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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.

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COVER PHOTOGRAPH: *Xyelodontophis uluguruensis* from Tanzania.
Photograph by: Bill Branch. Nikon D300 (1/80, F32, ISO 200).

EDITORIAL

And so the 50th issue of *African Herp News* is upon us. To mark the occasion I invited Bill Branch to write a review regarding some of the changes in African reptile systematics that he has been involved in over recent years. The review is not intended as a comprehensive assessment of changes over recent years, but rather a highlights reel that readers of *AHN*, amateur and professional alike may appreciate. Similar reviews were requested from other members of the herpetological community, however short notice and busy schedules meant that said members were sadly unable to contribute to this issue.

I also invited Marienne de Villiers and her co-workers to write a brief overview of the Southern African Reptile Conservation Assessment. Many of *African Herp News'* readers have been involved with the SARCA project, either through submissions to the Virtual Museum, during collecting trips run by Marius Burger, or as authors of conservation assessments, and so will be keen to hear of the SARCAs achievements over the last few years. I know that many readers are waiting for the final product of SARCA, which I am told will be this year some time.

Since the last issue I have been inundated with possible cover photographs from readers of *African Herp News*. I was pleased to see such a response, and ask that the submissions keep coming. Specifically, I am looking for images that are striking, with interesting compositions, subjects, and exposures. Please remember that cover shots are not necessarily great identification photos (although see ABOUT THE COVER), but rather images that portray the animal in an exciting manner. Unfortunately I could only use one of the submitted images and decided on the current image because of the unique combination of rarity, beauty and a carefully exposed and composed image.

I have also noticed that since taking over the editorship I have not received any amphibian related submissions. I hope that the herpetological community will remedy this situation in coming months.

Here is to the next 50 issues!

Bryan Maritz,
Newsletter Editor

ARTICLES

RECENT STUDIES ON THE EVOLUTION OF AFRICAN SNAKES AND CHELONIANS: A PERSONAL PERSPECTIVE

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Many of the recent systematic studies on Southern African reptiles have been reviewed elsewhere (Branch & Bauer 2010). I refer readers to that review for a more detailed presentation of recent systematic methodology and the resultant taxonomic insights and updates. In this less formal presentation, and as retirement looms and I enter my dotage, it seems opportune to review the changing paradigm in systematic research as illustrated by some of my recent collaborative studies on African snakes and chelonians. There is not space to document all the literature dealing with these changes; again I refer interested readers to the review above.

Modern systematics places emphasis on revealing patterns of relationship among groups. Such patterns are figuratively represented as trees or cladograms. Monophyly, the property of a clade (group) that consists of an ancestor and all its descendants, is the *sine qua non* of modern systematics, and all modern classifications comprises hypotheses of nested groups exhibiting monophyly (phylogenies). Biochemical adjuncts to traditional taxonomy have proliferated since the middle of the last century. However, detailed genomic analysis linked with increasingly sophisticated computer processing of sequence data, is a phenomenon of the 21st century. These recent technological advances have allowed a more objective assessment of phylogenetic relationships.

It has become increasingly obvious that species may result from different mechanisms and histories, and there is increasing use of evolutionary and phylogenetic species to reflect hypotheses about the boundaries of past and present gene transfer within evolutionary lineages of Life's diversity. The burgeoning discipline of 'Evo-Devo' (the interface between development and evolution; see Carroll 2005 for a popular review) has demonstrated how quickly drastic morphological change can occur by modulation of the activity of genes that govern embryonic development. Many findings of molecular phylogenies conflict with historical ideas of relationships previously based solely or largely on morphological analysis. The conflict between earlier classifications based on morphotypic species definitions, and modern molecular phylogenies becomes particularly evident with generic hierarchies. Earlier classifications that highlighted unique morphologies led to the creation of monotypic genera for extreme morphotypes. This is the case with the web-footed gecko (previously *Palmatogecko rangei*) which despite its bizarre morphology is now known to be closely related to thick-toed geckos (*Pachydactylus*), to which it has since been transferred. Conversely, the emphasis on morphology resulted in a lack of appreciation of deep evolutionary divergences that may be obscured by the selective maintenance of conservative morphologies. This again can be illustrated with a local example; many of the geographically isolated populations of leaf-toed geckos previously placed in the cosmopolitan genus *Phyllodactylus* are now assigned to different families of gekkotan lizards (e.g. African *Goggia* to the Gekkonidae, and New World *Phyllodactylus* to the Phyllodactylidae). As we have become aware of the extent of cryptic (in a morphological sense) diversity, there has been a burgeoning description of new species, genera, and higher categories, or the revival from synonymy.

Chelonia

My forays into chelonian biology have been opportunistic, often anecdotal and sadly superficial. Despite a few early forays (e.g. Branch 1984, Burger & Branch 1994) I have not given the group the effort and attention it deserves. However, for the last 15 years this has not been necessary as the detailed studies of Retha Hofmeyr and Victor Loehr, along with their students and colleagues, have brought a modern approach to the study of tortoise biology in the subcontinent. My work has simply resolved some taxonomic issues, i.e. the description of a new dwarf tortoise (*Homopus solus* Branch 2007) from Namibia, and to present a general overview of chelonian diversity and biology in sub-Saharan Africa (Branch 2008). However, I continue to be intrigued by the impact of avian predation on tortoises. I published a number of early studies on chelonian predation by Kelp Gulls (Branch & Els 1990) and Pale Chanting Goshawk (Malan & Branch 1992), and with Chris and Tilda Stuart I am currently looking at chelonian predation by White-necked raven in the Karoo. I am also involved with Uwe Fritz (Dresden) and others in assessing phylogeography and species boundaries within the Marsh terrapin (*Pelomedusa subrufa*) and Hinge-back tortoises (*Kinixys* sp.). The former has been particularly exciting, revealing deep genetic structure and possibly numerous cryptic species within this Pan-African species

Snakes

Higher Order Relationships

When I first started as a herpetologist at Port Elizabeth Museum in 1979 the landscape of snake systematics was very different. The ‘Colubridae’ existed as a massive (over 2500 species) and unwieldy assemblage of ‘advanced’ snakes. The family was little more than a rag bag for snakes that didn’t have other specialized features such as erectile (Viperidae) or fixed (Elapidae) front fangs. Due to the simplified anatomy that attends a serpentine life style, snakes do not possess many external or internal features that allow confident classification of monophyletic groups. Similar problems have dogged the classification of other serpentine squamates, including worm lizards (amphisbaenians) and even grass lizards (*Chamaesaura*).

The first snake classification I became familiar with had basically existed since the time of Boulenger (1858-1937), and it displayed a preoccupation with dentition using snake teeth as key features in assigning snakes to certain families. Now, with the genius of hindsight, it is difficult to appreciate why such strange snakes as 'mole vipers' (*Atractaspis*), as they were then known, were classified for so long as a viper, despite their completely un-viperid appearance and life style. Even their fang erection mechanism is completely different from that of true vipers. My early studies on hemipenes, chromosomes and the serotaxonomy of African snakes were all stimulated by the desire to address the systematic affinities of *Atractaspis,* as they were to tackle other taxonomic problems. Now different hypotheses of snake relationships appear almost monthly, and in bewildering diversity. I detail below some of the general and more specific problems in snake systematics with which I have recently been involved.

Scolecophidian Snakes

In recent years I have collaborated with Blair Hedges (Penn State University, USA), Nicolas Vidal (Paris, France) and Steve Donnellan (Adelaide, South Australia), along with other co-workers, on a broad assessment of higher level relationships within primitive scolecophidians snakes. We have constructed a molecular dataset for scolecophidians with detailed sampling within the largest family, Typhlopidae (blindsnakes).

The results (Vidal et al. 2010) show that scolecophidians have had a long Gondwanan history, and that initial diversification followed separation of East and West Gondwana ~150 million years ago (Myr ago). Monophyly of the Anomalepididae and Leptotyphlopidae is confirmed, but deeper than expected divergence occurs within the Typhlopidae. The major recent clades of blind snakes diverged between 63 (78–49) and 59 (74–46) Myr ago, just after the end-Cretaceous extinctions, and subsequent diversification of clades during the Cenozoic parallels that of their primary food sources—ants and termites.

Previous detailed morphological studies, particularly those of Don Broadley and Van Wallach (Broadley & Broadley 1999, Broadley & Wallach 1997a, b), were believed to have resolved much of the species diversity within African thread snakes (Leptotyphlopidae). However, evolutionary relationships within the family remained almost completely unknown. The family is relatively large (nearly 120 species) and has a mainly Gondwanan distribution. For many years it comprised a single massive genus (*Leptotyphlops*), with only one other monotypic West African genus (*Rhinoleptus koniagui*). Solny Adalsteinsson was the lead researcher on a molecular phylogeny of leptotyphlopids (Adalsteinsson *et al.* 2009) that revealed deep genetic divergence between morphologically very conservative lineages. A new classification of the family proposed massive higher order readjustment, with the recognition of two subfamilies, the Epictinae (New World and Africa) and Leptotyphlopinae (Africa, Arabia, and Southwest Asia). Three tribes were recognized within the latter subfamily, of which two

(Myriopholini and Leptotyphlopini) occur in southern Africa. Most southern African species were retained in a reduced *Leptotyphlops*, but a number were transferred to new genera including *Myriopholis longicaudus, Namibiana occidentalis* and *N. gracilor*. An additional finding of this initial study was evidence of an unusually large number of undescribed species. More than a dozen have been provisionally identified, particularly within the *Leptotyphlops scutifrons-conjunctus-incognitus* species complex. For other scolecophidians a large molecular dataset of all major lineages was assembled, and our results (Vidal et al. 2010) demonstrated that scolecophidians have had a long Gondwanan history, and that their initial diversification followed the separation of East and West Gondwana approximately 150 Ma. The earliest blindsnake lineages, representing two new families, were distributed on the palaeolandmass of Indigascar (India + Madagascar). Later evolution involved several oceanic dispersals, including westwards across the Atlantic.

Viperidae

The taxonomic status and phylogenetic relationships of the radiation of small adders (*Bitis*) of the subcontinent remain complicated. When describing *Bitis rubida* (Branch 1997) I specifically restricted the type locality to the Cederberg population, being aware that there existed confusing morphological variation in other populations, particularly from the Little Karoo (Branch 1999). Studies of variation within different populations of the Red Adder (*B. rubida*) and the Berg Adder (*Bitis atropos*), as well as phylogenetic relationships between all small *Bitis*, are currently underway. In conjunction with Chris Kelly (Rhodes University), Wolfgang Wüster and Axel Barlow (Bangor University, Wales) we have been accumulating tissues for molecular analysis and traditional morphological data in order to address these various problems. Studies of the four isolated populations of *B. atropos*, using molecular and morphological analysis, have already demonstrated that some of these populations should be treated as separate species, and that genetic divergence of populations within the Cape Fold mountains also indicate the possible presence of cryptic taxa (Branch & Kelly 2008; Kelly et al. 2009a). The formal description of these new species is in preparation.

