15th Conference of the Herpetological Association of Africa

16 – 19 January 2023

Hoedspruit, Limpopo, South Africa

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HERPETOLOGICAL ASSOCIATION OF AFRICA

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Conference Schedule

15th HAA Conference Draft Schedule (16 - 19 January 2023)

Monday 16 January	
8:00 - 8:30	Registration and Networking
8:30 - 9:00	Welcome and Announcements
9:00 - 10:00	Session 1: Plenary (Rom Whitaker)
10:00 - 10:30	Mini Presentations
10:30 - 11:00	Tea
11:00 - 13:00	Session 2
13:00 - 14:00	Lunch
14:00 - 15:30	Session 3
15:30 - 16:00	Tea
16:00 - 17:00	Session 4
17:00 - 18:00	Break
18:00 - 19:30	Ice Breaker
19:30 - 21:00	Ice Breaker dinner

Tuesday 17 January	
8:00 - 8:30	Registration and Networking
8:30 - 9:00	Welcome and Announcements
9:00 - 10:00	Session 5: Plenary (Krystal Tolley)
10:00 - 10:30	Mini Presentations
10:30 - 11:00	Tea
11:00 - 13:00	Session 6
13:00 - 14:00	Lunch
14:00 - 15:30	Workshop (Trade)
15:30 - 16:00	Tea
16:00 - 17:00	Workshops (Photography)
17:00 - 18:00	Break
18:00 - 19:30	Poster session
	Dinner on own

Wednesday 18 January	
8:00 - 8:30	Registration and Networking
8:30 - 9:00	Welcome and Announcements
9:00 - 10:45	Session 7: Tribute to Margaretha Hofmeyr
10:45 - 11:15	Tea
11:15 - 13:00	Session 8
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15:30 - 16:00	Tea
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17:00 - 18:00	Break
18:00 - 19:30	Pub quiz
19:30 - 21:00	Pub quiz dinner

Thursday 19 January	
8:00 - 8:30	Registration and Networking
8:30 - 9:00	Welcome and Announcements
9:00 - 10:00	Session 11: Plenary (Jeanne Tarrant)
10:00 - 10:30	Session 11
10:30 - 11:00	Tea
11:00 - 13:00	Session 12
13:00 - 14:00	Lunch
14:00 - 15:30	HAA Annual General Meeting
15:30 - 16:30	Tea
16:30 - 17:00	Closing
17:30 - 19:00	Auction
19:00 - 21:00	Banquet Dinner

Friday 20 January	
All Day	Departure

Student talks indicated by (S)

Mini talks: 5 minutes + 2 minutes for questions (^{M})

Full talks: 12 minutes + 3 minutes for questions (^{F})

Programme

15th Conference of the Herpetological Association of Africa

16 - 19 January, Hoedspruit, Limpopo

Sunday 15 January		
Open Workshop: Amphibian Red List Project Workshop		
9:00 - 15:00	Southern Africa's frogs were last assessed between 2010 and 2015. Since the previous assessments we now have 14 species that are Data Deficient (DD) or Not Evaluated and discussion of assessments for these will also be included, especially in light of recent research showing that 50% of DD species are likely to be threatened. As part of both National Red List processes and the next Global Amphibian Assessment (3), the Regional IUCN Amphibian Specialist Group will be leading the re-assessments for all species that occur in the region during 2023 and 2024. To prepare for this undertaking, we will hold a one-day preliminary workshop to inform interested herpetologists on these processes, including: 1. a brief review of how to apply the Red List criteria and changes introduced by the IUCN since the last amphibian assessments 2. identifying species of concern, and threats for consideration, including climate change 3. introduction of the new approaches to incorporating climate change into Red List assessments and discussion around the required life history information needed to formally include climate change as a future or present threat	
Time	Agenda	Items Lead(s)
09:00-09:15	Welcome and Introductions	Joshua Weeber/Jeanne Tarrant
09:15-10:20	Why Red List? Recap on what Red Listing is and the Red List Process	Jennifer Luedtke (pre-recorded), Krystal Tolley
10:20-10:45	Amphibian Red Listing in South Africa	Jeanne Tarrant
TEA: 15 minutes		
11:00-11:30	Current State of Amphibian Red List Project	Joshua Weeber
11:30-12:30	Threat identification	Joshua Weeber
LUNCH: 45 minutes		
13:15-14:15	Priority Species Identification	Group Session
14:15-14:45	Genetic monitoring	Jessica da Silva
14:45-15:00	Next steps	Joshua Weeber

Monday 16 January			
8:00 - 8:30	Registration and Networking		
8:30 - 9:00	Welcome and Announcements		
9:00 - 10:00	**Session 1**	**Chair: Graham Alexander**	
9:00 - 10:00	Plenary	Romulus Whitaker	Romulus Whitaker: A Life Less Ordinary
10:00 - 10:30	**Session 1**	**Chair: Graham Alexander**	
10:00 - 10:07 M	Elizabeth Patton (S)	Phylogenetic Systematics of Southern African Ground Agamas	
10:07 - 10:14 M	Nicolas Telford	Gecko Invasion: Tracing the range expansion of *Lygodactylus capensis* (Smith 1849) in South Africa	
10:14 - 10:21 M	Christiaan Steenkamp	A helping hand: Securing South Africa's Herpetological Collections	
10:21 - 10:28 M	Albert Myburgh	Crocodiles do not eat fish	
10:30 - 11:00	Tea Break		
11:00 - 13:00	**Session 2**	**Chair: Hiral Naik**	
11::00 -11:15 F	Jessica da Silva	Resolving species boundaries in the phenotypically diverse *Bradypodion ventrale* group	
11:15 - 11:30 F	Javier Lobón-Rovira (S)	Integrative revision of the *Lygodactylus gutturalis* (Bocage, 1873) complex unveils cryptic diversification in Central Africa	
11:30 - 11:45 F	Arthur Tiutenko	Systematics of African house snakes revisited: News about systematic placement of two former Lamprophis species endemic to the Ethiopian highlands	
11:45 -12:00 F	Bradley Gibbons	Sungazer lizard (*Smaug giganteus*) conservation in South Africa: their threats and challenges to reduce the threats	
12:00 -12:15 F	Graham Alexander	Factorial scope of ingestion and the potential functional response of puff adders (*Bitis arietans*) to high prey abundance	
12:15 - 12:30 F	Emily Jackson (S)	The natural history and stranding of the yellow-bellied Sea snake (*Hydrophis platurus*), along the South African coastline	
12:30 - 12:45 F	Jack Phillips (S)	A highspeed camera in the veld: what we can learn from new data types	
12:45 -13:00 F	Ryan van Huyssteen (S)	Habitat Heterogeneity and its Impact on Reptile Communities and Diversity in the Soutpansberg	
13:00 - 14:00	Lunch		
14:00 - 15:30	**Session 3**	**Chair: Amber Jackson**	
14:00 -14:15 F	Kim Scholtz (S)	The impact of climate change on the body condition of Cape cobras (*Naja nivea*) in the Kalahari	
14:15 - 14:30 F	Cora Stobie	A molecular analysis of the Common Girdled Lizard (*Cordylus vittifer*)	
14:30 - 14:45 F	Andrew Turner	Lessons from 18+ years of monitoring fynbos frog populations	
14:45 -15:00 F	Clearance Mnisi	The bacterial skin microbiome composition of the Endangered Pickersgill's reed frog (*Hyperolius pickersgillii*)	
15:00 -15:15 F	Toby Keswick	A study of a declining population of *Chersobius Boulengeri* in the Karoo, South Africa	

15:15 - 15:30 [F]	Francois Becker (S)	A musical mosaic: Cryptic speciation in barking geckos (Ptenopus: Gekkonidae), partitioned by vocalisation and soil texture
15:30 - 16:00	Tea	
16:00 - 17:00	**Session 4**	**Chair: Chris Cooke**
16:00 -16:15 [F]	Jessica Briner	Reptiles in Research
16:15 - 16:30 [F]	Alan Channing	Multiple colour patterns in the *Hyperolius viridiflavus* group, but how many species?
16:30 - 16:45 [F]	Riaaz Mohamed (S)	The impact of woody encroachment on Kalahari reptiles
16:45 -17:00 [F]	Chat Keates	Phylogenetic structuring in sub-Saharan Natriciteres (Colubridae: Natricinae)
17:00 - 18:00	Break	
18:00 - 19:30	**Ice Breaker: Hoedspruit Brewery**	
19:30 - 21:00	**Dinner**	

Tuesday 17 January			
8:00 - 8:30	Registration and Networking		
8:30 - 9:00	Welcome and Announcements		
9:00 - 10:30	**Session 5**	**Chair: Bryan Maritz**	
9:00 - 10:00	Plenary	Krystal Tolley	Living in the Anthropocene: Adaptation of reptiles to altered environments with Dwarf Chameleons as a model system
10:00 - 10:30	**Session 5**	**Chair: Bryan Maritz**	
10:00 - 10:07 **M**	Euan Genevier (S)	Aspects of the urban and rural ecology of Nile monitors (*Varanus niloticus*) in KwaZulu-Natal, South Africa	
10:07 - 10:14 **M**	Tiaan Botha (S)	Frogs of the greater Natures Valley area - Diversity, conservation, and community engagement	
10:14 - 10:21 **M**	Arno van Niekerk (S)	Assessing behavioural patterns and life history of an endangered endemic, the Kloof Frog (*Natalobatrachus bonebergi*), using monitoring and surveillance data	
10:21 - 10:28 **M**	Roger Bills	The South African Institute for Aquatic Biodiversity Frog Collection	
10:30 - 11:00	Tea Break		
11:00 - 13:00	**Session 6**	**Chair: Jess Briner**	
11::00 -11:15 **F**	Hiral Naik (S)	What makes a snake bite? A South African perspective	
11:15 - 11:30 **F**	Alexander Rebelo	Have South African frog ranges shifted or shrunk?	
11:30 - 11:45 **F**	Emma Buckley (S)	Reptile community responses to an avian ecosystem engineer	
11:45 -12:00 **F**	Marc Humphries	High lead exposure and clinical signs of toxicosis in wild Nile crocodiles (*Crocodylus niloticus*) from Lake St Lucia, South Africa	
12:00 -12:15 **F**	Chris Cooke	Shedding light on the impact of education to mitigate human-snake conflict	
12:15 - 12:30 **F**	Louis H. Du Preez	What parasite diversity tells us about *Xenopus laevis*	
12:30 - 12:45 **F**	Karen Lourens	Emergency treatment of wild snakes	
12:45 -13:00 **F**	Annette Hübschle	Follow-the-thing methods to study illicit reptile trafficking	
13:00 - 14:00	Lunch		
14:00 - 15:30	**Workshop**	Reptile Trade	
15:30 - 16:00	Tea		
16:00 - 17:00	**Workshop**	Photography	
17:00 - 18:00	Break		
18:00 - 19:30	**Poster Session: Hoedspruit Reptile Centre**		
19:30 - 21:00	**Dinner at own cost**		

Wednesday 18 January		
8:00 - 8:30	Registration and Networking	
8:30 - 9:00	Welcome and Announcements	
9:00 - 10:45	**Session 7**	**Chair: Uwe Fritz**
9:00 - 10:45		Tribute to Magaretha Hofmeyer
9:00 - 9:15 F	Bryan Henen	Margaretha Delina Hofmeyr, an Inspiration in Chelonian Biology and Conservation
9:15 - 9:30 F	Uwe Fritz	Phylogeny and phylogeography of chelonians from sub-Saharan Africa—a review of current knowledge in tribute to Margaretha D. Hofmeyr
9:30 - 9:45 F	Thomas Leuteritz	Chelonian Biodiversity and Conservation Program: Research on Tent Tortoises (*Psammobates tentorius tentorius*) in the Great Karoo
9:45 - 10:00 F	Jackie Austin (S)	The role ultrasound scanning plays in headstarting Geometric Tortoises (*Psammobates geometricus*)
10:00 - 10:15 F	Flora Ihlow (S)	Molecular phylogeny of African Hinge-back Tortoises (*Kinixys*)
10:15 - 10:30 F	Adrian Armstrong	Conservation genetics of the leopard tortoise (*Stigmochelys pardalis*) in South Africa and its application to tortoises in captivity
10:30 - 10:45	Melita Vamberger	The mysterious *Pelomedusa* species: Latest insights from southern Africa
10:45 - 11:15	Tea Break	
11:15 - 13:00	**Session 8**	**Chair: Gary Nicolau**
11:15 - 11:30 F	Werner Conradie	Phylogeny of African rough-scaled lizards (*Ichnotropis* Peters, 1854**)**
11:30 - 11:45 F	Azraa Ebrahim (S)	Adaptive capacity in selected body temperature of Dwarf Chameleons (*Bradypodion*) in a changing environment
11:45 -12:00 F	Marcel Van Driel	Herpetological research in Zambia
12:00 -12:15 F	Jeanne Tarrant	Croaks, Chirps and Clumps: Long-term monitoring and surveillance efforts for priority South African threatened frog species
12:15 - 12:30 F	Jan Jacobs (S)	An investigation into human-crocodile co-existence in the Limpopo-, Luvuvhu- and Olifants Rivers within the Limpopo Province, South Africa
12:30 - 12:45 F	Thilo Beck (S)	Thermal preferences and activity patterns of cape cobras (*Naja nivea*) in the Kalahari
12:45 -13:00 F	Chad Keates	Phylogenetic Structuring in Psammophiidae
13:00 - 14:00	Lunch	
14:00 - 15:30	**Session 9**	**Chair: Melissa Petford**
14:00 -14:15 F	Bryan Maritz	The ecology of snakebite in southern Africa: lessons from trapping studies

14:15 - 14:30 [F]	Susana Clusella-Trullas	Performance, territory quality and behaviour shape the reproductive output of the southern rock agama, *Agama atra*
14:30 - 14:45 [F]	Wade Stanton-Jones (S)	Gazing into the future: the potential impact of climate change on habitat suitability of the Sungazer (*Smaug giganteus*)
14:45 -15:00 [F]	Fortunate M. Phaka (S)	Herpetofauna in South Africa's urban traditional medicine markets: DNA barcoding and cultural perspectives inform monitoring and conservation
15:00 -15:15 [F]	Gary Nicolau (S)	Hiding in the cracks: Phylogenetics of the genus *Afroedura* (Squamata: Gekkonidae) in the Eastern Cape Province, South Africa
15:15 - 15:30 [F]	Grant Fairly	The life of Brian: an account of the treatment and rehabilitation of a male *Varanus niloticus* following severe injury
15:30 - 16:00	Tea	
16:00 - 17:00	**Session 10**	**Chair: Jody Barends**
16:00 -16:15 [F]	Krystal Tolley	Into Africa: Biogeography of the genus Python
16:15 - 16:30 [F]	Kurt van Wyk (S)	Responses of a Savanna Reptile Community to Historical Land Transformation
16:30 - 16:45 [F]	Melissa Petford	Convergent evolution and ecological diversification in Dwarf Chameleons
17:00 - 18:00	Break	
18:00 - 19:30	**Pub Quiz: Sleeper's Restaurant**	
19:30 - 21:00	**Dinner**	

Thursday 19 January			
8:00 - 8:30	Registration and Networking		
8:30 - 9:00	Welcome and Announcements		
9:00 - 10:00	**Session 11**	**Chair: Joshua Weeber**	
9:00 - 10:00	Plenary	Jeanne Tarrant	Looking back over ten years of frog conservation in SA – the EWT's Threatened Amphibian Programme
10:00 - 10:30	**Session 11**	**Chair: Joshua Weeber**	
10:00 - 10:15 [F]	Cherise Acker	Monitoring and surveillance to improve understanding of Kloof Frog (*Natalobatrachus bonebergi*) breeding biology – implications for conservation	
10:15 - 10:30 [F]	Keir Lynch	Promoting ecosystem resilience and creating a conservation landscape for the Critically Endangered Amathole Toad	
10:30 - 11:00	Tea Break		
11:00 - 13:00	**Session 12**	**Chair: Ryan van Huyssteen**	
11::00 -11:15 [F]	Ernst Baard	Ten years of protected area expansion in the Western Cape: more permanent space for tortoises and terrapins?	
11:15 - 11:30 [F]	Matthew Adair (S)	The Hitchhiker's Guide to the Microbiome of Dwarf Chameleons (*Bradypodion*): Composition and Capacity	
11:30 - 11:45 [F]	Aaron Bauer	Resolution of Species Boundaries in the *Trachylepis striata* complex (Squamata: Scincidae)	
11:45 -12:00 [F]	Wendy Willson	Turning up the heat: Changing the landscape of prosecution and punishment for cruelty to herpetofauna	
12:00 -12:15 [F]	Michael Bates	A new species of *Cordylus* from the Angolan highlands, and the rediscovery of *Cordylus angolensis*	
12:15 - 12:30 [F]	Jody Barends (S)	Trends in the feeding ecology of African egg-eating snakes, *Dasypeltis scabra*	
12:30 - 12:45 [F]	Joshua Weeber (S)	Assessing the effectiveness of an occupancy modelling framework to monitor a rare and threatened amphibian species, *Heleophryne rosei*	
12:45 -13:00 [F]		Q & A	
13:00 - 14:00	Lunch		
14:00 - 15:30	HAA Annual General Meeting		
15:30 - 16:00	Tea		
16:00 -16:30	Extra + Closing		
16:30 - 17:30	Break		
17:30 - 19:00	**Auction**		
19:00 - 21:00	**Banquet Dinner**		

Annual General Meeting

HERPETOLOGICAL ASSOCIATION OF AFRICA

Thursday 19 January 2023 14:00-14:45, Hoedspruit, Limpopo, South Africa

AGENDA

1. Welcome

2. Minutes of previous meeting 9 September 2019, Cape St. Francis, Eastern Cape

3. Chairman's report

4. Treasurer's report

5. Secretary's report

6. Journal Editor's report

7. Newsletter Editor's report

8. Student Portfolio report

9. Media Portfolio report

10. Awards Portfolio report

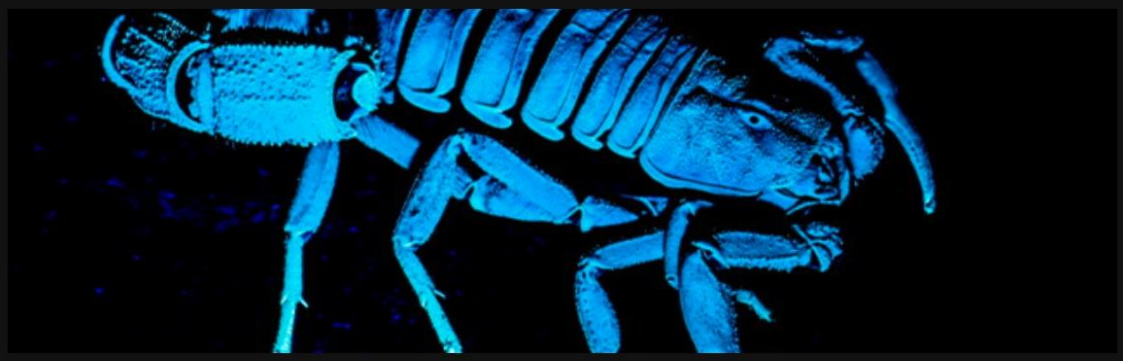
11. Conference Portfolio report

12. Board Chairman report

13. General Business

    12.1 Next conference (2025)

Plenary Speakers



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Romulus Whitaker[1,2]

[1]Global Snakebite Initiative; [2]Centre for Herpetology/Madras Crocodile Bank Trust, Mahabalipuram, Tamil Nadu 603104, India

Romulus Whitaker: A Life Less Ordinary

Being fascinated by reptiles all my life has resulted in some incredible adventures in the far corners of our wonderful world. Doing some science in my 60-year career, I've mostly concentrated on conservation and public education. Living in India all my life was real luck, and after setting up India's first reptile park it was a joy to be hired by United Nations and other organizations to work on reptile projects in Papua New Guinea, Indonesia, Malaysia, Bangladesh, Mozambique and Ethiopia. Producing and presenting a couple of dozen wildlife documentary films was fascinating work which reached millions of people, but my work is far from over and the mitigation of India's huge snakebite problem is what keeps me busy now.

