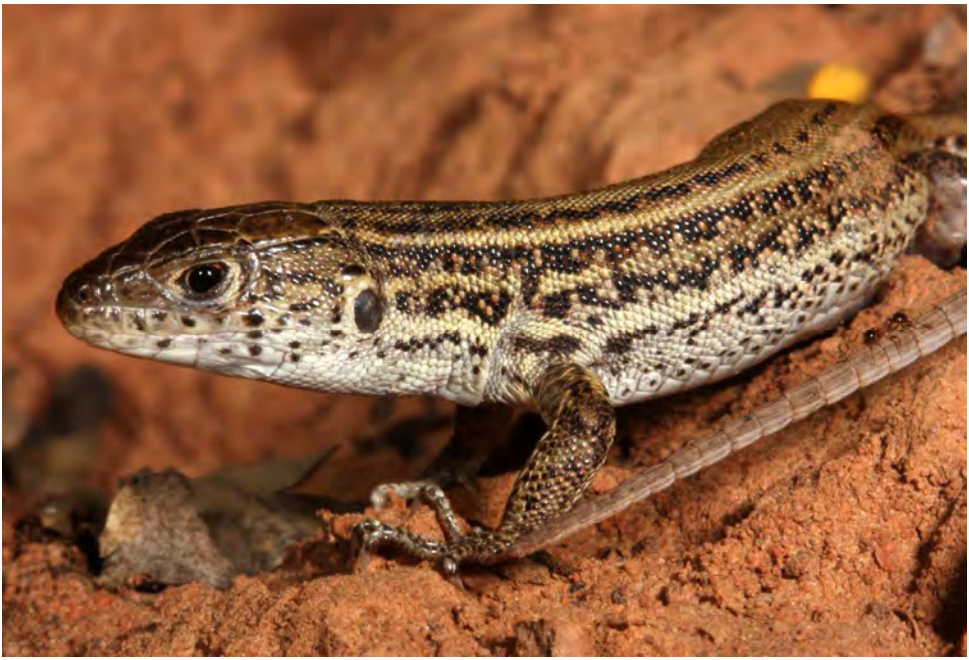
African Herp News

Newsletter of the Herpetological Association of Africa



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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, geographical distribution notes, herpetological survey reports, venom and snakebite 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: *Nucras taeniolata* from Groendal Wilderness Area, Eastern Cape Province, South Africa. Photograph by: Werner Conradie. Canon EOS 450D (1/160, F32, ISO 100).

ARTICLES

TAPPING INTO FROG CONSERVATION: A NEW PROGRAMME FOR THE ENDANGERED WILDLIFE TRUST

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With amphibians now recognised as the most threatened vertebrate group on Earth, with 32% of species Red Listed in threatened categories (IUCN 2012) conservation initiatives are gradually gaining momentum globally. Trends in South Africa follow those on the global scene, with 29% of our frog species listed as Critically Endangered, Endangered or Vulnerable (SA-FROG 2010; Measey 2011). Recognising this, and in an attempt to bridge the gap between research and conservation actions on the ground focussed on threatened South African Frogs, the Endangered Wildlife Trust has recently launched the Threatened Amphibian Programme. The programme aims to address a growing need in South Africa for the involvement of the Non-Governmental sector in frog conservation and fundraising. This will be done by implementing specific conservation actions to address direct threats to amphibian species and protect critical amphibian habitat; supporting relevant research projects focussed on critical knowledge gaps in amphibian conservation; and by raising awareness regarding amphibians in a South African context. The programme has been officially launched by the EWT in September 2012 and was initiated by Jeanne Tarrant, who recently received her PhD on conservation of South Africa's threatened frogs.

The Threatened Amphibian Programme has prioritised two projects on Critically Endangered species. Pickersgill's Reed Frog, *Hyperolius pickersgilli* (Raw 1982) is endemic to the KwaZulu-Natal coast. It is currently known only from less than 20 localities (Tarrant & Armstrong, in press), only two of which occur in Protected Areas (Umlalazi Nature Reserve and iSimangaliso Wetland Park). The majority of remaining sites face imminent threat and as such require urgent conservation action. A major potential threat includes the proposed development of a new Durban South Port, which could eliminate one of the known populations of this species. It is estimated that less than 1% of this species' range falls within protected areas, and this does not represent a viable population size for the long-term survival of this species (Armstrong 2001). As such, protection of the species at the remaining unprotected sites is critical. Some initial funding for this project has been received from Columbus Zoo and Aquarium, Ohio. Specific conservation actions for Pickergsill's Reed frog include:

- Development of a Biodiversity Management Plan for Species.

- Securing unprotected sites, through Biodiversity Stewardship agreements, where appropriate, land acquisition.
- Setting up a long-term monitoring programmes and population estimates.
- Assistance with developing the *ex situ* (captive breeding) programme at Johannesburg Zoo. A captive breeding programme commenced for Pickersgill's Reed Frog in January 2012; the first threatened species for which such a programme is being implemented in South Africa (Visser 2011).
- Habitat restoration/rehabilitation of new habitat for future reintroduction of rescue/captive-bred animals.

The second project is focussed the Critically Endangered Amathole Toad, *Vandijkophrynus amatolicus* (Hewitt 1925), which is restricted to the montane grasslands of the Amatola and Winterberg mountains. Funding for this project has so far been received from the Critical Ecosystem Partnership Fund. The species has proved extremely elusive despite regular surveys in recent years (Conradie & Tarrant 2011). A single female and some tadpoles and eggs were found in September last year; the first sighting in 13 years (Tarrant & Cunningham 2011; W Conradie pers. comm.). As part of this project, in October this year a single male was found in a new locality on Elandsberg near Hogsback (Fig. 1). Despite good conditions, the species was not located in the same site as it was in 2011. Explanations for this rarity are yet to be understood. The species appears to be threatened largely by forestry activity within its range was also recognized as having high priority by Amphibian Ark and was recommended for a full *ex situ* rescue plan. Specific conservation actions for the Amatola Toad include:

- Range surveys and niche modelling of the species to establish distribution and population size.
- Investigating the threats, including possible impact of a Ranavirus infection.
- Establishing a relationship with forestry companies in the range to implement long-term management strategies.
- Providing recommendations to forestry companies for lessening their potential impact on this species, e.g. wetland buffer zones.
- Working with ex-situ facilities to implement a captive breeding programme.

One of the main objectives of the programme is also to raise public awareness about frogs, their importance and conservation needs. As a result, a national awareness day, Save Our Frogs Day, was launched on 1 December 2012. Ten events took place countrywide including talks, outings and various activities for children. For more information on the Threatened Amphibian Programme, please contact the author.

ACKNOWLEDGEMENTS

Michael Cunningham and Adrian Armstrong are thanked for their help in the field. Critical Ecosystem Partnership Fund and Columbus Zoo provided funding. Pers. Comm.: Werner Conradie, Bayworld, Port Elizabeth.

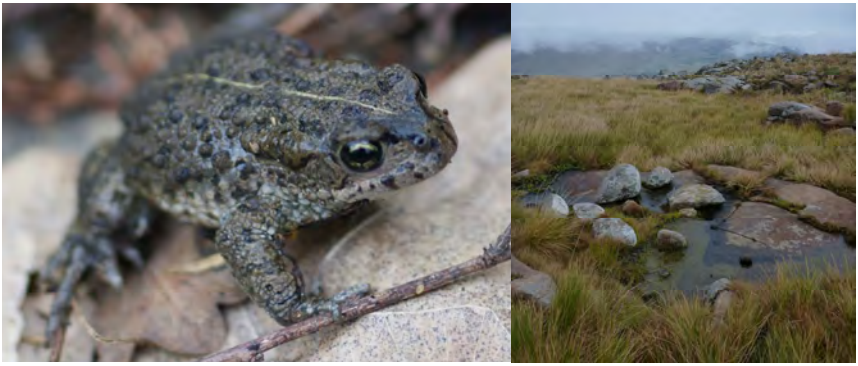

Figure 1: L - Amathole Toad (*V. amatolicus*) male found by M. Cunningham (17/10/2012; Elandsberg) Photo: J. Tarrant. R - Seepage habitat of the Amathole Toad on top of Elandsberg Mountain, October 2012. Photo: M. Cunningham

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BOOK REVIEW

The Amphibians and Reptiles of Ethiopia and Eritrea. By Malcolm Largen and Stephen Spawls. 2010. 693 pp. Chimaira, Frankfurt am Main. (Hard cover). €98. ISBN 978-3-89973-466-9.

This handsome volume (215 x 150 x 45 mm), No 38 of the Frankfurt Contributions to Natural History, provides splendid and long-needed coverage of the rich herpetofauna of Ethiopia and Eritrea, and it is superbly illustrated with 433 'figures' (mostly colour plates). It begins with a very comprehensive chapter on the zoogeography of north-east Africa, and it is pointed out that the vast Ethiopian Plateau accounts for almost 50% of all African land over 2000 m asl, and nearly 80% of all land over 3000 m asl. The plateau is inhabited by a unique assemblage of montane species, while the marginal lowlands show convergence of species characteristic of the East African savannas, the sub-Saharan savanna belt, the North African deserts, and the Somali-arid zone. Most of the original forests have unfortunately been destroyed by thousands of years of exploitive agriculture.

A brief chapter on Conservation reveals that Eritrea has only a single endemic, the blind snake *Letheobia erythraea*, which is known from only two specimens. On the other hand 10 species of Ethiopian amphibians are listed as Endangered or Threatened, while five reptile species are probably likely to qualify as Vulnerable. The importance of the Bale Mountains National Park, established in 1969, is emphasised. It includes extensive tracts of montane grassland, forest and Afro-alpine moorland at altitudes of 1500-4377 m. The following informative sections are entitled 'What are Amphibians and Reptiles', 'Observing and collecting Amphibians and Reptiles', 'Notes on names', and 'Identifying Amphibians and Reptiles.'

The systematic account for the Class Amphibia begins with the only Ethiopian caecilian, *Sylvacaecilia grandisonae*, an endemic. A comprehensive introduction to the Anura is followed by an impressive key to the genera of frogs in Ethiopia and Eritrea. I was surprised to find *Phrynomerus* Noble 1926 used instead of *Phrynomantis* Peters 1867. *Afrana* Dubois 1992 is used for *A. angolensis*, which southern African authors (e.g., Du Preez & Carruthers, 2009) refer to *Amietia* Dubois 1987, while *Amnirana* Dubois 1992 is used for *A. galamensis*, which southern African authors refer to *Hylarana* Rafinesque 1814. The toads are still assigned to *Bufo*, because although Frost et al. (2006) assigned nine Ethiopian species to *Amietophrynus*, and *B. lughensis* to *Poyntonophrynus*, it left *B. pentoni*, *B. dodsoni* and others in limbo. Figs 43 & 44 illustrate *B. garmani*, and the colour pattern certainly differs from that of southern African material presently assigned to that species. The endemic Ethiopian bufonid genera *Spinophrynoides* and *Altiphrynoides* are very distinctive. In the family Hyperoliidae, apart

from the widespread genera *Afrixalus, Hyperolius,* and *Kassina,* and two species of the Ethiopian endemic genus *Paracassina,* the genus *Leptopelis* (with six species) is still included, although southern African authors now assign this genus to the family Arthroleptidae. In the Microhylidae, the authors reject the proposal of Dubois (1989) that *Phrynomerus* be united with *Phrynomantis* of the New Guinea region, and propose the reinstatement of *Phrynomerus* as the only genus in an exclusively African subfamily Phrynomerinae. The family is represented in Ethiopia by *Phrynomerus somalicus* and the endemic genus and species *Balebreviceps hillmani.* The 13 species of *Ptychadena* include at least six endemic species on the Ethiopian Plateau.

In the Class Reptilia, the lizards are still assigned to the Order Sauria, now generally regarded as no more than a suborder of the Order Squamata. The introduction is followed by a useful key to the genera. I noted that the generic name *Mabuya* is retained instead of *Trachylepis, Lygosoma* instead of *Mochlus,* and *Panaspis* instead of *Afroablepharus,* taxonomic changes that have generally been accepted by those working on African taxa.

In the genus *Acanthocercus,* it is considered doubtful whether the smaller Ethiopian agamas are correctly assigned to *A. atricollis,* and the bright blue upper surfaces of the limbs in the male shown in Fig. 144 certainly show a feature not seen in southern African populations. In addition the Ethiopian lizards are not primarily arboreal, being most frequently encountered in open environments. The name *A. minuta* Klausewitz 1957 is available for the populations of Ethiopia and northern Kenya, it was originally described as a subspecies of *A. atricollis.* The *A. atricollis* complex is presently being revised by Philipp Wagner. I was fascinated by the fine illustrations of the incredible spiny-based tails of the two species of *Xenogama,* a genus endemic to northern Somalia and adjacent Ethiopia. It is surprising to find that only nine species of chameleon have been recorded from Ethiopia, but it is possible that the dwindling forests still harbour undescribed species. In contrast, no less than 22 species of *Hemidactylus* are recorded from Ethiopia and Eritrea, of these only *H. platycephalus* extends to southern Africa. It was nice to see a good colour photo of the poorly known Banded Velvet Gecko, *Homopholis fasciata.*

A comprehensive introduction to the Suborder Serpentes is followed by a key to the genera in Ethiopia and Eritrea. Although a new genus, *Myriopholis,* has recently been erected to accommodate the members of the *Leptotyphlops macrorhynchus* group, the peculiar species *L. parkeri* has been assigned to the previously monotypic genus *Rhinoleptus* of West Africa (Adalsteinsson et al., 2009). Only *L. aethiopicus* remains in the genus *Leptotyphlops.*

Figs 286-7 nicely show the brighter colour pattern of *Python sebae* in comparison to the southern African *Python natalensis.*

The recent partitioning of the superfamily Elapoidea by Kelly et al. (2009) into

seven families is not followed here, nor the recent changes with regard to the genera of Lamprophiidae (Kelly et al., 2011). The Colubridae still includes Natricidae and Lamprophiidae as subfamilies, and *Duberria* is included in the latter. The house snakes are well represented (as *Lamprophis*), with *Boaedon abyssinus, B. erlangeri, B. fuliginosus* and *B. maculatus* illustrated, but Fig, 300 (assigned to *L. fuliginosus*) represents one of the 'large-eyed' forms of the *B. capensis* complex. The four species of *Pseudoboodon* are also well illustrated, and I was pleased to see a good colour photo of a live *Lycophidion taylori* (Fig. 311). The local file snake is still assigned to *Mehelya.*

There are good illustrations of the local Egg-eaters, but Fig. 313 (as *D. scabra*) is a *Dasypeltis abyssina* from Mulu, the southernmost locality for this species. Fig. 319, a patterned *D. atra* from Addis Ababa, nicely shows the development of the '*lineolata'* pattern (described as a full species from Kenya by Peters, 1878).

With the restriction of the genus *Coluber* to the New World, six species of *Platyceps* are now recognised in the Horn of Africa (Schätti & Utiger, 2001). The Namibian species can now provisionally be called *P. zebrinus,* but it is anticipated that it will eventually require a new monotypic genus (Schätti, Pers. Comm.). The Prosymnidae are here included in the Colubridae and are represented by *Prosymna meleagris* in the west, *P. ruspolii* in the south, and *P. somalica* in the east. The colour photos by Dietmar Emmrich (Figs 345-6) show the striking difference in colour pattern between juvenile and adult *Scaphiophis raffreyi.*

In the Psammophiidae, *Psammophis lineatus* is still assigned to the synonymised genus *Dromophis*, and is restricted to the far west of Ethiopia, whereas both species of *Hemirhagerrhis* are confined to the south-east.

The Atractaspididae are represented in the Horn of Africa by six species of *Atractaspis,* but otherwise the family has only two local species of *Aparallactus* and two *Micrelaps.*

The Elapidae are represented by *Dendroaspis polylepis, Elapsoidea loveridgei*, and six species of cobra: *Naja haje, Naja melanoleuca,* and four spitting cobras (subgenus *Afronaja*), *N. nigricollis, N. ashei, N. pallida* and *N. nubiae.*

The Viperidae are represented in Ethiopia by three species of *Causus, C. resimus* in the south, *C. maculatus* in the west, and *C. rhombeatus* on the central plateau. The only species of *Bitis* are the ubiquitous *B. arietans,* and the poorly known *B. parviocula* from montane grasslands in southern Ethiopia. The saw-scaled vipers are represented by *Echis pyramidum,* and perhaps a second enigmatic form, *E. megalocephalus* from an island in the Dahlek Archipelago.

Among the Testudines, the Leopard Tortoise *(Stigmochelys pardalis*), and African Spurred Tortoise (*Centrochelys sulcata*) are still assigned to *Geochelone.* It is good to see photos of what is possibly the most 'typical' population of *Kinixys belliana.*

The final sections of the book comprise a Gazetteer, a comprehensive Glossary,

Bibliography, Index, and an alphabetical list of Amphibians and Reptiles of Ethiopia and Eritrea with authors.

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Amphibians of Malawi: An analysis of their richness and community diversity in a changing landscape. By Vincenzo Mercurio. 2011. Chimaira, Frankfurt am Main. 393 pages. Hard Cover. €49.80. ISBN 978-3-89973-495-9.

This handsome volume, No 49 of the Frankfurt Contributions to Natural History, marks a great leap forward when compared with the last book covering this subject, *The Amphibians of Malawi*, by Margaret Stewart (1968). It is profusely illustrated with 384 figures (including colour plates, distribution maps and sonograms). The comprehensive 40 page Introduction covers geography and geology,

climate and vegetation, conservation and protected areas, a history of herpetological research in Malawi, and African amphibians as biological indicators: a short overview.

The materials and methods section covers field methods: opportunistic search and pit-traps (a total of 115 days of field activity and 25 visited sites from 2006-2008), visual encounter survey, description of the seven study areas, laboratory methods: taxonomy and bioacoustics, and data analyses.

The results section (Systematic account) begins with Fig. 50 showing Amphibian diversity of Malawi, with 84 species currently recorded (unfortunately the colour code is difficult to interpret due to the small size of the key icons). This is followed by a key to the genera. The systematic section has been thoroughly researched, and all literature records evaluated. Families, genera and species are all listed in alphabetical order. This section is profusely illustrated with excellent colour photographs by the author, as well as Alan Channing and Colin Tilbury.

Hyperoliidae**:** On the basis of a preliminary molecular analysis (Mercurio & Schick, unpubl.) the *Hyperolius marmoratus/viridiflavus* complex is represented by two species, each with two subspecies, i.e. *H. marmoratus marginatus* and *H. m. taeniatus,* together with *H. v. albofasciatus* and *H. v. nyassae.* It should be noted here that *H. v. albofasciatus* has been recorded from northern Mozambique (Poynton, 1966). Fig. 218, captioned as *H. v. albofasciatus,* is actually a *H. v. nyassae.* No attempt has been made to partition the confused *Hyperolius nasutus* complex.

Phrynobatrachidae**:** The records of *Phrynobatrachus perpalmatus* from southern Malawi seem to be those of Loveridge (1953a, 1953b), which were assigned to *P. acridoides* by Poynton (1964b).

Pyxicephalidae**:** Some frogs from the Mapita and Wilindi forests in the Misuku Mountains at 1800-1900 m elevation are assigned to *Amietia* cf. *fuscigula*, while the status of *A. viridireticulata* Pickersgill of the Nyika Plateau requires further investigation. All Malawian bullfrogs are assigned to *Pyxicephalus adspersus,* with an adult male from Fort Lister (Mulanje Mtn) well illustrated. The frogs formerly called *Strongylopus fuelleborni* are now assigned to *S. merumontanus.*

Section 3.2 is entitled "Diversity of the reproductive mode of the Malawian anurans"**.** Six reproductive modes are recognised:

- Aquatic eggs and free feeding tadpoles in lentic water: e.g. *Amietophrynus, Ptychadena* and *Xenopus,* 72%.
- Eggs in leaves over water, hatching into free feeding tadpoles that drop into lentic water: e.g. *Afrixalus* and *Hyperolius,* 13%.
- Direct development of terrestrial eggs: *Arthroleptis* and *Breviceps,* 8%.
- Terrestrial eggs on ground above water, hatching into free feeding tadpoles which move into water: *Leptopelis* and *Hemisus,* 4%.

- Eggs above water on humid rocks or in rock crevices, hatching into free feeding tadpoles living on rocks in a water film: *Ptychadena broadleyi* and *Nothophryne broadleyi*, 2%.
- Arboreal foam nest hatching into free feeding tadpoles that drop into ponds or streams: *Chiromantis xerampelina*, 1%.

Section 3.3 is entitled "Analysis of communities: species richness and community diversity". The species richness of the anuran communities in Malawi varies between 5 and 45 species, with an average of 16.8 (± 9.0) species (N = 80). Sampling efficiency was analysed by means of species accumulation curves and richness estimates. Community diversity was assessed with regard to evenness, dominance and relative abundance, and similarity among study sites.

Although at least 84 amphibian species in 13 families and 25 genera have been recorded, at the localities surveyed only 17 species were found, and at only four localities (Nyika Plateau, Mangochi, Zomba and Mulanje Mountain) were more than 24 species found, with 32 species recorded from Zomba Mountain and 45 from Mulanje Mountain, the 'hot spots' of amphibian diversity in Malawi. No clear match was found between environmental degradation and amphibian diversity. The presence of temporary water bodies is of crucial importance for the preservation of amphibian diversity.

The final sections of this book are: 5. Abstract, 6. Zusammenfassung, and 7. a very comprehensive Bibliography.

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OBITUARY: VIVIAN JOHN WILSON

Viv Wilson suffered a heart attack and renal failure a few days before his death in Bulawayo on 9th September 2012. He had been in poor health for several months. His passing marks an irreplaceable loss to wildlife conservation in Africa.

Vivian John Wilson was born in Johannesburg on 31 October 1932, and matriculated in Durban in 1949. He worked in the laboratories of African Explosives and Chemical Industries in Umbogintwini, Natal, for four years from 1950, but at weekends caught mambas and other snakes for sale to the FitzSimons Snake Park in Durban, often in association with John Visser. In 1951 he had a bad time after being bitten on both index fingers by a large *Atractaspis bibronii*, leaving him with a permanently stiff right index finger (amputated 25 years later after being mauled by a lion). In 1954 he worked as a game ranger for a few months in the Umfolozi and Ndumu Game reserves, before taking up an appointment with the Department of Game and Tsetse Control in the Eastern Province of Northern Rhodesia, where he completed a thesis on the ecology and behaviour of tsetse flies in relation to wildlife and vegetation for a M.I. Biol. degree.

He first made contact with me in September 1957, when he offered to collect reptiles and amphibians for the National Museums of Southern Rhodesia. Viv also became a founder member of the Herpetological Association of Rhodesia. He collected approximately 1200 snakes between 1954 and 1964, of which over 800 were deposited in the Rhodesian museum. In 1965, his paper 'The Snakes of the Eastern Province of Zambia' was published (Wilson, 1965). Viv also deposited 300 lizards and over 1000 frogs in the museum, the latter were worked on by John Poynton. In 1964 Viv teamed up with Dr Margaret Stewart (State University of New York) to collect herpetological material on the Nyika Plateau, which resulted in the publication of their joint paper 'The herpetofauna of the Nyika Plateau (Malawi and Zambia)' in 1966 (Stewart & Wilson, 1966). Wilson also published an ecological study, 'The Leopard Tortoise *Testudo pardalis babcocki* in Eastern Zambia' (Wilson, 1968).

When Zambia became independent in 1964, Viv moved to Rhodesia, where he joined the Research Branch of the Department of National Parks and Wildlife Management. His research covered eland domestication and the reproductive physiology of game animals. In 1967 he was appointed Curator of Mammals at the National Museum in Bulawayo, where he catalogued the thousands of specimens (with full data, reproductive tracts and parasites) that he had collected in eastern Zambia, and in 1972 he became Director of that museum. His major paper 'The mammals of the Wankie National Park, Rhodesia' was published as Museum Memoir (Wilson, 1975).