In the introduction I discussed increasing awareness that morphology can change very rapidly and obscure evolutionary relationships. A good example is the recent description of a dwarf, terrestrial forest viper, *Atheris mabuensis*, from northern Mozambique (Branch & Bayliss 2009). Previously the bizarre fat, terrestrial Usambara viper (*Adenorhinus barbouri*) was placed in a monotypic genus when, in fact, it is genetically closely-related to arboreal forest vipers (*Atheris*) and has been formally transferred to that genus (Branch & Bayliss 2009). The new Mozambique species represents a terrestrial habitat shift within the genus that may have preceded the rapid morphological adaptations displayed by *A. barbouri*.

The African Snake Radiation

Recently I have collaborated on several molecular studies designed to investigate phylogenetic relationships within the African snake radiation, as well as studies on a number of more restricted groups within this radiation. In the first (Nagy et al. 2005), a spectrum of 49 snakes from a broad variety of families was investigated. The results identified a number of interesting groupings, particularly the monophyly of a number of informal groups discussed earlier by Charles Bogert (Bogert 1940) and Monique Bourgeois (Bourgeois 1968), i.e. the Atractaspidinae, Psammophiinae, Lamprophiinae, and Pseudoxyrhophiinae (although these are not always the names they used).

The removal of *Atractaspis* from the Viperidae to a new family (earlier the Atractaspidae, but now more correctly Atractaspididae or Atractaspidinae, depending on the hierarchy adopted – see below) led to conflicting common names for the group (burrowing asps, stiletto snakes, side-stabbing snakes), and also to a search for their close relatives. Sam McDowell (McDowell 1968) first indicated that dwarf garter snakes (now harlequin snakes, *Homoroselaps,* and then placed in the genus *Elaps*) were wrongly placed within the family Elapidae. His detailed morphological studies indicated that they were better grouped with a suite of other African burrowing snakes, including *Atractaspis,* the Natal Black Snake (*Macrelaps*), purple-gloss snakes (*Amblyodipsas*), centipede-eaters (*Aparallactus*), quill-snouted snakes (*Xenocalamus*), and several other small snakes from the central and west African tropical forests. However, the status of harlequin snakes as atractaspidids or elapids see-sawed for sometime, depending upon whether authorities placed emphasis on cranial anatomy or venom gland morphology (Underwood & Kochva 1993). In the last iteration of my field guide (Branch 1998) harlequin snakes were still grouped with elapids. However, Nagy et al. (2005) subsequently confirmed that harlequin snakes (*Homoroselaps*) were not elapids, despite their front fangs and venom, and that McDowell (1968) was correct in suggesting that they are most closely related to *Atractaspis* and other African burrowing snakes.

The clades Psammophiinae, Lamprophiinae, and Pseudoxyrhophiinae all group with atractaspidids and elapids, and have subsequently been placed in a superfamily Elapoidea. They are not closely related to other African 'back-fanged' snakes such as egg-eaters (*Dasypeltis*), twig snakes (*Thelotornis*), boomslang (*Dispholidus*), herald snakes (*Crotaphopeltis*), tiger snakes (*Telescopus*), green snakes *(Philothamnus*), etc, which are all colubrids (in a now more restricted clade). Neither are they related to marsh snakes (*Natriciteres*) or swamp snakes (*Limnophis*), which are African representatives of the mainly Eurasian and Neotropical water snakes (Natricidae).

The psammophiine genera (*Dipsina, Hemirhagerrhis, Malpolon, Mimophis, Psammophis, Psammophylax,* and *Rhamphiophis*) are distributed throughout Africa including Madagascar, the Middle East, south-central Asia, and southern Europe (Branch 1998). Their monophyly is well supported by morphological and molecular data, and the studies of Chris Kelly and colleagues have done much to resolve evolutionary relationships within the group, including the transfer of *Dromophis* into the synonymy of *Psammophis* (Kelly et al. 2008). The Pseudoxyrhophiinae includes numerous endemic Malagasy snake genera, as well as a number of species found in the Comoros. Surprisingly, a number of problematic genera from continental Africa (*Duberria, Amplorhinus* and possibly

Montaspis), whose evolutionary relationships were previously obscure, were found to associate with this clade (Vidal et al. 2008).

The Lamprophiinae (sensu Vidal *et al.* 2008), an assemblage of African snakes equivalent to the Lamprophiidae of Kelly et al. (2009b), includes a basic division between wolf snakes and their relatives (*Lycophidion, Hormonotus, Mehelya* and *Gonionotophis*) and house snakes and their relatives (*Pseudoboodon, Bothrolycus, Bothrophthalmus, Lamprophis* and *Lycodonomorphus*).

Generic and species boundaries within these clades are problematic, and a number of generic re-arrangements and descriptions of cryptic taxa are to be proposed (Kelly et al. in prep.). The relationships of a number of unusual snakes, such as shovel-snouts (*Prosymna*), Western keeled snake (*Pythonodipsas carinata*) and mole snake (*Pseudaspis cana*), sometimes placed in additional families (Prosymnidae and Pseudaspididae, Kelly et al. 2009b), I consider still unresolved.

There are different, and somewhat conflicting, classifications of Elapoid snakes, and these reflect different hypotheses of relationships among the snakes studied. I am co-author on conflicting treatments of Elapoid classification, that either recognize an inclusive Lamprophiidae containing varying numbers of subfamilies (e.g. Atractaspidinae, Psammophiinae, Lamprophiinae, and Pseudoxyrhophiinae; Vidal *et al*, 2008, 2009), or that threats these subfamilies as full families, each of equivalent status to the Elapidae (e.g. Kelly et al., 2008, 2009b). My apparent schizophrenia simply reflects differences among myself and my colleagues as to the hierarchical level to be placed on the major branches of the different phylogenies. These differ in their fine structuring and statistical support, and the different classifications are affected by both the number and variety of genes sequenced and the diversity of taxa sampled. It must be stressed that classifications are not 'cast in stone', but rather reflect consensus and usage, and only time will tell which of these various hypotheses, if any, serve the herpetological communities' needs.

'Colubridae'

There have been few studies on African Colubridae *sensu stricto,* and phylogenetic relationships within non-elapoid African snake groups remain poorly known. Bourgeois (1968) erected a subfamily Philothamninae, but this has not yet been assessed by molecular data and its status even as a tribe (Philothamini) remains problematic. Green snake tissues were incorporated into a molecular assessment of the status of green snakes from São Tomé and adjacent islands in the Gulf of Guinea (Jesus et al. 2009). The study revealed that the insular species *Philothamnus girardi* and *Philothamnus thomensis* should be consider as distinct sister species. They form a monophyletic unit that indicates a single colonization event of one island (probably São Tomé), followed by dispersal to Annobon. In addition, *Hapsidophrys principis* from Príncipe was also shown to be a valid species and sister to mainland *H. smaragdina*. Eli Greenbaum (University of Texas at El Paso, USA) and I are currently accumulating tissues from *Philothamnus* and related genera in order to resolve their phylogeny.

Final comments

This brief review is personal and idiosyncratic. These are exciting times in reptile systematics, with numerous individuals and groups publishing cutting-edge research. The phylogenies and proposed new classifications are bound to be unstable, and some will be discarded and others modified as a greater diversity of taxa and markers are incorporated. These hypotheses of relationship will be further impacted as herpetologists address the challenge of developing a full squamate classification. That snakes are a subset of lizards is uncontested. The nomenclatural problem is to reshuffle the familial and suprafamilial hierarchies of both snakes and lizards in a manner that reflects systematic truth, and yet causes the least disruption to familiar names and arrangements. It will not be easy!

ACKNOWLEDGEMENTS

Bayworld, the small provincial museum at which I'm based, does not have gene sequencing equipment, nor am I competent to undertake such studies. Thus the great majority of the laboratory work for the studies that I detail above was undertaken by colleagues, as reflected in the fact that I am a junior author on most of the resultant publications. I prefer to view this relationship as more symbiotic than parasitic….To all I acknowledge my debt, and give my thanks for friendship and collaboration.

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THE SOUTHERN AFRICAN REPTILE CONSERVATION ASSESSMENT, 2005-2009

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INTRODUCTION

In the more than twenty years that have elapsed since the publication of the last Red Data Book of Reptiles of South Africa (Branch 1988) there have been substantial improvements in our understanding of reptile diversity, distribution and threats. For example, between 1988 and 2006, there was a 25% increase in the number of recognized reptile species, with an average of six new species described per year (Branch et al. 2006). Over the past two decades the distribution ranges of several reptile species have been considerably altered by the transformation of land for agriculture, urban development and other human activities. Certain habitats have suffered a great deal more than others. For example, it is predicted that 30% of the remaining natural vegetation in the Cape Floristic Region could be transformed by 2020 (Rouget et al. 2003). Land transformation, together with global climate change, has been linked to distributional changes for some bird species (de Villiers 2009; SABAP2 2010) and the same is likely to apply to reptiles. Threats to reptiles have also not been static over the years. For example, in the Table Mountain National Park, there was a decrease in mean fire return interval from 31.6 to 13.5 years between 1970 and 2007 (Forsyth & van Wilgen 2008).

Reptiles have often been excluded from conservation action and planning in southern Africa. This is partly because they tend to be unpopular with members of the public, but also because useful scientific information necessary for their effective conservation has been lacking or difficult to access. The Southern African Reptile Conservation Assessment (SARCA) aimed to collect and collate information on the reptile species of South Africa, Lesotho and Swaziland, and to use this updated information to review the conservation status of the reptiles of this region.

METHODS AND RESULTS

SARCA was a partnership between the Animal Demography Unit at the University of Cape Town, and the South African National Biodiversity Institute. The project relied heavily on support from herpetologists, particularly members of the Herpetological Association of Africa, and other interested members of the public. Over four years (2005–2009), with a budget in the region of R3-million and with input from approximately 400 people and 14 institutions, progress was made on three fronts.

An integrated, comprehensive database of reptile distribution records was compiled.

