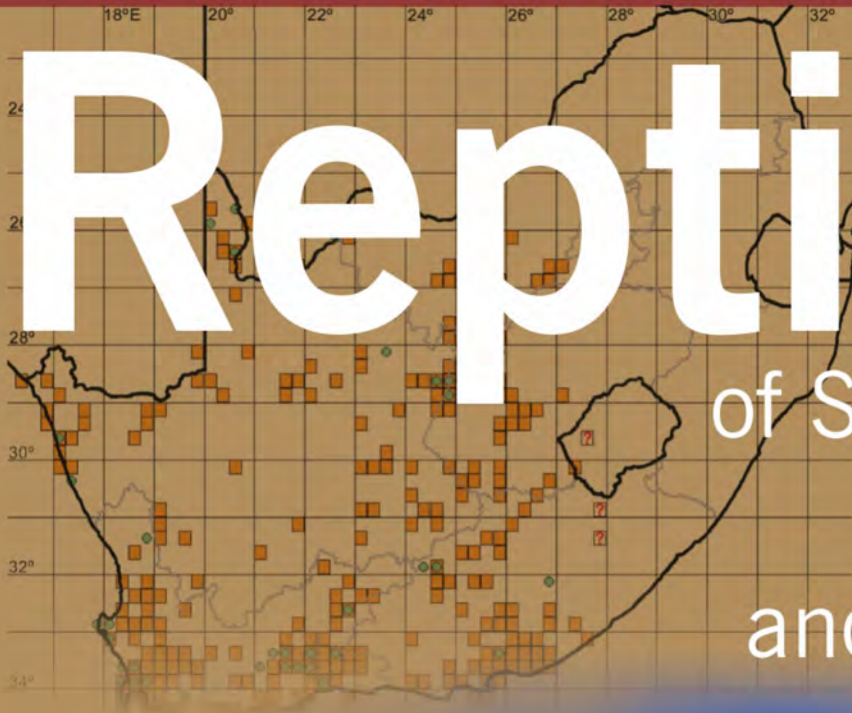
Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland



Edited by
Michael F. Bates, William R. Branch, Aaron M. Bauer, Marius Burger,
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SURICATA 1



















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SANBI
Biodiversity for Life
South African National Biodiversity Institute

Pretoria

2014

SURICATA

Suricata is the genus name of the suricate (*meerkat*), which is near-endemic to the arid western parts of southern Africa (occurring in Namibia, South Africa and Botswana; and just entering into a very small area in the extreme south of Angola). Behaviourally, suricates are socially inclusive and innately inquisitive, symbolising the commitment of South African National Biodiversity Insitute (SANBI) to include all biodiversity and serve all of Africa, and the scientific curiosity that precedes and drives research and publication of research results. Sister journal to SANBI's *Strelitizia*, *Suricata* is a peer-reviewed journal and publishes original and applied research such as monographs, revisions, checklists, Red Lists, Atlases, and Faunas of any taxa belonging to Regnum Animalia (the Animal Kingdom).

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Graham J. Alexander & Marienne S. de Villiers

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References to chapters, including family accounts:

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References to species and subspecies accounts:

BOYCOTT, R.C. 2014 (reprint 2014). *Pelomedusa subrufa* (Bonnaterre, 1789). In M.F. Bates, W.R. Branch, A.M. Bauer, M. Burger, J. Marais, G.J. Alexander & M.S. de Villiers (eds), Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. *Suricata* 1. South African National Biodiversity Institute, Pretoria.

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Sponsors

The total budget of the Southern African Reptile Conservation Atlas (SARCA) was almost R3 million—significant sums of money were required to pay staff salaries, running and travel expenses (including the costs of field trips, training workshops and conference attendance). Fortunately, there are individuals and organisations who appreciate the need to monitor and conserve biodiversity in its entirety, including under-appreciated faunal groups such as reptiles. SARCA was fortunate to find such sponsors and the project would not have succeeded without their input.

- American Museum of Natural History
- Cape Reptile Club
- Department of Environmental Affairs
- Eco Challenge and Toyota Enviro Outreach
- Fascination Books (now South African Snakebite Institute)
- JRS Biodiversity Foundation
- National Research Foundation
- Norwegian Ministry of Foreign Affairs
- SA Reptiles
- South African Biodiversity Information Facility

Animal Demography Unit, University of Cape Town

The Animal Demography Unit (ADU; http://adu.org.za) believes that the best way to achieve biodiversity conservation is through enabling conservation decisions to be based on solid quantitative evidence. We achieve this in three ways: we gather enormous volumes of data through our expanding citizen science programmes; we lead Africa in the emerging discipline of statistical ecology, and use its approaches to understand the dynamics of animal populations; we multiply our effectiveness by training postgraduate students to apply this paradigm.

The ADU is based in the Department of Biological Sciences at the University of Cape Town. We curate, analyse and disseminate information about biodiversity. Citizen scientists are our eyes and ears and their participation in our projects is key to our success. The data submitted by citizen scientists is analysed in such a way that it ultimately influences conservation policy. The Southern African Reptile Conservation Assessment (SARCA) project is the ADU's most recently completed atlas project.

Previous ADU projects include SABCA (Southern African Butterfly Conservation Assessment), SAFAP (Southern African Frog Atlas Project) and SABAP1 (Southern African Bird Atlas Project). Ongoing ADU projects include SABAP2 (Second Southern African Bird Atlas Project), SAFRING (South African Bird Ringing), CAR (Coordinated Avifaunal Roadcounts), CWAC (Coordinated Waterbird Counts), MammalMAP (African Mammal Atlas Project) and a series of Virtual Museums.

Les G. Underhill
Director, Animal Demography Unit

South African National Biodiversity Institute

The South African National Biodiversity Institute (SANBI; www.sanbi.org) was responsible for implementing the Southern African Reptile Conservation Assessment (SARCA) project, in partnership with the Animal Demography Unit (ADU). SANBI provided core funding for the project. SANBI has a mandate to monitor and report on the status of South Africa's species from the Biodiversity Act (Act 10 of 2004). This project was one of a host of projects on atlasing and Red Listing of South Africa's species that SANBI's Threatened Species Programme co-ordinates. The project was implemented by the Animal Demography Unit and benefitted significantly in scientific content contributed by local and international herpetological experts. The data generated as part of this project will be highly valuable for conservation planning and biodiversity monitoring work in South Africa.

Domitilla Raimondo
Threatened Species Programme Manager, South African National Biodiversity Institute

Department of Environmental Affairs

The vision of South Africa's Department of Environmental Affairs (DEA) is to have a prosperous and equitable society living in harmony with the country's natural resources. In line with its vision, DEA's key strategic priorities aim to protect, conserve and enhance environmental assets, natural and heritage resources, ensuring a sustainable healthy environment and contributing to sustainable economic growth, livelihoods and economic growth. Furthermore, DEA strives towards a better Africa and a better world by advancing national environmental interests through a global sustainable development agenda.

Effective protection of species is only possible when comprehensive information on their distribution and status and on the threats to their survival is readily available. The *Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland* is a major source of such information. Through support of the Southern African Reptile Conservation Assessment project, DEA confirms its commitment and sustainable use of South Africa's biological diversity.

Fundisile Mketeni
Deputy Director General, Biodiversity and Conservation

Norwegian Ministry of Foreign Affairs

The Norwegian Ministry of Foreign Affairs, via the Department of Environmental Affairs, provided the funding for the Southern African Reptile Conservation Assessment (SARCA) project. The South African National Biodiversity Institute's work on threatened species, between 2006 and 2011, formed part of a co-operation between Norway and South Africa in the environmental sector. Work on species atlasing and assessment was the main component of Norway's support to biodiversity and conservation work in South Africa. This investment has resulted in excellent-quality foundational biodiversity data, which is being used in South Africa for conservation and land-use planning. Thus, South Africa is able to fulfill its commitments to the Convention on Biological Diversity (CBD) to monitor and report on the status of its biodiversity. The generous funding provided to the SARCA project allowed it to be comprehensive in its inclusion of all possible datasets from natural history museums, private collections and field research. This means that this conservation assessment is of a very high standard and will form a solid baseline for future monitoring of South Africa's reptiles. It also serves as an excellent example to other countries that are signatories to the CBD convention and want to fulfill their responsibilities for monitoring biodiversity. Norway was proud to be able to facilitate this important conservation initiative.

Tor Gjerde
Councillor, Royal Norwegian Embassy

JRS Biodiversity Foundation

The JRS Biodiversity Foundation (www.jrsbiodiversity.org) provides grants to enhance knowledge and promote understanding of biological diversity for the benefit and sustainability of life on Earth. Our grant-making focuses particularly upon projects such as the South Africa Reptile Conservation Assessment, which improve biodiversity data and knowledge and which can be linked to conservation outcomes and to building capacity for biodiversity informatics in Africa.

Don S. Doering
Executive Director, JRS Biodiversity Foundation

Herpetological Association of Africa

Participating institutions

SARCA was supported by herpetologists based at a number of institutions. This support was vital to the success of the project. These institutions made a valuable indirect financial contribution to SARCA by allowing their employees to spend a significant amount of time on the project. A key component of SARCA was the collation of all available reptile distribution data. Sixteen institutions generously contributed data to the project.

- American Museum of Natural History, New York
- Animal Demography Unit, University of Cape Town, Cape Town
- Bayworld (Port Elizabeth Museum), Port Elizabeth
- California Academy of Sciences, San Francisco
- CapeNature, Jonkershoek
- Ditsong National Museum of Natural History (formerly Transvaal Museum), Pretoria
- Durban Natural Science Museum, Durban
- Ezemvelo KwaZulu-Natal Wildlife
- Field Museum of Natural History, Chicago
- Gauteng Department of Agriculture, Conservation and Environment
- Iziko South African Museum, Cape Town
- John Ellerman Museum, University of Stellenbosch, Stellenbosch
- KwaZulu-Natal Museum, Pietermaritzburg
- McGregor Museum, Kimberley
- Museum of Comparative Zoology, Harvard University, Cambridge
- National Museum, Bloemfontein
- National University of Lesotho, Roma
- Nelson Mandela Metropolitan University, Port Elizabeth
- South African National Biodiversity Institute (SANBI)
- South African National Parks
- University of Stellenbosch, Stellenbosch
- University of the Orange Free State (Qwa Qwa campus), Phuthaditjhaba
- University of the Western Cape, Cape Town
- University of the Witwatersrand, Johannesburg
- Villanova University, Villanova

Participating organisations

SARCA also benefited through the support of several other organisations and their members.

- Cape Reptile Club
- Endangered Wildlife Trust
- Herpetological Association of Africa
- SA Reptiles
- Transvaal Herpetological Association

SteerCo

SARCA Steering Committee members freely gave of their time to advise on data collection strategies, time frames, finances and other relevant matters. All people who served on the committee at some time are listed.

Graham Alexander, Michael Bates, William Branch, Marius Burger (*ex officio*), Marienne de Villiers (*ex officio*), Wendy Foden, Yolan Friedmann, James Harrison (*ex officio*), Sue Kuyper (*ex officio*), Rene le Roux, Johan Marais (Chairperson), Kristal Maze, Frank Mazibuko, Le Fras Mouton, Solomon Nkoana, Krystal Tolley, Andrew Turner, and Les Underhill.

Virtual Museum panel

Members of the Virtual Museum panel offered up their time and expertise to identify almost 6 000 photographic records of reptiles.

Graham Alexander, Michael Bates, Aaron Bauer, William Branch, Marius Burger, Wulf Haacke, James Harrison, Johan Marais, Bryan Maritz, Gavin Masterson, John Measey, Le Fras Mouton, Krystal Tolley, Andrew Turner and Martin Whiting.

Field trip volunteers

A total of 24 SARCA field surveys were conducted, each with the assistance of volunteers as listed below.

SARCA 1—Elsie Campher, Thea Felmore and Sakwa Makokho; SARCA 2—Peter Braat and Asher Hill; SARCA 3—Henning Janse van Vuuren, Candice Lyons and Sean Ward; SARCA 4—Donovan du Toit and Robert James; SARCA 5—P.G. Groenewald, Samantha Stoffberg and Krystal Tolley; SARCA 6—Daniela Haarmeyer and Devon Massyn; SARCA 7—Morné Carstens, Kareemah Jacobs and Adelé Pretorius; SARCA 8—Marlei Martins, Themba Mathebula and Sarah Whitelaw; SARCA 9—Ferdie Endeman and Tessa Oliver; SARCA 10— Ross Hawkins and Stiv Samuel; SARCA 11—Gerda Kriel, Marianna Lot, Alex Rebelo and Tony Rebelo; SARCA 12—Graham Alexander, Pierre Joubert and Marcel Witberg; SARCA 13—Sakwa Makokho and Devon Massyn; SARCA 14—Nelmarie Eloff, David Maguire and Marelise Spreeth; SARCA 15—Billy Chamberlain, Ross Hawkins and David Maguire; SARCA 16—Martin Buitendag, Fran Siebrits and Martin Steyn; SARCA 17—Michael Fabricius, Candice Lakay and René Navarro; SARCA 18—Michael Fabricius, Kareemah Jacobs and Adelé Pretorius; SARCA 19—Michael Fabricius and Philine Werner; SARCA 20—Michael Fabricius and Rajka Kleine; SARCA 21—Michael Fabricius, Alex Rebelo and Tony Rebelo; SARCA 22—Sara Greene and James Harvey; SARCA 23—Keshni Gopal, Sara Greene, Ross Hawkins, David Maguire, Karen Molenaar, Goran Šafarek and Inge Wiekenkamp; SARCA 24—Graham Alexander, Andrew Beck, Lucas Chauke, Amanda Coetzee, Augusti Constantinides, Clayton Cook, Pricilla Crause, Cliff Dorse, Suretha Dorse, Keshny Gopal, Rajka Kleine, Bryan Maritz and Paul Swanepoel.

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Project participants

Many more people contributed records to SARCA indirectly, through data provided by museums, other collections and the published literature. It is not practical to list all of these individuals here, but we nevertheless acknowledge them.

Sight records

We specifically acknowledge the following people who provided reptile sight records to SARCA.

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Virtual museum

Large-scale data collection is costly and time-consuming. Conservation and research agencies, challenged for resources, can benefit enormously through the involvement of 'citizen scientists'—interested members of the public who voluntarily assist with the collection of information. The following people—some professional herpetologists but the majority amateurs—contributed to SARCA through the submission of photographic records of reptiles to the project's Virtual Museum (underlined: 20–49 records; **bold**: 50–99 records; **bold and underlined**: 100+ records).

Abram K, Acton V, Adam S, Adams M, Aguilar G, Aiston G, Alberts AJ, Allcock AE, Altwegg L, Altwegg P, Altwegg R, Anderson MD, Anderson TA, Andri C, Archer AM, Archer T, Armstrong AJ, Armstrong Q, Aucamp J, Badenhorst W, **Badenhorst WJ**, Bakkes E, Bardo R, Barnard P, Becker R, Becker RW, Bezuidenhout M, Bezuidenhout R, Birch W, Bleeker M, Bosman K, Botha M, Botha P, Botha T, **Botha W**, **Bowker MB**, **Braat P**, Breet E, Brodman R, Brook C, Brooks G, Brouard JP, Brown R, Bruinzeel LW, Budge R, Budworth C, Burger F, Butler B, Buys E, Calitz M, Campbell L, Carey KI, Carstens M, Cauldwell A, Claassen C, Clanahan CRH, Cleaver G, Cleminson CM, Coetser W, Coetzee F, Coetzee M, **Coetzer A**, Colahan BD, Cole W, Coleman J, Combrink HJ, Compion E, Conrad R, Conradie W, Cook G, Cooke D & Cooke I, Cordiero B, Cordiero C, Cordiero K, Costandius E, Coverdale B, Craigie JD, Crocombe J, Culbert C, De Beer C, De Beer CL, De Coriolis BL, De Klerk B, De Kock C, De Kock M, De Ridder J, De Swardt D, De Villiers S, **Deacon AR**, Deal J, Delport M, Dempere J, Deuchar A, **Diedericks G**, Dippenaar SM, Dobson R, Dobson RA, **Dorse C & van Rooyen S**, **Douglas M**, Douque R, Drummond-Hay K, du Plessis A, Du Plessis CF, Du Plessis D, Du Plessis J, Du Plessis JB, Du Plessis R, Du Toit DA, During J, Durrheim G, Dyer B, East Rand Herpetological Association, Eberle D, Els J, **Els JC**, Engelbrecht M, Erasmus SJ, Erni B, Erni G, Esterhuizen W, Evans SW, Ewart-Smith J, Felmore T, Fillery K, Fisher JT, Fleming C, Foreman D, Forest F, Fouché T, Fourie A, Freislich J, Garth A, Gavhi MP, Gaynor D, Geddes D, Gelderblom R, Gerber B, Gerber L, Geyser RF, Gibbons B, Gilfillan C, Gilfillan CS, Giliomee J, Goemas W, Goodman PS, Grant C, Gray NK, Griffiths RMH, Groenewald G, Groenewald J, Grove F, **Grundlingh F**, Gsollpointner C, Gwynne-Evans D, Haacke KO, Haacke WD, Haas F, Hammon D, Hankey A, **Hardaker T & Hardaker M**, Hardy P, Harebottle D, Harvey J, Havemann P, Havenga M, Havengaar D, 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Others

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Credits

The following people were professionally involved in the production of this book. Note that editors, authors and photographers are not listed because they are credited elsewhere. All those listed below are/were employees of the Animal Demography Unit, University of Cape Town.

- Project management: James Harrison (March 2005–December 2007), Marienne de Villiers (June 2007–March 2009).
- Database curation: Marius Burger and René Navarro
- Field work: Marius Burger
- Computer programming: René Navarro
- Data processing: René Navarro
- Map design: René Navarro
- Fundraising: James Harrison, Marienne de Villiers, Marius Burger
- Financial administration: Sue Kuyper, Linda Tsipa
- Data capture: Linda Tsipa, Candice Lackay

Reviewers

The following individuals kindly acted as reviewers of a draft version of the *Atlas*. Their valuable insights and suggestions greatly contributed towards the quality of this publication:

- Don Broadley: Chapters 10–17
- Wulf Haacke: Chapters 3, 9
- Craig Hilton-Taylor: entire book, with emphasis on Chapter 1 and IUCN listings
- Niels Jacobsen: Chapter 3
- Christopher Kelly: Chapters 2, 18–20, 22, 24, 25
- Paul Moler: Chapter 8
- Peter Pritchard: Chapters 1, 4–7
- Wolfgang Wüster: Chapters 2, 21, 23

In addition, Domitilla Raimondo provided input on the conservation section (Chapter 2), Tony Phelps commented on the *Bitis* accounts, and Philipp Wagner commented on the agamid family and genus accounts.

It should be noted that although the *Atlas* accounts presented here were reviewed by an IUCN representative (Craig Hilton-Taylor), the full conservation assessments will still be subjected to the IUCN review process and the final listings—as they will eventually appear on the IUCN website—may differ from those in this publication.

Recommended citations

Reference to book:

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References to chapters, including family accounts:

BRANCH, W.R. & BAUER, A.M. 2014 (reprint 2014). Systematics and Phylogeny. In M.F. Bates, W.R. Branch, A.M. Bauer, M. Burger, J. Marais, G.J. Alexander & M.S. de Villiers (eds), Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. *Suricata* 1. South African National Biodiversity Institute, Pretoria.

References to species and subspecies accounts:

BOYCOTT, R.C. 2014 (reprint 2014). *Pelomedusa subrufa* (Bonnaterre, 1789). In M.F. Bates, W.R. Branch, A.M. Bauer, M. Burger, J. Marais, G.J. Alexander & M.S. de Villiers (eds), Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. *Suricata* 1. South African National Biodiversity Institute, Pretoria.

Foreword

Nearly half of the 421 species and subspecies of indigenous reptiles found in South Africa, Lesotho and Swaziland occur nowhere else. As a signatory to the Conservation for Biological Diversity, South Africa has a responsibility to monitor and conserve its impressive reptile fauna. However, effective conservation planning and management is impossible without a thorough understanding of the evolutionary relationships between different types of reptiles, of their geographical distribution, and of the threats they experience.

The last Red Data Book of reptiles of South Africa was published in 1988—25 years ago. Since then there have been considerable changes in our understanding of the taxonomy, biology, distribution, diversity and conservation status of the reptiles of the region. Over a four-year period, the Southern African Reptile Conservation Assessment (SARCA) collated all available reptile distribution data from various sources into a single database. The outcome of this is the series of detailed maps produced in this volume, by far the most comprehensive ever for this region. This has allowed for a modern-day revision of the conservation status of all of the region's reptile species according to the latest International Union for Conservation of Nature (IUCN) Red List Categories and Criteria (version 3.1)—for most taxa, the first such assessment ever. Additionally, a team of scientific experts has provided a valuable summary of the latest taxonomic research and a revised list of reptile common names. This publication boasts some of the top names in herpetology in the region and has the added distinction of having been reviewed by international herpetological experts, including the Manager of IUCN's Red List Unit.

The *Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland* will serve as a vital resource for researchers, conservationists and amateur naturalists alike, and has the full endorsement of the IUCN.

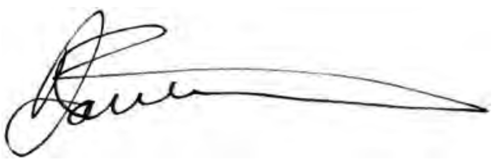
Valli Moosa
(Past President, IUCN)

Message from SANBI

The South African National Biodiversity Institute (SANBI) has since 2004 been mandated by South Africa's Biodiversity Act (National Environmental Management: Biodiversity Act 10 of 2004) to monitor and report on the status of the country's biodiversity. The Threatened Species Programme (TSP) housed at SANBI, has the primary role of fulfilling SANBI's mandate to monitor and report on the conservation status of South Africa's indigenous plant and animal species. The TSP co-ordinates the collection of information on species, particularly those that have historically received little research and conservation attention, such as reptiles, amphibians, spiders and marine fishes, through projects involving volunteers from the public, and scientists, taxonomists and conservationists from partner institutions across the country. The data collected through these projects are used to assess species' status against the internationally accredited Red List Categories and Criteria developed by the International Union for Conservation of Nature (IUCN).

The Southern African Reptile Conservation Assessment (SARCA) started in 2005 represents SANBI's first undertaking to set up a managed network partnership project to monitor animals. SARCA consisted of a partnership between SANBI and the Animal Demography Unit and also included a range of other academic and conservation agencies. It involved citizen scientist volunteers from the public throughout the project both in SARCA fieldtrips as well as via a web-based virtual museum of digital photographs. Virtual museum records provide valuable additional records for species distribution and SARCA was the first project to pilot virtual museums as a means to collect data for conservation assessments from the public in South Africa. Following on from SARCA, SANBI has successfully repeated the model of working with a range of conservation partners and volunteer citizen scientists from the public on conservation assessment projects. The South African Butterfly Conservation Assessment, also led by the Animal Demography Unit, and the South African Survey of Arachnids led by the Agricultural Research Council, are two important projects that have followed on from SARCA. Being the pilot project, many valuable lessons have been learnt from SARCA that have helped SANBI refine how conservation assessments can be done in partnerships.

This publication represents the first conservation assessment of South Africa's reptiles that is based not only on expert knowledge of taxa but also on a solid baseline of distribution data assembled for each species from a wide range of museum records and field sightings. This distribution data will be used by SANBI not only to report on the current status of reptiles in state of biodiversity reports but will feed into various national and regional biodiversity plans and protected area expansion strategies. Having a comprehensive data set on the distribution of South Africa's reptiles, as well as IUCN endorsed Red List conservation assessments, means that we can move forward to promote the conservation of reptiles from a sound scientific base.



Domitilla Raimondo
Threatened Species Programme Manager, South African National Biodiversity Institute

Preface

SARCA, the Southern African Reptile Conservation Assessment, was the first major non-botanical project undertaken by SANBI after its transition from being the National Botanical Institute to becoming the South African National Biodiversity Institute. The Animal Demography Unit, in the Department of Zoology at the University of Cape Town, is honoured to have been entrusted by SANBI with this crucial project and enormous responsibility.

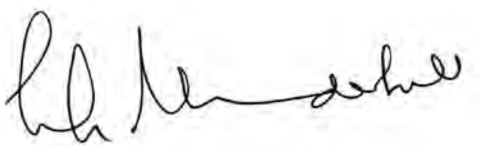
One of the most intriguing by-products of SARCA was the Virtual Museum, the 'public participation' component of the project. At the time when SARCA was initiated, the digital camera and the GPS unit had just started to become commonplace items. With hindsight, the idea of collecting georeferenced images seems an obvious one, but at the time the concept was a neat piece of lateral thinking. Approximately 7 000 images were received, and made a substantive contribution to the overall database—these are 21st century records of the distribution of the region's reptiles. These records supplement museum specimens, many of which date back decades, and some to the 19th century.

This book falls short of being 'the Reptile Atlas'—for the Animal Demography Unit's understanding of what constitutes an 'Atlas', there needs to be time and money to comprehensively search each and every grid cell for animals. But all the same, this publication represents a huge advance in knowledge. The overwhelming majority of all georeferenced specimens of reptiles in the region are now in a single database. This is a vital stepping stone, but the task is not yet finished. There is a major need for a follow-on project, which establishes the actual distribution of reptiles in South Africa at the start of the 21st century.

Many people were involved in this project in many roles. The prime mover, however, was James Harrison, and this is an appropriate point to celebrate his vision for biodiversity mapping. He was involved in the first bird atlas project, from beginning to end. By the mid-1980s, when the Southern African Bird Atlas Project started, the basic concepts of how to achieve a bird atlas were well established and there was a proliferation of protocols to choose from. With the frog atlas and this reptile atlas project to follow, there were no models to work from, either locally or internationally. James's skill was to take a cold hard look at the lessons learnt from the bird atlas project, to keep those which were transferable, and to invent workarounds for those which were not.

The hardest part of a project is closure. Marienne de Villiers and Mike Bates, assisted especially by Bill Branch and René Navarro, have achieved this. Everyone who reads these pages owes this team a huge debt of gratitude.

This book, by itself, achieves nothing for reptile conservation. However, it forms a vital link in the chain of activities. The threats it highlights and the priorities it assesses must be studied and absorbed, and the conservation community needs to be galvanised into action on the ground. The words which follow should be a tipping point for change.



Les Underhill
Director, Animal Demography Unit, University of Cape Town

SECTION 1

INTRODUCTORY CHAPTERS

CHAPTER 1

Introduction

Marienne S. de Villiers, Marius Burger, James A. Harrison, Bryan Maritz, René A. Navarro & *Barend Erasmus*

1. Background

South Africa, Lesotho and Swaziland comprise a region of exceptional biodiversity, including three of the 34 global biodiversity hotspots identified by Conservation International (www.biodiversityhotspots.org). This region (hereafter referred to as the *Atlas* region) is well-known for its rich mammal and bird fauna. As impressive, but receiving far less attention, is its exceptional reptile diversity. Levels of endemism in the region are high—45% of the 421 indigenous reptile taxa (species and subspecies) occur nowhere else in the world.

South Africa has a legal obligation to monitor biodiversity under the Convention on Biological Diversity (www.biodiv.org) and the National Environmental Management: Biodiversity Act (No. 10 of 2004). Monitoring—recording changes in distribution patterns and population trends—is essential for effective conservation, yet reptiles have largely been ignored in conservation plans. There are a number of reasons for this:

- Existing distribution information was not collated and integrated into a single database and was largely inaccessible.
- Distribution data were patchy, with many areas in the region having no data or inadequate data.
- There were various taxonomic uncertainties regarding the reptiles of the region. The previous Red Data Book (Branch 1988a) is now over 20 years old and the list of recognised reptile taxa has increased by almost 25% since its publication.
- There was a lack of clear conservation priorities with regard to reptiles. Only about 13% of the known taxa were previously evaluated according to the International Union for Conservation of Nature's (IUCN) Red List Categories and Criteria.
- Reptiles have a poor public image. Reptiles in general, and snakes in particular, tend to be feared and disliked by the general public.

These concerns led to the establishment of SARCA, the Southern African Reptile Conservation Assessment (De Villiers *et al.* 2010). SARCA's aims were to:

- Compile a comprehensive and integrated database of distribution records of the reptiles of the *Atlas* region, and use this information to map the distributions of all these taxa.
- Conduct field surveys to fill in gaps in ranges and to test survey methods.
- Collect and bank voucher specimens and tissue samples to serve as a tool for researchers addressing taxonomic issues. Produce summaries of the latest taxonomic information regarding reptiles of the region.
- Produce an updated Red List that includes conservation assessments of all described reptile taxa in the region, using the latest criteria of the IUCN.
- Raise public awareness and appreciation of reptiles and their conservation needs.

This product of SARCA, the *Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland*, is aimed at conservation planners and managers, researchers, professional and amateur herpetologists, legislators, environmental consultants, and interested members of the public.

2. Organization of SARCA

2.1 Initial buy-in

Early and comprehensive buy-in by stakeholders was a key factor in the success of SARCA. A project outline and discussion document was developed in 2003 by James Harrison of the Animal Demography Unit (ADU), University of Cape Town (UCT) and Graham Alexander of the University of the Witwatersrand (Wits). Discussions were held with professional herpetologists during that year and the next. A one-day workshop at Wits in August 2004 garnered support for the project from the herpetological community—in particular, from leading members of the Herpetological Association of Africa (HAA). The workshop was attended by 39 delegates from a wide range of institutions. An interim steering committee was established. A contract between the South African National Biodiversity Institute (SANBI) and UCT came into effect in March 2005. SARCA, a four-year project, was launched publicly in May 2005. Executive and Steering Committees were established.

2.2 Core funding

A funding application was submitted to SANBI and core funding for SARCA was secured from that institute at the end of 2004, through its partnership with the Norwegian Ministry of the Environment. In 2007, further core funding was provided by the JRS Biodiversity Institution. For part of the project period, the employment of a data technician was funded by the South African Biodiversity Information Facility (SABIF). The total budget of the project was just under R3 million.

2.3 Project team

SARCA was co-ordinated and administered from the ADU (see Credits and Acknowledgements). Core staff included a project co-ordinator (initially employed half-time but later full-time), a project herpetologist (initially 80% but later full-time), an information technology manager (30%), a data technician (full-time) and general administration officer (30%).

The project co-ordinator had overall responsibility for the co-ordination of project activities and the management of project personnel, liaised with SANBI and other funders, organised permits and licences for field surveys, managed the conservation assessment process, and compiled reports. The project herpetologist liaised with data owners, organised and led the field surveys and was responsible for the management of the distribution database and the final processing and quality control of this data. The co-ordinator and herpetologist together promoted the project, encouraged public participation and were responsible for feedback to project participants. The information technology manager designed and managed the SARCA databases (distribution and assessment), website and virtual museum, produced online distribution maps and designed online hotspot analyses.

2.4 Project governance

SARCA was governed by the project team based at the ADU, and a Steering and Executive Committee. The Steering Committee comprised up to 11 members (three *ex officio*) at any one time. Its membership was drawn from SANBI, ADU, museums, conservation agencies and academic institutions. The committee met annually to set policy, monitor progress, review finances, make decisions regarding data collection strategies, set time frames, and discuss finances and other relevant matters. During the last 18 months of the project, the committee was also provided with written monthly progress reports. The Executive Committee was composed of a representative from SANBI and ADU, as well as the chair of the Steering Committee. It provided short-term decision support to the project team in-between Steering Committee meetings.

2.5 Authors and editors

The 26 authors of this volume, who generously gave of their time and expertise are, for the most part, affiliated with academic institutions, museums and nature conservation agencies (see author address list). The scientific editors (first six listed) were drawn from the pool of authors. Authors were responsible for conducting IUCN conservation assessments and for writing the species accounts contained here. In August 2006, SANBI hosted a training workshop, facilitated by the IUCN Red List Unit, on the application of the IUCN Red List Criteria. A number of SARCA contributors attended the workshop. Three subsequent authors' workshops were held to provide training in IUCN assessment procedures and in the use of the assessment database. Authors also provided valuable assistance in identifying incorrect or questionable records in the distribution database, advising on the direction of fieldwork, identifying potential sources of distribution data, and considering the directions that a second phase of SARCA might take. Each species/subspecies account was reviewed by two editors and consistency in editing was assured by means of an editors' workshop held in the final year of the project.

2.6 Members of the public

SARCA was widely publicised on radio and television and in the print media. The SARCA project herpetologist and project co-ordinator presented public lectures, exhibitions and training courses. Members of the Cape Reptile Club assisted with local events. The public was invited to participate in the project by submitting photographic records of reptiles to the SARCA Virtual Museum and by assisting with field surveys. Approximately 350 people enthusiastically submitted photographic records, and 61 volunteers participated in field surveys. Quarterly newsletters were e-mailed to a list server of approximately 800 addresses. Newsletters (1–9), field trip reports (1–13) and other items of interest were posted on the SARCA website, http://sarca.adu.org.za.

3. Data

3.1 Data referencing

The *Atlas* region consists of South Africa, Lesotho and Swaziland. The region can be divided into 2008 quarter-degree grid cells (QDGCs), each cell measuring 15 minutes of latitude by 15 minutes of longitude. Because lines of latitude converge towards the poles, the grid cells in the north of the *Atlas* region are larger than those in the south, but the average QDGC area is 676 km^2.

All data was referenced to at least the QDGC level of accuracy, but higher resolution data were included where possible. Global Positioning System (GPS) data was referenced to the nearest second.

3.2 Species inventory

Over the past two decades there has been an astonishing increase in knowledge on reptile diversity in southern Africa. Since 1988, there has been a 25% increase in the number of recognised species, with an average of six species per year being newly described, elevated from subspecies to species, and/or resurrected from synonymy (Branch *et al.* 2006). For a synthesis of the taxonomy of reptiles of the *Atlas* region as it is currently understood, refer to Chapter 2. For names of currently recognised reptile taxa, refer to the index. This list also contains the preferred common names of taxa selected by consensus of the *Atlas* editors, as well as other often-used names. Note that introduced reptile taxa were not assessed for this *Atlas*.

3.3 Data sources

Data were accessed from approximately 400 people and 14 organisations (Table 1.1). The bulk of the data came from museums and nature conservation agencies. Other data were obtained from private collections, academic institutions, published literature, SARCA field surveys, and members of the general public via an online Virtual Museum.

3.3.1 Field surveys

Several major surveys and regional assessments of reptile communities have been conducted within the *Atlas* region over the past few decades, the most notable being those in the Free State (De Waal 1978), Limpopo, Mpumalanga, Gauteng and the eastern part of North West Province (Jacobsen 1989), Swaziland (Boycott 1992a,b) and KwaZulu-Natal (Bourquin 2004). A number of localised surveys conducted in protected areas or in regions of special herpetological interest have also contributed to our knowledge of reptile distributions. Examples include those for the Kruger National Park (Pienaar 1966, 1978), Addo Elephant National Park (Branch & Braack 1987), Tsitsikamma National Park (Branch & Hanekom 1987), Durban Metropolitan Area (Alexander 1990), Anysberg Nature Reserve (Burger 1993), Little Karoo (Branch & Bauer 1995), Free State nature reserves (Bates 1997) and Richtersveld National Park (Bauer & Branch 2003 [2001]). Additionally, a spate of new geographical distribution notes (many published by the Herpetological Association of Africa) and major taxonomic revisions (especially those of D.G. Broadley) published in the same period, have all contributed towards the mapping of reptile assemblages of this region. In spite of these efforts, the reptile fauna was still inadequately known in many areas, and SARCA therefore included a field survey component to address some of these shortfalls.

Twenty-four field surveys were undertaken in priority areas within the *Atlas* region. These were conducted over three

Table 1.1.—Sources of distribution data

Source		Number of records
Museums—South Africa	Bayworld, Port Elizabeth Museum	10 920
	Ditsong National Museum of Natural History (formerly Transvaal Museum), Pretoria	35 758
	Durban Natural Science Museum	1 438
	Iziko Museums of South Africa, Cape Town	5 361
	John Ellerman Museum, Stellenbosch University	3 441
	Natal Museum, Pietermaritzburg	481
	National Museum, Bloemfontein	7 643
Museums—USA	American Museum of Natural History, New York	287
	California Academy of Sciences, San Francisco	1 999
	Field Museum of Natural History, Chicago	994
	Museum of Comparative Zoology, Harvard University, Cambridge	1 282
Nature Conservation	CapeNature, Stellenbosch	17 926
	Ezemvelo KwaZulu-Natal Wildlife, Pietermaritzburg	1 433
	Gauteng Department of Agriculture, Conservation and Environment, Johannesburg	1 067
Sight records		9 230
Literature		25 323
SARCA surveys		4 220
Virtual Museum		6 709
TOTAL		135 512

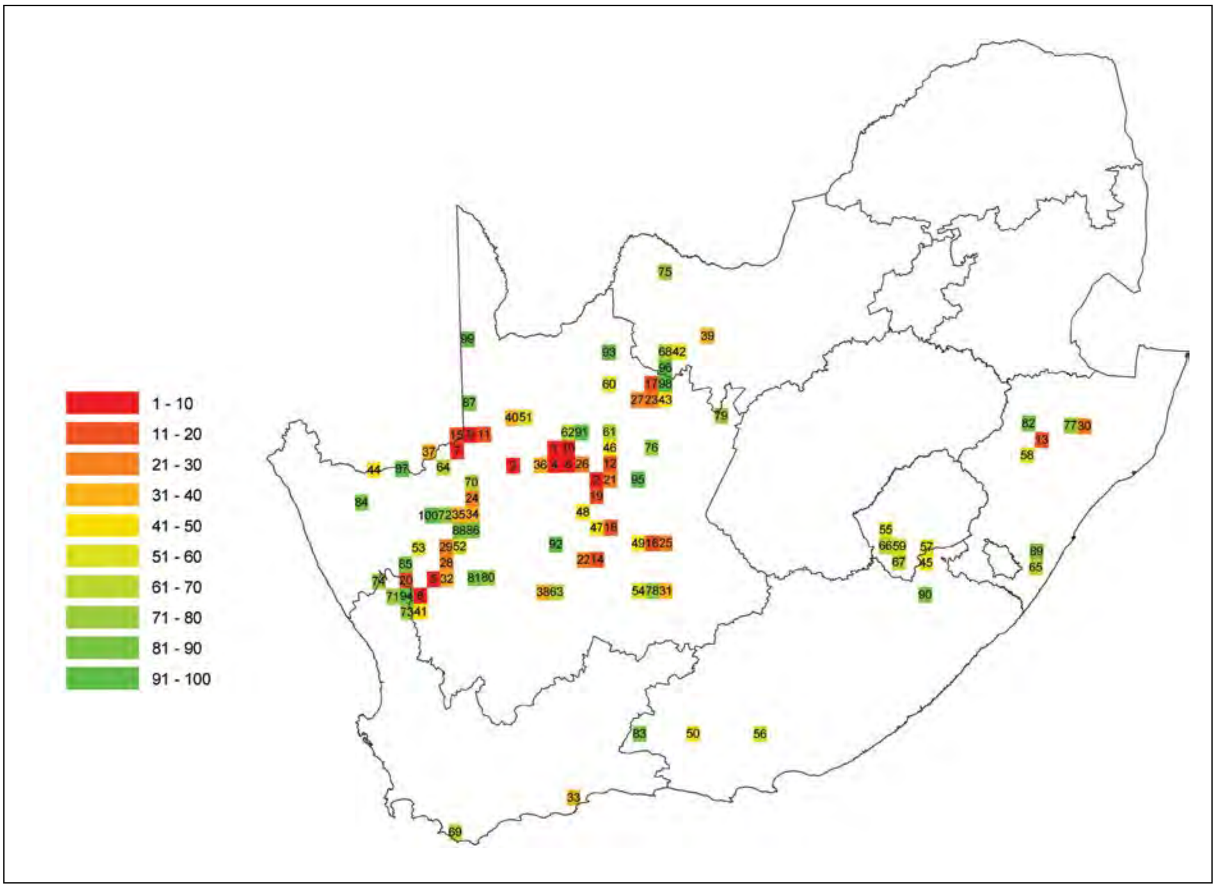


Figure 1.1.—Top 100 priority QDGCs indicated by the gap analysis for the first SARCA field season.

summer seasons from 2005 to 2008 and comprised approximately 270 days of sampling effort. Each survey had a public participation component, where volunteers accompanied the SARCA project herpetologist (Marius Burger) to conduct field work in priority areas. The 22 surveys of the first two seasons were each 10–11 days in duration, whereas the last two surveys covered 40 days in total. Sixty-one volunteer field workers provided assistance.

Prior to each surveying season, a gap analysis was conducted to choose priority QDGCs, based on a comparison of recorded species richness (number of species actually collected) in each QDGC with predicted species richness (number of species predicted to occur) in each QDGC. The gap analyses were conducted by Barend Erasmus and Bryan Maritz (both at the University of the Witwatersrand) who assessed each QDGC within the *Atlas* region in terms of expected species richness, based on the cumulative overlays of digitised generalised distribution maps from the *Field Guide to the Snakes and other Reptiles of Southern Africa* (Branch 1988b). These values were compared to a collection of databases that were obtained from several major South African museums, and which served as a starter dataset to evaluate potentially species-rich QDGCs in relation to known records from such grid cells. In addition to the mean of the percentage under-sampled, the ranking of priority QDGCs was further influenced by restricted range richness, environmental heterogeneity, percentage natural land cover, and number of neighbouring no-data QDGCs.

Although the initial starter dataset for the 2005/2006 season was relatively incomplete, it was nevertheless used to determine priority grid cells for the first 12 SARCA field surveys. The initial analysis indicated that most of the *Atlas* region was drastically under-surveyed. The top 100 priority QDGCs are shown in Figure 1.1. Priority was given to grid cells that showed a significant discrepancy between recorded and predicted species richness, and that were geographically distant from well-surveyed grid cells. Survey efforts were focused in these areas in order to maximise the number of novel records per survey.

The gap analysis for the second season (2006/2007) incorporated a substantially larger dataset and the weighting of some of the ranking criteria was adjusted (Figure 1.2). Additionally, the choices of the 12 survey sites for this season were partially guided by the results of *A Plan for Phylogenetic Studies of Southern African Reptiles* (Branch *et al.* 2006) that highlighted the areas where field surveys would benefit taxonomic investigations of cryptic taxa.

The third season (2007/2008) consisted of two prolonged surveys that spanned several regions. These surveys focused on priority species rather than priority regions and targeted taxa that were of special conservation or taxonomic significance. For example, a concerted effort was made to search for Eastwood's Long-tailed Seps (*Tetradactylus eastwoodae*) which appears to have become extinct.

Field surveys employed a variety of methods to obtain reptile records at a specific site, including trapping, active searching of suitable habitat, road cruising and interviews with local residents. Active searching generally involved

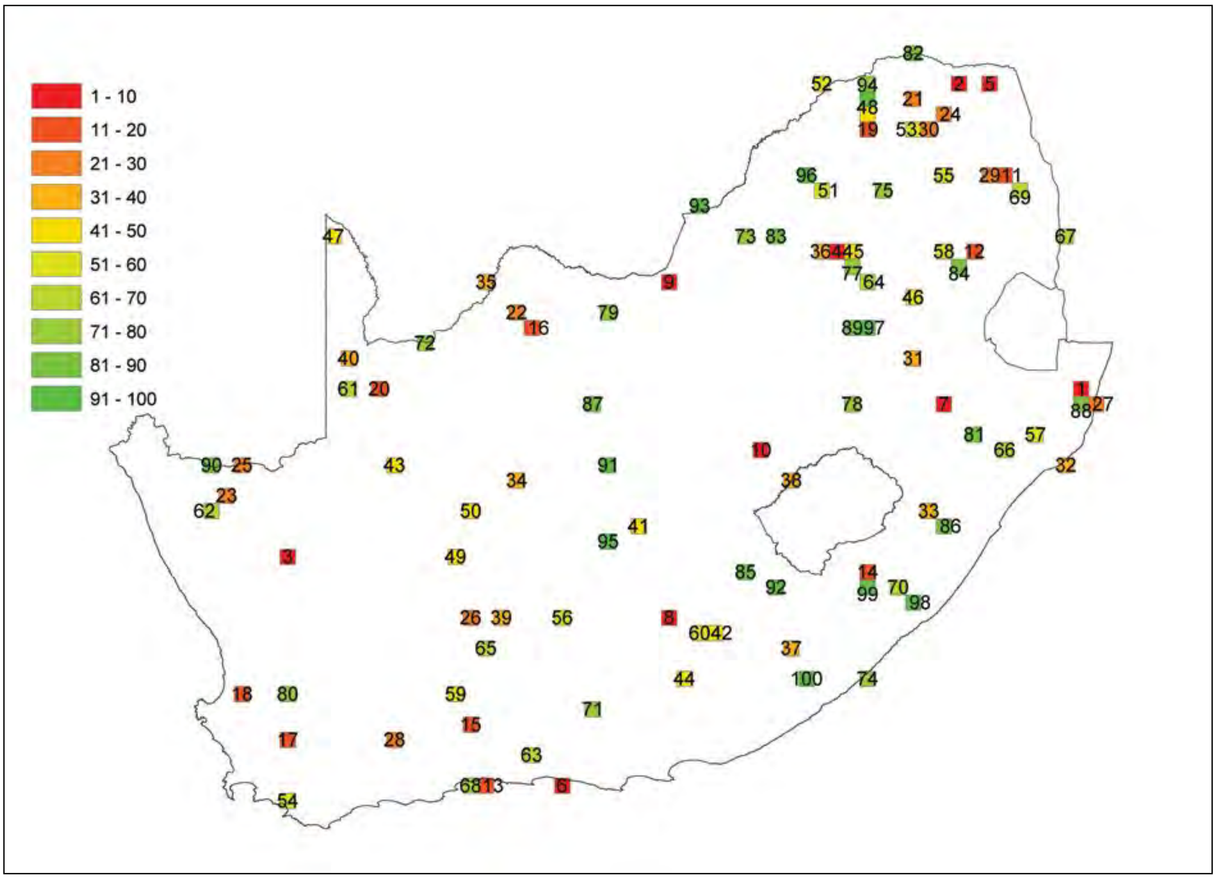


Figure 1.2.—Top 100 priority QDGCs indicated by the gap analysis for the second SARCA field season.

searching under rocks and logs, through leaf litter, and often under anthropogenic debris such as bricks, corrugated iron or asbestos sheets. Additionally, active searches for sleeping chameleons took the form of night-time spotlight surveys through vegetation. During a typical road cruise, a suitable stretch of road would be driven slowly at night to search for reptiles. This method provided an effective means of collecting nocturnal reptiles, especially geckos and snakes.

Trap arrays have been used extensively in other parts of the world to survey reptile populations (see references in Douglas 1992a). Recently, trap arrays were used in South Africa to answer questions related to the estimation of species richness (Masterson 2008), the influence of habitat structure on reptile communities (Maritz & Alexander 2007; Masterson *et al.* 2008), and the role of land use on reptile communities (Masterson *et al.* 2009). Trap arrays used during SARCA surveys were similar to those described by Maritz *et al.* (2007). Each array consisted of 3 × 10 m drift fences arranged in a Y-shape. Pitfall traps, i.e. 4 × 5-litre buckets buried flush with the ground, were installed at the centre of the array and at the end of each fence. Each trap array also included a set of six double-ended funnel traps, installed as pairs halfway along each drift fence (Figure 1.3). Each survey aimed to install eight arrays to sample a variety of habitat types, but on occasion, fewer arrays were employed owing to logistical difficulties. Traps were checked daily for the duration of each survey.

Collection permits were obtained from the relevant authorities. Collected specimens were euthanased and tagged with a unique identification number. Specimens were in-

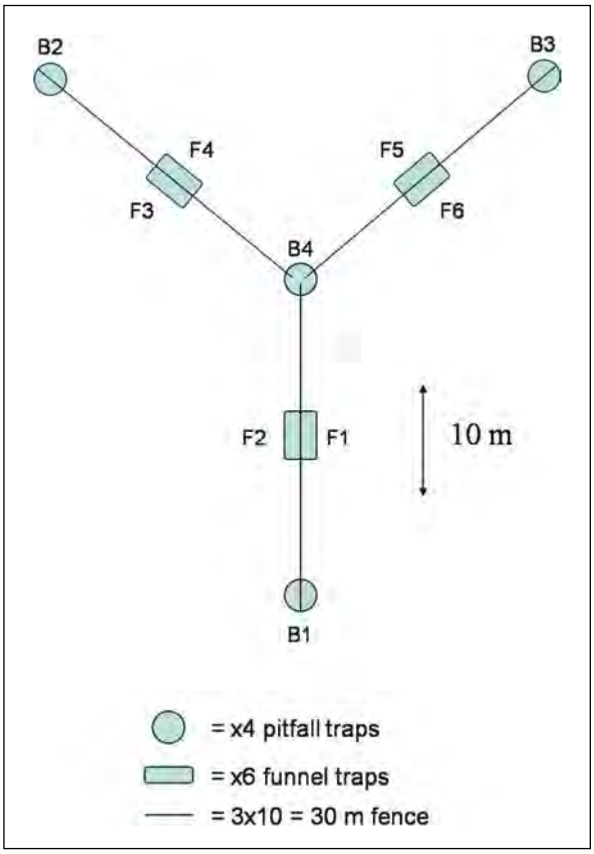


Figure 1.3.—Illustration of the layout of trap arrays used during SARCA field surveys.

jected with and set in 10% formalin for a few days, then rinsed with water and preserved in 70% ethanol. Specimens were deposited in the collections of the National Museum, Bloemfontein; Port Elizabeth Museum, Bayworld; and Ditsong National Museum of Natural History (formerly Transvaal Museum), Pretoria.

3.3.2 Virtual Museum

The SARCA Virtual Museum (VM) was developed as a novel online tool to encourage public participation in the project (De Villiers *et al.* 2008). Photographic records obtained from the public were organised in a manner analogous to a museum collection of voucher specimens, and this 'collection' was made accessible online. The availability of multiple photographic 'specimens' for each species makes the VM a powerful aid to the identification of reptiles by members of the public, with the added advantage that most of the photographic specimens are of living animals in the wild and therefore have a lifelike appearance in comparison to voucher specimens in museum collections.

Open source software was used; mySQL provided the database back end and the front end was written entirely in the general purpose scripting language PHP. Photographs of reptiles were submitted by members of the public via e-mail, along with basic information using the following fields: observer name; co-ordinates latitude; co-ordinates longitude; locality; province; country; date; number of photos; notes.

Submissions were processed, locality information verified, and photos edited, before uploading onto the online VM (http://vmus.adu.org.za/). Each record was identified to species level by a panel of experts, using an online procedure which automatically updated the VM database. Distribution maps for each species, generated in real time from the VM database, were also made available online.

Results of a questionnaire at the end of the third year of SARCA indicated that wildlife enthusiasts submitted the most records, and amateur naturalists were most often responsible for promoting the VM to other people. Over half of the respondents indicated a moderate to considerable increase in knowledge and appreciation of reptiles as a result of the VM. Submissions included new distribution records, significant species' range extensions, records of seldom-seen fossorial species, records of rare and threatened species, records of unusual colour morphs (Mecenero & De Villiers 2007), and the first record for the *Atlas* region of *Gerrhosaurus auritus*.

The successful application of the VM concept by SARCA has since lead to the initiation of similar VM collections for other biodiversity projects, namely the Southern African Butterfly Conservation Assessment (http://sabca.adu.org.za) and the South African National Survey of Arachnida (www.arc.agric.za/home.asp?pid=3272). The VM was extremely popular, and towards the end of the SARCA project, members of the Herpetological Association of Africa overwhelmingly indicated that they would like to see the reptile VM extend beyond the end of the SARCA contract. The ADU has since launched a new, automated version of the VM with an online submission procedure, which has been expanded to include records of amphibians, mammals and other taxonomic groups (http://vmus.adu.org.za/).

3.4 Database management

3.4.1 Distribution database

The distribution database was compiled at the ADU using MySQL. This open source database is used worldwide by web developers and industry leaders such as Yahoo!, Google and Nokia. MySQL is open-source software and runs on more than 20 platforms, including Linux, Windows, OS/X and Netware, and is therefore fully portable to most other modern databases. Data from published species distribution maps were captured using ArcView v. 9.2 (Esri).

Each data record contained:

- A unique record number.
- A scientific name.
- A date.
- A QDGC code.

Where available, the following were also included:

- A set of co-ordinates (12 digits) for the locality.
- A locality description.
- An observer name.
- An institution name and code.
- A museum catalogue number.

All computerised data (particularly geo-referencing) were checked for accuracy of data entry.

Some data received by SARCA had not been updated to reflect recent taxonomic changes and it was sometimes impossible to be sure of species identities without physically examining the specimen in question. This was generally beyond the scope of the project and such records were usually flagged as 'questionable' and excluded from subsequent analyses (data were seldom deleted from the database), although the identities of a few questionable specimens were checked by museum curators.

Errors arising from incorrect identifications or taxonomic changes were mainly detected through inspection of distribution maps. Where possible, dubious outliers were tracked back to their source and queried. These errors were mostly corrected, but if a queried record could not be verified, the record was flagged and excluded from analyses. Where the limits of species distributions were not well-defined, the editors and authors used their discretion with regard to outliers. Some errors that were not obvious from the maps may not have been detected, but these are not expected to seriously compromise the integrity of the database.

All VM species identifications were confirmed by a panel of expert herpetologists according to pre-determined criteria. In the case of species that were difficult to separate on morphological characters, known distribution ranges were taken into account when making identifications. Identifications were accepted only once there was agreement between at least two members of the panel. If a third panel member provided a conflicting identification, then a fourth opinion was sought and the identification was based on agreement between three of the four panel members.

Some records were obtained from more than one source, leading to replication of records in the database. However, this did not affect the SARCA maps, which merely reflect the presence or absence of a taxon in a given QDGC.

All processed data were uploaded into a comprehensive database. Prior to upload into the database, each data record was assigned a unique SARCA record number. During the upload process, each record was assigned a locus (i.e. QDGC). The database will relocate to SANBI, to be made publicly accessible via SANBI's online data portal (SIBIS: SABIF data portal; http://sibis.sanbi.org/).

3.4.2 Conservation assessment database

An online conservation assessment database was developed at the ADU. Open-source software was used; MySQL provided the database back end and the front end was written in PHP.

The database was designed according to the requirements for IUCN species assessments, and incorporated IUCN Species Information Service forms and fields. The database was used by authors to enter information for species assessments, and online editorial changes were made. Selected parts of the database were exported to text files for inclusion in this publication. The entire database will be transferred to the IUCN for incorporation into the Species Information Service and for publication on the IUCN Red List of Threatened Species (www.iucnredlist.org).

Taxa were assessed according to the IUCN Red Listing procedure (IUCN 2001; IUCN 2010a): Least Concern (LC), Near Threatened (NT), threatened (including the categories Vulnerable [VU], Endangered [EN] and Critically Endangered [CR]), Extinct (EX) or Data Deficient (DD) (see Appendix 1 for details on the categories and criteria used).

Distribution data were extracted from the SARCA database and linked to a vegetation map of the *Atlas* region (Mucina & Rutherford 2006) and shape files of protected areas from the National Spatial Biodiversity Assessment (Driver *et al.* 2005). This allowed the calculation of lists of vegetation types and protected areas for each reptile taxon, to assist authors in the completion of their accounts. This information is in the online assessment database but is not presented in this publication.

Please refer to Section 2, *Introduction to accounts*, for more detail on the data included in the conservation assessment database.

3.5 Data presentation

Species distribution maps for the *Atlas* region, with national and provincial boundaries and a one- or two-degree grid, were compiled using plain geographic co-ordinates (i.e. no geographic projection used) (Figure 1.4).

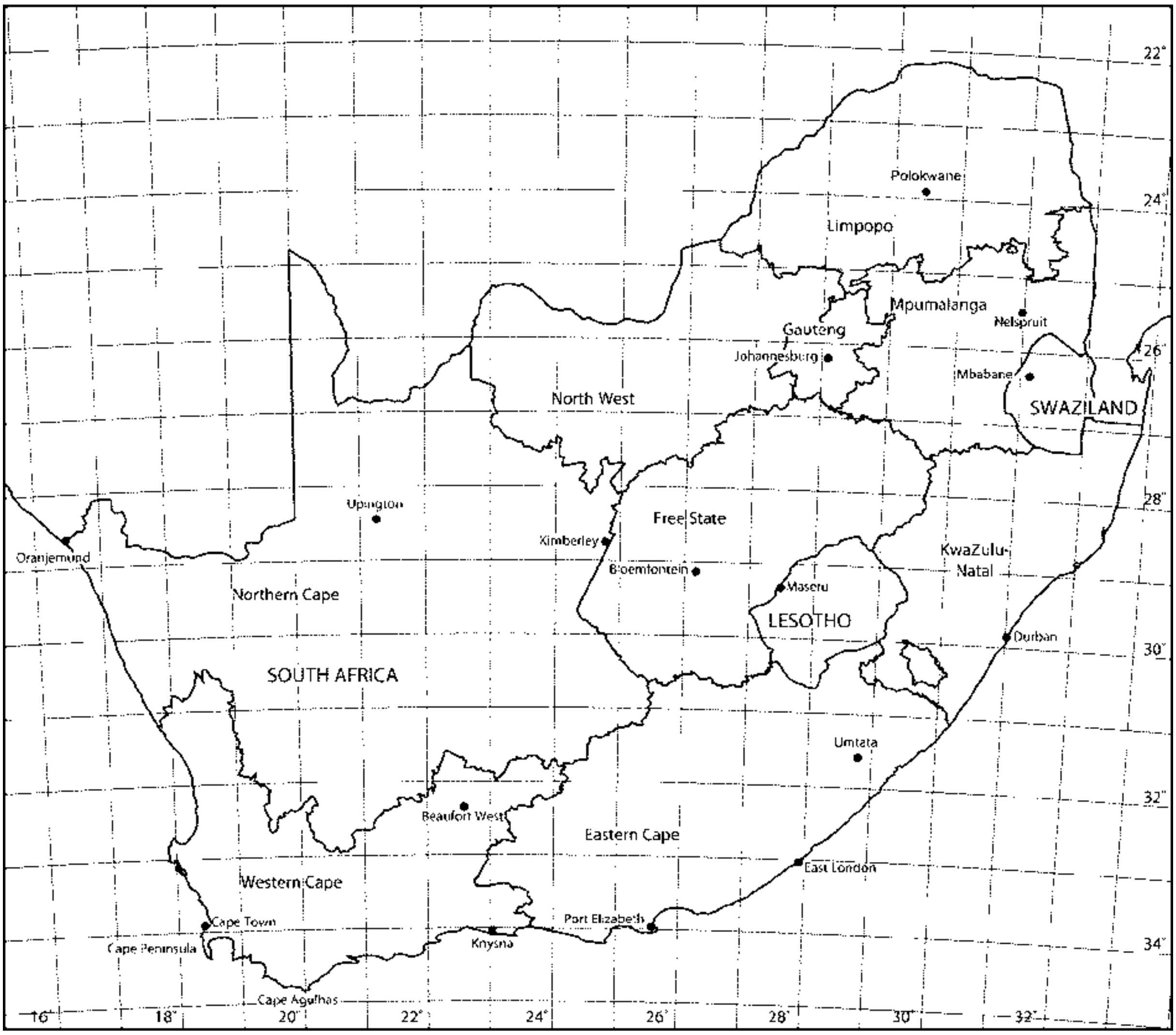


Figure 1.4.—Map of the *Atlas* region, showing degree grid cells and borders, with countries, provinces and major cities.

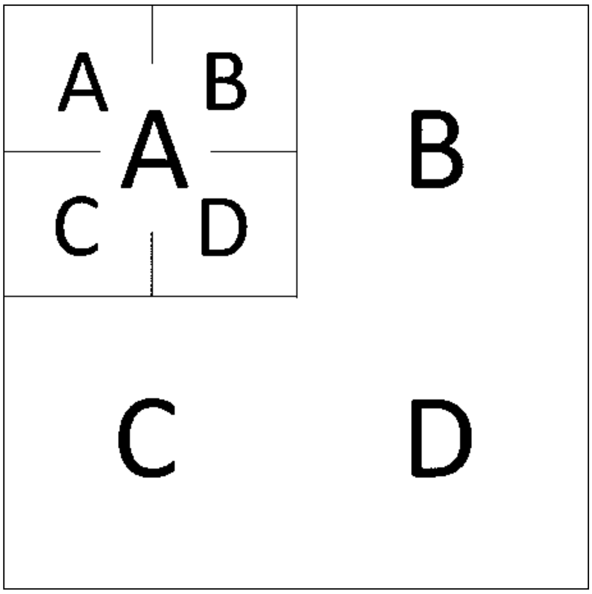


Figure 1.5.—Diagram illustrating the notation used for quarter-degree grid cells.

The maps were compiled at the quarter-degree grid cell (QDGC) scale (Figure 1.5). A QDGC is a 15’ × 15’ block (thus each degree grid cell has 16 QDGCs). The *Atlas* region is divided into 2008 QDGCs. The area of the average QDGC is 676 km^2—lines of longitude converge towards the poles thus the grid cells in the north of the *Atlas* region are larger than those in the south.

The maps present data contained in the database—only presence of a taxon per QDGC is indicated—and do not involve any extrapolations or interpolations.

In cases of taxonomic uncertainty regarding subspecies within a genus-species binomial, records for the species and its subspecies were combined in a single map.

Established subspecies that are easily diagnosable (e.g. *Lygodactylus ocellatus*) were accorded separate accounts, but in cases where the status of subspecies was considered unresolved (e.g. *Leptotyphlops scutifrons-conjunctus* complex and *Psammobates tentorius*) they were combined in a single species account.

For further details of species distribution maps, refer to Section 2, *Introduction to accounts*.

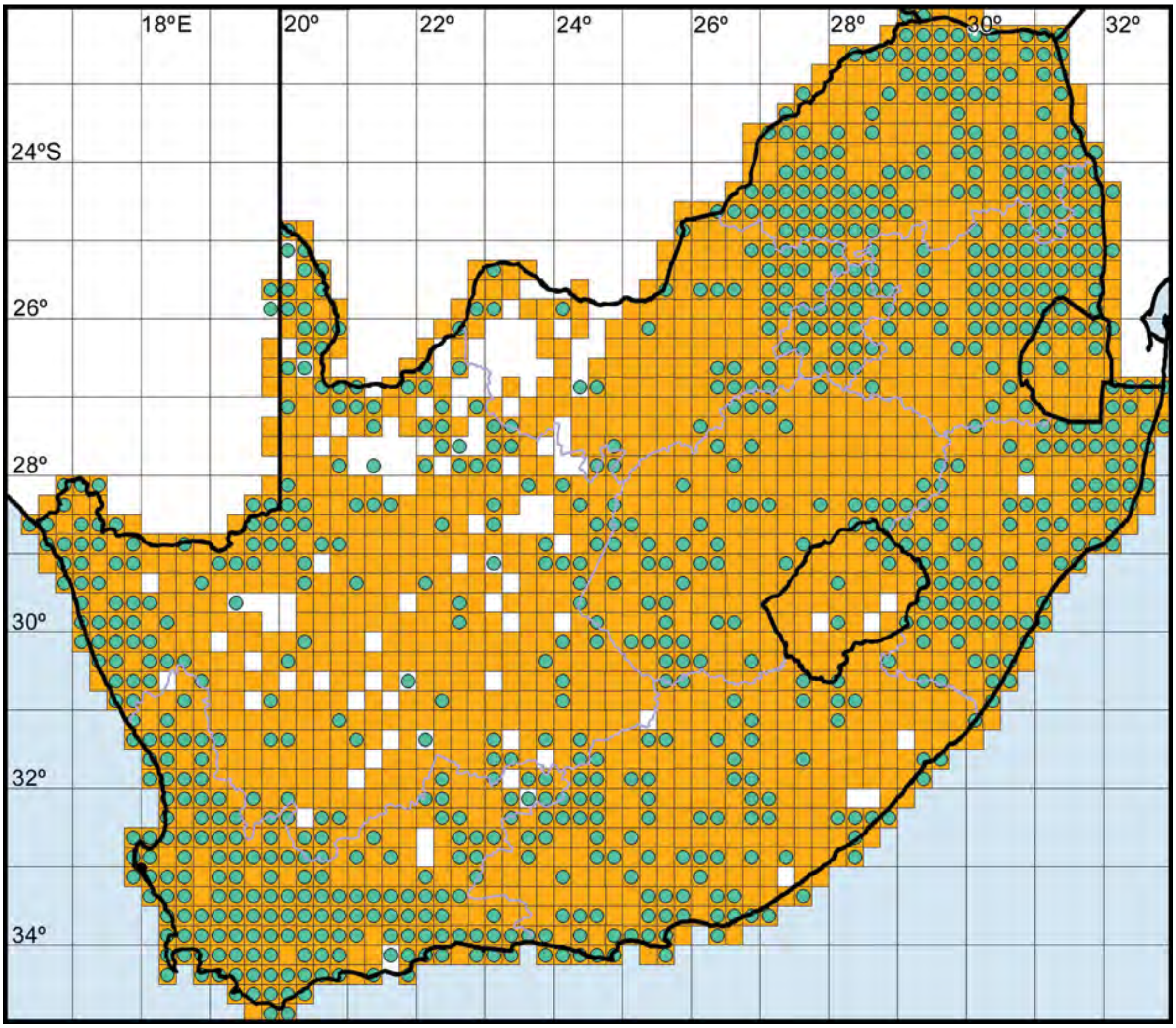


Figure 1.6.—Map showing coverage of *Atlas* region by SARCA records. Virtual Museum records: ● Other records: □

3.6 Data strengths and weaknesses

3.6.1 Geographical coverage

The geographical region covered by this *Atlas* is South Africa (including its offshore islands), Lesotho and Swaziland. The distribution maps are the result of a first comprehensive collation of records from many sources. Many of the species maps are thus more comprehensive than those previously published. This has allowed a more accurate assessment of conservation status. For example, when *Gerrhosaurus typicus* was assessed by McLachlan (1988a), it was known from only 12 QDGCs and was assessed as Lower Risk: Near Threatened (Baillie & Groombridge 1996). However, the SARCA map shows that the species has now been recorded in 28 QDGCs and, as a result of a more comprehensive understanding of its distribution, this species has been downgraded to Least Concern.

Geographical coverage at the degree level was excellent, with records obtained from all degree grid units and 94% of QDGCs in the region (Figure 1.6). However, many records were centered in urban areas, or areas within easy reach of major roads. The areas with the greatest gaps in coverage were in the Northern Cape and North-West provinces (northwestern part of the Savanna Biome and northern part of Nama-Karoo Biome). Because of difficulty of access, mountainous areas tended to be relatively poorly surveyed. However, the Cape Fold Mountains were an exception owing to a dedicated survey of the ranges led by Michael Cunningham (compared to large parts of the Northern Cape that remain unsurveyed), and records are therefore geographically biased.

Despite the good coverage, QDGC-scale data are too course for fine-scale conservation planning. Large numbers of records were supplied without geographical co-ordinates. Because of this lack of fine-scale distribution data, the IUCN Guidelines (IUCN 2003) for estimating area of occupancy (using 2 × 2 km grids) could not be used. Although areas of unsuitable habitat were excluded in the SARCA estimations of area of occupancy, these were likely overestimates. For taxa with restricted distributions and a paucity of data, this may have resulted in the underestimation of extinction risk.

Distribution records mainly reflect the presence of taxa within QDGCs and not their absence. It is important to note that presence of a taxon in a QDGC does not mean it occurs throughout the QDGC, so care should be taken when making inferences about distribution at a finer scale.

Thirty-percent of species assessments were done at the regional rather than the global scale, due to paucity of information regarding their distribution, habits and threats outside the *Atlas* region. The IUCN Regional Guidelines (IUCN 2003) were used to decide if regional assessments should be up- or down-listed.

3.6.2 Species coverage

Records tended to be biased towards common, easily observed or interest-group taxa, thus there was taxonomic bias in the database.

The number of records collected for each species was influenced by rarity (e.g. *Lamprophis fiskii*) but also by species characteristics which affected ease of observation. Some fossorial species (e.g. *Scelotes montispectus*) are often missed in field surveys and therefore few records exist for these. Likewise, localised high-altitude species (e.g. *Montaspis gilvomaculata*) are also seldom encountered. Data on some species that are restricted to high-altitude areas (e.g. *Tropidosaura cottrelli*) are sometimes lacking because of the difficulty of accessing mountainous areas. Positive identifications were sometimes impossible for cryptic taxa (e.g. some *Leptotyphlops* and *Goggia* species). In cases where there were recent taxonomic changes, such as the splitting of species, it was sometimes not possible to be sure of taxon identities and such records were excluded from analyses. Accounts were written for taxa with extremely marginal distributions in the *Atlas* region, but these taxa were not assessed. This is equivalent to the IUCN term 'Not Applicable' as defined in the IUCN Regional Guidelines (IUCN 2003).

3.6.3 Other limitations

Historically, the various efforts to collect herpetological data have not been co-ordinated, have not been standardised over time, and no record of observer effort has been kept. Using the existing data to interpret trends in reptile populations or changes in distributions over time is thus problematic. Standardised, regular and repeatable field surveys would add enormously to the conservation value of data.

CHAPTER 2

Systematics and Phylogeny

William R. Branch & Aaron M. Bauer

"Rigorous updated taxonomic lists should be the most important documents on which conservation policies and macroecology rely."

(Padial & De la Riva 2006)

A conservation assessment can only be meaningful if the units it treats correspond to real biological entities. The use of an outdated or incorrect taxonomy in an assessment can have serious negative consequences. For example, morphologically similar species, each with a small population size and limited geographical range, might be misinterpreted as being representatives of a single widespread species. This would result in one or more threatened taxa being assessed as Least Concern.

An integral part of SARCA involved an assessment of systematic priorities for the reptiles of the *Atlas* region. In a community effort, researchers identified taxa that were known or suspected to be problematic, i.e. consisted of cryptic species, with invalid names, or included undescribed species. To some extent, an up-to-date taxonomy is a moving target as additional data often results in changes. The majority of recent taxonomic changes have been associated with molecular phylogenetics.

Although explicitly phylogenetic studies are a phenomenon of the last 50 years, most classification schemes of the post-Darwinian era have attempted to reflect elements of evolutionary relationships. 'Modern' phylogenetics specifically attempts to discover monophyletic groups (clades) and the patterns of relationship among them. Such patterns, typically represented as tree diagrams or cladograms, constitute hypotheses of relationships that may subsequently be tested by the analysis of more or different data sets. Valid data for analysis can be any features intrinsic to the organism, from DNA to proteins to morphological features or behaviours. During much of the mid- to late 20th century, morphological characters typically provided the basis for phylogenetic studies. However, molecular data, chiefly in the form of mitochondrial and—more recently—nuclear DNA sequences, have become the most common source of phylogenetic information. While morphological data remain valuable in phylogenetic reconstruction, and certainly in the recognition and diagnosis of taxonomic units, molecular data do offer several advantages. The cost of data collection is lower and the speed of analysis greater than for morphological characters, which typically require a major time input by highly trained specialists. Furthermore, DNA sequence data provide researchers with the option of selecting from multiple models of molecular evolution in the course of their phylogenetic analyses. Currently three major types of analytical approaches are used in molecular phylogenetics: maximum parsimony, maximum likelihood, and Bayesian inference (the last two categorised as model-based methods).

A consideration of the positive and negative aspects of the analytical approaches is beyond the scope of this chapter, but suffice it to say that data sets with strong phylogenetic signals are largely robust to analytical approach, and the various approaches typically yield similar hypotheses of relationship. Moreover, the potential to provide a temporal calibration for the rate of neutral mutations in molecular phylogenies offers the opportunity to not only uncover Life's relationships, but also to date the nodes (cladogenic events) and to relate these to geographic, climatic or stochastic events that may have been instrumental in the evolution of clades (Hedges & Kumar 2009).

Recent studies on phylogenetic relationships in the different groups of reptiles in the region, and the consequent systematic modifications that have been made to accommodate these hypotheses of relationship, are summarised on the following pages. This summary does not claim to be complete and will certainly be outdated in many respects within the near future. Fuller details and the rationale for the changes can be found in the literature cited. As Agapow (2005) has noted, the application of the phylogenetic species concept has resulted in average species lists that contain about twice as many species as lists for the same groups based on the biological species concept.

For the purposes of providing a context for the taxonomy employed in the *Atlas* we outline on the following pages the major advances in the phylogeny and taxonomy of reptile groups occurring in the *Atlas* region since the last reptile assessment was published (Branch 1988a). We note that problems associated with the publication of new names in electronic media (Dubois *et al.* 2013), as well as ethical problems associated with some new names ('taxonomic vandalism', Kaiser *et al.* 2013), have recently affected herpetological nomenclature. The taxonomy adopted in the *Atlas* reflects the consensus view of the editors, and is the most up-to-date and recommended taxonomy for the region.

1. CHELONIA

A molecular phylogeny of tortoises (Le *et al.* 2006) demonstrated the polyphyly of *Geochelone*, with species distributed in four separate clades. The Spurred Tortoise, *G. sulcata*, that had been placed in the monotypic genus *Centrochelys* (Lapparent de Broin 2000), was found to be closely related to the Asian *G. elegans* (type species of *Geochelone*) and *G. platynota* and was therefore returned to that genus. However, the Leopard Tortoise, *G. pardalis*, was found to be the sister clade to *Psammobates*, and it was recommended that it be included in the latter genus. Earlier, Lapparent de Broin (2000) had revived *Stigmochelys* Gray for this species, and Fritz & Bininda-Emonds (2007), using an expanded data set, re-analysed the findings of Le *et al.* (2006) and concluded that recognition of *Stigmochelys* as a sister taxon to *Psammobates* was warranted. The validity of the subspecies *Stigmochelys pardalis babcocki* has been a contentious issue for some time. This situation was reviewed by Fritz *et al.* (2010a) and recognition of *S. p. babcocki* was abandoned.

A molecular phylogeny of African hinge-back tortoises (*Kinixys*) was presented by Kindler *et al.* (2012), with implications for the phylogeography and taxonomy of species in the *Atlas* region. Savanna species were found to be paraphyletic with respect to the rainforest species *K. homeana* and *K. erosa*, and the latter clade appears to be derived from a savanna-living ancestor. The name *K. belliana* (Gray, 1830) was restricted to hinged-back tortoises ranging from Angola to Burundi, while those from the East African coastal region—extending into the north-eastern parts of KwaZulu-Natal in the *Atlas* region—previously assigned to *K. b. belliana*, represent a distinct species, *K. zombensis*.

Up to nine deep genealogical lineages have been demonstrated in the widely distributed African Helmeted Terrapin (*Pelomedusa subrufa*), indicating numerous undescribed taxa that await resolution (Vargas-Ramírez *et al.* 2010). The level of genetic divergence in these *Pelomedusa* lineages is comparable to that between many well-differentiated hinged terrapin (*Pelusios*) species. Within the latter genus, cryptic species also appear evident in both *P. sinuatus* and *P. rhodesianus* (Fritz *et al.* 2011).

2. CROCODYLIA

Phylogenetic relationships among crocodilians have recently been re-evaluated (Brochu 2000, 2003; Schmitz *et al.* 2003; McAliley *et al.* 2006; Piras *et al.* 2010; Zhang *et al.* 2011). Recent authors (Janke *et al.* 2005; Roos *et al.* 2007; Meganathan *et al.* 2010; Zhang *et al.* 2011) have allocated the genera previously assigned to the Gavialidae (*Gavialis* and *Tomistoma*) to the Crocodylidae. A number of authors (e.g. Schmitz *et al.* 2003) have noted that Central African *Crocodylus cataphractus* is not closely related to other *Crocodylus*, and McAliley *et al.* (2006) revived *Mecistops* Gray 1844 to accommodate this species, which is considered to be the sole surviving member of an ancient lineage endemic to the African continent. Phylogenetic relationships within *Crocodylus* indicate that the genus is relatively young and has only recently colonised Africa (Brochu 2000). Schmitz *et al.* (2003) provided molecular evidence for species-level divergence in African Nile Crocodiles, and treated Central and West African crocodiles as a separate species, *C. suchus*. Further studies, using larger gene sequences and greater individual and taxon sampling (Hekkala *et al.* 2010; Meredith *et al.* 2011), have supported genetic divergence within Nile Crocodile populations and shown, perhaps surprisingly, that the New World radiation of crocodiles (*C. intermedius*, *C. rhombifer*, *C. acutus* and *C. moreletii*) are sister to East African *C. niloticus.* Further studies are underway to resolve the taxonomy in the light of these findings (see Meredith *et al.* 2011).

3. SQUAMATA

Camp (1923) presented one of the first detailed hypotheses of squamate relationships based on morphology. Estes *et al.* (1988) revisited squamate relationships in an explicitly cladistic framework and retrieved many of the same relationships as Camp. They recognised the Iguania (Iguanidae, Agamidae, Chamaeleonidae)—a group of diurnal, visually oriented, fully limbed, ambush predators—as the sister group of the Scleroglossa. The latter is a morphologically and ecologically diverse lineage of chemosensory specialists, including cryptic and/or nocturnal groups and mainly actively foraging predators. Within the Scleroglossa, the Gekkota (geckos and pygopods) were the sister to the remaining groups, constituting the Autarchoglossa, itself including the Scincomorpha and Anguimorpha. Under this phylogenetic hypothesis, the positions of snakes (Serpentes), amphisbaenians, and the enigmatic lizard family Dibamidae were unresolved, although there was strong support for the anguimorph origins of snakes. The framework of Estes *et al.* (1988) provided the basis for squamate classifications used by the most recent generation of herpetologists (Figure 2.1).

More recent analyses, including those of morphological data (Lee 1998, 2000; Conrad 2008) and molecular data (Saint *et al.* 1998; Harris *et al.* 2001; Townsend *et al.* 2004; Vidal & Hedges 2005, 2009; Wiens *et al.* 2012) have challenged this view of squamate genealogy. Vidal & Hedges (2009), for example, present a phylogeny that differs fundamentally from the 'orthodox' morphologically derived tree and that implies a very different resultant

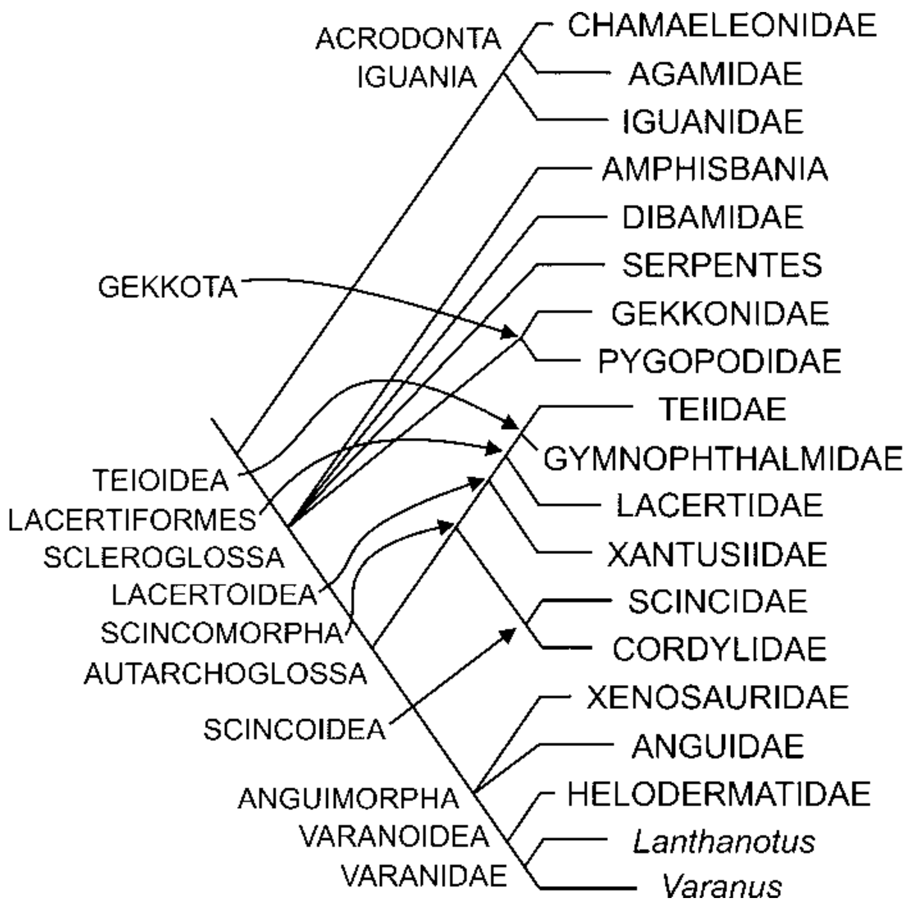


Figure 2.1.—Squamate inter-relationships based on morphology, as hypothesised by Estes *et al*. 1988 (adapted from Conrad 2008, and reproduced courtesy of the American Museum of Natural History).

classification scheme in which the Dibamidae is sister to the Bifurcata, including all remaining squamates. Within the latter group Gekkota is sister to the Unidentata (= Scinciformata + Episquamata). Scinciformata includes the Scincidae, Xantusiidae, Cordylidae and Gerrhosauridae. Within Episquamata the Laterata (Teiidae, Gymnophthalmidae, Lacertidae and all amphisbaenians) are sister to the Toxicofera (Anguimorpha and Iguania of Estes *et al.* [1988] + Serpentes). These relationships are supported chiefly by nuclear DNA sequence data, but they are consistent with other data sources, such as the presence of elements of a venom system in the toxicoferan groups (Fry *et al.* 2006, 2008). This new squamate classification (Figure 2.2) certainly upsets traditional views of higher order relationships, but it is nonetheless remarkably consistent with morphologically-derived hypotheses of relationships with regard to the recognition of major clusters of families (e.g. Gekkota, Anguimorpha and Iguania).

We accept the phylogeny of Vidal & Hedges (2009) as the best-supported current hypothesis of relationships among squamates, and in the checklist of taxa included in the *Atlas* we have, to a large extent, used their higher order groupings. However, the incorporation of snakes (Serpentes) within Toxicofera causes extreme nomenclatural upheaval, with hierarchical re-adjustment required for the numerous (nearly 20) snake families and other higher order categories currently recognised within the group. For this reason, the *Atlas* accounts are organised in more traditional groupings (lizards [including amphisbaenians] and snakes), largely to accommodate non-systematist users of the book who may not be familiar with recent advances in the field. That snakes are nested within lizards, however, is undoubted; but the nomenclatural consequences need further elaboration. Ultimately, classification schemes are dynamic because they are reflections of phylogenetic hypotheses that may be expected to change as more and better data become available for analysis.

4. SAURIA

4.1 Agamidae

Despite the small number of recognised taxa in the region, species boundaries among agamids remain a major area of uncertainty in southern African reptile systematics. A phylogenetic analysis of the family (Joger 1991) supported the recognition of *Acanthocercus* as a distinct genus separate from *Agama* (see also Leaché *et al.* 2009), with *Acanthocercus atricollis*, which includes a number of cryptic taxa, currently being investigated (Wagner & Bauer 2012; Wagner *et al.* 2012; P. Wagner pers. comm.). Although no new agamid species have been de-

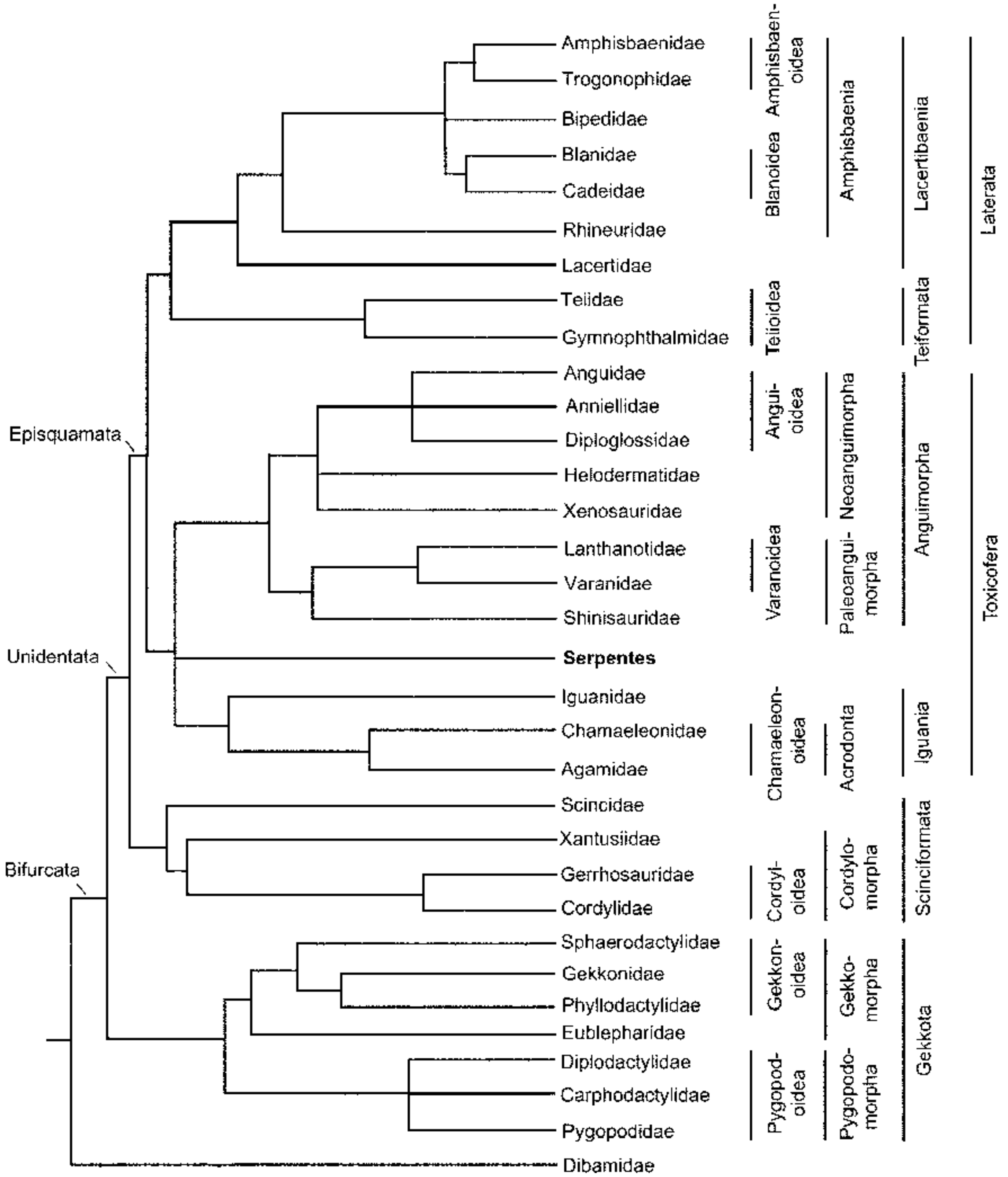


Figure 2.2.—Phylogeny of squamates based on molecular techniques, adapted from Vidal & Hedges (2009).

scribed from the *Atlas* region in the last 20 years, the status of the taxa *A. armata*, *A. aculeata distanti* and *A.* (*atra*) *knobeli* have been the focus of some research. Reproductive (Mouton & Herselman 1994) and genetic (Matthee & Flemming 2002) studies on *A. atra* have demonstrated significant geographic variation, with three identified populations (southern Namibia, western arid and southern mesic) that may merit taxonomic recognition. However, none of the agamids in the *Atlas* region are of conservation concern.

4.2 Chamaeleonidae

Although Frost & Etheridge (1989) treated chameleons as a subfamily within the Agamidae, this has not been accepted by most workers (e.g. Klaver & Böhme 1997). The recognition of subfamilies within the Chamaeleonidae is also problematic. Klaver & Böhme (1986) recognised two subfamilies, the Brookesiinae containing *Brookesia* and *Rhampholeon*, with the remaining genera included in the Chamaeleoninae. The relationships and content of genera in both putative subfamilies have been subject to much debate (Townsend & Larson 2002; Matthee *et al.* 2004), and continued recognition of subfamilies is not supported by recent molecular phylogenies (Tilbury *et al.* 2006). The validation of *Trioceros* (Tilbury & Tolley 2009a) and *Archaius* (Townsend *et al.* 2011) as full genera means that the remaining chameleonine genus in the *Atlas* region, *Chamaeleo*, now has a greatly reduced content and morphological diversity. Townsend & Larson (2002) found that *Chamaeleo namaquensis* represented a separate lineage from other *Chamaeleo*. However, their study was preliminary. Additional molecular phylogenetic studies supported these relationships but generic assignment as *C. namaquensis* was maintained (Tolley *et al*. 2013).

The transfer of East African dwarf chameleons previously placed in *Bradypodion* (Klaver & Böhme 1986) to the genus *Kinyongia* (Tilbury *et al.* 2006) means that *Bradypodion* is now the sole southern African endemic genus in the family. Several new species have recently been described in this genus: *B. atromontanum*, *B. caeruleogula* and *B. ngomeense* (Branch *et al.* 2006b; Raw & Brothers 2008; Tilbury & Tolley 2009b). An additional taxon, *B. nkandlae* (from Nkandla Forest in KwaZulu-Natal), was described by Raw & Brothers (2008), but genetic data do not support the distinctiveness of this form (Tolley *et al.* 2006) and it has since been synonymised with *B. nemorale* Raw 1978 (Tilbury & Tolley 2009b), to which it had previously been referred. Unravelling species boundaries within *Bradypodion* is difficult (see discussion in Branch *et al.* 2006), and the description of new species based on restricted morphological analysis and limited specimens (e.g. Raw & Brothers 2008) will only confound scientific insight and inflate synonymies unnecessarily. Ongoing phylogenetic and phylogeographic research suggests that existing taxonomy still does not reflect real biodiversity within the genus (Tolley *et al.* 2006).

4.3 Cordylidae

In a preliminary molecular phylogenetic study, Frost *et al.* (2001) relegated *Chamaesaura* and *Pseudocordylus* to the synonymy of *Cordylus.* This arrangement was not widely followed due to concerns about the study's low taxon sampling and nomenclatural complications arising from such a re-arrangement. A more taxon-complete phylogenetic study using a wider array of genetic markers has now been completed (Stanley *et al.* 2011), and necessitated numerous taxonomic re-adjustments. This study recognised a new subfamily, Platysaurinae, for *Platysaurus*, maintained generic recognition for the serpentine *Chamaesaura* and the typical *Pseudocordylus*, and also revived *Hemicordylus* for the gracile cliff lizards *H. capensis* and *H. nebulosa* previously included in *Pseudocordylus.* The greatest taxonomic disruption occurred in *Cordylus*, where five new genera were required in order to retain monophyletic groups (Stanley *et al.* 2011). These genera are: *Smaug* (*S. giganteus*, *S. warreni warreni*, *S. warreni barbertonensis*, *S. warreni depressus*, *S. vandami*, *S. breyeri*, *S. mossambicus*, *S. regius*), *Ninurta* (*N. coeruleopunctatus*), *Ouroborus* (*O. cataphractus*), *Karusasaurus* (*K. polyzonus*, *K. jordani*), and *Namazonurus* (*N. pustulatus*, *N. namaquensis*, *N. peersi*, *N. campbelli*, *N. lawrenci*). The remaining species were retained within a reduced *Cordylus.*

Within the *Atlas* region the most recently described taxa include *C. oelofseni* (Mouton & Van Wyk 1990), *C. imkae*, *C. cloetei*, *C. aridus* (Mouton & Van Wyk 1994), *Hemicordylus nebulosus* (Mouton & Van Wyk 1995), *Platysaurus lebomboensis*, *P. monotropis*, *P. intermedius inopinus* (Jacobsen 1994a) and *P. broadleyi* (Branch & Whiting 1997). Revisionary work in the *Smaug warreni* group is ongoing (E.L. Stanley & M.F. Bates in prep.) and suggests that an additional new taxon occurs in the *Atlas* region. Bates (2007a) has revised the *Pseudocordylus melanotus* complex, validating the specific status of *P. transvaalensis.*

4.4 Gekkonidae

Taxa formerly placed in the Gekkonidae have subsequently been allocated to six different families (Han *et al.* 2004; Gamble *et al.* 2008a,b), but only the Gekkonidae *sensu stricto* occurs in southern Africa. At the generic level, Bauer *et al.* (1997) separated out the new African leaf-toed genera *Cryptactites*, *Goggia* and *Afrogecko*, as well as *Haemodracon* (Socotra) and *Dixsonius* (Southeast Asia) from the formerly cosmopolitan *Phyllodactylus*. New species of the leaf-toed geckos from the *Atlas* region include *Goggia braacki* (Good *et al.* 1996), *G. gemmula* (Bauer *et al.* 1996), *G. hewitti* and *G. hexapora* (Branch *et al.* 1995a), and *Afrogecko swartbergensis* (Haacke 1996), while others were resurrected from synonymy (*G. essexi* and *G. rupicola* [Branch *et al.* 1995a]). Bauer & Lamb (2005) sank *Palmatogecko* into the synonymy of *Pachydactylus* and transferred *Pachydactylus bibronii* and *P. turneri* to *Chondrodactylus. Colopus* was also no longer monotypic with the transfer of *C. kochii* from *Pachydactylus*. *Elasmodactylus* was revived for the basal East African species, *E. tuberculosus* and *E. tetensis* (Bauer & Lamb 2005). Finer scale phylogenetic analyses within various groups of *Pachydactylus* have resulted in the elevation of various subspecies to specific rank (*P. barnardi*, *P. formosus*, *P. purcelli*, *P. montanus* [Bauer & Lamb 2002; Bauer *et al.* 2006a]), the removal of *P. serval* from the South African faunal list, and the description of many new taxa (*P. monicae*, *P. visseri*, *P. atorquatus*, *P. goodi*, and *P. carinatus*) from the Northern Cape (Bauer *et al.* 2006a,b). In addition, Bauer *et al.* (2012) revised the four taxa in the *P. mariquensis* group, treating all as full species. All four species occur in the *Atlas* region and only *P. latirostris* is not endemic, extending into Namibia. Both *P. amoenus* Werner, 1910 and *P. macrolepis* FitzSimons, 1939 have restricted ranges in Little Namaqualand, but neither are considered threatened. Within *Lygodactylus*, Jacobsen (1992a, 1994b) named *L. graniticolus*, *L. n. nigropunctatus*, *L. n. montiscaeruli*, *L. n. incognitus*, *L. waterbergensis* and *L. ocellatus soutpansbergensis*. Gecko groups currently receiving taxonomic attention include *P. geitje*, the *P. maculatus* group, *Lygodactylus* and *Afroedura*. This attention is particularly focused on *Afroedura* from Limpopo and Mpumalanga provinces, where numerous undescribed species are known to occur, most of which are likely to be of conservation concern. The status of *Hemidactylus mabouia* in Africa and the western Indian Ocean remains problematic, and is currently under investigation (Vences *et al.* 2004; Carranza & Arnold 2006; Rocha *et al.* 2005, 2010).

4.5 Gerrhosauridae

A recent molecular phylogeny of Gerrhosaurinae by Bates *et al.* (2013) confirmed earlier indications (Lamb *et al.* 2003, Lamb & Bauer 2013) of five major clades. To maintain existing genera, particularly the serpentine *Tetradactylus*, they described two new genera (*Broadleysaurus* and *Matobosaurus*), and revalidated *Gerrhosaurus intermedius*.

4.6 Amphisbaenidae

The phylogeny of Townsend *et al.* (2004) indicated that amphisbaenians formed a sister taxon to the Lacertidae. In another molecular study, Macey *et al.* (2004) assessed phylogenetic relationships among amphisbaenians and found the Rhineuridae (restricted to Florida, USA) to be basal and the Bipedidae (New World) to be the sister taxon to the Amphisbaenidae + Trogonophidae. Mott & Vieites (2009) also demonstrated that the morphological characters previously used to diagnose South American amphisbaenid genera were homoplasic, and the taxonomy based upon them inappropriate. The greatest amphisbaenian diversity occurs in the Amphisbaenidae, the only family represented in the *Atlas* region.

Broadley *et al.* (1976) discussed geographical variation in *Monopeltis* and recognised three forms (groups A–C) within *M. capensis*. These have all subsequently been treated as full species, with *M. decosteri* revived for Group C and *M. infuscata* described for Group B (Broadley 1997a). *Monopeltis mauricei* was treated as a subspecies of *M. sphenorhynchus* by Broadley *et al.* (1976), but re-elevated to specific status by Broadley (2001a) and treated as such by Gans (2005). Broadley & Broadley (1997) revived *Zygaspis.*

The updated checklist and bibliography of the Amphisbaenia of the world by Gans (2005) treats a number of taxa previously considered subspecies or synonyms of others, as full species. It is not obvious whether Gans (2005) considered these as nomenclatural adjustments or valid taxa within a phylogenetic species framework, or simply as potentially available names. Gans (2005) raised *Chirindia langi occidentalis* (Jacobsen 1984) to specific status without comment. This action seems reasonable given its close proximity (80 km) to typical *C. langi* and because there is no evidence of a clinal gradient in diagnostic morphology. However, supporting molecular data would be useful to resolve its status. In a similar manner, Gans (2005) raised *Dalophia transvaalensis* and numerous other taxa previously treated as synonyms of *Dalophia pistillum* to specific status, but these amendments have not been followed here and await further study.

4.7 Lacertidae

Recent molecular studies have indicated primary divisions within the family, although there has been debate as to whether these should be accorded subfamilial or tribal status. Harris *et al.* (1998) divided the family into three subfamilies: Gallotiinae, Eremiadinae and Lacertinae. However, Gallotiinae is sister to a clade containing Eremiadinae and Lacertinae, which thus cannot have the same rank. The latter two subfamilies have consequently been downgraded to tribes, as Eremiadini Szczerbak, 1975 and Lacertini Oppel, 1811 (Arnold *et al.* 2007). This also affirmed support for the generic level phylogenies of Arnold (1989) which recognised two Afrotropical groups: a South African one containing *Tropidosaura*, *Pedioplanis*, *Meroles* and *Ichnotropis*; and another made up of *Nucras* of south and east Africa plus a clade consisting of *Latastia*, *Heliobolus* and *Philochortus*, referred to as the Northeast African group. Arnold (1989) also erected *Australolacerta* for *A. rupicola* and *A. australis*, two South African endemics that were previously placed in the Palaearctic genus *Lacerta*. A molecular analysis by Engleder *et al.* (2013) confirmed the sister group relationship between a ‘South African clade’ (*Tropidosaura*, *Pedioplanis*, *Meroles*, *Ichnotropis* and *Australolacerta*) and an ‘East African clade’ (including *Nucras* and *Heliobolus*), and suggested that diversification in southern Africa was ‘explosive’ and associated with an incisive climatic event. Two recent independent molecular analyses showed that *Ichnotropis squamulosa* should be transferred to the genus *Meroles* (Edwards *et al.* 2012; Engleder *et al*. 2013). This was formally undertaken by Edwards *et al*. (2013a), who also demonstrated that *Australolacerta rupicola* was genetically well-defined from *A. australis*, and transferred it to a new genus, *Vhembelacerta*.