Email: kingcobra@gmail.com

Krystal A. Tolley[1,2,3]

[1]South African National Biodiversity Institute, Kirstenbosch Research Centre, Cape Town, South Africa; [2]School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg, South Africa; [3]Centre for Ecological Genomics and Wildlife Conservation, University of Johannesburg, Auckland Park, Johannesburg, South Africa

Living in the Anthropocene: Adaptation of reptiles to altered environments with Dwarf Chameleons as a model system

We have entered the Anthropocene Era – modification of the planet by humans has altered the Earth so drastically that our legacy will be visible in the fossil record millions of years into the future. We have created truly novel habitats that bear little or no resemblance to natural areas and our impact on the planet is driving a current mass extinction. A critical assumption for conservation is that species will go locally extinct in areas where habitat transformation is significant. However, extinction of a species may not always be the outcome of habitat transformation, with some species responding with phenotypic plasticity or acclimation to allow them to persist, while others exhibiting adaptation to these novel, anthropogenically shaped habitats through changes in genotype frequencies for a beneficial trait in a population, that is – adaptation. Notable examples include bird species that have shifted the frequency of their calls to compensate for noise in urban habitats (plasticity), lizards that have developed foot and hand morphology for urban substrates and fishes that have developed resistance against lethal levels of pollutants (adaptation). Although most instances of adaptation occur gradually, rapid adaptation to urban habitats has become more apparent. Species that adapt rapidly to highly modified habitats do so when selective pressure is intense and populations are fragmented, but also if their adaptive potential – the standing genetic diversity in a population – is adequate for beneficial genotypes to be present and to spread. In South Africa, some populations of Dwarf Chameleons (*Bradypodion*) appear to persist in urbanised habitats. These populations might simply be confined to areas that strongly resemble the natural vegetation or have possibly acclimated to new conditions, for example, by shifting their behaviour. Whether persistence of these urban populations is due to adaptation can be assessed by detecting differences in phenotypes that confer a fitness advantage. By quantifying ecology, behaviour, thermal physiology and morphology, the potential for adaptedness of urban populations can be explored. However, for adaptation to be shown, changes in phenotype must be linked to a shift in genotype frequencies and show a fitness advantage e.g., through performance. Going into the Anthropocene, assessment of adaptive responses to altered environmental conditions should be an important component of interventions to maximise conservation outcomes, and to guide urban planning under different land use scenarios that accounts for human population growth and density.

Email: k.tolley@sanbi.org.za

Jeanne Tarrant[1]

[1]Threatened Amphibian Programme, Endangered Wildlife Trust, Building K2, Pinelands Office Park, Ardeer Road, Modderfontein, 1609, South Africa

Looking back over ten years of frog conservation in SA – the EWT's Threatened Amphibian Programme

The Threatened Amphibian Programme (TAP) was established within the Endangered Wildlife Trust in 2012, with several key objectives, including linking research to applied conservation action. These actions were guided by the "Ensuring the future for South African Frogs" strategy document produced in 2011, the global ACAP, as well as outcomes from my PhD research through North-West University's African Amphibian Conservation Research Group. The first funding grant was secured from the Critical Ecosystems Partnership Fund in 2013 for the "Hogsback Threatened Frogs" project. The project aimed to establish a network of partners in the area, and to improve the understanding of the Critically Endangered Amatole Toad, *Vandijkophrynus amatolicus*, which until the previous year, had not been seen for 13 years. The project also aimed to provide management recommendations for grassland habitat. Today, these objectives are well in progress and will be the subject of a full presentation during the conference proceedings. Also in 2013, we initiated the development of the Biodiversity Management Plan for Pickergsill's Reed Frog, *Hyperolius pickersgilli*, which has proved an incredibly effective means of coordinating conservation activities across a wide range of stakeholders. This year, the plan enters its second 5-year iteration, and has been largely successful. From a focus on these two species, TAP now conducts projects on 10 threatened flagship species (including one snake), across three provinces, and the team has grown from 1 to 13 staff – the highest number of people directly employed for amphibian conservation activities and supported by multiple long-term funders and partners. Our conservation action is guided by the Conservation Measures principles, and we make use of several key strategies to guide project planning, including research (in particular, species and habitat monitoring), habitat management and rehabilitation, habitat protection facilitation, and social change to encourage appreciation of herps. Today I will be talking about these strategies and summarising progress over the last ten years of frog conservation in South Africa.

Email: jeannet@ewt.org.za

Special Session: Tributes to Margaretha D. Hofmeyr

Wednesday 18 January

Margaretha Delina Hofmeyr, an Inspiration in Chelonian Biology and Conservation

Bryan Henen[1]

[1]*Department of Biodiversity and Conservation Biology, University of the Western Cape, Private Bag X17, Bellville, South Africa*

Phylogeny and phylogeography of chelonians from sub-Saharan Africa—a review of current knowledge in tribute to Margaretha D. Hofmeyr

Uwe Fritz[1], Krystal A. Tolley[2], Melita Vamberger[1], Flora Ihlow[3]

[1]*Museum of Zoology, Senckenberg, Dresden, Königsbrücker Landstrasse 159;* [2]*South African National Biodiversity Institute, Kirstenbosch Research Centre, Private Bag X7 Claremont, Cape Town, South Africa;* [3]*Technische Universität Dresden,Rudolfstrasse 8, Dresden, Germany*

The mysterious *Pelomedusa* species: Latest insights from southern Africa

Melita Vamberger[1], Jasmin Noack[1], Marko Djurakić[2], Flora Ihlow[1], Uwe Fritz[1], Ann-Marie Waldvogel[3]

[1]*Museum of Zoology, Senckenberg, Dresden, Königsbrücker Landstrasse 159;* [2]*Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad;* [3]*Institute of Zoology, University of Cologne*

Chelonian Biodiversity and Conservation Program: Research on Tent Tortoises (*Psammobates tentorius tentorius*) in the Great Karoo

Thomas E.J. Leuteritz[1,2,3]

[1]*Chelonian Biodiversity and Conservation – Southern Africa;* [2]*University of the Western Cape, Robert Sobukwe Rd, Bellville, Cape Town;* [3]*U.S. Fish and Wildlife Service, USA*

The role ultrasound scanning plays in headstarting Geometric Tortoises *(Psammobates geometricus*)

Jackie Austin[1], Bernard Wooding[1]

[1]*Mapula Trust*

Molecular phylogeny of African Hinge-back Tortoises (*Kinixys*)

Flora Ihlow[1]

[3]*Technische Universität Dresden,Rudolfstrasse 8, Dresden, Germany*

Conservation genetics of the leopard tortoise (*Stigmochelys pardalis*) in South Africa and its application to tortoises in captivity

Adrian Armstrong[1], Sophia Kropff[2], Rynette Coetzee[3], Craig Whittington-Jones[3], Antoinette Kotze[4], Wade Whitehead[5], Melita F. Vamberger[6]

[1]*Ezemvelo KZN Wildlife, KwaZulu Natal;* [2]*National Zoological Garden, South African National Biodiversity Institute;* [3]*Gauteng Department: Agriculture and Rural Development, Johannesburg, Johannesburg, 2000;* [4]*South African National Biodiversity Institute, Kirstenbosch Research Centre, Cape Town, South Africa;* [5]*Freeme Wildlife Kwazulu Natal;* [6]*Museum of Zoology, Senckenberg, Dresden, Königsbrücker Landstrasse 159*

Abstracts: Full Presentations

Monitoring and surveillance to improve understanding of Kloof Frog (*Natalobatrachus bonebergi*) breeding biology – implications for conservation

Cherise Acker[1], Lizanne Roxburg[1], Jeanne Tarrant[1], Adrian Armstrong[2], Lesely Bentley[3], Mike Bentley[3]

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The Endangered Kloof Frog, Natalobatrachus bonebergi, is endemic to scarp and gallery forests of KwaZulu-Natal and the northern Eastern Cape, usually at altitudes below 900m. It is associated with forested streams and ravines, typically with short fast-flowing sections alternating with longer sections of slow-flowing water and pools that vary in size and depth. These slower-flowing sections are where the species deposits distinctive egg clumps on vegetation and rock surfaces above the water. The Endangered Wildlife Trust's Threatened Amphibian Programme developed a monitoring protocol in partnership with Ezemvelo KZN Wildlife. Since December 2013, the protocol has been tested and refined in partnership with Ezemvelo KZN Wildlife Honorary Officers at Vernon Crookes Nature Reserve in 2014 where data on egg clump variables has been collected along a 370m transect of the Mhlathikulu Stream. A robust 10-year data set has been collated (n = 899 egg clumps) showing that in 71% of egg-laying instances, N. bonebergi lays eggs on leaf surfaces, usually in full or partial shade. Mean water depth below egg clumps is 14cm, at an average height above water of 73cm. Since 2015, the protocol was also rolled out at additional sites including two provincial reserves in the Eastern Cape, a local conservancy in KZN, and swamp forest on the KZN South Coast, where the Kloof Frog and Endangered Pickersgill's Reed Frog occur in close proximity. Monitoring data from these sites provides an interesting comparison for differing levels in effort and consistency of citizen science groups who collect the data. To further enhance understanding of the life history of this unique species, in 2021 surveillance using camera traps has been undertaken, with over 4500 hours of recording data collected to date, revealing fascinating behaviours, including mate interaction and laying site selection. Understanding preferred breeding site condition is necessary to supporting effective conservation management actions to maintain present and future populations of this Endangered species. The importance of effective long-term monitoring and the benefit of these programmes supported by multiple partners is clearly demonstrated by the Kloof Frog Monitoring Protocol.

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The Hitchhiker's Guide to the Microbiome of Dwarf Chameleons (*Bradypodion*): Composition, and Capacity

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Initial descriptions of microbial life presented a microcosm of 'animalcula' inhabiting environments similar to those of macroscopic life. Since these early observations horizons have expanded and the microbial world is now seen as a nuanced and multitudinous system. With the advent of Next-Generation Sequencing (NGS) technologies, the ability to study these microscopic worlds has been expounded, revealing stunning complexity. One ultimate outcome of these expanding horizons has been the identification and study of the microbiome. This has even led to the proposal of novel, complex co-evolutionary theories (i.e., the Hologenome Theory of Evolution). Unfortunately, studies regarding the microbiomes of reptiles remain scarce, however, burgeoning research is unfolding. The chameleon genus *Bradypodion* is a prime candidate for studying the adaptive ability conferred by symbiotic micro-organisms as, beyond containing a score of comparable species, there is rich ecomorphological variation allowing many populations to thrive in both natural and transformed environments. Furthermore, microbial descriptions in *Bradypodion* remain undescribed in literature making insights to this aspect novel. This study, thus, aimed to apply current metagenomic methodologies, in the form of a MiSeq NGS platform (present at SAIAB), a High-Performance Computing facility (Ilifu), and machine learning algorithms (QIIME2) to visualise the bacterial microbial communities in *Bradypodion*. This has resulted in the first descriptions of the bacterial communities present in the digestive tracts (both buccal and faecal) for *Bradypodion melanocephalum*, *Bradypodion thamnobates*, and *Bradypodion setaroi* – endemics to southern Africa. Furthermore, these descriptions were used to inform the potential for phylosymbiosis within the genus based on the relative divergence times between the three chameleon species and the relative diversity of bacteria present. Here, appreciable microbial diversity was demonstrated across all samples with the use of alpha and beta diversity metrics. The comparison of bacterial diversity between the *Bradypodion* species showed that phylosymbiosis is not clearly defined within the genus, as different sample groupings offer contradictory outcomes to what is expected for phylosymbiosis. Due to the dichotomy, the explanation of partial phylosymbiosis is suggested, whilst further targeted sampling of other species in the genus is recommend and outlined. Furthermore, insight into the role that transformed habitat plays in the composition of the *Bradypodion* microbiome was produced; no differences were detected between populations from natural and transformed habitats, suggesting optimal microbiome composition regardless of habitat.

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Factorial scope of ingestion and the potential functional response of puff adders (*Bitis arietans*) to high prey abundance

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Predators can react to changing prey abundance in two fundamentally different ways: populations can respond functionally, where individuals simply eat more in times of plenty, or they can react numerically, where a surfeit of prey leads to an increase in predator numbers over time due to more successful reproduction. Unlike the numerical response, a functional response can stabilize fluctuations in prey numbers because the response is immediate. However, there has been a longstanding view that, due to their slow ectothermic physiology, digestion constraints, and 'leisurely lifestyle', snakes do not dramatically impact prey numbers in times of high prey abundance. It has been argued that snakes are only able to impact prey abundance when prey densities are low. This interpretation of the impact of snake foraging implies that snakes do not have a stabilizing effect on prey demographics when prey is abundant. In this study I measured several aspects of feeding in a captive colony of puff adders (*Bitis arietans*) to evaluate their potential impact on prey abundance. I introduce a new metric, the 'factorial scope of ingestion' (maximum food intake divided by maintenance intake) as a means of evaluating the ability of predators to functionally respond to dramatic increases in prey abundance. Rate of weight loss during fasting was also quantified as a means of estimating possible duration of fasting. Results suggest that puff adders must annually consume 63% of their body mass in rodents to maintain a constant body mass. However, when given the opportunity, puff adders voluntarily increased their food intake by an annualized average of 12 times (SD 3.9) measured over 3-month trials, resulting in dramatic increases in body mass. In the most extreme case, an individual had a factorial scope of ingestion of 20. Regression analysis between food intake and changes in body mass, and direct measures of weight loss, independently estimated an annualized loss in body mass of ~20% for fasting puff adders. This suggests that a puff adder with a high initial body condition index could survive for more than two years without feeding. The extreme flexibility of puff adder feeding biology suggests that this species has the potential to have a massive functional response to high prey abundance and this response is likely to be much more profound than the functional response of mammalian predators. This finding highlights the importance of snakes as potential stabilizers of prey populations.

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Conservation genetics of the leopard tortoise (*Stigmochelys pardalis*) in South Africa and its application to tortoises in captivity

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The leopard tortoise *Stigmochelys pardalis* is protected in some provinces of South Africa, including KwaZulu-Natal and Gauteng. Tortoises may be illegally acquired by members of the public from the wild or roadside vendors or other members of the public and may be transported considerable distances across provincial boundaries to their places of captivity. Some people want to dispose of their captive tortoises for a variety of reasons without disclosing or knowing their origins, while other tortoises are found wandering around in urban areas. The main avenues of disposal are to rehabilitation centres and zoos, resulting in accumulations of tortoises of unknown origin. Sometimes unwanted tortoises are simply released into the environment with little concern as to their survival or for the integrity and health of wild populations. For these reasons, we are working towards a scientifically sound, best-practice tortoise release protocol. An important part of this protocol will be the genetic testing of captive tortoises to ensure that those fit-for-release to the wild are released in their native environments. The work of Spitzweg et al. (2019) and Dajčman et al. (2021) has assisted considerably in this regard, and work is still being done to close some gaps in the genetic map for leopard tortoises in South Africa. Fruitful collaborations are now established between Senckenberg Natural History Collections Dresden, the South African National Biodiversity Institute, the Gauteng Department of Agriculture and Rural Development and Ezemvelo KZN Wildlife. In two provinces, Gauteng and KwaZulu-Natal, a process to collect DNA samples from captive leopard tortoises has been implemented to determine origin using the dataset that was developed. This research provides strong support for conservation decision-making, making the return of leopard tortoises to their geographical areas of origin feasible. The first implementation of the genetic testing protocol was for 72 leopard tortoises at the National Zoological Garden in Pretoria and 50 at FreeMe in Howick. Only one of the latter 50 tortoises was genetically suitable for release in KwaZulu-Natal. The genetic map for leopard tortoises in South Africa can be used to determine where to release the other 49 tortoises if they are fit for release. Some examples are presented using the results of the genetic testing at FreeMe. Use of DNA results to identify genetically pure individuals suitable for release will continue as well as the identification of hybrid tortoises.

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The role ultrasound scanning plays in headstarting Geometric Trotoises *(Psammobates geometricus*)

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The range of Geometric Tortoises is restricted to a small region in the western Cape where a few populations still survive in isolated habitat fragments. Habitat destruction and degradation has caused the greatest decline in the species. However, one of the most severe threats now is high mortality due to wildfires, which have become more frequent in recent decades. A January 2012 wildfire destroyed the largest remaining habitat fragment, and killed many of the geometric tortoises, on the Elandsberg Nature Reserve. We used surviving geometric tortoises, saved in a subsequent search-and-rescue operation, to initiate an in-situ head-start program. The program aim is to facilitate survival of hatchlings and juveniles and boost the wild population by introducing the head-started sub-adults to the reserve. We use ultrasonography to anticipate finding hatchlings and juveniles to head start. Ultrasound scanning of adult females allows us to assess whether they are vitellogenic (i.e., developing follicles in their ovaries). We scan female tortoises once per month to identify which females are gravid (i.e., have ovulated and are calcifying eggshells), and to estimate clutch size. Eggshell thickness helps us determine when we place females in the nesting camp to oviposit. We use subsequent ultrasound scans to determine that females have laid their eggs, and how many eggs they lay, helping us know how many hatchlings we can anticipate in the hatching season (the ensuing autumn). We normally scan camp females from March until early December, which is typically the end of the egg laying season. Then we return females home to the bigger camps and monitor the nesting camps for hatchlings. We use a water bath to conduct the ultrasound waves, pressing the probe to the inguinal openings while holding the hind leg extended and the posterior body submerged. Prof. Margaretha Hofmeyr mastered ultrasound scanning of geometric tortoises, which are very difficult to scan due to their narrow acoustic windows and extreme wariness to extend their limbs. Due to Retha's expertise in handling and scanning geometric tortoises, and keen ability to instruct me, we are continuing the headstart program through her vision.

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Ten years of protected area expansion in the Western Cape: more permanent space for tortoises and terrapins?