This comprised approximately 135 000 records obtained from members of the public, institutions, private collections, literature sources and field surveys. South African museums contributed the bulk (45%) of records. Twenty-four SARCA field surveys, spread over 300 days in three summer seasons and involving 58 volunteers, yielded about 4 220 distribution records. Additionally, 6 700 records were received from members of the public, giving a total of 10 920 new SARCA records accrued during the four-year period of the project. This is equivalent to at least 8% of all reptile records in the database, collected over roughly a century of herpetological exploration in the Atlas region. The collection of new records by SARCA was thus the largest per unit effort ever undertaken in southern Africa. SARCA field surveys also resulted in the collection of 2 250 voucher specimens and about 2 000 tissue samples, which will benefit future taxonomic studies.

Conservation assessments of 406 taxa (species and subspecies) were conducted by 19 authors according to IUCN criteria.

These assessments, together with distribution maps, will be published in an Atlas and Red Data Book. For 90% of taxa this was the first assessment using IUCN criteria. Of the species that had previously been assessed, most required no change in conservation status, but there were recommendations that twelve taxa should be downgraded (considered less threatened) and nine should be upgraded (considered more threatened). Twelve percent of taxa were considered threatened (four Critically Endangered, 11 Endangered and 33 Vulnerable), and 11% Near Threatened. The major threat to most species was habitat transformation or habitat destruction. Fire and pesticides were also identified as common threats, and some taxa were deemed vulnerable to illegal harvesting. Several threatened taxa were considered to be inherently at risk due to slow reproductive rates, restricted distributions and/or limited dispersal capabilities. Some taxa, e.g. several cordylids, were thought to be particularly vulnerable to climate change. Two species, *Tetradactylus eastwoodae* and *Scelotes guentheri*, were considered Extinct. Twelve species were rated Data Deficient, indicating the need for further reptile surveys and taxonomic assessments.

The negative public image of reptiles was addressed through a project website, numerous talks, media interviews and popular articles, and an online Virtual Museum.

The Virtual Museum (VM) generated considerable interest from members of the public. Photographic reptile distribution records were received from approximately 350 primary contributors and identifications were made by a panel of 14 experts. A survey indicated that the VM was used mainly by amateur herpetologists and other wildlife enthusiasts, and that the site was used to improve identification skills, to check distribution maps, for research and conservation, and for educational purposes. As well as raising awareness about reptile diversity, the VM made a significant data contribution. Over 6700 records representing about 300 taxa were received. Although 95% of records submitted were of Least Concern taxa, map coverage by VM records was fair and concentrations of VM records corresponded with those received from other sources, e.g. museum collections. Some particularly interesting records included: (i) significant extensions of known distribution ranges, e.g. Fisk's House Snake *Lamprophis fiskii and* Setaro's Dwarf Chameleon *Bradypodion setaroi*; (ii) records of rare and threatened species: e.g. Bloubergstrand Dwarf Burrowing Skink *Scelotes montispectus*, Breyer's Long-tailed Seps *Tetradactylus breyeri,* and Plain Mountain Adder *Bitis inornata*; (iii) records of species with few other distribution records: e.g. Two-striped Shovel-snout *Prosymna bivittata*, Cape Dwarf Burrowing Skink *Scelotes caffer*; Cregoi's Blind Legless Skink *Typhlosaurus cregoi cregoi;* (iv) records of poorly-knownforms: e.g. Variegated Slug-eater *Duberria variegata*; and (v) records which filled distributional gaps for common species: e.g. Puff Adder *Bitis arietans arietans*.

CONCLUSIONS

One of SARCA's main products is the reptile distribution database. Another will be an Atlas and Red Data Book of Reptiles of South Africa, Lesotho and Swaziland. The information collated will help to prioritize conservation actions (through the IUCN Red List) and inform conservation planning, inform legislation, e.g. CITES listings, improve opportunities for research and make recommendations for future surveying and monitoring. The Atlas and Red Data Book will be a hard-copy publication, printed in the conventional style of other red data books. However, printed RDBs are soon likely to become a thing of the past, and in future it is worth considering online alternatives, driven by panels of experts. The tools needed for this (an online assessment database and the Virtual Museum as a mechanism for collecting data) have already been put in place through SARCA. An online RDB would allow for more regular, cheaper and less effort-intensive assessment updates.

Other biodiversity projects are benefiting from some of SARCA's products. The Southern African Butterfly Conservation Assessment (SABCA) has inherited the online assessment database and Virtual Museum that were first trialled by SARCA. The success of the latter, both for motivating public interest and as a data collection tool, has stimulated the development of a new version of the VM, which will be almost completely automated and will be applicable to multiple faunal groups. For example, there are plans for a mammal VM, a shark VM, and a VM for reporting Bird Rarities.

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PREVALENCE OF *HEMOLIVIA MAURITANICA* (APICOMPLEXA: ADELEINA) IN THE BLOOD OF AN ALGERIAN POPULATION OF THE SPUR-THIGHED TORTOISE, *TESTUDO GRAECA*

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INTRODUCTION

The ecology and population biology of the Spur-thighed tortoise (*Testudo graeca graeca*) have been studied widely in both Europe (e.g., Lambert 1980, 1982; Braza et al. 1981; Andreu et al. 2000; Diaz-Paniagua et al. 2001) and north Africa (e.g., El Mouden et al. 2001; Rouag et al. 2007). These studies revealed that individuals of this species are long-lived, require a long time to mature, produce small clutches, and are rare over much of their range (e.g., Hailey et al. 1988; Diaz-Paniagua et al. 2001; Luiselli 2006; Rouag et al. 2007). Like other terrestrial tortoises, many populations of this species are vulnerable or threatened due to a range of anthropogenic factors affecting these demographic and ecological characteristics. Seasonal fires, habitat loss, habitat alteration and fragmentation, road kills, illegal pet trade, and infectious or parasitic diseases have been identified as particularly important threats (Lambert 1980; Corbett 1989; Inozemtsev & Pereshkolnik 1994). Several of these threats have been specifically studied (e.g., see Hailey 1988; Hailey et al. 1988; Inozemtsev & Pereshkolnik 1994), but the potential role of parasites has not been explored in detail. However, parasites can significantly alter host population demography, and are critical to study in evolutionary and ecological contexts (Hochberg & Lawton 1990a, 1990b; Combes 1995; Tyre et al. 2003).

Adeleorines are intracellular apicomplexan parasites that infect vertebrates, including reptiles and amphibians (Mihalca et al., 2002), mammals (e.g., *Hepatozoon canis*, Waned et al. 1994) and fish (e.g., *Cyrilia* spp. and *Desseria* spp.). Adeleorines are common intracellular blood parasites in reptiles, and over 300 species have been described (Chris et al. 2006). Currently, six genera are known within the Adeleorines, and at least five of these genera (of four families) may infect reptiles and amphibians. *Haemogregarina* spp. may infect water turtles (Mihalca et al., 2002) and *Hepatozoon* spp. may infect crocodilians and snakes, through their vector, *Culex* spp. mosquitoes (Paperna & Lainson 2003). *Hemolivia* spp. may infect lizards (*Hemolivia mariae*, Paperna & Smallridge 2001; Lainson et al. 2003), tortoises of the genus *Testudo* (*Hemolivia mauritanica*, Široký et al. 2007a, 2007b, 2009), and bufonid anurans (*Hemolivia stellata*, Petit et al.

1990). *Klossiella* spp. and *Karyolysus* spp. may infect lacertid lizards (Široký et al. 2007a).

In this paper, we analyse the prevalence of a reptile-specific parasite, *H. mauritanica*, in an Algerian population of Spur-thighed tortoises. This parasite was originally described as *Haemogregarina mauritanica* (Sergent & Sergent 1904), from an Algerian individual of Spur-thighed tortoise, and was later placed into the genus *Hemolivia* by Landau & Paperna (1997). The parasite has an indirect life-cycle, with *Testudo* being the intermediate vertebrate host while the tick *Hyalomma aegyptium* is the definitive invertebrate host. *Hyalomma aegyptium* is the only *Hyalomma* spp. known to parasitise *Testudo g. graeca* in northeastern Algeria (Meddour-Bouderda & Meddour 2006). *Hemolivia mauritanica* has received very little scientific attention until recently (Široký et al. 2005, 2007a, 2007b, 2009; Paperna 2006). In this study we aimed to i) describe this parasite's infection of the erythrocytes of its vertebrate host (*Testudo graeca*), and (ii) quantify the parasite's prevalence and intensity of infestation in a natural population of *Testudo graeca* in north Africa.

METHODS

This study was performed in the Parc National d'El Kala in north-eastern Algeria. The study area was part of the north-eastern Algerian Tell, and is situated between 36.43° N and 36.57° N and between 7.43° E and 8.37° E. The climate is Mediterranean (Seltzer 1946; Toubal 1986) with moderate rainfall (mean = 630 mm per annum) strongly concentrated during the winter months (Rouag et al. 2007).

We sampled adult tortoises between April and July in 2006 and 2007, the time of year when *T. g. graeca* are most active (Rouag et al. 2007), to optimise opportunities to increase sample size. Tortoises were bled only once to avoid excessive stress to the handled animals and to avoid pseudoreplication. Twenty-three free-ranging tortoises were captured, during nonsystematic walks throughout the study area. Each individual was sexed, measured (straight carapace length) and individually marked and aged (see Rouag et al. 2007 for details) before we sampled their blood (brachial vein, Lopez-Olvera et al. 2003; Campbell 2004). We sampled the blood without the use of anticoagulants, which may influence blood cell morphology, and immediately prepared the slides in the field. We used a May-Grünwald-Giemsa staining method (Petithory & Ardoin 2005), which is based on the consecutive use of two different stains, May-Grünwald and Giemsa Romanowsky.

All reptile haemogregarines are characterized by similar intra-erythrocyte morphology (Paperna & Smallridge 2001; Mihalca et al. 2002; Paperna & Lainson 2003). Identification to species level of this parasite was based on the developmental stages of gametocytes inside the infested blood cells. Infestation by this protozoan was determined by counting infected erythrocytes, among 10000 erythrocytes counted for each individual tortoise, with a microscope at ×1000 magnification. We considered infestation intensity as the relative frequency (%) of *Hemolivia*-infested cells per 10 000 erythrocyte sample (Široký et al., 2005). Prevalence (Pr, %) was the percentage of tortoises that were infected, and was calculated for each month and for the entire study. Mean parasite intensity, MPI (%), equalled the average infestation intensity for the infested animals (i.e., excluding non-infested animals). Data were grouped by month as the sum of records for both years. We report variable means and standard deviations.