Although no new species have recently been described from the *Atlas* region, phylogenetic analyses of *Meroles* (Harris *et al.* 1998; Lamb & Bauer 2003) and *Pedioplanis* (Makokha *et al.* 2007; Conradie *et al.* 2012) confirm morphologically-based suspicions that some widespread taxa are composed of several biological units. This applies particularly to *Meroles suborbitalis* and *Pedioplanis lineoocellata*, *P. namaquensis* and *P. inornata*. Within *Nucras taeniolata*, Broadley (1972) recognised a northern subspecies (*N. t. ornata*), but this was elevated to a full species by Jacobsen (1989), who also validated *N. taeniolata holubi* (subsequently shown to be a full species by Bates 1996a). Branch & Bauer (1995) elevated *N. livida* to full species status, and a new species of *Nucras* from the West Coast has been identified but remains undescribed. A molecular phylogeny of *Nucras* is underway (A.M. Bauer *et al.* in prep.).

4.8 Scincidae

Higher order studies of skink relationships (A.S. Whiting *et al.* 2003; Brandley *et al.* 2005) have indicated that neither the Scincinae nor Lygosominae are monophyletic. In the Acontinae, Daniels *et al.* (2002, 2005, 2006, 2009) demonstrated that existing generic and species boundaries did not reflect evolutionary groups and they recognised a new genus, *Microacontias*, for the small, slender-bodied western forms with moveable eyelids. However, a recent molecular study of acontines (Lamb *et al.* 2010) that included greater taxon sampling, particularly of typhlosaurs, synonymised *Micracontias* and *Acontophiops* with *Acontias*, to which they assigned all taxa with the exception of only five species now constituting a greatly reduced *Typhlosaurus* (*T. braini*, *T. caecus*, *T. lomiae*, *T. meyeri*, *T. vermis*). Because of secondary homonymy, the species formerly known as *Acontophiops lineatus* and *Typhlosaurus lineatus* are now *Acontias rieppeli* and *Acontias kgalagadi* respectively. Lamb *et al.* (2010) also raised *Typhlosaurus lineatus richardi* to specific level as *Acontias richardi*. The *Acontias meleagris* group is particularly problematic (Daniels *et al.* 2006, 2009) and further taxonomic work is needed in order to reconcile morphology and nomenclature with phylogeny. Lamb *et al.* (2010) raised *A. m. orientalis* to a full species with *A. percivali tasmani* as a synonym. They further recognised *A. lineacauda* as a species level taxon but acknowledged that both *A. meleagris* and *A. lineacauda* remain non-monophyletic and require further evaluation.

Mausfeld *et al.* (2002) partitioned *Mabuya*, assigning all regional members of the group to *Euprepis*. Bauer (2003), however, demonstrated that the name *Trachylepis* was the appropriate name for this clade of skinks. No new members of this genus have recently been named from the *Atlas* region, but Broadley & Bauer (1999) and Broadley (2000) raised several species (*T. margaritifer*, *T. sparsa*, *T. depressa*, *T. punctulata*, *T. punctatissima*) from subspecific to specific status. For at least some populations within the *T. striata* complex, this may have been premature (Castiglia *et al.* 2006). Additional questions of species boundaries still exist in some species, particularly in *T. varia* (Jacobsen 1989).

There remains discussion over the content and distribution of lygosomine genera. Wagner *et al.* (2009) re-validated *Lepidothyris* for the red-sided skinks (previously referred to *Lygosoma*) and also returned writhing skinks, e.g. *Lygosoma sundevalli* and *L. afrum*, to *Mochlus* with both *Riopa* and *Lygosoma* being restricted to Asia. Among regional lygosomines, a single new species, *Panaspis maculicollis*, was described (Jacobsen & Broadley 2000) during the last 14 years. On morphological characters, Greer (1974) described a new genus, *Afroablepharus*, for African species with an ablepharine (non-blinking) eye, and contact between the frontal scale and one subocular scale on either side of the head. Broadley (1989a) rejected this arrangement and retained *Panaspis* for savanna species, including those with an ablepharine eye from the *Atlas* region. Subsequent molecular studies (Schmitz *et al.* 2005a; Jesus *et al.* 2007) have confirmed the generic distinction of *Afroablepharus*, which is now the appropriate genus for the two *Atlas* species. Among scincines, new species of *Scelotes* have been described from KwaZulu-Natal (*S. fitzsimonsi*, *S. bourquini*, *S. vestigifer*; Broadley 1994) and Western Cape (*S. montispectus*; Bauer *et al*. 2003). Phylogenetic studies of *Trachylepis* and *Scelotes* are underway (Portik 2009; Heideman *et al*. 2011; Portik *et al.* 2011; A.M. Bauer & T.R. Jackman in prep.).

4.9 Varanidae

Numerous recent studies have addressed taxonomic diversity and relationships within Australasian varanids (see reviews in Böhme 2003 and Eidenmüller & Philippen 2008). However, there have been relatively few studies on the African radiation. Böhme *et al.* (1989) described *V. yemenensis* from Arabia, and later Böhme & Ziegler (1997) revived *V. ornatus* from the synonymy of *V. niloticus.* Various biogeographic scenarios have been proposed for the origin of varanids, including an African origin (supported by the presence of the earliest known varanid fossils from the upper Eocene and lower Oligocene of Egypt; Holmes *et al.* 2010), an Asian origin (supported by the distribution and diversity of anguimorph lizards) and vicariance associated with Gondwana following Jurassic and Early Cretaceous plate movements (Vidal *et al.* 2012). Molecular data support an Asian origin with dispersal into Africa about 41 (49–33) Ma (Vidal *et al.* 2012). Subsequent to this dispersal, *V. yemenensis*, which is sister to *V. albigularis*, invaded Arabia from Africa, either across a southern land bridge and/or by overwater dispersal (Portik & Papenfuss 2012).

5. SERPENTES

Phylogenetic relationships within snakes have been an active field in recent years, with numerous studies investigating different lineages. A good modern summary is that of Vidal *et al.* (2009), upon which much of the following discussion is based (see also Pyron *et al*. 2011). It is now evident that snakes have a Gondwanan origin, evolving on West Gondwana, the supercontinent comprising South America and Africa. Among extant lineages, the deepest divergences are found between what have been termed the Amerophidia and Afrophidia (Vidal *et al.* 2007), and occurred 106 (116–97) Ma, probably in association with continental breakup. Most (~85%) living snakes are afrophidians and are now globally distributed, having initially dispersed out of Africa through Laurasia or India. Most basal afrophidian families (Henophidia) diverged in the Cretaceous, 104–70 Ma, while most advanced afrophidian families (Caenophidia) diverged in the early Cenozoic, 63–33 Ma.

Living snakes display an evolutionary trend of increasing gape size, from fossorial scolecophidians (locally represented by the blind snakes, Typhlopidae, and thread snakes, Leptotyphlopidae), via various intermediate fossorial alethinophidians (e.g. Aniliidae, Uropeltidae)—none of which occur in Africa—to ecologically diverse 'large-mouthed' macrostomatans capable of ingesting very large prey. Among macrostomatans, the Henophidia comprise a suite of relictual lineages scattered throughout the tropical and subtropical regions. The great majority of extant snakes (~2 550 spp.) belong to the Caenophidia, which includes all venomous species. There remains controversy about relationships and content within the numerous caenophidian families.

5.1 Typhlopidae

Of the two infraorders of snakes, the Scolecophidia is by far the most poorly known in terms of species diversity, ecology and evolutionary history. Their deep (Cretaceous) roots and largely Gondwanan distribution makes these snakes prime candidates for study. The content and generic allocation of African typhlopids has been the subject of detailed and extensive morphological research (Broadley & Wallach 2000, 2007b, 2009), although explicit phylogenetic relationships were not analysed. A recent phylogeny of scolecophidians, including typhlopids (Vidal *et al.* 2010), dates the divergence of the group to the separation of East and West Gondwana. Five main clades are recognised, and the very deep genetic divergences observed necessitated the recognition of a new scolecophidian family (Xenotyphlopidae) for two typhlopid species from Madagascar, and another family (Gerrhopilidae) for 15 species from the Philippines (Vidal *et al.* 2010). Within Africa *Typhlops* Oppel, 1811 is now restricted to only seven species scattered in western, northern and eastern Africa. The *Atlas* species fall into three genera, none of which are endemic. A new genus, *Afrotyphlops*, was proposed by Broadley & Wallach (2009) for 20 species, most recently placed in *Rhinotyphlops* or *Typhlops.* Only two species (*A. bibronii* and *A. fornasinii*) occur in the subcontinent. *Megatyphlops* was described (Broadley & Wallach 2009) for four large and robust species that possess an angular snout with a horizontal edge and an incompletely divided nasal shield. Only two (*M. mucruso* and *M. schlegelii*) occur on the subcontinent. *Rhinotyphlops* is now restricted to only four species, three occurring in the *Atlas* region and one in Somalia (Broadley & Wallach 2009).

5.2 Leptotyphlopidae

Although much recent work has dealt with detailed morphological analyses of leptotyphlopids from the eastern half of the continent (Broadley & Wallach 1997a, 2007a; Broadley & Broadley 1999), including the description of new species from the *Atlas* region (*Leptotyphlops sylvicolus*), higher taxonomic relationships were not addressed. The first family-level molecular study on leptotyphlopid relationships (Adalsteinsson *et al.* 2009) revealed deep genetic divergence between morphologically-conservative lineages. To reflect this, two subfamilies, Epictinae (New World and Africa) and Leptotyphlopinae (Africa, Arabia and southwest Asia), were recognised. The latter subfamily contains three tribes, two (Myriopholini and Leptotyphlopini) of which occur in the *Atlas* region. Species within the *Atlas* region are now placed in three genera, most remaining within a reduced *Leptotyphlops.* Taxa transferred to new genera include *Myriopholis longicaudus*, *Namibiana occidentalis* and *N. gracilior*. There remains significant non-monophyly among separate populations of currently recognised species, indicating that an unusually large number of undescribed species exist, particularly within the *Leptotyphlops scutifrons-conjunctus-incognitus* species complex (Adalsteinsson *et al.* 2009) which is currently being investigated in more detail (Branch & Vidal unpubl. data).

5.3 Pythonidae

Historically there has been great confusion concerning relationships among the numerous groups traditionally assigned to basal macrostomatans (i.e. all snakes excluding small-mouthed scolecophidians). The Henophidia, of which pythons form part, has recently been restricted in scope to all non-caenophidian Afrophidia (Vidal *et al.* 2009). Early morphological studies of the relationships of pythons and their presumed relatives (e.g. Kluge 1991, 1993a,b) placed them in the subfamily Pythoninae in the Boidae, sister to two subfamilies, Boinae (boas) and Erycinae (sand boas). Recent molecular studies (e.g. Noonan & Chippindale 2006; Rawlings *et al.* 2008), however, confirm that these lineages are best treated as separate families within the superfamily Pythonoidea, with the Pythonidae more closely related to two small families, the Loxocemidae (containing only the Mexican Burrowing Python) and the Xenopeltidae (containing the two Asian sunbeam snakes) rather than to boas and their relatives. Pythons are restricted to the Old World with about 40 species in nine genera (Uetz 2012), most within Australasia, with only four in Africa.

5.4 Viperidae

Various subfamilies have been proposed within the Viperidae, the best supported being the Viperinae, Crotalinae and Azemiopinae (Zaher *et al.* 2009). Previous recognition of the Causinae (e.g. Cadle 1988; Lenk *et al.* 2001) was based on the assumption that night adders (*Causus*) represented the most basal lineage within viperids due to presumed primitive conditions of scalation, presence of round pupils, morphology of the venom apparatus, oviparity, etc. However, genetic phylogenies show *Azemiops* to be a basal lineage within Viperidae and it is placed in a monotypic subfamily (Azemiopinae). The two remaining clades contain Old World vipers (Viperinae) and Asian and New World pitvipers (Crotalinae). African night adders (*Causus*) are nested within other viperines (Nagy *et al.* 2005) and a separate subfamily for them is no longer justified.

A number of recent studies have looked at *Bitis* and its constituent parts, and various molecular phylogenies have been proposed (Hermann & Joger 1997; Lenk *et al.* 1999). The latter authors erected the new subgenus *Keniabitis* for *Bitis worthingtoni* Parker, which occupies a basal position with regard to the remaining species. In addition, they revived *Calechidna* Tschudi as a subgenus for the 11 small southern African species, with *B. atropos* as the type species. Lenk *et al.* (1999) also proposed the revival of *Macrocerastes* Reuss as a subgenus for *B. gabonica*, *B. rhinoceros* (recognised as a full species), *B. nasicornis* and probably *B. parviocula*, leaving *B. arietans* in the monotypic nominal subgenus. *Keniabitis* and *Calechnida* have recent support from venomics (Calvete *et al.* 2007) and Wallach (1998) recognised the latter subgenus on the basis of the lack of a tracheal lung in the eight species that he examined. All of the above subgenera (*Keniabitis*, *Calechidna* and *Macrocerastes*) are supported by current phylogenetic analyses of the genus *Bitis* (A. Barlow *et al.* in prep.), and recognition of any of these as full genera would pre-suppose recognition of the others to avoid paraphyly. Wüster *et al.* (2008) noted that although the subgenera proposed by Lenk *et al.* (1999) reflect the phylogenetic structure within *Bitis*, they caution against treating them as full genera and disrupting the nomenclatural stability of a medically-important snake group. Barlow *et al.* (2010, 2013) investigated phylogeography in the Puff Adder (*B. arietans*) and noted multiple parapatric mitochondrial clades, including a widespread southern African clade subdivided into four separate subclades. A dynamic and complex history of refugial isolation and secondary expansion in the subcontinent was revealed.

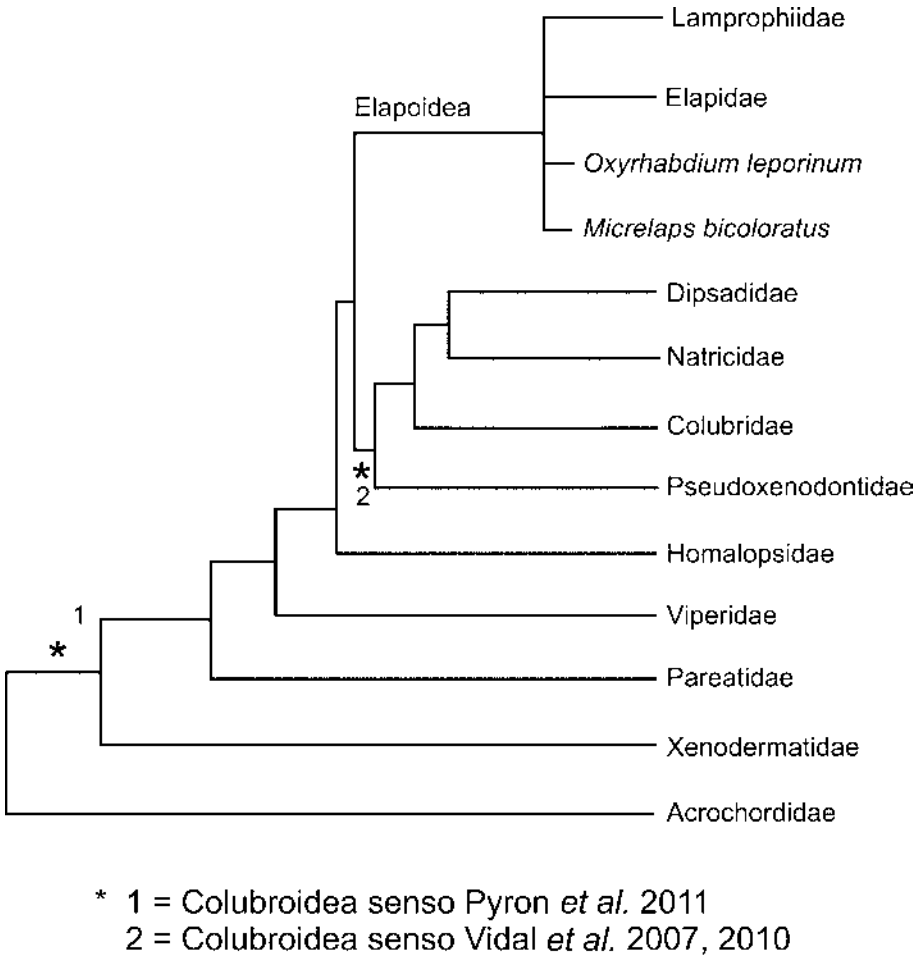
A modern revision of the four isolated populations of *B. atropos*, using molecular and morphological analyses, has demonstrated that all populations should be treated as separate species, and that genetic divergence of populations within the Cape Fold Mountains also indicates the presence of cryptic taxa (Branch & Kelly 2008; Kelly *et al.* 2009a). Previous understanding of the *B. cornuta* complex involved the recognition of central and eastern subspecies (Hewitt 1937a; FitzSimons 1946, 1962; Underwood 1968). The last revision of the complex (Branch 1999a) recognised a suite of isolated species (*B. inornata*, *B. albanica*, *B. armata*), including the recently described *B. rubida* (Branch 1997), and left *B. cornuta* as a monotypic species. This arrangement is being re-assessed by means of a molecular analysis (W. Wüster *et al.* in prep.).

5.5 Colubroidea

Within the *Atlas* region most snakes occur within the Caenophidian radiation, i.e. the ‘higher’ snakes not included in ‘primitive’ groups such as the Scolecophidia (Leptotyphlopidae and Typhlopidae; see above) or Henophidia (represented in the *Atlas* region solely by the African python, but including a number of other early snakes from elsewhere in the world) radiations. The more advanced caenophidians include a suite of snake families that comprise the Colubroidea. There is debate over the content of this group, with Vidal *et al.* (2007, 2010) and Zaher *et al.* (2009) restricting it to a clade of snakes that is sister to the Elapoidea (Elapidae + Lamprophiidae; Figure 2.3). The Colubroidea as understood by these authors includes various families that were previously treated as subfamilies within a more inclusive Colubridae (e.g. Calamariidae, Colubridae, Dipsadidae, Natricidae, Pseudoxenodontidae). In effect, the Colubridae of these authors contains a greatly reduced group of snakes, and their concept of the Colubroidea is equivalent to previous usage of the Colubridae (see Pyron *et al.* [2011], for a fuller discussion and a conflicting treatment). A fundamental difference between these arrangements is that basal caenophidian lineages such as the Viperidae are included (with other diverse snakes) within the Colubroidea of Pyron *et al.* (2011), but not within the restricted usage of Vidal *et al.* (2007, 2010) or Zaher *et al.* (2009). The latter concept of the Colubroidea is adopted in the *Atlas*, with only the families Natricidae and Colubridae present in the region (see 5.8).

5.6 Lamprophiidae

Recent molecular studies have helped to clarify interfamilial relationships within advanced snakes (Vidal & Hedges



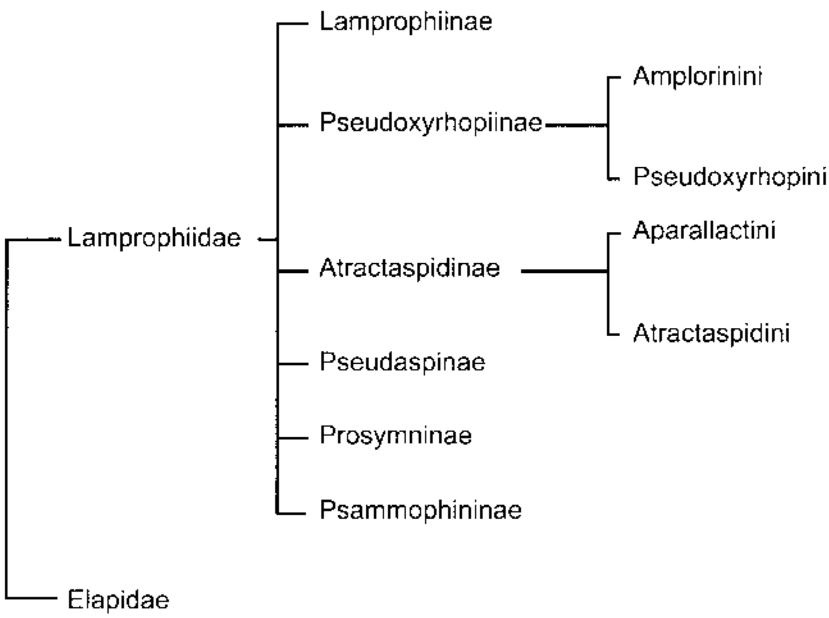


Figure 2.3.—Phylogeny of snakes, adapted from the proposal by Vidal *et al.* (2008a).

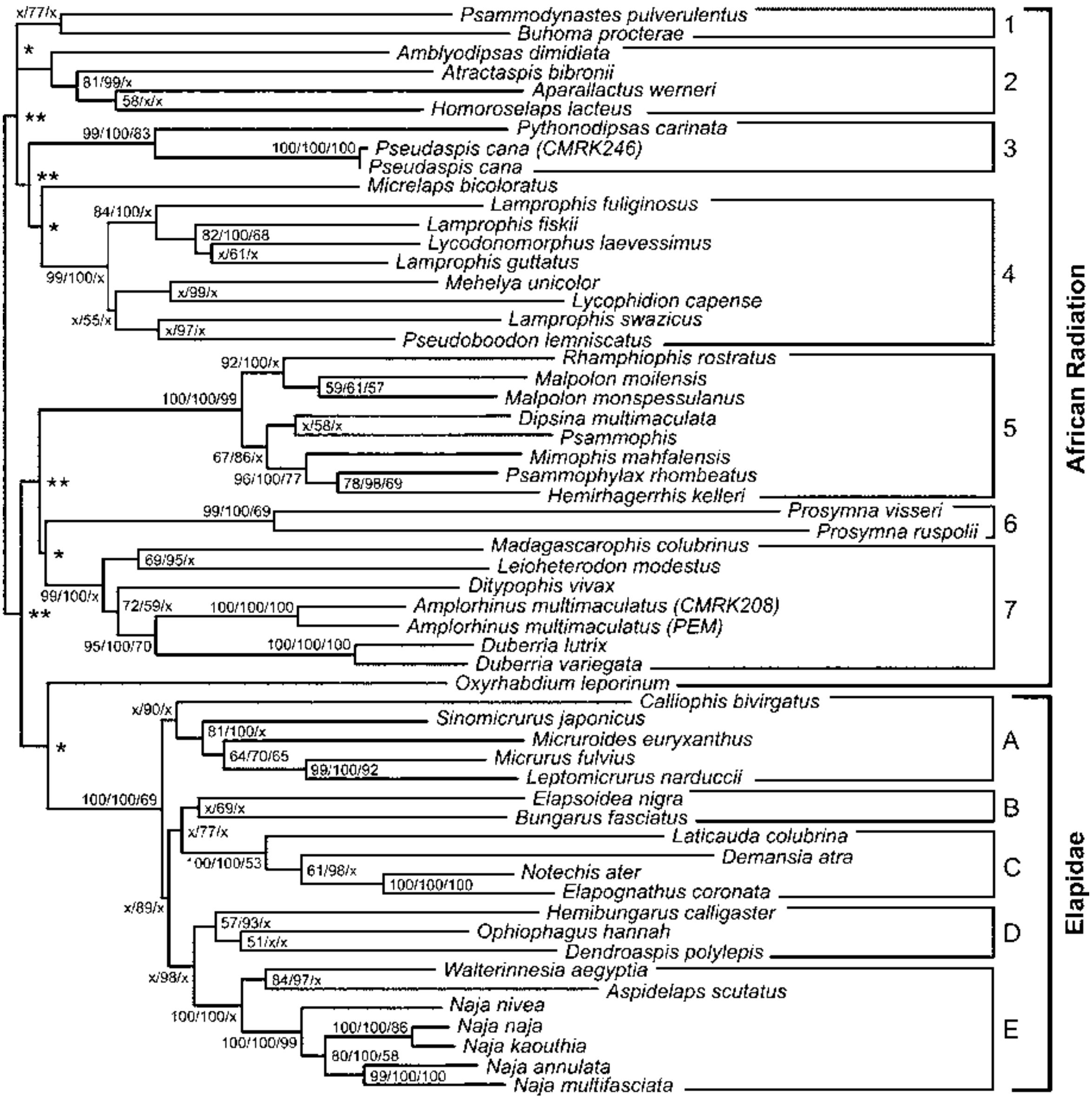


Figure 2.4.—Phylogeny of Elapoidea (African radiation plus Elapidae) as proposed by Kelly *et al*. (2009b) (reproduced courtesy of John Wiley & Sons Inc.).

Key to clades:

1: Genera *Psammodynastes* and *Buhoma* (Elapoidea *incertae sedis*)
2: Family Atractaspididae
3: Family Pseudaspididae (genera *Pythonodipsas* and *Pseudaspis*)
4: Family Lamprophiidae
5: Family Psammophiidae
6: Family Prosymnidae (genus *Prosymna*)
7: Family Pseudoxyrhophiidae
A: Asian/American coral snakes
B: *Elapsoidea* and *Bungarus* (very poorly supported grouping)
C: Laticaudinae plus Hydrophiinae
D: *Hemibungarus*, *Ophiophagus* and *Dendroaspis*
E: Afro-Asian cobras and allies

2002; Kelly *et al.* 2003; Lawson *et al.* 2005; Vidal *et al.* 2007a), with the recognition of a clade named Elapoidea (Vidal *et al.* 2007a) that includes elapids (cobras, mambas, sea snakes etc.) and a large and mostly African (including Madagascar) radiation (Figure 2.4). The latter has been treated as the Lamprophiidae (Vidal *et al.* 2008a), including four subfamilies: the psammophiines (~7 genera, 42 species), atractaspidines (~12 genera, 70 species), lamprophiines (~19 genera, 88 species) and pseudoxyrhophiines (~20 genera, 80 species). Others (e.g. Kelly *et al.* 2008) have accorded them familial status (Psammophiidae, Atractaspididae, Lamprophiidae and Pseudoxyrhophiidae), sometimes with the additional families Prosymnidae and Pseudaspididae (Kelly *et al.* 2009b). The *Atlas* has adopted the more conservative approach of Vidal *et al.* (2008a), while acknowledging that further study is required to resolve the relationships of the genera *Prosymna* and *Pseudaspis*. Pyron *et al.* (2011) considered the "most difficult aspect of higher-level colubroid taxonomy to be Lamprophiidae", and adopted the same approach as Vidal *et al.* (2008a)—as adopted in the *Atlas*—recognising a single family Lamprophiidae with a number of subfamilies. However, despite finding additional support for recognising the Pseudaspidinae and Prosymninae (proposed as new families by Kelly *et al.* 2009b), they surprisingly treated the Aparallactinae as a subfamily separate from the Atractaspidinae (Pyron *et al.* 2011). The latter proposal is not adopted in the *Atlas*. While the status of the Pseudaspidinae and Prosymninae is gaining support, we defer acceptance pending further analysis of the relationships of these genera, particularly the enigmatic genus *Prosymna*.

5.6.1 Atractaspidinae

A suite of genera have usually been assigned to the atractaspidines (*Amblyodipsas*, *Aparallactus*, *Atractaspis*, *Brachyophis*, *Chilorhinophis*, *Elapotinus*, *Homoroselaps*, *Hypoptophis*, *Macrelaps*, *Micrelaps*, *Poecilopholis*, *Polemon*, *Xenocalamus*) (McDowell 1968; Underwood & Kochva 1993; Spawls & Branch 1995; Branch 1998) which are distributed broadly in Africa, with a limited occurrence in the Middle East. The monophyly of atractaspidines is supported both by morphological (McDowell 1968; Underwood & Kochva 1993; Zaher 1999) and molecular (Vidal & Hedges 2002; Nagy *et al.* 2005) data, although inclusion of the rarer genera (e.g. *Brachyophis*, *Chilorhinophis*, *Elapotinus*, *Hypoptophis* and *Poecilopholis*) has not been rigorously assessed. *Micrelaps* did not associate tightly with other atractaspidines, and although it clearly belongs in the Elapoidea, its affinities remain equivocal (Vidal *et al.* 2008a). The relationship of the two South African harlequin snakes (*Homoroselaps*) to other atractaspidines now appears to be resolved. Vidal & Hedges (2002) confirmed McDowell's (1968) transfer of *Homoroselaps* to the Atractaspidinae, and more recent studies (Nagy *et al.* 2005) confirm that within the Atractaspidiinae, the genus *Homoroselaps* is the sister group to the genus *Atractaspis.*

5.6.2 Lamprophiinae

This 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*, *Gonionotophis* etc.) and house snakes and their relatives (*Boaedon*, *Lamprophis*, *Pseudoboodon*, *Bothrolycus*, *Bothrophthalmus*, *Lycodonomorphus*). Generic and species boundaries are problematic and recent molecular studies have resulted in a number of generic re-arrangements (Kelly *et al.* 2011). These include the description of a new genus (*Inyoka*) to accommodate the Swazi Rock Snake, which was shown to form a sister clade (but with deep divergence) to the Forest Wolf Snake (*Hormonotus modestus*). Similarly, the Olive Ground Snake (previously *Lamprophis inornatus*) was found to be misplaced, nested within water snakes (*Lycodonomorphus*) and it was therefore transferred to that genus, necessitating a change in both its scientific and common names. The remaining house snakes formed two large clades, with the small southern African endemic species (*L. aurora*, *L. fuscus*, *L. fiskii* and *L. guttatus*) being retained within *Lamprophis* (now essentially endemic to the *Atlas* region, with only one species, *L. guttatus*, having a limited occurrence in southern Namibia). All other house snakes recently placed within *Lamprophis* are transferred to a revived *Boaedon.* In agreement with the results of Vidal *et al.* (2008a), the Dwarf File Snake, *Gonionotophis brussauxi*, was found by Kelly *et al.* (2011) to be nested within *Mehelya.* As the former has priority, all members of *Mehelya* are therefore transferred to *Gonionotophis* to maintain generic monophyly. The description of additional cryptic taxa within *Lamprophis* and *Boaedon* is likely (Kelly *et al.* 2008, 2011).

5.6.3 Psammophiinae

The psammophiine genera (*Dipsina*, *Hemirhagerrhis*, *Malpolon*, *Mimophis*, *Psammophis*, *Psammophylax*, *Rhamphiophis*) are distributed throughout Africa including Madagascar, the Middle East, south-central Asia, and southern Europe (Branch 1998; Kelly *et al.* 2008). Their monophyly is supported by morphological and molecular data (Cadle 1994; Brandstätter 1996; Zaher 1999; Vidal & Hedges 2002; Kelly *et al.* 2008). *Dromophis* was recently synonymised with *Psammophis* (Kelly *et al.* 2008).

5.6.4 Pseudoxyrhophiinae

The pseudoxyrhophiines include numerous Malagasy genera with a number of species also found in the Comoros Islands. Surprisingly, a number of genera from continental Africa (*Duberria*, *Amplorhinus* and possibly *Montaspis*) are closely related to these Malagasy snakes and are now also included in this subfamily (Lawson *et al.* 2005; Vidal *et al.* 2008a; Kelly *et al.* 2009b). The latter authors proposed that the continental African genera *Duberria*, *Amplorhinus* and possibly *Montaspis*, along with the Socotran endemic *Ditypophis*, be placed in a new subfamily, namely Amplorhininae, which reverts to the Amplorhinini (Meirte 1992) in the *Atlas.*

5.7 Elapidae

The taxonomy of African cobras continues to be refined, with the description of numerous new species (Broadley 1968a, 1995; Broadley & Wüster 2004; Wüster & Broadley 2003, 2007; Wallach *et al.* 2009). Molecular phylogenies have revealed that the Water Cobra, *Boulengerina annulata*, is the sister taxon to *Naja melanoleuca* (Nagy *et al.* 2005; Wüster *et al.* 2007) and it was therefore synonymised with *Naja* (Branch 2005). In a controversial and taxonomically unavailable work (Hoser 2009), *Naja* was divided into a number of new genera, but these names have no nomenclatural standing (see Wallach *et al.* 2009). The latter paper formally proposed a series of subgenera into which African *Naja* have been placed. Cobras within the *Atlas* region are assigned to all three African subgenera, namely *Naja* (*Boulengerina*) *melanoleuca*, *N.* (*Uraeus*) *annulifera*, *N.* (*Uraeus*) *nivea*, *N.* (*Afronaja*) *mossambica* and *N.* (*Afronaja*) *nigricincta woodi*.

5.8 Natricidae and Colubridae

Natricid water snakes are poorly represented in Africa, with only two species of *Natriciteres* occurring peripherally in the *Atlas* region. Phylogenetic relationships within and among the four African genera remain unstudied. The content and relationships of colubrid snakes assigned to this family remains problematic. While a number of Palaearctic groups have been well-studied, there have been few African studies. Only a limited phylogeny (Nagy *et al.* 2003) of the African Colubridae *sensu stricto* (Vidal *et al.* 2007a; Zaher *et al.* 2009) has been presented and this suggests the recognition of several tribes. Whether these subclades are best treated as tribes or subfamilies within the reduced Colubridae requires further study. The Colubrini (*sensu* Nagy *et al.* 2005) includes diverse African (*Platyceps*, *Hemorrhois*, *Spalerosophis*), Socotran (*Hemerophis*) and Palaearctic (*Hierophis*, *Eirenis*) genera, as well as a number of species, e.g. '*Coluber*' *dorrii* (West Africa) and '*Coluber*' *zebrina* (Namibia) whose taxonomic assignment remains problematic (Schätti & Charvet 2003). The former species has been transferred to a new genus, *Bamanophis* (Schätti & Trape 2008), while the generic status of *C. zebrina* remains unresolved. Based on cranial features, Bourgeois (1968) recognised a subfamily Boiginae that included the genera *Boiga*, *Telescopus*, *Crotaphopeltis* and *Dipsadoboa*. This assemblage is, perhaps, best treated as a tribe (Boigini) within the Colubridae, and the molecular data of Gravlund (2001) and Kelly *et al.* (2003) support the inclusion of *Dasypeltis* within it. Bourgeois (1968) also erected two other subfamilies, Dispholidinae and Philothamninae, within the Colubridae, but the latter has not yet been supported by molecular data and its status, even as a tribe (Philothamnini), remains problematic. Broadley & Wallach (2002) recognised a tribe Dispholidini, including the genera *Thrasops*, *Rhamnophis*, *Dispholidus* and *Thelotornis*, to which they added a new genus (*Xyelodontophis*) from Tanzania.

CONCLUDING REMARKS

The last two decades of systematic studies on southern African reptiles has resulted in the recognition of nearly 200 additional species, an increase of over 50% on previously recognised diversity (Branch 1988a). Many of these new taxa were previously considered subspecies that have subsequently been elevated to full species. Others are newly recognised cryptic taxa, often revealed by genetic analysis of polymorphic species, that either utilised old names revived from synonymy or required new names (e.g. *Pachydactylus monicae*, *P. goodi*, *P. atorquatus*). Some discoveries were of spectacular new species such as *Afroedura hawequensis*, *Montaspis gilvomaculata* and *Afrogecko swartbergensis*, all of which were obvious taxonomic novelties.

In addition to this surfeit of new species, molecular studies have also allowed increasing insight into the evolutionary relationships of taxa. This is reflected in the description of numerous new genera and higher taxonomic ranks, including new or revived genera and/or subgenera of gekkonids, cordylids, chamaeleonids, leptotyphlopids, lamprophiids and elapids, as well as the new subfamilies Platysaurinae and Leptotyphlopinae. It is unlikely that this upheaval will end soon as numerous families and genera require further analysis. As has been noted elsewhere (Branch 2010), these are exciting times for systematic studies in the *Atlas* region, and indeed in the whole of Africa.

Perhaps one of the most important consequences of recent taxonomic studies on reptiles from the *Atlas* region has been the awareness that increased species diversity is often reflected in small species' distributions. Many taxa, including some recently described species, have ultra-restricted ranges and are known from less than 1–5 QDGCs—e.g. *Acontias kgalagadi subtaeniatus*, *A. poecilus*, *A. rieppeli*, *Scelotes limpopoensis albiventris*, *Bradypodion caffer*, *B. nemorale*, *B. ngomeense*, *Afroedura multiporis multiporis* and *Cryptactites peringueyi*. As a consequence they are often of conservation concern as even relatively localised stochastic events may threaten the entire range of the species. It has been noted previously (e.g. Padial & De la Riva 2006), and supported here and in the following chapter, that good conservation is best supported on a secure bedrock of vigorous, ongoing taxonomic research.

CHAPTER 3

Conservation status, diversity, endemism, hotspots and threats

William R. Branch

"Producing National Red Lists is a critical first stage in identifying where species are threatened, why they are threatened and what needs to be done about it."

(Jonathan Baillie, Zoological Society of London, June 2009)

1. INTRODUCTION

1.1 Scope

While much attention has been paid to global declines in amphibian populations (Blaustein & Wake 1990a,b; Wake 1991; Houlahan *et al.* 2000; Blaustein & Kiesecker 2002; McCallum 2007; Allentoft & O'Brien 2010) there has been relatively little attention directed towards the global conservation status of reptiles. This may be due to a variety of factors, including their greater diversity, the practical difficulties in surveying many reptile groups, their lack of charisma, and the venomous nature of a small minority of them. For whatever reason, reptile conservation in South Africa, Lesotho and Swaziland, and globally, has lagged behind that of all other terrestrial vertebrates.

Unlike fish and birds, reptiles are rarely of direct economic use and usually have limited appeal in ecotourism ventures. They cannot, therefore, play much of a part in tourist enterprises that stimulate employment to uplift disadvantaged communities. As a consequence, reptiles remain largely neglected in a fragile economic climate and a conservation paradigm that views wildlife not for its intrinsic value, but in terms of its use to people. Despite these caveats, however, reptiles are important components of both aquatic and terrestrial ecosystems, playing a role both as predators and as prey, and thereby providing links in trophic transfers. Many reptiles are also among the smallest known vertebrates, and many have very restricted ranges.

Assessment of the conservation status of any taxon requires knowledge of its diversity, distribution, endemicity, biology and habitat requirements, as well as quantification of the environmental and anthropogenic threats that it faces. A primary requirement of such an assessment is a stable taxonomy, or at least an awareness of its limitations. With recent taxonomic summaries of the reptiles of South Africa, Lesotho and Swaziland (Branch 1998; Alexander & Marais 2007), and the detailed mapping of their distributions (this *Atlas*), it is now opportune to review their conservation status.

This chapter summarises the findings of the individual assessments of the reptiles of the *Atlas* region (South Africa, Lesotho and Swaziland), and reviews the previous and current conservation status of this fauna. It includes a summary of geographical hotspots for all reptiles, for the major subgroups of reptiles, e.g. chelonians, lizards and snakes, for endemic reptiles, and also for threatened and Near Threatened reptiles. Descriptions of the threats that they face are also discussed. The chapter concludes with pointers to pragmatic measures for the protection of threatened species, and the need to stimulate taxonomic competence and awareness in Africa to direct and optimise conservation measures. There is a need for fundamental changes in the way that reptiles are viewed if they are to be succesfully conserved in the region.

1.2 Background

The last review of threatened reptiles in South Africa, included in the Red Data Book (RDB) series of the South African National Scientific Programme, was published in 1988. It formed part of a multi-authored review of the threatened herpetofauna of South Africa (Branch 1988a). Although the status and threats to species were discussed in a general forum of local experts, the criteria for selection remained individual and subjective. Candidate species were submitted and selection was based mostly on restricted distribution and perceived threats to known taxa. Little empirical data was presented and knowledge of the basic biology of many species, their distributions, population estimates and documented threats were largely unknown, or at best anecdotal. The final selection, therefore, included a number of charismatic species whose threatened status was uncritically accepted but which has subsequently been shown to be undeserved (see below). However, the publication was, like many other South African RDBs of the time, explicitly provisional and based on the best available information.

Despite these limitations, the 1988 RDB was an improvement on its predecessor (McLachlan 1978a) and adopted a number of modifications, the most important being recognition of its parochial nature, and awareness of its predictive and prescriptive value. Collar (1986) noted that RDBs should play a part in national conservation-strategy development by listing not only threatened species

Afforestation in grasslands near Ixopo, KZN M.F. Bates

but also providing "status notes on all species, however widespread and abundant, that are endemic to the country", a stance that has been emphasised recently (Baillie 2009). The recognition of national "ultimate responsibility" (Branch 1988a), i.e. that national authorities have global responsibility for the conservation of endemic species, led to the formal recognition of species within Restricted (endemic) and Peripheral categories in the 1988 RDB, and the inclusion of an appendix listing all endemic reptiles and amphibians occurring in South Africa, Lesotho and Swaziland. This approach was re-iterated by Gärdenfors *et al.* (2001), with the adoption of regional and global conservation assessments.

Since 1966, the IUCN has prepared RDBs (later Red Lists) to compile information on threatened species (Scott *et al.* 1987). The South African regional summaries, like the early IUCN reviews, were often subjective and driven by concern for a limited spectrum of charismatic species. As a consequence, there was a need to revise the categories of threat and to develop more rigorous criteria for the assignment of taxa (Fitter & Fitter 1987). Later, Mace & Lande (1991) initiated the use of quantitative criteria for assessing the conservation status of species, and these have been refined and upgraded on an ongoing basis. After discussion on various drafts by the international conservation community (Mace *et al.* 1992; Mace & Stuart 1994), standardised criteria were first globally adopted in 1994, first applied in the 1996 Red List, and updated in recent Red Lists (e.g. Hilton-Taylor 2000). For the SARCA assessment, the IUCN Red List Categories and Criteria Version 3.1 (IUCN 2001) were used.

The IUCN Red List categories (Appendix 1) include a hierarchy within the broad category of 'threatened', ranging in severity from Critically Endangered (CR) to Endangered (EN) and Vulnerable (VU). Other species of conservation concern, considered in danger of becoming threatened if relevant threats continue unabated, are categorised as Near Threatened (NT) (Mace 2000). Species that are evaluated and found currently non-threatened are categorised Least Concern (LC). Species having insufficient information to assess their conservation status are placed in a Data Deficient (DD) category, and are not included in counts of threatened taxa. Definitions of these categories, and their requisite criteria, are detailed in Appendix 1. Gärdenfors *et al.* (2001) discussed the application of IUCN Red List categories at the regional level and noted that, for endemic species, the IUCN criteria can be used without modification. For regionally threatened taxa that have wider distributions outside the region of assessment, the IUCN categories can be used for regional assessments.

With developments in international conservation, a regional re-evaluation of the conservation status of South African reptiles was urgently needed, especially as it was over 20 years since the previous compilation. This was prompted by many factors, including an increasing awareness of the global plight of species (Baillie *et al.* 2010), and the out-dated taxonomy on which the 1988 RDB was based. In addition, the success of the Southern African Frog Atlas Project (SAFAP), initiated in 1995 (Harrison & Burger 1998) and completed in 2001 (Harrison *et al.* 2001), stimulated a desire to develop a similar vehicle for a modern re-appraisal of the conservation status of South African reptiles. Because of their situation within/on South Africa's borders, the reptiles of Lesotho and Swaziland were included in this appraisal.

2. DIVERSITY AND ENDEMISM

In the early phases of the Southern African Reptile Conservation Assessment (SARCA), the South African herpetological community held a number of workshops to compile an updated checklist of the species to be assessed. Recent and ongoing taxonomic studies on reptiles in the *Atlas* region abound and the increased use of molecular studies has supported the application of new species concepts. Phylogenies based on multiple gene analysis have also revealed surprising levels of cryptic divergence at the species level (e.g. Bauer *et al.* 2006b; Branch *et al.* 2006b; Tilbury & Tolley 2009b), genus level (e.g. Bauer & Lamb 2005; Adalsteinsson *et al.* 2009; Stanley *et al.* 2011) and higher levels (e.g. Vidal *et al.* 2008a; Kelly *et al.* 2009b, 2010). For a fuller discussion of these changes, see Chapter 2. After taxonomic consensus was reached within the SARCA community on the content of the checklist, data sheets were produced for each taxon and assessments were submitted for review to the IUCN before final publication. Note, however, that where no agreement could be reached between an account author/*Atlas* editors and the IUCN reviewer, the editors' opinion took precedence.

Subspecies in herpetology are now used sparingly, and no new subspecies have been described within the subcontinent during the last decade. This is in part due to a decline in the use in herpetology of the problematic Biological Species Concept, and the increasing adoption of evolutionary and phylogenetic species concepts (see Frost & Hillis 1990 for a reasoned discussion).

There are 384 reptile species (422 species and subspecies, i.e. taxa) in the *Atlas* region. This includes the Brahminy Blind Snake (*Rhamphotyphlops braminus*) that is an established alien species, first recorded in the Cape by A. Smith (1838). The conservation status of this species was not assessed, nor was it considered in the following discussion of species diversity in the region.

2.1 Diversity

Among vertebrates, global reptile species diversity is lower only than that of fish and birds. New and powerful taxonomic techniques, as well as increasing access to poorly-known regions, have resulted in continual discoveries of overlooked reptile species. The checklist of global reptiles is therefore increasing almost daily. In the first electronic online reptile database, Uetz (2000) listed 7 870 extant reptile species and by 2008, this had risen to 8 734 (Uetz 2010). This number continues to climb and by February 2012 there were 9 547 known reptile species (Uetz 2012), an increase of 1 677 species and nearly 17.6% in only 12 years (Table 3.1).

The diversity of reptiles in the *Atlas* region reflects, with only a few exceptions, the full spectrum of families occurring in sub-Saharan Africa. It comprises 23 chelonian species (25 taxa, i.e. species and subspecies), one crocodile, 244 lizards (270 taxa) and 116 snakes (126 taxa). Ten recognised subspecies of some terrestrial species that have large contiguous ranges, e.g. *Aspidelaps scutatus*, *Zygaspis vandami* and *Psammobates tentorius*, were not assessed separately. However, geographically-isolated subspecies of species with fragmented ranges (e.g. *Lygodactylus ocellatus*) were assessed separately. Maps and assessments were prepared for all other subspecies (24 lizards, five snakes) when it was considered that their conservation status may differ from that of conspecifics, particularly montane isolates, e.g. subspecies of the black-spotted day geckos (e.g. *Lygodactylus nigropunctatus* and *L. ocellatus*) and some flat lizards (e.g. *Platysaurus intermedius* and *P. orientalis*).

Albany Thicket Biome, EC, with alien *Opuntia* (paddle cactus) infestation W. Conradie

Table 3.1.—Comparison of the *Atlas* region and global reptile species diversity

Group	*Atlas* region 2014	Global 2000 (Uetz 2000)	Global 2012 (Uetz 2012)	*Atlas* % global diversity
Chelonians	23	295	327	7.03
Crocodilians	1	23	25	4.0
Squamates				
Lizards	244	4 470	5 815	4.19
Snakes	116	2 920	3 378	3.43
Tuataras	0	1	1	NA
Total	**384**	**7 870**	**9 547**	**4.02**

South Africa has the richest national diversity of geckos, cordylids and amphisbaenids in Africa. Reptile diversity in the *Atlas* region is summarised by group in Table 3.2, including the total numbers of taxa (species and subspecies) and the number of endemic and near-endemic (at least 90% of range in *Atlas* region) taxa, in each major group.

The lizard fauna of the *Atlas* region (244 species) is dominated by geckos (70 species, 77 species and supspecies), but with high diversities of skinks (59, 61) and cordylids (39, 50). The lowest diversity occurs in agamids (6, 7) and varanids (2, 2), of which no endemic species occur in the *Atlas* region. Both families, particularly varanids, display relatively low diversity in Africa relative to Australasia, but the oldest unambiguous fossils of *Varanus* date from late Eocene and early Oligocene deposits in Egypt, indicating that the genus arose in Africa before dispersing to Australia and Asia (Holmes *et al.* 2010).

Although snake species diversity in the *Atlas* region (116 species, 126 taxa) is not as high as that in tropical Africa (Democratic Republic of Congo [DRC] 168 species, Tanzania 167 species, Cameroon 156 species [Uetz 2011]), it surpasses that of many other African countries of com-

Table 3.2.—Diversity and endemicity by family of indigenous reptiles in the *Atlas* region

Family	Number of species (plus subspecies)	Number of endemic (near-endemic) species and subspecies	% endemicity of endemic and near-endemic species and subspecies
Chelonians			
Sea turtles	5 (5)	0 (0)	0
Pelomedusidae	5 (5)	0 (0)	0
Testudinidae	13 (15)	6 (4)	40.0
Subtotal	**23 (25)**	**6 (4)**	**40.0**
Crocodiles			
Crocodylidae	1 (1)	0 (0)	0
Subtotal	**1 (1)**	**0 (0)**	**0.00**
Lizards			
Agamidae	6 (7)	1 (2)	42.9
Amphisbaenidae	10 (12)	2 (2)	25.0
Chamaeleonidae	19 (19)	16 (1)	89.5
Gekkonidae	70 (77)	42 (5)	61.3
Lacertidae	26 (29)	13 (2)	51.7
Scincidae	59 (61)	32 (4)	59.0
Cordylidae	39 (50)	42 (5)	94.0
Gerrhosauridae	13 (13)	7 (0)	53.8
Varanidae	2 (2)	0 (0)	0.0
Subtotal	**244 (270)**	**155 (24)**	**66.3**
Snakes			
Typhlopidae	6 (6)*	0 (1)	16.6
Leptotyphlopidae	10 (11)	4 (3)	63.6
Pythonidae	1 (1)	0 (0)	0.0
Lamprophiidae			
Lamprophiinae	15 (15)	7 (1)	53.3
Atractaspidinae	14 (16)	6 (1)	43.8
Psammophiinae	16 (16)	1 (1)	12.5
Incertae sedis (*Prosymna*, *Pseudaspis*)	7 (7)	0 (1)	14.3
Pseudoxyrhophiinae	4 (4)	2 (1)	75.0
Natricidae	2 (2)	0 (0)	0.0
Elapidae	13 (18)	3 (1)	22.2
Viperidae	13 (13)	4 (1)	38.5
Colubridae	14 (16)	2 (0)	12.5
Subtotal	116 (126)	29 (10)	31.0
TOTAL	**383 (421)**	**190 (38)**	**54.2**

* excludes introduced Brahminy Blind Snake

Augrabies Falls National Park, NC; Bushmanland Bioregion M.F. Bates

parable size, e.g. Ethiopia (107 species) and Nigeria (105 species) (Uetz 2012). The *Atlas* region is located in a temperate-subtropical transitional area and it is therefore surprising that its snake diversity is so much greater than that of many tropical African countries, and considerably higher than the 33 species recorded for Western Europe (Speybroek *et al.* 2010).

2.2 Endemicity

The *Atlas* region shows a high proportion of endemic (190) and near-endemic (38) taxa (228 of 421 indigenous taxa, 54.2%), but of these only one (the flat gecko *Afroedura major*) is endemic to Swaziland, and none are endemic to Lesotho (Appendix 3). Endemicity (endemic and near-endemic taxa) in lizards (179 of 270 taxa, 66.3%) is substantially higher than that of snakes (39 of 126 taxa, 31.0%), and is dominated by the cordylids (94.0%) and chameleons (89.5%). There is also high endemicity among geckos (61.3%), skinks (59.0%) and plated lizards (53.8%). Cordylid and gekkonid endemicity is associated with substrate specificity (Bauer 1990), particularly for rupicolous forms. Chameleon endemicity results from their more direct linkage with vegetation, with recent radiations of dwarf chameleons occupying open habitats, and older lineages persisting in relictual forested habitats that correspond to continental shifts in vegetation patterns since the Miocene Climatic Optimum (Tolley *et al.* 2006, 2008). The lower endemicity among lacertids and worm lizards (Amphisbaenidae) is a reflection of their adaptation to sandy habitats, with many having ranges that extend into neighbouring Botswana and Namibia. Many of these species, however, are endemic to southern Africa, if not strictly endemic to the *Atlas* region.

Table 3.3.—Diversity and endemicity of taxa within the 11 most speciose reptile genera in the *Atlas* region

Genus	Total species and subspecies	Endemic and Near-endemic species and subspecies in *Atlas* region
Pachydactylus	29	16
Acontias	21	14
Scelotes	19	18
Bradypodion	17	17
Platysaurus	15	13
Afroedura	14	13
Trachylepis	13	1
Lygodactylus	11	8
Cordylus	11	10
Bitis	11	5
Psammophis	11	2
Total	**172**	**117**

Within the *Atlas* region, significant reptile diversity is contained within just 11 speciose genera that each contain 11–29 taxa. These large genera are not artefacts of taxonomy and the individual monophyly of most has been confirmed by recent phylogenetic studies, in some cases necessitating significant generic re-adjustments, e.g. *Cordylus* (Stanley *et al.* 2011), *Acontias* (Lamb *et al.* 2010), *Bradypodion* (Tolley *et al.* 2008), *Platysaurus*

(Scott *et al.* 2004; Stanley *et al.* 2011), *Pachydactylus* (Bauer & Lamb 2005) and *Bitis* (Hermann & Joger 1997; Lenk *et al.* 1999). Together they contain a total of 172 taxa (40.9% of 421 taxa in the *Atlas* region) and 117 endemic or near-endemic taxa (51.3% of 228 endemic and near-endemic taxa; Table 3.3).

3. CONSERVATION ASSESSMENT

3.1 Coverage

This is the first time that an assessment of the conservation status of all reptiles within the *Atlas* region has been undertaken. Previous assessments were prepared for only a subset of reptiles in the region that were considered to be of conservation concern by either the editor (McLachlan 1978a), or by a select committee (Branch 1988a). Previous assessments (McLachlan 1978a; Branch 1988a), in part, were subject to individual preference and were therefore biased towards charismatic, well-known species. Moreover, it was impossible to decide whether species that were not included had been overlooked in previous assessments, or whether some species had become of conservation concern subsequent to previous assessments. To avoid such confusion this iteration has assessed all species naturally occurring in the *Atlas* region. The only exceptions are seven peripheral taxa (four lizards and three snakes) that all have much greater, contiguous ranges elsewhere, with >95% of their range outside the *Atlas* region, and have been recorded from two or less quarter-degree grid cells (QDGCs) within the *Atlas* region. These taxa were distinguished from species that had isolated populations within the *Atlas* region (e.g. Gaboon Adder, *Bitis gabonica*), and for which there was no evidence of migration into the regional populations.

One introduced species was also not assessed, although it is included in the *Atlas.* The Brahminy Blind Snake (*Ramphotyphlops braminus*) is an all-female parthenogenetic scolecophidian that was introduced into the Cape Town region as long ago as the early 19th century (A. Smith 1838). This is the only introduced species in South Africa known to have established breeding colonies (McLachlan 1978b; Alexander 1987). A number of other exotic species (Appendix 4) have either been accidentally translocated to South Africa or escaped from captivity but have not established breeding colonies, e.g. *Gekko monarchus* (Bauer & Branch 2004), *Agama agama* (A. Turner pers. comm.) and *Trachemys scripta* (Newbery 1984). Their conservation status is not assessed here and neither are they included in the *Atlas*.

The conservation status of 405 taxa (nearly 96%) of the reptiles occurring in the *Atlas* region was assessed. Only five species (the amphisbaenid *Monopeltis leonhardi*, the lacertid *Nucras caesicaudata*, the plated lizard *Gerrhosaurus auritus*, the snakes *Xenocalamus sabiensis* and *Natriciteres olivacea*), and the peripheral gecko subspecies *Chondrodactylus angulifer namibensis*, of the 421 indigenous taxa in the region, did not meet the criteria for assessment (i.e. <5% of range in *Atlas* region and known from two or less QDGCs in the region). Further taxa not assessed include the introduced Brahminy Blind Snake (*Rhamphotyphlops braminus*) and a number of poorly-defined subspecies, including: *Psammobates tentorius trimeni*, *P. t. verroxii*, *Zygaspis vandami arenicola*, *Tropidosaura montana natalensis*, *T. m. rangeri*, *Elapsoidea sundevallii decosteri*, *E. s. fitzsimonsi*, *E. s. longicauda*, *E. s. media* and *Leptotyphlops scutifrons conjunctus*. Therefore, 16 of the 421 indigenous taxa in the region were not assessed.

Global assessments were prepared for 283 taxa, including all endemic (190) and near endemic taxa (38), as well as for 54 additional taxa that are mainly endemic to southern Africa and for which an understanding of their biology, distribution and habitats was adequate to determine their global conservation status. The great majority of these additional assessments for taxa with ranges extended mainly extralimital to the *Atlas* region resulted in Least Concern status. An additional 122 regional assessments were prepared for species whose ranges extended mainly extralimitally, and/or the isolated local population was considered to merit a different conservation assessment to the documented or assumed global status, e.g. sea turtles for which the *Atlas* assessments were all regional.

3.2 Assessments

A summary of the assessments is given in Table 3.4. Seventy-seven percent (324 of 405) of taxa assessed were considered Least Concern. Six taxa were treated as Data Deficient because insufficient data was available for assessment. One of these was the Olive Ridley Turtle (*Lepidochelys olivacea*), for which there are very few records from the eastern coastal waters of the *Atlas* region and which has at best a marginal distribution in the region—it may even be considered a vagrant. Other taxa could not be assessed

Table 3.4.—Summary of assessment findings for 421 endemic reptile taxa in the *Atlas* region

Category	Conservation Assessment of *Atlas* Region: number of species and subspecies (% of 405 taxa assessed)	IUCN 2010b
Least Concern	324 (80.0)	
Near Threatened	37 (9.1)	18
Vulnerable	21 (5.2)	14
Endangered	10 (2.5)	3
Critically Endangered	5 (1.2)	3
Extinct	2 (0.5)	1
Data Deficient	6 (1.5)	2
Not Assessed	16 (4.0)	NA
Taxa of conservation concern (EX, CR, EN, VU, NT, DD)	**81 (20.0)**	**39**

Bokong Nature Reserve, Maloti Mountains, central Lesotho; Grassland Biome M.F. Bates

Black Rock, KZN; Indian Ocean Coastal Belt Biome J. Marais

due to taxonomic confusion concerning the status of the subspecies (*Acontias kgalagadi subtaeniatus*, *Lygodactylus nigropunctatus incognitus* and *Lygodactylus nigropunctatus montiscaeruli*). One species (*Leptotyphlops sylvicolus*, Adalsteinsson *et al.* 2009) may contain a number of cryptic species. Finally, the enigmatic and very rare Cream-spotted Mountain Snake (*Montaspis gilvomaculata*), known from only three specimens, is too poorly known to be assessed.

Extinct

This assessment confirms the Extinct status of Eastwood's Long-tailed Seps (*Tetradactylus eastwoodae*), which has not been re-discovered despite targeted searches in the 1980s (Jacobsen 1989) and during the *Atlas* period. It is now 100 years since the holotype was collected and

Bushveld at Nylsvley, LIMP; Savanna Biome W.R. Schmidt

Cape Point, WC; Fynbos Biome W.R. Schmidt

Deforestation in Mozambique W.R. Schmidt

since then only one additional specimen was collected (in 1928, see species account). Most of this species' grassland habitat has been destroyed by afforestation. An additional species of fossorial skink (*Scelotes guentheri*) is now also considered Extinct. The latter species was overlooked in previous assessments due to taxonomic confusion (Broadley 1994). It is known from a single specimen collected over 120 years ago at 'Port Natal', i.e. the Durban area. Recent extensive searches in the greater Durban area (J. Marais pers. comm.) have not uncovered additional specimens and the species is considered to have gone extinct (see also Broadley 1994) as a result of urban development.

South Africa now has two extinct reptiles. This may seem insignificant, but the country has the dubious distinction of being the only one in Africa in which any modern reptiles have been declared extinct. South Africa is highly-populated, and in some areas highly-developed, and both extinctions are believed to have resulted from anthropogenic habitat loss. However, the level of scientific study and documentation of the *Atlas* region's fauna is probably greater than that elsewhere in Africa, where it is likely that other reptiles have become extinct before being recognised and described.

Critically Endangered

Four endemic species, the Geometric Tortoise (*Psammobates geometricus*), the Salt Marsh Gecko (*Cryptactites peringueyi*), a fossorial skink (*Scelotes inornatus*), and a small adder (*Bitis albanica*) are now considered globally Critically Endangered (CR). Another lizard, the Web-footed Gecko (*Pachydactylus rangei*), has a marginal extension into the *Atlas* region where it is threatened by alluvial diamond mining and is considered regionally Critically Endangered. It has an extensive range outside the *Atlas* region in the desolate dune seas of the Namib Desert where it is of Least Concern. Of the aforementioned species, only the Geometric Tortoise was previously listed under a threat category (previously considered Endangered). The Salt Marsh Gecko's status was previously Indeterminate (Data Deficient) and the Web-footed Gecko was considered Peripheral (Branch 1988a). The remaining two species were not previously assessed due to confusion with other species. The five Critically Endangered taxa constitute 14% of the 36 threatened (CR, EN, VU) taxa in the *Atlas* region.

Eastern Kalahari Bushveld Bioregion between Griekwastad and Kimberley, NC M.F. Bates

Eastern Richtersveld, NC; Desert Biome W.R. Schmidt

Free State Drakensberg; Grassland Biome W.R. Schmidt

Endangered

Ten taxa are considered Endangered, including nine species and one isolated subspecies (*Lygodactylus nigropunctatus incognitus*). Only two of these taxa, the Leatherback Turtle (*Dermochelys coriacea*) and the Coastal Rag Skink (*Cryptoblepharus africanus*), were assessed regionally rather than globally. Almost all Endangered taxa are lizards (8), including three arboreal, three rupicolous and two fossorial species. All, with the exception of the isolated population of the Coastal Rag Skink, are endemic and have restricted distributions. The 10 Endangered taxa constitute 28% of the 36 threatened (CR, EN, VU) taxa in the *Atlas* region.

Vulnerable

Of the 21 Vulnerable taxa, only four were assessed regionally. These were two wide-ranging chelonians (*Pelusios rhodesianus*, *Caretta caretta*), a snake (*Dendroaspis angusticeps*) and the Nile Crocodile (*Crocodylus niloticus*), all of which have declining local populations. Globally Vulnerable species are dominated by lizards (14), but also include one tortoise (*Homopus signatus*) and two snakes (*Psammophis leightoni* and *Bitis armata*). All globally Vulnerable taxa are endemic. The 21 Vulnerable taxa constitute 58% of the 36 threatened (CR, EN, VU) taxa in the *Atlas* region.

Near Threatened

A large number (37) of taxa are not currently threatened, but are considered to be of conservation concern. Many of these Near Threatened taxa were overlooked in previous assessments (Branch 1988a; IUCN 2010b) or considered 'Restricted' (Branch 1988a), a category that was then used to signal local conservation concern, but which was not internationally recognised. Only three Near Threatened taxa were regionally assessed, including two wide-

Goegap Nature Reserve near Springbok, NC; Succulent Karoo Biome M.F. Bates ranging sea turtles (*Chelonia mydas* and *Eretmochelys imbricata*) and the Gaboon Adder (*Bitis gabonia*), all of which have wider ranges but relatively small distributions within the *Atlas* region. With the exception of three near-endemic species, the small gecko (*Goggia gemmula*) and two snakes (*Lycophidion pygmaeum* and *Leptotyphlops telloi*), all globally Near Threatened species are endemic.

3.3 Changes from previous assessments

The current and past status of taxa assessed in this *Atlas* is summarised in Appendix 2. The rationales for all changes in status are given in the individual species assessments (Section 2), and are discussed below.

A few species of conservation concern are taxonomic novelties that had not been discovered at the time of the previous assessment (Branch 1988a) and are therefore assessed here for the first time. They include the cordylids *Cordylus imkeae* (NT) (Mouton & Van Wyk 1994), *Hemicordylus nebulosus* (VU) (Mouton & Van Wyk 1995), *Platysaurus monotropis* (EN) (Jacobsen 1994a), and the geckos *Goggia braacki* (NT) (Good *et al.* 1996) and *G. gemmula* (NT) (Bauer *et al.* 1996). For other taxa, this first assessment results from recent recognition of their specific status, e.g. *Tetradactylus fitzsimonsi* (VU, previously considered a western isolated subspecies of *T. africanus*) and *Cordylus niger* (NT, previously considered a simple colour variety of *C. cordylus*).

A number of well known species seem to have either been simply overlooked in previous assessments (McLachlan 1978a; Branch 1988a), or their threatened status was only recognised later, e.g. *Bradypodion caffer* (EN), *B. kentanicum* (VU), *B. melanocephalum* (VU), *B. pumilum* (VU), *Cordylus macropholis* (NT) and *Dendroaspis angusticeps* (regionally VU).

Downgraded taxa

The status of several taxa has been significantly downgraded (i.e. their risk of extinction is considered to be lower) relative to previous assessments. For most, this change in status does not result from the implementation of successful conservation measures. Rather, it reflects the previous false promotion of many charismatic species that were subjectively considered to be of conservation importance, e.g. Southern African Python (*Python natalensis*, VU to LC), Gaboon Adder (*Bitis gabonica*, VU to regionally NT), Namaqua Dwarf Adder (*B. schneideri*, VU to LC), Setaro's Dwarf Chameleon (*Bradypodion setaroi*, EN to LC), and the girdled lizards *Ouroborus cataphractus* (previously *Cordylus cataphractus*) (VU to LC) and *Cordylus mclachlani* (VU to LC). In the current assessment the more objective IUCN criteria for inclusion in conservation categories have been implemented. The candidacy of charismatic species was also controlled by consensus amongst the reptile-expert community on individual assessments. Increased knowledge of species' biology and distribution (summarised in the individual species accounts) has also resulted in more informed assessments.

The dwarf chameleon *Bradypodion taeniabronchum* was initially treated as Endangered (Branch 1988a) but raised to the highest threatened status of Critically Endangered in IUCN Red Lists (2006 onwards). Here it has been downgraded back to Endangered as there have been new extensions of the species' range (Tolley & Burger 2007). Similarly, the fossorial lizard *Typhlosaurus lomiae*

Indigenous forest at Woodbush, LIMP K.A. Tolley

Indigenous forest at Woodbush, LIMP K.A. Tolley

Below Sentinel Trail, FS; Drakensberg Grassland Bioregion M.F. Bates

Mountains near Cradock, EC, as seen from the top of Buffelskop; Karoo Biome M.F. Bates

Protea grassland near Haenertsburg, LIMP M.F. Bates

Renosterveld, WC; Geometric Tortoise habitat A.L. de Villiers

had been described only recently (Haacke 1986) at the time of the previous assessment (Branch 1988a), but improved knowledge of its distribution and threats (Bauer *et al.* 2000) have led to its status being downgraded (VU to NT).

Four of the five species of sea turtles found in the coastal waters of South Africa have been assessed only regionally. Due to their relatively good local protection (particularly at breeding sites in KwaZulu-Natal), their mainly peripheral occurrence, and non-exploitative use, all have a lower Regional rank than their IUCN Global conservation status. The Olive Ridley Turtle (*Lepidochelys olivacea*) is so poorly known locally that it is considered regionally Data Deficient.

Although a number of new specimens and localities have been discovered for the enigmatic snake *Lamprophis fiskii*, little is known of its biology, trophic niche or habitat preferences and this was reflected in its previous classification as Rare (Branch 1988a). The status of this species was upgraded to Vulnerable in previous IUCN Red Lists (e.g. 2002–2010) although Data Deficient may have been a true reflection of our knowledge of its conservation status. In this assessment it is considered of Least Concern as knowledge of its distribution has increased considerably (1988, <10 records from five QDGCs; 2011, 38 records from 15 QDGCs). However, little is known about its biology.

Numerous other species listed in previous assessments (Branch 1988a; IUCN Red Lists) are also here considered

Seweweekspoort, Cape Fold Mountains, WC M.F. Bates

Soutpansberg, LIMP M.F. Bates

Least Concern (see Appendix 2). A number of these were in categories (Branch 1988a) that do not easily translate into the current IUCN categories. Peripheral species (*sensu* Branch 1988a) that are now considered of Least Concern include the terrapin *Pelusios castanoides*, and the snakes *Rhinotyphlops schinzi*, *Namibiana occidentalis*, *Dasypeltis medici*, *Meizodon semiornatus*, *Philothamnus angolensis*, *Naja melanoleuca*, *Lycophidion variegatum*, *Natriciteres sylvatica*, *Prosymna frontalis*, *Prosymna janii*, *Psammophis jallae* and *Bitis xeropaga*. Rare and Restricted (*sensu* Branch 1988a) species that are now also classed as Least Concern include the lizards *Afroedura multiporis haackei* and *Australolacerta australis*, and the snake *Naja nigricincta woodi*.

Some species considered of Least Concern in the *Atlas* region are considered of higher conservation concern in other areas. In Swaziland, *Python natalensis* is considered regionally Vulnerable, while the tortoise *Kinixys natalensis*, lizards *Chamaesaura aenea*, *C. anguina* and *Nucras lalandei*, and the snakes *Dasypeltis inornata* and *Meizodon semiornatus*, are all treated as regionally Near Threatened (Monadjem *et al.* 2003). The IUCN Red List 2010 includes a number of species from Branch (1988a) in higher categories than Least Concern, including global assessments of Endangered (*Bradypodion setaroi*), Vulnerable (*Cordylus mclachlani*, *Ouroborus* [previously *Cordylus*] *cataphractus*, *Bitis schneideri*) and Near Threatened (*Kinixys natalensis*, *Phelsuma ocellata*, *Gerrhosaurus typicus*, *Inyoka* [previously *Lamprophis*] *swazicus*). With the exception of *Chamaesaura aenea*, here also classified as Near Threatened, none of these assessments are supported by the current review.

Upgraded taxa

As in the case of downgrading, the upgrading of conservation status of taxa, i.e. the transfer of taxa into categories of higher extinction risk, may result from a number of reasons not related to their protection, including new taxonomic insight and increased knowledge of biology and/or threats.

A number of taxa were simply not previously recognised as separate species due to nomenclatural confusion with other wider-ranging species. These include the majority of taxa in higher threat categories, i.e. the snakes *Bitis albanica* (CR), *B. inornata* (EN) and *B. armata* (VU) which were all previously confused with *Bitis cornuta* (Branch 1999); the burrowing skinks *Scelotes guentheri* (EX), *S. inornatus* CR) and *S. bourquini* (VU) all previously confused with *S. mossambicus* (Broadley 1994); the chameleons *Bradypodion caeruleogula* (EN) and *B. ngomeensis* (NT) which were previously confused with members of the *B. nemorale-transvaalense* clade (Raw & Brothers 2008; Tilbury & Tolley 2009b); the flat lizard *Platysaurus intermedius inopinus* (EN) previously confused with *P. intermedius* (Jacobsen 1994a); and the girdled lizard *Cordylus niger* (NT) previously confused with *C. cordylus* (Mouton 1987). The Near Threatened geckos *Lygodactylus graniticolus* and *L. ocellatus soutpansbergensis* were confused with *L. ocellatus* (Jacobsen 1992a, 1994b).

One Critically Endangered gecko, *Cryptactites peringueyi* (previously *Phyllodactylus*), was known only from type material for over 80 years until re-discovered in 1992 (Branch *et al.* 1992). Previously treated as Indeterminate (Branch 1988a; Data Deficient IUCN 2010b), it is now known to be restricted to salt marshes and adjacent habitats, usually within 100 m of the coast line in areas of urban development (Branch & Bauer 1994), or further inland in association with dune swales (G. Darling pers. comm.).

The Geometric Tortoise (*Psammobates geometricus*) has long been the iconic image of South African reptile conservation, due to it attractive appearance, chelonian charisma, and the conflict between its existence and its biggest threat, the burgeoning human population in its restricted habitat (Baard 1997; Hofmeyr *et al.* 2006). That part of its habitat loss is associated with the production of luxury wines only adds to the poignancy of its likely extinction. Although there is a well-developed conservation strategy for its protection, the tortoise's dwindling Area of Occupancy, associated with habitat deterioration exacerbated by predicted climate change (Midgley *et al.* 2005), justifies its categorisation as Critically Endangered.

The status of a small number of species with restricted ranges has been changed from Near Threatened to Vulnerable, in some cases due to further habitat deterioration (e.g. the tortoise *Homopus signatus*, the gecko *Homopholis muelleri*, and the dwarf chameleon *Bradypodion thamnobates*). The regional population of the Nile Crocodile (*Crocodylus niloticus*) remains Vulnerable, as in the earlier local assessment (Branch 1988a), due to recent regional die-offs (Jacobsen 1989; Dixon *et al.* 2010), although globally the species is considered only Near Threatened (IUCN 2010b).

Springbok, NC; Succulent Karoo Biome M.F. Bates

Global context

An online summary of the global figures for the 2010 Red List (IUCN 2010b) records that of 55 926 species assessed (plants and animals), 24 080 (43%) were of Least Concern, 8 358 (15%) Data Deficient and 4 014 (7%) were Near Threatened. Threatened taxa comprised 35% of the total. However, this does not reflect the true proportion of threatened taxa as many early assessments did not consider common, non-threatened species. Hoffmann *et al.* (2010) have reviewed the impact of conservation activities on the threatened status of the world's vertebrates. They note that one-fifth of all vertebrates are classified as threatened (ranging from 13% of birds to 41% of amphibians) and that this number is increasing.

A random assessment of 1 496 reptile taxa was used to assess the conservation status of the world's reptiles (Baillie *et al.* 2010). Subsequent expansion of the dataset to 1 500 taxa, with analysis and refinement, was presented by Böhm *et al*. (2013), who noted that nearly one in five reptilian taxa were currently threatened with extinction, while knowledge of another one in five taxa was Data Deficient. Although there is general agreement in the percentage assignments into categories between the *Atlas* and recent IUCN (Bohm *et al.* 2013) assessments, there are some significant differences. More than three-quarters of reptilian species (324 of 405 taxa, 80.0%) in the SARCA assessment were classified as Least Concern, but the proportion of LC taxa in the IUCN assessment was much lower (881 taxa, 58.7%). Similarly, there were 37 Near Threatened taxa (9.1%) in the *Atlas* region, compared to 78 NT taxa (5.2%) in the IUCN assessment; and 36 (9.4%) threatened *Atlas* taxa (CR, EN, VU), but 223 (14.9%) threatened taxa in the IUCN assessment. When only threatened taxa are compared, percentages for the various categories for all assessed taxa is similar for Critically Endangered taxa (*Atlas* 13.3% versus IUCN 11.7%), but slightly different for Endangered taxa (*Atlas* 26.3% versus IUCN 41.3%) and Vulnerable taxa (*Atlas* 55.3% versus IUCN 47.1%). There is a considerable difference in the number of Data Deficient taxa between the two assessments: *Atlas* 1.7% of all taxa assessed versus IUCN 21.2%. A comparison of the percentage of taxa in IUCN categories for all taxa assessed in the *Atlas* region versus the IUCN Assessment (Böhm *et al.* 2013) is shown in Figure 3.1.

Differences between the IUCN assessment (Bohm *et al.* 2013) and that of the *Atlas* region may be explained, in part, by the greater general familiarity of the *Atlas* assessors with a regional reptile fauna. Despite the plethora of authors (Bohm *et al.* 2013) for the global reptile assessment, familiarity with all species may have been lower. This is perhaps reflected in the large difference between the two assessments for Data Deficient taxa (*Atlas* 1.7% versus IUCN 21.2%). Greater knowledge of the reptile fauna also resulted from specific surveys during the *Atlas* period that were targeted to address such data deficiencies. In addition, assessment consistency was a rigorous component of the *Atlas* assessment, with authors of all species accounts having to defend their assignments in group discussion. This control would have been more difficult in a global assessment. When comparing only percentages within threatened taxa, there are a greater

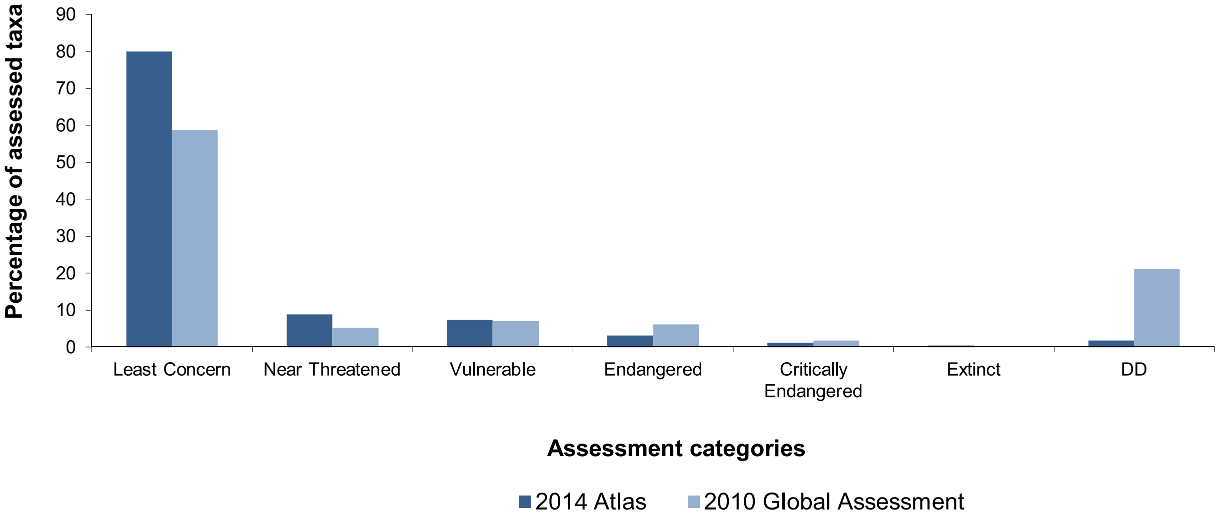


Figure 3.1—Comparison of percentage of taxa in IUCN categories according to *Atlas* assessment and the IUCN 2010 Global Assessment (Böhm *et al*. 2013).

proportion of Vulnerable *Atlas* taxa (55.3%) rather than Endangered taxa (26.3%), compared with those in the IUCN assessment (47.1% and 41.3%, respectively). This may suggest that the *Atlas* assessments were more conservative than those of the IUCN. However, many of the threatened taxa in the *Atlas* region are rupicolous, often inhabiting rocky, mountainous habitats currently subject to few obvious anthropogenic threats. Due to existing poor documentation of climate change impacts on *Atlas* reptiles, this threat was not specifically addressed during the current assessment. This limitation should be noted, however, as Sinervo *et al.* (2010) have documented lizard declines due to the effects of warming climate on thermal niches, particularly for rupicolous species.

Potential global declines in reptiles mirror those of amphibians (Gibbons *et al.* 2000), and there have been extinctions and declines of many snake populations (Reading *et al.* 2010). Despite these disturbing observations, many countries have never assessed the conservation status of their reptile faunas. The Global Reptile Assessment, launched in 2004, is still in progress. There have been few regional conservation assessments of African reptiles, and South Africa and Swaziland are amongst the few African countries to have published Red Lists on the group. Moreover, with the exception of an unpublished and less detailed report for Namibian reptiles (Griffin 2003), the *Atlas* region is the first in Africa to formally assess its entire reptile fauna.

3.4 Most threatened taxonomic groups

In all, 75 of the 405 (17.8%) reptile taxa assessed for the *Atlas* region are of conservation concern. As noted earlier, reptile taxonomic diversity within the *Atlas* area is skewed towards lizards, particularly geckos, skinks and cordylids. However, this overall diversity is only partially reflected in the spectrum of species of conservation concern (Figure 3.2). Chelonians (23 taxa) are disproportionately represented, with four sea turtles, three tortoises and a terrapin threatened or Near Threatened (34.7%). Lizards are also disproportionately threatened, with 59 of 263 (22.4%) taxa of conservation concern. Snakes are the least threatened reptiles, with only 11 of 118 (9.3%) threatened taxa.

To highlight the groups of greatest conservation concern, families were assigned a threat score based on the sum of scores of all species in each of the following IUCN cat-

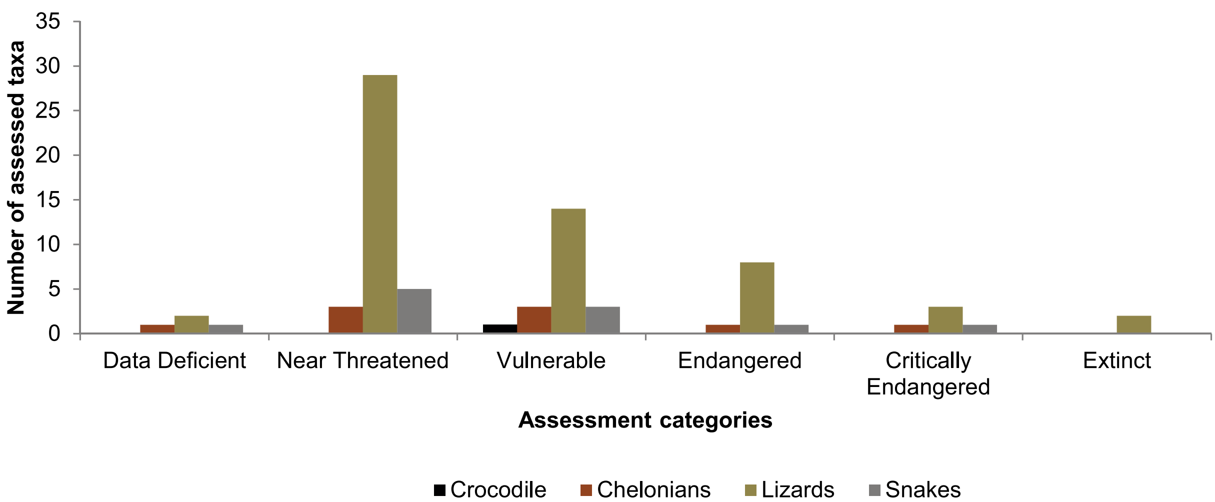


Figure 3.2—The number of Conservation Concern taxa by threatened category for the different reptile groups within the *Atlas* region.

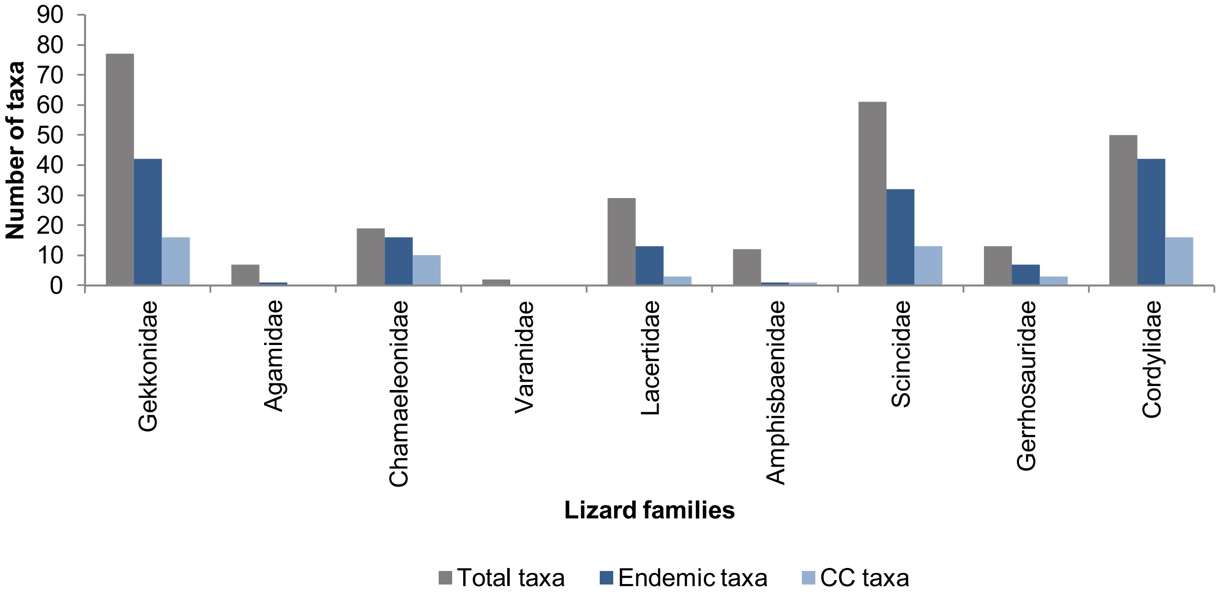


Figure 3.3—Lizard family diversity (total number of taxa), number of endemics and number of CC taxa for the *Atlas* region.

egories: Extinct (score 4), Critically Endangered (4), Endangered (3), Vulnerable (2) and Near Threatened (1). Data Deficient species were also included and assigned an intermediate value (2.5). The summed total weighted score for each group was then divided by the number of Conservation Concern (CC) taxa to give a mean weighting per CC taxon for each group. The order (lowest to highest) for the four groups (lizards 1.89, crocodiles 2.00, snakes 2.19 and chelonians 2.31) revealed that although having by far the highest number of CC taxa, lizards had the lowest weighted CC taxon score and were the least threatened group. Chelonians were the most threatened group, due to both threatened tortoises and sea turtles.

Among lizards, two families with relatively low species diversity, i.e. chameleons (Chamaeleonidae) and plated lizards (Gerrhosauridae), had relatively high numbers of CC taxa (Figure 3.3), unlike the Lacertidae and Amphisbaenidae, which despite having moderate taxon diversity, contained few CC taxa. The proportion of CC taxa within the most speciose lizard families, i.e. the Gekkonidae, Scincidae and Cordylidae, was generally proportional to their respective taxon diversity.

Snakes in the *Atlas* region have relatively few CC taxa. However, the radiation of small adders (*Bitis*) in the Cape region included a disproportionate number of CC taxa relative to the species diversity within the genus (Figure 3.4). Primitive scolecophidian (Typhlopidae and Leptotyphlopidae) and haenophidian (Pythonidae) snake families had limited diversity, both globally and within the *Atlas* region (but see species accounts for comments about the likelihood of numerous cryptic species of leptotyphlopids), and only the poorly-known and range-restricted Tello's Thread Snake (*Leptotyphlops telloi*) is considered Near Threatened. The Colubridae, Elapidae and Psammophiinae between them contain the majority of medium- and large-sized diurnal snakes in the region and could therefore be expected to suffer declining populations due to increased mortality from, for example, human contact and road mortalities. Surprisingly, these well-represented snake families contain relatively few CC taxa. Although it is likely that their population numbers are decreasing due to habitat loss, reduced prey availability and climate change (Reading *et al.* 2010), most populations have not yet reached threatened status. Globally, the majority of snakes with declining populations have small home ranges, sedentary habits and ambush foraging strategies (Reading *et al.* 2010), and these are attributes characteristic of small adders, which form the most threatened group of snakes in the *Atlas* region.

In an overview of the 2010 IUCN Red List, Baillie *et al.* (2010) noted that of 1 496 reptile species assessed, nearly 22% were threatened, and crocodilians and chelonians were the most threatened groups. In the 2010 IUCN Red List, 129 chelonian species representing 39.2% of all extant species were regarded as globally threatened. A more comprehensive assessment was performed by the Turtle Taxonomy Working Group (Turtle Taxonomy Working Group 2010), which assessed all 328 species of modern (since 1500 AD) chelonians and incorporated the (then) unpublished results of this SARCA assessment. They found that 156 (48%) of taxa were threatened, with 90 species (27%) Critically Endangered or Endangered. When Near Threatened and Extinct species are included, and adjusting for Data Deficient species, half of modern chelonians are either already extinct or threatened with extinction. They are therefore the world's most endangered group of vertebrates. The *Atlas* region includes the richest diversity of chelonians in Africa, and with Malaysia, has the 15th highest chelonian diversity in the world. It is commendable that a relatively low proportion (30%) of its chelonians is threatened, particularly when the globally threatened sea turtles are excluded (three threatened tortoises, 16% of 19 taxa).

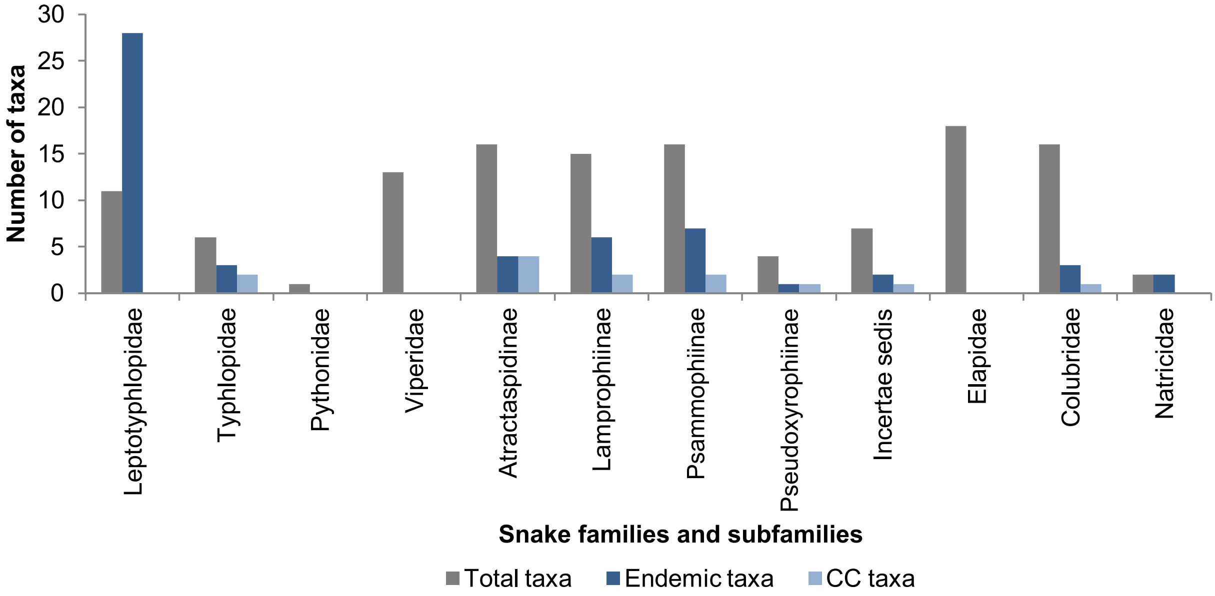


Figure 3.4—Snake higher taxon (family/subfamily) diversity, number of endemics and number of Conservation Concern taxa.

4. THREATS

During the SARCA assessment process, present and future threats to *Atlas* region reptiles were detailed in the individual species accounts. The commonest threats are discussed in more detail below (see also Figure 3.5). It should be stressed, however, that the greatest impact on conservation efforts occurs where diverse environmental threats (e.g. afforestation, pollution, urban and agricultural development) overlap with centres of endemism or regions with high reptile diversity.

4.1 Habitat loss, fragmentation and degradation

Previous assessments of major threats affecting Red Listed species (e.g. Hilton-Taylor 2000; Brooks *et al.* 2002; Butchart *et al.* 2010) considered habitat loss the most pervasive threat to mammals, birds and plants. Agricultural activities (including afforestation), extraction activities (mining, timber logging, fisheries, etc.) and development (activities associated with human development, e.g. industry and agriculture) all have significant impacts. About 3% of global forest cover has been lost in just the last five years (Hansen *et al.* 2010), and at the end of the 20th century, nearly 10% of South Africa's land surface had been invaded by more than 180 species of exotic plants (Richardson & Van Wilgen 2004).

As with amphibians (Harrison *et al.* 2001; Branch & Harrison 2004), habitat loss/degradation in all its forms, was cited as the commonest threat facing threatened reptiles (Figure 3.5). Fragmentation resulting from piecemeal habitat loss also threatens many species. The commonest form of habitat loss results from agricultural development (including afforestation), but localised urban developments and associated infrastructure threaten a number of species (Figure 3.6), particularly those with restricted ranges in coastal areas (e.g. *Cryptactites peringueyi*, *Cordylus niger*, *C. macropholis*, *Bitis armata*). Baillie *et al.* (2010) re-affirmed that "habitat loss is by far the greatest threat to reptiles, principally in the form of agricultural expansion, logging and urban development." Fragmentation may interact synergistically with other anthropogenic threats such as logging, hunting and especially fire, to create greater impacts.

Afforestation was considered to be a significant threat to many reptiles, including chameleons (*Bradypodion kentanicum*, *B. thamnobates*), snake lizards (*Tetradactylus breyeri*), dwarf geckos (*Lygodactylus methueni*), and even burrowing reptiles (*Chirindia langi occidentalis* and *Acontias rieppeli*). Not only is habitat directly lost to exotic plantations and alien vegetation, but indirect effects on hydrodynamics and fire frequency are often significant. The encroachment of invasive alien vegetation reduces groundwater levels and increases the risk of wildfires. When wildfires occur, the increased burden of woody material causes them to be especially hot and damaging.

Fire can be both a natural disaster and lead to habitat degradation. It affects by far the greatest number of reptiles in the *Atlas* region, with the severity of this threat predicted to increase in the future. Few detailed observations on the effects of fire on reptile populations in the *Atlas* region have been documented. Branch (2008, via E. Baard pers. comm.) gives details of tortoise mortalities resulting from a fire near the West Coast National Park in which over 100 000 tortoises (mainly *Chersina angulata*) died. Although fire in many ecosystems, especially in the Grassland and Fynbos biomes, is a natural phenomenon, increased fire frequency can result from anthropogenic influences (Van Wilgen *et al.* 1992). In forest habitats it is naturally infrequent (Geldenhuys 1994). However, chang-

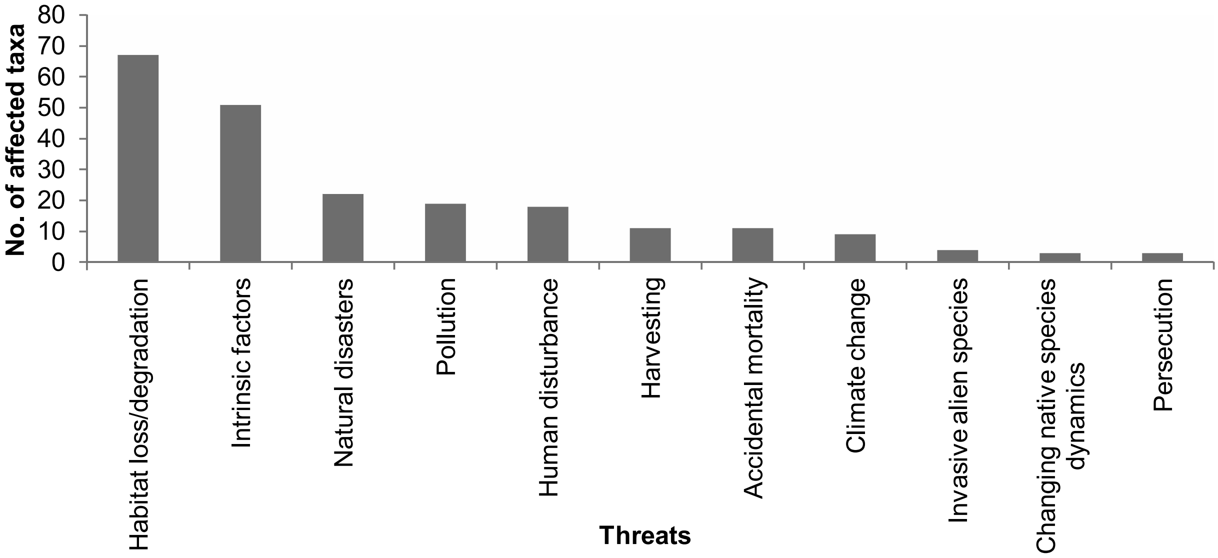


Figure 3.5—Number of Conservation Concern taxa affected by all major threats in the past, present and future.

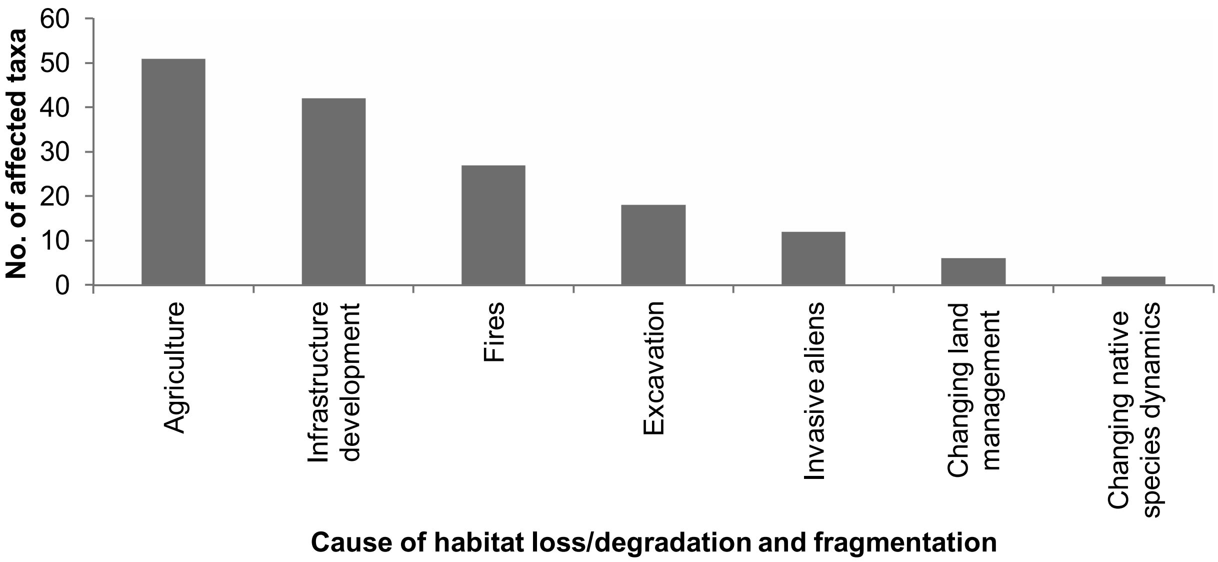


Figure 3.6—Number of Conservation Concern taxa affected by specific habitat loss/degradation and fragmentation.

es in water-flow dynamics following road construction or afforestation may lower the water table, drying vegetation to unnatural levels and making it more susceptible to fire. Fire was indicated as a threat for many threatened and Near Threatened species, particularly grassland lizards such as *Smaug giganteus*, *Hemicordylus nebulosus*, *Chamaesaura aenea*, *C. macrolepis*, *Tetradactylus fitzsimonsi*, *Bradypodion taeniabronchum* and *B. atromontanum.* Midgley *et al.* (2001, 2002) predicted an increase in the frequency and severity of fires in the Cape Fold Mountain region due to global climate change.

Management of mosaics, including those of natural grasslands and indigenous forests and plantations, requires an integrated approach that not only determines the viability of plant communities and plantations, but also assesses the requirements of the diverse vertebrate fauna (Castley 1997). Afforestation in South Africa has been noted to have a marked impact on biodiversity and has resulted in some plant and animal species, including one reptile (*Tetradactylus eastwoodae*), becoming extinct or threatened (Armstrong *et al.* 1998). Environmental criteria and indicators for sustainable plantation management in South Africa have been developed by Lawes *et al.* (1999).