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The successful implementation of a biodiversity stewardship programme by CapeNature, aimed at incorporating more private land under formal conservation through land acquisition and biodiversity stewardship agreements, resulted in the addition of more than 201,000 ha of land to the protected area estate in the Western Cape during the last 10 years. Based on the Western Cape Biodiversity Spatial Plan, protected area expansion targets are informed by ecosystem and species targets. Private landowners are engaged to nominate portions of their properties for expert evaluation, recommending stewardship status which includes contract nature reserve status in perpetuity captured in title deeds, and recognised under the National Environmental Management: Protected Areas Act (NEM:PAA). Naturally, the land added represent several different biome, terrestrial and freshwater ecosystem and habitat types inhabited by a variety of plants and animals, chelonians in particular. The aim of the study was to determine if land acquisition and the establishment of contract nature reserves during the last 10 years added significant safe, quality and permanent space for chelonians. An intersection of the protected area map with the spatial distribution of tortoises and terrapins in the Western Cape and extrapolation of distribution data and habitat preferences for *Stigmochelys pardalis*, *Chersina angulata*, *Psammobates geometricus* and *P. tentorius*, *Homopus areolatus* and *H. femoralis*, *Chesobius boulengeri*, *C. signatus*, and *Pelomedusa galeata* indicates that at least eight species are represented in the expanded estate, adding notable secure and well-protected land to augment traditional protected areas such as national parks, and provincial and local authority nature reserves recognised under NEM:PAA.

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Trends in the feeding ecology of African egg-eating snakes, *Dasypeltis scabra*

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The evolution of ecological specialization on a restricted set of resources requires that those resources are available when needed by an organism. Additionally, when morphological traits make resource access body size-dependent, changes in resource availability might disproportionately alter access to those resources for different cohorts within a population. We investigated monthly trends of the accessibility and availability of bird eggs suitable for consumption by differently sized *Dasypeltis scabra*, an obligate bird-egg specialist snake species. In a three-year laboratory study, we examined the feeding performance and eating habits of a colony of captive *D. scabra*. Based on their ability to ingest differently-sized eggs, we calculated the number of species of birds across southern Africa whose eggs are accessible for consumption by different cohorts of snakes. We then used information on the egg-laying habits of those bird species to quantify monthly patterns of egg availability. We also quantified the relationship between snake feeding and growth, from which we estimated the average yearly food requirements for snakes to maintain body condition. Finally, we quantified monthly patterns of snake food acceptance. We estimate that adult snakes can consume the eggs of 708 of 728 bird species (98%) and juveniles can consume the eggs of 363 of 728 bird species (50%). Suitably sized eggs are widely available during warm spring and summer months but less frequently available during colder winter months. This seasonal difference in availability is far greater for smaller-bodied snakes. Under laboratory conditions, snakes required food equal to only 61% of initial body mass to maintain body condition over one year. Moreover, snakes exhibited a seasonal feeding rhythm with high rates of food acceptance coinciding with peaks in monthly bird egg-laying in the Austral spring and summer. Our findings indicate that seasonal fluctuations of prey availability are probably one of the sources of the selective pressures that contributed to increased ingestion ability that allow smaller snakes to potentially access larger eggs that are more readily available through cooler months, as well as reduced metabolic rates which allow snakes to fast during periods of limited availability of food. Thus, seasonal variation in prey availability does not preclude dietary specialization within *D. scabra* but may well have driven the evolution of other traits that influence trends in these snakes' foraging and feeding.

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A new species of *Cordylus* from the Angolan highlands, and the rediscovery of *Cordylus angolensis*

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Cordylus angolensis Bocage, 1895 was described 127 years ago on the basis of a specimen from Caconda in the west-central highlands of Angola. Additional specimens collected at 'Mombolo' (also in the latter highlands) during the Vernay Angola Expedition in 1925, have also been referred to *C. angolensis*. In 1970, a specimen similar to the Mombolo series was found near Condé, north of Mombolo, by Wulf Haacke. The holotype of *C. angolensis* was destroyed in the fire of 1978 at the Museu Bocage in Lisbon, and no further collections of similar cordylids were made in west-central Angola until recently. The taxonomic status and phylogenetic relationships of these lizards has remained uncertain. Recent field work in the Angolan highlands resulted in the collection of a series of specimens from the mountains of Taqueta (west of Caconda), Mt. Verde (Sandula, 'Mombolo') and Uassamba (Vondo). A molecular analysis, using three mitochondrial and six nuclear genes, indicated the existence of two distinct species-level lineages in the Angolan highlands. These two species are allopatric and morphologically distinct, differing especially in terms of their dorsal colour patterns, eye colour and certain scalation characteristics. We therefore confirm that *C. angolensis* is a valid species and propose a neotype, and also describe a new species of *Cordylus*.

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Resolution of Species Boundaries in the *Trachylepis striata* complex (Squamata: Scincidae)

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We used a multilocus dataset (5 nuclear markers, 1 mitochondrial marker) to evaluate relationships among ~215 individuals of the *Trachylepis striata* complex and its sister taxon, *T. spilogaster*. A priori assignment to species-level taxa was typically based on colour pattern and/or geography. The nuclear data analysed in a maximum likelihood framework, as well as by clustering methods (Admixture, PCA) strongly supported four species-level, monophyletic groups within the *T. striata* complex. 16S data yielded a broadly similar pattern, but assignment to species was in conflict for some southern and western samples. *Trachylepis striata* sensu stricto is restricted to southeastern Africa whereas *T. wahlbergii* and *T. punctatissima* are chiefly western and southern taxa, respectively, although all three occur in sympatry or near-sympatry in some areas. The fourth species in the complex is *T. loluiensis*, which occurs in the Albertine Rift and the Eastern Rift systems. Two previously accepted taxa, *T. sparsa* and *T. mlanjensis*, are not supported by our data, but rather fall within *T. punctatissima* and *T. striata*, respectively. The complex as a whole diverged from *T. spilogaster* approximately 5 MY ago and divergence within the complex began approximately 2–2.5 MY ago. Colour pattern appears labile within members of the group and is not necessarily reflective of relationship. Our results support substantial changes to previous conceptions of species assignment and biogeography of all constituent taxa.

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Thermal preferences and activity patterns of cape cobras (*Naja nivea*) in the Kalahari

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Compared to endotherms, reptiles have a slow metabolism which causes them to generate very little body heat, and they thus rely primarily on behaviour to regulate body temperature (Tb). As a result of their thermal biology, reptiles are especially vulnerable to increasing temperatures due to climate change. We implanted free-ranging cape cobras (*Naja nivea*) at Tswalu Kalahari Reserve with temperature loggers and radiotelemetry to quantify their thermal preferences and examine the relationship between Tb and activity. Body temperature loggers were programmed to record Tb at 30-minute intervals. Target temperature (Ttarget) was calculated by averaging Tb values of thermoregulating snakes that were not thermally constrained. We used the first and third quartiles of selected Tb to calculate voluntary max and voluntary min Tb. In addition, we developed a method to score snake activity remotely by using a 0.5 SD threshold of Tb per 24h. Ttarget for cape cobras was estimated as 28.7 °C (SD 1.43). Male cobras (n = 12) had an average Vtmax of 30.8 °C (SD 1.25) and an average Vtmin of 26.7 °C (SD 1.07). Females (n = 9) had an average Vtmax of 30.0 °C (SD 0.78) and an average Vtmin of 26.2 °C (SD 0.53) with no significant difference between the sexes for Vtmax (P=0.10) or Vtmin (P=0.29). Analysis of activity patterns showed that snakes were active on 49% of the days in both spring (SD 19.6) and summer (SD 18.8) and on 66% of days in autumn (SD 15.7). In winter, snakes were rarely active, with activity on only 10% of days. However, three individuals were active on 72% of days in winter. A possible explanation for these exceptional levels of winter activity might be that these individuals had poor body conditions, possibly due to very low rainfall in the preceding rainy season. Animals living in climate change hotspots such as the Kalahari will be significantly affected by changing rainfall and temperature, which will directly impact their physiology and behaviour. Previous research on thermoregulation in African snakes mostly centred around ambush-foraging snakes as study subjects. This study offers insight into the thermal preferences of a large active foraging snake adapted to hot and arid conditions.

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A musical mosaic: Cryptic speciation in barking geckos (Ptenopus: Gekkonidae), partitioned by vocalisation and soil texture

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The southern African barking geckos (*Ptenopus*) are probably the worlds' most vocal squamates. Two species (*P. kochi* and *P. carpi*) demonstrate clear differences in advertisement call and soil texture preference, whereas the third and most widespread species, *P. garrulus*, occurs on a range of substrates and displays considerable variation in advertisement calls. Two subspecies are recognised within *P. garrulus*, with *P. g. garrulus* occurring throughout the Kalahari Basin and *P. g. maculatus* occurring across western Namibia and most of South Africa. Given the partitioning of substrate and advertisement calls of *P. kochi* and *P. carpi*, these factors may have driven speciation in this genus. Moreover, the variation in these traits within *P. garrulus* may signal the presence of cryptic species. To investigate this, Bayesian Inference and Maximum Likelihood phylogenetic analyses were performed on the ND2, 16S, and c-mos gene regions (2016 base pairs) of multiple individuals (n = 81) from across the range of all three species. Morphological and vocalisation data were contextualised in the phylogenetic framework and a general lineage species concept was applied. The phylogeny shows that *P. carpi* and *P. kochi* are both monophyletic but that *P. g. maculatus* is paraphyletic, containing one clade that is sister to *P. kochi* and several clades allied to *P. g. garrulus*. Using species delimitation approaches, we identified several species lineages within *P. garrulus*, representing different populations with limited gene-flow over small spatial scales. The geographic distribution of these populations appears to be substrate-specific in some cases, or to reflect climatic gradients in others. Differences in advertisement call were evident between clades or populations for number of notes, rhythm, and dominant frequency. Multiple lines of evidence support the evolution of separately evolving lineages in *Ptenopus* that are diagnosable through the integration of ecological and genetic evidence. Therefore, we suggest that *Ptenopus maculatus* Gray, 1866 should be removed out of synonymy with *P. garrulus* and reinstated as a full species, and that several new species should be described.

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Reptiles in Research

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Reptiles are widely used for research purposes. However, reptiles and their environmental and physiological needs are often overlooked. Reptile brains include the basal ganglia. The basal ganglia is primarily responsible for motor control, however, it is also responsible for other roles such as motor learning, behaviours and even emotions. Many reptiles use visual cues and noise to communicate with each other and their environment, displaying complex behaviours that may still not be fully understood; behaviours that can be difficult to study or quantify using current investigative standards. With current enclosure standards consisting largely of modular enclosures including opaque rack systems and small sterile containers, many species are not in environments where they are capable of displaying natural behaviours. Indeed, it could be considered that providing enriching environments or situations where reptiles can exhibit natural behaviour is misunderstood or not considered significant in the research context. Living conditions in captivity, whether in laboratories, holding facilities or field sites, needs to be appropriate for the species and contribute to their health and welfare. Researchers should consider the biology of their animals and what requirements are necessary for a particular species to thrive. Researchers should also be trained or experienced in the proper care, handling and use of the species being maintained and/or studied and have an appropriate understanding of how to identify an animal that needs care. Veterinary care should be readily available and/or accessible. Restraint and ease of maintenance by keepers or carers should not be the prime determinant of housing conditions. Good biosecurity measures and excellent cleaning practices should be maintained, and important considerations should include effects on behaviour, physiology, and survival. Reptiles used in research are also often captured from the wild and strict ethical considerations on population dynamics, impacts and habitat conservation should be applied. Where possible, specimens should be released back into the wild after research is concluded rather than euthanised. Keeping research animals happy and healthy will benefit scientific research as the study cohort will be most representative of the wild and natural populations or behaviours being studied.

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Reptile community responses to an avian ecosystem engineer

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In the Kalahari, Sociable Weavers (*Philetairus socius*) build huge, communal nests. Although Kalahari Tree Skinks (*Trachylepis spilogaster*) are known to preferentially utilize trees that host such colonies, the degree to which other reptiles use these trees is not well documented. We trapped reptiles at Tswalu Kalahari Reserve to assess the impact of Sociable Weaver colonies on selected reptile populations during weaver breeding and non-breeding seasons. We tested the hypotheses that the reptile community under trees with colonies would differ in diversity compared to those at nearby control trees without colonies. We also tested that the abundance of *T. spilogaster*, *Naja nivea* and *Pachydactylus capensis* under trees with colonies would differ to those at nearby control trees without colonies. Trapping for 11 days at 24 sites (12 colony trees, 12 control trees), on two occasions, once in March when weavers were breeding and once in September before they were breeding, resulted in 665 total detections of 13 reptile species, including 148 total recaptures. Mean species richness was significantly higher at colony trees than at control trees during both surveys (2.5 times higher when the birds were breeding; 1.6 times higher when the birds were not breeding). N-mixture modelling revealed that *T. spilogaster* was significantly more abundant on colony trees during the breeding (3.2 times) and non-breeding seasons (3.7 times). Similarly, Royle-Nichols modelling revealed that *P. capensis* were more abundant on colony trees during both the breeding (10.5 times) and non-breeding seasons (5.6 times). Conversely, *N. nivea* was ~13 times more abundant on colony trees during the breeding season but showed no difference in abundance between colony and non-colony trees in the absence of breeding. We interpret these results to suggest that lizards potentially utilize colony trees for both food and shelter whereas cobras preferentially utilize colonies for food only. Our work reveals that Sociable Weaver colonies can influence reptile communities though non-exclusive mechanisms such as microhabitat engineering, but also through food resource allocation.

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Multiple colour patterns in the *Hyperolius viridiflavus* group, but how many species?

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African reed frogs are widespread and highly polymorphic for colour pattern. The *Hyperolius viridiflavus* complex includes 121 described taxa, including subspecies, which are presently synonymised as 16 species. However, the taxonomy is confused as colour patterns have been used to identify species, despite an inadequate understanding of pattern variation and overlap. This study examined 271 sequences of the 16S rRNA fragment from individuals across the range of the group, from Senegal to Ethiopia, and to the southern tip of Africa. Maximum likelihood analysis showed that there were 14 species that only partially agreed with existing taxonomy. This study recognised the following species: *Hyperolius viridiflavus*, *H. marmoratus*, *H. marginatus*, *H. parallelus*, *H. nitidulus*, *H. glandicolor*, *H. tuberculatus*, *H. mariae*, *H. noblei*, *H. goetzei*, *H. spatzi*, *H. bangwae*, *H. dintelmanni*, *Hyperolius nimbae* and an undescribed species from southern Cameroon. *Hyperolius swynnertoni* was found to be embedded within *H. marmoratus*, *H. hutsebauti* was embedded within *H. parallelus*, *H. rhodesianus* and *H. pyrrhodictyon* were embedded within *H. marginatus* and *H. sheldricki* was embedded within *H. glandicolor*. The use of DNA sequences to identify animals is recommended in this group, as the variation in advertisement calls and morphology is not well understood.

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Performance, territory quality and behaviour shape the reproductive output of the southern rock agama, *Agama atra*

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Ectotherms, such as lizards, can utilize multiple strategies to cope with climate warming. In particular, the parameters that describe the thermal sensitivity of physiological traits such as optimal performance and critical temperature limits, and their plasticity, have been key to modelling the vulnerability of these species to climate change. In addition, behavioural thermoregulation buffers temperature extremes or allows individuals to reach optimal temperatures, driving their performance in the field. While multiple studies have examined these aspects, often in isolation, linking individual performance, field thermal exposure and associated fitness costs and benefits remains a challenge. In other words, we lack a fundamental understanding of how the transition from individual to population responses in the field are mediated by temperature, which requires an integration of these facets. Here, we studied a population of the southern rock agama lizard (*Agama atra*) and integrated (i) the temperature dependence of running performance, (ii) fine-scale measurements of field operative temperatures and lizard body temperatures, and (iii) the reproductive success determined via paternity assignments of offspring to individual adult lizards. We show that fitness is predicted by the association of lizards' thermal physiology and the thermal properties of their territories. Male lizards that occupied territories of low thermal quality spent more time thermoregulating and less time with behavioural displays. In addition, display rate was positively associated with lizard reproductive output. Therefore, our study suggests that engaging in thermoregulatory behaviour incurs missed opportunity costs, such as the time invested in behavioural displays. These effects may amplify when facing climate change scenarios.

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Phylogeny of African rough-scaled lizards (*Ichnotropis* Peters, 1854)

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The genus *Ichnotropis* consists of medium-sized lacertids that are characterised by their rough head shields. The genus currently comprises six recognised species that occur across most of southern, central and eastern Africa, but the collection of specimens has been geographically patchy and rare, hampering a systematic review of the genus. The lack of adequate specimen collection has led to many regional variants being described as separate species or subspecies, based solely on morphological characteristics. In recent years, genetic material for most of these elusive lizards has become available allowing for the first well-resolved phylogeny of the genus. We investigated the phylogenetic relationships within *Ichnotropis* with two mitochondrial (16S and ND2) and two nuclear (c-mos, RAG-1) gene markers. Both Maximum Likelihood and Bayesian Inference analyses were conducted using a total of 48 samples, representing five of the currently recognised species (only lacking *I. chapini*). Additionally, comprehensive geographic coverage of the widespread *I. capensis* allowed us to explore the validity of some of the described subspecies. The genus was recovered as monophyletic in relation to other African lacertids. We provide the first genetic sampling of *I. tanganicana*, *I. microlepidota* and *I. grandiceps* and confirm them all as valid taxonomical units. We further document cryptic diversity in *I. grandiceps*, while three well-supported clades were recovered in the widespread *I. capensis*. The latter clades may correspond to previously described species which have since been placed in the synonymy of *I. capensis*.

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Shedding light on the impact of education to mitigate human-snake conflict

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Human-snake conflict is an increasingly common problem around the world, stemming from a lack of education about snakes and human encroachment of natural habitats. This conflict often results in an increased risk of snakebite. To reduce human-snake conflict, education about snakes and snake safety is critical. The greater Hoedspruit area in Limpopo Province, South Africa, is predominantly rural with increasingly more development taking place in natural areas. Hoedspruit is home to a large diversity of venomous and non-venomous snake species which are often encountered and killed. To create a better relationship between snakes and humans in the area and reduce snakebite incidences, Save The Snakes, a non-profit organisation and Hoedspruit Reptile Centre, an education and conservation-focused reptile zoo, formed an initiative called the Snake Education and Community Awareness Program (SECAP). We have five core projects focusing on schools, rural communities, snake relocators, healthcare professionals and an essential antivenom bank. Through our schools project, we have been able to evaluate the impact of our work through surveys. We visited various schools in the greater Hoedspruit area, conducted pre-talk surveys, an interactive presentation, and a snake demonstration. The survey results indicated that learners had a range of different attitudes towards snakes, from loving snakes (28%) and fearing snakes (44%) to hating snakes (9%) and killing snakes (23%). A month after the first visit, we went for a second visit and conducted post-talk surveys to evaluate the impact of our efforts. The second survey results showed an improved perception of snakes and two times less likelihood of killing snakes. Our education models are designed to incorporate scientific research and to bring the science of snakes to the community and school curricula. Our ongoing research efforts focus on the ecology and behaviour of snakes in the area, their relationship with other wildlife and their relationship with humans. Through our continual engagement with learners and community members, we believe there will be a reduction in both the number of snakebite incidences and snake killings and the success of this project will contribute positively towards snake conservation.

