainties, such as the permanence of this allocation, and gaps, such as a complete absence of data from Africa. As a next step, we wish to accurately assess the extent to which mycorrhizal fungi are carbon sinks in African biomes and the role of fungal diversity in this. We intend to communicate our findings to not only scientists but also decision makers, with the desired impact of enabling prioritisation of protected areas and NCSs that take underground ecosystems into account.

## Soil seed bank dynamics as potential indicators of grazing-induced land degradation threshold in a dryland savanna

Ndamonenghenda Hamunyela<sup>1</sup>, Katja Tielbörger<sup>2</sup> and Wellencia C. Nesongano<sup>1</sup>

<sup>1</sup> University of Namibia, [monaeliaser@gmail.com](mailto:monaeliaser@gmail.com)

<sup>2</sup> University of Tübingen

This study investigated the influence of grazing on soil seed bank (SSB) density, richness and composition in a livestock-farming-dominated landscape in central Namibia. SSB samples were collected along grazing gradients established in two livestock management systems: freehold farms and communal areas. A total of 1 058 SSB samples were collected from a depth of 5 cm and germinated for SSB assessments. The results show that the SSB density, richness and composition varied significantly between the two management systems ( $p < 0,05$ ). In freehold farms, slight but significant variations were observed in SSB density, richness and composition along the grazing gradients ( $p < 0,05$ ), while no significant variations were found in communal areas ( $p > 0,05$ ). Evidence of a threshold indicating a distinct change in SSB patterns was observed only in freehold farms, although very weak. Overall, the findings suggest that rangelands managed under a freehold system exhibit lower levels of degradation compared with those under a communal system. Moreover, grazing in our study system appears to have a minimal effect on SSB patterns, indicating a relatively high SSB resilience and resistance to grazing.

## Managing African ecosystems for biodiversity and carbon

Guy F. Midgley

School for Climate Studies, Stellenbosch University, [gfmidgley@sun.ac.za](mailto:gfmidgley@sun.ac.za)

With tepid rates of transformation towards renewable energy in the global energy system, pressure is mounting on nature-based solutions to mitigate climate change. Terrestrial ecosystems already absorb roughly one third of anthropogenic emissions annually, but can they be managed to maintain this vital ecosystem service, or even enhanced to sequester a greater amount of carbon without adversely affecting biodiversity? In this talk, I will discuss emerging findings about the carbon sink strength and the behaviour of important African ecosystems, how these findings might inform the sustainable management of African ecosystems for both biodiversity and carbon benefits, and the trade-offs that we will come to face.

## Spatial ecology and interactions between cheetahs and their prey in the arid Kalahari, and implications for their management and conservation

Gus Mills

University of Mpumalanga, [mills.gus@gmail.com](mailto:mills.gus@gmail.com)

Unmanaged cheetah populations occur at low population densities (around 1/100 km<sup>2</sup>) and are usually wide-ranging. The cheetah is well adapted to arid regions; in the Kgalagadi Transfrontier Park, home range sizes (95% MCP) for females were found to be 1 344 (SD ±887) km<sup>2</sup> and for males 731 (SD ±294) km<sup>2</sup>, with considerable overlap in both sexes. Cheetah social groups tend to prey on different species: females with cubs kill mainly steenbok, springbok and hares; single males kill steenbok, hares and springhares; and coalition males kill mainly gemsbok calves, ostrich and steenbok. I will describe aspects of the hunting behaviour of cheetahs, their prey selection, the impact they have on some prey populations, as well as their relations with competitors and each other. I will then discuss the complicating issues in managing cheetahs in small, fenced areas, and suggest how these could be mitigated to achieve a more natural, functional biodiversity condition.

## Space use by elephants in Gonarezhou National Park and their ranging patterns beyond the protected area boundaries

Bob Mandinyenya

Gonarezhou Conservation Trust, [bob@gonarezhou.org](mailto:bob@gonarezhou.org)

This study used location data derived from GPS collars fitted on 26 African savanna elephants (*Loxodonta africana*) from 2016 to 2022 in Gonarezhou National Park (GNP) to understand their space use and ranging patterns. The collars were fitted on male (n=19) and female (n=7) animals inside the park. Home range size is an effective metric for understanding how variations in environmental factors during the Anthropocene alter the behaviour and spatial distribution of animals. The mean 95% kernel density estimate of home range was 1 159 km<sup>2</sup> (95% CI: 852-1 466 km<sup>2</sup>). Elephants in the study area maintained a high fidelity to the protected area, spending 84,5% of time tracked within the park. When dispersing beyond the park boundary, they preferred to use open woodland with a composition of deciduous

trees, shrubs and grassland. This movement was mostly dominated by bull elephants during the hot, dry season, when they ranged into Mozambique and the Kruger National Park in South Africa. Our results highlight the importance of protected areas, especially national parks, for elephants. The high fidelity to GNP by elephants in this study points to the success of this park in meeting elephant needs.

## Drivers of inter- and intraspecific variation in physiological responses of dominant South African savanna trees to high temperatures across an environmental gradient

Kerry-Anne Grey, Nicola Stevens, Carla Staver and Yadvinder Malhi  
Oxford University, [kerry-anne.grey@ouce.ox.ac.uk](mailto:kerry-anne.grey@ouce.ox.ac.uk)

Temperatures in southern Africa are rising at twice the global rate. To date, studies addressing the impact of warming on trees have been largely limited to forested systems, where large-scale tree mortality is occurring. How trees in non-forested systems (e.g., savannas) will respond to temperature extremes is uncertain. Physiological responses of plants (i.e., photosynthesis and respiration) to experimental warming are commonly used to test species' vulnerability to future warming. Such responses vary considerably inter- and intraspecifically due to differences in suites of plant functional traits (PFTs) and physiological acclimation to prevailing temperatures. This variation in responses of species and populations to warming can be neatly studied using naturally occurring environmental gradients (e.g., temperature). This study is investigating the physiological response of six dominant savanna tree species to experimental warming along a natural temperature and aridity gradient in South Africa. Whether inter- and intraspecific variation in species' responses can be predicted from prevailing climatic conditions or suites of PFTs is also being investigated.

## Strategic opportunism – what works in Africa: Twelve fundamentals for conservation success

Brian J. Huntley  
Research Centre in Biodiversity and Genetic Resources (CIBIO), University of Porto, [brianjhuntley@gmail.com](mailto:brianjhuntley@gmail.com)

Despite billions of dollars invested in recent decades by international aid agencies in Africa, the state of the continent's environment and biodiversity continues to decay. Yet, turning failure into success is possible. This paper presents pragmatic approaches learned from a wide diversity of long-term projects in both rich and poor countries, distilled into 12 fundamental drivers of success. Strategic opportunism is adaptive management writ large. It seeks to transform problems into solutions. The concept of strategic opportunism can be succinctly defined as "seizing the moment while imagining the future". It recognises serendipity and embraces unexpected opportunities and the political moment. The development and application of the concept is based on experience drawn from multiple projects across ten African countries, within biomes ranging from hyper-arid desert to tropical savanna and to sub-Antarctic tundra, and within dynamic socio-political landscapes. The thesis of this paper is that success depends on a clear and shared vision, within a flexible approach to project design and implementation, freed of the straightjackets of development agency project formats.

# Poster session abstracts

## 1 Species diversity and biomass variability among different woodland types in Zambezi dry forests

**Admore Mureva<sup>1</sup>, Luke Jimu<sup>1</sup>, Anderson Muchaona<sup>2</sup> and Lovemore Musemwa<sup>1</sup>**

<sup>1</sup>Bindura University of Science Education, admury@gmail.com

<sup>2</sup>Forestry Commission, Zimbabwe

Deforestation and forest degradation are major contributors to anthropogenic greenhouse gas emissions, making it essential to understand the carbon dynamics of forests. Although several studies have been conducted on forest carbon pools, there is still significant uncertainty surrounding carbon emissions from tropical forests. Estimating forest carbon stocks is challenging due to variations in forest structure, age, species composition and environmental conditions. In addition, estimating forest carbon stocks in tropical forests is difficult due to the high diversity and complexity of these forests. Therefore, this study aims to determine the above-ground biomass carbon in the gazetted Zambezi teak forests, which are of high economic value and cover approximately 265 000 km<sup>2</sup> of north-western Zimbabwe, north-eastern Botswana, south-western Zambia, north-eastern Namibia and south-eastern Angola. The study area was divided into strata based on the major vegetation types present, and 228 plots of 0,125 ha each were established to measure the height and diameter of individual wood species. The results showed that the 10 cm diameter class had the highest stem density in all communities under study.

## 2 Modelling the resilience of ecosystem service provision in African landscapes

**Akhabue Enimhien, Andrew Cunliffe, Anna Harper, Karina Williams and Tom Powell**

University of Exeter, efa206@exeter.ac.uk

African ecosystems face growing threats from human activities and climate change. We need to model the impact of changes on African ecosystems and how they respond to climate change, to help decision makers develop and implement more sustainable land management practices. Land surface models (LSMs) are key tools for understanding land surface processes over continental scales and assessing the ability of landscapes to provide ecosystem services, currently and in the future. This doctoral project will improve the Joint UK Land Environment Simulator (JULES) in simulating African landscapes. This involves assessing the adequacy and value of model outputs relative to needs, collating data to parameterise and evaluate the models, and simulating different scenarios to assess the impacts of change on ecosystem services. This will improve the value of model outputs for decision makers seeking to develop effective strategies and policies for ecosystem management in Africa. This project will also improve the representation of African landscapes in LSMs and the representation of African ecosystems in global biogeochemical cycles and decision-making frameworks.

### 3 Leveraging technology for transparency: Advancing data quality in southern Africa's trophy hunting sector

Alexander Chidakel and Brian Child

University of Florida, [achidakel@ufl.edu](mailto:achidakel@ufl.edu)

As trophy hunting in southern Africa faces growing international scrutiny, robust and reliable data is now critical to distinguishing well-managed conservation areas from their poorly managed counterparts. However, the current inconsistent and incomplete data landscape across the region obscures the distinction, threatening indiscriminate regulatory measures that place at risk the financial and economic viability of areas under sustainable use. We survey the current state of hunting data in the region to highlight the variation in economic returns and financial viability of trophy hunting, both between countries and between property types (i.e., private, state and community), as well as the variation in the extent of data collection. At both landscape level and national level, wildlife managers and proprietors have made significant strides towards the adoption of modern data management practices, yet the ability to analyse this information has not kept pace with the rapidly growing datasets. In order to link data to performance management, we explore the use of an app-based tool to scale up and streamline this process.

### 4 The effects of spotted hyaena (*Crocuta crocuta*) activity hotspots on the abundance and species richness of smaller predators and small mammal species

Amaurée Jansen van Vuuren<sup>1</sup>, Jan Adriaan Venter<sup>1</sup>, Hervé Fritz<sup>1</sup> and Lourens Swanepoel<sup>2</sup>

<sup>1</sup> Nelson Mandela University, [s215106210@mandela.ac.za](mailto:s215106210@mandela.ac.za)

<sup>2</sup> University of Venda

African ecosystems support a diverse variety of predator species and have the highest diversity of large carnivores on Earth. Through hunting and creating a landscape of fear, apex predators affect populations of smaller predators and prey. The largest activity hotspot of the spotted hyaena (*Crocuta crocuta*) is the den, around which aforementioned landscapes of fear may occur. Seeking a better understanding of the influence of hyaena den sites on the presence of other species, we aimed in our study to determine the difference between species richness and abundance at sites close to dens and at sites far from dens. This was achieved by analysing images captured by camera traps set up around den sites and capture-mark-recapture data of rodent species. Our analysis shows that rodent species richness and abundance near den sites are higher than at sites further away from the dens, whereas mesopredator species richness and abundance near den sites are lower than at sites further away from the dens. Our results suggest that den sites create a landscape of fear for mesopredator species, which in turn leads to increased rodent species richness and abundance nearby den sites.

## 5 Positive tipping points in regenerative practices in smallholder farming systems in Africa: What drives adoption?

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Regenerative agriculture (RA) practices have been promoted as a critical climate change resilience strategy and adaptation solution for smallholder farmers in sub-Saharan Africa (SSA). However, most RA programmes struggle with securing and sustaining high adoption rates, with many facing dis-adoption. We applied the positive tipping points framework proposed by Lenton et al. (2022) to identify the potential for rapid, self-sustaining adoption of RA by evaluating RA adoption drivers and barriers in SSA from existing literature. We found that the key enabling conditions for successful adoption were: affordability linked to innovative business models, compatible cultural beliefs, complementary infrastructure, availability of and access to key resources such as land, performance relative to alternative innovations, perceived usefulness of the innovation, and the capacity of the potential adopter to harness the promised benefits of the innovation. Accelerating adoption of sustainable regenerative agriculture requires: developing long-term collaborative networks, adopting participatory approaches, targeting highly connected social groups, monitoring, evaluation and learning, and accessible finance.

## 6 The impact of artificial light spectra and intensity on the feeding behaviour of *Anopheles gambiae*

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Mosquitoes are important vectors for a wide range of parasites and pathogens that cause severe diseases 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. With a better understanding of the impact of artificial light at night on mosquito blood-feeding, 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 of *Anopheles gambiae*, a major malaria vector across Africa. Under laboratory conditions, we performed biting assays to measure the blood-feeding propensity after a light pulse. The results thus far have shown that higher intensities (1 000 lux and higher) significantly reduce blood-feeding propensity compared with dark conditions and lower intensities. This suggests that a short pulse of relatively high intensity light can be used to reduce blood-feeding and, consequently, malaria transmission.

## 7 Stable isotope ratios of murid rodents in Gauteng, South Africa: Comparing invasive and indigenous rodents from historical and modern collections

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Biological invasions and urbanisation are among the leading causes of biological extinctions. We investigated how these processes interact by assessing long-term impacts of urbanisation on the trophic ecology of some indigenous and invasive murid rodent species in Gauteng, South Africa. We assessed the impact of various life history traits and environmental factors on the carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) isotope ratios of these species, using fur of modern and historical samples. Analysis of variance (ANOVA) and its associated post-hoc analyses found that sex, age and sampling year had minimal impact on  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  isotope ratios compared with locality and sampling season for most species. Collation of all results suggests that in the last century, short-term seasonal fluctuations accounted for a larger proportion of isotopic variation than long-term environmental changes. This suggests a need to identify quantifiable sources of short-term variation in stable isotope ratios in these rodents, in order to allow for accurate predictions of their possible responses to continued urbanisation in the future.

## 8 Reproductive behaviour of the Kloof frog (*Natalobatrachus bonebergi*), an endangered South African endemic

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The endangered Kloof frog (*Natalobatrachus bonebergi*) has been well monitored over the past decade at various sites across southern KwaZulu-Natal and the northern Eastern Cape. Egg clump monitoring data acquired from a monitoring protocol developed by the Endangered Wildlife Trust's Threatened Amphibian Programme will be analysed as a function of environmental pressures. Camera trap observational recordings will also be analysed to identify behavioural patterns and develop research questions aimed at better understanding predation and reproductive behaviour, such as parental care and the male-female interactions of the Kloof frog. The acoustic profile of the species's call will also be examined, using acoustic monitoring devices and analyses. Factors such as seasonal variability, circadian rhythm, call type and whether calls differ over the breeding season will be assessed. The Kloof frog is an Evolutionarily Distinct and Globally Endangered (EDGE) species and is also monotypic within its genus. Understanding the life history and behavioural patterns of this species is therefore of utmost importance in advancing conservation and management of this species and its habitat.



## 9 Understanding cattle forage preferences of holistically managed herds: A herder-friendly approach in determining biomass

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This study aimed to identify plant species most preferred by cattle, develop a simple biomass measure understood by laymen, and estimate daily biomass uptake under holistic management. Four large herds were observed during grazing time for two weeks, monitoring biomass uptake, species preference and hectareage covered in a day. Results indicated that *Cynodon dactylon* was preferred by all herds, and preference was not linked to any specific herd. The browsing behaviour of a herd was impacted by varied grazing areas and herd, with one herd showing the most browsed species. Grass height was negatively correlated to biomass, and biomass uptake varied between exotic mixed herds and indigenous herds. Mixed herds utilised a larger area with more biomass per livestock unit per day, while the indigenous herds required a smaller area and less biomass uptake. The study presents opportunities for future research if long-term monitoring and refining of methodology is done.