RESULTS AND DISCUSSION

We classified infested erythrocytes into five categories based on parasite gametocyte size, relative development, and effect on erythrocyte deformation (Fig. 1). In infested erythrocytes with the smallest, and youngest (Pavel Široký, Pers. comm.), gametocytes did not appear to deform erythrocytes or displace erythrocyte nuclei (Fig. 1A). However, larger gametocytes deformed (e.g., elongated) erythrocytes and gametocytes that developed nuclei deformed host cells and displaced host cell nuclei (Fig. 1B and 1C, respectively). One female tortoise had individual erythrocytes infected with two or more gametocytes, (Fig. 1D). Mature gametocytes, typically long, curved and with one nucleus and a stain resistant capsule (i.e., gamonts, P. Široký, Pers. comm.), were found inside (Fig. 1E) and outside (Fig. 1F) of erythrocytes. Gamont-infected erythrocytes were the most common (85.4%) type of infected erythrocyte. Extracellular gamonts were rare, appearing after erythrocytes lyse (P. Široký, Pers. comm.). We also noted samples in which the nucleus was displaced by the parasite (Široký et al. 2007a). This type of infestation was also observed in Adeleorines infestations of another Mediterranean terrestrial tortoise, *Testudo marginata* (Široký et al. 2007a).

In most cases, infection intensity was relatively low (ca. 1%, Table 1). However, an adult 21-year-old female had a very high infection intensity (22.5 %). In this female, 15.2 % of parasitised cells had more than one gametocyte (see also Široký et al 2005), and 84.8 % of parasitized erythrocytes had mature gametocytes (Fig. 1 and 2). Seven of 23 tortoises were infested by *H. mauritanica* (i.e., Pr = 30%), with MPI = 3.63 (Table 1). Pr and MPI were lowest in June and highest in July, even after excluding the outlier results from the one female sampled in July (Table 1), however our June and July samples suffer from small sample sizes.

Table 1. *Hemolivia mauritanica* infection intensity, prevalence and mean parasite intensity (MPI), all in %, for 23 Algerian spur-thighed tortoises (*Testudo graeca*) sampled April to July of 2006 and 2007. Intensity values are means ± SD. One female sampled in July had an infection intensity of 22.5%.

	April	**May**	**June**	**July**	**Total**
n	6	11	3	3	23
Intensity	0.13±0.27	0.01±0.04	0 (0)	8.15±12.42	1.11±4.67
Prevalence	33.3	18.2	0	100	30.4
MPI	0.41	0.08	0	8.15	3.63

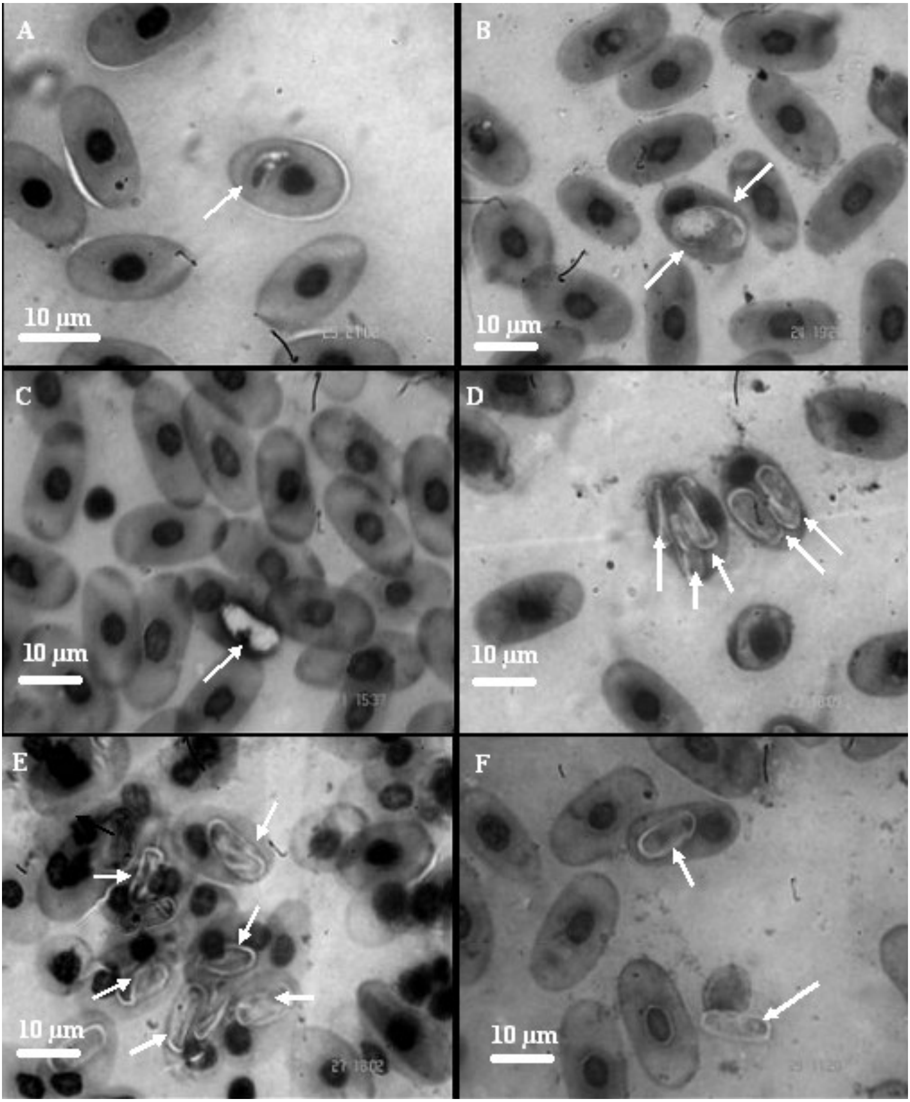

Fig. 1. *H. mauritanica*-infected erythrocytes of *T. graeca* fit five categories. Small gametocytes that do not deform erythrocytes or displace erythrocyte nuclei (A), large gametocytes that deform (elongate) the erythrocyte (B), one large, nuclei-containing gametocyte that displaces the host cell nucleus (C), two or three large, nuclei-containing gametocytes that displace the host cell nucleus, (D), or gamonts (long, curved, encapsulated parasites) inside (E & F) or outside (F) erythrocytes. Gamonts have one nucleus and the capsule resists stain.

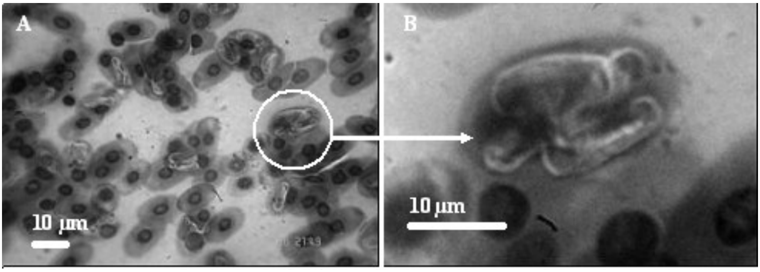

Fig. 2. Infection by *Hemolivia mauritanic*a on a 21-year-old female tortoise (22.5% of erythrocytes infected). In panel A, five erythrocytes were each infected by two gametocytes; in B, four gametocytes infected one erythrocyte. Blood was sampled 30th July 2006. Scale = 10 µm.

There seems to be significant inter-population variation of *H. mauritanica* prevalence in tortoise populations. Our study revealed a much higher Pr than that observed in conspecific tortoises from Bulgaria (14%, n = 14), but much less than that observed in conspecific tortoises from Turkey (81%, n = 47) or *Testudo marginata* from Greece (Pr = 63%; Široký et al. 2005, 2007b, 2009). Maximum MPI, as well as MPI range in our study were similar to those for Turkish *Testudo graeca* (Široký et al. 2005), thus indicating that infection intensity may vary among populations within a species.

Široký et al. (2005, 2007a, 2007b) found *H. mauritanica* in blood samples of *Testudo marginata* and in blood samples of populations of other *Testudo* from the eastern Mediterranean region (Bulgaria, Turkey, and Greece). However, *H. mauritanica* was not reported in blood samples of *Testudo hermanni* (Vettel 2006), another tortoise species whose distribution overlaps considerably with that of *H. mauritanica.*

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A CONTRIBUTION TO THE REPTILES OF THE FARASAN ISLANDS, SAUDI ARABIA

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The Farasan Islands are an assemblage of islands formed by raised fossil coral reefs located in the Red Sea. They are situated approximately 80 km off the coast of Saudi Arabia between 16°20' North and 17°20' North, and 41°30' and 42°30' East, and range between an elevation of 0 m and 30 m ASL (Flamand et al. 1988; Child & Grainger 1990) (Fig. 1). Large parts of the islands are weathered flat gravel plains incised by well vegetated *wadis* and other broken habitats formed when the fossil reef was raised by underlying salt domes (Flamand et al. 1988; Habibi & Thouless 1997). The climate is arid with annual rainfall highly variable and ranging between 50 to 100 mm (Child & Grainger 1990). There is no permanent surface water (Flamand et al. 1988). Isolated thickets of *Acacia ehrenbergiana* occur on the gravel plains while the vegetation in the wadis consist of a variety of grasses, shrubs and trees including *A. ehrenbergiana*, *Capparis decidua*, *Commiphora gileadensis*, *Salvadora persica* and *Zizyphus spina-christi* (Flamand et al. 1988; Jennings 1988). The Farasan Islands are protected for the conservation of the largest population of *Gazella gazella* in Saudi Arabia and their outstanding biological value as a marine reserve (Child & Grainger 1990).

Knowledge of the herpetofauna from the Red Sea islands are incomplete (Schätti & Gasperetti 1994) with the first scientific visit to the Farasan Islands made between 7 and 11 March 1825 by Friedrich Wilhelm Hemprich and Christian Gottfried Ehrenberg (Ehrenberg 1827). However, it seems that no reptiles were collected from Farasan although reptiles were subsequently collected on other islands in the Red Sea – e.g. Dahlak (Schätti & Günther 2001) and Howakil (Schätti 2001). Other publications regarding reptiles from the Farasan Islands are limited to Gasperetti (1988), Miller (1989), Gasperetti et al. (1993) and Schätti & Gasperetti (1994). During a gazelle census on Farasan Kebir between 23 and 29 July 2009, I opportunistically searched for terrestrial reptiles and spent approximately 2 to 3 hours a day scouring likely hiding places in a variety of habitats ranging from anthropomorphic (ruins) to indigenous (combination of *Acacia ehrenbergiana* dominated vegetation types) to alien (*Prosopis* stands). Sightings included in this paper are viewed as a contribution and update to a meagre checklist of the herpetofauna of the Farasan Islands.