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Resolving species boundaries in the phenotypically diverse *Bradypodion ventrale* group

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Dwarf chameleons of the genus *Bradypodion* are a phenotypically diverse group of southern African endemics that underwent a rapid radiation beginning approximately 6 Mya. The phenotypic variation characterizing the youngest clades is thought to be due to ecologically driven diversification, resulting in convergent ecomorphological states across the different clades, but with divergent ecomorphological states between closely related taxa. For example, the *Bradypodion ventrale* species complex includes several described species (*B. ventrale* occurring in diverse shrubby habitats, and *B. taeniabronchum*, *B. baviaanense* and *B. barbatulum* occurring in montane fynbos), with an undescribed candidate species from the fynbos habitat at Groendal Nature Reserve in the Eastern Cape Province, South Africa. Mitochondrial DNA was able to fully resolve the status of most species in the complex; however, the status of the Groendal population is unclear. This population is parapatric with *B. ventrale* but occupies a very different habitat and has a seemingly different morphology. Nevertheless, because the two are closely related, there may still be sufficient gene flow detected between them, blurring species boundaries. To investigate whether the two populations could be considered separately evolving lineages, we combined fine-scale genetic markers (microsatellites) and a suite of morphological measurements to assess the differences between these populations. Data from 18 microsatellite loci revealed distinct genetic structure between *B. ventrale* and the Groendal chameleons, suggesting there is no present-day gene flow between them. The morphological evidence showed the Groendal chameleons to be similar to *B. ventrale* for overall head shape, but diverse in terms of tail, casque and limb size showing more similarity to *B. taeniabronchum*. Given that Groendal chameleons are genetically and morphologically different from *B. ventrale*, we suggest that gene flow between these species has ceased due to an ecological barrier, allowing the Groendal chameleons to undergo ecological diversification and placing them as a separately evolving population that is in the early stage of speciation.

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What its parasite diversity tells us about *Xenopus laevis*

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The African Clawed Frog *Xenopus laevis* is the third most widely distributed amphibian globally. With its penchant for overland movement, ability to adapt to a variety of waterbodies and human-mediated translocation as fishing bait and scientific model organism, *X. laevis* is a successful disperser and pioneer in its native and invasive ranges. In its native range of southern Africa, it has been associated with more than 30 species of metazoan parasites, as well as a number of protozoan blood parasites and rectal endociliates. This parasite assemblage includes representatives of all the major parasitic groups, namely Protozoa, Monogenea, Digenea, Cestoda, Nematoda, Acari, Hirudinia, except the Acanthocephala. Many of the species are highly apomorphic and host-specific. Yet, *X. laevis* can act as a paratenic host to larval nematodes and digenean metacercariae with fish, reptiles and birds as final hosts, which draws attention to its key role in aquatic ecosystems. Tellingly, *X. laevis* plays a similar role in parasite dynamics in its invasive range, which covers parts of Europe, Asia, North and South America. In addition to three helminth species co-introduced along with the host from the native range, the parasite assemblage of *X. laevis* in its invasive range also includes larval nematodes and digenean metacercariae that most likely derive from its new environment. Traditionally, much attention has been afforded the concept of parasite loss during biological invasions. This globally invasive frog highlights the presence of accompanying parasites and novel parasite associations that characterise the parasite dynamics of a highly mobile species.

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Adaptive capacity in selected body temperature of Dwarf Chameleons (*Bradypodion*) in a changing environment

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Changes in habitat and climate can impact the local thermal environment, resulting in a mismatch between the thermal physiology of species and their environments. Species with low vagility cannot easily track climate if change is rapid, limiting their response to adapting to the new conditions if they are to avoid population decline. Originally, thermoregulatory setpoints (e.g., selected body temperature; Tsel) of reptiles were thought to have high adaptive inertia due to the buffering effect of behavioural thermoregulation. Additionally, any change to a thermoregulatory setpoint requires multiple adaptations to the thermal physiology of the animal. However, some recent studies have reported lability of thermoregulatory setpoints, whereby species have been shown to respond to changes in the thermal environment by adapting thermoregulatory setpoints to suite new conditions. We compared the thermal characteristics of the habitats of five species of *Bradypodion* chameleons and assessed the adaptive capacity of their Tsel. We sampled chameleons from Afrotemperate forests (*B. damaranum* and *B. thamnobates*), subtropical coastal forest (*B. setaroi*), montane fynbos (*B. barbatulum*) and grassy savanna/coastal vegetation (*B. melanocephalum*). We predicted that if the thermal physiology within *Bradypodion* is adaptable, that Tsel would differ between species, and that these differences may be attributed to differences in their thermal environments. To test this hypothesis, Tsel was measured for between 21 and 32 individuals for each species in a thermal gradient, and we recorded environmental temperatures in the habitat for each species using iButtons. Both Tsel and the environmental temperature profiles differed significantly between species, suggesting that Tsel is adaptable within *Bradypodion*. These findings suggest that *Bradypodion* has the potential to cope with some degree of future changes in the thermal landscape due to global climate change.

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The life of Brian: an account of the treatment and rehabilitation of a male Varanus niloticus following severe injury

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The Water Monitor *Varanus niloticus* is a well-known lizard of the family Varanidae which was described in 1766 by Linnaeus. The taxonomy and behaviour have been widely studied by leading scientists such as Alexander, Bôhme and Ziegler. What is not well understood, and where there is a paucity of information, is in the field of veterinary rehabilitation after surgery and other treatment. In this presentation I will table and explain the interventions, trials and tribulations in the rehabilitation of Brian. (He was named Brian after the leading character of the Monty Python classic.) Brian was admitted to Johannesburg Wildlife Veterinary Hospital in January 2022 and presented with a fractured right front forelimb and trauma to the right side of the head. He had been struck by a motor vehicle. The fracture was successfully treated by Dr Karin Lourens, and he recovered slowly with all indications being of a successful release into the wild in due course with no handicap. However, Brian did not gain mass as expected, remained lethargic, would not eat on his own, did not use his front right leg and generally did not exhibit the behaviour characteristic of a wild Water Monitor. Reptiles take a long time to heal from severe trauma, but Brian seemed to have lost his will to live. The choice had to be made if we should persevere with the rehabilitation of Brian or euthanise him as he would not survive as a free animal. The presentation and talk goes through the rehabilitation of Brian and tables the interventions, the successes and failures on his road to full recovery. It includes experimentation with dietary supplements, tube feeding of specialized veterinary products, massage techniques, physiotherapy, treatment with reptile lighting and heat sources, etc. over many months which eventually led to Brian recovering well and being able to continue his life as a free and wild Water Monitor.

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Phylogeny and phylogeography of chelonians from sub-Saharan Africa—a review of current knowledge in tribute to Margaretha D. Hofmeyr

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Species-level phylogeny and especially phylogeography of African chelonians is a comparatively under-studied field of research. We review the current knowledge of phylogeny and phylogeography, highlight congruence of spatial phylogeographic patterns amongst chelonians and other taxa, and suggest future research directions to address gaps in knowledge. Our review shows that phylogeographic investigations have led to unexpected findings for widely distributed taxa. For example, for *Pelomedusa*, a putatively wide-ranging monotypic genus, cryptic diversity was revealed, with more than ten species being uncovered. Together with taxonomy, the knowledge of phylogeographic structuring sets a solid foundation for conservation measures and allows the identification of Management and Conservation Units. However, the current legislation, in particular the enforcement of the Nagoya Protocol under the Convention of Biological Diversity, has largely halted research on widely distributed taxa and turned the well-intended concept of Access and Benefit Sharing into a major impediment for conservation and research. Sequencing historical DNA from museum specimens using aDNA approaches could be a short-term approach to mitigate, but not solve, this impediment.

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Sungazer lizard (*Smaug giganteus*) conservation in South Africa: their threats and challenges to reduce the threats

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Sungazers (*Smaug giganteus*) are endemic to South Africa, occurring in five populations with four in the Free State and one in southwestern Mpumalanga. By living in burrows in grasslands and not being dependent on rocky habitats has increased the threat of habitat fragmentation resulting from agricultural expansion and mining. Both these activities are currently taking place in Sungazer distribution areas, especially affecting the western population. The Endangered Wildlife Trust (EWT) is actively involved with conservation efforts for Sungazers including Biodiversity Stewardship, where formal agreements are made for the conservation of habitat on privately-owned properties. The challenge for the EWT is the rapid expansion of agricultural lands and possible lack of cooperation from landowners in areas with Sungazer populations. The landowners who have farms protected through a Biodiversity Stewardship agreement are offered very little incentives and the agreement is voluntarily. Therefore, the EWT is investigating other methods to ensure that habitats for species such as Sungazers can be protected by offering more rewards.

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Margaretha Delina Hofmeyr, an Inspiration in Chelonian Biology and Conservation

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From humble and loving beginnings in Kimberly, South Africa, Margaretha Delina Hofmeyr became a world-renowned scientist, advancing the biology and conservation of the world's greatest diversity of tortoises (skilpaaie). Along this path, Retha became a lecturer, professor, and Department Head in Zoology at the University of the Western Cape, a mother to three children, a mentor to dozens of students and post-doctoral scholars, and a colleague to a cadre of international scholars. Here we focus on her stellar research career in chelonian physiology, ecology and conservation. Retha expanded her physiological ecology training on ungulates to the ecology (behavioural, spatial, nutritional, reproductive and evolutionary) of eight tortoise species and one freshwater turtle species. She was also a prolific contributor to the phylogeography, phylogenetics, mapping and conservation efforts of African chelonians. Retha authored or co-authored nine species contributions to the Atlas and Red List of South African reptiles, and 12 species reviews for the IUCN Red List. Retha's conservation focus included the Critically Endangered Psammobates geometricus, Geometric Tortoise. She co-authored eight papers that focused on P. geometricus activity, refugia, diet, haematology, or body condition. During this time, Retha also developed the first successful headstart program for geometric tortoises, generating one hundred juveniles when the species' numbers had declined to 800. Retha's studies identified a suite of morphological, physiological, ecological and evolutionary approaches that appeared new to science, but not new to southern African chelonians. These included the bloody big eggs of the world's smallest tortoise (Chersobius signatus), reproductive variation in response to hatchling risk, shell morphology affecting mating behaviour, growing and shrinking tortoises, and the pliable reproductive cycles in Chersina angulata. She helped document facultative viviparity in Chersina angulata. While becoming an inspiration in Chelonian Biology and Conservation, Retha has inspired many students, colleagues, friends and family to strive, perform our best, and achieve beyond expectation while adhering to integrity. With an intense understanding, respect and dedication to diversity, Retha inspired many to become prominent academics, government officials or renowned biologists. As a person of exemplary standards, productivity and compassion, Margaretha Delina Hofmeyr is a brilliant star that will continue to shine and guide us.

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Follow-the-thing methods to study illicit reptile trafficking

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With this presentation, I would like to introduce an ongoing social science project entitled Trafficking Transformations. The project employs an innovative, multidisciplinary, object-centred methodological framework to understand the physical and contextual changes that rare and illicit 'criminogenic collectables' undergo during the trafficking process in three transnational criminal markets: antiquities, rare wildlife, and fossils. It explores the socio-economic effect of the objects being trafficked in these cross-border international illicit trades on the participants in the transnational criminal networks that move the objects. By moving the focus in commodity trafficking research away from the usual approach to studying the people involved, towards a new approach that follows the objects of desire, this project explores the broad and unusual question: *How do objects cause crimes?* As criminogenic collectables are trafficked from source to the market, their movements through different contexts and their social transformations during the smuggling process constitute an *object biography* that, when recorded, reveals significant information about the construction and functioning of illicit trafficking networks. Within this framing, borrowed from anthropology and archaeology, objects are considered to be agents in the networks that they are part of, and they influence the other agents (e.g., humans) in the network. If we focus on the biography of the trafficked object and the object's role as an agent within a network, we can document the transformations that link low level criminal activity (e.g., looting, theft, and poaching) to transnational organised crime, and on to white collar crime at the receiving (collecting) end of the market. We are currently working on two reptile object biographies - snakes of the genus *Bitis* and the giant girdled lizard - I will talk about some preliminary findings and open questions.

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High lead exposure and clinical signs of toxicosis in wild Nile crocodiles (*Crocodylus niloticus*) from Lake St Lucia, South Africa

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Lead (Pb) exposure is a widespread wildlife conservation threat but impacts on reptile populations remain poorly documented. In this study, we examined Pb exposure and accumulation in a wild population of Nile crocodiles (*Crocodylus niloticus*) at Lake St Lucia, South Africa. Recreational angling has occurred in the area since the 1930s and incidental ingestion of Pb fishing weights has previously been identified as a major source of Pb poisoning in the local crocodile population. In 2019, we sampled blood and tail fat tissues from wild (n = 22) and captive (n = 3) crocodiles at Lake St Lucia to investigate potential impacts of chronic Pb exposure on crocodilian health. Lead was detected in blood samples of all wild crocodiles, although concentrations varied widely between individuals (86–13 100 ng/ml). The incidence of Pb poisoning was higher in male crocodiles, with mean blood lead (BPb) concentrations in males (3 780 ± 4 690 ng/ml) significantly ($p < 0.001$) higher compared to females (266 ± 230 ng/ml). Blood Pb concentrations were correlated with concentrations measured in tail fat tissue (n.d. – 4 175 ng/g wet wt.). Although most of the crocodiles sampled appeared to be in good physical condition, highly elevated BPb concentrations (> 6 000 ng/ml) were associated with markedly suppressed packed cell volumes (4.6–10.8%) and severe deterioration in tooth condition. These findings suggest that anaemia and tooth loss may be clinical signs of long-term environmental exposure to Pb. Although previously undocumented in crocodilians, these symptoms are consistent with Pb poisoning observed in birds and mammals and suggest that crocodilians may be more susceptible to the long-term toxic effects of Pb than previously thought. In light of these findings, we suggest that the impact of accumulated Pb on crocodilian fitness, reproduction and mortality requires urgent attention.

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Molecular phylogeny of African Hinge-back Tortoises (*Kinixys*)

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The African Hinge-back Tortoise genus *Kinixys* covers eight species which were traditionally assigned to a rainforest group including *Kinixys erosa and K. homeana* and a Savannah group including *K. nogueyi*, *K. belliana*, *K. lobatsiana*, *K. zombensis*, *K. spekii*, and *K. natalensis*. However, first studies on the molecular phylogeny of the genus considerably deviated from this traditional concept as well as from each other indicating that phylogenetic relationships and species boundaries within *Kinixys* are not well resolved. In this study I address limitations of previous studies and reinvestigate the molecular phylogeny of the genus using a considerably broader sampling and independent estimates as derived from three mitochondrial and 17 nuclear loci. As exemplified by *Kinixys*, I highlight the vast potential of processing procedures and NGS sequencing techniques specifically designed for fossil and severely degraded historic samples in the face of a paucity of fresh material and legislative restrictions hampering research on wide-ranging species.

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The natural history and stranding of the yellow-bellied Sea snake (*Hydrophis platurus*), along the South African coastline

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Despite the yellow-bellied sea snake (*Hydrophis platurus*) having the largest distribution of all extant sea snakes, knowledge of its ecology and natural history are still mostly lacking and requires further investigation. We measured and dissected a total of 77 preserved museum specimens of *H. platurus*, to determine size ranges, sexual dimorphism, diet, and the reproductive aspects of the species. The sex ratio was heavily biased towards females (37 F: 8 M) in adults but evened out in juveniles/neonates (13 F: 9 M). At similar snout-vent length, female and male jaw width and mid-body circumference differed, but differences in other morphological features were minor, suggesting that *H. platurus* does not exhibit strong sexual dimorphism. Average clutch size was 4.4 (ranging from 3 to 7), with larger females producing marginally larger clutch sizes. Neonate's snout-vent length range from 157–275 mm (214 ± 3.45 mm STD). Most strandings took place in the late autumn to early summer months from August to October. These strandings showed clear bias associated with three major cities - Cape Town, Port Elizabeth and Durban, suggesting that human density has dramatically influenced the reporting of occurrences along the South African coastline.

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An investigation into human-crocodile co-existence in the Limpopo-, Luvuvhu- and Olifants Rivers within the Limpopo Province, South Africa

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Human-crocodile conflict (HCC) is a growing problem in Africa which mainly involves the Nile crocodile (*Crocodylus niloticus*). Compared to some other African countries, HCC research is limited in South Africa, while perceptions towards crocodiles remain unstudied. The aim of this study was to investigate the nature and extent of HCC and the perceptions towards crocodiles of people living adjacent to three large river systems in the Limpopo Province. A questionnaire was created using qualitative data collecting after 39 interviews were conducted at Limpopo River (eight) and Luvuvhu River (31). A total of 275 questionnaire surveys were conducted at Limpopo River (50), Luvuvhu River (106), and Olifants River (119). Data analyses were conducted using chi-square tests, correspondence analysis and logistic regression. One-hundred-and-twenty HCC incidents were recorded, mostly at Luvuvhu River (52.5%), followed by Olifants River (30%) and Limpopo River (17.5%). These incidents included attacks on humans (52.5%), attacks on domestic animals (34.17%) and damaged fishing equipment (13.33%). Potentially dangerous activities identified were fishing, fetching water, washing laundry, swimming, and crossing rivers. People most vulnerable to HCC were African men and women, children, people with a low level of education as well as the unemployed. Activities related to household chores (washing laundry and fetching water) were mostly associated with African respondents who were women, had a low education level and/or were unemployed, and led to several crocodile attacks on female respondents. These trends reflect the different status of men and women in African societies. Fishing was mostly conducted for subsistence and/or income by respondents who were African men, leading to many attacks on fishermen and damaged fishing equipment. These types of HCC experienced by fishermen were also found by other African HCC studies. Respondents who liked crocodiles (41.61%) mostly accepted them as part of the environment (46.49%) or God's creation (20.18%), while respondents disliking crocodiles (55.47%) gave depredation on humans (57.89%) and domestic animals (15.47%) as motivations. Their dislike was mainly influenced by HCC experiences of other people as well as the proximity of crocodiles to human habitations. The Luvuvhu River seemed to be the most problematic study site in terms of HCC. By contrast, mitigating human-wildife conflict (HWC) involving non-crocodilian species (elephants, primates and snakes) should be a higher priority at Limpopo River than HCC. Education campaigns targeting vulnerable groups (children and participants dependent on the rivers for resources) should be the main HCC mitigation method.