## 10 Habitat use and activity patterns of puff adders (*Bitis arietans*) in the Kalahari

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Activity patterns and habitat use of animals can provide insight into aspects of their ecology. Thermoregulation in animals is impacted by environmental heat load, which may result in microhabitat selection, influencing space use. Ambush-foraging species such as puff adders (*Bitis arietans*) spend long periods of time on the surface waiting for prey, and temperature increases due to climate change could significantly impact their site selection and movement ecology. The aim of this study is to compare the space use of a population of puff adders in the Kalahari with that of a population in a more mesic environment. We will assess how environmental differences influence microhabitat selection, home range size, daily and monthly displacement, and periods of activity. A sample of 30 snakes in Tswalu will be tracked for one year using radiotelemetry, and compared with a similar study conducted in Dinokeng. Location and microhabitat selection data will be recorded on average every second day. This data will allow the assessment of how extreme temperatures in the Kalahari affect puff adder behaviour, and the prediction of how other populations may respond to extreme conditions expected during climate change.

## 11 Plant species and functional diversity between the riparian and upland habitats along the Umgeni River at Wakefield

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The riparian zones are significant as they are a source of joining together the two most important systems: terrestrial and aquatic. Riparian vegetation helps improve water quality by absorbing excess nutrients and sediments from the surface runoff. They also stabilise stream banks and reduce floodwater velocity. Here, we aimed to determine the plant species and functional diversity in riparian and upland zones. We sampled from downstream and went upstream along the river. We sampled at 0 m (downstream), 50 m, 100 m and 300 m along the river. We also sampled away from the river to the upland, sampling from 0 m (on the edge of the river), 50 m, 100 m and 300 m. At each sampling point, two 30 m long transects (10 m apart) were laid out horizontally. At the beginning and end of each transect, a 1 m<sup>2</sup> quadrat was dropped, and all species were recorded. The percentage cover of each plant species inside the quadrat was estimated. Species richness was lower in riparian habitats compared with upland ones. The invasives were more abundant in the riparian zones than in the upland ones. Findings from this study provide baseline data and the condition of the Wakefield Farm riparian zones.

## 12 Temminck's pangolin (*Smutsia temminckii*) spatial ecology in Tswalu Kalahari Reserve

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Tswalu Kalahari Reserve hosts a population of Temminck's pangolin (*Smutsia temminckii*), but the population estimate and density is unknown. We have spatial locations for 20 individuals over an eight-year period, from 2015 to 2023. We are thus able to estimate their seasonal home range patterns and potential inter-individual and seasonal overlap. Having a detailed vegetation map also allows us to estimate the main vegetation types used by these individuals. The results will not only provide insight into the distribution and habitat use of the individual pangolins but will also allow an estimation of the potential size of the population based on the home range size and degree of overlap between the different individuals for which we have data. This is an important gap that is crucial for informed conservation management of this species within Tswalu.

## 13 Impala seasonal habitat utilisation and movement patterns in Sourish Mixed Bushveld

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Impala (*Aepyceros melampus*) populations are abundant in South Africa, spanning state- owned and private property. These animals play an important role in nature conservation and the game farming industry, and hold economic value for their meat. Seasonality influences the habitat utilisation patterns

of impala, subsequently affecting the utilisation of plant communities in their home ranges. This study examines impala habitat utilisation at the Loskop Dam Nature Reserve. Braun-Blanquet and TWINSpan methodologies were used to classify plant communities within impala home ranges. Movement data was collected using a GPS collar fitted on a dominant impala ram. Ivlev's Electivity Index was used to determine seasonal habitat preferences and utilisation. Vegetation maps were produced to visualise available plant communities, while home range maps depicted seasonal home range sizes. The impala home range comprised diverse plant communities, creating varied habitats that provided necessary resources for survival and reproduction. This research sheds light on the habitat preferences and movements of impala, contributing to a better understanding of their ecological role and conservation needs.

## **14 An assessment of the macroinvertebrate assemblage within the Pienaars River downstream and upstream from the Roodeplaat Dam**

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The Roodeplaat Dam is classified as a hyper-eutrophic aquatic system, primarily due to contamination from three inflowing rivers, with the Pienaars River being the most significant contributor. Limited data is available on the effect the polluted dam water has on the macroinvertebrate diversity within the Pienaars River downstream from the dam. This study aimed to investigate the macroinvertebrate community of the Pienaars River across seven selected sites, incorporating seasonal variation. An assessment of water and sediment quality was conducted, along with a habitat evaluation using the Integrated Habitat Assessment System (IHAS) protocol. Macroinvertebrates were sampled from various biotopes using the South African Scoring System (SASS5). The collected SASS5 scores were then used to calculate the Macroinvertebrate Response Assessment Index (MIRAI). Notably, the findings revealed a decrease in numbers of macroinvertebrate taxa and their abundance scores near the dam, while scores increased at sites further from the dam. Low-flow conditions exhibited the lowest number of macroinvertebrate taxa. The results provided valuable insights into the overall health and functioning of the Pienaars River.

## **15 Correlations between tourist activity and stress-related faecal glucocorticoid metabolite concentrations in wildlife**

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Growing global visitation rates to natural areas to view and hunt wildlife has brought the economic, social and ecological role played by wildlife tourism practitioners into the spotlight. This leaves wildlife tourism operators facing the challenge of providing different tourism activities to meet client expectations of a memorable guest experience, while still securing the welfare of the wildlife. These activities, which most often include safari game drives, mountain biking and hiking, often result in tourists coming in close proximity to free-ranging wildlife and are often perceived as disturbances to the species around which these activities take place. The present study examines the correlation between wildlife tourism activities and faecal glucocorticoid metabolite concentrations, as a stress-related biomarker for five mammalian species frequently utilised in safari wildlife tourism.

## 16 The influence of climate on cropland cover change (1984-2022) in former apartheid homelands of South Africa: A case study of the Maputaland Coastal Plain (MCP)

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In recent years, studies have indicated an overall decline in the extent of crop farming in former homelands. This paper seeks to quantify the patterns and trends in small-scale croplands in the MCP, a former apartheid homeland, and how the patterns are influenced by climate change. We hypothesised that climate would influence the pattern of change in cropland cover over time, since the agricultural activities in the MCP depend on rainfall and groundwater. We used Landsat imagery to quantify the extent of the croplands. The random forest classifier was used to classify the images in GEE. Annual precipitation, minimum and maximum temperature as well as SPEI were used as climate proxies to assess the influence of climate change on crop farming. Our preliminary results showed a decline in cropland cover between 1984 and 2022, with the smallest extent of actively used cropland (~3880 ha) being observed in 2014. This year coincided with the second lowest annual rainfall. The results show a correlated relationship between cropland cover and precipitation and SPEI, suggesting an influence of climate change on crop farming activities. Future work will further unpack the nature of climate influence in the MCP.

## 17 The true identity of *Polystoma channingi* (Monogenea: Polystomatidae)

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Polystomatid flatworms (Monogenea: Polystomatidae) infect all amphibian orders, freshwater turtles, the Australian lungfish and the eye of the hippopotamus. Polystomes of amphibians are known to be highly host-specific, to the extent that parasites were initially described based on host identity. *Polystoma channingi* (Du Preez, 2013) has been described from two sister host species, the common caco, *Cacosternum boettgeri* (Boulenger, 1882), and the bronze caco, *C. nanum* (Boulenger, 1887). These hosts occur syntopically at the type locality near Kenton-on-Sea in the Eastern Cape, South Africa. A population of *C. boettgeri* near Potchefstroom in North West has been found to be infected with what has provisionally been identified as *P. channingi*. Material has been stained and permanently mounted for microscopic examination. Specimens were prepared for molecular analyses and will be compared with the type material. Since polystomes are soft-bodied organisms, body measurements are of limited value. Measurements of sclerotized marginal hooklets, hamuli and genital spines will, however, provide valuable insight to determine the true identity of the parasites.

## 18 Monitoring the impact of land-use change and associated ecological disturbances and stress: A test using ants (Hymenoptera: Formicidae)

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Although natural phenomena cause some disturbances, anthropogenic disturbances are now commonly encountered and are a major cause of ecological disturbance. Among animals, insects are a highly abundant and now widely studied group. In the terrestrial ecosystem, ants (Hymenoptera: Formicidae) have the highest terrestrial biomass, supply various ecosystem services and respond to disturbances at a local scale. Here, I aim to present various recent studies documenting patterns of ant biodiversity and their responses to ongoing major ecological disturbances and stress factors in vulnerable systems in Limpopo and KwaZulu-Natal. High temperatures, habitat structures and dominance of ants drive diversity and assemblages of ants in Limpopo. Across KwaZulu-Natal, grasslands have the highest diversity, while natural forests have unique ant assemblages. Dominant ants in the genera *Pheidole*, *Anoplolepis* and *Crematogaster* seem to control assemblages in highly disturbed systems, including sugarcane plantations and bush-encroached systems. Despite recent efforts in the two provinces, most ant species are not described; for those described, their diversity and distribution are not known.

## 19 Spatio-temporal monitoring capabilities for land degradation in South Africa: Activities and findings from Sentinel-1 and -2 time series

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This presentation focuses on arising possibilities with the new European Sentinel satellite fleet, which ensures unprecedented spatial, spectral and temporal monitoring capabilities. We developed five major assessment goals for land degradation monitoring strategies: rangeland degradation, bush encroachment, degradation of croplands, vegetation cover change and alien species. Accordingly, the SPACES II project SALDi defined a workflow to generate the necessary indicators by exploiting Sentinel-1 and -2 time series as well as additional products, e.g., rainfall estimates from rain gauge and satellite observations (i.e., Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS)). To evaluate the Sentinel-1 time series to detect surface changes, irregularities in the radar backscatter and coherence time series were analysed. The aim is to identify regions where there are possible degradation processes, such as land use changes susceptible of erosion (e.g., clearings for macadamia plantations), fallow farmland or shrub encroachment. Further, radar-retrieved Surface Moisture Indices (SurfMI) were evaluated against in situ soil moisture, with good agreements in six regions.

## 20 Archaeology, spirit mediums and the environment: A study of continuity and change in the Mambo Hills, south-western Central Zimbabwe

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In this article, the author examines the case of the highly contested environmentally, economically, archaeologically, culturally and religiously opulent Mambo Hills. This site is located in the Bubi District of Matabeleland North Province in south-western Central Zimbabwe. The Mambo Hills were the last capital of the Rozvi State, and they served the religious needs of the Shona people from about AD 1500 to 1835, when it was conquered by the Ndebele people, who, however, continued to pay a tribute of black cattle as a sign of revering the settlement. What is more intriguing is the evidence that the Mambo Hills have continued to attract human life from the Stone Age period, through the Iron Age period and the historical period, to date. Apart from the religious activities of the Mwari religion protagonists, it remains the most environmentally attractive landscape. This study will therefore unravel and reconstruct ancient Mambo Hills environments to understand the development of the archaeological sites and the use of the hills for the Mwari religion.

## 21 Namibia's nature-based tourism: Balancing conservation, commerce and community development

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This review examines the challenges and opportunities in balancing conservation, commerce and community in Namibia's nature-based tourism (NBT) industry. The paper explores the importance of addressing these three aspects for sustainable and inclusive tourism development. Successful models and strategies, such as community-based natural resource management and public-private partnerships, are identified as pathways for achieving a balance between the three pillars. Implications and recommendations for the future include strengthening local ownership, enhancing economic linkages, embracing technology and sustainability, strengthening community proprietorship and land tenure, and diversification of NBT income streams. By implementing these recommendations, Namibia could position itself as a global leader in sustainable and inclusive tourism, benefiting both conservation efforts and the well-being of local communities.

## 22 DNA barcoding of Mozambique's aquatic fauna

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There remains a gap in the current species inventories for rivers and estuaries throughout the Republic of Mozambique, a country rich in biodiversity and whose ecosystems remain understudied due to ongoing armed conflicts in most parts of the country, logistical difficulties in accessing sites and limited local

expertise. Metabarcoding of environmental DNA (eDNA) presents a novel and promising means of rapidly documenting entire animal communities. Still, a reference database of DNA barcodes is largely lacking and is needed for researchers to begin to understand the current biodiversity within some of the country's essential rivers and estuaries. This project obtained DNA sequences of specimens collected at various sites along the coastline of Mozambique, which were added to a reference database of existing DNA barcodes, and an associated morphological collection was created. These DNA barcodes were added to the Barcode of Life Database (BOLD) for future reference. This information provides basic insight into the number of species present at all the sites and provides information on how much additional sampling is required to complete the reference collection.

## 23 Phylogeography of estuarine fauna in southeast Africa and the use of eDNA metabarcoding

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Southeast Africa has an extensive river network, vital in shaping local ecosystems and supporting communities. Despite this abundance, the biodiversity of these aquatic systems remains inadequately explored. Estuaries, which host diverse species like fish and invertebrates, remain largely understudied, and the phylogeography of their inhabitants remains poorly understood. To address these knowledge gaps, our study focused on the phylogeography of estuarine fauna in southeast Africa. Leveraging environmental DNA (eDNA) metabarcoding, we conducted sediment sampling across the region, spanning from South Africa's Eastern Cape to northern Mozambique. This sampling covered warm-temperate, subtropical and tropical biogeographical areas. Using standard DNA barcoding markers, we extracted and amplified eDNA from the collected sediment. By identifying species present across much of the sampling area, we selected suitable candidates to study large-scale genetic patterns. Each selected species underwent individual analysis using phylogenetic methods, allowing us to discern regional intraspecific patterns that shed light on biogeographical effects on their evolution.

## 24 Seasonal importance of wetlands to ungulates in a grassland system

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Grasslands are one of the largest biomes in the world. South Africa's grasslands comprise close to a third of the region's landscape, occurring largely on the central high plateau and mostly within the summer rainfall areas. Consequently, forage nutrient levels in most grassland habitats decrease during the dry periods, climaxing into a nutritionally stressful late dry season for herbivores. However, functional heterogeneity within ecosystems could support animals during resource-limited periods. Wetlands, with their shallow water tables, are among the most productive habitats worldwide, playing a critical role in maintaining herbivore populations in grassland biomes. Using a combination of five wetland sampling areas and five grassland control sites, I will use camera traps, dung transects and direct observations to

evaluate seasonal habitat use and movement of large herbivores. Moreover, vegetation quantity and quality will also be evaluated. Objectives thus are to 1) determine the extent to which herbivores in Telperion Nature Reserve make use of wetlands seasonally, 2) quantify the seasonal quantity and quality of grazing, and 3) identify food plants consumed by selected herbivores.

## 25 A rapid, affordable, non-destructive method for assessing the nitrogen content of different tree species

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The SPAD-502 meter is a simple tool that measures the greenness or the relative chlorophyll concentration of leaves. The agricultural industry has made the most progress in testing the SPAD-502's usefulness as an index of leaf nitrogen in crop species, i.e., it has been found to be useful for assessing differences in nitrogen content between individuals within a species, but it is not clear whether it can be a reliable measure of nitrogen content in comparisons between different species. Eight species were selected to represent as wide a range of plant functional types found in a South African savanna as possible. Three leaf samples were chosen from each individual tree species selected, and measured using the SPAD-502. Significant differences were found between all selected species, including between the compound-leaved *Vichellia tortillis* and *Burkea africana*, as well as between the simple-leaved *Terminalia sericea* and *Ziziphus mucronata*. This study has demonstrated that the SPAD-502 meter can be used to determine leaf nitrogen in the field. Further investigation into long-term or seasonal leaf nitrogen assessment across southern Africa's semi-arid savannas is needed.

## 26 The ecological role of Temminck's pangolins in a dryland ecosystem

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The global threat to biodiversity is directly affecting ecosystem stability, as the ecosystem services that organisms provide are compromised. It is often assumed that rare species have little influence on the functionality of the broader ecosystem, yet they often are the most in need of conservation efforts. One such species is Temminck's pangolin (*Smutsia temminckii*). Based on studies of other pangolin species, it has been suggested that Temminck's pangolin may impact its ecosystem through its role in nutrient cycling, soil turnover and the accumulation of biodiversity in dig sites. Our study aims to quantify the role of Temminck's pangolin by investigating aspects of its foraging practices. We hypothesise that pangolin foraging behaviour will increase the rate of nutrient cycling in the environment and allow for the increased accumulation of biodiversity. Six pangolins at Tswalu in the Kalahari will be tagged with VHF tracking transmitters and observed during their active phase for one year. Quantifying the ecosystem services provided by Temminck's pangolins will allow for the prioritisation of conservation efforts for this rare and vulnerable species.