Habitat loss and fragmentation can lead to genetic depletion in isolated populations (Garner & Pearman 2001), and in amphibians this may be reflected by lowered larval fitness (Hitchings & Beebee 1997; Rowe *et al.* 1999). Loss of amphibian diversity is related to habitat size in forest patches (Vallan 2002) and isolated wetlands (Semlitsch 2000). Allentoft & O'Brien (2010) have argued that a decrease in genetic variation can lead to reduced fitness and lack of adaptability to changing environments. They elaborate on the extent of recent fragmentation of amphibian gene pools and proposed the term 'dissociated populations' to describe residual amphibian population structure. These authors reviewed 34 studies on amphibians that explored linkages between genetic variation and various fitness traits, and showed that there were clear genetic-fitness-correlations in the majority of the published investigations. They argued that the ongoing loss of genetic variation may be an important underlying factor in global amphibian declines, and that this is exacerbated by the negative effects of various

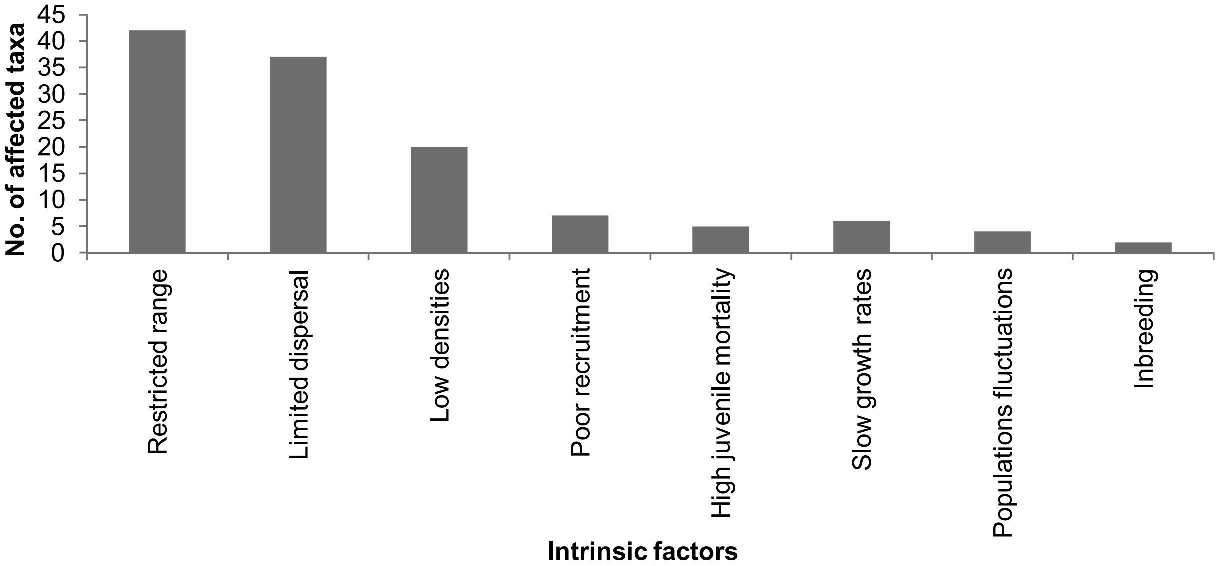


Figure 3.7—Number of Conservation Concern taxa affected by intrinsic factors.

environmental impacts (pollutants, pathogens, increased UV-B radiation). Unfortunately, no comparable studies on reptiles have been published although the fragmentation of reptile populations (Reading *et al.* 2010) can be expected to generate such problems, and this can be exacerbated by characteristics that are intrinsic to taxa. In the SARCA assessment, intrinsic factors were listed as the threat which affected the second-highest number of taxa (Figure 3.5). Restricted range and limited dispersal capabilities were the two intrinsic factors that affected most reptiles (Figure 3.7).

The relationship between habitat degradation, through over-grazing and wood collection, and reptile communities in South Africa was assessed by Smart *et al.* (2005). Unexpectedly they found no evidence that any species of lizard was negatively affected by habitat disturbance. However, although some terrestrial lizards were more common in communal lands, presumably due to their preference for open, sparsely grassed areas, the lizard community structure was different and this may influence ecosystem integrity and function.

4.2 Pollution

Pollution can take various forms, of which the commonest include chemical, light and noise pollution. The latter threaten species by disrupting their behaviour. Chemical pollution is as difficult to define as it is to define what constitutes a pollutant. Thousands of chemicals are discharged into the environment and their lingering presence may threaten biodiversity, affecting individual species or degrading entire ecosystems. Some, such as lead or PCBs, may be directly or indirectly toxic, while others, such as fertiliser runoff, are non-toxic but disrupt the normal functioning of ecosystems.

There are few studies on the effect of noise pollution on reptiles and negative impacts have been difficult to untangle from associated impacts, e.g. road mortalities and highway noise (see review in Kaseloo & Tyson 2004). The ecotoxicology of pesticides in reptiles has been reviewed by Pauli *et al.* (2010). A number of studies have implicated chemical pollution in reptile population declines. Botha *et al.* (2011) noted that the decline in crocodile populations in Loskop Dam corresponded with the deterioration of water quality in the Olifants River resulting from industrial, mining and agricultural activities in the region. They consider that dermal exposure is not the likely route of contaminant intake, but that toxins are probably accumulated through a diet of contaminated fish and other vertebrates. Phelps *et al.* (1986) demonstrated high levels of chlorinated hydrocarbons and heavy metals in crocodile eggs in Zimbabwe. In one of the few field tests of insecticide toxicity on reptiles in South Africa, Alexander *et al.* (2002) measured the effects of deltamethrin, a pyrethroid insecticide, on individuals of two lacertid lizard species (*Meroles suborbitalis* and *Pedioplanis namaquensis*), in enclosures and under field conditions. Lizards in the enclosure experiments suffered high mortality, with most lizards dying within two months of treatment. Over a five-month period, field studies also revealed significant reductions in the abundance of *M. suborbitalis* (reduced by 52%) and *P. namaquensis* (reduced by 72%), one and four weeks after spraying with deltamethrin.

Few studies of the consequences of artificial lighting on amphibians and reptiles have been conducted to date (see review by Perry *et al.* 2008). An exception is the information available on the negative impacts of artificial lights on the orientation of hatchling sea turtles (reviewed in Witherington & Martin 1996). Most anecdotal information about the effects of night lighting on reptiles relates to lizards, particularly geckos, where complex predator-prey interactions may occur between snakes and geckos feeding on insects attracted to artificial lights (Perry & Fisher 2006). These authors also reviewed the probable negative predator-prey interactions, such as the apparent decline of heteromyid rodents around artificial lights due to increased exposure to snake predators. They noted also that snakes usually elicit a negative response when seen by the general public, placing them at a special disadvantage in urban areas.

4.3 Human disturbance (tourism/recreation)

Human activities that alter, destroy and disturb habitats and species, and are associated with non-consumptive uses of biological resources may threaten species. This differs from other human activities, such as deforestation, by relating specifically to recreational activities of people spending time in nature or travelling in vehicles outside of established transport corridors. Conflicts arising from the recreational use of protected areas have been well documented (e.g. Cole 1993), albeit with few local studies. Even quiet, non-consumptive recreation has been shown to reduce protected area effectiveness (Reed & Merenlender 2008). Construction of roads both within and to wilderness areas has negative impacts on reptiles. The passage of vehicle traffic on access roads negatively influences snake movement and activity, while residual heat on tarmac surfaces may attract snakes in the early evening and result in greater mortalities (Andrews & Gibbons 2005).

Ecotourism is an important component of financing protected areas, and also of uplifting local communities. However, it is not without impact and Kiss (2004) has noted that ecotourism is a compromise land use that has greater impacts on biodiversity conservation than pure protection of habitats. Banks & Bryant (2007) noted that normal human activity in conserved areas, e.g. walking, caused significant declines in diversity and abundance of birds. However, the presence of dogs, even restrained on-leash, resulted in an even greater displacement of birds and they noted that, "local wildlife does not become habituated to continued disturbance by dogs." Declines in reptile populations may also result from indirect effects, and in a 20-year study, Garber & Burger (1995) demonstrated a decrease in populations of Wood Turtles (*Glyptemys insculpta*) caused by an increase in raccoons caused by increased recreational use of protected turtle habitat. Baboons (*Papio ursinus*) in the *Atlas* region are also known to become problem animals in association with human recreational use in protected areas (Van Doorn 2009; Hoffman & O'Riain 2011). The possible localised impact of increased baboon numbers on small terrestrial reptiles, particularly those that shelter in logs or under rocks, has not been assessed.

4.4 Harvesting

Over-exploitation (hunting, trapping and unsustainable harvesting) is a particular threat to some reptile groups, with sea turtles used for food, crocodilians for their skin, and terrestrial tortoises for the pet trade and for 'muti' (traditional medicine). This threat is expected to affect an even greater number of taxa in the *Atlas* region in future (Figure 3.5). There is increasing evidence of commercial trade in South African reptiles (Van Wilgen *et al.* 2008), and concerns about illegal collecting for the pet trade are expressed in a number of SARCA species accounts (e.g. the tortoises *Psammobates geometricus* and *Homopus signatus*, the lizards *Smaug giganteus* and *Ouroborus cataphractus*, and small adders, e.g. *Bitis albanica*). However, the levels of illegal exploitation of wild reptile populations for the pet trade are unknown, and it is currently impossible to assess the significance of this threat.

Whiting *et al.* (2011) have assessed the impact on South African vertebrates used in traditional medicine for both the healing of ailments and for symbolic purposes such as improving relationships and attaining good fortune. At one urban market (Faraday Market, Johannesburg) they identified 147 vertebrate species in trade, of which 17 species were of conservation concern, including the Nile Crocodile (*Crocodylus niloticus*, regionally VU). Non-threatened reptiles commonly offered included Rock Monitors (*Varanus albigularis*) and Water Monitors (*V. niloticus*), Southern African Pythons (*Python natalensis*) and Puff Adders (*Bitis arietans*). Similar findings were noted in rural communities, where the predominant users of reptiles were traditional healers who indicated that the reptiles most commonly used in traditional medicine, i.e. Leopard Tortoise (*Stigmochelys pardalis*), Puff Adder, Southern African Python and Rock Monitor, appeared to be declining in numbers (Smart *et al.* 2005). There are also indications that crocodiles are being increasingly poached, and in the last two years, no less than 15 crocodiles have either been found dead in snares or with snares attached at Ndumo Game Reserve, KwaZulu-Natal (J. Warner pers. comm. August 2011).

4.5 Accidental mortality

Many reptiles are killed or injured while crossing roads. Awareness of this problem is not new (Stoner 1925; Dreyer 1935; Dickerson 1939) and mortalities on roads, particularly in pristine areas, may impact significantly on long-lived, wide-ranging species (e.g. tortoises) (Nicholson 1978). Populations can easily be decimated by road mortalities, and this can lead to local extinctions. Rudolph *et al.* (1999) reported a reduction of up to 50% in large snake species up to a distance of 850 m from a road, and attributed the reduction to increased road mortality. Langen *et al.* (2007) reviewed various methodologies for surveying herpetofauna mortality on rural highways, and solutions to reduce excessive road mortalities have been proposed (Langton 1989; Woltz *et al.* 2008). These include specially constructed tunnels and temporary restrictions (7–10 days) on traffic movements at night along sensitive sections of roads. Large under-road culverts for storm water control may also serve as safe transit corridors in areas of high impact. However, road underpasses only work in association with costly barriers that prevent access onto roads, and are only feasible in certain situations. Moreover, experience at Suikerbosrand Nature Reserve in Gauteng suggests that the enforcement of measures to reduce speed on roads, such as posting reduced speed limits to minimise vehicle-wildlife collisions, is impractical (G. Masterson pers. comm.).

Significant mortality of sea turtles in KwaZulu-Natal has occurred in the past due to inshore shark nets (Dudley & Cliff 1993), but has declined since their use was reduced in 2002. Sea turtle mortalities also occur as a bycatch to fisheries, particularly the inshore shrimp fishery along the Mozambique coast where the application of turtle exclusion devices and monitoring of their use is poor (Bourjea *et al.* 2007; FAO 2009). Crocodile mortalities also arise from the increasing use of gill nets in inland water systems (Thomas 2006; Aust *et al.* 2009), and there is an ongoing threat to the regional crocodile population in KwaZulu-Natal from the use of these nets (Pooley 1982; Kyle 1999, 2008).

4.6 Climate change

Globally, predictions about the impact of climate change have received tremendous circulation, but little meaningful, integrated international or regional response. Disagreement about the accuracy of the predicted speed and local impact of climate-induced habitat change (be it anthropogenic or natural) has made it difficult to assess the future impact of climate change scenarios. In part for these reasons, Hoffmann *et al.* (2010) noted that climate change as a growing extinction threat has not been adequately captured by IUCN Red Lists, even though it is increasingly implicated in the continuing decline of many vertebrates (Laurance & Useche 2009; Sinervo *et al.* 2010).

In assessments of climate change in South Africa (Midgley *et al.* 2001, 2002, 2005), it was predicted that the whole of South Africa would experience higher temperatures, that summer rainfall would decrease by between 5% (north) and 25% (south), and that within 50–100 years, Fynbos, Succulent Karoo, Grassland and Forest biomes may be reduced to 35–55% of their present extent. These scenarios have stimulated a number of scientific studies that have predicted reptile distributions based on various climate models. Using genetic structure of lizard populations within the Cape Fold Mountains, Tolley *et al.* (2009) noted that climatically-suitable areas for chameleons (*Bradypodion*) and the lacertid *Pedioplanis burchelli* will decline, resulting in highly fragmented distributions and reduced genetic connectivity. In a global context, Sinervo *et al.* (2010) showed that seasonal air temperature changes affect the thermal habitats of Mexican *Sceloporus* lizards such that they must retreat to the shade more often in order to avoid overheating. As a result the lizards lose foraging time, particularly during the spring breeding season. By incorporating physiological characteristics into climate models, Sinervo *et al.* (2010) established a strong link between rising temperatures and the degree of local lizard extinctions. The incorporation of rupicolous cordylid distributional data into these models showed that these lizards would be more greatly imperilled by temperature increases than terrestrial or arboreal lizards. The model also predicted that rising air temperatures will be twice as likely to cause the extinction of viviparous lizards as oviparous lizards, probably due to the effects of temperature on embryonic development. Montane populations of cordylids in the *Atlas* region are therefore prime candidates for negative climate change impacts. Although the risk of cordylid extinctions now and over the next 40 years is not considered high, it will become increasingly severe thereafter. In other groups, e.g. crocodilians and chelonians, where many lineages demonstrate temperature-dependent sex determination, the effects of changing global temperatures on population dynamics may become significant.

4.7 Invasive aliens

The increasing number of Invasive Alien Species (IAS), i.e. non-indigenous animals becoming established after intentional or accidental introduction, is of increasing global concern, and it is increasingly evident that large, perhaps primary, conduits for introductions are the pet and ornamental plant trades (see Perry & Farmer 2011 for discussion). IAS have also been noted as the most significant drivers of amphibian declines, mainly mediated through introduced alien pathogens such as chytrid fungus (Stuart *et al.* 2004). Langton *et al.* (2011) estimated that in 2010, around 80 000 London households held about 150 000 captive reptiles and amphibians. This was lower than in the USA where in 1998 an estimated 3.9 million USA households (4% of total) held an estimated nine million reptiles and amphibians (Franke & Telecky 2001). In parallel with the increase in captive reptiles is an increase in the numbers of invasive alien species. Meshaka (2011) noted that the diversity of invasive alien reptiles and amphibians in Florida has doubled since 1980. Langton *et al.* (2011) discussed the 51 taxa of non-native herpetofauna recorded living wild in the London area, noting that of the 21 amphibian taxa, 14 had bred successfully, while of the 30 reptile taxa, only two had bred. The latter included the Aesculapian Snake (*Zamenis longissimus*), with breeding populations recorded from Colwyn Bay, North Wales (several hundred specimens), and Camden in north London (30 snakes). The latter is believed to have resulted from the deliberate release of adult snakes. Pimentel *et al.* (2005) estimated annual economic damages caused by invasive species in the United States to exceed US$ 100 billion, although estimates for Europe were lower, about EUR 12 billion (Kettunen *et al.* 2009). Langton *et al.* (2011) noted that costs to remove introduced American bullfrogs at one location in the London area exceeded £100 000, and the cost of the impacts of non-native species collectively cost the economy of the United Kingdom an estimated £1.7 billion per year (Nonnative Species Secretariat Website 2011—www.nonnativespecies.org).

Perry & Farmer (2011) have proposed, in part, to alleviate the cost to society of the impacts of IAS by raising funds (e.g. levies) from the main importers of IAS. However, Langton & Herbert (2011: 168) noted that this proposal appears "naïve for the kind of world that has developed", and proposed "allowing trade only in species judged highly suitable for captivity" and to "enforce heavily on unlawful activities". In a review concerned with ethical issues relating to poor survival and ill treatment by the public of feral exotic species, and issues about re-homing and re-wilding, Langton & Herbert (2011) noted that the bulk of irresponsible trading in reptiles and amphibians to the uninformed public was based upon highly exploitative large-volume sales with very low survival rates. They also claimed (p. 159) that "After twenty-five years CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington Convention) has not induced the form of sensible and caring yet tightly managed regulation that could in theory enable a low-impact exploitative trade to exist." They placed heavy emphasis on public education concerning the negative impacts resulting from the release of non-native species. This would not, however, solve the problems of the accidental escape of specimens of such species from pet owners or pet traders.

Van Rensburg *et al.* (2011) recently reviewed invasive alien vertebrates in South Africa, and Van Wilgen *et al.* (2008) noted that invasive alien herpetofauna have the potential to cause a number of negative effects, ranging from negative impacts on native biota to effects on the day-to-day course of society. However, although they discussed and reviewed in detail experiences with introduced alien reptiles and amphibians in many parts of the world, and reviewed potential problems that may arise in South Africa, they did not discuss any local examples. Only one introduced reptile, the all-female, parthenogenetic Brahminy Blind Snake (*Ramphotyphlops braminus*) is known to have become established in the *Atlas* region (Smith 1838; McLachlan 1978b; Alexander 1987). The Red-eared Slider (*Trachemys scripta elegans*) has been the most popular terrapin in the global pet trade, with more than 52 million individuals exported from the United States to foreign markets between 1989 and 1997. Feral individuals have been recorded from 79 countries (Turtle Taxonomy Working Group 2010), and breeding colonies have become established in numerous countries, leading to the slider's inclusion on the Top 100 of the World's Worst Invasive Alien Species (Global Invasive Species Database 2010). In the *Atlas* region, feral specimens have been recorded from Durban, Johannesburg, and Silverton in Pretoria (Newbery 1984), but no breeding populations are known to have become established. Although translocations of this terrapin were of global concern at the end of the last century, the banning of the importation of this species into many countries has reduced the problem.

There is a burgeoning use of reptiles for the pet trade (Kraus 2009), with increasing concern for the potential for their release and the development of breeding colonies of alien reptiles in South Africa (Van Wilgen *et al.* 2008, 2010). A list of alien reptiles that have been discovered in the wild in the *Atlas* region is provided as Appendix 4, and is informative in the light of the situation in Florida where numerous alien species have become established, including many with the potential for significant human and faunal impacts, e.g. *Python molurus* (Snow *et al.* 2007). Between 1976 and 2007, 275 reptile species in 30 families were imported into South Africa (Van Wilgen *et al.* 2010). While reptile trade in South Africa is very small by world standards (Auliya 2003), the numbers of imports are increasing each year, having more-or-less doubled every four years between 1976 and 2005 (Van Wilgen *et al.* 2010). The increasing number of captive-held alien reptiles in South Africa results from this ongoing importation and from the successful local captive breeding of alien species. The desire and need to keep herpetofauna in captivity is a contentious subject, involving on the one hand philosophical issues of civil liberties, and human and animal rights, and on the other hand national and international legislation relating to health and the control of disease and alien introductions. Although Arena *et al.* (2012) have recommended very strict control and numerous prohibitions to regulate the pet trade in reptiles and amphibians in the European Union, their prohibitive stance may reflect, at least in part, that of the report's source (it was commissioned, funded and circulated by various animal rights organisations). It should be read with caution and in conjunction with counter views, i.e. those documented in Joswig & Izaber (2012).

Directly linked to the growing pool of alien captives in South Africa is the increasing number of reports of escaped alien reptiles. There has been both an increasing expansion of indigenous commensal geckos such as *Hemidactylus mabouia* and *Lygodactylus capensis* (e.g. Branch 1998; Bates 2005b), and an increasing number of escaped exotics, particularly variant colour morphs of popular pet American colubrids such as the Corn Snake (*Pantherophis guttatus*), Yellow Rat Snake (*P. obsoletus*) and various king snakes (*Lampropeltis* spp.) (see Appendix 4). There are at least three records of large exotic pythons (2–3 m) having escaped in KwaZulu-Natal, with two being subsequently re-released in protected areas after capture due to confusion with indigenous pythons. A python from Verulam in Durban was reported to have been in the region for three years before capture. African and Burmese Pythons are closely related and are known to hybridise (Branch & Erasmus 1984), increasing the risk of genetic pollution following the escape of the latter species into the wild.

The discovery of feral American king snakes (*Lampropeltis* spp.) at various locations in South Africa (Appendix 4) is of particular concern in light of their recent introduction to Gran Canaria (Cabrera-Pérez *et al.* 2012). In 2007, its naturalisation on the island was confirmed, and attributed to the accidental or deliberate release of individual king snakes bred in captivity. During the next five years 1 064 king snakes were captured. Trapping these snakes has not been successful, and control has required labour-intensive visual searches and hand capture. This snake has a wide dietary niche, and the majority of its prey items on the island have included indigenous reptiles (69%), particularly the endemic Gran Canaria Giant Lizard (*Gallotia stehlini*). Up to the year 2011 there were still no regulations against the importation and sale of the California King Snake in the Canary Islands. As in South Africa, this species was very popular among hobbyists, and frequently offered for sale in local pet shops. The ownership, transport and sale of living or dead individuals of all species of Colubridae is now forbidden in the Canary Islands (Cabrera-Pérez *et al.* 2012).

Exacerbating this situation is the recent discovery of novel reproductive modes, including various forms of 'virgin' birth, in common captive species, e.g. Rainbow Boa, *Epicrates maurus* (Booth *et al.* 2011a); Boa Constrictor, *Boa constrictor* (Booth *et al.* 2011b); and Checkered Garter Snake, *Thamnophis marcianus* (Reynolds *et al.* 2012), as well as in wild populations of two pitviper species, the Copperhead (*Agkistrodon contortrix*) and Cottonmouth (*A. piscivorus*) (see review in Booth *et al.* 2012). Conservation and permitting authorities should be aware of the implications of this reproductive flexibility and the increased caution it merits, as populations may potentially become established from even single escapees or from a deliberately released specimen.

Although the small and localised breeding populations of the Brahminy Blind Snake in South Africa remains an exception, and no other alien reptiles are known to have become established in the *Atlas* region, the growing movement of exotic species around the globe and increasingly in South Africa necessitates active monitoring. More serious than the threat of venomous and/or dangerous reptiles becoming established is the conduit that alien imports provide for alien pathogens and parasites.

5. HOT SPOTS

The objective of identifying hotspots is to focus attention on areas that have the highest priority for conservation action for the group in question. This can be undertaken at the level of general reptilian diversity, and for species of recognised conservation concern. As for amphibians (Branch & Harrison 2004), a conservation 'hotspot' is here defined as a grid cell or cluster of grid cells containing a relatively large number of threatened and Near Threatened species and subspecies (taxa). The QDGCs containing these species can also be weighted to highlight spots where species in the categories of higher threat (e.g. Critically Endangered, Endangered) may clump. Only validated, non-introduced locality records were plotted. The same weighting used in the assessment of taxa of conservation concern (see above) was used in the hotspot analysis. There are multiple reasons for identifying such hotspots:

- To provide an indication of the area of greatest conservation concern.
- To alert planners to the opportunities to conserve several Red Listed taxa at a single or relatively few protected localities.

- To identify areas that contain sensitive localities and that need careful study prior to embarking on changes in land use.

5.1 Distribution of reptile diversity and endemism

5.1.1 Total reptile diversity

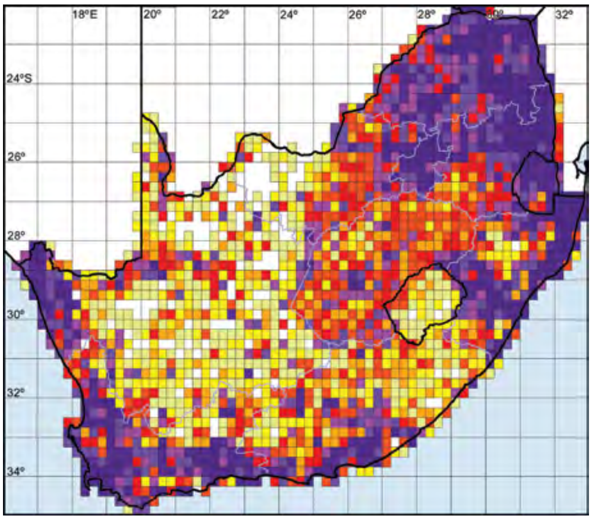
For this analysis, the number of taxa (species and subspecies) was categorised into quantiles and the number of levels was chosen to best illustrate the geographical spread of diversity.

This analysis revealed 125 039 reptile records from 1 888 QDGCs (93.2% of total) in the *Atlas* region. Distribution of reptiles in the region is not uniform. Diversity ranges from 0–80 taxa per QDGC, with 197 QDGCs (9.7%) having 38–80 taxa (the highest quantile used in the analysis). The distribution of total reptile diversity in the *Atlas* region is shown in Figure 3.8. Most grids with very low diversity, e.g. 1–2 taxa (256 QDGCs, 12.3% of total) are probably simply under-sampled; even on the high-altitude plateau of Lesotho at least 3–4 reptile species can be expected from most localities. Areas of high reptile diversity are associated with the main winter rainfall area of the western and southern Cape coastal regions, and with the summer rainfall area of the eastern regions, i.e. Mpumalanga, Limpopo and KwaZulu-Natal provinces. The central arid regions (Great Karoo and southern Kalahari) have low reptile diversity, as do the highlands of Lesotho and adjacent Transkei. Similar reduced chelonian diversity in the Transkei has previously been noted (Branch *et al.* 1995b), but this appears to be the case for all reptiles in that area. It is unclear whether this low diversity is a reflection of poor collecting or an effect of the long history of subsistence farming in the Transkei.

Measures of high reptile diversity are clustered around major human centres, particularly major cities with museums, e.g. Pretoria (2528CA), Durban (2931CC), Pietermaritzburg (2930CB), Bloemfontein (2926AA), Kimberley (2824DB), Cape Town (3118CD), East London (3327BB) and Port Elizabeth (3325DC). These clusters reflect the high levels of collecting in these areas. The high altitude grasslands of the Free State are known to have relatively reduced reptile diversity (De Waal 1978; Bates 1992), and yet the region displays slightly higher diversity than its surroundings. This again reflects the efficacy of detailed herpetological surveys in the region (De Waal 1978), as does the uniformly high reptile diversity shown throughout the former Transvaal Province, which Jacobsen (1989) surveyed from 1978 to 1985.

5.1.2 Endemic reptile diversity

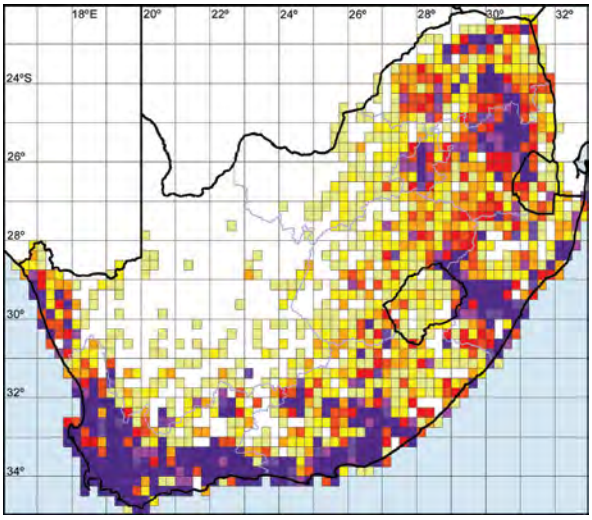
A list of all endemic and near-endemic reptiles in the *Atlas* region is provided in Appendix 3. There are 34 188 records of endemic reptiles from 1 304 QDGCs (64.4% of total), with 125 QDGCs (6.4%) having the highest number (12–24) of endemic taxa (Figure 3.9). QDGCs with very low diversity (1 taxon) comprise 16.8% of all QDGCs. For much of the region, patterns of reptile endemism match those of overall reptile diversity (Figure 3.8). The exception is the Kalahari region of the Northern Cape and



Number of records: 125 039
Number of grid cells: 1 888 (93.2%)

Number of taxa	Symbol	No. QDGCs	% QDGCs
1–2		256	12.64
3–5		236	11.65
6–8		173	8.54
9–11		221	10.91
12–14		207	10.22
15–18		174	8.59
19–24		204	10.07
25–37		220	10.86
38–80		197	9.73

Figure 3.8—Distribution of reptiles in the *Atlas* region.



Number of records: 34 188
Number of grid cells: 1 304 (64.4%)

Number of taxa	Symbol	No. QDGCs	% QDGCs
1		340	16.79
2		220	10.86
3		160	7.9
4		126	6.22
5		94	4.64
6		62	3.06
7		43	2.12
8–11		134	6.62
12–24		125	6.17

Figure 3.9—Distribution of endemic reptiles in the *Atlas* region.

Maputaland, KwaZulu-Natal, which both have very few endemic taxa but relatively high overall reptile diversity. The generally uniform habitats in the Kalahari region are associated with low levels of endemism, with most species that occur in the central Northern Cape having ranges that extend widely into Botswana and adjoining Namibia. Similarly, high reptile diversity in northern KwaZulu-Natal is associated with an Indian Ocean coastal zone herpetofauna that extends through Mozambique to Tanzania, and in some cases north to southern Kenya, and south to the Albany region. The southern part forms the Maputaland-Pondoland-Albany (MPA) biodiversity hotspot, which was initially recognised on the basis of high plant endemism (Steenkamp *et al.* 2004). This region was also highlighted as a centre of vertebrate endemicity (Perera *et al.* 2011), albeit that the MPA was increased to incorporate sections of the Great Escarpment from the Amatola-Winterberg-Sneeuberg Mountains through the Drakensberg to the Soutpansberg. This re-definition was justified to give rise to a Greater Maputaland-Pondoland-Albany region of vertebrate endemism, and it incorporates (with the exception of the southern and western Cape regions) many of the reptile hotspots noted above.

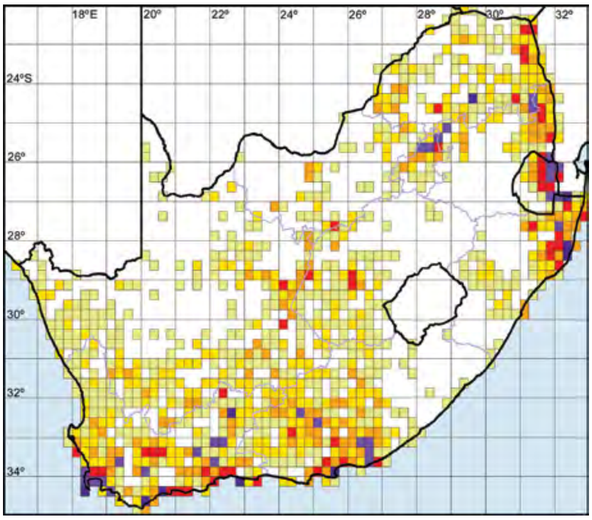
5.1.3 Chelonian diversity

There are 5 237 chelonian records in 958 QDGCs (47.3% of total). Diversity ranges from 0–8 taxa per QDGC, with less than 2% of QDGCs having five or more taxa. More than one-third of recorded QDGCs have very low diversity (1–2 taxa), and these are spread over most of the *Atlas* region (Figure 3.10). There are, however, large areas where chelonians are absent, including most of the Transkei and Lesotho, northeastern Free State and adjacent Mpumalanga and KwaZulu-Natal. The relative absence of tortoise shells in archaeological excavations in the Transkei area indicates that the absence of chelonians there, at least, is a natural phenomenon (Branch *et al.* 1995).

Chelonian hotspots in the southwestern Cape and Algoa Bay area result from *Atlas*-endemic tortoises and a number of sea turtle strandings associated with cold water upwelling. High diversity in the southern Cape and the adjacent inland escarpment results from the relatively high number of tortoise taxa and a single pelomedusid. Conversely, chelonian diversity in coastal Maputaland is dominated by pelomedusids and sea turtles.

Endemic chelonian diversity

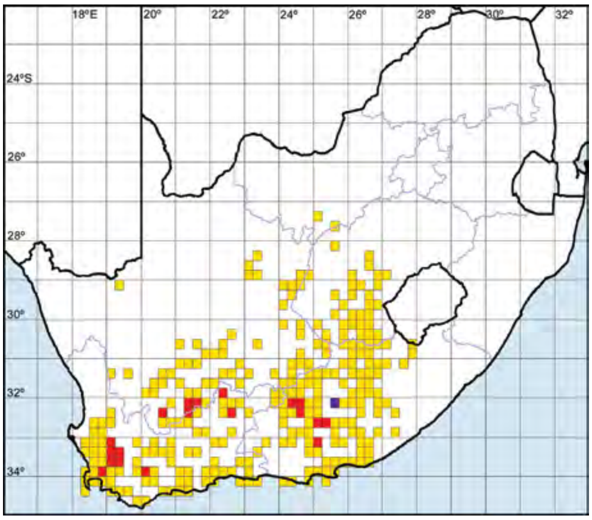
There are no endemic freshwater terrapins in southern Africa, although the taxonomic status of the isolated population of the Variable Hinged Terrapin (*P. rhodesianus*) in KwaZulu-Natal requires further investigation. Chelonian endemicity (Figure 3.11) is restricted to tortoises, with endemic tortoises recorded in 871 QDGCs (13.0%). Diversity ranges from 0–3 taxa per QDGC, with only one QDGC (3225BA) having three endemic taxa. QDGCs with two endemic chelonians cluster along the Cape escarpment and valleys of the southwestern Cape. Chelonian endemism in the *Atlas* region is restricted to the tortoise genera *Chersina*, *Homopus* and *Psammobates*, which characterise the Cape region and which confer on this region the distinction of having the highest tortoise (Testudinidae) diversity and endemism in the world. Although four species of hinged tortoise (*Kinixys*) occur in the northern parts of the *Atlas* region, they are mainly allopatric and all inhabit savanna. This contrasts with the four Cape *Homopus* species which inhabit, for the most part, different biomes—e.g. *Homopus areolatus* in Fynbos, *H. signatus* in Succulent Karoo, *H. boulengeri* in Nama-Karoo, and *H. femoralis* in Grassland and grassland patches in Nama-Karoo.



Number of records: 5 237
Number of grid cells: 958 (47.3%)

Number of taxa	Symbol	No. QDGCs	% QDGCs
1		470	23.21
2		267	13.19
3		130	6.42
4		51	2.52
5		30	1.48
6–8		10	0.49

Figure 3.10—Distribution of chelonians in the *Atlas* region.



Number of records: 871
Number of grid cells: 283 (14.0%)

Number of taxa	Symbol	No. QDGCs	% QDGCs
1		263	12.99
2		19	0.94
3		1	0.05

Figure 3.11—Distribution of endemic chelonians in the *Atlas* region.

5.1.4 Lizard diversity

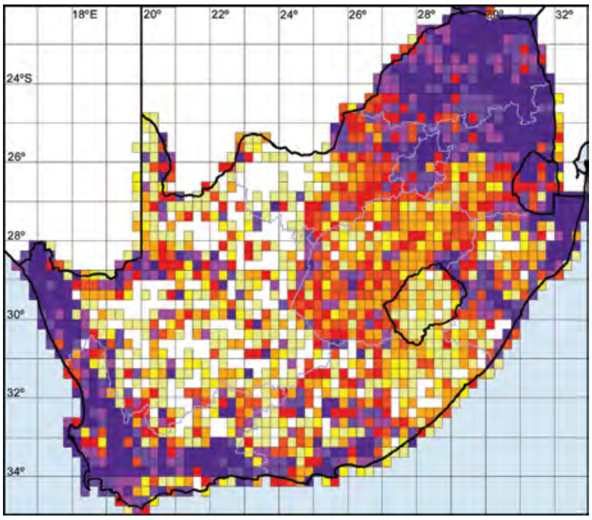
There are 79 769 lizard records in 1 741 QDGCs (86.0% of total). Diversity ranges from 0 to 41 taxa per QDGC, with 8.9% of QDGCs having 20 or more taxa. QDGCs with very low diversity, i.e. 1–2 taxa (294 cells, 14.5%), cluster within the central Karoo and adjacent Northern Cape (Figure 3.12). This reflects, in part, poor collecting in those areas. In the northeast, lizard diversity is heavily clumped in Maputaland, the eastern escarpment of Mpumalanga and Limpopo Province, and the Soutpansberg. In the south, high lizard diversity is associated with the Cape Fold Mountains (particularly the Little Karoo) and the West Coast (particularly Namaqualand), but there is also a cluster of high-scoring QDGCs around the Karoo National Park near Beaufort West. These peaks of diversity result from good collecting as these regions have been the focus of directed herpetological surveys during the last 20 years (Karoo National Park, Branch & Braack 1989; Little Karoo, Branch & Bauer 1995; Richtersveld National Park, Bauer & Branch 2003 [2001]).

Endemic lizard diversity

There are 28 533 records of endemic lizards in 1 173 QDGCs (57.9% of total), but only 5.7% of these cells contain most (9–20) endemics (Figure 3.13). Centres of lizard endemism are evident, with the major hotspot situated in the Cape Fold Mountains, and other smaller centres occurring in Namaqualand, the Maloti-Drakensberg region of KwaZulu-Natal, Lesotho and adjacent Free State, the Mpumalanga and Limpopo escarpment, and the Soutpansberg Range. Lizard families displaying the highest levels of endemism within the *Atlas* region are girdled lizards (Cordylidae, 94.0%), chameleons (Chamaeleonidae, 89.5%), geckos (Gekkonidae, 61.3%) and skinks (Scincidae, 59.0%), and these contribute significantly to the regional hotspots of lizard endemism. Rupicolous cordylids are a dominant component of the lizard fauna of the rugged Cape Fold Mountain region (Mouton & Van Wyk 1995, 1997) and the Lesotho and KwaZulu-Natal Drakensberg (Broadley 1964; Bates 2005a). Small generic radiations also occur in Namaqualand (*Namazonurus*, Stanley *et al.* 2011) and in association with the eastern escarpment and other mountain ranges of Mpumalanga and Limpopo provinces (*Smaug*, Stanley *et al.* 2011). A suite of dwarf chameleons (*Bradypodion*, Tolley & Burger 2004a, 2007a; Tolley *et al.* 2004, 2006; Branch *et al.* 2006b) is also associated with mesic habitats along the southern coast, while fossorial skinks (*Scelotes*, *Acontias*, *Typhlosaurus*, Bates *et al.* 1998; Lamb *et al.* 2010) have radiated in the sandy habitats of Namaqualand.

5.1.5 Snake diversity

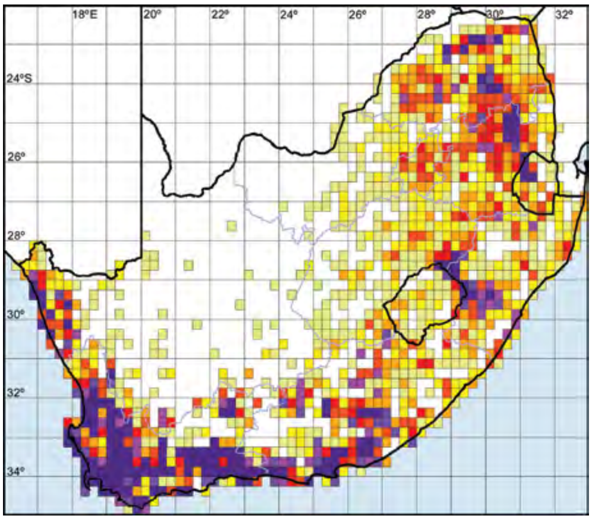
There are 39 647 snake records in 1 578 QDGCs (77.9% of total). Diversity ranges from 0 to 44 taxa per QDGC, with 8.2% of QDGCs having 20 or more taxa. QDGCs with very low diversity (1 taxon) comprise 232 (11.5%) of QDGCs (Figure 3.14). Snake hotspots are similar to those of lizards, but with more pronounced gaps in the highlands of Lesotho, the central Karoo, and the Kalahari region of the Northern Cape. Although these regions probably have relatively low snake diversity, particularly the



Number of records: 79 769
Number of grid cells: 1 741 (86.0%)

Number of taxa	Symbol	No. QDGCs	% QDGCs
1–2		294	14.52
3		118	5.83
4–5		225	11.11
6–7		205	10.12
8–9		185	9.14
10–11		171	8.44
12–14		178	8.79
15–19		185	9.14
20–41		180	8.89

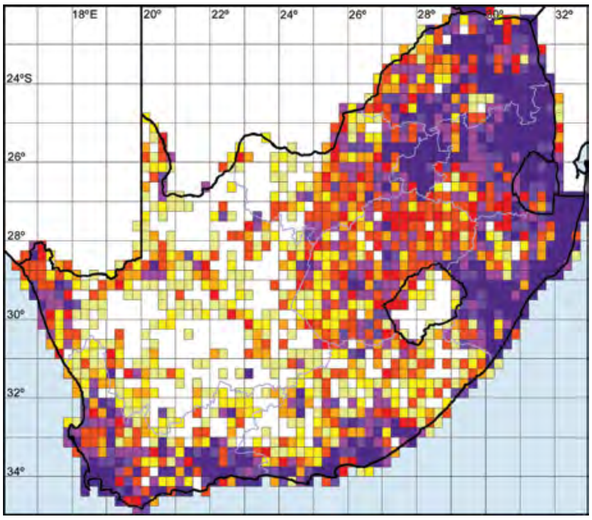
Figure 3.12—Distribution of lizards in the *Atlas* region.



Number of records: 28 533
Number of grid cells: 1 173 (57.9%)

Number of taxa	Symbol	No. QDGCs	% QDGCs
1		365	18.02
2		227	11.21
3		152	7.51
4		117	5.78
5		69	3.41
6		50	2.47
7		44	2.17
8		34	1.68
9–20		115	5.68

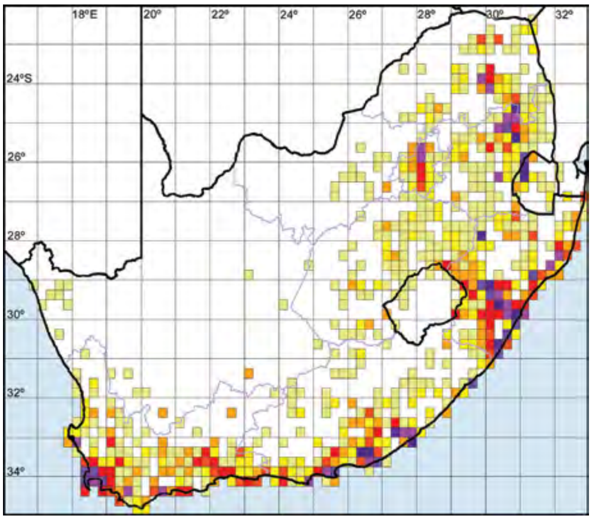
Figure 3.13—Distribution of endemic lizards in the *Atlas* region.



Number of records: 39 647
Number of grid cells: 1 578 (77.9%)

Number of taxa	Symbol	No. QDGCs	% QDGCs
1		232	11.46
2		176	8.69
3		158	7.8
4–5		243	12
6		104	5.14
7–9		200	9.88
10–12		138	6.81
13–19		161	7.95
20–44		166	8.2

Figure 3.14—Distribution of snakes in the *Atlas* region.



Number of records: 4 784
Number of grid cells: 646 (31.9%)

Number of taxa	Symbol	No. QDGCs	% QDGCs
1		317	15.65
2		123	6.07
3		81	4.00
4		31	1.53
5		43	2.12
6		23	1.14
7		15	0.74
8		6	0.30
9		7	0.35

Figure 3.15—Distribution of endemic snakes in the *Atlas* region.

highlands of Lesotho, much of the apparent absence is due to poor collecting in these regions.

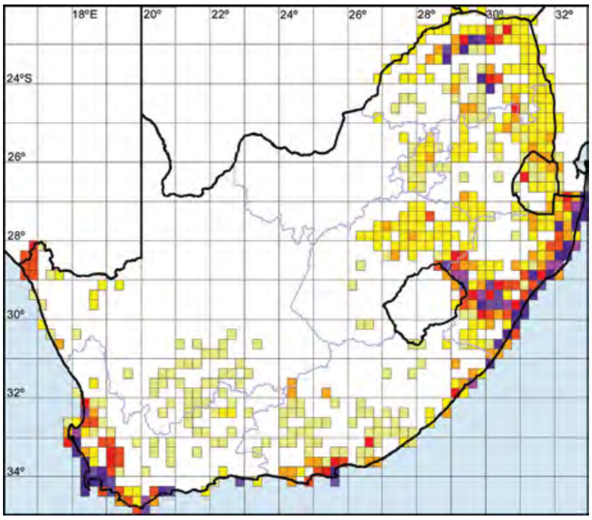
Endemic snake diversity

There are 4 784 records of endemic snakes from 646 QDGCs (32.0% of total), but only seven QDGCs (0.35%) contain the highest number (nine) of endemics (Figure 3.15). Centres of snake endemism are evident in the southwestern Cape, Algoa Bay area in the Eastern Cape, the KwaZulu-Natal Midlands, Waterberg Range, and escarpment region of Mpumalanga and Limpopo provinces. Unlike lizards, snake endemism is low in Namaqualand and the Soutpansberg.

5.2 Distribution of reptiles of conservation concern

Reptiles of Conservation Concern (CC) are those in Near Threatened, Vulnerable, Endangered, Critically Endangered and Extinct categories. As a precautionary principle, Data Deficient species are also included in this analysis. There are 6 252 records of CC reptiles in 573 QDGCs (28.3% of total; Figure 3.16). Several QDGCs (24, 1.2%) contain the highest weighted scores for reptiles of conservation concern. For much of the *Atlas* region, patterns of CC reptile endemism match those of overall reptile diversity (Figure 3.8), with the main hotspots of CC reptiles including the southwestern Cape, Algoa Bay, KwaZulu-Natal and the western Soutpansberg in Limpopo Province. The Richtersveld region is a minor hotspot of CC reptiles. When only CC taxa are plotted, the hotspots are similar to those when Near Threatened taxa are excluded, although there is less emphasis on the western Soutpansberg and northern Drakensberg escarpment region.

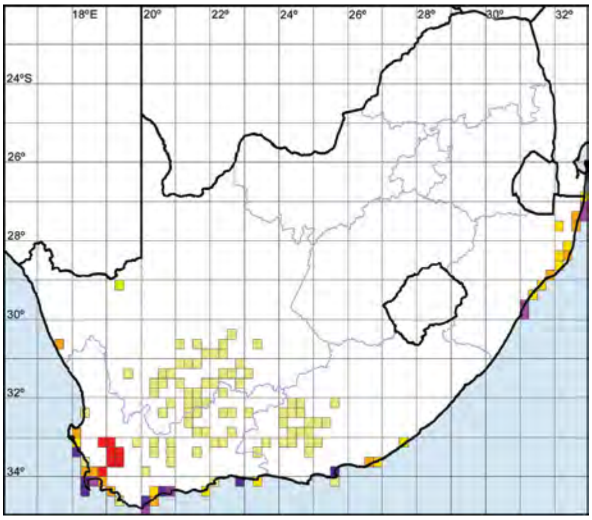
KwaZulu-Natal resolves into two basically contiguous hotspots. The coastal region, particularly in Maputaland, is home to a number of threatened sea turtles, i.e. Leatherback Turtle (*Dermochelys coriacea*, EN), Loggerhead Turtle (*Caretta caretta,* VU), Green Turtle (*Chelonia mydas*, NT), Hawksbill Turtle (*Eretmochelys imbricata*, NT), and Olive Ridley Turtle (*Lepidochelys olivacea*, DD), as well as the African Coral Rag Skink (*Cryptoblepharus africanus*, EN). The now fragmented coastal forests also include Green Mamba (*Dendroaspis angusticeps*, VU), Gaboon Adder (*Bitis gabonica,* NT), KwaZulu-Natal Black Snake (*Macrelaps microlepidotus,* NT) and Pygmy Wolf Snake (*Lycophidion pygmaeum*, NT), which also contribute to the KwaZulu-Natal coastal hotspot. A lesser hotspot occurs in the greater KwaZulu-Natal Midlands, with threatened taxa including the KwaZulu Dwarf Chameleon (*Bradypodion melanocephalum,* VU), Midlands Dwarf Chameleon (*Bradypodion thamnobates*, VU), Günther's Dwarf Burrowing Skink (*Scelotes guentheri*, EX), Durban Dwarf Burrowing Skink (*Scelotes inornatus*, CR), Bourquin's Dwarf Burrowing Skink (*Scelotes bourquini*, VU), and others. The Algoa Bay hotspot is restricted to the western region, centred on the Elandsberg and Port Elizabeth, with threatened taxa including Smith's Dwarf Chameleon (*Bradypodion taeniabronchum,* EN), Albany Adder (*Bitis albanica*, CR) and Salt Marsh Gecko (*Cryptactites peringueyi*, CR). This is the only hotspot that contains two Critically Endangered reptiles. The coastal region of the southwestern Cape is emphasised due to va-



Number of records: 6 252
Number of grid cells: 573 (28.3%)

Weighted score	Symbol	No. QDGCs	% QDGCs
1		178	8.79
2		196	9.68
3		64	3.16
4		39	1.93
5		19	0.94
6		10	0.49
7		12	0.59
8		10	0.49
9–16		24	1.19

Figure 3.16—Distribution of all reptiles of Conservation Concern in the *Atlas* region (quantiles are based on weighted scores).



Number of records: 439
Number of grid cells: 124 (6.1%)

Weighted score	Symbol	No. QDGCs	% QDGCs
1		77	3.80
2		14	0.69
3		12	0.59
4		7	0.35
5		6	0.30
6		3	0.15
7–9		3	0.15

Figure 3.17—Distribution of all chelonians of Conservation Concern in the *Atlas* region (quantiles are based on weighted scores).

grant sea turtles recorded from coastal waters; exclusion of these records would put greater emphasis on coastal lowland regions, including threatened taxa such as the Geometric Tortoise (*Psammobates geometricus*, CR), Cape Dwarf Chameleon (*Bradypodion pumilum*, VU), Cape Sand Snake (*Psammophis leightoni*, VU) and Southern Adder (*Bitis armata*, VU).

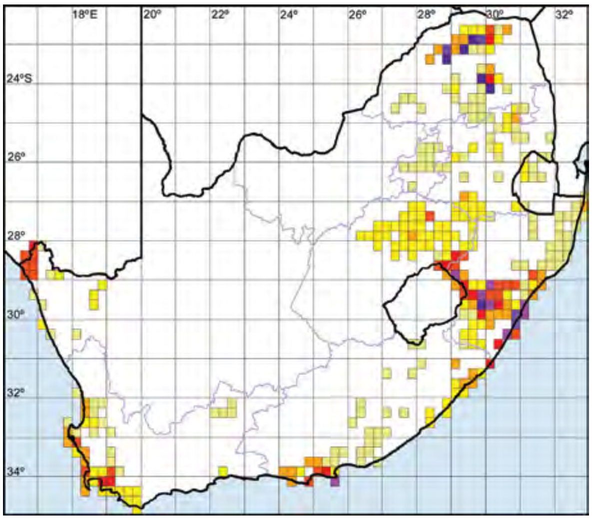
5.2.1 Chelonians

There are 439 records of chelonians of conservation concern in 124 QDGCs (6.1% of total; Figure 3.17). Three coastal QDGCs (3325DC, 3418AD and 3422BB) obtained the highest weighted score due to the presence of threatened sea turtles. High scores for the south and central Karoo result from the presence of the Near Threatened Boulenger's Padloper (*Homopus boulengeri*). The hotspot in the southwestern Cape is dominated by the Critically Endangered Geometric Tortoise (*Psammobates geometricus*).

5.2.2 Lizards

There are 4 583 records of lizards of conservation concern in 328 QDGCs (16.2% of total; Figure 3.18). There is a cluster of QDGCs in northern Limpopo Province, centred on the isolated mountains of the Blouberg and Soutpansberg in the north, and Wolkberg region on the Limpopo escarpment. Among them three QDGCs (0.05%) obtained the highest weighted scores due to the presence of CC lizards there. Two cells are located in the Soutpansberg region, i.e. 2229DC—Stripe-bellied Blind Legless Skink (*Acontias kgalagadi subtaeniatus*, DD), Soutpansberg Rock Lizard (*Vhembelacerta rupicola*, NT), Coppery Grass Lizard (*Chamaesaura aenea*, NT), Soutpansberg Worm Lizard (*Chirindia langi occidentalis*, VU), Cryptic Dwarf Gecko (*Lygodactylus nigropunctatus incognitus*, DD), and Soutpansberg Dwarf Gecko (*Lygodactylus ocellatus soutpansbergensis*, NT), and 2329AB—it lacks the Coppery Grass Lizard and Soutpansberg Worm Lizard, but includes Muller's Velvet Gecko (*Homopholis mulleri*, VU). The remaining QDGC occurs in the Woodbush region on the Limpopo escarpment, i.e. 2430AA—Woodbush Legless Skink (*Acontias rieppeli*, EN), Woodbush Flat Gecko (*Afroedura multiporis multiporis*, VU), Coppery Grass Lizard (*Chamaesaura aenea*, NT), Methuen's Dwarf Gecko (*Lygodactylus methueni*, VU), and the Northern Crag Lizard (*Pseudocordylus transvaalensis*, NT).

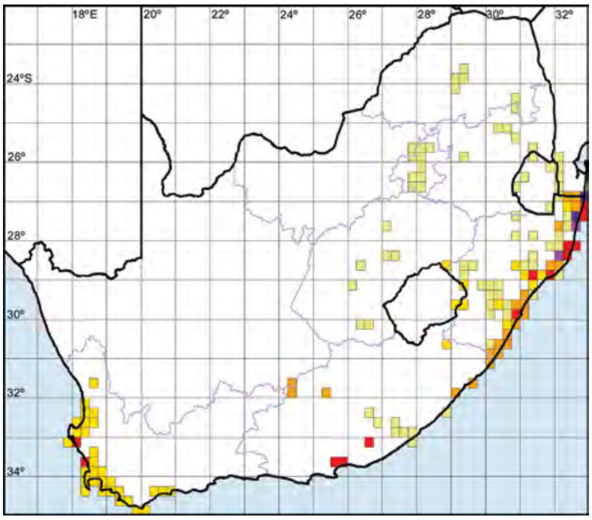
Other minor hotspots occur in the western Algoa Bay area due to the presence of a number of lizards with restricted distributions—e.g. Salt Marsh Gecko (*Cryptactites peringueyi*, CR), Smith's Dwarf Chameleon (*Bradypodion taeniabronchum*, EN), FitzSimons' Long-tailed Seps (*Tetradactylus fitzsimonsi*, VU) and Albany Sandveld Lizard (*Nucras taeniolata*, NT). Additional hotspots occur in the Lesotho, KwaZulu-Natal and Free State areas, centred on the Drakensberg escarpment and foothills, and extending into the southern KwaZulu-Natal coastal region due to the presence of a number of fossorial and relict forest species there. Another lizard hotspot in the southwestern Cape is more diffuse with a concentration of threatened or Near Threatened rupicolous cordylids, e.g. Black Girdled Lizard



Number of records: 4 583
Number of grid cells: 328 (16.2%)

Weighted score	Symbol	No. QDGCs	% QDGCs
1		129	6.37
2		103	5.09
3		40	1.98
4		24	1.19
5		14	0.69
6		8	0.40
7		4	0.20
8		3	0.15
9–10		3	0.15

Figure 3.18—Distribution of all lizards of Conservation Concern in the *Atlas* region (quantiles are based on weighted scores).



Number of records: 844
Number of grid cells: 153 (7.6%)

Weighted score	Symbol	No. QDGCs	% QDGCs
1		72	3.56
2		42	2.07
3		22	1.09
4		13	0.64
5		2	0.10
6		1	0.05
7–8		1	0.05

Figure 3.19—Distribution of all snake taxa of Conservation Concern in the *Atlas* region (quantiles are based on weighted scores).

(*Cordylus niger*, NT) and Dwarf Crag Lizard (*Hemicordylus nebulosus*, VU), as well as fossorial skinks, e.g. the dwarf burrowing skinks *Scelotes gronovii* (NT), *S. kasneri* (NT) and *S. montispectus* (NT). The Richtersveld region is an obvious lizard hotspot, but this is due to the presence of a suite of restricted Near Threatened species (e.g. *Goggia gemmula*, NT and *Typhlosaurus lomiae*, NT) rather than species in higher threat categories.

5.2.3 Snakes

There are 844 records of Near Threatened and threatened snakes in 153 QDGCs (7.6% of total; Figure 3.19). Only three QDGCs obtained the highest weighted scores. Due to their generally widespread distributions, few snakes qualify as threatened on the basis of restricted ranges (Criteria B, AOO). There are concentrations of threatened snakes in only two obvious hotspots: in the southwestern Cape, where the sand snake, *Psammophis leightoni* (VU) and the small adder, *Bitis armata* (VU), live in coastal regions subject to urban development; and the northern KwaZulu-Natal coast, particularly in the Maputaland region (QDGC 2632DD) where a number of regionally threatened snakes are concentrated, e.g. Gaboon Adder (*Bitis gabonica*, regionally NT), Green Mamba (*Dendroaspis angusticeps*, regionally VU), KwaZulu-Natal Black Snake (*Macrelaps microlepidotus*, NT) and Pygmy Wolf Snake (*Lycophidion pygmaeum*, NT). Some hotspots for lizards of conservation concern, e.g. Richtersveld and Soutpansberg regions, do not have significant numbers of threatened snakes. There are minor hotspots for threatened dwarf adders *Bitis inornata* (EN) and *B. albanica* (CE) in the central Karoo and Algoa Bay regions, respectively.

6. CONCLUSIONS

6.1 Recommended conservation actions

The accounts for each of the threatened, Near Threatened and Data Deficient species in this publication conclude with a section on 'Recommended conservation actions'. 'More research' was the most common recommendation (Figure 3.20).

The main research components required were surveys to both identify potential additional populations and to assess population densities and trends in surviving populations, surveys to determine the status of habitats, and basic biology studies to redress knowledge gaps relating to life history parameters and habitat dependence (Figure 3.21). A better understanding of threats was also considered important.

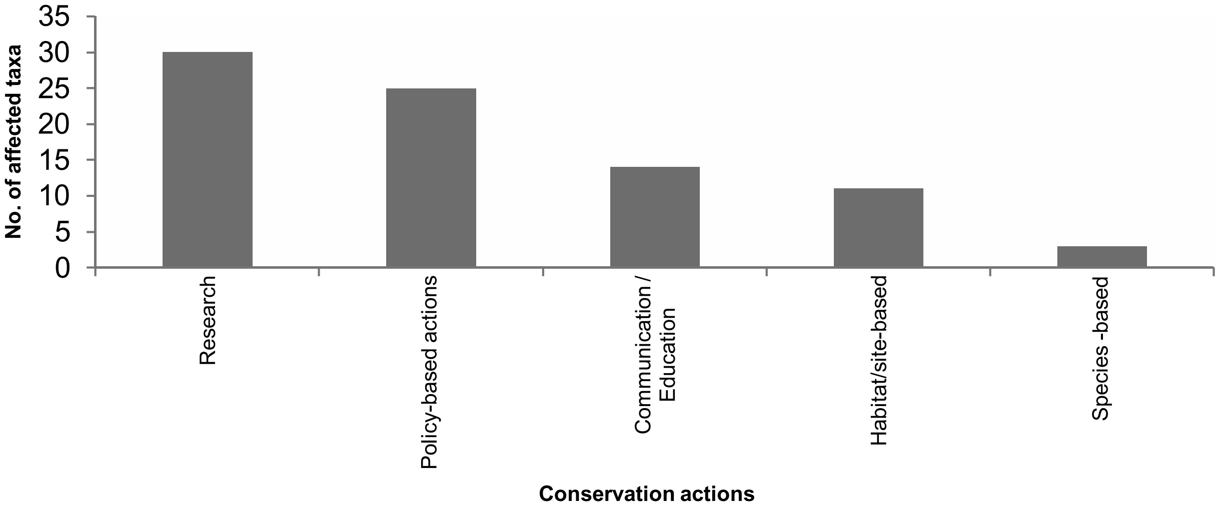


Figure 3.20—Conservation actions recommended for Conservation Concern taxa.

The importance of policy-based actions was also emphasised (Figure 3.20). Biodiversity Management Plans for Species were recommended for 38 taxa, to direct and prioritise conservation programs. Although existing protective legislation was believed to benefit 24 taxa, it was felt that there was room for improvement in terms of both development and implementation. The results of this Red List have been used to update South Africa's Threatened and Protected Species list for reptiles as part of South Africa's Biodiversity Act; the list was published by the Minister of the Department of Environment in 2012.

Improved education and communication, particularly improved public awareness, was believed to be important for effective conservation of reptiles. The need for site/habitat-based actions was also highlighted. Increasing protected areas would benefit 21 taxa, either through extensions to the existing national or provisional protected area networks or by encouraging various forms of public-private conservatories or partnerships.

6.2 Conservation planning

In the *Atlas* region the detailed distribution data generated for neglected groups such as amphibians (Minter *et al.* 2004), reptiles (this volume), butterflies (Mecenero *et al.* 2013), scorpions (www.arc.agric.za/home.asp?pid=3272), and dragonflies and damselflies (http://vmus.adu.org.za/) has important consequences for future conservation modelling in the region. It will allow better planning and development of protected area networks, as well as a more holistic education of environmental awareness for the public. The data from this *Atlas* was also used to inform South Africa's National Biodiversity Assessment and a number of regional conservation plans.

6.3 Future conservation assessments

This is the third national assessment of the conservation status of the reptile fauna of the *Atlas* region, following two earlier reviews (McLachlan 1978a; Branch 1988a). The assessment of threatened taxa at such lengthy (10–15 year) intervals is obviously undesirable. There is an urgent need for an ongoing assessment of threatened species so that their plight can be drawn to the attention of conservation authorities sooner rather than later. The plea for early notification to conservation authorities of the threatened status of taxa has been made on numerous previous occasions (Gärdenfors *et al.* 2001; Harrison *et al.* 2001; Branch 2002; Mills 2002; Branch & Harrison 2004). This need could be met by the formation of a permanent local Red List Committee to assess nominated taxa as submitted.

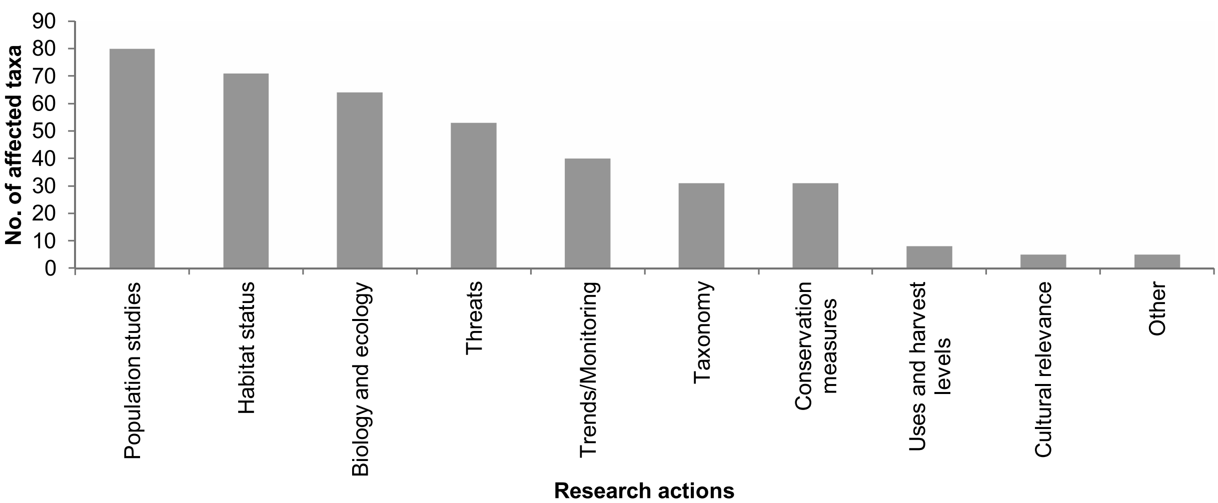


Figure 3.21—Research actions recommended for Conservation Concern taxa.

The nomination of Red List species would follow standardised international protocols, coupled with an objective assessment and quantification of threats. Awareness of this need is reflected in many new species descriptions which include preliminary conservation assessments (e.g. Bauer *et al.* 2006b; Branch 2007; Branch & Tolley 2010; Tilbury & Tolley 2009b). A vehicle for the immediate submission of these candidate species of conservation concern is essential. We therefore recommend that an IUCN Red List Authority be established for reptiles of this region. Branch & Harrison (2004) noted the need for ongoing proactive research and monitoring of threatened and Near Threatened amphibians, and a strategy for South African amphibian conservation research was recently proposed (Measey 2011). The summary information presented in this volume should empower similar reptile conservation plans.

7. CONCLUDING REMARKS

This chapter started with a quotation from Jonathan Baillie (2009) on the importance of National Red Lists. It is repeated here with emphasis: "*Producing National Red Lists is* ***a critical first stage*** *in identifying where species are threatened, why they are threatened and* ***what needs to be done about it.***"

The previous iteration of this Red List was prepared 25 years ago (Branch 1988a) and made numerous recommendations for the conservation of the region's herpetofauna. Many of these recommendations were re-iterated in the summary chapter on conservation in the Atlas and Red List for the region's amphibians (Branch & Harrison 2004). Many have been repeated again here. Baillie's comment is pertinent because it emphasises that Red Lists are a means to an end and not an end in themselves. Too often, however, it seems that conservation measures for non-charismatic groups, such as reptiles, amphibians and butterflies are limited to little more than Red Lists.

This *Atlas* is the best compilation to date of what is known about our reptiles, and it highlights many of the knowledge gaps that can be targeted to resolve outstanding problems. Its value, however, will stand or fall by its ability to stimulate and direct the efforts and finances of national and provincial conservation authorities, and by its ability to engage the enthusiasm and support of non-governmental organisations. Conservation in the subcontinent, and in much of Africa, has entered a new paradigm whereby it is viewed as a significant vehicle for sustainable utilisation that targets the social upliftment of neighbouring communities. In such a climate, what value is given to the small, cryptic and neglected lizards and snakes that do not attract ecotourism, that have no direct value in terms of sustainable resources, and which may even be venomous? Reptiles test our commitment to conservation, and also our awareness that biodiversity and ecological services depend on integrated ecosystems in which the value of the whole is exactly the sum of the parts. This *Atlas* must achieve these goals better than its predecessors (McLachlan 1978a, Branch 1988a) if the region is to withstand further reptile declines and extinctions.

SECTION 2

FAMILY, SUBFAMILY, GENUS, SPECIES AND SUBSPECIES ACCOUNTS

Introduction to accounts

Family accounts

Each of the remaining chapters deals with one of the 22 families in the Class Reptilia. The ordering of families reflects, as far as possible, evolutionary relationships as they are currently understood (see Chapter 2). Family accounts summarise information on any relevant taxonomic issues, the global and regional distribution of the family, global and regional richness of genera and species within the family, and the regional habitat diversity of the family. A brief biological summary is provided, as is a summary of the regional conservation status of species or subspecies within the family and their threats.

Subfamily accounts

Subfamily accounts are provided when there is good evidence for their usage. They are ordered alphabetically under the respective families. The exception is Subfamily Lamprophiinae, which is listed last under Family Lamprophiidae, because its relationships within elapoid snakes are unresolved.

Genus accounts

Genera are arranged in alphabetical order within each family. The same type of information provided in family accounts is provided for each genus.

Species/subspecies accounts

This *Atlas* is the official reference for the Red List status of species in the *Atlas* region, superceding all previous Red Data books. Species and subspecies accounts are arranged in alphabetical order within each genus, except that the account for the nominate subspecies is always presented first.

The accounts follow a standardised format. Each account begins with a heading containing the scientific name and common name(s) of the taxon under consideration. The first common name, in bold, is the name preferred by the SARCA editors. This is followed by other common names that are currently in use. The author(s) of the account is listed. The scope of the assessment (global or regional) is stated. Regional assessments were done for taxa with ranges extending outside of the *Atlas* region but for which there was insufficient information to allow for a global assessment; the status of such taxa was assessed for the region South Africa, Lesotho and Swaziland. This is followed by the Red List category assigned to the species and, for threatened or Near Threatened taxa, the IUCN criteria codes used to obtain the category (see Appendix 2 for the conservation status of select taxa, as assessed in this volume and compared with previous assessments). An explanation of IUCN categories and criteria is provided in Appendix 1. Taxa with extremely limited distributions in the *Atlas* region (regional extent of occurrence [EOO] <5% of global range <u>and</u> occurs in two or less QDGCs) were not assessed (see 'Not Applicable') but a species account was prepared. *Ramphotyphlops braminus*, an introduced species with established populations in the *Atlas* region, was also not assessed but a species account was prepared. The account heading indicates endemics (entire range within *Atlas* region) or near-endemics (90% of range contained within the region)—a list of these taxa is provided in Appendix 3, and taxa alien to the *Atlas* region are listed in Appendix 4. Each account is illustrated with one or more images. Current South African provinces referred to in the captions: Limpopo (LIMP), North-West (NWP), Gauteng (GP), Mpumalanga (MPM), Free State (FS), KwaZulu-Natal (KZN), Northern Cape (NC), Western Cape (WC) and Eastern Cape (EC). Other abbreviations used in captions: Nature Reserve (NR), National Park (NP) and Game Reserve (GR).

The account text begins with a section on *Taxonomy*, where any relevant taxonomic issues are outlined. This is followed by a description of *Distribution*, with particular emphasis on the *Atlas* region (South Africa, Lesotho and Swaziland). References to specific localities are sometimes accompanied by QDGC codes in brackets, corresponding to those used in the 1:50 000 South Africa Series of maps produced by the Chief Directorate of Geospatial Information. Altitute is indicated as metres (m) above sea level. For threatened or Near Threatened taxa, the text on *Distribution* concludes with estimates of the *extent of occurrence* (*EOO*) and *area of occupancy* (*AOO*) of each species (see below, and Appendix 1, for definitions of these parameters, and explanations of their methods of estimation).

Extent of occurrence (EOO)

Extent of occurrence (EOO) is defined as the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy (IUCN 2001). EOO estimates are not presented for Least Concern taxa. EOO values in this book are approximations, based on the available data and the authors' expert knowledge. The accuracy of these estimates is influenced by the quantity and quality of the data, and authors' confidence in estimates is indicated in accounts as high, medium or low.

Within the *Atlas* region, EOO for most species was estimated as the area of the minimum convex polygon around distribution records. Co-ordinates were projected (Lambert's equal area) to get real ground co-ordinates (in metres). For records where only a QDGC was available, the centerpoint co-ordinates of the QDGC were used. The projected co-ordinates were loaded into the software programme *R* (2.10.0, Windows version; R Development Core Team 2009). For each species or subspecies account, the convex hull was calculated using the function *chull()* and, with the points that were thus identified, the area of the polygon was calculated using a standard analytical geometry algorithm for the area of an *n-point* polygon.

For global assessments of taxa that are not endemic to the *Atlas* region, the EOO as calculated above was increased by the area outside the *Atlas* region in which the taxon is known to occur. The latter area was usually estimated by the authors of species accounts using published maps.

Area of occupancy (AOO)

Area of occupancy (AOO) is defined as the area within EOO that is occupied by a taxon, excluding cases of vagrancy but including new, established populations. AOO reflects the fact that a taxon will not usually occur throughout the area of its EOO, which may contain unsuitable or unoccupied habitats (IUCN 2001).

AOO estimates are not presented for Least Concern taxa. For species with wide distributions, AOO was estimated as the sum of the areas of occupied QDGCs minus the proportion of that area thought to contain habitat unsuitable for the taxon. The adjustment for unsuitable habitat was based on the account author's expert knowledge of the species. For taxa with very restricted distributions (limited to one or only a few adjoining QDGCs), and if the data allowed, AOO was estimated as the area of the minimum convex polygon around point localities. Note that due to the general lack of fine-scale distribution data, the IUCN Guidelines (IUCN 2008) for estimating AOO (making use of 2 × 2 km grids) could not be employed. Even where unsuitable habitat is excluded, the SARCA method likely over-estimates AOO. For wide-ranging taxa this may not be a serious issue but for more restricted taxa, extinction risk may be underestimated. As for EOO, authors' confidence in AOO estimates is indicated as high, medium or low.

Distribution maps

The distribution maps show national and provincial boundaries and grid lines at one-degree intervals. Distribution records are indicated on a quarter-degree grid cell (QDGC) scale in which a cell represents an area of 15 × 15 minutes. Only records collected within the SARCA region are plotted on maps (Table), which therefore represent global distributions only for taxa that are endemic to the region. On average for the region, each QDGC represents an area of approximately 676 km^2. Only presence/absence is indicated on maps; the number of records per QDGC is not represented in any way.

Table: Key to map symbols

SPECIMEN STATUS	TYPE OF RECORD	SYMBOL
Accepted	Non-VM records	■
	VM records	●
Introduced	Non-VM records	■
	VM records	●
Questionable	Non-VM records	?
	VM records	●
Historical	Non-VM records	☒

Non-VM and VM records are indicated by orange squares and cyan circles, respectively. Records that are considered questionable (e.g. records that are isolated from the bulk of distribution records, or records that may represent mistaken identifications) are coloured red. For taxa with restricted ranges, historical records (that have not been confirmed by recent sightings nearby) are represented by a cross (e.g. *Bradypodion taeniabronchum*). Pink cells on maps represent suspected human-assisted introductions/translocations (e.g. *Hemidactylus mabouia*). Records that are questionable, historical or represent introductions/translocations were excluded from estimates of EOO and AOO.

A short *Habitat* description is provided. This is followed by a habitat list which, for all taxa except the marine turtles and sea snakes, is according to the vegetation classifications of Mucina & Rutherford (2006) and is presented at one of three levels: biome or bioregion for wide-ranging species, or vegetation type for species with restricted distributions. For marine turtles and sea snakes, the IUCN Habitats Classification Scheme (www.iucnredlist.org/technical-documents/classification-schemes/habitats-classification-scheme-ver3) is used instead.

This is followed by the *Assessment rationale* which provides a justification for the given IUCN listing. For threatened taxa, it also provides the IUCN codes based on a strict set of defined criteria. The IUCN Regional Guidelines (IUCN 2003) were used in deciding whether or not to uplist or downlist regional assessments (see Appendix 1.5).

Accounts conclude with a description of *Threats* (not provided for Least Concern taxa) and recommended *Conservation measures* (provided for all taxa).

CHAPTER 4

Family Pelomedusidae

Richard C. Boycott

Freshwater side-necked terrapins of the family Pelomedusidae are mostly restricted to the southern hemisphere. The family is widely distributed in Africa, including Madagascar and the Seychelles, and comprises 19 species (Branch 2008; including *P. seychellensis* which may be extinct) in two genera. Both *Pelomedusa* and *Pelusios* are represented in southern Africa (Loveridge 1941; Boycott & Bourquin 2000). There are six species in southern Africa and five in the *Atlas* region. *Pelomedusa subrufa* is widely distributed, whereas the other species (all *Pelusios*) are restricted to subtropical regions in the north and east. Terrapins are found in a wide variety of natural and anthropogenic aquatic habitats. These range from permanent coastal lakes, swamps, rivers and dams to seasonal pans and flooded borrow pits and quarries.

Southern African terrapins are semi-aquatic, with somewhat depressed shells and flattened, paddle-like feet (adaptations for swimming), pointed snouts, flattened heads and feet with five claws. Members of the family are immediately recognisable by the manner in which the head and neck are withdrawn sideways into the shell. A distinctive feature of all side-necked terrapins is the presence of an intergular shield, located between the paired gular shields on the plastron. *Pelomedusa* lacks a flexible plastron, while *Pelusios* possesses a hinged plastron.

Terrapins are well-equipped for defence. Apart from withdrawing the head and neck into the shell, they have strong jaws and sharp claws, and will bite or scratch to defend themselves. They are also capable of exuding a foul-smelling fluid from glands located near the base of their forelimbs and hindlimbs and the stench can persist for days (Boycott & Bourquin 2000). Terrapins are primarily carnivorous but will also feed on the stems, leaves and flowers of aquatic plants. Their diet consists mainly of aquatic invertebrates and vertebrates, including insects, snails, worms, tadpoles, frogs, fish and birds. They are also opportunistic scavengers, taking carrion lying in the water or at the water's edge (Boycott & Bourquin 2000). Females lay 8–50 soft-shelled eggs in a nest hole excavated in the vicinity of a water body, usually on level ground. Incubation in southern African species ranges from 50 to 100 days (Boycott & Bourquin 2000).

Within the *Atlas* region, three species (*P. rhodesianus* [Vulnerable], *P. castanoides*, *P. subniger*) have restricted distributions and face a number of threats to their continued survival. Threats include loss of habitat, a decline in the quality of habitat, and persecution by humans.

Genus *Pelomedusa* Wagler, 1830—marsh terrapins

This monotypic genus contains the most common and widespread terrapin species in the *Atlas* region, namely *Pelomedusa subrufa*, found widely in sub-Saharan Africa. A recent study indicates that up to nine species may be subsumed under this name (Vargas-Ramírez *et al*. 2010). Unlike the other freshwater terrapins of the region which have hinged plastra, *P. subrufa* has an immovable plastron; the paired pectoral shields and the paired abdominal shields meet on the bridge that joins the carapace to the plastron. This is one of the hardiest and most successful terrapins in the region, occupying an ecological niche where competition with hinged terrapins is reduced or absent (Boycott & Bourquin 2008). This versatile terrapin survives in some of the more arid parts of the subcontinent, such as the Great Karoo and along the southern fringes of the Kalahari Desert, where it is able to colonise farm dams and other artificial wetlands. It has been found in areas far from water, indicating an ability to move over land to new habitats. In southern Africa females lay their eggs in autumn in the winter rainfall region of the southwestern Cape or in spring in the summer rainfall region, and clutches contain 10–30 eggs (Boycott & Bourquin 2008). The incubation period varies from three months in the summer rainfall region to six months in the winter rainfall region. Proliferation of farm dams has allowed these terrapins to expand their distribution. The species is under no immediate threat because suitable natural and man-made habitats inside and outside of protected areas are abundantly available throughout much of its continental range (Boycott & Bourquin 2008).

Pelomedusa subrufa (Bonnaterre, 1789)

MARSH TERRAPIN; HELMETED TERRAPIN

Richard C. Boycott

Regional: Least Concern

Taxonomy: The type description was previously assigned to Lacépède (1788), but Savage (2003) suggested that Lacépède's (1788) name appeared in a non-binominal work (Histoire Naturelle des Quadrupèdes Ovipares) and applied to have the work suppressed (Case 3226; Bull. Zool. Nom. 60 [2]). This application was successful (ICZN 2005) and the first available usage is thus that of Bonnaterre (1789). Various subspecies have been described, such as *P. s. olivacea* (olive in colour, pectoral scutes widely separated), but these are not generally recognised. However, a recent study identified nine strongly divergent mitochondrial clades within *P. subrufa*, indicating the possible existence of as many as nine species (Vargas-Ramírez *et al.* 2010).

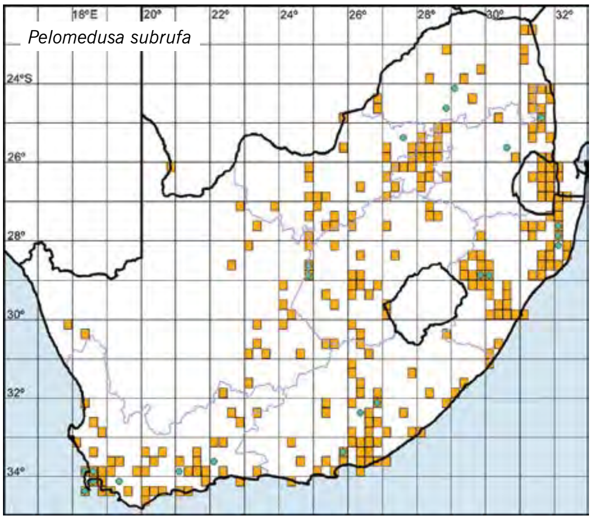
Distribution: Has a widespread distribution in Africa from the Cape Peninsula to Sudan (Iverson 1992; Boycott & Bourquin 2000). Also occurs on Madagascar and the Mascarene Islands but is absent from the Seychelles (Boycott & Bourquin 2008). In South Africa the range extends from the southwestern Cape eastwards through the Eastern Cape and northwards to northern and eastern South Africa and Swaziland. In the western half of South Africa this species is assumed to have expanded its range into semi-desert regions due to the prevalence of farm dams (Boycott & Bourquin 2008).

Habitat: Occurs in fresh or stagnant water bodies, including seasonal pans, flooded quarries and farm dams; avoids mountainous terrain, forests and desert regions (Boycott & Bourquin 2000). Survives droughts by burrowing into moist soil, sometimes far from its usual aquatic habitat, and emerges after rains (Branch 2008).

Biome: Savanna; Fynbos; Succulent Karoo; Nama-Karoo; Albany Thicket; Grassland; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common throughout Africa south of the Sahara. A resilient terrapin that can adapt to harsh environmental conditions. The possibility of as many as nine species (Vargas-Ramírez *et al.* 2010) being subsumed under the name *P. subrufa* indicates that the conservation status of some populations might have to be re-assessed, although it is unlikely that the status of populations within the *Atlas* region will change.

Conservation measures: None recommended.



Pelomedusa subrufa—Germiston, GP W.R. Schmidt

Genus *Pelusios* Wagler, 1830—hinged terrapins

Hinged terrapins are widely distributed in sub-Saharan Africa, Madagascar and the Indian Ocean Islands. Eighteen species are recognised, but *P. seychellensis* may be extinct (Branch 2008). In southern Africa the genus is represented by five species (Boycott & Bourquin 2000), four of which enter the *Atlas* region where they are largely restricted to the tropical and subtropical regions of eastern South Africa (Bourquin 2004) and Swaziland (Boycott 2001). These terrapins are characterised by the presence of a hinged plastron (weakly hinged in *P. broadleyi*), with the hinge located along the seam between the pectoral and abdominal shields (Branch 2008). Paired pectoral shields are excluded from the bridge that joins the carapace to the plastron. The articulation of the plastron provides additional protection once the head and neck have been withdrawn into the shell. *Pelusios* prefer perennial water bodies such as coastal freshwater lakes and large east-flowing rivers, although they are occasionally found in temporary water bodies such as seasonal pans, borrow pits and flooded quarries (Boycott 2001). Unlike *Pelomedusa*, hinged terrapins are less likely to travel long distances over land to colonise anthropogenic water bodies. Consequently, representatives of the two genera seldom occur in the same habitat, although there are some records of them occurring in the same seasonal pan (Boycott 2001). Females lay 8–25 eggs per clutch in spring and summer (Boycott & Bourquin 2000). The incubation period for eggs of one species, *Pelusios sinuatus*, is about 48 days under artificial conditions (Branch 2008). Three of the four hinged terrapins in the *Atlas* region have restricted ranges. In the context of their continental distribution these southern peripheral populations are under varying degrees of threat at the regional level, but the species are not threatened globally. Threats include habitat loss, a decline in the quality of habitat, and persecution by humans. In the *Atlas* region *P. rhodesianus* is classified as Vulnerable. *Pelusios castanoides* was previously classified as 'Peripheral' in the RDB, but it is no longer considered of conservation concern.

Pelusios castanoides Hewitt, 1931

YELLOW-BELLIED HINGED TERRAPIN

Richard C. Boycott

Regional: Least Concern

Taxonomy: Preliminary genetic results (Silva *et al.* 2010; Fritz *et al.* 2011) indicate that the Seychelles population is of very recent origin, possibly resulting from human-related colonisation, and recognition of a separate subspecies (*P. c. intergularis*) on the island is probably not valid.

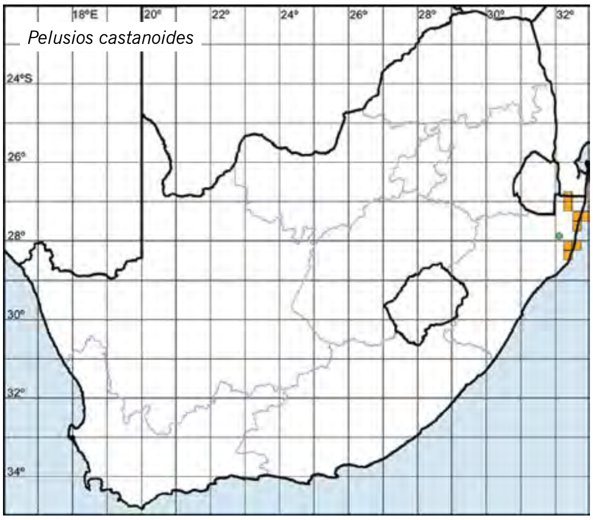
Distribution: Occurs in tropical eastern and southeastern Africa (Boycott & Bourquin 2000) with isolated, probably introduced, populations on Madagascar and the Seychelles. The distribution enters South Africa in the east along the Mozambique coastal plain, extending as far south as St Lucia and the Mfolozi River (D.G. Broadley & R.C. Boycott in prep.).

Habitat: Occurs in temporary pans and permanent well-vegetated water bodies in warm coastal regions (Bourquin 2004).

Bioregion: Lowveld; Indian Ocean Coastal Belt.

Assessment rationale: Within the region the species has a restricted EOO (<20 000 km^2 [B1]) and restricted AOO (<500 km^2 [B2]). However, there is no continuing decline or fluctuation in habitat quality or quantity. This species breeds in the *Atlas* region, there is significant immigration of reproductive individuals, and immigration is not expected to cease because the species is widespread, common and unthreatened outside the *Atlas* region in tropical eastern and southeastern Africa (Boycott & Bourquin 2000; Spawls *et al.* 2002). These terrapins are eaten by locals throughout Madagascar (P. Pritchard pers. comm.).

Conservation measures: Conserve its wetland habitats and conduct research into biology, population numbers and habitat status. It is listed in CITES Appendix II.

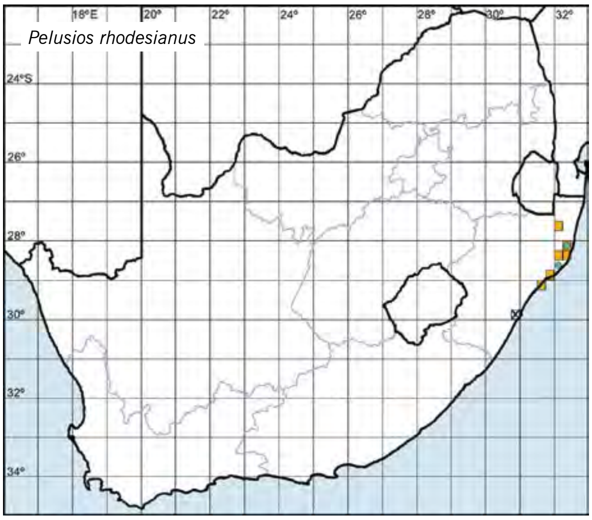


Pelusios castanoides—Tofo, Mozambique W.R. Branch

Pelusios rhodesianus Hewitt, 1927

VARIABLE HINGED TERRAPIN; MASHONA HINGED TERRAPIN; VARIABLE MUD TURTLE

Richard C. Boycott



Pelusios rhodesianus—E of Kwambonambi, KZN A. Shuttleworth

Regional: Vulnerable B1ab(iii)+2ab(iii)

Taxonomy: A molecular assessment of the isolated South African population is recommended as preliminary genetic results (Fritz *et al.* 2011) indicate that a number of cryptic taxa may be subsumed within this species.

Distribution: Occurs in tropical central and southern Africa (Boycott & Bourquin 2000). The population in South Africa is isolated and consists of three disjunct subpopulations in KwaZulu-Natal, i.e. Durban, Umlalazi and St Lucia. The southern population (2930DD) in Bluff Nature Reserve (Durban) is now considered to be extirpated (Bourquin 2004; Broadley & Boycott 2008).

EOO: 9 165 km^2 (confidence: medium); AOO: 466 km^2 (confidence: medium).

Habitat: Occurs in temporary pans and semi-permanent, well-vegetated water bodies in sandy coastal regions (Bourquin 2004).

Bioregion: Lowveld; Indian Ocean Coastal Belt.

Assessment rationale: Has a restricted EOO (<20 000 km^2) and AOO (<500 km^2, Endangered threshold), a severely fragmented distribution [B1a+2a], and is experiencing a continuing decline in area, extent and quality of habitat [B1b(iii)+2b(iii)] as a result of wetland destruction and pollution. Qualifies as Vulnerable. Although the species is widespread in tropical eastern and southeastern Africa (Boycott & Bourquin 2000), there does not appear to be any immigration into the *Atlas* region, therefore this regional assessment is not downgraded.

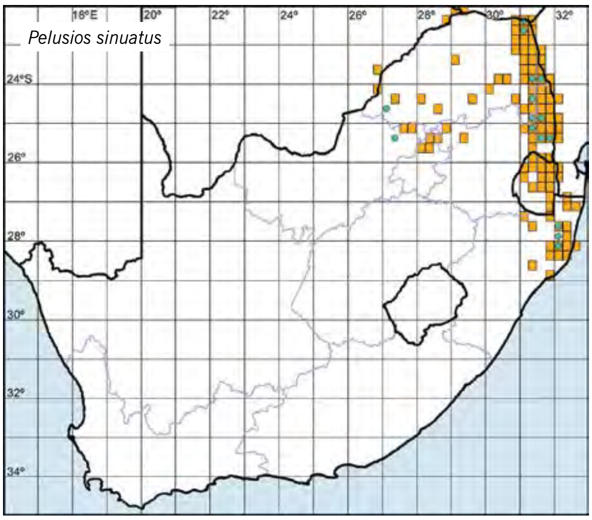
Threats: In KwaZulu-Natal the species may experience a decline in extent and quality of habitat as a result of the filling in of wetlands and, at some localities, pollution of the habitat (Broadley & Boycott 2008). Further fragmentation of habitat has probably occurred due to the expansion of agriculture (sugar cane fields) and silviculture (timber plantations). In some areas the roots of bluegum trees absorb large quantities of water, thereby lowering the water table and affecting wetlands. Mining of coastal dunes north and south of Mtunzini may also be detrimental to the continued existence of the Umlalazi subpopulation of these terrapins (R.C. Boycott pers. obs.). A lesser threat is the wanton killing of terrapins by locals in coastal pans south of Mtunzini (Broadley & Boycott 2008; O. Bourquin pers. comm.).

Conservation measures: Listed under CITES Appendix II. Conserve its wetland habitats and conduct research into biology, population numbers and habitat status.

Pelusios sinuatus (A. Smith, 1838)

SERRATED HINGED TERRAPIN

Richard C. Boycott



Regional: Least Concern

Taxonomy: Although it is generally considered that there are no notable taxonomic issues, preliminary genetic results (Fritz *et al.* 2011) indicate deep divergence in individuals from Phinda (KwaZulu-Natal) and Mashatu (northeastern Botswana), suggesting that a number of cryptic taxa may be subsumed within this species.

Distribution: Widespread in tropical eastern and southeastern Africa (Boycott & Bourquin 2000). In the *Atlas* region it is the most widespread of the hinged terrapins with a range extending from the northern parts of South Africa eastwards to the subtropical lowveld, and south through Swaziland to northern KwaZulu-Natal.

Habitat: Occurs in inland lakes and the larger perennial rivers of upland savanna, lowveld and the coastal belt. Found in fresh or stagnant water bodies including seasonal pans, flooded quarries and farm dams, but prefers medium to large perennial rivers (Boycott & Bourquin 2000). Often found basking on logs or rocks during the day (Branch 2008).

Bioregion: Lowveld; Mopane; Central Bushveld; Indian Ocean Coastal Belt.

Assessment rationale: Widespread in eastern and south-eastern Africa (Boycott & Bourquin 2000), inhabiting all the river systems of eastern Africa (Broadley 1981a). Very mobile, crossing land to take up residence in farm dams and temporary water bodies.

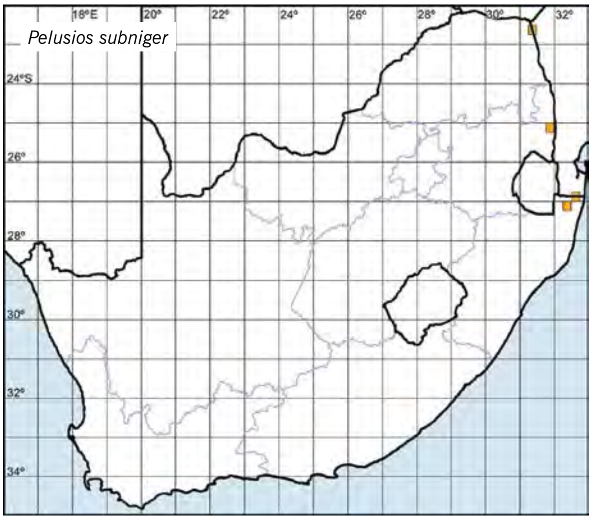
Conservation measures: None recommended.

Pelusios sinuatus—Cleveland NR, Phalaborwa, MPM M. Burger

Pelusios subniger (Bonnaterre, 1789)

PAN HINGED TERRAPIN

Richard C. Boycott



Regional: Least Concern

Taxonomy: Preliminary genetic results (Silva *et al.* 2010) indicate that the Seychelles population is of very recent, possibly human-related, colonisation. Recognition of a separate subspecies (*P. s. parietalis*) on the island is probably invalid.

Distribution: Widespread in eastern and southern Africa (Boycott & Bourquin 2000). Its range is peripheral in the northeastern parts of the *Atlas* region, where it occurs in Nyandu Sandveld (2231CB) (Pienaar *et al.* 1983) and at Lower Sabie (2531BB) (Hoffman & Van der Bank 2001) in the Kruger National Park, and in Tembe Elephant Park in northern KwaZulu-Natal (2632DC, 2732AB) (J. Harvey, L. du Preez, L. Meyer & O. Verneau in prep.). The latter is its southernmost locality. Has also been observed at a temporary stream near Salamanga on the boundary of the Maputo Special Reserve in southern Mozambique (J. Culverwell pers. comm.). Also found in northern Madagascar and the Seychelles. Introduced to Gloriosa and Mauritius islands—where it has been extirpated—and Diego Garcia in the Chagos Archipelago (Branch 2008).

Habitat: Occurs primarily in temporary pans in subtropical lowveld habitats (Boycott & Bourquin 2000), and elsewhere along small seasonal rivers and streams (Branch 2008).

Bioregion: Lowveld; Mopane.

Assessment rationale: Although known from only a few localities on the borders of South Africa (regional EOO 18 900 km^2, AOO 236 km^2), this species has a widespread distribution elsewhere. Within the *Atlas* region it occurs entirely within protected areas. It appears to be common in the wetlands of Tembe Elephant Park in KwaZulu-Natal, where 35 specimens were found in 10 out of 15 pans surveyed over two nights (J. Harvey, L. du Preez, L. Meyer & O. Verneau in prep.).

Conservation measures: None recommended as the species' range in the *Atlas* region is situated within protected areas.

Pelusios subniger—Tembe Elephant Park, KZN J. Harvey

CHAPTER 5

Family Cheloniidae

George Hughes & Ronel Nel

The family Cheloniidae is represented by five distinct genera comprising six species, four of which are circumglobal in distribution. Species in the *Atlas* region include the Green Turtle (*Chelonia mydas*) which was once divided into two species (Pritchard 1979) but is now regarded as a single circumglobal species (Hirth 1997; Limpus 2009), Loggerhead Turtle (*Caretta caretta*) (Hughes 1974a; Baldwin *et al.* 2003), Hawksbill Turtle (*Eretmochelys imbricata*) (Witzell 1983) and Olive Ridley Turtle (*Lepidochelys olivacea*) (Carr 1952; Reichart 1993). Two species have restricted distributions. Kemp's Ridley Turtle (*Lepidochelys kempii*) nests only on the shores of the Gulf of Mexico, although post-nesting movements take it into the North Atlantic Ocean (Carr 1952; Marquez-M. 1994). The Flatback Turtle (*Natator depressus*) nests only in northern Australia, with limited post-nesting feeding in the Gulf of Papua and the coastal waters of Papua in Indonesia. It is more or less endemic to the Australian continental shelf (Limpus 2009).

These large turtles are adapted to aquatic life and seldom visit dry land except to lay eggs. Their limbs are paddle-like and the carapace is covered with horny laminae, but weight is more or less reduced by the retention to varying degrees of the embryonic spaces between the ribs, and the connection between the upper and lower shells is not rigid. The neck is short, thick and incompletely- or non-retractile. The temporal region of the skull is completely roofed over both dorsally and laterally (Carr 1952). Excess salt is excreted via the salt glands located in the orbit of each eye (Schmidt-Nielsen & Fange 1958).

Cheloniids use beaches for egg laying. Hatchlings are widely distributed by ocean currents (e.g. Hughes 1978). As they mature, they establish feeding territories that are often widely dispersed and up to thousands of kilometres from natal beaches. They usually return to natal beaches to nest as adults after periods of up to 50 years (e.g. Limpus 2009). Many species return to nest after absences of up to 16 years and some species have extended reproductive lifespans. The recent recovery of a marked Flatback Turtle in Australia indicated a nesting lifespan of 35 years (C. Limpus pers. comm.). Most turtles have the potential to lay thousands of eggs during their reproductive lifetimes. Females of all species lay large numbers of fertile eggs from which only a few hatchlings (perhaps one or two) will survive to reproductive adulthood. Of the four species frequenting local waters, only *Caretta caretta* nests regularly on the South African coast, but rare cases of nesting have been recorded for *Lepidochelys olivacea* (e.g. Branch 1998). *Eretmochelys imbricata* and *Chelonia mydas* are common feeding residents in the region's waters (Hughes 1974a,b).

