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AHN

AFRICAN HERP NEWS

HAA
HERPETOLOGICAL ASSOCIATION OF AFRICA
www.africanherpetology.org

FOUNDED 1965

The HAA is dedicated to the study and conservation of African reptiles and amphibians. Membership is open to anyone with an interest in the African herpetofauna. Members receive the Association's journal, *African Journal of Herpetology* (which publishes review papers, research articles, and short communications – subject to peer review) and *African Herp News*, the newsletter (which includes short communications, natural history notes, book reviews, bibliographies, husbandry hints, announcements and news items).

NEWSLETTER EDITOR'S NOTE

Articles shall be considered for publication provided that they are original and have not been published elsewhere. Articles will be submitted for peer review at the editor's discretion. Authors are requested to submit manuscripts by e-mail in MS Word '.doc' or '.docx' format.

COVER PHOTOGRAPH:
Maluti River Frog
Photograph by: Gary Kyle Nicolau.
Awarded first prize in the 14th HAA Conference photography competition.

COMMITTEE OF THE HAA

AHN CONTENTS

AHN EDITORIAL

This issue of *African Herp News* is devoted to the 14th HAA conference, which was recently held at the Cape St. Francis Resort in the Eastern Cape Province of South Africa between 9–13 September 2019.

At the conference, I was taken aback at the exceptional and varied work being undertaken within African herpetology, not only by the veteran scientists and practitioners we all know (of), but by the numerous students who took part. The quality of work presented was truly outstanding, and made me proud to be part of this herpetological community and the HAA. I am not alone in this sentiment, as it was stated by many with whom I had the pleasure of interacting. It is also a common theme that comes out of the 'Report Backs' by the Student Travel Grant recipients (p. 30 - 36). For all who did not attend, you can get an idea of what I'm referring to by giving the abstracts a careful read.

Although the talks and posters made up the bulk of the conference, the success of the meeting was also attributed to the many social activities and events that took place throughout the week. They created an open and positive atmosphere for all to network and really get to know each other. Well done to Hanlie Engelbrecht, Nic Telford and Shivan (Pillay) Parusnath for their work in this regard. I have no doubt that many future collaborations will stem from these interactions.

Another event that took place during the conference was the organisation's General Meeting. The committee member reports presented at that meeting are printed here for your review (p. 9-29). I encourage you all to read them to better understand what and how the organisation is doing.

Finally, included in this issue is a special note from the chairperson relating to the reporting of sensitive species. This matter came out of the workshop on the trade in South African reptiles and amphibians, which was held a day prior to the conference. All HAA publications will now adopt new guidelines ensuring that the localities of sensitive species remain confidential, with immediate effect. Please refer to page 6 for more details.

EDITORIAL

For those of you who attended the conference, I hope this issue helps you reflect on what a great conference we had, remembering the energy and enthusiasm for African herpetology that was felt by all. For those of you who did not attend, may this issue inspire you to attend the next one.

I look forward to seeing you all at the 15th HAA conference in Kimberley in 2021.

Jessica da Silva

Editor

NATIONAL SENSITIVE SPECIES LIST FOR REPTILES AND AMPHIBIANS

The South African National Environmental Management: Biodiversity Act No. 10 of 2004 requires that the South African National Biodiversity Institute (SANBI) manages information on South Africa's biodiversity. This includes collating and disseminating species geographic distribution data on publicly accessible open access platforms. However, SANBI is also responsible for managing access to these platforms to ensure that our biodiversity is not exploited. As part of this obligation, SANBI must publish a list of species that are potentially sensitive to over-exploitation, and for which geographic distribution information must be withheld. The species listings must be defensible and based on scientific evidence and knowledge, and their vulnerability assessed in a common framework by taxon experts.

Under the framework, multiple criteria are evaluated in order for a taxon to qualify as sensitive:

Targeted exploitation extent: wild individuals of the species are known to be exploited, collected, traded or utilised in a targeted manner, and utilisation is widespread, affects the majority of wild populations and/or is causing rapid decline of the wild population.

Population vulnerability: the population is vulnerable: size is <= 2500 mature individuals OR the number of known subpopulations is <= 5 OR range is <= 100 km2 OR species is at risk of localised extinctions.

Targeted demographics: Mature (breeding) individuals are killed, significantly weakened or are permanently removed from the wild, OR immature individuals are targeted and this significantly impacts mature (breeding) individuals.

Regeneration potential: The species has a slow population growth

rate, or the growth rate varies depending on habitat, and there is a poor chance the wild population will recover from exploitation OR a collector might feasibly harvest the entire extant population removing the chance of subsequent recruitment.

In 2018, SANBI undertook assessments of selected groups of South African species for categorisation as potentially vulnerable to over-exploitation, and this was published on the National Sensitive Species List (NSSL, http://nssl.sanbi.org.za/). Both reptiles and amphibians were evaluated on the existing criteria and cross-checked by several taxon experts. Nine reptile species were evaluated as sensitive, while no amphibians were considered sensitive at this time.

Bitis albanica

Bradypodion caeruleogula

Bradypodion caffer

Bradypodion pumilum

Bradypodion thamnobates

Ouroborus cataphractus

Smaug giganteus

Homopus signatus

Psammobates geometricus

Species on the NSSL do not need to be listed as threatened on the IUCN Red List. The latter is an evaluation of extinction risk for a species that considers numerous additional criteria, whereas the NSSL are species that are potentially at risk from harmful exploitation. Furthermore, the NSSL should not be confused with the Threatened or Protected Species List (ToPS) of 2013 which is published by the Department of Environment, Forestry and Fisheries. The ToPs list includes species that are considered either threatened or in need of protection such that restricted activities apply.

In keeping with the spirit of the NSSL, the Herpetological Association of Africa (HAA) will be adhering to this list in terms of publishing geographic distribution information, and will not release such information. Both *African Herp News* (AHN) and *African Journal of Herpetology* (AJH) will obscure explicit geographic information for any species on the NSSL, although approximate locality information or a general locality description

will be published. The NSSL is a dynamic list and will be re-evaluated periodically to ensure that the list is relevant for current and emerging trends. Authors wishing to publish their work in HAA publications should check the NSSL prior to submitting their articles to ensure that geographical distribution information for species on the NSSL is appropriately presented.

Authors may consult the author guidelines or contact the editors of the AHN and AJH for advice on the presentation of content regarding NSSL species.

Krystal A. Tolley

HAA Chairperson

CHAIRPERSON'S REPORT 2018-2019

The last few years have seen some changes in the HAA, starting in 2017 with portfolios being assigned to the committee positions. Previously, the committee consisted of the Chair, Secretary, Treasurer, Journal Editor and Newsletter Editor, with the remaining positions considered as extra members without any real function. The extra portfolios were initiated by the previous Chairman, Graham Alexander and are: Conference, Student issues, Awards and Media. This has allowed the committee to have some teeth in being progressive and proactive in that each portfolio has the latitude to propose new initiatives and ideas upon which the committee can then vote. Because of this, there are exciting new opportunities for members including general research grants, student research grants, student conference travel grants, and insures continuation of the Don Broadley award for best student publication in the *African Journal of Herpetology*. The activities and awards now have several media platforms upon which there are announcements as well as postings of general interest to members and students, and the conferencing portfolio ensures some stability between conferences.

Another change is the updating of the Constitution which had not been looked at since 2002. It was primarily changed to modernized wording, removal of articles that are no longer valid, and also now includes a Code of Conduct. This new constitution and code is now on the HAA website for download, and has been released in the latest newsletter.

We are developing Standard Operating Procedures as well, for payments and invoicing, for conference requirements, and for document management. This is needed because it has come to our attention that conference reports have not been produced in the past (with a few exceptions), and that in previous years there was no clear operating procedure for making payments.

Document management has been a risk because in the past, all HAA documents were stored with the relevant Chair and Secretary. We now have a general email for the committee that is linked to a Google Drive where all HAA business documents, meeting minutes and reports are backed up and accessible to each committee member. This means that membership lists, reports, and other information will not become lost. At present, all the information from 2017-2018 has been stored on the drive, and we managed to get some documents from previous Chairs which are now on

the drive as well. Notably, this will make transfer of information to future committees hassle free, as they will simply be granted access to the drive and email address.

Another change is that the committee meets regularly every second month using an electronic platform. This has been essential for instituting the new changes in order to get agreement and coordination on the scope and approach.

I would like to highlight the fact that the composition of the current committee, for the first time ever, is >50% female. The committee is also relatively young, with an average age of 40 (but a median of 37 and a SD of 9.8). Overall, there is better representation of age, gender and race than ever before.

Krystal A. Tolley

HAA Chairperson

TREASURER'S REPORT

After many years without having had any annual financial statements, the African Herpetological Association is now in possession of audited annual financial statement for the financial year of 2012 till 2018. The 2019 annual financial statements are currently in the process of being prepared and after having been audit will be published in the *African Herp Newsletter.* At the close of the 2019 financial year, which was on the 28th of February 2019, we had a positive bank balance of R 583,099.18. This balance is however not a true reflection, as an incorrect deposit of R 150,000.00 was made to the association, which was picked up by the bookkeepers and this has since been refunded after the necessary investigations were completed. So the true balance should have been R 433,099.18.

Once the annual financial statements for the 2019 financial year have been completed and audited, these will be submitted to SARS so that we can receive our Tax Clearance Certificate. Once in possession of the Tax Clearance Certificate, we hope to register for an online Credit Card payment facility, which we hope will make membership payments for both local and international members much easier. Currently we are in the process of formally registering the association as a non-profit organisation which will hopefully help us in a number of ways.

Due to the good standing of the associations account, the committee has decided to increase various grants which are to be awarded to the association's membership. Please also be advised that the association has now only got one bank account, which is the one held at First National Bank. All other accounts have been closed to cut unnecessary bank charges and consolidated into the one current account.

Jens Reissig

HAA Treasurer

SECRETARY'S REPORT

MEMBERSHIP STATISTICS

HAA membership for 2018–2019 was as follows:

	January 2017	November 2018	September 2019
African members	113	103	132
Non-African members	39	37	36
Subscriptions to African Herp News only (institutions)	1	0	0
Total membership	**153**	**140**	**168**

Total membership was 153 paid members as reported at the general meeting during the 13th HAA Conference. This is a slight increase to 168 paid memberships since January 2017, even though there were was significant decrease of active members in 2018.

There were 10 new members as of 30 November 2018 (seven professionals and three students). New members as of 30 August 2019 were 33 (nine professionals and 24 students). Of the 132 African members 84 are professionals and 41 students. The conference fee included a membership fee for non-members that attended, therefore we have an additional seven professionals and 15 students that will be active members until the end of December 2020. This brings up the total to 190 paid members.

Another payment system was put into place to manage overseas payments however, there was low uptake as some countries have high bank fees for processing payments to South Africa.

Renewal notices were sent out to members during the first quarter of 2019. The

HAA had a student promotion (a three and a half year membership at the cost of a one-year membership) that was advertised in the last quarter of 2018 and ended in February 2019. I would like to thank supervisors for encouraging students in their labs to join the HAA. The membership structure was updated in 2018 for non-African members now offering a three-year membership at 60 USD, 50 EUR and 775 ZAR. There is a renewal drive planned for the first quarter of 2020 but expect the first notice by the end of the year. I anticipate a great response from all members. Lastly, lapsed members will be removed from the database.

SUBSCRIPTION MANAGEMENT

Membership fees for the year 2020.

African Senior Citizen	1 Year	R100	3 Years (10% discount)	R270
African Student	1 Year	R150	3 Years (10% discount)	R400
African Professional	1 Year	R200	3 Years (10% discount)	R540
Non African	3 Year	$60	€50	R775

Buyi Makhubo

HAA Secretary

JOURNAL EDITOR'S REPORT

EDITORS TERMS OF REFERENCE

A ToR was compiled to stipulate the responsibilities of journal editors. It also includes a section on the criteria for serving as editor, as well as a section on the election procedures. All newly appointed editors have to be familiar with the contents of the ToR. A copy is stored on the HAA's Google Drive.

EDITORIAL COMMITTEE TERMS OF REFERENCE

A ToR was compiled to stipulate the responsibilities of members of the editorial committee. It also includes a section on the criteria for serving as a member, as well as a section on the election procedures. All newly appointed members have to be familiar with the contents of the ToR. A copy is stored on the HAA's Google Drive.

ASSOCIATE EDITORS

There has been a reshuffle of the editors as follows. John Measey was replaced by Ché Weldon officially in January 2018.

Resigned/term ended	Continued on	Newly appointed	e-mail address
Eli Greenbaum	Ed Stanley		elstanley@flmnh.ufl.edu
Jörn Köhler	Shelly Edwards		s.edwards@ru.ac.za
	Jessica da Silva		jessica.m.dasilva@gmail.com
	Luis Ceríaco		luisceriaco@gmail.com
		Courtney Cook	courtney.cook@nwu.ac.za

EDITORIAL COMMITTEE

The editorial committee was replaced after most of the members had served a term of more than 10 years. All outgoing committee members received a letter of appreciation and a copy of the ToR for committee members. The HAA committee nominated new members and eventually nine new members were appointed. They will serve a term of three years and are eligible for a second term.

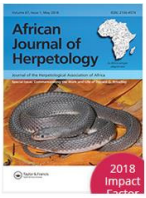
Outgoing members	Newly appointed	email address
Ariadne Angulo, *Canada*	Aaron Bauer, *USA*	aaron.bauer@villanova.edu
Bieke Vanhooydonck, *Belgium*	David Blackburn, *USA*	david.c.blackburn@gmail.com
Bill Branch, *South Africa*	Ed Netherlands, *South Africa*	ec.netherlands@gmail.com
Gerald Kuchling, *Australia*	Eli Greenbaum, *USA*	egreenbaum2@utep.edu
Graham Alexander (chair), *South Africa*	Jeanne Tarrant, *South Africa*	jeannetarrant@ymail.com
James Harris, *Portugal*	Krystal Tolley, *South Africa*	k.tolley@sanbi.org.za
le Fras Mouton, *South Africa*	Martin Whiting, *Australia*	martin.whiting@mq.edu.au
Louis du Preez, *South Africa*	Stefan Lötters, *Germany*	loetters@uni-trier.de
Luca Luiselli, *Italy*	Trent Garner, *UK*	trent.garner@ioz.ac.uk
Martin Whiting, *Australia*		
Michele Menegon, *Italy*		
Mike Bates, *South Africa*		
M.O. Rödel, *Germany*		
Retha Hofmeyer, *South Africa*		
Scott Keogh, *Australia*		
Sherif Baha El Din, *Egypt*		
Simon Loader, *UK*		
Wolfgang Wüster, *UK*		

PUBLISHED JOURNAL ISSUES

Five issues have appeared during the reporting period namely: 66(1), 66(2), 67(1), 67(2) and 68(1). Page quotas were filled with each issue. Cover illustrations displayed a good selection of the wide taxonomic variety covered by the journal.

66 (1) 2017

66(2) 2017



67(1) 2018

67(2) 2018

68(1) 2019

CHANGES TO ONLINE EPUB JOURNAL

The journal has undergone substantial changes to its appearance in an attempt to modernize its look and make it more interactive. Full colour is now used, ORCID accounts are inserted, in-text citations are linked with the reference list, etc. As an example visit https://www.tandfonline.com/doi/pdf/10.1080/21564574.2018.1462064?needAccess=true

INSTRUCTIONS TO AUTHORS

The instructions to authors has been revised to accommodate all the latest changes to the manuscript. These can be accessed at https://www.tandfonline.com/action/authorSubmission?journalCode=ther20&page=instructions. These changes were also published as an announcement in the *African Herp News* 69. A copy is also available on the Google Drive.

WEBSITE

The website of the journal was updated to include new information on the editors, editorial committee, and instructions to authors.

SPECIAL EDITION – DON BROADLEY

Sadly, Don Broadley passed away in 2016, and a special edition commemorating his life and work was published in AJH 67(1).

SPECIAL EDITION – BILL BRANCH

Sadly, Bill Branch passed away in 2018, and a special edition commemorating his life and work will be published in AJH 69(1).

Ché Weldon

Editor-in-Chief, *African Journal of Herpetology*

NEWSLETTER EDITOR'S REPORT

This report covers the two and a half years that I have been Newsletter Editor, during which time 7 issues of *African Herp News* have been published (issues 65–71), thus three issue per year. In total, these seven issues equate to 389 pages of content, averaging 55 pages per issue. These seven issues covered a total of seven articles, two surveys, 31 Natural History Notes, and 25 Geographic Distributions. Additional published material includes the abstracts from the 13th HAA conference, 18 announcements, four editions of Tomorrow's Herpetologist today, 1 edition of Herps Making Headlines, three corrections, one obituary, and most recently the HAA Constitution and Code of Conduct.

Much of the content in issues 65, 67 and 68 were part of a large backlog of submissions, which I tried to address immediately upon becoming editor. As such there were far more Natural History Notes and Geographic Distributions in those issues than in the last two. Hopefully this will change in the upcoming issues as I try to build back the confidence of our members and find new ways to connect the members and make each other aware of the wide-ranging work being done.

One way I am trying to do this is through the section Tomorrow's Herpetologists Today. I created this realising the disconnect between some established herpetologists and the up and coming herpetologists throughout Africa, and even just herpers from one region to another. There is so much great work being done and I hope that this section will help to introduce people and educate everyone about the quality of work being done on African herpetology. Although I try to find young herpetologists to feature, I encourage students to volunteer their submissions for this section.

Another section I created was Herps Making Headlines; however, this section has not had much traction. I encourage anyone wanting to advertise their work further to consider submitting something. It is on us to put our work in the spotlight.

Some other changes that have come about stem from requests or suggestions made at the last general meeting. To reduce costs, the newsletter is now only available in digital format. For their fabulous work with the production and layout of the newsletter, I thank Ash Miller and, most recently, Bianca Fizzotti.

Another request at the last GM was to have all issues of the newsletter digitized and made available to all members. I am proud to say that this was completed in 2018. All issues can now be accessed via the HAA website with a one-year embargo. You can

also access the newsletters online starting from issue 67, without an embargo, if you or your institution is a subscriber to EBSCO publishing – a provider of research databases, e-journals, e-books and magazines. This task could not have been completed without actual hardcopies of each issue, and for that I thank Mike Bates, Graham Alexander, and Jens Reissig. I am also grateful to Jody Taft for assisting me in digitizing them. This is an invaluable resource that I am happy to say is already being used by many of our members.

Jessica da Silva

Editor

AWARDS PORTFOLIO REPORT

HAA PROFESSIONAL RESEARCH GRANT

The subcommittee for evaluation of this award considered and scored all proposals, and selected Dr Julia Riley as the winner. She has been informed and arrangements are being made to pay her the amount of R15 000.

EXCEPTIONAL CONTRIBUTION TO AFRICAN HERPETOLOGY AWARD

There was one candidate proposed for this award and in accordance with the guidelines for the evaluation of such candidates (posted on the H.A.A. website), the H.A.A. committee voted in favour of presenting the award to Prof. Alan Channing. A new form of trophy was prepared and will be presented for the first time, during the banquet, at this conference

Figure 1. Prof. Alan Channing receiving the award for exceptional contribution to African herpetology.

BEST STUDENT PAPER PUBLISHED IN AFRICAN JOURNAL OF HERPETOLOGY

According to the agreed criteria for judging of student papers, the subcommittee for evaluation of such papers evaluated four contributions (published since the last conference) and selected Daniel Paluh of University of Florida, U.S.A. as the winner for a paper (in vol. 66[1]) titled "Sheddable Armour: identification of osteoderms in the integument of *Geckolepis maculata* (Gekkota)", co-authored by Aaron Griffing and Aaron Bauer. He will be contacted after the conference and arrangements made for his award of R5 000.

Michael F. Bates

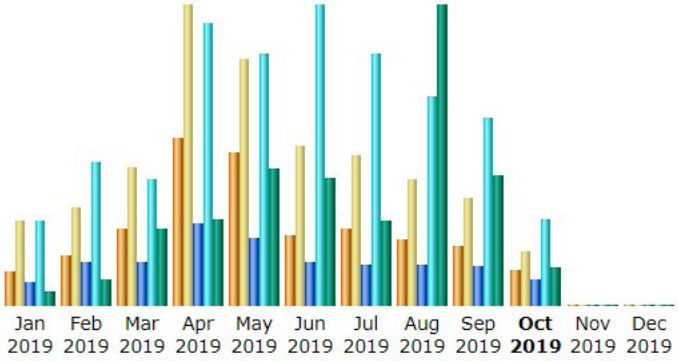
HAA Awards

WEBSITE AND SOCIAL MEDIA REPORT

This report is the first report of the dedicated website and social media portfolio for a committee member of the HAA executive committee. Since the formalisation of this portfolio in February 2018, I have strived to increase accessibility of the association to the greater public by facilitating the upgrade of the HAA website (www.africanherpetology.org) and building the association's social media presence via the Facebook platform (https://fb.me/HerpetologicalAssociationofAfrica). This report will report on these two entities separately.

WEBSITE

Following a period of stagnation, the HAA webpage was revitalised and updated. The renovations were implanted by Mr Craig Van Rensberg of 2XL Digital Solutions with advice and recommendations from myself and the HAA executive committee. The web page includes a home page that provides important links (conference web page, award nominations, membership information and links) and updated committee member details. The publications tab includes (1) information on and free access to the 24 issues of The Journal of the Herpetological Association of Rhodesia, (2) information on and access to all issues of *African Herp News* (with a 1 year embargo), and (3) information on and a link to the Taylor and Francis page for *African Journal of Herpetology*. Additionally, the website provides tabs or links to awards, grants, and opportunities, as well as page dedicated to providing important contact details for the members of the committee. The refurbished page went live in December 2018 and since then has received substantial traffic (Figure 1).



Month	Unique visitors	Number of visits	Pages	Hits	Bandwidth
Jan 2019	590	1,419	4,884	18,183	1.57 GB
Feb 2019	826	1,631	9,117	30,445	2.70 GB
Mar 2019	1,292	2,329	8,958	27,099	7.92 GB
Apr 2019	2,839	5,061	17,860	60,657	9.10 GB
May 2019	2,561	4,140	14,550	53,692	14.30 GB
Jun 2019	1,201	2,698	9,349	64,315	13.42 GB
Jul 2019	1,276	2,529	8,852	53,641	8.84 GB
Aug 2019	1,110	2,116	8,848	44,746	31.66 GB
Sep 2019	995	1,806	8,387	40,276	13.85 GB
Oct 2019	600	917	5,649	18,364	4.02 GB
Nov 2019	0	0	0	0	0
Dec 2019	0	0	0	0	0
Total	13,290	24,646	96,454	411,418	107.37 GB

Figure 1: Website usage statistics for africanherpetology.org for the period of Jan 2019 through to time of writing (October 2019).

SOCIAL MEDIA

Over this reporting period the HAA Facebook page following has grown by approximately 400 followers and has recently exceeded 2000 followers (Figure 2). From this platform various content items get shared including (1) information about the association and its conferences and awards, (2) publications from AJH and AHN, (3) other African herpetological scientific literature and news stories, (4) herpetological and environmental job and bursary opportunities, and (5) striking images of African herpetofauna.

Figure 2: Growth in HAA Facebook page following over the reporting period at time of writing (October 2019).

Bryan Maritz

Webpage and Social Media

STUDENT ISSUES REPORT 2018-2019

This report outlines the activities around the professional development of students involved in the African herpetological community. Throughout 2018–2019, I coordinated financial support, academic guidance, and networking opportunities for student members of the HAA.

During early 2019, the HAA ran a student membership deal, and students who took advantage of this opportunity paid for one year of membership and received two additional years of free membership until 2021. With this initiative, we aimed to increase student membership and provide financial support to potential student members of the HAA. The HAA also awarded grants and monetary prises towards African herpetological research conducted by students (Table1, Table 2). Apart from HAA Student Research Grant, students were also informed about, bursary, scholarship, internship, and job listings, through a joint effort with Buyisile Makubo (secretary) and Bryan Maritz (website and social media).

Table 1. General HAA student awards during 2019.

Award	Winner/ Grantee	Project title	Degree	Research institution
Best first-authored article by a student in *African Journal of Herpetology* **(issues 66-69)** **R5,000.00**	Daniel J. Paluh	Sheddable armour: identification of osteoderms in the integument of *Geckolepis maculata* (Gekkota)	MSc	Villanova University
HAA Student Research Grant 2019 **R5,000.00**	Jean R. Verster	EcoHealth perspective on ectothermic vertebrates in the Toamasina region of Madagascar	PhD	North-West University
Total awardees	**2**			

Table 2. Winners of the traditional conference awards at the 14th HAA conference.

Award	Winner / Grantee	Project title	Degree	University / institute
HAA Conference Student Grant 2019 (Conference registration & accommodation)	Mariana P. Marques	Islands in a sea of sand: diversity and conservation of South-western African Inselberg herpetofauna	PhD	University of Porto
HAA Conference Student Grant 2019 (Conference registration & accommodation)	Silindokuhle Tokota	Quantifying spatial partitioning in two co-occurring southern African snakes, *Psammophis crucifer* and *Psammophylax rhombeatus*	MSc	University of the Western Cape
HAA Conference Student Grant 2019 (Conference registration & accommodation)	Frans Reynecke	Efficacy of snake repellents when applied outdoors	MSc	North-West University
HAA Conference Student Grant 2019 (Conference registration & accommodation)	Samuel T. Peta	Herpetological survey at the University of Limpopo: preliminary findings Reptile and avian assemblage along a gradient of invasive alien plants in the critically endangered Woodbush Granite Grassland (Limpopo Province, South Africa)	Intern	University of Limpopo
Best oral presentation in PhD category	Shivan Parusnath	Complex sociality in the Sungazer (*Smaug giganteus*)	PhD	University of the Witwatersrand
Best oral presentation in Hons/ MSc category	Jackson Phillips	The mechanics of air-breathing in *Xenopus* tadpoles	MSc	University of Connecticut

Award	Winner / Grantee	Project title	Degree	University / institute
Best poster presentation (at any level)	Miary Raselimanana	Does climate change influence the phenology of chameleons? Insights from Madagascar	MSc	Université d'Antananarivo
Best 14th HAA photograph **First prize: R1 000.00 & cover photo of AHN**	Gary Nicolau	Maluti River Frog	Undergraduate	Rhodes University
Best 14th HAA photograph **Second prize: cover photo of AHN**	Gary Nicolau	Berg Adder	Undergraduate	Rhodes University
Best 14th HAA photograph **Third prize: cover photo of AHN**	Luke Kemp	Rinkhals	Professional	African Snakebite Institute (Pty) Ltd
Total awardees	**10**			

Expert guidance and networking opportunities were made available through the HAA Facebook page, and we encourage students to consult experts, open discussions on-site, and continue the exchange on other platforms. Other networking opportunities included social events at the 14th HAA Conference (Bingo de herpo, date night with a herpetologist, and banquiz).