## 27 Public perceptions of trophy hunting are pragmatic, not dogmatic

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Fierce international debates rage over the social acceptability of trophy hunting (TH), especially when people from the global north hunt iconic wild animals in sub-Saharan Africa (SSA). But what makes TH so divisive? We measured public perceptions of the acceptability of TH in SSA among people who live in urban areas of the USA, the UK and South Africa. Zebra hunts were more acceptable than elephant hunts, and hunts that would provide meat to local people were more acceptable than hunts in which meat would be left for wildlife. Hunts in which revenues would support wildlife conservation were more acceptable than hunts in which revenues would support economic development or hunting enterprises. Acceptability was generally lower among participants from the UK and those who more strongly identified as animal protectionists, but higher among participants with more formal education, who more strongly identified as hunters and who would more strongly prioritise people over wild animals. Overall, acceptability was higher when hunts would produce tangible benefits for local people, suggesting that public perceptions are more pragmatic than high profile, polarised international debates.

## 28 The *Greyia* endemic tree genus: Towards foundational biodiversity knowledge

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*Greyia* species are deciduous trees with spectacular red flowers that provide ecosystem services in some montane regions of the country. *Greyia* are endemic to South Africa. They are classified in the order *Geraniales*, with the closest relatives (*Francoa* spp.) in Chile. There are currently three recognised species with core populations in geographically separate areas from the Eastern Cape to Limpopo: *Greyia radlkoferi* (Szyszyl.), *Greyia sutherlandii* (Hook. & Harv.) and *Greyia flanaganii* (Bolus). However, these species are not always readily distinguishable based on morphological differences, and the *Greyia* genus has been prioritised by SANBI for taxonomic revision. DNA barcoding with nuclear and plastid genes did not resolve species in core geographical ranges, but not across all sites. Genome-wide SNP marker discovery using RADseq gave improved resolution of *Greyia* genotypes in wild populations. *G. sutherlandii* genotypes had lower medicinal activity (treatment for human skin hyper-pigmentation). This project aims to gather foundational biodiversity information on the *Greyia* genus for biodiversity conservation planning and the bioeconomy.

## 29 Engaging rural communities in promoting coexistence between humans and wild animals: A case study of Olkiramatian and Shompole community conservancies in Kenya's Southern Rift Valley

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Conflicts that arise between humans and wildlife, commonly known as human-wildlife conflicts (HWC), are a huge threat to biodiversity conservation. Community engagement in conservation activities and HWC interventions are often overlooked but are critically important, because interventions that are produced in collaboration with and acceptable to local communities are more likely to succeed. Therefore, it is important to understand the most appropriate platforms and effective levels at which local communities can be involved in conservation decision making, and how governments and other decision makers consider local perspectives in key decisions regarding wildlife conservation. Using a case study involving Maasai communities living in southern Kenya, we will conduct key informant interviews and an extensive questionnaire survey to explore the nature of community engagement in mitigating HWC. Our results will inform evidence-based decisions for sustainable wildlife conservation and identify clear and inclusive platforms to ensure the sustainability of HWC interventions.

## 30 Investigating the effects on nutrient hotspot sites two years after kraaling on Shangani Ranch in Zimbabwe

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Kraaled hotspot sites have critical roles in structuring tree-grass cohabitation on hotspot patches, forage availability and quality, and plant production in savanna systems and ranch areas. Previously, kraaled locations were shown to be appealing to herbivores, resulting in herbivores, particularly cattle, using these kraaled sites. This research looked at the impacts of time after kraaling on woody species variety, focusing on species abundance and richness in previously kraaled patches, as well as the effects of time after kraaling on grass species basal cover, biomass and richness in these hotspot areas two years later. Previously kraaled hotspot areas of 50 m x 50 m were selected at random and labelled as paddocks 11, 15, 64 and 66 two years following kraaling. The results reveal that two years after kraaling had a significant influence on grass plant biomass as the p-value ( $p = 0,000$  is less than  $p = 0,05$ ) at a 95% confidence interval, and grass species biomass as the p-value ( $p = 0,023$  is less than  $p = 0,05$ ) at a 95% confidence interval. The findings demonstrate that two years after kraaling had a significant influence on tree species richness ( $p = 0,000$ ) and tree species abundance.

## 31 Towards pro-conservation attitudes and behaviour by communities bordering protected areas: Stakeholder tools

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People-park win-wins that conserve biodiversity and improve the well-being of communities bordering protected areas are vital in Africa. For this, we need to investigate influences on pro-conservation attitudes and behaviour. Multi-method qualitative research was conducted at three case study sites in South Africa with park staff and local communities. Each case and ensuing cross-case analysis focused on local knowledge of the park, people-park relationships, benefits gained / costs incurred, local custodianship and how to improve positivity towards parks. This culminated in practical tools for stakeholders. First, the Framework of Influences on Pro-conservation Attitudes and Behaviour represents the findings – benefits, losses, facilitators, detractors and ways to improve positivity. Recommendations follow for both protected area management and communities. Second, to broaden applicability, findings were combined with previous research to develop an integrated “People-Parks Win-Win Framework”, representing influences on people-park relationships that can be customised. Win-wins are complex, but these tools can foster a balanced socio-ecological approach for long-term sustainability.

## 32 The effect of elevation on dung beetles in the Waterberg

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Describing the patterns and processes which make up biodiversity have become important questions in conservation science due to the numerous essential services biodiversity provides. The answers to these questions for groups such as insects, which are declining, are even more important. Scientists need to inform land management practices to ensure biodiversity is conserved. They, however, first need to know how biodiversity responds to changes in various conditions. Mountains offer ideal locations for experiments to test this due to their altitudinal gradients. Dung beetles offer various ecosystem services and are found on mountain systems. The biodiversity in the Waterberg region of Limpopo in South Africa is extremely undersurveyed, which is worrying, as plans for economic development have been outlined. Dung beetles are also present in this region. This study aims to describe which dung beetle species occur at a low, middle and high elevation in the Waterberg biosphere region and how altitude affects their abundance, species richness and species composition. We also aim to see if there are any distinct genetic differences between species that are common at all three elevations.

### 33 The hidden diversity of Tswalu Kalahari

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The visible stars in the Kalahari night are infinite in number, and the same is true with the diversity harboured in its soil. The fauna and flora of reserves attract extensive attention through tourism and scientific study. However, little is known about the microbial diversity supporting this above-ground diversity through ecosystem services. Soil microbial diversity encompasses bacteria, archaea and fungi that function in nutrient cycling, plant growth and disease. This study aimed at unravelling the total fungal complement, utilising high throughput sequencing of soil-extracted DNA that resulted in a higher number of potential fungal isolates than that from a study focusing on the South African grassland biome. The culturable fungal fraction focused on the genus *Fusarium*, a fungal genus with immense economic and food security importance. Comparison between the soil of Tswalu Kalahari and that of other nature reserves in the grassland biome allows us to focus on the endemic distribution of *Fusarium* and will allow comparisons with croplands and pasturelands. The microbial diversity within the soil of Tswalu Kalahari is truly no less fascinating than the astronomical expanse of its night sky.

### 34 What's the buzz about? Interactions between native pollinators and the invasive *Lantana camara*

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Honey bees are the most important pollinators, thanks to their super-generalist nature, pollinating a wide variety of plants and providing crucial ecosystem services. However, does this pollination prowess also make them great facilitators of invasive species? Are honey bees enabling alien plant invasions? We looked at the relationship between indigenous pollinating insects and one of South Africa's worst invasive plants, *Lantana camara*, to determine whether this is true. We show that the pollinator population utilising lantana is diverse. The main pollinators of lantana are thrips, and indeed not honey bees. With exclusion experiments, we further determined that there was no difference in the fruit production of lantana between different pollinators. Preference experiments were conducted on honey bees, where bees were presented with a choice between lantana and two indigenous aloes. This data showed that honey bees chose the indigenous aloes significantly more. This is the only study of its kind in South Africa, and provides important insights into how invasives interact with our native insect species and empirical evidence that the perception of honey bees promoting invasive plants is wrong.

### 35 Thermoregulation: The “dung” in dung beetle (*Scarabaeidae scarabaeinae*)

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Increasing global temperatures as a result of climate change have a large impact on different animals due to their reliance on specific temperature ranges for biological processes. Insects often utilise thermal refugia to combat such temperature changes. Dung beetles are regularly exposed to extreme heat while rolling their dung balls. Therefore, the question arises whether two dung beetle species (*Scarabaeus rusticus* and *Scarabaeus* sp.) could regulate their temperatures using their dung balls as mobile thermal refugia by cooling the sand or climbing onto them. We monitored these species in the Telperion Nature Reserve to find their average dung ball size and whether there were any effects of temperature changes on their behaviour. We looked at how many times they climbed their dung balls and whether there was a correlation between dung ball size and temperature. We did not find any significant correlations among these variables. We also found that the dung balls were big enough to cool the sand under the dung beetles' front legs. Further research will be done to see whether the dung balls have a cooling effect on the sand.

### 36 Fusing community engagement, tangible outputs and impactful research: The case of sustainable tourism in the Marico Biosphere Reserve

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The Marico Biosphere Reserve was designated as a biosphere reserve in 2018 by the UNESCO Man and Biosphere Programme due to its unique freshwater system in the broader Dolomitic Aquifer System of North West, South Africa. Its water quality is vital for South Africa and bordering countries. Biosphere reserves promote conservation, sustainable development and logistical support. This presentation focuses on our innovative approach to fuse community engagement and production of tangible outputs with impactful research. In 2019, the reserve management authorities identified the need for input on sustainable tourism to address SDG 12. Working with stakeholders, we crafted a layered, ongoing approach. Via different methodologies, we use engagements in the reserve to gather data that feeds into research (several papers in progress); produce practical, tangible outputs that assist the reserve in developing sustainable tourism (e.g., sense of place toolkit and interpretation app); and meet community needs in terms of education (e.g., sustainable tourism workshops). Through the vehicle of sustainable tourism, this project aims to support stakeholders and the wider community to conserve this valuable biosphere reserve.

### 37 Whole mitochondrial genome sequencing of the black-footed cat (*Felis nigripes*): A primer-walking approach

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The black-footed cat (BFC) is a rare felid species found in southern Africa, with fewer than 10 000 adult individuals remaining in the wild. Despite its Vulnerable listing on the IUCN Red List, genetic data is limited. Currently, a single whole mitochondrial genome is publicly available. Based on available ND5 gene sequences, there are two evolutionary BFC lineages in South Africa. In this study, we generated a whole mitochondrial genome sequence for the second, unrepresented lineage using a primer-walking approach with primers designed to avoid amplification of nuclear-mitochondrial (numt) paralogs. This was achieved by using cytochrome b as the starting point and sequencing both the numt copy and the mitochondrial copy. The generated data and reference sequences permitted the design of mitochondrial-specific primers and enabled a guided walk around the mitochondrial genome. In addition to establishing a suite of reliable mitochondrial-specific assays that exclude numt amplification, this allowed the assessment of the comparative variability and phylogenetic utility of different gene regions for a subset of BFCs from captive and natural populations in South Africa.

### 38 Utilising the potential of plant biostimulants in improving lateral roots and root architecture

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Crop productivity and abiotic stress tolerance of crop plants depend on a well-developed root system. A better understanding of root architecture, anatomy and physiology may aid in sustained productivity in agriculture and horticulture. An increase in the vascular system and enhanced lateral root production may lead to an improved water status of the crop plants under drought conditions, since the potential for additional water uptake and utilisation might be possible. Root system architecture can influence the capacity of roots towards more efficient uptake of nutrients and better nutrient availability. Environment-friendly biostimulants have been proven to promote lateral root growth and improve root architecture in a sustainable manner. Though biostimulant products have no defined mode of action, they indirectly influence root development, including lateral roots, as they may contain plant growth-promoting substances, such as auxins, cytokinins and gibberellins. The review emphasises the utilisation of environmentally friendly biostimulants in promoting the lateral root system and its architecture, its role in nutrient foraging, and crosstalk with other phytohormones.

## 39 Naming South Africa's herptiles: From general names to a comprehensive list of indigenous names for all frog and reptile species

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Folk taxonomy, the naming and classification of wildlife according to cultural perspectives, uses indigenous names that can facilitate communication with non-expert collaborators in a familiar language. These indigenous names used for wildlife are not well documented, thus they are inaccessible for wider use and are not specific to all known species. With the aim of having a folk-formal taxonomy that is relevant to both expert and non-expert conservation stakeholders, we conducted the first comprehensive analysis of South African indigenous cultures' naming and classification of herptile species (frogs and reptiles). Etic and emic approaches were used to analyse inherent guidelines of folk taxonomy and its comparability with scientific taxonomy respectively. Taxonomic correspondence analysis was used to analyse correspondence between scientific species and folk generic taxa. Understanding the principles underlying folk taxonomy and their correspondence to scientific taxonomy enabled the extension of folk generic taxa into a comprehensive list of indigenous names for each of South Africa's 132 frog species and 422 reptile species in the country's nine officialised indigenous languages.

## 40 Cheap protein: Can the edible house cricket be a safe and reliable nutrient source?

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Our population has reached eight billion people and may reach over nine billion. This will greatly increase demand on our natural resources, especially if we want to help the 10% who do not get enough nutrition. Therefore, we need to continue to develop methods that work towards the United Nations' Sustainable Development Goals. Edible insects have received a lot of attention for their high feed conversion efficiency, needing very little water and space and producing almost no greenhouse gases. The house cricket is of particular interest because of its high protein and nutrient content. Unfortunately, there are not enough guidelines to ensure the food safety of edible insects. More research is needed to determine the food-borne risks of edible insects and what role the insects' diet will have. Vegetable waste, lucerne, chicken feed or a combination of these were provided to the crickets to compare potential risks along with benefits, such as growth rate and nutrient quality. It was found that multiple factors affect mass rearing, and results may change over longer periods. This is important to consider if we want to produce consistent, nutrient-dense and safe edible insect food and feed.

## 41 Twenty-two years of green turtle monitoring at one important ecotourism destination in East Africa: Mnemba Island

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Sea turtles are species that play a key ecological role in marine ecosystems, serve as a keystone species for conservation and ecotourism, and have high social and economic value for coastal communities. Nesting attempts and hatched nests were recorded for a 22-year period (2001 to 2022) on Mnemba Island, Zanzibar. The observations were recorded by &Beyond Mnemba Island Lodge staff who were trained by sea turtle experts, before the monitoring activities started, to record daily observations following the standard protocols. We used the generalised linear regression model (GML) in R (a language and environment for statistical computing) to test whether there were differences in annual, seasonal and monthly nesting activity, as well as in the associated incubation periods of the hatchlings. Our results demonstrated that there are statistically significant differences ( $p = 0,001$ ) in nesting attempts between years, while differences in incubation periods of hatchlings were found not to be statistically significant ( $p = 0,05$ ). Our findings suggest that additional research is necessary to explain the variations, such as changing environmental and climatic variables, that could influence these differences.

## 42 Mapping and quantifying the invasive species *Prosopis* in the rangelands of the south-western Kalahari with multi-scale remote sensing techniques

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Exotic invasive plant species are an increasing threat to rangelands and contribute to complex land degradation problems in Africa. We carried out research to detect, map and quantify the important invasive alien plant species *Prosopis* (mesquite) in the Kalahari savanna ecosystems in south-western Botswana, combining drone-acquired, narrow-band, multi-spectral image data with multi-scale and multi-temporal satellite data. We found that drone-based techniques have excellent utility for monitoring the presence of *Prosopis* and quantifying the structure and extent of the invasive plants and native vegetation. We demonstrate that integration of the results from drone-acquired image data with optical satellite data and machine learning could upscale mapping efforts for application across the wider landscape. Combined with the results of a community questionnaire on perceptions of *Prosopis*, we discuss the rapid increase in the rate of spread of *Prosopis* in the landscape in the last 25 years and evaluate the management options for the community to control the spread and minimise the impact of *Prosopis* on livelihoods and the Kalahari ecosystem.



## 43 Honey adulteration in South Africa: How stable isotope analysis can aid in resolving key issues

**Grant Hall**

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Honey is the third most adulterated food globally. This issue has recently been highlighted in South Africa, causing public concern and negatively affecting the local honey industry. South African regulations contain 11 chemometric tests and labelling requirements to ensure honey authenticity and quality. A number of adulteration detection methods are carried out locally on a limited scale but are not well understood by regulatory bodies and the industry. Stable isotope analysis (SIA) is a relatively quick and internationally accepted technique used to determine potential adulteration of honey. To date, SIA using local facilities, such as the UP laboratory, has been minimal, but could become a regular means of honey testing. I present preliminary results of stable carbon isotope analyses of local and imported honey and sugar samples and compare these with published data from the northern hemisphere. Using this data and a review of current literature on honey adulteration, I propose suggestions for future research and applications to aid the South African honey industry. This includes a need for collaboration and communication between specialists and producers.