With his wife Paddy, Viv established the Chipangali Wildlife Orphanage (Wildlife Trust) in April, 1973, and he resigned from the museum in 1975 to devote

his full time to this organisation. The orphanage became a world-renowned centre for animal care and rehabilitation, wildlife research and especially an educational institute particularly directed at children.

After 15 years of field work in over 20 African countries, Viv published his *magnum opus, The Duikers of Africa* (800 pages) in 2001 (Wilson, 2001). In January 1993 he made an important opportunistic collection of reptiles when an airstrip was extended at the headquarters of the Mole National Park in Ghana. The grader uncovered six species of snake that were new to the Bulawayo collection, in addition to some useful lizards and frogs.

During 2001-2005 V. J. Wilson's associates made large collections of reptiles and amphibians in the Matobo National Park while carrying out a biodiversity survey, and in 2011 we collaborated to publish 'The reptiles and amphibians of the Matobo Hills, Zimbabwe' (Broadley & Wilson 2011). Viv maintained a collection of snakes for educational purposes at his house in Matsheumhlope, Bulawayo, until his death.

V.J. Wilson's List of honours include the United Nations Environmental Award, the Rolex Award for Enterprise, the Zimbabwe Meritorious Medal and Civic Honours (Bulawayo). He was a member of several IUCN Specialist Groups and numerous international wildlife organisations. Viv's son, Kevin Wilson, will continue as Director of the Chipangali Wildlife Orphanage.

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NATURAL HISTORY NOTES

REPTILIA: SQUAMATA

CORDYLIDAE

***Smaug giganteus* (A. Smith, 1844)**
Sungazer

PREDATION

At approximately 10:00 AM on 10th October 2012 an adult Rinkhals (*Hemachatus haemachatus*) was observed eating a neonatal Sungazer (*Smaug giganteus*) on the farm Kommandantspan (S 27^0 52.838 E 26^0 54.889, altitude 1411 masl) in the Welkom district of the Free State province, South Africa. The Rinkhals was situated approximately 150 mm down the Sungazer burrow, and attacked the Sungazer as it retreated into the burrow. The predation event as witnessed appeared to be an ambush from within the burrow, however it may have been opportunistic as Rinkhals are known to shelter in empty Sungazer burrows (Van Wyk, 1992). The predation was confirmed by capturing and palpating the snake. The Sungazer was approximately 130 mm long and was likely less than three months old. Rinkhals are unlikely to consume juvenile or adult Sungazers due to the large sharp caudal spines that are used to deter predators when in the burrow. The spines of neonate Sungazers are not yet ossified and would probably not cause internal damage to the snake if consumed.

Various authors (Jacobsen *et al.*, 1990; Groenewald, 1992) have inferred predation of Sungazers by Rinkhals and other predators including Secretary Birds (*Sagittarius serpentarius*), Black-headed Herons (*Ardea melanocephala*), and Yellow Mongoose (*Cynictis penicillata*). However, recent comprehensive summaries of mammal (Skinner & Chimimba, 2005) and avian (Hockey et al., 2007) diets lack any direct evidence of these predations. Additionally, Shine et al. (2007) dissected 237 Rinkhals and found only fewer than 5 % of feeding records were attributable to lizards, and none of those were of predation on *Smaug giganteus.* This is therefore the first recorded instance of predation of Sungazers by Rinkhals.

ACKNOWLEDGMENTS

I thank Graham Alexander for assisting with palpating the snake and Bryan Maritz for assisting with the preparation of the manuscript.

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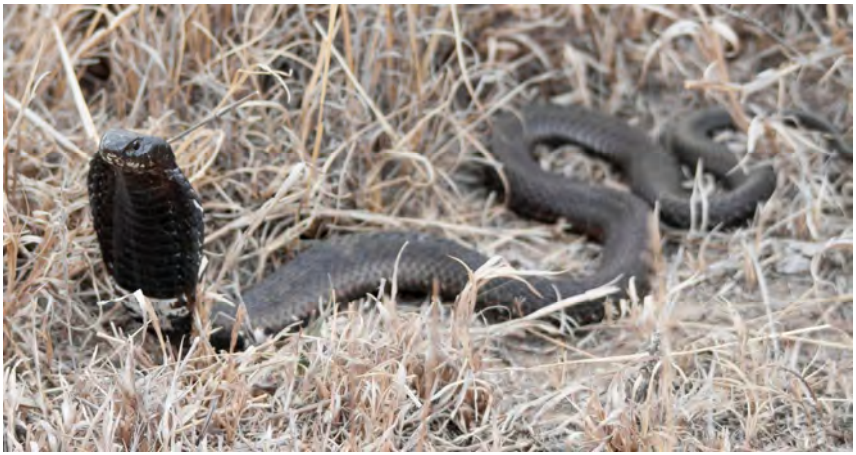

***Hemachatus haemachatus* from Welkom District, Free State Province, South Africa. Photograph b y: Shivan Parusnath. Canon EOS 500D (1/200, F5, ISO 125)**

VARANIDAE

Varanus albigularis **(Daudin, 1802)**
Rock Monitor

DIET

On 11 November 2012 a road-kill *Varanus albigularis* was encountered 20 km south of Fort Beaufort on the R64 heading to Grahamstown (32° 57' 26" S; 26° 37' 14" E, 3226DC, 614 m a.s.l). The stomach was removed for further analysis at the Port Elizabeth Museum (PEM). After washing out the stomach contents the following were discovered in the stomach (Fig. 1): (1) an intact male *Nucras taeniolata*, a new distribution record (see Conradie, 2012, this volume); (2) invertebrates (Coleoptera and Hymenoptera); (3) bones of a unidentified frog; (4) the helix of an unidentified snail species; (5) baby Leopard tortoise scales (*Stigmochelys pardalis*); and (6) hooves, bones and hair of a medium size antelope (possibly a duiker). Grass and gravel were present, likely having been taken as secondary ingestion. One nematode was also present in the stomach.

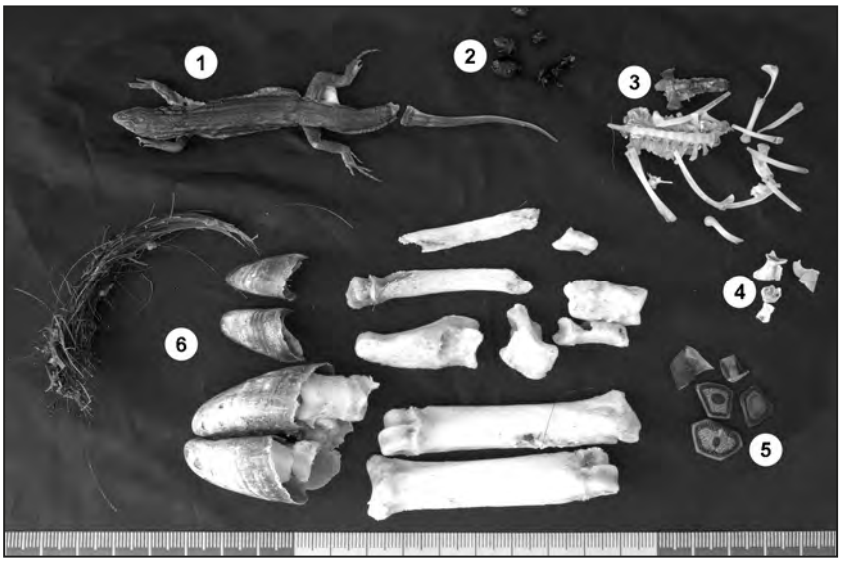

Figure 1: Stomach contents of *Varanus albigularis* from Eastern Cape Province, South Africa. Scale bar in centimeters. See text for details.

The diet of *V. albigularis* consists mostly of invertebrates, but individuals will take lizards, amphibians, birds, snakes, tortoises, eggs, and small mammals (Branch, 1991; Branch, 1998; Branch, 2006). *Varanus* spp. are known to scavenge on carrion, but carrion feeding in *V. albigularis* has been rarely recorded in the primarily literature and only anecdotal accounts exist (Branch, 1998). It is likely that the duiker leg found was scavenged from a road-kill animal, but this remains uncertain. The increase in the number of vehicles on our national roads is most likely leading to higher numbers of road-kills and thus presents an easy food source for these and other scavengers.

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GEOGRAPHICAL DISTRIBUTIONS

AMPHIBIA: ANURA

HYPEROLIIDAE

***Afrixalus knysnae* (Loveridge, 1954)**
Knysna Leaf-folding Frog

On October 27th 2012, during a butterfly census of the Garden Route Botanical Garden (23^0 56' 50,8" S; 22^0 27' 46,5" E), an adult male *Afrixalus knysnae* (Fig. 1) was found in the flower cup of an Arum Lily *Zantedeschia aethiopica*, growing close to a drainage furrow below a well vegetated dam. The drainage ditch is flanked by vegetation including sedges, restios and clumps of *Dietes grandiflora* as well as scattered Arum Lily plants. The dam is densely vegetated with clumps of sedges with water up to 1 m in depth in the middle. Several *Hyperolius marmoratus* were also found in close proximity to the *Afrixalus*. *Afrixalus knysnae* is distinguished from other *Afrixalus* taxa by the dark band along the flanks (which appears to change with light intensity), the generally even distribution of the asperities on the dorsum and the absence of transverse bands across the tibia.

Figure 1: *Afrixalus knysnae*, showing extensive distribution of asperities on the back and limbs.

Unconfirmed reports of the species from the Saasveld Campus have also been received indicating that this species is perhaps more widely distributed than previously recorded. The record extends the known distribution of the species some 40 km west of Groenvlei, the closest recorded locality (Minter et al., 2004; Du Preez & Carruthers, 2009) and the possibility exists that it may still be recorded further west in suitable habitat.

The Garden Route Botanical Garden is approximately 200 years old, having been established by Adriaan van Kervel, the first Mayor of the town to provide vegetables and fruit. Furrows lead off the Red and Camphersdrift streams via storage dams to provide water to George along a system of furrows, most of which have since been covered over during road construction. One of these furrows and the storage dams is still present. The subsequent and recent change to a botanical garden has added other wetlands, several of which likely provide good habitat for the Knysna Leaf-folding Frog. It also indicates that man-made wetlands and impoundments are suitable habitats for the species as mentioned by Minter et al. (2004), provided they are protected from livestock which denude the vegetation cover essential for these frogs. The Garden Route Botanical Garden is a proclaimed nature reserve, hopefully ensuring the continued survival of this endangered species locally and perhaps compensating to some extent for the threats from an increase in salinity at Groenvlei and the loss of habitat at Covie in the Eastern Cape (Minter et al., 2004).

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REPTILIA: SQUAMATA

LAMPROPHIIDAE

***Macrelaps microlepidotus* (Günther, 1860)**
Natal Black Snake

Here we report two new localities of *Macrelaps microlepidotus* in the Eastern Cape Province of South Africa and validate the Broadley (1990) Katberg record. All specimens were deposited in the Port Elizabeth Museum (PEM). One juvenile specimen (PEM R20167; Fig. 1) from Hogsback (32° 36' 11" S; 26° 56' 9" E, 1160 m a.s.l, 3226DB), and two adult specimens (PEM R19786 & -19791) from Dwesa Nature Reserve (32° 18' 41" S; 27° 55' 0" E, 20 m a.s.l, 3228BD).

Figure 1: Natal Black Snake (*Macrelaps microlepidotus*) from Hogsback. Photo: Justin Nicolau.

The species is widely distributed along the coastal areas of KwaZulu-Natal, but with only a few records for the Eastern Cape Province: King Williams Town (3227CD & DC), East London (3227DD & 3327BB), Isidenge Forest (3227CB), Coffee Bay (3129CC) and Port St Johns (3129DA). The Hogsback specimen extends the distribution of the species 34 km inland from Isidenge Forest, whilst the Dwesa specimens represent a new quarter degree grid square record for the Eastern Cape coastal region.

Broadley (1990) reported the presence of a specimen from Katberg (3226BC), deposited in the Albany Museum (AM). This specimen was however unaccounted for and led to the questionability of the record (SARCA: http://vmus.adu.org.za), but was recently rediscovered in the PEM collection. The herpetology collection of AM was transferred to PEM in 1993 after consolidation of the old Cape Province museums. The specimen had the following details: AM no. 5883, Katberg, J. Hewitt, January 1928 and has been re-accessioned into the PEM collection under PEM R20168 with the same details. Hewitt (1937) first reported the presence of this species in the Katberg forests, subsequently followed by Fitzsimons (1962) and Broadley (1990). More than 80 years have elapse with no further records from the Katberg area. Further surveys in the indigenous forest patches from Katberg to Fort Fordyce Nature Reserve are needed to understand the full existent of this species' distribution in the region.

Scalation and measurements of the Hogsback specimen: length 225 + 40 = 265 mm; internasal divided; prefrontal divided; undivided frontal; parietal divided; prenasal not divided; pariental barely touching 3rd upper labial; undivided postnasal nearly enters orbital; one post-ocular; one supra-ocular: no sub-ocular or pre-ocular; temporals 1 + 2; 5th upper labial not touching parietal; upper labials 7 (3rd and 4th entering orbital, 5th largest); lower labials 8, first 4 in contact with sublinguals, 2 pairs of sublinguals; dorsal scale rows 23/25/19; 160 ventrals; anal shield entire; 39 entire subcaudals. The Katberg specimen has the same scalation as the Hogsback specimen, but differs in: length 520 + 90 = 610 mm; temporals 0 + 1 + 2; 5th upper barley labial touching parietal; 164 ventrals; 38 subcaudals.

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LACERTIDAE

***Nucras taeniolata* (Smith, 1838)**
Albany Sandveld Lizard

A single intact male *Nucras taeniolata* was found in the stomach contents of a road -kill *Varanus albigularis* (Conradie, 2012, this volume). *Nucras taeniolata* is a poorly documented species which has a restricted distribution within the Eastern Cape Province, South Africa. Branch & Burger (2009) reports that only 33 specimens exist in museum collections, and that these are restricted to two populations within the Eastern Cape Province (from Groendal Wilderness Area to Addo National Elephant Park, and from the Thomas Baines Nature Reserve to the Great Fish River Reserves), representing only 11 quarter-degree grid squares (QDGS). This specimen from 3226DC represents a new QDGS record for the species. The closest documented record is 17 km east in the Doubledrift Nature Reserve (3226DD). The specimen has been lodged in the Port Elizabeth Museum under catalogue number PEM R20208. This new record shows the importance of collecting road-kills and analyzing stomach contents (see also Branch & Haagner, 1999) in documenting the distribution of poorly known species.

Another notable record of this species is a recently deposited specimen in the Port Elizabeth Museum from the Gamtoos Valley near Thornhill (PEM R20003), now representing the most southern record for the species (3325CC) as well as the recent additional of six specimens to the PEM collection from the Groendal Wilderness Area (PEM R20188–20193; and see cover image), bringing the total of preserved specimens of this species up to 40 and adding an additional two QDGS cells to the species distribution map.

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THE SEVENTH WORLD CONGRESS OF HERPETOLOGY: AN AFRICAN PERSPECTIVE

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The 7th World Congress of Herpetology was held from 8 to 14 August 2012 at the University of British Columbia in Vancouver, Canada. This was a joint herpetology and ichthyology meeting attended by nearly 1700 delegates from around the world. Apparently it was one of the two largest ever gatherings of herpetologists. The conference was a joint meeting of various societies, including Society for the Study of Amphibians and Reptiles (SSAR), American Society for Ichthyology and Herpetology (ASIH), Herpetologists League (HL) and American Elasmobranch Society (AES). It was the first WCH to be held in North America.

The program guide lists 1063 papers (820 herpetological) and 434 posters (herpetology and ichthyology). These were presented over four days in venues of varying size located in five buildings at the University. Herpetological presentations covered almost every conceivable subject in the field, including systematics, phylogenetics, phylogeography, biogeography, behaviour, reproduction, ecology, parasitology and conservation.

The meeting involved the largest ever contingent of South African-based delegates (at least 16) at a herpetological conference abroad. Most if not all of them were also HAA members, but when other countries are included, at least 30 HAA members attended. Most HAA members at the meeting presented papers and/or posters, and these were of a high standard. There were also several delegates from other parts of Africa, as attested by the authorship of abstracts (see below). The full book of abstracts is available for download at www.wch2012vancouver.com/abstractdownload.

A number of symposia were organised to group together similar talks, including a well–attended symposium *Biogeography of African Amphibians and Reptiles* held on the last day of talks, where 16 papers were presented. Apart from these, another 72 papers and posters presented during the rest of the conference also dealt with African reptiles and/or amphibians, i.e. a total of 88 presentations were on African herps (see abstracts below). There were several presentations on Southern African and Madagascan herps, but it was also pleasing to note that there were many presentations on the herps of West, Central and North Africa, and the Arabian Peninsula (including the Socotran archipelago). Although a lot more work needs to be done in Africa, it was

good so see that so much attention is now being devoted to the continent's herpetofauna.

As more comprehensive sampling is conducted on widespread genera and species of reptiles and amphibians, especially in poorly collected areas in Africa, more and more cryptic species are being identified. Molecular analyses of some genera, and even supposedly widespread monotypic species, often reveal the existence of cryptic species. A few presentations at the conference involving African species are noteworthy in this regard. For example, Alan Channing and colleagues found that the frog *Hyperolius nasutus* comprises as many as seven species; Eli Greenbaum and colleagues have discovered several cryptic species of *Amietophrynus* toads in the Congo Basin; and Maria Medina and colleagues have determined that the skink *Panaspis wahlbergi* consists of at least five species. These are indeed interesting times for taxonomists!

Apart from the many interesting talks and posters, this well organized conference also provided an opportunity to meet up with old friends and spend time discussing projects with collaborators. Vancouver was a splendid setting for the meeting, with its beautiful mountains, forests and sea views. The University of British Columbia was an excellent venue, and most delegates stayed in the reasonably affordable student accommodation on the campus.

The next WCH will be held in August 2016 in the city of Hangzhou in China. I trust that the HAA will once again be well represented at this meeting.

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Alexander, Graham (University of the Witwatersrand); Maritz, Bryan (University of the Witwatersrand)

Movement Patterns and Behavior of an African Viperid, *Bitis arietans*

Ambush-foraging snakes rely on crypsis and surprise to capture prey and avoid predators. Thus, many ambush-foraging snakes are well camouflaged and highly sedentary. However, they must move in response to certain cues: they leave lie-ups after shedding, defecation, during mate-seeking, after being discovered by prey, and when the site proves to be unproductive or risky. Bouts of movement represent periods of greatly-increased risk of predation, and activity patterns are thus likely to be under intense selective pressure. We quantified the frequency and distance moved by Puff Adders (*Bitis arietans*) in relation to season and sex, over a 27-month study. We also quantified the proportion of time that snakes spent moving, resting, basking and in ambush. *Bitis arietans* is a widespread, abundant, highly venomous viperid, making it one of the most medically-important snakes in Africa. We tracked 30 telemetered Puff Adders and located snakes every 2.45 days on average, resulting in a total of 2686 behavioral observations. Puff Adders spent more than 90% of their time on the surface, usually

under grass or leaf litter, and only rarely entered termitaria, mainly during the fire season. We assessed the sensitivity of our measures to sampling frequency by resampling our database and corrected our measures of Mean Daily Displacement (MDD) and frequency of movement accordingly. Sampling regime had a significant effect on movement estimates; in comparison to a daily sampling regime, sampling every 2.45 days underestimated MDD by 30% (and as much as 51% in mate-searching males) and movement frequency by 19%. Corrected MDD was 112.3 m.day $^{-1}$ for males during the mating season, but dropped dramatically to 10.1 m.day $^{-1}$ for males and females during all other seasons. Corrected frequency of movement was low, with snakes moving every 4.7 days on average. Puff Adders spent 68% of their time resting; 16% in ambush, and 11% basking. Males spent a greater proportion of their time moving (6%) than did females (2%). All behaviors showed significant trends in seasonality. The emergent pattern is one of Puff Adders as sedentary animals that move primarily during the mating season in autumn. Our study reveals the potential impact of sampling regime on measures of movement, and we propose that researchers explicitly account for such effects by reporting measures of displacement and movement frequency adjusted to a daily sampling regime.

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Alshammari, Ahmed (University Of Hail)

Reptiles of the Faid Protected Area, Ha'il region, Saudi Arabia

A reptile survey was carried out in the Faid protected area, Ha‘il region, Saudi Arabia from January to December 2011. The protectorate occupies 3200 km 2 , and lies between 26° 20` N, 41° 23` E and 27° 34` N, 42° 31`E. Faid, the major city, is one of most famous in the Ha‘il region because of its historical records and monuments. The study area was classified into five major study sites including all available habitats such as sandy, gravel, mountainous, and cultivated areas. Highways and roads connecting Faid City with villages were surveyed while driving during the day and night time periods. This study revealed twenty one species of reptiles, including one amphisbaenian, *Diplometopon zarudnyi*; 15 lizards and five snakes. Lizards were represented by five families; Family Lacertidae, including five species, *Acanthodactylus boskianus*, *A. opheodurus*, *A. schmidti*, *Mesalina guttulata*, *and M. adramitana* ; Family Gekkonidae, comprising four species, *Bunopus tuberculatus* , *Ptyodactylus hasselquistii*, *Stenodactylus doriae*, and *S. slevini*; Family Scincidae, encompassing three species, *Chalcides ocellatus*, *Scincus mitranus mitranus* and *Scincus scincus conirostris*; Family Agamidae, comprised of two species, *Trapelus ruderatus fieldi* and *Uromastix aegyptia*; and Family Varanidae, included one species, *Varanus griseus griseus*. Snakes were represented by five species belonging to four families as follows: Family

Atractaspididae, including one species, *Atractaspis engaddensis*; Family Colubridae, comprised of two species, *Coluber elegantissimus*, and *Spalerosophis diadema*; Family Viperidae, one species, *Cerastes gasperetti*, and Family Elapidae , one species, *Walternessia aegyptia*. The following species: *Acanthodactylus schmidti*, *Stenodactylus doriae*, *S. slevini* and *Chalcides ocellatus* were recorded for the first time in the Faid protected area.

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Policymaking and preventing the introduction of Chytrid Fungus in Madagascar

The amphibians of Madagascar exhibit a great number of species (more than 290) and an exceptionally high endemicity rate. Being Madagascar a large island, it is also particularly relevant to understand the relationships in terms of biogeography and commercial and pathogenic exchange it could have with other nearby countries. The presence of the lethal chytrid fungus *Batrachochytrium dendrobatidis* (Bd) was for long -time unreported in Malagasy amphibians, although continental African countries not far from Madagascar already revealed its occurrence. Due to this peculiar situation, an official national anti-chytrid plan was launched in 2010 within the framework of the Sahonagasy Action Plan, and subsequently approved by Malagasy governmental agencies. The situation was suddenly changed when positivity occurrence was reported for the Makay Massif, a remote area in the West of the island. The occurrence at this site was particularly unexpected, since Makay did not seem to be the most suitable locality where the Bd should occur. At least this was what turned out from predictivity analyses, and due to the fact that tourism and commercial exchange occurred at a very low rate in that area. No mass mortality was observed so far in two occasion visits, and therefore we still wonder whether this situation reflects a real and objective presence of the Bd, a non -lethal situation, or whether it is the effect of being just the beginning of an epidemic event. The chytrid monitoring planning launched in 2010 dealt with the screening analysis by means of nested PCR of 8 sites in Madagascar (and now also includes Makay as a potential Bd site), chosen for their geographic location and potential suitability due to high tourist level, proximity to towns and commercial harbours. For each site samples ($N > 50$) are being taken twice a year, during the dry and the rain season. Considerations about the long-term success of such a plan depend – among the other things – on the political stability of the country and possibility to form local people to routine surveys and captive breeding programs.

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Retracing Pleistocene refugial isolation in southern Africa: a case study of the widespread African puff adder (*Bitis arietans*).