Over the last 500 years there has been widespread exploitation of chelonian populations around the globe, leading to severe declines in, and even extirpation of, some nesting populations. A few determined conservation projects were started in the 1950s and a South African programme was initiated in 1963. During this period there has been dramatic growth in both research and conservation effort and this has greatly improved our understanding of turtle biology and the long-term survival probabilities of all species. During the last 50 years there have been marked recoveries in turtle rookeries that have received formal protection. Outstanding results have been achieved in Réunion, Comores, Seychelles and South Africa. The establishment of the Indian Ocean and South East Asia Memorandum of Understanding (IOSEA MoU) of the Convention on Migratory Species has provided a dynamic vehicle to further improve the survival of the cheloniids of this region (Anonymous 2001).

IUCN Red List status of cheloniids ranges from Critically Endangered to Vulnerable. It has been suggested that the flaw in this system of classification lies in the IUCN mandate to categorise sea turtles on a global scale (Mrosovsky 2003). For example in the southern African region there are six or seven discrete populations of Green Turtles, most of which comprise thousands or even hundreds of thousands of individuals in various stages of development. Despite the threats to the species, it is difficult to categorise such populations as threatened according to IUCN criteria. All four cheloniid species in the *Atlas* region were assessed on a regional scale and at least three are of conservation concern. *Caretta caretta* is considered Vulnerable, and *Chelonia mydas* and *Eretmochelys imbricata* are Near Threatened. *Lepidochelys olivacea* is considered Data Deficient.

Genus *Caretta* Rafinesque, 1814—loggerhead turtles

Caretta apparently originated in the Pliocene and is now restricted to a single species, *C. caretta*, that occurs in every major ocean basin around the globe. This is the only turtle species that prefers temperate or subtropical mainland areas for nesting and is seldom found in the tropics. Large nesting assemblies occur on the east coast of the United States, Japan, east and west Australia, Oman and South Africa. This is the most common species of sea turtle nesting in South Africa, with extensions of the main nesting area into Mozambique and an outlier nesting population in southern Madagascar. The local metapopulation structure is important because about 1 000 females nest in the *Atlas* region every season (Nel 2009). Individuals are known to undertake extensive inter-nesting migrations as far afield as Somalia and Seychelles, and are known to enter the Atlantic Ocean (Hughes 2010). The local population has genetic links with populations around Oman and in the Mediterranean Sea (Bowen *et al.* 1994). Loggerheads nest in summer between October and February, with the densest nesting taking place in Maputaland, South Africa. Hatchlings emerge in late summer and are distributed widely by the Agulhas Current. Many enter Indian Ocean surface currents (gyres) and others are carried around the Cape into the Atlantic (Hughes 1974a,b). Subadults return to coastal waters after 5–10 years at sea, during which time they change feeding regimes and search for permanent feeding areas. Hatchlings feed on macroplankton and adults are omnivorous and feed opportunistically on benthic crustaceans and molluscs. On average they are sexually mature at 21–22 years. Females return to natal beaches to lay approximately 400 eggs per season, in batches of about 100 eggs. Intervals between clutches vary from 21 days at the cooler beginning of the season to 13 days during the height of summer. Up to 50% of each nesting cohort returns in subsequent seasons, with widely varying inter-seasonal intervals of 1–16 years (Nel 2009). The most common re-migration intervals are two or three years but many females do not seem to nest more than once. Although there are no widespread or focused exploitation programmes—killing of adults being normally accidental or fortuitous—the Loggerhead Turtle is regarded as Vulnerable in the *Atlas* region.

Caretta caretta (Linnaeus, 1758)

LOGGERHEAD TURTLE

Ronel Nel & George Hughes

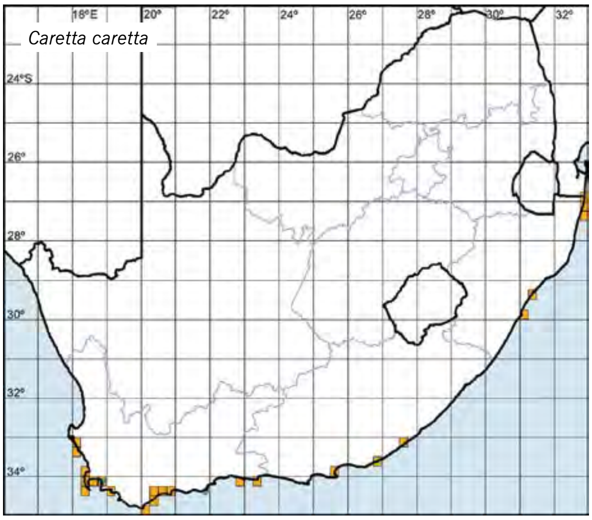
Regional: Vulnerable **D1**

Taxonomy: A poorly defined subspecies, *C. caretta gigas* (Indo-Pacific), is not generally recognised (Branch 2008).

Distribution: Globally distributed and migratory but with strong nest fidelity (Muller 1997; Dutton *et al.* 1999; Nordmoe *et al.* 2004). Nests in subtropical and temperate regions and frequents oceans from the tropics to higher latitudes, including the Mediterranean. Western Indian Ocean (WIO) Loggerhead Turtles nest in the northeastern part of South Africa, southern Mozambique and southern Madagascar (Hughes 1974c). They have been seen off Aldabra, the St Brandon Islands, Réunion Island and southern Madagascar (Hughes 1974c). Loggerhead rookeries have been identified between Richards Bay, South Africa and Bazaruto, Mozambique, along the east African mainland and around southern Madagascar on the beaches of Tulear and Fort Dauphin (Hughes 1974c; Louro *et al.* 2006). Tag returns indicate that there is probably genetic interchange at feeding grounds between animals from South Africa, Mozambique and southern Madagascar. The species is thus assessed according to this region, which forms a logical management unit. Adult females from the Tongaland rookery (Zululand, South Africa) appear to migrate north, south and east after the nesting season. Generally, large numbers of hatchlings passively follow the Agulhas current southwards and may become stranded along the south coast. Animals from Tongaland have been recorded off Namibia (Petersen 2008) and Madagascar, as far north as southern Somalia and as far east as Sri Lanka (Luschi *et al.* 2003a), but more typically feed off the east coast of Africa, especially Mozambique and Tanzania.

EOO: Not applicable; AOO: Not applicable.

Habitat: In summer it nests on beaches comprising medium- to coarse-grain intertidal silica sands backed by fine, wind-blown back beaches, forming a combination of stabilised, parabolic or mobile dunes. Preferred coastline



Caretta caretta—in captivity: Ushaka Marine World, Durban, KZN J. Marais is wave-exposed and dynamic, with storm tides exposing rocky sandstone platforms on the low shore or eroding foredunes on the high shore (R. Nel pers. obs.). Such coastline is backed by high (up to 100 m), steep dunes covered in *Scaevola* (Hughes 1974c; Louro *et al.* 2006) and *Ipomoea*, and subtropical lowland forest (McAllister *et al.* 1965). Females apparently prefer nesting against or in primary dune vegetation (Hughes 1974c). Nesting may be concentrated around lakes, particularly the Kosi Lake system, South Africa, which may provide a seepage point and possibly a strong chemical cue (Hughes 1989). Approximately 8 km of beach on the border between South Africa and Mozambique supports a very concentrated rookery, housing 40–60% of the western Indian Ocean Loggerhead nests. The niche occupied differs at different life history phases (Hughes 1989). Little is known about diet of hatchlings and post-hatchling phases, although these are assumed to be pelagic drifters that feed on gelatinous macroplankton such as ctenophores and cnidarians (Houghton *et al.* 2006) until they change from their neritic to benthic phase. Stomach content analysis of Loggerhead Turtles caught in shark nets indicate a wide variety of food items including crabs, starfish, and whelks that are associated with reef and sand substrate (R. Nel pers. obs.).

Biome: Marine oceanic—epipelagic (0–200 m); Marine intertidal—sandy shoreline/beaches, sandbars and spits; Marine Coastal/supratidal—coastal sand dunes.

Assessment rationale: The annual number of nesting females in South Africa ranges between 300 and 600 (Baldwin *et al.* 2003; Nel 2008). It is estimated that fewer than 100 individuals nest per annum in Mozambique (Lombard 2006) and an even smaller and declining population exists in Madagascar. The total number of adult females per annum is thus estimated to be less than 1 000 [D1].

Threats: Across the entire management area (i.e. southern Africa and adjacent waters), major threats are the harvesting of eggs (in Mozambique) and incidental capture in artisanal fisheries and longlining (from the South African fleet and from those vessels fishing under bilateral agreements). The three major fisheries in the western Indian Ocean are longlining, gill netting and shallow water shrimp trawling (FAO 2006). Longlining may be the greatest threat, but little information is available (Petersen 2008). Petersen (2008) estimated that about 100 Loggerhead Turtles are caught per annum in the South African longline industry. This is the turtle species that is most often taken in bather protection nets operated by Natal Sharks Board (NSB unpubl. data). On average, 30 turtles per annum are trapped and only half are released alive (Nel 2008). In South Africa, Loggerhead strandings are dominated by hatchlings that often strand alive and in good health (R. Nel pers. obs.). Intrinsic threats are slow growth and late maturation.

Conservation measures: Sea turtles are listed on the Appendices of CITES (South Africa is a signatory) and the Convention of Migratory Species (CMS). CMS has two additional, independent memoranda of understanding among countries in the Indian Ocean South East Asia region (IOSEA MoU) and the western seaboard of Africa (Atlantic MoU). All the Western Indian Ocean countries are signatories of the IOSEA agreement, with Mozambique being one of the most recent signatories (December 2008). In South Africa, they are also protected under the Marine Living Resources Act (1998). In South Africa, 170 km of nesting beaches and adjacent coastal waters (up to three nautical miles) are Ramsar sites and are in coastal and marine protected areas (Hughes 1996) with World Heritage status. Enforcement in South Africa is good, with beach patrols providing effective protection against nest raiding. In Mozambique, turtles are protected by general wildlife and hunting legislation and decrees relating to harvesting. In 2002, further protective measures were introduced through fisheries legislation (FAO 2006; Fennesy & Isaksen 2007). Protective legislation exists in Madagascar and although turtle meat is still consumed (Kimakwa & Ngusaru 2008), turtle excluder devices have been successfully implemented since 2004 (Kimakwa & Ngusaru 2008). Madagascar has yet to establish long-term monitoring programmes at rookeries, but such monitoring exists in South Africa and Mozambique (Kimakwa & Ngusaru 2008). A Biological Management Plan for Species is required. Taxonomic studies would be useful for investigating the relationships between animals from South Africa, Mozambique and Madagascar, and to determine whether or not there is genetic exchange between this and other subpopulations.

Genus *Chelonia* Brongniart, 1800—green turtles

This is an ancient genus now restricted to only one species, *Chelonia mydas*, which has a pantropical distribution (Carr 1952). Large and well-protected populations occur off the coasts of Australia (Limpus 2009), Oman, Yemen, Saudi Arabia, Republic of the Comores (Frazier 1985) Seychelles (Mortimer 1984), British Indian Ocean Territories, Mayotte and the scattered French-controlled islands, and from La Réunion, Costa Rica, Brazil and Surinam to the United States, including the Hawaiian Islands. Extensive but more vulnerable populations occur off the coasts of Mozambique, Turkey, Indonesia, Philippines, Thailand, Sri Lanka, India and Pakistan. The most important local metapopulation is found on Mayotte, Moheli (Comores) (Bruton *et al.* 1989), Europa (Le Gall 1988), and Tromelin, Les Glorieuses and Aldabra (Mortimer 1984). In this metapopulation approximately 30 000–35 000 females nest per annum and 2 000–5 000 females probably also nest on smaller, infrequently monitored beaches. Green Turtles undertake extensive migrations (Hughes 1974b). There are many examples of feeding grounds shared by metapopulations, especially in western Madagascar where there are extensive seagrass beds. The Europa population has genetic links with populations in the Atlantic Ocean (Broderick 2001; Bourjea *et al.* 2007a). Some nesting occurs throughout the year on islands off the coast of Mozambique and peaks in summer. Hatchlings lead a pelagic life for a year and then return to coastal estuaries and lagoons where they take shelter and change their diet from macroplankton to marine algae and sea grasses. Green Turtles do not nest in South Africa, but thousands feed along the coast on algae and *Cymodocea* where available. Turtles return to natal beaches to lay 400–800 eggs per season, with an average of just over 100 eggs per clutch. Some females return to nest in subsequent seasons after intervals of 3–4 years. Although categorised as Endangered by IUCN, this does not apply to the *Atlas* region as there are 10 fully-protected nesting areas off the coast of Mozambique, many of which receive increasing numbers of nesting females every year. The total number of Green Turtles of all sizes in the southwest Indian Ocean is estimated to be in the millions (G. Hughes, unpubl. data). However, Green Turtles are still hunted extensively in Madagascar and the recommended category for the *Atlas* region is therefore Near Threatened.

Chelonia mydas (Linnaeus, 1758)

GREEN TURTLE

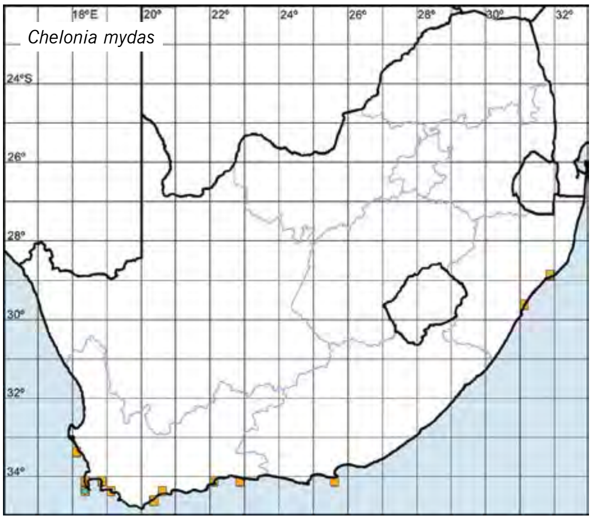
Ronel Nel & George Hughes

Regional: Near Threatened

Taxonomy: Although studies have demonstrated some genetic diversity between and within ocean basins (e.g. Roberts *et al.* 2004; Bourjea *et al.* 2007a), they do not support recognition of any subspecies. Turtles in the Eastern Pacific are sometimes considered a subspecies of *C. mydas*, or even a full species (*C. agassizi*), but these are best treated as a melanistic population (Branch 2008).

Distribution: Globally distributed, occurring in all of the large ocean basins (Seminoff 2004). In the Indian Ocean it is the most widely distributed of all the sea turtles, with nesting taking place outside of South Africa. Nesting has been reported at 64 localities, 25 of which are rated as important (www.IOSEATURTLES.org). Records of nesting in Mozambique are under-represented because no national report is submitted by this country. There are index beaches with long-term monitoring at only four localities: Europa Island, Juan du Nova, Tromelin and the Seychelles Islands of Aldabra and Assumption (Seminoff 2004; Lauret-Stepler *et al.* 2007). In-water distribution is throughout the Western Indian Ocean and Green Turtles are frequently observed by divers (pers. obs.) or encountered in artisanal or industrial fisheries (Hirth 1969; Hirth & Carr 1970; Frazier 1975; Hughes 1976; Frazier 1980; Hughes 1989; FAO 2006; Petersen 2008). This species is mainly restricted to eastern coastal waters of the *Atlas* region, but with records from along much of the Namibian coast. A large population (200+ individuals) feeds in the Cunene River estuary. There is one transoceanic basin record of a female tagged on Europa Island found at Wlotzkas Baken, Namibia (Griffin 2003). No breeding colonies occur in the *Atlas* region.

EOO: Not applicable; AOO: Not applicable



Chelonia mydas—in captivity: Ushaka Marine World, Durban, KZN J. Marais

Habitat: Adult females nest on sandy beaches on clear sand or in vegetation (R. Nel pers. obs.), while hatchlings and post-hatchlings are oceanic pelagic drifters (Seminoff 2004). Subadults and adults feed in neritic waters (Lutz & Musick 1996). Few reports are available on the diets of *C. mydas* in the western Indian Ocean (Björndal 1996), but elsewhere, during the post-hatchling phase when animals have depleted yolk, they have a pelagic drifting life (Seminoff 2004) that lasts until they reach a length of about 300 mm (Björndal 1996; Musick & Limpus 1996). They are fairly opportunistic and will feed on whatever is available, most often ctenophores and pelagic snails (*Janthina*). When they settle into this lifestyle they adopt a more herbivorous diet, feeding predominantly on seagrass and algae. This is unique among sea turtles (Björndal 1996).

Biome: Marine oceanic—epipelagic (0–200 m); Marine intertidal—sandy shoreline/beaches, sandbars and spits; Marine Coastal/supratidal—coastal sand dunes.

Assessment rationale: Data from French islands in the western Indian Ocean suggest that *C. mydas* is doing extremely well where it is protected adequately in the subregion and that it cannot be regarded as threatened (Bourjea *et al.* 2007b). However, since the species is not receiving equal protection everywhere, nor are population numbers likely to be as high as they were three generations ago, a Near Threatened categorisation is suggested. The number of nesting females is estimated to be >1 000 per annum, and growing at most of the monitored rookeries (Lauret-Stepler *et al.* 2007).

Threats: Threats include harvesting of eggs/animals, incidental capture through fisheries, and habitat destruction (Troëng & Drews 2004).

Conservation measures: In South Africa, this species is protected under the Marine Living Resources Act (1998), CITES and the Convention for Migratory Species (CMS). South Africa is also a signatory to two CMS memoranda of understanding among countries in the Indian Ocean South East Asia region (IOSEA MoU) and the western seaboard of Africa (Atlantic MoU). Nesting beaches and adjacent coastal waters (up to three nautical miles) are Ramsar sites, and are in coastal and marine protected areas (Hughes 1996) with World Heritage status (Baldwin *et al.* 2003). A BMP-S is needed. Sea turtles are also legally protected in the 10 other countries of the western Indian Ocean. Protection ranges from turtle-specific legislations to decrees protecting turtles in fisheries activities or development practices (Hamann *et al.* 2006). Enforcement varies from country to country. All these countries are also signatories to CITES. Where this species is protected, e.g. on index beaches, its numbers are increasing (Lauret-Stepler *et al.* 2007).

Genus *Eretmochelys* Fitzinger, 1843—hawksbill turtles

Eretmochelys imbricata is the sole member of the genus and has a pantropical distribution. It is the source of 'tortoiseshell' in many cultures and has been heavily exploited throughout its range for centuries. Although numbers have declined dramatically, the species' range has not contracted. Important populations still exist off the coasts of Yemen, Oman, Australia, Malaysia, Cuba and the Seychelles, with some populations showing signs of recovery (Witzell 1983; Hitchins *et al.* 2004). This turtle is most common around Madagascar where it is still exploited for its shell (Rakotonirina & Cooke 1994). No nests have been recorded in South Africa, but *E. imbricata* is a frequent visitor to the region's coastal and offshore reefs (Hughes 1974a), where it feeds primarily on sponges (Meylan 1988). The key to the survival of Hawksbill Turtles is that they seldom breed in dense aggregations, preferring to nest singly or in very small groups on sheltered and isolated beaches. In many areas they nest throughout the year, with some increase in frequency during summer. Females lay 100–180 or more eggs per clutch. Some females make multiple visits to nesting beaches at varying intervals. These turtles are still hunted extensively throughout much of their range and are generally regarded as Critically Endangered. In the *Atlas* region, however, they are classified as Near Threatened as a number of monitored beaches in the Seychelles are showing an encouraging increase in nesting numbers following the excellent controls imposed by the Seychelles government.

Eretmochelys imbricata (Linnaeus, 1766)

HAWKSBILL TURTLE

Ronel Nel & George Hughes

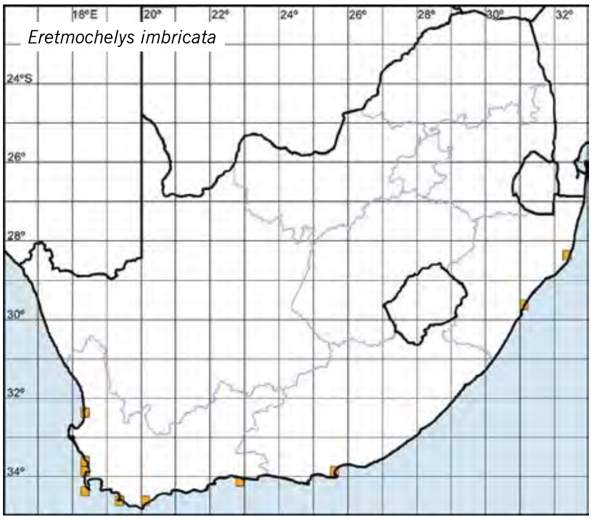
Regional: Near Threatened

Taxonomy: No information is available on the genetics of the population structure of Hawksbill Turtles in the western Indian Ocean. There are, however, no taxonomic disputes regarding the species (Bowen *et al.* 1993).

Distribution: Nest on beaches around the tropics in all major ocean basins across 70 countries (Mortimer & Donnelly 2008). Feeding grounds have been identified at 108 countries across the tropics of the globe (Mortimer & Donnelly 2008). Genetic studies indicate that there are mixed stocks on feeding grounds but separate, identifiable stocks on nesting grounds (Bowen *et al.* 2007). These nesting/feeding populations therefore form separate management units. The western Indian Ocean population has a relatively restricted distribution (based on nesting) and is thus expected to comprise a single stock. Nesting has been reported at a minimum of 47 sites throughout the south-western Indian Ocean (IOSEA 2009), including Comoros, the French-ruled islands of Mayotte, Glorious Islands and Juan de Nova, Kenya, Madagascar, Mauritius, Seychelles, British Indian Ocean Territories (Chagos Archipelago) and Tanzania. Louro *et al.* (2006) also reported nesting in the extreme north of Mozambique. There is no information available for Somalia, and no nesting of Hawksbills in South Africa has been recorded. However, strandings are reported annually and include turtles caught in bather protection nets in KwaZulu-Natal (Nel 2008).

EOO: Not applicable; AOO: Not applicable

Habitat: This species does not nest in South Africa. Elsewhere adult females use sandy beaches that are often associated with vegetation during the breeding season (Diamond 1976). Hatchlings and post-hatchlings are oceanic pelagic drifters. Subadults and adults are bottom feeders in neritic waters (Lutz & Musick 1996) associated with coral reefs, sea grass, algal beds or intertidal mangroves (Mortimer & Donnelly 2008). They are predominantly sponge feeders but eat a variety of food items depending on the habitat and the availability of prey. Thus, they range from being strictly spongivores to soft coral feeders to omnivores (Mortimer & Donnelly 2008). They may act



Eretmochelys imbricata—Angoche, Mozambique G.R. Hughes as ecosystem agents by enhancing coral growth through reducing competitors of corals for space.

Biome: Marine oceanic—epipelagic (0–200 m); Marine intertidal—sandy shoreline/beaches, sandbars and spits; Marine Coastal/supratidal—coastal sand dunes.

Assessment rationale: The global population is listed as Critically Endangered on the basis of an observed population reduction and threats due to levels of exploitation [A2b,d] (Mortimer & Donnelly 2008). Mortimer & Donnelly (2008) reported a >90% decline in the number of Hawksbills in the region. However, using the same approach employed for the other sea turtles, *E. imbricata* is here regarded as Near Threatened on the basis of >2 000 nesting females per annum (Mortimer & Donnelly 2008).

Threats: There are three main threats to sea turtles: direct harvesting of eggs/animals, incidental capture through fisheries, and habitat destruction (Troëng & Drews 2004). These all apply to Hawksbill Turtles, although for this species there are some special considerations. The meat of Hawksbills is not popular because it is known to accumulate toxins that can be lethal when ingested. However, when the species is caught in coastal fisheries the meat is kept, tested for edibility and then consumed. The shell is extremely valuable and has been globally traded, especially on the Asian markets (Mortimer & Donnelly 2008). CITES legislation seems to be effective in protecting this species and conservation programmes work well in places where the habitat is well-protected.

Conservation measures: Develop a BMP-S and conduct a Population and Habitat Viability Assessment (PHVA). In South Africa, this species is protected under the Marine Living Resources Act (1998), CITES and the Convention for Migratory Species (CMS). South Africa is also a signatory to two CMS memoranda of understanding among counties in the Indian Ocean South East Asia region (IOSEA MoU) and the western seaboard of Africa (Atlantic MoU). Nesting beaches and adjacent coastal waters (up to three nautical miles) are Ramsar sites and are in coastal and marine protected areas (Hughes 1996) with World Heritage status. Sea turtles off the coast of Mozambique are theoretically fully protected. Mozambican national legislation protecting turtles includes Forestry and Wildlife Regulation Decree No. 12/2002 Article 43, Sport and Recreational Fishing Decree No. 51/99 Article 14, and Maritime Fishery General Regulation Decree No. 43/2003 Article 110. The latter insists on the obligatory use of Turtle Excluder Devices (TEDs) in the trawling and motor fisheries (Louro *et al.* 2006). Mozambique is also a signatory to CITES, CMS and now the IOSEA MoU. This is one of the smallest sea turtle species and has suffered greatly under the shell trade. Two decades ago, the industry was responsible for large mortalities. Although it no longer seems to be as much of a threat, the shell trade should be strictly monitored.

Genus *Lepidochelys* Fitzinger, 1843—ridley turtles

The genus *Lepidochelys* is closely related to *Caretta*. There are two species of *Lepidochelys*: the Olive Ridley (*L. olivacea*), which is circumglobal in distribution, and Kemp's Ridley (*L. kempi*), which has a nesting distribution restricted to shores of the Gulf of Mexico, but an overall distribution throughout the North Atlantic (Marquez-M 1994). Major nesting concentrations of Olive Ridley Turtles occur in Orissa, India, the Pacific Coast of Central America (Costa Rica and Mexico) and French Guiana. Nesting has also been recorded in central and west Africa from Angola northwards. Scattered nesting occurs in East Africa, Australia, Bangladesh, Sri Lanka and Indonesia (Limpus 2009). Occasional massive coordinated nesting emergences (*arribada*) occur, when hundreds of thousands of females emerge in synchrony (Carr 1952). *Lepidochelys olivacea* is a very rare visitor to South Africa with only one nesting record (Warner Beach) (Hughes 1974a). Nesting takes place during the summer months. In the *Atlas* region these turtles grow to a carapace length of 730 mm. They feed primarily on crustaceans and are often encountered in prawn fisheries. Because the main population of *L. olivacea* in the Indian Ocean experiences mortalities due to accidental drowning in trawl nets, and because the main nesting beaches are not well-protected, the population in the *Atlas* region may be of conservation concern. However, because no quantitative information is available on population nesting trends or catch rates, and as it is uncertain whether all rookeries have been identified, *L. olivacea* is considered Data Deficient.

Lepidochelys olivacea (Eschscholtz, 1829)

OLIVE RIDLEY TURTLE

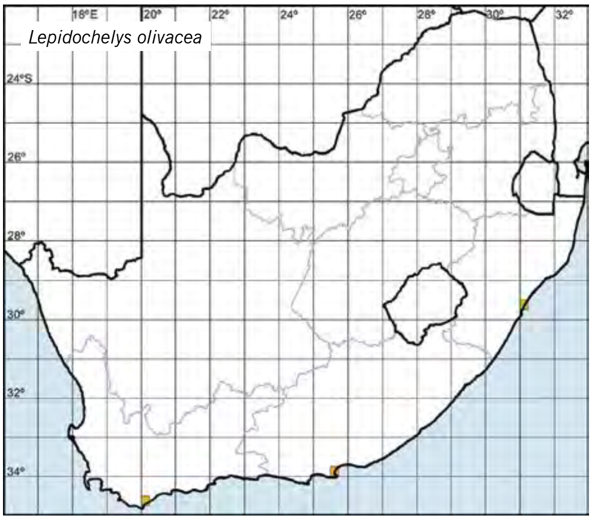
Ronel Nel & George Hughes

Regional: Data Deficient

Taxonomy: No notable issues.

Distribution: No information is available for the southeastern Atlantic (Abreu-Grobois & Plotkin 2008), except for a small number of nesting events in Angola. The number of individuals recorded in the southwestern Indian Ocean is negligible relative to elsewhere (Hughes 1974c; Hughes 1980). Sightings at islands in this area were first reported in 2007 (Hughes 1974c; Remie & Mortimer 2007). Small rookeries in Kenya (Zanre 2005) and incidental nesting in Tanzania (Pharaoh *et al.* 2003) have been recorded. There are historic (Hughes 1972) but not recent (Louro *et al.* 2006) records of nesting in Mozambique and Madagascar. Feeding takes place throughout the tropics and the species rarely migrates into the subtropical/temperate regions. It is therefore considered a vagrant in South African waters, where the average number of sightings per annum is <1 (Natal Sharks Board unpubl. data). A single vagrant nesting event has been reported for South Africa, at Warner Beach (Hughes 1971).

EOO: Not applicable; AOO: Not applicable



Lepidochelys olivacea—Port Elizabeth, EC W.R. Branch

Lepidochelys olivacea, female—Cabinda, Angola G.R. Hughes

Habitat: Little is known about its diet but, on the basis of its close relationship with *Caretta caretta*, it is expected to be carnivorous (but with weaker jaws than the latter), feeding predominantly on shrimps, crabs, pelagic tunicates and jellyfish (Hughes 1974c; Mortimer 1995). Two reproductive strategies exist, i.e. unsynchronised nesting and synchronised mass nesting (Jensen *et al.* 2006). The latter strategy may flood natural predators with eggs/hatchlings, resulting in an improved overall reproductive output for a rookery.

Biome: Marine oceanic—epipelagic (0–200 m); Marine intertidal—sandy shoreline/beaches, sandbars and spits; Marine Coastal/supratidal—coastal sand dunes.

Assessment rationale: No quantitative information is available on population nesting trends or catch rates. It is uncertain whether all rookeries have been identified.

Threats: Expected to experience the same threats as other species of turtles in the Western Indian Ocean, i.e. direct harvesting of eggs and animals, incidental capture through fisheries, and habitat destruction (Troëng & Drews 2004). The best quantitative data for South Africa is from entanglements in bather protection nets (Natal Sharks Board unpubl. data) and longline catch estimates (Petersen 2008), but these are minor threats that do not result in more than one or two fatalities per year. The number of strandings per decade in South Africa is likely to be less than one. Walker *et al.* (2004) reported a single Olive Ridley Turtle traded in Madagascar. The lack of trade probably reflects low availability, since prohibitions on harvesting and trade are generally ignored (Walker *et al.* 2004).

Conservation measures: Carry out a PHVA and develop a BMP-S. Improve protective legislation. Focus on education and public awareness. Monitor population numbers and habitat, and investigate the biology and ecology of the species. Proclaim protected areas that encompass beaches used for nesting.

CHAPTER 6

Family Dermochelyidae

George Hughes & Ronel Nel

This family is represented by a single, mainly pantropical genus, *Dermochelys*, comprising one species, *D. coriacea*. Leatherback Turtles represent a distinct lineage that probably diverged from the main chelonian stem in the early Cretaceous (Gaffney 1991). Recent genetic studies have demonstrated that there are discrete differences between the South African population and those in other ocean basins, peninsular Malaysia and northern New Guinea (Dutton *et al.* 1999).

Dermochelys coriacea is the largest of all sea turtles. Adults average 1.5 to 2 m in carapace length, with the largest recorded size 2.91 m (916 kg) for a stranded specimen found in northern Wales (Branch 2008). The Leatherback Turtle has an elongated, streamlined carapace with seven prominent longitudinal ridges covered by a thin layer of skin. Occasionally totally black, Leatherbacks are normally heavily spotted and streaked with pale blue on the upper surface with pink and white mottling on the underside. They are characterised by having a large pink pineal blotch on top of the head. The skin is soft to the touch. This is a pelagic, far-ranging animal capable of travelling long distances, even penetrating into Arctic and sub-Antarctic waters, and diving to depths of a kilometre or more to feed (Sale *et al.* 2006). The diet consists mostly of jellyfish. Satellite-tagged animals in the South African region are known to have travelled 20 000 km in 10 months. After nesting, they move far to the north, south and east, and commonly swim round the Cape and into the Atlantic Ocean, reaching as far north as the waters off Angola (Hughes *et al.* 1998; Luschi *et al.* 2003b; Lambardi *et al.* 2006).

Major nesting grounds are the northern coasts of New Guinea, the Pacific coast of Mexico, the Andaman and Nicobar Islands (India), South Africa, Trinidad, Virgin Islands, Surinam, French Guiana and Gabon. Several nesting areas (e.g. Sri Lanka, and Terengganu in Malaysia) have been nearly or completely eradicated; some show catastrophic declines (e.g. east and west Pacific rookeries), while others, such as sites in Florida and the Atlantic coast of Costa Rica, are recovering well (Hamann *et al.* 2006). The South African population is the largest in the southern Indian Ocean and the most southerly rookery in the world. It averages 80–90 females per year and appears to be stable after rapid population size increases in the 1970s (R. Nel unpubl. data).

Leatherbacks nest in summer from October to March, with hatchlings entering the sea from January. Hatchlings are distributed by the Agulhas Current with some entering the Indian Ocean gyres and others reaching the Atlantic around the Cape. Leatherbacks lay about 100 eggs per clutch and up to ten clutches per season. Hatching success is variable as nests are frequently situated low down on the beach and are prone to being washed over by tides. Females have been shown to return at intervals of 2–7 years (Hughes 1974b).

The small South African population represents the most southerly extent of the species' breeding range. It is threatened by various fishing activities and is thus classified as Endangered.

Genus *Dermochelys* Blainville, 1816—leatherback turtles

Dermochelys is a monotypic genus with a pantropical distribution. *Dermochelys coriacea* is the largest living species of sea turtle, reaching a carapace length of over 2 m and a mass of nearly a ton (Carr 1952). This pelagic, far-ranging species feeds mainly on jellyfish (Hamann *et al.* 2006). The South African population is the largest in the southern Indian Ocean and the most southerly rookery in the world (80–90 females per year) (Nel 2009). Leatherbacks nest in summer (October–March) with females laying an average of 104 eggs per clutch and up to ten clutches per season; hatchlings enter the sea from January (Hughes 1974a). Many hatchlings are swept southwards by the Agulhas Current with strandings recorded from Cape Agulhas (Hughes 1978). The South African population is small and threatened by various fishing activities, and therefore regarded as Endangered.

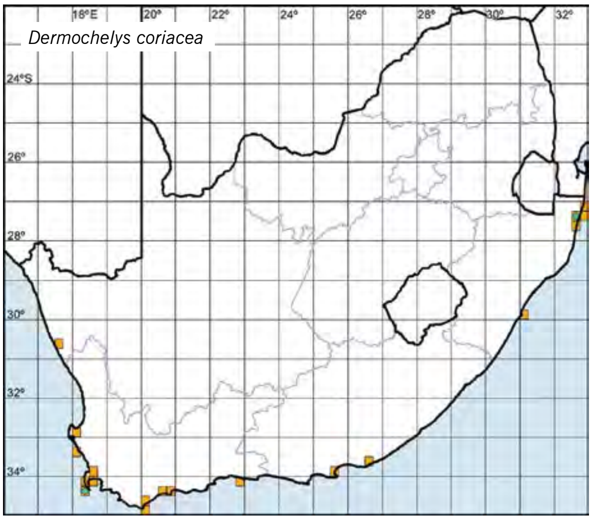
Dermochelys coriacea (Vandelli, 1761)

LEATHERBACK TURTLE

Ronel Nel & George Hughes

Regional: Endangered D

Taxonomy: It is unknown whether individuals from the southwestern Indian Ocean and southeastern Atlantic Ocean are genetically distinct from those in other regions. Tagging of nesting females in the region has not revealed emigration or immigration from/to rookeries outside the region (Hughes 1996). However, satellite-tagged females undergo extensive migrations off the east and west coasts of southern Africa, and flipper-tagged females have been recovered as far as the Seychelles (Luschi *et al.* 2006). The only published genetic study addressing the distinctness of individuals from the region assessed here is inconclusive (Dutton *et al.* 1999). More recent evidence in the grey literature suggests that this is indeed a discrete population (Dutton 2006), but further research is required to confirm this.



Dermochelys coriacea—Sodwana Bay, KZN W.R. Schmidt

Distribution: Globally distributed, occurring in all of the large ocean basins. Although nesting takes place in many tropical rookeries (biggest is on beaches of southern Gabon), Leatherbacks can venture into temperate regions and very low latitudes (Southwood *et al.* 1999; Branch 2008) and migrate long distances at sea. Climate change may lead to further range expansions (McMahon & Hays 2006), with only the extreme polar waters remaining uninhabitable. Dutton *et al.* (1999) indicated that, despite the migratory lifestyle of this species, there is significant subdivision of populations due to high nest site fidelity and consequent reproductive isolation. Nevertheless, proximal/adjacent rookeries are genetically indistinguishable (Dutton *et al.* 1999). This assessment thus considers the southwestern Indian Ocean and southeastern Atlantic Ocean as a unified region and within this region, focuses on the South African/Mozambican rookery. This rookery, at 28°23'S, 32°26'E, is one of the most southerly for the species, and its occupation is facilitated by the warm Agulhas Current flowing southwards along the southeastern seaboard (Hughes 1974a,b; Lambardi *et al.* 2008). At the end of the breeding season, hatchlings and adults leave the natal beach and drift, usually southwards, with the Agulhas Current. Near Cape Agulhas the current turns eastward, with small circulation cells migrating up the west coast. This relatively warm water (especially up the west coast) presumably contains high concentrations of food. Individuals from northern KwaZulu-Natal have been recorded off the coasts of Mozambique and Namibia (Sale *et al.* 2006) and below 40°S in the southern oceans (Hughes *et al.* 1998; Lambardi *et al.* 2008).

EOO: Not applicable; AOO: Not applicable

Habitat: Nesting and hatching take place from October to March. Beaches in South Africa and southern Mozambique where nesting takes place comprise medium- to coarse-grain intertidal sands backed by fine, wind-blown back beaches forming a combination of stabilised or mobile dunes. The coastline is wave-exposed and extremely dynamic, with storm tides exposing rocky sandstone platforms on the low shore or eroding foredunes on the high shore (R. Nel pers. obs.). The entire coastline is backed by high (up to 100 m), steep dunes covered in *Scaevola* (Hughes 1996) and *Ipomoea* as primary colonisers to coastal dune forest, and subtropical lowland forest (McAllister *et al.* 1965). It tends to nest where it can approach the beach unobstructed, i.e. in deep water without coral reefs or jagged rocks (Hughes & Mentis 1967), and nests are located in clear bare sand rather than in vegetation, as is the case for other turtle species. These turtles are permanent pelagic drifters, feeding on gelatinous macroplankton such as ctenophores and cnidarians (Leslie *et al.* 1996). Movements are largely influenced by currents, either through the physical force these exert or through their dissipation or concentration of food (Lambardi *et al.* 2008). Diving depth is generally <200 m, but changes with temperature and food availability (Sale *et al.* 2006). Leatherbacks generally occur in coastal waters above the continental shelf when near nesting areas, but disperse off the shelf away from nesting beaches (Lambardi *et al.* 2008). While feeding, they tend to spend most time between oceanographic eddies or areas of convergence or upwelling (including seamounts), where food is concentrated (Lambardi *et al.* 2008).

Biome: Marine Oceanic—Epipelagic (0–200 m); Marine Intertidal—Sandy Shoreline and/or Beaches, Sand Bars, Spits etc.; Marine Coastal/Supratidal—Coastal Sand Dunes.

Assessment rationale: The appropriate index used to measure turtle population trends is the number of nesting females per annum. Combining the data for all the rookeries clearly indicates that the number of Leatherback females nesting per annum in the western Indian Ocean is much fewer than 250 individuals but more than 50, and on this basis the species qualifies as Endangered [D].

Threats: The major threat in Mozambique is probably the stealing of eggs from nests. Longlining, from the South African fleet and vessels of other nations fishing under bilateral agreements (or no agreements at all), is a major threat throughout the region (Petersen 2008), although data on fisheries-related impacts are limited. The estimated annual unnatural mortality is approximately 60 individuals of all sizes for South Africa, and 6–10 for Mozambique (based on the estimate that the Mozambican population is 15% of the South African one). There is also a suspected threat off Namibia, the centre of the Benguela fishery operations. Stranding is a relatively minor threat, with less than three strandings per year in South Africa and approximately 10 strandings per year along the west coast of Africa, particularly the Namibian Skeleton Coast. Some strandings may be related to injuries caused by ship or ski-boat propellers (R. Nel unpubl. data). The mortality rates described above are high relative to the number of nesting females (on average, fewer than 100 per season in the region). Human modification of the coastal habitats upon which these animals depend is intense. However, most of the rookery occurs within a World Heritage Site and coastal protection is very good. The impact of tourists in South Africa is limited through restrictions placed on tour operators. The feeding ground is assumed to be modified because it overlaps with major pelagic fisheries. Potential effect of climate change on turtles is speculative but they have survived previous climatic perturbations. The effect of climate change on sea turtles in the southwestern Indian Ocean is expected to be minor because it should favour the production of females. Nesting beaches (in KwaZulu-Natal) are currently pristine enough to respond to moderate changes in sea level rise. The Leatherback, like other turtles, is also intrinsically vulnerable because it takes about a decade to mature (e.g. Zug & Parham 1996). However, it is the fastest growing of all turtle species (Jones *et al.* 2011).

Conservation measures: Develop a BMP-S. In South Africa, this species is protected under the Marine Living Resources Act (1998), CITES and the Convention for Migratory Species (CMS). South Africa is also a signatory to two CMS memoranda of understanding among countries in the Indian Ocean South East Asia region (IOSEA MoU) and the western seaboard of Africa (Atlantic MoU). Nesting beaches and adjacent coastal waters (up to three nautical miles) are Ramsar sites, and are in coastal and marine protected areas (Hughes 1996) with World Heritage status. In Mozambique the Leatherback is theoretically fully protected. Mozambican national legislation protecting turtles includes Forestry and Wildlife Regulation Decree No. 12/2002 Article 43, Sport and Recreational Fishing Decree No. 51/99 Article 14, and Maritime Fishery General Regulation Decree No. 43/2003 Article 110. The latter insists on the obligatory use of Turtle Excluder Devices (TEDs) in the trawling and motor fisheries (Louro *et al.* 2006). Mozambique is also a signatory to CITES, CMS and now the IOSEA MoU. In South Africa beach patrols have been established where nesting occurs (since 1963), to physically protect, tag and monitor nesting females (McAlister *et al.* 1965; Hughes 1996; Baldwin *et al.* 2003). A similar programme has been ongoing in southern Mozambique since 1994 (Lombard 2006). Turtles are still periodically slaughtered (including harvesting for consumption) in Mozambique despite growing conservation awareness. Conservation efforts, including monitoring programmes and education and awareness in Mozambique, should be expanded. Research in South Africa is currently geared to answer population-related questions such as age at maturity, genetics (including paternity/maturity testing), sex ratios and hatching success. These studies should be expanded to Mozambique. Little is known about fisheries impacts on any sea turtle species throughout the western Indian Ocean and southeastern Atlantic. South Africa has an onboard observer programme on longline vessels (Petersen 2008), which has identified longlining as the single biggest offshore threat. Fisheries impacts have not been quantified for the rest of the region (except for Réunion Island). Anecdotal evidence suggests that fisheries-related mortality is high on both the eastern and western seaboard and should be managed actively. This will require active intervention and participation from the regional fisheries management bodies such as the Indian Ocean Tuna Commission (IOTC), as Leatherback Turtles are not restricted to exclusive economic zones and are caught on the high seas.

CHAPTER 7

Family Testudinidae

Margaretha D. Hofmeyr, Richard C. Boycott & Ernst H.W. Baard

Tortoises occur worldwide in many temperate and tropical regions, but excluding Australia (Boycott & Bourquin 2000). The CITES Nomenclature Committee recognises 15 extant tortoise genera and 42 extant tortoise species (Fritz & Havaš 2007), but the number of known species increased to 43 after Branch (2007) described *Homopus solus* from Namibia. The *Atlas* region supports five genera (33% of world total) and 13 species (30% of world total) of tortoises. Eleven species are endemic to southern Africa and five species (*Homopus areolatus*, *H. femoralis*, *H. signatus*, *H. boulengeri* and *Psammobates geometricus*) are endemic to the *Atlas* region. Preliminary results of genetic studies indicate that the tortoise fauna of southern Africa may be more diverse than is reflected by the current taxonomy (Daniels *et al.* 2007; M.D. Hofmeyr & S.R. Daniels unpubl. data).

Linnaeus (1758) assigned all chelonian species (tortoises, terrapins and turtles) known at that time to the genus *Testudo*, but this genus was later limited to a single family of land-living chelonians. In subsequent years, several new genera were named for species groups in different zoogeographic regions, and only Palaearctic tortoises are still assigned to *Testudo* (Fritz & Bininda-Emonds 2007). In their revision of African cryptodires, Loveridge & Williams (1957) recognised *Chersina* and the strictly southern African genera *Homopus*, *Kinixys* and *Psammobates*, but placed Leopard Tortoises with other large-bodied tortoises in the genus *Geochelone*. The latter species was subsequently transferred to the monotypic genus *Stigmochelys* (see genus account and taxonomic notes under *S. pardalis*).

Tortoises have a bony shell (dorsal carapace and ventral plastron, joined by lateral bridges) consisting of dermal bony plates covered by horny scutes. Taxonomists use the arrangement of scutes and bony elements to distinguish different taxa. For example, *Kinixys* (hinged tortoises) is the only genus with submarginal scutes and a carapacial hinge that allows closure of the posterior shell opening (Loveridge & Williams 1957). Most tortoises have a domed carapace and the dorsal scutes of *Psammobates* species are often pyramidal in shape. The dwarf tortoises (*Homopus*) have a flat shell which facilitates access to narrow crevices in rock-dwelling taxa. Tortoises have stout limbs to support their heavy bodies, and each foot has four or five claws. The enlarged scales of the front limbs provide protection when tortoises withdraw into their shells. The pattern of front limb scales and head shields, as well as the presence or absence of buttock tubercles, have been used in tortoise taxonomy.

The endemic tortoise genera of southern Africa inhabit nearly all terrestrial biomes in the *Atlas* region. Diversity is particularly high in fynbos (four genera), where several species may be sympatric or even syntopic. Within the Savanna Biome, in the north and east of the *Atlas* region, four species of hinged tortoises occur. Tortoises are ectothermic herbivores and food specialisations and physiological tolerances are major determinants of their distribution. Many species live in regions of low rainfall, and recent research has highlighted the adverse effects of protracted drought on the body condition, growth and reproduction of the small endemic tortoise *Homopus signatus* (Loehr *et al.* 2007a,b; Loehr 2008). Most southern African tortoises have low fecundity and females of several species lay only one egg per clutch (Hofmeyr 2004; Loehr *et al.* 2004; Hofmeyr *et al.* 2005; Leuteritz & Hofmeyr 2007). Egg production often coincides with the rainy season, so that species in winter rainfall regions nest from winter to spring (e.g. *Homopus signatus* [Loehr *et al.* 2004; Loehr 2008], *P. geometricus* [Hofmeyr *et al.* 2006]) and species in summer rainfall regions nest in summer (e.g. *Psammobates oculifer* [M.D. Hofmeyr & T. Keswick, unpublished data]). However, some species produce eggs over many months (e.g. *Psammobates tentorius tentorius* [Leuteritz & Hofmeyr 2007]) or throughout most of the year (e.g. *Chersina angulata* [Hofmeyr 2004]).

Southern African tortoises appear to favour herbaceous plants with low fibre content when these are available (*S. pardalis* [Milton 1992], *P. oculifer* [Rall & Fairall 1993], *P. geometricus* [Balsamo *et al.* 2004; Henen *et al.* 2005], *H. signatus* [Loehr 2006]), but become less selective in the dry season (e.g. Leopard Tortoises switch from herbs and grasses to succulents). Although predominantly herbivorous, an important part of the natural diet of *Kinixys* consists of invertebrates such as millipedes, beetles, alate termites and snails (Boycott & Bourquin 2000).The diet of *C. angulata* includes flowering plants, mosses, mushrooms and animal products (Hofmeyr 2009; Joshua *et al.* 2010), similar to the diet of *K. spekii* (Hailey *et al.* 1998). On Dassen Island off the coast of the southwestern Cape, rabbit faeces comprised more than 27% of Angulate Tortoises' dry season diet (Joshua *et al.* 2010).

This assessment classifies *Psammobates geometricus* as Critically Endangered, *Homopus signatus* as Vulnerable and *H. boulengeri* as Near Threatened, with habitat degradation being the major threat. Indications are that *H. boulengeri* may become Vulnerable in the near future, and that deterioration in habitats of *Kinixys lobatsiana*, *K. natalensis* and *Psammobates tentorius trimeni* may require that these taxa be considered threatened. Most southern African tortoises are small, and their concomitant low dispersal potential may affect their ability to survive in the future, particularly in fragmented habitats.

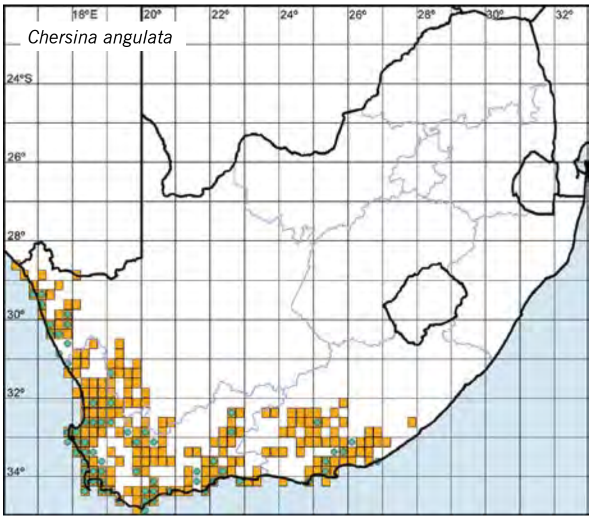
Genus *Chersina* Gray, 1831—angulate tortoises

This monotypic genus is restricted to South Africa and southwestern Namibia. *Chersina angulata* is medium-sized (maximum carapace length 300 mm) and distinguishable by its large, undivided gular scute. Its carapace is domed and the dorsal scutes are straw-coloured with dark centres and edges. Adult males are larger than adult females, which produce one egg at a time throughout most of the year (Hofmeyr 2004). This genus is not presently of conservation concern.

Chersina angulata (Schweigger, 1812)

ANGULATE TORTOISE

Margaretha D. Hofmeyr & Ernst H.W. Baard



Global: Least Concern

Near-endemic

Taxonomy: Although this tortoise's scientific name has been used in error (Bour 2008), Bour & Ohler (2008) argued for the retention of *Chersina*, distinct from *Chersine*, to maintain nomenclatural stability. *Chersina angulata* has no subspecies, but mitochondrial DNA markers indicate the presence of two genetically distinct clades associated with the western and southern regions of South Africa (Daniels *et al.* 2007). The taxonomic status of these clades has not been determined. In the past, fossil material from the Miocene (Arrisdrift) and early Pliocene (Langebaanweg) was assigned to *Chersina* (Meylan & Auffenberg 1986), but Lapparent de Broin (2003) showed that the Miocene material is referable to *Mesochersus*.

Distribution: Endemic to southern Africa. Found mainly within South Africa (about 90% of the range) but distribution extends marginally into southwestern Namibia. In South Africa it occurs from Komga in the Eastern Cape, westwards through most of the Western Cape, into the western region of the Northern Cape. Its range extends across the Orange River into Namibia, where the species is found in the Sperrgebiet and surroundings, as far north as Lüderitz and Aus; introduced populations have become established further north at Swakopmund and Walvis Bay (Griffin 2003). Also occurs on several offshore islands, reaching high densities on Dassen Island off the southwestern coast of South Africa.

Chersina angulata—Koingnaas, Namaqualand, NC J. Marais

Habitat: Occurs from the coastal plains all along the escarpment to altitudes of 1 200 m on the plateau. Habitat in fynbos consists of open to dense fire-prone shrubland covered with ericoid and asteraceous shrubs, restios and grasses. In the east, the range extends into Albany Thicket, which comprises dense semi-succulent and thorny vegetation, including large and small shrubs, geophytes, annuals and grasses (Hoare *et al.* 2006). Excluded from dense thicket, but high population densities can occur in partially cleared areas (Branch 1989). A large portion of the habitat falls in the Succulent Karoo which is dominated by dwarf succulent shrubs, with annuals, grasses and geophytes. Also found in the dwarf, open shrubland of the Nama-Karoo. These tortoises prefer a sandy substratum in which they partially bury themselves when taking refuge under vegetation. Nevertheless, they also occur in rocky areas where they take refuge under large boulders or among rocks.

Biome: Fynbos; Succulent Karoo; Albany Thicket; Nama-Karoo.

Assessment rationale: Widespread and common.

Conservation measures: Strongly discourage translocations between genetically distinct populations in the western and southern parts of the range.

Genus *Homopus* Duméril & Bibron, 1835—dwarf tortoises (padlopers)

Homopus areolatus shares with *H. femoralis* the unusual feature of four claws on the front feet. The other three species, *H. signatus*, *H. boulengeri* and *H. solus*, have five claws on their front feet. Hewitt (1931) created a new genus, *Pseudomopus*, for the latter group but later realised that the name *Chersobius* Fitzinger, 1835 was available (Hewitt 1937b). Although Loveridge & Williams (1957) acknowledged the differences between the two groups, they retained all species within *Homopus*. Mitochondrial DNA markers indicate substantial differences among the species, and the genus *Chersobius* might be re-instated (M.D. Hofmeyr & S.R. Daniels, unpubl. data). *Homopus solus* is endemic to a small area in southwestern Namibia, whereas the other four species are restricted to the *Atlas* region. *Homopus* are small, dorso-ventrally flattened tortoises, and all but *H. areolatus* live among rocks. Females of the 'Chersobius' group produce single egg clutches whereas the others lay 1–3 eggs at a time (Hofmeyr *et al.* 2005). *Homopus signatus* (Vulnerable) and *H. boulengeri* (Near Threatened) are of conservation concern. The main threats to these two species are habitat destruction (e.g. cultivated fields, overgrazing by livestock) and the pet trade.

Homopus areolatus (Thunberg, 1787)

PARROT-BEAKED DWARF TORTOISE; COMMON PADLOPER

Margaretha D. Hofmeyr & Ernst H.W. Baard

Global: Least Concern

Endemic

Taxonomy: Preliminary results of a molecular study indicate significant genetic differentiation within the species (M.D. Hofmeyr & S.R. Daniels unpubl. data).

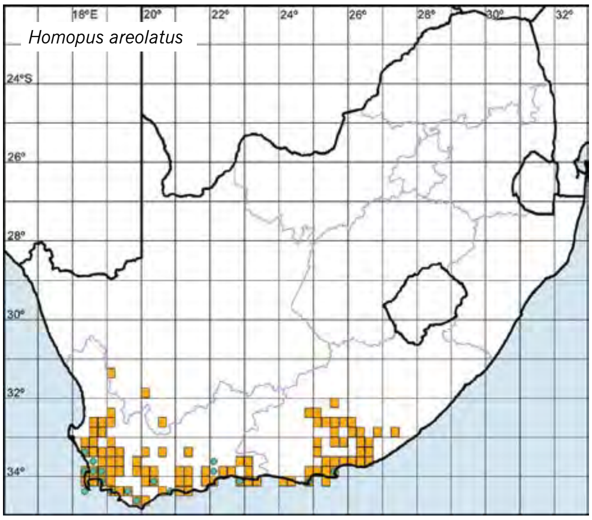
Distribution: Endemic to South Africa, occurring along the south coast from Eendekuil and Fish Hoek in the Western Cape to Cradock and King William's Town in the Eastern Cape. Relict populations are known from the southwestern interior of the Roggeveld-Bokkeveld region in the Northern Cape.

Habitat: Mainly associated with fynbos and renosterveld vegetation, but occurs in Albany Thicket in the east. Relict populations in the southwestern interior are associated with fynbos or renosterveld inclusions in the Succulent Karoo. It occurs from sea level to elevations of 1 300 m in the interior. Prefers low but dense vegetation cover that provides protection against temperature extremes and predation.

Biome: Fynbos; Albany Thicket.

Assessment rationale: Widespread and common in some areas.

Conservation measures: A re-assessment of this taxon may be required once its genetic structure has been revealed.



Homopus areolatus—6 km SE of Herbertsdale, WC M. Burger

Homopus boulengeri Duerden, 1906

KAROO DWARF TORTOISE; KAROO PADLOPER; BOULENGER'S PADLOPER; RED PADLOPER

Margaretha D. Hofmeyr & Ernst H.W. Baard

Global: Near Threatened

Endemic

Taxonomy: There appears to be little regional variation in morphology and colour pattern. Mertens (1955) referred specimens from Aus in southern Namibia to *H. boulengeri*. This record was questioned by Greig & Burdett (1976) and the dispute was finally resolved when Branch (2007) included this material in his description of the Namibian species *H. solus*.

Distribution: Endemic to South Africa, occurring from Pearston in the Eastern Cape to Touwsrivier in the Western Cape. The range in the Northern Cape extends to Calvinia in the northwest and beyond Carnarvon in the northeast.

EOO: 168 313 km^2 (confidence: medium); AOO: 4 708 km^2 (confidence: medium)

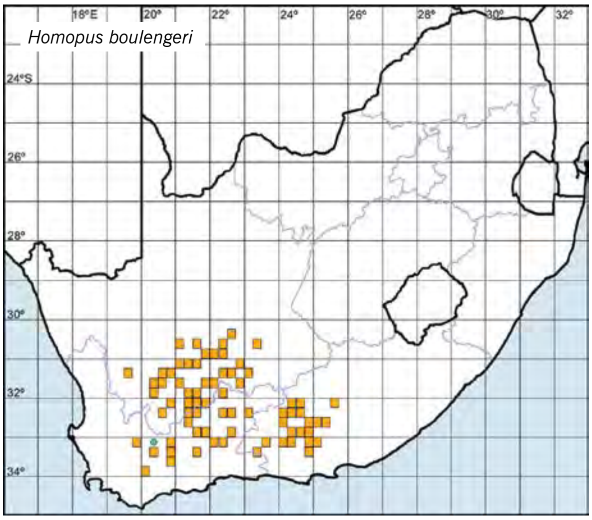
Habitat: Associated with dolerite ridges and rocky outcrops of the southern Succulent Karoo and Nama-Karoo biomes, and Albany Thicket in the southeast, at altitudes of approximately 800 m to 1 500 m. Occurs in dwarf shrubland that often contains succulent and grassy elements. Usually takes shelter under rocks in vegetated areas or in rock crevices (Boycott & Bourquin 2000).

Biome: Nama-Karoo; Succulent Karoo; Albany Thicket.

Assessment rationale: Extensive surveys by Greig & Burdett (1976) extended the range substantially and suggested that the species is not rare—as was previously believed—but that specimens were seldom encountered because they were so well-camouflaged. Recent efforts to study the species were not successful because no viable populations were found, even though surveys were conducted at sites where the species occurred previously (V.J.T. Loehr pers. comm.; M.D. Hofmeyr pers. obs.). It is not clear whether these populations have been extirpated or if the species was and is simply scarce. The species may be considered to be of Least Concern, based on its relatively wide distribution, but specimens are seldom found in the wild and there are indications that the species may be in decline. Considerable search effort at locations where *H. boulengeri* was recorded previously (Greig & Burdett 1976) produced only three live tortoises at one site and a few shells at two other sites. The search effort of nearly 600 person-hours covered about 20 localities in the districts of Williston, Carnarvon, Loxton, Victoria West and Beaufort West. During each field trip, farmers and labourers indicated that they seldom, or no longer, encountered these tortoises or that they had never seen them on their farms or even in their region. This indicates that populations from these areas are declining or may have been extirpated. The data is not good enough to list the species as Vulnerable (based on a past decline of 30% or more, i.e. A2), but a listing of Near Threatened seems appropriate.

Threats: Overgrazing by livestock can degrade habitat, but the extent of this threat is not known.

Conservation measures: Alert conservation officers in the Northern, Western and Eastern Cape provinces to concerns about the species' status. Thereafter, involve local communities in determining the status of populations and the extent of population declines over the range of the species. These efforts may help to identify suitable populations for scientific study, which should focus on population dynamics, resource requirements and reproduction. An attempt should be made to determine: i) whether the range has decreased over the past few decades, ii) whether the conservation status of populations has been compromised by threatening processes in the landscape, iii) whether there are sufficient reproducing populations within the current range, and iv) whether these tortoises spend long periods hidden deep in rocky crevices, which may explain their apparent scarcity.



Homopus boulengeri—vicinity of Loxton, NC A.L. de Villiers

Homopus boulengeri—Komsberg, Sutherland distr., NC W.R. Branch

Homopus femoralis Boulenger, 1888

GREATER DWARF TORTOISE;
GREATER PADLOPER

Margaretha D. Hofmeyr & Ernst H.W. Baard

Global: Least Concern

Endemic

Taxonomy: No notable issues.

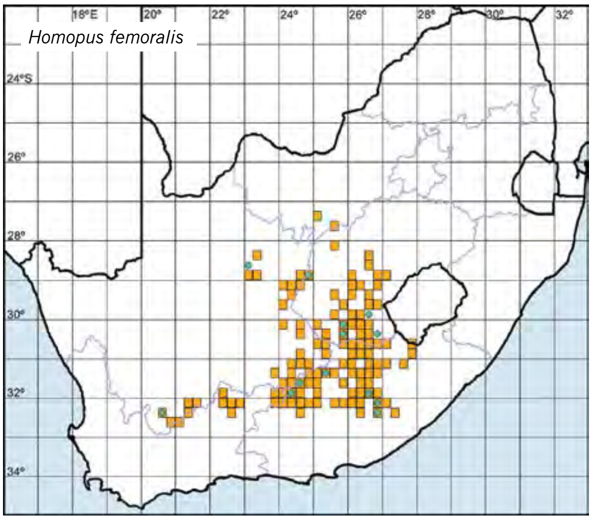
Distribution: Endemic to the *Atlas* region. Occurs in the southern Free State and the northwestern part of the Eastern Cape. From the Koueveldberge in the east, the distribution extends along the Onder-Sneeuberg Mountains and Nuweveldberg Mountains of the escarpment to Sutherland in the west. The northern range extends westwards to Postmasburg in the Northern Cape. The species also has a marginal presence in the North-West Province.

Habitat: Found at altitudes of 900–1 900 m. The habitats fall mainly in regions with sweet veld such as the Dry Highveld Grassland, the eastern Nama-Karoo and the southern Savanna. The species has a marginal presence in grasslands with sour veld. These tortoises prefer rocky areas with relatively dense vegetation, where they take shelter among rocks or under plants.

Biome: Grassland; Nama-Karoo; Savanna.

Assessment rationale: Widespread and relatively common in some areas.

Conservation measures: None recommended.

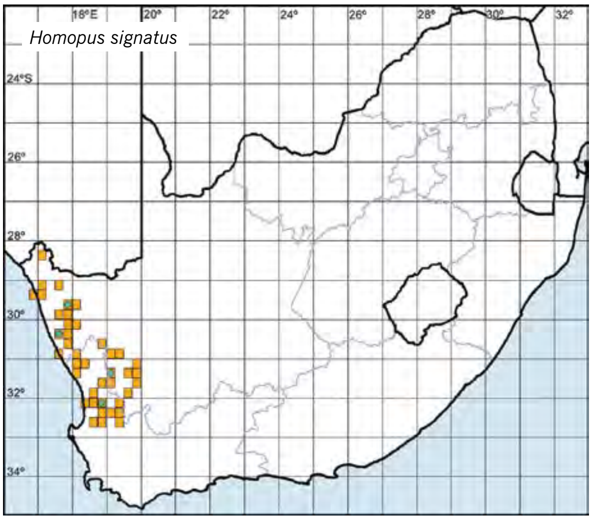


Homopus femoralis—S of Jamestown, EC A.L. de Villiers

Homopus signatus (Gmelin, 1789)

SPECKLED DWARF TORTOISE;
SPECKLED PADLOPER

Ernst H.W. Baard & Margaretha D. Hofmeyr



Global: Vulnerable A2acde

Endemic

Taxonomy: Two subspecies have been recognised, namely *H. signatus signatus* and *H. s. cafer*, with a zone of intergradation in the eastern part of the range in the western Great Karoo (Boycott 1986, 1989; Bour 1988; Iverson 1992; Branch 1998; Boycott & Bourquin 2000; Loehr 2008). However, a range-wide study by Daniels *et al.* (2010) evaluated the genetic distinctiveness of the two putative subspecies as well as intergrades and found limited differentiation within the species. It was concluded that *H. s. cafer* is not a valid taxon, rendering *H. signatus* monotypic. However, the status of a population from the Pofadder area (2919AB) requires further investigation (Daniels *et al.* 2010). Colour patterns previously used to distinguish the two subspecies appear to be related to crypsis on different substrates.

Distribution: Endemic to South Africa, occurring mainly along the West Coast region of the Western Cape and Northern Cape, from Piketberg and around Citrusdal in the south, northwards across the Olifants River into the Namaqualand Hardeveld to the Springbok-Steinkopf area. Eastwards, the distribution reaches as far inland as the Klipwerf-Loeriesfontein-Calvinia area of the Roggeveld-Bokkeveld region in the Northern Cape. The most northerly records are from the Richtersveld (Bauer & Branch 2003 [2001]) and from just north of Pofadder (Branch *et al.* 2007). Griffin (2003) did not substantiate any *H. signatus* records from Namibia, including a record from the Fish River Canyon Park (Boycott & Bourquin 2000). Earlier records of this species from Namibia (Mertens 1955, 1971) are referable to *H. solus* (Branch 2007).

Homopus signatus—Onseepkans, NC W.R. Branch

Homopus signatus—Springbok area, Namaqualand, NC A.L. de Villiers

EOO: 97 213 km^2 (confidence: medium); AOO: 2 730 km^2 (confidence: medium)

Habitat: Occurs predominantly in the winter rainfall region of the northwestern Succulent Karoo and Fynbos biomes along the West Coast and adjacent inland of South Africa. Found from a few metres above sea level on the West Coast to elevations of around 1 000 m in the interior at Loeriesfontein-Calvinia and the Cederberg Range (Boycott 1989). Shows a particular preference for rocky terrain, which includes typical Namaqualand and Hardeveld granite koppies in the north, and typical Sandveld and Cederberg sandstone koppies and rocky ridges in the south. Occurs in low to medium-high Namaqualand succulent blomveld and heuweltjieveld, and fynbos and strandveld shrub vegetation, both in the Succulent Karoo and Fynbos biomes. Prefers to shelter in rock crevices or under medium to large boulders and rock slabs, a behaviour that provides protection against temperature extremes and predation.

Bioregion: Karoo Renosterveld; Namaqualand Hardeveld; Trans-Escarpment Succulent Karoo.

Assessment rationale: Inferred population reduction of over 30% in the past three generations (75 years) due to anthropogenic land transformation, where the causes of destruction may not have ceased, based on direct observation [A2a], a decline in AOO, EOO and habitat quality [A2c], actual levels of exploitation [A2d] and the effects of introduced taxa [A2e]. These declines are considered likely to continue into the future.

Threats: Listed as Restricted by Boycott (1988) and as Lower Risk/near threatened in the 1996 IUCN global listing (IUCN 1996). Currently considered Vulnerable, mainly due to human-induced habitat degradation and destruction and the international reptile pet trade. Observations and focused research throughout the known range indicate that this species is intolerant of habitat modification. There appears to be a strong correlation between population status and habitat quality. Severe habitat fragmentation has resulted from extensive agricultural development throughout the range and especially in the Sandveld region. This includes the irreversible alteration of the inter-koppie (small hill) habitat—a zone that probably plays an important role in inter-population gene flow. Overgrazing by domestic stock, especially goats, further degrades and threatens remaining natural koppie habitats. There is illegal collection for export to the international pet trade, although this is infrequent. Midgley *et al.* (2005) recorded the imminent threat and potential impact of global climate change on the western parts of South Africa. Loehr (2008) clearly demonstrated that the expected changes in rainfall pattern and temperature across the range is likely to severely impact growth rates and fecundity of individuals, and consequently the survival of the species.

Homopus signatus—Citrusdal/Clanwilliam area, WC A.L. de Villiers

Conservation measures: Continue research into the life history of the species. Develop a BMP-S. Cultivate conservation stewardship arrangements that include more natural habitat (throughout the range) in formal conservation arrangements. Be vigilant for illegal collection of specimens for the pet trade.

Genus *Kinixys* Bell, 1827—hinged-back tortoises

The genus *Kinixys* consists of eight species that are widely distributed in west, central and southern Africa. It also occurs in Madagascar where it was probably introduced (Branch 2008). This diverse genus was traditionally considered to contain two ecological species groups, one occurring in rainforest habitats (*K. homeana* and *K. erosa*) in western and central Africa, and the other in savanna habitats (Loveridge & Williams 1957). However, recent phylogenetic studies have revealed that the rainforest species may be derived from a savanna-living ancestor (Kindler *et al.* 2012). Four savanna species, *K. zombensis* (as *K. belliana*), *K. spekii*, *K. lobatsiana* and *K. natalensis* extend into southern Africa, including the *Atlas* region (Broadley 1993; Boycott & Bourquin 2000; Branch 2008). Although some of these forms have been known since the 1860s, all the southern African species were for some time treated as a single species, *K. belliana* (Loveridge & Williams 1957). However, with reference to *K. belliana* in southern Africa, Pritchard (1979) suggested that a more detailed investigation might confirm the validity of some of the forms described earlier, e.g. *K. spekii* Gray, 1863; *K. darlingi* Boulenger,1902; *K. lobatsiana* Power, 1927; *K. zombensis* Hewitt, 1931; *K. australis* Hewitt, 1931; and *K. natalensis* Hewitt, 1935. The latter was revived as a full species and *K. belliana spekii* as a subspecies by Broadley (1981b), who later treated *K. spekii* as a full species and also revived *K. lobatsiana* (Broadley 1993). A recent study of phylogeography, phylogeny and taxonomy of hinged-back tortoises (Kindler *et al*. 2012) found that the previously recognised savanna species *K. belliana* comprises a conglomerate of three deeply divergent clades that are now treated as distinct species. *Kinixys belliana* (Gray, 1830) ranges from Angola to Burundi, and does not extend into the *Atlas* region. It may also occur in Cameroon (the type locality of the species is "West Africa"—see Iverson 1992) and extend as far northeast as Ethiopia (Broadley 2012). *Kinixys nogueyi*, previously recognised as a West African subspecies of *K. belliana*, characterised by having only four-clawed feet, is treated as a full species, but includes five-clawed tortoises from the northernmost part of the formerly recognised range of *K. belliana*. These two species are allied to *K. spekii*, whereas southeast African and Malagasy hinged-back tortoises formerly lumped together with *K. belliana* represent the distinct species *K. zombensis*, which is sister to *K. lobatsiana*. The latter two species together constitute the sister group of the rainforest species *K. homeana* and *K. erosa* (Kindler *et al*. 2012).

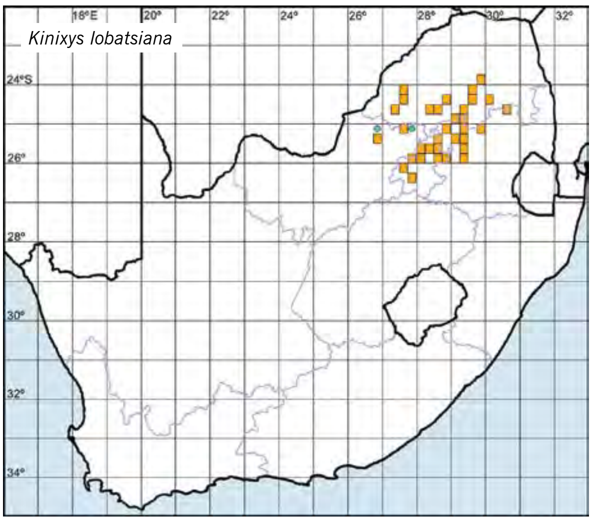
The genus name, derived from Greek, means 'movable back' and refers to the posterior, hinging part of the carapace, a unique feature that distinguishes these tortoises from other testudinids. The hinge is located between some of the individual bones of the shell and is visible externally between marginal shields seven and eight and costal shields three and four. The hinge develops with maturity, so a more reliable identification guide to the genus is the fact that the lower margin of the third costal shield is narrower than the lower margins of the second and fourth costal shields. Hinged tortoises are omnivorous, feeding on vegetation as well as many types of invertebrates such as millipedes and snails. In southern Africa females lay their eggs during summer, but sometimes as late as April. Females of some species produce more than one clutch in a season. Clutch size varies (2–10 eggs) and depending on the species, eggs hatch after 3–12 months (Boycott & Bourquin 2000). *Kinixys natalensis* was classified as Near Threatened in Swaziland and also by the IUCN (IUCN 1996) due to habitat loss and a decline in the quality of its habitat. It has been suggested that the species' status in Swaziland, Mozambique and South Africa should be monitored (Boycott & Broadley in prep.). In this assessment all four species of *Kinixys* in the *Atlas* region are considered Least Concern.

Kinixys lobatsiana Power, 1927
LOBATSE HINGED-BACK TORTOISE

Richard C. Boycott

Global: Least Concern

Near-endemic



Taxonomy: All southern African *Kinixys* were referred to *K. belliana belliana* by Loveridge & Williams (1957). *Kinixys lobatsiana* was re-instated as a full species by Broadley (1993).

Distribution: Occurs from Lobatse in southeastern Botswana, eastwards into South Africa (D.G. Broadley & R.C. Boycott in prep.). Near-endemic to the *Atlas* region, extending from the northeastern parts of the North-West Province, eastwards through northern Gauteng and adjacent parts of Mpumalanga and northwards into Limpopo south of the Soutpansberg. An easternmost record for the species from Manyeleti Game Reserve (2431CB) in the subtropical lowveld is believed to represent a translocation from the bushveld (Broadley 1993) and is not shown on the map. Similarly, a single record from Waterpoort (2229DC) on the northern side of the Soutpansberg is excluded. This specimen was considered by Broadley (1993) to have been washed through the gorge during a flood, but it could have been transported by human agency.

Habitat: Occurs in savanna, bushveld and thornveld habitats, and is absent from highveld grassland and subtropical lowveld. Vegetation ranges from dense, short bushveld to open tree savanna. Prefers rocky hillsides and rocky ridges (Boycott & Bourquin 2000). The type locality, near Lobatse in Botswana, was described as “kloofs among the hills” by Power (1931). Similar habitat is represented along the Magaliesberg in South Africa. Based on the distribution data it does not appear as if there is any fragmentation of the population. Within the Central Bushveld Bioregion there is minimal variation in the general structure of the vegetation, with some areas comprising dense, short bushveld and others composed of open tree savanna. No preference for either is indicated and the species probably occurs in both areas where there is rocky terrain.

Bioregion: Central Bushveld.

Assessment rationale: Common and widespread, occurring in a number of nature reserves.

Conservation measures: None recommended.

Kinixys lobatsiana—Roodepoort, GP W.R. Branch

Kinixys natalensis Hewitt, 1935

KWAZULU-NATAL HINGED-BACK TORTOISE

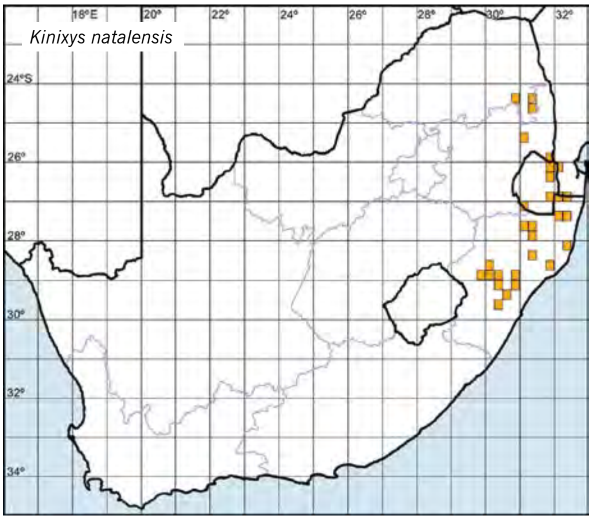
Richard C. Boycott

Global: Least Concern

Near-endemic

Taxonomy: All southern African *Kinixys* were referred to *Kinixys belliana belliana* by Loveridge & Williams (1957). *Kinixys natalensis* was re-instated as a full species by Broadley (1981b).

Distribution: Endemic to southern Africa, occurring in South Africa, Swaziland and southwestern Mozambique (Boycott & Bourquin 2000). The range extends from Weenen Nature Reserve in the KwaZulu-Natal Midlands, northeastwards and northwards through the mountainous inland regions and along the Lebombo Range through Swaziland, southern Mozambique and the eastern parts of South Africa, to Manyeleti Game Reserve and Hoedspruit. In this assessment, six sub-populations are recognised: Bushman’s River basin (Weenen Nature Reserve); Tugela River basin (type locality and surrounding populations); south Pongolo River basin (Itala and Magdalena Game Reserve); north Pongolo River basin (Bergplaats); Lebombo (mountain range and adjacent lowveld); and central and northern lowveld (Manyeleti, Sabi-Sand, western Kruger National Park and Hoedspruit). A few new localities have been recorded in protected areas since 1988 (Broadley 1993; Boycott & Bourquin 2000; Boycott 2001).



Habitat: Occurs in rocky grasslands, rocky wooded grasslands, dry thickets and valley bushveld; avoids forests and deep sand areas (Bourquin 2004).

Bioregion: Lowveld; Sub-Escarpment Savanna; Indian Ocean Coastal Belt.

Assessment rationale: More widespread and common than previously believed and not globally threatened.

Conservation measures: Proclaim additional protected areas within the species’ range.

Kinixys natalensis—Manyiseni region, Lebombo Mtns, KZN M. Burger

Kinixys natalensis—near Empangeni, KZN A.L. de Villiers

Kinixys spekii Gray, 1863

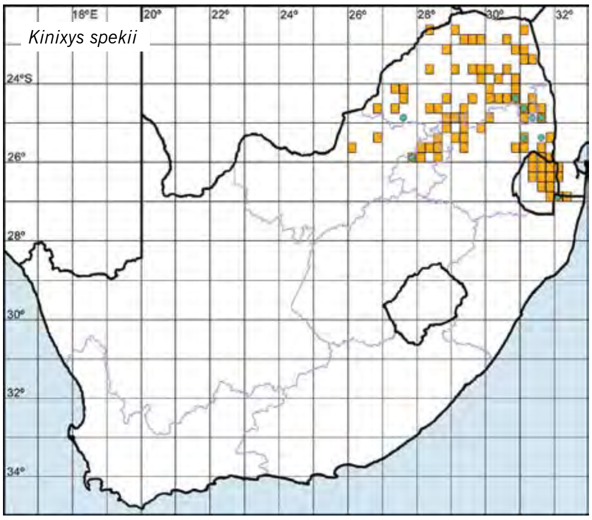
SPEKE'S HINGED-BACK TORTOISE

Richard C. Boycott

Regional: Least Concern

Taxonomy: All southern African *Kinixys* were referred to *K. belliana belliana* by Loveridge & Williams (1957). Broadley (1981b) considered *K. spekii* to be a subspecies of *K. belliana* but later recognised it as a distinct species (Broadley 1993).

Distribution: Widespread and common in tropical central, eastern and southern Africa (Boycott & Bourquin 2000). In the *Atlas* region the range extends from the northern parts of Limpopo Province southwards to the northeastern parts of North-West Province and northern Gauteng, and eastwards into the subtropical lowveld regions of Mpumalanga, Swaziland and extreme northern KwaZulu-Natal. It occurs sympatrically with *K. natalensis* on the Lebombo Mountains and its foothills in Swaziland (Boycott 2001). There appear to be two subpopulations. One is a fairly remote population in the upper Limpopo basin in western Limpopo. The other is a contiguous population extending from the bushveld regions of northern Limpopo into the subtropical lowveld of Mpumalanga, east of the Mpumalanga escarpment, and southwards through Swaziland into the extreme northern part of KwaZulu-Natal. The only major geographical barrier between the two is in the central and southern part of the mountain range, where the Mpumalanga escarpment separates the lowveld populations of *K. spekii* from the inland populations of *K. lobatsiana*. It is possible that the Great Usutu River, at the southern limit of the range, has served as a geographical barrier to the species because only a few specimens have been found on the southern side (Bourquin 2004; R.C. Boycott pers. obs.). Some of these are believed to have been translocated (Bourquin 2004).



Habitat: Occurs in subtropical savanna, mixed bushveld and thornveld habitats (Boycott & Bourquin 2000), and avoids pure highveld grassland. There is some evidence of seasonal movement into thicker woodland in the winter months (Lambiris *et al.* 1989).

Bioregion: Central Bushveld; Mopane; Lowveld.

Assessment rationale: Widespread, occurring in a number of protected areas. No serious threats are known although there is some harvesting for food and the muti (traditional medicine) trade. Fire could be a threat in Swaziland where bush clearing on the Lebombo Mountains has transformed the habitat to grassland.

Conservation measures: None recommended.

Kinixys spekii—E of Plumtree, Zimbabwe W.R. Branch

Kinixys spekii—near Lydenburg, MPM G.J. Alexander

Kinixys spekii, adult female—Dinedo Farm near Mafutseni, Swaziland R.C. Boycott

Kinixys spekii—Usuthu Gorge Community Conservation Area, KZN M. Burger

Kinixys zombensis Hewitt, 1931

EASTERN HINGED-BACK TORTOISE

Richard C. Boycott

Regional: Least Concern

Taxonomy: In the *Atlas* region this taxon was previously known by the name *Kinixys belliana belliana*. *Kinixys belliana zombensis* was recognised as a valid subspecies by Broadley (1989b) and McCord *et al.* (2005), but later considered a junior synonym of *K. b. belliana* (Broadley 1993). It was elevated to species status by Kindler *et al*. (2012). A population in Madagascar, previously referred to *K. belliana domerguei* (e.g. McCord *et al.* 2005), is only weakly differentiated from South African *K. zombensis*, but further sampling is needed to determine whether there is support for its status as a subspecies of the latter (Kindler *et al*. 2012). It has not been generally recognised because it appears to be based on an introduced population (Branch 2008).

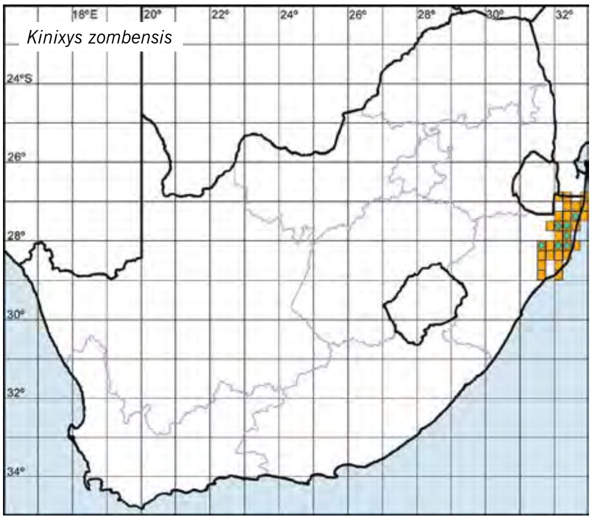
Distribution: Widespread in southeastern Africa, from northeastern Tanzania southwards to northeastern KwaZulu-Natal in South Africa, and also in Madagascar where it was probably introduced (Broadley 1989b; Boycott & Bourquin 2000; Kindler *et al*. 2012). In the *Atlas* region it occurs from around Kwambonambi (D. Kewley pers. comm.) northwards to the Mozambique border, including areas east of the Lebombo Mountains.

Habitat: Occurs in subtropical coastal bushveld and forest. Vegetation ranges from dense bushveld and coastal forest to scrub savanna. Prefers sandy areas and is absent from rocky hillsides and rocky ridges (Boycott & Bourquin 2000).

Bioregion: Lowveld; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common in southeastern Africa, and protected in many national parks and game reserves throughout its range, including areas within the *Atlas* region (Broadley 1989b; Boycott & Bourquin 2000).

Conservation measures: None recommended.



Kinixys zombensis, adult female R.C. Boycott

Genus *Psammobates* Fitzinger, 1835—tent and geometric tortoises

Psammobates is endemic to southern Africa (South Africa, Namibia and Botswana) and consists of three species. The type species, *P. geometricus*, is restricted to South Africa's southwestern Cape. Alternating light and dark rays on the scutes give many members a characteristic geometric pattern. The carapace is domed and the dorsal scutes of some taxa show excessive pyramiding, hence members of the genus are commonly known as tent tortoises. All species are small and males are smaller than females. Clutch size ranges from one egg (*P. oculifer*) to five eggs (*P. geometricus*) (Hofmeyr *et al.* 2005). One member of the genus, *P. geometricus*, is classified as Critically Endangered, mainly as a result of habitat destruction or degradation (e.g. wheatlands and vineyards).

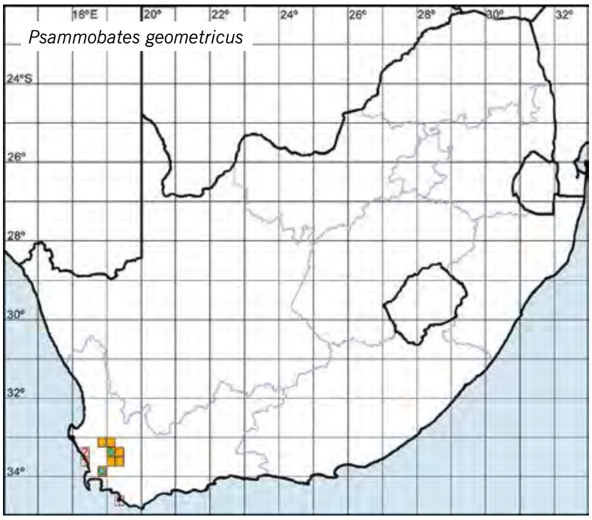
Psammobates geometricus (Linnaeus, 1758)

GEOMETRIC TORTOISE

Ernst H.W. Baard & Margaretha D. Hofmeyr

Global: Critically Endangered A2acde

Endemic



Taxonomy: Wallin (1977) established that the Linnaean type specimen of *Psammobates geometricus* is in fact *Geochelone elegans*, hence the erroneous type locality of "Asia". Hoogmoed & Crumly (1984) assigned the animal depicted by Piso (1658) as syntypical to *P. geometricus* and designated it as lectotype (see Baard 1991). The type locality was restricted to "southwestern Cape Province, South Africa" by Baard (1991). No subspecies are currently recognised. Although earlier research showed no significant genetic distance between three seemingly isolated subpopulations (Cunningham *et al.* 2002), the phylogeographic relationships of these should be given further attention.

Distribution: Endemic to the Western Cape, South Africa. Historically, the species occurred from around Eendekuil and Piketberg in the north, southwards through the Swartland (Porterville, Hermon, Wellington, Paarl) to the Strand-Gordon's Bay area in the south, and eastwards in the Upper Breede River Valley, from Tulbagh in the north to just west of Worcester, as well as in the Ceres Valley in the northeast (Baard 1993a). Isolated populations can now be found in the Paarl district, north of Wellington towards Porterville, between Tulbagh, Wolseley and Worcester, and in the Ceres Valley. The only confirmed record outside this region is of an approximately 2 000 year old specimen from De Kelders (3419CB), Gans Bay (Rau 1971). Indications are that the indigenous Khoisan people of the region carried this shell there at the time. Surveys by Baard (1993b) could not confirm the suspected presence of this species in the Bot River and Villiersdorp area, or in the Darling area. The Darling (3318AD) record is based on two specimens in the Port Elizabeth Museum, collected from this area by B. Peers and an unknown collector, in March and April 1905, respectively. No further locality data are available. Darling lies within the historical distribution of Granite and Shale Renosterveld, and it is therefore likely that this species occurred here, on the western extreme of its range. The Koeberg Nature Reserve (3318CB) record is based on a specimen photographed by the reserve manager and identified by EHWB in the early 1990s. This reserve is situated near Melkbosstrand and lies within Dune Strandveld and Sand Fynbos (these two habitats are not occupied by this species), and small, isolated patches of Shale Renosterveld. Subsequent visits to both areas did not yield additional records and the recent natural occurrence of this species there requires confirmation.

Psammobates geometricus—Elandsberg NR, WC M. Burger

EOO: 4 034 km^2 (confidence: medium); AOO: 22 km^2 (confidence: high)

Habitat: Occurs in the Mediterranean region (mean annual rainfall 350–600 mm) of the southwestern part of the Western Cape at altitudes of about 70–600 m (Baard 1995). This is within the Fynbos Biome and predominantly in the Renosterveld Bioregion, which comprises a number of Critically Endangered and Endangered vegetation types including Alluvium Fynbos, Sand Fynbos, Shale Fynbos, Shale Renosterveld, Granite Renosterveld and Silcrete Renosterveld (Rebelo *et al.* 2006). The general habitat comprises low-lying, undulating plains (seldom rocky terrain, but never koppies) with a dominant low to medium-high shrub layer, a strong restiod and ericoid presence and an essentially annual, herbaceous understorey with perennial grasses (Baard 1995). During unfavourable periods of the year, *P. geometricus* takes refuge in slightly damper microhabitats under dense vegetation (E.H.W. Baard unpubl. data). This tortoise does not dig its own burrows but occasionally makes use of the burrows of other animals.

Vegetation type: FFa 3 Swartland Alluvium Fynbos; FFa 2 Breede Alluvium Fynbos; FRs 9 Swartland Shale Renosterveld; FRs 4 Ceres Shale Renosterveld; FFa 4 Lourensford Alluvium Fynbos; FRg 2 Swartland Granite Renosterveld; FFs 5 Winterhoek Sandstone Fynbos; FFs 7 North Hex Sandstone Fynbos; FFg 2 Boland Granite Fynbos; FFd 6 Hangklip Sand Fynbos; FFd 4 Atlantis Sand Fynbos; FFh 4 Breede Shale Fynbos; FRc 1 Swartland Silcrete Renosterveld.

Assessment rationale: Inferred population reduction of over 90% in the past three generations (90 years) due to anthropogenic land transformation, where the causes of destruction may not have ceased, based on direct observation [A2a], a decline in AOO, EOO and habitat quality [A2c], actual levels of exploitation [A2d], and the effects of introduced taxa [A2e]. These declines are considered likely to continue into the future. The plight of this tortoise recently worsened following a wildfire on 8–9 January 2012 that destroyed a large portion of Elandsberg Nature Reserve and surrounding habitat, including large tracts of Shale Renosterveld and Alluvium Fynbos. Intensive post-fire surveys located 225 specimens of *P. geometricus* of which 136 were killed by the fire; a portion of the live tortoises were placed in fire- and predator-proof pens, while the remainder were relocated to unburnt habitat on the reserve (M.D. Hofmeyr & E.H.W. Baard unpubl. data). It is now estimated that only 700–800 individuals of this species survive in the wild (Goode *et al.* 2012).

Threats: Human-induced habitat alteration, degradation and destruction, largely due to extensive agricultural development (vineyards and wheat farming), have led to the irreversible alteration of more than 90% of preferred habitat. Survival in remaining habitats is seriously threatened by human settlement, invasive alien species (both woody and herbaceous species), predators (including the invasive feral pig), overgrazing by domestic stock, droughts and wildfires (Baard 1997). Within its severely fragmented range, these threats are exacerbated in small, isolated populations which barely remain viable. Although infrequent, the illegal collection of specimens for the pet trade cannot be ruled out as a potential threat. The conservation status is dire and climate change, involving warmer and drier conditions (Midgley *et al.* 2005), is likely to seriously compromise the survival of remaining, fragmented populations (Hofmeyr *et al.* 2006).

Conservation measures: Continue research into aspects of conservation biology in order to inform conservation measures. Prioritise conservation stewardship of remaining lowland habitats by landowners. Include more of the remaining habitat in formal conservation arrangements. Develop a BMP-S.

Psammobates oculifer (Kuhl, 1820)

SERRATED TENT TORTOISE; KALAHARI TENT TORTOISE

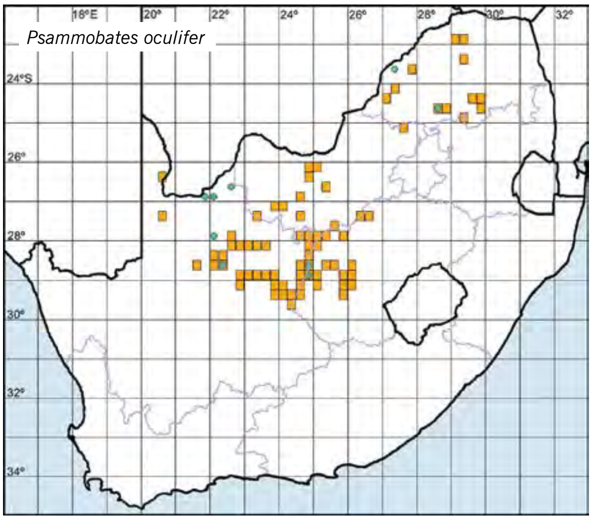
Margaretha D. Hofmeyr & Ernst H.W. Baard

Global: Least Concern

Taxonomy: Hewitt (1933, 1937b) retained the name *oculifera* when he removed the 'geometricus' group from the genus *Testudo*. Subsequently, Loveridge & Williams (1957) pointed out that the gender of the name *Psammobates* is masculine and amended it to *P. oculifer*. In later years the specific names *oculifer* and *oculiferus* were used interchangeably, but the former is the correct form of the name (Fritz & Havaš 2007; Bickham *et al.* 2007).

Distribution: Endemic to southern Africa and found throughout the Kalahari region of South Africa, Botswana and Namibia. The northeastern range limit was recently extended to include Hwange National Park in Zimbabwe (Broadley *et al.* 2010). This species has not yet been recorded south of the Orange River (Boycott & Branch 1989). The distribution in South Africa falls mainly in the Northern Cape and adjacent regions of the Free State and North-West Province. There are no records from the eastern part of North-West Province or in Gauteng, but disjunct populations occur in Limpopo. This species does not occur in northeastern Botswana (Boycott & Branch 1989) or the southern and western parts of Namibia (Griffin 2003).

Habitat: Occurs in arid regions on the central plateau of southern Africa, at altitudes of 800–1 500 m. Mostly inhabits arid savannas but has a peripheral presence in Dry Highveld Grassland and Nama-Karoo. Habitat consists of undulating sandy plains with open tree cover and well-developed grass and shrub layers. During unfavourable



Psammobates oculifer—35 km NE of Groblershoop, NC M. Burger periods *P. oculifer* shelters under dense vegetation or in animal burrows.

Biome: Savanna; Grassland; Nama-Karoo.

Assessment rationale: Although population densities are normally low, this species is widespread.

Conservation measures: None recommended.

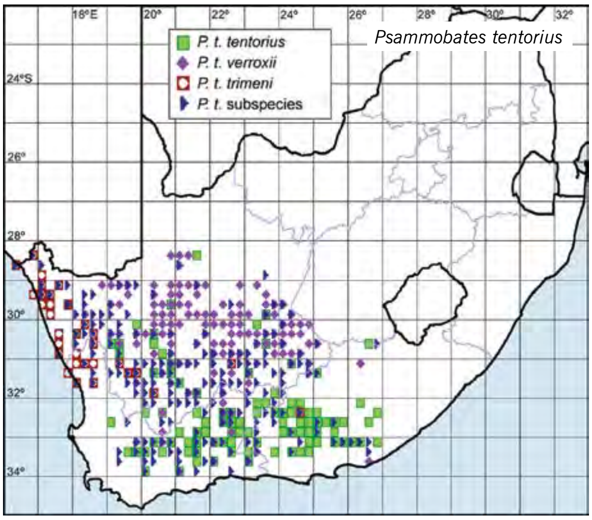
Psammobates tentorius (Bell, 1828)

TENT TORTOISE

Margaretha D. Hofmeyr & Ernst H.W. Baard

Global: Least Concern

Taxonomy: Members of the *Psammobates tentorius* complex vary considerably with regard to colour pattern, pyramiding (raised or flat) of vertebral scutes and other morphological features. Hewitt (1933, 1934) described several species and subspecies within the *P. tentorius* complex. Loveridge & Williams (1957) recognised only three subspecies of *P. tentorius*: *P. t. tentorius*, *P. t. trimeni* and *P. t. verroxii*. These subspecies have been accepted by most subsequent authors (Greig & Burdett 1976; Branch *et al.* 1995; Branch 1998, 2008; Boycott & Bourquin 2000), but with general acknowledgement of the unresolved taxonomic complexities involved. Distribution maps based on museum and other records show substantial overlap in the ranges of the three subspecies. In many instances, this apparent overlap is due to misidentification of specimens. However, in some regions the overlap in distribution is real, indicating that some subspecies may deserve specific status. Furthermore, the large morphological variation within recognised subspecies, particularly within *P. t. verroxii*, may indicate that some synonymised taxa should be re-instated. A major revision based



Psammobates tentorius tentorius—24 km S of Jansenville, EC W.R. Branch

Psammobates tentorius verroxi—near Pofadder, Namaqualand, NC J. Marais

Psammobates tentorius trimeni— S of Bitterfontein, Namaqualand, WC A.L. de Villiers

Psammobates tentorius verroxii—Namaqualand, NC W.R. Branch on molecular and morphological data is in progress (M.D. Hofmeyr & S.R. Daniels unpubl. data).

Distribution: Endemic to South Africa and Namibia. The ranges of the three subspecies overlap, and there is uncertainty about their exact limits. Of the three subspecies, *P. t. tentorius* occurs furthest south, but is most distinctive in the southeast. Its range extends from Fort Brown in the Eastern Cape to Matjiesfontein (or Touws River) in the Western Cape. Further north, the range extends to Victoria West and the Kamiesberg Mountains in the Northern Cape. The distribution of *P. t. trimeni* extends from Helmeringhausen in southwestern Namibia (Griffin 2003) across the Orange River into Namaqualand in the western region of South Africa. *Psammobates t. verroxii* has the widest distribution of the three subspecies. It occurs throughout the Northern Cape, across the Orange River into Namibia, as far north as Mariental (Griffin 2003). In the west, *P. t. verroxii* extends into Namaqualand and through the Ceres Karoo into the Western Cape. There may be considerable overlap between the distributions of *P. t. verroxii* and *P. t. trimeni* in South Africa and Namibia. The distributions of *P. t. verroxii* and *P. t. tentorius* overlap in the Karoo, but it is not certain if *P. t. verroxii* occurs below the southern escarpment. In the northeastern part of its range, this species does not occur north of the Orange River, which may be a barrier to movement.