ACKNOWLEDGMENTS

All general HAA grant and award applications were evaluated by the HAA Awards Subcommittee, and awards presented at the 14th HAA Conference were assessed by independent reviewers. Thank you, Aaron Bauer, for coordinating the 14th HAA Conference auction, and thank you Anthony Emvlambiou, and Cara Trivella for assisting. Thank you, Marius Burger for being the Master of Ceremony at the 14th HAA banquet dinner. A special thanks to Shivan Parusnath and Nicolas Telford, who helped to coordinate the social events at the 14th HAA Conference.

Hanlie Engelbrecht

Student Support

CONFERENCE PORTFOLIO REPORT

The 14th HAA Conference occurred from the 9th – 13th September 2019, at the Cape St Francis Resort, Eastern Cape Province, South Africa. Dr Shelley Edwards was nominated as HAA committee member in 2018, and assigned the "conference portfolio" of the HAA committee. Planning for the conference began in late 2018, and the organizing committee was established, consisting of the HAA committee members. Initially, the venue proposed was in Hogsback, but was later moved to Cape St Francis Bay.

Funding for the travel and accommodation of international speakers was applied for (NRF/KIC travel grant), but due to problems with the Rhodes University NRF liaison submitting the application late, the funding application was not considered by the NRF. Two local (South African) plenary speakers were invited and accepted.

Registration and abstract submission was done by creating Google forms using the newly established Google account for the HAA committee. Information about the conference was posted on the HAA website and on the HAA Facebook page, in addition to be sent via email to HAA members. Invoicing and receipts were handled by student helpers and by the secretary of the HAA committee.

Sponsorship for items given in the conference bags were provided by the African Snakebite Institute (posters and coffee mugs) and by Rhodes University (travel mugs).

The Cape St Francis Bay Resort (conference venue) were excellent in their organisation and preparation before the conference, responding to requests within a day of emailing, or dealing directly with the organisation committee members directly by phone.

The conference began on Monday 9th September, and 98 delegates had registered and arrived by Tuesday the 10th, when presentations began. Three workshops took place on Monday (two invited workshops, and one open workshop), which were well-attended.

The first ice-breaker events (Bingo and Speed-dating events) went incredibly well, and students commented that they felt very welcome and more able to talk to established researchers without feeling scared to do so.

The second day of the conference (Tuesday) began with two very moving talks by Prof Aaron Bauer and Mr Werner Conradie, commemorating the late Prof Bill Branch

and was attended by Prof Branch's family.

The scientific program for the conference consisted of two plenary talks (excluding that of Prof Bauer's), one travelogue, 58 full-length talks, and 22 mini talks.

Two poster sessions were held (Tuesday and Wednesday evenings), and 12 posters were presented.

The HAA auction was held on the third night and was well attended. Items auctioned were provided by delegates and by HAA members (in absentia). Prof Aaron Bauer was an excellent auctioneer and the total amount made during the auction totalled approximately R26 000.

The banquet dinner was held on Thursday evening, during which the student awards were presented and the Exceptional Contribution to Herpetology award was presented to Prof. Alan Channing.

The general meeting of the HAA was held on Thursday afternoon, and Dr Beryl Wilson presented a short description of the potential venue for the next conference, to be held in January 2021 in Kimberley, South Africa.

Volunteers for the organizing committee for the 2021 HAA conference were called for and approximately six people volunteered. In order to facilitate a smooth planning process, the HAA committee is compiling a standard operating procedure on conference organisation.

Shelly Edwards

Conference Convener

MARIANA P. MARQUES

PhD Student
CIBIO Research Center in Biodiversity and Genetic Resources
InBIO Research Network in Biodiversity and Evolutionary Biology
University of Porto, Porto, Portugal

With the help of the Herpetological Association of Africa (HAA) Travel Award I had the opportunity to attend and present an oral communication at the 14th Conference of the HAA which was held from 9th to 13rd September of 2019 at the Cape St. Francis Resort, South Africa.

The opportunity to be together with other inspiring and dedicated herpetologists (both young and senior researchers), listen about their works and career trajectories, discuss with them ideas and future projects, and especially getting in contact with the most recent development in the fields as systematics, phylogenetics, biogeography, ecology, biodiversity management and conservation of African herps, was definitively an important experience for me as a young researcher. This experience was also crucial to expand my network of colleagues working in the same topics I do.

I had also the great pleasure to present and share my firsts results of my PhD research, the discovery of a new species of dwarf gecko (genus *Lygodactylus*) on one of the most incredible and unexplored inselbergs in Africa, the Serra da Neve Inselberg, in southwestern Angola. My talk was entitled "*Mountain dwarfs – A new species of Lygodactylus (Squamata: Gekkonidae) from the Serra da Neve Inselberg, southwestern Angola*". I do not see myself as a good speaker and I usually get very nervous in such events, but given the supporting and welcoming audience, I have felt very comfortable and confident, and I am extremely grateful for this opportunity and moment. I truly believe that the good vibes of the room and the whole conference helped me during the preparation and moment of presentation. I had very good feedback and comments from colleagues after my talk, which I value and consider of uttermost importance to strength my research.

The conference was packed with very interesting talks, covering a good number of different research fields in herpetology. Sessions focusing on taxonomy and systematics, as well as phylogenetic revisions and biogeographic approaches, were the topics that interested me the most. Participate in those sessions gave me important perceptions of other projects, approaches and methods that are being done by several colleagues that somehow interlink with my research. One of the projects that I enjoyed most

was the outstanding work that is being done by Darren Pietersen in Zambia and Malawi, which is similar to our Angolan Atlas project. Other projects regarding Angolan herpetofauna that were presented during Bill Branch's Memorial were also very interesting and source of important novelties.

I want to acknowledge the HAA committee for all effort in promote such a great event, 1) by giving an enormous support to students before, during and after the conference, always trying to create opportunities, inspire and encourage to keep going with their researches; 2) organise such a high quality conference with a wide range of different topics in herpetology; 3) for their contribute to create such a good and welcoming environment for the participants; and 4) for providing such good times during the social events. Given the success of the auction, I would strongly recommend the nomination of Prof. Aaron Bauer as master of ceremonies for all future auctions!

I very much like to thank to all HAA community for this inspiring conference.

Profile:

I am a PhD candidate at CIBIO, University of Porto, Portugal and my research entitled "*Islands in a sea of sand: diversity and conservation of South-western African inselberg herpetofauna*" focus the comparative phylogeography, diversity and conservation of southwestern African (mainly Angolan and Namibian) inselbergs, using the herpetofauna as model. Southwestern African inselbergs are important areas in terms of endemism and biodiversity, although they remain poorly understood in terms of their biological diversity, affinities and biogeographic patterns. With my research I aim to uncover that diversity, understand their relationships and highlight these inselbergs as priority conservation areas.

SAMUEL PETA

University of Limpopo
Herpetology Student
SANBI Project Development Intern

I would like to extend immense gratitude towards the HAA committee for offering me the 14th HAA conference support grant. I would also like to thank Prof. John Measey for the support of the conference grant acquisition. No words can amount

to the appreciation of this opportunity.

As a young and growing herpetologist, the conference provided the platform to meet diverse and passionate students and influential herpetology experts across universities, independent research institutions and museums – both within and outside South Africa. Furthermore, open vital conversations and network with people regarding some of the aspects of my research interests.

It was an amazing and overwhelming experience to participate with both an oral (*Reptile and avian diversity along a gradient of invasive alien plants in the critically endangered Woodbush Granite Grassland, Limpopo Province, South Africa*) and poster (*Herpetological survey at the University of Limpopo: Preliminary findings*) presentations. The overall post-presentation feedback provided valuable ideas on the project I am currently developing prior master's registration next year (2020). These ideas circulated key methodologies – ranging from trap designs f or effective sampling to understanding key elements to consider when selecting sampling sites that align with the objectives of the project I would love to do.

To be able to participate in the 14th HAA conference was beyond just sharing my research endeavors; that opportunity extended into expanding my knowledge based on other people's research interests and experiences. The latter was important to interact with people based on; this is because the University of Limpopo does not cater for herpetology research nor provide any research expertise in the arena of biological invasions. Although I am and always have been passionate about herpetology, it was important for me to network with people and get to ask questions regarding their own experiences and interests. This provides opportunities for future research collaborations and further expand my knowledge and research growth. I am the first and only herpetology student at the University of Limpopo, I rely on assistance from the herpetology community and research institutions i.e. SANBI and DST-NRF CIB for support. The conference provided immense support in terms of contributing ideas and herpetological experts sharing their knowledge and first-hand experiences during the sessions.

The overall conference atmosphere was welcoming and engaging. It was a successful event, thanks to the organizing committee who kept everything running smooth. There was a great pool of exciting presentations across all facets of herpetological research – focusing on ecology, ethology, climate change, genetics, and biogeography. Special mention of the plenary speakers (Prof. Graham Alexander and Prof. Hannes Van Wyk) and Travelogue (Mr. Luke Verburgt) for opening the sessions with exceptional presentations. I believe that the conference ticked all the right boxes – information, entertainment and provided

a networking platform for participants pleasantly and comfortably. The open workshop: *Trade in South African Reptiles* provided valuable information on the sensitive species within the trade circles and future consideration of species that could be looked at. This information is crucial for conservation management purposes.

I am grateful for the 14th HAA conference grant and everyone who shared their research expertise. I believe that this will help immensely in my future research endeavors and further expand the horizon of my passion for herpetofauna. I took upon great responsibility to be the first and only student to explore herpetology at the University of Limpopo. Based on the amazing and inspiring network opportunity I had at the HAA conference; I shall pass on the knowledge I gained to encourage other students who are interested to pursue herpetology related career. This shall increase the HAA student membership, further grow herpetology discipline at the University of Limpopo and build network of research collaborations.

SILINDOKUHLE TOKOTA

MSc
University of the Western Cape, South Africa

The 14th HAA conference was literally the first conference I have ever attended in my academic career. I felt nervous and intimidated by the people that where going to be at the conference. However, nothing could be worse than the nerve wracking fear of presenting my own work for the first time at a conference to an audience that includes renowned authors in the field of herpetology. In case it is not clear, imagine presenting for the first time at a conference to an audience with people that you reference in your own research.

I had spoken to a bunch of people

about what to expect going into the conference and how to best deal with the anxiety that built within me every time I thought about my presentation delivery. Fortunately, the people I spoke to at the conference were kind and gave positive comments to boost my confidence for my talk. In summary, they had told me not to stress about it because no one there was out to get me and everyone wants to hear about my work and want me to succeed in delivering it too. After hearing different versions of the same message I had begun to feel more confident and positive about my talk. All was well until the last few minutes towards the end of the speaker before me. I suddenly felt something pounding while I sat down waiting to go up front to speak. I looked behind me to see what was pounding my chair so hard and loud like that. To my surprise, it turned out to be my heart pounding so hard in my chest that I could hear it. Suddenly all my confidence was nowhere to be found and I had started panicking. As I went up front and stood in front of the crowed, I saw the faces that had reassured me that this was a safe space and no one was out to get me. I started my talk with confidence and finished it strong. The questions and comments after my talk were really good and showed that the people were really interested in what I was presenting to them and some of which had discussions with me surrounding my research topic.

The HAA conference really opened my eyes to what is happening in the field of herpetology across Africa. All the projects people presented were very interesting and really broadened my knowledge about Africa's herpetofauna systems. Moreover, I value the privilege of meeting the authors that publish the literature we read and even more so for having to listen to them share their passion with us in person. The HAA conference really provides the platform and opportunity to cast your net wide and network with a bunch of intelligent and passionate people in the field and also make new friends in the process too. In fact I have made friends at the conference, friends whom I now keep contact with via social media and we share all sorts of exciting experiences.

Lastly, I would like to thank the HAA for granting me the funds to register as a member of the organisation and for the lovely accommodation they provided during the week of the conference. I am super excited to meet everyone and the new members of the HAA in the 15th HAA conference.

FRANS REYNECKE

MSc
University of the Pretoria, South Africa

As one of the students who were awarded the student presenter grant, I attended the 14th conference of the Herpetological Association of Africa at the Cape St. Francis Resort from 9–13 September 2019 and consider it to be one of the most valuable experiences of my post graduate career.

A Master of Science (MSc) student enrolled at the University of Pretoria, I am currently conducting research to assess the in-field efficacy of various, commonly used snake repellents. The opportunity to practice sharing findings whilst learning from peers and experts in the various fields of herpetology was an opportunity I greatly appreciated. Talks, both from students and plenary speakers were informative and the feedback constructive. In light of this, the conference proved to be an invaluable learning experience.

Herpetology is a multidisciplinary field, and as such, continuously expanding on one's knowledge and skills is crucial, as is the establishment of professional relationships with peers from other universities, NGO's and professions.

The conference provided a professional, yet friendly atmosphere which facilitated networking and with the feedback provided in response to the presentations, promoted not only the sharing of ideas but the improvement of my own project. During the conference I was able to meet and comfortably converse with experts in the field, including but not limited to Alan Channing, Aaron Bauer, Bryan Maritz, Graham Alexander, Hannes van Wyk, John Measey, Werner Conradie and Luke Verburgt. The opportunity to personally meet with each of these individuals made it possible to discuss prospective job opportunities and potential future research opportunities and collaborations.

The experience, feedback and professional relationships that I have been able to build and improve upon due to the Herpetological Association of Africa's 14th conference has helped me to gain valuable insight in to not only my own research but in to the field of herpetology as a whole. It is in light of this that I would whole-heatedly recommend attending

the future conferences presented by the Herpetological Association of Africa to any other aspiring herpetologists.

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HERPETOLOGICAL ASSOCIATION OF AFRICA

14TH CONFERENCE

CAPE ST FRANCIS, SOUTH AFRICA

PLENARIES & GUEST SPEAKERS

SNAKE FORAGING ECOLOGY AND DIGESTIVE PHYSIOLOGY – TIME FOR ANOTHER BITE OF THAT APPLE

Graham J. Alexander[a]

[a]University of the Witwatersrand (South Africa)

Abstract - Snakes have been touted as model organisms for foraging ecology and digestive physiology, and over the last two decades a general paradigm of snake foraging ecology has emerged. Research has focused on aspects of predator-prey interactions, foraging mode and the digestion physiology. In spite of this upsurge in snake research, their importance as predators in ecosystems is still often disregarded, even when snake species richness exceeds that of all other vertebrate predators. This can be partially explained by a simple lack of data as feeding in free ranging snakes is difficult to study. However, it has been argued that snakes also have low functional and numerical responses to changes in prey abundance in comparison to small endothermic predators. This, and the fact that snakes are low energy ectotherms, has been used to argue that snakes are not important top-down prey regulators. However, this is at odds with data from several island snake populations and invasive snakes in Florida and Guam which clearly demonstrate that snakes can have very significant impacts on prey numbers. More obviously than for any other group of predators,

snakes can be divided into two (almost) dichotomous groups of foragers: ambush (sit and wait) and active foragers. Foraging mode is undoubtedly associated with adaptive traits in morphology, anatomy, physiology, ecology and behaviour of each group, locking species into particular foraging strategies and resulting in adaptive peaks at the extremes of the foraging continuum. For example, ambush foragers generally have squat bodies, large heads, highly fragmented head shields, small body scales and crypsis. A central theme to the concept of ambush foraging snakes is that they are large-meal specialists and feed infrequently. However, this is based on data collected using methods that suffer from inherent biases in measurement of meal type, size and frequency. The adaptive digestion hypothesis is based on the notion that ambush foragers eat large infrequent meals and posits that large-meal specialists have evolved dramatic digestive down-regulation in response to their feeding regime. The model predicts that down-regulation is advantageous for these snakes because energy savings over the long between-meals periods exceed the costs of up-regulation. However, several findings do not support the model: there appears to be no minimum start-up cost, quick succession feeding does not reduce specific dynamic action (SDA) and costs of hypertrophy make up only ~5% of SDA. In this talk I present an alternative synthesis of snake foraging ecology and digestive physiology, and propose several studies that would directly test whether this new synthesis explains reality better.

Keywords: digestive shutdown, foraging mode, hypertrophy, infrequent meals, predator-prey

WILLIAM ROY BRANCH (1946-2018), MEMORIAL REFLECTIONS ON A FRIEND AND COLLEAGUE

Aaron M. Bauer[a]

[a]*Villanova University (USA)*

Abstract - William Roy Branch was an "elder statesman" of the South African herpetological community and he contributed significantly to the Herpetological Association of Africa. and to almost every major herpetological initiative in South Africa over the last four decades. His life was marked by many achievements as a field naturalist, scholar, populariser, mentor and photographer. Bill's interests and expertise expanded over time, from venoms and chromosomes when he first arrived in Africa to eventually include phylogenetics, ecology, conservation, and biogeography. Likewise, his geographic area of concern started in greater Pretoria but ultimately encompassed the entire continent and beyond. Taxonomically, Bill was more of a reptile biologist than a "frog man," although he famously described "a new toad from Paradise." Tortoises, chameleons, vipers, geckos, and cordylids were just some of his favourite taxa. Uncle Bill, as he was known, mentored and collaborated with many students and colleagues and his influence was significant and far-reaching. Bill's legacy includes not only the collections he built at the Port Elizabeth Museum, his dozens of species descriptions and his 600+ publications, but also the many lives he touched, both personally and professionally. He never ceased to appreciate his family and friends or the life in herpetology he built for himself. We will miss his wide-ranging intellect, his sage advice, his rapier wit, and his comradery.

Keywords: Herpetological Association of Africa, history, Port Elizabeth Museum, systematics, William Roy Branch

XENOPUS LAEVIS, AN INTERNATIONAL AQUATIC MODEL WITH CELEBRITY STATUS: FROM THIRD WORLD TO FIRST WORLD TO THIRD WORLD

A REVIEW OF HOW IT SERVED SOUTH AFRICA IN ENDOCRINE DISRUPTION STUDIES

Hannes van Wyk[a]

[a]*Stellenbosch University*

Abstract - Several keystone papers echoed scientific concerns regarding the potential that exposure to many pollutants may modulate the normal functioning of the endocrine system of wildlife. South Africa produces and use most of the chemicals listed as potential endocrine disruptors (EDCs). The Water Research Commission (WRC) published a first report on the potential of estrogenic activity in water sources in 2000. It is against this backdrop that our research, using *Xenopus laevis* to study relevant biomarkers related to endocrine disruptors, evolved. The aim of this paper is to review the progression and achievements of our research programme since 1998. Our initial focus was on estrogenicity screening, using the estrogen induced hepatic produced yolk precursor, vitellogenin (Vtg) as biomarker. To study seasonality and develop bioassays we validated available hormone assays as well as produced anti-Vtg antibodies to quantify plasma vitellogenin. We explored the potential of males having the capability of Vtg production when exposed to estrogen. We confirmed this phenomenon and exposed males in cages held in rivers and dams in different agricultural areas in the Western Cape, to assess estrogenic activity. We also developed a novel in vitro liver culture Vtg bioassay. It soon became evident that EDC activity may be more than just estrogenicity and that the disruption of the androgen system needs attention. This led us to the male breeding glands that develop under androgen control during mating season. Although, most of the international EDC focus was on the disruption of male and female reproduction the disruption of the thyroid endocrine system became a real concern. Xenopus laevis was internationally selected using the thyroid control of metamorphosis as biomarker complex. Although, we did not participate in the interlaboratory validation studies, the WRC helped us to validated the *Xenopus* Metamorphosis Assay (XEMA). More recently, the use of the frog (*Xenopus*) embryo teratogenesis assay (FETAX) along with XEMA allowed us to gain a wider perspective on developmental concerns. In conclusion, after using

Xenopus laevis as a model system, it is clear that this robust aquatic species remains a valuable asset with great potential as a biological indicator to explore organismal-environmental interaction in a human-disrupted environment. *Xenopus laevis* is a true international model, but unfortunately not fully appreciated locally!

Keywords: biomarkers, endocrine disruption *Xenopus laevis*

TRAVELOGUE - HERPETOFAUNA ENCOUNTERS FROM SELECTED AFRICAN COUNTRIES

Luke Verburgt[a,b]

[a]*Enviro-Insight (South Africa),* [b]*University of Pretoria (South Africa)*

Abstract - Environmental Impact Assessments (EIA) are now mandatory in most countries prior to the initiation of development projects (e.g. mines). In African countries, there is often a shortage of local expertise to perform biodiversity assessments, a necessary component of an EIA. This affords consulting herpetologist such as myself opportunities to visit these countries during the fieldwork phase of the EIA process. Frequently, these projects are located in very rural and difficult to access places, which increases the value of these findings for science, given the general paucity of herpetofauna sampling data across the continent. Here, I present some interesting findings from a selection of projects that I participated in across Africa, since the previous HAA conference in 2017. I'll be showcasing some of the herpetofauna and the conservation challenges they face from countries including Lesotho, Mali, Guinea, Liberia, Cameroon, Angola, Zimbabwe and South Africa. Although the presentation will be delivered in an informal setting with a focus on entertaining photography of interesting species and their habitats, I will nevertheless highlight the importance of communicating biodiversity specialist study findings from EIAs to the scientific community and using EIA acquired data as an important tool for conservation actions. I will also present several personal accounts of experiences that demonstrate some of the logistical challenges and rewarding moments that I've encountered in this time.

Keywords: Africa, herpetofauna diversity, EIA, travelogue

HERPETOLOGICAL ASSOCIATION OF AFRICA

14TH CONFERENCE

CAPE ST FRANCIS, SOUTH AFRICA

ORAL PRESENTATIONS

(bold names indicate presenter, asterix indicates student talk)

IMPLEMENTATION OF THE BIODIVERSITY MANAGEMENT PLAN FOR PICKERSGILL'S REED FROG (*HYPEROLIUS PICKERSGILLI*)

Adrian J. Armstrong[a], Jeanne Tarrant[b], Ian du Plessis[c], Antoinette Kotze[d]

[a]Ezemvelo KZN Wildlife (South Africa), [b]Endangered Wildlife Trust (South Africa), [c]Johannesburg City Parks and Zoo (South Africa), [d]South African National Biodiversity Institute (South Africa)

Abstract - The Biodiversity Management Plan for Pickersgill's Reed Frog (*Hyperolius pickersgilli*) (BMP-PRF) was gazetted on the 2nd June 2017. Ezemvelo KZN Wildlife was appointed as the lead agent for its implementation, with the Endangered Wildlife Trust (EWT) as the supporting implementing agent. The Pickersgill's Reed Frog Forum was constituted at its inaugural meeting on 20 April 2018 and now has 25 members representing 17 entities. Three municipalities have included wetlands containing *H. pickersgilli* into their environmental planning or management systems. Approximately 450 ha of alien invasive plants have been cleared and approximately 300 indigenous plants planted at *H. pickersgilli* habitat through the creation of 75 local jobs by the EWT using Department of Environmental Affairs funding. One wetland site has been rezoned to 'Conservation Reserve' status and 70 ha of habitat are under a "Biodiversity Agreement" elsewhere. Four youths have been trained as local Nature Site Guides and two employed as 'Biodiversity Protection Officers'. Acoustic monitoring of *H. pickersgilli* sub-populations has been done at four wetlands. New *H. pickersgilli* sub-populations have been found. A database of distribution records for *H. pickersgilli* is

kept updated. Research led by the National Zoological Garden (NZG-SANBI) resulted in the publication of a scientific paper indicating that *H. pickersgilli* has a single genetic population. The life cycle of *H. pickersgilli* has been documented through captive-breeding, reaching F2 generation, at Joburg Zoo and a captive assurance population established. A detailed husbandry manual has been compiled. A protocol that considers wild population sources for the parental frogs for captive breeding, diseases, simulation of natural environmental conditions in captivity, genetics, life-cycle stage for release, and choice of release sites was implemented. Testing for the lethal chytrid fungus in *H. pickersgilli* was carried out by NZG-SANBI. A total of 250 captive-bred *H. pickersgilli* were released at Mount Moreland and River Horse Valley. Initial monitoring resulted in one release frog being sighted. Media coverage of the implementation of the BMP-PRF included television, online documentaries, social media and newspaper articles. Over 600 learners have done the EWT's "Frogs in the Classroom" educational modules. Awareness activities included the annual Leap Day for Frogs and posters at the Joburg Zoo.