Phylogeographic studies of widespread African savannah mammals have typically found distinct mitochondrial clades in East, West or southern Africa, leading to the hypothesis that these areas served as open habitat refugia during the Pleistocene, isolated from each other by expanding tropical forests during warm and humid interglacial periods. However, comparative data from widespread African reptiles is currently lacking. We present a phylogeographic investigation of the widespread African puff adder (*Bitis arietans*), a snake that inhabits open habitat formations throughout sub-Saharan Africa. Multiple parapatric mitochondrial clades occur across the current distribution of *B. arietans*. These include a widespread southern clade that is subdivided into four separate clades, suggesting a history of refugial isolation in southern Africa. We investigated the possible causes of isolation using a species distribution model derived from locality records and environmental data. The results indicate that range reduction and fragmentation occurred in southern Africa during Pleistocene cold phases (glacial maxima) with subsequent range expansion during warmer interglacials. The spatial pattern of range fragmentation also corresponds well with the geographic location of the common ancestor of each clade inferred from the genetic data using a coalescent spatial diffusion model, further supporting the hypothesis of refugial isolation. Interglacial expansion has resulted in secondary contact between refugial populations (mitochondrial clade contact zones). Data from five anonymous nuclear loci reveal male-mediated gene flow across these contact zones. However, the geographic extent of admixture varies considerably between clades, suggesting varying periods of contact between different refugial populations. Overall, our study reveals a complex history of refugial isolation and secondary expansion for puff adders in southern Africa. Critically, although range contraction and isolation in widespread savannah mammals is thought to have occurred during warm interglacials, in southern Africa the sympatric puff adder shows the opposite pattern of range contraction during cooler glacial periods.

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Bates, Michael (National Museum, Bloemfontein); Broadley, Donald (Natural History Museum, Bulawayo); Barlow, Axel; Wuster, Wolfgang (Bangor University); Tolley, Krystal (South African National Biodiversity Institute)

Taxonomy and distribution of the African egg-eating snakes of the genus *Dasypeltis*

Carl Gans (1959, 1964) conducted detailed studies of morphological variation in the pan-African egg-eating snake genus *Dasypeltis*. His taxonomic conclusions were conservative however, and he recognized only six species: *D. scabra*, *D. palmarum*, *D. inornata*, *D. fasciata*, *D. medici* (two subspecies) and *D. atra*. Since then large collections of *Dasypeltis* from throughout the continent have accumulated in various museums. In 2006 Trape & Mané reviewed the genus in West Africa and described three new species: *D. confusa*, *D. sahelensis* and *D. gansi* (two subspecies); and another new species from this area is currently being described (S. Trape pers. comm.). We have initiated morphology-based revisions of *Dasypelis* in the W half of Southern Africa, E half of Southern Africa, central Africa, and NE Africa & SW Arabia. A separate molecular phylogenetic study (mitochondrial and nuclear genes) has now been extended to provide pan-African coverage of the genus. Where possible we have used both morphological and genetic data to resolve taxonomic problems. Preliminary phylogenetic results indicate that apart from the basal species *D. medici*, there are two distinct *Dasypeltis* clades: 1) populations from W, SW and central Africa (*D. s. loveridgei*, and sister species *D. palmarum* and *D. confusa*), and 2) remaining species analysed so far (*D. inornata*, *D. scabra*, and sister species *D. fasciata* and *D. atra*). *D. scabra* in Southern Africa consists of three clades, with two possible new species. Molecular and morphological data indicate that *D. s. loveridgei* of Namibia and adjacent regions in SW Africa, currently considered a synonym of *D. scabra*, is in fact a distinct species sympatric with the latter in north-central Namibia. Populations in S Namibia and N Cape of South Africa, as well as NW Namibia and SW Angola, respectively, appear to represent new subspecies of ―*D. loveridgei*‖. A morphology-based revision of *Dasypeltis* in NE Africa & SW Arabia confirms the validity of *D. abyssina*, a species with unusual dorsal and ventral colour patterns, and high ventral counts, and identifies a new subspecies of *D. abyssina* from Ethiopia, Eritrea and the Arabian Peninsula. Distribution ranges of the various taxa have been mapped and will be illustrated. Although previously considered restricted to W Africa, *D. confusa* is widely distributed through central Africa to Uganda and as far south as S Angola; while *D. atra* extends from S Tanzania to central Ethiopia and westwards into E DRC.

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Bauer, Aaron (Villanova University); Heinecke, Matthew; Jackman, Todd (Villanova University)

Substrate-mediated endemism in southern African geckos

Southern Africa has a rich lizard fauna, within which gekkonid geckos are a dominant group. High species-richness in geckos is associated with substrate-specificity which, in conjunction with the complex geological history of the subcontinent, has resulted in

extensive cladogenesis and narrow endemism in most rupicolous species. Phylogenetic analyses of each of several major clades of southern African geckos: the *Pachydactylus* group (*Pachydactylus*, *Rhoptropus*, *Colopus*, *Chondrodactylus*, *Elasmodactylus*), *Goggia* and *Afroedura* recovered well-resolved trees with most branches receiving significant support. Divergence timing and diversification analyses reveal that an increase in the rate of speciation in the most species- rich genus, *Pachydactylus*, was associated with a shift from terrestriality to rock-living in the late Oligocene to early Miocene. Rupicoly is ancestral in both *Goggia* and *Afroedura*. Basal lineages in these two taxa are present in the southwestern Cape of South Africa where several species of *Pachydactylus* also occur, but their chief diversification has been in the temperate Cape Fold Mountains (*Goggia*) and along the Eastern Escarpment and into the Eastern Cape (*Afroedura*), where *Pachydactylus* is poorly represented. Conversely, *Pachydactylus* and its related genera have their greatest diversity in the arid regions of the Northern Cape and Namibia, where the other genera are represented by only two species each. The approximately contemporaneous diversification of these genera suggests that ecological interactions between them may have contributed to their largely complementary distributions.

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Blackburn, David (California Academy of Sciences)

Diversification of the Squeaker Frogs across Africa's mountains

The deep-time historical biogeography of Africa's montane faunas remain incompletely known, especially the relationships between montane regions. I present recent and on-going work on the phylogenetic relationships within the frog genera *Arthroleptis* (Squeakers) and *Cardioglossa* (Long-fingered Frogs), which are sister taxa. The evolutionary history of these genera sheds light on the relationships between species in the mountains of the Cameroon Volcanic Line (CVL), the Albertine Rift, and the Eastern Arc. The phylogenetic relationships within these genera reveal replicated biogeographic patterns, including the discovery that the Albertine Rift fauna is of mosaic origin, with some montane species part of clades from the CVL and others from the Eastern Arc.

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Bowie, Rauri (University of California-Berkeley)

Climate cycles, stability, and diversification in an African biodiversity hotspot

That existing models based on contemporary environmental variation fail to predict richness patterns of many species including the bulk of vertebrates on most continents, is now well-established. To understand species distribution patterns we need to integrate large-scale macroecology with evolutionary biology. Of particular interest are mountains

where climate interacts with topographic relief to generate sharp local habitat gradients. This may allow complex communities and species to persist locally, promoting population isolation and speciation, as well as facilitating the long-term persistence of relictual lineages so characteristic of tropical biodiversity hotspots. In this talk I explore the hypothesis that localized habitat persistence through time (stability) promotes lineage diversification and persistence. I evaluate the importance of habitat stability using a multi-faced approach that includes: (1) the development of a climate-based model of habitat stability extending to 120,000 BP in order to predict which sky islands of the Eastern Arc Mountains were likely to have retained forest throughout glacial and interglacial cycles; (2) I examine how climatic cycles have shaped regional diversification patterns using a comprehensive molecular dataset from several lineages of birds; and (3) given predictions of which sky islands had persistent montane habitat I make use of a phylogeographic-scale approach from a multilocus DNA datasets in order to estimate the extent of genetic structure and diversity among East African sky island birds, and establish whether peaks of allelic diversity and estimates of population stability through time correlate with predicted areas of stability.

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Brandley, Matthew (University of Sydney); Thompson, Michael (University of Sydney); Wagner, Gunter (Yale University)

Gene expression associated with pregnancy in a viviparous skink

Although the morphological and physiological changes involved in pregnancy in live-bearing reptiles are well studied, the genetic mechanisms that underlie these changes are not known. We used the viviparous African Ocellated Skink, *Chalcides ocellatus*, as a model to identify a near complete gene expression profile associated with pregnancy using RNA-Seq analyses of uterine transcriptomes. Pregnancy in *C.ocellatus* is associated with upregulation of uterine genes involved with metabolism, cell proliferation and death, and cellular transport. Moreover, there are clear parallels between the genetic processes associated with pregnancy in mammals and *Chalcides* in expression of genes related to tissue remodeling, angiogenesis, immune system regulation, and nutrient provisioning to the embryo. In particular, the pregnant uterine transcriptome is dominated by expression of proteolytic enzymes that we speculate are involved both with remodeling the chorioallantoic placenta and histotrophy in the omphaloplacenta. Elements of the maternal innate immune system are downregulated in the pregnant uterus, indicating a potential mechanism to avoid rejection of the embryo. We found a downregulation of major histocompatability complex loci and estrogen and progesterone receptors in the pregnant uterus. This pattern is similar to mammals, but cannot be explained by the mammalian model. The latter finding provides evidence that

pregnancy is controlled by different endocrinological mechanisms in mammals and reptiles. Finally, 88% of the identified genes are expressed in both the pregnant and non-pregnant uterus, and thus morphological and physiological changes associated with *C. ocellatus* pregnancy is likely a result of regulation of genes continually expressed in the uterus rather than the initiation of expression of unique genes.

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Carranza, Salvador (Institute of Evolutionary Biology (CSIC-UPF))

Biogeography and evolution of North African reptiles and amphibians: dating the origin of the Sahara Desert

Deserts carry an aura of antiquity, but reconstruction of their past histories is not easy. This is largely because there may be little direct evidence of their previous presence. Erosion is generally dominant, with few sites favoring the orderly accumulation of stratified deposits, so that the essential evidence tends to be scanty, scattered and difficult to date and correlate. Because of this paucity of evidence, relatively recent dates are often given for the onset of really dry conditions, even though the deserts concerned have distinctive endemic plants and animals that suggest at least parts of them are really quite old. The Sahara, the main arid region in North Africa, is by far the biggest desert in the world, covering some nine million square kilometers, and extending 5500 km across North Africa from the Atlantic Ocean to the Red Sea. The Sahara has often been thought to have been originated after the Pliocene, at least in its present very arid form. Various large-scale phenomena in the late Tertiary and Pleistocene, such as the uplift of the Tibetan plateau, increase of ice caps and cooling of the oceans, are likely to have caused desiccation of the areas concerned; so it was thought probable that a really high level of aridity only became established in North Africa 2-3 My ago. Recently, fossil sand dunes around 7 my old have been found in northern Chad, suggesting that the Sahara Desert may be much older than was previously thought. However, this hypothesis has been heavily criticized and a younger origin for the Sahara Desert has been suggested. In spite of the harsh environment, several reptile groups have colonized the Sahara Desert and some of them show morphological and physiological adaptations that allow them to survive under arid and hyper-arid conditions. On the other hand, the Sahara Desert has acted as a vicariant agent for some other groups. In this talk, I will use robust phylogenies for some of these North African reptile and amphibian groups in order to understand how the Sahara Desert has acquired its endemic faunas and to try to infer the age of the largest desert in the world. The molecular phylogenies recovered will also be used to infer the biogeography and evolution of the main groups concerned.

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Carranza, Salvador (Institute of Evolutionary Biology (CSIC-UPF))

Origin and diversification of the geckos of the Socotra Archipelago

Continental islands are very important hotspots of biodiversity and provide premier settings for studying the evolutionary and ecological processes that have resulted in such unique biotas. The Socotra Archipelago, in the western Indian Ocean, is a case example of an ancient continental fragment, a block of Precambrian Gondwanaland with a long biogeographic history. The Archipelago comprises four islands: Socotra, Darsa, Samha and Abd Al Kuri and is located in the Arabian Sea, situated 380 km southeast from the coast of Yemen and about 100 km east from the Horn of Africa (Somalia). Often referred to as the ―Galapagos of the Indian Ocean‖, it was designated a UNESCO World Heritage Natural site in 2008 as a result of its high level of endemicity at both specific and generic levels. From an evolutionary point of view, the archipelago is of particular significance because of its ecological diversity and long biogeographic history and thus represents a unique model to unravel the origin and speciation process in ancient continental fragments and to understand how different biogeographic, evolutionary and ecological factors have interplayed in the assemblage of Socotra‘s unique biota. The integration of phylogenetic and phylogeographic analyses at multiple loci and at various evolutionary time scales allowed us to reconstruct the evolutionary history of the 18 species of endemic geckos of the Socotra Archipelago of the genera *Hemidactylus*, *Pristurus* and *Haemodracon*, giving an approximate time frame to the origin and in situ diversification in these three groups. The study revealed the existence of complex patterns of within-island diversification and high levels of intra-species genetic divergence suggesting that the interplay of both historical and ecological factors seems to have a role in the speciation process. Interestingly, the case of *Hemidactylus forbesi* and *Hemidactuylus oxyrhinus*, which inhabit the island of Abd al Kuri with an area of 133 km2, may represent one of the most extreme cases of intra-island speciation in reptiles ever reported.

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Channing, Alan (University of the Western Cape); Hillers, Annika (Museum für Naturkunde, Berlin); Loetters, Stefan (Trier University); Roedel, Mark-Oliver (Museum für Naturkunde, Berlin); Schick, Susanne (Trier University); Conradie, Werner (Port Elizabeth Museum); Roedder, Dennis (Zoologisches Forschungsmuseum Alexander Koenig); Mercurio, Vincenzo (Museum für Naturkunde, Berlin); Wagner, Philipp (Villanova University); Dehling, Maximillian (Universität Koblenz-Landau); Du Preez, Louis (North-West University); Kielgast, Jos (University of Copenhagen); Burger, Marius (University of the Western Cape)

Taxonomy of the super-cryptic *Hyperolius nasutus* group of long reed frogs of Africa (Anura: Hyperoliidae), with descriptions of six new species

Specimens from across the range of the *Hyperolius nasutus* species group were sequenced for two mitochondrial genes and one nuclear gene. Advertisement calls were recorded from the same specimens where possible, and morphological characters were compared. Bayesian inference and maximum likelihood produced a well-supported tree indicating 15 clades that were assigned to existing or new species. *Hyperolius lamottei* is confirmed to be outside the *H. nasutus* group clade. On the basis of molecular, vocalisation and morphological data we recognise *H. acuticeps*, *H. adspersus*, *H. benguellensis*, *H. dartevellei*, *H. igbettensis*, *H. nasutus*, *H. poweri*, *H. viridis* and describe six new species. *Hyperolius granulatus*, *H. nasicus*, *H. oxyrhynchus*, *H. punctulatus* and *H. sagitta* are assigned as junior synonyms. As our results are based on a small number of specimens, these hypotheses await testing with larger sample sizes and more characters. A species distribution model suggests where outlier populations might be found.

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Conkey, Nancy (University of Texas at El Paso); Greenbaum, Eli (University of Texas at El Paso); Pramuk, Jennifer (Bronx Zoo/Wildlife Conservation Society); Carr, John (University of Louisiana at Monroe); Oliver Rödel, Mark (Leibnitz Institute for Research on Evolution and Biodiversity at the Humboldt University)

Phylogenetics of African Toads (Anura: Bufonidae: *Amietophrynus*)

African "true" toads (frog genus *Amietophrynus*) include forty morphologically conserved species that live in an array of habitats from the fringes of the Sahara to the mountains of South Africa. We examined the evolutionary relationships of these African bufonids by sequencing approximately 4 kb of combined mitochondrial (12S–16S) and nuclear (CXCR4, POMC, and RAG1) sequence data from sixty-two divergent samples of the genus Amietophrynus, and several bufonid outgroups. DNA sequences were analyzed with maximum parsimony, maximum-likelihood and Bayesian inference with the programs PAUP, RAxML and MrBayes v.3.1, respectively, after appropriate models of nucleotide substitution were identified in the program jModelTest. Our phylogeny agrees in most respects with the results of the most comprehensive, previously published hypothesis investigating the relationships of African bufonids (e.g., the monophyly of African *Amietophrynus* is well supported). However, our phylogeny supports several novel relationships, clarifies chromosome evolution in the group, demonstrates the importance of the Congo Basin as a center of endemism, and notes widespread cryptic speciation, suggesting that current diversity of *Amietophrynus* is vastly underestimated.

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Cunningham, Michael (South African Institute for Aquatic Biodiversity); Bloomer, Paulette (University of Pretoria)

Comparative Phylogeography of the Cape Fold and Maluti-Drakensberg Herpetofauna, Southern Africa

Two complementary montane hotspots of endemism occur at the southern end of Africa. In the south and south-west the Cape Fold Mountains form parallel series of craggy sandstone ranges along the coast, dissected by rivers running from inland. The Maluti-Drakensberg highlands, in the south-east interior, is an extensive basalt plateau, deeply incised by rivers flowing east and west of the continental watershed. Each region hosts a suite of endemic frog and lizard species, many with sister lineages in the alternate region. Contrasting opportunities for dispersal have resulted in distinct patterns of species diversity and local endemism in each of these regions. Here we present a comparative phylogeographic analysis of diversity and divergence within endemic montane species of *Hadromophryne*, *Heleophryne*, *Strongylopus*, *Vandijkophrynus*, *Tropidosaura*, *Hemicordylus* and *Pseudocordylus*. Species in the Cape Fold Mountains show concordant patterns of Plio-Pleistocene vicariance into 4-5 subregional lineages. Species in the Maluti-Drakensberg show less concordance, with fewer subregional splits, but where they exist, older divergences between northern and southern lineages. We explore the likely consequences of climate change for phylogeographic diversity in each region using spatial modelling of lineage distributions.

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da Silva, Jessica (South African National Biodiversity Institute); Tolley, Krystal (South African National Biodiversity Institute)

Phenotypic divergence and recent radiation in dwarf chameleons: Adaptation to habitat or widespread speciation?

Dwarf chameleons (*Bradypodion*) are thought to have adaptively radiated into different habitats, but the mode of these radiations is not well understood. In the present study, we examined the correspondence between genetic and morphological variation in a clade of *Bradypodion* from KwaZulu-Natal Province, South Africa. The clade is comprised of two species - *B. thamnobates* and *B. melanocephalum*; however, overall appearance (e.g. colour, size, shape) is extremely variable across the range, leading to speculation that there are multiple ecomorphs. We used a combination of genetic (n=279, 10 microsatellite loci & one mitochondrial marker) and morphometric data (n=392, 24 measurements) to examine the hypothesis that recent radiation into novel habitats is accompanied by morphological changes for ecologically relevant characters. Because the radiation is recent (i.e. Pleistocene), we expected a lack of genetic divergence at the species level. A hierarchical clustering analysis revealed the presence of three

morphological clusters (Bootstrap – AU: 95-100%; BP: 82-98%) corresponding to 1) *B. melanocephalum*, 2) *B. thamnobates*, and 3) a cluster off which *B. thamnobates* branches. A multivariate analysis of the three clusters (PCA & MANOVA) using size corrected residuals showed that *B. melanocephalum* has significantly smaller hands and feet, yet generally longer limbs compared to the other two clusters, as well as a significantly smaller casque compared to *B. thamnobates* and cluster 3 males. These morphological patterns correspond with those in other *Bradypodion* clades, reflecting macro-habitat differences – *B. melanocephalum* occurs in grasslands; whereas B. thamnobates and cluster 3 occur in forest fragments. Bayesian clustering on the microsatellite data identified five populations (FCT = 0.371; $p < 0.001$) –, a population corresponding to morphological cluster 3 (both matching the morphological analysis), and three populations within *B. thamnobates*. Shared mitochondrial *B. melanocephalum* haplotypes between most populations indicate a lack of divergence typically expected at the species level, and this incomplete lineage sorting suggests that populations were formerly connected. The population genetic structure within *B. thamnobates* could be representative of the dynamic environmental changes during the Pleistocene that resulted in the regression of forests, creating isolated patches preventing gene flow between populations. The genetic divergence was not accompanied by morphological divergence, as these chameleons inhabit similar micro (perch size) and macro (forest) habitats, suggesting that adaptations to the environment are retained despite suspension of gene flow. The strong morphological divergence present in this group of chameleons does not reflect widespread speciation, but indicates that chameleon morphology is highly labile and coupled to habitat.

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Davies, Sarah J. (Stellenbosch University); Clusella-Trullas, Susana (Stellenbosch Unviersity,); McGeoch, Melodie A. (South African National Parks)

Painted into a corner: Physiological tolerance limits spread in a sub-tropical amphibian *Hyperolius marmoratus*

The painted reed frog (*Hyperolius marmoratus* Rapp), previously restricted to the summer rainfall regions of southern Africa, has established multiple breeding populations across the south-western winter rainfall region of South Africa. This range expansion occurred over a period of only twelve years following their introduction in 1997/8. Painted reed frogs have colonised the Western Cape by virtue of the presence of perennial farm dams, and appear to fill the role of ‗urban exploiters'. Occupancy is limited by summer aridity, low winter temperatures and the absence of fringing vegetation around water bodies. This study, as well as evidence from mitochondrial DNA analyses, indicates that the distribution in the novel range has considerable spatial

structuring. We investigated the spatial pattern of spread and the responses of thermal tolerance and resting metabolic rate to temperature acclimation in frogs from the novel range. Critical thermal limits responded to acclimation to temperatures within the range of ambient temperatures commonly encountered in the study area. However, frogs from sites with different invasion histories showed distinct physiological responses to acclimation, suggesting that phenotypic plasticity or adaptation have enabled this species to expand its range extra-limitally. The results are examined in relation to the invasion history and known genetic and biogeographic structuring of these populations.

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Dehling, J.M. (University of Koblenz-Landau); Sinsch, Ulrich (University of Koblenz-Landau, Department of Biology)

Advertisement call differentiation mimic phylogenetic relationship among Rwandan reed frogs (Hyperoliidae: *Hyperolius*)

Since 2009 we have been analysing the diversity of hyperoliid frogs of Rwanda by recording their advertisement calls and collecting specimens for morphological and molecular identification using 16s rRNA barcoding. So far, we identified four described *Hyperolius* species (*castaneus*, *discodactylus*, *kivuensis*, *lateralis*), and another five not assignable to any described species which is currently considered valid (sp. 1: *nasutus* -group; sp. 2 and 3: *viridiflavus* -group, sp. 4: *cinnamomeoventris* -group; sp. 5: *castaneus* -group). *Afrixalus quadrivittatus* were included as a related non-*Hyperolius* taxon. According to maximum likelihood and maximum parsimony phylogenetic analyses, *A. quadrivitattus* is an outgroup to all *Hyperolius*, and H. sp. 1 (*nasutus* -group) is basal to the other *Hyperolius* , whereas *H. castaneus*, *H. discodactylus*, *H. lateralis* and H. sp. 5 are closely related and form a well-supported clade. A separate clade is formed by the species of the *viridiflavus*-group. This pattern is supported by advertisement call structure. The *castaneus*-clade gives short calls consisting of a single pulse group including equidistantly spaced 7 – 20 pulses. The *viridiflavus*-clade has very short and tonal advertisement calls.

The basal *nasutus*-group taxon produces a complex call including a *castaneus* –like long first pulse group followed by up to three single well spaced pulses. *A. quadrivittatus* has the most complex advertisement call including a long first pulse group followed by up to 50 short pulse groups with 2-3 pulses.

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Dehling, J.M. (University of Koblenz-Landau); Sinsch, Ulrich (University of Koblenz-Landau)

Diversity of Ridged Frogs (*Ptychadena*) in montane wetlands of eastern Rwanda: Bioacoustic, morphological and molecular evidence

We investigated the diversity of Ridged Frogs in cultivated as well as natural montane wetlands in eastern Rwanda. At thirteen locations we detected between one and three syntopic species of *Ptychadena* on visual and acoustic encounter surveys. We identified the three species tentatively as *P. anchieta*, *P. porosissima*, and *P. cf. mascareniensis*. Comparison of a partial sequence of the mitochondrial 16S rRNA gene of the collected specimens showed an uncorrected pairwise distance of 10.5-14.2 % between the three species. From each individual collected, we recorded 30 mensual and meristic characters. Principal component analysis identified several mensural characters on the basis of which the species can be distinguished unequivocally. We further provide a number of qualitative morphological characters that allow easy species identification in the field. Prior to collection, we recorded the advertisement call of the male specimens. A discriminant analysis showed that the three species can be distinguished unequivocally based on the parameters of their advertisement calls.