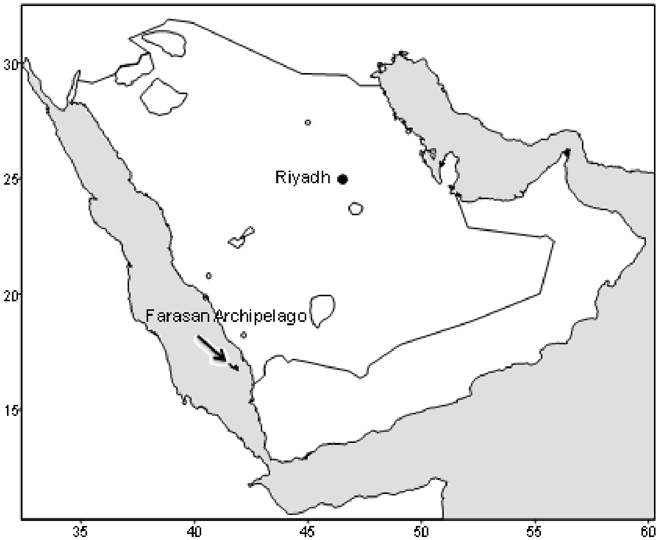

Fig. 1. The location of the Farasan Archipelago in the southern Red Sea.

List of species

Four reptile species, three of which had not previously been documented from the Farasan Islands, were observed during this survey, increasing the known terrestrial reptile species richness from 7 to 10 species (Table 1). These four species are the geckos *Hemidactylus flaviviridis* and *Ptyodactylus hasselquistii*, the lacertid *Mesalina guttulata* and the skink *Eumeces schneiderii*.

1) *Hemidactylus flaviviridis* was located after dark on external walls of a guest room complex in the new part of Farasan City, the main town on the Farasan Islands.

2) *Ptyodactylus hasselquistii* was located in a historic, partially renovated, building during daylight hours in the old part of Farasan City, the main town on the Farasan Islands.

3) *Mesalina guttulata* was located at two very different sites on Farasan Kebir. One specimen was located under flotsam on a vegetated sandy strip bordering the beach approximately 15 m from the edge of the water, while the other was located on a sparsely vegetated inland gravel plain area. Both specimens were observed during early morning (i.e. before 09h00) with one individual still found actively foraging while the other already having retreated under flotsam.

4) *Eumeces schneiderii* was located actively foraging in a sparsely vegetated boulder strewn rocky ridge – typical of the general broken Farasan Island terrain during early morning (i.e. before 09h00).

Table 1. Checklist of the reptiles known to occur (or associated with) on the Farasan Islands.

Species	Farasan Islands	Source
Family: Gekkonidae		
Hemidactylus flaviviridis	Kebir	Cunningham (Unpub. data; July 2009)
Hemidactylus turcicus	Kebir	Schätti & Gasperetii (1994); Anon (2000)
Pristurus flavipunctatus	Sarso	Steindachner (1901); Schätti and Gasperetii (1994); Anon (2000)
Ptyodactylus hasselquistii	Kebir	Cunningham (Unpub. data; July 2009)
Family: Lacertidae		
Mesalina guttulata	Kebir	Schätti and Gasperetii (1994); Cunningham (Unpub. data; July 2009)
Family: Scincidae		
Eumeces schneiderii	Kebir	Cunningham (Unpub. data; July 2009)
Family: Colubridae		
Platyceps insulanus	Sarso	Mertens (1965); Anon (2000); Schätti (2001); Llewellyn (in press)
Platyceps rhodorachis	Kebir	Schätti and Gasperetii (1994); Anon (2000)
Psammophis schokari	Kebir	Gasperetti (1988); Schätti and Gasperetii (1994); Anon (2000); Llewellyn (in press)
Family: Viperidae		
Echis pyramidum	Kebir	Schätti and Gasperetii (1994); Anon (2000); Schätti (2001); Llewellyn (in press)
Family: Cheloniidae		
Chenonia mydas	Kebir	Miller (1989); Gasperetti et al. (1993); Anon (2000); Llewellyn (in press)
Eretmochelys imbricata	Dhi Dhahaya, Dosan	Miller (1989); Gasperetti et al. (1993); Anon (2000); Llewellyn (in press)
Family: Dermochelyidae		
Dermochelys coriacea	Offshore	Anon (2000)

The herpetological inventory for the Farasan Islands is far from complete and in urgent need of a formal detailed survey and update. The Dahlak Archipelago on the opposite side of the Red Sea and part of Eritrea has 15 terrestrial species (Schätti 2001) while mainland south-western Saudi Arabia has at least 51 saurians, 1 amphisbaenid and 25 species of snakes (Arnold 1886; Gasperetti et al. 1988; Schätti & Gasperetti 1994; Egan 2007). There is a high degree of correspondence between the herpetofauna of south -western Arabia and Somalia which may be evidence of the Straits of Bab al-Mandab connection between Africa and Arabia (Joger 1987) although this link is not supported geologically (Fernandes et al. 2006). The Farasan Islands may offer a unique natural laboratory for systematic and zoogeographic studies and the phylogenetic relationships between reptiles from the Horn of Africa and the south-western Arabia Peninsula.

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NATURAL HISTORY NOTES

REPTILIA: CHELONIA

TESTUDINIDAE

***Kinixys spekii* Daudin, 1802**
Speke's Hinged Tortoise

PREDATION

Reports of carnivore predation on African chelonians are rare, although such instances may be greater than currently appreciated. On December 28th 2009 an adult Speke's Hinged Tortoise, *Kinixys spekii* (with a shell approximately 140-150 mm in length, was observed being eaten by a subadult lion (*Panthera leo*) in the Mala Mala Game Reserve, Sabi Sands Conservancy, Mpumulanga Province, South Africa. No attempt was made to recover the tortoise, which was identified on the basis of its relatively large size and the vague zonary pattern on the plastron (Branch 2008). *Kinixys natalensis* has not been recorded from Mala Mala (pers. comm. local rangers).

Chelonians in the diet of most large carnivores are probably incidental and opportunistic. Several video clips (see YouTube web links below) show young lions eating subadult Leopard Tortoises (*Stigmochelys pardalis*) in the in the Kruger National Park, and at an unspecified location. In all of these cases, including that reported here, the tortoise was opened at the rear of the carapace. Another anecdotal report (Kwando 2008) notes a young leopard (*Panthera pardus*) eating a leopard tortoise at Lagoon camp, Kwando River, northern Botswana, but gives no further details.

In Eurasia striped hyaena (*Hyaena hyaena*) are recorded to be able to locate tortoises in their retreats during periods of aestivation and hibernation (Kullman 1965; Gaisler et al. 1968), and one hyaena was observed locating and digging out three tortoises in two and a half hours in one night (Heptner & Sludskij 1980). Whether hyaena in Africa show similar abilities is unknown. Branch (2007) recorded a Nama padloper (*Homopus solus*) shell recovered from a brown hyaena (*Hyaena brunnea*) den, but this may have been scavanged.

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YouTube. Website views of lion predation on chelonians.
http://www.youtube.com/watch?v=c9StzQ0cfEs&NR=1
http://www.youtube.com/watch?v=KoQtkUcopEI

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Fig.1. Adult Speke's Hinged Tortoise (*Kinixys spekii*) being eaten by a sub-adult lion (*Panthera leo*), Mala Mala Game Reserve, South Africa.

REPTILIA: SQUAMATA: SERPENTES

ELAPIDAE

Dendroaspis jamesoni Traill 1843
Jameson's Mamba

REPRODUCTION

Dendroaspis jamesoni is known from parts of Kenya, Uganda, Rwanda, Tanzania, Nigeria, Ghana and Sudan (Spawls et al. 2002. *A Field Guide to the Reptiles of East Africa*. Academic Press, San Diego). Little information is known of its biology (Spawls et al. *op. cit.*). In this note I present information on reproduction of *D. jamesoni*.

Ten *D. jamesoni* from Uganda, (8 females, SVL = 1526 mm ± 180 mm, range = 1283 -1835 mm; 2 males, SVL = 1630 mm ± 81 mm, range = 1573 - 1687 mm) were examined from the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, U.S.A. Their numbers and collection dates were: LACM 38629, 38630, 38632-38634, 38636, 38637 (June 1967); LACM 46317, 46318, 46320 (November 1968).

For histological examination, the left testis was removed from each male to study the testicular cycle and the left ovary was removed from each female to check for the presence of vitellogenesis (yolk deposition) and/or corpora lutea. Oviductal eggs were counted. Slides were stained with Harris hematoxylin followed by eosin counterstain. Histology slides were deposited at LACM.

The only stage observed in the testicular cycle was sperm formation (spermiogenesis) in which the lumina of the seminiferous tubules were lined by sperm and/or metamorphosing spermatids. This was observed in two males from June. The vasa deferentia were packed with sperm.

None of five females from June were undergoing yolk deposition. Two of the three females from November (67%) contained oviductal eggs; LACM 46320 (SVL = 1462 mm) contained 6 and LACM 46317 (SVL = 1507 mm) contained 13. The third female (LACM 46318) (SVL = 1283 mm) was not undergoing yolk deposition. The absence of ovarian activity in five June females suggests seasonality exists in the ovarian cycle of *D. jamesoni*.

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ELAPIDAE

Naja nivea Linnaeus, 1758
Cape Cobra

REPRODUCTION

Naja nivea occurs through the western half of the Republic of South Africa, north to southern Namibia and adjacent Botswana (Branch, 1998: *Field Guide to Snakes and other Reptiles of Southern Africa.* Third edition. Struik, Capetown). The mating period has been reported to be September to October, with 8 - 20 eggs deposited in midsummer (FitzSimons, 1980: *A Field Guide to the Snakes of Southern Africa.* Collins, London). The purpose of this note is to provide information on the timing of events in the testicular cycle of *N. nivea*.

Seven adult male *Naja nivea* (SVL = 1302 mm ± 140 mm, range: 1125 - 1474 mm) from Namibia and South Africa were examined. Specimens collected from the Hardap Region, (LACM 84053) during March 1970, the Karas Region (LACM 77056, 77346, 77347, 77349, 77355) in Namibia during October 1972 and the Northern Cape Province of the Republic of South Africa (LACM 84196) during January 1970, were borrowed from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, U.S.A.