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Phylogenetic Structuring in Psammophiidae

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Psammophiidae is a diverse family of snakes that is relatively well-represented in the literature, with various taxonomic and systematic papers underpinning their current nomenclature. The group remains troublesome both because of its previous morpho-centric taxonomical assignments and because it is ecologically, phenotypically, behaviourally, and genetically complex. The group is wide-ranging and ecologically diverse, with fossorial, arboreal, and terrestrial lifestyles being represented. Many constituent species also overlap with geographically and morphologically similar congeners, complicating systematic sorting and assignment. To this end, we attempted to generate the most robust phylogenetic reconstruction possible using Maximum Likelihood and Bayesian Inference and representative sampling from every available species in the family. We also used time-calibrated phylogenetic modelling (BEAST) and distance/threshold-based species delimitation (bGMYC, PTP, bPTP, ABGD, ASAP and STACEY), to elucidate the finer-level structuring within the family. The final phylogenetic tree incorporated 320 samples and five genes (16S, cyt-b, ND4, c-mos, RAG1), representing the most comprehensive phylogenetic reconstruction of the family to date (missing only *Kladirostratus togoensis*, *Psammophis pulcher* and several of the Asiatic *Psammophis*). By using a near-complete taxon sampling approach, we were able to resolve previously unsupported relationships within the family and for the first time ever, *Hemirhagerrhis nototaenia*, *Psammophis leithii*, *Psammophis longifrons* and *Psammophis zambiensis* were phylogenetically placed, shedding light on the validity of the *Taphrometopon* genus. Threshold-based species delimitation uncovered several putative taxa within *Psammophis*; a feat made possible by the acquisition of multiple samples from novel localities throughout Africa. Even though phylogenetic reconstruction did not recover novel taxa in the other genera, the robust taxon-sampling afforded to this study ratified, and in some cases improved upon the findings of past papers focusing on genera such as *Malpolon*, *Rhagerhis*, and *Mimophis*. Whilst the study built upon our understanding of these taxonomically complex snakes, it also highlighted just how much we still need to learn about them.

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Phylogenetic structuring in sub-Saharan Natriciteres (Colubridae: Natricinae)

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The natricines are a species-rich (over 250 species), geographically widespread sub-family of predominantly aquatic and semi-aquatic snakes. Although well studied abroad, the African radiation of six genera (*Natriciteres*, *Afronatrix*, *Helophis*, *Hydraethiops*, *Lycognathophis* and *Limnophis*) remains poorly understood. Whilst representative sampling is available for all the African genera, the intra- and inter-specific structuring within the group has yet to be assessed. In this study we aimed to elucidate the finer-level phylogenetic structuring within *Natriciteres* to determine the most robust systematic structuring of the group. All available tissue samples of African natricines, with specific focus on *Natriciteres*, were sequenced for six genetic markers (16S, ND2, cyt-b, ND4, c-mos, RAG1) and phylogenetically placed using both the Maximum Likelihood and Bayesian Inference algorithms. A time-calibrated phylogeny was estimated in BEAST to date the divergences and determine the potential phylogeographic events that resulted in the radiation of the African genera. Lastly, species delimitation approaches (STACEY, bPTP, PTP, ABGD, ASAP) were implemented to determine whether the group harbours any unrecognised species diversity. Given the rising threats to aquatic ecosystems throughout Africa, it is critical to the implementation of conservation policies that the most comprehensive taxonomic account of the group is recognised.

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Chelonian Biodiversity and Conservation Program: Research on Tent Tortoises (*Psammobates tentorius tentorius*) in the Great Karoo

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This presentation summarizes the research done on the Tent tortoise (*Psammobates tentorius tentorius*) through the Chelonian Biodiversity and Conservation Program at the University of the Western Cape. The research was carried out at the Tierberg Karoo Research Centre on the southern edge of Great Karoo - 10 km N Swartberg mountain range and 30 km E of the town of Prince Albert. Like much of Dr. Margaretha Hofmeyr's research, we gleaned answers to bigger ecological patterns beyond the basic biology. We examined the extended reproductive season of tent tortoises as a response to an arid and unpredictable environment. In our research we explored the reproductive patterns of tent tortoises in South Africa's arid Karoo. What we found was an interesting strategy – the use of an extended breeding season. The long breeding season of tent tortoises does not reflect extended favourable conditions but is probably a response to the low and unpredictable rainfall of their natural habitat. Given their small clutch sizes, the extended breeding season allows tent tortoises more time and opportunities to produce offspring in their arid and unpredictable environment. We also examined the population structure and sexual dimorphism in a southern population of Tent tortoises of the Karoo. We found a relatively low density of tortoises (49 tortoises/km2) skewed to adults with a 1:1 sex ratio. The largest female was 14.7 cm, which makes her approximately 42 years old. The largest male was 11.6 cm, which makes him approximately 42 years old. We can distinguish males and females at carapace lengths of approximately 8-10 cm, when the tortoises are approximately 8-10 years old. *Psammobates t. tentorius* are sexually dimorphic in which adult females are significantly larger than are males. Selection for body shape and size appears attributable to fitness among the sexes (e.g., egg production and size in females, and opportunities to mate by males). We characterize this first group of nominate tent tortoises for future comparisons to other population. The study provides critical baseline information for the long-term management and conservation of this species and adds to our understanding of the fauna of the Succulent Karoo. I conclude with a personal tribute to Retha.

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Integrative revision of the *Lygodactylus gutturalis* (Bocage, 1873) complex unveils cryptic diversification in Central Africa

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Diurnal dwarf geckos of the genus *Lygodactylus* Gray 1864, are widely distributed in Madagascar and sub-Saharan Africa. They represent the most speciose group of the family Gekkonidae in Africa, and the fifth-most speciose genus worldwide. However, with more than 20 new candidate species confirmed (Lanna et al. 2018; Gippner et al. 2021), the actual diversity of this group remains poorly understood. *Lygodactylus gutturalis* has the largest geographic distribution of any *Lygodactylus*, occurring from Senegal in West Africa to Ethiopia and SW Somalia in East Africa, and to western Tanzania, southeastern Democratic Republic of Congo, and northern Angola in Central Africa. Because many other widely distributed reptile groups have proven to be cryptic species complexes, we utilized an integrative taxonomic approach for *L. gutturalis*. We combined data from DNA sequences of mitochondrial and nuclear genes, external morphometric measurements, meristic characters including scale counts, high-resolution CT scans, and biogeography to demonstrate extensive cryptic diversification within *L. gutturalis*. The recovered patterns of endemism from our combined analyses mirror those recovered in other groups of African squamates.

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Emergency treatment of wild snakes

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Serpents have been shrouded in myth since the beginning of time. They were once symbols of fertility, rebirth, renewal and even immortality. Over the years they have been made into villains, responsible for lies, evil and temptation. In truth, they are fascinating and mysterious creatures, just as much deserving of our veterinary oath as any mammal. Their anatomy and physiology are very different to other vertebrates, and they can make for complicated and perplexing patients. In this talk I will dispel some of the myths surrounding their treatment and care with a few practical case studies as examples. Snakes often do not receive the standard of care that they require or deserve. One commonly held myth that they cannot feel pain causes them great harm. Many studies have now proven that reptiles, especially snakes, feel pain just as acutely as mammals. Outdated thought has veterinarians performing surgical procedures without anaesthesia, antibiotics, or analgesia. Like other reptiles, snakes take longer than mammals to show symptoms of illness and moreover, take a long time to heal. Their husbandry and feeding play a major role in their well-being and not understanding this part of their care can have serious health consequences. Serpent medicine may seem daunting, but with careful study and gentle care, they can be one of the most rewarding patients to treat.

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Promoting ecosystem resilience and creating a conservation landscape for the Critically Endangered Amathole Toad

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The Amathole Toad *Vandijkophrynus amatolicus* was described as being locally abundant in studies conducted in and around Hogsback in the 1980s. However, during the period 1998 through 2011, there were no sightings of the species, even though numerous herpetologists and enthusiasts repeatedly visited the Hogsback region. The situation became so concerning that discussions were held as to whether the toad may well become South Africa's first amphibian species to be declared extinct. In 2011 a single Amathole Toad was located on the edge of a forestry plantation and the Endangered Wildlife Trust (EWT) Threatened Amphibian Programme began implementing a conservation project in the Amathole Mountains. In 2020, Bionerds became an implementing partner with the EWT and have conducted three field seasons in the region. This presentation highlights the in-field knowledge gained regarding the ecological niche of the species and the possible solutions to conserving the Amathole Toad in a landscape dominated by agriculture and forestry. The protected area expansion methods being implemented to create a landscape conservation corridor in the Amathole Mountains are also unpacked, as well as the opportunity to make the Amathole Toad the ecological 'canary in the coalmine' for the seeps and grasslands of the Amathole Mountains in Hogsback.

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

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

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The bacterial skin microbiome composition of the Endangered Pickersgill's reed frog (*Hyperolius pickersgillii*)

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The Endangered South African endemic Pickersgill's reed frog (*Hyperolius pickersgilli*) conservation efforts date as far back as early 2000's through multi-lateral Biodiversity Management Plan (BMP) between 15 stakeholders, including listing on the International Union for Conservation of Nature (IUCN) Red Data List and South Africa's Threatened or Protected Species (TOPS) Regulations of NEMBA. The aim of the study was to utilize a novel 16S rRNA NGS approach to characterize the bacterial skin microbiome of Pickersgill's reed frogs from three localities, namely Saint Lucia (n=6), Mount Moreland (n=7) and Adams Mission (n=7). DADA2 (q2-dada2) sequence quality filtering retained 6 535 451 (70%) single-end sequences, Qiime2 core bacterial community richness (Faith's Phylogenetic Diversity) were highest in Adams Mission (886.667), followed by Mount Moreland (653.428) and lowest in individuals from St Lucia (523.645) ($p = 0.289$, Kruskal-Wallis). Beta diversity phylogenetic analysis of bacterial community dissimilarities for un-weighted UniFrac and weighted UniFrac clusters inferred through PCoA (PERMANOVA) showed no significant dissimilarity for both un-weighted and weighted UniFrac, Axis-1 (15.28%), Axis-2 (7.26%) and Axis-3 (6.61%). Taxonomic classification at phyla, class and family levels conducted against the Greengenes 13_8 99% OTUs full-length 16S rRNA reference sequences showed Proteobacteria (39.67%), Actinobacteria (14.83%), Firmicutes (11.21%) and Chlamydiae (9.80%) as the highest relative bacterial frequency abundance. Further research will expand to include samples collected from in-situ individuals, environmental samples (soil, water) and generating a microbiome database for South African frog species.

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The impact of woody encroachment on Kalahari reptiles

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Woody encroachment, defined as the increase in density, cover and biomass of indigenous woody plants, has emerged as a major threat to African open grassland systems. The lack of robust reptile population data, as a consequence of the inherent low detection probability associated with reptile surveillance, has resulted in reptiles being notoriously overlooked in conservation planning. With the aim of understanding the impacts of woody encroachment on reptile populations, we conducted four 18-day reptile surveys along a woody encroachment gradient at Tswalu Kalahari Reserve, Northern Cape Province, South Africa. Traps were checked twice a day, in the morning and afternoon. We recorded a total of 1 019 captures across 29 species. We estimated relative and mean abundance of six lizard and three snake species by using multi-season N-mixture models, from repeated count data of unmarked animals. Abundance was modelled against two woody encroachment indices: (1) canopy cover, (2) number of trees > 2 m. With varying responses across species, we found encroachment indices to be important positive predictors of abundance for four species and negative predictors for two species. Based on our results, we expect reptile species richness to remain stable, but forecast changes in community composition with increasing encroachment. Our findings support the idea that woody encroachment is reorganising savanna ecosystems.

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What makes a snake bite? A South African perspective

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Snakebite is a public health challenge that has substantial impact on humans and snakes. While considerable investments have been made in the treatment of snakebite, our knowledge on the ecology of snakes in relation to snakebite is low. Millions of people are affected by snakebite globally, particularly in rural areas and in South Africa this number is in the thousands. Historically, case studies on snakebites have only been published by medical professionals and few scientists, however most snakebite cases are not published. Here we review past and present literature on snakebite in the South African context and compare this to known bite incidences from personal accounts and social media. The results indicate that while many venomous snakes are featured in the snakebite literature, there are also numerous bites from non-venomous snakes. We discuss various bites and the circumstances under which people have been bitten. To prevent snakebite, it is pertinent that we learn about the situations that lead to snakebites by gaining more insight on the activity and behaviour of not only medically important snakes but also other snakes that feature in snakebites.

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Hiding in the cracks: Phylogenetics of the genus *Afroedura* (Squamata: Gekkonidae) in the Eastern Cape Province, South Africa

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Afroedura are a group of geckos widely distributed throughout southern Africa. Due to the rupicolous lifestyle and major geographical isolation within populations, high rates of radiation and endemism has been found within the genus. We investigated the phylogenetic relationships of the *A. nivaria* group within the Eastern Cape Province, South Africa. Our aim was to identify the status of newly found populations, stabilise the taxonomy, and estimate the most comprehensive phylogenetic analysis of this group. Two phylogenies were estimated, Bayesian Inferences and Maximum Likelihood, using a concatenated dataset of [16S, ND4 and RAG1]. Our results, and those from previous studies, highlight between seven to ten undescribed flat geckos within the *A. nivaria* group, predominantly within the Eastern Cape Province. Five of these new candidate species are a direct result of this study. These are from the Baviaanskloof mountains, Kouga mountains, Albany region, Great Kei River, and the Mthatha region. Based on apparent geographical isolation and morphology, there is a strong likelihood that additional material from the Haven in the Great Fish River valley, also represents an undescribed species. This study highlights the diversity of the genus and that there remain unresolved taxonomic issues within the *A. nivaria* group.

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Convergent evolution and ecological diversification in Dwarf Chameleons

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Environmental constraints are a major driver of phenotypic diversification and adaptation. Different species occupying similar ecosystems and microhabitats frequently exhibit parallel morphological and behavioural traits, due to convergent evolution. Different morphological forms exist within Dwarf Chameleons of the genus *Bradypodion* and appear to be associated with differences in habitat use. Previous work on *Bradypodion* has identified two main ecomorph types: 'open' and 'closed', found in heathland/grasslands and forests, respectively. Our observations suggest that at least one additional ecomorph exists: 'shrub', occurring in moderately dense, shrubby vegetation. There are several species/populations within each ecomorph which appear to be united by similarities in their morphology and performance traits. However, whether these traits are true adaptations to differences in habitat use has not yet been empirically investigated for the entire genus. Here, we investigated whether populations/species in *Bradypodion* occupying similar environmental niches are different in morphological traits even when taking into account their phylogenetic relationships, suggesting that these traits may indeed represent true adaptive differences between groups. We focus on characters (e.g., limb length, hand/foot size) that have been shown to be related to performance and interpreted these in the context of microhabitat use. Phylogenetic multivariate analyses of covariance suggest that head shape is significantly different between males of the three ecomorphs, with open morphs having smaller casques and shrub morphs having longer lower jaw lengths. Body shape was significantly different between ecomorphs for both sexes, with shrub and open ecomorphs having shorter tails, shorter hind limbs and shorter forefeet than forest morphs. There was also evidence of convergent evolution for several functionally relevant measurements including tail length for forest and shrub ecomorphs and head shape for open habitat ecomorphs. Our results demonstrate that populations of *Bradypodion* within similar environmental niches have evolved parallel morphological features, indicating that these groups represent true ecomorphs. Thus, ecology appears to have a stronger effect on morphology than evolutionary history. These morphological adaptations are likely driven by directional selection and have fitness benefits for animals in their respective habitats.

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Herpetofauna in South Africa's urban traditional medicine markets: DNA barcoding and cultural perspectives inform monitoring and conservation

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Published literature suggests that Indigenous cultural practices, specifically traditional medicine, are commonplace among urban communities contrary to the general conception that such practices are associated to rural societies. We reviewed literature for records of herptiles sold by traditional health practitioners in urban South Africa, then used visual confirmation surveys, DNA barcoding, and folk taxonomy to identify the herptile species that were on sale. Additionally, interviews with 11 SePedi and IsiZulu speaking traditional health practitioners were used to document details of the collection and pricing of herptile specimens along with the practitioners' views of current conservation measures aimed at traditional medicine markets. The herptile specimens sold by traditional health practitioners included endangered and non-native species. The absorbance ratios of DNA extracted from the tissue of herptiles used in traditional medicine were found to be unreliable predictors of whether those extractions would be suitable for downstream applications. From an initial set of 111 tissue samples, 81 sequencing reactions were successful and 55 of the obtained sequences had species level matches to COI reference sequences on the NCBI GenBank and/or BOLD databases. Molecular identification revealed that traditional health practitioners sometimes mislabel the species they use. The mixed methodology employed here is useful for conservation planning as it updates knowledge of animal use in Indigenous remedies and can accurately identify species of high conservation priority. Furthermore, the study highlights the possibility of collaborative conservation planning with traditional health practitioners.

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A highspeed camera in the veld: what we can learn from new data types

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The past 20 years has seen rapid development and democratization of digital high-speed video equipment, such that cameras capable of high resolution, framerate, and magnification are more readily available than ever before. The effects of this advancement in the natural sciences have mostly manifested in increased work in the field of organismal biomechanics and functional morphology. However, the positive effects have been felt primarily in the Global North, with much of the world not being included in this field. Herpetology has, since early in the field of organismal biology, been a major player in the field of organismal biomechanics and functional morphology, with lizards, snakes, and frogs all being used as model systems for understanding the relationships between morphology, behaviour, and adaptive functionality. There has been remarkably little work done in sub-Saharan Africa, particularly by African scientists, in comparative biomechanics, likely due to high-speed video costs and a lack of tradition using the high-speed video camera as a tool for scientific inquiry. This is deeply unfortunate for the field of biomechanics on two fronts: the organisms present in sub-Saharan Africa represent an untapped scientific resource of undescribed biomechanical and morphological diversity, and African scientists have unlimited potential to contribute both theoretically and empirically to the field. During a 50-day period, I was able to capture a small fraction of that undescribed biomechanical diversity in reptiles and amphibians via high-speed video. My project specifically focuses on the mechanics of air-breathing in South African tadpoles, and I will show how different lineages and ecological groups do or do not differ in breathing mechanics and kinematics. I will also present videos of other taxa in an effort to invite collaboration both on the publishing of those data and emphasizing the collaborative potential high-speed videography presents. By opportunistically filming chameleon feeding events from species encountered during my trip, for instance, I have been able to build a collaboration with co-author Anderson, contributing novel data to a larger dataset he has been collecting for many years focusing on various comparative biomechanical, behavioural, and ecophysiological topics related to chameleon feeding. Finally, I hope these videos will simultaneously garner enthusiasm for efforts to secure international funding to bring more biomechanical work to South Africa and sub-Saharan Africa generally.

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Have South African frog ranges shifted or shrunk?