Keywords: awareness, captive breeding, conservation, genetics, habitat management, translocation

SPATIO-TEMPORAL VARIATION IN THE AVAILABILITY OF BIRD EGGS FOR CONSUMPTION BY *DASYPELTIS SCABRA* IN SOUTH AFRICA

Jody M. Barends[a*], Bryan Maritz[a]

[a]*University of the Western Cape (South Africa)*

Abstract - African egg-eating snakes of the genus *Dasypeltis* feed exclusively on bird eggs, presenting an ideal model for answering questions linking functional morphology to specific resource use. *Dasypeltis* possess unique morphological adaptations that allow them to ingest bird eggs several times larger than their heads. However, the degree to which bird eggs of differing size classes are available for consumption by *Dasypeltis* remains unclear. Three species of *Dasypeltis* occur in South Africa, with *D. scabra* being the most widespread, having a near-cosmopolitan distribution across the country. We investigated spatio-temporal variation in the availability of bird eggs for consumption by *D. scabra* across each biome of South Africa. We built

Royle-Nichols occupancy models using South African Bird Atlas Project 2 survey data to estimate bird species abundances at pentad resolutions within each biome of South Africa. We subsequently used bird abundance estimates in conjunction with details on egg size, clutch size, and laying months of each bird species to quantify the distributions of different size classes of bird eggs available each month. Our results show that the frequency distributions of bird eggs of varying size classes statistically vary geographically and temporally across biomes. Bird eggs are available year-round in each biome but are extremely limited during winter, with eggs between 0–20 mm in size being absent during those months. Our findings suggest that adult and sub-adult *D. scabra* can likely feed year-round but that hatchlings with small head morphologies are potentially restricted in winter months depending on when and where they hatch. Our findings also suggest that because adult *D. scabra* feeds gluttonously when bird eggs are abundant, they are likely able to produce eggs with sufficient nutrient content to sustain hatchlings during periods of appropriately-sized egg deficiency. These findings further emphasize the importance of bird breeding habits to the life history of *D. scabra*, providing additional insight into the ecology of these snakes.

Keywords: abundance estimates, ecology, functional morphology, prey size, specialization

THE DIET OF SOUTHERN AFRICAN BROWN HOUSE SNAKE (*BOAEDON CAPENSIS*)

Ielhaam Bassier[a*], Bryan Maritz[a]

[a]*University of the Western Cape (South Africa)*

Abstract - Through predation, snakes can play important roles within the ecosystems in which they occur. Several snake species occur in urban environments where they potentially carry out anthropogenically beneficial ecosystem services such as regulatory pest control via predation on small mammals that carry diseases, pathogens, and parasites that are detrimental to human health. The African Brown House Snake (*Boaedon capensis*) occurs abundantly in urban areas throughout southern Africa. These snakes are thought to be small mammal specialists and could potentially play a large role in controlling urban populations of small mammals, but the full extent of the diet of this species has yet to be quantified. We examined the diet of *B. capensis* by examining gut contents of preserved museum specimens, extensively reviewing

literature, and collating citizen science reports from social media networks to test the hypothesis that Brown House Snakes are small mammal specialists. Additionally, we tested for differences in diet as reported by museum and social media sources. We collated 103 prey items from museum specimens, and a further 94 prey items from social media reports. Overall, we found that *B. capensis* are not small mammal specialists as amphibians (3%), birds (8%), and reptiles (32%) made up significant proportions of their diet. Moreover, our results show that the consumption of lizards is not restricted to juvenile snakes. Importantly, we found that museum data and citizen science data differed drastically, particularly in the proportion of reptiles consumed (museum data = 6%; citizen science data = 27%) and illustrated vastly different dietary patterns for *B. capensis* when examined independently. Our findings suggest that Brown House Snakes may be involved in providing a natural pest control service in reducing small mammal populations in urban areas. However, this function may be less prominent than previously thought as these snakes have broader diets than previously assumed. Our data also reiterate the importance of examining multiple sources of information when characterizing the diet of species.

Keywords: dietary niche breadth, ecological function, foraging ecology, generalist predator, predator

A NEW 'CRYPTIC' SPECIES OF DRAGON LIZARD FROM SWAZILAND AND SOUTH AFRICA

Michael F. Bates[a,b], Edward L. Stanley[c]

[a]*National Museum (South Africa),* [b]*University of the Free State (South Africa),* [c]*Florida Museum of Natural History (USA)*

Abstract - A recent molecular phylogeny of the lizard genus *Smaug* recovered a south-eastern clade of relatively lightly armoured, geographically proximate species (*S. barbertonensis* and *S. warreni*). Unexpectedly, *S. barbertonensis* (Van Dam) was found to be paraphyletic, with individuals sampled from northern eSwatini being more closely related to *S. warreni* (Boulenger) than to *S. barbertonensis* from the type locality of Barberton in Mpumalanga, South Africa. Examination of voucher specimens used for the molecular analysis, as well as most other available museum material, indicated that specimens from the 'eSwatini' lineage (including populations in a small

area on the northern eSwatini-Mpumalanga border, and northern KwaZulu-Natal in South Africa) were readily distinguishable from *S. barbertonensis sensu stricto* (and *S. warreni*) by their unique dorsal, lateral and ventral colour patterns. In order to further assess the taxonomic status of the three populations, a detailed morphological analysis was conducted. Multivariate analyses of scale counts and body dimensions indicated that the 'eSwatini' lineage and *S. warreni* were most similar. High resolution Computed Tomography also revealed differences in cranial osteology between specimens from the three lineages. The 'eSwatini' lineage is being described as a new species. *Smaug barbertonensis sensu stricto* is therefore a South African endemic restricted to an altitudinal band of about 300 m in the Barberton–Nelspruit–Khandizwe area of eastern Mpumalanga, while *S. warreni* is endemic to the narrow Lebombo Mountain range of South Africa, eSwatini and Mozambique.

Keywords: Cordylidae, *Smaug*, South Africa, Swaziland, taxonomy

REVISED PHYLOGENY, TAXONOMY AND BIOGEOGRAPHY OF THE SCANSORIAL SPECIES OF *CHONDRODACTYLUS* (SQUAMATA: GEKKONIDAE)

Aaron M. Bauer[a], Todd R. Jackman[a], Ian G. Brennan[b]

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Abstract - Geckos of the genus *Chondrodactylus* are widespread throughout southern Africa and as far north as northern Angola in the west and southern Kenya in the east. The padless *C. angulifer* is sister to a clade of large, morphologically conservative climbing geckos. We augmented earlier DNA sequence data from the RAG-1 nuclear gene and ND2 mitochondrial gene with data from the nuclear marker PDC and increased our sampling to include 234 individuals from across the range of the group. Molecular data unambiguously support the monophyly of *C. bibronii*, restricted chiefly to temperate regions of western southern Africa as far north as the Hardap Region of Namibia, *C. pulitzerae*, which extends from Sesfontein, Namibia to at least Luanda, Angola and *C. fitzsimonsi,* occurring from the Brandberg north to Namibe Province, Angola. The last of these is represented by two distinct morphological forms which do not correspond to genetic units within the species, which in one of

the lineages may exhibit introgression with *C. laevigatus. Chondrodactylus turneri* is restricted to southern Zimbabwe, northeastern South Africa and adjacent regions, and is sister to *C. laevigatus*, which occupies the remainder of the range of the genus. The latter is divided into three well-supported, deeply divergent subclades, one from the Northern Cape to the Khomas Hochland, which exhibits the characteristic button-scales of this species, one in northern and eastern Namibia and Botswana, and a third from Lake Kariba eastwards and northwards to Kenya. The eastern forms converge in their dorsal scalation on *C. turneri*, accounting for past taxonomic confusion between them. *Chondrodactylus turneri* is characterized by a unique mitochondrial genome rearrangement. One genetically unsampled dwarf species from the Uri-Hauchab Mountains in the Namib remains to be described. Up to three sympatric scansorial *Chondrodactylus* occur in parts of northern Namibia, and two in southern Namibia and adjacent Northern Cape, but elsewhere all species are allopatric with respect to one another. The genus likely spread northward and eastward from an ancestral area in the arid southwest of the continent. Western species and western populations of *C. laevigatus* are typically widespread and occur in high abundance, whereas eastern forms have more restricted habitat preferences and often occur in low densities, perhaps due to interactions with other large-bodied geckos like *Homopholis, Elasmodactylus* and larger *Hemidactylus*.

Keywords: gecko, *Chondrodactylus*, systematics, Namibia

A METHOD FOR REMOTELY MEASURING ACTIVITY PATTERNS IN FREE-RANGING SNAKES

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Abstract - The secretive nature of snakes makes their behaviour and activity patterns difficult to study in a natural setting. This is especially true for alert, actively foraging snakes such as Cape Cobras, whose vigilance while foraging can easily result in significant observer effects. Additionally, Cape Cobras may spend a major portion of each day underground, making traditional focal animal analysis an extremely

inefficient method for collecting information on their activity. Over recent years, bio-logging has become more important in the study of free-ranging animals. Custom built bio-logging devices attached to, or implanted into, large highly mobile and active mammals have proved to be very successful in collecting data on a range of physiological and behavioural traits. However, this has been less successful for small, less active animals such as snakes. We used implanted iButtons to record body temperature (T_b) of telemetered free-ranging Cape Cobras in the Kalahari Desert, South Africa. We inferred the behaviour (e.g., inactive underground; active above ground; basking etc.) of snakes from the resulting T_b profiles. We then compared our inferences of T_b profiles to field observations in a ground truthing exercise to verify the accuracy of our interpretations. T_b profiles revealed distinctive patterns that, when compared to environmental temperatures (T_e), allowed us to score behaviour remotely. This made it possible to assess activity periods in relation to time of day, season and T_e. We concluded from the thermal profiles that if active, the cobras display a daily bimodal activity pattern in summer, and occasionally forage at night. During the hot months of the year, the snakes spend a large proportion of their active time foraging and less time basking. The snakes usually limit surface activity to the mornings and evenings as they avoid the hottest hours of the day. In the winter months, however, the snakes may come out more frequently and regularly but if active they stay on the surface during the warmest hours in the middle of the day. While foraging behaviour occurs less in winter the snakes bask frequently close to their shelter and tend to stay on the surface for longer periods than in summer. This method opens the path to assess and analyse the thermal ecology of free-ranging animals without human disturbance.

Keywords: activity patterns, inferring behaviour, thermal ecology

INVESTIGATING THE PHYLOGEOGRAPHY AND VENOM COMPOSITION OF RINKHALS (*HEMACHATUS HAEMACHATUS*) ACROSS SOUTH AFRICA

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Abstract - The Rinkhals, *Hemachatus haemachatus*, is a monotypic species of elapid snake that is endemic to southern Africa. This species shows great phenotypic variation across its distribution. Anecdotal evidence also suggests that populations from different regions vary in venom composition. As Rinkhals occur across different ecotypes, we aimed to assess whether there are genetic differences as well as differences in venom composition between populations from different localities within South Africa. Our sampling covered a large portion of the distribution of this species: We collected 70 tissue and 16 venom samples. We sequenced cytochrome b and 16S gene regions from which we inferred phylogenetic relationships. Locality data were plotted onto a South African map to infer phylogeographic patterns. Venom was subjected to RP-HPLC, densitometric analysis of SDS-PAGE lanes under non-reduced and reduced conditions, in-gel digestion of electrophoretic bands and analysis of each tryptic digest by MS/MS. Genetically all samples appear to form part of a single population that is divided into two broad mitochondrial lineages. This pattern possibly arose from two refugial populations that were separated and gene flow has subsequently been re-established. Preliminary venom analyses indicate six possible clusters that are geographically isolated.

Keywords: phylogeography, phylogeny, snake venom, serpentes, *Hemachatus*

TAXONOMIC REVISION OF THE *TRACHYLEPIS* (SQUAMATA: SCINCIDAE) OF ANGOLA

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Abstract - *Trachylepis* Fitzinger, 1843, is one of the most diverse skink genera in Africa, and the most species-rich genus of reptiles in Angola. Modern revisions of the country's herpetofauna list the presence of 19 species, one of which, *Trachylepis monardi*, known only from Angola. Available knowledge regarding the country's herpetofauna is limited and many of these species are known from very few records and molecular

data is not available for most Angolan populations. Also many of the recorded species have not been illustrated and/or have had their types destroyed. Furthermore, many of the taxa that occur in Angola are part of taxonomically and nomenclaturaly challenging species-complexes where cryptic diversity has already been noted. Recent surveys have yielded new material of all recognised species in Angola, and has also uncovered considerable cryptic diversity, especially in the southwestern areas of the country. Using an integrative taxonomic approach, combining molecular (mitochondrial and nuclear) data, morphological characters and ecological data, we provide the first phylogeny of Angolan *Trachylepis*, note the existence of at least six new species, revalidate taxa that were sunk into synonymy, and elevate subspecies to species rank. Given the diversity of the genus in Angola and its wide distribution across the country's several habitats, we present a preliminary attempt at using *Trachylepis* as a proxy to the study biogeographic patterns in the country.

Keywords: Angola, nomenclature, reptiles, species description, taxonomy

A DWARF AMONG GIANTS: BIOGEOGRAPHY AND PHYLOGENETIC POSITION OF THE ELUSIVE ANGOLAN ADDER, *BITIS HERALDICA* (BOCAGE, 1889)

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Abstract - The Angolan Adder, *Bitis heraldica* (Bocage, 1889), endemic to the Angolan central plateau is one of the most poorly known and rarely observed species of African snakes. The phylogenetic placement of *B. heraldica* within the four subgenera of the genus *Bitis* (*Bitis*, *Macrocerastes*, *Calechidna*, *Keniabitis*) remains highly problematic. The few recent taxonomic and phylogenetic revisions dealing with African viperids and the genus *Bitis* have faced a complete lack of molecular data on it, and all recent authors followed the morphology-based opinion that considered *B.*

heraldica as member of the subgenus *Calechidna*, due to its diminute size and similar morphology. During a survey to Huambo Province, central Angola, we collected the first specimens of this species in the last 65 years, allowing us to test its phylogenetic affinities. We generated sequence data for the species from two mitochondrial (16S, ND2) and one nuclear (PRLR) marker. To place *B. heraldica* in a phylogenetic context, Bayesian and maximum likelihood analyses were run. Additional data were downloaded from GenBank for individuals from all species of *Bitis*, with the exception of *B. harenna* for which no genetic data are available. Contrary to what was expected, our results unambiguously place *B. heraldica* among other members of the subgenus *Macrocerastes*, constituted by the largest members of the genus. The placement of *B. heraldica* within *Macrocerastes* raises interesting questions about body-size evolution in viperids, as well as contributes to a better understanding of the biogeographic patterns of Southwestern Africa, and especially to the increasingly known faunal-turnover in Angola.

Keywords: Angola, conservation, phylogeny, taxonomy, Viperidae

A MOLECULAR STUDY OF DELALANDE'S SAND FROG (*TOMOPTERNA DELALANDII*) FINDS ANOTHER CRYPTIC SPECIES

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Abstract - Delalande's Sand Frog extends from St Francis Bay in the east, to Cape Town in the West, and Springbok in the north of South Africa. A phylogeny of the genus shows that the extreme northern population does not cluster with those elsewhere. This population differs by advertisement call, 16S rRNA sequence and consistent differences in adult morphology from the southern form. Haplotype networks of mitochondrial and nuclear genes show that the northern populations are distinct from *Tomopterna delalandii* and all other described taxa, and represent a new species. We are happy to name the new Namaqua Sand Frog for Bill Branch.

Keywords: Amphibia, Namaqualand, new species, *Tomopterna branchi*

CORRELATES OF SNAKE COMMUNITY STRUCTURE IN A HETEROGENEOUS FYNBOS ECOSYSTEM

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Abstract - Within a heterogeneous ecosystem, variation in the composition of communities of co-occurring species can result from variation in habitat structure, and is thought to be influenced by trophic interactions with both predator and prey species. To better understand how differences in vegetation structure, prey abundance, and predator abundance influence fine-scale snake communities we examined snake community traits in a heterogeneous fynbos ecosystem. Snakes, prey and predators were sampled at ten sites within Koeberg Nature Reserve (KNR), Western Cape Province, South Africa. Sites were stratified across unburnt fynbos, recently burnt fynbos, and previously invaded fynbos cleared of non-native *Acacia cyclops* and *Acacia saligna*. We used multiple non-invasive sampling techniques including artificial cover objects, drift fences, funnel traps, pitfalls and camera traps to quantify the species richness, abundance and biomass of the snake communities at each site. We calculated an index of prey availability as the total count of all detections of suitable prey items at each site, and a similar index for predator abundance based on the total number of mesocarnivores and raptorial birds detected at each site. Snake communities varied in species richness (median species richness = 4 species; range = 2–6 species), relative abundance (median unique individuals = 17; range = 2–28), and mean biomass = 494 g.site^{-1}; range = 53 g.site^{-1}–1379 g.site^{-1}. Snake communities were not significantly influenced by vegetation type, presence of predators, or prey availability. Differences among snake species in their selection of prey showed no significant relationship to prey species richness across sites. We found no preference of predators for a particular vegetation type or prey abundance and predator species appear to be evenly distributed across sites. We conclude our study by discussing potential future directions for analysis, and identifying reasons for the apparent lack of relationships between snake community variation and site specific predator and prey abundances.

Keywords: diet, ecological community, predation, vegetation structure

CONTRIBUTION TO THE HERPETOFAUNA OF SOUTH-EASTERN ANGOLA

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Abstract - The herpetofauna of Angola has been neglected for decades, but recent surveys have revealed previously unknown diversity and a consequent increase in the number of species recorded for the country. The majority of the historical surveys focused on the north-eastern and south-western parts of the country, with the south-east, comprising the provinces of Bié, Moxico, and Cuando-Cubango, being neglected. To address this gap, a series of rapid biodiversity surveys of the upper Okavango, Cuando, Zambezi and Kwanza River basins were conducted by the National Geographic Okavango Wilderness Project between 2015 and 2018. We made use of both active and passive sampling methods. We employed 15 trap arrays that accounted to total of 188 trap days. Here we present the results of these surveys, together with a checklist of current and historical herpetofauna records from the region. In summary, ~142 species are known from the region, comprising 48 snakes, 45 lizards, six chelonians, a single crocodilian and 42 amphibians. The surveys further added seven new country records and some novel species. As a result of these surveys, the herpetofauna of the region is now relatively well known, and our understanding of its biogeographic importance and complex biodiversity more fully appreciated. This knowledge can now be used to drive sound and integrated ecological management of these sensitive and unique habitats, which lack formal protection.

Keywords: Angola, herpetofauna, Cuito, Cubango, Cuando

BIODIVERSITY OF APICOMPLEXAN BLOOD PARASITES OF TORTOISES (TESTUDINIDAE) OF SOUTH AFRICA

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Abstract - Apicomplexan blood parasites are obligate intracellular parasites infecting a range of vertebrate and haematophagous invertebrate hosts; vertebrates acting as intermediate hosts and invertebrates as definitive hosts (vectors). Development of these parasites is cyclic, alternating between asexual reproduction in the vertebrate and sexual reproduction in the vector. Infections are transmitted to vertebrate hosts during a blood meal by an infected vector, in which infective stages of the parasite are inoculated into the vertebrate, or via the ingestion by the vertebrate host of the infected vector. Groups reported infecting tortoises (Testudinidae) include haemogregarines and haemosporidia (malaria-like organisms). Approximately 400 haemogregarine species and >540 haemosporidia species have been described to date infecting a range of vertebrates worldwide. However, less than 20 of these have been described from chelonians, with less than 10 from tortoises; most descriptions from the beginning of the last century, with few elucidated life cycles. As such, most of the vectors and the transmission routes remain unknown. Recent molecular work has identified further concerns regarding these parasites' systematics, which further complicates the capacity to identify potential vectors. For some of the haemogregarines infecting tortoises, molecular work has proven invaluable. One such case is that of *Hepatozoon fitzsimonsi* (Dias, 1953), a parasite of southern African tortoises, previously described as a member of the genus *Haemogregarina* (a genus strictly transmitted by leech vectors via inoculation). Its recent assignment, based on molecular data, to Hepatozoon (a genus transmitted by various vectors via ingestion) has assisted in identifying the most probable vector, a tick, subsequently supported by the light microscopic isolation of infective stages. With the illegal trade in wildlife, particularly of reptiles, some of these vectors (ticks) have established populations in naïve habitats. Even though it would appear that many of these parasites are host-specific, some like *H. fitzsimonsi* appear to be generalist. As such there is a good probability that a number of these parasites may be able to infect naïve hosts with unknown consequences. This study serves as a review of these parasites in tortoises with the aim to encourage further awareness and studies in this field.

Keywords: apicomplexan, tortoise, chelonian, haemogregarine, haemosporidian

RIGHTING SOME WRONGS: PHYLOGENETICS HELPS REDEFINE THE DISTRIBUTIONS OF BANDED GECKOS ACROSS SOUTH AFRICA

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Abstract - The *Pachydactylus mariquensis* species complex is comprised of four species, namely *P. mariquensis, P. latirostris, P. macrolepis*, and *P. amoenus* that occur in Northern, Western Cape and Free State provinces of South Africa. *Pachydactylus mariquensis* and *P. latirostris* are both widespread, while *P. macrolepis* and *P. amoenus* have small distributions. The former two species have a substantial geographic overlap zone in the Great Karoo, while the latter two probably have overlapping geographic ranges in the northwest, but locality data are sparse making it difficult to understand their ranges. Recent phylogenetic work shows all these species to be genetically well differentiated, with some specimens having been misidentified, calling into question the validity of the geographic overlap zones and the distribution of these species. We examined the extent of these species distributions and associated overlap zones by combining phylogenetic, taxonomic and species distribution modelling (SDM) approaches using comprehensive geographic sampling. Bayesian and maximum likelihood analyses were run using two mitochondrial markers (16S and ND2) for 37 samples. The SDMs were run in MaxEnt using a dataset of 132 locality records for *P. mariquensis* and *P. latirostris*. The phylogenetic analysis highlighted several misidentifications between *P. latirostris, P. mariquensis and P. macrolepis*. The large overlap zone previously shown on distribution maps for *P. mariquensis* and *P. latirostris* in the Great Karoo was not as apparent once the phylogenetic analysis was used to assign individuals. Indeed, the distributions of the two species overlap in a very narrow region below the Great Escarpment. Moreover, the distribution of *P. macrolepis* extends farther south along the west coast, possibly overlapping with *P. mariquensis*. Thus, our previous understanding of the distributions and overlap within this species complex is likely due to misidentifications.

Keywords: geckos, misidentifications, overlap, phylogenetics, South Africa

YOU SHALL NOT PASS: A DISTINCT POPULATION OF GIRDLED LIZARD IN NORTHEASTERN NAMIBIA

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Abstract - Northeastern Namibia is a biodiverse region that remains significantly understudied. Of particular interest is a species of Girdled Lizard from the genus *Cordylus* located in the Otjihepa and Baynes Mountains. Few specimens were ever collected and nearly all were lost. Currently, its phylogenetic placement requires further investigation and its biology and ecology is surmised from congeners. This basic information is crucial for general conservation and has elevated importance for girdled lizards because they are CITES II protected due to high desirability in the illegal wildlife trade. In the description of *Cordylus namakuiyus*, morphological analysis includes a juvenile specimen from the Otjihepa Mountains and suggests that it shares characteristics from both *C. namakuiyus* and *Cordylus machadoi*. Further, a principal component analysis clustered the Otjihepa individual with *C. machadoi*, but was placed at the edge of the morphospace. We identified an uncatalogued specimen in the National Museum of Namibia (adult, male) collected from the Otjihepa mountains and conducted comparable analyses to identify any differentiation and phylogenetic placement. Results suggest a taxonomic change to the Namibian *Cordylus* species. Mensural measurements and meristic characters cluster with *C. namakuiyus*. High resolution x-ray computed tomography revealed osteoderms completely different from *C. machadoi* and more similar to *C. namakuiyus*. We speculate that a significant barrier, the Cunene River, has restricted gene flow between *Cordylus* populations to the north and south resulting at a minimum in morphological differentiation. Our study identifies the *Otjihepa Cordylus* as more closely related to *C. namakuiyus*, but requires further molecular investigation to determine cryptic speciation.

Keywords: biogeography, Cordylidae, CT-scan, morphology, taxonomy

DEVELOPMENT OF DNA-BASED ASSAYS FOR THE DETECTION OF *BATRACHOCHYTRIUM DENDROBATIDIS* IN ENVIRONMENTAL SAMPLES AND AMPHIBIANS

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Abstract - Chytridiomycosis is an emerging infectious disease affecting amphibians on a pandemic scale. The disease causing organism, *Batrachochytrium dendrobatidis*, has been identified as the leading causative driver behind enigmatic declines in frog populations. Certain limitations do exist for the detection of *B. dendrobatidis*, such as low efficacy when sampling the environment and time intensive protocols. We developed a DNA-based assay, Loop-mediated Isothermal Amplification (LAMP), for the detection of *B. dendrobatidis* which surpasses above mentioned short-comings. In vitro tests involving viable cultures were used to develop the LAMP assay, followed by in vivo tests to assess its viability and integrity. Initial results of the assay delivered promising data. One LAMP primer set was designed specific to *B. dendrobatidis*, consisting of 6 primers labelled Bd3F3, Bd3B3, Bd3FIP, Bd3BIP, Bd3LF and Bd3LB. Our LAMP assay tested positive for both BdGPL and BdCAPE lineages from South Africa. The assay proved to be extremely sensitive for these isolates, yielding positive results up to a DNA serial dilution of 5fg and 0.1 zoospores within less than an hour respectively. The Mont aux Sources (Drakensberg) since the native population of *Amietia hymenopus* (Phofung River Frog) was used for this assessment as part of an established *B. dendrobatidis* monitoring program. LAMP successfully detected chytridiomycosis on both ventral skin swabs and toe clippings from several individuals across four sites. In regards to conventional PCR means, positive LAMP results were obtained in less than half the incubation time with a higher positive output while smaller DNA volumes were used for all LAMP reactions. Additionally, we were able to detect *B. dendrobatidis* in archived African samples consisting of several frog species from across several localities, revealing for the first time that amphibian populations from the Okovango Delta in Botswana are infected with *B. dendrobatidis*. The developed LAMP assay is a promising and powerful tool which can be implemented to overcome several limitations associated with histology, PCR and qPCR.