For histological examination, the left testis and vas deferens were removed, embedded in paraffin, sectioned at 5µm and stained with Harris hematoxylin followed by eosin counterstain. Histology slides were deposited in LACM.

Two stages were observed in the testicular cycle. During spermiogenesis, the seminiferous tubules are lined by clusters of sperm and/or clusters of metamorphosing spermatids (observed in January and March). During regression, germinal epithelium of the seminiferous tubules is exhausted, reduced to 2-3 cell layers, and spermatogonia predominate (observed in October). The vasa deferentia were packed with sperm in all months sampled.

From the above histological observations and reproductive information in FitzSimons (*op. cit.*), it appears *N. nivea* exhibits an aestival spermatogenesis *sensu* Saint Girons (1982. *Herpetologica* 38:5-16) in which spermiogenesis ends in autumn and matings occur in spring using sperm produced the previous summer and stored through winter in the vasa deferentia.

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I thank C. Thacker (LACM) for permission to examine specimens.

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ELAPIDAE

Naja nivea Linnaeus, 1758
Cape Cobra

ENDOPARASITES

Naja nivea occurs through the western half of the Republic of South Africa north to southern Namibia and adjacent Botswana (Branch 1998). To our knowledge, there is one valid report of helminths of *N. nivea*: *Xenopharynx sola* (Digenea); *Oochoristica rostellata, Ophiotaenia* sp. (Cestoda) and *Rhabdias fuscovenosa* (Nematoda) (Fantham & Porter, 1950). Both Yamaguti (1959) and Schmidt (1986) list *Ophiotaenia marenzelleri* as a parasite of *N. nivea*, however, we believe this to be a misreading of Fantham and Porter (*op. cit.*) whose statement was "*Ophiotaenia* near, if not identical with, *O. marenzelleri* La Rue". The purpose of this note is to reassess and add to the helminth list of *N. nivea*.

The coelomic cavity of one male *N. nivea* (SVL = 1386 mm) collected in Namibia, Karas Region, 89 km ENE Koes, (25.9500°S, 19.1166°E, datum:WGS84, elev. 965 m) during October 1972 and deposited in the herpetology collection of the Natural History Museum of Los Angeles County (LACM 77347) was opened and visually examined. One nematode measuring 57 mm in length with 0.96 mm as greatest diameter was found. It was cleared in glycerol on a glass slide, cover-slipped, studied under a compound microscope and identified as a male *Hexametra quadricornis.* It was deposited in the United States National Parasite Collection, Beltsville, Maryland, USA as USNPC (102693).

Hexametra quadricornis is widely distributed in colubrid, elapid and viperid snakes of the old world (Sprent 1978). Small mammals serve as intermediate hosts (Anderson, 2000). *Hexametra quadricornis* in *N. nivea* is a new host record.

We would assess the host list of *N. nivea* as follows: *Xenopharynx sola* (Digenea); *Oochoristica* sp. (Cestoda)*, Ophiotaenia* sp. (Cestoda); *Hexametra quadricornis* (Nematoda); *Rhabdias fuscovenosa* (Nematoda). We consider *Oochoristica rostellata* to be a parasite of Palearctic colubrid snakes and *Ophiotaenia marenzelleri* to be a parasite of the Nearctic crotalid, *Agkistrodon piscivorous* only. The specimens of Fantham & Porter (*op. cit.)* need to be reassessed for assignment elsewhere.

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VIPERIDAE

Bitis arietans arietans (Merrem, 1820)
Puff Adder

WINTER MATING ACTIVITY

Sexually active male snakes of many species detect receptive females by following pheromonal trails laid by the female on the substrate over which she moves (Shine 2003). Observations of males trailing females can thus be used as an indication that both sexes are sexually active at the time, and a peak in such activity reveals any seasonality in mating activity. Most snakes reproduce seasonally (Shine 2003). This may be in response to variation in several factors including food availability, survival rates, thermoregulatory constraints and costs of reproduction (Bonnet 1999; Shine 2003), and so seasonality of mating can vary from one geographic location to the next within the range of a particular species (Smith et al. 2009). In fact, timing of mating within a population may even respond to temporal fluctuations in energy availability (Madsen & Shine 2000; Bonnet et al. 2001) and may thus be labile, to a degree, from one year to the next.

Variability in mating times may lead to a mismatch in the timing of mating, ovulation and sperm production (Smith et al. 2009). This mismatch is generally resolved by sperm storage, which allows decoupling timing of mating from ovulation and sperm production. Sperm storage may occur in the ductus deferens of the males before mating, or in the oviducts of females after mating, where it may remain viable for several years (Seigel & Ford 1987). Thus mating may potentially occur at any time of the year, as long as environmental temperatures are not limiting and that both sexes respond similarly to environmental stimuli.

In this note, we report on observations of free ranging Puff Adders (*Bitis arietans arietans*) engaging in sexual activity over the middle of winter in the Hammanskraal area of northern Gauteng. The observed snakes were fitted with transmitters, allowing for observations to be more extensive than is usual for free ranging snakes. The observed mating activity and activity levels during this period were in obvious contrast to the usual activity for Puff Adders in the area.

On the 31st of May 2009, an adult male Puff Adder (Pu5; 900 mm + 130 mm; 1029 g) was observed investigating the area around the water pump of a small reservoir in Jakkals Camp, Kwalata Game Ranch (South Africa; Gauteng; 25° 24’ 11” S; 28° 20’ 10” E). The snake was captured as part of an ongoing telemetry project on this species. On the following day (1st June 2009), an adult female Puff Adder (Pu4; 710 mm + 60 mm; 837 g) was discovered partially concealed under the same water pump. It is probable that the female Puff Adder was already present under the water pump before the male was captured, but was not discovered then because it was hidden from view by the pump. Three days later (4th June 2009), another adult male Puff Adder (Pu2; 780 mm + 130 mm; 724 g) was found in the same lie-up as the female Puff Adder, and two days later (6th June 2009) a further two adult male Puff Adders (Pu1; 750 mm + 125 mm; 672 g; Pu6; 680 mm + 110 mm; 520 g) were discovered under the water pump, Pu1 during the morning and Pu6, during the afternoon. All snakes were captured, implanted with transmitters (Holohil, SI-2T) and released on the 3rd July 2009 (length of stay in captivity was longer than intended due to delay of supply of transmitters; snakes maintained under constant temperature of 28 °C during captivity), approximately 40 m from the point of capture, immediately outside and adjacent to the Jakkals Camp electric fence line (25° 24’ 10” S; 28° 20’ 10” E).

Further evidence of mating activity was observed after the release of the snakes: On the 8th July 2009, Pu4 (female) and Pu1 (male) were located together back in Jakkals Camp near to their original capture site. Their close proximity to each other and relative positions indicated that Pu1 had trailed Pu4 back into Jakkals Camp. Safety issues (proximity to houses) necessitated the removal of the snakes back across the fence line, this time approximately 600 m distant, and they were observed mating at this location on the 9th July 2009.

In a separate incident on the 5th of June 2009, a large female Puff Adder (Pu3; 835 mm + 60 mm; 1323 g) was caught at one of the staff residences (25° 23’ 44” S; 28° 21’ 03” E) on Kwalata, and was implanted with a transmitter as described above. On the following day (6th June 2009), an adult male Puff Adder was found where the female had been captured, but was not captured as no snake handlers were present. Pu3 was released on the 3rd July 2009, 600 m to the south of its capture site (25° 24’ 03” S; 28° 20’ 56” E; distance from release site due to proximity of house). As with the other individuals, Pu3 was tracked every second day and had returned to within 40 m of its original capture site by the 16th October 2009. It was found dead on the 18th October 2009, approximately 10 m from the electric fence line, possibly as a result of electrocution while passing beneath the fence. Autopsy revealed that this individual was heavily gravid and contained many developing embryos.

It could be argued that our observations of Puff Adder aggregation was in response to factors other than mate searching. Other factors could include movement to hibernacula or to areas of food concentration, which are likely to occur around human habitation. However, we do not believe that either of these are credible explanations of our observations. The most obvious argument against them is the fact that we directly observed mating between two of the Puff Adders. We also know from measures of telemetered snakes, that none were showing any feeding behaviour during the winter months. Furthermore, Puff Adders are not known to brumate in communal hibernacula, and the locations where the snakes were found were certainly not suitable for overwintering snakes.

The fact that two females were trailed on more than one occasion by a total of five males and that we directly observed mating, all within a 5-week period demonstrate that Puff Adders can be sexually active in winter. This finding is apparently at odds with Broadley (1983), who states with regards to Puff Adder mating, only that "males are unusually active in the pursuit of females during October to December" (i.e., austral spring and early summer). Alexander & Marais (2007) record mating in *B. arietans* in autumn, winter and spring, while Branch (1998) reports mating in spring and late autumn. Certainly, several species of temperate viperids and other snakes are known to have bimodal peaks in mating activity, usually with a peak in early spring as snakes emerge from hibernacula, and again in summer (Graham et al. 2008; Smith et al. 2009). However, the hypothesis that the population of *B. arietans* at Kwalata has more than one peak in mating activity is thus far not supported by our telemetry data, as the four males that were telemetered during this period did not subsequently show any obvious increase in distance travelled in October and December. We caution that we require more data over a longer time-period before we can state this with the necessary degree of certainty.

We recorded up to four males attending a single receptive female. We thus conclude that attending male Puff Adders must, on occasion, come into contact with each other during mating activity, and that there is therefore a potential for male-male combat in this species. Indeed, male-male combat has been recorded in Puff Adders (Shine 1978; Branch 1998; Alexander & Marais 2007). Shine (1978) found a much higher prevalence of male-male combat in snake species where the male attains a larger body size than the female. Although Shine (1978) cites Pitman (1974) in recording larger female body size for *B. arietans* in Uganda, males typically grow longer than females in South Africa, although females may become heavier (Broadley 1983), especially when gravid.

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VIPERIDAE

Bitis arietans arietans (Merrem, 1820)
Puff Adder

PARTIAL RESISTANCE TO *NAJA* VENOM

The resistance of prey species to sympatric predator venoms is relatively well documented. Fry & Wüster (2004) have shown that the constituents of most snakes' venom evolved early in their histories and are shared by most modern lineages – five out of eight toxin families appear to have evolved before the diversification of modern snakes, while two toxin families appear to have evolved within the Viperidae and Elapidae independently. The cosmopolitan nature of these toxin families may provide a basis for resistance of snakes to the venom of other snake species, despite their distant relationships. Sand Boas (*Eryx jaculus*) show resistance to components of the venom of Indian Cobras (*Naja naja*), to which they are only distantly related (Barchan et al. 1992). Other authors have noted similar cases of resistance: Noguchi (1904) demonstrated the resistance of *Opheodrys* to *Crotalus* venom while Keegan & Andrews (1942) showed that numerous (though not all) of the North American snake species that they tested could survive injection of viperid venom. While information regarding the biochemistry of resistance is readily available, comparatively few cases demonstrate the resistance of one species to the venom of another in an ecologically meaningful context. Here we report on a case of envenomation of an adult Puff Adder (*Bitis arietans arietans*) by a large Snouted Cobra (*Naja annulifera*).