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The natural environment is changing rapidly. Land transformation, disease spread, and climate change are all responsible for amphibian declines worldwide, but do we have evidence for this in South Africa? The South African Frog Atlas Project took place from 1996-2003, resulting in the collection of over 25 000 frog records. This provided an excellent opportunity to compare the historical data (pre-1996), amounting to approximately 17 000 records, with the new SAFAP data to investigate long-term trends in frog distribution. Botts et al. (2012, 2013 & 2015) compared frog species range size and position, as well as elevation, between these two data sets. Botts et al. (2012) concluded that the range size of approximately 60 % of South African frog species had declined; Botts et al. (2013) concluded that species with smaller ranges and narrow niches were more likely to have reduced in size; and Botts et al. (2015) found that there was no evidence for poleward shifts, but that the elevation of frog ranges had shifted by an average of 48 m upslope and tentatively attributed this to climate change. Since 2003, the phenomenon of 'citizen science' has become popularised through initiatives such as FrogMAP, iNaturalist and social media in general. Distribution data is amassing faster than ever before in the history of South African herpetology. In this presentation, I re-evaluate the findings of Botts et al. (2012, 2013 & 2015) using these novel data and address the following questions. Is there evidence for an amphibian response to climate change in the distribution data? Are our frogs ranges declining and shifting, and if so, which species are being affected and why?

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The impact of climate change on the body condition of Cape cobras (*Naja nivea*) in the Kalahari

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Hot and dry weather conditions are known to impact the body condition and thus the evolutionary fitness of many organisms. However, these relationships have not been studied extensively in snakes. We examined the impact of rainfall and temperature on the body condition of cape cobras (*Naja nivea*) at Tswalu Kalahari Reserve (Northern Cape Province, South Africa) over a period of five years. We measured the mass and body length of 108 cobras, 66 from which we collected repeat measures, and calculated a body condition index (BCI) for each observation (N = 174). Using these data, we tested whether BCI is impacted by season, sex, and/or differences from expected mean daily rainfall (during the preceding four-, 12-, and 24-week periods) and mean daily maximum temperature (during the preceding four-, 12-, and 24-week periods). Secondly, we tested whether BCI of cobras during the mating-season (September–November) was impacted by sex and an index of environmental conditions (PC1 of rainfall and temperature which were autocorrelated) in the preceding summer. We found that the best-fitting model included season, sex, the amount of rain in the preceding twelve weeks (positive coefficient), and temperature in the preceding twelve weeks (negative coefficient). Moreover, the BCI of cobras during the mating-season was correlated with environmental conditions in the previous summer, with cobras exhibiting lower BCIs following hot and dry summers. Our results indicate that prolonged hot dry periods, or increased frequency of hot dry periods in the future, will have detrimental effects on cobra fitness, and thus populations, in the Kalahari.

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Gazing into the future: the potential impact of climate change on habitat suitability of the Sungazer (*Smaug giganteus*)

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Climate is arguably one of the most influential factors determining the geographic range of reptile species. Consequently, climate change is expected to be detrimental to many reptile species and has resulted in some species shifting their distributions to track suitable conditions. For habitat specialists such as the sungazer (*Smaug giganteus*), the ability to track suitable conditions may be limited by their life history traits, and these species may therefore face an increased risk of extinction. We assessed how climate change could potentially impact the geographic range of the sungazer, a grassland specialist which is currently listed as Vulnerable. We modelled the current distribution of sungazers using bioclimatic and environmental variables to estimate its ecological niche envelope. We then projected the ecological niche envelope to 2040, 2060, 2080 and 2100 under two climate change scenarios using Shared Socioeconomic Pathways (SSP), SSP2-4.5 (moderate case) and SSP5-8.5 (worst case). A mean ensemble of three global circulation models for each time period and climate change scenario was then used to create habitat suitability maps which were refined using a natural grassland variable overlay. Resulting maps were clipped to the current extent of occurrence (EOO) and interpreted distribution to identify potential fine scale changes in habitat suitability. Our models predicted that habitat suitability for sungazers will remain stable under SSP2-4.5, with a 3% decline in habitat suitability within the interpreted distribution by 2100. However, we predict a 24% decline in habitat suitability under SSP5-8.5. At a broader scale (buffered EOO), we found that habitat suitability increased in south-west regions, which was also more prominent under SSP5-8.5. Although this finding suggests that sungazers could potentially track favourable conditions, their life history and low dispersal ability makes climate tracking unlikely. Because sungazers occur within an agriculturally dominated region of South Africa, further land use developments are likely to affect the survival of the species. Thus, careful conservation management is essential for the species. We have shown that modelling future distributions of species may identify potential changes, but predictions should be interpreted with caution.

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A molecular analysis of the Common Girdled Lizard (*Cordylus vittifer*)

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The rupicolous Common Girdled Lizard (*Cordylus vittifer*) is widespread in the northern and north-eastern parts of South Africa and much of Eswatini and extends peripherally into Botswana and Mozambique. Some populations of this species are known to differ in terms of their scalation and colour pattern. Morphological analyses conducted over 40 years ago on material from the northern provinces of South Africa, as well as KwaZulu-Natal and, more specifically, Free State Province, indicated the existence of three morphotypes, including one that appeared to be restricted to the eastern Free State. However, a subsequent evaluation of specimens from the northern provinces indicated a much greater degree of overlap in characters in two of the forms than had been recorded previously, bringing into question the validity of the distinction. In the present study, specimens were sourced from several localities throughout the species' South African range. Tissues were sequenced for two mitochondrial and two nuclear genes. Using molecular analyses, we investigated relationships between populations of *C. vittifer*, which we find consists of 3–4 main clades. The relationships between clades, and their geographical distribution, will be discussed.

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Croaks, Chirps and Clumps: Long-term monitoring and surveillance efforts for priority South African threatened frog species

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Global amphibian population declines dictate that a vigilant approach is needed for implementing monitoring regimes, and to identify stressors if declines are discovered. Species and species assemblage monitoring are essential tools for detecting possible amphibian population declines, gauging trends over time, and for assessing effectiveness of conservation interventions. Many amphibian population fluctuations can be attributed to responses to ecological conditions. Long-term monitoring can help to distinguish such fluctuations from actual declines. Of 20 threatened frog species that were prioritised for monitoring in the 2011 Conservation & Research Strategy (Measey 2011), nine species have been included in monitoring and surveillance work by the EWT over the past decade. This includes extensive work on the number 1 ranked species, *Hyperolius pickersgilli* (Endangered), for which over 20 localities are now known, threats are better understood, a Biodiversity Management Plan is into its second iteration and several sites have been prioritized for conservation action. Acoustic surveillance for the species has produced several subpopulation estimates, confirmed 15 previously unknown subpopulations, and assessed cohabiting species assemblages at eight sites. The species ranked 3rd, *Vandijkophrynus amatolicus* (Critically Endangered), was confirmed to be extant in 2012, and as a result over 12,000 hectares has been identified (and is in the process of being declared) for protection and improved landscape-level management interventions. Acoustic monitoring is currently being used to improve the understanding of the ecology of this species. *Natalobatrachus bonebergi* (Endangered), ranked 4th has been the subject of a decade-long monitoring protocol in partnership with Ezemvelo KZN Wildlife and Ezemvelo KZN Wildlife Vernon Crookes Honorary Officers looking at breeding biology and threats, based on egg-clump counts. *Heleophryne rosei* (Critically Endangered), (ranked 6th) has been the subject of an in-depth tadpole occupancy modelling study; while four other threatened (and one Data Deficient) species from the Western Cape have also been included in survey and acoustic monitoring efforts since 2020 to guide conservation actions.

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Systematics of African house snakes revisited: News about systematic placement of two former *Lamprophis* species endemic to the Ethiopian highlands

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The systematic affinities of two rare and little-known lamprophiid snakes have been reviewed. One of these species has been long known either as *Lamprophis erlangeri* or as *Boaedon erlangeri*. It is endemic to moist montane forest remnants and formerly forested areas in the south and south-west of the Ethiopian highlands. New molecular and morphological data brought evidence that this species has been misplaced in both genera of 'African house snakes'. A new genus has been described that represents a sister clade to the Western and Central African genera *Bothrophthal¬mus* and *Bothrolycus* from which it differs by general body form and proportions, head shape, number of preocular scales, absence of loreal pits, maxillary dentition as well as by a number of cranial features. The second Ethiopian endemic, *Lamprophis abyssinicus*, that had been treated in the recent past as a close relative of *Lamprophis erlangeri* was assigned in the course of this revision to the genus *Pseudoboodon* on a basis of similar external morphology and cranial osteology.

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A study of a declining population of *Chersobius Boulengeri* in the Karoo, South Africa

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Karoo dwarf tortoises (*Chersobius boulengeri*), like many other small tortoises, are elusive and hard to find making studies of these species difficult. Although previous surveys in the 1970s found *C. boulengeri* was distributed over a large area in the Karoo, South Africa, recent surveys from 2005 to 2016 located few, isolated tortoises. In 2017, a population was discovered in the Karoo, near Williston. A three-year (2018-2020) mark and recapture study was performed. In total, 74 tortoises were captured and marked. Of these tortoises only 8% were small (straight carapace length <65 mm) and over a third appeared old suggesting recruitment was limited, despite finding three hatchlings. It is doubtful the lack of juveniles was a function of our methods, because we targeted hiding tortoises and inspected most available retreats frequently and thoroughly. Using Program MARK, we calculated tortoise density as 3.3 individuals/ha which is relatively low. On revisiting the site this April, eight tortoises were found dead and almost a quarter of the number of marked tortoises had been killed over a four-year period. In addition, it was a brief visit, meaning other dead tortoises could have been overlooked. Predation of adult tortoises was probably by birds, most likely white necked ravens; shell damage was consistent with that of other tortoise species depredated by ravens elsewhere. Small tortoises could have been carried away, possibly by pied crows that also frequented the study site. Within the range of Karoo (and speckled) dwarf tortoises, subsidies for corvids should be reduced. These are no-regret measures, such as removal of obsolete poles, storing water in closed containers, using watering systems for livestock that make water unavailable for corvids (there are many examples), and perhaps measures to reduce or clean up roadkill (more difficult). Specifically for remnant Karoo dwarf tortoise populations, active reduction of local corvids should also be considered.

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Into Africa: Biogeography of the genus Python

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Most genera and species within the Pythonidae occur in south-east Asia and Australia. However, the genus Python stands out as it also ranges into Africa. Currently there is a large distribution gap between Africa and south-east Asia with no species of Python in the Saharo-Arabian region. Fossil evidence suggests Python was once more widespread occurring in regions from which they are currently excluded. In Africa, Python occurs in tropical and sub-tropical habitats. *Python natalensis* and *P. sebae* are the most widespread, with *P. natalensis* occurring throughout north-eastern southern Africa, extending north of 10° S, especially in the east. *Python sebae* occurs in East and West Africa, extending to the northern parts of Angola in the southwest. These species are morphologically similar which led to *P. natalensis* formerly being classified as a subspecies of *P. sebae*. They are partly sympatric in East Africa and hybrids have been reported calling into question their taxonomic status. In contrast, the distributions of *P. anchietae* and *P. regius* are more restricted, with *P. anchietae* occurring in arid savanna in Namibia and Angola, and *P. regius* in forest and mesic savanna in central to west Africa. Given the current geographic distribution of Python, a plausible scenario is that the African species and the south-east Asian species belong to different monophyletic clades. Nevertheless, it has been suggested that *Python regius* (from Africa) is sister to all other Python species including African and Asian species. This would necessitate a convoluted biogeographic explanation that would include at least two separate dispersal events to Africa from Asia. Alternatively, if the African clade is monophyletic, the entire African clade would be sister to the Asian clade with only one dispersal event to Africa, with the African species later diversifying on the continent. To test these scenarios, a dated phylogeny based on two mitochondrial and one nuclear gene was constructed, and biogeographic scenarios were tested statistically. The dated phylogeny suggests a single origin for the African clade, diverging from the Asian species approximately 28 Mya. Within the African clade, all currently described species are clearly genetically distinct, including *P. natalensis* and *P. sebae*. Ancestral area reconstruction supports an Asian origin for the genus, with a single dispersal event to Africa after which species diversified on the continent. There is no support for multiple dispersal events into Africa. Accounting for the distribution of fossils, it appears that Python was formerly more widespread but that ranges were reduced as a response to persistent global cooling since the mid-Miocene.

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Lessons from 18+ years of monitoring fynbos frog populations

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As a response to global amphibian declines and global climate change, CapeNature began formal long-term frog monitoring at two sites in 2002. Two additional sites were added later to expand the spatial scope of the project and to include two threatened frog species. Here I present generalised linear model and time series analyses of the climate and frog population estimate data over the past 18 years at the two original sites. These results indicate weak influence of climate as a driver of frog population dynamics and a strong influence of fire. These data assist in determining appropriate fire return intervals which has a direct management implication. The complications arising from different frog species' responses to fire return frequency is discussed and a workable management goal is suggested for multiple species' fire return interval ranges.

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The mysterious *Pelomedusa* species: Latest insights from southern Africa

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Helmeted terrapins of the genus *Pelomedusa* are morphologically similar across their huge distribution range in the Afrotropics. Therefore, it was long assumed that a single wide-spread species *P. subrufa* (Bonnaterre, 1789) sensu lato occurs in this vast area. However, some years ago *Pelomedusa* was revealed to represent one of the most speciose turtle genera of the world. In southern Africa two species, namely *Pelomedusa galeata* and *P. subrufa*, are distributed and have surprising adaptation capabilities to various climates and even extreme habitats, like the arid desert. *Pelomedusa galeata* inhabits most of South Africa and consists of two deeply divergent genetic lineages, which represent unconfirmed candidate species. In contrast, *P. subrufa* is recorded from the northeast of South Africa, but its distribution range reaches northwards up to Kenya lacking phylogeographic differentiation. Using increased sampling from southern Africa, we study genetic differentiation, gene flow patterns and adaptation capabilities of helmeted terrapins. In addition, genetically verified specimens are used for 2D geomorphometric analyses to examine whether the taxa can be told apart in the field. We narrow down the distribution ranges for *Pelomedusa* species in South Africa and show that Helmeted Terrapins are not absent from the central Northern Cape as believed before.

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Herpetological research in Zambia

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Helping Hands in Snake Safety (HHiSS) is an NGO operating in Zambia since 2019. Our objectives are to reduce the number of snakebites while at the same time, through education reduce the needless killing of snakes. To achieve this, we conduct sensitisation activities in schools and in communities and give various training courses. Over the past few years, we have established partnerships with various organisations in the conservation and health sector and we are now recognised as the leading snake-related training provider in the country. In addition, we work together with the Ministry of Health in improving snakebite management in Zambia. Zambia is a large, land-locked country with an abundance of herpetological wildlife. So far, while 102 species of snakes, 77 lizard species, 11 Cheloneans, 2 crocodiles and 90 species of frogs are recorded, little is known about many of these species and their distribution. In addition, a comprehensive DNA-database seems absent. Helping Hands in Snake Safety intends to change this, by facilitating herpetological research in one of the wildlife hotspot areas of Africa: the Luangwa Valley. We will be building a nature conservation centre on the banks of the Luangwa river, opposite of the South Luangwa National Park and in the Nsefu game management area. The Conservation centre will be able to accommodate day visitors by having many of Zambia's reptiles and amphibians on display. We will keep many more for research purposes as well as for training, as HHiSS intends to conduct training in snake awareness, identification, first aid and handling. However, the focal point will be research and therefore the centre will be equipped with a basic lab and a computer station. Apart from herpetological research, other animals, such as the typical African wildlife species can be studied from our centre as well. We are, further, exploring the possibility of developing antivenom for Zambia and possibly surrounding countries. To ensure that the research facility becomes a success, we need support, especially from those that we hope to invite to our facilities: researchers and students. To this purpose we intend to partner with other research institutions, universities etc. The objective of the presentation is to establish further, research-related partnerships and obtain more information from herpetologists and other interested parties. What should we think of? What should the lab contain? What research requirement may we encounter, what kind of research ideas may be pursued at our centre?

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Habitat Heterogeneity and its Impact on Reptile Communities and Diversity in the Soutpansberg

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For most of Africa, information on how reptiles are distributed across large areas of the continent is largely incomplete. South Africa is an exception, and it is considered the most well studied African country in terms of reptile species richness and distribution at the landscape level. However, knowledge of reptile communities at finer spatial scales (for example the community level) and what drives their diversity at the local scale remains inadequate. This has conservation implications in terms of evaluating extinction risk and ensuring that range restricted reptiles are adequately protected by protected areas. Using an extensive citizen science dataset of over 10 000 observations, we examined the reptile communities of the Soutpansberg at 22 locations across the mountain range. Additionally, we explicitly tested whether habitat heterogeneity is a predictor of diversity across those communities. By comparing taxonomic and functional diversity to GIS-derived habitat heterogeneity estimates for each site, we found that both functional and taxonomic diversity were positively correlated with habitat heterogeneity. This study provides the first analysis of the effect exerted by habitat heterogeneity on reptile taxonomic and functional diversity in the Soutpansberg. Additionally, this study provides the first quantification of reptile species richness, community structure and functional diversity for multiple reptile communities, at fine spatial scales within the Soutpansberg. In doing so, our work increases the herpetological knowledge of the Soutpansberg beyond the landscape resolution which could prove valuable for future studies concerning African reptile communities and their stability over time.

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Responses of a Savanna Reptile Community to Historical Land Transformation

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Habitat loss via agricultural land transformation constitutes one of the greatest threats to global biodiversity, and to reptiles in particular. Current rates of land transformation are highest in less economically developed countries, where the overlap with regions of high species richness is pronounced. In order to better facilitate sustainable development, we must urgently account for the impacts of past land-use practices on all taxa. Reptiles are rarely included in global conservation assessments, despite their sensitivity to environmental change. In this study, we investigate the relative abundance of squamate reptiles in three habitats (untransformed, structurally heterogeneous; transformed, high structure; and transformed, low structure) on a private nature reserve in the lowveld of south-eastern Zimbabwe, using data from a trapping survey carried out across nine sites in January–February 2022. We find that total reptile abundance, species richness, and functional diversity remained highest in structurally heterogeneous, untransformed habitat. Functional diversity was significantly suppressed in transformed habitats – by an estimated minimum of 54%, even decades after disturbance events took place – and total abundance was lowest where habitat structure had been removed. We discuss the relative efficacy of two selected analyses used in this study, concluding that Royle-Nichols occupancy modelling was ill-suited to quantifying the effects of large-scale, multivariate habitat structure change on reptiles. Model-based multivariate abundance analysis offers a suitable alternative provided the sample size is sufficiently large, although it does not explicitly account for the influence of detection covariates. We argue that further, restructured surveys will reduce uncertainties in both analyses. We conclude that land management, both within and outside protected areas, strongly affects reptile communities in savannas, and note that there is scope to study the impacts of current and historical land-use practices on herpetofauna across the broader landscape. Our work represents the first study of reptile community ecology in Zimbabwe in over a decade and contributes towards forming a modern baseline for continued monitoring in the region.

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Assessing the effectiveness of an occupancy modelling framework to monitor a rare and threatened amphibian species, *Heleophryne rosei*.