Keywords: amphibian disease, *Batrachochytrium dendrobatidis*, chytridiomycosis, loop-mediated isothermal amplification (LAMP), molecular diagnostics

PHYLOGENETIC RELATIONSHIPS IN THE SLUG-EATER SNAKES, *DUBERRIA* (LAMPROPHIIDAE)

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Abstract - Slug-eater snakes, of the genus *Duberria*, are a fairly unique group as their specialised diet of molluscs is one that is rarely found in snakes. The genus, comprising four species, is distributed across the eastern regions of Africa stretching from Ethiopia down into South Africa, with each of the five subspecies of *Duberria lutrix* occupying isolated distributional ranges. We investigated the taxonomic level of the four currently described species (*D. lutrix, D. rhodesiana, D. shirana,* and *D. variegata*) and subspecies of *D. lutrix* (*D. l. abyssinica, D. l. atriventris, D. l. basilewskyi, D. l. currylindahli,* and *D. l. lutrix*). We produced phylogenetic trees from a concatenated dataset of two mitochondrial genes and one nuclear gene, and used Maximum Likelihood and Bayesian Inference to construct two trees. We assessed species level delineations using sequence divergence values, bGMYC methods and a program called 'Species Identifier'. From the analyses, we investigate whether currently described *D. lutrix* subspecies should be raised to species level.

Keywords: Africa, *Duberria*, Lamprophiidae, taxonomy

HERALDING A NEW SYSTEMATIC ACCOUNT OF THE SNAKE GENUS *CROTAPHOPELTIS,* WITH A SPECIAL FOCUS ON THE WIDE-RANGING *C. HOTAMBOEIA* (SERPENTES: COLUBRIDAE)

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Abstract - *Crotaphopeltis* is one of Africa's most widespread snake genera. Of the six species, the Herald Snake, *C. hotamboeia*, has the widest distribution across nearly all Afrotropical biomes, except rainforest and hyper-arid regions. Its extensive range, relative abundance, and presumed high dispersal ability suggest that gene flow may be adequate to prevent species-level diversification between populations. Yet, it is possible that ecological and geographical barriers throughout the heterogeneous landscape of sub-Saharan Africa may have promoted allopatric speciation within *C. hotamboeia*. In contrast, the habitat discontinuity of specialist conspecifics (e.g., the Afromontane *C. tornieri*) might have induced allopatric speciation, and thus strong genetic structure is especially expected for the habitat specialists in the genus. Therefore, we assessed phylogenetic species boundaries within four of the six *Crotaphopeltis* species using five genetic markers (16S, cyt b, ND4, c-mos, and RAG1), coupled with a phylogeographical study of the wide-ranging *C. hotamboeia*. The species-delimitation approach included genetic barcoding in combination with two coalescent-based methods. Results indicated *Crotaphopeltis barotseensis*, *C. degeni*, and *C. hotamboeia* are valid species, whereas *C. tornieri* comprised two candidate species. *Crotaphopeltis hotamboeia* did not show cryptic speciation, although strong phylogeographic structure was detected, which appears to correspond with the spatio-temporal pattern of the African savanna.

Keywords: Africa, coalescent species delimitation, phylogeography

A MORPHOMETRIC STUDY ON LEGLESS SKINKS (*ACONTIAS*) TO DETERMINE LINK BETWEEN HEAD SHAPE AND ENVIRONMENT

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Abstract - The subfamily Acontinae (Scincidae) consists of burrowing lizards that are endemic to southern Africa and was thought to be species-poor until recently. This was because their body shapes are all relatively conserved, with no external ornamentation. Morphological analyses can be used to understand the phenotypic differences between species and to investigate the selective forces that shaped the phenotypes of the species. Environmental characteristics, including soils, differ between the various biomes of South Africa, and it is expected that the burrowing species of *Acontias* will show phenotypic adaptations to the various environmental characteristics of the biome that the species inhabit. The aim of this study, then, was to investigate the morphological differences in the heads between species of *Acontias*, and identify whether the head shapes observed were linked to the environment or to ancestry. Eighteen species of *Acontias* were used in this study. The *Acontias* phylogeny was used to account for the ancestry in the evolution of the phenotypic traits and to understand whether the evolution of a certain genotype is linked to ancestry and not an independent evolution. Geometric morphometric techniques, including photographing and placing landmarks on the heads of individuals, were used to determine head shape and ecological functioning behaviour, such as burrowing behaviour. Both dorsal and lateral (right side) photographs were taken of each individual from the different species. Landmarks were determined based on intersecting head scales. The study thus far has shown that the dorsal view separates clades quite well but not the lateral view.

Keywords: Acontias, environmental links, geometric morphometrics

THE EFFECTS OF ROADS ON PUFF ADDER (*BITIS ARIETANS*) MOVEMENT

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Abstract - The movement ecology of a species can dictate their survival and success. Animals are motivated to move depending on resource priorities and in turn their movements are influenced by the surrounding environment. Natural habitats are being increasingly disturbed by anthropogenic changes which often creates several implications for the existing wildlife. One of these changes include extensive road networks that may fragment landscapes and increase mortality risks for local fauna. This current and global issue is often researched with the aid of road kill statistics which can create a biased view. My study highlights a more realistic method for understanding how organisms interpret and react to road infrastructure by using the movement patterns of 109 telemetered Puff Adders (*Bitis arietans*). To assess the effect of roads on these snakes within Dinokeng Game Reserve (Gauteng, South Africa) over eight years, Puff Adder lie-up locations (to the nearest road) and movement paths were analysed. Sex, season, years, and the types of roads within the reserve were included to evaluate the motivation for movement and if roads were inhibiting or aiding movement patterns. Compared to random, Puff Adders were closer too, and crossed roads more often. Males crossed roads more frequently than females and during non-mating season, both sexes were closer to roads. Narrow roads with low levels of traffic were also crossed more often. Overall, the roads in Dinokeng Game Reserve do not inhibit movement and patterns suggest that roads may be advantageous for Puff Adders. Roads appear to be foraging hotspots because of micro habitats created along the verges. However, these positive attributes could result in a potential risk when road usage is intensified by traffic. Understanding how species interact with changes to their environment is essential for appropriate management and mitigation and this study illustrates the necessity for unbiased research to properly evaluate these changes and reactions.

Keywords: animal-road interactions, movement patterns, road crossings, proximity to roads, telemetry

SEXUAL DIMORPHISM IN SIZE AND SHAPE FOR THE GREATER PADLOPER *HOMOPUS FEMORALIS* (REPTILIA: TESTUDINIDAE)

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Abstract - Many chelonian species display sexual dimorphism in size (SSD), shape and other morphological features, which are usually ascribed to natural or sexual selection, or a combination thereof. Female-biased SSD is considered the basal chelonian pattern, which has been retained by most aquatic, but few terrestrial species. Many tortoise species in southern Africa show female-biased SSD, which may be a consequence of their small size, but information from more species is needed to test this hypothesis. We studied sexual dimorphism in *Homopus femoralis* to assess if this small-bodied species shows female-biased SSD, and if other sexual dimorphic characteristics are similar to patterns discovered in other species. Differences in body size and shape were examined in 261 adult and 35 juvenile *H. femoralis* using 33 morphological measurements. We used one-way or Kruskal-Wallis ANOVA's to assess absolute differences in measurements among juveniles, males and females, and ANCOVA to evaluate if measurements differ when corrected for body size. Based on absolute values, females were larger than males and juveniles for all traits, but male values did not always exceed those of juveniles. When scaled to body size using straight carapace length, females were proportionally larger than males for only a third of the morphological measurements. For a given size, females had longer, wider and higher shells, resulting in a larger shell volume compared to males. Males had proportionally larger posterior shell openings than females due to shorter bridge and plastron lengths, as well as a narrower posterior plastron width. The shorter male plastron length was due to reduced lengths of the humeral, abdominal and anal scutes. In many instances, the growth trajectory of male or female parameters deviated from the juvenile pattern to obtain the specific differences in body size, shape or shell opening. A larger size for females may reflect selection for fecundity by having larger abdominal cavities to accommodate more eggs and vitellogenic follicles, whereas the larger posterior openings of males may reflect selection on mobility for mate searching and courtship.

Keywords: Greater Padloper, morphology, selection, size, shape

BIG TORTUCE, FROM WHENCE THOU HAS'T COMETH TO THINE HOME? ANCIENT MITOGENOMICS RESOLVES RADIATION OF EXTINCT MASCARENE GIANT TORTOISES

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Abstract - *Cylindraspis* is a genus of extinct giant tortoises endemic to the Mascarene Islands. Recently, it has been suggested that humans introduced these tortoises, spurring a debate about their origin. To contribute further to this matter, we produced almost complete mitogenomes for all five currently recognized species. We applied optimized NGS protocols for ancient DNA approaches, including single-stranded library preparation, and in-solution hybridization capture. We included the resulting data in phylogenetic, molecular clock, and biogeographic analyses using mitogenomes of representatives of all extant genera and species groups of tortoises (Testudinidae) with all extant taxa from Madagascar and the Seychelles represented. The mitogenomes of all five *Cylindraspis* species were deeply divergent from those of any other extant tortoise. In phylogenetic analyses of the mitogenomes, all *Cylindraspis* species are monophyletic and sister to a clade containing tortoise taxa from Africa, Asia, Madagascar, the Seychelles, and South America. The divergence date inferred for *Cylindraspis* exceeds by far the age of the Mascarene Islands, while the divergence dates for the mitogenomes of two species pairs (*C. indica* vs *C. inepta* and *C. peltastes* vs *C. vosmaeri*) suggest dispersal and vicariance within the Mascarenes, explaining also the former occurrence of two sympatric species on Mauritius and Rodrigues. Biogeographic analyses including our complete data set suggest that the ancestor of *Cylindraspis* lived in Africa and island-hopped to the Mascarenes circumventing Madagascar. According to our data, the Mascarene giant tortoises were definitely not introduced by humans.

Keywords: ancient DNA, *Cylindraspis*, Mascarenes

DIFFERENTIAL FOOD RESOURCE UTILISATION BY TWO NEST PREDATORS (*NAJA NIVEA* AND *DISPHOLIDUS TYPUS*)

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Abstract - It is widely reported that snakes can be major predators of avian nests, but the use of shared avian prey by competing species has not been examined. In southern Africa's Kalahari Desert, Sociable Weavers (*Philetairus socius*) experience high rates of nest predation by Cape Cobras (*Naja nivea*) and Boomslang (*Dispholidus typus*). We used repeated visual surveys to quantify predation rates of Sociable Weaver offspring at Benfontein Nature Reserve, South Africa. We additionally quantified the time of arrival of Cape Cobras and Boomslang at colonies following a Sociable Weaver breeding attempt over an entire breeding season. We hypothesized (i) that predation rates for Cape Cobra and Boomslang would be similar, (ii) the frequency with which chicks and eggs were predated by each snake species would be similar, (iii) that the mean age of prey consumed by each species of snake would be similar, and (iv) that the two species of snakes would arrive at colonies at similar times following the onset of laying. We observed and inferred 38 Cape Cobra and 19 Boomslang feeding events. Our results showed a significant difference in mean (± SD) predation rate, with Boomslang consuming more prey items (17.11 ± 9.33 individuals) than do Cape Cobras (11.13 ± 7.89 individuals). The two snake species consume similar numbers of chicks, but Boomslang consume significantly more eggs than do Cape Cobras. As a result, the mean age of prey consumed by Cape Cobras was significantly greater than that of Boomslang, likely because Boomslang arrive at colonies sooner than Cape Cobras after a new breeding attempt by the birds. Although both snake species consume eggs and chicks, our findings suggest that Boomslang raid colonies earlier, feeding primarily on eggs. We discuss this finding in the light of Cape Cobra and Boomslang ecology.

Keywords: foraging ecology, interspecific competition, nest predation, *Philetairus socius,* visual surveys

SHELL SIZE AND BODY CONDITION OF THE COMMON PADLOPER (*HOMOPUS AREOLATUS)* IN THE WESTERN CAPE, SOUTH AFRICA

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Abstract - Animal size is central to species descriptions, morphology, ecology, physiology and evolution. Here we describe shell length (L, carapace), width (W), height (H), shell volume (SV= π x L x W x H/6000, mL), body mass (M, g) and body condition indices (M/SV, g/mL) of wild adult (females and males) and juvenile *Homopus areolatus* at one site over three years, from May 2000 to December 2003. For females and males that we radiotracked during 2002 and 2003, 12 months for males and 18 months for females, we used repeated measures ANOVA to assess body mass variation among seasons. Females were larger (L, W, H and SV) and heavier (M) than were males, which were larger and heavier than the juveniles. Shell height and width scaled allometrically to carapace length (slopes <1 on log-log basis) for all groups except shell height of females, which scaled isometrically to carapace length (slope ~1); this isometry may accommodate the large eggs and reproductive mass in females. Similarly, female SV, female M, and male M appeared to scale isometrically to carapace length (i.e., log-log slope of 3). Relative to the other two groups, female shell height grew faster with increased shell length, and male shell width grew slower with increased shell length. Body condition indices were similar between females and males, but juvenile indices were significantly lower than female and male indices. Yet, body condition indices for each group did not differ from 1 g/mL. Body mass of radiotracked adult females and males varied significantly among seasons, reaching maxima in winter-spring (July through October) and minima in summer-early autumn (January through March), corresponding to wet and dry periods, respectively. Body mass for females peaked during months when they are gravid. The female's large size, distinct isometric growth of shell height, and the peak body mass in the egg production period coincides with high reproductive production in the small tortoises of sub-Saharan Africa.

Keywords: body condition, growth, sex, shell shape, shell size

NICHE DIVERGENCE SUPPORTS GENETIC DIFFERENTIATION WITHIN THE PARROT-BEAKED TORTOISE *HOMOPUS AREOLATUS*, ENDEMIC TO SOUTH AFRICA

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Abstract - *Homopus areolatus* is endemic to South Africa where it is found mainly in the Cape Floristic Region (CFR) below the Great Escarpment (GE), including valleys of the Cape Fold Mountains (CFMs). A few relictual populations occur above the GE in the Northern Cape Province. Plant and animal diversity in the CFR have often been attributed to climate change over the Pliocene and Pleistocene, but few studies combined genetic analyses with niche modelling to test if lineage and niche divergences correspond. We hypothesized that abiotic gradients that developed over the Pliocene-Pleistocene would have influenced the genetic structure of *H. areolatus*. We also tested for the expansion or contraction of suitable habitat between glaciation (Last Glacial Maximum, LGM) and interglacial (current) conditions to assess how climatic fluctuations over the Pliocene-Pleistocene could have influenced the divergences and distribution of clades. We used mtDNA (ND4) and nDNA (prolactin) for a phylogenetic analysis of 69 specimens from 26 localities over the species' range. Based on our mtDNA results, we computed niche models for the species (262 unique localities) as well as for clades and subclades separately, using SDMtoolbox in combination with Maxent. In addition, we used ENMTools to compute niche breadth and niche overlap of clades. The nDNA showed little diversity but mtDNA retrieved two monophyletic clades, respectively in the southwest (clade 1) and southeast (clade 2), with the two clades co-occurring in the syntaxis zone of the CFMs, and both clades occurring above the GE. Clade 1 showed a north-south divergence and clade 2 a west-to-east divergence. Suitable habitat for clade 1 was restricted to the winter rainfall zone, and rainfall was the major determinant under current and LGM conditions. For the southeastern clade, altitude was of major importance and temperature was of greater importance than rainfall during current and past climates. Suitable habitat shrank from the LGM to current, probably due to reduced rainfall in the west and higher temperatures in most regions. Niche breadth was low for clade 1 and higher for clade 2, with little niche overlap between the clades. We conclude that the pattern of genetic divergence is strongly associated with ecological niche divergence of *H.*

areolatus clades. More studies are needed to assess the taxonomic status of clade 1, particularly in view of its shrinking habitat due to climate change and anthropogenic factors.

Keywords: Cape Floristic Region, Last Glacial Maximum, niche models, niche overlap, paleoclimate

A SNAKE IN THE GRASS: A MOLECULAR STUDY OF THE WIDESPREAD *PSAMMOPHYLAX* GENUS

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Abstract - *Psammophylax* (Fitzinger 1843) is a widespread yet poorly studied genus of African grass snakes. Grass snakes or 'skaapstekers' as they are sometimes referred, are terrestrial, diurnal, active foragers that can often be found in grassland and savanna. A genetic phylogeny of six of the seven species was estimated using both Bayesian and Maximum Likelihood Inference. To support the genetic analyses, we conducted morphological analyses on the body (traditional morphology) and head (geometric morphometrics) separately. Phylogenetic analyses recovered a similar topology to past studies, but with better resolution and node support. We found substantial genetic structuring within the genus, supported by significantly different head shapes between *P. a. acutus* and other *Psammophylax. Psammophylax a. acutus* was recovered as sister to its congeners, and sequence divergence values, bGMYC analysis and morphometric analysis supported its recognition as a new genus, described in honour of the late Bill Branch. Increased sampling in East Africa (Tanzania, Kenya and Ethiopia) revealed that *Psammophylax multisquamis* is polyphyletic, necessitating the description of a new, morphologically cryptic species from northern Tanzania. The distribution of *P. multisquamis* sensu stricto is likely restricted to Kenya and Ethiopia. The study has resolved multiple aspects of *Psammophylax* systematics, including the taxonomic validity of two central African subspecies. The inclusion of specimens from the more remote parts of Africa, in future analyses, may result in the recovery of additional diversity within *Psammophylax.*

Keywords: Grass snake, molecular biology, phylogenetic analysis, Psammophiinae, taxonomy

SPATIAL SORTING ON DISPERSAL TRAITS ARE STAGE DEPENDENT IN THE INVASIVE AMPHIBIAN *XENOPUS LAEVIS* IN WESTERN FRANCE

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Abstract - Organisms are exposed to trade-offs constraining their anatomy, physiology, and behavior between dispersal and life-history traits. The spatial sorting theory predicts the enhancement of dispersal traits due to resource re-allocation at the periphery of expanding populations. A more nuanced view of spatial sorting emerges when one considers organisms with complex life cycles in which dispersal usually occurs at a particular ontogenic stage. It is currently not known if enhancement of dispersal traits in organisms with complex life cycle emerges only at the dispersal stage. In amphibians, larval development can influence life-history traits that directly influence dispersal in post-metamorphic juveniles. Spatial sorting for dispersal traits occurs in adults of the invasive African Clawed Frog, *Xenopus laevis*, in western France. Individuals have been expanding from a single introduction point since the 1980s colonizing an area of ~2000 km2. The mass of reproductive organs is reduced at the range periphery while the dispersal rate, probability and distance are increased. In *X. laevis* all stages are aquatic and dispersal is terrestrial. We predict that the enhancement or adaptation of dispersal traits due to spatial sorting occurs at the onset of their development regardless of dispersal ability of tadpoles. To test this, we conducted experiments in outdoor mesocosms and in microcosms in the lab. We surveyed tadpole development for 10 weeks from hatching to metamorphosis. We observed no effect of site position (core vs. periphery) on morphology, development, and survival of tadpoles. This study shows that spatial trait variation in pre-dispersal and dispersal stages are decoupled to a large extent in species with complex life cycles. In amphibians, tadpole development is constrained by factors such as initial density, food availability, and predation whereas in adults, resource allocation to dispersal can be enhanced at the dispersing stage and not at the pre-dispersal stage.

Keywords: development, dispersal, invasion, spatial sorting, tadpoles

PHYLOGENY, SPECIES DELIMITATION AND ANCESTRAL BIOGEOGRAPHY IN *CHAMAELEO*

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Abstract - *Chamaeleo* is a pan-African genus of chameleons that also extends into southern Europe, southern Asia, and the Middle East, with much geographic overlap and confusing phenotypic variation between its taxa. It is thought to have substantial cryptic diversity and has long been in need of a taxonomic revision informed by a phylogenetic framework. Accordingly, the aims of the present study were to carry out a comprehensive phylogeny of the genus, accompanied by species delimitation methods. Additionally, we sought to investigate whether the *Chamaeleo* genus originated in southern Africa, given that *C. namaquensis* has a sister taxa relationship with the rest of the genus and is currently confined to the arid southwest African coast. Two mitochondrial (ND4 and 16S) and two nuclear (RAG1 and PRLR) markers were sequenced for representative individuals of every known species in the genus, spanning their natural ranges where possible. Bayesian and maximum likelihood analyses were carried out and species delimitation was investigated using the Bayesian General Mixed Yule-Coalescent model, distance-based DNA barcoding, and the Bayesian Phylogenetics and Phylogeography programme. An ancestral area reconstruction was carried out in RASP. The analyses suggested the presence of 18 species within *Chamaeleo*, splitting *C. dilepis* and *C. gracilis* into three candidate species each, and *C. anchietae* into two candidate species. Additionally, the results suggest that *C. necasi* should be synonymised with one of the candidate species within the *C. gracilis* complex. The origin of the genus *Chamaeleo* dates to the Eocene, most likely in the Zambezian region. *Chamaeleo* probably exploited mesic corridors that opened up during forest contractions of the Oligocene and Miocene to move into North Africa and Eurasia.

Keywords: cryptic species, herpetofauna, phylogenetics, systematics

HOW MANY HARLEQUINS? MORPHOLOGICAL, MOLECULAR, AND ECOLOGICAL EVIDENCE FOR CRYPTIC DIVERSITY WITHIN THE AFRICAN LAMPROPHIID *HOMOROSELAPS LACTEUS*

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Abstract - *Homoroselaps lacteus* (Linnaeus, 1758) is a species of polymorphic, ornately-coloured lamprophiid snakes from southern Africa. Herpetologists have long recognised that the three colour morphs are largely geographically predictable, with barred individuals occurring in the south-western Cape, blotched individuals occurring in the Eastern Cape Province, and striped individuals occurring across the north eastern parts of the geographic distribution. Several workers have speculated that the colour patterns represent different species—an idea corroborated by a recent publication that showed significant genetic divergence between a small number of samples. Here we draw on meristic data from the examination of 148 specimens, geo-referenced digital images of 131 animals, phylogenetic maximum likelihood analysis of molecular sequence data (16S, cyt-b, RAG-1) from 23 individuals, and species distribution modelling approaches to examine the evidence for species-level differentiation within the group. Additionally, we present a thorough summary of the diet of *H. lacteus* as revealed by examination of museum specimen gut contents and observations drawn from a social media platform used to gather dietary data for southern African herpetofauna. Our results reveal that, in general, the three colour morphs occupy three parapatric geographical ranges which correspond broadly with three well resolved phylogenetic clades. However, not all specimens could be unambiguously assigned to one of the three colour patterns or phylogenetic clades suggesting additional evolutionary complexity within the clade. Our meristic data revealed a subtle increase in the number of ventral scales and subcaudal scales of the barred colour morph relative to the two other forms, however our dietary data suggested that diet is largely conserved across the clade, being restricted to the consumption of elongate squamate reptiles. We conclude by discussing the implications of our findings for the systematics of *H. lacteus*, and highlight the value

of integration of morphological, molecular, and ecological data in understanding the evolutionary origins of snakes.

Keywords: colour polymorphism, diet, ecological niche modeling, Lamprophiidae

SHARING FOR SCIENCE: USING SOCIAL MEDIA TO BETTER UNDERSTAND THE DIETS OF AFRICAN SNAKES

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Abstract - An incomplete understanding of the feeding ecology of organisms impedes our ability to address questions related to energy flow within an ecosystem, predator-prey dynamics, population dynamics, niche partitioning, habitat preference, and the evolution of behaviours and traits. For most African snake species, it is difficult to study feeding ecology due to low detectability of study organisms and an even lower incidence of in situ feeding observations. Moreover, the cost and time associated with extensive field sampling are often prohibitive and sampling often involves destructive methods. In our study, we harnessed the power of Facebook as a crowdsourcing platform, which is comprised of thousands of potential observers, to collect photographic records of predation events involving reptiles and amphibians in sub-Saharan Africa. Feeding events in snakes were particularly well-represented with nearly 1,000 feeding events recorded in the last four years. To evaluate the usefulness of this method, we compared the observations collected from Facebook to observations we recorded from an extensive literature review on the diets of wild southern African snakes (~3,200 feeding observations). An analysis of the two datasets revealed how effectively and rapidly information on these difficult to detect ecological interactions can be collected at broad spatial, temporal, and taxonomic scales. Our work highlights that our understanding of snake feeding ecology is far from complete and that multiple methods should be utilised to compile a comprehensive and robust dataset.

Keywords: natural history, predation, predator-prey interactions, snake feeding ecology

MOUNTAIN DWARFS – A NEW SPECIES OF *LYGODACTYLUS* (SQUAMATA: GEKKONIDAE) FROM THE SERRA DA NEVE INSELBERG, SOUTHWESTERN ANGOLA

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Abstract - The dwarf geckos of the genus *Lygodactylus* Gray, 1864, are one of the most diverse groups of geckos in Africa. According the modern revisions of the Angolan herpetofauna five members of the genus occur in Angola, although this certainly represents an underestimation. Recent expeditions to Angola have yielded new material of all recognized species in Angola, new records for the country, as well as undescribed species. One of these undescribed species was collected at Serra da Neve, an isolated inselberg at the northern limit of Namibe Province, southwestern Angola. Serra da Neve is the second highest peak in Angola and remains poorly studied in terms of its biodiversity. However, new amphibian and reptile species have been described from the area in the last two years. In order to understand the phylogenetic and biogeographic relationships of the Serra da Neve *Lygodactylus*, we conducted morphological (scalation, body measurements and coloration pattern) and molecular (mitochondrial and nuclear genes) analyses. Preliminary results confirm that this population represents a new species and reveals phylogenetic affinities with eastern-African lineages.