At 19h00 on the 25th January 2010, while tracking snakes in Kwalata Game Ranch (25° 24' 16" S; 28° 19' 52" E), we witnessed an attack on one of our telemetered Puff Adders (male, 493 g; 700 mm + 110 mm; measured 13th August 2009) by a large Snouted Cobra. We arrived on the scene after the attack had already begun, and witnessed the Snouted Cobra deliver a series of three deliberate bites to the anterior flanks of the Puff Adder. Given the commotion that drew our attention to the interaction, we believe that the Puff Adder had already been bitten several times prior to our arrival. The Puff Adder showed only feeble attempts to escape and avoid the cobra, and did not bite in self defence during our observations. After the Puff Adder became less responsive, the Snouted Cobra displayed investigatory behaviour typical of a snake prior to the ingestion of its meal. After approximately 10 minutes of observation, the cobra abruptly left the scene, possibly as a result of our presence. (We were observing from approximately 5 m away). The Puff Adder remained immobile and appeared to have become lethargic. We assumed this to be a result of envenomation. The Puff Adder was left *in situ*, and we expected to find it dead at the scene the following morning. The deliberate nature of the bites delivered by the cobra, the lethargic behaviour of the Puff Adder following the bite and its subsequent behaviour (see below) indicate that significant envenomation had indeed occurred.

The following morning at 07h10, the Puff Adder was located crossing a gravel road 170 m from where the attack had taken place. Continued tracking of the snake revealed that it chose a lie-up position in rank grass 200 m from the attack site and remained resting (not the typical and distinctive positioning of an ambushing snake) in this location until the 8th February 2010. During the entire 13 day-period that the snake spent in this lie-up, it was not once observed to go into an ambush position or show any interest in feeding. In fact, we gently prodded it on occasion to check that it was still alive. This behaviour was in stark contrast to the behaviour of other telemetered Puff Adders that were being observed over the same period, and which spent most of their time in ambush when not digesting. Rather, its behaviour was reminiscent of an animal that was in ill health. On the 8th February 2010, the Puff Adder moved approximately 10 m and took up an ambush position amongst shrubs under the canopy of a Sickle Bush (*Dichrostachys cinerea*). It remained in ambush, moving only very short distances (< 5 m) over the following 10 days and, on the 19th February 2010, moved 30 m into thick grass, where its behaviour alternated between periods of ambush and rest. On the 5th March 2010, the Puff Adder was weighed, measured (527 g; 700 mm + 110 mm) and examined. Although body mass was slightly higher than our initial mass measurement made in August (+ 34.5 g), other telemetered conspecifics had gained significantly more mass over this period. It did not appear to have eaten since the attack as it was very lean and the vertebrae were pronounced. It had partially regained an alert disposition.

On the 30th March 2010, the Puff Adder was found dead. Small pieces of flesh on the back of the head and neck region had been eaten (> 5% body mass), but this appeared to be unrelated to the cause of death. Dissection revealed a large amount of unconsolidated and putrefied faeces in the stomach and gut of the snake, and the digestive tract in this area appeared to have become necrotic.

Puff Adders are regularly preyed upon by Snouted Cobras (Branch 1998; Shine et al. 2007), and so our observations are not unusual from this perspective. The more interesting aspect was that the Puff Adder did not succumb immediately to the effects of envenomation, but appeared only to have become temporally immobilised and to have made a recovery. A similarly sized rodent would have succumbed in seconds, indicating that Puff Adders appear to display strong resistance to the effects of the Snouted Cobra venom. However the Puff Adder's internal anatomy appears to have been damaged by the effects of the venom, which ultimately resulted in its death more than two months later. Our observations highlight the importance of assessing the long term effects of envenomation rather than only the immediate symptoms as is typical of most studies.

Acknowledgements

We thank Kwalata Game Ranch for permission to work in Kwalata. All work was passed by the Ethics Screening Committee of the University of the Witwatersrand (2009/28/04) and was conducted under permit Z1 No 1249. This work was partially funded by NRF and the University of the Witwatersrand.

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REPTILIA: SAURIA

LACERTIDAE

Meroles reticulatus (Bocage, 1867)
Reticulate Sand Lizard

ENDOPARASITES

Meroles reticulatus is known from coastal areas of the northern Namib Desert from near Walvis Bay to southern Angola (Branch 1998). We know of no reports of helminths for this species. In this note we establish the initial helminth list for *M. reticulatus.*

Six *M. reticulatus* (mean SVL = 48.5 mm ± 3.7 mm, range: 43 - 52 mm) from the Erongo Region, Namibia collected in November 1972 and deposited in the herpetology collection of the Natural History Museum of Los Angeles County, Los Angeles, California, USA as LACM 77676, 77678, 77679, 77681, 77682, 77684 were examined for helminths.

The body cavity was opened by a longitudinal incision, and the digestive tract was removed, opened longitudinally, and examined under a dissecting microscope. Eight cestode proglottids (as a segment) were found in the small intestine of LACM 77676. These were regressively stained in hematoxylin, mounted in balsam, studied under a compound microscope. Because mature nongravid proglottids were found, the cestode could be identified as *Oochoristica truncata.* Prevalence (number infected lizards/ number lizards examined X100) was 17%). The *Oochoristica truncata* specimen was deposited in the United States National Parasite Collection, Beltsville, Maryland, USA as USNPC (102696).

Oochoristica truncata is widely distributed in reptiles from southern Africa; hosts are summarized in Goldberg & Bursey (2004) and Bursey & Goldberg (2007). To those lists should be added the snake *Psammophis trinasalis* (Goldberg & Bursey 2007). The life cycle of *O. truncata* is unknown, however, the congener *O. anolis* utilizes beetles as intermediate hosts (Conn 1985). *Oochoristica truncata* in *M. reticulatus* is a new host record.

Acknowledgements

We thank Cecilia Nava (Whittier College) for assistance with dissections and Christine Thacker (LACM) for permission to examine specimens.

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GEKKONIDAE

Afrogecko plumicaudus Haacke, 2009
Feathertail Gecko

REPRODUCTION

Since the end of 2007 we have kept two males and four female *Afrogecko plumicaudus* from Tambor (1612Ab), Namibé (=Mossamedes) district, Angola, in Germany. The animals are housed in groups of three (one male and two females). Each group is kept in a terrarium measuring 400 mm (l) x 400 mm (b) x 400 mm (h). Limestone plates lean against the sides and back walls providing crevices as retreats. The cage floor is covered with loose sand. The ground temperature is maintained between 26°C and 29°C, while the temperature near the top of the cage is 32 °C. The geckos are fed every 3 or 4 days with crickets, wax worms, fruit-flies and larvae of small beetles. Twice a week the terrarium is sprayed with water. No permanent water is provided.

On February 13th, 2007 we found a single egg in the loose sand behind the limestone plates. A second egg was found four weeks later. Females continued to lay single eggs every 3 or 4 weeks. Our observations suggest that *Afrogecko plumicaudus* lay a single egg per clutch, and produce more than one clutch a year. Prior to oviposition, the female digs a small depression in the sand. She then positions her cloaca over this depression and while keeping her tail curled horizontally. She deposits the egg in the hollow and then covers it with sand. The eggs measure 7.9 mm – 10.1 mm (mean 8.9 mm) × 6.0 mm – 7.7 mm (mean 6.8 mm), (n = 18) and weigh 0,2 g (n = 2). All eggs have a small projection on the longest side.

Each egg was placed into a small plastic box and then into an incubator. The eggs were incubated at a temperature of 28°C during the day and between 24°C and 26°C at night. The young hatched between 170 and 232 days (mean 196 days) (n = 9) after being laid, which is an exceptionally long period. Hatchlings measured between 15.8 mm and 19.0 mm SVL (mean 17.37 mm) and had tail lengths between 16.1 mm and 20.5 mm (mean 18.51 mm) (n = 9).

Hatchlings are very small, fragile and not easy to maintain in captivity. We have kept them singly in plastic containers (110 mm x 70 mm x 180 mm) and feed them very small crickets. Every two days their containers were lightly sprayed with water. Hatchling *A. plumicaudus* appear to grow very slowly and the young we have kept only reached adult size after 15 months.

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GEKKONIDAE

Afroedura bogerti Loveridge, 1944
Bogert's Flat Gecko

REPRODUCTION

Since the beginning of 2008, we have kept a pair of *Afroedura bogerti*, collected in Tambor, Namibé (=Mossamedes) district, Angola, in Germany. The geckos are housed in a terrarium measuring 500 mm (l) x 250 mm (b) x 300 mm (h). Limestone and slate plates leaning against the side and back walls form crevices as retreats. The ground is covered with loose sand. A small spotlight is installed in the top of the terrarium providing light and heat. Ground temperature is maintained between 27 °C and 29 °C, while the temperature higher up in the cage is generally around 32 °C. Food in the form of crickets and wax worms are provided every 3 or 4 days. Twice a week the terrarium is sprayed with water to allow the geckos to drink. No free water is available in the terrarium. Gravid females can be recognised as the eggs become visible through the skin.

On August 10th, 2009 we found an egg between two limestone plates. The egg was stuck to the limestone plate 10 mm above the ground. A second clutch (two eggs) was found 14 days later on August 25th and a third clutch (two eggs) on September 20th, 2009. The eggs of each of the last two clutches were stuck together and attached to the same limestone plate as the first clutch, but near the upper end and on the other side.

The eggs of *A. bogerti* are white and elongated. They measure 12.9 mm – 14.7 mm (mean = 13.8 mm) x 10.5 mm – 12.1 mm (mean = 11.6 mm) (n=5). We placed the limestone plate with attached eggs into a separate terrarium. Incubation temperatures varied between 26 °C and 32 °C during the day and 22 °C and 26 °C at night. The young hatched between 88 and 92 (mean = 90, n = 5) days later. Hatchlings measured between 30.2 and 30.9 mm (mean = 30.6 mm) in SVL, and 26.5 mm and 27.9 mm (mean = 27.4 mm, n = 5) in tail length. The hatchlings are being maintained in the terrarium that they hatched in and are fed a diet of small crickets.