## 44 Dynamics of flower resources across habitats and seasons in human-dominated agroecosystems: The case of the Zvimba district in Zimbabwe

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This study attempts to estimate the amounts of flower resources across habitats (homesteads, pastures, croplands, gardens and natural woodlots) and seasons (hot-wet, cold-dry and hot-dry) in order to explore spatio-temporal dynamics in availability of food for many pollinator species in an agro-ecosystem of Zimbabwe. Vegetation surveys were conducted across the habitat types and seasons to quantify potential floral resources from flowering plants. This was complemented by a desktop survey to establish flowering periods of each plant species. The number of plant species potentially flowering and the crown volume in flowers/fluorescents across habitats and seasons were analysed. Greater floral resources were generally found during the hot-wet season, but in homesteads it was in the hot-dry periods. The cold-dry season had the least number of flowering plants as well as flower resources. Pastures also had the least number of flowering plants, and few trees were recorded on them. It is therefore recommended that floral resources that bloom during the cold-dry season be boosted and pastures be prioritised in pollinator conservation activities.

## 45 Death in the long grass

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Vertebrate carcasses are ephemeral, nutrient-rich resource nodes which likely influence local ecosystematics substantially. We employed a before, after, control, impact design to test the extent of this impact. We used blue wildebeest carcasses in Telperion Nature Reserve as the model species for this experiment. We applied three treatments – caged carcasses, open carcasses and controls – and monitored impacts on soil properties and microbes, invertebrates, mammals and birds. We found that carcass decomposition significantly impacted soil properties and nutrient values. Soil microbe functional diversity significantly increased and bacterial activity reduced at carcasses. Vegetation under caged carcasses increased in vigour, species richness, diversity and veld condition relative to open carcasses and controls. We found increased coleopteran activity and diversity at carcass decomposition sites. Small terrestrial mammal and predator activity increased at carcass sites, and bats foraged over carcass sites. There was no influence on the avian assemblage. The presence of decomposing carcasses influences local ecosystems and has important implications for biodiversity management.

## 46 Building a climate culture with art-science interventions

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I have developed an art-science praxis with various Nature Based Solutions (NBS). Growing up under apartheid, which built an inequitable society, even infrastructurally, my life's mission has been to learn how to unlearn and undo the wrongs of the past. Through my collaborative eco-art praxis, I find ways to build a climate culture through regenerative art interventions to help build resilience against the uncertain future and an unjust past. Public interventions and experiments: 1. Urinals designed so that plants process the urea on the spot. In partnership with inner city property owners, phytoremediation scientists from WITS APES, and UJ PEETS academics; 2. Climate culture project at the southernmost tip of Africa where plants cannot migrate further south, with local Eco-Rangers. Metis AFD funded with SANParks and Wendy Foden; 3. PSHB replant tree list art-science project with Trudy Paap (FABI). A project which germinated with A Still-Life -Johannesburg during the 2022 Social Impact Art Prize research period; 4. Kwa MaiMai – rare medicinal plant conservation with Nolwazi Mbongwa and other WildWall Tile installations.

## 47 Pangolin-friendly farm fences

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Pangolin.Africa, the Kalahari Wildlife Project and the Tikki Hywood Foundation have been working in partnership since 2019 to identify ways in which to reduce animal mortalities on electrified fences significantly. Electrified fences are potentially the biggest threat to Temminck's pangolin (*Smutsia temminckii*) populations in southern Africa, but we believe this threat can be effectively addressed and the associated

pangolin mortalities substantially reduced through the solutions outlined in this project proposal. Our goal is, firstly, to develop mitigation methods that are effective in curbing the accidental electrocution of pangolins and other vertebrates on electrified fences, and once these have been developed, to change government legislation to enforce pangolin- friendly measures as a standard feature in all new electrified fencing installations. For the next phase of the project, we have brought in a new partner – WESSA (The Wildlife and Environment Society of South Africa).

## 48 Ruminants plant grass and fix the soil

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Nature has already done all the experiments, over many centuries, as to what works and does not work, and yet we insist that we know better. What needs to be done on each property is to change management on a small piece of ground, which I call an inclusion zone, to observe the results nature will give us. Increase livestock density: all life needs energy to live, including soil life, and ruminants provide this through the action of grazing (documented), giving kinetic energy and symbiotic energy (last two not documented) and increasing the amount of carbon in the ground. This also protects the soil, improves the water cycle, mineral cycle and energy flow and changes community dynamics. This study measures the recovery periods of the plants that germinate. Plants should be grazed in a vegetative stage, while the energy is available to grazing animals. Energy is the elusive part of the equation in getting animals to perform. Conduct planned grazing to get the animals to the right place at the right time, in order to harvest the energy by taking one bite off the top of most plants. This builds standing forage called stockpile, which will be grazed in the non-growing season and obviate the need for feeding bales.

## 49 Supplementary description of *Wetapolystoma almae* (Monogenea: Polystomatidae)

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Polystomes infect primarily amphibians, but also freshwater turtles, the Australian lungfish and the hippopotamus. Of the 30 extant genera in the family, *Polystoma* is the most specious. *Wetapolystoma almae* Gray, 1993 was discovered by a student while dissecting archived specimens of *Rhinella margaritifera* (Laurenti, 1768) (Amphibia: Bufonidae) in Peru. *Wetapolystoma almae* was described from a single badly fixed specimen and lacked comprehensive morphological details and molecular evidence. Molecular analysis, conducted on fresh material from *R. margaritifera* in French Guiana, revealed that *W. almae* is nested within *Polystoma*. These specimens were used for a supplementary description. Morphometric measurements were obtained, histological examinations performed and phylogenetic analysis conducted. This species has an exceptionally large uterus, holding up to 135 white-grey, soft-membraned eggs, in contrast to *Polystoma* with a small uterus holding a few yellow-tan eggs. Our findings confirmed the phylogenetic position of *W. almae*, and the morphological evidence supports it as a valid and unique genus. Furthermore, a neotype is assigned for *W. almae* since the holotype is missing.

## 50 Does varroa infestation affect Cape honey bee drone sperm quality and reproduction?

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Varroa destructor has been the major cause of a global decline in honey bee populations. The varroa mite has a specific affinity for drones during development and has been shown to impact drone weight and survival negatively. However, little is known about the sublethal effects of varroa mite infestations on drone reproductive development and sperm quality. As drones play an important role in the reproductive success of a colony, as well as queen and colony health, this study aimed to assess the impact of different varroa mite infestation levels on the sperm quality of Cape honey bee (*Apis mellifera capensis*) drones. Sperm functionality parameters were assessed using a computer-aided sperm analysis system. Higher varroa infestation levels resulted in decreased sperm motility and kinematic parameters. Varroa infestation appears to have a negative effect on honey bee drone sperm functionality. In addition, drone reproductive success may also be negatively impacted.

## 51 Response of mammalian communities to environmental and landscape variables in northern KwaZulu-Natal game parks, South Africa

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Reinvestigation of mammal assemblages at the landscape level is crucial to understanding how natural ecosystems function or self-regulate over time. We assessed changes in mammalian species richness across Protected Areas (PAs) in northern KwaZulu-Natal in the Maputaland Conservation Unit, South Africa. Using a multi-species occupancy model, we identified abiotic and biotic drivers of mammalian species in PA and contrasted them across two independent survey cycles. We collected data using camera traps during 2013-2014 and 2022-2023, comprising 348 camera trap sites covering four PAs (iSimangaliso Wetland Park: Eastern Shores, Western Shores, False Bay and Tembe Elephant Park) that vary in size, habitat diversity and disturbance levels. We applied the Royle–Nichols multi-session multi-species hierarchical model to estimate the species richness and occupancy dynamics of several mammalian species for different PAs while accounting for imperfect detection. Species richness increased with protected area size across both camera trap cycles. Our reinvestigation facilitated the comparison and identification of potential drivers affecting mammalian communities across PAs.

## 52 Oxytocin administration provides a potential solution for conservation management strategies in felids

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Living in a group setting is essential for the health and well-being of social carnivores; however, the managed formation of captive groups of territorial animals can be challenging because of the risk of aggression, injury and even death. Numerous laboratory and clinical studies have implicated oxytocin in the formation of social bonds. Previously, we showed that oxytocin administration reduced social vigilance in African lions. Here, we describe a series of case reports in which oxytocin administration was used to facilitate social bonding in both familiar and unfamiliar conspecific pairs and groups of African lions and tigers, and we provide qualitative descriptions of the study animals' behaviour before and after treatment. We hypothesised that the repeated intranasal administration of oxytocin over a period of one to three weeks would facilitate 1) the bonding process during introductions of unfamiliar individuals, and 2) reconciliation between paired individuals that had developed ongoing negative social relationships. Following oxytocin treatment, positive social interactions were observed for the first time or restored in all seven study groups.

## 53 Food for thought: Insights on how dung beetle gut bacteria differ between five distinct feeding strategies

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The insect gut microbiome is important for their successful functioning, allowing insects to exploit previously unexploitable resources and avoid intoxication from crop plants. However, research into the factors affecting the composition and function of insect gut microbes is sparse; this is especially true for Africa, where studies rarely focus on these important symbiotic relationships. Diet is commonly cited as one of the main factors that determine gut microbial diversity within insects. African dung beetles possess a wide array of diets, ranging from coprophagy to carnivory. To investigate the effect diet has on insect gut microbes, we analysed the gut bacterial diversity of seven dung beetle species feeding on five different diets. Our results indicate that diet plays an important role in determining the dung beetle gut microbial composition, with all diets forming distinct bacterial clusters. The millipede-feeding dung beetle possesses the most specific gut microbiome. This effect could result from the millipede's defensive secretion (hydrogen cyanide) creating an extreme environment, where only certain bacterial species can survive and detoxify the toxic chemicals.

## 54 Reproductive ecology of Africa's only known suburban African woolly-necked stork population

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Across the globe, an increasing number of wildlife species have been found to exploit urban environments, with varying degrees of success. The African woolly-necked stork (*Ciconia microscelis*) has expanded in KwaZulu-Natal, South Africa, over the past 30 years, and has particularly colonised developed areas. Woolly-necked storks are now a common resident in suburban residential areas and are routinely fed by homeowners, which is an unprecedented behaviour for the species in Africa. It remains unclear how, demographically, a large, long-lived stork could have expanded so rapidly in a novel environment, and what ecological trade-offs it may face. Therefore, we initiated a study of population dynamics in developed areas. During the 2022-2023 breeding season, we observed 43 nesting attempts from 37 nests in an urban landscape mosaic in KwaZulu-Natal. Of these nesting attempts, 79% successfully hatched chicks and 58% successfully fledged at least one chick. The mean age at fledging of 71 days was longer than previously reported. This is the first study in Africa on the reproductive ecology of the woolly-necked stork to understand how urbanisation influences breeding parameters.

## 55 Assessing the local community's knowledge, attitudes and perceptions towards vultures: A case study of communities neighbouring Shangani Holistic, Zimbabwe

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Communities' knowledge, attitudes and perceptions towards species ultimately determine conservation success. Vulture populations are in decline, and there is a need to involve communities in conservation action. Our study focused on assessing the knowledge, attitudes and perceptions of communities toward vultures, evaluating the importance of vultures to communities, and formulating ideas to encourage communities to conserve vultures around Shangani Holistic. Semi-structured questionnaires were administered through interviews to randomly selected households (n = 88). We classified these according to distance from the ranch boundary. Distance had an influence on the appreciation of vultures as important, with those nearer the ranch seeing the positive value of the species, and those further away mostly being neutral. The majority of respondents had no opinion on what could be done to mitigate vulture declines, as they were not aware of the problems faced. There is a willingness to be involved in a vulture-safe zone around the ranch to save African vultures. Community-driven vulture conservation awareness campaigns are critical, and should be supported by enhanced restrictions of access to hazardous chemicals.

## 56 Implications of light at night on the activity rhythms of the vlei rat (*Otomys auratus*)

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Anthropogenic activities and resultant environmental changes are increasing as the human population continues to grow. The most prominent disturbance is artificial light at night (ALAN); it is increasing rapidly and radically changes the nightscape of wildlife. Vlei rats (*Otomys* spp.) are widespread throughout Africa and across a variety of habitats and elevations. They are relatively understudied, and the vlei rat (*O. auratus*) is currently under threat from habitat loss. We investigated their general circadian biology and response to light at night in the laboratory. Vlei rats showed a strong preference for nocturnal activity, but with some intraspecific variation. Wheel-running activity of all vlei rats is strongly masked by light. Low-intensity ALAN (0,5 lux) has little effect on the activity of vlei rats; however, at an intensity of 2 lux, reduced activity was observed. This highlights the potential impact of ALAN and can inform strategies to mitigate it. Further, we suggest that simply isolating a habitat for conservation is insufficient, and more aggressive strategies are required to reduce other disturbances that result from nearby human habitation.

## 57 Soil erosion by water assessments in South Africa – revisited

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Land degradation by soil erosion has been an issue in South Africa for over a century. In the middle of the last century, measures to combat soil erosion by water were 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<sup>-1</sup> yr<sup>-1</sup>, a value exceeding what is often considered the natural soil formation rate (SFR) of 5 t ha<sup>-1</sup> yr<sup>-1</sup>. But recent studies on cosmogenic nuclides indicate that long-term, steady-state denudation and soil formation rates are only ~ 0,1 t ha<sup>-1</sup> yr<sup>-1</sup>. At the same time, a reassessment of soil erosion by water using the RUSLE with new, Earth observation-based, high resolution input data indicates considerably lower rates of soil erosion. Based on the analysis of six 100 km x 100 km study sites across South Africa, the previously estimated mean rate was 10 t ha<sup>-1</sup> yr<sup>-1</sup>, and the updated rate is 2 t ha<sup>-1</sup> yr<sup>-1</sup>. For some sites, the difference reaches an order of magnitude. The presentation looks in detail at the causes of the deviations.

## 58 Sterkfontein and Swartkrans: Discoveries and debates in South Africa's Cradle of Humankind

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The World Heritage Sites of Sterkfontein and Swartkrans in Gauteng together document the early stages of both human and cultural evolution from ca 3,7 to 1 million years ago. From 1936 and 1948 respectively, Sterkfontein and Swartkrans have collectively yielded well over 1 000 hominid fossils of *Australopithecus*, *Paranthropus* and early *Homo*, while very early stone tools of the Oldowan and early Acheulean have been excavated in deposits dating to 2,2 Ma, 1,5 Ma and 1 Ma. Swartkrans, also at 1 Ma, records the early use of fire and the last appearance date of *Paranthropus* in Africa. However, the chronologies of both sites have been much debated, with controversy particularly over the early dates for Sterkfontein. Since 2014, we have been achieving much better resolution for this long sequence of discoveries. We review the history and reasons behind these dating debates and demonstrate why certain key deposits in both sites are significantly older than previously considered. This work now places South Africa's early heritage more accurately in time, providing a better understanding of its significance in human and cultural evolution and the associated palaeoenvironments.

## 59 Differences in gene expression between sardine run participants and non-running sardines

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The KwaZulu-Natal sardine run is the north-eastward movement of millions of South African sardines from their temperate eastern core range towards the subtropical Indian Ocean. Only a portion of the sardine population participates in this mass migration, and it has thus been suggested that the sardine run is a migration of a genetically distinct group of individuals. Recent research provides support for the possibility of two separate stocks in the South African sardine population, and the role that genetic factors may play in the formation of the sardine run has been brought to light. Investigating genetic diversity and functional content of the liver transcriptome is informative in better understanding the underlying dynamics and physiological adaptations that are necessary for such an event. In this study, we compared differences in gene expression profiles between sardine run participants and non-running sardines using massive parallel sequencing. We also identified several genes related to energy metabolism, regulatory processes and immune function that were differentially expressed between the two groups.



## 60 Geographical variation in the body size of small mammals in South Africa

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The body size of an individual is key in its survival. Bergmann's rule proposes that an animal's body size increases with latitude, accounting for larger animals in the polar regions. This is due to the surface area to volume ratio of the organism; a larger animal has a smaller ratio, which leads to a slower rate of heat loss. Bergmann's rule has been studied for centuries across the world and in various species, but only 30% of warm-blooded animals comply with the rule. Alternative hypotheses have been proposed to explain the variations that are observed in body size, such as the effects of geographical variations, including temperature, precipitation, vegetation, etc.). However, these have not been tested extensively in African species. In this project, we use skull dimensions of 200 *Elephantulus myurus* specimens from the Ditsong Museum collection, overlaid with geographical data, to determine how the skull shape and size vary. It will also examine how the skulls' shapes and sizes change with sex and age.