These findings provide new data that highlights the exceptional importance of this inselberg in terms of biodiversity and endemicity. It also emphasizes the need to incorporate Serra da Neve in future conservation plans for Angola.

Keywords: Angola, biogeography, dwarf gecko, inselberg, phylogenetics

HOW DO HERPETOLOGISTS STUDY INVASIONS?

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Abstract - Invasion Biology is a young discipline, Charles Elton only coined the term in 1958. Although the subject was generally ignored by most people for 40 years, the last 20 years has seen a near exponential rise in papers by herpetologists on alien reptiles and amphibians (and not only by Rick Shine!). But how do herpetologists go about studying invasions? In this study, we reviewed 836 publications on alien herps and compared their objectives with 30 well known hypotheses from invasion biology. We found that although the field is rapidly expanding, very few researchers had specified any of the invasion hypotheses, but 26% had the data to test one or more. The most commonly tested hypothesis resembled the concept of the 'ideal weed', that invasion success of a non-native species depends on its specific traits (3.8%). Other popular hypotheses referred to habitat filtering (1.7%), preadaptation through human commensalism (1.8%), novel weapons (1.3%), novel associations (1.4%) and invasion meltdown (1.5%). Perhaps more excitingly, are the new hypotheses that herpetologists can donate to invasion biology, including spatial sorting, invasion hubs and hybridisation. We conclude that herpetologists need to pay more attention to existing hypotheses in invasion biology, many of which stem from classical questions in ecology. Better transdisciplinary communication will likely lead to increased impact of studies which could teach invasion biologists more about reptiles, amphibians and their amazing invasions.

Keywords: Amphibia, hypotheses, invasion biology, Reptilia

THE GLOBAL PET TRADE IN AMPHIBIANS: SPECIES TRAITS, TAXONOMIC BIAS, AND FUTURE DIRECTIONS

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Abstract - The burgeoning global pet trade in vertebrates has multi-pronged conservation implications, including overexploitation of native populations, spread of diseases, and invasions. The majority of amphibian invasions are due to the pet trade pathway and current lists of extra-limital amphibians (including those in trade) suggest that future invasions will encompass a broader taxonomic diversity than is known. Given that trade is dynamic, it is essential to move beyond currently traded species and understand which species are likely to be traded in the future and serve as candidates for invasions. In this study, we systematically assess amphibian species in the pet trade, i) characterising taxonomic bias, ii) evaluating species-traits as predictors of traded species and trade volume, and iii) forecasting likely future pets. We collated a global list of 443 traded amphibians and a regional dataset (USA) on trade volume. Species-traits (body size, native range size, clutch size, and breeding type) and conservation status, were considered as predictors of traded species and volume. Six Families contributed disproportionately to the amphibian pet trade; the likelihood for species to be traded was positively associated with body size, range size, and a 'larval' breeding type. However, species-traits performed poorly in predicting trade volume, suggesting an overriding effect of socio-economic aspects of the trade. The identified species-traits and taxonomic bias of the trade were then used to predict species likely to be traded as pets in the future. This study formalizes the knowledge on amphibian species that are traded as pets. We found a strong bias for certain families, along with a preference for large-bodied and widely distributed species with a larval phase. Our results pave way for more trait-based approaches to forecast amphibians entering the trade. Such understanding of the pet trade can help pre-emptively tackle the pathway responsible for most invasions and disease spread in amphibians.

Keywords: amphibian, invasive species, life-history traits, trade

COMPLEX SOCIAL STRUCTURE IN THE SUNGAZER LIZARD (*SMAUG GIGANTEUS*)

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Abstract - Complex social structure is a life history trait previously thought to only be present in groups such as birds and mammals. Research on reptiles over the past several decades, however, has revealed evidence of complex social structure in more than 100 species of squamate reptiles. In lizards, social structure has been reported in five families, including the Cordylidae. Although there have been anecdotal reports of family structure in several species of cordylids, there has been no substantiated evidence confirming this using behavioural or genetic studies. In this study, we investigated the social structure of the Sungazer (*Smaug giganteus*) using 21 species-specific microsatellite markers. Tissue samples and demographic data were collected from 149 Sungazers across 10 colonies to assess relatedness of lizards using the same burrows, lizards from neighbouring burrows, and between lizards from different colonies. The average pairwise relatedness within Sungazer colonies was significantly higher than overall pairwise relatedness for population-wide relatedness. The majority of Sungazers sharing burrows did so with first-degree relatives (49% - parents, offspring, full siblings), and second-degree relatives (28% - cousins, aunts, uncles, half-siblings). The majority of Sungazers in neighbouring burrows within a colony were second-degree relatives, regardless of distance between burrows. Almost all juvenile Sungazers share burrows with their mother/father and siblings, with the remainder living with second-degree relatives. This gregarious sociality may have evolved as a result of Sungazers inhabiting flat grasslands where burrows are the only form of safe refuge, and are thus shared by close relatives and this could potentially improve juvenile survival rates. Although these findings elucidate details on the complexity of sociality in African lizards, future studies on this species and other cordylids should combine genetic techniques with long-term population demographic studies for a more comprehensive understanding of these systems.

Keywords: cordylid, microsatellite, relatedness sociality, *Smaug*

REPTILE AND AVIAN ASSEMBLAGE ALONG A GRADIENT OF INVASIVE ALIEN PLANTS IN THE CRITICALLY ENDANGERED WOODBUSH GRANITE GRASSLAND (LIMPOPO PROVINCE, SOUTH AFRICA)

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Abstract - Invasive alien plants species (IAPs) are a significant problem in South Africa and can pose complex and far-reaching challenges to biodiversity, with impacts on fauna poorly understood. The study aimed for multi-site comparison of reptile and bird assemblages between pristine grassland, alien plant invaded and plantation habitats. Reptiles and birds were surveyed using standard Y-shape trap array and fixed-point counts respectively. Vegetation structure and invasion intensity was determined using point-intercept method. Five IAPs were identified: *Acacia mearnsii*, *Eucalyptus grandis*, *Pennisetum clandestinum*, *Pinus patula* and *Solanum mauritianum.* Reptiles (23 individuals from five species) were recorded, with highest abundance and diversity in the grassland. Birds (2113 individuals from 67 species) showed the greatest abundance, diversity and richness in the invaded habitat. *Trachylepis varia* was a common reptile species, showing overlap between grassland and invaded habitat. *Lygodactylus methuen* was the only identified endemic reptile species. Grassland bird specialists (i.e. *Anthus similis, Cisticola lais*, and *Sphenoeacus afer*) were observed in more open and moderately invaded habitat but absent in denser and heavily invaded habitat. The study demonstrated that reptiles and birds respond differently to alien plants invasion. Reptiles were mostly supported by low vegetation cover, availability of microhabitats e.g. rocks and bare ground for thermoregulation while birds responded to rich vegetation stratification. Clearing of invasive alien plants can be considered as management strategy if it is to promote biodiversity. Clearing can create more thermal opportunities for reptiles and accommodate open habitat bird species.

Keywords: invasive alien plant species, multi-site comparison, native, thermoregulation, vegetation stratification

ASSESSING THE VULNERABILITY OF ENDEMIC, RUPICOLOUS REPTILES TO THE EFFECTS OF CLIMATE CHANGE IN THE SOUTPANSBERG MOUNTAINS, SOUTH AFRICA

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Abstract - Climate change is one of the biggest anthropogenic pressures currently threatening species persistence. In response to climate change, species are predicted to track suitable climatic conditions and thus alter their distributions. Species with limited dispersal ability are unlikely to be able to track suitable conditions and therefore are at higher risk of extinction. As a result of this, there is an increased need to investigate the potential effects climate change will have on the distribution of restricted species, specifically when designing protected areas and to identify potential climatic refugia. Here we focused on investigating the potential impacts climate change will have on the distribution of five, rupicolous endemic reptiles to the Soutpansberg Mountains in South Africa (*Afroedura pienaari; Lygodactylus incognitus; Lygodactylus soutpansbergensis; Platysaurus relictus* and *Vhembelacerta rupicola*). This was achieved through conducting ecological niche models using Maxent and projecting them into future climates. Out of the five endemic species *L. incognitus, L. soutpansbergensis, P. relictus* and *V. rupicola* were predicted to be extremely vulnerable to the effects of climate change with a predicted decrease in suitable habitat of over 85% by 2070 in the highest carbon emission scenario. Specifically, the suitable habitat for the species investigated were predicted to increase in average altitude and display westward latitudinal shifts. Importantly, the distribution of these vulnerable species are predicted to persist in the western Soutpansberg, indicating that this area may act as a climatic refugia in the future. Our results highlight the importance of future climatic refugia and the usefulness of conducting ecological niche models to identify species which are most at risk, areas of potential refugia and to drive future research.

Keywords: climate change, endemic, ecological niche model, rupicolous

THE MECHANICS OF AIR-BREATHING IN XENOPUS TADPOLES

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Abstract - The physiology of tadpole air-breathing has been studied in a small number of well-known taxa, and previous authors have demonstrated the physiological importance of air-breathing in tadpoles for gas exchange. However, the biomechanics of air-breathing has never been investigated in any tadpole. We use a combination of high-speed videography, gross dissection, and paraffin histology to describe the functional morphology and mechanics of air-breathing in *Xenopus* tadpoles (Anura: Pipidae). We raised tadpoles in the lab until metamorphosis and characterized the kinematics of air-breathing throughout ontogeny. Large tadpoles breathed in a manner similar to other aquatic vertebrates by swimming up to the surface and then breaking the surface tension of water to gain access to gaseous air. Smaller tadpoles however, performed a novel form of air-breathing, previously undescribed in any other vertebrate, termed 'bubble-sucking'. During bubble-sucking, tadpoles attach to the under-surface of the water and pull the surface into the pharynx, creating a bubble. While the surface is pulled into the mouth, the lungs empty into the air-bubble while it is still connected to the atmosphere. After the lungs empty, the tadpole closes the mouth, pinching off an air-bubble, which is then compressed and used to fill the lungs. Small, slow animals may be incapable of overcoming the physical constraints imposed by surface tension, thereby preventing them from breaching the surface to breathe normally. We propose that bubble-sucking allows smaller organisms that are incapable of breaching the water's surface to circumvent the physical constraints of surface tension for air-breathing. This was supported by our finding that tadpoles below a certain size threshold exclusively bubble-suck, while larger tadpoles are able to breach-breathe instead.

Keywords: biomechanics, breathing, functional morphology, lung, tadpole

REPTILES OF ZAMBIA AND MALAWI: A SYNTHESIS OF CURRENT KNOWLEDGE

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Abstract - Zambia and Malawi are land-locked countries at the northern extreme of geographical southern Africa. Despite their geographical placement in southern Africa these two countries, together with Angola and Mozambique north of the Zambezi River, are usually omitted from southern African field guides, including reptile field guides. This absence of comprehensive field guides hinders the layman from accurately identifying many reptiles and also results in less research interest in these regions. This lack of synthesized data is also hampering country-level conservation actions such as protected area strategies and regional conservation assessments. To address this situation, we collated all available reptile observation data for Zambia and Malawi. Questionable records were verified where possible or else removed from the dataset. The resultant dataset consists of 14 941 georeferenced occurrence records for 235 species that were used to construct species-specific distribution maps using Species Distribution Modelling, based on eight uncorrelated biophysical and climatic predictor variables. Spatial analysis of the occurrence records indicates that sampling was biased towards Malawi, high-population areas and areas characterized by unique habitats (e.g. mountains and lowland forests). While the generated geographic distributions appear to be accurate for species with many records, modelled distributions based on low sample sizes should only be used as guidelines for further targeted surveys to improve the understanding of reptile distributions in Zambia and Malawi. Of the 235 species recorded from the region, 14 are endemic and one is possibly extinct. Our synthesis has resulted in eight new species being verified to occur in these countries and includes eight species described or elevated from synonymy within the last five years. Detailed species accounts have been developed for each species and includes at least one good photograph for nearly every species. Dichotomous keys have been developed to aid in the identification of each taxonomic group from family to species-level and have been made more accessible to the layperson by the inclusion of photographs and illustrations where unfamiliar morphological features provide the distinction. The intention is to make this information available as a comprehensive field guide by 2020 followed by a pocket field guide, and after an embargo period the collated dataset will be deposited in a publicly-accessible repository.

Keywords: distribution, Malawi, modelling, reptiles, Zambia

THE UTILISATION OF PASSIVE ACOUSTIC MONITORING AS A TOOL TO DETERMINE ANURAN DIVERSITY IN NORTH-EASTERN KWAZULU-NATAL, SOUTH AFRICA

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Abstract - Various animal groups have developed the ability to produce species-specific vocal signals, each with unique acoustic patterns. Among these groups, amphibians are one of the most well-known vocalising species. The study of vocal signals allows scientists to monitor anurans based on their acoustic behaviour. The last known survey done on the anuran presence, diversity and geographical distribution in north-eastern KwaZulu-Natal, South Africa was conducted by Minter *et al.* (2004) using a number of different methods. In an attempt to document the anuran diversity in north-eastern KwaZulu-Natal, the study was conducted by making use of passive acoustic monitoring (PAM) by means of automated recorders. Six localities were identified in Kwazulu-Natal where recorders were arrayed. The recording frequency was set at ten minutes of recording every hour, on the hour between 18h00 to 07h00 for twelve on-going months. In addition to determine the presence of anurans at the sample localities, analysis of the data allowed for the differentiation between both diurnal and seasonal variance in vocal activities. A total of 54% (29/54) of the expected species were recorded at the six localities. Two species, *Leptopelis mossambicus* and *Ptychadena anchietae*, were recorded at all sampled localities. The highest anuran diversity was recorded at St. Lucia with 16 species. Due to the El Niño phenomenon, rainfall patterns were not typical for the studied area, which contributed to the low presence of anurans at the different localities. Ultimately the use of PAM to detect the presence and anuran behaviour (seasonal and diurnal), proved to be a practical method for medium- to long-term non-invasive biodiversity estimates at different localities.

Keywords: anurans, El Niño, north-eastern KwaZulu-Natal, passive acoustic monitoring, vocal signals

ASPECTS OF THE ECOLOGY OF TWO TERRAPIN SPECIES (*PELOMEDUSA GALEATA* AND *PELUSIOS SINUATUS*) IN KWAZULU-NATAL, SOUTH AFRICA

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Abstract - South Africa's freshwater systems are under increasing anthropogenic pressures due to a growing population, land-use change and climate change. It is important to understand how organisms reliant on wetland systems are coping with pressures to assess their ability to persist. There is a paucity of general knowledge of terrapin ecology in South Africa, despite their importance in freshwater ecosystems. Measures of movements, regularity, and activity regimes can provide valuable insights into an animal's behaviour, and what is required to ensure populations remain stable. Consequently, we investigated aspects of terrapin (*Pelomedusa galeata* and *Pelusios sinuatus*) ecology, using several different techniques. Ten individuals of each species had UHF tags attached to monitor movements and activity patterns at two different field sites in KwaZulu-Natal Province. This showed trends in individual behaviour/ movement in relation to environmental variables, especially drought conditions. As well as the two telemetry sites, other sites throughout the province specimens from both species were permanently marked on their marginal scutes using a standardised numbering system, for the event of recapture. All specimens had bio-morphometric data collected to evaluate general condition, and a tissue sample was collected for genetic analysis. A total of 98 serrated hinged terrapins (not including dead specimens, which brought the total to 115) were captured and analysed. The total for marsh terrapin was 55 (not including dead specimens, which brought the total to 82). The capturing methods varied, and their success also varied at different sites. We present our findings on both species' ecology from areas of KZN. Our findings can aide in the conservation, and understanding of both species

Keywords: activity, morphology, movement, telemetry, terrapins

EFFICACY OF SNAKE REPELLENTS WHEN APPLIED OUTDOORS

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Abstract - There is a necessity for viable methods of reducing encounters with venomous snakes in high-risk areas. The objective of this study was to investigate the efficacy of geraniums (*Pelargonium hortorum*), Jeyes Fluid Original®, naphthalene, potassium permanganate and Snake Repel®, five commonly used snake repellents in South Africa. A total of 24 drift fence funnel trap arrays were deployed on a game farm in Northern Limpopo for 55 days. The treatments (repellents and a water control), were replicated four times. Traps were inspected twice daily and all snakes trapped were marked, recorded and released. Repellents were analysed at four time intervals (0 hr, 12 hr, 24 hr and 72 hrs) using gas chromatography-mass spectrometry and the peak areas of their respective, major, volatile components were recorded. A total of 88 snakes consisting of 17 species were trapped over the course of the sampling period. The majority of snakes were trapped under the naphthalene treatment, followed by Jeyes Fluid Original®, geraniums, potassium permanganate, the control and finally, Snake Repel®. The difference in the number of snakes trapped under the various treatments, however, was not significant. A comparison of the peak areas of the major volatile components at the four time intervals showed that 12 hours following deployment, naphthalene and Snake Repel were reduced to 5% of their original 'strength', whereas Jeyes Fluid Original® persisted longer, with at least 30% of its original strength still present 72 hours following deployment. This is the first long term experiment performed outdoors using a passive trapping system that provided strong evidence, that even with repeated reapplication at high dosages, these treatments were not viable snake repellents. Alternative measures to the use of ineffectual repellents, should be investigated as prevention of envenomation remains the most prudent course of action in areas at high risk of snakebite. Both rural communities and staff deployed to high-risk areas would benefit more from appropriate safety training and alternative, precautionary measures directed towards the prevention of snakebite.

Keywords: decay, efficacy, envenomation, repellent, snake

SCALY SOCIALITY: TESTING FOR THE PRESENCE OF KIN-BASED SOCIALITY IN AUSTRALIAN AND AFRICAN LIZARDS

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Animals exhibit tremendous diversity in sociality; from organisms that live their life almost exclusively alone to those that live in large groups. Yet, our understanding of sociality has a taxonomic bias. Research is mainly focused on birds, eusocial insects, and primates, which confines our understanding of the diversity and evolution of sociality. In the last few decades, lizards have shown to exhibit a range of social and mating systems. It is thought that, for particular animals, specific ecological and life history characteristics act in concert to select for the evolution of family-living and parental care. For example, live bearing and longevity favour natal philopatry, and a species' reliance on limited resources, like rock crevices for shelter, promote grouping. I will present research investigating the social systems of 5 lizards that exhibit life history and ecological characteristics that, combined, may select for the evolution of family living. First, the Australian Tree Skink (*Egernia striolata*), which belongs to the social *Egernia*-group of lizards, as well as preliminary data on a potentially novel lineage of family-living squamates – four species of cordylids from South Africa. We have collected field data on lizard space use and social associations, and are using molecular analyses to estimate relatedness between individuals. Group size and composition will be reported for each species. For Tree Skinks I will also present correlations between home range overlap, social associations, and relatedness data to assess the kin-basis of their social system. This research expands our knowledge of reptile and vertebrate sociality.

Keywords: Cordylidae, family-living, Scincidae, social behaviour

GOLIATH FROGS BUILD NESTS FOR SPAWNING – THE REASON FOR THEIR GIGANTISM?

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Abstract - In contrast to its popularity, astonishingly few facts have become known about the biology of the Goliath Frog, *Conraua goliath*. We herein report the so far unknown construction of nests as spawning sites by this species. In West Cameroon we identified three nest types. Type 1 constitutes rock pools that were cleared by the frogs from detritus and leaf-litter; type 2 constitutes existing washouts at the riverbanks that were cleared from leaf-litter and/or expanded, and type 3 were depressions dug by the frogs into gravel riverbanks. The cleaning and digging activities of the frogs included removal of small to larger items, ranging from sand and leaves to larger stones. In all nest types eggs and tadpoles of *C. goliath* were detected. All nest types were used for egg deposition several times, and could comprise up to three distinct cohorts of tadpoles. Nests seemed to be clustered. Camera trapping revealed that nests are guarded by adult frogs at night. The breeding nests may allow the frogs to deposit their eggs away from the torrent rivers, and potential egg and tadpole predators. As nest construction, at least in some cases, requires the removal of large and heavy items, we hypothesize that this can only be achieved by decent sized frogs, possibly explaining the unique size of the species.

Keywords: Amphibia, Anura, Cameroon, *Conraua*, parental care

HABITAT USE, POPULATION SIZE ESTIMATION AND ASSESSMENT OF FACTORS AFFECTING AN URBAN EXPLOITER, THE SOUTHERN TREE AGAMA: *ACANTHOCERCUS ATRICOLLIS ATRICOLLIS* (SQUAMATA: AGAMIDAE)

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Abstract - Continued anthropogenic land-use change, especially urbanisation, has extensively impacted natural environments. Urbanisation has caused major alterations to ecosystems, generally resulting in decreased biodiversity. However, some species thrive in urban environments by making use of available opportunities and resources. The Southern Tree Agama, *Acanthocercus atricollis* (Squamata: Agamidae), has reportedly had increased numbers in urban areas, specifically in KwaZulu-Natal Province, South Africa. Therefore, we investigated aspects of their ecology (habitat use, microhabitat preferences, population size) and behaviour to determine what factors influence their persistence within urban environments. Our study was conducted at two sites in Pietermaritzburg; an urban area (Azalea Gardens Retirement Village) and a periurban semi-green area (Maritzburg Golf Course). Agamas were marked with beads to identify individuals. Basking and shading patterns changed with season and time of day. We found that an increase in food availability, decreased predators and competition, and sufficient basking opportunities, promoted their population increase in the urban area, and that the tree agama is a typical urban exploiter.

Keywords: Acanthocercus a. atricollis, basking, lizard, urban exploiter

THE DEVELOPMENT AND USE OF AN AUTOMATED CELLULAR PIT TAG READER FOR ASSESSING THE ACTIVITY PATTERNS OF SUNGAZERS (*SMAUG GIGANTEUS*)

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Abstract - The use of radio-frequency identification (RFID) to monitor the activities and movement patterns of animals has gained momentum in recent years. Typically, RFID systems only comprise two main components to monitor animal activities: the transponder tag which is fitted to an animal either externally or sub-dermally, and the interrogator which electromagnetically powers the transponder to read its unique identification code. While autonomous systems have proved advantageous to behavioural ecology studies, they are limited by the storage capacities of dataloggers, and require researchers to actively attend to the system to download captured data. In this study we followed the FDX-A protocol to develop an automated cellular reader system (ACRS), capable of reading 125 kHz passive integrated transponder tags (PITs) to enable completely remote access to data at any given time from any electronic device with internet connectivity. We used the system to monitor the seasonal (winter and spring) activity patterns of the highly sedentary, burrow dwelling lizard, the Sungazer (*Smaug giganteus*). We built 12 ACRSs which were each fitted with a cellphone engine in which a SIM card was installed in each reader and loaded with data and airtime for the duration of the study. The reading antennas were fitted around the circumferences of 12 Sungazer burrows and the activity patterns of 10 marked-Sungazers were monitored. The ACRSs provided a 98.5% success rate in their ability to report on the emergence and retreating activities of Sungazers, with failures attributed to poor cellphone reception. ACRSs were able to accurately report time and date stamps, with disparity between recording and reporting data in only 0.5% of instances of activity. Seasonal variation in terms of activity patterns was present in Sungazers. Six lizards were active for 37% of the days during the winter months, displayed significantly less frequent shuttling behaviours, and showed higher variation in the proportion of the duration of daily activity above ground during this time compared to spring. Male Sungazers visited neighbour burrows significantly more frequently than did females but site fidelity in both sexes was high. Increased

movements of male Sungazers suggests that spring is the mating season of Sungazers. The ACRS proved to be an accurate and efficient system that was able to function maintenance free for the duration of the study period and is easily adaptable to studies on other animals.

Keywords: activity patterns, automated reader systems, RFID technology, PIT tags, *Smaug giganteus*

COUNTING EGGS: CONTRIBUTIONS FROM CITIZEN SCIENCE TOWARDS AMPHIBIAN CONSERVATION IN SOUTH AFRICA

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Abstract - Tackling the global amphibian extinction crisis requires that the amphibian conservation community makes use of all the tools available to us. With 40% of all amphibians now classified as threatened, and with limited resources to address the issues causing these declines, a cooperative, interdisciplinary approach is needed that enables exchange of information across both academic and professional disciplines, as well as between diverse stakeholders and partners. This includes harnessing active participation in amphibian and habitat conservation through citizen science. One of the priorities under the global 'Amphibian Conservation Action Plan' is to coordinate efforts to synthesize and communicate findings from citizen science data back to the amphibian community. On the other hand, professional scientists need to facilitate citizen science data collection to strategically link it to desired conservation outcomes. Through the amphibian-related conservation work of the Endangered Wildlife Trust, we have several projects that involve inputs from citizen science contributions. These include monitoring and surveillance of the Endangered Kloof Frog, *Natalobatrachus bonebergi*, for which protocols have been refined and new sites identified and added. A dataset over six years for one site, Vernon Crookes Nature Reserve, provides valuable trend information for breeding activity. We are also collecting data for *N. bonebergi* and general frog occurrence records from Adams Mission, KwaZulu-Natal, where we are working towards formal habitat protection of 500 hectares of coastal wetland

and swamp forest for this species, and its conjoiner, the Endangered Pickersgill's Reed Frog, *Hyperolius pickersgilli*. Towards this end, we are also using citizen science to collect extensive data on Ecological Goods & Services (EGS) to gauge long-term responses to habitat management and protection interventions.