Habitat: Occurs in arid regions under varying temperature regimes, from sea level to at least 1 500 m. *Psammobates t. tentorius* occurs in regions with summer or all-year rainfall, frequent frost, and dwarf shrubland with succulents, annuals, grasses and geophytes. *Psammobates t. trimeni* occurs in winter rainfall regions dominated by dwarf succulent shrubs and annuals. *Psammobates t. verroxii* occurs mainly on the inland plateau above 900 m in dwarf open shrubland, although its range extends below the escarpment in the west; rainfall is predominantly in summer and is generally unpredictable.

Biome: Nama-Karoo; Succulent Karoo; Fynbos; Albany Thicket.

Assessment rationale: Widespread, but normally found at low densities.

Conservation measures: Clarify the taxonomic status of the three subspecies.

Genus *Stigmochelys* Gray, 1873—leopard tortoises

This monotypic genus occurs throughout southern and eastern Africa as far north as Ethiopia. All large tortoises were previously grouped in the genus *Geochelone*, but because this genus was polyphyletic, some authors (e.g. Lapparent de Broin 2000; Gerlach 2001) placed *G. pardalis* in the monotypic genus *Stigmochelys*. A recent molecular study (Le *et al.* 2006) indicated a sister relationship between *G. pardalis* and *Psammobates* and the authors suggested that *G. pardalis* should be placed within the genus *Psammobates*. Because the two groups of tortoises are morphologically distinct, Fritz & Bininda-Emonds (2007) rejected this proposal and recommended that the name *S. pardalis* should be retained. In the Eastern Cape as well as Ethiopia and South Sudan, they may exceed 700 mm in carapace length and 40 kg in weight (Branch 2008). These large tortoises have a domed carapace and lack a nuchal scute. Females lay 3–6 clutches of 6–30 eggs per clutch at monthly intervals during summer (Branch 1998). *Stigmochelys pardalis* is common and widespread and not of conservation concern.

Stigmochelys pardalis (Bell, 1828)

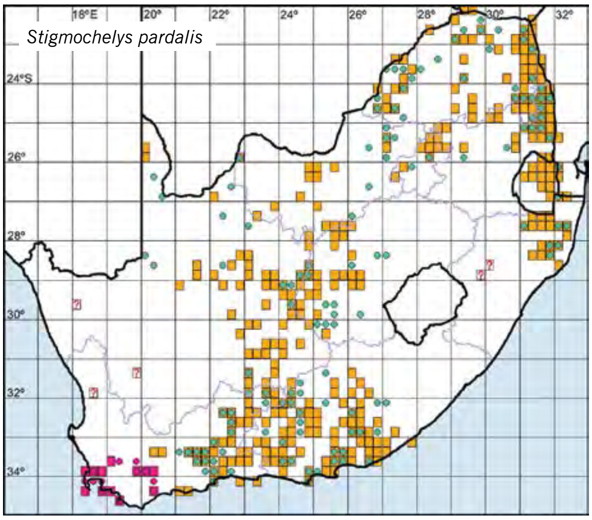
LEOPARD TORTOISE; MOUNTAIN TORTOISE

Margaretha D. Hofmeyr & Ernst H.W. Baard

Global: Least Concern

Taxonomy: Loveridge & Williams (1957) recognised two subspecies: *Geochelone* (= *Stigmochelys*) *pardalis pardalis* and *G.* (= *S.*) *p. babcocki*. Many herpetologists reject this distinction because the application of diagnostic characters is weak and the ranges of the two subspecies overlap considerably (Greig & Burdett 1976). Recently, Le *et al.* (2006) found substantial genetic differences between two specimens assigned to the two subspecies, but their geographical origin was unknown. A subsequent Africa-wide phylogeographic study of *S. pardalis* identified seven mainly parapatric clades (five in southern Africa), resulting from restricted gene flow, but none of these were considered representative of cryptic taxa (Fritz *et al.* 2010). This study showed that the findings of Le *et al.* (2006) were incorrectly based on a pseudogene, and that there was no basis for the recognition of *S. p. babcocki*.

Distribution: Widespread in sub-Saharan Africa (Iverson 1992). This species occurs throughout most of southern Africa, from the Western Cape of South Africa in the south to southern Angola in the west, and Mozambique in the east. Its range extends northwards as far as Ethiopia and South Sudan. Loveridge & Williams (1957) and Greig & Burdett (1976) described the distribution of *S. p. pardalis* as southwestern Namibia and western South Africa, but Broadley (1989c) included the Western and Eastern Cape and areas as far north as the southwestern Free State. The remainder of the range was assigned to *S. p.*



Stigmochelys pardalis—Greater Kuduland Safaris, E of Tshipise, LIMP M. Burger

Stigmochelys pardalis, hatchling—Steytlerville, EC W.R. Branch

Stigmochelys pardalis, old adult—Richmond district, NC M.F. Bates *babcocki*. This is a popular pet species in South Africa and the release of unwanted tortoises in the wild (Greig & Burdett 1976) confounds interpretation of the species' natural distribution. *Stigmochelys pardalis* is mostly absent from large areas in the eastern and the western regions of South Africa. Greig & Burdett (1976) postulated that humans exterminated *S. pardalis* in the east and in the Cape coastal region. Branch *et al.* (1995b), however, argued that there is no conclusive evidence that *S. pardalis* ever occurred there because tortoise bones are rare at archaeological sites in the eastern region, and it is conspicuous in its absence from archaeological sites along the southwestern coast where the remains of *Chersina angulata* are common (Klein & Cruz-Uribe 2000; Halkett *et al.* 2003; Avery *et al.* 2004). Isolated records of *S. pardalis* in western South Africa are also problematic. Many herpetologists believe that these populations have been introduced, but *S. pardalis* has occurred in the western region for at least the past 200 years. The French naturalist, Pierre Delalande, collected specimens from the Olifants River between 1818 and 1820 (Loveridge & Williams 1957). Much of the southwestern Cape distribution is considered to be represented by introduced populations that have been established in the past two centuries. The exact natural southwestern limit is not known but it may be in the Breede River region. As such, all records to the west of the Breede, and also those to the east around Ashton and Montagu, are plotted as introduced on the SARCA map.

Habitat: Occurring from sea level to elevations greater than 1 500 m in the interior. The northern habitats fall mostly in savanna but those in the south overlap Nama-Karoo, Succulent Karoo, Fynbos, Albany Thicket and Dry Highveld Grassland. Most of the habitat in South Africa contains sweet, palatable grasses (Kruger *et al.* 2006). This may explain the limited occurrence or absence of the species in the eastern parts of South Africa, where sour grasses dominate.

Biome: Savanna; Nama-Karoo; Fynbos; Albany Thicket; Grassland; Succulent Karoo; Indian Ocean Coastal Belt (marginal).

Assessment rationale: Widespread and common in some areas.

Conservation measures: None recommended.

CHAPTER 8

Family Crocodylidae

James Harvey & Johan Marais

The two crocodilian families Crocodylidae and Alligatoridae are widely distributed throughout the tropics and subtropics, occurring in South and Central America (two species extend into southern United States), northern Australia, southern Asia and its islands, Iran, most of mainland Africa and Madagascar (King & Burke 1997). The monotypic genus *Tomistoma* is considered by some recent authors to be referable to Gavialidae (Willis *et al.* 2007; Feng *et al.* 2010) but Janke *et al.* (2005) suggested that *Tomistoma* and *Gavialis* (at that time the sole member of Gavialidae) should be grouped together as a subfamily of Crocodylidae. The latter relationship was supported by the mitochondrial DNA analyses of Roos *et al.* (2007), Zhang *et al.* (2011) and others, although the morphological analysis of Piras *et al.* (2010) suggested that *Tomistoma* is more closely related to non-*Gavialis* crocodylids. Crocodylidae currently contains 17 species in five genera and is the only one of the two crocodilian families that is represented in Africa (Schmitz *et al.* 2003; Uetz 2011).

In Africa there are three genera: *Crocodylus* (two species), *Osteolaemus* (1–3 species) and *Mecistops* (one species). Taxonomy of African crocodiles is still unsettled, with *Mecistops cataphractus* recently removed from *Crocodylus* (McAliley *et al.* 2006), and molecular evidence suggesting that there are three, rather than one, species of African dwarf crocodiles in the genus *Osteolaemus* (Eaton *et al.* 2009). The recent mitochondrial DNA analysis of Feng *et al.* (2010) indicated that *Mecistops* and *Osteolaemus* are sister taxa, distinct from *Crocodylus*. *Crocodylus niloticus* is the only crocodilian species found within the *Atlas* region. It is widespread, occurring from South Africa northwards to Egypt. The remaining African crocodile species (except *C. suchus*, see below) are largely confined to the forested wetlands of central and western Africa.

Crocodiles are large, strongly armoured, aquatic reptiles adapted for swimming. The largest species is the Saltwater Crocodile (*C. porosus*) of Asia and Australia which may on occasion achieve a length of 7 m and weigh over a tonne, making it the world's largest reptile. Adults have limited numbers of enemies due to their large size and strength. They use their strong jaws and impressive sets of sharp teeth to capture a variety of prey, from invertebrates taken by juveniles to fish, frogs, reptiles and even large mammals that are usually seized at the water's edge. Females lay up to 80 eggs that are buried in sand near the water's edge (Branch 1998). Once the eggs hatch, the mother helps the hatchlings free themselves from the nest.

In the *Atlas* region, *C. niloticus* is threatened by loss and degradation of aquatic habitat, and direct persecution by humans, and is classified as Vulnerable.

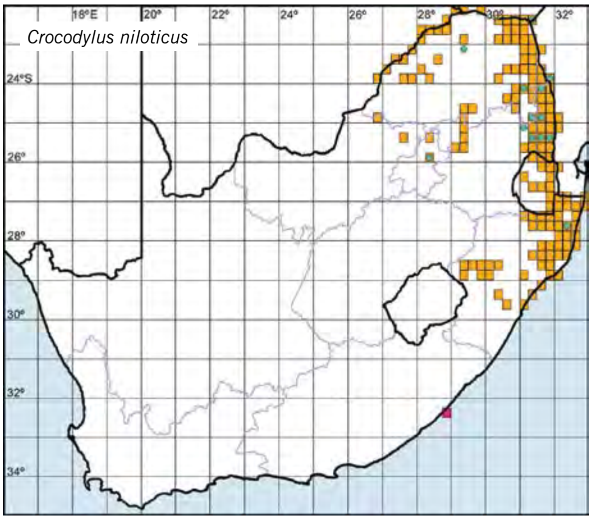
Genus *Crocodylus* Laurenti, 1768—true crocodiles

The 13 species in the genus *Crocodylus* are found in Africa, the Caribbean, northern South America, Central America, tropical and subtropical regions of North America, southern Asia, the Phillippines, Indonesia, New Guinea, and northern Australia (Schmitz *et al.* 2003; Uetz 2011). A mitochondrial DNA analysis by Meredith *et al.* (2011) supported the monophyly of all Asian and Australian species of *Crocodylus* but found that *C. niloticus* was paraphyletic. They reported that eastern populations of *C. niloticus* grouped with a suite of New World *Crocodylus* to the exclusion of western populations of *C. niloticus*. Two species occur in Africa, with only the Nile Crocodile, *C. niloticus*, occurring in the *Atlas* region. The other African species is the recently revived *C. suchus*, a name used for West African crocodiles previously referred to *C. niloticus.* (Schmitz *et al.* 2003; Meredith *et al*. 2011). Hekkala *et al.* (2010) found that *C. niloticus* showed high levels of genetic structuring across its range, but they did not comment on the validity of *C. suchus*. In the *Atlas* region, *C. niloticus* is largely confined to well-watered, northeastern, subtropical areas (Branch 1998; Alexander & Marais 2007). This species occurs in large rivers, swamps, pans, estuaries and artificial dams, and is occasionally found at sea when it moves between freshwater habitats (Leslie & Spotila 2000). Crocodiles are large, robust animals. In South Africa, adult *C. niloticus* average 3–3.5 m in length but can grow to a length of at least 4.5 m. Today, specimens over 5 m are rare. These large reptiles feed on a variety of animals and display an ontogenetic shift in diet: yearlings feed primarily on invertebrates; juveniles and subadults include amphibians and fish in their diets; and adults also take birds and large mammals (Wallace & Leslie 2008). At least nine species (e.g. *C. niloticus*, *C. porosus*) are known to attack humans, especially in areas where people come into contact with these animals during their daily activities. Attacks by *C. niloticus* are rare in the *Atlas* region but more common in some other parts of Africa. Crocodiles are oviparous and female *C. niloticus* lay 20–80 eggs per clutch in self-excavated nests from October to December. The nests are covered and protected by the mother until the eggs hatch 70–100 days later (Alexander & Marais 2007). Crocodiles are seldom found outside protected areas. The Nile Crocodile is threatened by loss and degradation of aquatic habitat (even in some protected areas) and direct persecution by humans, and is classified as Vulnerable in the *Atlas* region. Trade in *C. niloticus* products is regulated under CITES.

Crocodylus niloticus Laurenti, 1768

NILE CROCODILE

Johan Marais



Regional: Vulnerable A2ac

Taxonomy: The mitochondrial DNA studies of Hekkala *et al.* (2010) and Meredith *et al.* (2011) suggest that *C. niloticus* may contain cryptic species.

Distribution: Widespread throughout Africa, from Senegal in the west to Somalia in the east, and from Egypt in the north to South Africa in the south. In the *Atlas* region it is distributed from the Zinkwazi River south of the Tugela River in KwaZulu-Natal (Combrink *et al.* 2011) northwards into Swaziland, Mpumalanga, Limpopo, northern Gauteng and adjacent parts of North-West Province. Introductions, especially unintentional releases from commercial crocodile farms, are becoming quite common (J. Marais pers. obs.) and individuals have been observed in the Umgeni River near Durban. Introduced adults often survive and there is evidence of successful breeding following an intentional (and ill-advised) introduction to the Dwesa Nature Reserve in the Eastern Cape (Combrink *et al.* 2011).

EOO: 326 983 km^2 (confidence: medium); AOO: 38 689 km^2 (confidence: medium)

Habitat: Inhabits swamps, lakes, rivers and river mouths; and coastal estuaries in KwaZulu-Natal (Branch 1998).

Biome: Savanna; Indian Ocean Coastal Belt; Grassland.

Assessment rationale: This species was previously globally assessed as Lower Risk/least concern (IUCN 1996). However, Branch (1998) regarded it as Vulnerable. Nearly two decades ago the total South African population was estimated at about 9 500 individuals (Blake & Jacobsen 1992), but it is not known whether this figure included

Crocodylus niloticus—in captivity, Kwena Gardens, Sun City J. Marais both mature and immature individuals. Because some of the counts were done by helicopter, it can safely be assumed that the figure underestimated the number of mature adults. Recently, there were substantial numbers of adult deaths in the Kruger National Park as a result of water pollution—at least 200 deaths (Ferreira & Pienaar 2011) but possibly double that number (D. Pienaar pers. comm.). There were also large-scale adult deaths in Loskop Dam in 2005 and 2007 (Botha *et al.* 2011; R.F. Fergusson pers. comm.). Blake & Jacobsen (1992) estimated the Ndumo Game Reserve population at 1 250 individuals but a 2010 aerial count revealed that there are about 600 crocodiles over 1 m in length remaining in this reserve, a decrease of over 50% (Matthews 1994; P. Caverley pers. obs.). This was caused mainly by habitat transformation, destruction of the Pongola floodplain and persecution (P. Caverley pers. comm.). There have been severe population declines in unfenced areas such as Lake Sibaya, where the 1970 adult population was estimated at a maximum of 374 individuals and in June 2009 only three adults were counted (X. Combrink pers. comm.). The Kosi Bay population has experienced an estimated decline in adult crocodiles of 93% in 19 years (Combrink *et al.* 2011). There has also been increased poaching of crocodiles between Ndumo Game Reserve and Mozambique recently, following the removal of a large portion of the reserve's fence (X. Combrink pers. comm.). The St Lucia population, regarded as the second largest population in South Africa, has declined by 32% in seven years, largely as a result of hydrological changes to the lake affecting freshwater inflow, habitat transformation and destruction, as well as persecution (X. Combrink pers. comm.). There is little evidence that neighbouring populations are well protected. In fact, the Okavango population is now threatened (Bishop *et al.* 2009) and the population in the middle Zambezi region is declining (K.M. Wallace *et al.* in prep.). It is probable that *C. niloticus* in the *Atlas* region has experienced a population reduction of >30% over three generations (estimated at about 144 years), and the species is considered regionally Vulnerable on the basis of direct observations [A2a] and a decline in habitat quantity and quality [A2c]. Populations in many parts of Mozambique and Zimbabwe (the only adjacent potential source populations for immigration) are under threat from significant habitat degradation, poaching, and lack of conservation interest (Ferguson 2010; R. Ferguson pers. comm.; X. Combrink pers. comm.). There is currently some uncertainty as to whether viable populations of crocodiles exist within Mozambique's protected areas (Dunham *et al.* 2010). Immigration is likely to be minimal and will probably decrease in future. In the long run these adjacent populations will probably become sinks rather than sources. The regional classification of Vulnerable is therefore not downgraded.

Threats: The main threat is degradation of aquatic habitat. This includes degradation of lakes, wetlands, dams, rivers, and estuaries, construction of dams in rivers, water contamination, and removal of water for agricultural and industrial uses. Illegal sand mining and urbanisation also result in habitat destruction. Other threats include persecution by humans (killing of adult crocodiles and destruction of nests), negative effects of invasive vegetation, fire, over-fishing with gill nets, crop encroachment, harvesting for the medicine market, and accidental poisoning that may be associated with leaching of fertilisers into water sources.

Conservation measures: Improve effectiveness of the various management regimes and protective legislation that are already in place. Educate local communities about the species. Review its habitat status, population numbers and range. Recent deaths of adult animals in Loskop Dam, Kruger National Park (especially the Olifants River) and Ndumo Game Reserve have been observed and reported in the popular media, and require further investigation, as does the status of the drought-stricken population at St Lucia.

CHAPTER 9

Family Gekkonidae

Aaron M. Bauer, William R. Branch, Michael F. Bates & *Richard C. Boycott*

The Gekkonidae is one of seven gekkotan lizard families (Han *et al.* 2004; Gamble *et al.* 2008a,b) and the only one occurring in southern Africa. Gekkonids comprise approximately 933 species in 56 genera (Uetz 2012) and are widely distributed globally, from Mediterranean Europe through Central Asia to Japan and south throughout Africa, tropical Asia and Australia. In the New World, they are restricted to portions of tropical South America and the West Indies. These lizards also occur on most tropical and subtropical Indo-Pacific islands, and a small number of highly vagile species have been established anthropogenically in parts of both North and South America that are outside the natural range of the family (Lever 2003). In Africa, gekkonids are particularly diverse and species-rich in the Horn of Africa and in southwestern Africa (Namibia and the Northern Cape Province of South Africa) (FitzSimons 1943; Loveridge 1947; Bauer 1993). Within the *Atlas* region there are 70 recognised species (five with two subspecies each, one with three subspecies) of gekkonids in 12 genera. New taxa continue to be described and synonyms revived. In the *Atlas* region, three genera (*Afrogecko*, *Cryptactites* and *Goggia*) have been erected and 18 species described or revived from synonomy within the last 20-odd years. Over a dozen additional species are in the process of being described (e.g. A.M. Bauer *et al.* unpubl. data; M.F. Bates & W.R. Branch in prep.), and the content and generic assignment of species within *Afrogecko* is being re-appraised (A.M. Bauer *et al.* unpubl. data).

Geckos occupy the entire *Atlas* region but diversity is greatest in areas providing rocky substrates, where the species-rich and largely rupicolous genera *Pachydactylus* and *Afroedura* occur (Bauer 2000 [1999]). However, terrestrial gekkonids occur from coastal sands to sandveld and bushveld, to the dunes of the Namib and Kalahari, and even in seasonally flooded estuarine vegetation (*Cryptactites*). Some scansorial geckos occur on trees or anthropogenic structures such as buildings. In the *Atlas* region, as in most of their global range, most gekkonids are nocturnal. However, there are two diurnal lineages in the region, namely *Lygodactylus* and *Phelsuma*.

Most geckos feed chiefly on arthropods, but small vertebrate prey is occasionally taken by larger species (Pianka & Huey 1978). All species are oviparous and usually produce 2–3 clutches per year, each clutch consisting of two (rarely one) calcareous-shelled eggs (Werner 1972). Among the more distinctive biological features of gekkonids are their specialised adhesive toepads. Among South African taxa these are absent only in *Ptenopus* and some species of *Pachydactylus* and *Chondrodactylus*, which posses pedal modifications for burrowing (Russell 1972, 1976; Haacke 1976a; Lamb & Bauer 2006). Gekkonids are also the most vocal of southern African lizards, with *Ptenopus garrulus* having a particularly loud and distinctive call (Haacke 1969).

Although many regional gekkonids have quite restricted ranges and limited dispersal capabilities, most occur in areas that are not subject to intensive anthropogenic or natural threats. As a consequence, most species are classified as Least Concern. However, in the *Atlas* region one species, *Cryptactites peringueyi*, is considered globally Critically Endangered due to its restricted distribution and threats to its sensitive coastal strand habitat. Four taxa (*Afroedura multiporis multiporis*, *Homopholis mulleri*, *Lygodactylus methueni*, *Pachydactylus goodi*) are classed as Vulnerable and seven taxa (*Afroedura hawequensis*, *A. major*, *Goggia braacki*, *G. gemmula*, *Lygodactylus graniticolus*, *L. ocellatus soutpansbergensis*, *L. waterbergensis*) are considered Near Threatened. Major threats to these species include mining activities and urbanisation. Two subspecies of *Lygodactylus nigropunctatus* with small ranges are considered Data Deficient because of taxonomic uncertainty. Although of no conservation concern globally, *Pachydactylus rangei* is considered regionally Critically Endangered, mainly due to habitat destruction. Two species previously classified as Restricted in the 1988 Red Data Book (Branch 1988a), *Phelsuma ocellata* (considered Near Threatened by the IUCN 2009) and *Afroedura multiporus haackei*, are now considered Least Concern. *Chondrodactylus angulifer namibensis* has a peripheral distribution in the *Atlas* region and was therefore not assessed.

Genus *Afroedura* Loveridge, 1944—African flat geckos

The genus *Afroedura* contains 15 recognised species (18 species and subspecies) distributed from southern Angola and Zimbabwe south to the Cape provinces of South Africa (Loveridge 1947; Branch 1998). Thirteen species (one with two subspecies) occur in the *Atlas* region, mostly in rocky montane habitats. Twelve species and subspecies are strictly endemic. *Afroedura* is particularly diverse in the Eastern Cape and eastern Free State, and in Mpumalanga and eastern Limpopo, where more than a dozen new species await description (Kuhn *et al.* 2012; Makhuba *et al.* 2012). All species are nocturnal insectivores and most are rupicolous, occupying narrow rock crevices (Branch 1998). *Afroedura pondolia* and *A. transvaalica* are often found in trees. All species produce two hard-shelled eggs per clutch. Most species are not of conservation concern, but *A. multiporis multiporis* is considered Vulnerable because of its restricted range, afforestation and the destruction of habitat as a result of dam construction.

Afroedura africana namaquensis (FitzSimons, 1938)

NAMAQUA FLAT GECKO

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: The relationship between the three subspecies of *Afroedura africana* should be investigated using molecular techniques.

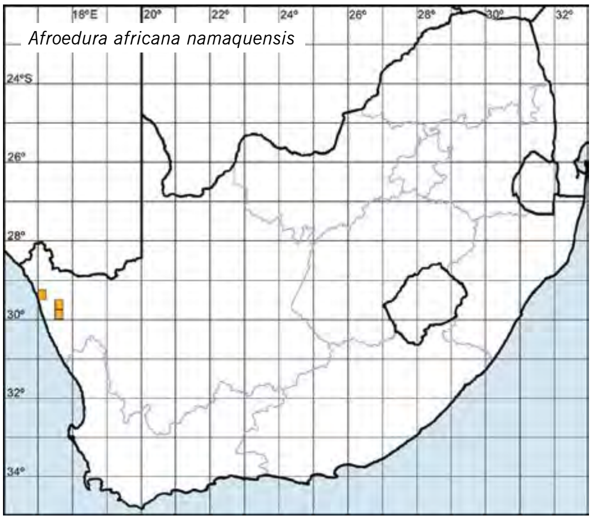
Distribution: Endemic to the western part of the Northern Cape, South Africa (Branch 1998). Actual distribution is probably much greater than existing records indicate.

Habitat: Occurs in association with exfoliating granite boulders at elevations of about 200–900 m (Branch 1998).

Biome: Succulent Karoo.

Assessment rationale: Has restricted EOO and AOO, but no major extrinsic threats exist.

Conservation measures: None recommended.

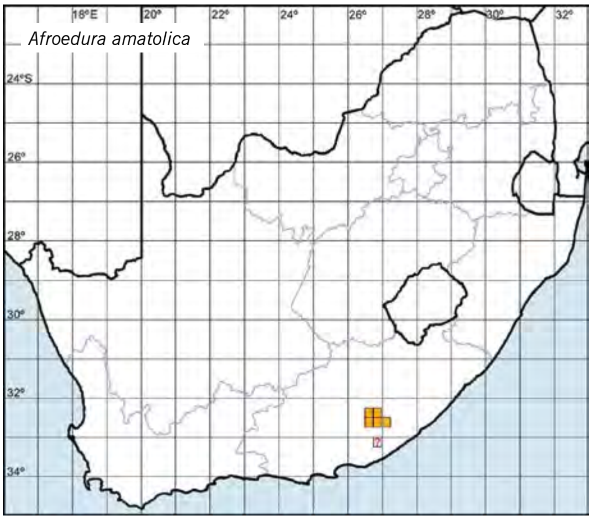


Afroedura africana namaquensis—near Kommagas, NC J. Visser

Afroedura amatolica (Hewitt, 1925)

AMATOLA FLAT GECKO

Aaron M. Bauer



Global: Least Concern

Endemic

Taxonomy: Synonymised with *Afroedura nivaria* by Loveridge (1947). Some earlier references to *A. amatolica* may be found under *A. nivaria* (e.g. Wermuth 1965). An examination of phylogenetic relationships among *Afroedura* species, and species boundaries within the genus, is in progress (A.M. Bauer, N.H.G. Jacobsen & T.R. Jackman in prep.).

Distribution: Endemic to the Amatola Region of the Eastern Cape, South Africa. The relationship of the isolated southern record (Double Drift, 3326BB) to a probable new species from the eastern Cape Fold Mountains (e.g. Cunningham *et al.* 2003) is under investigation (W.R. Branch pers. comm.).

Habitat: Rupicolous, occurring in mesic rocky habitats in grassland and thicket (Branch 1998), from elevations of 1 400 to 1 830 m.

Bioregion: Drakensberg Grassland; Albany Thicket; Sub-Escarpment Grassland.

Assessment rationale: Has a relatively restricted distribution but is common where found and not subject to widespread threats.

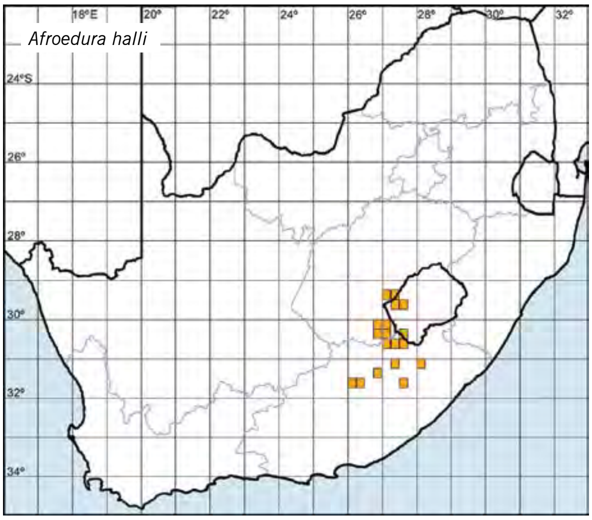
Conservation measures: None recommended.

Afroedura amatolica—Hogsback, EC M.F. Bates

Afroedura halli (Hewitt, 1935)

HALL'S FLAT GECKO

Michael F. Bates & Aaron M. Bauer



Global: Least Concern

Endemic

Taxonomy: *Afroedura halli* was regarded as a subspecies of *A. karroica* (Loveridge 1947; Wermuth 1965), but later considered a valid species (Bates 1996b; Branch 1998). The *A. nivaria* species complex (including *A. halli*) is being revised on the basis of morphological data (M.F. Bates & W.R. Branch in prep.) and the taxonomic status of isolated populations in the eastern and southeastern Free State is also being investigated by means of a molecular analysis (B.G. Makhubo, K.A. Tolley & M.F. Bates in prep.).

Distribution: Endemic to western Lesotho and adjacent areas in the South African provinces of Free State and Eastern Cape, where it occurs at or near the tops of mountains, including inselbergs, and on parts of the southern Drakensberg (Bates 1989, 1996a,b; Branch 1998). Bourquin (2004) considered this species to occur in the Drakensberg of western KwaZulu-Natal, apparently based on FitzSimons' (1943) Giant's Castle record. However, this record is in reference to a specimen of *A. nivaria* with the rostral excluded from the nostrils (i.e. *A. halli*-like) (M.F. Bates & W.R. Branch in prep.).

Habitat: Found only on sandstone cliffs and boulders at or near the summits of mountains (1 750–2 200 m), where it shelters in very narrow crevices. These crevices may be horizontal spaces between thin, sheet-like flakes on the roofs of overhangs, spaces between large slabs set against cliff faces, or small exfoliating flakes at the base of cliffs or on boulders (Bates 1996b).

Bioregion: Mesic Highveld Grassland; Drakensberg Grassland; Sub-Escarpment Grassland.

Assessment rationale: A fairly restricted species that occurs mainly as a series of isolated montane populations that are largely inaccessible, but within suitable habitat it may be quite common (Bates 1996b).

Conservation measures: Re-assess the conservation status of any isolated populations that may prove to be valid species.

Afroedura halli—Stormberg, 24 km W of Dordrecht, EC M.F. Bates

Afroedura hawequensis Mouton & Mostert, 1985

HAWEQUA FLAT GECKO

Aaron M. Bauer

Global: Near Threatened

Endemic

Taxonomy: No notable issues.

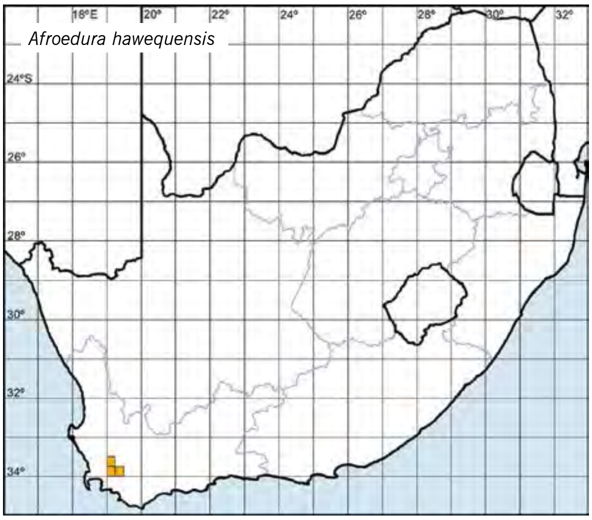
Distribution: Endemic to the Du Toitskloof and Limietberg mountains in the southwestern portion of the Western Cape, South Africa.

EOO: 2 010 km^2 (confidence: medium); AOO: 1 307 km^2 (confidence: medium).

Habitat: Occurs in mesic habitats with sandstone boulders and outcrops in fynbos, at elevations of 1 100–1 400 m (Mouton & Mostert 1985).

Vegetation type: FFs 10 Hawequas Sandstone Fynbos; FFs 11 Kogelberg Sandstone Fynbos.

Assessment rationale: Locally abundant within several protected areas (Mouton *et al.* 1987), but occurs in a fire-prone habitat where regular fires may partially deplete its insect prey source. It meets some but not all threat catego-



Afroedura hawequensis—Limietberg near Bain's Kloof Pass, WC
A.L. de Villiers

Afroedura hawequensis—Limietberg, WC S. Nielsen ry criteria (has a restricted range with EOO <5 000 km², AOO <2 000 km², and occurs at only five locations) and can therefore be considered Near Threatened. A review of the potential responses of terrestrial biodiversity in southern Africa to anthropogenic climate change (Midgley & Thuiller 2011), mediated in part by changes in fire regime and invasion (Chown 2010), projects significant biodiversity loss for the winter rainfall region of the *Atlas* area. These concerns support the Near Threatened classification.

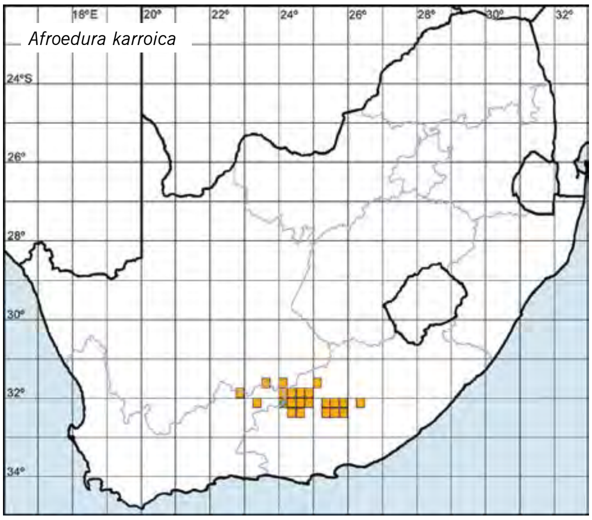
Threats: Has a limited distribution and probably has limited dispersal capabilities. Afforestation and frequent veld fires might be localised threats (Mouton 1988a).

Conservation measures: Monitor the frequency and severity of fires.

Afroedura karroica (Hewitt, 1925)

KAROO FLAT GECKO

Aaron M. Bauer



Global: Least Concern

Endemic

Taxonomy: *Afroedura halli* (South Africa and Lesotho) and *A. bogerti* (Angola and extreme northwestern Namibia) were previously regarded as subspecies of *A. karroica* (Loveridge 1944a, 1947; Wermuth 1965). An examination of phylogenetic relationships among *Afroedura* species, and species boundaries within the genus, is in progress (A.M. Bauer, N.H.G. Jacobsen & T.R. Jackman in prep.). The taxonomic status of *A. k. wilmoti* is being investigated (M.F. Bates & W.R. Branch in prep.).

Distribution: Endemic to South Africa, occurring in the central-western Eastern Cape and adjacent regions of the southern Northern Cape and northeastern Western Cape.

Habitat: Occurs in rocky habitats, chiefly in grasslands (Branch 1998) from elevations of 1 300 to 2 200 m.

Biome: Grassland; Nama-Karoo.

Assessment rationale: Relatively widespread, occurring in protected areas and not subject to any major extrinsic threats.

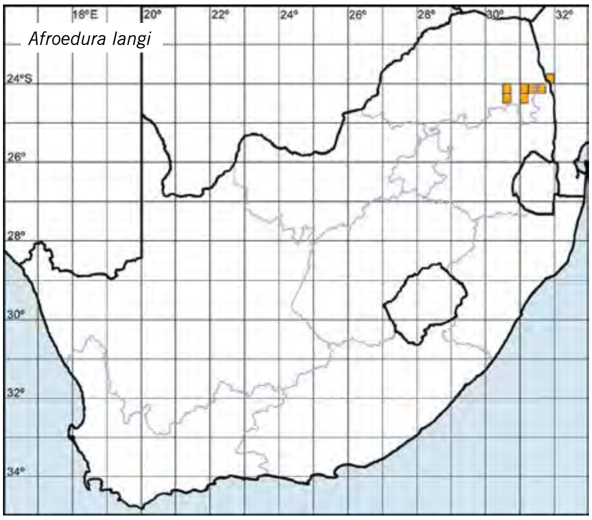
Conservation measures: None recommended.

Afroedura karroica—Asante Sana, Sneeuberg Mtns, EC W. Conradie

Afroedura langi (FitzSimons, 1930)

LANG'S FLAT GECKO; LOWVELD FLAT GECKO

Aaron M. Bauer



Global: Least Concern

Near-endemic

Taxonomy: Formerly considered a subspecies of *Afroedura pondolia* (e.g. Onderstall 1984) but returned to full species status by Jacobsen (1989). Jacobsen (1989, 1992) recognised and described, but did not formally name, eight new members of the *A. langi* group occurring in the former Transvaal Province of South Africa. These were given the manuscript names 'Soutpansberg', 'Waterberg', 'Lillie', 'Waterpoort', 'Tshipise', 'Shinokwen', 'Matlala' and 'Leolo', after their areas of occurrence. Formal description and molecular phylogenetic analysis of these species is in progress (A.M. Bauer, N.H.G. Jacobsen & T.R. Jackman in prep.) and their distributions are not shown on the map.

Distribution: Endemic to southern Africa, occurring in South Africa in southeastern Limpopo and northeastern Mpumalanga, and immediately adjacent in Mozambique (Visser 1984a; Jacobsen 1989).

Habitat: Occurs in Lowveld savanna in rock outcrops that provide crevices for retreat, at elevations of 250–300 m (Jacobsen 1989).

Vegetation type: SVl 3 Granite Lowveld; SVmp 7 Phalaborwa-Timbavati Mopaneveld; SVl 15 Northern Lebombo Bushveld; SVmp 4 Mopane Basalt Shrubland.

Assessment rationale: Has a relatively restricted distribution, but is not subject to any major threats and occurs in several protected areas.

Conservation measures: None recommended.

Afroedura langi—Tsere River, Kruger NP, LIMP W.D. Haacke

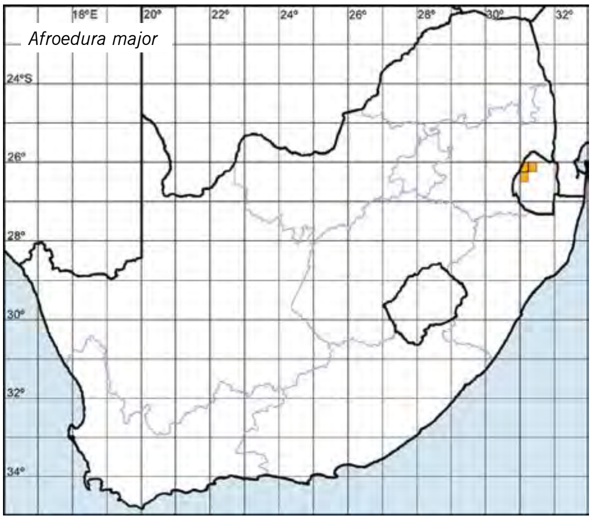
Afroedura major Onderstall, 1984

SWAZI FLAT GECKO; GIANT SWAZI FLAT GECKO

Richard C. Boycott

Global: Near Threatened

Endemic



Afroedura major—Matenga Falls, Swaziland W.D. Haacke

Taxonomy: Described by Onderstall (1984) as a subspecies of *Afroedura pondolia*. The taxon's specific status was first recognised by Branch (1998) and this has been followed by subsequent authors (Monadjem *et al.* 2003; Boycott *et al.* 2007).

Distribution: Endemic to Swaziland, where it is restricted to the highveld and middleveld regions (Boycott 1992a). It occurs along the Nkomati, Malolotja, Black Mbuluzi and Little Usutu Rivers in western Swaziland.

EOO: 697 km^2 (confidence: medium); AOO: 693 km^2 (confidence: high).

Habitat: Found in mountainous terrain, favouring horizontal cracks and overhanging rock ledges along medium-sized and large rivers in woodland and grassland (Monadjem *et al.* 2003), and semi-dark caves in boulder outcrops away from rivers (pers. obs.).

Vegetation type: SVl 14 Swaziland Sour Bushveld; Gm 16 KaNgwane Montane Grassland (marginal).

Assessment rationale: Has a restricted EOO and AOO (less than the Endangered and Vulnerable thresholds, respectively [B1+2]) but fragmentation is slight, there are no extreme fluctuations and the species is fairly abundant at some sites. However, there has been a presumed reduction in population size and extent of occurrence [B1b(i,iii,v)+2b(i,iii,v)] as a result of substantial loss of habitat in the Nkomati River valley due to inundation of the Maguga Dam. The species is thus regarded as Near Threatened and was also listed as such in the Swaziland Red Data Book (Monadjem *et al.* 2003).

Threats: Habitat fragmentation has occurred in one of the four locations, namely the Nkomati basin, as a consequence of inundation by the Maguga Dam. Approximately 16 km of suitable habitat along the Nkomati River was lost (Monadjem *et al.* 2003). Because there are no more dams proposed for the basins in which the species occurs, future threats are unlikely.

Conservation measures: Monadjem *et al.* (2003) recommended that the Nkomati River valley population be monitored after inundation. Future research should be directed towards the species' biology and ecology.

Afroedura marleyi (FitzSimons, 1930)
MARLEY'S FLAT GECKO

Aaron M. Bauer

Global: Least Concern

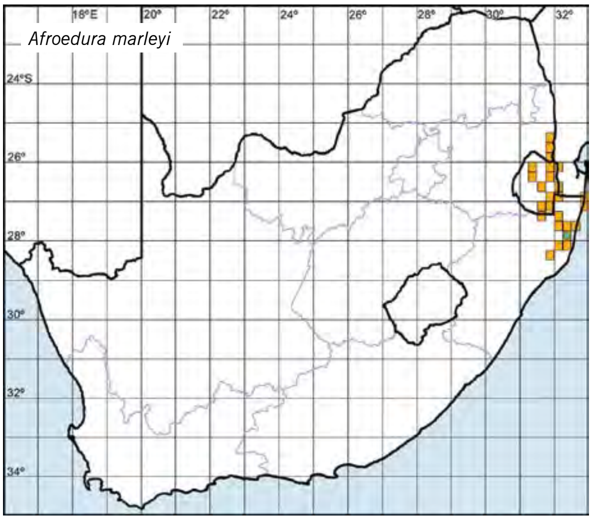
Endemic

Taxonomy: Formerly considered a subspecies of *Afroedura pondolia* (e.g. Onderstall 1984), but since elevated to specific status (Branch 1998).

Distribution: Endemic to the *Atlas* region, occurring in South Africa and Swaziland, but probably also southern Mozambique (Branch 1998). In South Africa it occurs in northeastern KwaZulu-Natal and the extreme eastern portion of Mpumalanga (Jacobsen 1989; Bourquin 2004).

Habitat: Arboreal or rupicolous, occurring in mesic habitats from coastal forests to savanna. Found at elevations of 0–700 m (Jacobsen 1989; Bourquin 2004).

Bioregion: Lowveld; Indian Ocean Coastal Belt.



Assessment rationale: Relatively widespread and common in the varied habitats occupied. Potential major threats are localised.

Conservation measures: None recommended.

Afroedura marleyi, adult—Manyiseni area, Lebombo Mtns, KZN
M. Burger

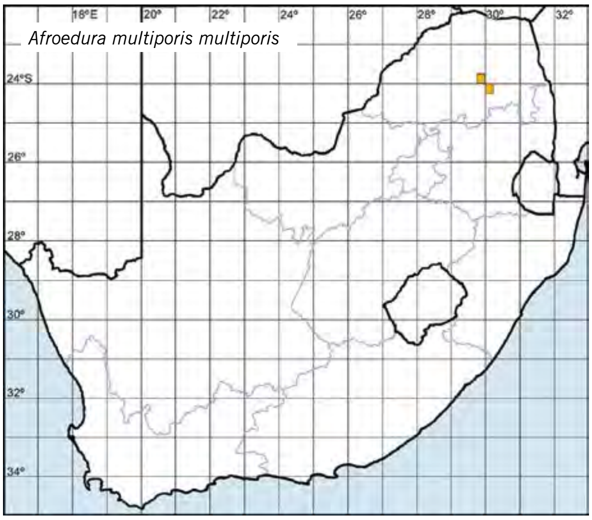
Afroedura marleyi, juvenile—Manyiseni area, Lebombo Mtns, KZN
M. Burger

Afroedura multiporis multiporis (Hewitt, 1925)
WOODBUSH FLAT GECKO

Aaron M. Bauer

Global: Vulnerable A2c

Endemic



Taxonomy: Relationships among members of the *Afroedura pondolia* group require further investigation, as do species boundaries of the named species and subspecies, including *A. multiporis multiporis*. Jacobsen (1989) referred to this taxon as *A. haackei multiporis*, and later as *A. m. multiporus* (Jacobsen 1992b). Jacobsen (1989, 1992b) described, but did not formally name, two additional members of the *Afroedura multiporis* complex, i.e. *A. multiporis* 'Abel Erasmus' and *A. multiporis* 'Lebombo'. A molecular phylogenetic analysis of *Afroedura* and formal descriptions of these species are in progress (A.M. Bauer, N.H.G. Jacobsen & T.R. Jackman in prep.). The geographical ranges of these undescribed taxa are not shown on the map.

Distribution: Endemic to the central portion of Limpopo, South Africa.

EOO: 1 412 km² (confidence: medium); AOO: 565 km² (confidence: medium).

Habitat: Found in areas of granite or quartzite cliffs and boulders, at elevations of 1 400–1 800 m (Jacobsen 1989).

Vegetation type: SVcb 24 Mamabolo Mountain Bushveld; Gm 25 Woodbush Granite Grassland; SVcb 25 Poung Dolomite Mountain Bushveld.

Assessment rationale: Irreversible population reduction of >30% in the past, inferred from a reduction of at least one-third of the AOO in association with the construction of Ebenezer Dam [A2c]. Furthermore, this taxon has a highly restricted range (the estimated AOO is close to the Endangered threshold and might be an overestimate). It is thus regarded as Vulnerable.

Threats: Has relatively limited dispersal capabilities and a restricted range. May be locally affected by afforestation (Jacobsen 1988a). The construction of the Ebenezer Dam flooded an area containing a population of this taxon (Onderstall 1984).

Conservation measures: Conduct further taxonomic research. Investigate population size, range and habitat status. Expand protected areas.

Afroedura multiporis multiporis—Wolkberg, LIMP J. Marais

Afroedura multiporis haackei Onderstall, 1984

HAACKE'S FLAT GECKO

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: Relationships among members of the *Afroedura pondolia* group require further investigation. Taxon boundaries, including those of *A. multiporis haackei*, should also be investigated. Jacobsen (1989) referred to this taxon as *A. haackei haackei*, but it was referred to as *A. m. haackei* by Jacobsen (1992b).

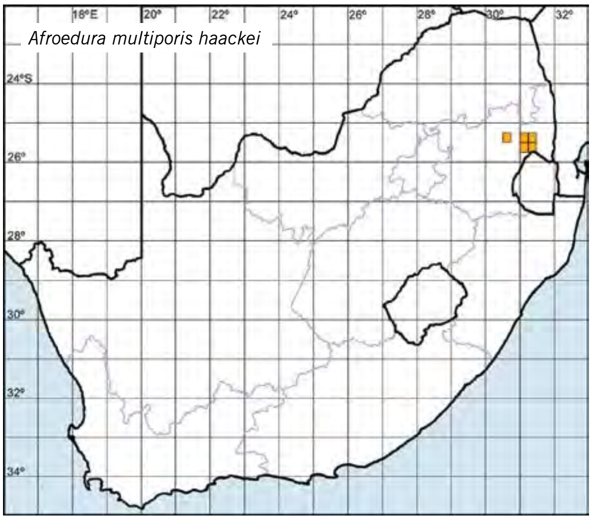
Distribution: Endemic to the *Atlas* region, occurring in the Lowveld of Mpumalanga, South Africa.

Habitat: Found in areas with granite boulders in well-wooded Lowveld, and on buildings offering similar microhabitats. It occurs at elevations of 500–1 100 m (Jacobsen 1989).

Bioregion: Lowveld.

Assessment rationale: Has a restricted EOO (4 050 km²) but is locally abundant and occurs within protected areas. Relevant extrinsic threats are localised.

Conservation measures: None recommended.



Afroedura multiporis haackei—about 28 km WNW of Nelspruit, MPM
M. Burger

Afroedura nivaria (Boulenger, 1894)

DRAKENSBERG FLAT GECKO;
MOUNTAIN FLAT GECKO

Michael F. Bates & Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: *Afroedura amatolica* was synonymised with *A. nivaria* by Loveridge (1947), and some earlier references to *A. nivaria* may refer to this species. The *A. nivaria* species complex (including *A. amatolica, A. halli, A. karroica* and *A. tembulica*) is being revised on the basis of morphological data (M.F. Bates & W.R. Branch in prep.) and the taxonomic status of isolated populations in the eastern Free State and Eastern Cape is also being investigated by means of a molecular analysis (B.G. Makhubo, K.A. Tolley & M.F. Bates in prep.).

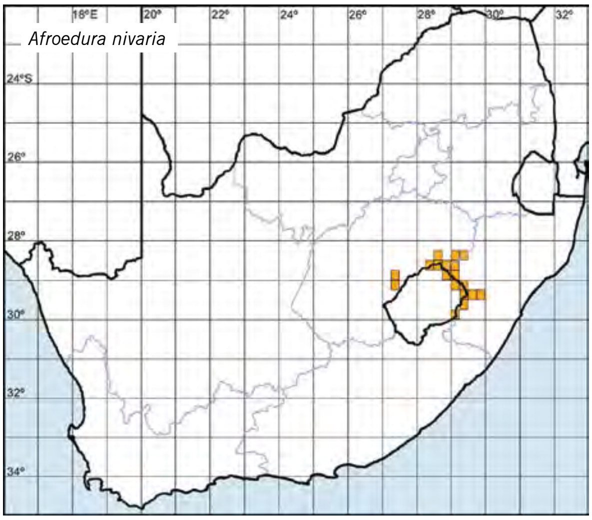
Distribution: Endemic to the South African provinces of KwaZulu-Natal (Bourquin 2004) and Free State (De Waal 1978; Bates 1996a) where it is restricted to the Drakensberg and its outliers. It may also occur in Lesotho.

Habitat: Found under rock flakes and in very narrow crevices on sandstone cliffs, outcrops and boulders, at elevations of 1 370–3 000 m (De Waal 1978; Bourquin 2004; M.F. Bates unpubl. data).

Bioregion: Drakensberg Grassland; Mesic Highveld Grassland.

Assessment rationale: Although the AOO is small (<2 000 km² [B2]) and there are at least a few isolated subpopulations (e.g. Silasberg 2828BC: Bates 1996a), this species is fairly widespread and locally abundant in a mountainous area where it is not generally threatened by anthropogenic activities.

Conservation measures: Re-assess the conservation status of any isolated populations that may prove to be valid species (M.F. Bates & W.R. Branch in prep.; B.G. Makhubo, K.A. Tolley & M.F. Bates in prep.).



Afroedura nivaria—Royal Natal NP, KZN W.D. Haacke

Afroedura pondolia (Hewitt, 1925)

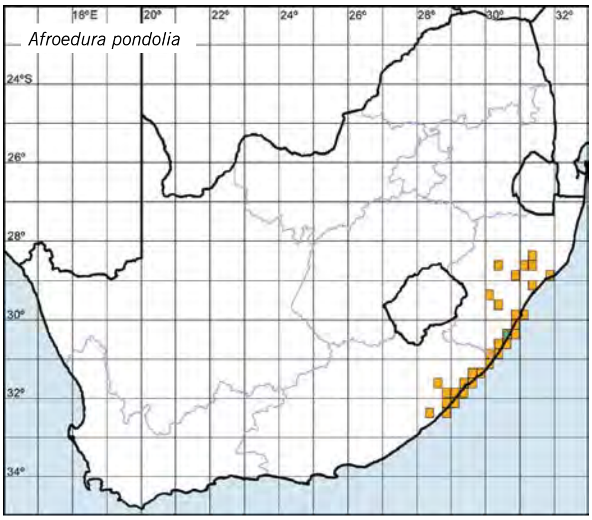
PONDO FLAT GECKO

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: Hewitt (1925) described *Afroedura multiporis* as a subspecies of *A. pondolia* and Loveridge (1947) subsequently considered *A. marleyi* as another subspecies of *A. pondolia*. Jacobsen (1989, 1992b) recognised and described, but did not formally name, two additional members of the *A. pondolia* complex, *A. p.* 'Godlwayo' and *A. p.* 'Maripi'. Formal description and molecular phylogenetic analysis of these species is in progress (A.M. Bauer, N.H.G. Jacobsen & T.R. Jackman in prep.); their distributions are not indicated on the map below.



Distribution: Endemic to South Africa, occurring from the eastern parts of the Eastern Cape to central KwaZulu-Natal.

Habitat: Rupicolous, occurring on rock outcrops and cliffs in a variety of wooded habitats (Branch 1998; Bourquin 2004) at elevations of 0–900 m. Also found on trees in and around Durban (Alexander 1990; J. Marais pers. comm.).

Bioregion: Indian Ocean Coastal Belt; Sub-Escarpment Grassland; Sub-Escarpment Savanna; Lowveld.

Assessment rationale: Has a relatively wide range and is common in most areas. May be locally threatened by land conversion, but can occur commensally with humans. Reported to be displaced by *Hemidactylus mabouia* in coastal areas (Bourquin 1987; Alexander 1990; Branch 1998), but this threat is localised.

Conservation measures: None recommended.

Afroedura pondolia—Durban, KZN J. Marais

Afroedura tembulica (Hewitt, 1926)

TEMBU FLAT GECKO; TEMBO FLAT GECKO

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: An examination of phylogenetic relationships among *Afroedura* species, and of species boundaries within the genus, is in progress (A.M. Bauer, N.H.G. Jacobsen & T.R. Jackman in prep.).

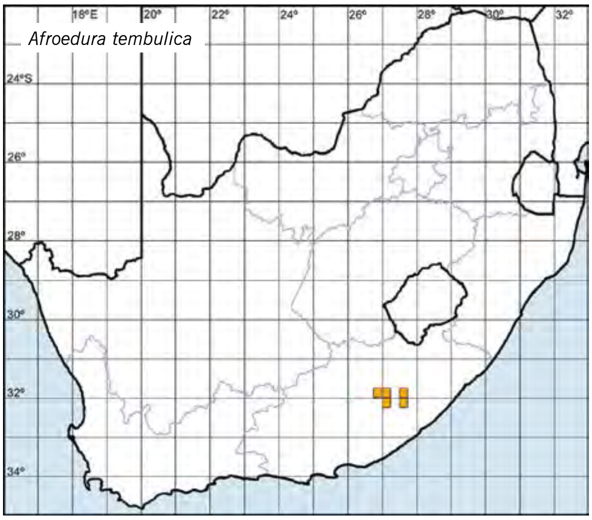
Distribution: Endemic to the Queenstown region of the Eastern Cape, South Africa.

Habitat: Rupicolous, occurring in mesic rocky habitats in grassland (Branch 1998) at elevations of 1 150–1 800 m.

Vegetation type: Gs 10 Drakensberg Foothill Moist Grassland; Gs 15 Tsomo Grassland; Gs 16 Queenstown Thornveld.

Assessment rationale: Has a restricted range but appears to lack major extrinsic threats. Nevertheless, it should be noted that parts of the range are heavily overgrazed by livestock, especially goats (M.F. Bates pers. obs.), and this may impact on the abundance of insect prey.

Conservation measures: None recommended.



Afroedura tembulica—Indwe, EC W.R. Branch

Afroedura transvaalica (Hewitt, 1925)

ZIMBABWE FLAT GECKO;
TRANSVAAL FLAT GECKO

Aaron M. Bauer

Global: Least Concern

Taxonomy: The taxonomic status of the various disjunct populations of this species should be investigated. *Afroedura loveridgei* was formerly considered as a subspecies of *A. transvaalica* (Onderstall 1984) but has since been elevated to specific status (Branch 1998).

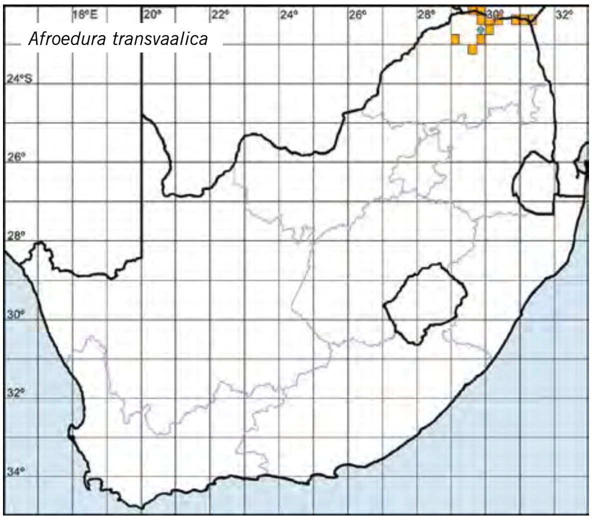
Distribution: Endemic to southern Africa. Distributed in several disjunct populations across Zimbabwe (Onderstall 1984), the southernmost of which is contiguous with northern Limpopo Province, South Africa. There is at least one record from central Mozambique, adjacent to the Zimbabwean border (Onderstall 1984; Jacobsen 1989). It may occur in eastern Botswana (Auerbach 1987).

Habitat: Rupicolous, found in areas of granite and sandstone boulders and outcrops in mesic savanna (Jacobsen 1989; Branch 1998). Occurs at elevations of about 500–1 300 m. Also found on trees.

Bioregion: Mopane; Central Bushveld.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Afroedura transvaalica—Mapungubwe, LIMP M. Burger

Genus *Afrogecko* Bauer, Good & Branch, 1997—African leaf-toed geckos

The genus *Afrogecko* currently contains four species of leaf-toed geckos, three of which were previously included in the genus *Phyllodactylus* (Bauer *et al.* 1997). It is endemic to southwestern Africa, with two species (*A. porphyreus*, *A. swartbergensis*) endemic to the *Atlas* region. The other two species (*A. ansorgii* and the spectacular and newly described *A. plumicaudatus*) are restricted to southwestern Angola (Haacke 2008). New research indicates that *Afrogecko* is non-monophyletic and *A. swartbergensis* is to be placed in a new monophyletic genus (M. Heinicke, J.D. Daza, E. Greenbaum, T.R. Jackman & A.M. Bauer in prep.). All species are nocturnal and rupicolous, with one commensal species (*A. porphyreus*) that is readily translocated (Branch 1991, 1998). Both species in the *Atlas* region are classified as Least Concern as they are either widespread (*A. porphyreus*) or occur in mountainous, relatively undisturbed habitat (*A. swartbergensis*).

Afrogecko porphyreus (Daudin, 1802)

MARBLED LEAF-TOED GECKO; MARBLED AFRICAN LEAF-TOED GECKO

William R. Branch

Global: Least Concern

Endemic

Taxonomy: Hewitt (1935, 1937c) described two isolated subspecies: *Phyllodactylus porphyreus cronwrighti* from Cape St Francis in the Eastern Cape, and *P. p. namaquensis* from Bitterfontein, Little Namaqualand. Loveridge (1947) dismissed *P. p. cronwrighti* but continued to recognise the northern subspecies, *P. p. namaquensis*. However, no additional Namaqualand material has become available. Neither subspecies is currently recognised (e.g. Branch 1998) but substantial genetic divergence within populations from the Cape Fold Mountains has been noted and this provisionally supports the recognition of *P. p. cronwrighti* and a possible new taxon on the Cape Peninsula (K. Whitaker unpubl. data).

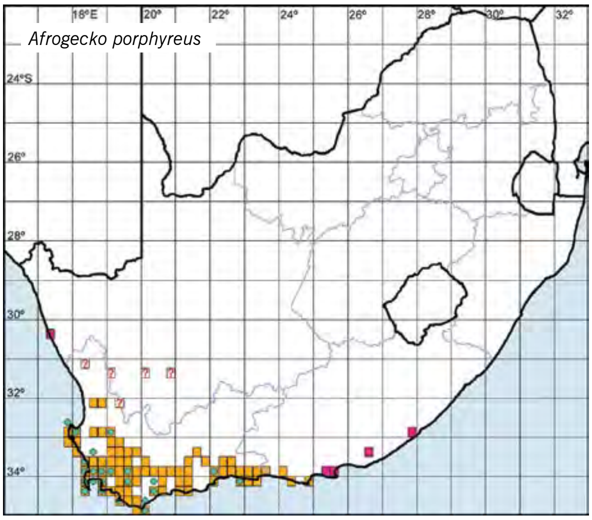
Distribution: Naturally endemic to the Cape Fold Mountain region of the Western and Eastern Cape provinces, but its commensal habits have resulted in numerous translocations (e.g. Port Elizabeth, Grahamstown, East London, and numerous offshore islands on the West Coast of South Africa and Namibia, as well as St Helena in the mid-Atlantic Ocean; Branch 1991). A number of unsupported records from inland areas of Namaqualand, including Bitterfontein (PEM), Nieuwoudtville (SAM), and QDGCs 3219AB, 3120AC and 3120BD (Visser 1984b) are plotted on the map as questionable. No recent collections or VM observations confirm these localities, which may represent translocations.

Habitat: Nocturnal, occupying moist habitats where it shelters under tree bark, exfoliating rock flakes and fissures in rock outcrops. Communal; groups may occupy the same shelters. Commensal with humans and common in urban areas (Branch 1998).

Biome: Fynbos.

Assessment rationale: Common in the *Atlas* region and tolerant of transformed habitats.

Conservation measures: None recommended.



Afrogecko porphyreus—Cape Point, WC W.R. Schmidt

Afrogecko porphyreus—Cape Town, WC W.R. Branch

Afrogecko swartbergensis (Haacke, 1996)

SWARTBERG LEAF-TOED GECKO;
SWARTBERG AFRICAN LEAF-TOED GECKO

William R. Branch

Global: Least Concern

Endemic

Taxonomy: No notable issues.

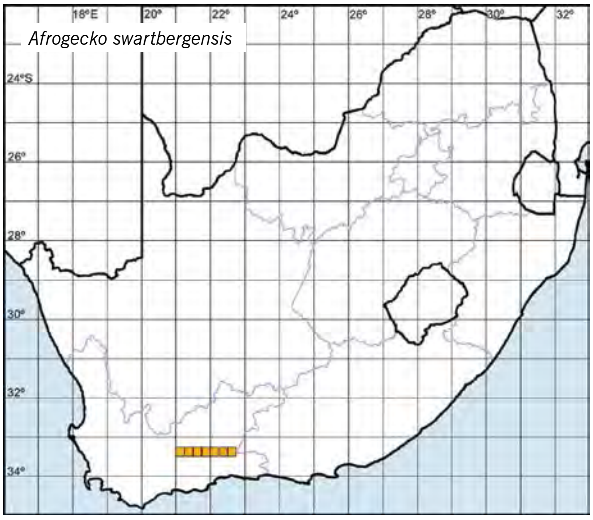
Distribution: Endemic to South Africa and restricted to the summit of the Groot and Klein Swartberg ranges. Recent surveys (M.J. Cunningham, K. Henderson, A.A. Turner & M.F. Bates unpubl. data) have extended the range westwards along the Groot Swartberg to Towerkop in the Klein Swartberg. There are only two records to the east of Meiringspoort, although suitable habitat occurs further east along the Groot Swartberg summit.

Habitat: Found in rock cracks and under exfoliating flakes, usually on large, north-facing sandstone outcrops in montane fynbos. Occurs at altitudes of 1 300–2 100 m (Branch & Bauer 1996; M.J. Cunningham unpubl. data).

Bioregion: Western Fynbos-Renosterveld.

Assessment rationale: Has a restricted range with EOO (1 000 km^2) and AOO (500 km^2) above the Vulnerable thresholds, but with only minor decline in the quality of habitat. Most of the distribution is in protected areas, although the Swartberg summit area is a tourist region that is increasingly used for hiking and leisure activities, with a concomitant increase in fire risk and some habitat deterioration. Future climate change (increase in temperature) may affect populations.

Conservation measures: Collect data on specific habitat requirements and extent of available habitat, total range and population numbers within suitable habitat, and the effect of fire on habitat and population numbers.



Afroedura swartbergensis—Seweweekspoort Peak, WC M.F. Bates

Genus *Chondrodactylus* Peters, 1870—giant geckos

The genus *Chondrodactylus* was previously considered monotypic (i.e. containing only the species *C. angulifer*) but now contains three additional species (Bauer & Lamb 2005) previously placed in *Pachydactylus.* Preliminary molecular analysis indicates that two (*C. turneri*, *C. fitzsimonsi*) of the four species display substantial genetic divergence that suggests the presence of cryptic taxa (Heinz 2011). These are large nocturnal geckos of which three species (*C. bibronii*, *C. turneri, C. fitzsimonsi*) are rupicolous and one species (*C. angulifer*) is terrestrial. Three species (*C. angulifer*, *C. bibronii*, *C. turneri*) are found in the *Atlas* region (the other species is *C. fitzsimonsi* from Namibia and Angola) and none are considered threatened.

Chondrodactylus angulifer angulifer Peters, 1870

COMMON GIANT GECKO; GIANT GROUND GECKO

William R. Branch

Regional: Least Concern

Taxonomy: A western subspecies, *Chondrodactylus angulifer namibensis*, was described by Haacke (1976b). However, possible sympatry between it and *C. a. angulifer* has been noted in the Sperrgebeit (Branch 1994a) and the Richtersveld (Bauer & Branch 2003 [2001]), necessitating a modern taxonomic revision.

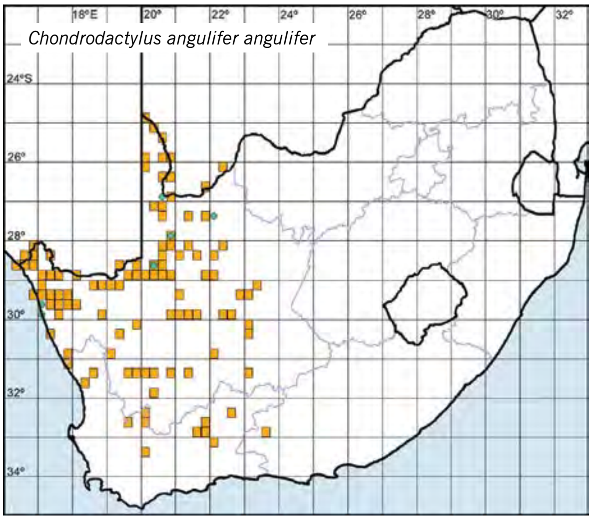
Distribution: Occurs in the western part of South Africa, southern Namibia and southwestern Botswana. In South Africa it is widespread throughout the sandy regions of the western and northwestern Kalahari, Great Namaqualand and Karoo.

Habitat: A large terrestrial gecko that burrows in loosely compacted sand in the sparsely vegetated, sandy valleys of the western arid region (Haacke 1976b).

Biome: Nama-Karoo; Succulent Karoo; Desert.

Assessment rationale: The species is widespread, common and not threatened.

Conservation measures: None recommended.

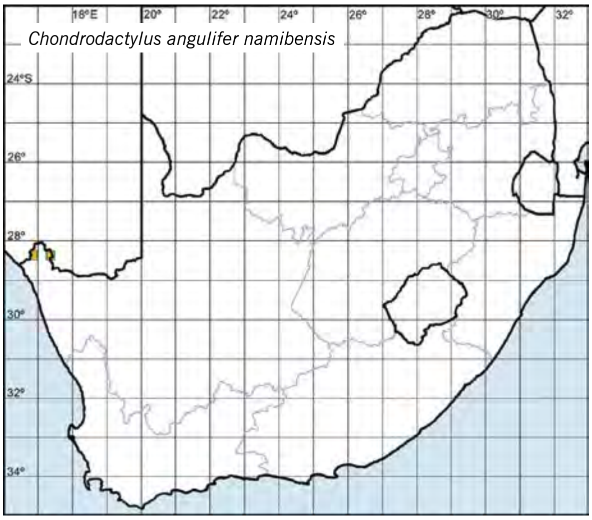


Chondrodactylus angulifer angulifer, male (back) and female (front)—Augrabies, NC W.R. Branch

Chondrodactylus angulifer namibensis Haacke, 1976

NAMIB GIANT GECKO

William R. Branch



Not Applicable

Taxonomy: Possible sympatry between this form and *C. a. angulifer* has been noted in the Sperrgebeit (Branch 1994a) and in the Richtersveld (Bauer & Branch 2003 [2001]), suggesting that *C. a. namibensis* may deserve specific recognition. Provisional molecular analysis indicates low levels of divergence between the two subspecies of *C. angulifer* (A.M. Bauer unpubl. data). A modern taxonomic revision of the species is recommended.

Distribution: Occurs in Namibia and South Africa (Haacke 1976b; Branch 1998). Found in gravel plains and interdune spaces of the Namib and pro-Namib, mainly north of the Kuiseb River to the vicinity of Orupembe in the western Kaokoveld, and apparently along a narrow coastal strip to Lüderitz. It enters the *Atlas* region only marginally in the northern Richtersveld, its southern range limit.

Habitat: A large terrestrial gecko of sandy habitats in the Namib Desert and Richtersveld.

Biome: Desert; Succulent Karoo.

Assessment rationale: This taxon has an extremely limited distribution in the *Atlas* region (known from only two records in the Richtersveld) and was therefore not assessed. It is widespread and common throughout its global range, with only local and limited threats from mining and agriculture. Within the *Atlas* region, however, suitable habitat is restricted to the lower Orange River where coastal habitats have been impacted by mining activities (Bauer & Branch 2003 [2001]). Based on criteria D1 and D2, a regional assessment of this species would be Vulnerable, whereas application of criteria B and C could yield an Endangered assessment. However, the only known populations occur in a protected area (Richtersveld National Park) and there is almost certainly unimpeded immigration from Namibia, thus the regional listing would be downgraded.

Conservation measures: None recommended.

Chondrodactylus angulifer namibensis—Walvis Bay, Namibia J. Visser

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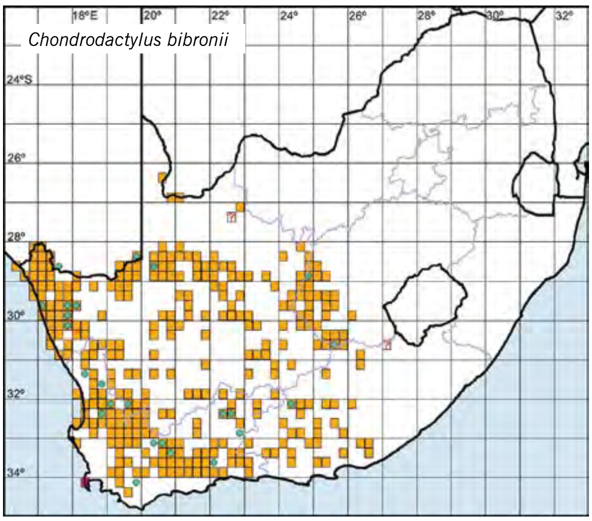
Chondrodactylus bibronii (A. Smith, 1846)

BIBRON'S GECKO; BIBRON'S TUBERCLED GECKO

William R. Branch



Global: Least Concern

Taxonomy: Previously treated as *Pachydactylus bibronii* (FitzSimons 1943; Branch 1998) but transferred to the genus *Chondrodactylus* by Bauer & Lamb (2005). Confusion with *C. turneri* (previously *Pachydactylus laevigatus*) was resolved by Benyr (1995).

Distribution: Occurs in southern Namibia, Botswana and South Africa. In the *Atlas* region it is found in the Northern and Western Cape provinces, extending into the western Free State and western half of the Eastern Cape. It is not known whether the introduced population in the Kommetjie region still persists.

Habitat: A large nocturnal and rupicolous gecko that may form large colonies in rock outcrops throughout the Karoo region. Commensal in farm buildings and outhouses but rarely common in large urban areas (Branch 1998).

Biome: Nama-Karoo; Succulent Karoo; Fynbos; Albany Thicket; Savanna; Grassland.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Chondrodactylus bibronii—Farm Donkiedam, NW of Loeriesfontein, NC
M. Burger

Chondrodactylus turneri (Gray, 1864)

TURNER'S GECKO; TURNER'S TUBERCLED GECKO

William R. Branch

Global: Least Concern

Taxonomy: This taxon was previously referred to as *Pachydactylus laevigatus laevigatus* (FitzSimons 1943; Branch 1998) but was assigned to *P. turneri* by Benyr (1995) and subsequently transferred to the genus *Chondrodactylus* by Bauer & Lamb (2005).

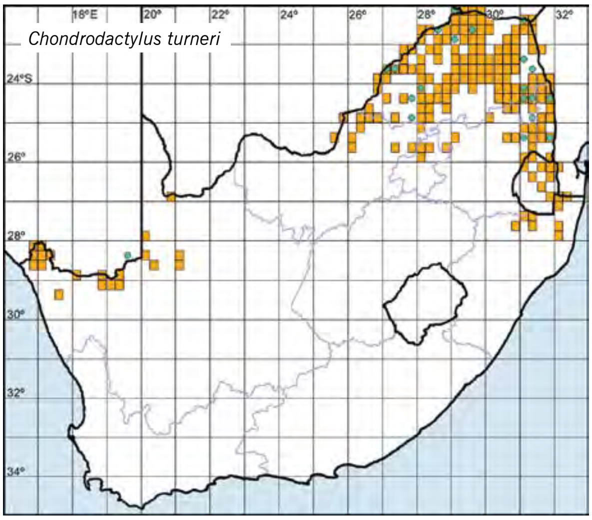
Distribution: A predominantly tropical species ranging from Little Namaqualand and the northwestern parts of the Northern Cape, northwards through Namibia and Botswana into southern Angola, eastwards to Tanzania (with scattered records in Kenya) and southwards to KwaZulu-Natal. It appears to be sympatric with *C. bibronii* in the Northern Cape.

Habitat: A large nocturnal and rupicolous gecko common in the western arid region and extending into savanna habitats in East Africa. It inhabits rock outcrops and old houses (Branch 1998), and hollow trees.

Biome: Savanna; Desert; Succulent Karoo; Nama-Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Chondrodactylus turneri—Venetia Limpopo NR, LIMP M. Burger

Genus *Colopus* Peters, 1869—ground geckos

Colopus was previously considered monotypic (i.e. containing only *C. wahlbergii*), but it now contains an additional species, *C. kochii,* previously placed in *Pachydactylus* (Bauer & Lamb 2005). These are small, delicate, nocturnal and strictly terrestrial geckos with elongate bodies and reduced subdigital lamellae. *Colopus wahlbergii* is the only species that enters the *Atlas* region, where its two subspecies are not considered threatened.

Colopus wahlbergii wahlbergii Peters, 1869

KALAHARI GROUND GECKO

William R. Branch

Global: Least Concern

Taxonomy: Haacke (1976c) revised *Colopus wahlbergii* and described a western subspecies, *C. w. furcifer*.

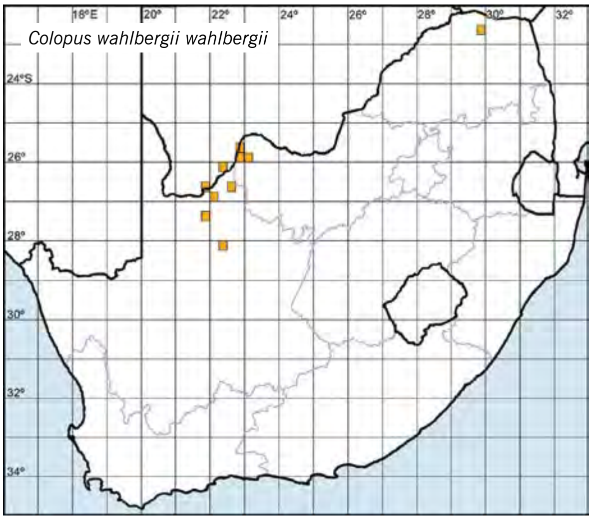
Distribution: Found throughout much of the central Kalahari of Botswana and adjacent Northern Cape, with scattered records in northern Limpopo and southern Zimbabwe (Broadley & Rasmussen 1995; Broadley & Van Daele 2003).

Habitat: A small terrestrial gecko of dune and savanna habitats in the central Kalahari and adjacent regions.

Bioregion: Eastern Kalahari Bushveld; Kalahari Duneveld; Mopane.

Assessment rationale: Common and not threatened throughout its range, much of which falls in semi-arid areas with very low agricultural or urban impact.

Conservation measures: None recommended.



Colopus wahlbergii wahlbergii—near Duvundu, Caprivi, Namibia J. Marais

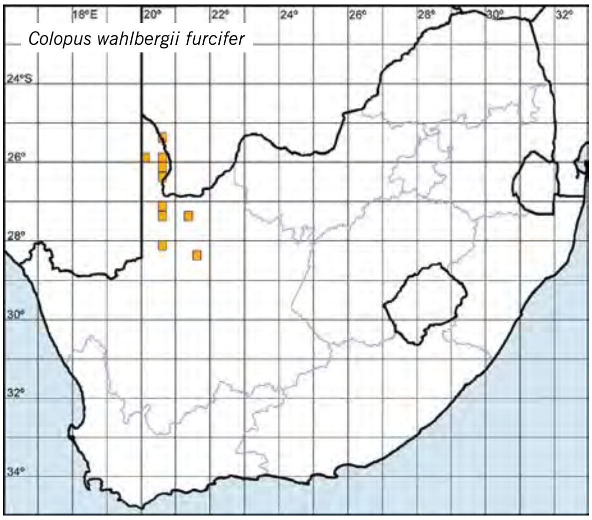
Colopus wahlbergii furcifer Haacke, 1976

STRIPED GROUND GECKO

William R. Branch

Global: Least Concern

Colopus wahlbergii furcifer—Kameelsleep, Kgalagadi Transfrontier Park, NC W.D. Haacke



Taxonomy: Haacke (1976c) revised *Colopus wahlbergii* and described a western subspecies, *C. w. furcifer*.

Distribution: Occurs in the 'dune area' of the western and southwestern Kalahari of eastern Namibia, extending into the Northern Cape, South Africa.

Habitat: A small terrestrial gecko of dune habitats in the western Kalahari.

Bioregion: Kalahari Duneveld; Bushmanland.

Assessment rationale: Common and not threatened throughout its range. Much of its range within the *Atlas* region is in formally (e.g. Kgalagadi Transfrontier Park) and informally protected areas.

Conservation measures: None recommended.

Genus *Cryptactites* Bauer, Good & Branch, 1997—salt marsh geckos

Cryptactites is a monotypic genus endemic to South Africa. Its only member, *C. peringueyi*, was previously included in the genus *Phyllodactylus* (Bauer *et al.* 1997). These geckos are nocturnal and terrestrial, and are globally unique amongst geckos in that they inhabit periodically inundated salt marsh habitat. They have a very restricted distribution, and are considered Critically Endangered due to coastal urban development and predicted sea level changes.

Cryptactites peringueyi (Boulenger, 1910)

SALT MARSH GECKO;
PÉRINGUEY'S COASTAL LEAF-TOED GECKO

William R. Branch

Global: Critically Endangered **B1ab(iii)+2ab(iii)**

Endemic

Taxonomy: This taxon was separated from *Phyllodactylus* and placed in the monotypic genus *Cryptactites* by Bauer *et al.* (1997).

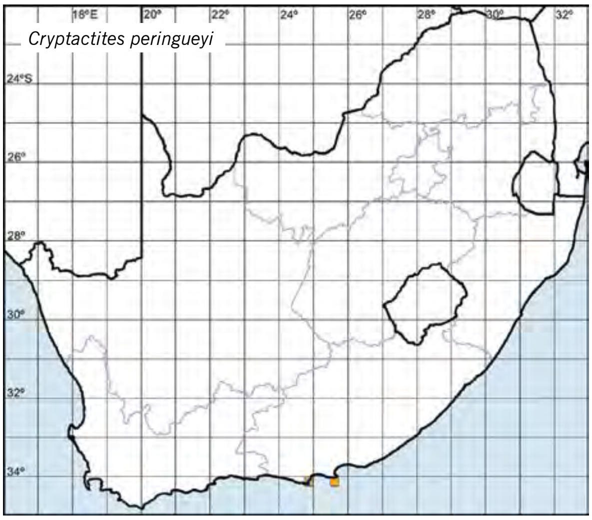
Distribution: Endemic to the Eastern Cape and known from only two small populations. The first occurs along 11 km of shoreline immediately west of Cape Recife, from Chelsea Point to Schoenmakerskop. The second population occurs approximately 40 km to the west and is restricted to salt marsh and adjacent strand at the mouth of the Kromme River, extending 10 km inland along the tidal reach of the river (Branch & Bauer 1994; subsequent records) and in habitats adjacent to the coast at Cape St Francis, 8 km south of the Kromme River Mouth (photograph of specimen examined by the author). All known habitats occur within 100 m of the high water mark, and below 30 m.

EOO: 40 km^2 (confidence: high); AOO: 4 km^2 (confidence: high).

Habitat: Restricted to coastal strand and salt marsh habitat, particularly in association with *Phragmites* reed clumps.

Vegetation type: AZd 3 Cape Seashore Vegetation.

Assessment rationale: This species has an exceptionally small range with EOO <100 km^2 [B1] and AOO <10 km^2 [B2]. It has been recorded from two subpopulations, with all records from within 100 m of the high water mark on the shore or along the river bank of the tidal reaches of the Kromme River. With the exception of single specimens from Schoenmakerskop and Cape St Francis (found 25–30 m above the beach), all other localities lie between 0–5 m. The two known subpopulations are far apart and searches in the intervening area (e.g. Kini Bay, Maitland River mouth, Van Stadens River mouth, Gamtoos River mouth, Seekoei River mouth) have all been negative (pers. obs.). The species is vulnerable to changes in coastal sea levels, both stochastic (e.g. tsunamis) and otherwise [one location, B1a+2a]. It has very specific habitat associations and its habitat is declining in extent and quality due to coastal development [B1b(iii)+2b(iii)].



Cryptactites peringueyi—Kromme River Estuary, EC W.D. Haacke

Threats: Occupies a very restricted range in a naturally fragmented, sensitive habitat (coastal strand) that is subject to numerous threats: coastal development pressures, increasing incidents of fire, potential oil pollution from sea spills, and increasing sea storm flooding associated with climatic changes. The area where it occurs is not protected.

Conservation measures: Perform detailed coastal surveys to re-evaluate the size of the species' range, and develop monitoring protocols that will allow the assessment of threats and of potential habitat loss or transformation. Draft a BMP-S and conduct a PHVA.

Genus *Goggia* Bauer, Good & Branch, 1997—pygmy geckos

The genus *Goggia* contains eight species of leaf-toed geckos previously included in the genus *Phyllodactylus* (Bauer *et al.* 1997). This genus is almost endemic to South Africa, with the ranges of two species (*G. gemmula*, *G. lineata*) extending marginally into adjacent southern Namibia. *Goggia* are mainly dwarf, nocturnal, rupicolous geckos, with one mainly terrestrial species (*G. lineata*) and one medium-sized species (*G. microlepidota*) (Branch *et al.* 1995a; Bauer *et al.* 1996; Branch & Bauer 1996 [1997]; Branch 1998). Two species have restricted ranges and are of conservation concern: *G. gemmula* (Vulnerable) and *G. braacki* (Near Threatened).

Goggia braacki (Good, Bauer & Branch, 1996)

BRAACK'S PYGMY GECKO; BRAACK'S DWARF LEAF-TOED GECKO

William R. Branch

Global: Near Threatened

Endemic

Taxonomy: Initially placed in the genus *Phyllodactylus* (Good *et al.* 1996) but transferred to *Goggia* by Bauer *et al.* (1997).

Distribution: Endemic to the Western Cape, South Africa. Restricted to a narrow belt of dolerite rocks and montane grassland on the summit ridge of the Nuweveldberg (Good *et al.* 1996; Branch 1998).

EOO: 125 km^2 (confidence: medium); AOO: 75 km^2 (confidence: medium).

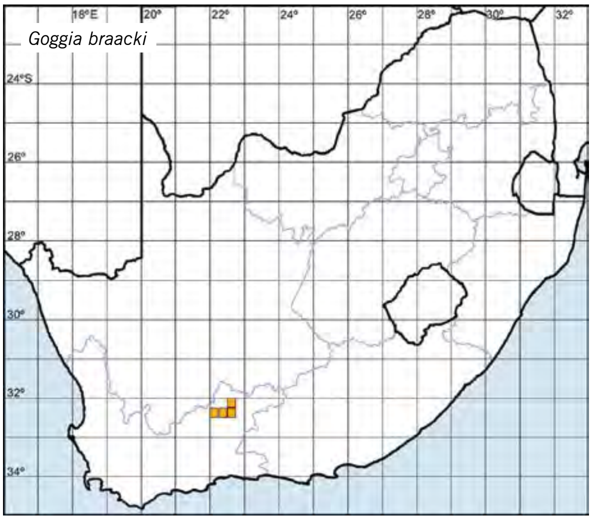
Habitat: Found in rock cracks and beneath exfoliating flakes on dolerite boulders and outcrops in montane grassland (Branch & Braack 1989; Branch 1998).

Bioregion: Upper Karoo.

Assessment rationale: Has a very restricted distribution with EOO and AOO below the Endangered thresholds (<5 000 km^2 and <500 km^2 respectively, [B1+2]) and is experiencing a continuing decline in habitat quality [B1b(iii)+2b(iii)] due to increased tourist activity in the Karoo National Park and livestock grazing of montane grassland along the escarpment outside of protected areas. However, there is no habitat fragmentation and number of locations >10. This species is therefore considered Near Threatened.

Threats: Occurs in a narrow habitat strip on the summit of Nuweveldberg that is subject to grazing (some of the habitat is not protected), increased anthropogenic fires and tourist developments.

Conservation measures: A significant part of the range occurs in Karoo National Park, a protected area. Protect critical habitat in the escarpment region from tourist developments and the danger of anthropogenic fires. Survey adjacent areas along the escarpment for the species, and investigate its biology and habitat requirements. Draft a BMP-S.

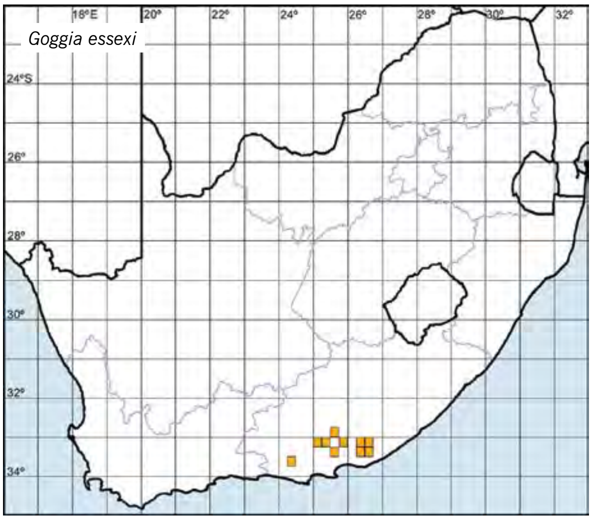


Goggia braacki—Beaufort West, WC J. Marais

Goggia essexi (Hewitt, 1925)

ESSEX'S PYGMY GECKO;
ESSEX'S DWARF LEAF-TOED GECKO

William R. Branch



Global: Least Concern

Endemic

Taxonomy: Described in the genus *Phyllodactylus* and treated as an eastern subspecies of *P. lineatus* (FitzSimons 1938, 1943; Loveridge 1947), but revived as a full species by Branch *et al.* (1995a) and transferred to the newly-erected genus *Goggia* by Bauer *et al.* (1997).

Distribution: Endemic to the Eastern Cape, South Africa. Occurs from near Steytlerville, eastwards along the Suurberg Range to Grahamstown and the Great Fish River, with a single record from Somerset East.

Habitat: Utilises small rock outcrops and exfoliating flakes on shale and sandstone with low vegetation cover (Branch *et al.* 1995).

Bioregion: Albany Thicket; Lower Karoo; Eastern Fynbos-Renosterveld.

Assessment rationale: Has a restricted range (EOO <20 000 km²) but is relatively common and found in a number of formally and privately conserved areas. It appears to be tolerant of relatively high grazing pressure in thicket habitat.

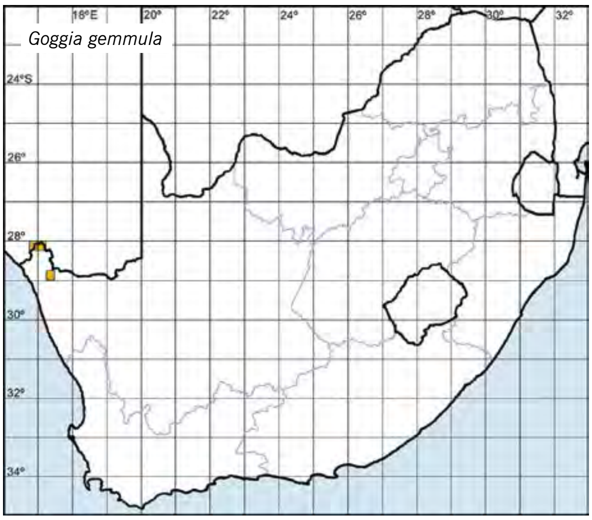
Conservation measures: None recommended.

Goggia essexi—Steytlerville, EC W.R. Branch

Goggia gemmula (Bauer, Branch & Good, 1996)

RICHTERSVELD PYGMY GECKO;
RICHTERSVELD DWARF LEAF-TOED GECKO

William R. Branch



Global: Near Threatened

Near-endemic

Taxonomy: Initially placed in the genus *Phyllodactylus* (Bauer *et al.* 1996) but transferred to the newly-erected genus *Goggia* by Bauer *et al.* (1997).

Distribution: Endemic to the Richtersveld, Northern Cape, South Africa and adjacent parts of southern Namibia.

EOO: 4 050 km² (confidence: medium); AOO: 405 km² (confidence: medium).

Habitat: Found only under exfoliating flakes on small dolerite outcrops in valley bottoms (Bauer *et. al.* 1996; Bauer & Branch 2003 [2001]).

Bioregion: Gariep Desert; Richtersveld.

Assessment rationale: Has a very restricted distribution (EOO <5 000 km², AOO <500 km²) with range estimates under the Endangered thresholds, and is experiencing some decline in the extent and quality of habitat [B1b(iii)+2b(iii)] due to livestock grazing and tourism. However, these are not major threats and the species occurs mainly within the Richtersveld National Park where it is largely protected. Alluvial diamond mining occurs mainly along the Orange River and does not directly affect the habitat of this species. It is considered Near Threatened.

Threats: Loss and deterioration of habitat has occurred due to overgrazing by livestock, tourism developments in the Richtersveld National Park, and alluvial diamond mining (which affects the general area).

Conservation measures: Initiate studies on the species' biology. Identify core habitat and protect this from mining and tourism developments. Develop a BMP-S.

Goggia gemmula—Richtersveld, NC W.R. Branch

Goggia hewitti (Branch, Bauer & Good, 1995)

HEWITT'S PYGMY GECKO; HEWITT'S DWARF LEAF-TOED GECKO

William R. Branch

Global: Least Concern

Endemic

Taxonomy: Described in the genus *Phyllodactylus* (Branch *et al.* 1995a) but transferred to *Goggia* by Bauer *et al.* (1997).

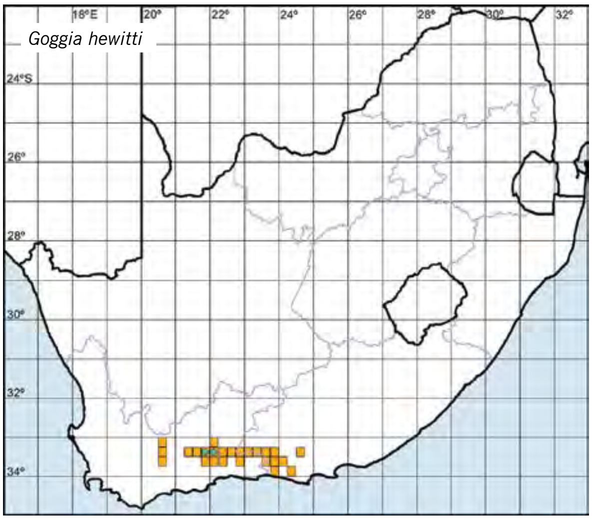
Distribution: Endemic to the *Atlas* region in the central Cape Fold Mountains, from the Swartberg south through the Little Karoo to the Langeberg and Outeniekwaberg mountains.

Habitat: Inhabits small rock outcrops and exfoliating flakes on shale and sandstone outcrops with low vegetation cover (Branch 1990a; Branch & Bauer 1995).

Biome: Fynbos; Succulent Karoo; Albany Thicket.

Assessment rationale: Has a relatively restricted range but remains fairly common even in areas subject to livestock grazing. Found in a number of formally and privately conserved areas.

Conservation measures: None recommended.



Goggia hewitti—Humansdorp, EC W.R. Branch

Goggia hexapora (Branch, Bauer & Good, 1995)

CEDERBERG PYGMY GECKO;
CEDERBERG DWARF LEAF-TOED GECKO

William R. Branch

Global: Least Concern

Endemic

Taxonomy: Initially described in the genus *Phyllodactylus* (Branch *et al.* 1995a) but transferred to *Goggia* by Bauer *et al.* (1997).

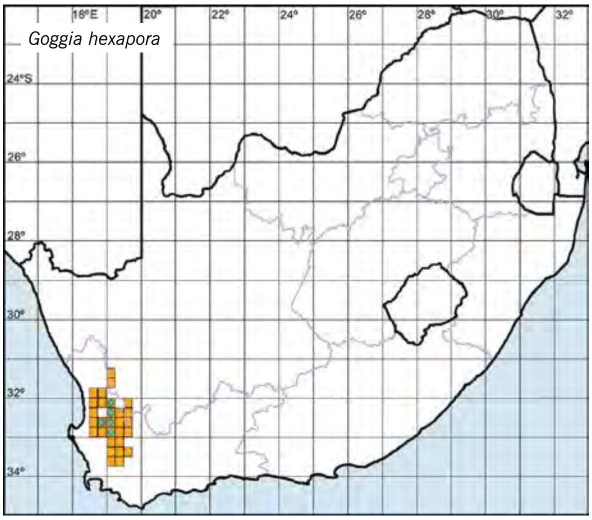
Distribution: Endemic to the *Atlas* region. Largely restricted to the Western Cape, with a few records in the adjacent Northern Cape. Occurs from the Bokkeveldberg Mountains in the north through the Cederberg, Kouebokkeveldberg and Skurweberge to Ceres, and to Piketberg in the west.

Habitat: Inhabits small rock outcrops and exfoliating flakes on shale and sandstone with low vegetation cover (Branch *et al.* 1995a).

Biome: Fynbos; Succulent Karoo.

Assessment rationale: Common, with a relatively wide distribution.

Conservation measures: None recommended.



Goggia hexapora—Farm Traveller's Rest, Cederberg, WC M. Burger

Goggia lineata (Gray, 1838)

STRIPED PYGMY GECKO;
STRIPED DWARF LEAF-TOED GECKO

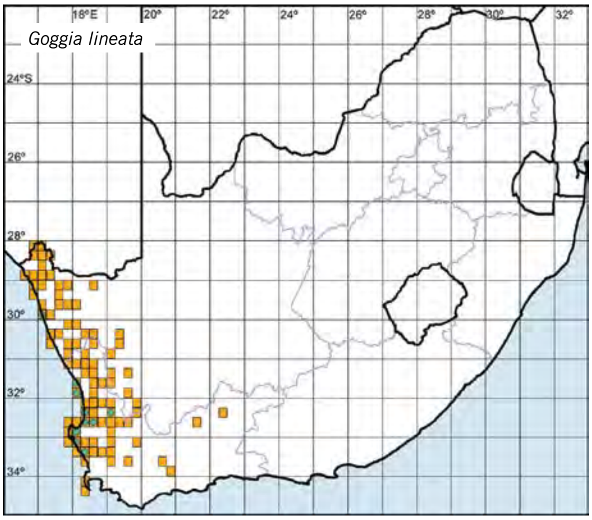
William R. Branch

Global: Least Concern

Near-endemic

Taxonomy: Described in the genus *Phyllodactylus* but later transferred to *Goggia* (Bauer *et al.* 1997). Many specimens previously referred to this species (e.g. FitzSimons 1943) have subsequently been transferred to other species (Branch *et al.* 1995a).

Goggia lineata—just N of Noup, NC G.J. Alexander



Distribution: Largely restricted to South Africa, with isolated populations in the Sperrgebiet (Aurusberg) and Karasburg district of southern Namibia (Branch 1994a). In South Africa the distribution includes the western parts of the Northern and Western Cape provinces, where it extends into the western parts of the Little Karoo. Records from the foothills of the Nuweveldberg Mountain (Karoo National Park, Branch & Braack 1989) might represent an isolated population. It has also been recorded from offshore islands (Schaapen and Meeuw) near Saldanha (Branch 1991).

Habitat: Inhabits small rock outcrops and rock piles with low vegetation cover, and dead *Aloe* and *Crassula* stems (Branch *et al.* 1995a).

Biome: Fynbos; Succulent Karoo; Nama-Karoo.

Assessment rationale: Widespread and common, and relatively tolerant of low-level agricultural and urban development.

Conservation measures: None recommended.

Goggia lineata—near Lambert's Bay, NC J. Marais

Goggia microlepidota (FitzSimons, 1939)

SMALL-SCALED GECKO;
SMALL-SCALED LEAF-TOED GECKO

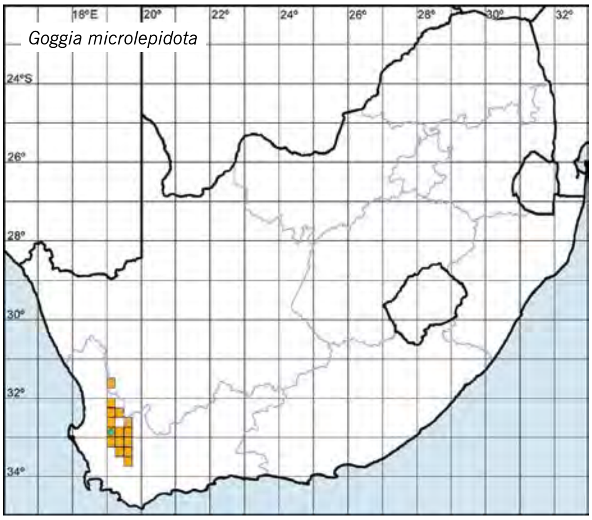
William R. Branch

Global: Least Concern

Endemic

Taxonomy: Initially placed in the genus *Phyllodactylus* (FitzSimons 1939, 1943) but transferred to *Goggia* by Bauer *et al.* (1997).

Distribution: Endemic to the Western Cape, South Africa, inhabiting the northern Cape Fold Mountains, from Kliphuis to Heuningvlei in the Cederberg in the north, and to Keeromsberg in the south. The northernmost record (3119CA, Visser 1984b) has not been confirmed by vouchers or recent records.