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Donnelly, Maureen (Florida International University); Shoo, Luke (Centre for Tropical Biodiversity & Climate Change); Olson, Deanna (US Forest Service); McMenamin, Sarah (University of Washington); Murray, Kris (University of Queensland); Van Sluys, Monique (Universidade do Estado do Rio de Janeiro); Msuya, Charles (University of Dar es Salaam); Stratford, Daniel (Griffith University); Terhivuo, Juhani (Finnish Museum of Natural History); Merino-Viteri, Andres (James Cook University of North Queeensland); Herbert, Sarah (EcoGecko Consultants); Bishop, Phillip (University of Otago); Corn, P. Steven (US Geological Survey); Dovey, Liz (Dept. of Climate Change); Griffiths, Richard (The Durrell Institute of Conservation & Ecology); Lowe, Katrin (Griffith University); Mahoney, Michael (The University of Newcastle); McCallum, Hamish; Shuker, Jonathan; Simpkins, Clay (Griffith University); Skerratt, Lee (James Cook University); Williams, Stephen (James Cook University of North Queeensland); Linhoff, Luke (Florida International University); Hero, Jean-Marc (Griffith University)

Engineering a Future for Amphibians under Climate Change

Following the 2009 INTECOL meeting in Brisbane Australia, a workshop was convened to discuss potential efforts that might mitigate some climate change effects on amphibians. A survey of the literature revealed three types of interventions that could help amphibians threatened with extirpation/extinction: installations of microclimatic and microhabitat refugia, enhancement and restoration of breeding sites, and manipulation of hydroperiod. In this presentation we review the findings of Shoo et al. (2011) and focus on the international efforts to re-establish the Kihansi Spray Toad in

Tanzania. We use the Kihansi Spray toad as a case study because it involves efforts across all three types of interventions described by Shoo et al. (2011). The assurance population exported to the United States crashed to very low numbers until new husbandry efforts at the Toledo Zoo improved captive reproduction success. The United States now has six zoological gardens involved in captive rearing and Tanzania has established a biosecure site to hold captive animals for release into the re-engineered wildlands of the Kihansi Gorge.

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Du Preez, Louis (North-West University); Badets, Mathieu (North-West University); Corrado, Costa (CRA ING (Roma)); Claudio, Angelini (Università `La Sapienza)

Investigating colors and patterns in *Cacosternum boettgeri*: Do parasites matter?

Polymorphic color and body patterns of anurans are underexploited systems for studying the evolution of phenotypic variations in nature. A well documented part of this phenomenon is the sexual dimorphism that may account for the intra specific variation of ecology and behavior. However, despite attempts to find correlations between fitness-related traits and morph types, the results were mostly inconclusive. The effects of direct selection by visually-oriented predators were more significant. Because parasites would act as long term predators, their distribution within host populations may indirectly reveal cost associated to sexual selection processes. We initiate here a first step towards answering this question, using the amazing diversity of color and patterns variations in *Cacosternum boettgeri* (Pyxicephalidae) and its species-specific parasite *Polystoma* sp . (Trematoda, Monogenea). The study involved 211 adult frogs that were analyzed for both phenotypic traits and parasitic loads. In addition, 11 different clutches were reared until metamorphosis resulting in 492 froglets to estimate the genetic inheritance of the phenotypic traits. Preliminary results indicate a classic Mendelian genetic system behind the color and stripe patterns of the host species. Although parasitic loads are not correlated to any specific phenotype among males, a significant bias was observed between expected and observed female phenotypes. Relying on preliminary analyses of this present study, a great, a great potential for evolutionary ecology is uncovered.

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Du Preez, Louis (North-West University); Viviers, Joanita; Badets, Mathieu (North-West University)

Sex in the city: *Amietia angolensis* in an urban environment

We aim to understand the fundamental biological processes behind the distribution of amphibians in urban environments. The description of social structure and appropriate

spatial scales in amphibian populations remain a major issue for their conservation, especially when they inhabit urban environments. Although numerous studies have provided insight in the behavioural strategies and spatio-temporal distribution of amphibians, there is a serious lack of long term monitoring to shed light on migration patterns and mirco habitat utilization in a social context. The common river frog (*Amietia angolensis*) presents an ideal model for a long term monitoring since they are active almost throughout the year, utilize a variety of water bodies and have an extended breeding period. Intra specific interactions and spatial distributions over various scales can be studied depending on large variation of abiotic environmental parameters such as rainfall and temperature. We engaged in a long term monitoring of the population dynamics of *A. angolensis* in order to describe how prenuptial migrations and intra specific interactions affect the social structure of the population. The study was conducted at a semi-natural environment namely the Botanical Garden of the North-West University (Potchefstroom, South Africa), where 18 water bodies provide breeding habitat for the species. Throughout the botanical garden a total of 165 frogs were captured by hand, measured, weighed, sexed and individually mark with a subcutaneous pit tag that allow future identification without disturbing the frog. Over a period of one year we conducted a survey every two weeks, scanning every frog we could find throughout the garden and documented its position and behaviour. The following night we focussed on a single pond where we every 90 minutes documented the exact position, orientation and behaviour of each frog at this pond. Migration between and within ponds were documented in relation to density and breeding events. Here we present the preliminary results dealing with calls, migration, population dynamics and inter-individual interaction. An integrated framework of spatial migration and individual behaviour allows describing the importance of territorial aspects and social structures in the complete population of *A. angolensis.*

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Edwards, Shelley (University of Stellenbosch); Vanhooydonck, Bieke (University of Antwerp, Antwerpen); Herrel, Anthony (CNRS-MNHN); John, Measey (Nelson Mandela Metropolitan University); Tolley, Krystal (South African National Biodiversity Institute)

Convergent evolution associated with substrate decouples phenotype from phylogeny in the southern African lacertid lizards (Eremiainae, Lacertidae)

Convergent evolution can explain similarities in morphology between species, due to strong selection on a fitness-enhancing phenotype in response to local environmental conditions. Previous work has revealed how morphological convergence exists between ecotypes, with morphology being directly related to microhabitat usage, some well-

known examples of which include cichlids, finches and anoline lizards. Southern Africa possesses a high diversity and endemism of reptile taxa. The southern African landscape is varied in terms of habitat, with many lizard species inhabiting a particular micro habitat (e.g. rock, compact sand, loose sand, grass, trees). Within the African radiation of lacertid lizards, species range from strictly rupicolous to strictly psammophillic, whilst others are generalists in terms of habitat choice. We hypothesised that in the African radiation of lacertid lizards (Eremiainae) overall body and limb morphology would be independent of phylogeny, but dependent on substrate type. To test this hypothesis Bayesian inference and maximum likelihood methods were used to examine evolutionary relationships for 17 species from all 5 Eremiainae genera using two mitochondrial (16S and ND4) and two nuclear (RAG1 and KIAA-2018) markers. Principal component analysis and clustering analysis on size-corrected linear measurements of body, head and limbs were conducted to examine congruence between evolutionary 196 relationships and morphology. Our phylogenetic analysis reveals taxonomic mis-assignments of species within *Australolacerta* and *Ichnotropis*. However, morphological analyses indicate that the mis-assigned species are convergent in body features: species utilising compact substrates exhibited more slender bodies and shorter limbs compared to the stockier bodies and longer limbs of the sand-dwelling species. Sand-diving lacertids possessed significantly larger heads. We attribute this to convergence as a result of adaptation to substrate types, and we conclude that in the Eremiainae, similarity in body plan is not always congruent with shared ancestry, but in all cases it is coupled to habitat usage.

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El Mouden, El Hassan (Cadi Ayyad University); Fattah, Abderazzak Fattah; Slimani, Tahar Slimani; Radi, Mohamed; Tabrouri, Fatima Ezzahra (Cadi Ayyad University); Marquez, Rafael (Museo Nacional de Ciencias Naturales (CSIC)); Beltran, Juan Francisco (Universidad de Sevilla); De Pous, Philip (Society for the Preservation of Herpetological Diversity; Institute of Evolutionary Biology (CSIC-UPF))

Breeding site characteristics and amphibian species diversity in the Tensift-Haouz region (Marrakech-Morocco)

Several studies show that amphibians are the most threatened animal group in the world. The causes of this phenomenon are very diverse and include habitat destruction and fragmentation, pollution, pathogens, climate change or interactions among several factors. Understanding habitat use and characteristics of different species is than a major challenge in conservation biology. This study focused on amphibian species diversity and their abundance in the Tensift-Haouz region in south-western Morocco, as well as on the environmental factors (including human activity impact) determining their occurrence patterns and abundance. For this purpose, we used 16 variables to

characterize the breeding site and their surrounding terrestrial areas. The fieldworks were taken between February 2007 and March 2011. From the 13 species inventoried in Morocco, a total number of 7 species were identified in the studied region. *Pelophylax saharicus*, *Amietophrynus mauritanicus* and *Bufo boulengeri* are common in the studied region. Among these species, only the first one occurred in a polluted site (the Tensift River with Pt>13 mg/l, NH4+>3 mg/l, DCO>2000 mg/l; indicating high pollution). *Bufo bufo*, *Hyla meridionalis* and *Discoglossus scovazzi* are localized in the mountainous region and surrounding areas, whereas *Bufo brongersmai* is restricted to the arid zone of the northern part of studied region. Concerning the distribution of this Moroccan endemic species, five new localities were identified in the Jbilet region which reveals its abundance in the region, while its absence and despite several prospecting, in the Tensift River indicate its disappearance from this site, likely as a result of pollution. Based on the collected data and additional data from literature and fieldwork, the potential distribution under current climatic conditions was predicted using maximum entropy modelling. This study has been supported by the Hassan II Academy for Science and technique – Project ICGVSA.

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Ernst, Raffael (Senckenberg Natural History Collections Dresden)

Merging community ecology and phylogenetic biology in amphibian research: How habitats shape anuran trait communities and species life-history traits

Amphibians are not only known to be one of the most diverse tetrapod vertebrate groups, they also exhibit an outstandingly high diversity in terms of life history traits that have evolved in particular lineages. Amphibian habitat requirements are very diverse and complex. They exhibit distinct assemblage patterns over a range of spatial, temporal, and functional scales and community composition is largely influenced by the effects of environmental variables and spatial or biotic processes. Provided that similar environmental templets lead to similar adaptations, observed trait distribution patterns would reflect how evolution has shaped amphibian species to cope with the temporal and spatial variability of their present environment. Human activities and global change processes would therefore not only have the potential to alter species ranges but also the trait composition and therefore the response variability and thus flexibility of entire ecosystems. Within a large scale meta-analysis we searched for multiple trait-habitat relations in tropical anuran assemblages. Our aim was to investigate whether these relations converge across global regions. The specific goal was to test whether trait-habitat relations reflect common evolutionary history or environmental trait filters. We compared large anuran data sets derived from investigations of anuran assemblages in three biogeographic regions (Guiana Shield, South America; Upper Guinea Forest Block, West Africa; Borneo Rain Forests, South-East Asia). These were complemented

by molecular community phylogenies in order to test for phylogenetic structure and phylogenetic signal in traits. We present first results that highlight the importance of integrating trait-habitat links into analyses of biological assemblages as this can enhance the predictive power and general application of species assembly rules in ecology, particularly when phylogenetic comparative methods are simultaneously applied. In order to predict anuran trait composition based on habitat templates, trait-habitat links cannot be assumed to be universal but rather have to be individually established prior to model building. Only then can direct trait-based approaches be useful tools in predicting fundamental anuran community patterns.

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Flecks, Morris (Zoologisches Forschungsmuseum Alexander Koenig); Weinsheimer, Frank; Böhme, Wolfgang (Zoologisches Forschungsmuseum Alexander Koenig); Chenga, Jumapili (TRAFFIC East/Southern Africa); Lötters, Stefan (Deutsche Gesellschaft für Herpetologie und Terrarienkunde); Rödder, Dennis (Zoologisches Forschungsmuseum Alexander Koenig)

Watching extinction happen: the dramatic population decline of the critically endangered Tanzanian Turquoise Dwarf Gecko, *Lygodactylus williamsi*

The Turquoise Dwarf Gecko (*Lygodactylus williamsi*) is endemic to two small forests in eastern Tanzania, where it exclusively dwells on screwpines (*Pandanus rabaiensis*). To assess its population status, we surveyed its habitats at the Kimboza Forest Reserve and (under different assumptions) estimated the population size of the territorial *L. williamsi* based on habitat availability, using *Pandanus* abundance as a proxy. Furthermore, threats to the species, especially the impact of the international pet trade on the population, were studied. Our results suggest a severe population decline, as the observed population size is one third smaller than its potential size based on habitat availability (i.e., *Pandanus*). We estimate that in a period of four and a half years, at least 15% of the potential population were collected for the pet trade, making it a major threat to *L. williamsi* next to habitat degradation. The species‘ extent of occurrence covers only 20 km² and suitable habitats are severely fragmented, leading to an area of occupancy of less than 1 km². Based on our results, we consider this species to be threatened with extinction (Critically Endangered‘ according to the IUCN Red List criteria).

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Greenbaum, Eli (University of Texas at El Paso); Conkey, Nancy (University of Texas at El Paso); Pramuk, Jennifer (Bronx Zoo/Wildlife Conservation Society); Carr, John (University of Louisiana at Monroe); Rödel, Mark-Oliver; Penner, Johannes (Leibniz Institute for Research on Evolution and Biodiversity at the Humboldt University Berlin)

Systematics of Congo Basin True Toads (Anura: Bufonidae: *Amietophrynus*) Reveals Widespread Cryptic Speciation

Two competing hypotheses have been proposed to explain speciation patterns in the Congo Basin of Central Africa: (1) the Refuge Hypothesis states that contemporary areas of rainforest endemism in the 270
Congo Basin were not affected by past climatic fluctuations, and these stable areas (i.e., forest refugia) led to allopatric speciation in forest-adapted taxa; whereas (2) the Montane Speciation Hypothesis focuses on montane regions of Central Africa (i.e., Cameroonian Highlands and Albertine Rift) as stable forest refugia where allopatric speciation occurred, with the inference that the Congo Basin served as a ―museum where some species persisted since the Miocene with little subsequent diversification. A testable prediction of the latter hypothesis is that there is limited or no geographic structure in the genetic diversity of widespread Congo Basin species. We tested these hypotheses by examining phylogenetic patterns and divergence timing of two widespread, lowland species (*Amietophrynus camerunensis* and *A . gracilipes*) in the Congo Basin, with sampling of multiple populations from all ecoregions. We sequenced approximately 4 kb of combined mitochondrial (12S–16S) and nuclear (CXCR4, POMC, and RAG1) genes from over 30 samples of *Amietophrynus*, and several outgroups. These data were analyzed with maximum parsimony, maximum-likelihood and Bayesian inference with the programs PAUP, RAxML and MrBayes v.3.1, respectively, after appropriate models of nucleotide substitution were identified in the program jModelTest. Our phylogeny identified widespread cryptic speciation among our toad samples from the Congo Basin, which supports the Refuge Hypothesis. Our findings are consistent with recent phylogenetic analyses of birds and rodents. One of the new toad species is restricted to the forests that transition into the Itombwe Plateau, a region of paramount conservation importance that is renowned for its amphibian endemism and diversity.

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Hawlitschek, Oliver (Zoologische Staatssammlung); Rösner, René; Guggenbichler, Daniel; Glaw, Frank (Zoologische Staatssammlung)

SmartHerper Comoros, a free field guide to the herpetofauna of the Comoro archipelago as a mobile application.

We present SmartHerper Comoros, a free field guide to the reptiles and amphibians of the Comoros as a mobile application for smartphones. SmartHerper Comoros fulfills every function of a traditional printed field guide. It includes an introduction to the Comoran environment and herpetofauna, an interactive key, and species accounts. The species accounts include text information, a photograph gallery, sounds of frog calls, and

a map with localities that can be viewed in a GoogleMaps window and are available for navigation via the GPS function of the smartphone. An interactive glossary provides explanations of specific terminology in popup windows. Weblinks connect to the related Reptile Database, AmphibiaWeb and IUCN Red List entries via the browser of the smartphone. The app enables users to contribute photographs and locality data of the species included. This data is directly uploaded to the database for inspection by the administrator and will be made available to the user community in regular updates. The app is freely available for download at the website of the Zoologische Staatssammlung München (http://www.zsm.mwn.de/). It was programmed using Java and is currently available for the Android operating system. We chose Android because all software necessary for the development is open-source, and because many smartphones use this operating system. The development of versions runnig on iOS and Microsoft Windows Mobile is planned. The application targets scientists working in biodiversity research, taxonomy, ecology, and conservation planning, as well as non-professional naturalists visiting or resident of the focus region. In addition to the current English version, editions in other languages are planned. Since SmartHerper Comoros and planned future SmartHerpers are free, easily available and easy to use, we hope that they will contribute to the dissemination and generation of knowledge on biodiversity of their focus regions and thus stimulate interest in the observation and conservation of regional biodiversity in visitors, e.g., ecotourists, and residents alike. The structure of SmartHerper allows for easy modification to create field guides of other organism groups and regions.

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Hipsley, Christy (Museum für Naturkunde Berlin); Müller, Johannes (Museum für Naturkunde Berlin)

Evolutionary consequences of Cenozoic climate change on African lacertid lizards (Squamata: Lacertidae)

The Lacertidae is a large family of Old World lizards with considerable variation in clade size, morphology and ecology. In contrast to the global pattern of increasing biodiversity towards the tropics, African lacertids are most diverse in deserts north and south of the equator, despite being spread throughout the continent. This disparity in species richness is particularly surprising given that desert lacertids are thought to be evolutionarily younger than their mesic relatives, suggesting increased speciation rates in arid habitats. To identify the environmental and evolutionary factors underlying this pattern, we used a combination of phylogenetic, morphological, and ecological approaches to estimate timing and rates of diversification for the main lineages, and to test if historical shifts in ecology, morphology, and rates of diversification coincide with paleoclimatic events. A time-calibrated phylogeny for Lacertidae was constructed based on 1012 bp of the nuclear gene RAG1 and 3 fossil-calibrated nodes with hard minimum

and soft maximum bounds. Our results suggest that lacertids arose in the early Cenozoic and entered Africa about 45 million years ago, with the majority of their African radiation occurring in the Eocene and Oligocene. Based on the above branch lengths, rates of diversification were estimated for the main clades. The African radiation as a whole shows higher rates of diversification than their Palearctic sister clade throughout the Oligocene to mid-Miocene. Within the African radiation, desert-dwelling taxa also show higher diversification rates early in their evolutionary histories than equatorial African and temperate groups. Colonization of independent deserts is also accompanied by similar derived morphologies, including an overall decrease in ossification and fusion of cranial bones. Geometric morphometric analysis of 3-D Computed Tomography scans shows that these taxa achieve convergent cranial morphologies via enlarged orbits, lengthening and narrowing of the snout and frontals, and shortening of the postorbital region. Ancestral state reconstruction of morphology and habitat suggests that these traits evolved with the onset of aridification in Africa. These results emphasize the importance of deserts as centers of reptile evolution and provide comparative climate impact data for terrestrial vertebrates.

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Hirschfeld, Mareike (Museum fuer Naturkunde, Leibniz Institute for Research on Evolution and Biodiversity at the Humboldt University Berlin); Roedel, Mark-Oliver (Museum fuer Naturkunde, Leibniz Institute for Research on Evolution and Biodiversity at the Humboldt University Berlin, Berlin)

Life history traits and adaptation ability to changing environments? - Leaf-litter frogs in the Cameroonian highlands.

Globally many species are negatively affected by fragmentation and alteration of the climate. In particular species living in tropical highlands suffer from these environmental changes as dispersal from disappearing to appropriate habitats is limited. The respective species thus are captured on their mountain ‘islands_. However, the susceptibility of different species to the same environmental changes may vary due to differences in their resilience to these changes. Such variation may depend on a variety of different species-specific ‘ecological properties’; like e.g. dispersal ability, mean maximum age, reproductive strategy and investment, trophic niche, physiological constraints and in sum their habitat preferences. Most tropical leaf-litter frogs occur in forested habitats. Although belonging to different taxonomic groups, their environmental requirements often seem similar. However, it is apparent that some species may tolerate forest degradation to partly huge extends, whereas others are exclusively found in primary tropical forest with closed canopy. We herein ask if this variation of mountainous frog species in adaptability to forest degradation is related to their particular sets of

ecological properties. The study is conducted on the Mount Manengouba, a peak of the volcanic chain in southwestern Cameroon. Apart from the altitudinal gradient (up to 2411 m asl) there are horizontal and vertical gradients of habitats ranging from pristine forest to farmbush. This mountainous region is exceptional concerning amphibian species richness (> 100 species), including a high diversity of leaf-litter frogs belonging to different genera (e.g. *Cardioglossa*, *Phrynobatrachus*). First results revealed high variation in adaptability of species to environmental changes even within one genus. For instance, *Cardioglossa* species vary not only in their altitudinal ranges, but as well in their occurrences along different degraded habitat types. We investigate species distributions in correlation to species specific ecological traits, using different leaf-litter frogs (related and non-related genera) on the Mount Manengouba as example.

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Ibrahim, Adel (Suez Canal University)

The Herpetology of the Suez Canal Zone, Egypt

Banks of the Suez Canal (east and west) were surveyed for herpetofauna between 1999 and 2009. Study site was comprised of (1) western bank of Suez Canal from Port Saïd to Suez (168 km) and within a range of five km westward (occasionally up to 10 km) from the canal, covering a minimum total area of 1000 km2, and (2) the eastern bank of Canal from Port Fuad to Ash-Shatt (opposite Suez city) including the old city Al-Qantara East and newly established villages. Observations on the west bank included seven roads and highways and all possible habitats were surveyed. The survey revealed 34 herpetofaunal species from the west bank (three amphibians, 20 lizards, 10 snakes, and one sea turtle), and 22 east bank species (three amphibians, 13 lizards, and six snakes), with several new records documented in the Suez Canal zone—one amphibian, *Pelophylax bedriagae*; and four reptiles, *Tarentola annularis*, *Psammophis sibilans*, *Ramphotyphlops braminus*, and *Chelonia mydas*. Several species were recorded for the first time from each of the Suez Canal provinces—two species, *Chalcides ocellatus* and *Natrix tessellata* reported in Port Saïd; six species in Ismailia, *Acanthodactylus boskianus*, *Cyrtopodion scabrum*, *Hemidactylus flaviviridis*, *Malpolon monspessulana*, *Cerastes cerastes* and *C. vipera*; and three species in Suez, *Trachylepis quinquetaeniata* and *Trapelus pallidus* and *Natrix tessellata*. On the eastern bank, all species were recorded for the first time except for *Cerastes cerastes*, *C. vipera*; *Varanus griseus*, and *Acathodactylus scutellatus*. *Natrix tessellata*, inhabiting freshwater canals east of Bitter Lakes, represents the first record for the Sinai Peninsula. Additional new records for amphibians and reptiles of the Suez Canal area, especially on the east bank, are apparently a result of recent major changes to reptile habitat (urban expansion and land cultivation with Nile freshwater supply). In some cases these new environmental changes have resulted in more invasive herpetofaunal taxa expanding their ranges into new territories over the past three

decades. The number of species occurring on the west bank was greater than on the east bank presumably due to greater variety of habitat, increased urbanization and huge web of irrigation canals which have allowed several species to move from the River Nile to the Canal zone. This study suggests the Suez Canal acts as passage for herpetofauna from west to east, but in parallel with the creation of new suitable habitat on the east side for invasive species. Several species such as *A. regularis*, *P. mascareniensis*, *H. flaviviridis*, and *N. tessellata* were transported via the Suez Canal and colonized on the east bank. On the west bank, the subspecies of chameleon was *Chamaeleo chamaeleon chamaeleon*, whereas on the east bank, *Chamaeleo chamaeleon musae*. *Trapelus savignyi* recorded on the west bank with smooth ventrals was not previously known for the species.