Keywords: amphibian, citizen science, conservation, monitoring

ORIGIN OF INVASIVE POPULATIONS OF THE GUTTURAL TOAD, *SCLEROPHRYS GUTTURALIS*

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Abstract - The Guttural Toad, *Sclerophrys gutturalis*, has three established invasive populations on Mauritius, Reunion and in Constantia, a peri-urban area of Cape Town, South Africa. The native range of this toad covers much of central and southern Africa. Here we use mitochondrial DNA (mtDNA) to sample across the range of the natural distribution (from Kenya to South Africa) and compare ND2 and 16S sequences to those from animals sampled from each of the three invasive populations. We show that all invasive populations refer to the same mtDNA clade, which is naturally distributed in north-eastern South Africa, but not from adjoining Mozambique or southernmost Eastern Cape areas. Our findings corroborate previous reports of deliberate introductions from South Africa to Mauritius, and from Mauritius to Reunion. Similarly, our results suggest a single accidental translocation within South Africa from the northeast to Constantia. Our findings highlight the combination of anthropophilic behavior, and extreme long-distance dispersal occurring with accidental translocation for this species. We caution that accidental pathways are likely to continue into the future, with increasing numbers of invasive populations of this species.

Keywords: Anura, biogeography, phylogeography, invasive species, mitochondrial DNA

QUANTIFYING SPATIAL PARTITIONING BETWEEN TWO CO-OCCURRING SOUTHERN AFRICAN SNAKES, *PSAMMOPHIS CRUCIFER* AND *PSAMMOPHYLAX RHOMBEATUS*

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Abstract - For ecologically similar sympatric species to coexist without competitive exclusion, niche theory predicts that there has to be a degree of variation in their use of shared resources. Data that demonstrate niche partitioning in African snakes is rare, with only five studies ever having measured competition in African snake study systems in this context. Museum and field-based studies of *Psammophis crucifer* and *Psammophylax rhombeatus* strongly show that they are similar in several ecological aspects including large overlap in geographic distribution at multiple spatial scales, occupation of similar habitats, fine-scale syntopy, similarities in gross morphology, and dietary similarities. Here, we aimed to examine spatial partitioning between these two snake species by quantifying relative abundance of each species at the habitat-patch scale (~1 ha) and micro-patch scale (~ 4 m2). We selected ten sites at Koeberg Nature Reserve, Western Cape, South Africa and at each site placed twenty-five (600 mm x 600 mm) artificial cover objects and surveyed them twice a month for the presence of snakes over a period of 33 months. All captured snakes were marked, measured, and released at their exact capture sites. A paired t-test between the number of unique *P. crucifer* and *P. rhombeatus* at the habitat-patch scale showed that the latter species was significantly more abundant (mean ± SD = 3.8 ± 3.1 individuals) than the former (5.8 ± 3.9 individuals). However, regression analyses of these raw capture data, as well as estimates of population size derived from the implementation of Royle-Nichols single season occupancy models both showed consistent positive relationships between the abundance of each species (Pearson's r=0.70 and r=0.66, for the count data and occupancy model data, respectively). We additionally failed to detect any evidence for fine scale niche partitioning, but we recognize that our data are heavy zero-inflated. Overall, we failed to detect spatial niche partitioning between *P. crucifer* and *P. rhombeatus* at the habitat-patch and micro-patch scales in the study population. It appears as though spatial partitioning is not apparent and conclude by discussing the potential for dietary character displacement in the ecology of these animals.

Keywords: competition, mark-recapture, Psammophiinae, spatial partitioning, spatial scale

SOUTH AFRICAN REPTILE SPECIES AND THEIR PHYLOGENETIC RICHNESS NOT SUFFICIENTLY SAFE-GUARDED

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Abstract - African reptiles are under threat primarily due to habitat loss as a result of agriculture, resource extraction, and urbanisation. Extinction risk of South African reptiles was assessed as of 2018 using IUCN criteria and we 'backcast' these assessments to infer extinction risk circa 1990. A Red List Index (RLI: a measure of the extinction risk for a group of species) for 1990 and 2018 was estimated, and the protection level afforded to South African reptiles was investigated by intersecting reptile distributions with the network of protected areas. Furthermore, phylogenetic diversity of South African reptiles was mapped and intersected with national land cover for 1990 and 2013 to identify areas of high phylogenetic richness that may be impacted by habitat transformation. Level of extinction risk for South African reptiles (ca. 5.4%) is lower than the global average, and most currently threatened species would have already been at risk by 1990. The RLI is slightly lower in 2018 than it was in 1990, and the decrease is more prominent for endemic reptiles than for all reptiles combined. Most South African reptiles fall into the Well Protected category, implying that the protected area network has substantial conservation impact. However, most threatened reptile species are Poorly Protected or Not Protected. The current extent of the protected area network therefore, does not adequately mitigate extinction risk for reptiles. Notably, two South African reptiles are Critically Endangered and in protected areas, two others are already classified as Extinct, and rough estimates of extinction rates are similar to values estimated for other vertebrates. Phylogenetic diversity mapping showed that the greatest historical impacts to phylogenetic richness for reptiles are in the northeast (Limpopo, Mpumalanga, and Gauteng provinces), southwest (Western Cape Province) and the coastal margin of KwaZulu-Natal. By

considering additional metrics that are directly guided by our in-depth knowledge of the species, their distributions and the threats, we demonstrate that South African reptiles are under pressure, that risk of extinction is tangible for several species and that phylogenetic richness of reptiles in certain areas of South Africa is imperilled by loss of habitat.

Keywords: Africa, biodiversity, conservation, Global Reptile Assessment, habitat loss

OPERATIVE TEMPERATURE (TE) MODELS TO STUDY THE EFFECT OF CLIMATE CHANGE ON THE VIVIPAROUS CORDYLID LIZARD, *OROBOURUS CATAPHRACTUS*, POPULATIONS ALONG THE WEST-COAST OF SOUTH AFRICA

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Abstract - Species specific operative temperature (Te) may be an important variable to use when trying to understand the real microclimatic space that an individual experience in a spatial-temporal situation. Te- estimates integrate physical environmental variables that may affect heat exchange. Considering available operative temperatures in relation to preferred body temperature helps to understand the thermal quality of habitat and therefore the effort used for thermoregulation. A more realistic multivariate climatic model has predicative value, when considering climate warming or cooling. Although climate warming mostly refer to an average increase in air temperature, the assumption remains that it would lead to a decrease in thermal quality. The aim of this paper is to consider the thermal ecology of the viviparous cordylid lizard, *Orobourus cataphractus* occurring along the west-coast of South Africa. Reported restricted activity coinciding with low thermal quality outside crevices during the hot dry season, was confirmed. Using a multiple regression modelling approach, to link variation in operative temperatures to local climate variables, and model the effect of a predicted 4C increase in air temperature on operative temperatures and thermal quality, showed that the buffering potential of the cool crevice microenvironment may be compromised during climate warming.

On the other hand, modelling results also showed that a decrease in available solar radiation linked to an increase in cloud cover (or incidence of fog) associated with a predicted increased upwelling intensity along the west coast of South Africa, could potentially buffer predicted increases crevice temperatures during hot summer months. These preliminary correlative modelling results underlines the importance of using operative temperatures, rather than air temperatures, as well as considering secondary climatic effects, when hoping to understand the real effects of climate warming at the microclimatic level.

Keywords: climate warming, operative temperatures, *Orobourus cataphractus*, thermoregulation

UNEXPECTED PHYLOGENETIC RELATIONSHIPS WITHIN THE WORLD'S LARGEST LIMBLESS SKINK SPECIES (*ACONTIAS PLUMBEUS*) HIGHLIGHT THE NEED FOR A REVIEW OF THE TAXONOMIC STATUS OF *ACONTIAS POECILUS*

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Abstract - *Acontias plumbeus* has traditionally been considered a monotypic, invariable species, a fact that highly contrasts with documented examples of high phylogenetic complexity and phenotypic diversity in other members of the Acontinae. We employed mitochondrial and nuclear DNA markers to investigate genetic structuring among *A. plumbeus* populations and the relationship between *A. plumbeus* and the closely related *A. poecilus*. Molecular genetic analyses revealed three clades with non-overlapping distributions: an Eastern clade, a widely distributed Northern clade, and a Southern clade that includes topotypical *A. poecilus*. Morphometric analyses of preserved specimens showed that Southern clade populations are comprised of individuals with absolute and proportionally smaller body sizes than their Northern and Eastern relatives. Phylogenetic affinities within *A. plumbeus* indicate a complex biogeographic scenario within South Africa and suggest that *A. poecilus* should be

considered a junior synonym of *A. plumbeus* instead of a truly valid species.

Keywords: Acontinae, clade, morphometrics, phylogeny, species

AMPHIBIAN CHYTRID FUNGUS (*BATRACHOCHYTRIUM DENDROBATIDIS*) LINEAGES DISPLAY SIGNS OF COMPETITION

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Abstract - Risk modelling predicted a high likelihood of occurrence in the Orange River for *Batrachochytrium dendrobatidis* (Bd), a pathogen causing chytridiomycosis in amphibian populations. During field surveys conducted between 2015 and 2017 it was confirmed that *B. dendrobatidis* is indeed widely prevalent within the river. Significantly, two distinct genotypes - the Global Panzootic Lineage (BdGPL) and the African lineage (BdCAPE) - were found to be present in certain sections of the river. We wanted to test the transmission and disease outcomes of multiple pathogen lineage co-occurrence on a local amphibian species. The experimental design included treatments that tested the transmission capability of both lineages to an animal without any prior Bd infections. Another treatment also tested the ability of each lineage to infect a host with an established Bd infection of the other lineage. *Sclerophrys gutturalis* was used as model animal to test South African Bd lineages on a South African host. This would allow us to determine individual fitness and competition of lineages in relation to infected and naïve hosts.

Infection intensity for both lineages was significantly lower in naïve animals, as opposed to the carrier animals ($p<0.0001$) after the period of co-housing. When exposed to one lineage at a time, 64.7% of the naïve animals got infected with BdGPL, while 85% were infected with BdCAPE. When lineages faced competition, all infected animals retained their initial Bd lineage. However, three BdCAPE individuals gained an additional infection of BdGPL. There was no significant difference in infection intensity between these three individuals and the rest of the animals. None of the BdGPL animals gained an infection with BdCAPE. These findings corroborated our field observations that co-infection with more than one lineage of *B. dendrobatidis* is possible. In addition, BdGPL appears to be the more dominant lineage, which could

explain its wider distribution in South Africa.

Keywords: *Batrachochytrium dendrobatidis*, Chytridiomycosis, pathogen transmission

XENOPUS LAEVIS PROGENY DISPLAY LOCAL ADAPTATION OF PHYSIOLOGICAL PERFORMANCE TO ENVIRONMENTAL EXTREMES

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Abstract - Altitudinal variation of environmental temperatures is expected to shape the evolution of physiological functions of widespread populations. Adaptation to thermal extremes can create altitudinal differentiation in ectotherm physiological performance. In this study, a common garden experimental approach was employed to determine whether thermal adaptations to contrasting environmental regimes are heritable and how these thermal adaptations affect performance. To address this, we compared the critical thermal limits and swimming performance of African Clawed Frog (*Xenopus laevis*) tadpoles bred from two adult populations captured from high (~ 2000 m above sea level) and low (~ 5 m above sea level) altitudinal extremes. Parental-origin significantly affected tadpoles' critical thermal minima (CTmin), maximum velocity, maximum acceleration, total distance and distance travelled in the first 200 m.s-1. Tadpoles with low-altitude parental-origins had a higher optimal temperature (Topt) for swimming performance and CTmin than tadpoles with high-altitude parental-origins. Performance of tadpoles bred from high-altitude adults was significantly higher at cooler temperatures and lower at the highest test temperature, in comparison with tadpoles bred from low-altitude adults. These results suggest that thermal performance curves of *X. laevis* tadpoles have adapted in response to contrasting local environmental conditions experienced by adults. Future studies should focus on whether similar thermal performance trait variations are present in other populations of the widely distributed African Clawed Frogs (*X. laevis*).

Keywords: locomotor performance, thermal adaptation, thermal performance curve, thermal tolerance, *Xenopus laevis*

SHEDDING LIGHT ON TIME TO POSTNATAL ECDYSIS

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Abstract - Many snakes are visually cryptic which is vitally important for predator avoidance. Miller et al. (2015) demonstrated that Puff Adders (*Bitis arietans*) are also chemically cryptic and that macrosmatic predators are unable to detect them by smell. However, these predators can easily detect the odour of Puff Adder shed skin and newborns before postnatal ecdysis (PNE; Miller unpubl. data). Unlike most other snakes that shed after more than a week from birth or hatching, neonate Puff Adders shed within hours of birth resulting in a dramatic drop in detectability via olfactory cues, suggesting that reduction in time to PNE may be under strong selection from predation. It is also conceivable that early PNE is present in other species of snakes, especially those that may be scentless or rely on crypsis for predator avoidance. We tested the hypotheses that time to PNE is related to life histories traits, and that early PNE is apomorphic. Our analyses support these hypotheses: multiple linear regression and ANOVA revealed that time to PNE is significantly related to reproductive mode, parental care, and subfamily, and is indirectly affected by camouflage and biogeography. Ancestral state reconstruction also supports our contention that early PNE has arisen from standard PNE and is thus likely to be an antipredation adaptation. Our study suggests that time to PNE is dependent on several life history attributes in snakes and that early PNE may indicate chemical crypsis in snakes.

Keywords: ancestral reconstruction, crypsis, ecdysis, life history

CONSERVATION AND REHABILITATION OF A FRESHWATER MOUNTAIN ECOSYSTEM: USING A HIGHLY SENSITIVE AMPHIBIAN AS A PROXY FOR CHANGE

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Abstract - Amphibians are presumed to be heavily affected by human activities and habitat transformation is causing declines in an estimated 40% of species globally. In South Africa, the proportion of amphibian species of conservation concern has increased by over 12% in the last decade, largely due to habitat transformation and degradation. The Table Mountain Ghost Frog (*Heleophryne rosei*) is a Critically Endangered amphibian restricted to just six perennial streams on Table Mountain, Cape Town, South Africa. The species has a naturally small distribution (7.87 km^2), and is entirely within Table Mountain National Park and the Kirstenbosch National Botanical Gardens estate. Despite its distribution fully occurring within a Protected Area, the recent National Biodiversity Assessment classifies the species as "Not Protected". It has disappeared from two streams that have been directly impacted by alien vegetation encroachment and habitat degradation due to heavy foot traffic from popular hiking paths. Ghost frogs are extremely well adapted to the unique freshwater ecosystems found in the Afromontane forested gorges and valleys of Table Mountain, and act as early indicators of environmental change within the ecosystem. Their disappearance from several streams emphasizes the impact that human activity has had on ecosystem function and integrity. Through a new project, we make use of Visible Implant Elastomer (VIE) markers and detailed presence/absence monitoring data within an occupancy modelling framework to understand the species habitat requirements, as well as acoustic data to estimate population size. Gaining insights into the species habitat requirements is crucial to accurately address the impacts they face and rehabilitate their habitat, safeguarding not only the species, but the broader freshwater ecosystem, into the future.

Keywords: amphibians, conservation, habitat transformation

AMPHIBIAN CHYTRID FUNGUS IN AFRICA - REALIGNING HYPOTHESES AND THE RESEARCH PARADIGM

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Abstract - Based on its phylogeny and genetic diversity, the amphibian chytrid fungal pathogen (*Batrachochytrium dendrobatidis*), appears to have recently originated from Asia. This discovery challenges some of the working hypotheses about *B. dendrobatidis* and its likely conservation impacts. One new perspective, for example, is that this widespread and destructive pathogenic chytrid fungus has been recently introduced to the African continent. Not much evidence on diseases related adverse amphibian population trends in Africa is available. A notable exception is the Kihansi Spray Toad (*Nectophrynoides asperginis*) that was driven to extinction in the wild in Tanzania. More recently, however, the presence of *B. dendrobatidis* has been found to correlate with amphibian declines elsewhere in Cameroon, with puddle frogs (*Phrynobatrachus* spp.), long-fingered frogs (*Cardioglossa* spp.) and small-tongue toads (*Werneria* spp.) being particularly affected. Conversely, the cause(s) of enigmatic declines of the Western Cape endemic Rose's Mountain Toad (*Capensibufo rosei*), remain(s) unknown, but *Bd* is known to cause amphibian population declines and extinctions in the absence of notable mortality events. Given the recent discovery that *Bd* is an introduced pathogen to Africa, the population monitoring of a wide range of African amphibian species in concert with contemporaneous *B. dendrobatidis* surveillance is urgently required. Assessing the distribution of chytrid lineages across the rest of Africa should receive priority for better understanding the evolutionary history of the African *Bd*CAPE and other strains, and to determine possible routes of spread. Amphibian and wildlife disease biologists in Africa should shift their research paradigm from assuming *Bd*GPL is indigenous to the continent, to the latest phylogenetically driven hypothesis that it is an introduced pathogen that may invade naïve host populations as it expands its distribution into new regions.

Keywords: amphibian disease, genotyping, host responses, introduced pathogen, lineage

UNRAVELLING THE DIVERSIFICATION AND SYSTEMATIC PUZZLE OF THE HIGHLY POLYMORPHIC *PSAMMOBATES TENTORIUS* (BELL, 1828) COMPLEX (REPTILIA: TESTUDINIDAE) THROUGH PHYLOGENETIC ANALYSES AND SPECIES DELIMITATION APPROACHES

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Abstract - The high level of phenotypic diversity in southern African tent tortoises (*Psammobates tentorius* complex) has for decades prevented systematists from developing a stable taxonomy for the group. Here we used a comprehensive DNA sequence dataset (mtDNA: Cytb, ND4, ND4 adjacent tRNA-His and tRNA-Ser, 12S, 16S; and nDNA: PRLR gene) of 455 specimens, and the latest phylogenetic and species delimitation analytical procedures, to unravel the long-standing *P. tentorius* complex systematic puzzle. Our results for mtDNA and nDNA were incongruent, with the poorly-supported nDNA phylogeny differentiating the three recognised subspecies, and showing potential hybridisation in some regions. In contrast, the concatenated mtDNA phylogeny identified seven operational taxonomic units, with strong support. Clades 1, 4, 5 and 7 corresponded to tortoises identified as *P. t. tentorius*, clade 3 to *P. t. trimeni*, and clades 2 and 6 to *P. t. verroxii*. Our analyses showed conflicting topologies for the placement of C6 (*P. t. verroxii* north of the Orange River), with stronger support for it being sister to C2+C3 than to the other clades. Clades 1, 2 and 6 had significantly higher genetic diversity than clades 3, 4, 5 and 7, perhaps because these clades inhabit substantially larger areas. The potential for future cladogenic radiations seems high in C1 and C6, particularly in C6 for which the within-clade diversification level was highest. Further research involving microsatellite DNA, phylogeographic evaluations, and morphological variation among clades, is crucial for understanding the adaptive radiation of the P. tentorius complex and for modifying their taxonomy.

Keywords: mtDNA, phylogeny, reptile, southern Africa, tent tortoise

HERPETOLOGICAL ASSOCIATION OF AFRICA

14TH CONFERENCE

CAPE ST FRANCIS, SOUTH AFRICA

MINI ORAL PRESENTATIONS

(bold names indicate presenter, asterix indicates student talk)

SNAKES IN THE CITY: A STUDY OF MOLE SNAKE (*PSEUDASPIS CANA*) POPULATIONS IN THE GREATER CAPE TOWN AREA

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Abstract - Snakes are highly adaptable organisms and several species have become attuned to life in altered and sub-urban habitats. However, despite their adaptability, the urban landscape still poses numerous challenges to snakes. Urban features such as roads, human activity and domestic pets, serve as barriers to gene flow, alter activity patterns in snakes (diurnal to nocturnal) and contribute to their mortality. Additionally, snake rescue and translocation, by volunteer-based welfare organisations, affects predator-prey interactions at both rescue and recipient sites. Mole Snake (*Pseudaspis cana*) presence in the greater Cape Town area pre-dates human settlement. Despite the rapid, historical and ongoing, development of the area, Mole Snake populations continue to thrive across the sub-urban landscape. Although Mole Snakes are a locally abundant and familiar species, gaps in our understanding of their ecology, and particularly their urban ecology, still exist. This study will provide an ecological study of Mole Snake populations, across the greater Cape Town area, using mark-recapture techniques, occupancy modelling, and the examination of museum specimens. Specifically, this study aims to: (a) map Mole Snake distribution and estimate Mole Snake occupancy at ± 30 sites, across the greater Cape Town area, stratified by land-use, degree of transformation, and level of fragmentation; (b) determine the

environmental variables that influence Mole Snake occupancy and detectability across sites; (c) provide estimates of Mole Snake population size across sites; and (d) estimate growth rate and fecundity of Mole Snakes, using museum specimens, across the greater Cape Town area. This study is important as it will further our understanding of Mole Snake ecology, serve as a model for other large bodied snakes that operate within the urban environment, and better inform management strategies to minimize human-snake conflicts and maximize the benefit gained from the ecological services that snakes provide.

Keywords: distribution, occupancy modelling, snake ecology, urban development, urban ecology

RUNNERS AND FIGHTERS: CLUTCH EFFECTS AND BODY SIZE DRIVE INNATE ANTIPREDATOR BEHAVIOUR IN HATCHLING LIZARDS

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Abstract - Innate antipredator responses are integral for survival in many species, particularly those which lack parental care. Antipredator responses include both active (fight or flight) and passive behaviours (immobility). As the success of antipredator responses directly relates to survival and fitness, investigating the drivers that explain variance in these traits is key to understanding how predation shapes the instinctive behaviour of animals. We quantified innate antipredator behaviour of hatchling Australian Water Dragons (*Intellagama lesueurii*) immediately after hatching using a model snake to simulate a series of attacks, and scored their behaviour using a fight or flight index. Then we explored which factors were related to dragon antipredator behaviour, such as habitat disturbance, origin population, morphology, and parental genetic effects and phenotype (clutch effects). We developed multiple hypotheses and used model selection to determine which factors drive variation in hatchling antipredator behaviour. Clutch effects explained a significant proportion of variation in innate antipredator responses, suggesting a heritable component. We also found an effect of body size on innate antipredator behaviour: larger hatchlings were more prone to flight behaviour (e.g. short-distance runs and long-distance sprinting), while

smaller individuals were more prone to standing their ground and being aggressive (e.g. throat puffing, mouth gaping, biting). Clutch effects also explained a significant proportion of the variance in dragon body size. Our study provides evidence that the innate antipredator responses of water dragons are heritable in origin (directly through clutch effects, and indirectly through body size) and not associated with particular populations or habitat types.

Keywords: agamids, behavioural ecology, clutch effects, fight or flight, *Intellagama lesueurii*

THE INFLUENCE OF ECOMORPHOLOGY ON TADPOLE SUSCEPTIBILITY TO CHYTRIDIOMYCOSIS

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Abstract - An often overlooked factor that might influence disease susceptibility, or at the risk of becoming infected with amphibian chytrid fungus (Bd) is habitat utilisation. If we assume that certain habitats will facilitate persistence of Bd, then the species that occupy those habitats have a corresponding risk of becoming infected. Amphibian larvae species are adapted to different habitat within the aquatic environment depending on their mode of feeding. In turn their mode of feeding is determined by their particular morphology. The relationship between an organism's morphology and its ecological drivers is defined as ecomporhology. We investigated the drivers behind the relationship between an amphibian pathogen and the trophic assemblage of a complex amphibian community in the Brits district of the North-West Province. We targeted a total of 20 samples per species at three localities, and environmental diatoms were also sampled. All procedures on tadpoles, including oral swabs, digestive system dissection, and excision of mouthparts took place post-mortem. Samples were analyzed for Bd infection and diatom assemblage (from tadpole digestive system). All of the guilds involved in this study occurs within site one. This includes the lentic-nectotic guild (*Kassina senegalensis*), the bentic-profundal guild (*Ptychadena mossambica*), the suspension-feeder guild (*Phrynomantis bifasciatus*), the rheophillic guild (*Amietia delalandii*) and the lentophytophillic guild (*Phrynobatrachus natalensis*). The most prominent diatoms found in site one includes diatoms from the genera

Microcostasis, Hantzschia, Stauroneis, Nitzschia and *Eunotia. Nitzschia* and *Eunotia* is commonly present in acidic to alkaline water, oligotrophic to eutrophic of nature. Data analyses are ongoing and includes correlations for binominal data (presence/absence) to determine how strong the groups (tadpole guilds) correlate, and their significance (e.g. how and if morphological features related to ecomorphological guild influences susceptibility to chytrid). We will also determine if certain diatoms are associated with certain ecomorphological guilds.

Keywords: Batrachochytrium dendrobatidis, diatoms, ecomorphological guilds, infectious diseases, tadpoles

WILLIAM ROY BRANCH: A LIFETIME CONTRIBUTION TO PORT ELIZABETH MUSEUM HERPETOLOGY

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Abstract - The Port Elizabeth Museum was established in 1856 and is one of the oldest in South Africa. In 1906, Fredrick William FitzSimons was appointed as director of the museum. He actively started research on snake venom while establishing a research collection, but after his retirement, research at the museum only continued in dribs and drabs. It was only with the appointment of William Roy Branch (or simply Bill to those who knew him) in 1979 that research in the herpetology department was revitalised, and the herpetology collection upgraded. Bill actively grew the collection, initially only doing fieldwork in the old Cape Province, and subsequently crossing the border when apartheid sanctions were dropped. In his tenure as Curator of Herpetology (1978-2011), he built up the collection to the level of second largest in South Africa, with significant international importance. This short presentation is to introduce you to the man behind Port Elizabeth Museum Herpetology as we know it, elaborating on his invaluable contributions to the museum.