## 61 Long toes but hopefully not such a long shot

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The endangered long-toed tree frog is a species that was only recently discovered, in 1963, with little research having been conducted on it since. In response to the IUCN recommendation, a study commenced in 2019 to establish a broader knowledge of this species, including a more informed opinion of its distribution and population. This resulted in 21 new localities being discovered for the species during the course of the project. The habitat preference for the species was established to be temperate alluvial hummock wetlands in U-shaped valleys at mid-altitudes in south-western KwaZulu-Natal. A model was developed, including the information from the new localities, for use in spatial planning. All the known localities were then analysed in relation to the predictions of two downscaled climate change models and a vulnerability framework, and climate change was found to be a potentially significant threat to the species according to one of these models. However, the new localities resulted in an increase of 9% in the extent of occurrence and 429% in the area of occupancy, indicating that the species might be eligible to be downgraded at the next red-listing.

## 62 Mitogenomic characterisation of South African leopards (*Panthera pardus*) and the effect of past climatic events

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Revealing phylogeographic structure is important for understanding a species's evolutionary history. In leopards (*Panthera pardus*), there are currently nine subspecies recognised. On the African continent, historical mitochondrial DNA suggests the presence of three putative lineages: (1) West Africa (WA), (2) Central Africa (CA) and (3) Southern Africa (SA). The Mpumalanga province of South Africa is of particular interest, as here the CA and the SA clades possibly meet. The aim of this study was to clarify how South African leopards fit into continental patterns of genetic differentiation. Complete mitogenomes from six Mpumalanga leopards were assembled de novo and included in phylogenetic analysis. We identified two deeply diverged putative lineages within South Africa which are more genetically distinct than two subspecies in Asia. The lineages were dated back to 0,73-0,87 million years ago, indicating that they originated during the climatically unstable Pleistocene. The Pleistocene refuge theory states that the maintenance of savanna refugia in South Africa promoted the divergence between current populations. More genomic research is needed to confirm this phylogenetic hypothesis.

## 63 Invasion processes of fleshy-fruited invasive alien plants and their impact on vegetation structure and biodiversity in grasslands, with examples from South Africa

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Biological invasions threaten biodiversity and require substantial conservation and management efforts. Our study focused on the encroachment of the woody, fleshy-fruited, invasive alien plants yellow fire-thorn, eglantine and silver-leaved cotoneaster in grasslands, where they change vegetation structure, modify the microclimate and threaten native plants, animals and ecosystem services. Their spread and impact on grassland ecosystems remain understudied. We collected seeds from faeces of mammalian species to assess germination rates and success, and compared recent invasion photographs with old photographs. Repeat photography showed that these invasive plants compete with native species in grasslands. Chacma baboons and eland were the main mammalian seed dispersal agents. Our study contributes knowledge for better management of these invasive plants, as they are candidates for biological control. They are also relatively widespread and damaging invasive plants in South Africa and many other countries, so understanding how they spread is important. This study contributes to understanding the weakest phase of the life cycle of these invasive plants in grasslands, and makes management recommendations.

## 64 Concurrent effects of elevated carbon dioxide levels and temperature on the polyphenolic compounds profile and the antioxidant and antimicrobial activities of *Carpobrotus edulis* (L.)

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Elevated atmospheric carbon dioxide levels and temperature influence the physiological and biochemical activities of plants, thus influencing the pharmaceutical properties of medicinal plants. This study investigated the possible modifications in the polyphenolic profiling and the antioxidant and antimicrobial activities of *Carpobrotus edulis* leaves under concurrently elevated CO<sub>2</sub> levels and temperatures. *C. edulis* plants were exposed to combined 600 and 800 ppm: 35/30°C and 45/35°C (day/night) respectively, for a duration of 192 hours. Control samples were kept at 400 ppm and 28/25°C (day/night). Preliminary phytochemical screening indicated the presence of tannins, phenolics, flavonoids, steroids, terpenoids, glycosides and saponins; however, flavonoids were not detected under 800 ppm and 35/30°C (day/night). LC-MS/MS showed the presence of 24 polyphenolics, and only 10 (58,83%) were detected exclusively under treatment conditions. Antioxidant activity of the leaves decreased with increasing CO<sub>2</sub> levels and temperatures. Antimicrobial activity against *Staphylococcus aureus* and *Escherichia coli* remained constant under all treatment conditions. Results suggest that *C. edulis* is a strong antioxidant and antimicrobial agent.

## 65 Annual fire patterns around KwaZulu-Natal Afromontane forests from 2001 to 2020

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This study looked at the impact of fire on KwaZulu-Natal Afromontane forests in South Africa. Fire extent, fire severity, fire frequency and forest extent were examined using Landsat 5, 7 and 8 images, Google Earth Engine and ArcMap 10.3. Difference in Normalised Burn Ratio (dNBR) was used to determine the fire severity from 2001 to 2020. Our results showed that fire patterns could be grouped into two periods: pre-2015 and post-2015. Post-2015 had a higher fire extent, severity and frequency than pre-2015. A possible explanation for this could be the 2015/2016 drought that would have provided the conditions for increased fires. The main issue with the results was an overestimation of the low severity class post-2015, and this is possibly due to issues with the Landsat images or misclassification with dNBR. Fires were burning the surrounding matrix of forests and did not enter the forest canopy. Forest extent increased from 2001 to 2020; however, the data was unclear on the quality of the expanding vegetation. These results can be used to understand the impact fire has on areas surrounding forests and provide information that can be used for the necessary policies and management plans and practices.

## 66 A new insight into southern right whale reproduction via baleen endocrine and stable isotope analysis

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Although aspects of female southern right whale (*Eubalaena australis*; SRW) reproductive behaviour have been studied at calving grounds through observation, information regarding reproductive physiology is limited. In this study, endocrine and stable isotope profiles from baleen plates of four adult females stranded on the South African coast were used to describe patterns of female reproductive physiology in this species for the first time. Baleen progesterone profiles showed elevations above baseline, interpreted as individual pregnancies. Peaks in baleen oestrogen concentrations were used to estimate time of parturition. Some progesterone profiles showed shorter intervals between peaks, suggestive of a failed reproductive cycle. In this study, successful gestation was estimated to last  $\pm 15$ -18 months. Finally, from superimposing endocrine profiles with stable isotope profiles, we suspect that conception may not take place in coastal waters, which has broader implications for connectivity between SRW populations. This data provides novel information on SRW reproduction, critical in light of increased reproductive failure currently observed among the South African population.

## 67 What forms of militarised conservation are morally acceptable? Perspectives from sub-Saharan Africa, the US and the UK

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Protected areas are on top of the global conservation agenda. Using military-style tactics and equipment to protect wildlife in and around protected areas, also known as militarised conservation, is controversial. Understanding how different groups of people, particularly those who live near protected areas, perceive militarised conservation could help identify socially acceptable or unacceptable approaches to wildlife conservation. However, little research has been conducted on this topic. In this study, we investigate some aspects of militarised conservation commonly practised in SSA, such as rangers carrying and firing guns, monitoring people's movements, and searching and arresting people. We compare rural and urban perspectives from SSA, the UK and the US to understand better which forms of militarised conservation are socially acceptable, and to whom. Evidence of how different groups think about militarised conservation could inform decisions on wildlife conservation and protected area management in SSA.

## 68 Morally contested conservation: Evidence to inform policy

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Conservation in Sub-Saharan Africa (SSA) is morally contested. Who should decide what is best for wildlife in SSA and the people who live alongside it? What conservation approaches are acceptable or unacceptable, and to whom? How decision-makers answer these questions will impact wildlife and people in SSA. Hence it is crucial to study what people think about contested issues in wildlife conservation in SSA to ensure informed decisions. The Morally Contested Conservation project combines on-the-ground fieldwork and online methods to investigate public perspectives on contested issues such as: hunting; militarised conservation; punishments for wildlife crimes, and wildlife ownership. We measure perspectives of people living in five rural locations in SSA, urban areas of SSA, the UK, and the USA. Comparing local and external perspectives allows us to identify conservation approaches that are especially acceptable or unacceptable, including areas of agreement and disagreement. We communicate findings directly to people whose decisions influence wildlife conservation, protected area management, and rural development in SSA.

## 69 Lichens: The hidden diversity at Grootbos and Tswalu Kalahari Reserves

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Grootbos and Tswalu Kalahari Reserves, realising that lichens are an important yet unknown component of the biodiversity of their reserves, invited us to provide a preliminary assessment of their lichen biotas. At both reserves, we recorded morphospecies in randomly placed quadrats on both trees and rocks, allowing us to quantitatively assess the diversity of the lichen biotas. At Grootbos, we found a rich and varied lichen biota in the Afromontane and milkwood forests and a less diverse biota on the sandstone rocks, whereas at Tswalu, the trees had relatively few species but the rocks, especially the dolerite/sandstone, supported a diverse biota, completely different from that at Grootbos. Although the lichen biota of southern Africa is very poorly understood, and collecting specimens was not a primary objective of this project, we were able to identify at least three species that are almost certainly new to science and

one further species that is, at the very least, new to Africa. Our work shows that southern Africa has a rich but poorly understood lichen biota, and much more research is required, preferably by local scientists, to document it fully.

## 70 Control of indigenous woody species encroachment at selected sites in Tswalu Kalahari Reserve, Northern Cape, South Africa

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Bush encroachment is a phenomenon caused by indigenous woody species such as *Senegalia mellifera* and *Rhigozum trichotum*, especially in Kalahari savanna landscapes. Therefore, this study aims to investigate how these two species can be controlled to improve the production potential in a semi-arid Kalahari rangeland. Research plots will be established in the Tswalu Kalahari Reserve. The effect of de-bushing on the grass sward and the implementation of rehabilitation technologies will be evaluated. Measurements for woody and herbaceous species will include (1) thinning of woody species at different intensities using various methods, (2) determining re-growth (coppicing) ability of treated individuals at different height classes, (3) above-ground biomass sampling, (4) determining frequency and density of herbaceous species, (5) determining responses of annual and perennial grasses to bush treatments in the dry and wet season, (6) determining carrying capacities before and after bush control, and (7) evaluation of rehabilitation technologies. Technical assessment of de-bushing technologies and best practices regarding affordability, maintenance and biomass production will be evaluated.

## 71 The ecology, dynamics and persistence of grazing lawns in Telperion Nature Reserve

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Grazing lawns play a vital role in supporting various herbivore species, particularly in fenced-off reserves where no migrations take place. These areas are characterised by short-statured grasses that spread and persist through grazing. Grazing lawns serve as resource-rich niches, reducing the need for interspecific competition. This research investigates the ecological aspects of grazing lawns in three distinct plant communities within a mesic highveld-grassland ecosystem in Telperion Nature Reserve, Mpumalanga. Additionally, the project aims to identify which herbivores frequent these plant communities during different seasons. Using veld condition assessments, we will monitor changes in herbaceous species composition, ground cover and aboveground biomass in response to rainfall, considering the impact of herbivory, trampling and nutrient cycling. We envisage that our findings will provide valuable insights into the rehabilitation of grazing lawns if their size or abundance negatively affect grassland ecosystems. Furthermore, the results could guide the establishment or maintenance of grazing lawns in similar plant communities and assist with effective management strategies.

## 72 How informative is the response of carabid beetles' assemblages to agroecosystem management practices?

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The sustainability of agroecosystems is at risk, owing to continuous anthropogenic disturbance. As a result, there is a need to evaluate indicator taxa that may be used to monitor the health of agricultural management. Carabid beetles are ubiquitous and critically important in agroecosystems. Their rapid response to anthropogenic disturbances has been proposed as a practical and realistic tool for monitoring the sustainability of agricultural management practices. We assess the ecological response of carabid beetles' biodiversity to contrasting agricultural management practices. The beetles were sampled over a two-year period, from 2020 to 2021, in the Free State province using pitfall traps. During this study, 14 carabid morphospecies and 3 034 individuals were recorded. The abundance and richness of carabids were significantly greater under conservation grazing and semi-conservation management than under semi-natural grassland and conventional tillage. Of the 14 carabid morphospecies, seven were considered indicators of conservation grazing practices. The study highlights the potential of carabid beetles as indicators for sustainable management assessments.

## 73 The honey bees of Reunion and how the landscape and climate shape them

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Local is lekker. Honey bee populations show local adaptations which have a positive fitness effect. Whether endemic or introduced by humans, the 30 different subspecies of honey bees occur on most continents. This diversity makes it important to understand local honey bee species. Morphology is often used to differentiate between subspecies. Yet, could factors such as habitat structure affect the morphology of honey bees and thereby allow them to adapt to the local conditions? Reunion Island is well known for its vast variety of landscapes and climates. We collected bees from randomly selected sites throughout the island, each presenting different climates, vegetation and elevations. We measured morphological features and tested for differences across sites. Our results show that bees collected from the same site are more morphologically similar than those from different sites, indicating the possibility of local adaptations. Altitude was also highlighted, as morphological features differed from low to high altitude. Our results add to the growing evidence that local adaptations are relevant to the fitness of our bees, and that using the local bees is beneficial for all parties.

## 74 The lesser of two evils: The role of an instream barrier to control the distribution and invasive potential of non-native fish species in the Mooi River, South Africa

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Recreational angling has a history of species introductions that have caused a great loss of native biodiversity. Despite this, they represent a relatively large economy supporting many people's livelihoods. The Mooi River, South Africa, supports trout fisheries in its upper reach. The Inchbrakie weir was constructed to mitigate the loss of a natural barrier, now inundated by a large impoundment. We evaluated the weir's efficacy in restricting non-native fish's movement using fish surveys. We then used species distribution modelling to assess the potential for bass to invade the upper reaches should they make their way past the barrier. Our surveys detected three bass species. *Micropterus dolomieu* was the main concern but was not found upstream of the fish barrier. Distribution modelling showed that suitable habitat was available for all three detected bass species. Implications concern the local trout fishery and native fauna persistence in the upper Mooi River. We suggest that a structured long-term monitoring plan be set to detect the early invasion of *M. dolomieu* and that a pre-emptive management plan is in place.

## 75 Exploring SSLiME biodiversity along South Africa's coast

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Microbialites are organosedimentary aquatic formations that became ubiquitous on Earth in the Proterozoic eon (ca 2,5 bya), with a few remnant communities persisting to the present. These commensal formations are built by bacterial and algal communities, and support a plethora of metazoans (e.g., crustaceans, insects and polychaetes). The Supratidal Spring-fed Living Microbialite Ecosystems (SSLiME) of South Africa were first described in the early 2000s; however, much is still unknown about them and the ecosystems they support, thus offering an opportunity for novel research. This project aims to use metabarcoding of environmental DNA (eDNA), extracted from sediment and water, to explore and describe the biodiversity in these SSLiME. This project aims to provide an overview of the community structure across diverse taxonomic levels, including bacteria, phytobenthos and animals; an assessment of fine- and broad-scale community structure in microbialite pools, based on spatial separation; as well as a comparison of microbialite community structure with rocky shore pools and estuaries to provide information on community similarities between these disparate coastal habitats.



## 76 Life and death in an arid savanna: Tree establishment, recruitment and survival in a Kalahari savanna

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In savannas, trees are limited by a number of different factors, most notably fires, herbivores and, especially in more arid savannas, moisture. These limitations create a bottleneck at different life stages of the trees. In arid savannas, establishment is thought to be particularly limited by rainfall, except in above-average wet years, when fairly large cohorts of seedlings establish. We tagged and measured the size of woody seedlings, saplings and trees in an arid Kalahari savanna, and recorded survival and growth of individuals over the period of a year after an exceptionally wet summer. We show that seedling attrition of *Senegalia mellifera* and *Vachellia erioloba* seedlings is fairly high, though large numbers of seedlings of especially *S. mellifera* survive. No evidence of seedling recruitment of *Vachellia haematoxylon* was seen. Sapling density of *S. mellifera* was high, suggesting that recruitment of saplings to adults is a major bottleneck for this species, but also that the species has the potential to become a major encroacher in this system should the factors that keep saplings from recruiting to adults (herbivory and possibly fire) be lost.

## 77 A Biodiversity Investment Ratings Agency for Africa

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Since COP 15 in 2022, there has been increasing recognition of the importance of biodiversity to the global economy. Frameworks such as TNFD and SBTN are being developed to facilitate the need to invest in conserving biodiversity. However, the project details, the metrics and the returns on investment will be complex and risk becoming embroiled in questions around credibility and quality in a similar way to how carbon offsets have been affected. Africa's potential for attracting investment in biodiversity conservation is large, but requires assurances of credibility and quality. We present a framework for assessing quality and assuring investment confidence through the establishment of a Biodiversity Investment Ratings Agency for Africa.

## 78 OPALS impact project: Utilising machine learning to verify carbon in rangelands within the Umzimvubu Catchment, Eastern Cape, South Africa

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Regenerative agriculture has the potential to sequester atmospheric carbon to mitigate climate change and protect the provision of ecosystem services under climate change. Measuring rangeland soil carbon in Africa is crucial for understanding the potential of carbon markets to support improved management.