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Effective monitoring of threatened species typically requires accurate data on population trends. Gathering these data can however be challenging, particularly for rare, elusive species that occur in regions where management resources and capacity are limited. It is therefore important to determine the optimum study design that balances recording data to accurately monitor a species against cost, capacity, and management objectives. Here, we use 3 years of tadpole surveys of the Table Mountain Ghost Frog (*Heleophryne rosei*) to explore a cost-effective monitoring protocol that tracks fluctuations in tadpole occupancy at key sites (i.e., pools along each stream) over time whilst accounting for imperfect detection. This species is highly restricted in range, occurring only on Table Mountain (Cape Town, South Africa) and tadpoles have extreme adaptations allowing them to inhabit high-flow streams. Detectability was influenced by extreme levels of siltation but remained high (>90%) throughout the study, suggesting no more than two repeat visits are needed per site per annum. However, the influence of observer expertise on detectability remains unknown in this context and needs to be assessed to inform future sampling design. Very minor fluctuations in occupancy were apparent between each of the three years, implying that tadpole spatial distribution is stable over short time periods and that sampling intervals could be extended to occur once every three to five years for at least a subset of sites. The benefit of this monitoring framework is that it provides a cost-effective and resource efficient option to monitor general trends in occupancy within a species range – for example, optimizing the detection of localized extinction events at important locations within the species distribution. However, even with high detectability, it is likely that minor changes in occupancy at a site would not be recorded. Given the temporal and spatial variability of pool dynamics within streams in this high energy system, only detecting large or moderate changes in occupancy may actually be beneficial, masking out localized changes in occupancy as a result of natural flow variation over time and associated pool movement. Long-term implementation of this monitoring protocol will be important to track population change since the occurrence of tadpoles reflects the presence of reproductive adults, although more work is needed to translate changes in tadpole occupancy to population fluctuations of adults.

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Turning up the heat: Changing the landscape of prosecution and punishment for cruelty to herpetofauna

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South Africa has a very rich and unique herpetofauna, but the beauty and sentience of this group of animals is seldom recognised. Aesthetics and low social acceptability greatly influence the support given by the public and various other decision-making bodies to the preservation, protection and sentience of reptile and amphibian species. Reptiles and amphibians are particularly neglected in the justice system, faring badly when compared with other attention lavished African creatures who fall victim to cruelty and criminal activities. Many African countries have laws in place to protect these animals from exploitation and cruelty, but a law is only as strong as its enforcement. Although incidents of reptiles and amphibian species being removed from illegal circumstances, inhumane keeping conditions and situations of cruelty are fairly common, the incidents are rarely even recorded, let alone prosecuted. A vicious cycle is created - little to no risk of detection, prosecution or punishment for these crimes has resulted in rampant illegal behaviour and cruelty contraventions pertaining to our herpetofauna being rife. Johannesburg Wildlife Veterinary Hospital undertook to change this state of play and in just 12 months have already made remarkable progress in ensuring that the risk of engaging in illegal activities and premeditated cruelty of any sort with these species outweighs the reward. Ensuring safety and security for all the individuals of a society requires empowered citizens and communities, an understanding of the law and its application, support of that law and the means to ensure its enforcement. It is not only official enforcement agencies that should bear the responsibility for preventing these crimes against the animals we all revere. Veterinarians, para-veterinarians, animal keepers, community members, species specialists, herpetology enthusiasts, academics, government officials, members of the judiciary, social welfare workers, and educators all have an intrinsic role to play.

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Photo: Wade Stanton-Jones

The South African Institute for Aquatic Biodiversity Frog Collection

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The South African Institute for Aquatic Biodiversity (SAIAB) started a formal collection of Amphibians in 2001. This is an account of our motivation for starting the collection, progress and our holdings in the hopes for more widespread use of this resource. SAIAB originally started as the JLB Smith Institute of Ichthyology in 1977 with the primary focus of fish. In 1999 the institute was renamed SAIAB, which incentivised the inclusion of more taxa into the collection. SAIAB's researchers – regularly collected amphibians as by-catches from freshwater fish research and sent them to Port Elizabeth Museum. In the late 1990's, at the suggestion of Dr. Bill Branch we agreed that amphibians were an obvious new group to add to the SAIAB collection. Milestones in our developments have been several significant gifts: amphibians from the Stellenbosch University's Ellerman Collection, Eddie van Djik's African herpetological literature collection, substantial donations from Alan Channing and Michael Cunningham, SAIAB's freshwater expeditionary work in southern Africa, and Stellenbosch University's herpetological slide collection. Finally, and worth special mention, is the merging of the North-West University (NWU) amphibian collection in collaboration with Prof. Louis du Preez. This collection remains physically at NWU but is being catalogued into the SAIAB collection database and is thus accessible to the wider scientific community. Currently our holdings are: 7020 lots of specimens comprising 16 types, 33 families, 97 genera and 337 species. Most of our collection are whole specimens (formalin fixed and ethanol preserved). We have a few skeletal preparations (dry skeletons and cleared and stained specimens) and we plan on developing more of these. Our biobank holds over 500 tissues from specimens held in our collection – currently these are being audited/catalogued. The geographic spread of our collections is vast and encompasses much of sub-Saharan Africa. SAIAB, as a national government entity, has a policy of open access to our research materials, so we invite you to work with us and build not only our collection but our knowledge of southern African anurans.

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Frogs of the greater Natures Valley area - Diversity, conservation, and community engagement

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Nature's Valley is a small, tourist-centric residential neighborhood tucked well away within the Tsitsikamma coastal forests of South Africa. Nature's Valley Trust (NVT) and Endangered Wildlife Trust (EWT) have identified that this area is lacking recent and accurate biodiversity data and a detailed amphibian diversity assessment has not been done in this area since 1987. In the meantime, touristic, residential, and agricultural development took leap within the catchment. From West to East, the natural vegetation changes from Floristic Fynbos to Indigenous forests, to traces of west-coast thicket, fostering various ecotones and associate biodiversity from all fronts. According to a desktop study, it is expected that approximately 21 frog species may occur in the proposed study area. Distribution maps indicate that this area is the easternmost limit for some frog species and the westernmost for other. This study will therefore attempt to verify the amphibian species diversity. In doing so, various micro-habitats will be identified along with assessments of the percentage of protected indigenous and representative habitats. Acoustic monitoring using song meters will provide information on seasonal and circadian call patterns. The security and stability of these habitats will be evaluated by determining and identifying any risks towards these protected and unprotected areas such as water column nitrification, deforestation, and possible illegal harvesting. This could provide important conservation perspectives since two river systems (Groot River & Sout River) flow through the proposed study area. The Sout river catchment includes cultivated agricultural land. Moreover, the agriculture in this area predominantly focuses on timber cultivation, therefore introducing invasive coniferous vegetation into the area which could have conservation implications. Some areas of the Nature's Valley region are old timber plantations that have fallen victim to natural succession, and this could provide useful evidence of the effect of previously developed areas versus pristine, natural areas on frog diversity. Nature's Valley is a popular tourist destination. Community engagement and ethnical importance of frogs toward the surrounding residential and touristic community could provide important conservation angles that should be further explored. The ultimate goal will be to provide evidence-based conservation solutions for the Nature's Valley area and surrounding Tsitsikamma National Park from a frog-monitoring perspective.

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Aspects of the urban and rural ecology of Nile monitors (*Varanus niloticus*) in KwaZulu-Natal, South Africa

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Globally, with the continued increase in human populations, there is unprecedented changing anthropogenic land use. Little is known about how reptiles respond to anthropogenic changing land use, especially in Africa. Nile monitors (*Varanus niloticus*) are Africa's largest, most widespread, and most exploited varanid. Yet, they remain poorly understood throughout their range. Although urban exploitation comes with additional threats, it may also be a key to Varanid population maintenance with successful management in an increasing anthropogenic land-use change scenario. There is, therefore, a need to fill research gaps in urban Varanid ecology to make critical research-based management decisions. We are using a gradient of urbanisation from Durban to Fountainhill Estate, KwaZulu-Natal, South Africa. Urban monitors will mainly be rescues caught in Durban and Pietermaritzburg through collaborations with KZN Amphibian & Reptile Conservation and other local reptile removers. Morphometrics, weight, capture coordinates, ticks and blood samples are gathered, and passive integrated transponders (PIT) tags are inserted. Data obtained are used to assess various aspects of their ecology, including habitat use, behavioural plasticity, population dynamics (mark-recapture), persistence and parasite load. Semi-urban and natural habitat monitors will be caught using baited step plate traps, active searching and using a noose and pole apparatus. The same data will be gathered with the addition of bead tagging for mark-resight in both the semi-urban and natural field sites to analyse population dynamics. Furthermore, we are using online questionnaires to investigate cultural aspects, perceptions and human/domestic pet interactions with Nile monitors. We aim to determine if Nile monitors are successful exploiters in areas of changing land use and what factors affect their persistence positively. We will determine whether they modify their ecology and behaviour to respond to increasingly anthropogenic dense areas. So far, we have had 237 sightings, including 20 processed individuals. Preliminary findings show that Nile monitors are susceptible to dog attacks and have a low survival rate following these. We have no records of dog fatalities from monitors. Hunting and selling of Nile monitors occur in Durban. Nile monitors are generally close to waterways, with them seen, on average, 231.2m away from waterways in urban areas (n = 110). A female was seen depositing eggs in a mulch pile in Durban on May 14th, 2022, and two confirmed gravid females were caught in late May 2022 showing, evidence that they may breed earlier in KwaZulu-Natal than in other areas of their South African distribution range.

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Crocodiles do not eat fish

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Nile crocodile (*Crocodylus niloticus*) populations that exist outside of protected areas are under threat in South Africa. They are believed to predominantly feed on fish, but they also take prey from the terrestrial system, which brings them in to conflict with humans and hampers their management. We use stable light isotope analysis to explore the diet of an unprotected Nile crocodile (*Crocodylus niloticus*) population in the Olifants River, Mpumalanga and Limpopo Provinces. Nitrogen stable isotope ratios were obtained from fish and crocodile populations along the length (± 430 km) of the river. The catchment is severely polluted resulting in elevated δ 15 N values at nutrient hotspots, which provides a basis for tracking the trophic response of crocodiles to the longitudinal profile of fish δ 15 N values. Crocodiles did not respond to changes in the δ 15 N values of fish populations and dietary predictions based on size specific diet to tissue discrimination factors suggests a non-aquatic food base. The data suggesting terrestrial diet dependence in one of the few viable crocodile populations outside of protected areas and poses unique challenges to their conservation.

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Phylogenetic Systematics of Southern African Ground Agamas

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Morphological conservatism, incomplete taxon sampling and inadequate geographic coverage have resulted in uncertainties with respect to species boundaries and the validity of certain taxa within Southern African ground agamas. Prior data have established deep divergences within more widespread taxa including the *A. atra*/*A. knobeli* complex in the southwest and within *A. aculeata* and *A. anchietae* to the north, but whether such substructure is consistent with species-level divergence remains an open question. Using range-wide sampling with an emphasis on specimens from Namibia and Angola, we generated fine-scale molecular phylogenies in maximum likelihood and Bayesian frameworks using a combination of two mitochondrial (ND4, 16s) and two rapidly evolving nuclear (Rag1, PNN) genes. We were able to resolve phylogenetic relationships between more recently diverged clades, confirm earlier findings of genetically distinct populations within *A. atra* (although with lack of support for the elevation of *A. knobeli* to species status), and uncover undescribed genetic structuring within *A. anchietae*. We used a predictive niche modelling approach in MAXENT in order to estimate and compare the geographic distributions of western ground agamas based on climatic, soil, and ecoregion variables. This approach provides insight into environmental correlates that serve to distinguish morphologically similar species with largely overlapping ranges and can evaluate whether subclades (e.g., *A. atra atra* and *A. a. knobeli*) are characterised by differing spatial niches. An integrative approach utilising molecular data, morphology and niche modelling will be employed to reconsider the taxonomy of all members of the Southern African Agama clade.

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A helping hand: Securing South Africa's Herpetological Collections

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The Natural Science Collections Facility (NSCF) was launched on 17 October 2017 by the Department of Science and Technology (DST) and the South African National Biodiversity Institute (SANBI). A vital function of the NSCF is to promote and facilitate networking between institutions with natural science collections and to establish common goals. Many institutions were operating separately, and in some cases, this was also happening in collections within institutions. In the spirit of a collections network, the NSCF, collaborating with various partner institutions, started developing national curation standards and policies for botanical, zoological and paleontological collections. In 2021 a significant milestone was reached with the release of the Collection Management and Conservation Manual. During this time, collections with substantial backlogs and at-risk and orphaned collections received attention. The first vertebrate groups to receive attention were the reptile and amphibian collections housed at the Ditsong Museum, McGregor Museum, KwaZulu-Natal Museum, Port Elizabeth Museum and Durban Natural Science Museum Research Centre. Work in the collections started in 2018, with each collection posing different challenges. Significant progress has been made so far in the following areas. Labelling of storage cabinets, shelves and specimen containers with unique identifiers. Rebottling of at-risk specimens. Transfer of formalin specimens, except tadpoles, to ethanol. Increasing the concentration of ethanol in storage containers where possible. Verification of specimen identifications, identification and cataloguing of backlog specimens. Digitisation of field notes, physical datasheets and labels where required. Cleaning and enhancing specimen data. Georeferencing of localities for selected records. Updating the Specify database with missing information and creating storage trees linking specimens to containers, cabinets and shelves. Currently, we are conducting data verification work at the Ditsong Museum. This phase will be completed around March 2023, after which the focus will shift to taxonomic updates and locality verification. The type specimens have received attention, and work has started on reviewing information for the paratypes. The labelling of containers is complete, as well as the collection and digitisation of storage tree information. We present here the impact this initiative has had thus far on the quality of herpetological data. How the incorporation of backlog specimens has added value, and where we need to focus our collecting efforts in the coming years to further improve the coverage of our herpetological collections.

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Gecko Invasion: Tracing the range expansion of *Lygodactylus capensis* (Smith 1849) in South Africa

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The Common Dwarf Gecko, *Lygodactylus capensis* (Smith 1849), occurs widely across the northern parts of southern Africa. Since the earliest reporting of extralimital distribution records of this species in the 1980s, *L. capensis* has subsequently spread to many areas in South Africa. Several of these populations have been shown to be established, and the range expansion appears to be ongoing with new localities still being recorded. The widespread occurrence of this species outside its known natural range demonstrates a substantial range change for this species, but the mechanisms for dispersal are not known. Establishing whether this range expansion has progressed through natural processes (evolution and natural environmental changes), human-mediated dispersal, and/or human-induced environmental changes (i.e., land use change, human disturbance and human-mediated climatic change) as well as detecting the sources from which these populations are spreading from is essential so that these populations are correctly classified (i.e. alien, cryptogenic, neonative or native-alien/extra limital) and appropriately managed. Using mitochondrial sequence data from individuals originating in natural (N = 62) and introduced (N = 38) populations, we assessed the spread of *L. capensis* and found that this gecko has spread widely across South Africa through multiple dispersal events, most likely through human mediated jump dispersal. These dispersal events originate from various locations across the natural range, with established populations consisting of individuals introduced from multiple different source populations. This indicates that the populations outside of the species known natural range can therefore be classified as native-alien/extra limital populations. Furthermore, using species distribution models, we show that *L. capensis* has a very wide climatic envelope and in introduced locations it occurs in climate space that differs from that of its native range. This flexibility might predispose it to be a highly successful invader whether in South Africa or globally.

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Assessing behavioural patterns and life history of an endangered endemic, the Kloof Frog (*Natalobatrachus bonebergi*), using monitoring and surveillance data

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The Endangered Kloof Frog (*Natalobatrachus bonebergi*) has been well monitored over the past decade across various sites across southern KwaZulu-Natal and northern Eastern Cape. These monitoring data form part of a monitoring protocol developed by Endangered Wildlife Trust for Ezemvelo KZN Wildlife. The protocol was designed as to enable citizen scientists/volunteers and park rangers to collect data. To this end, three different groups of data have been collected on egg clump transects, namely data from honorary officers of Ezemvelo KZN Wildlife, data from park rangers of the Eastern Cape monitoring sites, and citizen science data from school groups in KZN. These data – collectively part of the Endangered Wildlife Trust's Threatened Amphibian Programme – will be analysed, together with camera trap observational recordings, to identify behavioural patterns and develop research questions aimed at better understanding the life history of the Kloof Frog. The acoustic profile of the species' 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. Data on egg clump- and tadpole development will be collected. Egg clump data will be analysed as a function of environmental pressures and predation. Visible Implant Elastomer (VIE) tags will be implanted on selected Kloof Frog tadpoles to capture growth rates and migration data. The Kloof Frog is an Evolutionarily Distinct and Globally Endangered (EDGE) species and is also monotypic of 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.