Habitat: Inhabits large rock cracks on extensive rock outcrops in fynbos and transitional vegetation (Branch & Bauer 1996).

Bioregion: Northwest Fynbos; Southern Fynbos.

Assessment rationale: The EOO (9 499 km^2) is below the Vulnerable threshold, and the area where it occurs is extensively used for outdoor activities. Although included (as Restricted) in previous regional Red Data Books (McLachlan 1978; Branch 1988a) and considered to be rare, the species is now known to be fairly widely distributed in mostly undisturbed mountainous country. Because of their size and attractiveness, these geckos may be targeted by the pet trade—they prefer large exfoliating rock cracks which are easily destroyed by targeted collecting. However, there is no evidence of range contraction or of major threats that have caused population declines. For the current assessment this species is thus classified as Least Concern.

Conservation measures: Periodically monitor the species' known range, population densities and habitat to detect any declines and threats.

Goggia microlepidota—Witsenberg, WC A.L. de Villiers

Goggia rupicola (FitzSimons, 1938)

NAMAQUA PYGMY GECKO;
NAMAQUALAND DWARF LEAF-TOED GECKO

William R. Branch

Global: Least Concern

Endemic

Taxonomy: Initially described in the genus *Phyllodactylus* and treated as a northern subspecies of *P. lineatus* (FitzSimons 1938, 1943; Loveridge 1947), but revived as a full species by Branch *et al.* (1995a) and transferred to a new genus (*Goggia*) by Bauer *et al.* (1997).

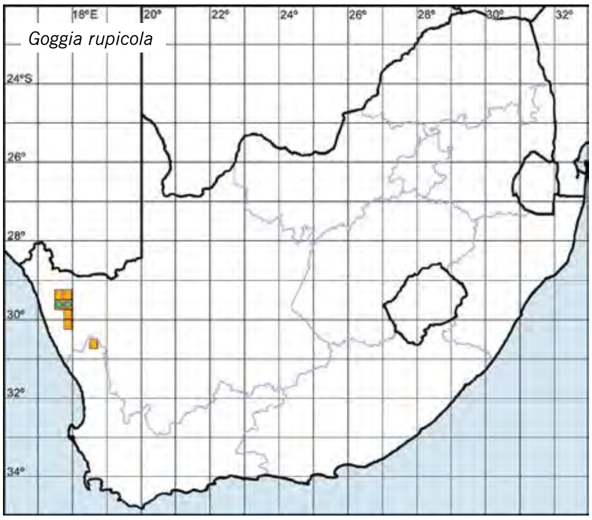
Distribution: Endemic to Namaqualand, South Africa where it occurs in the Kamiesberg and Komaggas Hills, reaching Steinkopf in the north. It is absent from the Richtersveld (Bauer & Branch 2003 [2001]).

Habitat: Utilises small rock outcrops and exfoliating flakes on rock boulders and bedrock in Succulent Karoo vegetation.

Biome: Succulent Karoo.

Assessment rationale: Has a moderate distribution in an area of low agricultural and human impact. Some parts of its habitat have been transformed by livestock overgrazing, but this practice may also have generated some habitat by exposing bedrock.

Conservation measures: None recommended.



Goggia rupicola, adult and juvenile—Kliprand, NC M. Burger

Genus *Hemidactylus* Oken, 1817—tropical house geckos

Hemidactylus is a large genus distributed widely throughout the Pacific region, southern Europe, Asia, South America, Africa and the Arabian Peninsula. Some commensal species continue to spread through tropical and subtropical regions. The genus contains over 122 species (Uetz 2012), only one (*H. mabouia*) of which occurs in the *Atlas* region. These are medium-sized, nocturnal geckos that occur in a wide range of habitats—the genus includes terrestrial, arboreal and rock-living species. Females usually lay a pair of hard-shelled eggs, and some all-female species (e.g. *H. garnotii*) reproduce parthenogenetically (Kluge & Eckhardt 1969). Several species, including *H. mabouia,* have become commensal and are so common that they are considered pests in some urban areas.

Hemidactylus mabouia (Moreau de Jonnès, 1818)

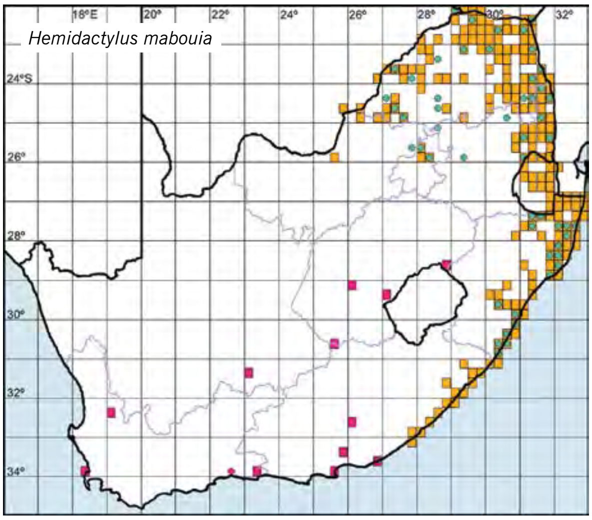
COMMON TROPICAL HOUSE GECKO; MOREAU'S TROPICAL HOUSE GECKO

William R. Branch

Regional: Least Concern

Taxonomy: Problematic. There is little genetic divergence between specimens throughout most of the species' large range, particularly in the New World, indicating anthropogenic colonisation within the last 500 years (Carranza & Arnold 2006). However, the situation in east and southern Africa is confusing. Vences *et al.* (2004) noted deep genetic divergence in populations in the western Indian Ocean region and revived *H. mercatorius* for these populations. A single African specimen from Mozambique was also divergent and they noted that the status of populations in the Indian Ocean coastal region and the subcontinent required more detailed study. Rocha *et al.* (2005) noted that *Hemidactylus* from the Gulf of Guinea islands clustered with populations from Madagascar and the Comores, and they also used the name *H. mercatorius* for these populations (Rocha *et al.* 2010). They also noted for mainland African *H. mabouia* that "... multiple cryptic lineages exist within this 'species', and the current taxonomic arrangement is completely inadequate". Provisionally, *H. mabouia* is retained for populations in the *Atlas* region, although it should be cautioned that not all anthropogenic translocations within this region necessarily derive from the same source population.

Distribution: The natural distribution in Africa is along the Indian Ocean coastal area from southern Somalia to northern KwaZulu-Natal, and in West Africa from Angola to Liberia and Senegal. The species also occurs naturally along the east coast of South America and in the Antilles. Within the *Atlas* region the natural range was previously restricted to mesic areas of the northern provinces and Indian Ocean coastal strip south to Maputaland (FitzSimons 1943). Bourquin (1987) noted the expansion of populations along the whole KwaZulu-Natal coast. As it is commensal, its range within the *Atlas* area has increased due to translocations, mainly to urban areas (pink cells on map reflect further expansion since Bourquin 1987). FitzSimons (1943: 48) dismissed early records from Pretoria (Roux 1907) and Mortimer in the Western Cape (Cott 1934) as 'extremely doubtful' and 'quite unacceptable', respectively. However, both may have reflected very early translocations. This gecko has also been extensively translocated internationally (see review by Kraus 2009), but only in its natural range does it inhabit trees and rock outcrops in woodland.



Hemidactylus mabouia—Malangane, S Mozambique J. Marais

Habitat: Mainly found in the Indian Ocean Coastal region but extends into adjacent habitats. Scansorial and found in varied habitats, especially on trees where it shelters under bark (Branch 1998). Readily translocates to urban areas where it occupies buildings (Branch 1998).

Biome: Savanna; Indian Ocean Coastal Belt; Grassland; Albany Thicket.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Genus *Homopholis* Boulenger, 1885—velvet geckos

Homopholis is a small genus consisting of three species of large-bodied African geckos, of which two (*H. mulleri*, *H. wahlbergii*) occur in the *Atlas* region. The third species, *H. fasciata*, occurs in East Africa with a northern subspecies (*H. f. erlangeri*) found in Somalia. Madagascan species previously included in *Homopholis* (e.g. *H. heterolepis*) are now referred to *Blaesodactylus*, together with a few recently described species (see Greenbaum *et al.* 2007 for a discussion of the convoluted history of these genera). These are large, soft-skinned, nocturnal and mainly arboreal geckos. In the *Atlas* region the endemic *H. mulleri* has a restricted range and is considered Vulnerable.

Homopholis mulleri Visser, 1987

MULLER'S VELVET GECKO

William R. Branch

Global: Vulnerable **B1ab(iii)+2ab(iii)**

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to Limpopo Province, South Africa, where it is restricted to Mopane Veld around the Soutpansberg.

EOO: 13 500 km² (confidence: medium); AOO: 2 564 km² (confidence: medium).

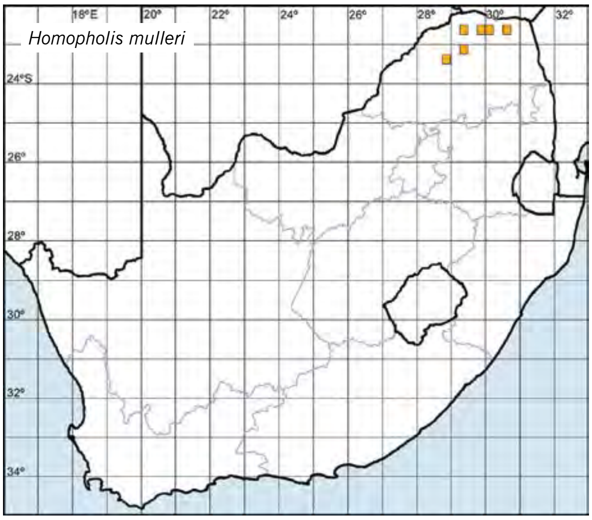
Habitat: Nocturnal, sheltering in holes in Marula (*Sclerocarya birrea* subsp. *caffra*) and Knob-thorn (*Acacia nigrescens*) trees in Mopane Veld (Visser 1987; Jacobsen 1989).

Bioregion: Central Bushveld; Mopane.

Assessment rationale: Very poorly known with a restricted range (EOO <5 000 km², AOO <2 000 km²), number of locations <10 [B1a+2a]), and inhabiting specialised habitat subject to loss and degradation due to increasing land transformation for agriculture and urban development [B1b(iii)+2b(iii)].

Threats: Mopane habitat is subject to multiple threats including increased fire events, bush clearance for agricultural use, extraction of mature trees for firewood, wood carving and charcoal production, and open-cast coal mining.

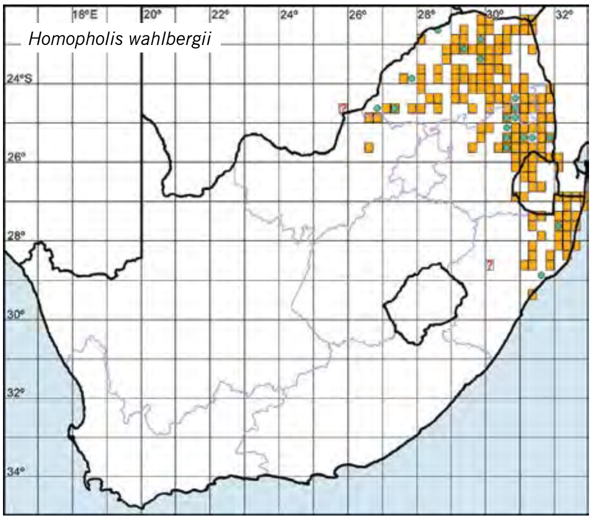
Conservation measures: Obtain detailed habitat and distribution data, and basic biological data. Assess the species' possible dependence on mature Mopane Trees (*Colophospermum mopane*), because of the threats to Mopane habitat from fire, wood utilisation and land clearance for agricultural use. Develop a BMP-S.



Homopholis mulleri—Makgabeng area, W of Senwabawana (Bochum), LIMP M. Burger

Homopholis wahlbergii (A. Smith, 1849)
WAHLBERG'S VELVET GECKO

William R. Branch



Global: Least Concern

Taxonomy: Greenbaum *et al.* (2007) noted that Boulenger's (1885) amendment of the species name to '*wahlbergii*', the name used predominately in subsequent literature, was unjustified. However, according to Ulber (1999), this is incorrect as Smith (1849) included a separate publisher's errata slip which indicated that 'walbergii' should be corrected to 'wahlbergii' wherever it appeared. Such an inserted slip, under Article 32.5.1.1 of the ICZN (1999), is clear evidence of an inadvertent error that must be corrected. The absence of the errata slip from some copies of Smith's work has contributed to confusion on this point. Greenbaum *et al.* (2007) found significant genetic divergence in a specimen from northern Limpopo and this should be investigated. Loveridge's (1944b) name *Homopholis wahlbergii arnoldi* (type locality: Mahalapsi River, Botswana), with paratypes from the Zimbabwean localities of Birchenough Bridge, Bulawayo and World's View, may be applicable to this specimen.

Distribution: Distributed from Mozambique (south of the Zambezi River) to KwaZulu-Natal in the east, extending westwards through central and southern Zimbabwe, and Limpopo and Mpumalanga provinces in South Africa, and along the eastern border of Botswana to Gaborone. An old record of a specimen (TM 1534) collected in 1919 at Malahopye (plotted at 2526DA) is unsupported by modern records and may represent a translocation. Bourquin's (2004) record (2830CA) in central KwaZulu-Natal is outside the species' expected range and requires confirmation.

Habitat: Mainly nocturnal but also active on overcast days. Shelters in shaded rock cracks in savanna habitats; also occasionally inhabits hollow trees and hides under loose bark (Branch 1998). May be found on farmhouses but is uncommon in dense urban areas.

Biome: Savanna; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common, and tolerant of low density urban developments.

Conservation measures: None recommended.


Homopholis wahlbergii—Schoemanskloof region, MPM M. Burger


Homopholis wahlbergii—41 km S of Lephalale, LIMP M. Burger

Genus *Lygodactylus* Gray, 1864—dwarf day geckos

The genus *Lygodactylus* is distributed throughout sub-Saharan Africa and Madagascar, with two species—sometimes placed in the genus *Vanzoia*—found in South America. A number of Madagascan species have also been placed in separate genera/subgenera (e.g. *Domerguella*, *Millotisaurus*, *Microscalabotes*) but until their status has been satisfactorily resolved, they are best included in *Lygodactylus* (Puente *et al.* 2005). There are about 60 species (Uetz 2012) in the genus, with about 40 species on mainland Africa. Eight species (two with isolated subspecies, one poorly defined)—five endemic—occur in the *Atlas* region (Jacobsen 1992a; Branch 1998). A molecular phylogenetic analysis of the genus is underway (Scott *et al.* 2012). These dwarf diurnal geckos have a taste for ants. They may be arboreal or rupicolous, the latter species often having very restricted ranges. As a consequence, one species (*L. methueni*) in the *Atlas* region is considered Vulnerable and three taxa (*L. graniticolus*, *L. ocellatus soutpansbergensis*, *L. waterbergensis*) are considered Near Threatened. The chief threats are deterioration of habitat quality, afforestation and fire risk. *Lygodactylus nigropunctatus incognitus* and *L. n. montiscaeruli* have small ranges but are considered Data Deficient because of taxonomic uncertainty.

Lygodactylus bradfieldi Hewitt, 1932

BRADFIELD'S DWARF GECKO

William R. Branch

Regional: Least Concern

Taxonomy: Treated as a subspecies of *Lygodactylus capensis* by FitzSimons (1943), and as a synonym of the same species by Loveridge (1947), but revived as a full species by Pasteur (1965). Preliminary (and ongoing) genetic studies (Travers 2012) indicate that *L. bradfieldi* does occur in Limpopo Province as indicated by Jacobsen (2011).

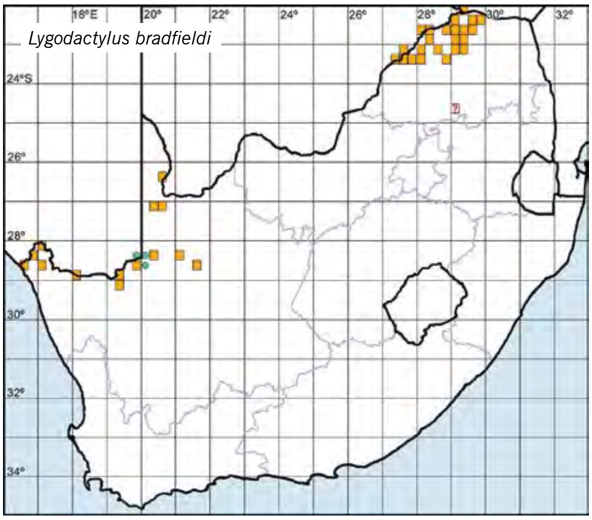
Distribution: Occurs from the Northern Cape through Namibia to southern Angola, with an apparently isolated population in northwestern Limpopo Province, eastern Botswana and adjacent southwestern Zimbabwe (Branch 1998; Jacobsen 2011). The southernmost record (2429CA) in Limpopo Province is considered questionable as it may represent a translocation or an atypical *L. c. capensis* specimen (Jacobsen 2011).

Habitat: Arboreal, living on tree trunks and sheltering under dead bark or in holes (Branch 1998). Favours stands of Acacia trees along river courses.

Biome: Savanna; Desert; Nama-Karoo; Succulent Karoo (marginal).

Assessment rationale: Widespread and common, with no major threats.

Conservation measures: None recommended.



Lygodactylus bradfieldi—Venetia Limpopo NR, LIMP M. Burger

Lygodactylus capensis capensis (A. Smith, 1849)

COMMON DWARF GECKO; CAPE DWARF GECKO

William R. Branch

Regional: Least Concern

Taxonomy: A widespread species with a number of poorly defined subspecies. *Lygodactylus bradfieldi* was also previously considered a subspecies of *L. capensis*. A modern genetic analysis is required to resolve the taxonomy.

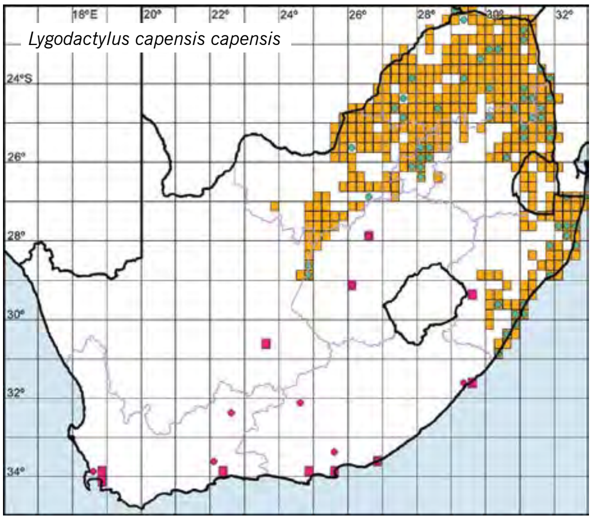
Distribution: Its natural range is from Tanzania southwards to Botswana, Northern Cape, northwestern Free State, Gauteng, Swaziland and KwaZulu-Natal, and westwards into southern Angola. Like the Tropical House Gecko (*Hemidactylus mabouia*), this species is commensal and is expanding its range. There are numerous introduced populations (pink cells on map), e.g. Port Elizabeth, Grahamstown (Branch 1998); Bloemfontein (Bates 2005b); near Stellenbosch and at Somerset West (De Villiers 2006), near Cape Town (Witberg & Van Zyl 2008), George (Jacobsen 2012), East London, and even in Addo Elephant National Park (W.R. Branch pers. obs.).

Habitat: Arboreal in savanna habitats but adapts readily to urban situations. Rapidly expanding its range in the *Atlas* region, but apparently not extending into natural vegetation.

Biome: Savanna; Indian Ocean Coastal Belt; Grassland (marginal).

Assessment rationale: Widespread and common with no major threats. It is also commensal and easily translocated.

Conservation measures: None recommended.



Lygodactylus capensis—Port Elizabeth, EC W.R. Branch

Lygodactylus graniticolus Jacobsen, 1992

GRANITE DWARF GECKO

William R. Branch

Global: Near Threatened

Endemic

Taxonomy: Previously confused with *Lygodactylus ocellatus* (FitzSimons 1943).

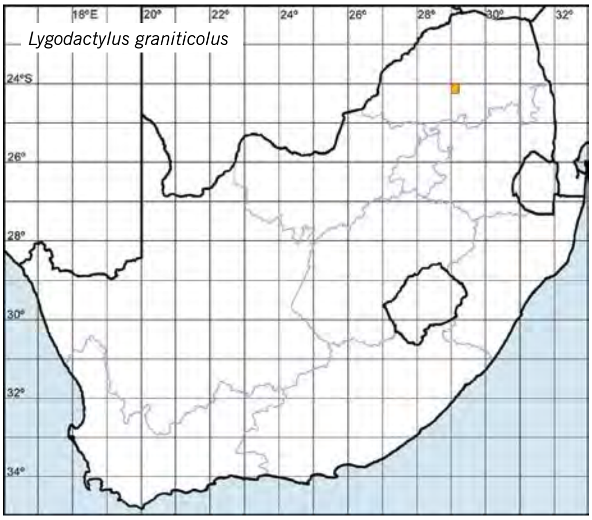
Distribution: An ultra-endemic restricted to granitic hills in Percy Fyfe Nature Reserve (Jacobsen 1992a) and the nearby Witvinger Nature Reserve (see photo) in Limpopo Province, South Africa.

EOO: 675 km^2 (confidence: high); AOO: 9 km^2 (confidence: medium).

Habitat: Inhabits crevices between boulders on rock outcrops at 1 500 m in bushveld habitat (Jacobsen 1992a).

Vegetation type: SVcb 23 Polokwane Plateau Bushveld.

Assessment rationale: An ultra-restricted endemic (EOO = 675 km^2, AOO 9 km^2) known from two adjacent populations at a single location [B1a + 2a] in Percy Fyfe and Witvinger nature reserves. Both are protected areas but public access is allowed, and at Percy Fyfe, firewood is removed (W.R. Branch pers. obs.) and there have been reports of cattle grazing within the reserve, so some loss of quality and extent of habitat may occur. Some areas adjacent to the reserve with seemingly suitable habitat are used for cattle ranching, but there do not appear to be any threats to the species habitat there (A.M. Bauer pers. comm.). Considering its highly restricted range and the possibility of future threats, this species is classified as Near Threatened.



Threats: Although part of the population falls in a protected area, this area is small and adjacent regions are affected by agriculture and urbanisation. Tourist developments within the reserve can also be expected. Fire is the most likely threat affecting the location, but it is unlikely that this would seriously compromise the population, as the geckos would be protected by their rocky habitat.

Conservation measures: Carry out detailed surveys of the population and of suitable habitat in areas adjacent to Percy Fyfe Nature Reserve. Confirm the species' status by means of a molecular assessment.

Lygodactylus graniticolus—Witvinger NR, LIMP W.D. Haacke

Lygodactylus methueni FitzSimons, 1937

METHUEN'S DWARF GECKO

William R. Branch

Global: Vulnerable **B1ab(iii)+2ab(iii)**

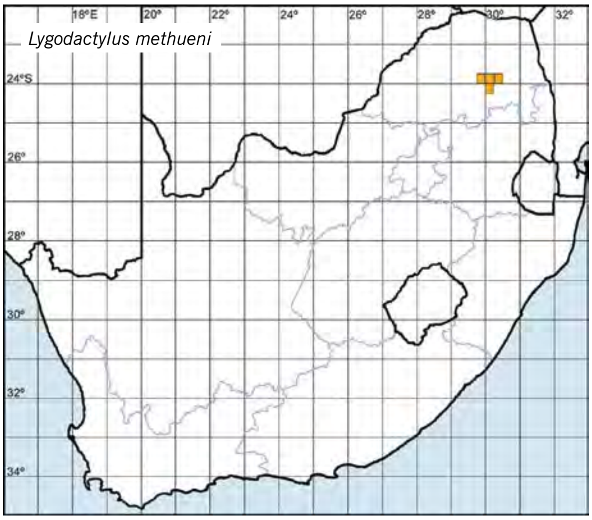
Endemic

Taxonomy: No notable issues.

Distribution: Endemic to southern Limpopo Province, South Africa. Found only in Woodbush Forest Reserve and vicinity (Jacobsen 1988b, 1989) and Wolkberg Wilderness Area.

EOO: 1 620 km^2 (confidence: high); AOO: 495 km^2 (confidence: high).

Lygodactylus methueni—Wolkberg Wilderness Area, LIMP M. Burger



Habitat: Rupicolous, inhabiting rock cracks on isolated outcrops in montane grassland at elevations of about 1 700 m; may climb onto tree trunks adjacent to rock outcrops, but does not enter forests or plantations (Jacobsen 1989; Branch 1998).

Vegetation type: Gm 25 Woodbush Granite Grassland; Gm 26 Wolkberg Dolomite Grassland.

Assessment rationale: Has a very small range (EOO <5 000 km^2 and AOO <500 km^2, both under the Endangered thresholds) with 6–10 locations (under the Vulnerable threshold) [B1a+2a]. This species has very specific habitat associations and much of the known range has experienced extensive afforestation that has contributed to fragmentation of its range. Other threats include the use of herbicides in forestry management and an increase in anthropogenic fire risk in montane grasslands, both of which result in a decline in the extent and quality of habitat [B1b(iii)+2b(iii)].

Threats: There is a decline in habitat quality due to shading by exotic plantations, increases in fires and possibly also the use of herbicides.

Conservation measures: Assess isolated populations (colonies) and manage connectivity between them. Estimate the threats from existing forestry practice and increased anthropogenic fire risk. Carry out a PHVA and develop a BMP-S.

Lygodactylus nigropunctatus nigropunctatus Jacobsen, 1992

BLACK-SPOTTED DWARF GECKO

William R. Branch

Global: Least Concern

Endemic

Taxonomy: The taxonomic status of the three subspecies has been assessed using molecular techniques, and all appear to represent distinct species (Travis 2012). The status of the isolated population in North-West Province, currently assigned to *Lygodactylus nigropunctatus nigropunctatus*, should be investigated.

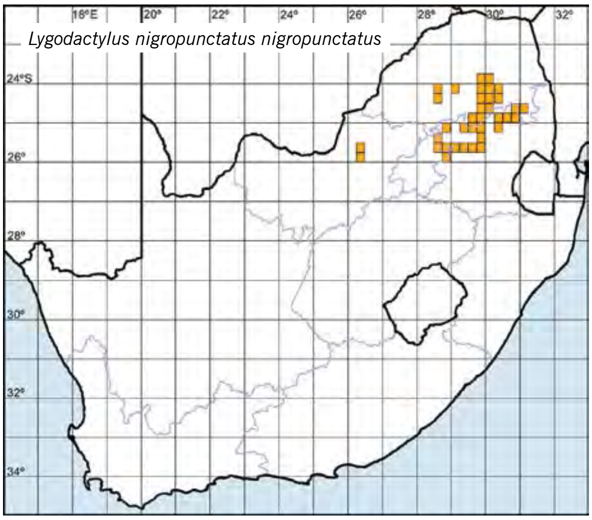
Distribution: Endemic to South Africa where it is fairly widespread in southern Limpopo, northern Mpumalanga and northern Gauteng, with an isolated population in North-West Province.

Habitat: Rupicolous, sheltering in cracks in rock outcrops in savanna at elevations of 700–800 m (Jacobsen 1992a).

Biome: Savanna.

Assessment rationale: Fairly widespread and common.

Conservation measures: None recommended.



Lygodactylus nigropunctatus nigropunctatus—13 km SW of Haenertsburg, LIMP J. Marais

Lygodactylus nigropunctatus incognitus Jacobsen, 1992

CRYPTIC DWARF GECKO

William R. Branch

Global: Data Deficient

Endemic

Taxonomy: A recent molecular study (Travers 2012) indicates that this subspecies is genetically well-defined and may represent a full species.

Distribution: An ultra-endemic, restricted to the summit of the Soutpansberg, Limpopo, South Africa (Jacobsen 1992a). A visual/photographic record (A.A. Turner & S.J. Davis pers. obs., SARCA 135011) from Lajuma Peak (2329AB, not plotted) in the Soutpansberg may be referrable to *Lygodactylus nigropunctatus incognitus*.

EOO: 2 700 km^2 (confidence: medium); AOO: 675 km^2 (confidence: medium).

Habitat: Found on outcrops in grassland and woody patches at altitudes of 1 282–1 747 m (Jacobsen 1992a; Kirchhof *et al.* 2010). Has also been observed on the walls of houses (Kirchhof *et al.* 2010).

Vegetation type: SVcb 21 Soutpansberg Mountain Bushveld; Gm 28 Soutpansberg Summit Sourveld.

Assessment rationale: Poorly known. It has a restricted range (EOO <5 000 km^2), is known from less than 10 locations, and its habitat quality may be negatively affected by agriculture and ecotourism, indicating that it could be considered Vulnerable. However, it is classified as Data Deficient because its taxonomic status is unresolved.

Threats: This gecko's range is subject to increasing ecotourism developments where range management promotes large mammal grazing, possibly leading to an increase in frequency of anthropogenic fires. Habitat loss also occurs due to the development of lodges and infrastructure (e.g. the use of natural rock for the building of lodges or other walls).

Conservation measures: Investigate the taxonomic status of this subspecies. Carry out detailed surveys to assess range and habitat requirements, and the extent and nature of threats. Conduct a PHVA and draft a BMP-S.

Lygodactylus nigropunctatus incognitus—Soutpansberg, LIMP A.M. Bauer

Lygodactylus nigropunctatus montiscaeruli Jacobsen, 1992

MAKGABENG DWARF GECKO

William R. Branch

Global: Data Deficient

Endemic

Taxonomy: This taxon is genetically well-defined and may represent a full species (Travers 2012).

Distribution: Endemic to the Makgabeng Hills and Blouberg, Limpopo, South Africa.

EOO: 2 025 km^2 (confidence: low); AOO: 600 km^2 (confidence: low).

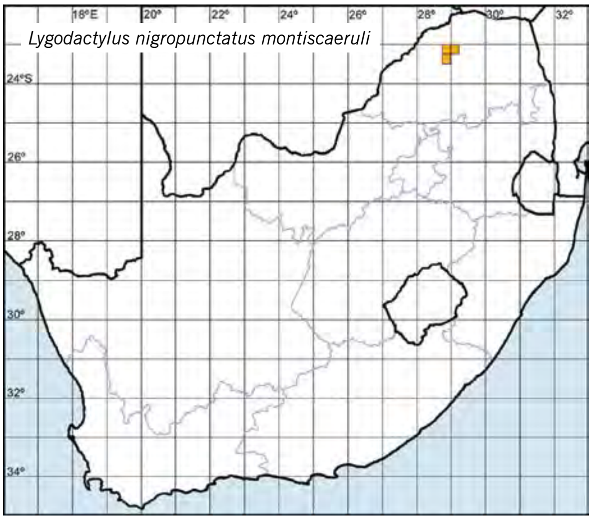
Habitat: Occupies cracks and cliff faces on sandstone outcrops (Jacobsen 1992a).

Bioregion: Central Bushveld.

Assessment rationale: Restricted and known from two adjacent populations. EOO <5 000 km^2 and AOO <2 000 km^2, occurs at no more than five locations [B1a+2a], and experiencing loss of quality and extent of habitat [B1b(iii)+2b(iii)] outside protected areas, indicating that it could be considered Vulnerable. However, it is classified as Data Deficient because its taxonomic status is unresolved.

Threats: The range is subject to increasing ecotourism and game farming developments where range management promotes large mammal grazing, possibly leading to an increase in the frequency of anthropogenic fires. Habitat loss also occurs during development of lodges and infrastructure (e.g. the use of natural rock as building material).

Conservation measures: Assess the taxonomic status of this subspecies. Conduct detailed surveys of its range and habitat requirements, and assess existing threats. Conduct a PHVA and draft a BMP-S.



Lygodactylus nigropunctatus montiscaeruli—Blouberg, LIMP W.R. Branch

Lygodactylus ocellatus ocellatus Roux, 1907

SPOTTED DWARF GECKO

William R. Branch

Global: Least Concern

Endemic

Taxonomy: With the recognition of a northern subspecies, *L. ocellatus soutpansbergensis* (Jacobsen 1994b), the typical subspecies now has a reduced range. There is a need for molecular studies to determine the status of *L. o. soutpansbergensis*, the isolated populations of *L. o. ocellatus*, and specimens listed as '*Lygodactylus ocellatus* Complex' by Jacobsen (1989).

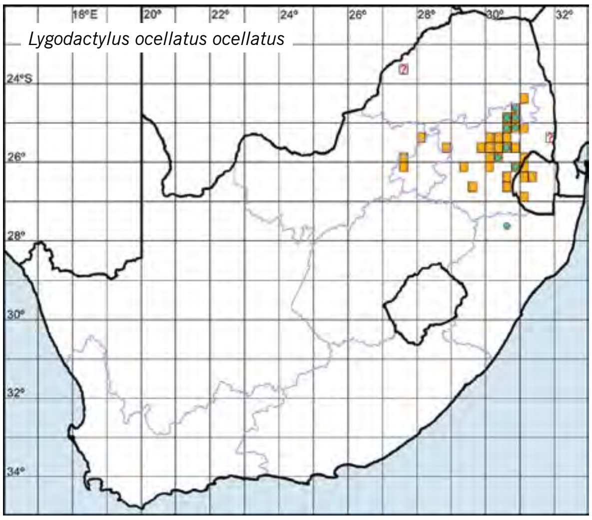
Distribution: Endemic to the *Atlas* region. The species is widespread in Mpumalanga, extending into adjacent southeastern Limpopo, Gauteng, the northeastern parts of North-West Province and western Swaziland. A Virtual Museum record (2730DA) extends the known range southwards into northern KwaZulu-Natal. The record in the Lebombo Mountains (2531BD) adjacent to Mozambique requires confirmation, as does an isolated record at Farm Hangklip (2327DA, TM 64842). Several records from throughout the former Transvaal Province, mapped under the name '*Lygodactylus ocellatus* Complex' by Jacobsen (1989), were not plotted on the map here because their status requires investigation.

Habitat: Rupicolous on small rock outcrops in grassland and savanna (Branch 1998). It may occur in small groups in large outcrops, and takes refuge in crevices between and under boulders (Jacobsen 1989).

Biome: Grassland; Savanna.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Lygodactylus ocellatus ocellatus—near Dullstroom, MPM J. Marais

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Lygodactylus ocellatus soutpansbergensis Jacobsen, 1994

SOUTPANSBERG DWARF GECKO

William R. Branch

Global: Near Threatened

Endemic

Taxonomy: There is a need for a molecular study to evaluate the relationship between this isolated subspecies and *L. o. ocellatus*.

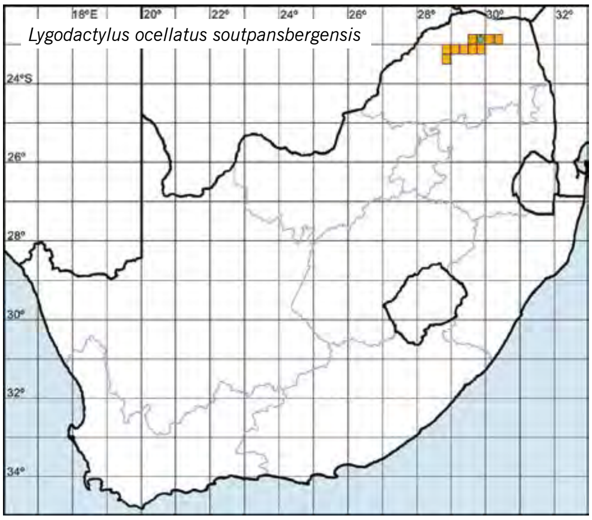
Distribution: Endemic to the summit region of the Soutpansberg, Limpopo, South Africa.

EOO: 4 050 km^2 (confidence: medium); AOO: 1 250 km^2 (confidence: medium).

Habitat: Rupicolous, living in small rock outcrops in montane grassland and savanna (850–1 500 m) (Jacobsen 1994b).

Vegetation type: SVcb 21 Soutpansberg Mountain Bushveld.

Assessment rationale: Has a restricted range (EOO <5 000 km^2, AOO <2 000 km^2). Loss of quality and extent of habitat [B1b(iii)+2b(iii)] outside of protected areas is likely due to increased human activity in the region (ecotourism, hiking, agriculture), but a classification of Near Threatened is considered appropriate at this time.



Threats: Its range is subject to increasing ecotourism developments where range management promotes large mammal grazing, possibly leading to an increase in frequency of anthropogenic fires. Habitat loss also occurs due to the development of lodges and infrastructure (e.g. the use of natural rock for lodge building or walls).

Conservation measures: Investigate the taxonomic status of this subspecies, the extent of its range and habitat requirements, and the threats present in the region. Compile a BMP-S.

Lygodactylus ocellatus soutpansbergensis—Soutpansberg, LIMP J. Marais

Lygodactylus stevensoni Hewitt, 1926

STEVENSON'S DWARF GECKO

William R. Branch

Global: Least Concern

Taxonomy: Although treated as a subspecies of *Lygodactylus capensis* by FitzSimons (1943), *L. stevensoni* was elevated to a full species by Pasteur (1965). There is a need for a more complete assessment, with molecular analysis, of the identity and taxonomic status of the 'relict' populations at Lillie Nature Reserve (Jacobsen 1989).

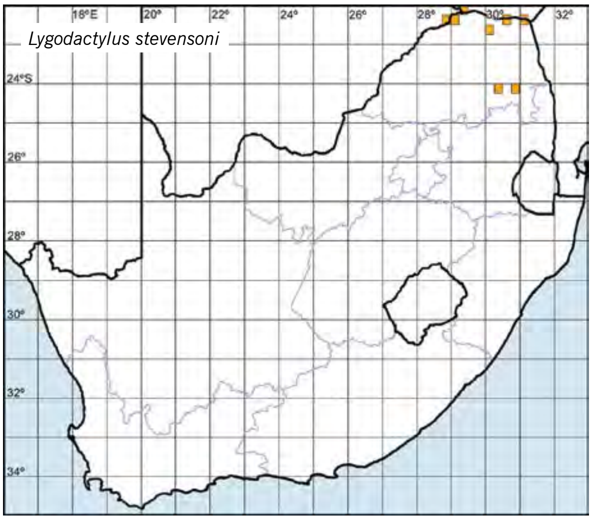
Distribution: Restricted to the Limpopo River valley, extending east into the extreme northern parts of the Kruger National Park and north to the Khami Ruins and Matopos Hills in southern Zimbabwe (Branch 1998). A possible relict population in the Lillie Nature Reserve (Jacobsen 1989) and vicinity in southeastern Limpopo has been plotted on the map, but its taxonomic status requires further assessment.

Habitat: Prefers shaded crevices in sandstone and granite outcrops in wooded savanna, but may also utilise dead trees and the walls of buildings (Branch 1998).

Bioregion: Mopane; Lowveld.

Assessment rationale: Although this species has a relatively restricted and fragmented distribution in the *Atlas* region (EOO <20 000 km^2), it is not known to be experiencing population declines or habitat loss and is tolerant of habitat transformation. Its range in the region constitutes <33% of its global range.

Conservation measures: Conduct further studies on the species' range in the *Atlas* region, concentrating on the conservation and taxonomic status of the relict population from Lillie Nature Reserve (Jacobsen 1989).



Lygodactylus stevensoni—Venetia Limpopo NR, LIMP M. Burger

Lygodactylus waterbergensis Jacobsen, 1992

WATERBERG DWARF GECKO

William R. Branch

Global: Near Threatened

Endemic

Taxonomy: No notable issues, although genetic distance between the apparently isolated populations should be assessed.

Distribution: Endemic to the Waterberg region, including rocky outliers (e.g. 2427BC), in Limpopo Province, South Africa.

EOO: 2 025 km^2 (confidence: medium); AOO: 600 km^2 (confidence: medium).

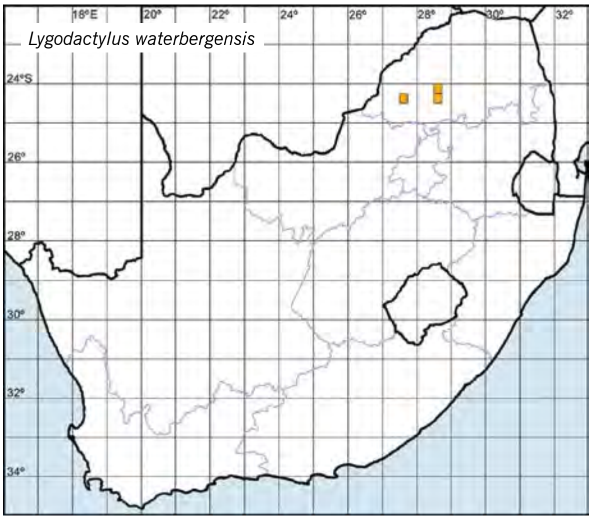
Habitat: Rupicolous, sheltering in sandstone outcrops in grassland or scrub at 1 500–2 000 m (Jacobsen 1992a).

Vegetation type: SVcb 17 Waterberg Mountain Bushveld.

Assessment rationale: Has a restricted range (EOO <5 000 km^2, AOO <2 000 km^2), is known from less than 10 locations [B1a+2a], and a loss of quality and extent of habitat outside of protected reserves is predicted. However, as the area is poorly surveyed and the range has recently been extended, the species is conservatively treated as Near Threatened.

Threats: Its range is subject to increasing ecotourism developments where range management promotes large mammal grazing, possibly leading to an increase in frequency of anthropogenic fires. Natural rock may be used for building lodges and walls, resulting in habitat loss.

Conservation measures: Determine the full extent of this species' range and population densities. Check the status of the isolated record from Farm Groothoek (2427BC). Develop a BMP-S.



Lygodactylus waterbergensis—Marakele NP, LIMP M. Burger

Genus *Pachydactylus* Wiegmann, 1834—thick-toed geckos

The species-rich genus *Pachydactylus* was recently revised (Bauer & Lamb 2005), resulting in the synonymisation of *Palmatogecko* and the transfer of some species to the genera *Chondrodactylus*, *Colopus* and *Elasmodactylus*. This genus is endemic to Africa and only one species (*P. katanganus*, known from southern Democratic Republic of the Congo) occurs entirely outside southern Africa. Fifty-five species are distributed throughout southern Africa and a few extend as far north as the southern Democratic Republic of the Congo and northern Malawi (Loveridge 1947; Branch 1998; Uetz 2012). Twenty-nine species occur in the *Atlas* region, of which 11 are strictly endemic. Another seven occur mainly in this region but extend extralimitally into adjacent southern Namibia or Mozambique. Within the *Atlas* region, *Pachydactylus* is most diverse in arid western regions and along the lower Orange River, but all areas except the higher elevations of Lesotho and KwaZulu-Natal are occupied by one or more species. *Pachydactylus* are chiefly terrestrial or rupicolous, feed on arthropods and produce clutches of two hard-shelled eggs (Branch 1998; Alexander & Marais 2007). Most species occur in areas that are not subject to major extrinsic threats and most are therefore considered Least Concern. Only two species are considered to be threatened. The recently described *P. goodi* is categorised as Vulnerable because of its extremely restricted range and because of threats from mining activities. In the *Atlas* region, mining and agriculture have caused a recent, dramatic population decline of *P. rangei*, which is considered regionally Critically Endangered.

Pachydactylus affinis Boulenger, 1896

TRANSVAAL GECKO;
TRANSVAAL THICK-TOED GECKO

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: *Pachydactylus affinis* was regarded as a subspecies of *P. capensis* by FitzSimons (1943) and Loveridge (1947). Its specific distinctness was recognised by McLachlan (in Branch 1981) and this was later accepted by Branch (1988a, 1998) and Jacobsen (1989). Jacobsen (1989) suggested that there might be taxonomically significant variation within *P. affinis* and this requires further investigation. Although *P. affinis* has been shown to be genetically distinct from *P. capensis* and *P. vansoni* (Bauer & Lamb 2002), these three species can be difficult to distinguish morphologically (e.g. Jacobsen 1989).

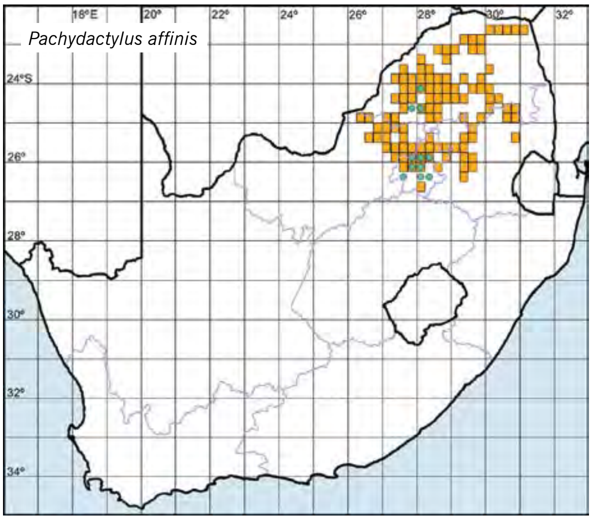
Distribution: Endemic to South Africa where it occurs throughout most of Gauteng, eastern North-West Province and large parts of Mpumalanga and Limpopo, exclusive of most of the Lowveld and Limpopo Valley (Jacobsen 1989).

Habitat: Found in rock outcrops but occasionally also in moribund termitaria or on buildings, in grassland and savanna at elevations of 500–2 200 m (Jacobsen 1989).

Bioregion: Central Bushveld; Mesic Highveld Grassland; Mopane; Dry Highveld Grassland; Lowveld (marginal).

Assessment rationale: Has a broad distribution that includes numerous protected areas. It prefers rocky habitats that are suboptimal for human use.

Conservation measures: None recommended.



Pachydactylus affinis—Marakele NP, LIMP M. Burger

Pachydactylus amoenus Werner, 1910

NAMAQUA BANDED GECKO

Michael F. Bates

Global: Least Concern

Endemic

Taxonomy: *Pachydactylus amoenus* was considered a valid species by FitzSimons (1943), Loveridge (1947) and Branch (1981), although the latter noted that its status was unresolved. Loveridge (1947), however, stated that it may be merely a subspecies of *P. mariquensis*. Branch *et al.* (1988) and Branch (1988b, 1998) did not mention it. Some authors continued to treat it as a full species (e.g. Kluge 2001), and Bauer *et al*. (2011) confirmed this status on the basis of molecular data and morphology.

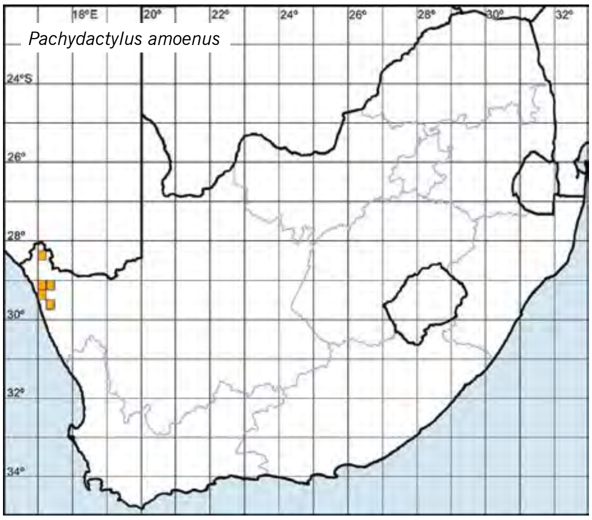
Distribution: Endemic to Little Namaqualand in the western Northern Cape, South Africa.

Habitat: Found in sandy arid areas, but no detailed information is available.

Bioregion: Namaqualand Sandveld; Namaqualand Hardeveld; Richtersveld.

Assessment rationale: Has a restricted range, but there are no known threats, population declines or fluctuations (Bauer *et al.* 2011).

Conservation measures: None recommended.



Pachydactylus amoenus—between Port Nolloth and Anenous Pass, NC
J. Boone

Pachydactylus atorquatus Bauer, Barts & Hulbert, 2006

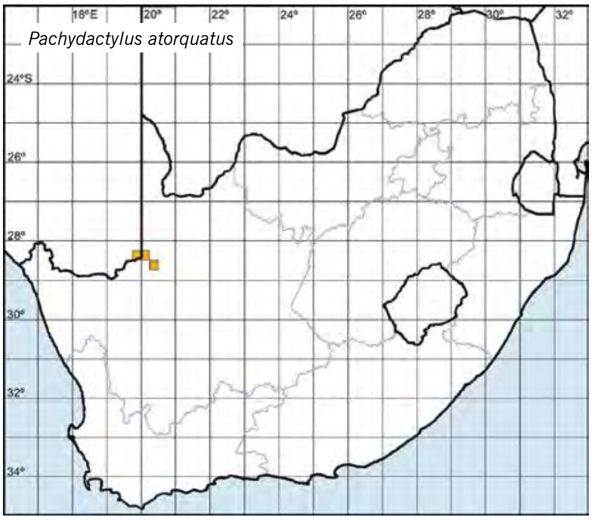
AUGRABIES GECKO

Aaron M. Bauer

Global: Least Concern

Taxonomy: This species is part of the *Pachydactylus weberi* group (Bauer *et al.* 2006a). The taxonomic status of a specimen of the *P. weberi* group from Farm Leerkrans (2821BC) remains uncertain but it is superficially similar to both *P. atorquatus* and the southern Namibian endemic *P. robertsi*.

Pachydactylus atorquatus—Farm Daberas, Orange River, NC W.R. Branch



Distribution: Found in the Northern Cape, South Africa, where it occurs along the Orange River at and immediately below Augrabies Falls. Recorded in Namibia at one locality (Haib Mine) in the adjacent Karasburg district (Bauer *et al.* 2006b).

Habitat: Found in arid rocky habitats with little vegetation, at 500–800 m elevation (Bauer *et al.* 2006b).

Vegetation type: NKb 1 Lower Gariep Broken Veld.

Assessment rationale: Has a restricted range (EOO and AOO below the Vulnerable thresholds) but is abundant (probably more than 10 000 individuals) and actual and potential threats are minimal.

Conservation measures: Evaluate range size and population numbers.

Pachydactylus austeni Hewitt, 1923

AUSTEN'S GECKO; AUSTEN'S THICK-TOED GECKO

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: No notable issues.

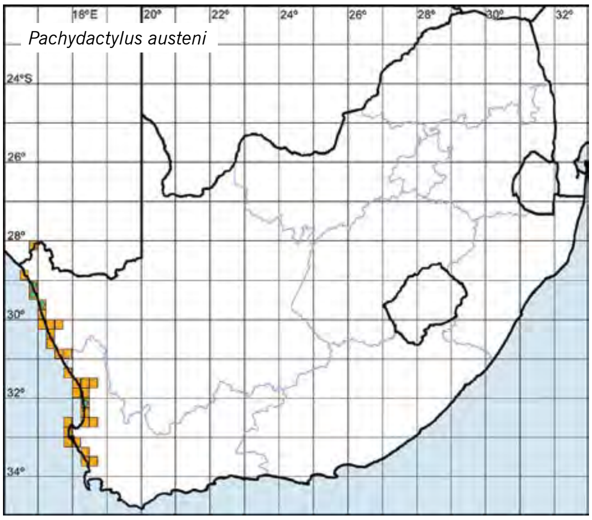
Distribution: Endemic to South Africa, extending through the coastal regions of the Western and Northern Cape, from slightly north of Cape Town northwards to the Holgat River in the southern Richtersveld (Haacke 1976d). There is an isolated record at Potjiespram (2816BB) on the lower Orange River in the northern Richtersveld, and scattered localities up to 95 km inland.

Habitat: Found in areas of loose sand, chiefly in sparsely vegetated coastal dunes (Branch 1998), but also in alluvial sands and in other sandy pockets in coastal and near-coastal habitats. Mainly present below 100 m, but may occur as high as 600 m.

Bioregion: Namaqualand Sandveld; West Strandveld; Northwest Fynbos; Namaqualand Hardeveld; Seashore Vegetation; West Coast Renosterveld; Knersvlakte; Karoo Renosterveld; Alluvial Vegetation; Estuarine Vegetation.

Assessment rationale: Has a large range and is abundant and not threatened, except in localised areas where mining or housing developments and recreational use of beaches may degrade habitat.

Conservation measures: None recommended.



Pachydactylus austeni—Port Nolloth, NC J. Marais

Pachydactylus barnardi FitzSimons, 1941

BARNARD'S ROUGH GECKO; BARNARD'S GECKO

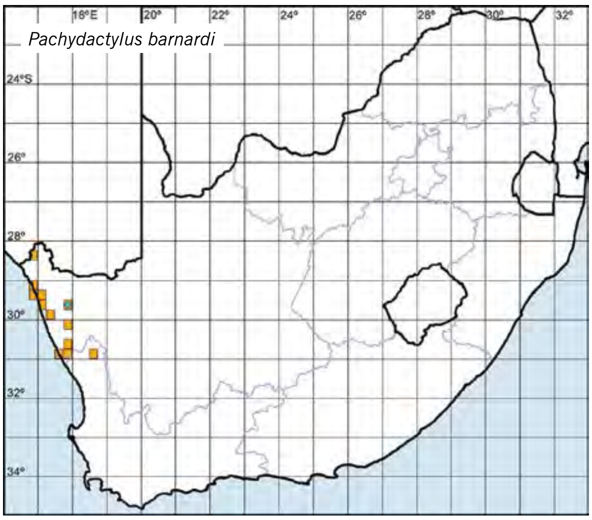
Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: First described as a subspecies of *Pachydactylus capensis* (FitzSimons 1941), elevated to species status by Broadley (1977a), but treated as a subspecies of *P. rugosus* by McLachlan (1979). The latter arrangement has been followed by most subsequent authors (e.g. Branch 1998). Lamb & Bauer (2000a) raised *P. barnardi* to full species status once again, based on a molecular analysis.

Distribution: Endemic to South Africa, where it occurs in the western parts of the Northern Cape and adjacent areas in the extreme northern parts of the Western Cape, from



the western Richtersveld in the north to the Knersvlakte and Groenriviermond in the south (Lamb & Bauer 2000a).

Habitat: Usually associated with mesic microhabitats. Terrestrial and found in rocky areas with succulent plants, but also in habitats fringing rivers or near the coast, from sea level to 1 200 m (Bauer & Branch 2003 [2001]).

Bioregion: Namaqualand Hardeveld; Namaqualand Sandveld; Richtersveld.

Assessment rationale: Relatively widespread and common; occurs across a diversity of habitats and is not subjected to any significant threats.

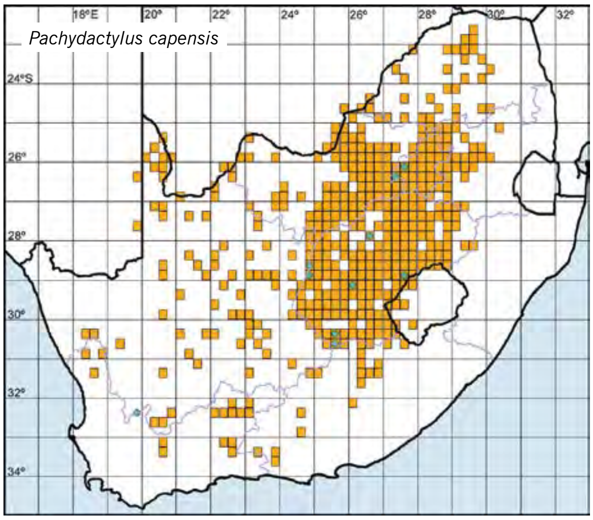
Conservation measures: None recommended.

Pachydactylus barnardi—Noup, NC M. Burger

Pachydactylus capensis (A. Smith, 1845)

CAPE GECKO; CAPE THICK-TOED GECKO

Aaron M. Bauer



Regional: Least Concern

Taxonomy: FitzSimons (1943) and Loveridge (1947) regarded *Pachydactylus capensis* as a polytypic species with many subspecies. Subsequently, Broadley (1971c, 1977a), Branch (1988a, 1998) and Jacobsen (1989) elevated these subspecies, resulting in a monotypic *P. capensis*. Earlier records of this species from both the west coast and northeast of South Africa require individual confirmation, because specimens referable to *P. labialis*, *P. affinis* and *P. vansoni* were often identified as *P. capensis*. There is still confusion with respect to specific identity within the *P. capensis* group due to gross morphological similarities. This applies particularly to *P. capensis* and *P. affinis*, which occur in sympatry throughout much of the range of the latter (Jacobsen 1989). Some juvenile *P. capensis* have distinctive head markings that are similar to those of *P. vansoni* and this may also lead to misidentifications.

Distribution: Occurs throughout most of central and western southern Africa and extralimitally in southern Angola (see Jacobsen 1989). It is present in the eastern two-thirds of Namibia (exclusive of the Caprivi Strip) (Visser 1984c), most of Botswana (Auerbach 1987), western Lesotho and parts of all South African provinces except KwaZulu-Natal. Within South Africa it occurs throughout the Free State except the far northeastern part of the province (Bates 1996a), in Gauteng, North-West Province and above the escarpment in Limpopo and Mpumalanga (Jacobsen 1989), and in inland portions of the Cape provinces at least as far southwest as the Tankwa Karoo.

Habitat: A terrestrial species occurring in a wide range of mostly open habitat types, wherever there are appropriate refugia (rocks, disused termitaria, logs, debris, building materials) (Loveridge 1947; De Waal 1978; Branch 1998). Generally absent in extremely mesic areas and in true desert. Altitudinal range 500–1 800 m (Jacobsen 1989).

Biome: Grassland; Savanna; Nama-Karoo; Succulent Karoo.

Pachydactylus capensis—Suikerbosrand NR, GP J. Marais

Assessment rationale: Widespread and common in the *Atlas* region, and extralimitally in Botswana, Namibia and parts of southern Angola.

Conservation measures: None recommended.

Pachydactylus carinatus Bauer, Lamb & Branch, 2006

RICHTERSVELD GECKO

Aaron M. Bauer

Global: Least Concern

Taxonomy: This species is part of the *Pachydactylus serval* group (Bauer *et al.* 2006a). Older references to *P. serval* and *P. onscepensis* from the lower Orange River valley west of Goodhouse (e.g. McLachlan & Spence 1966) may be referable to *P. carinatus*. The identity of a population of geckos at Koboop (2819CD) near Onseepkans (not plotted on map), tentatively referred to *P. carinatus* by Bauer *et al.* (2006a), must be verified.

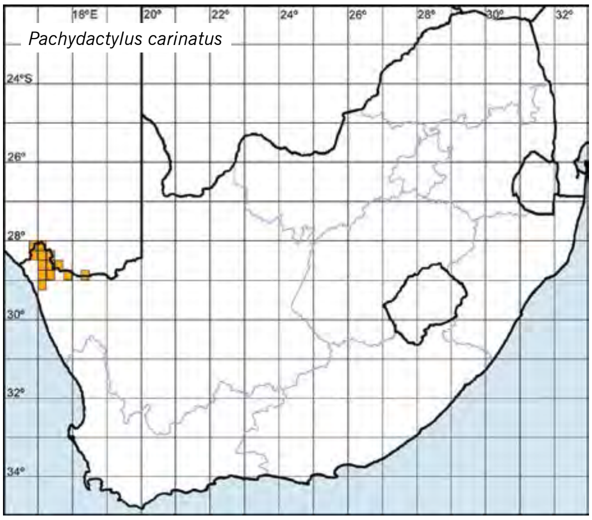
Distribution: Endemic to southern Africa, occurring in the Richtersveld and lower Orange River valley of the Northern Cape, South Africa and the Karasburg and Lüderitz districts of Namibia. Occurs along the Orange River valley from Goodhouse in the east to Annisfontein in the west, and from Kuboes (Northern Cape) in the south to Namuskluft and Ai-Ais (Namibia) in the north (Bauer *et al.* 2006a).

Habitat: Found in relatively mesic habitats in river valleys or on rocky mountain slopes in otherwise arid areas, at altitudes of 40–720 m (Bauer *et al.* 2006a).

Bioregion: Richtersveld; Gariep Desert; Southern Namib Desert; Alluvial Vegetation.

Assessment rationale: Has a restricted range but is abundant and not threatened. Most of the range is in protected areas.

Conservation measures: None recommended.



Pachydactylus carinatus—Richtersveld, NC J. Marais

Pachydactylus formosus A. Smith, 1849

SOUTHERN ROUGH GECKO; KAROO GECKO

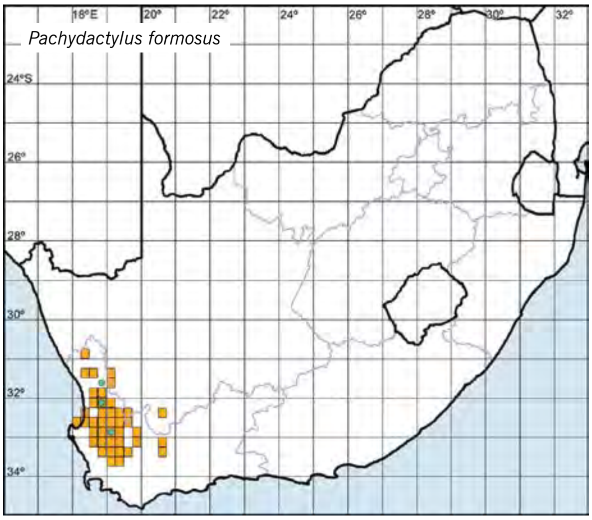
Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: This species was relegated to the status of a subspecies of *Pachydactylus capensis* by Hewitt (1927). McLachlan (1979) transferred it from *P. capensis* to *P. rugosus*, regarding it as a subspecies of the latter. Lamb & Bauer (2000b) raised *P. formosus* to full species status.

Pachydactylus formosus—Engelsmanskloof, Cederberg, WC W.D. Haacke



Most pre-2000 citations are to *P. rugosus formosus* (e.g. Branch 1998).

Distribution: Endemic to South Africa where it occurs in the western half of the Western Cape and adjacent portions of the Northern Cape, from the vicinity of the Slanghoekberg Mountains in the southwest to Matjiesfontein and Sutherland in the east, and as far north as Bitterfontein in Namaqualand.

Habitat: Usually associated with mesic habitats that provide rocky crevices for retreats. Especially common in montane habitats at elevations as high as 2 000 m, but also occurs near sea level where river gorges, rock cuttings and low hills provide suitable rocky habitat (Branch 1998; Lamb & Bauer 2000b).

Biome: Fynbos; Succulent Karoo.

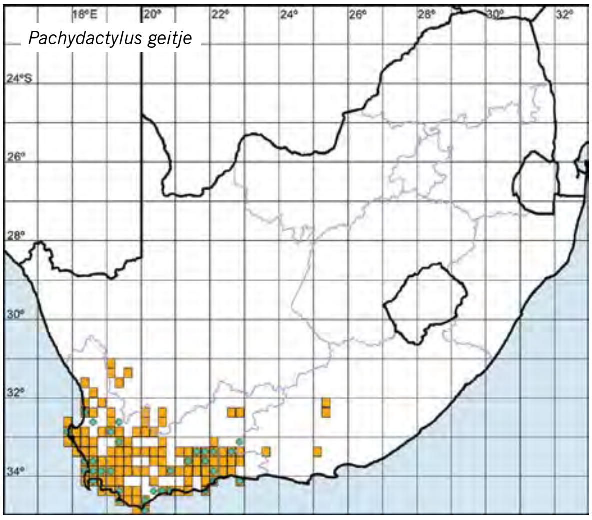
Assessment rationale: Widespread and common. Occurs in several protected areas and there are no major identifiable threats.

Conservation measures: None recommended.

Pachydactylus geitje (Sparrman, 1778)

OCELLATED GECKO;
OCELLATED THICK-TOED GECKO

Aaron M. Bauer



Global: Least Concern

Endemic

Taxonomy: Following FitzSimons (1943), the junior synonym *Pachydactylus ocellatus* was widely used for this species. Although Loveridge (1947) clearly identified *Lacerta geitje* Sparrman, 1778 as the correct name for this taxon, the name *P. ocellatus* continued to be used for decades thereafter and some museum and literature records may still be found under this name. The status of *Pachydactylus monticolus* FitzSimons, 1943, sometimes used for inland forms from higher elevations, remains uncertain (McLachlan in Branch 1981; Branch *et al.* 1988; Branch & Bauer 1995). Molecular systematic research is currently in progress (A.M. Bauer, M. Heinicke & T.R. Jackman in prep.) to resolve the status of this name, here conservatively considered a synonym of *P. geitje*.

Distribution: Endemic to South Africa where it is restricted to the Western Cape and adjacent parts of the Eastern and Northern Cape provinces. Present in coastal areas as well as the Cape Fold Mountains and along the inland escarpment (Visser 1984d; Branch 1998).

Habitat: A habitat generalist, typically found in cool, mesic areas from the high tide level to at least 2 000 m, wherever suitable rock, vegetation or debris provide retreat sites (Branch & Bauer 1995; Branch 1998).

Biome: Fynbos; Succulent Karoo; Albany Thicket; Nama-Karoo.

Assessment rationale: Widespread and common. Found in several protected areas and not experiencing any major identifiable threats.

Conservation measures: None recommended.

Pachydactylus geitje—Gondwana GR, E of Herbertsdale, WC M. Burger

Pachydactylus geitje—Lambert's Bay, WC J. Marais

Pachydactylus goodi
Bauer, Lamb & Branch, 2006
GOOD'S GECKO

Aaron M. Bauer

Global: Vulnerable B1ab(iii)+2ab(iii)

Endemic

Taxonomy: Recently described as a member of the *Pachydactylus weberi* group (Bauer *et al.* 2006b). Older references to *P. weberi* from the Aggeneys area may be referable to *P. goodi*.

Distribution: Endemic to South Africa where it is restricted to the northwestern margin of the Northern Cape between Vioolsdrif and Aggeneys (Bauer *et al.* 2006b). Despite the proximity of its range to the Orange River, it has not been found in adjacent southern Namibia.

EOO: 4 179 km^2 (confidence: low); AOO: 1 349 km^2 (confidence: low).

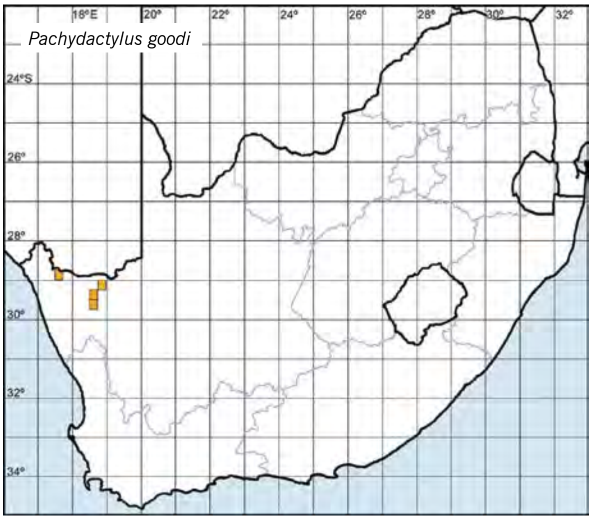
Habitat: Found in broken rocky habitats with little or no vegetation, at the base or on slopes of rocky hills adjacent to desert plains. Occurs on the slopes (chiefly south-facing) of inselbergs (Bauer *et al.* 2006b).

Vegetation type: Dg 7 Northern Nababiepsberge Mountain Desert; SKr 18 Bushmanland Inselberg Shrubland.

Assessment rationale: EOO <5 000 km^2, AOO <2 000 km^2 and number of locations <10 [B1a+2a]; and a continuing decline in the area, extent and quality of habitat [B1b(iii)+2b(iii)] due to ongoing mining activity.

Threats: Potentially threatened by its inherently restricted dispersal capabilities and limitation to a restricted substrate type. An additional threat exists from ongoing copper, zinc, lead and silver mining activity that has degraded or destroyed suitable habitat around Aggeneys. This appears to be an ongoing threat only at this location.

Conservation measures: Develop a BMP-S. Collect data on the actual range of the species and on population numbers within suitable habitats, as well as the status of the habitat (extent of destruction or degradation due to mining activities). Identify any potential protected areas within the AOO, and establish new protected areas if necessary.



Pachydactylus goodi—Aggeneys, NC J. Marais

Pachydactylus haackei
Branch, Bauer & Good, 1996
HAACKE'S GECKO; HAACKE'S THICK-TOED GECKO

Aaron M. Bauer

Global: Least Concern

Taxonomy: This species was previously confused with *Pachydactylus namaquensis* (Branch *et al.* 1996; Bauer & Branch 2003 [2001]). Most old records of *P. namaquensis* from Namibia and the Orange River valley are almost certainly referable to *P. haackei*.

Distribution: Endemic to southern Africa where it occurs from southern Namibia (Maltahöhe district) to the northern part of the Northern Cape, South Africa. In the *Atlas* region it occurs from the Richtersveld east to Augrabies (Branch *et al.* 1996; Barts *et al.* 2005).

Habitat: Rupicolous, found in association with rock outcrops and rock faces with deep cracks, at altitudes of 100–1 100 m (Branch *et al.* 1996; Barts 2002).

Bioregion: Gariep Desert; Richtersveld; Bushmanland.

Assessment rationale: Widespread and common, occurring chiefly in areas with little human impact.

Conservation measures: None recommended.

Pachydactylus haackei—Farm Daberas, Orange River, NC W.R. Branch

Pachydactylus kladaroderma Branch, Bauer & Good, 1996

THIN-SKINNED GECKO; THIN-SKINNED THICK-TOED GECKO

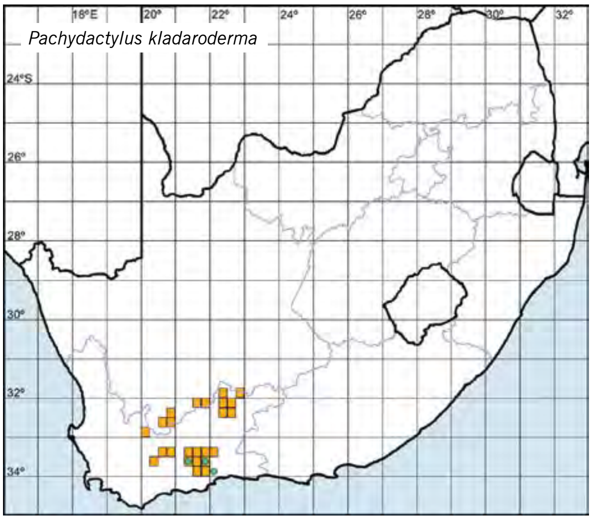
Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: This species was previously confused with *Pachydactylus namaquensis* (Branch *et al.* 1996). Old literature records of *P. namaquensis* from the Western Cape and southern Northern Cape are almost certainly referable to *P. kladaroderma*.

Distribution: Endemic to South Africa where it occurs in the eastern Cape Fold Mountains and southern escarpment mountains of the Western Cape and adjacent Northern Cape (Branch *et al.* 1996).



Habitat: Rupicolous, found in relatively mesic habitats with large rock outcrops and deep horizontal cracks, at altitudes of 750–1 682 m (Branch & Bauer 1995; Branch *et al.* 1996).

Bioregion: Western Fynbos-Renosterveld; Karoo Renosterveld; Upper Karoo; Lower Karoo; Rainshadow Valley Karoo; Trans-Escarpment Succulent Karoo; Eastern Fynbos-Renosterveld; Southern Fynbos.

Assessment rationale: Has a relatively broad range in largely inaccessible montane habitats that are not under any major threat.

Conservation measures: None recommended.

Pachydactylus kladaroderma—Sutherland, NC J. Marais

Pachydactylus labialis FitzSimons, 1938

WESTERN CAPE GECKO;
WESTERN CAPE THICK-TOED GECKO

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: FitzSimons (1943) and Loveridge (1947) regarded *Pachydactylus labialis* as a subspecies of *P. capensis*. Branch (1988a, 1998), reflecting the prevailing views of the herpetological community at that time, treated it as specifically distinct. It is now known that *P. labialis* is not particularly closely related to the *P. capensis* group (Bauer & Lamb 2002, 2005). Records of *P. capensis* from the West Coast of South Africa are generally referable to *P. labialis*. There is significant morphological variation within the species and further study is required to assess any possible taxonomically significant sub-structuring of populations.

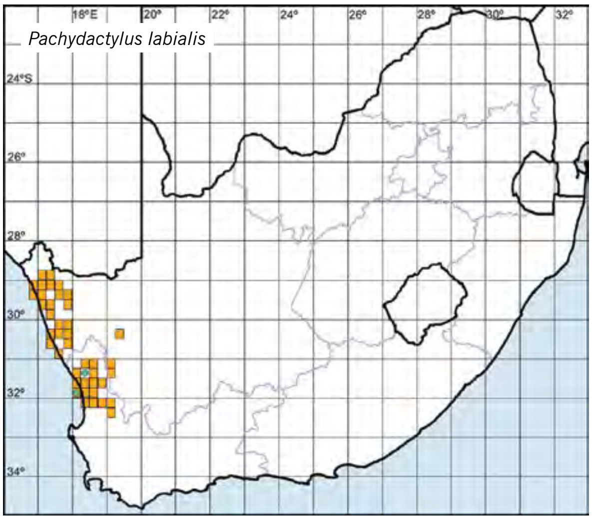
Distribution: Endemic to South Africa. Occurs in western portions of the Western and Northern Cape provinces, from Fonteinskop in the Ceres Karoo northwards to Gelykwerf in the Richtersveld National Park (Bauer & Branch 2003 [2001]).

Habitat: Found in moderately mesic situations in a diversity of habitat types that provide suitable rocky or vegetative ground cover. Prefers coastal habitats and river valleys with sandy substrates. Occurs from sea level to at least 800 m (Branch 1998; Bauer & Branch 2003 [2001]).

Bioregion: Namaqualand Sandveld; Namaqualand Hardeveld; Richtersveld; Knersvlakte; Northwest Fynbos; West Strandveld; Rainshadow Valley Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



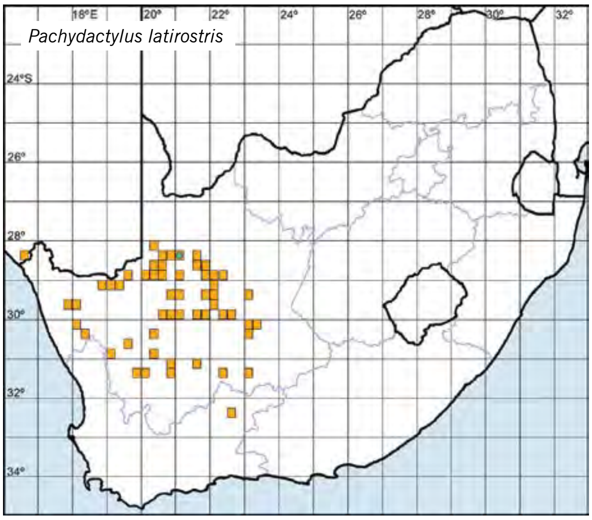
Pachydactylus labialis—Noup, NC W.R. Branch

Pachydactylus latirostris Hewitt, 1923

QUARTZ GECKO

Aaron M. Bauer

Global: Least Concern



Taxonomy: This species has often been considered as a subspecies of *Pachydactylus mariquensis* (e.g. Loveridge 1947; Branch 1998), but consistent morphological differences in cephalic scalation, as well as molecular differences, support its specific distinctness (Bauer *et al.* 2011). The identification of older specimens from areas of sympatry and near sympatry with *P. mariquensis* should be confirmed.

Distribution: Endemic to South Africa and Namibia. In South Africa this species occurs throughout much of the Northern Cape, with one record in the northeastern portion of the

Pachydactylus latirostris—Kenhardt, NC M. Burger

Western Cape. In Namibia it occurs chiefly in the south, adjacent to the South African population, but with scattered isolated populations extending about 800 km to the north (Bauer 1990; Branch 1998). The apparent distribution disjunction in Namibia is probably artefactual (Bauer 1990).

Habitat: Found in areas of sandy soils and sparse vegetation in several habitat types, such as sand plains and dry river beds (Branch 1998). Occurs from near sea level to at least 1 500 m elevation.

Biome: Nama-Karoo; Succulent Karoo; Desert; Fynbos; Savanna.

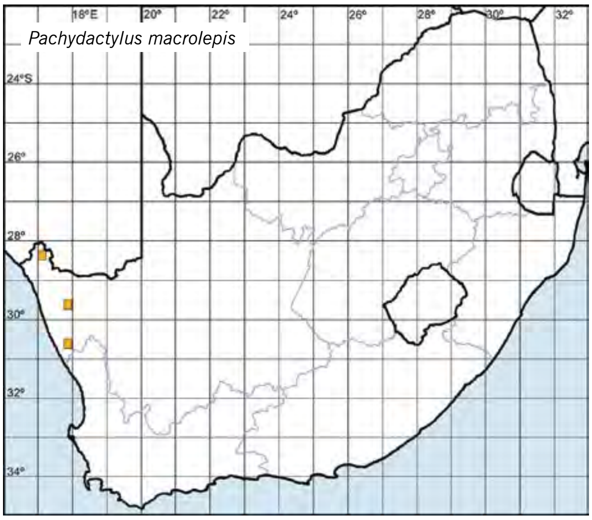
Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Pachydactylus macrolepis FitzSimons, 1939

LARGE-SCALED BANDED GECKO

Michael F. Bates



Global: Least Concern

Endemic

Taxonomy: *Pachydactylus macrolepis* was originally described as a subspecies of *P. mariquensis*. This taxonomic arrangement was adopted by FitzSimons (1943), Loveridge (1947), Branch (1981) and Branch *et al.* (1988). However, Loveridge (1947) considered it a possible synonym of '*P. mariquensis amoenus*', Branch (1981) noted that its status was uncertain, and Branch *et al.* (1988) regarded it as a possible synonym of *P. mariquensis mariquensis*. The latter arrangement was later adopted by Kluge (2001). Branch (1988b, 1998) did not mention this taxon. It was resurrected as a valid species by Bauer *et al.* (2011).

Distribution: Endemic to Little Namaqualand in the western Northern Cape, South Africa.

Habitat: Found in sandy, arid areas, but no detailed information is available.

Bioregion: Namaqualand Hardeveld; Richtersveld.

Assessment rationale: This species has a restricted range, but there are no known threats, population declines or fluctuations. It is protected within the Richtersveld National Park and may occur in Namaqua National Park and Goegap Nature Reserve (Bauer *et al.* 2011).

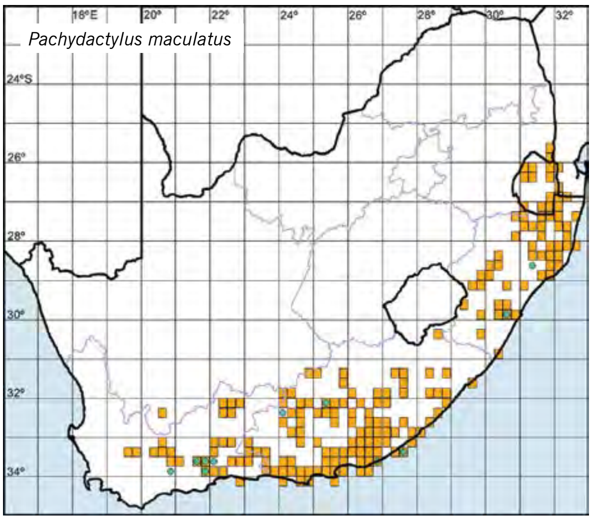
Conservation measures: None recommended.

Pachydactylus macrolepis—Springbok, NC J. Marais

Pachydactylus maculatus Gray, 1845

SPOTTED GECKO; SPOTTED THICK-TOED GECKO

Aaron M. Bauer



Global: Least Concern

Near-endemic

Taxonomy: *Pachydactylus maculatus* is sometimes confused with *P. oculatus* Hewitt, 1927, which was removed from its synonymy and treated as a subspecies by De Waal (1978) and as a full species by Branch (1988a, 1998). The two forms are considered sister taxa (Bauer & Lamb 2005). *Pachydactylus microlepis* and *P. albomarginatus* were synonymised with *P. maculatus* by Loveridge (1947). Although *P. microlepis* has universally been accepted as a junior synonym of *P. maculatus*, De Waal (1978) regarded *P. albomarginatus* as a synonym of *P. oculatus* whereas other authors (e.g. Kluge 2001) have followed Loveridge's interpretation. The broad distribution of *P. maculatus* warrants a thorough revision to determine whether taxonomically significant sub-structuring exists.

Distribution: Endemic to southern Africa, occurring in the eastern and southern parts of South Africa, Swaziland and extreme southern Mozambique (Branch 1998). Within South Africa, it occurs in southeastern Mpumalanga, most of KwaZulu-Natal, Eastern Cape, parts of the Western Cape, and the southern margin of the Northern Cape. Also found on St Croix Island in Algoa Bay.

Habitat: Found in a broad range of habitat types, chiefly in relatively mesic areas, where it uses rocks, old termitaria, logs or debris as refuge sites (Branch & Braack 1987). Occurs from sea level to at least 1 600 m.

Biome: Savanna; Albany Thicket; Fynbos; Grassland; Nama-Karoo; Indian Ocean Coastal Belt; Succulent Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Pachydactylus maculatus—George, WC W.R. Branch

Pachydactylus mariquensis A. Smith, 1849

COMMON BANDED GECKO; MARICO GECKO; MARICO THICK-TOED GECKO

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: The *Pachydactylus mariquensis* species complex consists of four distinct species, namely *P. mariquensis*, *P. amoenus, P. latirostris* and *P. macrolepis* (Bauer *et al.* 2011).

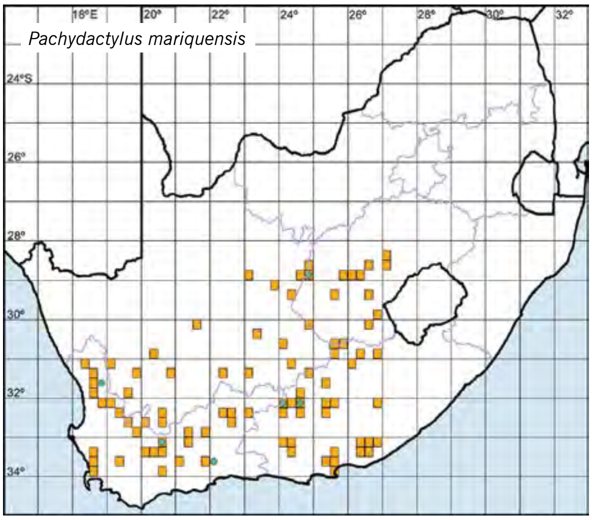
Distribution: Endemic to South Africa where it occurs in the Free State, Northern Cape, Western Cape and western half of the Eastern Cape. Recently found as far south as Blaauwberg Conservation Area (3318CD) in Cape Town (http://www.hardaker.co.za/r-maricothicktoedgecko1.htm; not plotted on map).

Habitat: Found in sandy soils and sparse vegetation in several habitat types, such as sandy plains and dry river beds (Branch & Braack 1987, 1989; Branch & Bauer 1995; Bauer & Branch 2003 [2001]). Occurs from near sea level to at least 1 500 m elevation.

Biome: Grassland; Nama-Karoo; Succulent Karoo; Albany Thicket; Fynbos; Savanna.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Pachydactylus mariquensis—23 km along N10 from Britstown to Prieska, NC M. Burger

Pachydactylus monicae Bauer, Lamb & Branch, 2006
MONICA'S GECKO

Aaron M. Bauer

Global: Least Concern

Taxonomy: This recently-described species is part of the *Pachydactylus weberi* group (Bauer *et al.* 2006a). Some old records of *P. weberi* from the Richtersveld and adjacent southern Namibia may be referable to *P. monicae* (e.g. Bauer & Branch 2003 [2001]).

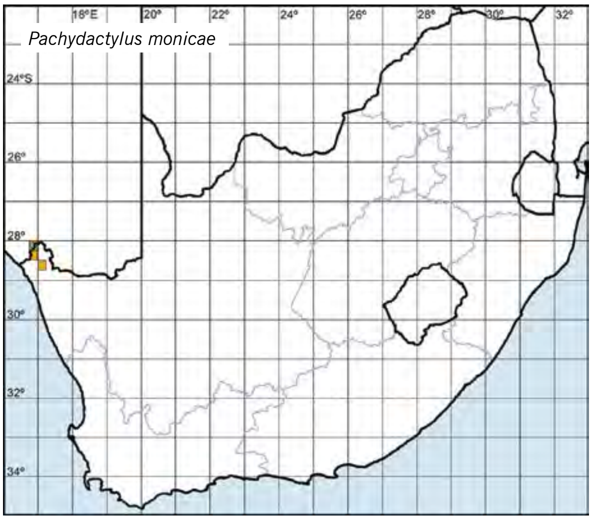
Distribution: Endemic to southern Africa where it occurs in the northwestern part of the Northern Cape and in the Lüderitz and Karasburg districts of Namibia. All known localities are in the lower Orange River valley, lower Fish River valley and Holoog River valley, or in the plains and hills west of the Huib Hoch Plateau (Bauer *et al.* 2006a).

Habitat: Found in relatively mesic microhabitats close to major rivers and on adjacent boulder outcrops in arid habitats. Occurs mainly at elevations below 100 m but also on the lower slopes (below 900 m) of mountains (Bauer *et al.* 2006a).

Vegetation type: Dn 5 Western Gariep Hills Desert; AZa 3 Lower Gariep Alluvial Vegetation; SKr 1 Central Richtersveld Mountain Shrubland.

Assessment rationale: Has a restricted range globally but is abundant and not threatened. Most of the distribution is in protected areas or in non-mined buffer zones of the Diamond Area, where it also receives de facto protection. This species is also tolerant of disturbance and is found in and around human habitations at Sendelingsdrif (Bauer & Branch 2003 [2001]; Bauer *et al.* 2006a). Although there are less than five locations in the *Atlas* region, *P. monicae* is considered regionally Least Concern.

Conservation measures: None recommended.



Pachydactylus monicae—Potjiespram, Richtersveld, NC J. Marais

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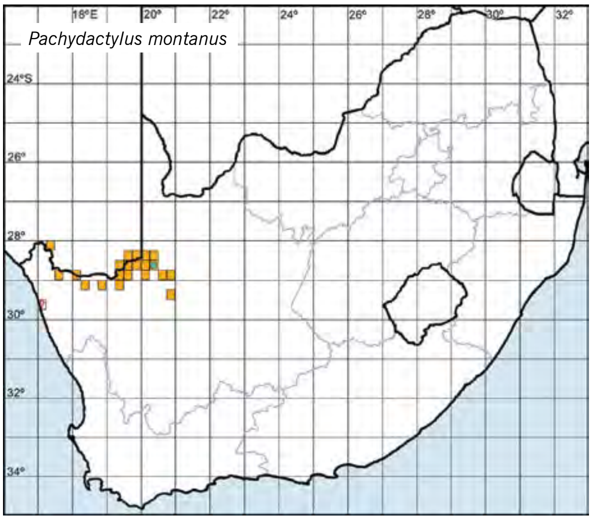
Pachydactylus montanus Methuen & Hewitt, 1914
NAMAQUA MOUNTAIN GECKO

Aaron M. Bauer

Global: Least Concern

Taxonomy: Until a recent revision (Bauer *et al.* 2006a), this species was generally cited as *P. serval onscepensis* following the work of McLachlan & Spence (1966). Many records of *P. serval* from the Northern Cape and southern Namibia are therefore referable to *P. montanus*. Although there are no known diagnostic features that separate populations of *P. montanus* from the Onseepkans area from other populations, there is a large divergence in mitochondrial DNA (Bauer *et al.* 2006a) and further taxonomic



Pachydactylus montanus—Augrabies, NC G.J. Alexander studies are warranted. Adult *P. montanus* are very similar in appearance to *P. serval* and also *P. purcelli*. Because *P. montanus* co-occurs with one or both of these congeners across most of its range, identifications of all specimens should be carefully checked. Further study of isolated populations in southern Namibia (30 km east of Aus; Farm Houmoed, Tirasberg Mountains) is warranted.

Distribution: Endemic to southern Africa, from the northern parts of the Northern Cape (Kakamas to Vioolsdrif) to the Lüderitz, Bethanie, Karasburg and Keetmanshoop districts of Namibia. Namibian localities situated away from the Orange River valley are disjunct. A locality north of Wallekraal (2917CA) should be verified (Bauer *et al.* 2006a).

Habitat: Found in rocky habitats from mountain slopes to cliff faces to boulder piles, in semi-arid regions and arid zones, from near sea level to the top of the Great Karasberg Mountain in Namibia at 2 225 m (Methuen & Hewitt 1914).

Bioregion: Bushmanland; Gariep Desert; Alluvial Vegetation.

Pachydactylus montanus—62 km S of Aus on road to Rosh Pinah, Namibia J. Marais

Assessment rationale: Widespread and common with only very localised threats of intensive mining activity in scattered areas.

Conservation measures: None recommended.

Pachydactylus namaquensis (Sclater, 1898)

NAMAQUA GECKO; NAMAQUA THICK-TOED GECKO

Aaron M. Bauer

Global: Least Concern

Near-endemic

Taxonomy: Two recently described species, *Pachydactylus kladaroderma* and *P. haackei* (Branch *et al.* 1996), were previously confused with *P. namaquensis*. Records of *P. namaquensis* from the Western Cape and southern Northern Cape are referable to *P. kladaroderma*, whereas most records from the Orange River valley and southern Namibia are referable to *P. haackei*. Sclater (1898) originally described this species in the genus *Elasmodactylus*, but this name is now restricted to a clade of the *Pachydactylus* group of geckos occurring from northern Zimbabwe and central Mozambique northwards (Bauer & Lamb 2005).

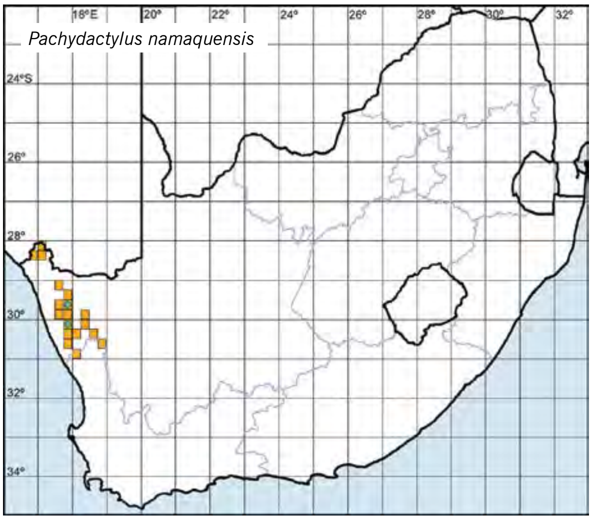
Distribution: Endemic to southern Africa where it occurs chiefly in the western parts of the Northern Cape, from the Kamiesberg Mountains in the south to the Vandersterberg Mountains in the north. There is a single Namibian record from the Namuskluft Inselberg in the Lüderitz district (Branch *et al.* 1996; Bauer & Branch 2003 [2001]).

Habitat: Rupicolous, inhabiting large rock outcrops with deep cracks in relatively mesic microhabitats. Elevational range approximately 500–1 500 m (Branch *et al.* 1996; Bauer & Branch 2003 [2001]).

Bioregion: Namaqualand Hardeveld; Richtersveld; Namaqualand Cape Shrublands; Southern Namib Desert.

Assessment rationale: Has a moderately restricted EOO, slightly above the Vulnerable threshold. However, the range is not fragmented or declining in size and the species is abundant and not threatened. Large portions of its range are included in protected areas.

Conservation measures: None recommended.



Pachydactylus namaquensis—Farm Kamas, E of Kliprand, NC M. Burger

Pachydactylus oculatus Hewitt, 1927

GOLDEN SPOTTED GECKO;
GOLDEN SPOTTED THICK-TOED GECKO

Aaron M. Bauer

Global: Least Concern

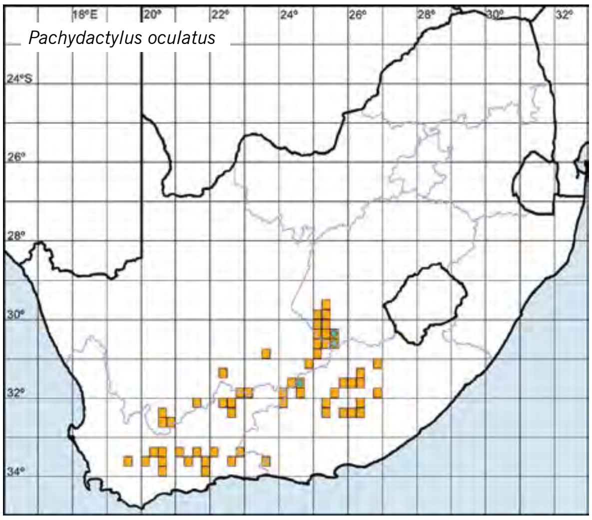
Endemic

Taxonomy: *Pachydactylus oculatus* is sometimes confused with its sister species, *P. maculatus*, and records from their area of sympatry on the inland escarpment of the Eastern and Western Cape provinces require individual verification. This species was resurrected from the synonymy of *P. maculatus* by De Waal (1978) as *P. maculatus oculatus*, and subsequently elevated to full species status (Branch 1988b; Branch & Braack 1989).

Distribution: Endemic to South Africa where it occurs from the southwestern Free State southwards along the inland escarpment and northern Cape Fold Mountains of the Eastern, Western and Northern Cape provinces.

Habitat: Found in rocky habitats in karroid vegetation and adjacent grasslands, at altitudes of 800–2 000 m (De Waal 1978; Branch & Braack 1989).

Biome: Fynbos; Grassland; Nama-Karoo.



Assessment rationale: Widespread and common, occurring mainly in areas without major anthropogenic disturbances.

Conservation measures: None recommended.

Pachydactylus oculatus, adult—Farm Lemoenfontein, SE of Britstown, NC
M. Burger

Pachydactylus oculatus, juvenile—Farm Lemoenfontein, SE of Britstown, NC
M. Burger

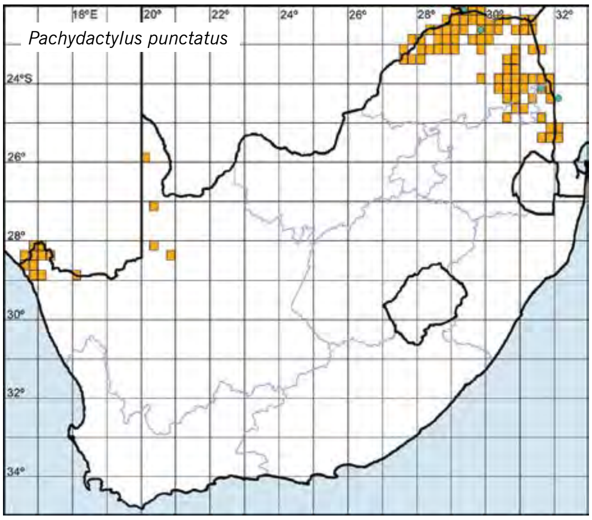
Pachydactylus punctatus Peters, 1854

SPECKLED GECKO;
SPECKLED THICK-TOED GECKO

Aaron M. Bauer

Regional: Least Concern

Taxonomy: Bauer & Branch (1995) elevated the northwestern Namibian subspecies *Pachydactylus punctatus scherzi* to specific status, and considered all other subspecies and synonyms of *P. punctatus* as being referable to *P. p. punctatus*. However, they indicated that there was extensive geographically-correlated colour pattern variation in the species and further study was required. *Pachydactylus amoenoides* has occasionally been considered as a valid species (Wermuth 1965) or subspecies of *P. punctatus* (Jacobsen 1989) from southwestern Namibia, but it was tentatively included in the synonymy of *P. punctatus* by Bauer & Branch (1995). A phylogeographic study of *P. punctatus* is being undertaken (A.M. Bauer, H. Heinz & T.R. Jackman in prep.).



Distribution: Endemic to southern and east-central Africa. Occurs in South Africa (Jacobsen 1989; Bauer & Branch 2003 [2001]), Namibia (Bauer & Branch 1995), Botswana (Auerbach 1987), Zimbabwe (Visser 1984d), Mozambique (Peters 1854; Visser 1984d), Malawi (Bauer 1993 [1992]), Zambia (Broadley 1971c), Angola (Laurent 1964) and the Democratic Republic of the Congo (De Witte 1953). Within South Africa it occurs in the Northern Cape, in the Richtersveld and adjacent lower Orange River valley, and in the Mier Kalahari. In the east, it is present in the northern and eastern portions of Limpopo and in northeastern Mpumalanga. Extralimitally its distribution is more-or-less continuous from western Namibia (exclusive of the Namib and pro-Namib), across Botswana and Zimbabwe to Mozambique (exclusive of coastal regions). Its distribution further north is poorly documented but extends to at least 8°S.

Habitat: Chiefly tropical, occupying a diversity of open habitats from grassy savanna to desert margins to dry river beds. Occurs from sea level to at least 1 800 m (100–1 500 m within South Africa) (Bauer & Branch 1995).

Biome: Savanna; Desert; Succulent Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

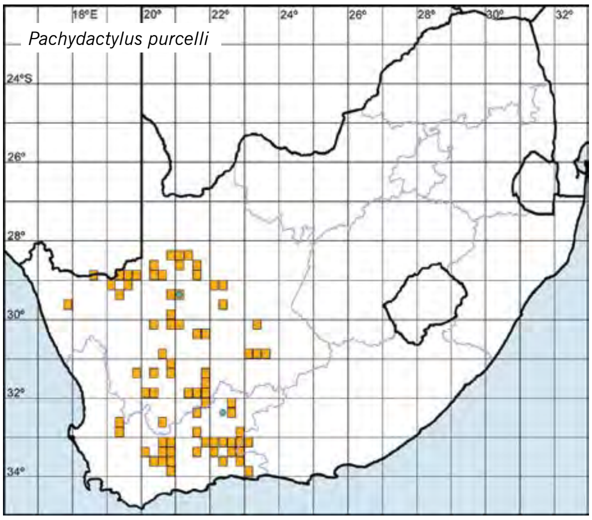
Pachydactylus punctatus, adult—Venetia Limpopo NR, LIMP M. Burger

Pachydactylus punctatus, juvenile— Greater Kuduland Safaris, E of Tshipise, LIMP M. Burger

Pachydactylus purcelli Boulenger, 1910

PURCELL'S GECKO; PURCELL'S THICK-TOED GECKO

Aaron M. Bauer



Global: Least Concern

Taxonomy: Until recently, this taxon was treated as a subspecies of *Pachydactylus serval* based on the work of McLachlan & Spence (1966). The *P. serval* species complex was recently revised and it was elevated to species status (Bauer *et al.* 2006a). Several literature references to *P. serval* in South Africa are actually based on *P. purcelli*. Adults are very similar to those of the closely-related *P. serval* and *P. montanus*, and the identity of specimens from areas of sympatry or near-sympatry (both sides of the Orange River between Goodhouse and Kakamas, and the Karasberg Mountains in Namibia) must be carefully checked.