Therefore, improved modelling and monitoring capacities to track soil carbon changes and greenhouse gas emissions at granular scales for agroecosystems are urgently needed. Conservation South Africa (CSA) is establishing a project in South Africa's Eastern Cape that aims to generate carbon credits to help fund regenerative agricultural practices. This dissertation explores potential approaches to enhance the accuracy of carbon stock assessments as part of an impact-orientated collaboration between OPALS and CSA. The research examines existing machine-learning modelling approaches for rangeland carbon verification, focusing on regenerative grazing practices. Our findings are expected to contribute to a more robust rangeland carbon verification framework and inform the commercial feasibility of soil management practices for carbon sequestration through regenerative agriculture.

## 79 A health assessment of fish from freshwater systems treated with effective microorganisms (EM)

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Pollution of aquatic ecosystems by anthropogenic activities can have adverse health effects on fish. The use and introduction of effective microorganisms (EM) have been proposed as a way to treat polluted river systems. The study aimed to assess selected health aspects of fish inhabiting an impoundment that has been treated with EM for the past nine years (SITE-A) and compare the results with those from fish of the same species (*Clarias gariepinus*) from an untreated impoundment (SITE-B) as well as an aquarium-kept reference group. A histology-based health assessment and selected haematological parameters were used to assess and compare the health of the fish. Compared with SITE-A and the reference group, fish from SITE-B had significantly higher values for haematocrit as well as RBC and WBC counts. The results indicated slight to moderate histological changes in the liver, kidney and gills in fish from both sampling sites and the reference group, and included melano-macrophages, vacuolation, intracellular deposits and epithelial lifting.

## 80 Importance of freshwater systems and eels in KwaZulu-Natal, South Africa: Community perspectives

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The conservation status of global inland fishery resources and rivers is vulnerable, threatening the livelihood of communities dependent on these species. Little is known about the economic contributions of catadromous eels and rivers to livelihoods in KwaZulu-Natal, South Africa, while a decline in the range distribution and decline of freshwater eel species have been documented from 1957 to 2020. In this study, we review literature about how important *Anguillid* eels are and their uses in southern Africa, comparing these findings with published findings from countries in the northern hemisphere. The community perspective data was collected using a questionnaire to interrogate the *Anguillid* eel's importance to inland fisheries. One hundred and fifty-four people were interviewed in urban and rural areas (66% males and 34% females); 74% were subsistence fishers. Of this 74%, 41% targeted eels. Findings showed a lack of studies of eels and a lack of published reports on freshwater systems. However, *Anguillid* eels have a high

value in small-scale fisheries and cultural value. Eels' and rivers' social benefits remained private, with the use of *Anguillid* eels being more private.

## 81 Identification of ticks and tick-borne pathogens using archived samples

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Ticks are arthropods of medical and veterinary importance. They transmit bacteria, viruses and protozoa, with infections reported in both humans and animals leading to morbidities and mortalities worldwide. Globally, they come second following mosquitoes as vectors of human infections. However, information on their diversity and the role ticks that feed on wildlife play in the epidemiology of zoonotic diseases in South Africa is not well documented, partly due to limited available information. It is therefore important to identify tick species and the pathogens they transmit in order to inform policies that talk about the translocation of animals and tick control. This study aimed at identifying archived wildlife tick species from various localities in South Africa using morphological traits and DNA barcoding. Additionally, we detected associated pathogens using a reverse line blot (RLB) assay. To achieve this, metadata was mined from the National Wildlife Disease Database for cases of wildlife from captive facilities brought to the SANBI Zoological Garden for necropsy.

## 82 *Encephalartos villosus*-associated bacterial communities and extracellular enzymes improve soil nutrition in rhizosphere soils in forest ecosystems

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Plant-associated bacteria, soil bacteria and extracellular enzymes play a significant role in nutrient cycling. This study investigated the role of soil bacteria and associated enzyme activities on soil nutrition in forest ecosystem soils in Rhebu and Oceanview, Eastern Cape. Soil samples from *E. villosus* rhizosphere and non-rhizosphere soils were collected for bacterial identification, extracellular enzyme activity analysis, and soil characteristics (nutrient concentrations and pH). The bacteria isolated from the rhizosphere and non-rhizosphere soils were N-cycling, N-fixing and P-solubilising. There were no significant differences in the concentrations of soil macronutrients, alkaline and acid phosphatase, glucosaminidase, and nitrate reductase activity of *E. villosus* rhizosphere and non-rhizosphere soils; this may be attributed to dung and urine deposited by grazing cattle. Our results show that soil bacterial communities with nutrient cycling and fixing functions may be linked to nutrient bioavailability contributing to nutrient enrichments in *E. villosus* rhizosphere soils.

### 83 Waste acid-based geopolymerisation of gold mine tailings

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Gold mine tailing (GMT) was activated with phosphoric acid (PA) and waste-based acid activator to synthesise acid-based geopolymer. The waste-based geopolymer (WBGMT) was activated with phosphorus (P) leachate from sewage sludge. The phase formation and reaction process were determined using scanning electron micrograph (SEM), X-ray diffraction (XRD), energy dispersive X-ray spectroscopy (EDX) and Fourier transform infrared spectroscopy (FTIR). The results indicated that oven-cured GMT geopolymer activated with 10M PA at 0,25 L/S yielded unconfined compressive strength (UCS) of 11,2 MPa, while WBGMT with 34% PA addition yielded UCS of 10,7 MPa after five days of curing. The strength development was attributed to the denser compact structure and  $\text{AlPO}_4$ , Si-O-P-O-Al, Si-O-Al-O-Si, Al-O-P-O and Si-O-P-O-Si network in the geopolymer matrix. The high UCS on WBGMT with low PA addition was attributed to the P and Al in the leachate. The WBGMT performed better than ABGMT as the 34% PA addition is equivalent to a 5M pure PA solution, showing a UCS of 10,7 MPa compared with 2,1 MPa for the latter. The WBGMT meets the requirements for application as load-bearing and building bricks.

### 84 Practical benefits in using Weeva's data management software tool to communicate sustainability performance and progress to stakeholders effectively

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Reliable data and smart analysis are key to steering the travel and tourism industry, especially through times of uncertainty. We present Weeva's agility as a data management software tool across the "four Cs". The four Cs are Conservation, Community, Commerce and Culture, which make up Weeva's 360° model for sustainability. Each C will showcase an exemplary "Weeva property" by showcasing their respective data progress within a specific project. We demonstrate how these datasets have the potential to assist each property showcased to internalise sustainability in their operations and decision making. Our results indicate that the Weeva tool improves resilience for data gathering and reporting on sustainability initiatives.

### 85 Dietary preference of the critically endangered estuarine pipefish *Syngnathus watermeyer*

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The estuarine pipefish (*Syngnathus watermeyer*) is one of the rarest animals in Africa, currently occurring in only two estuaries, the Kariega and Bushmans. The estuarine pipefish was declared extinct in 1994, but was later rediscovered and is currently listed as a critically endangered species. A re-introduction conservation programme was launched in 2017 and requires knowledge of the species's dietary preferences.

In the present study, we used metabarcoding of faecal DNA to identify prey species consumed by wild *S. watermeyerii* and compared the species's diet with that of the sister species, the longsnout pipefish (*S. temminckii*). Compared with the longsnout pipefish, it was found that the estuarine pipefish is much more specialised. Calanoid crustaceans make up 63% of its diet, and mollusc larvae. Our finding confirms the hypothesis that population declines and localised extinctions during previous decades were the result of reductions in the abundance of their main food source. Calanoid zooplankters rely on freshwater pulses to thrive, but such events have become rare because both estuaries suffer from excessive freshwater abstraction for urban and agricultural use.

## 86 The nexus between climate change and human wildlife interactions: Perspectives from TFCAs in southern Africa

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This study used a case study of TFCAs in southern Africa to document the linkages between climate change and human wildlife interactions. A bibliometric literature review on climate change extreme events and their influence on human wildlife interactions was done to identify major research themes and gaps. This study selected articles using two leading databases, namely Scopus and Web of Science, and one supporting database, namely Google Scholar. The literature was analysed using VOSviewer, whilst other data was analysed using SPSS Version 26. Key findings indicate that drought spells and heat wave conditions are one of the major drivers of human-wildlife interactions in human-dominated systems where people, livestock and wildlife share the same landscapes. This has led to habitat changes, compromising the availability of ecosystem goods and services, particularly surface water and rangelands. Human-elephant and human-carnivore conflict has also intensified due to habitat overlap and encroachment. The results provide stakeholders and other agencies with information that could support various management decisions and represent a benchmark for future monitoring of climate change and human-wildlife interactions.

## 87 Phylogenomics of northern and southern African populations of the ascidian *Pyura herdmani*

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With the constant expansion of the global shipping network, there is the opportunity for many species of fauna and flora to reach new locations, either by being transported in the ballast water or by being attached to the ships' hulls. If the new location is suitable for the organism, it can become invasive in that ecosystem. Ascidians are marine-dwelling, sessile, filter-feeding invertebrates. They are described as bioengineers that gain biomass and can alter the environment they invade. *Pyura praeputialis* (Heller, 1878) is an ascidian from Australia that has now invaded the coasts of Chile, changed its invaded habitat and reached the highest biomass ever recorded on rocky shores. On the coastline of South Africa, there is *Pyura herdmani* (Drasche, 1884), a dominant ascidian. *P. herdmani* is antitropical, existing in northern and southern Africa but not in the equatorial regions. There has been genetic research on *P. herdmani*

that suggests there are four separate lineages that present the potential for the realisation of entirely separate species. The antitropical distribution pattern can be reconstructed using phylogenomics on the four separate lineages.

## 88 Black rhino trophic rewilding and top-down vegetation control: A test case in a semi-arid savanna

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During the Late Pleistocene, key natural drivers that maintained lower trophic levels were removed, resulting in ecosystem downgrading. This was largely owing to anthropogenic impacts, coupled with climatic shifts. To date, intact trophic cascades have persisted only in sub-Saharan Africa and southern Asia. Rewilding theory argues that species – especially megafauna – reintroductions into degraded areas should stabilise ecosystem functioning and promote biodiversity. Although this is a popularised topic, there is a considerable lack of rewilding in practice and empirical analyses thereof. This study will combine remote sensing with field and lab techniques to investigate what impact black rhino rewilding has had on the vegetation composition and density in Tswalu Kalahari Reserve (TKR), South Africa. These effects will then be projected in scenarios with variable rhino population sizes to determine what output has an optimally restorative effect in TKR. It is hypothesised that black rhinos have the capacity to reduce woody density and promote the abundance of *Vachellia erioloba* in TKR. This study serves as a baseline to fill a gap in scientific literature and has global relevancy.

## 89 Cultivating a wild future for all

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Imagine anyone, anywhere in the world, contributing to the conservation of wildlife, biodiversity and the future of our planet by simply eating what they already like, meat – but in this case, real, cultivated meat! We hunt down innovative agribiotech solutions that secure the future of wildlife, biodiversity and food security.

## 90 Malaria vector *Anopheles funestus* from different geographical locations expresses differing response to same light environment in captivity

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Simulating conditions that favour the mosquito's life history in nature has benefited laboratory rearing of *Anopheles* mosquitoes for malaria control. These conditions have been effective for rearing malaria vector species in the *Anopheles gambiae* complex but not in the *An. funestus* group, which has shown low mating success. This study evaluated the impact of manipulating the light environment inside adult mosquito rearing cages by the inclusion of artificial horizons and light contrasting markers, on the mating success of two *An. funestus* strains from different geographical localities. We found that *An. funestus* from different geographical locations differ in their response to the same light environment. Covering the top half of the adult holding cage with black opaque cloth and placing a black light-contrasting marker on the base of the adult holding cage increased mating success of *An. funestus* from Mozambique, while the same species from Angola showed increased mating success only when the side of the cage was covered. Hence, malaria vector control initiatives should consider customisation of the light environment in the attempt to colonise *Anopheles* mosquitoes, as well as in vector control.

## 91 Constraints on mountain zebra distribution: The role of competitors and changing climate

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Several factors influence the distribution of a species, such as resource availability, predation and inter-specific competition. All these factors influence population distribution and growth, and consequently the long-term survival of the species. The mountain zebra (*Equus zebra*) is one of the two zebra species found in southern Africa. The species is endangered and threatened by habitat loss, disruption of movements and droughts. The species also naturally occupies a narrow climatic niche. Because of ongoing changes in the species's niche, it is considered a refugee species. Therefore, we assessed the current and future distribution of habitat for the mountain zebra and examined how the density of plains zebras (*Equus quagga*) shapes the distribution of mountain zebras. We predicted that mountain zebras would occupy mountainous and semi-arid areas, like their current habitat. However, we also predicted that the presence of plains zebras would limit mountain zebra distribution, because, once in sympatry, the two species can compete for similar resources. Studies of changing species distributions like ours will help to understand the factors limiting the long-term survival of a species.

## 92 Characterising properties and drivers of long-distance migration by male elephants (*Loxodonta africana*) between Hwange National Park and Shangani Ranch, Zimbabwe

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Balancing trade-offs between foraging and risk factors is an important behaviour that shapes species spatial distribution. We aim to understand how male African elephants (*Loxodonta africana*) balance anthropogenic disturbance factors, natural factors and resource access during foraging and migration; specifically, why only males reach Shangani Ranch. Using GPS collar data, we assessed how elephants respond to human features, resource availability, topography and water. We demonstrated that male elephants aggregated near water sources during the dry season. Elephants avoided roads, human habitation and steep slopes, but were frequently found in crop fields at night. Their speed increased when they were further away from human settlement and during the day. The results demonstrate that the migration route is a risky area, although bulls still utilise the area (no risk, no gain). The increased risk may explain why females avoid this landscape as they protect their young. These results are important in elephant conservation and migration ecology.

## 93 Non-invasive detection of faecal antibodies to assess immune response following vaccination in wild canids

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The endangered African wild dog (*Lycaon pictus*) faces increased risk of exposure to infectious pathogens such as canine distemper virus, which has caused recent population-wide fatalities within reserves. Invasive blood-sampling is currently one of the only options available to assess immune function in wild-life. The present study aimed to measure immunoglobulins in non-invasively collected faecal samples after a vaccination event in domestic dogs, Australian dingoes and African wild dogs. Faecal samples were collected from adult domestic dogs, Australian dingoes and African wild dogs just prior to receiving vaccinations against canine distemper virus, and then weekly over an eight-week period post-vaccination. Preliminary data has shown that IgM and IgG were measurable in faecal samples pre- and post-vaccination and shows expected immune response. A degradation trial showed that IgM and IgG is stable up to 144h post-thaw in African wild dog samples. Current ongoing optimisation and validation of this method to measure immunoglobulins in canid faeces may provide a non-invasive tool to assess immune function within endangered animal populations.



## 94 The development of a seed propagation protocol for *Pachycarpus schinzianus* (Schltr.) N.E.Br. for the commercial Gauteng horticultural market

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UNISA undertook an investigation at Telperion Nature Reserve to identify plant species with horticultural potential for cultivation for the commercial market. Three plants were selected for a pilot study, which indicated *Pachycarpus schinzianus* as most popular with the public, so it was consequently selected for further propagation. Project objectives: to heighten awareness of *P. schinzianus* with the public, develop a protocol for its cultivation for the commercial market, reintroduce it at Telperion reserve and alleviate it over harvesting in the wild for medicinal purposes. Methodology: three different treatments in Petri dishes in growth chambers were applied at 15, 20 and 25°C, with 50 seeds soaked in smoked water, 50 seeds soaked in distilled water and 50 seeds having no treatment. This experimental procedure was duplicated in a greenhouse, where seeds were sown in multi-trays in different growth media. Results: smoked-water-treated seeds in Petri dishes germinate best at 15°C (63%) and at 20°C (42%) to date in germination mix in the greenhouse. Conclusion: smoked water enhances seed germination at 15°C and 20°C.

## 95 Taxonomic revision, distribution and Red List assessment of the “red millipede” genus *Centrobolus* (Spirobolida: Pachybolidae) in South Africa

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There are over 500 described species of millipedes in southern Africa, as well as a large number of species that have not been discovered or described. One group of poorly studied millipedes is the genus *Centrobolus*, for which 39 species have been described, mostly from the Western and Eastern Cape, KwaZulu-Natal, Mpumalanga and Limpopo, with a few species recorded from Swaziland, Mozambique and Zimbabwe. The species in this genus have not been described in detail, and specimens are difficult to identify based on the existing literature and identification keys. A large amount of material representing *Centrobolus* has been collected over the last 20 years, but this is mostly unidentified. The distribution of the genus is also not well known, but it is thought that most species have narrow ranges and that they may be threatened by habitat loss and degradation. This study revises the taxonomy of *Centrobolus* and provides detailed species descriptions, an identification key and illustrations of the main characters. The distribution of each species is updated. An assessment of the threat status of each species according to the IUCN Red List criteria is also carried out.