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Jackman, Todd (Villanova University); Rocha, Nicole; Bauer, Aaron; Koolpe, Rachel (Villanova University)

Multilocus phylogeography of the *Pachydactylus serval* and *Pachydactylus weberi* complexes

Once considered to be subspecies of *Pachydactylus serval*, *Pachydactylus montanus* and *Pachydactylus purcelli* have only been recently described. Both gecko species have a relatively wide distribution, spanning the Cape Province of South Africa up into the southern half of Namibia, with their ranges overlapping in the northern end of the distribution of *P. purcelli*. Representative samples of these species as well as all species that are members of the *P. serval/weberi* clade were taken from an array of localities across their ranges. Patterns of genetic variation were analyzed by obtaining molecular data for the mitochondrial gene ND2 as well as five nuclear protein coding loci. Results from mitochondrial DNA data for *P. purcelli* showed significant geographical substructure, with northern populations being fairly distinct from the more southern localities. *P. montanus* also showed a fair amount of geographical substructure, although the correlation was not as obvious as for *P. purcelli*. In comparing mitochondrial and nuclear genes, there is clear evidence of either deep coalescence or introgression between *P. carinatus* and nearby and sympatric *P. montanus* populations. Results indicate that the Orange River appears to present a geographical barrier, which can be seen by the division between *P. montanus* populations north and south of the river and the distinctiveness of the sole *P. purcelli* population sampled north of the river. Species tree approaches are compared to various concatenation configurations.

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Kawai, Ushio (Texas Tech University); Mori, Akira (Kyoto University); Horita, Juske (Texas Tech University); Hori, Michio (Kyoto University); Perry, Gad (Texas Tech University)

Analysis of diet and trophic position of lizards in a dry forest of northwestern Madagascar, using stomach contents, feces, and stable isotopes

Madagascar is one of the hottest biodiversity hotspots and contains over 400 species of reptiles, and many of them endemic. The Malagasy forest is rapidly disappearing because of clearing and other human activities, making conservation of flora and fauna an international priority. Many studies of reptilian taxonomy and biogeography have been conducted, but ecological studies are few. During the rainy season (November to March) of 2009-2012, we conducted a dietary study of lizards living in a dry forest of northwestern Madagascar. The study focused on four diurnal species (*Lygodactylus tolampyae*, *Oplurus cuvieri*, *Phelsuma kochi*, and *Zonosaurus laticaudatus*) and one nocturnal species (*Blaesodactylus ambonihazo*) in disturbed and less disturbed habitat in Ankarafantsika National Park. Diets were examined by stomach flushing and feces, and stable isotope ratio was analyzed to determine their trophic positions. Stomach contents and feces analysis showed that the lizards mainly utilize invertebrates, predominantly insects such as Hymenoptera and Coleoptera but also plant materials such as fruits. The results of stable isotope analysis indicated that trophic dynamics of these lizard species differed between habitats.

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Kuhn, Arianna (Villanova University); Bauer, Aaron; Todd, Jackman (Villanova University)

Molecular phylogenetics of South African flat geckos (Gekkonidae: Afroedura) Loveridge, 1944 and the recognition of seven new species

The Family Gekkonidae comprises over 900 species in 54 genera and is nearly cosmopolitan in its distribution. Among the areas of highest gekkonid diversity is the geologically complex and ecologically diverse region of southern Africa. A number of gecko genera endemic to this region have been studied phylogenetically, but one diverse genus of particular biogeographic interest for which no explicit phylogenetic hypotheses have been published is *Afroedura*. The members of this genus are restricted in their distributions chiefly to rocky areas of South Africa but a limited number of species extend northwards into Namibia, southern Angola, Zimbabwe, and southern Mozambique. The distribution of flat geckos, however, is highly fragmented and most species are allopatric. We investigated phylogenetic relationships for 14 of the 18 recognized species and subspecies of *Afroedura*, using nine molecular markers, six of

which have never been used in a comparative framework for squamates. Using Likelihood and Bayesian analyses, a species tree was estimated that identified four distinct clades corresponding to discrete biogeographic regions. *Afroedura hawaquensis*, the only representative taxon from the southwestern Cape, is sister to all other *Afroedura*. Other groups include an Eastern Cape clade comprising *A. karroica*, *A. tembulica*, and *A. amatolica*, and a tropical clade — *A. bogerti*, *A. africana*, *A. loveridgei*, and *A. transvaalica*. Remaining species fell into an Eastern clade distributed chiefly in Mpumalanga and Limpopo provinces of South Africa and in Swaziland. This final clade includes several recognized species — *A. lang*i, *A. marleyi*, *A. major*, and *A. multiporis*, but also seven new species, all previously distinguished on morphological grounds but as yet undescribed. These new taxa highlight the significance of the Eastern Escarpment and adjacent regions for *Afroedura* and provide further evidence for discrete areas of endemism in this part of the subcontinent. *Afroedura*'s area of greatest diversity complements those of other rupicolous geckos in the genera *Pachydactylus* and *Goggia*, which show their greatest richness in the southwestern Cape and in arid regions of the Northern Cape and Namibia.

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Leache, Adam (University of Washington)

Biogeography of African Agama lizards

African lizards in the genus *Agama* are a diverse and widespread component of squamate diversity in Africa. Their extensive distribution across Africa makes them an ideal group for investigating continent-wide biogeography. *Agama* lizards are also exceptionally diverse morphologically and behaviorally and have evolved a variety of social structures, habitat preferences, body sizes, and sexual dimorphic colorations. In collaboration with 15 researchers from across Europe, Africa, and the United States, I present a comprehensive phylogeny for African *Agama* lizards that captures nearly all species diversity and paves the way for new insights into continent-wide analyses of diversification and biogeography. Estimating phylogenetic relationships using a combination of two mitochondrial genes and four nuclear genes provides strong support for unique evolutionary radiations within each region of Africa. The phylogeny also supports the parallel evolution of body sizes, habitat preferences, and social structures, and transitions in this suite of characters are correlated. The weak support for critical nodes at the base of the phylogeny result in estimates of the historical connections between areas and ancestral character states with wide confidence intervals. Reducing this error by estimating a phylogeny with increased support is being accomplished with new DNA sequence capture techniques that target 500 homologous nuclear loci simultaneously.

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Liedtke, Hans Christoph (Univeristy of Basel); Müller, Hendrik (Friedrich-Schiller-Universität Jena); Menegon, Michele (Museo Tridentino di Scienze Naturali); Beck, Jan; Ballesteros, Liliana; Nagel, Peter; Loader, Simon (University of Basel)

Do mountains promote terrestrialization of life history strategies in African amphibians?

Many amphibian lineages show a terrestrialization of their reproductive breeding strategy, though it is unclear what causal factors are linked to this. Predation and habitat have been proposed as factors driving the evolution of terrestrialized breeding strategies. The influence of habitat on the evolution of terrestrialized breeding strategies has never been tested using appropriate data or methods. We test whether species occurring across different habitats show different patterns of terrestrialization in their breeding strategy. Based on species distribution data, we assembled a dataset comprising 180 amphibian species and coded life history modes for East African species. We tested whether montane forest amphibian species have significantly different breeding strategies compared to lowland forest and non-forest, and montane grassland communities. We show significant association between terrestrialized breeding and montane forest assemblages. This result is robust to likely biases in the data. We also accounted for phylogenetic non-independence in tests of correlations between habitat and breeding strategies. Terrestrial oviposition is strongly correlated with montane forest habitat, but terrestrial development is not. Various hypotheses have tried to explain the high frequency of terrestrial breeding strategies in amphibian communities, and our analysis points to montane forest habitats being an important factor in terrestrialization.

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Maddin, Hillary (Harvard University); Russell, Anthony; Anderson, Jason (University of Calgary)

Morphological evolution and phylogeny of caecilian amphibians (Gymnophiona)

Caecilian amphibians remain the least well understood of the three lissamphibian orders, in terms of many fundamental aspects of their biology and evolution. Currently, phylogenetic analyses of characters drawn from the morphology of caecilians lack resolution, as well as complementarity with the results of phylogenetic analyses that employ molecular data. A hypothesis of phylogeny that incorporates morphological data permits the identification synapomorphies and provides a context for exploring evolutionary transitions within a group. Stemming from the hypothesis that the braincase has the potential to yield phylogenetic information, the braincases and intimately associated stapedes of twenty-seven species (twenty-three genera) of extant caecilians were examined using images assembled via micro-computed tomography. Thirty-four new morphological characters pertaining to the braincase and stapes were identified and

tested for congruence with previously recognized morphological characters. The results reveal that characters of the braincase and stapes resolve generic-level relationships in a way that is largely congruent with the results of molecular analyses. The results of a combined analysis of molecular and morphological data provide a framework for conducting ancestral character state reconstructions and permit the generation of a hypothesis relating to the plesiomorphic condition of the caecilian braincase, which bears relevance to ongoing discussions about lissamphibian phylogeny. The current analyses resulted in the identification of 70 new synapomorphies for various clades of taxa, 24 of which appear to be unique for the taxa that possess them. Together these data demonstrate the utility of the application of characters of the braincase and stapes for resolving phylogenetic relationships in this group. The results are discussed as they pertain to caecilian systematics and morphological evolution.

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Makhubo, Buyisile (University of Stellenbosch); Tolley, Krystal (South Afircan National Biodiversity Institute); Bates, Michael (National Museum, Bloemfontein)

Phylogenetic relationships among members of the *Afroedura nivaria* species complex in South Africa

The *Afroedura nivaria* complex is one of six recognized species complexes within the southern African endemic gecko genus, *Afroedura*. The *A. nivaria* complex is a morphologically conservative group of medium-sized geckos endemic to South Africa. They are unevenly distributed in the Eastern Cape, Free State and KwaZulu-Natal provinces. The complex currently comprises five described species. These nocturnal and rupicolous geckos shelter in narrow rock crevices on outcrops. The status of these species has not yet been confirmed using molecular methods and it is unknown whether or not additional lineages are present on isolated outcrops. We investigated the hypothesis that endemics with a narrow distribution (i.e., *A. amatolica* and *A. tembulica*) are single valid species, but that isolated populations in the widespread species (*A. nivaria*, *A. karroica* and *A. halli*) demonstrate genetic variation at the species level. To investigate the evolutionary relationships among these taxa, fragments of two mitochondrial genes (16S and ND4) and one nuclear marker (KIAA) were sequenced and analysed using Bayesian inference, maximum parsimony and maximum likelihood. All analyses strongly supported the genetic distinctiveness of known species. However, the *A. nivaria* complex is not monophyletic, with some lineages clustering within the other species complexes. The phylogeny also shows some structuring at the species level within the three widespread species, suggesting the presence of cryptic species. In addition, one narrow endemic (*A. amatolica*) also showed two distinct lineages. These findings suggest the existence of five (up to seven) additional cryptic lineages.

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Marchand, Rheana (Erell Institute/Salish Kootenai College)

Microhabitat analysis of *Chondrodactylus turneri*

I characterized the habitat use and activity patterns of adult male, adult female, and juvenile *Chondrodactylus turneri*, a common nocturnal gecko endemic to southern Africa, during December-January 2011-2012 in the Namib-Naukluft National Park, Namibia. I assessed their activity periods relative to time of night and the lunar cycle, measured characteristics of habitable rocks, determined microhabitat use by adult and juvenile geckos, and examined measurement data for size differences among males, females, and juveniles. Of the 120 lizards that were captured and measured, 40 were adults (snout-to-vent length (SVL) = 78.8 ± 0.6 mm) and 80 were juveniles (SVL = 41.9 ± 0.6 mm). There was no sexual dimorphism in body length (SVL) between adult males and females, but adults did differ in body proportions. Head width, but not head length, was significantly associated with snout-vent length in adult males. The opposite trend occurred among adult females: head length, but not head width was significantly correlated with snout-vent length. Rocks were considered habitable if they were at least 0.5 m wide and 0.5 m long and had at least 1 crevice that was 15 X 5 cm. Lizards were captured by hand on habitable rocks significantly more often than on uninhabitable rocks. Juveniles were captured in the open 84% of the time, but adults were captured equally often in the open and in crevices. Adult males and adult females did not differ in their capture locations. Higher rocks with more crevices were preferred by geckoes; together, rock height and number of crevices accounted for 31.8% of the variation in gecko captures. Proximity to other rocks did not explain any of the variation in lizards occupying rocks. More detailed observations on lizard movement patterns and the characteristics of lizards co-occurring will be provided.

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Maritz, Bryan (University of the Witwatersrand); Alexander, Graham (University of the Witwatersrand)

Striking it rich: why ambush predators eat large meals?

Snakes that ambush prey are known to consume relatively enormous meals. While the costs associated with consuming large meals have been investigated, few studies have attempted to quantify the relative advantages of consuming very large meals, primarily because the frequency with which such prey items are encountered by wild snakes remains unknown. We quantified prey availability and feeding preferences for the African viperid *Bitis schneideri* in order to understand the advantages of consuming very large meals. We used captures from 4185 pitfall trap-nights to quantify the prey community available to ambushing snakes. Additionally, we used observations of

feeding by wild snakes, and examined the stomach contents of road-killed snakes to quantify the relative abundance of prey types in the diet of *B. schneideri* . Finally we used an individual-based modeling approach to estimate the relative energetic advantages of the capacity to consume very large meals (largest 5% of prey items in the prey community). We found that the prey community at my study site was dominated by lizards, particularly *Meroles knoxii*, and that community structure did not vary significantly between seasons. Moreover we found a strong, positive correlation between the relative abundance of prey types in my traps, and in the diet of *B. schneideri*, suggesting that they are generalist feeders that consume prey types proportionally to the rate at which those prey types are encountered. We found that the distribution of availability of prey, and thus energy, was right-skewed, and that very large meals were encountered infrequently by ambushing snakes. However, my modeling suggests that even when snakes only very rarely encountered large meals, the ability to consume those meals increased energy intake by 1.3 times. We propose that this represents a strong selective force, especially given the strong relationship between energy intake and reproductive output in snakes.

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Medina, Maria Fernanda (The University of Texas at El Paso); Greenbaum, Eli (The University of Texas at El Paso); Bauer, Aaron (Villanova University); Branch, William R. (Bayworld)

Systematics of African Skinks in the *Panaspis wahlbergi* Complex

Snake-eyed skinks are relatively small lizards of the genus *Panaspis/Afroablepharus* that are mostly endemic to the savanna areas of Sub-Saharan Africa. During an expedition in January 2010, specimens of this genus were collected from a moss forest in Katanga Province, Democratic Republic of the Congo (DRC). Three species, listed by de Witte (1953) and Broadley and Cotterill (2004), are known to reside in the Katanga province: *P. seydeli*, *P. smithii* and *P. wahlbergi*. Only the latter species has a congruent morphology with the newly collected specimens. To test our hypothesis of conspecificity between *P. wahlbergi* (described from Natal, South Africa) and the newly collected Katanga specimens, we used PCR to amplify the mitochondrial genes 16S and cyt b (550 bp and 614 bp respectively) and the nuclear gene PDC (422 bp). We aligned these data for analyses with maximum likelihood (RAxML program) optimality criteria. We reconciled the molecular and morphological datasets gathered from the newly collected species with previously published literature. Based on the relatively long branch lengths of lineages in our well-supported phylogeny, *P. wahlbergi* is a complex of at least five cryptic species.

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Meyer, Leon (North-West University); du Preez, Louis (North-West University); Verneau, Olivier (CNRS-EPHE-UPVD)

Impact of invasive parasites on the biology and conservation of indigenous terrapins in South Africa and France

Terrapins have been distributed across the globe in pet and food trade. The juveniles are attractive but tend to lose their colours as they grow. This results in them being released into the environment where they establish natural populations due to their ability to adapt to a broad range of habitats. *Trachemys scripta elegans*, native to the USA, is one of these species that is used in the pet trade and is being released. It‘s estimated that between 1988 and 1994 roughly 26 million specimens were exported worldwide. Some countries banned turtle imports. Nevertheless, 3-4 million terrapin hatchlings are exported each year. Terrapins of the genera *Chrysemys*, *Graptemys*, *Trachemys* and *Pseudemys* were imported into France as pets and many were released. *Trachemys* became an invasive threat to indigenous species, *Emys orbicularis* in some habitats, as they compete for resources because *Trachemys* is bigger and more aggressive. The same happened in South Africa where natural populations of *Trachemys* were documented near Durban and Pretoria and probably contributed to the local extinction of *Pelusios rhodesianus*. A wide variety of Terrapins are infected with various parasites. These parasites are transported with the terrapin wherever it goes. When terrapins are released and natural populations are established, their parasites can escape and switch hosts to infect native species. Evolutionary old parasitic relations rarely have unfavorable effects on the host, but when host switching take place and new parasitic relations are formed, infections often are relentless with unfavorable effects. Monogenetic flatworms known as polystomes are found all over the world where terrapins occur This study will determine the extent to which invasive blood and flatworm parasites spread from invasive American freshwater terrapins to native species in France and South Africa and determine the conservation threats posed by them.

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Nagy, Zoltan T. (Royal Belgian Institute of Natural Sciences); Chifundera Kusamba, Zacharie (Centre de Recherche en Sciences Naturelles); Loetters, Stefan (Trier University); Kielgast, Jos (University of Copenhagen)

Diversity of snakes and frogs in the DR Congo, the green heart of Africa

During the last two years, two major expeditions were conducted in the Democratic Republic of the Congo. In 2010, four field sites between Kisangani and Bumba were surveyed along the Congo river and tributaries. In the Congo basin we visited a wide variety of habitats; such as tropical rainforests, inundated swamp forests and savannah-shrub land mosaics. In 2011, the Upemba and Kundelungu National Parks were

surveyed. This region is a patchwork of plains and plateaus varying from 700 to 1800 m in altitude, dominated by grassland savannah, gallery forest and miombo woodland including a vast number of springs, swamps and streams. In total, more than 1300 specimens of amphibians and reptiles were collected representing around 60 and 70 species, respectively. Tissue samples were taken for genetic analyses. As the first step in these extremely poorly known faunas, we used a DNA barcoding approach to assist the survey of herpetological diversity. DNA barcoding was applied for species delineation complementing morphological identification. Furthermore, we analyzed intraspecific diversity and tested the possible isolating effect of large rivers on reptiles. In general, reptile species proved to be well diverged and easy to delineate using mitochondrial sequences while intraspecific variation is usually low. However, remarkable intraspecific divergence was found in skinks and in some snakes, notably in scolecophidians. We also report the rediscovery of several frog species which were not encountered for several decades.

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Nestler, Jennifer (University of Iowa)

Identification of cryptic species using geometric morphometrics: an analysis of African *Crocodylus*

The Nile crocodile *Crocodylus niloticus* currently has an extensive range throughout the African continent and Madagascar, though fossils reveal a larger historical range included parts of the Sahara Desert, Mediterranean coast, and Arabian Peninsula. Recent molecular studies have yielded genetically distinct populations of *C. niloticus*, dividing African *Crocodylus* into *C. niloticus* and *C. suchus*. However, morphological variation remains unassessed. A geometric morphometric analysis of cranial variation in African *Crocodylus* demonstrates two distinct morphological groups are present. These groups are more morphologically distinct from each other than they are from other members of the genus *Crocodylus*, which supports the presence of a cryptic species complex. The morphometric analysis is coupled with a geographic analysis that reveals the morphological variation is broadly bound by river basins, with one group located in Northern and Western Africa and another in Southern Africa. However, cluster analyses indicate that the two species overlap considerably in Central Africa. These results are congruent with molecular analyses, supporting the methods employed herein as an effective way to distinguish cryptic species. Because the vast majority of the skulls included in this analysis were collected prior to the mid-20th century, this analysis provides insight to past population structure and can be used to inform conservation efforts. The greatest potential for the survival of these species lies in a thorough understanding of their evolutionary history, interrelationships, and biogeography.

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Nielsen, Stuart (University of Mississippi); Bauer, Aaron (Villanova University); Tolley, Krystal (South African National Biodiversity Institute); Noonan, Brice (University of Mississippi)

Comparative phylogeography of three rock dwelling lizard species gives unparalled insights into the speciation process in southern Africa

We explored how geology, geography and changing climate have affected the distribution of organisms in southern Africa, particularly for species spanning the arid/ semi-arid Karoo biome. Using comparative phylogeography, we explored patterns within three co–distributed yet distantly related, rock-dwelling lizard species: the southern rock agama, *Agama atra*; Bibron‘s gecko, *Chondrodactylus bibronii*; and the Karoo girdled lizard, *Karusasaurus polyzonus*. All three taxa are saxicolous, greatly utilizing the geologically complex, ancient, rock formations found throughout the subcontinent, yet differ in period of daily activity, social structure, and microhabitat use, (although *C. bibronii* has been observed inhabiting the same rock cracks with either *K. polyzonus* or *A. atra*). In many regards *C. bibronii* could be considered a ―rock generalist, often living in rocky habitat unsuitable for either *A. atra* or *K. polyzonus*. This habitat-leniency could potentially erase significant, informative genetic signal, as it would allow for better individual dispersal throughout this species‘ range. In light of this, we theorized that there would be a degree of shared evolutionary history across the subcontinent between the three, particularly at recognized barriers of gene flow for other rock-dwelling organisms (e.g. the Knersvlatke plain) due to shared distribution and gross ecological requirements. Employing multiple sources of genetic data (i.e. mtDNA, fast-evolving nuclear DNA, and single nucleotide polymorphisms) we asked: what is the structure of ‘populations‘ within a species, and what are the geographic boundaries of those groupings; 2) are these clusters/populations isolated (or conversely, is gene flow ongoing between them), and for how long; and 3) how have climatic shifts affected species/ population distributions? The species-specific patterns granted unique insight into the processes of speciation in the poorly understood arid zones of the southern hemisphere.

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Nopper, Joachim (University of Hamburg); Braskamp, Enzo; Lauströer, Balten; Ganzhorn, Jörg (University of Hamburg)

Habitat affinities and population characteristics of reptiles from arid south-western Madagascar

South-western Madagascar is exceptional in its reptile species richness with more than sixty species occurring in the Tsimanampetsotsa National Park and its surroundings. The vegetation is very diverse, depending on soil and land use type. The region is

characterized by a mosaic of different forms of land use growing into formerly undisturbed areas with growing needs of people living in the area. The mosaic contains areas of grazing (zebus and goats), agriculture (slash and burn), and charcoal production. We aim to understand the origin of the mosaic for reptile distributions and population dynamics to arrive at sustainable conservation (i.e. sustainable land use that will lead to a preservation of natural communities). This also incorporates the determination of suitable indicator species of habitat transformations. In this talk we will present results on the affinities of reptile species (including fossorial species) towards certain (micro-) habitats and the role of land use systems on species distributions along a transect of 60 km, stretching from west to east, covering agricultural used land, littoral forest, dry spiny bush, dry forests and savanna. We will provide information on the constitution of certain reptile species by analyzing morphometric data, and their variation between habitat types. These morphometric measures might provide additional insights on the effects of habitat degradation and land use impacts on possible indicator species that are not reflected in species compositions yet and thus might serve as an early warning system.

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Ofori-Boateng, Caleb (Forestry Research Institute of Ghana); Oduro, William (Kwame Nkrumah University of Science and Technology); Norris, Ken (University of Reading); Rödel, Mark-Oliver (Museum für Naturkunde)

Differences in the Effects of Selective Logging on Amphibian Assemblages in Three West African Forest Types

Making generalizations about the impact of commercial selective logging on biodiversity has so far remained elusive. Species responses to logging depend on a number of factors, many of which have not been studied in detail. These factors may include the natural forest conditions (forest types) under which logging impacts are investigated; but this question has so far remained unexamined. In a large-scale replicate study we aimed at clarifying the relationship between logging and forest types on frog richness, diversity, and assemblage composition. We contrast three distinct and naturally occurring forest types, including wet evergreen, moist evergreen and semi-deciduous forests. Selectively logged sites were compared with primary forest sites for each forest type. We found that the response of frog communities to logging varies in different forest types. In the wet evergreen forest, richness was higher in logged forest than primary forest, while diversity measures were not different between logged and primary forest sites. In the moist evergreen forest, richness and diversity were higher in selectively logged areas compared to primary forest habitats. In the semi-deciduous, logged forests were characterized by drastic loss of forest specialists, reduced richness and diversity. These results indicate that the net effect of logging varies with respect to

forest type. Forest types that are characterized by adverse climatic conditions (i.e., low rainfall and protracted dry seasons) are more likely to produce negative effects on leaf litter anuran communities. For comparisons of the impact of logging on species to be effective, future research must endeavour to include details of forest type, rainfall patterns, logging intensities, and rotation cycles.