Distribution: Endemic to western South Africa and southeastern Namibia. In the Western Cape it occurs in the Little Karoo, and north and east of the Cape Fold Mountains, just reaching the southwestern border of the Eastern Cape, and is widely distributed in the Northern Cape as far north as the Orange River valley between Goodhouse and Upington. In Namibia it occurs at scattered localities along the Orange River in the Karasburg district, and in and around the Karasberg Mountains of the Karasburg and Keetmanshoop districts. The record from Carolusberg (2917DB) should be confirmed (Bauer *et al.* 2006a).

Habitat: Found in rocky habitats, from cliff faces to boulder piles and road cuttings, throughout semi-arid regions and riverine corridors in arid zones, chiefly from 450 m to 1 800 m (Bauer *et al.* 2006a).

Pachydactylus purcelli, adult and juvenile—Beaufort West, WC M. Burger

Biome: Nama-Karoo; Succulent Karoo; Fynbos; Savanna; Desert; Albany Thicket.

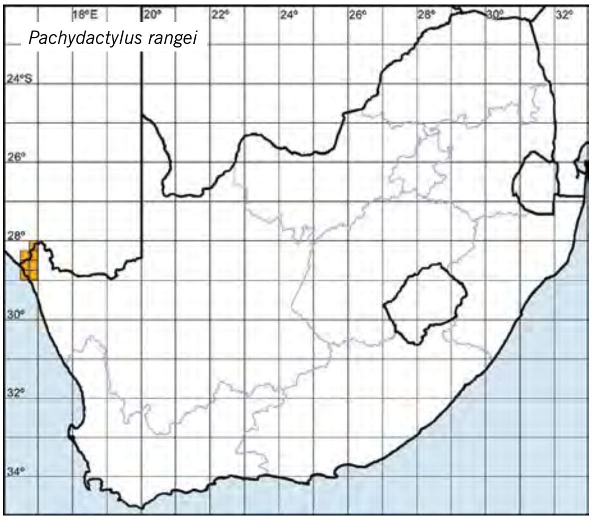
Assessment rationale: Widespread and common; no known threats.

Conservation measures: None recommended.

Pachydactylus rangei (Andersson, 1908)

NAMIB WEB-FOOTED GECKO; NAMIB DUNE GECKO

Aaron M. Bauer



Pachydactylus rangei—Swakopmund, Namibia J. Marais

Regional: Critically Endangered **A2c**

Taxonomy: This species was initially described as the type species (by monotypy) of the genus *Palmatogecko* Andersson, 1908. Immunological comparisons with other African geckos suggested, however, that the species was a highly derived *Pachydactylus* (Joger 1985). The close relationship to *Pachydactylus austeni* was confirmed by DNA-based phylogenetic analysis (Bauer & Lamb 2005; Lamb & Bauer 2006). The genus *Palmatogecko* was formally synonymised with *Pachydactylus* by Bauer & Lamb (2005).

Distribution: Endemic to southern Africa and adjacent southwestern Angola. Occurs along the entire length of the Namib Desert in western Namibia and the extreme northwestern portion of the Northern Cape, South Africa, north of the Holgat River and along the lower Orange River to Sendelingsdrif in the Richtersveld National Park (Haacke 1976d; Bauer & Branch 2003 [2001]).

Regional EOO: 1 989 km^2 (confidence: high); regional AOO: 235 km^2 (confidence: high).

Habitat: Found in areas of dunes or loose sand or silt, including dry river beds, from coastal areas to at least 160 km inland (Koch 1962; Haacke 1976d). It occurs chiefly below 750 m elevation.

Biome: Succulent Karoo; Desert.

Assessment rationale: Widespread and common throughout its global range, with threats from mining and agriculture in limited areas. Within the *Atlas* region, however, the majority of suitable habitat along the lower Orange River has been converted for agricultural use and coastal habitats have been impacted by mining activities (Bauer & Branch 2003 [2001]). Based on criteria D1 and D2 the regional assessment of this species would be Vulnerable, whereas application of criteria B and C would yield an assessment of Endangered. However, an apparent dramatic decline (>80%) in the regional population in the last 50 years, attributable to the above-mentioned ongoing human activities, justifies Critically Endangered status under criterion A2c. No individuals have been documented from the native South African range in several decades and the possibility of extirpation exists. However, most recent survey work has concentrated on the narrow and heavily impacted habitat corridor along the Orange River (Bauer & Branch 2003 [2001]). The subpopulation in coastal habitat north of Gifkop is more likely to remain viable in the long term, as a greater area of potentially suitable habitat exists.

Threats: Threatened by agricultural development (Northern Cape: Bauer & Branch 2003 [2001]), housing development (Namibia, chiefly near Swakopmund and Walvis Bay) and mining (mainly in the Sperrgebiet, Namibia and in unprotected parts of the western Richtersveld, Northern Cape). There is also some international pet trade, but most collecting is probably limited to certain areas in Namibia where the species is easily accessed. However, all threats are relatively limited in geographical extent and scope. Threats, especially from agriculture and mining, are most severe in the small South African portion of the range.

Conservation measures: Although this species is classified as Least Concern in its global range, South African populations are highly restricted (McLachlan 1988b) and are here considered Critically Endangered. It is recommended that the Richtersveld National Park be extended to include parts of the western Richtersveld that are inhabited by *P. rangei*, in order to protect this species in South Africa. Studies on the current range and population status of South African populations are required.

Pachydactylus rugosus A. Smith, 1849

COMMON ROUGH GECKO; ROUGH GECKO

Aaron M. Bauer

Regional: Least Concern

Taxonomy: Prior to the elevation of *Pachydactylus barnardi* and *P. formosus* from subspecific status within *P. rugosus* (Lamb & Bauer 2000b), some references to *P. rugosus* from the western portions of the Western and Northern Cape actually referred to these other species.

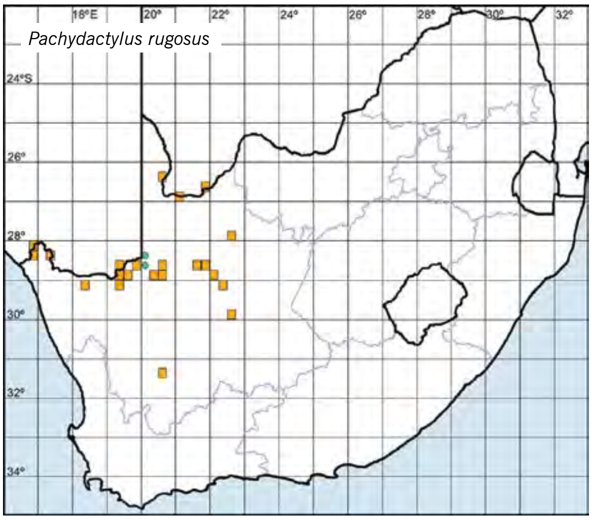
Distribution: Endemic to southern Africa. Occurs in South Africa, southwestern Botswana (Auerbach 1987) and large parts of Namibia (Visser 1984e). Within South Africa it is limited to the Northern Cape, chiefly along the course of the Orange River, but with outlying localities as far south as the Williston area (3120BC).

Habitat: Mainly associated with river courses and most often found under bark on dead trees or in association with dry, dead, fallen or standing trees. However, also found under debris in areas of human activity (Bauer & Branch 2003 [2001]). In the *Atlas* region, it occurs from near sea level to at least 1 200 m. Extralimitally, it occurs at altitudes as high as 1 500 m in parts of Namibia (A.M. Bauer pers. obs.).

Biome: Nama-Karoo; Desert; Savanna; Succulent Karoo (marginal).

Assessment rationale: Widespread and common; not subject to any major identifiable threats.

Conservation measures: None recommended.



Pachydactylus rugosus—Farm Good Hope, 30 km SW of Prieska, NC
M. Burger

Pachydactylus tigrinus Van Dam, 1921

TIGER GECKO; TIGER THICK-TOED GECKO

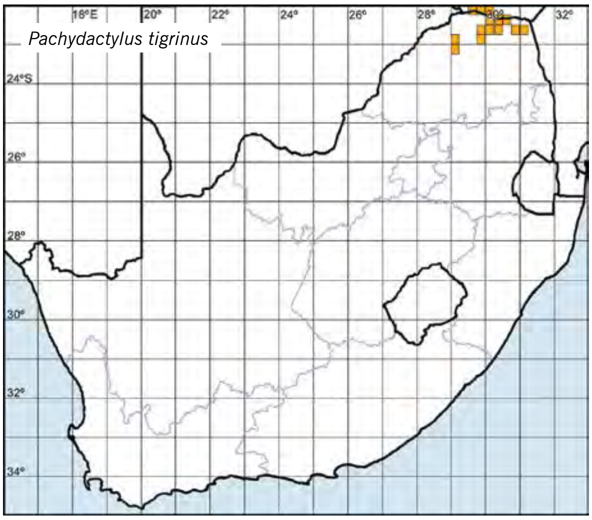
Aaron M. Bauer

Global: Least Concern

Taxonomy: Broadley (1977a) elevated *Pachydactylus tigrinus* to full species status within the *P. capensis* group, and also established its synonymy with *P. rhodesianus*.

Distribution: Restricted to southern Africa where it occurs throughout Zimbabwe, in west-central Mozambique, eastern Botswana and in the northern part of Limpopo Province, South Africa (Broadley 1977a; Jacobsen 1989).

Pachydactylus tigrinus, adult—Greater Kuduland Safaris, E of Tshipise, LIMP
M. Burger



Habitat: Rupicolous, found in rocky habitats that provide narrow crevices, in savanna and savanna woodland (Barts 2005). Most common between elevations of 550 m and 1 500 m (chiefly below 1 000 m in South Africa).

Bioregion: Mopane; Central Bushveld; Lowveld.

Assessment rationale: Widespread and common in its range as a whole. In its relatively restricted range in South Africa it is abundant, not threatened and occurs in several protected areas.

Conservation measures: None recommended.

Pachydactylus tigrinus, juvenile—Greater Kuduland Safaris, E of Tshipise, LIMP M. Burger

Pachydactylus vansoni FitzSimons, 1933

VAN SON'S GECKO;
VAN SON'S THICK-TOED GECKO

Aaron M. Bauer

Global: Least Concern

Near-endemic

Taxonomy: *Pachydactylus vansoni* was regarded as a subspecies of *P. capensis* by FitzSimons (1943), Loveridge (1947) and Broadley (1977a). Its specific distinctness was demonstrated by Jacobsen (1989), who found this taxon in strict sympatry with *P. capensis* (at least one locality). He also suggested that there might be taxonomically significant variation within *P. vansoni*, with distinctive Highveld versus Lowveld groups, and this requires further investigation.

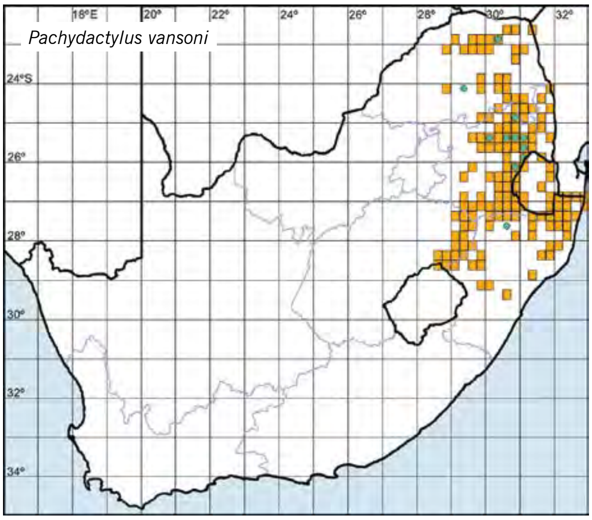
Distribution: Endemic to southern Africa where it occurs in southeastern Zimbabwe, southern Mozambique, Swaziland and northeastern South Africa (Broadley 1977a). Within South Africa it is present in all but the southernmost portions of KwaZulu-Natal (Bourquin 2004), central and eastern Limpopo, and Mpumalanga (Jacobsen 1989) and the northeastern Free State (Bates 1996a).

Habitat: Chiefly terrestrial. The Highveld form is found in rocky outcrops in grasslands whereas the Lowveld form is most often found on soil under rocks or dead aloes; occurs from sea level to 2 300 m (Broadley 1977a; Jacobsen 1989).

Bioregion: Mesic Highveld Grassland; Lowveld; Central Bushveld; Sub-Escarpment Grassland; Mopane; Indian Ocean Coastal Belt; Sub-Escarpment Savanna; Drakensberg Grassland.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Pachydactylus vansoni—Entabeni, Soutpansberg, LIMP M.F. Bates

Pachydactylus visseri Bauer, Lamb & Branch, 2006

VISSER'S GECKO

Aaron M. Bauer

Global: Least Concern

Taxonomy: Part of the *Pachydactylus weberi* group (Bauer *et al.* 2006a). Some earlier references to, and photographs of, *P. weberi* from the lower Orange River and the Fish River Canyon are at least in part referable to this species (Branch 1988b, 1994b, 1998; Bauer & Branch 2003 [2001]; Bauer & Lamb 2005).

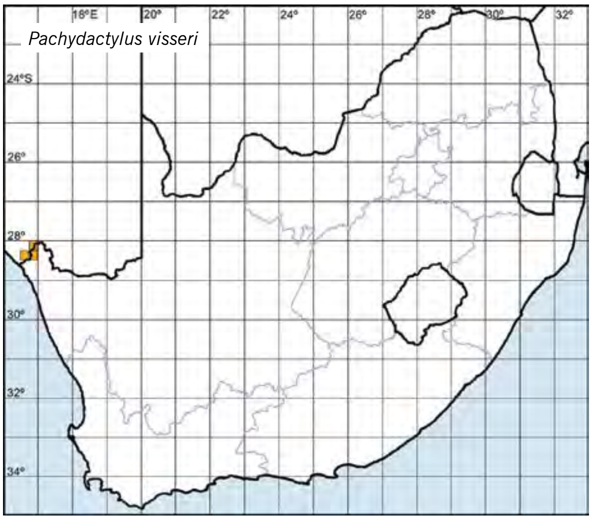
Distribution: Endemic to southern Africa where it occurs at the margin of the northwestern Northern Cape and in the adjacent Lüderitz and Karasburg districts of Namibia. Most localities are in the lower Orange River valley and lower Fish River valley, but there are scattered localities from the Aurus Mountains to just south of Aus.

Habitat: Found in relatively mesic microhabitats in rocky arid areas, such as on boulders and cliffs along large river valleys and on rocky hills and mountains. Occurs from sea level to at least 500 m.

Vegetation type: AZa 3 Lower Gariep Alluvial Vegetation; Dn 5 Western Gariep Hills Desert.

Assessment rationale: Has a restricted range but is abundant and not threatened. Most of the distribution occurs in protected areas or in non-mined buffer areas of the Diamond Area, where it also receives de facto protection.

Conservation measures: None recommended.



Pachydactylus visseri—Fish River Canyon, Namibia W.D. Haacke

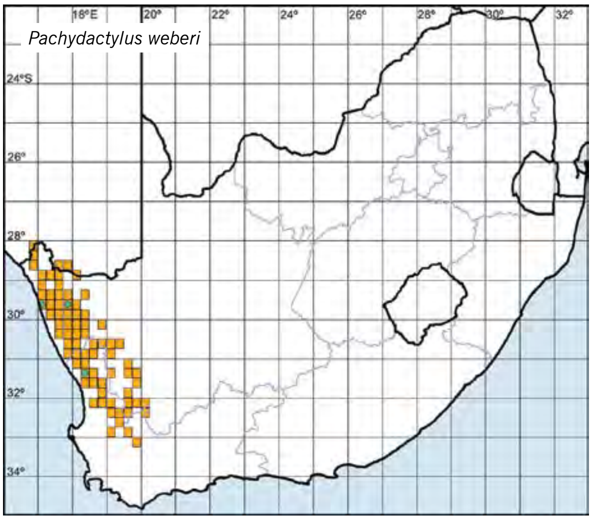
Pachydactylus weberi Roux, 1907

WEBER'S GECKO; WEBER'S THICK-TOED GECKO

Aaron M. Bauer

Global: Least Concern

Near-endemic



Taxonomy: Until the recent revision by Bauer *et al.* (2006a), the name *Pachydactylus weberi* was employed for a diversity of closely related, chiefly rupicolus geckos distributed widely from the Cederberg and Bokkeveldberg to northern Namibia. Specimens now assigned to the following names would all previously have been assigned to *P. weberi*: *P. werneri*, Hewitt, 1935; *P. robertsi*, FitzSimons, 1938; *P. acuminatus* FitzSimons, 1941; *P. waterbergensis* Bauer & Lamb, 2003; *P. atorquatus* Bauer, Barts & Hulbert, 2006; *P. reconditus* Bauer, Lamb & Branch, 2006; *P. monicae* Bauer, Lamb & Branch, 2006; *P. mclachlani* Bauer, Lamb & Branch, 2006; *P. visseri* Bauer, Lamb & Branch, 2006; *P. goodi* Bauer, Lamb & Branch, 2006; and *P. otaviensis* Bauer, Lamb & Branch, 2006. There has occasionally also been some confusion with the Namibian endemic *P. fas-*

Pachydactylus weberi—near Calvinia, NC J. Marais *ciatus* Boulenger, 1888 (e.g. FitzSimons 1938; Loveridge 1947). Genetic comparisons reveal no appreciable differences between near-topotypical (Springbok area) *P. weberi* and specimens from Garies, the type locality of *P. capensis gariesensis* (Bauer *et al.* 2006a), thus confirming the synonymy of these names. Specimens from the Calvinia area are uniformly more robust than those from western Namaqualand, and their status should be re-assessed using genetic markers.

Distribution: Endemic to southwestern Africa, including western portions of the Western and Northern Cape Provinces of South Africa and a single locality (Skerpioenkop) in the Lüderitz district, Namibia. In South Africa it ranges from the Ceres district to the northern Richtersveld, with inland populations as far east as the Roggeveldberg and Hantamsberg mountains.

Habitat: Found in rocky habitats of many types, from large outcrops and cliff faces to boulder clusters and small rock piles, wherever narrow horizontal cracks or exfoliations exist. Occurs from sea level to at least 1 500 m (Bauer *et al.* 2006a).

Biome: Succulent Karoo; Fynbos; Desert; Nama-Karoo.

Assessment rationale: Widespread and common; no widespread threats.

Conservation measures: None recommended.

Pachydactylus weberi—Groenriviersmond, Namaqualand, NC W.R. Branch

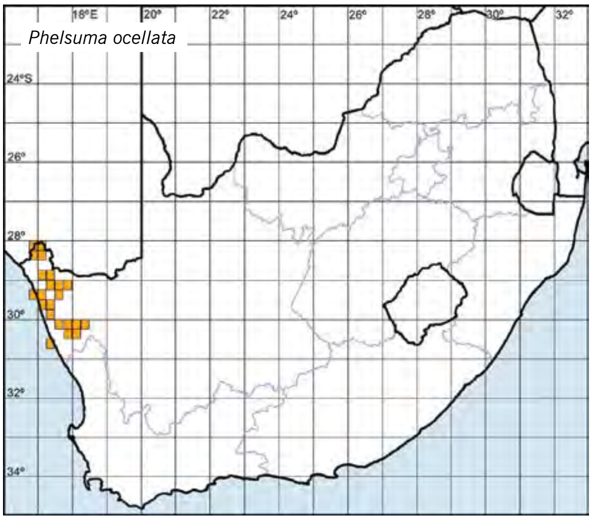
Genus *Phelsuma* Gray, 1825—day geckos

This is a large genus of at least 52 diurnal gecko species (many with subspecies) distributed throughout the islands and coastlines of the Indian Ocean, particularly Madagascar (Rocha *et al.* 2010; Uetz 2012). One isolated species, *Phelsuma ocellata*, is endemic to Namaqualand in the *Atlas* region and is not threatened. Its generic status has been the subject of much debate (Roux 1907; Schmidt 1933; Hewitt 1937c; Russell 1977; Russell & Bauer 1990; Good & Bauer 1995; Röll 1999) and it has been placed in a number of different genera, including the monotypic *Rhoptropella*. Recent findings (A.M. Bauer pers. comm.) suggest that it is best treated as the most basal lineage within *Phelsuma*, although Rocha *et al.* (2010) continue to recognise a monotypic *Rhoptropella*. *Phelsuma ocellata* is an agile, diurnal, rupicolous species that shelters in rock cracks and overhangs.

Phelsuma ocellata (Boulenger, 1885)

NAMAQUA DAY GECKO

William R. Branch



Global: Least Concern

Near-endemic

Taxonomy: The generic placement of this species has long been in question. It was originally placed in *Rhoptropus* by Boulenger (1885), but Roux (1907) subsequently recognised its affinities to *Phelsuma*, to which it was transferred by Schmidt (1933). Hewitt (1937c), however, considered *ocellata* to be intermediate between the two genera and erected the new genus *Rhoptropella*. Although this combination was extensively used for many years (e.g. FitzSimons 1943; Loveridge 1947), subsequent data on digit morphology (Russell 1977; Russell & Bauer 1990) and allozymes (Good & Bauer 1995) supported placement in *Phelsuma*. However, a number of phylogenetic studies on Indian Ocean *Phelsuma* (Röll 1999; Austin *et al.* 2004; Sound *et al.* 2006) have noted that *ocellata* does not group strongly with other *Phelsuma.* Sound *et al.* (2006), using the nomen *Rhoptropella ocellata*, noted that it may form a clade with *Lygodactylus*, which together is the sister group of *Phelsuma*. However, this result was not sufficiently supported in their study or in the analysis of Austin *et al.* (2004). Recent findings (A.M. Bauer pers. comm.) suggest that it is best treated as the most basal lineage within *Phelsuma*, rather than being included in a monotypic genus (*Rhoptropella*). This finding has been adopted here.

Phelsuma ocellata—near Port Nolloth, NC J. Marais

Distribution: Confined to Namaqualand, from the Spoeg River mouth northwards to the Orange River valley, with a possibly isolated population near Augrabies (2820AD, not plotted on map). An isolated record (Süd Witpütz, Bauer & Branch 2003 [2001]), unsupported by recent collections, is the only record for southern Namibia.

Habitat: Rupicolous, favouring small rock outcrops in coastal regions, or summit ridges receiving moisture in the fog belt.

Biome: Succulent Karoo.

Assessment rationale: Has a wide range in Namaqualand, albeit in scattered pockets of suitable mesic habitat within the fog belt. Global climate change may affect the extent and frequency of fog in the region and this may negatively impact the species. Known from two localities within the Richtersveld National Park (Bauer & Branch 2003 [2001]). There are few anthropogenic threats and none of major concern.

Conservation measures: None recommended.

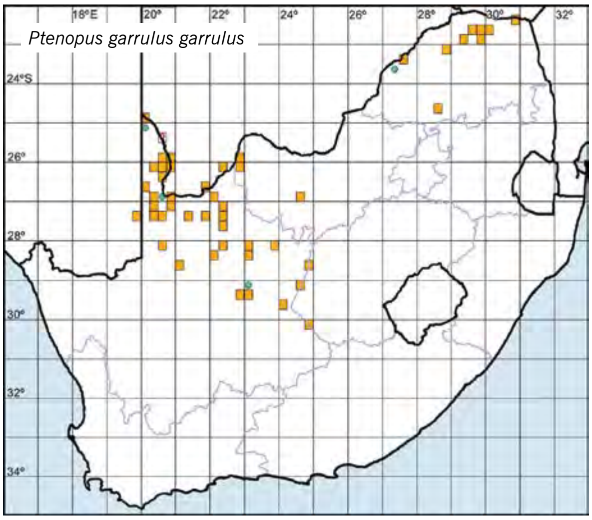
Genus *Ptenopus* Gray, 1865 [1866]—barking geckos

Ptenopus is a small genus consisting of three species of nocturnal geckos found in the western arid region of the subcontinent (Branch 1998). One species consists of two subspecies (*Ptenopus garrulus garrulus*, *P. g. maculatus*), both of which enter the *Atlas* region (Brain 1962; Haacke 1975e). Within the family Gekkonidae, *Ptenopus* appears to be a basal lineage only distantly related to other African geckos. Barking geckos live in sandy habitats, digging complex, branched, underground burrow systems. The dominant males vocalise at their burrow entrance (Hibbitts *et al.* 2007). Their sunset choruses (*tich*, *tich*, *tich*, *tich*…) are a common feature of summer nights in western scrublands and deserts. Neither subspecies is threatened in the *Atlas* region.

Ptenopus garrulus garrulus (A. Smith, 1849)

COMMON BARKING GECKO

William R. Branch



Global: Least Concern

Taxonomy: Trinomials have been used since FitzSimons (1935) treated *Ptenopus maculatus* Gray, 1865 as a subspecies of *P. garrulus* (Brain 1962, Haacke 1975e). A phylogeographic survey of this wide-ranging species may reveal greater intraspecific diversity.

Distribution: Endemic to southern Africa. Found from the northern parts of the Northern Cape and adjacent areas in the southwestern Free State and western portions of North-West Province in South Africa through Botswana and adjacent eastern Namibia, and along the Limpopo River Valley to extreme southwestern Zimbabwe and Limpopo Province (Haacke 1975e; Branch 1998).

Habitat: A small, terrestrial gecko of dune and savanna habitats in the central Kalahari and adjacent regions. It digs complicated branched burrows in sandy soil. Dominant males call at the mouth of the burrow, mainly at sunset (Hibbitts *et al.* 2007).

Biome: Savanna, Nama-Karoo.

Assessment rationale: Common and not threatened throughout its range, much of which is in semi-arid areas with very low agricultural or urban impact.

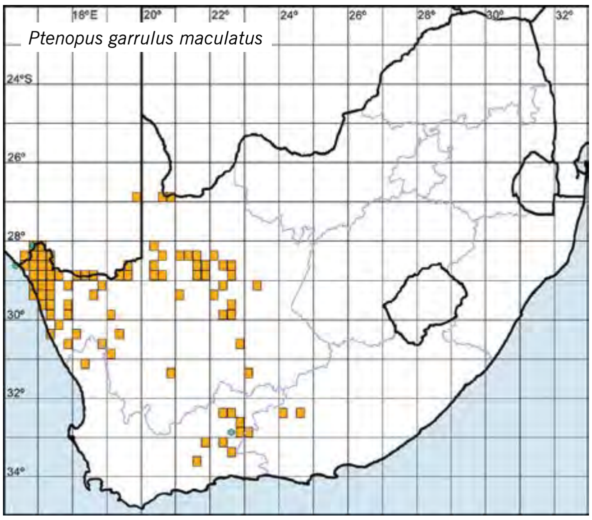
Conservation measures: None recommended.

Ptenopus garrulus garrulus—Tswalu Kalahari Reserve near Kuruman, NC
W. Conradie

Ptenopus garrulus maculatus Gray, 1865 [1866]

SPOTTED BARKING GECKO

William R. Branch



Global: Least Concern

Taxonomy: FitzSimons (1935) treated *Ptenopus maculatus* Gray, 1865 as a subspecies of *P. garrulus* and this was followed by Haacke (1975e). A phylogeographic survey of this wide-ranging species may reveal greater intra-specific diversity.

Distribution: Endemic to southern Africa. It is found in southern and central Namibia—including the Namib Desert and pro-Namib region—extending into the western half of South Africa (Haacke 1975e; Branch 1998). In the *Atlas* region it is widely distributed in the Northern Cape, extending into the northern and eastern parts of the Western Cape and western parts of the Eastern Cape. It occurs in the southern and western Karoo, with a single record in the Little Karoo.

Habitat: A small terrestrial gecko found mainly in dune habitats in the pro-Namib, and sandy areas in the Karoo. Its burrows and behaviour are similar to those of *P. g. garrulus* (see Haacke 1975).

Biome: Succulent Karoo; Nama-Karoo; Desert; Savanna.

Assessment rationale: Common and unthreatened throughout its range, much of which is in semi-arid areas with very low agricultural or urban impact.

Conservation measures: None recommended.

Ptenopus garrulus maculatus—Aus, Namibia J. Marais

CHAPTER 10

Family Amphisbaenidae

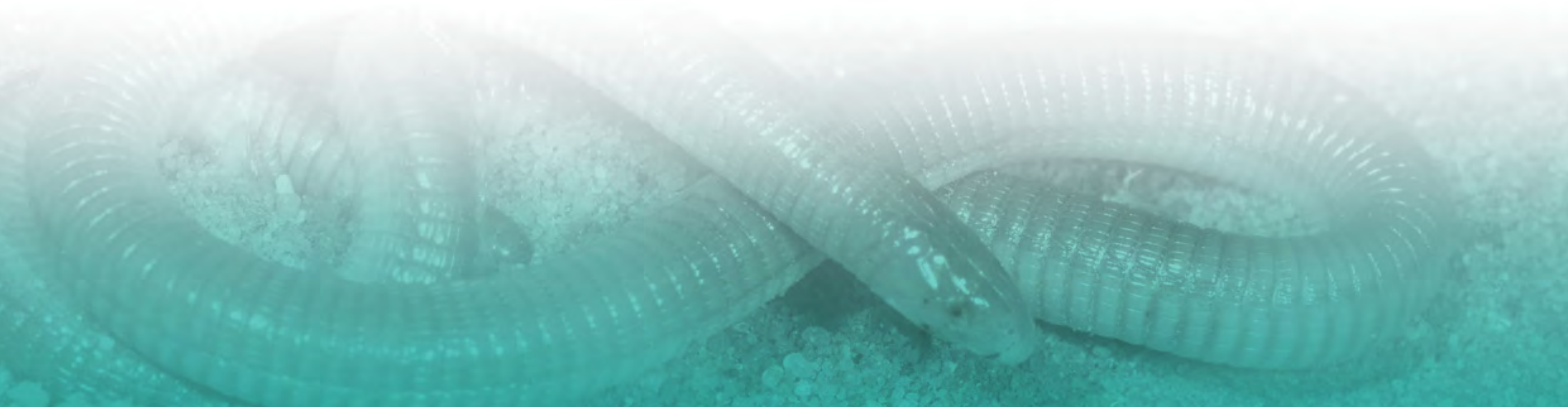
G. John Measey

There are six families of amphisbaenians (Vidal *et al.* 2008b), a group of reptiles that have been traditionally treated separately from lizards and snakes, even though their relationships were controversial and poorly resolved. Recent molecular phylogenies have placed the Amphisbaenia unambiguously within the lizards (Sauria: Lacertilia) as the sister group of the Lacertidae (e.g. Townsend *et al.* 2004). Amphisbaenians are therefore considered to be a specialised group of limbless lizards. There are 183 species (Uetz 2012), distributed principally in sub-Saharan Africa (77 species) and South America (95 species), with small groups of species in the Caribbean, North America and Europe. The alpha-level taxonomy of the family has relied upon morphological characters (Gans 2005) but there appears to be much intraspecific morphological variation (e.g. Broadley *et al.* 1976) and results from molecular work have shown that the taxonomy used to diagnose genera of South American amphisbaenians was not appropriate (Mott & Vieites 2009). Of the seven genera previously recognised in South America, no less than five have been synonymised with *Amphisbaena* (Mott & Vieites 2009). The entire family would benefit from molecular phylogenetic investigation, and this is certainly true of species within the *Atlas* region (see Measey & Tolley 2013). African amphisbaenids include seven genera, with *Baikia* (one species) and *Cynisca* (18 species) restricted mainly to West and central Africa, and *Loveridgea* (two species) restricted to Tanzania. There are ten species in four genera within the *Atlas* region, distributed mainly in the north: Northern Cape, Free State, North-West Province, Gauteng, Limpopo, Mpumalanga, and northern KwaZulu-Natal. Most species tend to inhabit loose soils, although some are capable of using their specialised heads to burrow into very hard substrates.

Amphisbaenians bear a superficial resemblance to earthworms, with rings of scales encircling the body. Closer examination reveals a prominent scaly head with toothed mouth and nostrils, and an eye-spot can often be distinguished. These animals display a variety of adaptations for burrowing. Convergent evolution has resulted in four head shapes adapted for burrowing and feeding on soil macro-invertebrates (Kearney & Stuart 2004). The *Atlas* region contains both round- and shovel-headed species, while keel-headed species exist elsewhere in Africa (Kearney 2003). Most species are oviparous but others give birth to young (e.g. Webb *et al.* 2000a). All species prey on soil macrofauna, mostly termites, but a wide range of other soil invertebrates are eaten by various species; prey is usually swallowed whole (Webb *et al.* 2000a).

The amphisbaenians have not previously been considered in conservation terms because they are infrequently encountered, many species are known only from type series and their ecology is poorly known. As a result, a large proportion are considered to be Data Deficient (Böhm *et al*. 2013). Broadley *et al.* (1976: 474) remarked that: "collecting amphisbaenians by hand is usually a back-breaking business with little reward". This appears to be due to their subterranean habits rather than because they are uncommon, since densities are very high at times (Pooley *et al.* 1973; Broadley *et al.* 1976; Measey *et al.* 2009). There is anecdotal evidence that land-use change may impact negatively on their populations. For example, approximately 50 animals were found per hectare in one area when virgin land was first ploughed, but after a few years of ploughing, no amphisbaenians were found (Broadley *et al.* 1976). Measey *et al.* (2009) found that even within a protected area, densities declined over a period of 35 years, perhaps due to increased stocking of ungulates and the negative effect of this on leaf litter. Little is known about the current distribution, ecology and taxonomy of amphisbaenians in the *Atlas* region, and this prohibits a comprehensive conservation assessment. The contents of this chapter therefore represent a 'best guess' for most species.

The only amphisbaenian considered threatened in the *Atlas* region is *Chirindia langi occidentalis*, classified as Vulnerable. Major threats to this taxon are agriculture, afforestation and changes in game stocking levels. In the *Atlas* region *Monopeltis leonhardi* is known from only two QDGCs and it was therefore not assessed. There is a need to increase our knowledge of this family in general and this should include both taxonomic and biological studies.



Genus *Chirindia* Boulenger, 1907—pink round-headed worm lizards

This genus contains 5–9 species (Gans 2005; Uetz 2012) that occur in eastern and southeastern Africa. Two subspecies are known within the *Atlas* region: *Chirindia langi langi* and *C. l. occidentalis* occur on either side of the Soutpansberg in Limpopo Province. Both species have restricted ranges and are deserving of further taxonomic work. Like other amphisbaenians, little is known of their ecology or the threats that they face. *Chirindia l. occidentalis* is now classified as Vulnerable and is threatened by agriculture, afforestation and changes in game stocking levels.

Chirindia langi langi FitzSimons, 1939

LANG'S WORM LIZARD; LANG'S ROUND-HEADED WORM LIZARD

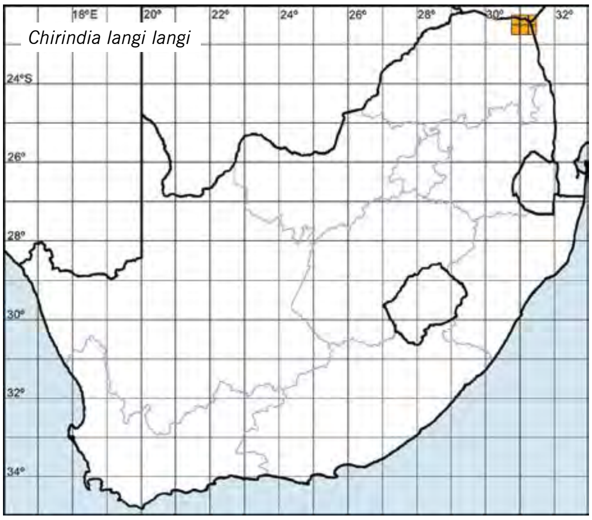
G. John Measey

Global: Least Concern

Near-endemic

Taxonomy: The taxonomic status of *Chirindia langi occidentalis* should be re-assessed, preferably using a combination of morphological and molecular techniques.

Distribution: Endemic to the northeastern corner of Limpopo, South Africa and a small portion of adjoining Mozambique (Jacobsen 1989; Branch 1998). May also occur in southeastern Zimbabwe.



Habitat: Mostly fossorial, found under rocks on the soil surface, in burrows or in rotting logs, in sandy Kalahari soils and clayey Mopane woodland on both north- and south-facing slopes, at altitudes of 230–1 400 m (Jacobsen 1989).

Bioregion: Alluvial Vegetation; Lowveld; Mopane.

Assessment rationale: Very little is known about the distribution of this taxon, e.g. how far it extends into Mozambique. Threats in Mozambique are unknown. In South Africa, AOO and habitat quality are probably influenced by human land-use changes, although some small-scale changes such as subsistence agriculture may favour the taxon. Its range in the *Atlas* region is largely protected within the Kruger National Park, and its global range is mainly within the boundaries of the Great Limpopo Transfrontier Park.

Conservation measures: Perform taxonomic studies. Conduct distribution surveys, especially in Mozambique. Investigate the effects of land-use change, especially in Mozambique.

Chirindia langi langi—Saseladonga, Kruger NP, LIMP (TM 28869) W.R. Schmidt

Chirindia langi langi—Mabyeni Hill, Kruger NP, LIMP (TM 59089) W.R. Schmidt

Chirindia langi occidentalis Jacobsen, 1984

SOUTPANSBERG WORM LIZARD; WESTERN ROUND-HEADED WORM LIZARD

G. John Measey

Global: Vulnerable **B1ab(iii)**

Endemic

Taxonomy: The taxonomic status of this taxon should be re-assessed, preferably using a combination of morphological and molecular techniques.

Distribution: Endemic to the low-lying areas of the Soutpansberg in northern Limpopo, South Africa (Jacobsen 1989).

EOO: 6 030 km^2 (confidence: low); AOO: 2 670 km^2 (confidence: low).

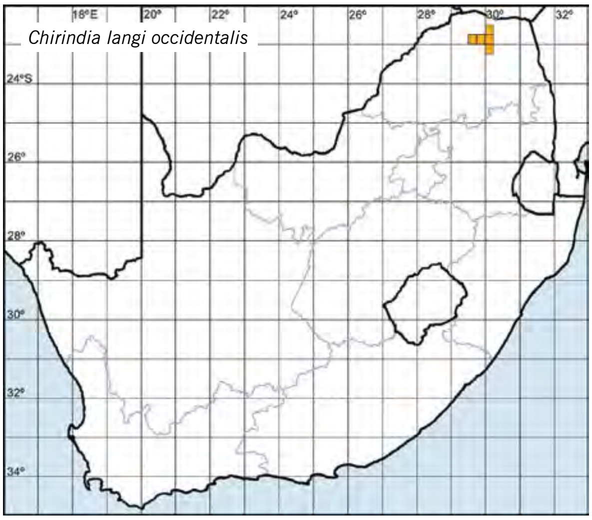
Habitat: Found singly under stones partially imbedded in sandy soils—mostly on the surface or in burrows with the stone as a roof—and occasionally under rotting logs, in mixed bushveld at elevations of 800–1 300 m (Jacobsen 1989).

Bioregion: Mopane, Central Bushveld.

Assessment rationale: EOO <20 000 km^2 [B1]; there are 6–10 locations [B1a], and there is a continuing decline in area, extent and quality of habitat [B1b(iii)] due to afforestation, use of land for crops, and changes in game stocking levels.

Threats: Threatened by afforestation, agriculture and changes in game stocking levels (see Measey *et al.* 2009).

Conservation measures: Conduct surveys to collect data that will allow for more accurate estimates of EOO and AOO. Carry out taxonomic studies and investigate land use changes.



Chirindia langi occidentalis—Soutpansberg, LIMP G.J. Alexander

Genus *Dalophia* Gray, 1865—blunt-tailed worm lizards

Dalophia is distributed in central and southern Africa. Members of this small genus of six (Uetz 2012) to 10 (Gans 2005) species are superficially similar to *Monopeltis* in that they are thick-bodied and have shovel-shaped heads. However, the tail is unusual because it is truncated and has a flattened terminal pad. These rarely-encountered lizards live within the soil, prey on macro-invertebrates, and lay eggs (Branch 1998). A single species, *D. pistillum*, occurs within the *Atlas* region (Limpopo, North-West Province and Northern Cape). Although there are no known threats to this species, it may be susceptible to soil compaction and the other land-use changes that affect amphisbaenians (see family account).

Dalophia pistillum (Boettger, 1895)

PESTLE-TAILED WORM LIZARD; BLUNT-TAILED WORM LIZARD

G. John Measey

Regional: Least Concern

Taxonomy: No notable issues.

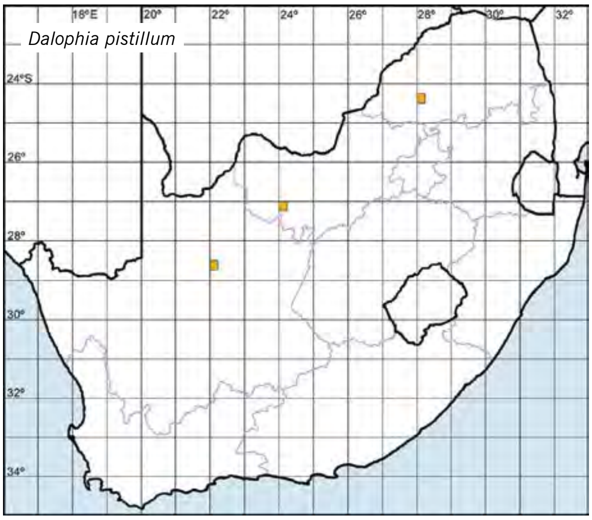
Distribution: Distributed widely in southern Africa, occurring in Botswana, eastern Namibia, southern Zambia and northern Zimbabwe, and extending as far east as mid-Mozambique (Branch 1998). In the *Atlas* region it is known only from the Nylstroom-Vaalwater area of Limpopo, the Vryburg area of North-West Province, and east of Upington in the Northern Cape (Bates *et al.* 2010).

Habitat: Fossorial, usually found within 20 cm of the soil surface; known to take refuge in grass roots at depths of 10 cm (Jacobsen 1989).

Bioregion: Central Bushveld; Eastern Kalahari Bushveld; Kalahari Duneveld.

Assessment rationale: Widespread and common outside the *Atlas* region. Although known from only three localities within the *Atlas* region (Bates *et al.* 2010), it is not considered to be under any specific threat here.

Conservation measures: None recommended.



Dalophia pistillum—Little Vumbura camp, Okavango Delta, Botswana
T. Reumerman

Genus *Monopeltis* A. Smith, 1848—African shovel-snouted worm lizards

The genus *Monopeltis* consists of 21 species (Gans 2005; Uetz 2012) found in sub-Saharan Africa. Six species occur within the *Atlas* region but there are taxonomic uncertainties surrounding some of these (e.g. *M. infuscata*). All species are fossorial, with a characteristic shovel-shaped head, which is used to lift soil when burrowing (Gans 1974). These lizards spend all their time underground where they feed on macro-invertebrate prey. Females give birth rather than laying eggs (Webb *et al.* 2000a). They are occasionally encountered when stones are turned or soil is tilled. Threats are poorly understood but might include mechanised agriculture and soil compaction (Broadley *et al.* 1976).

Monopeltis capensis A. Smith, 1848

CAPE WORM LIZARD;
CAPE SPADE-SNOUTED WORM LIZARD

G. John Measey

Global: Least Concern

Near-endemic

Taxonomy: Broadley *et al.* (1976) identified three allopatric forms of *Monopeltis c. capensis* that differed mainly in annulation, size and degree of pigmentation. Typical *M. capensis* is referable to Group A. Group B was later described as *M. infuscata*, while Group C is referable to *M. decosteri* (Broadley *et al.* 1976; Broadley 1997). Broadley (1997) also elevated *M. c. rhodesianus* to full species status, rendering *M. capensis* monotypic. A molecular and phylogenetic analysis of *Monopeltis* is required.

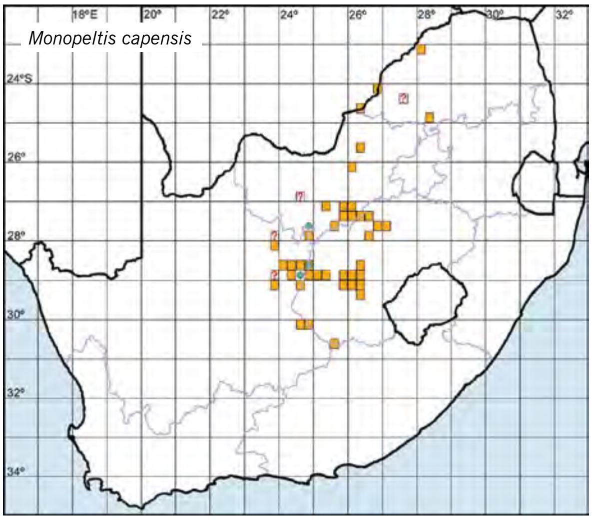
Distribution: Endemic to extreme southern Botswana and the central regions of South Africa (Broadley 1997). Within the *Atlas* region this species occurs in the western half of the Free State and adjacent areas in the Northern Cape, North-West Province and the western half of Limpopo. It has also been recorded from the southern bank of the Orange River in the Eastern Cape (Broadley 1997). Distribution appears to coincide largely with Highveld Grassland and Kalahari Bushveld, but the species also occurs along the Vaal River, and along the Limpopo River on the border with Botswana. A few records on the map are considered questionable because of possible confusion with *M. infuscata.*

Habitat: Fossorial, especially in red soils, and found as deep as 20 cm in the Odendaalsrus area of the northwestern Free State (Broadley *et al.* 1976). In the Free State it has also been found in damp soil and in sand on the banks of rivers, and one specimen was found when a Suricate (*Suricata suricatta*) colony was excavated (De Waal 1978). A specimen from the Northern Cape was found under a large stone (Conradie *et al.* 2011).

Biome: Grassland; Savanna.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

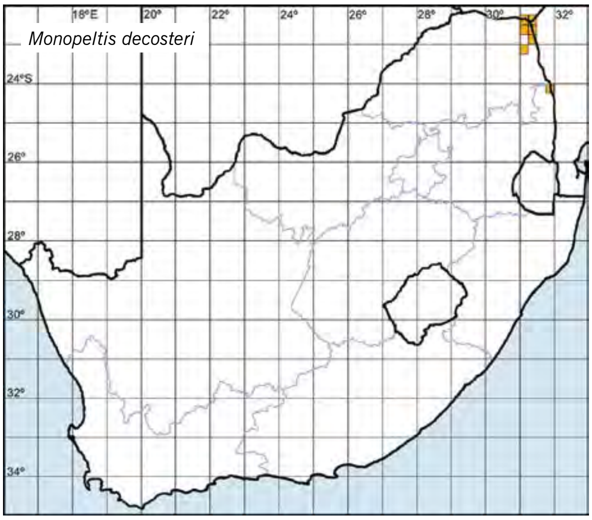


Monopeltis capensis—Rooipoort NR, NC W. Conradie

Monopeltis decosteri Boulenger, 1910

DE COSTER'S WORM LIZARD;
DE COSTER'S SPADE-SNOUTED WORM LIZARD

G. John Measey



Regional: Least Concern

Taxonomy: Broadley *et al.* (1976) considered *Monopeltis decosteri* to be a synonym of *M. capensis*, referable to Group C. However, a subsequent revision by Broadley (1997) revived *M. decosteri* as a full species. The entire *M. capensis* group requires a taxonomic investigation using molecular methods because morphological traits appear to be very variable.

Distribution: Endemic to southeastern Africa. Found in southern Mozambique, southeastern Zimbabwe and along the eastern border of the Kruger National Park in Limpopo and Mpumalanga provinces, South Africa (Broadley 1997).

Habitat: Fossorial. Occurs in sandy soils in moist savanna (Branch 1998). Habitat and behaviour are probably similar to *M. capensis*.

Bioregion: Mopane; Lowveld.

Assessment rationale: Within the *Atlas* region it occurs mainly within the protected Kruger National Park. EOO (8 000 km^2) is below the Vulnerable threshold but there are no known specific threats and no known barriers to immigration from surrounding regions.

Conservation measures: Collect more comprehensive distribution data from inside and outside the *Atlas* region.

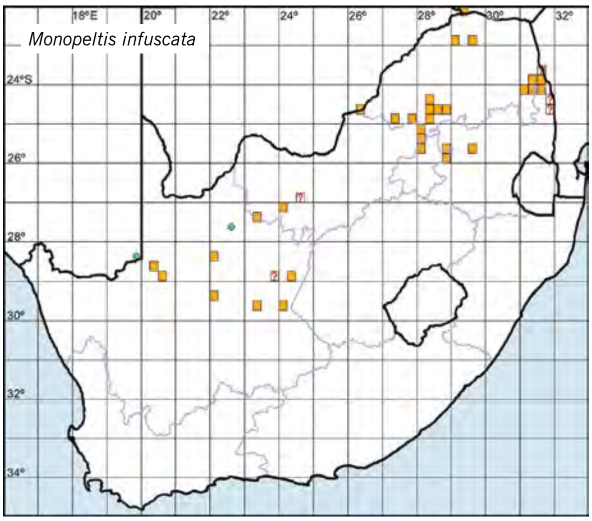
Monopeltis decosteri—Maputo Bay, Mozambique (holotype, SAM 650)
M. Burger

Monopeltis decosteri—Maputo Bay, Mozambique (holotype, SAM 650)
M. Burger

Monopeltis infuscata Broadley, 1997

DUSKY WORM LIZARD;
DUSKY SPADE-SNOUTED WORM LIZARD

G. John Measey



Regional: Least Concern

Taxonomy: Broadley (1997a) elevated *Monopeltis capensis capensis* Group B to species status as *M. infuscata*. The taxonomy of the entire group will be improved by a systematic revision using molecular methods.

Distribution: Endemic to southern Africa. Most of the range lies north of the *Atlas* region in southwestern Angola, Namibia and southern Botswana (Broadley 1997). In the *Atlas* region it is found in Limpopo, Gauteng, western Mpumalanga, North-West Province and Northern Cape (Broadley 1997). A few records on the map are considered questionable because of possible confusion with other species of *Monopeltis.*

Habitat: Fossorial. Habitat probably similar to that of *M. capensis*.

Biome: Savanna; Nama-Karoo; Grassland.

Assessment rationale: Widespread inside and outside the *Atlas* region.

Conservation measures: None recommended.

Monopeltis infuscata—Umbabat Private NR, LIMP D. Pietersen

Monopeltis leonhardi Werner, 1910

KALAHARI WORM LIZARD;
KALAHARI SPADE-SNOUTED WORM LIZARD

G. John Measey

Not Applicable

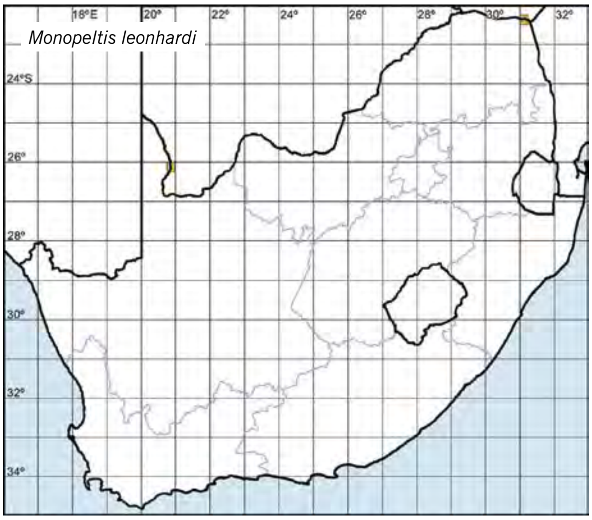
Taxonomy: No notable issues.

Distribution: Endemic to southern Africa. Distributed in the Kalahari of Namibia and Botswana, western and southern Zimbabwe, and along the Limpopo River into extreme northeastern South Africa (Branch 1998). In the *Atlas* region it is known from two marginal records, one in the Kgalagadi Transfrontier Park (Northern Cape) and one in Kruger National Park (Limpopo).

Habitat: Recorded from Kalahari sands. Found in shallow soil under logs and in gerbil burrows (Broadley *et al.* 1976).

Bioregion: Mopane; Kalahari Duneveld.

Assessment rationale: Widespread outside South Africa. The range within the *Atlas* region (where it is known from only two QDGCs) is less than 5% of the global range and the species was therefore not assessed.



Conservation measures: Carry out surveys to determine the distribution of this species within the *Atlas* region. Such information will be helpful for future assessments.

Monopeltis leonhardi—Farm Labota, Gobabis distr., Namibia (TM 33229) W.R. Schmidt

Monopeltis leonhardi—Farm Labota, Gobabis distr., Namibia (TM 33229) W.R. Schmidt

Monopeltis mauricei Parker, 1935

MAURICE'S WORM LIZARD;
MAURICE'S SPADE-SNOUTED WORM LIZARD

G. John Measey

Regional: Least Concern

Taxonomy: *Monopeltis mauricei* was described from near Ghanzi, Botswana by Parker (1935) but later treated as a subspecies of *M. sphenorhynchus* by Broadley *et al.* (1976). Subsequently, when he recorded the first specimen of the typical form from Botswana, Broadley (2001a) elevated *M. s. mauricei* to specific status. This arrangement was followed by Gans (2005), but genetic support is needed.

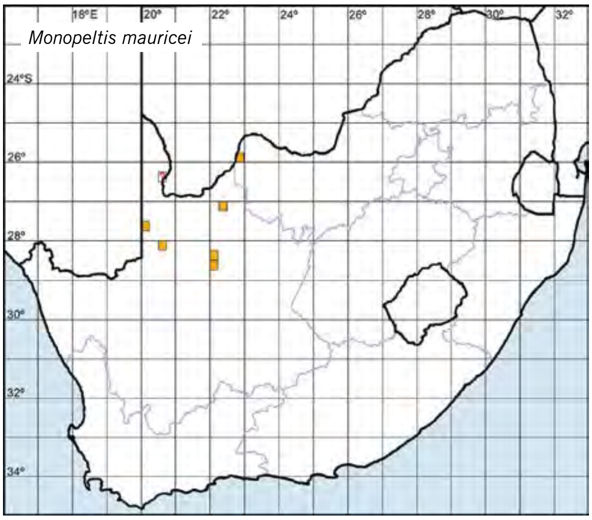
Distribution: Occurs in the Kalahari Desert, throughout much of Botswana and into adjacent Namibia and Angola in the west, Zambia and western Zimbabwe in the north (Broadley *et al.* 1976) and into the Northern Cape (north of the Orange River) and North-West provinces of South Africa (Bates *et al.* 2010). A specimen from Kgalagadi Transfrontier Park in the Northern Cape was tentatively referred to *M. sphenorhynchus* by Bates *et al.* (2010), but its status is uncertain and it is plotted here as a question mark.

Habitat: A fossorial species that digs deep burrows in sparsely-vegetated Kalahari sands.

Bioregion: Eastern Kalahari Bushveld; Kalahari Duneveld; Bushmanland.

Assessment rationale: Widespread in habitats that remain largely intact and not degraded by either human settlement or agriculture.

Conservation measures: None recommended.



Monopeltis mauricei—Tswalu Kalahari Reserve, near Kuruman, NC
G. van Dyk

Monopeltis sphenorhynchus Peters, 1879

SLENDER WORM LIZARD;
SLENDER SPADE-SNOUTED WORM LIZARD

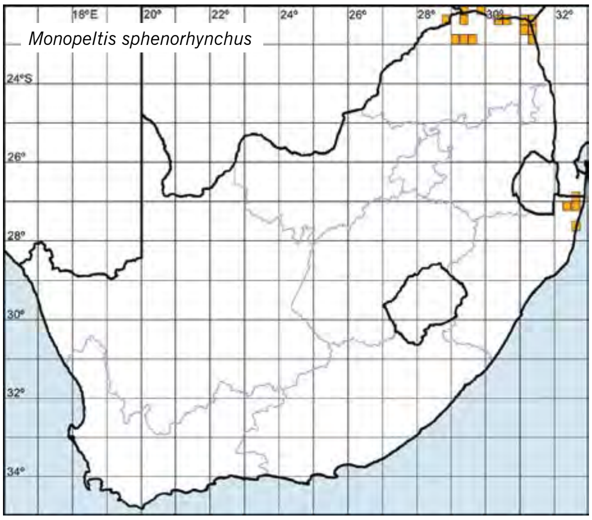
G. John Measey

Regional: Least Concern

Taxonomy: *Monopeltis mauricei* was previously considered to be a subspecies of *M. sphenorhynchus* (Broadley *et al.* 1976) but was raised to specific status by Broadley (2001a). A specimen from Kgalagadi Transfrontier Park in the Northern Cape was tentatively referred to *M. sphenorhynchus* by Bates *et al.* (2010) but its identification is uncertain.

Distribution: Endemic to southern Africa. Two disjunct populations are known, one in northern KwaZulu-Natal and coastal southern Mozambique, and another in Limpopo (Branch 1998) and southeastern Botswana (Broadley 2001a). These may be contiguous through the poorly-surveyed regions of southern Mozambique. The species may also occur in southern Zimbabwe.

Monopeltis sphenorhynchus—Venetia Limpopo NR, LIMP M. Burger



Habitat: Fossorial. Usually found in deep sand from near sea level to at least 800 m (Jacobsen 1989).

Bioregion: Mopane; Lowveld; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common.

Conservation measures: Gain a better understanding of the distribution of this species; this will benefit future assessments.

Genus *Zygaspis* Cope, 1885—purple round-headed worm lizards

Zygaspis is a small genus of seven species distributed in central and southern Africa (Broadley & Broadley 1997). Two species occur in the northern and northeastern parts of the *Atlas* region, but neither is of immediate conservation concern. The two subspecies of *Z. vandami* were evaluated together as a single entity, but if *Z. v. arenicola* proves to be a valid species, the status of the two taxa should be re-assessed because their ranges are relatively restricted. These small amphisbaenians live in sandy soils where they feed on termites and other invertebrate prey and lay small clutches of elongate eggs (Webb *et al.* 2000a). Threats are poorly understood, but may include soil compaction and reduction in leaf litter (Measey *et al.* 2009).

Zygaspis quadrifrons (Peters, 1862)

KALAHARI DWARF WORM LIZARD; KALAHARI ROUND-HEADED WORM LIZARD

G. John Measey

Regional: Least Concern

Taxonomy: No notable issues.

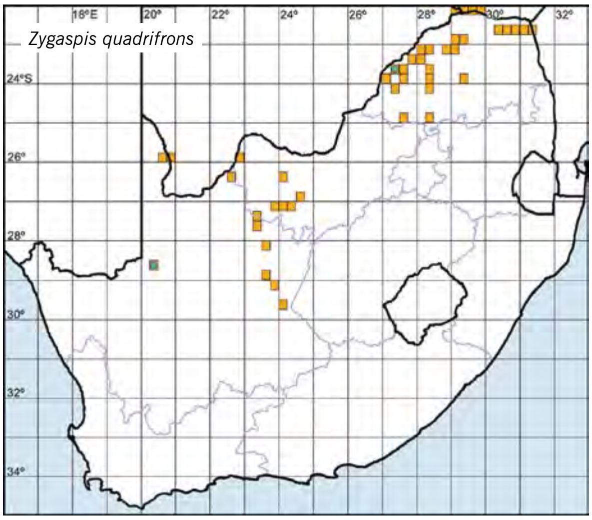
Distribution: This is the most widely distributed species of *Zygaspis*, occurring from northern South Africa through Namibia, Botswana, southern Angola, Zimbabwe, Zambia, southern Democratic Republic of the Congo, southern Malawi and Mozambique (Saiff 1970; Broadley & Broadley 1997). It is on the periphery of its range in the *Atlas* region where it occurs in Limpopo, the western parts of North-West Province, and the northern half of Northern Cape.

Habitat: In Limpopo it is found in deep Kalahari sands and in loamy as well as clayey soil; usually under stones or rotting logs, on or slightly below the soil surface, at altitudes of 250–1 200 m (Jacobsen 1989). Populations in Limpopo are found mainly in Mopane (*Colophospermum mopane*) woodland and bushveld on a granite substrate, extending into Waterberg sandstone; populations in North-West Province and the Northern Cape are found in Kalahari sands (Broadley & Broadley 1997). Individuals from the Northern Cape were found basking under neighbouring stones to those with *Monopeltis capensis* (Conradie *et al.* 2011).

Biome: Savanna; Nama-Karoo (marginal).

Assessment rationale: Widespread.

Conservation measures: None recommended.



Zygaspis quadrifrons—Caprivi, Namibia W.R. Branch

Zygaspis vandami (FitzSimons, 1930)
VAN DAM'S DWARF WORM LIZARD

G. John Measey

Global: Least Concern

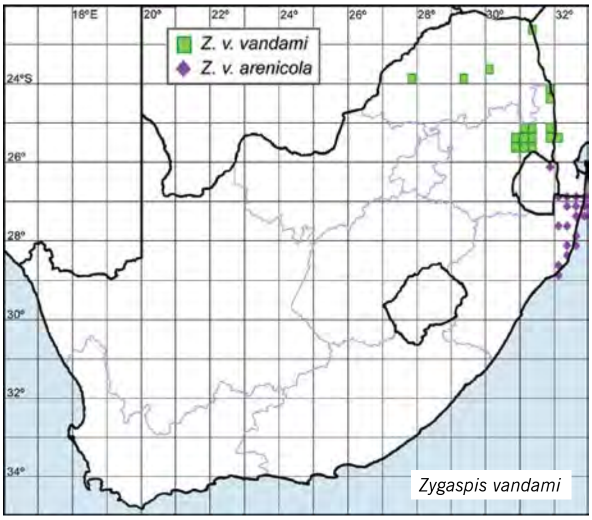
Taxonomy: Broadley & Broadley (1997) recognised two subspecies, namely *Zygaspis vandami vandami* and *Z. v. arenicola*, differing only with regard to the number of postoculars and the fusion of temporal head shields. Gans (2005) recognised these as separate species, although no taxonomic reasons were given. The taxonomic status of these taxa should be clarified, preferably through a combination of morphological and genetic techniques. Here they are treated together because their ranges appear to be contiguous.

Distribution: Endemic to southern Africa. *Zygaspis v. vandami* is probably endemic to South Africa but may also occur in adjacent parts of Mozambique and Swaziland. It has been recorded from Limpopo and northeastern Mpumalanga (Jacobsen 1989, as *Z. violacea*; Broadley & Broadley 1997). *Zygaspis v. arenicola* occurs in northeastern KwaZulu-Natal, northeastern Swaziland, southern Mozambique and southeastern Zimbabwe (Broadley & Broadley 1997; Litschka *et al.* 2008; Bates & Maguire 2009). Of particular interest are the isolated records in central and western Limpopo, which deserve closer attention. The most westerly locality (2327DD) is represented by a VM record and requires confirmation as it lies within the range of *Z. quadrifrons* (see Broadley & Broadley 1997).

Habitat: Fossorial. The two subspecies are found in different substrates and this may account for their morphological variation. *Zygaspis v. vandami* is found in shallow soils of minimum development, whereas *Z. v. arenicola* is found mostly in coastal sandy soils. They inhabit areas where leaf litter is densely aggregated, with commensurate high macro-invertebrate density (Measey *et al.* 2009). *Zygaspis v. vandami* is found under stones or logs on sandy or loamy humus-rich soils along the eastern escarpment (Jacobsen 1989; Broadley & Broadley 1997). This substrate is mostly granite, but rhyolite occurs in the Lebombo Range along the border with Mozambique. *Zygaspis v. arenicola* occurs in alluvial sands on the Mozambique plain (Broadley & Broadley 1997).

Bioregion: Lowveld; Indian Ocean Coastal Belt; Central Bushveld.

Assessment rationale: Despite a continuing decline in area, extent and quality of habitat, and a restricted number of locations (<10), this species has a large geographical range and is thus not regarded as threatened. However, if *Z. v. arenicola* is found to be a valid species, then the two taxa will need to be re-assessed and both may qualify as Near Threatened or Vulnerable. *Zygaspis v. arenicola* would be at risk because of its small EOO and the ongoing change in human land use and management in the areas where it occurs (Measey *et al.* 2009).



Conservation measures: Little is known of normal population sizes and densities for this or any other amphisbaenian species. Such studies are urgently required, especially in KwaZulu-Natal and Mpumalanga, where much land is under management for game or is being transformed for agriculture and forestry. A PHVA would be useful in this respect.

Zygaspis vandami vandami—Nelspruit, MPM D. Pietersen

Zygaspis vandami vandami—Farm De Hoop, SE of Nelspruit, MPM (TM 59091) W.R. Schmidt

Zygaspis vandami arenicola—Kosi Bay, KZN J. Marais

CHAPTER 11

Family Lacertidae

Andrew A. Turner, Marius Burger, Michael F. Bates, Michael J. Cunningham & *James Harvey*

The Lacertidae comprises the typical lizards, a large group currently represented by 42 genera and 309 species (Uetz 2012; Edwards *et al.* 2013a) found throughout Africa and Eurasia. Some relationships within the family are not resolved but the members of this family are universally considered to form a clade consisting of three well-resolved subfamilies, of which only the Eremiadinae occurs in southern Africa (e.g. Harris *et al.* 1998; Mayer & Pavlicev 2007; Pavlicev & Mayer 2009; Hipsley *et al.* 2011). In the *Atlas* region there are eight genera and 26 species (one with two subspecies, another with three subspecies) (Branch 1998; Edwards *et al.* 2013a), but a few additional species in South Africa have yet to be described (e.g. Makokha *et al.* 2007; M.J. Cunningham unpubl. data). Lacertids occupy a wide range of ecological niches, and occur in a wide variety of habitats, from deserts to tropical forests. These lizards are found throughout the *Atlas* region but are most diverse in the arid western parts.

All southern African lacertids are diurnal and oviparous, and most species actively forage for small insects (Branch 1998; Kirchoff *et al.* 2010; Van der Meer *et al.* 2010). At least one *Nucras* species, *N. tesellata*, is known to dig up and eat scorpions (Pianka *et al.* 1979). Most African species are small, with a snout–vent length seldom exceeding 100 mm, although their tails may be up to twice that length. Some species exhibit sexual dichromatism.

Most lacertids have large ranges and are often common. The majority of species are not unduly affected by agricultural practices, but are negatively impacted by urban and industrial development. Three species (*Vhembelacerta rupicola*, *Nucras taeniolata*, *Tropidosaura cottrelli*) in the *Atlas* region are classified as Near Threatened, mainly due to habitat transformation (e.g. croplands, stock farming, afforestation). The poorly known *Nucras caesicaudata* just enters the *Atlas* region in the northeast and was not assessed (IUCN category Not Applicable). *Australolacerta australis* was classified as Restricted in the last Red Data Book and *Nucras lalandii* was treated as regionally Near Threatened in the Swaziland Red Data Book, but both species are here classified as globally Least Concern.

Genus *Australolacerta* Arnold, 1989—Southern rock lizards

Australolacerta contains a single species, *A. australis,* endemic to the Western Cape, South Africa. Salvi *et al.* (2011) found that *A. australis* was part of the southern African branch of the tribe Eremiadini, which includes *Tropidosaura*, *Meroles* and *Pedioplanis*. A recent analysis of mitochondrial and nuclear DNA sequences indicated that *A. rupicola* is not closely related to *A. australis* (which is more closely related to *Tropidosaura*—see also Salvi *et al.* 2011) and it was placed in a separate genus, *Vhembelacerta* (Edwards *et al.* 2012, 2013a). Female *A. australis* lay clutches of up to seven eggs (Branch 1998). This species occurs in several protected areas and is considered to be of Least Concern.

Australolacerta australis (Hewitt, 1926)

SOUTHERN ROCK LIZARD

Andrew A. Turner

Global: Least Concern

Endemic

Taxonomy: No notable issues.

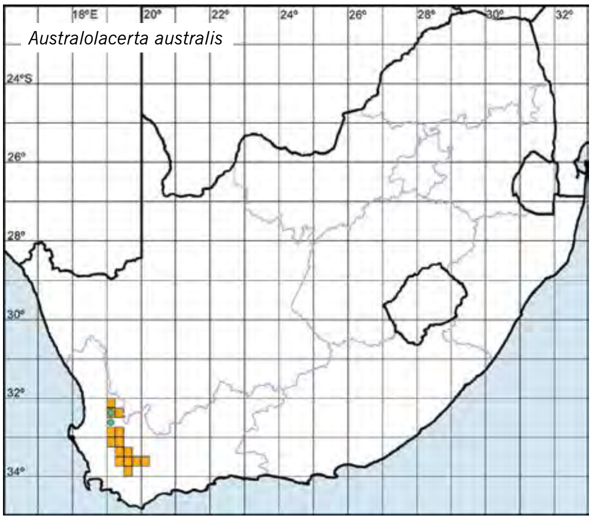
Distribution: This montane species is endemic to the Western Cape, South Africa, occurring from the northern Cederberg in the north to the Hex River Mountains in the south, and eastwards to Kwadouwsberg (Mouton 1988b; Branch 1998). The eastern limits on the Langeberg have not yet been determined.

Habitat: Found in fynbos on the rocky mountain slopes of the Cape Fold Mountains, often near moisture. Prefers large exposed rock such as cliff faces and rock slabs on sandstone outcrops (Branch 1998).

Bioregion: Northwest Fynbos, Southern Fynbos, Western Fynbos-Renosterveld, Southwest Fynbos.

Assessment rationale: Recent surveys in the Cape Fold Mountains indicate that this species is widespread and reasonably common (M.J. Cunningham pers. comm.). It occupies rugged, rocky areas that provide shelter from fire and minimise direct anthropogenic threats. Much of its range is protected.

Conservation measures: Given the extensive protection already afforded to this species, no conservation actions are recommended.



Australolacerta australis—Heuningvlei, Cederberg Wilderness Area, WC
P. le F.N. Mouton

Genus *Heliobolus* Fitzinger, 1843—bushveld lizards

The genus *Heliobolus* contains four species widely distributed in Africa (Uetz 2012). Together with *Nucras*, *Heliobolus* is the sister clade to *Pseuderemias* (Mayer & Pavlicev 2007). The only representative in the *Atlas* region is *Heliobolus lugubris*, which is widespread in central southern Africa. These lizards prefer open, sandy habitats. Females of this species lay clutches of 4–6 eggs in a self-excavated hole (Branch 1998). Hatchlings mimic the 'oogpister' or predacious ground beetle (*Anthia*) and this probably provides some protection from predators (Huey & Pianka 1977a; Schmidt 2004). These lizards may be locally abundant and apparently are not especially threatened by cattle farming, the main human activity in their habitat.

Heliobolus lugubris (A. Smith, 1838)

BUSHVELD LIZARD

Andrew A. Turner

Regional: Least Concern

Taxonomy: No notable issues.

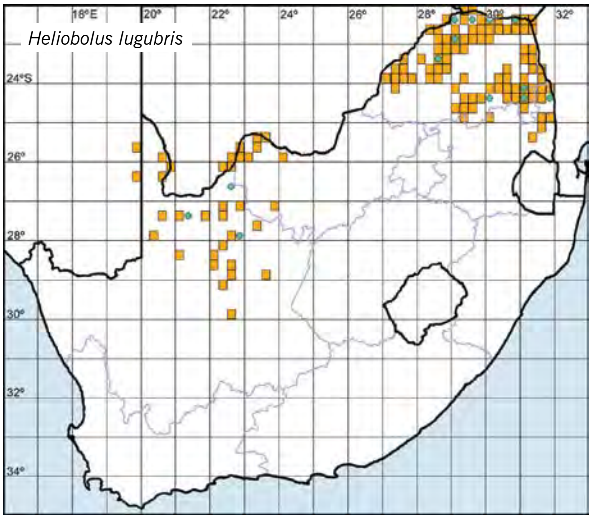
Distribution: Very widely distributed, from southern Angola over the Kalahari sands through Namibia, Botswana, south-western Zimbabwe, southern Mozambique and South Africa (Branch 1998). In the *Atlas* region it occurs in Limpopo, northern Mpumalanga, the western part of North-West Province and and the northern parts of Northern Cape.

Habitat: Occupies hot, low-lying savanna, often overlying Kalahari sands.

Biome: Savanna; Nama-Karoo.

Assessment rationale: Widely distributed and not known to be negatively impacted by the livestock grazing that commonly takes place in its habitat. Occurs in a number of large protected areas.

Conservation measures: None recommended.



Heliobolus lugubris, adult—Farm Good Hope, 30 km SW of Prieska, NC M. Burger

Heliobolus lugubris, juvenile—Greater Kuduland Safaris, E of Tshipise, LIMP M. Burger

Genus *Ichnotropis* Peters, 1854—rough-scaled sand lizards

Ichnotropis is a small genus of subtropical lizards occurring in mesic to arid savanna. The genus is endemic to Africa, but only one of its six species (Uetz 2012), namely *I. capensis*, occurs in the *Atlas* region. This species has a large range and may be locally abundant. *Ichnotropis* is the sister taxon to *Meroles* (Mayer & Pavlicev 2007). *Ichnotropis capensis* and *Meroles squamulosus* (until recently contained in the genus *Ichnotropis*—see Edwards *et al.* 2012, 2013a and Engleder *et al.* 2013) are sympatric in large parts of their ranges and their life cycles are staggered so that juveniles and adults of the two species are present at different times of the year (Broadley 1979). These two species are regarded as 'annuals' as they mature quickly (5–8 months), live for less than a year, and die soon after breeding (females lay one or two clutches of 3–12 eggs) (Branch 1998). *Ichnotropis capensis* is not known to be threatened, except by urbanisation, and is classified as Least Concern.

Ichnotropis capensis (A. Smith, 1838)

ORNATE ROUGH-SCALED LIZARD;
CAPE ROUGH-SCALED LIZARD

Andrew A. Turner

Global: Least Concern

Taxonomy: The status of the isolated population of this species in Maputaland and adjacent southern Mozambique should be assessed.

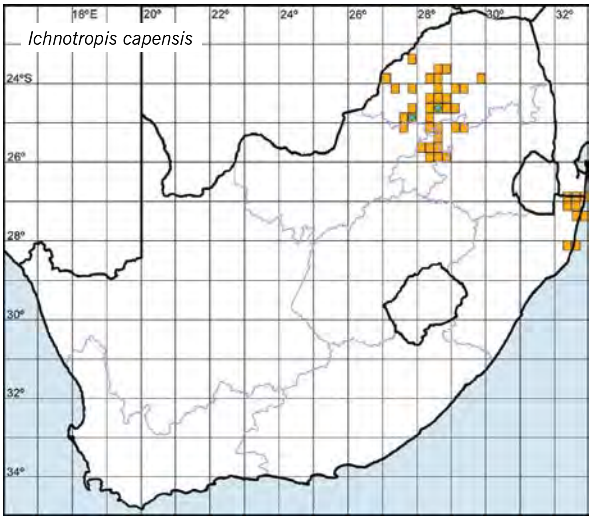
Distribution: Endemic to the southern half of Africa. Found from Angola and Zambia south and east across the Kalahari sands through Namibia, Botswana, Zimbabwe, Limpopo, northern Gauteng and adjacent western Mpumalanga. Also occurs in Maputaland, the KwaZulu-Natal coast and southern Mozambique (FitzSimons 1943; Branch 1998).

Habitat: Inhabits hot sandy areas with open vegetation separated by patches of bare soil.

Biome: Savanna.

Assessment rationale: Has a wide distribution and occurs in several large protected areas. Apart from the negative effects on its habitat by urbanisation in a few areas, there are no serious known threats.

Conservation measures: None recommended.



Ichnotropis capensis—Caprivi Strip, Namibia W.R. Branch

Genus *Meroles* Gray, 1838—desert and savanna lizards

The genus *Meroles* contains eight species that occur mainly in extremely arid environments in the western parts of southern Africa (see Uetz 2012). The centre of diversity is Namibia, but the ranges of four species extend into the western part of the *Atlas* region, while *M. squamulosus* has a large range elsewhere in the southern and south-eastern parts of Africa. These lizards have been the subject of recent phylogenetic research and the taxonomy of most species is well-resolved (Lamb & Bauer 2003; Edwards *et al.* 2012; Engleder *et al.* 2013). *Ichnotropis squamulosa* was recently transferred to this genus (Edwards et al. 2012, 2013a; Engleder *et al.* 2013). Clutch size in the *Atlas* region varies from two to eight eggs, but as many as 12 eggs may be laid by *M. squamulosus* (Branch 1998). There are no endemic species in the *Atlas* region. These lizards generally occupy very large ranges and occur in areas that are sparsely inhabited by humans, and therefore they are probably not threatened by anthropogenic activities.

Meroles ctenodactylus (A. Smith, 1838)

GIANT DESERT LIZARD; SMITH'S DESERT LIZARD

Andrew A. Turner

Regional: Least Concern

Taxonomy: No notable issues.

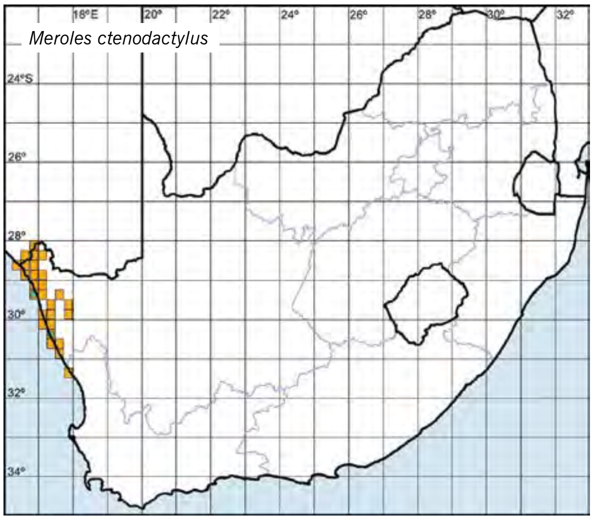
Distribution: Distributed from Sossusvlei in southern Namibia, southwards along the West Coast of South Africa in the Northern Cape, to Brand se Baai in the upper Western Cape (Branch 1998; Branch 2013). In the *Atlas* region its range extends inland as far as Okiep.

Habitat: Inhabits sparsely vegetated areas with loose sand (Branch 1998). Recorded from well-vegetated dune slacks and dune hummocks at Sossusvlei (Branch 2013).

Bioregion: Namaqualand Sandveld; Richtersveld; Namaqualand Hardeveld; Northwest Fynbos; Southern Namib Desert; Inland Saline Vegetation.

Assessment rationale: Occurs over a large area that is sparsely occupied by humans. No known threats.

Conservation measures: None recommended.



Meroles ctenodactylus—N of Alexander Bay, Richtersveld, NC J. Marais

Meroles cuneirostris (Strauch, 1867)

WEDGE-SNOUTED DESERT LIZARD

Andrew A. Turner

Regional: Least Concern

Taxonomy: No notable issues.

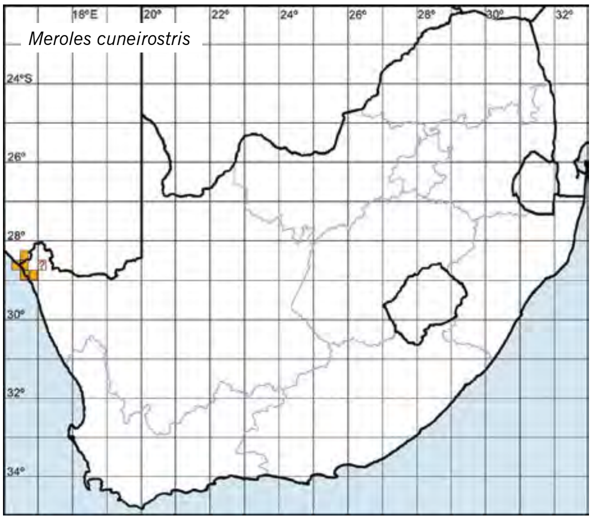
Distribution: Occurs throughout most of the southern Namib Desert of Namibia south of Walvis Bay, just entering South Africa along the sandy southern banks of the Orange River (Branch 1998). A QDGC record at the eastern edge of the range is considered questionable as it is not located in typical sandy habitat.

Habitat: Found in sparsely vegetated desert and on coastal dunes, especially those with loose sand (Branch 1998).

Bioregion: Southern Namib Desert; Namaqualand Sandveld.

Assessment rationale: Occurs peripherally in South Africa, where its distribution is restricted and EOO (109 km²) and AOO (94 km²) are below the Endangered thresholds. Local populations are threatened by land-use changes (agricultural activities on the banks of the Orange River have negatively impacted much of the loose, sandy habitat that this species requires; Bauer & Branch 2003 [2001]) and there is a continuing decline in area and quality of habitat [B1+2b(iii)], indicating Near Threatened status. However, immigration from outside the *Atlas* region is almost certain and therefore this regional assessment is downgraded to Least Concern.

Conservation measures: Survey suitable habitat south of the Orange River to assess the status of South African populations.



Meroles cuneirostris, adult—Sossusvlei, Namibia W.R. Branch

Meroles knoxii (Milne-Edwards, 1829)

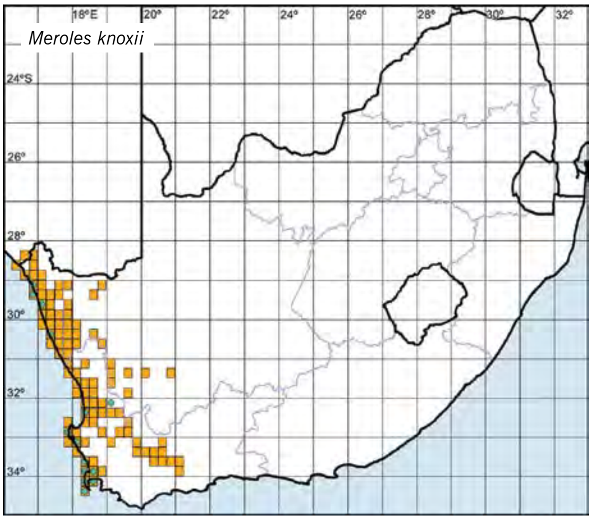
KNOX'S DESERT LIZARD

Andrew A. Turner

Global: Least Concern

Taxonomy: Previously, two subspecies were recognised, namely *Meroles knoxii knoxii* from south of the Orange River in the Northern Cape, and *M. k. pequensis* from north of the Orange River in Namibia. Although no longer regarded as valid, the status of *M. k. pequensis* should be re-assessed because of notable differences in body size and egg clutch size across the north–south extent of the species' range (Branch 1998). A review of the taxonomic status of the latter subspecies is currently being conducted by A.M. Bauer & T. Jackman (in prep.). In addition, Little Karoo populations may have diverged from western populations (Branch *et al.* 2006a).

Meroles knoxii—Port Nolloth, NC G.J. Alexander



Distribution: Occurs from southwestern Namibia in the north, southwards along the West Coast of the Northern and Western Cape to the Cape Peninsula, and inland through the Cederberg Mountains and Tankwa Karoo to the western Little Karoo (Branch 1998).

Habitat: Found in dry areas with sparse vegetation, mostly on sandy soils (Branch 1998).

Biome: Succulent Karoo; Fynbos; Nama-Karoo; Desert.

Assessment rationale: Widely distributed and often very abundant, particularly near the coast. Tolerates grazing herbivores and is not known to be threatened by human activities. The conservation assessment presented here is likely to be appropriate even if the species is separated into two or three taxa as mentioned above, because limited ranges, small populations and serious threats are unlikely to apply.

Conservation measures: None recommended.

Meroles squamulosus (Peters, 1854)

SAVANNA LIZARD;
COMMON ROUGH-SCALED LIZARD

Andrew A. Turner

Global: Least Concern

Taxonomy: A recent analysis using mitochondrial and nuclear sequence data showed that this species, long known by the name *Ichnotropis squamulosa*, should be transferred to the genus *Meroles* (Edwards *et al.* 2012, 2013a; Engleder *et al.* 2013).

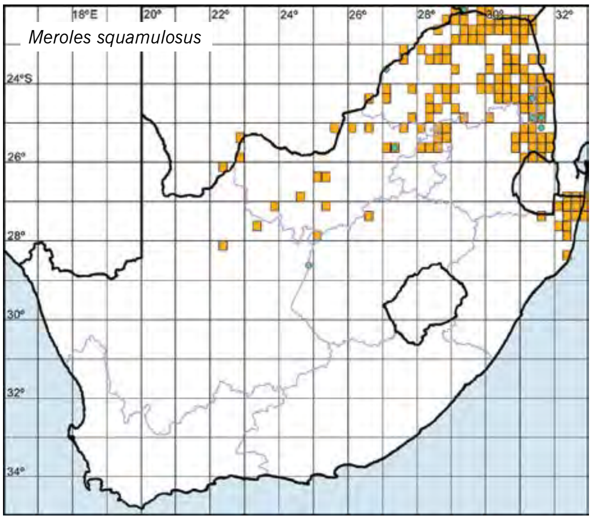
Distribution: Endemic to the southern half of Africa. Found from Angola and Tanzania southwards through Zimbabwe, central Mozambique, Botswana, eastern Namibia, and the northern and northeastern parts of the *Atlas* region (Branch 1998; Spawls *et al.* 2002). In the *Atlas* region it is found in Limpopo, northern Gauteng, northern Mpumalanga, northeastern KwaZulu-Natal, North-West Province, northwestern Free State and the northeastern parts of the Northern Cape. A Virtual Museum record at 2824DB is the southernmost record for the species.

Habitat: Occurs on sandy soils in both mesic and arid savanna (Branch 1998).

Biome: Savanna; Indean Ocean Coastal Belt; Grassland (marginal).

Assessment rationale: Occurs over a very large area and is abundant in places. No known threats.

Conservation measures: None recommended.



Meroles squamulosus—Greater Kuduland Safaris, E of Tshipise, LIMP
M. Burger

Meroles squamulosus—Greater Kuduland Safaris, E of Tshipise, LIMP
M. Burger

Meroles suborbitalis (Peters, 1869)
SPOTTED DESERT LIZARD

Andrew A. Turner

Regional: Least Concern

Taxonomy: A very variable, widely distributed species. The possibility of significant population structuring and the presence of cryptic species should be investigated, particularly in the vicinity of the lower Orange River (Bauer & Branch 2003 [2001]; Branch *et al.* 2006a).

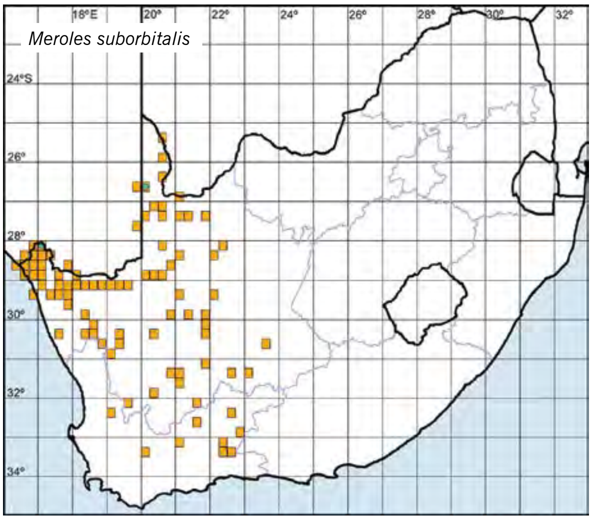
Distribution: Widely distributed from north-central Namibia to the Tankwa Karoo in the south, and eastwards to the southeastern Great Karoo (Branch 1998). In the *Atlas* region it occurs in the Northern and Western Cape provinces.

Habitat: Occupies open, sparsely-vegetated areas in desert and semi-desert (Branch 1998).

Biome: Succulent Karoo; Nama-Karoo; Desert; Savanna; Fynbos.

Assessment rationale: Widely distributed and fairly abundant in many parts. No known threats.

Conservation measures: None recommended.



Meroles suborbitalis—Farm Eselkopvlakte, WNW of Loeriesfontein, NC
M. Burger

Genus *Nucras* Gray, 1838—sandveld lizards

The genus *Nucras* contains 10 species primarily restricted to southern Africa but extending into central and eastern Africa (Branch 1998; Spawls *et al.* 2002). Eight species occur in the *Atlas* region and three of these (*N. lalandii*, *N. livida*, *N. taeniolata*) are endemic. Another potential undescribed species, also endemic to the *Atlas* region, is currently being investigated (A.M. Bauer in prep.). *Nucras* appears to be the sister taxon to *Heliobolus* (Makokha *et al.* 2007). Members of this genus are found in savanna and grassland where they are diurnal, terrestrial, active hunters that feed primarily on invertebrates (Van der Meer *et al.* 2010). Females lay 2–9 eggs in summer (Branch 1998). *Nucras caesicaudata* was previously listed as 'Peripheral' (Branch 1988a) but is here considered Not Applicable as there are too few records in the region to allow for a proper assessment. *Nucras taeniolata* is now classified as Near Threatened as a result of its restricted range in combination with habitat destruction and degradation.

Nucras caesicaudata Broadley, 1972

BLUE-TAILED SANDVELD LIZARD

Marius Burger

Not Applicable

Taxonomy: There are no alpha-level taxonomic issues, but the phylogenetic position of the species within *Nucras* requires investigation.

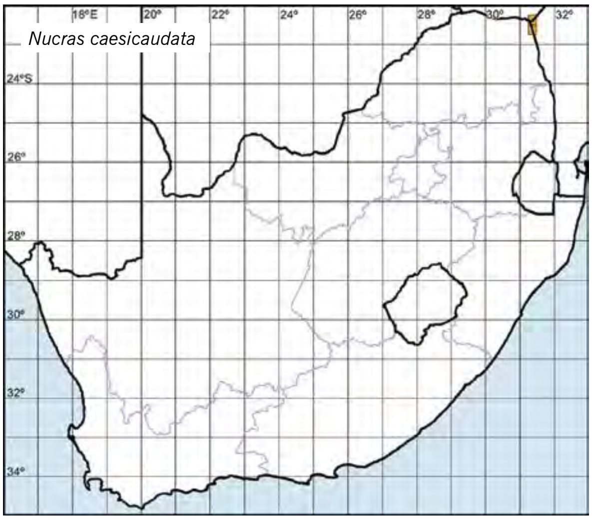
Distribution: This species occurs peripherally in South Africa, where it is confined to the extreme northeastern limits of the Kruger National Park in Limpopo Province. Elsewhere it occurs in the plains of southern Mozambique and in southeastern Zimbabwe (Broadley 1972; Jacobsen 1988d, 1989; Branch 1998). Recently recorded as far east as the San Sebastian Peninsula in southern Mozambique (Jacobsen *et al.* 2010). The global distribution suggests four disjunct populations, but this may be an artefact of under-sampling.

Habitat: A terrestrial species recorded amongst clumps of *Hyphaene* palms on the edge of pans where these merge into *Terminalia* savanna (Broadley 1972). Found below 100 m in Miombo woodland in the San Sebastian Peninsula (Jacobsen *et al.* 2010). Limited ecological information is currently available but the species appears to be associated with deep sands. The altitude of the South African records is around 300 m and the type locality in Zimbabwe is at 425 m (Broadley 1972; Pienaar *et al.* 1983; Jacobsen 1989).

Bioregion: Mopane.

Assessment rationale: The range within the *Atlas* region (where it is known from only two QDGCs) is less than 5% of the global range, and therefore this species was not assessed.

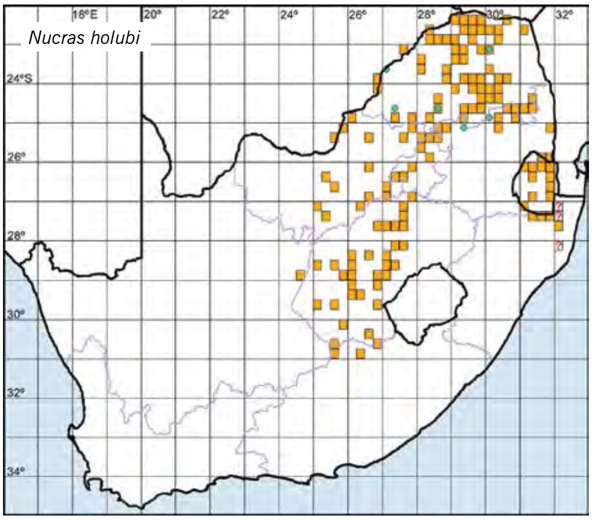
Conservation measures: Conduct surveys of known localities and areas of potential occurrence in order to gain insight into basic ecology and population dynamics, and especially to assess the types and extent of threats. Determine the current status of the Kruger National Park population and assess the impacts of environmental management regimes there.



Nucras caesicaudata—Wambia Sandveld, Kruger NP, LIMP W.D. Haacke

Nucras holubi (Steindachner, 1882)
HOLUB'S SANDVELD LIZARD

Marius Burger



Nucras holubi—Greater Kuduland Safaris, E of Tshipise, LIMP M. Burger

Regional: Least Concern

Taxonomy: In his assessment of the *Nucras tessellata* complex, Broadley (1972) treated *Nucras* (as *Eremias*) *holubi* as a junior synonym of *N. taeniolata ornata* and considered it a variety or morph of the latter. Jacobsen (1989) presented morphological characters to distinguish between the *holubi* and *ornata* morphs of *N. taeniolata* in the northern parts of South Africa. He treated *N. t. holubi* as a valid taxon and considered the *ornata* morph a full species. Bates (1996a) presented additional diagnostic morphological characters which, together with a pronounced geographical range separation between *N. t. taeniolata* in the Eastern Cape and *N. t. holubi*, he regarded as justification for full species status for the latter. A molecular phylogeny of *Nucras* confirmed the species status of *N. holubi*, which is most closely related to the sister species pairing of *N. intertexta* and *N. ornata* (Edwards *et al.* 2013b). The status of the seemingly disjunct Namibian population of *N. holubi* requires investigation.

Distribution: The exact limits of the distribution are uncertain but the species apparently occurs in two disjunct nodes. The first is comprised of the central and northeastern regions of South Africa, i.e. parts of the Northern and Eastern Cape, Free State, North-West Province, Gauteng, Mpumalanga, Limpopo and northern KwaZulu-Natal, as well as Swaziland, Botswana, Zimbabwe, southern Malawi and possibly Mozambique, while the second node appears to be restricted to northeastern Namibia (De Waal 1978; Branch 1998; Jacobsen 1989; Bourquin 2004). Some records from Swaziland (e.g. 2631BA, BB, AD, CD) require confirmation (Boycott 1992a,b), and records east of 32°E in KwaZulu-Natal may be referable to *N. ornata*.

Habitat: A terrestrial species with a wide habitat tolerance, generally associated with broken rocky terrain in mesic savanna in the north and open sandy flats in the south. As is typical for most sandveld lizards, this species also shelters in burrows in the ground or under rocks. The altitudinal range in the *Atlas* region is 150–1 500 m (De Waal 1978; Jacobsen 1989; Branch 1998; Bourquin 2004). Also found in open grassland in the Free State (Bates 1992).

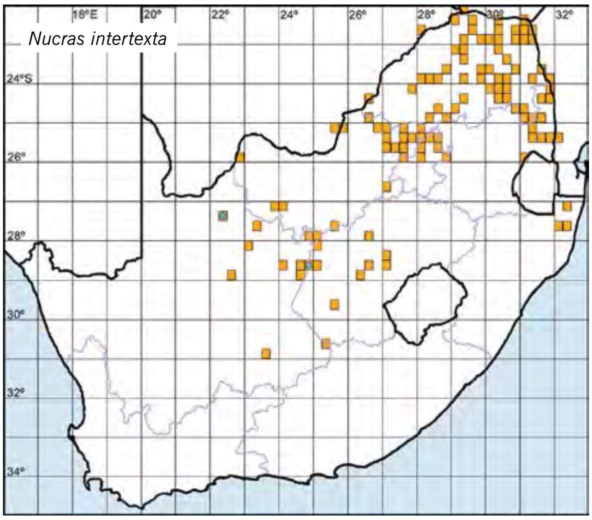
Biome: Savanna; Grassland; Nama-Karoo.

Assessment rationale: Widespread and common. Threats in its range are not considered to be significant.

Conservation measures: None recommended.

Nucras intertexta (A. Smith, 1838)
SPOTTED SANDVELD LIZARD

Marius Burger



Regional: Least Concern

Taxonomy: Previous assessments of the *Nucras tessellata* complex, which includes *N. intertexta*, presented various morphological characters to distinguish between the taxa (Broadley 1972; Jacobsen 1989; Bates 1996a). A molecular phylogeny of *Nucras* confirmed the species status of *N. intertexta*, which is the sister species of *N. ornata* (Edwards *et al.* 2013b).

Distribution: Due to the taxonomic confusion regarding the *N. tessellata* complex, our understanding of the distribution of *N. intertexta* is inadequate. The distribution map approximates the appraisal of Broadley (1972) but was amended according to the subsequent assessments of Jacobsen (1989), Bates (1996a) and Bourquin (2004), with the addition of new records. Globally, the species occurs in Namibia, Botswana, southern Zimbabwe, southern Mozambique and South Africa (Branch 1998). Within the *Atlas* region it is distributed in the central (Free State, Northern Cape, North-West Province) and northeastern (Limpopo, Mpumalanga, Gauteng) parts, with an isolated population in northeastern KwaZulu-Natal. It may also occur in Swaziland.

Habitat: A terrestrial species associated with sandy substrates, usually Kalahari sands, in relatively arid savanna and open scrubland. The altitudinal range in the *Atlas* region is 300–1 400 m (Jacobsen 1989; Branch 1998; Bourquin 2004).

Biome: Savanna; Grassland; Nama-Karoo.

Assessment rationale: Common and widely distributed in the *Atlas* region, extending into several other countries to the north.

Conservation measures: None recommended.

Nucras intertexta, adult—Farm Blackridge, NE of Groblershoop, NC M. Burger

Nucras intertexta, juvenile—Skukuza, Kruger NP, MPM G.J. Alexander

Nucras lalandii (Milne-Edwards, 1829)

DELALANDE'S SANDVELD LIZARD

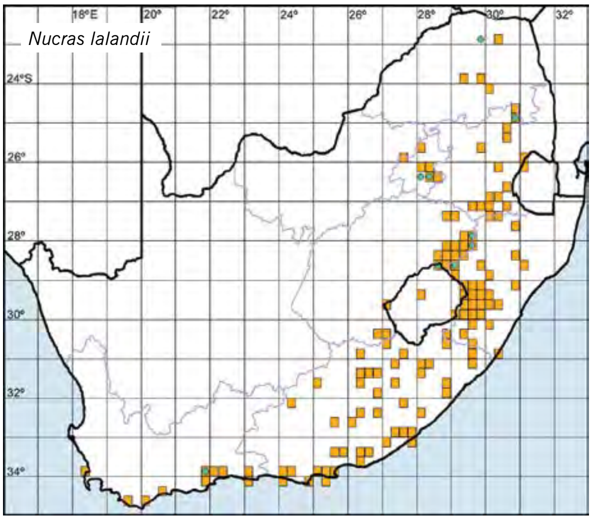
Marius Burger

Global: Least Concern

Endemic

Taxonomy: *Nucrus lalandi* is most closely related to *N. livida* and *N. tessellata* + *N. taeniolata* (Edwards *et al.* 2013b). A molecular investigation covering the large range of this species may reveal the existence of cryptic taxa.