## 96 Liver structure and enzymatic activity alterations in *Clarias gariepinus* following active biomonitoring at Roodeplaat Dam

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Numerous studies have reported the heightened concern surrounding the ecological condition of Roodeplaat Dam due to its hypereutrophic status. Previous studies have specifically reported hepatic pathology in fish inhabiting the dam. The current study aimed to compare the liver function and structure of 25 unexposed, translocated fish (*Clarias gariepinus*) acutely exposed to the dam water, with that of fish inhabiting the dam, as well as of a laboratory control group, using liver enzyme biomarkers and histological analysis. A statistically significant decline in the activity of the three liver enzymes (AST, ALT and ALP) was observed in the translocated fish, and the percentage prevalence of melanomacrophage centres, hepatocellular and nuclear pleomorphism, intracellular deposits and steatosis was higher in the translocated fish compared with the control group. These results suggest an adverse liver response in terms of enzyme activity and microscopic structure in fish acutely exposed to the dam water.

## 97 Planning considerations for climate-smart wildlife conservation around protected areas in Zimbabwe

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Climate change mitigation within and around protected areas requires collaborative effort from both local communities and authorities. This chapter focuses on the role of communities living around protected areas in combating climate change in an effort to enhance wildlife and biodiversity conservation in the nearby Gonarezhou National Park. A qualitative research design was adopted to establish the planning considerations for climate-smart conservation around protected areas. An option-by-context (OxP) approach informed data collection and analysis. Research participants included community leaders and local community members. The chapter adds to the discourse of climate-smart conservation by outlining critical planning areas to take into consideration. Stakeholder engagement, community involvement, resource inventory, climate information, institutional arrangements (policies, finance, water use efficiency), social enterprises as low carbon emitters, land tenure (the eight baskets of rights) and risk management emerge as the key considerations to promote wildlife conservation while enhancing community livelihoods.

## 98 Ecosystem restoration

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Ecosystem degradation and climate change pose formidable challenges to our planet's sustainability. To address these pressing issues, Justdiggit has been at the forefront of promoting ecosystem restoration through innovative approaches such as Farmer-Managed Natural Regeneration (FMNR). In this

results-based presentation at the Oppenheimer Research Conference, we will showcase the transformative impact of these initiatives on a global scale. By leveraging the power of local communities, Justdiggit's FMNR and ecosystem restoration approaches empower farmers and pastoral communities to regenerate degraded landscapes through the systematic regrowth of trees, shrubs and grasses. Through comprehensive monitoring and evaluation, our initiatives have successfully restored ecosystems, resulting in enhanced biodiversity, improved soil health and increased water retention capacity. Our presentation will highlight the tangible outcomes achieved through ecosystem restoration projects implemented in various regions. We will demonstrate how our approaches have reversed desertification, revitalised ecosystems and promoted sustainable socio-economic impacts.

## 99 Methods to count butterfly assemblages in Africa

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Results, limitations and advantages of butterfly counting methods that have been tested in southern Africa during recent decades, and lessons learnt, are discussed. A sharper focus on the use of standardised butterfly counting methods for monitoring purposes, follows on from the Leipzig workshop (2014) that led to the Guidelines for Standardised Global Butterfly Monitoring (2015). The butterfly counting methods proposed for use in Africa include a rapid assessment protocol, 15-minute counts at 20 m x 10 m rectangular sample plots, 15-minute counts at 5 m x 5 m square sample plots, 15-minute hilltopping surveys, fruit bait trapping and Pollard walk transects. A highlight of 15-minute counts within half-hour brackets is the result of hilltopping butterfly surveys at the Tswalu Kalahari Reserve. People from all walks of life can use these butterfly counting methods after acquiring identification skills for local butterfly fauna. The scope for butterfly counts includes counting butterflies at a rooftop urban garden during a lunch break for a project that was initiated in 2023, the African Butterfly Migrations (ABM) project.

## 100 Metagenomics as a tool for measuring parasite load, parasite diversity and transmission dynamics in *Diceros bicornis* populations at the Tswalu Kalahari Reserve

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Gut-borne helminth infections decrease the fitness and fecundity of their mammalian hosts – a major concern for critically endangered species like the black rhinoceros (*Diceros bicornis*), which is uniparous and has a long gestational period, resulting in slow population growth. This project aims to assess the gut parasite load and the transmission between black rhinoceros populations and other mammal species in the southern Kalahari Desert. Using rRNA with next-generation sequencing within each sample, we can determine the parasitic diversity. The identified list of gut parasites will be analysed in ecological contexts.

Diminished genetic diversity in black rhinoceros populations, due to their small size and inbreeding, leaves them particularly susceptible to infection. Attempts to increase this diversity through exchange can also inadvertently introduce parasitic infections to new areas. Data from this study will improve current conservation efforts and allow wildlife managers to reduce parasite transmission among the black rhinoceros and other mammalian megafauna populations, as well as provide an assessment of the parasite load harboured in a critical black rhinoceros population.

## 101 Restoring and maintaining demographic resilience of African elephant populations across southern Africa

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Conservation management of African elephant populations aims at restoring and maintaining demographic resilience – the ability to resist and recover from disturbances (droughts, poaching, isolation and management interventions). Resistance is measured as the rate of decline, and recovery as the rate of increase – which should decline with a recovery of resilience. We completed 18 Rapid Elephant Population Assessments across southern Africa, which returned a demographic profile for each population. We used life tables to populate stage-structured (Lefkovich) population projection matrices and modelled asymptotic and transient growth, elasticity and life table response experiments to model the contribution of vital rates to changes in growth. The effect of adult survival for modelled asymptotic and transient growth was greater than a change in fecundity and was heightened by isolation. Juvenile survival contributed most to changes in transient growth and was a function of environmental pressure. African elephants have slow life history and are resilient to disturbances due to high adult survival, but poaching erodes demographic resilience by lowering adult survival.

## 102 A multifaceted study on the neurological effects of cadmium chloride on *Oreochromis mossambicus*

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The impacts of anthropogenic activities on ecosystems can be severe, with freshwater habitats being no exception. Cadmium is a metal toxic to living organisms and has been identified as having neurodegenerative properties. The metal has been found in South African freshwater systems, increasing the need to understand how it could neurologically impact animals within that ecosystem. This study aimed to determine how an environmentally relevant concentration (27 µg/l) of cadmium chloride affects the brain of *Oreochromis mossambicus* after acute and chronic exposure. This was done by conducting a behavioural analysis of the olfactory response time and analysing the histology and the activity of acetylcholinesterase (AChE) within the brain. The behavioural analysis of the olfactory response time showed a significant decline in olfactory ability when acutely exposed, but not chronically exposed. The histology showed no differences across the exposed and control groups. There was a non-significant decrease in AChE activity in the acute group compared with the control, but a non-significant increase in the chronic group.

### 103 A reproductive health assessment of the sharptooth catfish (*Clarias gariepinus*) inhabiting the Rietvlei and Marais Dams of the Rietvlei Nature Reserve

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Aquatic ecosystems are adversely affected by pollutants such as pesticides, heavy metals and pharmaceuticals. These chemicals can adversely affect the health of fish and can bio-accumulate in fish tissues, and subsequently pose a human health risk when consumed. The Rietvlei and Marais Dams are located in the Rietvlei Nature Reserve, within the City of Tshwane. Previous studies conducted at these dams have reported the presence of endocrine-disrupting chemicals in the water, as well as gonadal abnormalities in the sharptooth catfish (*Clarias gariepinus*). The monitoring and remediation of freshwater systems in South Africa is very important. This study aimed to assess the current reproductive health of the sharptooth catfish inhabiting these dams through histological analyses of the gonads, and to do a chemical analysis of water and sediment samples. An LC-MS/MS analysis of the water samples collected from the dams showed a range of pesticides, indicating the presence of potential endocrine-disrupting chemicals in the water. A standard necropsy showed testicular abnormalities in fish, with associated histological alterations.

### 104 Toxicity assessment of the Sesmylspruit within Rietvlei Nature Reserve

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Rietvlei (RD) and Marais (MD) Dams, located in the Rietvlei Nature Reserve (RNR), are connected by the Sesmylspruit (SS), which is impacted by human activities further upstream. The aim of the study was to determine the possible toxicity of the water environment at various sites along the SS, including RD and MD. Water was sampled during both low- and high-flow conditions. Metal screening was done using ICP-MS/MS, and pesticide screening was done using LC-MS/MS, followed by OECD toxicity testing. Iron, manganese and phosphorus were found at levels of concern for both seasons, and aluminium for the low-flow sampling. Pesticide levels were within the threshold values for South Africa. Algal testing using *Selenastrum capricornutum* expressed no acute toxicity. Invertebrate testing using *Daphnia pulex* showed no significant differences in mortality; however, high mortality rates were seen overall. Vertebrate testing using *Poecilia reticulata* showed no significant differences spatially, but a significant difference was observed temporally ( $p = 0,03$ ). The water within the RNR was determined not to be acutely toxic to the plants and vertebrates tested; however, invertebrate toxicity is of concern.

## 105 Contributions of wildlife-based tourism to conservation and livelihoods: A case of wildlife management areas in northern Tanzania

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The primary goal of wildlife-based tourism (WBT) is to generate economic benefits for conservation agencies and local communities. Benefits include funding for conservation activities such as anti-poaching patrols, wildlife habitat protection, and employment opportunities for communities living in or around wildlife areas. However, information on which benefits, if any, local communities perceive from WBT is scant. This knowledge gap limits our understanding of how communities, especially those living alongside wildlife, perceive the contribution of WBT to their livelihoods and conservation efforts. Understanding local perspectives is critical when making decisions around contentious issues, such as trophy hunting, which are subject to highly contentious international debates. Using wildlife management areas in northern Tanzania as a case study, this research seeks to understand local perceptions of trophy hunting and photographic tourism contributions to local livelihoods and conservation efforts. Robust information on local perspectives of WBT could support informed decisions about wildlife conservation and economic development.

## 106 Establishing the EWILD Laboratory to address the illegal wildlife trade in Eswatini

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Between 2017 and 2019, more than 230 incidents of wildlife crime (22 species) were reported from Eswatini, with specimens destined for local and international markets. Processed products, e.g., ground powders, are not easily identifiable without the application of molecular techniques. Successful prosecution requires such identification to match the crime scene with the suspect. Currently, due to a lack of facilities, forensic samples are transported across the border to South Africa. Necessary export and import permits are sought before samples are sent to South Africa, thus increasing both costs and time to trial. Here, we present the successes and challenges experienced by our team of Swazi scientists in establishing the country's first wildlife forensic laboratory (EWILD) with molecular capacity. The USAID-VukaNow activity equipped EWILD, and the team was trained in wildlife forensics by the South African National Biodiversity Institute. TRACE audited the laboratory against international standards. Within a week, the EWILD Laboratory received its first forensic case, highlighting the value, need and importance of capacitating countries to use the latest technologies in combating wildlife crime.

## 107 Why we should all be talking about management if we want to reverse global desertification and climate change

Sarah Savory

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We're experiencing increasing global successes with everything we produce. But we're experiencing rapidly increasing social, economic and environmental problems. We produce everything through the management of three things: people, economies and nature. This immediately shows that our management is failing – on a global scale. Everything we use, consume and produce comes from nature – none of us can have social or economic stability if nature is unhealthy. This tells us that almost every decision and policy we make has inseparable short- and long-term social, financial and ecological elements or complexity to consider and balance simultaneously. Allan Savory discovered that no human is born with the need or ability to consider the complexity of each decision, because we're using an inherited decision-making process designed for a time when we had simple stick and stone tools and only had to meet needs or solve our problems in a social context. There were no ecological or financial consequences to consider, because we weren't managing those things yet.

## 108 A histology-based health assessment of the African clawed frog (*Xenopus laevis*) in the Rietvlei Nature Reserve

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The Marais Dam (MD) and Rietvlei Dam (RVD), located within the Rietvlei Nature Reserve (RNR), are two impoundments subjected to various pollutants. Previous studies assessing the effects of pollution within the RNR have reported reduced diversity in macroinvertebrate communities, pathology in the testes of eland, as well as histological alterations in various organs of *Clarias gariepinus*. Although previous studies have evaluated various animal responses caused by pollutants within the MD and RVD, there is little data on the effects of these pollutants on amphibians exposed to water in the RNR. This study, therefore, aimed to assess the effects of pollution in the MD on the health of *Xenopus laevis*, using a histology-based health assessment. Frogs were sampled from the MD using fyke nets and bucket traps. Water and sediment samples were collected for chemical analyses, and in situ water quality parameters were recorded. Biometric indices and histological assessments were carried out on the liver, kidney and gonads of the frogs. The histological results were semi-qualitatively assessed and compared with frogs from an aquarium-housed reference group.

## 109 The influence of grazing lawns on ant (Hymenoptera: Formicidae) diversity and assemblage composition in Welgevonden Game Reserve, Waterberg mountains

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Across Africa, grazing lawns have recently been receiving considerable attention. However, most studies have focused on how plants and vertebrates respond to these habitats, with very few studies focusing on the response of invertebrates. Here we aimed to document how ant diversity and assemblage composition vary between the grazing lawns and adjacent woodlands dominated by *Terminalia sericea* in Welgevonden Game Reserve. Three-paired sampling sites replicated four times (replicates were 300 m apart) representing three different elevational bands were sampled in April 2022. In each replicate, 10 pitfall traps were left open for five days. We collected a total of 10 351 ant specimens, representing 77 ant species in 23 genera and five subfamilies. Species richness was lowest in grazing lawns compared to adjacent woodlands, while abundance was highest in grazing lawns. Disturbance tolerant species, *Angelaleris sustadiens*, a generalist and numerical dominant species, *Phiedela megaserhala*, dominated the ant assemblages in the grazing lawns. We infer that disturbance (grazing) and dominant ants shape diversity and assemblage across the Welgevonden landscapes associated with grazing by large mammals.

## 110 Conservation psychology and environmental justice in SA

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Conservation, climate change and biodiversity loss are strongly influenced by human behaviour, and in response, there have been calls to integrate psychology into conservation research and practice. Psychology may provide a bridge between conservation research and implementation. This research echoes Soule's (1985) calls for social scientists to contribute to conservation based on the notion that biological sciences depend upon social sciences for implementation of decisions and strategies. However, Western conceptualisations of conservation have not sufficiently addressed historical and contemporary issues of injustice. To address this gap, this research incorporates environmental justice to envision a relevant and impactful conservation psychology in South Africa. Foregrounding issues of justice to merge psychology and conservation may contribute to the protection of biodiversity and human well-being in a manner that promotes fairness and justice. The research demonstrates the valuable contributions psychology professionals may contribute to conservation, given its strength of appreciating the complex and dynamic ways in which communities and individuals interact with nature.



## 111 Conservation through the lens: Monitoring vegetation change in Tswalu Kalahari Reserve

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Long-term vegetation monitoring is necessary to monitor change over time. Timing is everything, and single snapshots at a few points in time do not provide a complete picture of changes or trends. Vegetation structure has been shown to be changing in many parts of the country, with implications for stocking rates and the appropriate ratio of grazers to browsers. There is also a concern that global climate change will have a significant impact on biological diversity and ecosystem function, and dynamic adaptation measures will be required. The monitoring programme at Tswalu Kalahari Reserve includes a fixed-point photographic record and transect-based sampling. Since 2016, one of the five major land forms/annum has been surveyed at fixed-point photo station sites. Some preliminary results are discussed.

## 112 Aquatic macroinvertebrate community colonisation dynamics in reservoirs across different land-use types

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Agricultural and human-settlement activities in subtropical landscapes are often in close proximity to natural waterways, given the relative lack of water at the landscape level. These activities are likely to have different implications for aquatic macroinvertebrate colonisation, should it reach these waterways. The current study investigated macroinvertebrate colonisation associated with macadamia orchard and communal area reservoirs to test for potential effects of these stressors on colonisation dynamics. This was done by contrasting colonisation of stones in macadamia orchard and communal area reservoirs. We further investigated macroinvertebrate community structure in relation to physio-chemical variables over time. A total of 644 macroinvertebrate individuals were recorded across macadamia and communal reservoirs, mostly dominated by *Chironominae* (55,1%), *Ostracoda* (14,4%), *Trithemis* sp. (5,2%), *Anax* sp. (5,2%) and *Radix natalensis* (5,0%). In general, macadamia orchard reservoirs were the most species-diverse compared with communal area reservoirs, whereas communal area reservoirs had high abundances of the five most dominant macroinvertebrate taxa.