Keywords: Bill Branch, collection, herpetology, museum, tribute

HIDING IN THE BUSHES FOR 110 YEARS: REDISCOVERY OF AN ICONIC ANGOLAN GECKO (*AFROGECKO ANSORGII* BOULENGER, 1907, SAURIA: GEKKONIDAE)

Werner Conradie[a,b], Pedro Vaz Pinto[c,d], Shelley Edwards[e], Chad Keates[e], William. R. Branch[a f]

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Abstract - Boulenger (1907) described a new gecko '*Phyllodactylus*' *ansorgii* based on two adult females from 'Maconjo, Benguella, Angola', but subsequent taxonomic reviews of leaf-toed geckos ascribed southern African lineages to new genera and this species has since been tentatively placed under *'Afrogecko'*. For over 110 years the type locality remained a mystery, and the gecko became a lost icon of Angolan herpetology. Early searches for the gecko were confounded by misinterpretation of the type locality 'Maconjo', which it is now evident was confused with a toponym that is a well-known historical locality. Following the discovery of new material in coastal Benguela, an examination of historical documents and cartographic material allowed the original collecting area for the type material to be identified. Specific surveys in this area resulted in the collection of topotypic material and the recording of behavioral observations and notes on the ecology of the species. *Afrogecko ansorgii* is a slender, gracile and arboreal gecko that inhabits small bushy trees, particularly Blackthorn (*Senegalia mellifera* subsp*. detinens*), in the arid coastal scrubland of the Benguela coastal region. All *A. ansorgii* have been found in or nearby Blackthorn in which the activity of termites (Kalotermitidae) has created hollow stems in which the geckos shelter. The type locality for *Phyllodactylus* (= *Afrogecko*) *ansorgii* Boulenger, 1907 and *Mabuia* (= *Trachylepis*) l*aevis* Boulenger, 1907, both described at the same time from 'Maconjo, Benguella' is accordingly restricted. We will briefly elude to the phylogenetic placement of this iconic little gecko.

Keywords: Angola, Gekkonidae, Reptilia, topotypic, Maconjo

MORPHOLOGICAL VARIATION AMONG VARIOUS CHYTRID LINEAGES FOUND IN SOUTH AFRICA

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Abstract - The chytrid fungus *Batrachochytrium dendrobatidis* is one of the leading causes of amphibian population declines and species extinctions around the world and continues to expand in distribution to this day. A global, hypervirulent, panzootic lineage of Bd, namely BdGPL occurs throughout amphibian inhabited continents. Sequencing of South African isolates has indicated the existence of an African lineage (BdCAPE) as well as a hybrid lineage. Even though the virulence of both BdGPL and BdCAPE is known, the selecting pressures that are affecting the virulence of the various strains, are yet to be determined. We assessed whether morphological differences exist among two known and one hybrid lineage of *B. dendrobatidis* namely BdCAPE, BdGPL and BdHybridSA as a possible predictor of virulence. Spectrophotometer analyses indicated that the hybrid isolate, as well as one of the BdGPL isolates grow significantly faster than any of the other isolates. Interestingly, the hybrid isolated in Brazil displays higher virulence than the local BdGPL isolate. Determining virulence of the South African hybrid isolate should therefore be prioritized to determine its threat to local amphibians. Although variation in zoospore density and sporangium size exists among South African isolates, there is no correlation with virulence. Preliminary data indicate that energy metabolism may be a vital attribute of virulence.

Keywords: Batrachochytrium dendrobatidis, morphological differences, metabolism, virulence

GRASSLAND AND SAVANNA FOSSORIAL HERPETOFAUNAL DENSITIES

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Abstract - Ecological data on soil living amphibians and reptiles are largely lacking. Specialised methods relying on substrate excavation are required to adequately quantify fossorial herpetofaunal densities as surveying techniques which rely on surface movement (e.g. pitfall or funnel trap surveys) are biased against soil-living species which infrequently move over the soil surface. As part of a larger study, we quantified baseline densities for fossorial herpetofauna in grassland at Sileza Nature Reserve and in savanna at Tembe Elephant Park. All sites were underlain by aeolian sand. Grassland surveys were conducted at two adjoining sites, one during summer, and one in winter while both savanna sites were only surveyed during winter. Quadrats of 4 m2 (2 m x 2 m) were excavated to a mean depth of 0.25 m (volume of 1 m3) as most species of fossorial herpetofauna are considered to live at shallow soil depths. The excavated substrate was momentarily stored in 20 litre buckets before being sifted through a 2 mm x 2 mm (4 mm2) metal mesh, exposing soil living reptiles and amphibians. Grassland fossorial herpetofaunal densities were marginally lower during winter (0.56 individuals.m-2) compared to the summer (0.67 individuals.m-2) survey. Grassland species richness consisted of a single amphibian, *Breviceps mossambicus*, as well as five reptile species. Although amphibian species richness was considerably lower in grassland compared to reptiles, densities were higher especially during summer. Inter-seasonal demographic variability was observed in the grassland amphibian population with higher numbers of juveniles present during the summer. Herpetofaunal fossorial densities at savanna sites were on average more than four times lower (0.11 and 0.14 individuals.m-2 respectively) compared to grassland. Once again, the only amphibian present was *B. mossambicus*, but in much lower densities (0.01 and 0.02 individuals.m-2). It is hoped that the outcomes of this study will contribute to a better ecological understanding of soil megafauna in grassland and savanna ecosystems.

Keywords: fossorial herpetofauna, grassland, quadrat sampling, savanna

PHYLOGEOGRAPHIC ANALYSIS OF *PSAMMOPHYLAX RHOMBEATUS* (LAMPROPHIIDAE, SERPENTES)

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Abstract - South Africa boasts the highest reptile biodiversity in Africa with over 520 described species. Much taxonomic work is focused on range-restricted taxa because of the perception that these animals yield a higher potential for undescribed genetic diversity. Widely distributed and abundant taxa are thus ignored due to the perception that they are taxonomically well understood. The Spotted Skaapsteker, *Psammophylax rhombeatus*, is a southern African endemic lamprophiid with a very large distribution, and substantial colour variation within and between populations. The aim of this study was to determine whether this species, sampled from across its range, contained hidden genetic divergences enough to warrant taxonomic re-evaluation. The study utilised standard genetic procedures to extract and amplify three mitochondrial (Cyt b, ND4, 16S) and one nuclear (Cmos) gene. Phylogenetic trees were constructed using a Maximum Likelihood (ML) Phylogenetic Reconstruction and a Bayesian Inference (BI) analysis and supported further using bGMYC and distance-based analysis. A haplotype network was constructed for each gene to investigate the smaller scale variation within the different populations. We will discuss the evolutionary history of the taxon in context of our current molecular findings and discuss the way forward in this project, using a holistic multidisciplinary approach to lineage sorting.

Keywords: Grass Snake, molecular biology, Psammophiinae, species delimitation

FROG SKIN MICROBIAL DIVERSITY OF *AMIETIA HYMENOPUS* (PHOFUNG RIVER FROG) ON MOUNT-AUX-SOURCE IN THE DRAKENSBERG MOUNTAIN RANGE

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Abstract - Infectious diseases are pressuring amphibian populations globally and threaten frog species occurring in restricted areas especially. Chytridiomycosis, which is caused by the pathogenic fungus *Batrachochytrium dendrobatidis* (Bd), is arguably the most devastating disease confronting wildlife today and is a major driving force of the current amphibian extinction crisis. A healthy amphibian host and its cutaneous microbial community can have a symbiotic relationship to grant the host protective benefits. Previous studies on frog skin microbiomes only looked at the bacterial component, or at most fungal yeasts, while other components of the microbiome have been neglected such as filamentous fungi. In this study *Amietia hymenopus*, a chytridiomycete disease-challenged frog from southern Africa, was sampled from remote locations of the frog's distribution on the Drakensberg mountain range. Using denaturing gradient gel electrophoresis, skin microbiomes was compared, investigating both the bacterial and fungal components of the frogs' skin microbial community. Results represent an important component of the microbial biodiversity found on this frog, and will aid to shed light on the complex interaction between host and microbial communities in amphibian populations. Knowledge on this intricate relationship between host and cutaneous symbionts could help inform amphibian conservation efforts against infectious disease.

Keywords: chytrid, DGGE, microbiome

STICKY FINGERS: *LYGODACTYLUS CAPENSIS* GETS AROUND SOUTH AFRICA

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Abstract - The Common Dwarf Gecko (*Lygodactylus capensis*) is a widespread species, ranging across most of southern Africa. In South Africa, its native range is in the mesic northeast. The presence of *L. capensis* in areas outside of its native range was noted in the early 1980s in the Free State and Eastern Cape provinces, but since has been recorded in the Western Cape and Northern Cape provinces. Humans are implicated as the agent responsible for the inadvertent translocation of *L. capensis* to areas outside its native range; however, it is unclear whether those populations originate from a single introduction event and subsequent spread or multiple introduction events. Furthermore, the presence of *L. capensis* near the edge of its natural range (e.g. at particular localities within the Free State and Northern Cape provinces) could be due to either human-mediated dispersal or be part of a range expansion. We conducted a phylogenetic assessment of the species using broad geographic sampling to better understand the origins of *L. capensis* across South Africa. The 16S mitochondrial marker was sequenced for 36 individuals from eight sites outside its natural range, and eight sites within its natural range. The two Eastern Cape sites showed two unique 16S haplotypes, and the four Cape Town sites had a total of nine different haplotypes. The nucleotide diversity of the invaded sites and the natural range was similar (approx. 0.01), suggesting that the invaded sites are not the result of single colonisations followed by range expansions. Instead, it appears that there were either multiple invasion events in these areas or multiple different individuals introduced during the same event. There was no significant difference (analysis of molecular variance) between any of the invaded sites and the natural range, although the Cape Town sites were significantly different than the Eastern Cape sites (F_{ST} = 0.19, $p < 0.05$) further supporting a multiple introduction hypothesis. The sites near to the natural range edge showed a haplotype that appears to be common across most of the natural and invaded range, making it impossible to distinguish between an introduction or a natural range expansion. These results provide new information about the invasion history of the Common Dwarf Gecko and points to the fact that

L. capensis introductions into the Western and Eastern Cape are ongoing. This is not surprising given that gekkonids are some of the most successful reptile invaders. To date, very little is known about the impact of these invasive geckos on the native ecology of the invaded sites, but considering their rapid spread and ability to persist in these sites, further studies investigating their potential influence are needed.

Keywords: biological invasions, colonisation, invasive reptiles, jump-dispersal

BIOINFORMATIC APPROACHES TOWARDS UNDERSTANDING PATTERNS OF AMPHIBIAN SKIN MICROBE ACQUISITION, DIVERSITY AND DISEASE SUSCEPTIBILITY

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Abstract - Several studies have been done on the skin microbiome of amphibians over the past 12 years. What has been observed is that the skin microbial communities in certain amphibian populations are host-species specific, thus showing variability in comparison of the microbes over-represented in the environment. In other cases, the microbes that are found on the skin of other species are basically a representation of its environment, with very limited host specificity. With chytrid fungus, *Batrachochytrium dendrobatidis* (bd) it has been observed that infection varies among amphibian species and populations due to temperature, innate defence and host life history traits. In addition, the habitat also plays an important role in the persistence of the chytrid fungus. The focus of this study is to highlight the application of Bioinformatics approaches toward unravelling the wealth of information currently available in the public domain, focusing on the skin microbiome of frogs. Our research focuses on two aspects which include: (i) Implementing deep machine learning approaches in order to understand associations between environmental factors in conjunction with the skin microbiomes, between frogs showing resistance vs susceptibility to bd and (ii) to understand what role the relative abundances of specific microbes play in these two study groups (resistant vs susceptible). The results presented will start to unpack the

value of the available public metadata, in respect to improving complex data analysis, through deep machine learning. In addition we will also report on the development of a tool to evaluate relative abundances of operational taxonomic units (OTU's) between differential experimental datasets.

Keywords: correlation, frog-skin microbiomes, habitat, machine learning

WHAT IS THAT RIVER FROG? A MORPHOLOGICAL APPROACH

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Abstract - Southern African *Amietia* have had a turbulent taxonomic past. Most recently, molecular techniques have prompted the description of *A. poyntoni* and shown surprising spatial integration between *A. fuscigula* and *A. delalandii*. Although *A. poyntoni* is closely allied to *A. delalandii*, no reliable morphological traits were given to distinguish it from the morphologically similar *A. fuscigula*. In this work we attempt to distinguish these three *Amietia* species using a morphological approach, and thus provide suitable morphological traits for field identification as well to identify museum specimens. In addition, we use morphology to identify some 700 specimens across the region to increase the spatial resolution of their distribution ranges. To do this we train a linear discriminant analysis on measured specimens that have sequenced data, and predict the identity for those without. We find that all three species can be separated in morphospace, but that *A. poyntoni* lacks any significant morphological differences from *A. fuscigula*. Our results show the distribution of *A. delalandii* extends along the Orange River, intermixes with *A. fuscigula* in the Garden Route and has an isolated record from the western Cape Fold Mountains, and that *A. fuscigula/poyntoni* extends into the Free State and parts of KwaZulu-Natal provinces. More genetically confirmed material will improve the predictive power of the analysis.

Keywords: Amietia, distribution, identification, morphology, South Africa

STILETTOS FOR BILL

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When Bill started his herpetological career, one of his first interests was stiletto snakes. It was thus more than happy when I discovered a new *Atractaspis* species in Liberia which I could name to honor him. The talk is about the discovery, the snake and Bill.

Keywords: *Atractaspis*, Bill Branch, Lamprophiidae, Liberia

USING FAECAL DNA TO INVESTIGATE THE DIETS OF THE SNAKES *PSAMMOPHIS CRUCIFER* AND *PSAMMOPHYLAX RHOMBEATUS*

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Conventional approaches to studying snake diets rely upon visual identification of prey items obtained either via palpation of meals from live snakes, examination of faecal remains, or from gut contents of preserved specimens. These approaches can be biased, invasive, and often do not depict the full dietary breadth of a species. Molecular approaches provide novel mechanisms for gathering information that allows us to increase our knowledge and understanding of a predator's prey intake. Here, we propose a project that demonstrates the use of molecular analysis of snake faeces to study the diet of *Psammophis crucifer* and *Psammophylax rhombeatus*. We intend to use PCR analysis in conjunction with DNA cloning techniques to identify prey items of known identity from faecal samples of captive snakes thereby testing the hypothesis that molecular techniques can be used to identify, to species level, the remains of prey items in the faeces of these two species of snakes. Should our approach be successful, researchers would be able to sample snake diets at the population level with high intensity, including resampling individual snakes, all in a relatively non-invasive manner.

Keywords: DNA cloning, ecology, faecal analysis, snake feeding

THE EFFECTS OF ANTIFUNGALS ON AMPHIBIAN SKIN CYTOLOGY

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Abstract - There is an increasing need to refine the efficacy of safe treatment methods for the amphibian fungal pathogen, *Batrachochytrium dendrobatidis*. Although some antifungals have been proven to be successful in eliminating *B. dendrobatidis* infection, the effects of these antifungals on amphibian skin cytology remain largely unexplored. We tested the permeability and integrity of *Xenopus laevis* skin for three antifungals; F10Sc, itraconazole and chloramphenicol. The Franz Cell Diffusion method was used to perform a replicated diffusion study at recommended and high concentrations, with exposure times of 15, 30, 45 and 60 minutes. The majority of samples were analysed with high performance liquid chromatography (HPLC), which was used to quantify the active ingredient of antifungals, while another portion was subjected to histopathology. The diffusion results indicated that there are significant differences in skin permeability toward different antifungals as well as a concentration effect. The histopathology provided evidence of the degree of cellular damage inflicted by the different antifungals. Furthermore, the histopathology also indicated correlations between the diffusion results and the degree of cellular damage that was observed in the skin. The method proved useful for studies on amphibian skin, and with some refinements can be suitable for a range of future studies related to skin permeability.

Keywords: antifungals, *Batrachochytrium dendrobatidis*, diffusion, histopathology, skin permeability

FILLING THE GAPS: PRIORITY AREAS FOR HERPETOFAUNAL SURVEYS IN THE NORTHERN CAPE

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Abstract - Effective planning and prioritization of conservation efforts rely on spatially explicit knowledge of species distributions. Species distributions are commonly mapped at specific planning units. In this respect, South Africa's herpetofauna is relatively well-documented and mapped. Despite, being well-documented considerable sampling gaps remain, of which the most notable gaps are present in the arid western regions of South Africa's Northern Cape Province. For this reason, efforts should be made to conduct surveys in the Northern Cape. One of the main challenges with the collection of baseline biodiversity data is that it is often expensive and logistically challenging. Thorough planning is therefore required and should ideally focus on identifying overlapping priority areas for both reptiles and amphibians at quarter degree level to maximise the cost-effectiveness of surveys. Ideally, the selection of quarter degree survey areas should be based on vegetation types, elevation ranges and climate conditions. In this study, we explore the current coverage of herpetofaunal records in the Northern Cape, including new quarter degree records. We used gap analysis to inform causal factors related to sampling bias and highlight priority sampling areas using a spatially explicit approach.

Keywords: conservation, herpetofauna, Northern Cape, priority areas, sampling bias

A ZONE OF GEOGRAPHIC OVERLAP BETWEEN TWO MORPHOLOGICALLY SIMILAR AFRICAN SKINKS

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Abstract - *Trachylepis* is a morphologically conservative, species rich genus of African skinks. Recent genetic analyses within Trachylepis have identified several cryptic lineages as distinct species; however, phenotypic conservatism makes it difficult to rely only on morphology for distinguishing species, especially in the field. In the *T. striata* group, there are a number of species that are commonly misidentified in the field, for example *T. punctatissima* and *T. spilogaster.* Previous phylogenetic work reveals clear genetic divergence between the two species, yet their morphological similarity makes them difficult to distinguish particularly where they are in sympatry, such as in the North West Province, South Africa. Thus, the area of sympatry may either be genuine or the result of misidentification. We examined these alternatives by sequencing individuals from the potential overlap zone and evaluated them within a phylogenetic framework. A preliminary phylogeny using one mitochondrial marker (16S) was constructed using the Bayesian and maximum likelihood methods. There is evidence of a narrow zone of geographic overlap between the two species, although the area of sympatry appears to be smaller than previously thought. Given that the phylogeny showed a number of misidentified individuals in the presumed area of sympatry, the current species distributions are probably overestimated as a result of historical misidentifications. Furthermore, the phylogeny showed that misidentification is a common problem throughout the entire *T. striata* group with a number of other species being misidentified. For *T. punctatissima* and *T. spilogaster*, sympatry exacerbates the likelihood of misidentification and should be considered when the species is studied in the North West Province. Additionally, genetic identification should be used to confirm morphological identification when working on the *T. striata* group because many samples were found to be incorrectly identified.

Keywords: phylogenetics, skink, South Africa, *Trachylepis punctatissima*, *Trachylepis spilogaster*

GHOSTBUSTING: SEQUENCING THE GENOME OF THE TABLE MOUNTAIN GHOST FROG (*HELEOPHRYNE ROSEI*)

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Abstract - The Table Mountain Ghost Frog (*Heleophryne rosei*) is a Critically Endangered species endemic to Table Mountain in Cape Town. It occurs in patchy habitat in an area of only 4 km^2, almost entirely within Table Mountain Nature Reserve. This species is ranked 11th on the list of Evolutionarily Distinct Globally Endangered (EDGE) amphibians. It belongs to the Southern African-endemic family Heleophrynidae, which consists of seven species in two genera. This family is the sister group to all modern frogs (Neobatrachia) and diverged over 150 mya. Previous genetic research using mitochondrial sequences indicated that *H. rosei* may represent a distinct lineage warranting the status of a monotypic genus. However, current genetic tools are insufficient to answer this question due to the great divergence time between this family and other frogs. There are currently only a handful of frog genomes fully sequenced and annotated, with six species' genomes currently available on GenBank. For this study, collaborators at the Garvan Institute in Sydney will sequence and map the genome of *H. rosei*. We will then perform comparative genomic and genome mining analyses on this genome. The genome of this species will represent a valuable comparison point with existing genomes due to the unique placement of the family as sister to modern frogs. This will allow us to investigate key comparative genomic questions such as the evolution of tetrapods, and the development of frog antimicrobial and antifungal proteins. An assembled genome will also allow us to design genetic markers for use in population-level studies for this and related species.

Keywords: comparative genomics, genome sequencing, *Heleophryne,* phylogenetics, molecular marker development

YOU'VE MISSED A SPOT: THE KAROO BIOGAPS PROJECT FROM A HERPETOLOGY PERSPECTIVE

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Abstract - Over 50% of South African reptile species are endemic, with at least 35% of these species found in the semi-arid Karoo region. The research attraction of the Karoo however, has been eclipsed by megadiverse areas within South Arica, resulting in a lack of baseline biodiversity data for the region. Shale gas development (fracking) in the Karoo has been proposed as a benefit for South Africa in terms of economy, job creation and the current energy crisis. However, the potential impacts on biodiversity could be substantial. Without sufficient biodiversity data, decisions relating to infrastructure development will be poorly informed, and monitoring future impacts on species diversity and ecosystem function will not be possible. Here we discuss the outcomes of the Karoo BioGaps Project, with particular interest in the contributions to reptiles in the region. From 2016-2018, 36 sites were surveyed in the Karoo, where over 2,000 new records were collected for 84 reptile species. Our surveys have doubled the number of individual records from the region. At some survey sites, we validated the presence of a large percentage of expected species, but we also found a number of unexpected species at several sites. DNA barcoding was an integral part of the project, and results suggests that some taxa are in need of revision. These findings demonstrate that biodiversity patterns can shift and change given improved survey data. Poor data therefore, can result in poor land use management decisions and emphasis should be placed on improving data in data deficient areas.

Keywords: conservation, collaboration, Reptilia, surveys

A SPATIAL AND TEMPORAL ASSESSMENT OF HUMAN-SNAKE CONFLICTS IN URBAN AND PERI-URBAN AREAS OF WINDHOEK, NAMIBIA

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Abstract - Conflict between snakes and people in urban areas is a problem Windhoek shares with many cities around the world. Surrounded by farm and natural land, the capital city of Namibia experiences regular snake occurrence in and around houses, gardens and industrial sites. We analysed snake removal data from the city's designated snake removal institution, Snakes of Namibia, in order to determine abundance and diversity of snakes occurring in the city during the summer of 2015-2018, and identify possible reasons for conflicts. Between August 2015 and July 2018, 509 snakes of 17 species were removed from homes, gardens and industrial sites in the city. Puff Adder (*Bitis arietans*) which represented 32 % (n = 163) and Zebra Snake (*Naja nigricincta*) 27% (n = 135) dominated removal incidents. Of the other species, Brown House Snake (*Boaedon capensis*) 11% (n = 57) and Boomslang (*Dispholidus typus viridis*) 10 % (n = 52) accounted for 10 % and more of removals. Monthly snake removal frequency correlated highly with monthly total rainfall, air pressure, and moderately with humidity, with highest number of incidents reported in the month of January (18%, n = 92) over three years combined. Incidents were concentrated in the affluent eastern and southern suburbs, possibly as a result of garden irrigation although the study could not measure whether reporting diligence was consistent across all suburbs. Although 76% (n = 388) of snake incidents involved venomous species, no snakebite incidents were reported during the period.

Keywords: human-snake conflict, mitigation, snake bite

ASSESSING THE HABITAT SPECIFICITY OF THE ENDEMIC KNYSNA DWARF CHAMELEON (*BRADYPODION DAMARANUM*)

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Abstract - *Bradypodion damaranum* is a relatively large dwarf chameleon species occurring from George, in the Western Cape Province, to the Tsitsikamma Forest in the Eastern Cape Province. According to the IUCN Red List of Threatened Species, it is listed as Least Concern. There are two main reasons for this: firstly, the Extent of Occurrence (EOO) of this species is large enough to be stable and secondly, their indigenous forest habitat was declining but it is no longer. Suitable habitat for this species, however, remains patchy throughout their range. We know that chameleons are highly adapted to their arboreal lifestyle due to their zygodactylous feet, prehensile tail, and cryptic colouration. There is some contradiction in the literature as to whether this species prefers ferns or trees as their primary vegetation association, and this information could be useful when assessing how much suitable habitat remains within the chameleon's range. We, therefore, aimed to determine if this species is limited to specific habitat or vegetation types, such as certain plant species or vegetation densities. This was done by collecting chameleons at six sites throughout their distribution and recording which plant species they were found on and analysing the surrounding vegetation.

Keywords: Afromontane forests, Chameleonidae, conservation, Garden Route, lizard

SOUTPANSBERG: A HOTSPOT FOR REPTILE DIVERSITY AND ENDEMISM

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Abstract - The Soutpansberg has long been recognised as an important region for reptile diversity, yet very few studies have been conducted in the area. Through fieldwork over several seasons, focusing on various localities throughout the mountain range, supplemented with online databases and literature reviews, we have created the first comprehensive and detailed list of reptiles for the region. We have identified 126 species of reptiles in the Soutpansberg so far (roughly 30 percent of South Africa's total) with elements from all three broad biogeographic zones in South Africa. The data collected will be used to catalogue and map reptiles of the Soutpansberg, providing a deeper understanding of distribution patterns and habitat selection. Following this, we will identify conservation hotspots and drivers of species richness. This information is already being used for conservation planning in the region and could guide further research and create more scientific herpetological interest in this unique reptilian hotspot.

Keywords: conservation, diversity, reptiles, Soutpansberg

(bold names indicate presenter, asterix indicates student poster)

A BRIEF HERPETOLOGICAL ASSESSMENT OF FUTULULU FOREST IN NORTHERN KWA-ZULU NATAL

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Abstract - The Futululu forest is an area of indigenous forest located just outside iSimangaliso Wetland Park, a World Heritage Site in northern Kwa-Zulu Natal, which forms part of the Maputo-Pondoland Biodiversity Hotspot. The World Heritage Site status of iSimangaliso means that it is protected, however, herpetofaunal endemics of the region may be at risk to ever growing sugarcane monoculture and mining industries in areas located outside the boundaries of the park. Given this, during a third year ecology field trip we sought to assess herpetofaunal diversity within the Futululu forest. We carried out herpetological surveys at night over a period of seven nights of active sampling with torches. Organisms were identified morphologically and acoustically (for certain amphibians). We found a total of 17 species (11 amphibians and six reptiles) representing 13 genera. One of the species found, *Hyperolius pickersgilli* is listed as Endangered on the IUCN's Red List of Threatened Species. Our findings indicate that Futululu forest harbours rich herpetofaunal diversity even in the wake of impending industrial and agricultural encroachment in the surrounding area. The finding of multiple, sexually mature (male and female) Pickersgill's Reed Frogs in Futululu forest was particularly promising.