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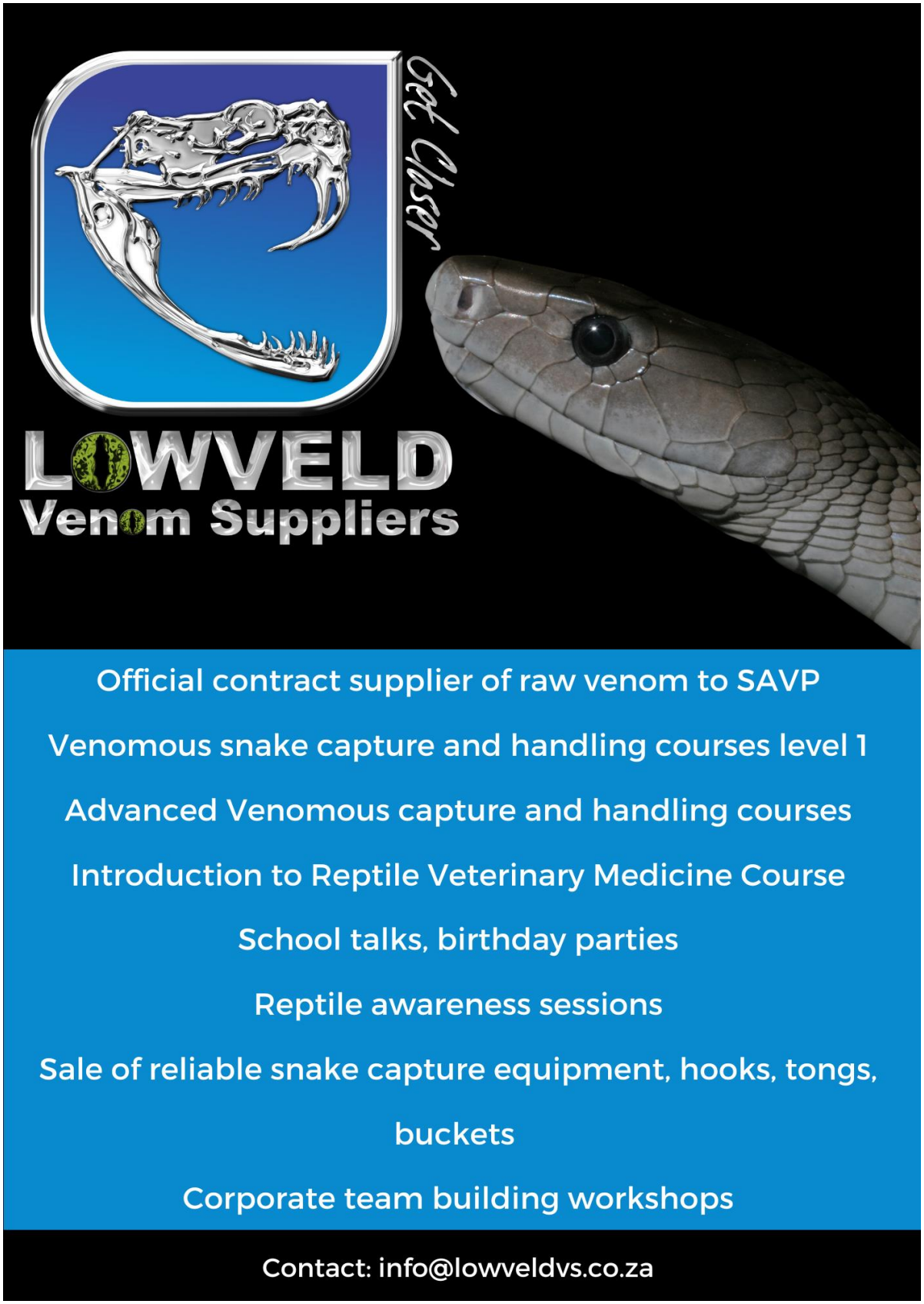
Abstracts: Posters



Anuran blood parasite fauna of the Soutpansberg mountain range

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The Soutpansberg mountain range is part of the Vhembe Biosphere Reserve, an area known to harbour at least 33 species of frogs. Additionally, frogs are known to host a variety of intra- and extracellular blood parasites. However, currently no data is available for the diversity and distribution of frog blood parasites from within the study area. In the present study we show that the rich frog diversity found within the Vhembe Biosphere also serve as hosts for a number of blood parasite species. Blood samples from over 400 individual frogs across 31 species were collected and screened for blood parasites. Morphological characteristics and molecular analysis indicated that seven frog species were infected by various blood parasites. This includes trypanosomatids, haemogregarines, haemociccidians and filarial nematodes. These results demonstrate a diverse parasite community across the Vhembe Biosphere providing insight to understanding the diversity and distribution of South African anuran blood parasites.

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Sniffing out Critically Endangered Frogs: A case study for Rose's Mountain Toadlet (*Capensibufo rosei*)

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Rose's Mountain Toadlet (*Capensibufo rosei*) is Critically Endangered due to a decline in the number of breeding sites since the 1980s. Despite targeted searches for this species, it is currently only known from two breeding areas within Table Mountain National Park, Cape Town, South Africa. Because this species does not have an advertisement call, locating breeding sites using auditory signals is not possible. Thus, breeding sites must be located visually, which is challenging given that breeding occurs in small ephemeral pools in thick fynbos vegetation, and because these frogs are small and cryptic (e.g., adult males measure about 2 cm in length). Our aim, therefore, was to assess whether trained conservation detection dogs could be used to validate presence/absence of breeding pools at current and historic sites. *Capensibufo rosei* is a good target species for scent detection, because it remains concentrated around breeding pools during breeding season, providing an abundance of target individuals on which dogs can detect scent. During the 2020 and 2022 breeding seasons, dogs were trained to detect *C. rosei* toadlets and egg masses in a scent line-up and in the field where various other amphibian species (e.g., Cape Stream Frog, Clicking Stream Frog, Lightfoot's Moss Frog) co-occur. One dog through exposure to in-situ searches generalised progressively in alerts from live toadlets to eggs in a breeding pool. The dog was able to detect completely new breeding pools that had been overlooked by humans. Due to the small size and mobility of the target species in the associated vegetation, in many cases the dog would identify and alert in an area and then the handler would need to search within a 1 m radius to pinpoint the exact source of the target. Notably, in 2022 the dog detected two new breeding pools that were concealed with taller vegetation and had been previously overlooked. Additionally, if a dog shows no behaviour characteristic of being in the presence of target scent, that suggest a low likelihood of *C. rosei* thus corroborating absences at historical sites. Overall, our findings show that detection dogs could add significant value to improve knowledge of this Critically Endangered amphibian by identifying previously unknown breeding pools.

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Morphological and molecular diagnosis of two species of *Trypanosoma Gruby*, 1843 infecting South African cordylids (Squamata: Cordylidae: Cordylinae)

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Despite reptile trypanosomes forming a large group, the majority of species descriptions are data deficient, lacking key characteristic data and supporting molecular data. Reptile hosts show potential to facilitate transmission of zoonotic trypanosomiases and offer key information to understanding the genus of Trypanosoma. Several species of squamates from different localities in South Africa were screened molecularly and microscopically for trypanosomes in the present study. Based on the combination of morphological and molecular analyses, two species of Trypanosoma infecting South African cordylid lizards (Cordylidae: Cordylinae) are reported in the present. Furthermore, this study provides the first molecular data for a South African reptile trypanosome.

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Angolan leaf-toed geckos: A decade of change

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African leaf-toed geckos are amongst the most ancient and taxonomically problematic Gekkonidae groups in Africa and thus, not surprisingly, these geckos have been the focus of several studies. Angolan leaf-toed geckos had previously been considered as members of *Afrogecko* Bauer, Good & Branch 1997, represented by two species, *A. plumicaudus* Haacke 2008 and *A. ansorgii* (Boulenger 1902). However, with the availability of new material, in 2014 Heinicke et al. revised the monophyletic Circum-Indian Ocean leaf-toed geckos, where they erected Kolekanos to accommodate *A. plumicaudus*. However, due to the lack of fresh genetic material and detailed morphological assessment, they tentatively assigned *A. ansorgii* this species to the genus Afrogecko. In the last decade, new material of *K. plumicaudus* and *A. ansorgii* have been collected across western Angola, that have allowed us to revisit the group with the description of a new genus, *Bauerius gen. nov.*, to accommodate *A. ansorgii* and a new species of Kolekanos, *K. spinicaudus sp. nov*. from the arid coastal savanna of Benguela Province. Furthermore, thanks to these intensive surveys in the arid coastal Angola, we provided updated distribution maps and IUCN conservation status for both taxa. Therefore, here we provide a new paradigm that could lead to future evolutionary studies of this group and other reptiles.

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G(e)nomes and dwarfs: A phylogenomic inquisition into the southern African dwarf chameleon (*Bradypodion*) radiation

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The advent of next generation sequencing technologies has made it feasible to reconstruct phylogenies using whole genome sequence data. In this 'phylogenomic era', it is now possible to take a closer look at the effects of incomplete lineage sorting and adaptive introgression on species relationships – factors that have long hampered interpretations for some phylogenetic analyses. Recombination rates differ across the genome, which can cause certain loci to be more prone to introgression than others resulting in conflicting gene tree topologies. Southern African dwarf chameleons of the genus Bradypodion are characterized by pronounced ecologically driven phenotypic specialization particularly evident in the more recent clades of Bradypodion that diversified in the late Pliocene. Deep phylogenetic relationships within the genus have been well resolved using single locus data, however, relationships within and between some of the more recent, closely related clades are yet to be fully resolved. Here we use single nucleotide polymorphisms from whole genome sequence data to reconstruct the evolutionary history of Bradypodion, aiming for complete taxon sampling including populations that have not previously been incorporated into phylogenetic analyses. In addition, using data from different parts of the genome, we weight the likelihood of dissimilar tree topologies produced. This will allow for assessment of the presence and extent of introgression and an evaluation as to whether introgression has mired interpretation of relationships within young clades, or whether this has been due to incomplete lineage sorting. Finally, we make use of a genome-wide association approach to ascertain whether convergence in phenotypes across the phylogeny is underlain by conserved genetic architecture, or if different mutations in the genome have produced similar outcomes in phenotypes.

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Dietary metabarcoding in Dwarf Chameleons: A comparison of taxonomic resolutions achieved through different sampling methods

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Dietary studies are key to understanding species interactions, food web structure and ecological dynamics. Classic methods of diet quantification typically rely on invasive sampling methods such as stomach dissection or oral lavage followed by microscopy to identify small or fragmented prey items (due to chemical and mechanical breakdown during digestion) often only to taxonomic Order. With the development of next-generation sequencing and DNA metabarcoding, non-invasive sampling (e.g., through the examination of faecal samples) is becoming more widely used for dietary analyses, with studies often reporting more efficient and accurate assessments of dietary composition, even to the species level. However, few such studies have been conducted on reptiles, and even fewer within a South African context. Consequently, this study aims to investigate the difference in dietary composition and taxonomic resolution achieved between invasive oral lavage and non-invasive scat sampling methods for the Knysna Dwarf Chameleon, *Bradypodion damaranum*. Twenty dietary samples from oral lavage will be examined through microscopy to identify prey to the lowest possible taxonomic level. DNA will then be extracted from the 20 oral lavage samples, as well as from 20 faecal samples. The extracts will then be amplified using two arthropod specific primers (mitochondrial CO1 and 16S) designed for broad-spectrum dietary analysis. Successful PCRs will be indexed and pooled, then processed on an Illumina MiSeq. The resulting metabarcoded sequence reads will be analysed using the Ilifu high-performance computer cluster (University of Cape Town) and compared against invertebrate reference sequences available on Genbank, as well as against a reference library of local prey species that has been generated specifically for dietary analyses of Bradypodion. We hypothesise that finer taxonomic resolution of prey items will be achieved using metabarcoding as opposed to the manual identification approach by microscopy, thereby showing that metabarcoding provides more accurate information for dietary studies. We also expect similar dietary compositions to be observed between stomach and faecal samples based on the metabarcoding approach, although it is possible that the dietary signal from faecal samples will show lower richness than the stomach samples due to the potential for DNA to be degraded during digestion.

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Exploring colour polymorphism in the Mole Snake (*Pseudaspis cana*)

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Colour polymorphism is widespread in many species of reptiles. However, colour variation might also indicate important underlying genetic variation that indicates genetic isolation or even speciation. In southern Africa, Mole Snakes (*Pseudaspis cana*) are known to range in colour from pale yellow-brown to black. Moreover, differences in colour pattern are known to correlate with hemipenal morphology in at least some populations, resulting in speculation of potential taxonomic differences among colour patterns. In this context, we aimed to explore geographical variation in *P. cana* colour. We specifically asked whether the variation in colour represents a simple geographical gradient, whether extremes of colour variation occur sympatrically, and if so, can we identify such geographic regions to target genetic sampling? We downloaded 809 Research Grade *P. cana* records from iNaturalist and scored each for the presence of patterning (marked vs plain) and colour (using a five-category colour scale ranging from very pale to black). In total, we were able to score 548 records of plain snakes. We mapped colours to their geographic locations and assessed the resulting patterns visually. We showed that although there is an overall colour gradient running along a SW to NE axis, most regions host both light and dark coloured individuals. We showed that extremes of colour variation can be found in close proximity to one another, particularly in the Kalahari, ranging from Kgalagadi Transfrontier Park eastwards to Mahikeng, and northward through central Botswana. We recommend that a thorough genetic analysis of *P. cana* take place, including sampling from regions with extreme variation in colour. Such a study would inform the taxonomic status of these animals, but also provide a basis for understanding colour polymorphism in general.

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TshiVenda naming and classification of South African herpetofauna

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Conservation scientists have standardised methods and practices. Their means of communication are also standardised through the use of scientific names, which likely have limited use in conversations with non-scientist stakeholders such as farmers, cultural custodians, and local communities. This might lead to conservation scientists missing out on important information from non-scientists due to the language barrier. Folk taxonomy, or the naming of species according to cultural perspectives, can simplify communication in collaborative conservation initiatives with non-scientists as they are already familiar with those names. However, the documentation of folk names is lacking; thus, they are inaccessible for use. This study analyses the TshiVenda names of South African herptiles. The names of frogs and reptiles in TshiVenda were documented using an online questionnaire and analysed to understand the principles underlying the assigning of those names. The analysis shows that most folk names lack specific names for species, and species are often grouped according to their similarities in traits. However, folk taxonomy shares some similarities with scientific taxonomy. From a biodiversity studies perspective, folk names can be used to judge local communities' perception of biodiversity since names are considered a categorisation of biodiversity. The documentation of folk names makes them available for use in conservation contexts and contributes to the inclusion of previously marginalized languages and people. Furthermore, the principles underlying folk taxonomy can be used to extend folk-generic names to compile a comprehensive list of South African Indigenous names for the country's known herptile species.

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On the Type Locality of *Pachydactylus tigrinus* van Dam, 1921

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The type series of *Pachydactylus tigrinus van Dam*, 1921 was reportedly collected along the Brak River, immediately southeast of the Blouberg's eastern foothills (Blinkwater). However, there appears to be no suitable micro-habitat for it there. Follow-up surveys have been unable to yield the species at this location since its description more than 100 years ago, only producing *Pachydactylus affinis* from the foothills of the mountain. Morphological and ecological observations suggest that subsequent records of *P. tigrinus* from the Blouberg massif are misidentifications. It appears that *Pachydactylus tigrinus* does not occur west of the Soutpansberg and that its type locality is either an error or its true location has been lost. The present investigation seeks to establish which is the case, and whether or not *P. tigrinus* occurs west of the Soutpansberg.

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Highly-quality whole genome assemblies of southern African dwarf chameleons, *Bradypodion pumilum* and *B. ventrale*

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A complete and high-quality reference genome has become a fundamental tool for the study of functional, comparative, and evolutionary genomics. Genomic resources have also enabled evolutionary biologists to uncover the genetic underpinnings for traits associated with adaptation in many taxa. With recent advances in sequencing technologies, genome assemblies can now be rapidly constructed for non-model organisms. The southern African dwarf chameleons (*Bradypodion*) are one such group, with a large body of evidence demonstrating the highly adaptive capacity of this relatively young lineage. *Bradypodion* are known for their distinct habitat specialization, with evidence of convergent phenotypes across the phylogeny. However, the underlying genetic architecture of these phenotypes remains unknown for *Bradypodion* and without adequate genomic resources, many evolutionary questions cannot be answered. We present de novo assembled whole-genomes for *B. pumilum* and *B. ventrale*, using Pacific Biosciences (PacBio) long-read data. Based on Benchmarking Universal Single-Copy Ortholog (BUSCO) analysis and scaffold length (N50) statistics, these genomes rival all other publicly available reptile genome assemblies for overall quality and coverage. BUSCO analysis revealed that 96.36 % of single-copy orthologs (i.e., genes of the same function) from vertebrates were present in the *B. pumilum* genome and 94 % in *B. ventrale*. Moreover, these genomes boast scaffold N50 of 389.6 Mb and 374.9 Mb, respectively. Based on a whole genome alignment of both Bradypodion genomes, *B. pumilum* is highly syntenic (genes occur on the same chromosomes) with *B. ventrale*. Furthermore, *Bradypodion* is also syntenic with Anolis, despite divergence between these lineages being nearly 170 Mya. These high-quality Bradypodion genome assemblies will support future research on the evolutionary history, diversification, and genetic underpinnings of adaptation in *Bradypodion*.

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Living in the Anthropocene: Does the Knysna Dwarf Chameleon show adaptation to urbanization?

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Several species of Dwarf Chameleons appear to tolerate some urbanisation, inhabiting transformed vegetation in towns. For example, the Knysna Dwarf Chameleon (*Bradypodion damaranum*) occurs in Afrotemperate forests along the southern margin of South Africa. It also occurs in some towns where the natural forest vegetation has been fundamentally altered, giving way to a mix of exotic and native trees, bushes and herbaceous plants that occurs in patchy habitat fragments. The Knysna Dwarf appears to be in high density in some towns, possibly having adapted to these new conditions. Mechanisms for the acquisition of characters allowing species to tolerate urbanisation are likely along a continuum that includes plasticity and/or acclimation, but ultimately with adaptation that produces a new phenotype. We hypothesised that given the lower density of vegetation in urban areas; those populations would have reduced ornamentation as an adaptation to decrease conspicuousness. We also assumed that structural changes in vegetation could influence limb traits, whereby populations living on thicker branches would have larger limbs. To examine these hypotheses, we analysed 22 head/limb traits of 453 chameleons from natural and urban populations from the towns of Knysna and George, and quantified performance (bite and grip forces). Multivariate analyses of covariance suggest that ornamentation (casque) is reduced in urban populations for both sexes. In contrast, urban populations have wider hands and wider/higher heads than natural populations. Bite force is higher in urban populations if casque measurements are used as covariates, suggesting that urban chameleons produce higher forces despite having smaller ornamentation. This might be achieved through greater muscle mass on the head, which is possibly accommodated by the higher and wider heads of the urban chameleons. Overall, urban chameleons may have adapted to the structural differences in vegetation by increasing hand size for gripping larger branches and reducing ornamentation to be less conspicuous but can attain higher bite forces potentially enhancing their ability to overcome increased inter- or intra- specific exchanges in a habitat that provides relatively little cover for concealment.

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Rates of body water loss: a new currency for predicting vulnerability of lizards to warming?

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Reptiles, such as lizards, are typically viewed to be resistant to water loss due to thick integuments and independence from water bodies. However, the rate of water loss of lizards increases exponentially with temperature, impacting activity levels and thermoregulatory behaviour. Therefore, this often-neglected trait may affect the fitness of these organisms and limit their geographic distributions, as forecasted conditions predict increasing heat waves and drought events. For many reptile species, data are not sufficient to evaluate their vulnerability to warming from dehydration. The water loss of lizards can be divided into cutaneous and respiratory routes of evaporation. While cutaneous water loss depends on the total surface area and skin composition, water lost via respiration is a function of breathing patterns, metabolic rate and body size. In dryer environments, the total water lost by lizards is less compared to lizards from more moist environments, due to lower skin permeability to water, likely an adaptive mechanism to conserve water. Lizards use strategies such as gaping (opening of the mouth) and panting (fast breathing patterns) to lower body temperature when conditions become too warm. While evaporative cooling can allow lizards to escape from extreme temperatures, the associated increase in water loss is not sustainable and dehydrated lizards spend less time gaping and postpone panting to conserve water in high heat loads. Thus, knowledge of water loss rates via these two routes, respiratory and cutaneous, is at the core of understanding physiological adaptations of these organisms to warm temperatures. This study aims to measure the cutaneous and respiratory water loss of five lizard species native to South Africa (*Agama atra*, *Bradypodion pumilum*, *Chondrodactylus bibronii*, *Cordylus cordylus* and *Trachylepis capensis*). Using open flow respirometry and infrared thermal imaging, we aim to determine the partitioning of cutaneous and respiratory water loss and the thermoregulatory strategies of these species as temperature increases above optimal levels. We present preliminary data on the effects of mass and temperature on rates of water loss of South African lizards and place these results in the context of interspecific scaling relationships of water loss across the globe. Relating these responses to temperature and body size will provide key information for predictive mechanistic models of lizard species vulnerability to climate change.

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