### 113 The human-wildlife landscape: Effects of fences as a conservation management tool

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The increased use of fences globally has raised concerns in terrestrial ecology, as the intrinsic costs to wildlife are not fully understood. We investigated these costs using the case of spotted hyaenas (*Crocuta crocuta*) in fenced reserves in South Africa. South Africa has used fences as a conservation tool for decades and can provide insight into the intrinsic costs over varying time scales. We considered the responses of territorial behaviour and movement to genetic isolation over a 20- and 30-year time scale. We determined how fenced protected areas may affect behavioural responses to social cues. We used auditory intrusion simulations between spotted hyaena social groups to assess responses. We fitted satellite collars on each clan over one year in Madikwe Game Reserve and Addo Elephant National Park, South Africa. Further, we assessed stress responses to multiple variables. We found that protected area conservation management tools contribute significantly to how spotted hyaenas respond to their environment. Our results emphasise the role that conservation tools have in ecosystem management and how they should be strategically integrated into management strategies.

### 114 Solifugae (Arachnida): Current state of knowledge in southern Africa

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Solifugae, or solifuges, is a bizarre group of arachnids, known in southern Africa as romans, sunspiders, jaagspinnekoppe, haarskeerders, mole solifuges and, recently, Kalahari Ferraris due to their running speeds. Over 1 100 species are described globally. Southern Africa has an extraordinary species and family level diversity and endemism, reflected in their spectacular variation in morphology and behaviour. This does not reflect their true diversity in the region, however. Due to undersampling, especially of the *Psammophilus* species (e.g., Hexisopodidae Pocock, 1897) and small, cryptic species (e.g., Melanoblossiidae Roewer, 1993), many species remain undiscovered. Taxonomic chaos in Old World taxa prevails; even spectacularly coloured diurnal species are often difficult to identify using existing keys. A general absence of series hampers taxonomic studies. Molecular studies could accelerate taxonomic understanding, but suitable specimens are hard to get. We will provide an overview of the group and the current state of knowledge of solifuges in southern Africa (geographical hotspots, estimated number of species). We will highlight areas in need of systematic sampling and taxonomy.

## **115** Using bioacoustic surveying techniques to investigate occupancy and distribution of small mammals at Telperion Nature Reserve, Mpumalanga, South Africa

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Bioacoustic monitoring offers efficient and effective, low-cost methods for assessing biodiversity. Acoustic monitoring has been used to identify small mammals; however, such studies are limited to the northern hemisphere. This study will develop a vocalisation library and assess the viability of acoustic approaches to modelling occupancy of small mammals in Telperion Nature Reserve. Three orders of small mammals: Eulipotyphla (shrews), Macroscelidea and Rodentia (rats and mice) will be investigated. We will use live, focused trapping in species-specific habitats. Vocalisations of captured animals will be recorded using a combination of ultrasonic and audible range detectors. A call library will enable us to identify free-roaming species. The second component of the study will model the occupancy of small mammals in the reserve. We will use live trapping grids and acoustic detectors to compare detection rates of small mammals across four distinct habitat types and assess viability of occupancy modelling using acoustic monitoring. The study will verify the feasibility of using bioacoustics to investigate occupancy and distribution of small mammal species in South Africa.

## **116** An assessment of plant species diversity and veld condition in the KwaZulu-Natal Sandstone Sourveld communal grassland at eThekweni Municipality area

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KwaZulu-Natal Sandstone Sourveld (KZNSS) grassland is a critically endangered vegetation in South Africa. It is a species-rich system endemic to KwaZulu-Natal with about 68% completely transformed. However, little research has been done to understand the state and condition of the grassland. Study aimed to determine plant diversity and veld condition in iNanda Mountain, KwaCele, and Zwelibomvu communal KZNSS grassland patches and compare them with Silverglen Nature Reserve. Main objective was to quantify biodiversity by determining species diversity and grazing capacity of the grassland at all four sites. Diversity indices calculated were Shannon-Wiener diversity, species richness, and Pielou's evenness. Grass and forb diversity indices were highest at Silverglen, followed by KwaCele then Zwelibomvu and lowest at Inanda ( $p=0.001$ ). Inanda and Silverglen had higher veld condition scores of 58% and 56% respectively, while KwaCele scored 34% and Zwelibomvu was the lowest with 28% ( $p=0.001$ ). All sites are impacted by different pressures, which are site-specific. Since there is a variation in pressures between sites, management strategies also need to be site-specific.

## 117 Monoculture plantations may be a suitable habitat for some ground-dwelling arthropods

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Timber plantations have expanded at the expense of native habitats. This has implications for arthropods, which facilitate essential ecological processes in forest ecosystems. Studies have suggested that timber plantations can form ecological networks for forest invertebrates. Therefore, this study aimed to explore the drivers of arthropods in monoculture timber plantations. Arthropod functional diversity was considered to indicate ecosystem stability. Arthropods were collected in a native forest (*Pinus* and *Eucalyptus* plantation) at the Umngeniport Research Facility in the Natal Midlands. A significant proportion of arthropods were sampled in the native forests, with more detritivores than in other habitats. Generalist predators (spiders and centipedes) were abundant in *Pinus* plantations, which may indicate prey availability. Ants and beetles were common in all the habitats. The ongoing analysis is focusing on the specific microhabitat variables that affect arthropod patterns in timber plantations. The outcomes of this study will highlight the importance of arthropod conservation in human-managed environments and the maintenance of abiotic factors to enhance their conservation.

## 118 Contributing towards resolving taxonomic issues in South African Arachnida fauna, focusing on the genus *Euryopsis* Menge, 1868 (Araneae: Theridiidae)

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The South African National Survey of Arachnida (SANSA) was launched in 2006 to improve the knowledge of the arachnid diversity of the country through collaboration and coordination of arachnological research. The latest stage of this project is the evaluation of South African spiders according to the IUCN Red List categories and criteria. Currently, more than 2 200 species in 70 families known in the country have been assessed. From all the species assessed, 32% are data-deficient. This means that they are poorly described, one of the sexes is unknown, the description does not include illustrations, or the distribution data is vague. As a result of this, research focusing on addressing some of these issues will be undertaken to publish data for the data-deficient species. *Euryopsis* Menge, 1868 is one of the genera in the family Theridiidae, and it has about 75 species recorded worldwide. Through the SANSA surveys, specimens of the genus have been found within South Africa. This paper will focus on determining the real diversity of the genus within South Africa. These spiders are commonly known as cobweb spiders and, according to the World Spider Catalog, occur only in Canada and the USA.

## 119 A review on biogas technology uptake and its contributions to rural livelihoods in rural areas of Limpopo, South Africa

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Development and dissemination of the technology certainly minimize energy poverty and improve peoples' status in the energy ladder. Although conversion of waste to biogas is an established technology, it has been under-used, probably because until recently, electricity was relatively affordable to most of the population in South Africa. However, the increase in both the demand for, and the cost of, electricity has prompted engineers to revive their interest in rolling out biogas technology in South Africa. A salient reason for advocating biodigestion as an alternative source of energy is that electricity is not available in all parts of this country. Biogas technology access is impacted by two issues which are technical potential and economic potential, technical potential referring to the ease of use of the technology whilst economic potential referring to the benefits provided by the technology. This study seeks to demonstrate the potential of biogas technology in rural development and poverty alleviation. Data was collected through questionnaire, field survey and desktop studies.

## 120 Human thoughts, feelings and behaviour towards frogs of three separate communities in the Western Cape

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Questionnaire-based surveys are used to investigate the relations between society and nature. Questionnaire-based surveys regarding frogs in RSA are limited to quantitative sampling methods. This study will be the first questionnaire-based survey that embraces an embedded, concurrent, mixed-methods approach to understand human thoughts, feelings and behaviour towards frogs. The study area includes the communities of Nature's Valley, Covie and Kurland in the Western Cape. Preliminary results show strong agreement with those found in the literature. Quantitative results reveal contrasting views on frogs: some perceive them as repulsive, while others find them appealing. Nature's Valley residents overwhelmingly view frogs positively, considering them cute, interesting and pretty. In contrast, participants from Kurland and Covie entertain certain superstitions about frogs, attributing rain, warts and snake venom to them. Although many disregard these beliefs as old-fashioned, they still advocate killing frogs due to their perceived association with snakes and bad omens. This study has put emphasis on the importance of consulting qualitative reasoning in human-wildlife interaction.

## 121 The function and use of Little Muck Shelter's stone scrapers: A replication and use-wear study

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Little is known of forager behaviour shifts in the middle Limpopo Valley, especially after the arrival of farmers. Some studies have shown changes in forager toolkits, but what these represent is not clear. A dominance of stone scrapers at Little Muck Shelter, for example, has been interpreted as the result of changing trade dynamics. However, what these tools were used to produce is not known. To resolve this, an experimental protocol was designed to examine wear traces from working a range of materials with replicated scrapers in various fashions, and using different tool and motion organisations to assess edge damage, wear and polish. These results were compared with archaeological scrapers retrieved from excavations at the site. Our results show a preference for working rigid items and also leather. We argue that this demonstrates forager involvement in the production of various goods at a time when trade wealth was driving the appearance of wealthy elites and state-level society.

## 122 Polyphagous shot hole borer (PSHB) Replant List 2023

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The polyphagous shot hole borer (PSHB) is an invasive ambrosia beetle which has emerged as a major threat to trees across South Africa. PSHB tunnels into the trees, establishing galleries in which it breeds. It carries a fungal symbiont as its food source, but the combination of beetle tunnelling and fungal infection causes dieback and death in many trees. The impact of this invasion is hardest felt in urban environments, where several commonly planted species are rapidly succumbing. While scientists continue to explore management options, the need arises for suitable species to be available for replanting into PSHB-impacted areas. Establishing such a list is challenging, as the PSHB host list continues to grow as the invasion expands. Also, criteria for what constitutes a suitable replacement tree varies, based on the needs and objectives of the stakeholder looking to replant. Nevertheless, we have embarked on a sciant collaboration: a replant poster featuring six indigenous trees, selected based on their adaptability and performance in urban areas. While it is by no means an exhaustive list, we hope this poster highlights the impact of PSHB and initiates the replant conversation.

## 123 Resolving the taxonomic status of giant land snails in northern KwaZulu-Natal using DNA barcoding

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Giant land snails of the family Achatinidae are kept as pets and exhibited in zoological gardens. The taxonomic status of four species of the achatinid genus *Cochlitoma* from northern KwaZulu-Natal has recently come under scrutiny. Two species with yellow shells (*C. zuluensis* and *C. churchilliana*) and two species with flammulated shells (*C. natalensis* and *C. sanctaeluciae*) were synonymised based on their genital morphology, without considering differences in shell morphology and the highly constrained geographical range of each species. The current study uses DNA barcoding to reassess the species status of the four snails by determining whether each comprises a distinct genetic lineage.

## 124 Mapping ecosystem energetics using the Biodiversity Intactness Index for Africa

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As a common currency for ecological vibrancy, energy allows conservationists to compare diverse groups of species using a unified metric. As energy flows up the trophic web from plants through animals, the size of energy flow through particular animal guilds indicates their contribution to ecosystem functions like seed dispersal and pollination. We combined datasets on the population densities, ranges, allometries and biodiversity intactness of African birds and mammals to estimate how energy flows through key ecosystem functions have changed. Using the Biodiversity Intactness Index for Africa, changes were mapped across a gradient of land uses spanning the Afrotropics. Declines in key ecosystem function were then related to biodiversity intactness to clarify the possible location of a biodiversity planetary boundary. Results suggest that functions realised by large herbivores declined most rapidly and with the highest certainty, collapsing even in relatively intact ecosystems. Declines associated with small mammals and birds were highly uncertain, highlighting the need to understand better how small vertebrate declines are undermining ecosystem resilience.

## 125 Modelling the cryptic *Mastomys* species distribution in southern Africa: Insights into the likely encephalomyocarditis virus reservoir

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In 1993/94, an outbreak of encephalomyocarditis virus (EMCV) occurred in African elephants in the Kruger National Park (KNP), which coincided with a rodent irruption. *Mastomys natalensis* was implicated as the reservoir of the EMCV outbreak. However, as both *Mastomys natalensis* and *M. coucha*, which are

morphologically indistinguishable, occur in the KNP, the true reservoir host remains unclear. *Mastomys natalensis* was implicated based on distribution maps compiled using genetically unverified specimen occurrence records. We address the resulting high levels of uncertainty in species distribution by using genetically identified individuals to determine the potential distributions of the two species in southern Africa, using correlative species distribution models and bioclimatic variables in MaxEnt. The predicted distribution of the two species suggests that broad areas of sympatry exist. However, the predicted distributions, when assessed against historical EMCV records, provide insights into the likely reservoir host in South Africa.

## 126 Gauteng's faunal groundwater connectivity as assessed through environmental DNA (eDNA) metabarcoding

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Groundwater protection is a national priority, as ratified by the South African Department of Human Settlements, Water and Sanitation. Groundwater provides a vital freshwater resource for human consumption and the agricultural and industrial sectors. Yet it is one of the most understudied ecosystems, with poorly known food web interactions, energy flows and connectivity between adjoining ecosystems. This is because subterranean landscapes are difficult to access using conventional sampling methods. Environmental DNA (eDNA) metabarcoding has proven helpful in such cases. Genetic data from entire communities can be obtained from water or sediment samples into which organisms have released genetic material such as saliva, faeces, skin or gametes. This data can then be used to assess biodiversity and determine the connectivity of animal communities in the groundwater. This study is a pilot project aimed at assessing the connectivity between the subterranean communities of different regions of the dolomitic formation in Gauteng, to gain insight into evolutionary and ecological processes by analysing groundwater and sediment from the Bakwena and Sterkfontein Caves. The recovered eDNA was amplified using the standard DNA barcoding marker for animals (COI), followed by high throughput sequencing of the amplicons.

## 127 Human-wildlife conflicts at the interface of rural communities and wildlife conservation zones along the KAZA TFCA in Zimbabwe

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In Zimbabwe, conflict with hippos and crocodiles accounts for almost 50% of reported cases of human-wildlife conflicts. Nonetheless, human-crocodile conflict (HCC) and human-hippo conflict (HHC) have not received as much research or policy attention as conflicts with terrestrial species such as lions or elephants. In this study, we use multiple social research methods including individual interviews, focus group discussions and key informant interviews to explore attitudes and perceptions of rural communities towards crocodiles and hippos in northern Zimbabwe. Our study seeks to provide insights on



why rural communities in fishing camps along Lake Kariba may oppose or support existing conservation policies related to HCC and HHC. Our findings will highlight the importance of directly involving rural communities in the designing and implementation of HCC and HHC resolution mechanisms and policies that can promote coexistence with dangerous wild animals in ways that benefit people and wildlife.

## **128 The Ecological Engineering Nexus Accounting Framework: Advancing impact valuation for sustainable conservation practices in a South African provincial park**

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The Ecological Engineering Nexus Accounting Framework (EENAF) is a comprehensive tool for assessing the impact of ecological engineering projects in the conservation sector. It integrates ecological, social and economic dimensions and enables easy comparison, benchmarking and scalability of projects. It contributes to the achievement of Sustainable Development Goals by addressing the interconnected and multifaceted nature of sustainability challenges. The application of the EENAF in a South African provincial park highlights its practical implications and real-world value for policymakers, investors and project developers, driving positive change and fostering sustainable conservation practices.

## **129 Indigenous knowledge about consumption of edible insects in South Africa**

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Consumption of edible insects is an indigenous practice that has played an essential role in human nutrition across Africa. However, indigenous knowledge about insect consumption is being lost because recent generations have adopted Western methods. We conducted 500 questionnaires in five local municipalities in KwaZulu-Natal and 122 questionnaires in four local municipalities in the Vhembe district in Limpopo, to document indigenous knowledge about the consumption, collection and preparation methods used for edible insects in Limpopo and KZN. Eight insect species belonging to five insect orders were used as food in Limpopo and KZN. Ninety-five percent of the respondents occasionally consumed insects in Limpopo, while only 28% did so in KZN. Nutritional benefits and tradition were the main reasons for consuming insects. Edible insects are a nutritious diet and play an important role in people's livelihoods in rural areas. However, there was a notable decline in entomophagy, particularly in KZN. The decline may be related to the discomfort associated with eating insects; to promote acceptability of entomophagy, people should incorporate edible insect flour into food products such as bread.



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