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GEOGRAPHICAL DISTRIBUTIONS

REPTILIA: SQUAMATA: SERPENTES

COLUBRIDAE

Meizodon semiornatus semiornatus (Peters, 1854)
Semiornate Snake

Punda Maria Rest Camp, Kruger National Park, Limpopo Province, South Africa. S22º 41' 29" E31º 00' 58". Collected 1 May 2009 by Su-Mari Swanepoel. Photographed and submitted to the Virtual Museum of the Southern African Reptile Conservation Assessment (SARCA); Animal Demography Unit; University of Cape Town; SARCA entry number 6709.

Meizodon (Fischer) is a typically African genus, with a distribution that extends marginally into Arabia. *M. s. semiornatus* is widespread and found from northern KwaZulu-Natal and eastern Limpopo Province in South Africa, through Swaziland, the Mozambique plain and Zimbabwe to east Africa and Yemen (Broadley 1990; Branch 1998, Spawls et al. 2002). *M.s. semiornatus* is replaced in Sudan and Chad by *M. s. tchadensis*.

On 1 May 2009 around 9:30 I unexpectedly came across a Semiornate snake that was moving across a public area in the Punda Maria Rest Camp, Kruger National Park. I caught the snake so that I could relocate it to a less public area, but noticed that it was an unfamiliar species to me and decided to investigate. The specimen was easily identifiable by the patterns on the head and body. Identification was confirmed by the SARCA virtual museum panel of experts. The specimen was released after being photographed.

This record represents only the third specimen for the Kruger National Park (G. Zambatis, *Pers. comm.*). Haagner (1990) reported the first record of the species for the park from the Crocodile Bridge gate, 2531BD, while Haagner & Leslie (1993) reported on a juvenile collected on the Metsi-Metsi trails area to the east of Tshokwane (2431DD). Both locations are more than 250 km from Punda Maria (2231CA). This record thus represents a significant extension to the known range of this species in the Kruger National Park and South Africa.

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COLUBRIDAE: DISPHOLIDINI

Xyelodontophis uluguruensis Broadley & Wallach, 2002
Dagger-tooth Vine Snake

Tanzania, Morogoro Region and District, Nguru Mountains (NE 0637AB). Collected in early 2003 by a snake catcher for J. B. Brought down to Bulawayo by Chris Kelly and deposited in the Natural History Museum of Zimbabwe, NMZB 17088.

This adult female measures 920 + 525 mm. Dorsal scale rows 22-19-13, feebly keeled dorsally (vertebral row + two rows on each side), smooth laterally; ventrals 167 (not keeled); anal divided; subcaudals 148. Upper labials 8, the fourth and fifth entering the orbit; lower labials 11, the first 5 or 6 in contact with the anterior sublinguals, loreals 2; preocular 1; postoculars 3; temporals 1+2. Top of head dark olive brown, labials, chin and throat pale green, body grey, heavily speckled with black, dense speckling forms broad crossbands which are confluent craniad but become widely spaced caudad, while on the tail they are very wide, leaving only small pale interspaces; venter mottled green with vague pale lateral lines. Eye with a horizontal oval pupil. This second recorded female differs little from the holotype (Broadley & Wallach, 2002, *Bull. nat. Hist. Mus.* Lond. (Zool.) **68** (2): 57-74).

This female laid 10 eggs while in captivity at M.B.L.'s Snake Farm and Reptile Centre, Arusha. These all hatched, but nine of the hatchlings refused to eat and died, and two of these are now catalogued as NMZB 17089-90, the other three are held by C.M.R. Kelly and will be deposited in the Port Elizabeth Museum collection (Bayworld). The tenth hatchling grew to maturity and was photographed by Bill Branch for the cover of this issue of *African Herp News.*

The male hatchlings measure 240+137 mm and 245 +137 mm respectively; they have shorter heads than the adults and resemble hatchling *Dispholidus typus* very closely in colour pattern. Dorsal scale rows 19-19-13, only vertebral and paravertebral rows with very faint keels, otherwise smooth; ventrals 168 & 166; anal divided; subcaudals 158 & 159. Upper labials 8, the fourth and fifth entering the orbit; lower labials 9-10, the first 4 or 5 in contact with the anterior sublinguals; loreals 2; preocular 1; postoculars 3; temporals 1+2. NMZB 17090 has an umbilical scar on ventrals 139-141. Eye with horizontally oval pupils. Top of head uniform brown, labials chin and throat white anteriorly, becoming bright yellow posteriorly, dorsal scales on neck brown, but black basally and with black and bluish white interstitial skin, together with scattered bright yellow spots; caudad pale brown with black-bordered paler cross-bands, fading out on the tail; venter pale brown with darker speckling.

This record represents a northwestern range extension of approximately 100km from the type locality in the Uluguru Mountains. This species may yet be found in the Rubeho Mts further west.

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ABOUT THE COVER

Xyelodontophis uluguruensis Broadley & Wallach, 2002
Dagger-tooth Vine Snake

Photographs of a live specimen of this very rare snake reveal several features not mentioned in the type description (Broadley & Wallach. 2002. *Bull. nat. Hist. Mus.* Lond. (Zool.) **68** (2): 57-74) or the article in this issue (Broadley & Beraducci. 2010, this issue). The surviving male was photographed by Colin Tilbury when it was a juvenile in 2004 (see Branch 2005, p 61. Photographic Guide to Snakes and other reptiles and amphibians of East Africa, Struik, Cape Town). In that picture the forepart of the snake is inflated in threat display and shows blue-grey interstitial skin. The seven year old adult now has black interstitial skin on the forebody. The ventral coloration of the live adult is also similar to that of adult Twig snakes (*Thelotornis*) and juvenile Boomslang (*Dispholidus*), being mottled in red-brown and cream but with a yellow infusion on the lateral edges. Moreover, although the ventrals are angular not keeled (as noted by Broadley & Wallach, *Op. Cit.*), they are notched on the posterior edge. The vaguely banded body of the juvenile is also retained in the adult. In life the pupil shape is better described as that of a slightly flattened oval rather than "pear-shaped", and the pupil colour is emerald green (similar to that of juvenile Boomslang) with irregular cream patches. The tongue in life is bright red with a black tip and forks.

Photograph and extended caption submitted by:
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INSTRUCTIONS TO AUTHORS

Contributions submitted in an incorrect style (see guide-lines below) will be returned to the authors.

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)**(1,2) (bold, centred); Author's address(es) (use superscripts with authors' names and addresses if more than one author); **HEADINGS** (bold, centred) and **Subheadings** (bold, aligned left) as required; **REFERENCES**, following the formats given below:

BRANCH, W.R. 1998. *Field Guide to the Snakes and Other Reptiles of Southern Africa*. Third edition. Struik, Cape Town.

BROADLEY, D.G. 1994. The genus *Scelotes* Fitzinger (Reptilia: Scincidae) in Mozambique, Swaziland and Natal, South Africa. *Ann. Natal Mus*. **35**: 237-259.

COOK, C.L., & MINTER, L.R. 2004. *Pyxicephalus adspersus* Peters, 1854. pp. 303-305, *in* Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J., and Kloepfer, D. (eds.), *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland*. SI/MAB Series #9. Smithsonian Institution, Washington, DC.

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: **Scientific name** (including author citation); **Common name** (using Bill Branch's *Field Guide to Snakes and Other Reptiles of Southern Africa*, third edition, 1998, for reptiles; and Passmore & Carruthers' *South African Frogs*, 1995, 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 and in abbreviated form); **Locality** (Country; Province; quarter-degree locus; location; latitude and longitude if available; elevation above sea level); **Date** (day, month, year); **Collector(s); Place of deposition and museum accession number** (required if specimens are preserved). **References**, if only one or two, should be incorporated into the text; three or more references should be placed after the main text, as for Articles. **Submitted by**: **NAME**, Address.

GEOGRAPHICAL DISTRIBUTION

Brief notes of new geographical distributions (preferably at least 100 km from the nearest published record) of amphibians and reptiles on 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: **Scientific name** (including author citation); **Common name** (for sources, see Natural History Notes); **Locality** (Country; Province; quarter-degree locus; location; latitude and longitude; elevation above sea level); **Date** (day, month, year); **Collector(s)**; **Place of deposition and museum accession number** (required if specimens are preserved); **Comments**, including data on the size, colour and taxonomic characters, eg. scalation, webbing, especially for taxonomically problematic taxa; and nearest published locality record(s) in km; **References**, if only one or two, should be incorporated into the text; three or more references should be placed after the main text, as for Articles. **Submitted by**: **NAME**, Address.

Records submitted should be based on specimens deposited in a recognised collection.

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.

Survey results should be presented in the following format: **TITLE, including an indication of the survey area or locality** (country, province or state, location, quarter-degree units, or bounding latitude and longitude); **AUTHOR(S)** (format as for long articles, above) **Dates** (day, month, year); **Statement of relevance**; and **SPECIES LIST**, in tabular form comprising ***Scientific name*** (including author citation), **Location / Habitat**; **Evidence** (including registration numbers and location of vouchers); and **Comments** (where required). The note should end with a **SUMMARY** statement and **REFERENCES**.

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).

PHOTOGRAPHS AND FIGURES

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 or senior author of the article.

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(Posting to addresses in Africa)

	1 year	**3 years**
Ordinary members	ZAR 200	ZAR 600
Scholars (attending high school)	ZAR 100	

FEE STRUCTURE 2010 FOR NON-AFRICAN RESIDENT MEMBERS

(Posting to addresses outside Africa)

Membership	**1 year**	**3 years**
	US$60	US$180

BANKING DETAILS

Account Name: Herpetological Association of Africa
Account Number: 1793 6077
Bank: ABSA
Branch: Eastgate
Swift Code: ABSAZAJJ
Clearing Code: 6356050

CREDIT CARD PAYMENTS

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NOTICE REGARDING ELECTRONIC PAYMENTS

It is essential that your **membership reference number** (or initials and surname, if you are a new member) be used as a reference for electronic payments, and that you let the HAA Treasurer, Abeda Dawood (abeda@nzg.ac.za), know when you authorize the payment, so that it can be traced.

NB: BANK FEES

Please note that **all bank fees for credit card and electronic payments** to the HAA must be **borne by you, the payee**. Thus, please ensure that you **add an extra 5%** to cover bank charges, or that these come **directly off your account** when electronically transferring money, and **NOT off the amount to be received by the HAA**.

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