Keywords: biodiversity, Greater St Lucia Wetland Park, herpetofauna, South Africa

HEAD-START PROGRAM FOR THE CRITICALLY ENDANGERED GEOMETRIC TORTOISE (*PSAMMOBATES GEOMETRICUS*)

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Abstract - The range of Geometric Tortoises is restricted to a small region in the southwestern Cape where a few populations still survive in isolated habitat fragments. Apart from habitat destruction and degradation, the species' most severe threat is high mortality due to wildfires, which over recent decades increased in frequency. In January 2012, a wildfire destroyed the largest remaining habitat fragment, and killed most Geometric Tortoises on the nature reserve. Tortoises saved by a subsequent search-and-rescue operation were then used to initiate an in-situ head-start program. The aim of the program is to facilitate survival of hatchlings and juveniles, and ultimately boost the wild population by introducing the head-started sub-adults into the reserve. Captive adult tortoises are housed in two one-hectare camps within natural habitat, surrounded with electrified fences to protect the tortoises against terrestrial predators. The cryptic colour of the tortoises makes them difficult to find; consequently, each adult tortoise was fitted with a radio-transmitter to facilitate regular monitoring, reproductive evaluation of females, and annual health assessments. Female tortoises are examined once per month by ultrasound to identify females with calcified eggs. Those females are placed into one of two nesting camps inside one of the fenced camps, and kept there until the subsequent ultrasound examination showed that the eggs have been laid. At the start of the hatching season, the nesting camps are covered with avian netting to protect the hatchlings from aerial predation, and search daily for new hatchlings. When found, hatchlings are transferred to a large predator-proof nursery, which houses raised boxes, filled with soil and planted with natural vegetation. Up to six hatchlings are housed in a box, where they have ample hiding spaces and receive food and water daily. After two years the juveniles are transferred to predator-proof juvenile tunnels, where they have access to natural vegetation and receive supplementary food and water. The hatchlings and juveniles receive a mixture of natural food plants, collected daily from a variety of species on the reserve, and edible plants grown from commercial seeds. This program had many challenges, which we overcame, and thus offer guidelines for similar head-starting project on threatened tortoises.

Keywords: hatchlings, health assessments, juveniles, telemetry, wildfires

INTEGRATIVE TAXONOMY OF ANGOLAN *ICHNOTROPIS* (SQUAMATA: LACERTIDAE)

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Abstract - *Ichnotropis* is one of the most diverse lacertid genera in sub-Saharan Africa, reaching its maximum richness in Angola, where seven species and subspecies are represented. However, it has been poorly investigated, and there is taxonomic uncertainty with virtually all of these taxa. In the *I. bivittata* complex it is unclear if the subspecies *I. b. pallida* Laurent, 1964 is specifically distinct from the nominotypical form and if *I. micropelidota* Marx, 1956, known only from its type series is a synonym of one of these taxa. In order to clarify these and other issues related to the Angolan taxa, we conducted morphological and morphometric analyses and incorporated new distribution data. *Ichnotropis bivittata* and *I. b. pallida* occur in sympatry in southwestern Angola and, there is significant morphological differentiation between the two, with the former being larger in body size and having more midbody scales. New material of *Ichnotropis* from Mt. Moco, the type locality of I. micropelidota supports the contention that it is a senior synonym of I. b. pallida. Three mitochondrial markers (ND2 and 16S) and one nuclear marker (RAG1) were also used to corroborate our findings. Using a combination of morphological and molecular approaches reveals that the taxonomy of Angolan *Ichnotropis* is in need of revision, just as has been demonstrated in the lacertid genera *Pedioplanis* and *Heliobolus.*

Keywords: Ichnotropis, taxonomy, morphometric, phylogeny, Angola

HAVE LARGE MEALS DRIVEN THE EVOLUTION OF SMALL SCALES IN AMBUSH FORAGING SNAKES?

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Abstract - Foraging mode can have a significant impact on the evolution of morphology, physiology, ecology and behaviour of organisms. In particular, snakes have been obviously shaped by their foraging ecology and are thus usually easily classified as either ambush or active foragers. Ambush-foraging snakes are generalist feeders since infrequent encounters with prey means they cannot afford to be choosy. As a consequence, they have also evolved the capacity to consume a wide range of prey sizes. We hypothesised that since it is the distensible skin between the scales that allows snakes to ingest large meals, an increase in scale number and a concomitant reduction in scale size is an adaptation to ambush foraging as it allows for more stretch. We compared head shield fragmentation and midbody scale row numbers between ambush and active foraging southern African macrostomatan snakes while controlling for the effects of phylogeny. We found that ambush foragers had more head shields and midbody rows compared to active foragers, suggesting that the consumption of large meals has driven the evolution of small scales in ambush foraging snakes. Thus, scale number (and relative scale size) appears to be another trait that has been shaped by foraging mode in snakes.

Keywords: active foragers, foraging syndrome, macrostomatan snakes, scalation, sit-and-wait foragers

100 YEARS OF THE PORT ELIZABETH SNAKE PARK

Varla Fiona King[a]

[a]*Port Elizabeth Musuem (South Africa)*

Abstract - This year the Port Elizabeth Snake Park at Bayworld is celebrating its centenary, having first opened in 1919. This poster will commemorate the history of the oldest Snake Park in Africa through pictures and stories.

Keywords: Bayworld, centenary, snake park

NEW INSIGHTS ON THE GEOGRAPHICAL DISTRIBUTION, ECOLOGY, AND CONSERVATION STATUS OF THE ENDEMIC SALT MARSH GECKO (*CRYPTACTITES PERINGUEYI*)

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Abstract - The Salt Marsh Gecko, *Cryptactites peringueyi* (Boulenger, 1910) is a small endemic leaf-toed gecko known only from two distinct populations in the Eastern Cape Province, South Africa. In the past, this gecko has caused much confusion and was once referred to as "one of the herpetological mysteries of the region". Since then, our knowledge of the species has grown, in both a molecular and geographical sense. However, through recent surveys our understanding of the species on a geographical level has increased considerably, and this is predominately due to new insights into the species ecological preferences. This new data allowed for surveys of both historical localities as well as newly identified sites. Our findings through random sampling techniques resulted in recording the presence of *C. peringueyi* at three of the four historical sites, and five new localities. These new findings resulted in an increase of Extent of Occurrence (EOO) from 785 km2 to 1238 km2. Data from these preliminary surveys already resulted in a downgrade in conservation status from Critically Endangered to Near Threatened in 2018, but with the additional most western record at Eersteriverstrand and the protected locality within Sardinia Bay we further recommend a new listing of Least Concern. The reason being that it occurs over a much wider range, has no substantial threats and also occurs within several protected areas. This will make *C. peringueyi* only the third species in the Class Reptilia globally to undergo a move from the previous listing of Critically Endangered into the Least Concern category; all due to improved knowledge on the species. This data not only illustrates a dramatic change in our knowledge of *C. peringueyi* but also the importance of fully understanding a species ecology in order to address a species conservation status.

Keywords: demography, endemic, Lead-toad Gecko, South Africa

HERPETOLOGICAL SURVEY AT THE UNIVERSITY OF LIMPOPO: PRELIMINARY FINDINGS

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Abstract - Reptiles and amphibians represent a high proportion of biodiversity on a global scale with wide spatial distribution. Herpetological surveys are often performed as part of inventory and monitoring studies. The aim of this study was to evaluate the biodiversity of the herpetofauna at the University of Limpopo. Species were surveyed using standard Y-shape trap array. Habitats sampled included two open patches of grassland and one rocky outcrop. A total of thirteen (13) species of reptiles and amphibians from 36 individuals were reported. These included four individuals of two amphibian species: *Breviceps adspersus* (3) and *Schismaderma carens* (1). Thirty-two (32) individuals distributed in 11 reptile species were sampled: *Trachylepis punctatissima* (9), *Agama aculeata distanti* (2), *Nucras intertexta* (3), *Trachylepis varia* (7), *Nucras lalandi* (1), *Lygodactylus capensis capensis* (1), *Gerrhosaurus flavigularis* (1) *Mochlus sundevallii* (1), *Matobosaurus validus* (2), *Chondrodactylus turneri* (4) and *Philothamnus semivariegatus* (1). *Trachylepis varia and T. punctatissima* were the most abundant species (n ≥ 5), all which accounted 50% of the reported reptile individuals. The diversity of reptiles was greater than amphibians, with H´= 2.06 and H´= 0.56 respectively. The study provided preliminary data of the herpetofauna community parameters (species abundance, richness and diversity). Other survey methods (e.g. coverboards and active searching) are being considered to effectively detect the presence of even the most elusive species.

Keywords: active searching, biodiversity, elusive species, herpetofauna, trap array

RESPECT THY NEIGHBOUR: HUMAN, BLACK MAMBA AND MOZAMBIQUE SPITTING COBRA (*DENDROASPIS POLYLEPIS* AND *NAJA MOSSAMBICA*) INTERACTION IN THE CITY OF DURBAN, KWAZULU-NATAL PROVINCE, SOUTH AFRICA

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Abstract - Anthropogenic land-use change especially urbanisation, generally affects biodiversity negatively. However, some species can persist in urban areas. The Black Mamba (*Dendroaspis polylepis*) and the Mozambique Spitting Cobra (*Naja mossambica*) are two snake species capable of living in urban landscapes. However, this likely leads to increased human-snake conflict. We are investigating aspects of the ecology, behaviour and gene flow patterns of black mambas and spitting cobras in the city of Durban, KwaZulu-Natal Province, South Africa. Since 2016 we have been retrieving, examining and recording both species presence within the city. Geographical location, body length and sex of each snake caught are recorded and tail tips obtained for genetic analyses, before their release. To date tail tips have been collected from 130 Black Mamba and over 70 Mozambique Spitting Cobras from different locations throughout the city (these figures could be different on presenting day as collecting is ongoing). Only three individual Black Mambas have been recaptured. Most times both snake species are found in urban areas close to remnant natural forest. Different types of telemetry technology are being examined to track the movements of individual snakes. This will be a major technological challenge due to the urban setting and the amount of private property, tags must have a long data emitting range and be able to store data so the examination of potential technology is ongoing. Experiences and attitudes of people from all sectors of Durban towards these snakes are been assessed and education awareness conducted to determine if human-snake conflict can be further mitigated.

Keywords: human-snake conflict, snakes, urban

DOES CLIMATE CHANGE INFLUENCE THE PHENOLOGY OF CHAMELEONS? INSIGHTS FROM MADAGASCAR

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Abstract - Published studies on reptile shifts in natural history parameters associated with climate change are few. Those published on chameleons are even rarer. However, as different aspects of these parameters are directly related to climatic variation, they are among the vulnerable groups. Therefore, this study attempted to understand the possible effect of climate change on the life-history traits of chameleons, using *Furcifer labordi* as a biological model. This species is restricted to western and southwestern Madagascar. Its life history is annual and unique with the population mostly represented in the egg stage during austral winter, and the adults having by the shortest lifespan (6-9 months) among tetrapods. Chameleons were sampled in 2013, 2015 and 2017 and temperature and precipitation data were gathered from 2012 to 2018 in Kirindy Forest (CNFEREF), western Madagascar. This forest is characterized by a seasonal and unpredictable climate. The results showed a variation in the hatching time of *F. labordi* over the years. In addition, a significant temperature and precipitation variation was also observed with a delayed rainy season in 2017, coinciding with a delayed hatching time. Eggs hatched at the onset of the rainy season and a shortening period between the first rains and first hatching was observed. Furthermore, growth in this species was positively correlated with temperature. Therefore, climatic variation influenced the life cycle of *Furcifer labordi* with a quick phenological response expressed by a shift in hatching time. However, a shorter/longer embryonic diapause period may affect the hatching rate. Survivors are subject to natural selection and have to adapt to the year-to-year climatic conditions variation. Thus, as an annual species, a complete population could be lost if a single cohort cannot cope with climatic shifts, demonstrating the vulnerability of chameleons to climate change. Nevertheless, further studies are required to assess the long-term effect of climate change on their life-history traits.

Keywords: Furcifer labordi, growth, hatching period, rainfall, temperature

A DECADE OF GENETIC MONITORING REVEALS INCREASED INBREEDING FOR THE *ENDANGERED* WESTERN LEOPARD TOAD, *SCLEROPHRYS PANTHERINA*

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Genetic monitoring is a useful tool for tracking the status and trends of threatened species; and, as such, can be valuable toward their effective management and conservation. Because threatened species are often made up of small, fragmented populations, they are at increased risk of reduced genetic diversity, which can lower their ability to adapt to a changing environment, and hence increase their extinction risk. Within South Africa, specific amphibian species have been targeted for long-term genetic monitoring studies due to their short generation times, their threat status, and the availability of temporally varied tissue samples. One of these species is the *Endangered* Western Leopard Toad (*Sclerophrys pantherina*). This species is endemic to the south-western Western Cape of South Africa and exists as two disjunct populations approximately 100 km apart – the City of Cape Town (CoCT) population and the Overstrand Municipality population. The predominant threats are increased urbanisation and agricultural expansion that modify their habitat and fragment their populations. Using samples collected from roadkills in 2008 and 2018, we looked for changes in genetic diversity in the CoCT population by genotyping 78 individuals across 12 microsatellite loci. Of the seven genetic diversity metrics investigated, one ($F_{IS:}$ inbreeding coefficient) showed significant differences between sampling periods, with 2018 showing increased levels of relatedness (i.e. inbreeding) compared to 2008 ($F_{IS\text{-}2008}$: -0.039; $F_{IS\text{-}2018}$: 0.124). A trend toward higher levels of inbreeding over time might be expected for populations in demographic decline, whereby population sizes are decreasing. Indeed, the Western Leopard Toad is thought to be heavily impacted through roadkills, and this could cause a population decline. These results will form the baseline for future monitoring to better understand the genetic status and trends of diversity within this *Endangered* species.

Keywords: allelic richness, amphibian, Bufonidae, Western Leopard Toad

INVESTIGATING THE HERPETOLOGICAL DIVERSITY OF THE KAROO – A REPORT FROM THE BIOGAPS PROJECT

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The Karoo boasts a wide variety of unique flora and fauna yet the region is still currently poorly surveyed for biodiversity. This lack of knowledge is true for all taxonomic groups, but none more so than reptiles. For example, only 3.5% of South Africa's reptile records have been obtained from the Karoo despite the region making up more than 30% of the country's total land mass and offering exceptional habitat for many of our reptile species. The Karoo has also been identified as an important development area for South Africa. Large scale international development projects such as shale gas drilling, uranium mining and the Square Kilometre Array, in conjunction with renewable energy infrastructure and continued farming will require responsible and informed planning. Here we present a detailed account of the herpetological surveys conducted by SANBI as part of the Karoo Biogaps Project made possible by a grant from the Foundational Biodiversity Information Programme (FBIP), and offer preliminary investigations into the herpetological diversity of this unique region.

Keywords: diversity, herpetology, Karoo, occurrence data

AHN INSTRUCTIONS TO AUTHORS

AFRICAN HERP NEWS

publishes manuscripts in four categories, namely Articles, Herpetological Surveys, Natural History Notes, and Geographical Distributions.

CONTRIBUTIONS SUBMITTED IN AN INCORRECT STYLE (SEE GUIDELINES BELOW) WILL BE RETURNED TO THE AUTHORS

The type of submission (e.g., Article, Natural History Note, Geographical Distributions) should be clearly indicated in the file name. As a general note, always use the latest available issue of AHN for instructions.

All submissions should be typewritten in English (UK spelling), set in 10 pt Calibri. Words should not be divided at the right-hand margin. Use the active voice in the first person where possible (except for submissions for *Tomorrow's Herpetologists Today*). Formatting should be achieved with paragraph settings rather than tabs or spaces. Authors should consult the *Council of Biology Editors Style Manual,* 5th edition (1994) for style and abbreviations. Sentences should be separated by a single space (character). Genus and species names must be italicised. Centre major headings in small caps. Subheadings are in bold and left justified (*also in title case*). Footnotes are not accepted. The International System of Units (Systeme Internationale; SI) should be followed. Use decimal points rather than commas. Measures should be in mm, m or km rather than cm or dm. Integers less than 10 should be spelled, while those greater than 10 (including 10) should be given numerically. Group integers of thousands together with a space and do not use a comma (e.g. 10 500 and 1 230). All statistical symbols should be italicised. Follow the Fourth Edition (1999) of the International Code of Zoological Nomenclature. Every word in English common names should start with a capital letter (e.g., Namaqua Dwarf Adder). Appendices, Material Examined, Tables, legends to Figures, and Figures must follow the References.

ARTICLES

African Herp News publishes longer contributions of general interest that would not be presented as either Natural History Notes or Geographical Distributions. A standard format is to be used, as follows:

TITLE (bold, centred, upper case);

AUTHOR(S) (initials and surname, bold, centred)

HEADINGS (bold, centred, upper case)

Subheading 1 (bold, aligned left, lower case except first letter of first word) as required

Subheading 2 (bold, italics, aligned left, lower case except first letter of first word) as required

ACKNOWLEDGEMENTS (bold, centred)

REFERENCES (bold, centred), following the standardised formats described below.

SUBMITTED BY: (bold, aligned left), following the standardised format described below

HERPETOLOGICAL SURVEYS

African Herp News publishes succinctly annotated species lists resulting from local surveys of amphibians and reptiles on the African continent and adjacent regions, including the Arabian Peninsula, Madagascar, and other islands in the Indian Ocean. The area surveyed may be of any size but should be defined as a geographic unit of special relevance to the herpetological community. For example, surveys should address declared or proposed conservation reserves, poorly explored areas, biogeographically important localities or administrative zones. The relevance of survey results should be judged by the extent that these records fill distributional gaps or synthesise current knowledge. As far as possible, survey records should be based on accessible and verifiable evidence (specimens deposited in public collections, photos submitted illustrating diagnostic features, call recordings and sonograms, or DNA sequences accessioned into international databases).

Survey results should be presented in the same format as used for Articles (described above), and must additionally include:

SYSTEMATIC ACCOUNT (bold, aligned left): comprises Scientific name (including author citation), location and habitat, evidence (including registration numbers and location of vouchers), and comments (where required).

NATURAL HISTORY NOTES

Brief notes concerning the biology of the herpetofauna of the African continent and adjacent regions, including the Arabian Peninsula, Madagascar, and other islands in the Indian Ocean. A standard format is to be used, as follows:

FAMILY (bold, centred, uppercase)

Scientific name (bold, italicised, centred)

Author citation (centred)

English Common Name (centred, all words starting with a capital letter)

KEYWORD (bold, centred)

AUTHOR(S) (initials and surname, bold, centred)

[Original text] (left aligned)

ACKNOWLEDGEMENTS (bold, centred), if applicable

REFERENCES (bold, centred), following the standardised formats described below

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The Keyword should be one or two words best describing the topic of the note (e.g., Reproduction, Avian predation, etc.).

The body of the note should include information describing the locality (Country; Province; quarter-degree locus; location; latitude and longitude in D° M' S" format; elevation above sea level), providing the date (day, month, year), naming the collector(s), and stating the place of deposition and museum accession number or describing the fate of the animal.

GEOGRAPHICAL DISTRIBUTIONS

Brief notes of new geographical distributions of amphibians and reptiles on the African continent and adjacent regions, including the Arabian Peninsula, Madagascar, and other islands in the Indian Ocean. Records submitted should be based on specimens deposited in a recognised collection. A standard format is to be used, as follows:

FAMILY (bold, centred, uppercase)

Scientific name (bold, italicised, centred)

Author citation (centred)

English Common Name (centred, all words starting with a capital letter)

AUTHOR(S) (initials and surname, bold, centred)

Original text (left aligned)

ACKNOWLEDGEMENTS (bold, centred), if applicable

REFERENCES (bold, centred), following the standardised formats described below

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English common name (using Bill Branch's Field Guide to Snakes and Other Reptiles of Southern Africa, third edition, 1998, for reptiles; and Du Preez and Carruthers' A Complete Guide to the Frogs of Southern Africa, 2009, for amphibians as far as possible).

The body of the note should include information describing the locality (country; province; quarter-degree locus; location; latitude and longitude in D° M' S" format; elevation above sea level), providing the date (day, month, year), naming the collector(s), and stating the place of deposition and museum accession number, or fate of the animal. The body should also include information on the size, colour and taxonomic characters (e.g., scalation, webbing) used to identify the specimen, as well as the distance to the nearest published locality.

HERPS MAKING HEADLINES

This section features the latest research and news relating to African herpetology, with the intent of making the AHN readership more aware of some of the cutting-edge research, discoveries and on-the-ground work being done both locally and abroad on African herps.

A standard format is to be used, as follows:

TITLE (bold, centred, upper case)

AUTHOR(S) (initials and surname, bold, centred)

Original text [left aligned]

Study citation (italics), if applicable

TOMORROW'S HERPETOLOGISTS TODAY

This is a popular style article showcasing the work and/or research of young, upcoming herpetologists across the African continent. Unlike any of the other submissions, this style should be written in the third person. It could feature work already published or ongoing work. Photographs to accompany the article are highly encouraged. These may include

study specimens, study area, and/or researchers.

A general format should be followed:

Author name ([in full], centred, upper case)

TITLE (bold, centred, upper case)

Original text (aligned left)

ACKNOWLEDGMENTS

Acknowledgements should be brief and should not list titles and institutions, but should include the first name and surname in full. Institutions should only be listed where individuals are cited as pers. comm. in the text. Authors must acknowledge collecting permits and animal care protocols together with which author they were granted. Any mention of authors should refer to them by initials only (e.g. GJA for Graham J. Alexander). It is recommended that authors acknowledge reviewers by name if they waive anonymity. This is not a requirement, but would be greatly appreciated.

REFERENCES

Reference formatting is similar to *African Journal of Herpetology*. As of 2019, extensive changes have been made to simplify its appearance. However, as always, references should be listed in alphabetical order and should refer only to publications cited in the text. Abbreviate journal names in the References in the standard way. Standard abbreviations can be found at various web sites such as: www.bioscience.org/atlases/jourabbr/list.htm or home.ncifcrf.gov/research/bja/

References should be in the following format:

African Herp Newsletter: Bates MF, Nuttall R. 2013. Article: A case of death-feigning in the striped grass snake *Psammophylax tritaeniatus* (Gunther), with a review on the occurrence of this phenomenon in southern and eastern African snakes. African Herp News 60: 5–9.

Bates MF, Boshoff D. 2018. Natural History Note: Death-feigning: *Psammophis crucifer*. African Herp News 67: 19.

Broadley DG, Farooq HOM. 2013. Geographical Distributions: *Thelotornis usambaricus* Broadley, 2001. African Herp News 59: 50.

Article: Branch WR. 2007. A new species of tortoise of the genus *Homopus* (Chelonia: Testudinidae) from southern Namibia. Afr. J. Herpetol. 56: 1–21.

Book: Spawls S, Howell K, Drewes R, Ashe J. 2002. A field guide to the reptiles of East Africa. London: Academic Press.

Chapter in a collection: Bruford MW, Hanotte O, Brookweld JFY, Burke T. 1992. Singlelocus and multilocus DNA Fingerprinting. In: Hoezel AR, editor. The South American Herpetofauna: Its Origin, Evolution, and Dispersal. Molecular Genetic Analysis in Conservation. Oxford: IRL Press.

Thesis: Russell AP. 1972. The foot of gekkonid lizards: a study in comparative and functional anatomy. [PhD thesis]. London: University of London.

Website: Wilgenbusch JC, Warren DL, Swofford DL. 2004. AWTY: a system for graphical exploration of MCMC convergence in Bayesian phylogenetic inference. [accessed 15 April 2011]. http://ceb.csit.fsu.edu/awty.

In text citations should be in chronological order: (Jacobs 1952, 1966; Edwards and Holmes 1965; Rosen et al. 1990). When a paper with more than two authors is cited, only the first appears in the text (Taylor et al. 1993). If a paper has more than ten authors, only the first five should appear in the references followed by et al. Cite unpublished data as e.g. Alexander (in press), which then appears in the list of references, or as G. J. Alexander (pers. comm.), in which case Graham J. Alexander's name and institutional affiliation should appear under Acknowledgements. Unpublished reports are cited as personal communications.

AUTHOR AFFILIATIONS

Authors' full names and affiliations should be provided at the end of the submission, as follows:

SUBMITTED BY: [for each author] **AUTHOR'S NAME** (bold, upper case), address or affiliation.

E-mail: example@gmail.com (hard return)

TABLES

Tables should be in Arabic numerals, double spaced and on separate pages with a legend at the top. Lines should only be used to separate headings. Table formatting is most convenient when 'table commands' are used to separate columns. Do not use vertical lines. All tables must be mentioned in the text and numbered consecutively (Arabic numerals).

FIGURES AND PHOTOGRAPHS

Figures must be restricted to the minimum needed to clarify the text. The same data should not be presented in both graph and table form. Photographs and figures should be provided at high resolution (minimum of 600 dpi for colour images). Lower resolutions are not acceptable. Files should be saved and submitted as one of the following file formats: TIFF (Tagged Image File Format; preferred), PostScript or EPS (Encapsulated PostScript). Please submit line art as a scalable vector diagram (EPS). Labelling in figures should be in lower

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