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Ogoanah, Sylvia (University of Benin); Ehiosu, Kingsley (University of Benin)

Distribution of Anuran species in Iyanomo Rubber Research Institute, Benin City, Nigeria

Distribution of anuran species in Iyanomo Rubber Research Institute, Nigeria was studied by a combination of handpicking and visual encounter survey method between March and October 2011. Twelve species belonging to four families and ten genera were recorded. These include *Bufo maculatus*, *Afrixalus dorsalis*, *Hyperolius concolor*, *Leptopelis viridis*, *Hemisus marmoratus*, *Ptychadena bibroni*, *P. mascareniensis*, *P. pumilio*, *Chiromantis rufescens*, *Silurana tropicalis*, *Hoplobatrachus occipitalis* and *Arthroleptis poecilonatus*. The most abundant species was *Bufo maculatus* (18.4%) while *H. marmoratus* and *P. mascareniensis* recorded the least (5%). The species were distributed within four sites situated in the Rubber plantation – pond, rubber, oil palm and plantain farms. The plantain farm had the highest diversity (2.3) while the oil palm farm had the least (1.09). There was a significant difference between pond and rubber and oil palm plantations ($P < 0.05$). Cluster analysis showed two main clusters and one outlier. The work aims to reduce the gap in the knowledge of anuran species diversity in Nigeria.

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Pabijan, Maciej (Jagiellonian University); Wollenberg, Katharina (Trier University); Vences, Miguel (Technical University of Braunschweig)

The influence of body size on diversification in anurans: a case study from Madagascar

The processes affecting species diversification may also exert an influence on patterns of genetic variability within species. We evaluated the contributions of five potential explanatory variables affecting rates of species formation (body size, reproductive mode, range size, microhabitat and skin texture) on nucleotide divergence between populations and polymorphism within populations in the mitochondrial 16S rRNA gene for 40 species of frogs (Mantellidae) from two rainforest communities in Madagascar. We find that with the exception of body size, none of the proposed factors correlate with regional differentiation or levels of genetic variation within populations of mantellid frogs.

However, we detected a significant but weak (ca. 11% of the explained variation in nucleotide divergence) inverse relationship between body size and divergence between populations, and in most cases a complete lack of haplotype sharing between populations of small-bodied species. This implies considerable population subdivision and low levels of gene flow in small and medium sized frogs. Lower vagility and shorter generation times, both putatively associated with small body size, are hypothesized to be the proximate mechanisms producing this pattern. The biological correlates of small body size may thus establish a basis for regional genetic fragmentation, which in turn may accelerate rates of allopatric speciation in small-bodied frogs relative to large species. Our results are corroborated by a recent phylogeny-based study in mantellids that found a link between small body size and higher mtDNA substitution rates. Taken together, our findings suggest a mechanism through which variation in body size might influence species formation and thus has important implications for diversification rates in tropical amphibians and possibly other vertebrate groups.

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Penner, Johannes (Museum für Naturkunde); Barej, Michael F. (Museum für Naturkunde)

Biogeographical patterns of West African amphibians - searching for causes in time and space

The detailed distribution of many amphibians is rarely known. Especially in tropical regions fine grained information is lacking. Furthermore, the reasons for the observed patterns are even harder to unlock. One way to close these gaps is via environmental niche modelling (ENM). Our study area, the forests of Upper Guina are one of the worlds hotspots and therefore of special importance. We used ENMs to model the distribution of all West African amphibian species, hence including Upper Guinea. The resulting pattern of diversity is compared against major barriers (altitude and rivers) as well as against patterns derived from phylogenetic data for selected families. Explanations are searched for all species in the selected niche parameters used in the ENMs but also in parameters not modelled. Unfortunately, all identified important and unique areas in the region experience an ever increasing pressure from habitat alteration and destruction. Gained results are compared against the current set of conservation areas, depending on their formal status. In our opinion a regional conservation plan is urgently required.

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Portik, Daniel (University of California, Berkeley)

Counter-current faunal exchanges across the Arabian Peninsula: Patterns from varanids and toads

Faunal exchanges between Africa and Asia, driven by climatic oscillations and the availability of land bridge connections, have resulted in patterns of admixture across Northern Africa, the Arabian Peninsula, and throughout much of the Middle East. The Arabian Peninsula and the Red Sea have a complex geological history, and varying levels of connectivity with Africa have allowed for scattered vicariance events and uneven periods of potential dispersal opportunities. The dynamic geology of the formation of the Red Sea and associated dates of major events leads to several hypotheses that can explain current distributional patterns of fauna around the Middle East. These hypotheses are testable in a phylogenetic framework using divergence time estimates. I investigate these patterns in African monitor lizards (*Varanus*), focusing on one species group (*V. albigularis*) that displays a disjunct Afro-Arabian distribution. I also investigate these patterns in a toad complex (*Duttaphrynus* [= *Bufo*]) distributed across the Horn of Africa (Somalia), the Arabian Peninsula (Yemen, Oman), and the Middle East (Iran, Afghanistan, Pakistan). By comparing these newly generated data sets to previously conducted studies, I attempt to summarize major biogeographic patterns and shed light on the complex history of the Red Sea region.

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Portillo, Frank (University of Texas at El Paso); Greenbaum, Eli (University of Texas at El Paso)

Systematics of *Leptopelis* (Anura: Arthroleptidae) from the Itombwe Plateau, eastern Democratic Republic of the Congo

Leptopelis, a genus of Central African treefrogs, includes 52 species that live in tropical forests and savannas. Currently, only two species of *Leptopelis* are known from the poorly explored Itombwe Plateau in eastern Democratic Republic of the Congo (DRC). Itombwe is renowned for its rich and endemic amphibian fauna, including: *Xenopus itombwenesis*, *Chrysobatrachus cupreonitens*, *Laurentophryne parkeri* and at least three species of *Arthroleptis*. Within the framework of a larger *Leptopelis* phylogeny, we examined the evolutionary relationships of 27 samples of Itombwe *Leptopelis* by sequencing two mitochondrial (16S and cyt b; 1100 base pairs [bp]) and two nuclear (RAG1 and c¬-mos; 1400 bp) genes. These DNA sequence data were analyzed with maximum parsimony in PAUP* 4.0b, maximum likelihood in RAxML v7.2.6 and Bayesian inference in MrBayes v3.1. For Bayesian inference, the appropriate model was inferred using jModelTest. We used multiple morphological characters and male advertisement call data to examine species boundaries in distinct lineages identified from our molecular phylogeny. Results indicated that several distinct lineages deserve recognition as new species and demonstrate the importance of the Itombwe Plateau as a center of endemism.

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Randrianantoandro, Christian (Madagasikara Voakajy); Andriantsimanarilafy, Raphali (Madagasikara Voakajy); Jenkins, Richard; Griffiths, Richard (Durrell Institute of Conservation and Ecology)

Conservation and sustainable use of chameleons in Madagascar

In Madagascar, 76 species of chameleons in the genera *Brookesia* , *Calumma*, and *Furcifer* are described. These species are distributed in different habitat types from savannah grassland to the primary humid or dry forests across an elevational gradient from sea level to the highest mountains. Chameleons are important for ecotourism and trade but not well known by Malagasy people. Recent initiatives have been undertaken to improve the conservation and sustainable use of these species. Red List assessments of all Malagasy chameleons in 2011 identified 41 of the 76 species to be threatened. The major threat identified is loss of habitat due mainly to selective logging and bush fires. Priority species for research and conservation were identified. Research is underway to determine the distribution areas of the most threatened chameleons in the protected areas network in Madagascar. Only four large chameleon species - *Furcifer lateralis*, *Furcifer oustaleti*, *Furcifer pardalis*, and *Furcifer verrucosus* - have received quotas for the legal trade since 1994. A better understanding of illegal chameleon trade was obtained after meetings with Malagasy operators and a pet market survey in Thailand. All recorded imports to Thailand are reported as captive-bred animals from Lebanon and Kazakhstan. Some activities were undertaken with the CITES authorities to re-evaluate all Malagasy chameleons for trade. Initially, *Furcifer campani* was identified as an additional species that could support moderate harvest. This species is easy to identify using identification guides. Public awareness, environmental education in primary schools and student training were carried out to improve the knowledge and awareness of Malagasy people concerning chameleons. Despite recent progress in research and conservation, significant challenges remain to ensure the long-term conservation and sustainable harvest of chameleons in Madagascar.

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Riemann, Jana Carina (University of Hamburg); Ndriantsoa, Serge Herilala; Raminosoa, Noromalala R. (University of Antananarivo); Rödel, Mark-Oliver (Museum für Naturkunde Berlin); Glos, Julian (University of Hamburg)

Biodiversity loss due to habitat fragmentation? The case of frogs in Madagascar

Habitat fragmentation is a process that may lead to the loss of biodiversity, i.e. to species -depleted communities in fragments. Various phenomena are associated with habitat fragmentation, e.g. the reduction in the total habitat area, an increasing ratio of edge to

interior habitat, and the isolation of one forest fragment from others. Matrix habitat, i.e. the non-forested area in between patches of natural forest habitat, might have a key influence on community structures in a fragmented landscape as it might or might not act as a corridor for dispersal, or it might even be suitable habitat per se for some species. In our study we aim at understanding how patterns of amphibian diversity depend on fragmentation related properties of amphibian habitat such as forest fragment size and matrix quality, and how local extinctions depend on functional components of diversity. Our study site is the Ranomafana National Park (RNP) and its surroundings, a mid-altitude rainforest ecosystem in Eastern Madagascar that is exceptional in its amphibian diversity (>100 species). We determined species richness and composition along transects distributed along streams (community of stream breeding frogs) and in terrestrial parts (community of frogs that reproduce independent from running water) that were spread over three major habitat types: RNP (control area), forest fragments, and matrix (i.e., secondary vegetation, matrix streams, rice fields, banana plantations). We found no differences in total species richness and local species richness (i.e., SR per transect) along stream transects between RNP, fragments and matrix. Hence species richness of stream dependent frogs was not affected by fragmentation. However, local species richness along terrestrial transects decreased with increasing degradation, with most species found in RNP and least in the matrix. Species turnover between RNP and fragments was similar as between RNP and matrix, as well as between fragments and matrix, an entirely unexpected result. Beside a relatively consistent community along streams, each habitat type comprises unique species. Therefore we hypothesize that amphibian communities in RNP, fragments and matrix sites differ in functional diversity, and that the functional groups from which species are lost are non-random.

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Rödel, Mark-Oliver (Museum fuer Naturkunde Berlin)

West African amphibians: diversity, threats and future

Globally the biodiversity of the Afrotropics is probably among the least well known. West Africa is no exception from that rule. Although amphibians of this region were intensively studied, in particular since the 1960s, we continuously added new and spectacular discoveries throughout the last 20 years. This process is still far from being completed. In the first part of the talk I will summarize our findings and pinpoint on the major gaps that still exist. Unfortunately, biodiversity in the region suffers from a constantly increasing exploitation of natural resources (i.e. conversion of habitats to agricultural land, logging, mining, bush meat trade), as well as from changing climatic conditions. To uncover the potential effects of these environmental changes, amphibians are an especially valuable group of organisms. In the second part of my talk I will

highlight the known responses of West African amphibians to these challenges and outline what we may deduce from their evolutionary history (biogeography, life histories) concerning their future.

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San Mauro, Diego (University of Barcelona); Gower, David (The Natural History Museum); Zardoya, Rafael (Museo Nacional de Ciencias Naturales); Wilkinson, Mark (The Natural History Museum)

The Tree of Life of caecilian amphibians: from mitogenomics to multilocus

Caecilians (Gymnophiona), along with frogs and salamanders, are one of the three orders or extant amphibians. They are a highly specialized group with elongate, annulated and limbless bodies, and sensory tentacles in the head. Most of the nearly 200 currently recognized species have a secretive fossorial lifestyle, but members of one family are secondarily adapted to aquatic habitats. Although they are a relative small group, they have a remarkable morphological, ecological, and reproductive diversity. There are 10 currently recognized families of caecilians (35 genera) distributed in tropical regions of Africa, Central and South America, India, and South East Asia. During the past 10 years, we have used complete mitochondrial genomes to unravel the phylogenetic relationships and systematics of the major lineages of caecilians. This mitogenomic approach has eventually yielded a robust phylogenetic framework for 45 caecilian taxa representing most described genera (over 80%), including some for which molecular data had never been collected before. More recently, we have moved on a multilocus approach in order to reconstruct the caecilian tree of life at a finer level. We have sequenced six nuclear (four protein-coding, one ribosomal, and one intron) and six mitochondrial (four protein-coding and two ribosomal) markers for an expanded taxon sampling of 70 caecilians representing virtually all the diversity in Gymnophiona. Preliminary phylogenetic results of this multilocus dataset are robust and definitively promising. We are now using both the mitogenomic and the multilocus phylogenetic frameworks to study morphological and reproductive evolution, as well as historical biogeography and diversification patterns in caecilians.

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Schweiger, Susan (Jena University); Müller, Hendrik (Jena University)

Skeletal and muscular ontogeny of the direct developing frog *Arthroleptis xenodactyloides* (Anura: Arthroleptidae)

Direct development is widespread throughout the animal kingdom and raises interesting questions in evolutionary and developmental biology. The development of direct

developing taxa is characterized by the loss of the aquatic, larval stage and usually differs considerably from taxa with the plesiomorphic, metamorphosing life-cycle. In frogs direct development is widespread, both phylogenetically and in terms of species numbers, but surprisingly little information is available on the development of direct developing species. In this study, we examined the skeletal and muscular development of the direct developing, East African squeaker frog *Arthroleptis xenodactyloides* (Arthroleptidae) using whole mount immunohistochemistry. The focus of investigation lies on characters involved in larval feeding, which have often been altered in comparison to biphasic frogs. Embryonic development in *A. xenodactyloides* is altered in comparison to taxa with a free-living aquatic larva shows similarities to other direct developing anurans, such as *Eleutherodactylus coqui* and *Philautus silus*. In *A. xenodactyloides* , the absence of nearly all larval cartilages typical for the ancestral life-history is an obvious feature of embryonic development. In metamorphosing frogs, bone formation occurs post-hatching, whereas cranial ossification in *A. xenodactyloides* has been advanced into the embryonic period. Furthermore, the plesiomorphic cranial muscle ontogeny in metamorphosing anurans differs considerably from that seen in the direct developing *A. xenodactyloides* embryos. Comparing the limited, available data on direct developing anurans, the degree to which direct development deviates from the ancestral life-history appears to vary substantially between species that evolved direct development independently.

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Scott-Prendini, Elizabeth (American Museum of Natural History); Oliver, Lauren (Louisiana State University); Visser, John (National Museum of Namibia); Lewis, Amanda (Louisiana State University)

Morphological variation in African Bullfrogs (Pyxicephalidae: *Pyxicephalus*), assessed from CT scan data and morphometrics

African bullfrogs (*Pyxicephalus*) are large, impressive anurans which display reversed sexual dimorphism, male-male combat and male parental care. Three species are currently recognized from throughout the arid savannas of Africa. Morphometric data have traditionally underpinned the diagnoses of species within *Pyxicephalus*. However, the two most commonly encountered species (*P. adspersus* and *P. edulis*) are problematic to diagnose: none of the four traditionally used characters separate all individuals from all regions. This study aimed to examine the morphology of all previously named taxa (valid or synonymized), assess the extent of geographical variation across Africa, and identify consistent diagnostic characters for each species. The rarity of some material, and general poor results obtained through double staining and clearing large vertebrates preclude this method for *Pyxicephalus*. Computed

Tomography (CT) scanning was used to create non-destructive 3D images of the skeletons. A dataset from external morphology and osteology from discrete characters was compiled. Various notable skeletal characteristics specific to *Pyxicephalus* were discovered, some of which appear to be correlated with its fossorial lifestyle, whilst others may be the result of structural constraints caused by large body size, or even ecology. We found that many of the traditional morphometric characters are not reliable for species diagnosis, and examined the osteological basis for this. Further work on genetics and vocalizations of *Pyxicephalus* is underway, and may reveal further cryptic taxa.

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Shirk, Philip (Virginia Commonwealth University); Patrick, David (Paul Smith's College); Howell, Kim (University of Dar es Salaam); Harper, Elizabeth (Paul Smith's College); Vonesh, James (Virginia Commonwealth University)

Community and population-level responses of an Afromontane chameleon assemblage to forest fragmentation

Habitat modification in the form of fragmentation and loss is a leading cause of biodiversity decline. The basic predictions from island biogeography theory that species richness and population size decrease with declining area and increased isolation have received considerable support. However much of this research has focused on birds and mammals in temperate regions or the Neotropics, limiting our ability to generalize to other taxa and regions. Reptiles in particular are understudied and have not shown a clear response. Here we examine the community and population-level responses of an Afromontane chameleon assemblage to forest fragmentation. The East Usambara Mountains of Tanzania have high rates of endemicity within a highly fragmented forested landscape. Within this fragmented habitat are eight species of chameleon, many of which are of conservation concern. We used repeated distance-based sampling in a large forest block and 11 forest fragments in order to estimate species‘ densities and overall richness. This allowed us to quantify the population and community-level responses to habitat fragmentation while accounting for differences in detectability. Chameleon richness decreased with both decreasing fragment size and with increasing isolation. The chameleon communities of 10 of the 11 forest fragments were subsets of the community of the largest block sampled, suggesting that smaller fragments contribute little to landscape-level biodiversity. Chameleon densities are better predicted by fragment area alone than by any model including isolation, but species‘ responses differ. *Rhampholeon temporalis* shows a strong decrease in density with decreasing fragment area, while *Trioceros deremensis*‘ density decreases only slightly with decreasing fragment area. Neither species was found in the two smallest forest fragments

(< 3.5 ha), suggesting that each has a similar fragment area threshold. The combination of *Kinyongia matschiei* and *K. vosseleri* show an increase in density as fragment area decreases. Due to the alteration of chameleon communities in smaller fragments, with declines in species richness and species-dependent changes in density, several small blocks are not equivalent to a single large block. A possible functional cause for this non -equivalency is altered vegetation characteristics in smaller fragments. In some cases the vegetation variables are more strongly correlated with species‘ density than is fragment area.

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Shirley, Matthew (University of Florida)

Phylogeographic perspective on the population histories of sympatric Central African crocodiles

Recent molecular phylogenetic studies have shown that the three traditionally recognized extant African crocodilian taxa (*Crocodylus niloticus*, *Mecistops cataphractus*, and *Osteolaemus tetraspis*) are each comprised of highly divergent, cryptic lineages. Interpreting these results in light of continent-scale biogeographic events indicated several common, putatively vicariant, patterns. Our study represents the first comparative study across Africa crocodilian taxa. Cryptic African crocodile complexes provide a unique opportunity for comparison because they are of different evolutionary age yet display similar levels of distributional stability. Despite being broadly sympatric throughout western Africa, they each exhibit significant niche partitioning and life history differences, as well as different capacity for dispersal. Comparative phylogeographic analyses provide a framework under which genealogical concordance between sympatric species is used to test the strength of geographic features in structuring regional biotas. Comparing phylogeographic structure between these crocodile species complexes will produce significant insights into the relative role of vicariance, notably basin entrapment, and the effects of paleoclimatic change on forest distribution and desertification. Individuals of all three crocodile species were sampled from throughout their known distributions from both wild populations and museum collections and sequenced at up to five homologous gene regions including both mitochondrial and nuclear markers. Individuals of *Mecistops* and *Osteolaemus* were additionally genotyped for 10 homologous microsatellite loci. Sequence data for all three species was analyzed under a comparative, statistical phylogeographic framework to test congruent vicariance and divergence timing between the Congo and Ogooué Basins, as well as across the Cameroon Volcanic Line. Both sequence and microsatellite data were used to test for patterns of comparative structure between *Mecistops* and *Osteolaemus* within the Ogooué Basin. Preliminary results show congruent patterns of

high interbasin differentiation, though not for all species complex pairs, with low intrabasin structure. These results support the importance of both species specific and landscape-level factors in driving the evolution of faunas across regions over time.

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Shirley, Matthew (University of Florida)

Range-wide Hierarchical Processes Structuring Slender-snouted Crocodile Populations

The factors shaping landscape-level population genetic structure are dynamic and dependent on both fine and coarse spatial and temporal scale processes. Therefore, a comprehensive understanding of regional evolutionary processes can best be gained by integrating data that are affected by factors operating at a broad spatiotemporal scale. The slender-snouted crocodile (*Mecistops cataphractus*) is an old (min. 10-12 mya), widely distributed habitat specialist (forest-restricted) that has undergone large-scale anthropogenic population reductions. We assessed the phylogenetic, phylogeographic and landscape genetic structure of this species with the objectives of elucidating regional biogeographic process and better managing wild populations of this increasingly threatened crocodile. Samples from wild individuals from throughout the range were collected and sequenced for four mitochondrial genes and unlinked nuclear loci, as well as genotyped for 14 unlinked microsatellites. Phylogenetic and coalescent-based methods were used to test for cryptic, species level diversity between the three major biogeographic zones of western Africa following expectations from sympatric crocodile species, and to test the relative importance of historic versus contemporary events on population structure. Phylogenetic analysis provided support for two highly divergent, monophyletic clades with no support for finer-scale structure within each independent biogeographic zone; though the observed phylogeographic pattern is incongruent with expectations from closely related crocodile species suggesting that *M. cataphractus* may be older than evidenced by the fossil record. Within the Ogooué Basin, preliminary results support drainage structured populations with higher isolation between more distantly distributed populations likely exacerbated by anthropogenically-mediated population declines. In the face of rapid environmental change, studies aiming to impact the conservation of biodiversity can no longer afford to be narrow in scope. This project utilized a novel, multi-level approach to species conservation that integrated field and molecular techniques to improve our understanding of the ecological and evolutionary processes driving population structure and persistence in the slender-snouted crocodiles across western Africa.

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Sinsch, Ulrich (University of Koblenz-Landau); Dehling, J. Maximilian (University of Koblenz-Landau)

Acoustic niche partitioning in an anuran community inhabiting an afromontane wetland (Butare, Rwanda)

The species richness and calling activity of an anuran community inhabiting an agricultural wetland area at 1 645 m asl near Butare, Rwanda, was assessed with visual and acoustic transects. The community included 15 species which were readily distinguishable using morphological, bioacoustic and molecular features. Eight species (*Xenopus victorianus*, *Amietophrynus regularis*, *Ptychadena anchietae*, *P. porosissima*, *Kassina senegalensis*, *Afrixalus quadrivittatus*, *Hyperolius kivuensis*, *H. lateralis*) were taxonomically identified. The remaining seven species (3 species of *Hyperolius*, 2 *Phrynobatrachus*, 1 *Amietia*, 1 *Ptychadena*) represent undescribed or currently unrecognized taxa suggesting a significant magnitude of overlooked amphibian diversity in afromontane communities. Acoustic niche analysis of the 14 species producing airborne advertisement calls integrated the spatial dimension, i.e. the microhabitat used for calling, the temporal dimension, i.e. the daytime at which calling takes place, and the call structure dimension, i.e. the physical features of the advertisement call . Average standardized acoustic niche breadth was narrow (measured: 0.08, predicted: 0.07) and showed low variability (0.04 - 0.16) among species, which means that empiric data are in full agreement with the predictions of stochastic niche theory for species-saturated communities. Niche segregation was mainly based on advertisement call features, whereas spatial and temporal niche dimension contributed less. Measured average niche overlap (0.30) was intermediate between random overlap (0.51) and minimum possible overlap (0.11) indicating significant acoustic resource partitioning. The only taxon group with widely overlapping acoustic niches were *Ptychadena* spp. which might indicate a recent invasion of the community by one or two of the three species.

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Sinsch, Ulrich (University of Koblenz-Landau); Neukirch, Sarah (University of Koblenz-Landau)

Diel vocalization activity of the afromontane umbrella species *Hyperolius castaneus* under controlled conditions

The highland anuran communities (2000 – 2800 m) of the Albertine Rift in Rwanda and DR Congo include Ahl´s reed frog (*Hyperolius castaneus*) which represents a suitable umbrella species for threatened highland Albertine Rift endemics. *H. castaneus* is easily detected in field based on the characteristic advertisement and aggression calls which were emitted during the day and at night. In captivity (LD 12:12, temperature range 20-27°C), we recorded continuously calling activity of nine males collected in the Nyungwe

National Park at 2370m, using a Song Meter SM2 (Wildlife Acoustics, Inc .). Responses to acoustic stimulation by playback-advertisement calls and of simulated rainfall were tested. During trials frogs gave predominantly advertisement calls and rarely aggression calls. Independent of ambient humidity, call activity was significantly greater during darkness, but never ceased. Acoustic stimulation increased daytime activity to night levels, but direct vocal response to playback-advertisement calls were rare. Calling activity decreased with rising temperature. Our study supports that advertisement of *H. castaneus* occurs throughout the whole year day and night, making this species an ideal umbrella species for the rapid assessment of threatened anurans in montane Rift communities.

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Slimani, Tahar (Cadi Ayyad University); Abderazzak, Fattah; El Hassan, El Mouden; Mohamed, Radi (Cadi Ayyad University); Stefano, Doglio (Società Romana di Scienze Naturali)

Ecology and population parameters of *Pseudepidalea brongersmai* (Hoogmoed, 1972) living in small temporary ponds in the arid area of Jbilets (Western Morocco)

Climate Change including more or less extended drought periods in arid environments may be one of the major causes of animal populations decline. The object of this work is to study the population demography and ecology of *Pseudepidalea brongersmai*, a Moroccan endemic amphibian living in an arid environment. The study was conducted in the central Jbilets (Western Morocco) during 4 years (2008-2011). The relative abundance of the species in two nearby located temporary ponds (maximal diameter of 4 and 6 meters, respectively) was 86 individuals. The adult sex ratio was close to 5.4 for males. The average size of individuals was 43.8 mm (min: 35.5 mm to max: 48.1 mm), with an average weight of 5.8g (min: 5g to max: 6.4g). The specimens with size between 40 and 45 mm represented over 53% of the sample. The study of the reproduction and behaviour activity provided us extensive knowledge about the adaptation of this toad to an arid and unpredictable environment. In fact, there is a strong connection between this species phenology and the rainfalls: an early activity and reproduction occurred immediately after the rains, apparently as an adaptation of this species to its constraining environment (to optimize the chances of tadpoles survival). The diets of adults analyzed from faecal contents and based on the occurrence frequency and the relative number of prey showed that Coleopteran and Formicidae constitute the dominant dietary items. This study has been supported by the Hassan II Academy for Science and Technique – Project " ICGVSA".

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Smid, Jiri (National Museum); Carranza, Salvador (Institute of Evollutionary Biology); Gvozdik, Vaclav (Nationa Museum, Prague); Kratochvil, Lukas (Charles University); Moravec, Jiri (National Museum, Prague)

Cryptic diversity of Arabian geckos of the genus *Hemidactylus*

The genus *Hemidactylus* includes over one hundred species, majority of which occurs in tropical Africa and Indian subcontinent. The Arabian Peninsula is known to host 13 species, some of them described very recently suggesting that overall diversity of these geckos in this particular region is still underestimated. In our study we used material comprising more than 200 specimens densely covering Oman, Yemen (including Socotra Island), UAE, Jordan as well as several localities from adjacent Northwest Africa (Egypt, Sudan, Ethiopia, Somalia) and Iran. Sequence data gained from up to four mitochondrial (12S rRNA, ND4, tRNAs and cytochrome b) and four nuclear genes (RAG-1, RAG-2, C-mos, MC1R) were used to infer the phylogenetic relationships among all known Arabian species from the Arid clade species group. As our results suggest, the real diversity of *Hemidactylus* in Arabia is much higher than ever expected. Analysis of mtDNA revealed about nine new main lineages (depending on the level of accepted intraspecific variation), all of them were also clearly identifiable and supported by nuclear data. Most of these new lineages inhabit mountain areas in northern Oman and southern and central Yemen. In addition, several oversea dispersal events of the gecko fauna across the Gulf of Aden are reported.

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Smolensky, Nicole (Texas A&M University)

Phylogeography of Dwarf Crocodiles (*Osteolaemus* spp.)

The dwarf crocodile, *Osteolaemus tetraspis*, is hunted throughout its geographic distribution primarily for food and there is concern that this species cannot endure current harvest pressure. Moreover, there is new evidence suggesting this species is part of a cryptic species complex (Eaton et al. 2009) making the geographic distributions of *Osteolaemus* species uncertain. The Guineo-Congolian region is one of seven regions of endemism containing mountain archipelagos and river basins that serve as biogeographic boundaries for amphibian, bird and mammal communities. I test two alternative hypotheses that may serve as a biogeographic divide among cryptic species of *Osteolaemus*. An extensive mountain range along the Cameroon-Nigerian border may hinder gene flow among *Osteolaemus* species and thus serve as a biogeographic boundary among the cryptic species. Alternatively the cryptic species may be sorting by river basins. I collected tissues samples from *Osteolaemus* species on east and west side of the Cameroon-Nigerian highlands and from the Ogoouè, Cross River and Congo

River basins. Preliminary evidence of the mitochondrial COI gene do not support the hypothesis that the highlands serve as a biogeographic divide among cryptic species.

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Solovyeva, Evgeniya (Lomonosov Moscow State University); Poyarkov, Nikolay; Dunayev, Evgeniy (Moscow State University)

Toad-headed agamas: some new insights on phylogeny of the genus *Phrynocephalus* (Agamidae, Reptilia) inferred from mt and nuDNA markers

Phrynocephalus is a genus of agamid lizards with rather uncertain phylogeny. There are about 40 species of *Phrynocephalus* (from 37 to 50 according to different opinions), they can be grouped in several species complexes, but their phylogenetic relationships are still unclear. One of the main problems is the large area of the genus, from Arabian Penninsula to NW China and from S Russia to Afghanistan. It is difficult and almost unreal to collect samples of all existing species, so we used several species for one species group. We studied 2 nuDNA gene fragments (1200 b.p. of RAG-1, recombination activating gene, and 1000 b.p. of BDNF, brain derived factor) and 3 mtDNA gene fragments (650 b.p. of COI, 1000 b.p. of ND2 and 900 b.p. of ND4), in total 4750 b.p., of more than 25 species. Maximum Likelihood and Neighbour Joining trees where constructed on the base of separate and concatenated alignments. Several species groups had valueble bootstrap for their monophyletic origin: viviparous chinese species, ocellatus-group, helioscopus-group, versicolor-group and guttatus-group; Iranian and Arabian species in some analysis splitted into two distinct independent groups. The position of *Ph. mystaceus* is floating on the phylogenetic trees, but in all cases it doesn`t form a monophyletic clade with *Ph. interscapularis* and *Ph. scutellatus*. Thus the subgenus *Megalochilus* previously proposed by several authors should be considered unvalid. Basal position on the tree is occupied by Iranian and Arabian species. The recent origin of *guttatus* and *versicolor*-groups also is supported.

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Soorae, Pritpal (Environment Agency); Al Dhaheri, Shaikha (Environmental Agency)

Ecology and Chytrid Fungus Surveillance of two toad species from the United Arab Emirates

The United Arab Emirates (UAE) is a federation of seven Emirates, which lies in the north of the Arabian Peninsula, and is a predominantly desert country with a hyper-arid climate. It has two toad species namely the Arabian Toad (*Duttaphrynus arabicus*) and the Dhofar Toad (*Duttaphrynus dhufarensis*), which are restricted to the mountainous north where there are wadis (seasonal river in mountainous areas). The wild toad populations are mostly limited to the Northern part of the UAE which is mountainous

and has wadis (seasonal rivers in mountainous areas). A chytrid fungus baseline survey was done to collect any baseline information on chytrid fungus presence or absence in the UAE due to the lack of information on this fungus which has decimated amphibian populations worldwide. This survey also generated useful information on toad distribution in the UAE.

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Stanley, Edward (American Museum of Natural History)

Evolutionary patterns of ecology and biogeography in the Cordylidae

The Cordylidae is the only squamate family endemic to sub-Saharan Africa and comprises 80 species of rupicolous, arboreal and fossoreal lizards. The majority of the phylogenetic and ecological diversity occurs in Southern Africa, although the family‘s range extends to Northern Angola and Ethiopia. Previous comparative and historical biogeographic analyses of the group has been hindered by poorly understood phylogenetic relationships, but following a recent systematic revision of the family, comparative analyses are now possible. Utilizing the biogeography programs LaGrange and DIVA in conjunction with an updated phylogeny, strong support is recovered for a Southeast African origin of the family. The ancestral platysaurines are revealed to have a northern distribution within this range, while the Cordylinae are shown to have a southerly distribution, dispersing into southwest Africa, with two lineages subsequently radiating to East Africa. Ecological niche modeling reveals a strong relationship between distribution and reproductive strategy, supporting the hypothesis that a shift from oviparity to viviparity resulted in the colonization of higher latitudes. Ancestral state reconstructions of habitat type show that a shift from rupicoly to arboreality coincides with northerly radiations in two cordyline lineages.

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Starnberger, Iris (University of Vienna); Poth, Dennis; Schulz, Stefan; Vences, Miguel (Technical University of Braunschweig); Walzl, Manfred; Hödl, Walter (University of Vienna)

Multimodal Signaling in African Reed Frogs: Attraction through calls, colors and chemical cues?

During calling the vocal sac serves anurans as an air reservoir, in minimizing the loss of sound energy and in distributing calls omni-directionally. The vocal sac‘s role beyond acoustics has been largely neglected in the past. The diversity in vocal sac coloration and shape found in different anuran species is striking to the human observer and recently the vocal sac‘s role as visual cue has gained vast attention. Males of many reed frog species (Anura: Hyperoliidae) have a prominent colorful patch on their vocal sac, which

gains in conspicuousness once the vocal sac is inflated. To date, the function of this gular patch remains unknown.
Histological analysis indicates that the gular patch is a gland extending into the vocal sac cavity. We suggest that this gland, which exceeds 10 times the thickness of the vocal sac skin, produces volatiles emitted while calling. Furthermore, the coloration of vocal sac and gular patch might be species specific and serve as visual signal component in calling males. First results of an explorative study integrating histological and biochemical analyses, spectrometry and behavioral experiments to investigate signal modalities and their role in intra- and intersexual communication will be presented.

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Stümpel, Nikolaus (Naturhistorisches Museum Braunschweig); Joger, Ulrich (Naturhistorisches Museum Braunschweig)

Phylogeny and Biogeography of west Palaearctic vipers

We reconstructed the phylogeny of the true Vipers (Viperinae) of western Palaearctic based on molecular data. We sequenced two mitochondrial and four nuclear genes of 75 representative evolutionary Viper lineages and reconstructed their ancestry with Bayesian Inference and Maximum Likelihood approaches and found oriental Vipers of the genus *Montivipera* , *Macrovipera* and *Daboia* to be monophyletic. Hence, *Daboia* is the sistergroup of *Montivipera* and *Macrovipera* . We then used complete mitogenomes from a subset of Vipers and calculated divergence times, calibrated with deep amniote fossils and correlated them with tectonically events in the circum Mediterranean region. With the data at hand we reconstructed the biogeography of west Palearctic vipers. We found strong incidence that the repeated isolation of the Anatolian landmass from the beginning of Oligocene was one of the driving forces of allopatric speciation of oriental vipers.

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Tarrant, Jeanne (North-West University); Armstrong, Adrian (Ezemvelo KZN Wildlife)

Using Ecological Niche Modelling to predict and survey the distribution the Critically Endangered KwaZulu-Natal endemic Pickersgill's Reed Frog (*Hyperolius pickersgilli*)

Hyperolius pickersgilli has recently (2010) been listed as Critically Endangered and has an estimated AOO less than 9 km2. It is endemic to the KwaZulu-Natal coastal area and is known only from a few localities, most of which are unprotected and face increasing pressure from anthropogenic development. Given its status, cryptic behaviour and limited distribution, this species is an ideal candidate for predictive modelling. Here we

use a maximum entropy model (MaxEnt) to create a predicted distribution for this species based on limited occurrence data. Predicted sites with an occurrence-probability greater than sixty percent were surveyed during the species‘ breeding season of 2010-2011 and 2011-2012. Despite extensive surveys, few new localities were revealed: in total 5 new populations were discovered during the study period. In addition, known historical locations (pre-2007) were re-visited to verify the species‘ presence there. Of 15 historically known sites, *H. pickersgilli* was deemed absent at seven. Taking this into account and including additional populations discovered between 2007 and 2010, the total number of localities currently known is fourteen. We also use our results to recalculate AOO and EOO. The Critically Endangered status of this species is warranted given its limited and very fragmented distribution. The degree of isolation, development pressure and human-posed threats facing the majority of locations make the long-term survival of these populations dubious and thus emphasises the need for urgent conservation action, including ex-situ measures, for this species.

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Taylor, Dylan (Villanova University); Bauer, Aaron (Villanova University); Blackburn, David (California Academy of Sciences)

Diet of two species of Libyan *Acanthodactylus* (Lacertidae) based on historical museum material

Although modern herpetological collections from Libya are limited, extensive historical material from the Italian colonial period in the early 20th century is represented in a number of European collections, most notably the Museo Civico di Storia Naturale di Milano, Italy. We used this historical material to study diet in the common desert-dwelling lacertid lizards *Acanthodactylus boskianus* and *A. scutellatus*. Although the two species are broadly sympatric *A. scutellatus* is a loose sand specialist, whereas *A. boskianus* prefers more hard-packed substrates. Stomach contents were investigated in 100 specimens of *A. boskianus* and 104 specimens of *A. scutellatus* initially collected between 1922 and 1937 in southern Libya. 60% and 61% of specimens of these two species, respectively, contained prey items. The most important prey categories are the same for both species, albeit ranked differently. Formicids were the most important for *A. scutellatus* (70% by number, 33% by volume), followed by insect larvae of multiple orders (11% by number, 15% by volume), followed by coleopterans (5% by number, 16% by volume). For *A. boskianus*, larvae were the most important (33% by number, 54% by volume), formicids were second (39% by number, 9% by volume), and coleopterans were third (8% by number, 19% by volume). Diets also included spiders, scorpions, and cockroaches. Intersexual dietary overlap was considerable (92%) in both species. These species of *Acanthodactylus* appear to show substantial variation in diet across their broad ranges. Although ants make up a large part of the diet in other

locations, as in Libya, elsewhere spiders, orthopterans, and other groups predominate. Unfortunately, seasonal patterns in diet could not be assessed as many of the specimens lacked complete collection data. These results reveal both the usefulness of museum collections as data sources, particularly for areas with limited accessibility, as well as the limitations imposed by the use of data-incomplete historical material.

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Tolley, Krystal (SANBI); Herrel, Anthony (CNRS/MNHN); Measey, G. John (Nelson Mandela Metropolitan University); Townsend, Ted M. (San Diego State University); Vences, Miguel (Technische Universitat Braunschweig)

Chameleons through time and space: Extinction or Adaptation?

Biogeographic patterns are often explained by spatial shifts that match changing environmental conditions to which species are adapted. We hypothesize that biogeographic patterns however, can also be explained through the adaptation of organisms in situ to changing environments over time, rather than purely through shifting distributions as a response to those changes. We combined multiple existing and newly dated phylogenies, using between three and thirteen genetic markers, for 174 taxa representing ca. 90% of described species in the family Chamaeleonidae (BEAST, MrBayes). We show that most genera radiated in the Oligocene, and that recent radiations are scarce, resulting in a phylogeny dominated by paleo-endemic lineages. We suggest that the reduction of the Pan African forest coupled to the increase in open habitats (savannah, grassland, fynbos) since the Oligocene has generated a preponderance of paleo-endemic lineages (e.g. *Brookesia*, *Kinyongia*, *Nadzikambia*, *Rieppeleon*, *Rhampholeon*). Geographic regions (Eastern Arc, northern Madagascar, and eastern Madagascar) which contain fragments of ancient forests show comparatively higher phylogenetic diversity (PD) due to the retention of paleo-endemic lineages. Randomisations were performed to obtain a null model for comparison against observed PD, and the result shows that PD is lower than expected by chance across all areas. This suggests that on the whole, the phylogeny is over-dispersed, possibly as a result of extinction filtering (and/or undiscovered taxa). Recent radiation (e.g. Pliocene and later) is uncommon, and occurs primarily within the genera *Bradypodion* and *Trioceros*. We suggest that these lineages were able to take advantage of fine-structure microhabitats (e.g. grasses, fynbos) within the open vegetation that has been dominant since the Pliocene. We investigated a combination of morphological and performance data (bite force, gripping, sprinting) among *Bradypodion* species, and conclude that some *Bradypodion* lineages adapted to fine-structure habitats through the evolution of small body size, limb lengthening, hand/feet reduction, and ornamentation reduction. In contrast, paleo-endemic lineages have not radiated substantially since the Oligocene-

Miocene, and these lineages retain morphological features that are adaptive in habitats that lack fine-structure vegetation (i.e. bushes/trees, or leaf litter). Our work suggests that biogeographic patterns of chameleons can be explained primarily by lineage loss that corresponds with forest habitat reduction since the Oligocene, but that certain lineages in this family have adaptively radiated to new habitats since the Pliocene.

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Travers, Scott (Villanova University); Bauer, Aaron; Jackman, Todd (Villanova University)

Diversification of an African dwarf: Molecular phylogenetics, species limits, and historical biogeography of southern African dwarf geckos (Gekkonidae: *Lygodactylus*)

Dwarf geckos of the genus *Lygodactylus* are a species-rich group of small, diurnal lizards. Currently, 64 species are recognized. Most are distributed in sub-Saharan Africa and Madagascar, but two species are endemic to South America. Although these diminutive geckos are morphologically conservative, they have diversified considerably in an ecological context, occupying most of the major African biomes. Some species or species complexes are widespread across large parts of sub-Saharan Africa, whereas others are restricted to single mountaintops. Given their ubiquity in much of sub-Saharan Africa, their high species richness, and their range of spatial patterns of diversity, dwarf geckos provide an excellent model to test a variety of hypotheses regarding the evolution and biogeography of continental African organisms. We here provide the most comprehensive hypothesis of phylogenetic relationships among African *Lygodactylus* to date, with a regional focus on southern African representatives. Phylogenetic relationships were inferred from the analyses of mitochondrial (ND2) and nuclear (RAG1 and MXRA5) genes of 38 *Lygodactylus* species (> 200 individuals), including all 15 nominal species and subspecies from southern Africa. We used this hypothesis to: (1) test the monophyly of the previously proposed mainland African species-groups of *Lygodactylus*, and evaluate the validity of the currently recognized species and subspecies within southern Africa; (2) investigate species limits in members of the widespread capensis-group; and (3) reconstruct the historical biogeography of southern African *Lygodactylus*. Our results indicate extensive paraphyly in the species-groups and non-monophyly of the polytypic southern African species. There are also high levels of cryptic diversity in the widespread *capensis*-group. Lastly, southern African *Lygodactylus* appear to have undergone two independent radiations, one in the savanna and the other in the Afromontane biome, which account for most of the diversity found in the region today. The results of this study have taxonomic and conservation implications, and add to the growing body of knowledge on the origin and evolution of African biodiversity.

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Turner, Andrew (CapeNature); de Villiers, Atherton (CapeNature)

Impacts of fire on the fynbos frogs of South Africa

Data from CapeNature's Long Term Frog Monitoring Project at two monitoring sites over the last 8 years show that fire can have dramatic effects on certain species of frogs in the fynbos biome of South Africa. Although these frogs evolved in a fire-driven environment over the last 5-3 million years, changes in land-use, fire frequency and the presence of invasive alien vegetation presents an unprecedented threat to these species. Species affected are species in the genera *Arthroleptella*, *Capensibufo*, and *Poyntonia* and *Microbatrachella*. Most of the species in these genera occur in small and very patchily distributed habitat. This may be a result of the past effects of fires and a drying climate. These patchy distributions and the generally small extent of suitable habitats exposes individual populations to an increased risk from fires. The impacts of fire include the direct reduction of population sizes, reduction in permanently available surface moisture and increased invasion of fire-adapted alien plant species. The described threats may result in the local extirpation of populations and eventually extinction of these range-restricted amphibians. Recolonisation of breeding sites from nearby populations is slow relative to the average inter-fire interval. This coincidence of factors has direct implications for: A) the threat assessment of these species: individual populations need to counted and monitored; B) the mitigation of these threats through management of alien invasive species: local removal of pine trees; and C) pro-active fire management: creation and maintenance of tracer belts and rapid response to ecologically damaging wild fires to maintain viable meta-populations.

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Ukuwela, Kanishka (Univerisity of Adelaide); Lee, Michael (University of Adelaide); de Silva, Anslem (Amphibian and Reptile Research Organization of Sri Lanka); Rasmussen, Arne (University of Copenhagen); Mumpuni, Mumpuni (Museum of Zoology, Indonesia); Sanders, Kate (University of Adelaide,); Fry, Bryan (University of Queensland)

Evolution and faunal assembly of the viviparous sea snakes (Elapidae: Hydrophiinae) of the Indian Ocean

One of the major goals in biogeography is to understand how biotas have been assembled in different regions of the world. The origins of the viviparous sea snakes in the Indian Ocean pose a unique question in this regard. Viviparous sea snakes evolved from the viviparous terrestrial elapids in the Australasian region approximately 8 mya (million years ago). Ancestors of present day viviparous sea snakes initially colonized the seas adjacent the northern Australian regions and then dispersed to the Indian and

Pacific Oceans. Thus, the Indian Ocean sea snake fauna is currently considered a recent derivative of the Southeast Asian and Australian sea snake faunas. To test this hypothesis we assessed the phylogenetic relationships of the Indian Ocean sea snakes to their counterparts in Southeast Asia and Australia and estimated their divergence times. We used a six-locus molecular dataset and Bayesian inference to assess the phylogenetic relationships and divergence times. Our results support the dispersal and colonization hypothesis but indicate evidence for in-situ radiations and vicariant speciation in the Indian Ocean sea snakes. In several species, our results revealed deep genetic divergence between the populations in the Indian Ocean, Southeast Asia and Australia that is largely congruent with patterns reported for marine fishes and invertebrates. Divergence dating suggested that most South Asian species diverged from their Southeast Asian populations approximately 2.0-3.5 mya. These results indicate that viviparous sea snakes have a relatively long and complex evolutionary history in the Indian Ocean region and have a unique conservation value.

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Vences, Miguel (Technical University of Braunschweig)

Origins and biogeographic patterns of Madagascar's amphibians and reptiles

Elucidating the origin of Madagascar's biota by time-calibrated molecular phylogenies has been a major success story. It has become obvious that a major proportion of Madagascar's vertebrates, including amphibians and reptiles, originated on Madagascar by ancestors rafting over the ocean from Africa. Several other groups such as microhylid and mantellid frogs probably dispersed shortly after the KT-boundary from Asia. New analyses indicate that their diversification on Madagascar was then weakly influenced by a time effect, early arriving lineages being today more species rich. However, the most important influence on species richness of clades appears to be their ability to colonize rainforest – those clades that could not adapt to this habitat and remained stuck in Madagascar's drier western regions are remarkably species-poor. Spatial patterns of diversity within Madagascar are furthermore strongly influenced by body size, and a remarkable degree of microendemism appears to characterize especially miniaturized taxa such as *Stumpffia* frogs and *Brookesia* leaf chameleons. Phylogeographic case studies as well as geographic meta-analyses suggest that a variety of mechanisms have been active in the diversification of the Malagasy herpetofauna and highlights the southern and especially northern parts of the islands as important centers of species richness and endemism, and possibly of centers of adaptive speciation.

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Wagner, Philipp (Villanova University); Bauer, Aaron (Villanova University)

Out of the blue: a preliminary review of the African whorl-tailed agamas (Agamidae: Acanthocercus)

The African whorl-tailed agamas include two genera: the eight lizards in the genus *Acanthocercus* Fitzinger, 1843 are widespread in savannas and woodland, while the two *Xenagama* Boulenger, 1895 species occur from woodland to semi-deserts to savannah areas. Most of the species occur in the nearly herpetologically unexplored areas in the Horn of Africa. Two are present in the southwestern part of the Arabian Peninsula, but on the African continent only a single species, *A. atricollis*, is known to occur outside the Horn region. In general, relationships between these whorl-tailed species as well as the relations of these genera to the Asian whorl-tailed lizards and other members of the Agaminae are poorly understood. A robust phylogeny of the whorl-tailed lizards as well as a good understanding of diagnostic characters and species delimitation are required. Relationships and distinctions between subspecies of the *A. atricollis* Smith, 1849 complex are particularly vexing, but the boundaries between other *Acanthocercus* species are also unresolved. However, African whorl-tailed agamas are an ideal group for testing zoogeographic hypotheses of colonization events in the so-called 'arid corridor' linking the Horn of Africa to the southwest arid region. We provide a preliminary morphological and molecular phylogeny of the whorl-tailed agamas that clarifies species limits and establishes their position within the Agaminae. First results support that the diagnostic value of the whorl-tail has been over estimated and that *Acanthocercus* is a mixed genus including several distinct lineages which will be described as new genera. The species status of *A. cyanogaster* is supported and it is clearly distinct from *A. atricollis*, with which it has often been considered conspecific. A preliminary review of the *A. atricollis* complex shows that several subspecies must be elevated to species rank.

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Wagner, Philipp (Villanova University); Bauer, Aaron (Villanova University)

Zoogeography of arid Africa

The African tropical rain forests, extending from southern Senegal in the west to the East African coastal forests of Kenya and Tanzania in the east harbor a huge number of reptile species and have been inventoried. A zoogeographical analysis revealed complex faunal relationships between the forests but also gave insight to the 'arid history' of the continent. A comparison of distribution patterns of both arid and rainforest species shows two main corridors allowing a migration of arid species from north to south and east to west in sub-Saharan Africa and indicates a possible colonization of Africa by certain taxa from the southwestern Arabian Peninsula. However, the analysis also shows

that our knowledge of arid Africa is limited and that savannah eco-regions and dry woodlands seem to be the most unexplored parts of the continent.

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Weldon, Ché (North-West University); Botha, Vidette; Taylor, Jonathan (North-West University)

The use of the South African Diatom Index in conservation management of Hewitt's Ghost frog

The critically endangered *Heleophryne hewitti* (Hewitt's Ghost Frog) is only found in four streams of the Elandsberg Mountains, Eastern Cape. The species entire habitat is restricted to the bounds of the Mountain to Ocean (MTO) forestry area. This study focuses on three areas within this habitat, each differing in shade coverage due to the density of pine trees in the riparian zone. Diatoms have value as water quality indicators, which qualify them for use in conservation management. In addition diatoms comprise a large part of tadpole diet, thus providing information about the ecology of amphibians. The aim of the project was to determine the impact of water quality and shading on the distribution of diatoms. A survey for adult *H. hewitti* frogs was conducted during breeding and non-breeding seasons, in order to provide forestry with the information needed to make informed decisions regarding the future wellbeing of *H. hewitti*. Initial results indicate that samples from riverine substrate and tadpole gut content samples differ in terms of diatom species composition, which could be attributed to tadpole grazing strategy. Cell deformities in diatom species suggest the possible presence of environmental toxins.

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White, Lauren (Erell Institute)

Home Range and Spacing Patterns of the Wedge Snouted lizard, *Meroles cuneirostris*

Space use patterns can help interpret social structure, and can also indicate habitat preferences. *Meroles cuneirostris*, a diurnal lacertid endemic to the west-central coast of Namibia, occupies an ecotone consisting of sparsely vegetated sand dunes and an inter-dune gravel plain. The habitat varies in both prey availability, with termites common in the gravel plain but rare in the dunes, as well as in predator avoidance options; lizards can easily bury themselves in sand or escape into bushes in the dunes but the coarse, packed sand and dearth of large shrubs precludes these strategies in the gravel plain. Space use may reflect the relative advantages offered by the two habitat types as well as social structure. Over a 4 week period during December 2011 – January 2012, resighting locations were recorded for 95 marked adults on a study site approximately 30 m x 500 m following the base of a large sand dune in the Namib-Naukluft National Park,

Namibia. Recorded locations were compiled to estimate home ranges and core areas using the Minimum Convex Polygon method. Home range estimates were calculated for 89 animals. The mean ± SE home range size was 0.1887 ± 0.0417 ha for females and 0.1896 ± 0.0278 ha for males. Home range size did not differ significantly between the sexes. Results of regression analysis also showed no significant relationship between body size and home range size. Individuals in this population exhibit a high level of home range overlap (mean overlap: males = 973.4 ± 54.5% and females = 929.6 ± 54.5%), and with no relation to body size. The high levels of home range overlap we found suggest that *M. cuneirostris* is not territorial. For each resighting, habitat was recorded; the proportion of sightings and home range relative to each habitat was determined. Patterns of home range/core area size, overlap, and habitat characteristics will be addressed by further analyses within and between the sexes.

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Whiting, Martin (Macquarie University); Holland, Brenden (University of Hawai'i); Keogh, Scott (The Australian National University); Stuart-Fox, Devi (University of Melbourne)

Evolution of a conspicuous dynamic visual signal in an introduced chameleon

Rapid adaptive evolution frequently follows a significant change to an organism‘s environment, such as during colonization of a novel habitat. Vertebrates, including Caribbean *Anolis* lizards and Galapagos finches, have demonstrated a remarkable capacity for morphological change of functional traits (limb length, beak size) on ecological time scales. Traits that are sexually selected can be similarly affected, although well-documented examples from wild populations are rare (a notable exception is Trinidadian guppies). The Jackson‘s chameleon (Chamaeleo x. jacksonii) from East Africa was inadvertently introduced to the Hawaiian island of Oahu in 1972. In its native range, Jackson‘s chameleons are preyed upon by a wide range of predators, including snakes and birds, which are thought to shape the dynamics of color change in chameleons. We took advantage of the Hawaiian introduction, an environment with only a few potential predators and therefore, very low predation pressure, to test for character release of conspicuous social color signals. To test this hypothesis, we measured color change in response to multiple social and predator stimuli in wild chameleons in both Hawai‘i and Kenya. We used visual modelling of colour signals, together with irradiance and vegetation background color, to estimate signal conspicuousness to both the chameleon and predator (bird, snake) visual systems. The Hawai‘i and Kenya backgrounds were the same color, but the major difference was in brightness: the Hawai‘i background was darker. As a result, chameleons from both Kenya and Hawai‘i were brighter against the Hawai‘i background. However, Hawai‘i males were more conspicuous (courtship, display) against their own background for some body regions

(mainly gular), providing evidence for character release. Also, Hawai‘i males more conspicuous (courtship, display) to snake and bird predators against their own background for some body regions. We discuss how relaxing natural selection can result in signal release in systems experiencing strong sexual selection.

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Wollenberg Valero, Katharina (Trier University); Vieites, David (Museo Nacional de Ciencias Naturales, Madrid); Glaw, Frank (Zoologische Staatssammlung München); Vences, Miguel (Braunschweig Technical University)

Madagascar's frog radiations as a model system to test hypotheses of diversification

We review different diversification mechanisms proposed for the fauna of Madagascar, and the perspectives for testing them. Madagascar has a diverse biota that has evolved in isolation, and is characterized by regionally pronounced and locally steep environmental gradients, common patterns of microendemism across taxa and numerous evolutionary radiations. These characteristics establish Madagascar as a promising system for the study of pattern and process in species diversification. Species diversification in Madagascar is thought to occur either via mechanisms involving the physical landscape (e.g., river catchments and mountain chains), or via mechanisms that involve clade-specific traits. Both types of diversification hypotheses have recently been tested on the endemic Malagasy frog radiations. The integration of phylogenetic information with distribution records made it possible to study the effect of extrinsic factors on patterns of diversification, which allowed to imply underlying causal mechanisms. In contrast, the effect of intrinsic factors on lineage diversification is less well studied as ecological and life history information on many species of Malagasy frogs is still scarce. As an example for this type of hypothesis we present a study on the effect of body size variation on patterns of lineage diversification in the endemic frog family Mantellidae. Based on these results we define a testable hypothesis under which small body sizes result in limited dispersal capabilities and low physiological tolerances, causing smaller and more strongly fragmented ranges. This can be thought to facilitate reproductive isolation and thus favor speciation. Contrary to the expectation of the faster speciation of such microendemic phenotype species, we only found small body sizes of mantellid frogs to be linked to higher diversification and substitution rates, but not small range sizes. However, in order to get a better estimate of the connection between patterns of diversification past and the general underlying mechanisms, studies using phylogenetic comparative methods need to be integrated with population genetic studies.

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Wüster, Wolfgang (Bangor University); Hall, Cara; Barlow, Axel (Bangor University)

Comparative phylogeography of widespread African snakes: is there a pattern?

Comparative phylogeographic studies of co-distributed species or species complexes are potentially powerful tools in identifying common causes for observed distribution patterns. Here we use a combination of sequences from two mitochondrial genes and two independent nuclear markers to infer the phylogeographic history of eight species or species complexes of widespread African elapid and viperid snakes (genera *Naja*, *Dendroaspis*, *Bitis*). Our results reveal that most of the widespread species complexes, both from forests and open formations, originated in the latest Miocene. Forest species display congruent phylogeographic patterns (Guinea forests, (Congo forests, East Coast)), and most divergences across the Dahomey Gap are dated to the latest Miocene, highlighting the importance and antiquity of this habitat break. Open-formation species display largely incongruent phylogeographic patterns, although most have distinct southern African mitochondrial haplotype clades. The results highlight the likely importance of the expansion of grasslands habitats in the latest Miocene in either causing speciation through forest fragmentation or allowing the radiation of open-formation species. The combination of mitochondrial and nuclear markers also provides strong evidence for substantial cryptic species diversity in several widespread taxa.

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Yu, Shuangying (Texas Tech University); Wages, Mike (Texas Tech University); Cobb, George (Baylor University); Maul, Jonathan (Texas Tech University)

Acute Toxicity of Chlorothalonil to African Clawed Frogs *Xenopus laevis*

Chlorothalonil is a broad spectrum, non-systemic fungicide that is widely used in agriculture to protect crops and is also used to control mold, mildew, microbes, algae, insects, mites, and ticks. Although studies have suggested that chlorothalonil is highly toxic to fish and invertebrates, little is known about the impact of chlorothalonil on amphibians. Therefore, we evaluated the acute toxicity of chlorothalonil on two developmental stages of African clawed frog (*Xenopus laevis*; NF stage 8-11 embryos and stage 45-46 larvae). Embryos are less sensitive to chlorothalonil compared to larvae, with 96-h LC50s of 42.14 µg/L (95%CI: 39.67-44.94 µg/L) for embryos and 11.65 µg/L (95%CI: 10.43-12.67 µg/L) for larvae. Growth was inhibited at concentrations of 21.6 µg/L and 10.24 µg/L for embryos and larvae, respectively. Embryos exposed to 36 µg/L chlorothalonil showed abnormal gut coiling. Because it is difficult to identify gut structures at later developmental stage, larvae were not examined for gut malformations. However, irregular gut shape was observed in larvae exposed to all concentrations of chlorothalonil. Interestingly, chlorothalonil caused tail shortening in larvae, and the tail

to total length ratios for all chlorothalonil treatments were reduced compared to control and tadpoles collected from the same clutches prior to the experiment (P < 0.05). Our results indicate that chlorothalonil could be highly toxic to X. laevis embryos and larvae, and exposure in the larval stage may lead to lethal and developmental effects. Disruption of tail development in later developmental stages is likely to impair swimming, feeding, and predator avoidance, and may have significant consequences on larval survival. Future studies on the mechanism of tail shortening caused by chlorothalonil and evaluation of chlorothalonil toxicity in North American amphibians are recommended.

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Zancolli, Giulia (University of Würzburg); Steffan-Dewenter, Ingolf (University of Würzburg); Rödel, Mark-Oliver (Leibniz Institute for Research on Evolution and Biodiversity at the Humboldt University Berlin)

Altitudinal distribution of amphibian diversity on tropical mountains: a perspective from the roof of Africa

Mount Kilimanjaro is the tallest freestanding mountain in the world and thus it encompasses several ecological life zones including hot dry savanna, submontane and montane tropical rain forests, subalpine heathlands and alpine cushion vegetation. It has been designed as a UNESCO World Heritage Site and included in the Eastern Afromontane Hotspot of Biodiversity. Nevertheless, most of the herpetological surveys in Tanzania are conducted on the Eastern Arc Mountains and adjoining coastal lowlands, whereas the herpetofauna of Mount Kilimanjaro has never been intensively explored. In this study, we aimed to assess the amphibian species richness of the Kilimanjaro area and to investigate diversity patterns and distribution along an altitudinal gradient. Additionally, we investigated the effects of anthropogenic disturbance on species richness and community composition. We surveyed the southern slope of the mountain from the foothill to 4000 m by means of time constrained visual and acoustic encounter surveys. To prevent underestimating the true species richness we performed additional opportunistic searches, especially in the forest within the National Park. Here we present the results and elucidate the picture we have gained so far concerning the pattern of amphibian diversity on Kilimanjaro and compare it to older mountain blocks in the Eastern Arcs.

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Znari, Mohammed (Cadi Ayyad University); Naimi, Mohamed; Aitbaamrane, Moulay Abdeljalil; El Hajjy, Mustapha; Namous, Salwa; Hichami, Nawal (Cadi Ayyad University)

Conservation and restoration potentials of the Souss Valley Tortoise, *Testudo graeca soussensis* Pieh, 2001 (Testudines: Testudinidae) in an arid area of West central Moroccos

The Moorish tortoise, *Testudo graeca* L., 1758, is the unique tortoise in Morocco. It includes three subspecies two of which are endemic to the country: *T. g. marokkensis* and *T. g. soussensis*. It is also among the Morocco‘s most threatened reptile species as a result of destruction and loss of its natural habitat, overgrazing, illegal harvest for pet trade and climate change. These threats are more serious in the case of *T. g. soussensis* in arid areas of west central Morocco where the chronic drought of the last ten years, accelerated the population decline as a consequence of a reduced food availability and water stress. To address this issue, and in order to conserve et restore the tortoise populations and their natural habitat in arid and overgrazed areas in the central Jbilet mountains, a study of the conservation and restoration potentials has been carried out. This comprises an experimental captive breeding essay including a survey of reproduction, natural and artificial incubations of eggs and rearing of young tortoises born in captivity. The maintenance conditions (housing, feeding, care, etc.) are described. Newly hatched tortoises, collected in the natural habitat, are also hand reared in the framework of a Head Starting operation, and will be, as the captive-born tortoises, released in the wild at an age of 5-6 years for the reinforcement of remnant populations or rehabilitation of the habitats where the species disappeared. Furthermore, actions of habitat restoration or rehabilitation are proposed and consist, according to the level of environment deterioration, of an improved resource management or the reintroduction of the jujube shrub and tortoises which depend on. Finally, the creation of a tortoise sanctuary in the central Jbilet is proposed and its design described. The conservation and restoration potentials of *T. g. soussensis* and its habitat in arid areas of west central Morocco, revealed great opportunities of measures and actions to be carried out in favor of the safeguard of one of the most remarkable and threatened species of Morocco.

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Znari, Mohammed (Cadi Ayyad University); Hichami, Nawal; El Hamidy, Mohamed; Namous, Salwa; Naimi, Mohamed (Cadi Ayyad University)

Osmotic responses of the Souss valley tortoises (*Testudo graeca soussensis*) to the effects of chronic drought in an arid area of West central Morocco

The Souss Valley tortoises, *Testudo graeca soussensis*, occupies various habitats in west central Morocco, including arid environments where they are frequently confronted to unpredictable chronic droughts. These can affect their water and osmotic balances due to the lack of water and high salt concentrations in food plants. Seasonal patterns of osmoregulation were investigated during different periods between 2002 and 2012 in an arid area of West central Morocco. From April 2011 to March 2012, plasma osmolality in free ranging tortoises remained relatively constant across seasons, but not urine osmolality which showed significant seasonal changes due to variation in water availability related to chronic drought and occurrence of rainfall events. Dehydrated

adult tortoises (9 males and 8 females) which experienced 6-8 weeks of drought during 2008, were captured, weighed, bleeded (100 to 300 µl) and, occasionally, their voided urinary fluid collected. They were then kept in captivity and rehydrated while provided with a mixture of fresh vegetables and lucerne and water ad libitum for two weeks. They were then reweighed, rebleeded, and voided urinary fluids taken 24h before and after an acute KCl overloading. The plasma and urinary fluid osmolalities, electrolytes‘ (sodium, potassium and chlorine) and total nitrogen concentrations were measured. The urinary fluid/plasma osmolality ratio, approaching isotonicity, in both dehydrated and potassium overloaded tortoises was much higher than in rehydrated ones (respectively 0.80 and 0.86 vs. 0.24). These were indicative of an advanced dehydration condition in free-living tortoises the urinary electrolytes‘ concentrations of which were relatively higher and comparable to those in potassium overloaded tortoises. These showed a relatively higher urine total nitrogen concentration. Implications for conservation are discussed with respect of the PEP (Potential Excretion of Potassium) hypothesis (Oftedal, 2002) according to which plants high in water and/or proteins, but low in potassium should be selected in favorable periods.

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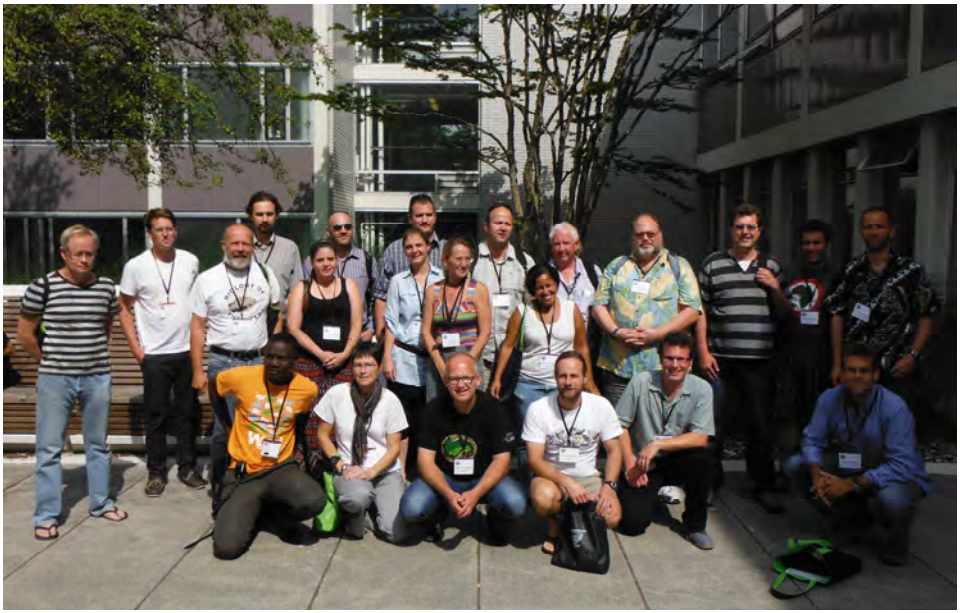

Participants of the Biogeography of African Amphibians and Reptiles symposium held at the 7th World Congress of Herpetology, Vancouver, Canada

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**. All submissions should be set in 10 pt, Times New Roman font, with 1.15 line spacing throughout. Submitted manuscripts should not contain any consecutive space characters, nor should they contain tab characters. Every word in English common names should start with a capital letter (e.g., Namaqua Dwarf Adder).

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** (capitals, bold, centred); **AUTHOR(S)** (bold, centred); *Author's address(es)* (italicised; use superscript Arabic numerals with authors' names and addresses if more than one author); **HEADINGS** (bold, aligned left) and **Subheadings** (bold, aligned left) as required; **REFERENCES** (bold), following the standardised formats 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 a defined geographic unit of especial relevance to the herpetological community. For example, surveys could 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 for Articles (described above), and must additionally include a section titled **SYSTEMATIC ACCOUNT** (bold) comprising *Scientific name* (including author citation), location and habitat, evidence (including registration numbers and location of vouchers), and comments (where required). **REFERENCES** should follow the standardised formats described below.

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**; ***Scientific name*** (**including author citation**); **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 & Carruthers' *A complete guide to the frogs of southern Africa*, 2009, for amphibians as far as possible); **KEYWORD** (this should be one or two words best describing the topic of the note, e.g. Reproduction, Avian predation, etc.); the Text (in concise English with only essential references quoted). 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. **REFERENCES** should follow the standardised formats described below. **SUBMITTED BY: NAME**, Address, E-mail.

GEOGRAPHICAL DISTRIBUTION

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**; ***Scientific name* (including author citation)**; **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 & 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. **REFERENCES** should follow the standardised formats described below. **SUBMITTED BY: NAME**, Address, E-mail.

REFERENCES

Reference formatting is similar to *African Journal of Herpetology*. References should be listed in alphabetical order and should refer only to publications cited in the text. References should be in the following format:

ALEXANDER, G.J. 2007. Thermal biology of the Southern African Python (*Python natalensis*): does temperature limit its distribution? Pp. 50-75. In HENDERSON, R.W., AND POWELL, R. (eds.), *Biology of the Boas and Pythons*. Eagle Mountain Publishing, Utah.

BRANCH, W. R. 1998. *Field guide to the snakes and other reptiles of southern Africa*. Third edition. Struik Publishers. Cape Town.

COTTONE, A.M. 2007. Ecological investigations of the Psammophiidae (Squamata: Serpentes). Unpubl. MSc thesis. Villanova University, Pennsylvania.

FROST, D.R. 2010. Amphibian Species of the World: an Online Reference. Version 5.4 (8 April, 2010). http://research.amnh.org/vz/herpetology/amphibia/ (accessed 27 April 2010).

LAMB, T., BISWAS, S. & BAUER, A. 2010. A phylogenetic reassessment of African fossorial skinks in the subfamily Acontinae (Squamata: Scincidae): evidence for parallelism and polyphyly. Zootaxa, 2657:33 – 46.

Note that author names are set as SMALL CAPS, not ALL CAPS, and that Journal Titles are not abbreviated. Formatting should be achieved using paragraph settings and NOT tabs or spaces. Citations should occur in chronological order: (Branch 1998, Alexander 2007, Cottone 2007, Frost 2010, Lamb et al. 2010). For papers with more than two authors, only the first author should be named in the text (e.g., Masterson et al. 2010) without italicising "et al.". Cite unpublished data as in press, e.g., Marais (in press), which then appears in the list of references, or as J. J. Marais (pers. comm.), in which case Johan J. Marais's name and institutional affiliation should appear under Acknowledgements. Unpublished reports should be cited as personal communications.

TABLES, FIGURES, AND PHOTOGRAPHS

Tables should be submitted as separate MS Excel files. Tables should be small enough to fit onto an A5 page, and should NOT contain any vertical lines. Photographs and figures should be submitted as separate JPEG files, and not embedded in the text. They should preferably be 500—800 KB in size, and not more than 1.5 MB. The name of the photographer should be given, if not taken by the author of the submission. Each table, figure, or photograph, needs to be associated with an appropriate caption that should follow the reference list in the submission.

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