Distribution: Endemic to the *Atlas* region where its range extends over the eastern and southern parts, from northern Limpopo southwards through Mpumalanga, Gauteng, KwaZulu-Natal, Eastern Cape, and into the Western Cape along the southern Cape coast to Cape Town (Jacobsen 1989; Branch 1998; Bourquin 2004). A few records are also known from the Free State, Swaziland and Lesotho (De Waal 1978; Boycott 1992a; Bates 1996a; Ambrose 2006).



Habitat: A terrestrial species generally associated with montane and temperate grassland. Also utilises coastal fynbos habitat in the southern Cape. As is typical for most sandveld lizards, it shelters in burrows in the ground or under rocks. Usually frequents high altitudes, e.g. 1 550–2 300 m in Limpopo and Mpumalanga, but occurs at lower elevations in KwaZulu-Natal and near sea level along the southern Cape coast (Jacobsen 1989; Branch 1998).

Biome: Grassland; Savanna; Albany Thicket; Fynbos; Nama-Karoo (marginal).

Assessment rationale: Widely distributed and relatively common throughout most of its range. None of the IUCN Red List Criteria for a threatened listing are met, but the extent of habitat loss, degradation and fragmentation due to afforestation, and increased burning in montane grass-

Nucras lalandii—Bushman's Nek, KZN W.R. Schmidt lands, are reasons for concern. These threats are continuing and may ultimately cause this species to become threatened in such areas.

Conservation measures: Protect substantial units of montane grassland habitat where the species occurs. Through legislation, regulate burning at unprotected grassland sites.

Nucras livida (A. Smith, 1838)

KAROO SANDVELD LIZARD

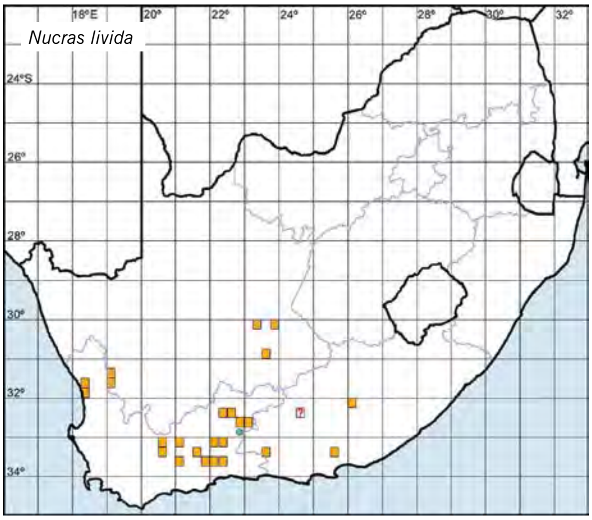
Marius Burger

Global: Least Concern

Endemic

Taxonomy: Previously treated as a subspecies of *Nucras tessellata* (Broadley 1972) but elevated to species rank by Branch & Bauer (1995). A molecular phylogeny of *Nucras* confirmed the species status of *N. livida*, which is most closely related to the sister grouping of *N. tessellata* and *N. taeniolata* (Edwards *et al.* 2013b). Nevertheless, a detailed molecular phylogeny of this species is still needed. The photograph at the bottom right represents the first record of blue hindlimbs in a juvenile of this species.

Distribution: Endemic to South Africa where it occurs primarily in karroid regions of the Western Cape, extending into the Eastern and Northern Cape provinces. The isolated records in the Nieuwoudtville and Vredendal areas (Du Toit & Alblas 2003), southeastern parts of the Northern Cape (Broadley 1972), Eastern Cape at Graaff-Reinet (3224BC, questionable as the specimen was not examined by Broadley 1972), Dunbrody (3325BC, Broadley 1972) and Commando Drift Nature Reserve (3226AA, Burger & Hahndiek 1993), should stimulate further investigation. An old record from Port Elizabeth (see Broadley 1972) is doubtful and was not plotted on the map, as this species has not been recorded from the area for over 50 years.



Habitat: Mainly associated with well-vegetated karroid sandy flats (Branch 1998) but also recorded from sandy soils of the Bokkeveld Group with thorny shrubs and scattered succulents (Du Toit & Alblas 2003).

Bioregion: Rainshadow Valley Karoo; Lower Karoo; Karoo Renosterveld; West Strandveld.

Assessment rationale: Common, with a fairly wide distribution in South Africa and no known significant threats.

Conservation measures: None recommended.

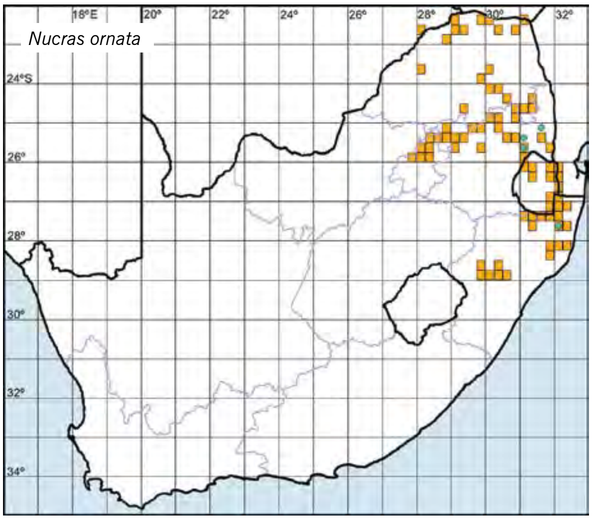
Nucras livida, adult—About 28 km SE of Britstown, NC M. Burger

Nucras livida, juvenile—Farm Tierberg, NE of Prince Albert, WC M. Burger

Nucras ornata (Gray, 1864)

ORNATE SANDVELD LIZARD

Marius Burger



Regional: Least Concern

Taxonomy: Previous assessments of the *Nucras tessellata* complex, which includes *N. ornata*, presented various morphological characters to distinguish between the taxa (Broadley 1972; Jacobsen 1989; Bates 1996a). Jacobsen (1989) presented morphological characters to distinguish between the *holubi* and *ornata* morphs of *N. taeniolata* in the northern parts of South Africa. He revived *N. t. holubi* as a valid taxon (later raised to species rank by Bates 1996a) and considered the *ornata* morph a full species. A molecular phylogeny of the genus *Nucras* confirmed the species status of *N. ornata*, which is the sister species of *N. intertexta*, but is also closely related to *N. holubi* (Edwards *et al.* 2013b).

Distribution: Extends from southern Zambia and Malawi, south through Zimbabwe into South Africa and Swaziland, with a few records from Mozambique (Broadley 1972; Jacobsen 1989). Namibian records plotted by Broadley (1972) are isolated and require further investigation. The boundaries of this species' distribution in the *Atlas* region have not been clearly established because of uncertainty about specimen identifications. Its distribution here is in the northeastern regions, primarily Limpopo, Gauteng, northern Mpumalanga (Jacobsen 1989), Swaziland (Boycott 1992) and KwaZulu-Natal (Bourquin 2004). Based on the assessment of Bates (1996a), records of *N. t. ornata* from the Free State and Northern Cape plotted by Broadley (1972) and Visser (1984f) are not plotted here because they are probably referable to *N. holubi* or *N. intertexta*.

Habitat: A terrestrial species that frequents grass tussocks and leaf litter on rocky hillsides in montane grassland and in mesic savanna. It often occupies burrows in the ground, including those under rocks. The altitudinal range in the *Atlas* region is from about 300 m in KwaZulu-Natal to about 1 700 m in the northern part of the range (Jacobsen 1989; Branch 1998; Bourquin 2004).

Nucras ornata—Manyiseni region, Lebombo Mtns, KZN M. Burger

Biome: Savanna; Grassland; Indian Ocean Coastal Belt.

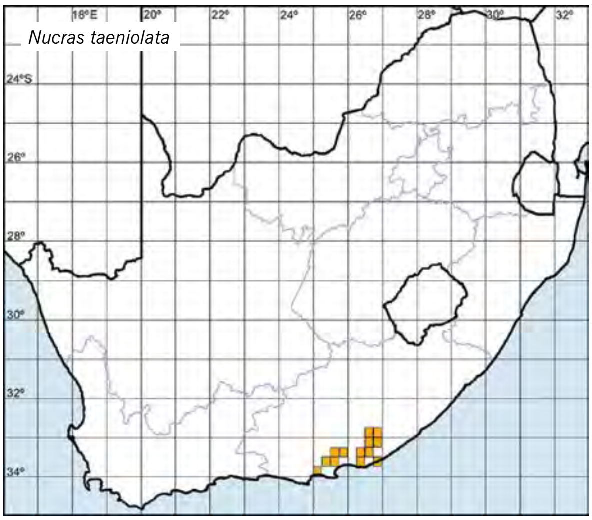
Assessment rationale: Common, with a relatively wide distribution in the *Atlas* region. The range extends into several other countries to the north.

Conservation measures: None recommended.

Nucras taeniolata (A. Smith, 1838)

ALBANY SANDVELD LIZARD; STRIPED SANDVELD LIZARD

Marius Burger



Global: Near Threatened

Endemic

Taxonomy: Taxonomy within the *Nucras tessellata* complex is unresolved. *Nucras taeniolata* is regarded as a monotypic species following the elevation of *N. ornata* and *N. holubi* to full species status (Jacobsen 1989; Bates 1996a). A molecular phylgeny of the genus *Nucras* confirmed the species status of *N. taeniolata*, which is the sister species of *N. tessellata* (Edwards *et al.* 2013b).

Distribution: An Eastern Cape endemic restricted to the Algoa Bay region. Distribution extends from the Double Drift Game Reserve in the north, southwards through the Albany district to just north of Port Elizabeth, and westwards through Addo Elephant National Park to Groendal

Wilderness Area (Branch & Burger 2009) and the Gamtoos Valley near Thornhill (Conradie 2012).

EOO: 9 602 km^2 (confidence: high); AOO: 3 987 km^2 (confidence: medium).

Habitat: Very little is known about the ecology of this seemingly rare lizard, with only 40 specimens known from museum collections (Branch & Burger 2009; Conradie 2012). It is terrestrial and has been observed on soft and hard soils and shale in mesic to arid environments, where it may burrow in at the base of bushes or shelter under rock slabs (Branch & Braack 1987; Fabricius *et al.* 2002). Altitude ranges from about 50 m near Port Alfred and Bushmans River to about 500 m in the Groendal and Zuurberg regions.

Vegetation type: AT 8 Kowie Thicket; AT 6 Sundays Thicket; SVs 7 Bhisho Thornveld; AT 11 Great Fish Thicket; AT 10 Great Fish Noorsveld; AT 7 Coega Bontveld; AT 9 Albany Coastal Belt.

Assessment rationale: Almost qualifies as Vulnerable based on EOO <20 000 km^2 [B1] and a continuing decline in AOO, extent/quality of habitat and number of mature individuals [B1b(ii,iii,v)]. The disconcerting current and predicted future extent of habitat transformation, degradation and fragmentation result primarily from agricultural, urban and industrial sprawl and may result in this species becoming more threatened. It is therefore of conservation concern and classified as Near Threatened.

Threats: Generally restricted to the Albany Thicket Biome, of which 7.3% is completely transformed and much of the remainder degraded. Only 11% of the untransformed area is still in pristine condition and 60% is severely degraded. The main causes of habitat transformation are bush clearing for livestock and crop cultivation, herbivory by livestock, urban residential and industrial developments, afforestation and alien plant infestations. These threats are on the increase, particularly the extent of coastal urbanisation and industrial development in the Coega region (Lloyd *et al.* 2002).

Nucras taeniolata—Amanzi, EC W.R. Branch

Conservation measures: *Nucras taeniolata* is well represented in several existing protected areas and a number of mega-conservancy networks, and park expansions are earmarked for the region in which it occurs (Hoare *et al.* 2006). The species is thus likely to maintain a viable long-term presence in spite of habitat transformation, but it should nevertheless be considered in the Environmental Impact Assessments of forthcoming development projects in the area.

Nucras tessellata (A. Smith, 1838)

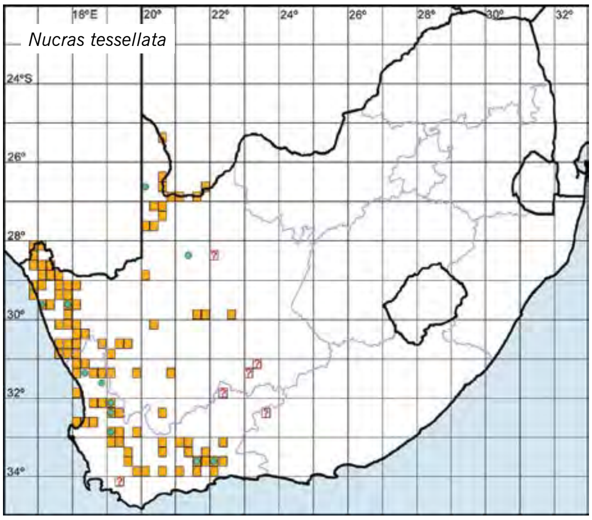
WESTERN SANDVELD LIZARD

Marius Burger

Global: Least Concern

Taxonomy: The *Nucras tessellata* complex was last revised by Broadley (1972), who recognised three subspecies (*N. t. tessellata*, *N. t. livida* and an unnamed subspecies of *N. tessellata*). Apart from typical *N. t. tessellata*, Broadley (1972) also recognised two varieties (*N. t. tessellata* var. *elegans* and *N. t. tessellata* var. 'T'). Although *N. t. livida* was subsequently elevated to species level (Branch & Bauer 1995), the taxonomic status of the two varieties and the unnamed subspecies remain unresolved. Although a molecular phylogeny of *Nucras* confirmed the species status of *N. tessellata*, which is the sister species of *N. taeniolata* (Edwards *et al.* 2013b), a detailed molecular investigation of *N. tessellata* is still needed. For the purposes of the SARCA assessment, *N. tessellata* includes the two varieties but excludes the supposed Angolan subspecies which, considering its vast geographical separation from other conspecifics, probably represents a separate species.

Nucras tessellata—Loeriesfontein, NC W.R. Branch



Distribution: Endemic to southern Africa. Found in the western regions, extending from central Namibia southwards through southwestern Botswana, and Northern and Western Cape provinces, South Africa. The true distribution limits are still unresolved, as explained above, but the map here includes all of Broadley's (1972) *N. t. tessellata* records as well as new records assignable to this species. A number of questionable records are also indicated.

Habitat: A terrestrial species generally associated with rocky terrain (Branch 1998), but it also frequents open karroid veld and dry river beds.

Biome: Succulent Karoo; Savanna; Nama-Karoo; Fynbos.

Assessment rationale: Common with a wide distribution spanning three countries.

Conservation measures: None recommended.

Genus *Pedioplanis* Fitzinger, 1843—sand lizards

Pedioplanis is a group of typical lacertid lizards endemic to Africa, with most of the 13 species (Uetz 2012) restricted to southern Africa and a few occuring in southern Angola (Branch 1998; Bauer & Branch 2003 [2001]; Conradie *et al.* 2012). Five species (one with two subspecies) are present in the *Atlas* region. Phylogeography of the genus in the subcontinent was recently investigated (Makokha *et al.* 2007), revealing the existence of a few cryptic taxa that await formal taxonomic description. The majority of species live in very arid habitats. They are diurnal, active foragers capable of astonishing bursts of speed. Females in the *Atlas* region lay clutches of 2–8 eggs (Branch 1998). Most species have extensive distributions and are often locally abundant. None are regarded as threatened.

Pedioplanis burchelli (Duméril & Bibron, 1839)

BURCHELL'S SAND LIZARD

Andrew A. Turner

Global: Least Concern

Endemic

Taxonomy: This species may be confused with its morphologically similar sister species *Pedioplanis laticeps* (but see phylogeny in Makokha *et al.* 2007).

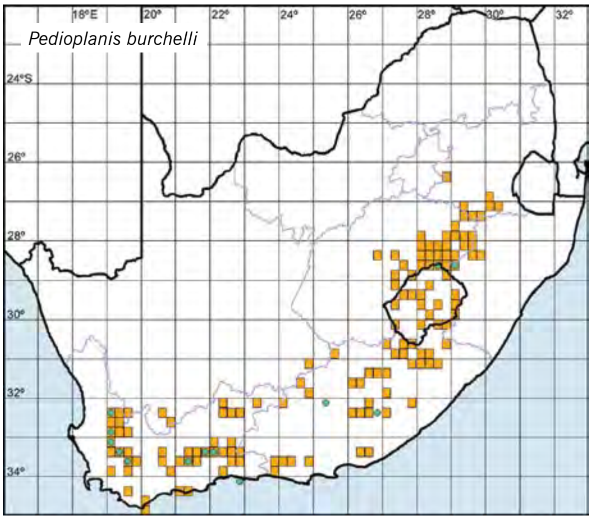
Distribution: Endemic to South Africa and Lesotho. Occurs in the eastern part of the *Atlas* region, extending from southern Mpumalanga through the eastern Free State, western KwaZulu-Natal, Lesotho, southern parts of the Northern Cape, and throughout most of the Eastern and Western Cape provinces. The isolated northernmost record (Rietfontein 313IR; 2628BD) in western Mpumalanga was reported by Jacobsen (1989).

Habitat: Found in rocky areas, particularly those with exposed bedrock and sparse vegetation (Branch 1998). Often associated with large mountains.

Biome: Grassland; Fynbos; Albany Thicket; Nama-Karoo; Succulent Karoo.

Assessment rationale: Very widespread and often abundant; no known threats.

Conservation measures: None recommended.



Pedioplanis burchelli, adult—Fever village, about 25 km SW of Cedarville, EC M. Burger

Pedioplanis burchelli, subadult—near Farm Hartbeesfontein, Nieu Bethesda area, EC W.R. Branch

Pedioplanis inornata (Roux, 1907)
PLAIN SAND LIZARD

Andrew A. Turner

Regional: Least Concern

Taxonomy: *Pedioplanis inornata* is paraphyletic with respect to *P. gaerdesi*, with a clade from northern Namibia and another from southern Namibia and the Northern Cape. These clades represent two different species (Makokha *et al.* 2007). This impending taxonomic change is unlikely to affect the Red List status of the South African taxon.

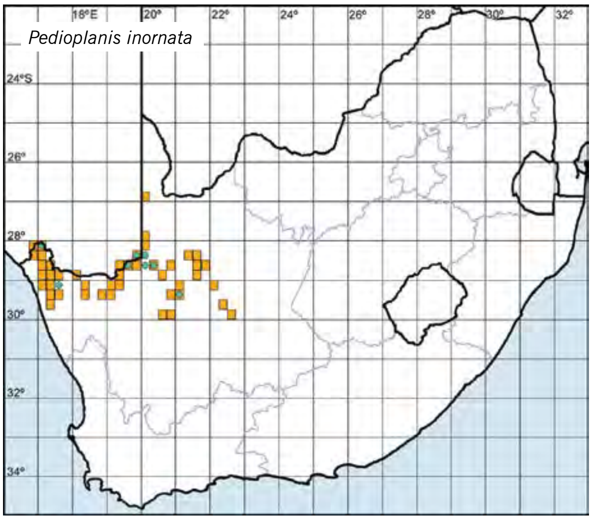
Distribution: Endemic to southern Africa. Found from Swakopmund in Namibia southwards through Namaqualand to Prieska in the Great Karoo. In reality, it comprises two taxa; one endemic to Namibia and another endemic to Namibia and South Africa (see Makokha *et al.* 2007).

Habitat: Inhabits exposed bedrock on the lower slopes of mountains (Branch 1998).

Biome: Nama-Karoo; Succulent Karoo; Desert.

Assessment rationale: Widely distributed in South Africa. Occurs in areas that are not heavily impacted by human activities. No known threats.

Conservation measures: None recommended.



Pedioplanis inornata—near Potjiespram, Richtersveld, NC J. Marais

Pedioplanis laticeps (A. Smith, 1844)
KAROO SAND LIZARD; CAPE SAND LIZARD

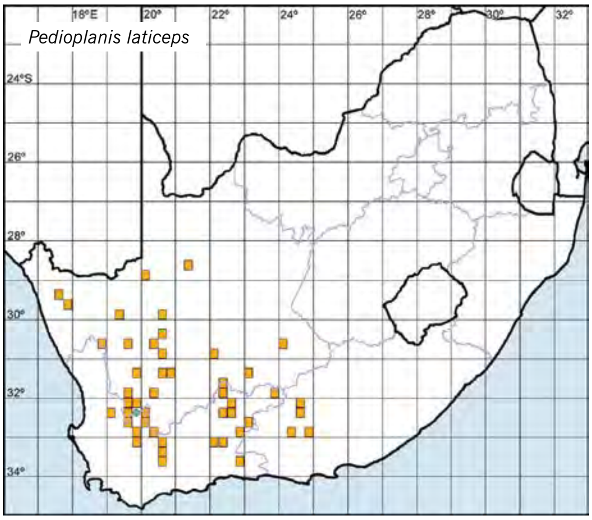
Andrew A. Turner

Global: Least Concern

Endemic

Taxonomy: This species may be confused with its morphologically similar sister species *Pedioplanis burchelli*, but the two taxa are genetically distinct (Makokha *et al.* 2007).

Distribution: Endemic to South Africa. Occurs widely from the Orange River in the north to Anysberg in the south and Graaff-Reinet in the east. Branch (1990a) noted that old, unvouchered records of *P. laticeps* (as *Eremias capensis*) from localities on the western Cape coast (Papendorp,



Pedioplanis laticeps—Sutherland, NC W. Conradie

Pedioplanis laticeps—Sutherland, NC W. Conradie

Hondeklipbaai and Kleinsee; Burrage 1978) were probably due to mis-identification with *Meroles knoxii*. These old records are not plotted on the map here.

Habitat: Found on compacted, well-vegetated soils in Succulent Karoo and montane grassland (Branch 1998), often in open areas with stones.

Biome: Succulent Karoo; Nama-Karoo; Fynbos; Albany Thicket; Grassland (marginal).

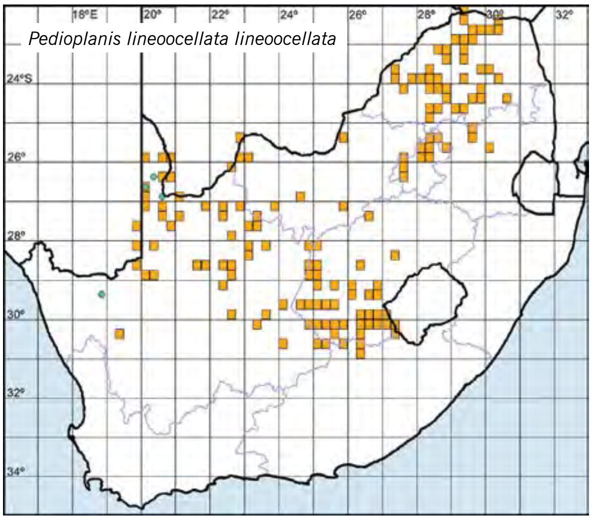
Assessment rationale: Widespread with no significant threats.

Conservation measures: None recommended.

Pedioplanis lineoocellata lineoocellata (Duméril & Bibron, 1839)

SPOTTED SAND LIZARD

Andrew A. Turner



Regional: Least Concern

Taxonomy: There is some genetic structure within *P. lineoocellata*. Makokha *et al.* (2007) used molecular techniques to show that the currently recognised subspecies (*lineoocellata*, *pulchella*), as well as an undescribed form from Limpopo, may all represent distinct species (but see comments under *P. l. pulchella* below). Branch (1998) noted morphological differences between the three named subspecies, *lineoocellata*, *pulchella* and *inocellata*.

Distribution: Endemic to southern Africa where it is widely distributed. Found from the northern parts of Namibia and Botswana to Limpopo in the northeast and the Karoo in the south (Branch 1998). In the *Atlas* region it occurs in the South African provinces of Limpopo, Mpumalanga (northern half), Gauteng, North-West, Free State, Northern Cape, and the extreme northern parts of the Eastern Cape. The most westerly locality (2918BD) in the *Atlas* region is a VM record.

Habitat: Prefers dry, open vegetation.

Biome: Savanna; Grassland; Nama-Karoo.

Assessment rationale: Very widespread and tolerant of many agricultural activities. Not considered threatened. It is unlikely that any of the taxa contained within *P. lineoocellata* (see *Taxonomy* above) would qualify for threatened status.

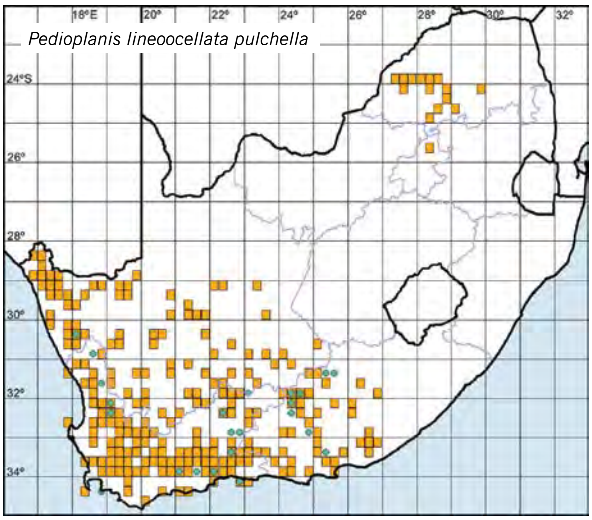
Conservation measures: None recommended.

Pedioplanis lineoocellata lineoocellata—Tswalu Kalahari Reserve, NC
W. Conradie

Pedioplanis lineoocellata pulchella (Gray, 1845)

COMMON SAND LIZARD

Andrew A. Turner



Global: Least Concern

Near-endemic

Taxonomy: Previous studies had indicated that this taxon may represent a valid species, distinct from *Pedioplanis lineoocellata* and *P. inocellata* (see Bauer & Branch 2003 [2001], Makokha *et al.* 2007). However, a recent mitochondrial DNA analysis did not support the elevation of this taxon to species status (Edwards 2013). Nevertheless, the allopatric population in the Waterberg Range of Limpopo Province and adjacent areas is genetically distinct and may be described as a new species (Makokha *et al.* 2007; Edwards 2013).

Distribution: Occurs from southern Namibia southwards through Namaqualand and the eastern Great Karoo to the Cape Peninsula, and eastwards to Barkly East in the Eastern Cape, with an apparently isolated population in the Waterberg region of Limpopo and adjacent areas (e.g. northern Gauteng) (Jacobsen 1989; Branch 1998).

Habitat: Found in a large variety of habitats from the coast to mountain slopes. Generally associated with rocky areas.

Biome: Fynbos; Succulent Karoo; Nama-Karoo; Albany Thicket; Grassland; Desert; Savanna; Forests.

Assessment rationale: Very widely distributed, and abundant in some areas. Occurs in many protected areas. Not known to be threatened.

Conservation measures: None recommended.

Pedioplanis lineoocellata pulchella—Steytlerville, EC W.R. Branch

Pedioplanis lineoocellata pulchella—Williston, NC W.R. Branch

Pedioplanis namaquensis (Duméril & Bibron, 1839)

NAMAQUA SAND LIZARD

Andrew A. Turner

Regional: Least Concern

Taxonomy: A molecular analysis indicated that *P. namaquensis* consists of two distinct taxa, one in Namibia and the other in South Africa (Makokha *et al.* 2007), but their exact distributions are unclear.

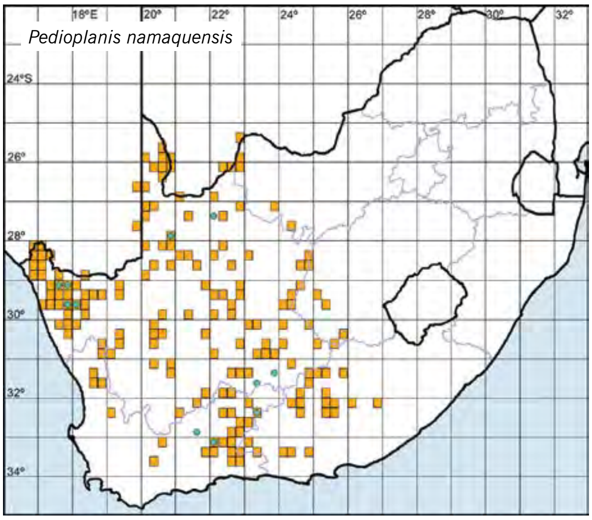
Distribution: Occupies a large part of the dry western half of southern Africa, from west of Algoa Bay in the Eastern Cape, northwards through the Karoo and Kalahari to southern Angola and eastern Botswana (Branch 1998). In the *Atlas* region it occurs in the Eastern, Western and Northern Cape provinces, southwestern Free State and western parts of North-West province.

Habitat: Inhabits open sandy areas in karroid veld, arid savanna and semi-desert. Digs its own burrows in sand at the base of bushes (Branch 1998).

Biome: Nama-Karoo; Succulent Karoo; Savanna; Grassland; Desert; Fynbos; Albany Thicket.

Assessment rationale: Abundant, widespread and not threatened.

Conservation measures: None recommended.



Pedioplanis namaquensis—Farm Slangfontein, between Wolwefontein and Jansenville, EC W.R. Branch

Genus *Tropidosaura* Fitzinger, 1826—mountain lizards

Tropidosaura currently comprises four species endemic to South Africa and Lesotho. A recent molecular study by Engleder *et al.* (2013) confirmed that *T. cottrelli* and *T. essexi* are sister taxa, but showed that *T. gularis* was more closely related to *T. montana*. The phylogeography of the genus and relationships within it, especially the status of the three subspecies of *Tropidosaura montana*, is being reviewed (M.J. Cunningham unpubl. data). These lizards are associated with mountainous areas and generally occur in moist, grassy habitats. Females produce clutches of 2–8 eggs (Branch 1998). Montane populations are barely affected directly by human activities but may be influenced by climate change. Most species are affected to some extent by changing fire regimes, and in grassland areas by changes in grazing intensity. The range of *T. cottrelli* is now known to be smaller than was previously thought and the species is listed here as Near Threatened. All other species are placed in the category Least Concern.

Tropidosaura cottrelli (Hewitt, 1925)

COTTRELL'S MOUNTAIN LIZARD

Michael J. Cunningham, Andrew A. Turner &
Michael F. Bates

Global: Near Threatened

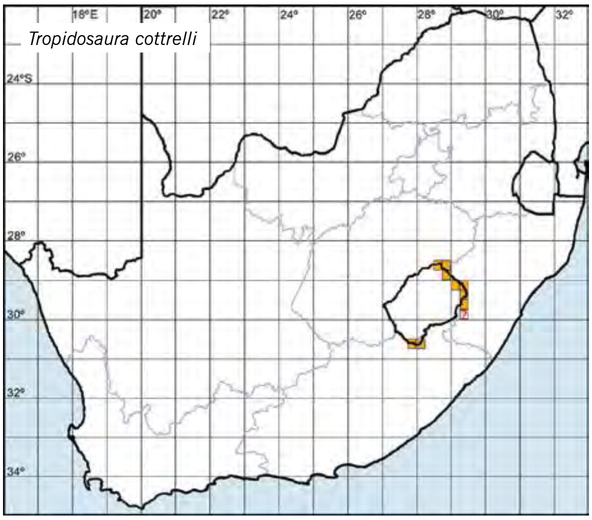
Endemic

Taxonomy: *Basutosaura cottrelli* Hewitt, 1925 was described as a new genus and species, distinguished from *Tropidosaura* (*T. montana* Duméril & Bibron, 1839 and *T. burchelli* Smith, 1849) by the presence of a single postnasal scale (versus two post-nasals), each nostril being pierced in a single scale (versus nostrils pierced between three scales), and by the keeled but not acuminate rhombic dorsal scales (versus keeled and spine-tipped elongate dorsal scales) (Hewitt 1925). The subsequent discovery and description of *T. m. rangeri* Hewitt, 1926, *T. essexi* Hewitt, 1927 and *T. gularis* Hewitt, 1927 bridged the geographical and morphological gap between these genera (Hewitt 1926, 1927). Consequently, Hewitt (1927) transferred this species to *Tropidosaura*, but assigned it, together with *T. essexi* and *T. gularis*, to the subgenus *Basutosaura*. A recent molecular study by Engleder *et al.* (2013) confirmed that *T. cottrelli* and *T. essexi* are sister taxa, but showed that *T. gularis* was more closely related to *T. montana*.

Distribution: Endemic to the Maloti-Drakensberg highlands of South Africa and Lesotho (Branch 1998; Bates 2013), from Ben McDhui in the south to Mont-aux-Sources and Namahali Pass in the north. It probably also occurs in the area between the known northern and southern localities. Its range includes areas on the periphery of the Eastern Cape, KwaZulu-Natal and Free State, along the Lesotho border, as well as areas on the higher ranges in eastern and northern Lesotho. Within this area, the species is sparsely distributed along the crests of mountain ridges and along the escarpment summit edge. This area is poorly surveyed and although *T. cottrelli* has been recorded from only nine out of 37 QDGCs with suitable bioclimates (M.J. Cunningham unpubl. data), it is likely that there are many additional populations of this species within this well-demarcated range. The type locality of 'Nemahedi Camp' (on the escarpment summit at Namahali Pass) is located within Free State Province, South Africa. A specimen (TM 41593) record from 'Black Mountain' (= ?Swartberg; 2929CD, question mark on map) in East Griqualand is probably incorrectly assigned to this locality because it would extend the geographical, habitat and climatic range beyond that generally known for this species.

EOO: 12 815 km^2 (confidence: medium); AOO: 52 km^2 (confidence: low).

Habitat: Found on stony, heath- and grass-covered mountain tops near the escarpment edge of the Drakensberg and



Tropidosaura cottrelli—Drakensberg M.F. Bates

Tropidosaura cottrelli—above Chain Ladders, Drakensberg, FS M.F. Bates along the interior high ridges of Lesotho, at altitudes of 2 467–3 278 m. The exposed, weather-beaten sites where this species occurs typically include similar proportions of cover by small boulders, low shrubs (particularly *Erica* and Asteraceae), short grass and bare patches of gravel or bedrock. It is known to shelter among rocks (Bates 2005c).

Vegetation type: Gd 10 Drakensberg Afroalpine Heathland; Gd 8 Lesotho Highland Basalt Grassland.

Assessment rationale: Has a limited high-altitude distribution (EOO <20 000 km² [B1], an AOO that is below the Endangered threshold—i.e. <500 km² [B2]), and is likely to be threatened by climate change (global warming). Frequent fires and overgrazing are relatively minor threats causing some decline in the quality of habitat. Specimens are seldom found and appear to occur in low densities, even in apparently suitable habitat (M.J. Cunningham unpubl. data). However, the population is not severely fragmented, nor does it appear to be fluctuating.

Threats: Climate change (warming) may reduce available habitat and therefore constitutes a major threat to *T. cottrelli*, which has limited opportunity for compensatory migration. There are also indications of intensification of grazing by stock across the Lesotho highlands and in adjacent areas of South Africa above the escarpment, including areas inhabited by this species (Stewart 2001). It is intrinsically threatened by its restricted range and possibly by anthropogenic changes in fire regime in some areas. Despite these threats, there is little evidence that the species has declined, and there are many areas with suitable habitat that have not yet been surveyed but that may support these lizards.

Conservation measures: Conduct annual monitoring for the species at 2–3 sites of known occurrence spanning its distribution, such as Mont-aux-Sources and Ben McDhui. Conduct surveys of suitable areas where the species has not yet been collected, so as to obtain better information on the threats facing it.

Tropidosaura essexi Hewitt, 1927

ESSEX'S MOUNTAIN LIZARD

Michael F. Bates, Michael J. Cunningham & Andrew A. Turner

Global: Least Concern

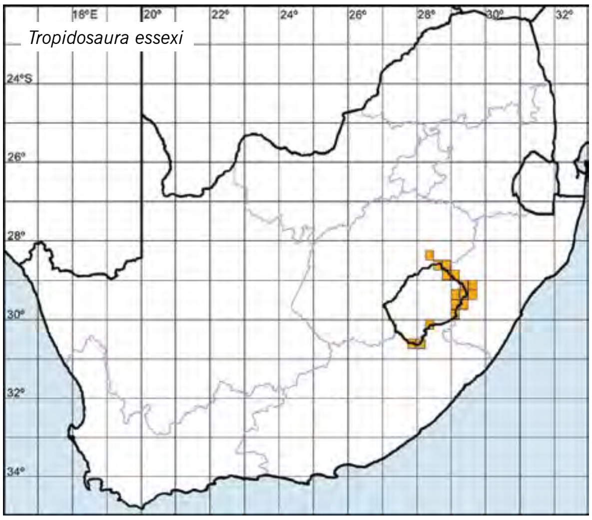
Endemic

Taxonomy: Although *Tropidosaura essexi* and *T. montana natalensis* are morphologically very similar, these taxa are grouped in different clades (*T. essexi* with *T. cottrelli*, and *T. montana* with *T. gularis*) (Engleder *et al.* 2013; M.J. Cunningham unpubl. data). There is substantial geographical variation within *T. essexi* with regard to the number of femoral pores, colour pattern, and mitochondrial DNA sequences. This variation appears to be bimodal and further investigation is needed to determine whether or not this reflects the presence of cryptic taxa within *T. essexi* (M.J. Cunningham unpubl. data).

Distribution: Endemic to the *Atlas* region and largely restricted to the Maloti-Drakensberg highlands of Lesotho and the South African provinces of Free State, KwaZulu-Natal and Eastern Cape. It extends from near Clarens in the Free State (Bates 1996a) southwards to the vicinity of Rhodes in the Eastern Cape. Bourquin's (2004) record at 2730AD on the KwaZulu-Natal/Mpumalanga border, which refers to a specimen collected in 1971, is rejected because this locality is situated far from any other known records of the species (or any other *Tropidosaura*) and falls in a different bioregion (Mesic Highveld Grassland); the museum specimen may have been mislabeled. There appears to be altitudinal separation between *T. essexi* and the morphologically similar *T. montana natalensis*, which occurs at lower elevations.

Habitat: Terrestrial and diurnal, usually found in short basalt grasslands and afroalpine heathlands on the high escarpment slopes and summit plateau (2 392–3 337 m) of the Maloti-Drakensberg highlands in the Grassland Biome. Often found in thick vegetation at the edges of streams, around loose rock in wetlands or at the base of rock faces (M.J. Cunningham pers. obs.; Branch 1998).

Vegetation type: Gd 10 Drakensberg Afroalpine Heathland; Gd 8 Lesotho Highland Basalt Grassland; Gd 7 uKhahlamba Basalt Grassland; Gd6 Drakensberg-Amathole Afromontane Fynbos.



Tropidosaura essexi—Top of Chain Ladder, Drakensberg, FS M.F. Bates

Assessment rationale: Fairly widespread and common. There are indications of intensification of grazing by stock across the Lesotho highlands and in adjacent areas of South Africa above the escarpment, including areas inhabited by *T. essexi* (Stewart 2001). Climate change (warming) may reduce available habitat and therefore constitutes a threat to this species, which has limited opportunity for compensatory migration. Despite these threats, there is no evidence that *T. essexi* has declined. It is intrinsically threatened by its relatively restricted range and the occurrence of frequent anthropogenic fires in some areas. Occurs in the same general area as *T. cottrelli* but is more widespread and common.

Conservation measures: None recommended.

Tropidosaura gularis Hewitt, 1927

CAPE MOUNTAIN LIZARD

Andrew A. Turner

Global: Least Concern

Endemic

Taxonomy: No notable issues.

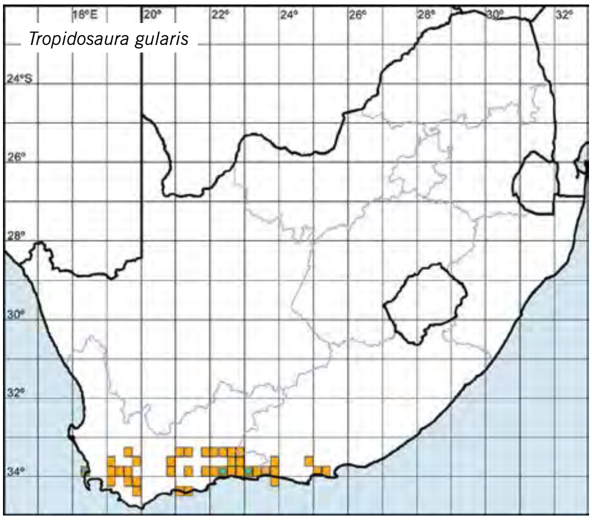
Distribution: Endemic to the Western and Eastern Cape provinces, South Africa. Occurs throughout most of the Cape Fold Mountains from the Cape Peninsula to Port Elizabeth. Its absence from the Cederberg region may reflect competitive exclusion by *Australolacerta australis.*

Habitat: Found in very rocky areas on high fynbos mountain slopes comprising scree and other loose boulders.

Biome: Fynbos.

Assessment rationale: Occurs over a wide area where there is little human disturbance. Found in a number of protected areas. No known threats.

Conservation measures: None recommended.



Tropidosaura gularis—Knysna, WC W.R. Schmidt

Tropidosaura gularis—Klein Swartberg Range, WC M.F. Bates

Tropidosaura montana (Gray, 1831)

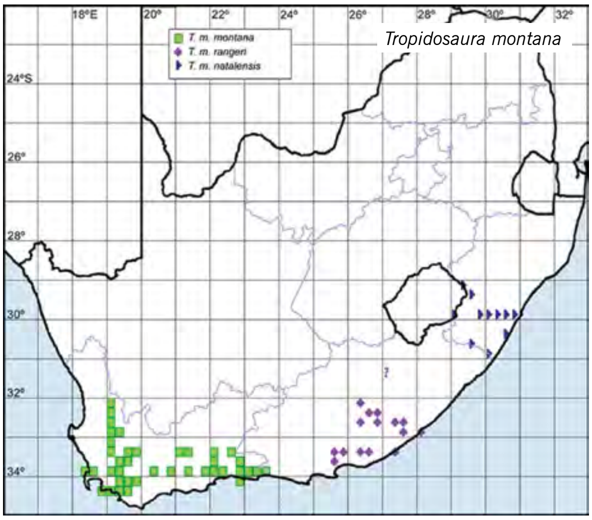
COMMON MOUNTAIN LIZARD

Andrew A. Turner

Global: Least Concern

Endemic

Taxonomy: There are three subspecies: *Tropidosaura montana montana*, *T. m. rangeri* and *T. m. natalensis*. The first two forms are morphologically poorly separated, based on slight differences in the development of the collar and the numbers of femoral pores in males (Branch 1998). *Tropidosaura montana natalensis* is separated from the other two subspecies by several differences in scalation (FitzSimons 1947) and is also geographically disjunct. Mitochondrial DNA sequence data support the continued recognition of the three subspecies as minor variants within *T. montana*, the sister species of *T. gularis* (M.J. Cunningham unpubl. data). This status was confirmed for *T. m. montana* and *T. m. natalensis*, which were included in the analysis of Engleder *et al.* (2013).



Distribution: *Tropidosaura m. montana* occurs in the Cape Fold Mountains from the Cederberg in the north to the Cape Peninsula and eastwards to Prince Alfred's Pass near Knysna and the Kammanasieberg. *Tropidosaura m. rangeri* occurs along the Suurberg Range and extends along the coast to the East London area, with scattered inland populations associated with grassland and forest edge in the central part of the Eastern Cape. The northernmost record for *T. m. rangeri* is somewhat out of range and considered questionable. The eastern subspecies, *T. m. natalensis*, is found in coastal and montane grasslands of southern KwaZulu-Natal.

Habitat: In the Western Cape it inhabits densely covered fynbos slopes, often in short restio veld and rocky areas. In the Eastern Cape and KwaZulu-Natal it occurs on dense grassy slopes, particularly around seepage areas with tall tufted grasses such as *Merxmuellera* (M.J. Cunningham pers. comm.). Specimens have been observed basking in long, dense grass at Umtamvuna Nature Reserve on the KwaZulu-Natal South Coast (A.J. Armstrong pers. comm.).

Biome: Fynbos; Grassland; Indian Ocean Coastal Belt; Savanna; Albany Thicket.

Assessment rationale: Has a large range and occurs in many protected areas. Often abundant and not considered threatened. The habitat of *T. m. montana* is seldom significantly disturbed because this subspecies occurs primarily on rugged mountain slopes, but some parts of the ranges of the other two subspecies are severely overgrazed (with shrub encroachment in parts), resulting in some fragmentation of populations (M.J. Cunningham pers. comm.). Because the subspecies *T. m. rangeri* is poorly defined from typical *T. m. montana*, and since the relationship of *T. m. natalensis* to *T. essexi* must still be fully resolved, the three subspecies have not been separately assessed. The conservation status of the two eastern subspecies may need to be re-evaluated if they prove to be valid species.

Conservation measures: None recommended.

Tropidosaura montana montana—WC W.D. Haacke

Tropidosaura montana rangeri—Asante Sana GR, EC W. Conradie

Tropidosaura montana natalensis—Highmoor, Drakensberg, KZN M.F. Bates

Genus *Vhembelacerta* Edwards, Herrel, Vanhooydonck, Measey, Tolley & Branch—Soutpansberg rock lizards

Vhembelacerta contains a single species, *V. rupicola*, restricted to the Soutpansberg range in Limpopo Province, South Africa. A recent analysis of mitochondrial and nuclear DNA sequences indicated that this species, until recently classified in the genus *Australolacerta*, is not closely related to *A. australis* (which is more closely related to *Tropidosaura*—see also Salvi *et al.* 2011) and it should be placed in a separate genus (Edwards *et al.* 2012, 2013a). Female *A. rupicola* lay clutches of 3–4 eggs (Kirschoff & Richter 2009). The habitat of *A. rupicola* is inadequately protected and subject to large-scale timber planting, but it is for the most part not inhabited by people and this species is therefore categorised as Near Threatened.

Vhembelacerta rupicola (FitzSimons, 1933)

SOUTPANSBERG ROCK LIZARD

Andrew A. Turner

Global: Near Threatened

Endemic

Taxonomy: An analysis of mitochondrial and nuclear DNA sequence data indicated that *A. rupicola* should be placed in a separate genus (S. Edwards *et al.* 2012).

Distribution: Endemic to Limpopo, South Africa. Occurs widely throughout the Soutpansberg Range (Jacobsen 1988c; Branch 1998).

EOO: 2 570 km^2 (confidence: medium); AOO: 1 216 km^2 (confidence: medium).

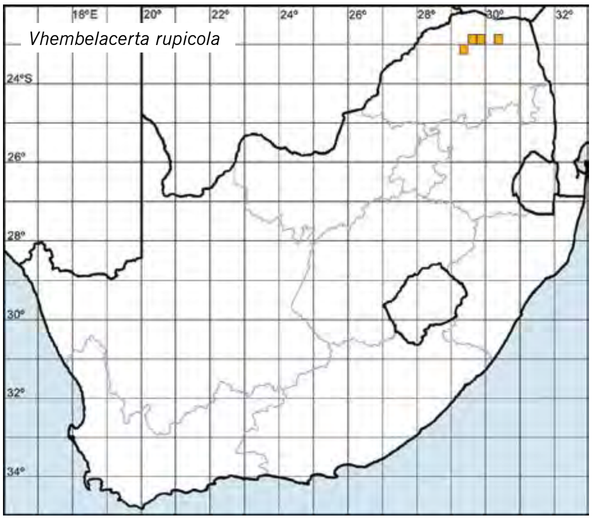
Habitat: Occurs on rocky outcrops, scree slopes and bedrock (Jacobsen 1988c) in wooded savanna and forest fringes on mountain slopes. Found mainly at the edge of Soutpansberg Mountain Bushveld or mistbelt forest with rocky outcrops on southern and southeastern slopes at altitudes of 800–1 600 m (Kirchhof & Richter 2009). Forages in leaf litter and seeks refuge in rock cracks at night (Kirchhof *et al.* 2010).

Bioregion: Central Bushveld, Mesic Highveld Grassland.

Assessment rationale: Both EOO and AOO are below the Vulnerable threshold and a decline in the quantity and quality of suitable habitat due to future land-use changes is predicted [B1b(ii,iii)+2b(ii,iii)]. However, it is not known to what extent existing populations are fragmented or how many locations exist. The species is therefore considered Near Threatened.

Threats: Large-scale timber plantations. However, this lizard is able to survive in areas that are too arid for plantations and this reduces the severity of the threat. The increasing demand for indigenous trees as a fuel source may reduce the amount and quality of habitat.

Conservation measures: Perform a detailed survey of the Soutpansberg range to accurately assess EOO. Not known to occur in any formally protected areas, but does occur at Lajuma where it receives some protection. Therefore, establish secure protected areas that include the range of the species.



Vhembelacerta rupicola—Soutpansberg, LIMP J. Marais

CHAPTER 12

Family Cordylidae

P. le Fras N. Mouton, Michael F. Bates & Martin J. Whiting

Recent changes in squamate taxonomy place the Cordylidae in the Scinciformata, which also includes the families Scincidae, Xantusiidae and Gerrhosauridae (Vidal & Hedges 2009). Cordylids and gerrhosaurids form the Cordyliformes, a subclade of Scinciformata (Lang 1991), but there has been disagreement as to whether they should be treated as separate families or subfamilies (e.g. Frost *et al.* 2001; Lamb *et al.* 2003). The Cordylidae is the only lizard family endemic to mainland Africa. It comprises at least 63 species (80 species and subspecies) previously partitioned into four genera: *Platysaurus*, *Cordylus*, *Chamaesaura* and *Pseudocordylus* (FitzSimons 1943; Loveridge 1944c; Lang 1991; Adolphs 2006; Greenbaum *et al.* 2012; Uetz 2012).

The recent taxonomic re-assessment of Stanley *et al.* (2011) divided the family into two subfamilies, Cordylinae with nine genera: *Cordylus*, *Smaug*, *Ninurta*, *Chamaesaura*, *Pseudocordylus*, *Ouroborus*, *Karusasaurus*, *Namazonurus*, *Hemicordylus*, and Platysaurinae with a single genus, *Platysaurus*. Nine new species have been described in the last 23 years (Mouton & Van Wyk 1990, 1994, 1995; Broadley & Mouton 2000; Broadley & Branch 2002; Greenbaum *et al.* 2012) and several others await validation (e.g. Bates 2007a; M.F. Bates & E.L. Stanley in prep.). The majority of species and subspecies occur in southern Africa south of the Zambezi River, and as many as 42 of the 50 taxa in the *Atlas* region are endemic.

Although the majority of cordylids are rupicolous, all *Chamaesaura* taxa, two species of *Cordylus* (*C. macropholis* and *C. ukingensis*) and *Smaug giganteus* are terrestrial, while two *Cordylus* species (*C. jonesi* and *C. tropidosternum*) are arboreal. Cordylids are diurnal and most are insectivorous. All species are essentially sit-and-wait foragers and many display high levels of territoriality. The shifts from active to sit-and-wait foraging mode, and from a terrestrial to a rupicolous lifestyle in the immediate ancestor of the Cordylidae are considered indications that the family had a cold climate origin (Mouton & Van Wyk 1997). The possession by cordylids of a unique type of generation gland is apparently the result of increased territoriality that accompanied these shifts (Mouton & Van Wyk 1997; Mouton *et al.* 2010). At least three species in the family are group-living (Mouton *et al.* 1999; Mouton *et al.* 2000a; Fell 2005). All *Platysaurus* species and a few *Pseudocordylus* species are sexually dichromatic, but sexual dichromatism is absent in most other cordylids (except *Smaug mossambicus* and *S. regius*) including *Chamaesaura* (FitzSimons 1943; Mouton & Van Wyk 1993; Bates 2007a). *Platysaurus* is oviparous but all other species in the family are viviparous. The genera *Karusasaurus*, *Namazonurus*, *Hemicordylus* and *Cordylus* contain melanistic species/populations and all of these are restricted to southwestern South Africa where they occur mostly in association with a high incidence of fog and cloud cover (Janse van Rensburg 2009). Molecular analyses and associated dating techniques suggest a mid-Miocene origin for melanism in at least one of the four clades, possibly in response to climatic changes associated with the development of the cold Benguela sea current (Daniels *et al.* 2004).

Because they are restricted to rocky environments, the habitat of most cordylids is fairly undisturbed and secure. As a consequence, most species are classified as Least Concern. However, a number of rupicolous species have extremely restricted distributions and this, in combination with one or more other threats, renders some of them highly threatened (e.g. *Platysaurus intermedius inopinus* and *P. monotropis*, both listed as Endangered). The collecting of cordylids for the pet trade is a problem, as indicated by regular newspaper reports about specimens being confiscated by CapeNature in the Western Cape. The snake-like *Chamaesaura* species are heavily impacted by fire in their grass and restio habitats and their aseasonal reproduction and high fecundity are apparently adaptations that allow rapid recruitment after fire (Du Toit *et al.* 2003). Of the 50 species and subspecies of cordylids evaluated here, two (*Platysaurus intermedius inopinus* and *P. monotropis*) are listed as Endangered, two (*Smaug giganteus* and *Hemicordylus nebulosus*) as Vulnerable, 10 as Near Threatened and the rest as Least Concern.

SUBFAMILY CORDYLINAE

The recent taxonomic re-assessment of Stanley *et al.* (2011) divided the family Cordylidae into two subfamilies, Cordylinae and Platysaurinae. Cordylinae contains 48 species (a few with subspecies, 53 taxa in total) in nine genera: *Cordylus*, *Smaug*, *Ninurta*, *Ouroborus*, *Karusasaurus*, *Namazonurus*, *Pseudocordylus*, *Hemicordylus* and *Chamaesaura* (Adolphs 2006; Stanley *et al.* 2011; Greenbaum *et al.* 2012). All of these genera are represented in the *Atlas* region, where 30 species (two with three subspecies, one with two subspecies) occur.

Genus *Chamaesaura* Schneider, 1801—grass lizards

The genus *Chamaesaura* contains five species (one with two subspecies), occurring as disjunct populations in the grasslands of southern and eastern Africa from South Africa to Angola, Democratic Republic of the Congo and Tanzania (Stanley *et al.* 2011). Three species occur in the *Atlas* region, with *C. aenea* endemic to South Africa and Swaziland. Grass lizards are all diurnal, insectivorous and found mainly in grasslands on mountain slopes and plateaus, although *C. anguina* extends into fynbos regions. Females give birth to 5–17 young and reproduction is aseasonal in at least one species, namely *C. anguina* (Branch 1998; Du Toit *et al.* 2003). The elongated snake-like bodies, long tails and minute limbs (forelimbs absent in *C. macrolepis*) of these lizards allow for rapid movement in long grass; the minute limbs may provide support when at rest (Branch 1998). *Chamaesaura aenea* and *C. macrolepis* are considered Near Threatened, mainly because of the destruction of grasslands for cultivation and the frequent occurrence of anthropogenic fires.

Chamaesaura aenea (Fitzinger, 1843)

COPPERY GRASS LIZARD;
TRANSVAAL GRASS LIZARD

Michael F. Bates

Global: Near Threatened

Endemic

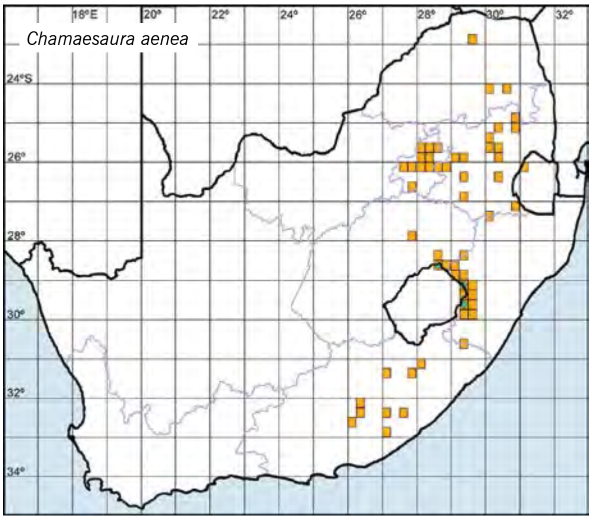
Taxonomy: The relationship of isolated populations (e.g. Soutpansberg) to the main population should be investigated using molecular markers.

Distribution: Endemic to the *Atlas* region, occurring in western Swaziland and the South African provinces of Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal (associated with the Drakenberg), northeastern Free State and Eastern Cape. The northernmost record is of an isolated population in the grasslands of the Soutpansberg Range. An apparently isolated relict population also occurs on the Amatole Mountains in the Eastern Cape (Branch 1985). The species occurs even further south (3227CC) in the vicinity of King William's Town. Although recorded from only two areas in the eastern Free State, namely Lindley and Golden Gate (Bates 1996a), these lizards are expected to have a wider distribution in this area. Several records that appear to be located on the South Africa-Lesotho border were, in fact, collected on the lower slopes of the Drakensberg and the species is therefore not expected to occur in the highlands of Lesotho.

EOO: 621 352 km² (confidence: medium); AOO: 19 126 km² (confidence: medium).

Habitat: Restricted to the Grassland Biome. Found on the grassy slopes and plateau of the eastern escarpment and Highveld (Jacobsen 1989; Bates 1996a; Branch 1998; Bourquin 2004). Occurs at elevations of 1 400–2 100 m in KwaZulu-Natal (Bourquin 2004) and as high as 2 218 m in Mpumalanga and 2 228 m in Free State (M.F. Bates, unpubl. data). Probably shelters in the base of grass tussocks, as do other *Chamaesaura* species.

Bioregion: Mesic Highveld Grassland; Drakensberg Grassland; Sub-Escarpment Grassland; Dry Highveld Grassland.



Chamaesaura aenea—Kamberg NR, Drakensberg, KZN M.F. Bates

Assessment rationale: A population reduction of over 20% in the last 18 years (three generations) is inferred from the transformation of large parts of the Grassland Biome, as is an associated decline in the taxon's AOO, EOO and habitat quality [A2c]. This decline is expected to continue into the future. Intensive surveys throughout Gauteng over the period 2000–2008 recorded only two specimens from Rietvlei Nature Reserve (Whittington-Jones *et al.* 2008), indicating a dramatic reduction in abundance in this province. The species is close to being classified as Vulnerable.

Threats: Threatened by transformation of land for crop farming and plantations, overgrazing by livestock, infrastructural development (including extreme urbanisation in Gauteng), frequent anthropogenic fires and the use of pesticides. About 35% of the Grassland Biome, in which this species' range is located, has been degraded or converted into cropland, forestry plantations or urban settlements (Le Roux 2002).

Conservation measures: Conservation organisations and legislating bodies should treat this species as Near Threatened and afford it the necessary protection. Develop and implement a BMP-S. Communicate with farmers and other locals and educate them about this species. Determine population numbers and exact ranges, as well as the status of available habitat. Monitor population trends, taking special note of the number of mortalities as a result of fires. Identify more potential protected areas and establish these where possible.

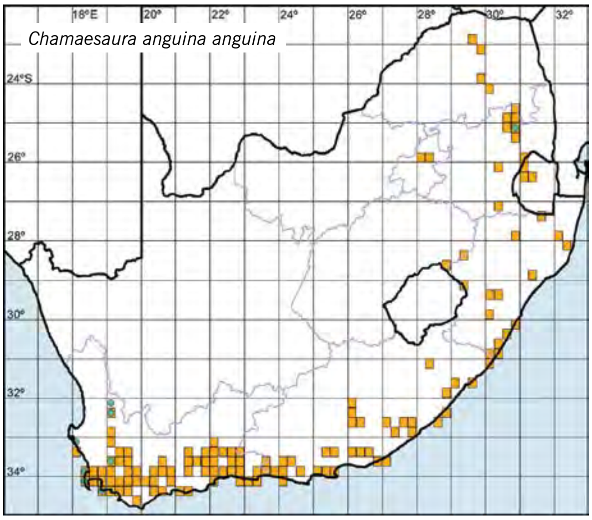
Chamaesaura anguina anguina (Linnaeus, 1758)

CAPE GRASS LIZARD

Michael F. Bates

Global: Least Concern

Endemic



Chamaesaura anguina anguina—Montagu Pass, George, WC D. Maguire

Taxonomy: Two subspecies are currently recognised since Stanley *et al.* (2011) found that *C. a. tenuior* (Rwanda, Uganda, Kenya, Tanzania, eastern Democratic Republic of Congo) is a valid species. *Chamaesaura a. anguina* occurs in South Africa and Swaziland while *C. a. oligopholis* occurs as isolated relict populations in Angola and in upland grasslands (900–2 500 m) in eastern Democratic Republic of Congo (Branch 1998; Spawls *et al.* 2002). The relationship between *C. a. anguina* and *C. a. oligopholis* remains problematic and a molecular assessment is required to determine the extent of divergence between the two subspecies.

Distribution: Endemic to the *Atlas* region. Widespread in the Fynbos and Grassland biomes, occurring in Swaziland and the South African provinces of Limpopo, Mpumalanga, KwaZulu-Natal, Eastern Cape and Western Cape, with an isolated population in Highveld grassland near Pretoria, Gauteng (Jacobsen 1989; Branch 1998). The northernmost records are of an isolated population in the grasslands of the Soutpansberg, where three *Chamaesaura* species co-occur.

Habitat: Found mostly on mountain slopes in fynbos and grassland (Branch 1998; Du Toit *et al.* 2003). Essentially an arboreal species, resting on and 'swimming' over the tops of low-growing vegetation such as restios and grasses. Takes shelter at the base of restio or grass tufts, not even sheltering in rock crevices or rodent burrows during fires (Du Preez 2007). In KwaZulu-Natal, the habitat is grassland and wooded grassland at 0–1 500 m (Bourquin 2004). Jacobsen (1989) recorded specimens from the northern part of the range basking on flat rocks and grass tussocks, and noted that they are usually found on rocky hillsides at altitudes of 1 400–1 550 m.

Biome: Fynbos; Grassland; Savanna; Indian Ocean Coastal Belt; Albany Thicket.

Assessment rationale: A population reduction of nearly 20% in the last 18 years (three generations) is inferred from the transformation of large parts of the Grassland and Fynbos biomes (as much as 35% and 17%, respectively; Le Roux 2002), as is an associated decline in the taxon's AOO, EOO and habitat quality. Threats include crop farming and plantations, overgrazing by livestock, infrastructural development, frequent anthropogenic fires, and use of pesticides. Intensive surveys throughout Gauteng over the period 2000–2008 did not detect this species (Whittington-Jones *et al.* 2008), indicating a dramatic reduction in abundance in this province. The population decline is expected to continue into the future and the species may soon be listed as Near Threatened.

Conservation measures: Communicate with farmers and other locals and educate them about this species. Determine population numbers and exact ranges, and the status of available habitat. Monitor population trends, paying special attention to the number of fire-related mortalities. Identify more potential protected areas and establish these where possible. These lizards are particularly susceptible to fires, as they do not seek shelter in anything but grass tussocks or certain kinds of fynbos vegetation such as restios (Jacobsen 1989; Boycott 1990; Du Preez 2007). They may therefore become extirpated in certain areas, and population monitoring, even of re-introductions, may be necessary. However, they are adapted to survival in fire-prone habitats and it is expected that at least some areas will be re-populated over time, especially if frequent anthropogenic fires are avoided. In the northern part of their range, much of the original habitat has been afforested and annual anthropogenic fires are likely to be detrimental to remaining populations (Jacobsen 1989). Overgrazing is also a concern, especially outside protected areas (Boycott 1992a).

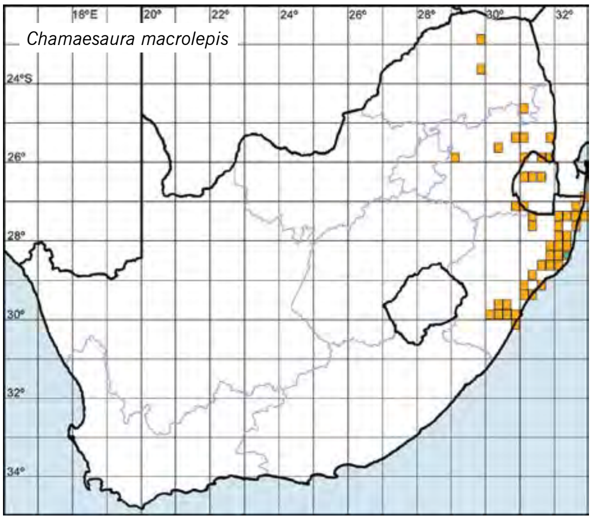
Chamaesaura macrolepis (Cope, 1862)

LARGE-SCALED GRASS LIZARD

Michael F. Bates

Global: Near Threatened

Near-endemic



Taxonomy: Until recently, *Chamaesaura miopropus* was treated as a northern subspecies of *C. macrolepis* (Broadley 1966a, 1971c; Broadley & Howell 1991; Branch 1998; Spawls *et al.* 2002). However, *C. miopropus* is geographically isolated (Angola, Zambia, Democratic Republic of Congo, Malawi, Tanzania) and distinguished by the presence of vestigial forelimbs, which are absent in *C. macrolepis* (Loveridge 1944c; Broadley & Howell 1991; Haagner *et al.* 2000; Spawls *et al.* 2002; Broadley & Cotterill 2004). It should therefore be considered a valid species, such that *C. macrolepis* reverts to binomial status. A molecular analysis would be helpful in assessing the taxonomic status of isolated populations of *C. macrolepis* such as the one in the Chimanimani Mountains of Zimbabwe.

Distribution: Endemic to South Africa (KwaZulu-Natal, Mpumalanga and Limpopo), Swaziland and Zimbabwe. There are two isolated records in the north of Limpopo, one in the grasslands of the Soutpansberg Range (2229DD; Jacobsen 1989) and the other in grassland/scrub at the edge of the Pietersburg Plateau (2329DB Jacobsen 1995). A specimen (TM 39892) from Clewer (2529CC) in western Mpumalanga represents an isolated population that was not recorded or plotted by Jacobsen (1989). The isolated relict population in Zimbabwe is restricted to the Chimanimani Mountains on the border with Mozambique (Broadley 1966a). It is probably also found in southern Mozambique.

EOO: 245 220 km^2 (confidence: medium); AOO: 15 648 km^2 (confidence: medium).

Chamaesaura macrolepis—Cape Vidal, KZN G.J. Alexander

Habitat: Occurs in the Savanna, Indian Ocean Coastal Belt and Grassland biomes. Found in grassland, especially rocky, grassy hillsides (Jacobsen 1989; Branch 1998). According to Bruton & Haacke (1980) it occurs in dry, open, sandy grasslands near the coast and on the Lebombo Mountains. Found from sea level to 900 m in KwaZulu-Natal (Bourquin 2004). The only specimen collected during Jacobsen's (1989) survey was found in a hollow in the soil under a rock.

Bioregion: Indian Ocean Coastal Belt; Lowveld; Sub-Escarpment Savanna; Mesic Highveld Grassland.

Assessment rationale: A population reduction of over 20% in the last 18 years (three generations) is inferred from the transformation of large parts of the Grassland, Savanna and Indian Ocean Coastal Belt biomes, as is an associated decline in the taxon's AOO, EOO and habitat quality [A2c]. This decline is expected to continue into the future. The species is close to being classified as Vulnerable.

Threats: Threatened by transformation of land for crop farming and plantations, overgrazing by livestock, infrastructural development, frequent anthropogenic fires and use of pesticides. About 33% of the Savanna Biome, in which most of its range is located, has been degraded or converted into cropland or forestry plantations (Le Roux 2002). Large parts of its habitat have been afforested and much of the remaining area is burnt once or twice a year (Jacobsen 1989). Fires make it difficult for populations to re-establish and are probably the reason why specimens are most often found on protected rocky hillsides (Jacobsen 1989). Jacobsen (1989: 563) was of the opinion that this species may be 'endangered', at least in Mpumalanga and Limpopo.

Conservation measures: Conservation organisations and legislating bodies should treat this species as Near Threatened and afford it the necessary protection. Draw up a BMP-S. Communicate with farmers and other locals and educate them about conservation. Determine population numbers and exact ranges, and the status of available habitat. Monitor population trends and take note of the extent of mortalities due to fire. Identify potential protected areas and establish these where possible.

Genus *Cordylus* Laurenti, 1768—girdled lizards

Cordylus is the second largest genus in the family Cordylidae, comprising 21 species (Stanley *et al.* 2011; Greenbaum *et al.* 2012). *Cordylus tasmani* is considered doubtfully distinct from *C. cordylus* and is here treated as a synonym of the latter. However, further analyses are needed (Stanley *et al.* 2011) and samples from the type locality of *C. tasmani* should be included. The genus is endemic to sub-Saharan Africa and 11 species occur in the *Atlas* region. All are small to medium-sized heliothermic baskers. They are viviparous (1–6 young) and have a prenuptial reproductive cycle. All species are strict sit-and-wait foragers displaying limited sexual size dimorphism and no sexual dichromatism (Branch 1998). Two species, *C. niger* and *C. oelofseni*, are melanistic. Several of the most recently described rupicolous species have restricted ranges and some are considered to be of conservation concern. The terrestrial species *C. macropholis* is now considered Near Threatened due to extensive habitat destruction along the West Coast as a result of urban development and mining. Three other species are listed as Near Threatened (*C. imkeae*, *C. niger*, *C. oelofseni*) and seven as Least Concern.

Cordylus aridus Mouton & Van Wyk, 1994

EASTERN DWARF GIRDLED LIZARD;
DWARF KAROO GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic

Taxonomy: The taxonomic status of species in the *Cordylus minor* complex (Mouton & Van Wyk 1994), which includes *C. aridus*, should be re-evaluated using molecular techniques.

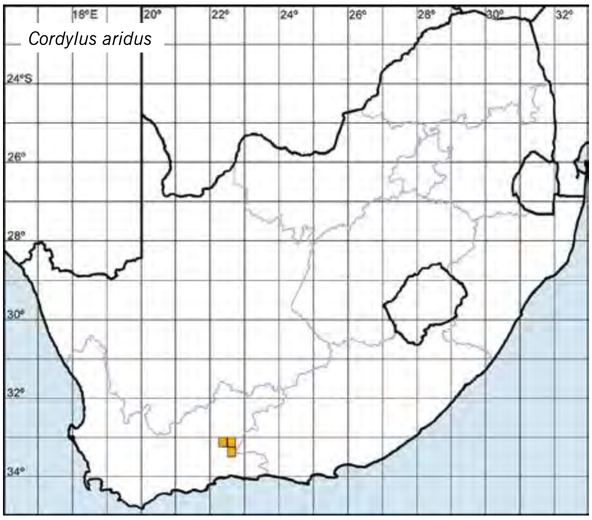
Distribution: Endemic to the Western Cape where it occurs in the southern Karoo, immediately north of Klaarstroom. Since its description in 1994 it has been recorded from two additional, adjacent QDGCs.

Habitat: A rupicolous, heliothermic, ambush-foraging species that prefers low ridges and outcrops of Dwyka tillite (Mouton & Van Wyk 1994; Branch 1998).

Vegetation type: NKl 1 Gamka Karoo; SKv 11 Eastern Little Karoo.

Assessment rationale: Has a very restricted range (EOO 2 357 km^2 [B1], AOO <970 km^2 [B2]) in a lowland area but there are no major threats. Because of its small range, over-exploitation by the pet trade could easily become a major concern.

Conservation measures: Conservation authorities should exercise strict control and issue collecting permits only under exceptional circumstances. Perform field surveys to gain knowledge about range and population size, and to improve understanding of the biology of the species. Gather information on habitat status and threats.



Cordylus aridus—Farm Botterkraal, Prince Albert distr., WC
P. le F.N. Mouton

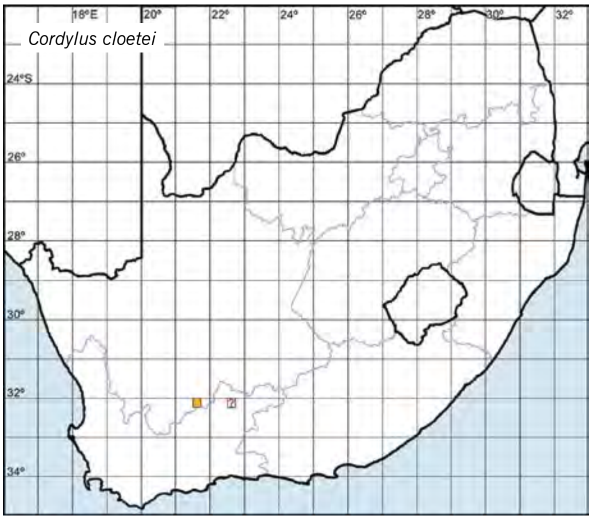
Cordylus cloetei Mouton & Van Wyk, 1994

CLOETE'S GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic



Taxonomy: The taxonomic status of forms in the *Cordylus minor* species complex (Mouton & Van Wyk 1994), to which *C. cloetei* belongs, should be re-evaluated using molecular techniques.

Distribution: Endemic to the Nuweveldberg Mountains in the Western Cape. Since its discovery in 1994 in the Steenkampsvlakte area, there appears to have been only one additional record for this species, at Molteno Pass (3222BA). However, this refers to a sight record and the possibility of confusion with *C. cordylus*, which also occurs in the area (Branch & Braack 1989), cannot be ruled out.

Habitat: Prefers horizontal crevices in large fluvial sandstone rocks from the Teekloof Formation (Beaufort Group), where it can be found singly or in groups of up to three individuals (Mouton & Van Wyk 1994).

Vegetation type: NKu 2 Upper Karoo Hardeveld; NKu 4 Eastern Upper Karoo.

Assessment rationale: Based on the only verifiable locality, this species has a small range (EOO: 675 km^2, AOO: 338 km^2) and appears to be uncommon. However, as there are no serious immediate or future threats, and suitable protected habitat is available in the Karoo National Park, it is considered Least Concern. Because of its small range, over-exploitation by the pet trade could easily become a major concern and would be exacerbated by the species' inherently slow reproductive rate.

Cordylus cloetei—De Hoek, Nuweveldberg, WC W.R. Branch

Conservation measures: Conservation authorities should exercise strict permit control and issue collecting permits only under exceptional circumstances. Carry out field surveys to determine the true range and population numbers, and gather data on the biology of the species. Perform taxonomic studies to confirm its status.

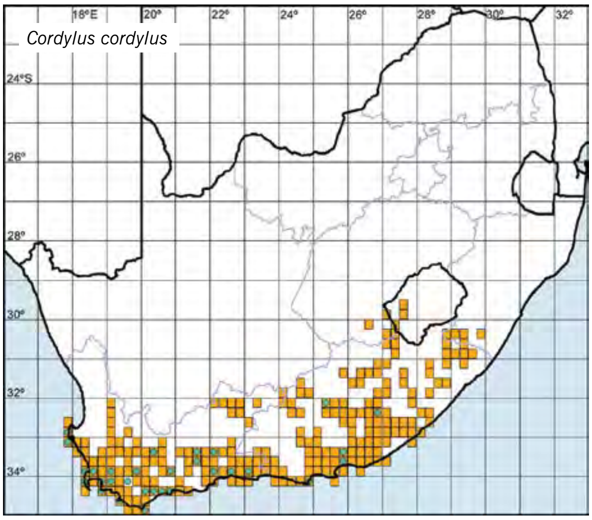
Cordylus cordylus (Linnaeus, 1758)

CAPE GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic



Taxonomy: A molecular analysis by Stanley *et al.* (2011) revealed that specimens assigned to *Cordylus tasmani* showed little genetic divergence from *C. cordylus*. *Cordylus tasmani* is therefore treated as a synonym of *C. cordylus.*

Distribution: Endemic to the southern parts of southern Africa, from the Cederberg and Saldanha in the west (Western and Eastern Cape) (Branch 1998) to the southeastern Free State (De Waal 1978), southwestern Lesotho (Bates 2007b) and southern KwaZulu-Natal (Bourquin 2004). Also found on St Croix Island off the coast of Port Elizabeth (as *Cordylus tasmani*, Branch 1998).

Habitat: Rupicolous, occurring in diverse habitats from coastal rock to mountain top. Often abundant on mountain plateaus in fynbos, or on shale bands in mesic thickets (Branch 1998). In populations previously referred to

C. tasmani, individuals are often found under the apron of dead leaves on tall aloes, under the bark of trees, on dead aloe stems and in piles of rotting Spekboom (*Portulacaria afra*) trunks, but they also occupy cracks in limestone and sandstone outcrops (Branch 1998).

Biome: Fynbos; Albany Thicket; Grassland; Savanna; Nama-Karoo; Forests; Succulent Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Cordylus cordylus—Oyster Bay, EC W.R. Branch

Cordylus cordylus—Indwe, EC W.R. Branch

Cordylus imkeae Mouton & Van Wyk, 1994

ROOIBERG GIRDLED LIZARD

P. le Fras N. Mouton

Global: Near Threatened

Endemic

Taxonomy: The taxonomic status of forms in the *Cordylus minor* species complex (Mouton & Van Wyk 1994), to which *C. imkeae* belongs, should be re-evaluated using molecular techniques.

Distribution: Endemic to the Rooiberg in the Kamiesberg range near Garies in Namaqualand, Northern Cape, South Africa (Mouton & Van Wyk 1994).

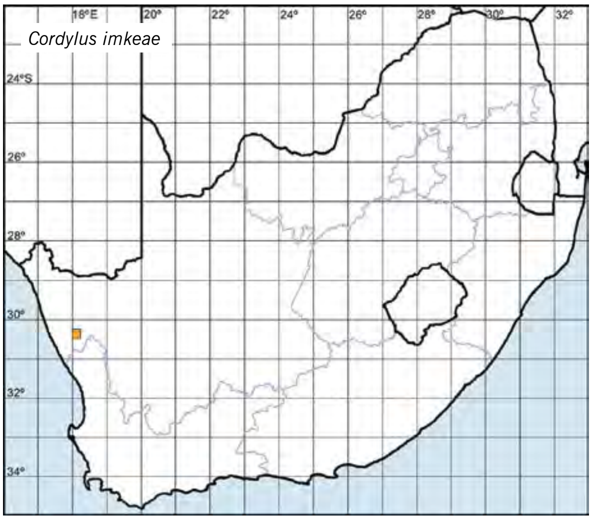
EOO: 675 km^2 (confidence: medium); AOO: 333 km^2 (confidence: medium).

Habitat: Rock-dwelling, sheltering in crevices in granite rocks on high fynbos-covered mountain slopes (Mouton & Van Wyk 1994; Loehr 2010).

Vegetation type: FFg 1 Kamiesberg Granite Fynbos.

Assessment rationale: Although this taxon has a very restricted distribution (EOO and AOO below the Endangered thresholds) and is known from only a single locality, it is not currently experiencing any major threats, and its habitat is not undergoing a continuous decline. The main potential threat is over-exploitation by collectors. It also appears to be a mesic-adapted relict species whose microhabitat might well be one of the first to be threatened by predicted aridification.

Threats: There is no information available on population size, but its restricted distribution and limited dispersal ability makes this species particularly prone to the effects of alien plant infestations, poor fire management and over-exploitation by collectors. The area it occupies is becoming a popular tourist destination.



Cordylus imkeae—Rooiberg near Garies, NC E.L. Stanley

Conservation measures: Collecting permits should be issued only under exceptional circumstances. Conduct field surveys to determine the true range, population size and biology of this species. Control alien plant infestations and manage fires effectively. Compile a BMP-S. Monitor the potentially threatened status of the species.

Cordylus jonesii (Boulenger, 1891)

JONES' GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Taxonomy: Jacobsen (1989) was of the opinion that this taxon is conspecific with *Cordylus tropidosternum*. However, a recent molecular analysis (Stanley *et al.* 2011) indicated that the two species are not closely related.

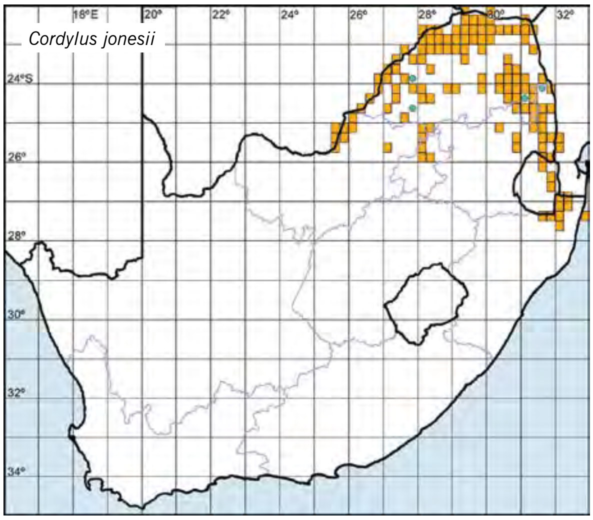
Distribution: Endemic to the east African lowlands including southern Zimbabwe, eastern Botswana, the northeastern provinces of South Africa (eastern North-West Province, Limpopo, northern Gauteng, northeastern Mpumalanga, northeastern KwaZulu-Natal), eastern Swaziland and southern Mozambique (Branch 1998).

Habitat: Largely restricted to dry Lowveld, particularly Mopane savanna (Branch 1998), where it shelters in holes in trees, under loose bark and especially in rotting logs, but occasionally also found in rock crevices (Jacobsen 1989).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt (marginal).

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Cordylus jonesii—Umbabat Private NR, MPM D. & E. Pietersen

Cordylus macropholis (Boulenger, 1910)

LARGE-SCALED GIRDLED LIZARD

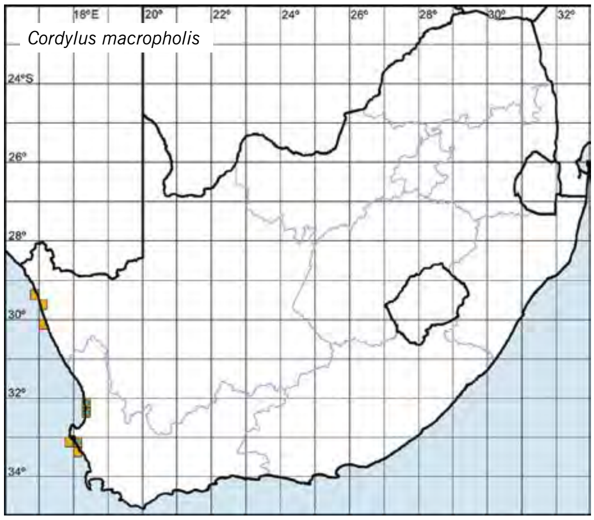
P. le Fras N. Mouton

Global: Near Threatened

Endemic

Taxonomy: A phylogenetic study of the apparently isolated populations (see below) is needed.

Cordylus macropholis—Noup, NC W.R. Branch



Distribution: Endemic to the West Coast of South Africa, in the Northern and Western Cape provinces. Occurs in three subpopulations along the West Coast, from Port Nolloth in the north to Yzerfontein in the south. The distributional gap between northern and southern populations appears to be real.

EOO: 20 528 km² (confidence: high); AOO: 2 700 km² (confidence: high).

Habitat: A terrestrial cordylid, preferring the succulent plant *Euphorbia caput-medusae* and related species as shelter (Mouton *et al.* 2000b). It may also shelter beneath calcrete rocks and in the stick nests of vlei rats (*Otomys* species) (pers. obs.).

Vegetation type: FS 1 Lambert's Bay Strandveld; FS 3 Saldanha Flats Strandveld; AZe 2 Cape Estuarine Salt Marshes; FFd 2 Leipoldtville Sand Fynbos; FS 5 Langebaan Dune Strandveld; SKs 8 Namaqualand Coastal Duneveld.

Assessment rationale: EOO and AOO are close to the Vulnerable thresholds and there is continuing decline in area, extent and quality of habitat [B1b(iii), B2b(iii)] due to coastal developments and mining activities. The species is thus considered Near Threatened.

Threats: Coastal developments, including mining, pose a major threat.

Conservation measures: Draw up a BMP-S. Provide increased habitat protection, e.g. do not allow coastal developments to impact on any populations. Conduct basic research on the biology and ecology of the species.

Cordylus mclachlani Mouton, 1986

MCLACHLAN'S GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic

Taxonomy: No notable issues.

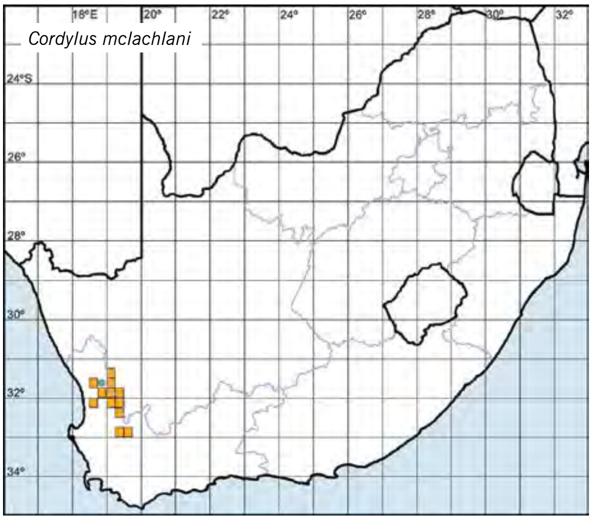
Distribution: Endemic to the greater Cederberg area in the Western and Northern Cape provinces of South Africa, from the Koue Bokkeveld in the south, along the eastern fringes of the Cederberg to the Bokkeveld Mountains in the north (Nieuwoudtville district) (Mouton *et al.* 1992). Since its description in 1986, numerous new locality records have been obtained and the species has been found to be common within its range (Mouton *et al.* 1992).

Habitat: A rupicolous form found in narrow cracks in rocks of the Witteberg and Table Mountain Sandstone formations, in karroid habitat. Appears to prefer low rock formations, being absent in areas of large, piled rock typical of the Skurweberg and Cederberg mountains (Mouton 1986; Mouton *et al.* 1992).

Bioregion: Northwest Fynbos; Rainshadow Valley Karoo; Karoo Renosterveld; Trans-Escarpment Succulent Karoo.

Assessment rationale: Has a restricted range but is abundant and not threatened.

Conservation measures: None recommended.



Cordylus mclachlani—Matjiesrivier NR, Cederberg, WC P. le F.N. Mouton

Cordylus minor FitzSimons, 1943

WESTERN DWARF GIRDLED LIZARD; DWARF GIRDLED LIZARD

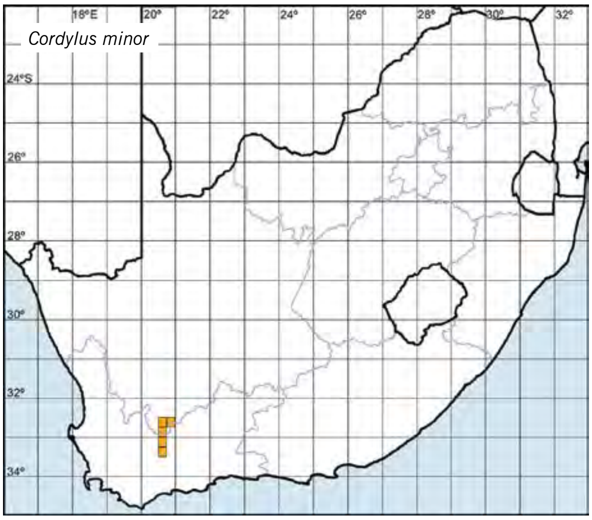
P. le Fras N. Mouton

Global: Least Concern

Endemic

Taxonomy: Originally described as a subspecies of *Cordylus cordylus* by FitzSimons (1943), this taxon was elevated to full species status by Mouton & Van Wyk (1989). The taxonomy of the *C. minor* complex (Mouton & Van Wyk 1994) should be re-evaluated using molecular techniques.

Distribution: Endemic to the western Karoo in the Western and Northern Cape provinces, South Africa, from the Komsberg Range in the north to Matjiesfontein in the south (Branch 1998).



Habitat: Shelters in small, vertical cracks in rock outcrops in lowland areas as well as on mountain slopes (Branch 1998).

Vegetation type: SKv 6 Koedoesberge-Moordenaars Karoo; FRs 5 Central Mountain Shale Renosterveld.

Assessment rationale: EOO <5 000 km² (below the Endangered threshold); AOO <2 000 km² (below the Vulnerable threshold); not common anywhere. Future threats may include climate change and over-collecting, exacerbated by the species' limited dispersal ability. However, *C. minor* is here considered Least Concern as there are currently no significant threats, severe habitat fragmentation or declines in habitat quality.

Conservation measures: Conservation authorities should exercise strict permit control and issue collecting permits only under exceptional circumstances. Carry out field surveys to determine true range and population size, and conduct studies on biology and ecology.

Cordylus minor—Matjiesfontein, WC W.D. Haacke

Cordylus niger Cuvier, 1829

BLACK GIRDLED LIZARD

P. le Fras N. Mouton

Global: Near Threatened

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to the extreme southwestern coastal region of the Western Cape, South Africa, occurring as five isolated subpopulations: two at Saldanha, one each on the Langebaan Peninsula and Jutten Island, and the main subpopulation on the Cape Peninsula (Cordes & Mouton 1996).

EOO: 3 000 km² (confidence: medium); AOO: 415 km² (confidence: medium).

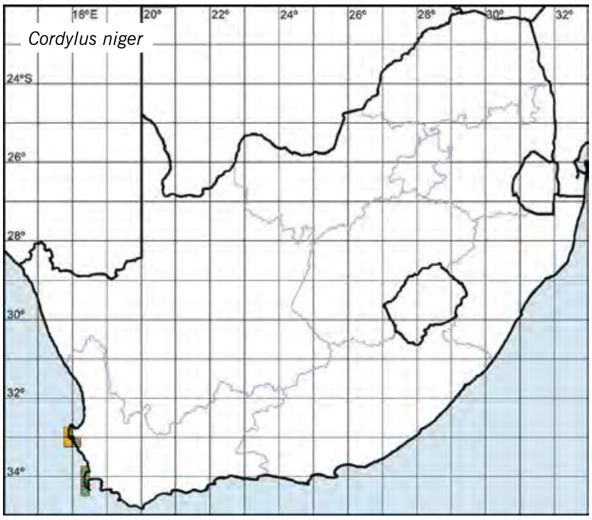
Habitat: Occurs in dense colonies in rocky areas from sea level to mountain tops (Cordes & Mouton 1996).

Vegetation type: FFs 9 Peninsula Sandstone Fynbos; FS 2 Saldanha Granite Strandveld; FFd 6 Hangklip Sand Fynbos; FFg 3 Peninsula Granite Fynbos; FS 5 Langebaan Dune Strandveld.

Assessment rationale: EOO (<5 000 km²) and AOO (<500 km²) are below the Endangered thresholds and there is a continuing decline in the quality of habitat [B1b(iii)+2b(iii)], particularly in the Saldanha area. However, the range does not appear to be severely fragmented, the number of locations exceeds 10, and the species appears to be adaptable to human developments that maintain a semblance of natural habitats, e.g. dry rock walls. The Cape Peninsula population is largely protected within the Table Mountain National Park. This species is thus considered Near Threatened.

Threats: Coastal developments, especially in the case of subpopulations in the Saldanha-Langebaan region (Cordes & Mouton 1996). Being melanistic, *C. niger* is likely to be especially vulnerable to climate change. The high prevalence of domestic cats in suburban areas adjoining suitable mountainous habitat takes a high toll on these lizards (M. Burger pers. comm.).

Cordylus niger—Table Mountain, Cape Town, WC G.J. Alexander



Conservation measures: Draw up a BMP-S. Do not allow further coastal developments, especially in the Saldanha region, to impact on populations of this species. Monitor population trends in the Saldanha-Langebaan area.

Cordylus oelofseni Mouton & Van Wyk, 1990
OELOFSEN'S GIRDLED LIZARD

P. le Fras N. Mouton

Global: Near Threatened

Endemic

Taxonomy: The populations occurring at Dasklip Pass, Landdroskop and Piketberg all display genetic differences comparable to those seen between distinct species elsewhere in the family (Daniels *et al.* 2004; Stanley *et al.* 2011). The latter two populations await formal description as valid species.

Distribution: Endemic to the Western Cape, South Africa, occurring at isolated localities along the western Cape Fold Mountains, from Piketberg and Piekenierskloof Pass in the north to the Hottentots Holland Mountains in the south. Since its description in 1990, *C. oelofseni* has been recorded from one additional QDGC (3319CC).

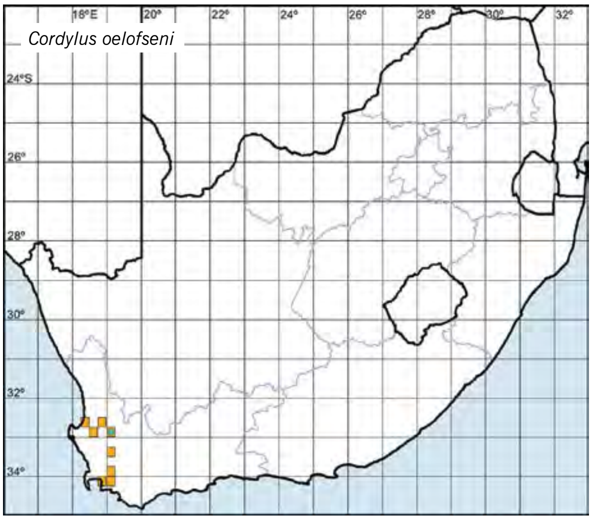
EOO: 7 666 km^2 (confidence: medium); AOO: 1 119 km^2 (confidence: medium).

Habitat: A rock-dwelling species sheltering in narrow cracks along road cuttings or in small sandstone outcrops at higher elevations above 300 m (Mouton & Van Wyk 1990; Janse van Rensburg *et al.* 2009). Occurs in dense colonies on fynbos mountain plateaux (pers. obs.).

Vegetation type: FFs 11 Kogelberg Sandstone Fynbos; FFs 5 Winterhoek Sandstone Fynbos; FFs 3 Olifants Sandstone Fynbos; FFs 6 Piketberg Sandstone Fynbos; FFs 10 Hawequas Sandstone Fynbos; FFs 4 Cederberg Sandstone Fynbos.

Assessment rationale: Has a restricted distribution (EOO and AOO are both below the Vulnerable thresholds) in montane areas where there are distinct threats of alien plant infestation and poor fire management. All populations occur at high altitude, suggesting extensive fragmentation, but there is no data to confirm this.

Threats: This high-elevation melanistic species is likely to be especially vulnerable to climate change (Janse van Rensburg *et al.* 2009). Other threats include alien infestation and poor fire management.



Cordylus oelofseni—Landdroskop, WC P. le F.N. Mouton

Conservation measures: Control alien plant infestations and implement effective fire management strategies. Undertake taxonomic studies to assess the status of the isolated subpopulations. A change in taxonomic status of some of these will necessitate a re-assessment of the conservation status of all taxa in the complex.

Cordylus vittifer (Reichenow, 1887)
COMMON GIRDLED LIZARD; TRANSVAAL GIRDLED LIZARD

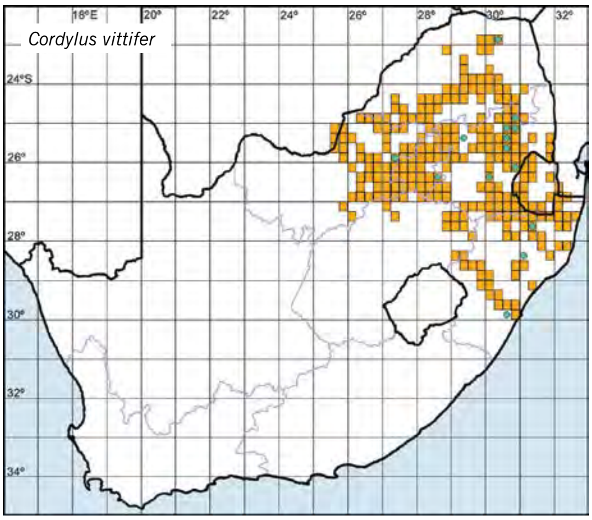
P. le Fras N. Mouton

Global: Least Concern

Near-endemic

Taxonomy: De Waal (1978) recognised three varieties of *Cordylus vittifer vittifer*. Branch (1998) elevated *C. v. machadoi* to full species status, rendering *C. vittifer* a monotypic species. This status was confirmed in a molecular analysis by Stanley *et al.* (2011). The taxonomy of *C. vittifer* is currently being evaluated using molecular and morphological approaches (M.F. Bates & M.J. Cunningham in prep.).

Distribution: Endemic to the northeastern parts of South Africa, Swaziland and southeastern Botswana, with a single locality in southern Mozambique (Auerbach 1987;



Boycott 1992a; Branch 1998; Bates & Broadley 2012). Found in the South African provinces of Limpopo, Mpumalanga, Gauteng, (eastern) North-West, (northern and northeastern) Free State and KwaZulu-Natal (De Waal 1978; Jacobsen 1989; Bourquin 2004).

Habitat: Occurs in rock outcrops in grassland and savanna habitat (De Waal 1978; Jacobsen 1989).

Bioregion: Mesic Highveld Grassland; Central Bushveld; Lowveld; Dry Highveld Grassland; Sub-Escarpment Grassland; Sub-Escarpment Savanna; Indian Ocean Coastal Belt; Mopane (marginally).

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Cordylus vittifer—Wolkberg, LIMP J. Marais

Cordylus vittifer—De Berg Pass, MPM W.R. Branch

Genus *Hemicordylus* Smith, 1838—cliff lizards

The genus *Hemicordylus*—originally used as a subgenus—was resurrected to contain the gracile forms previously assigned to *Pseudocordylus* (Stanley *et al.* 2011). This genus comprises two melanistic species, *H. capensis* and *H. nebulosus*, both endemic to the Cape Fold Mountains of southwestern South Africa. These lizards have relatively long limbs and tails allowing them to scale vertical rock surfaces, hence their preference for cliff and boulder habitats (Janse van Rensburg 2009). In both species, the occipital and caudal scales lack spines and only the southern populations of *H. capensis* have body osteoderms (Janse van Rensburg 2009). Both species have a prenuptial reproductive cycle and females give birth to 1–3 young in autumn. Compared to other cordylids, these are less strictly sit-and-wait foragers (Janse van Rensburg 2009). *Hemicordylus nebulosus* has an extremely restricted mountain top range in an area where alien plant infestation and poor fire management pose distinct threats, and the species is accordingly classified as Vulnerable. *Hemicordylus capensis* is listed as Least Concern.

Hemicordylus capensis (A. Smith, 1838)

CAPE CLIFF LIZARD; GRACEFUL CRAG LIZARD

Michael F. Bates

Global: Least Concern

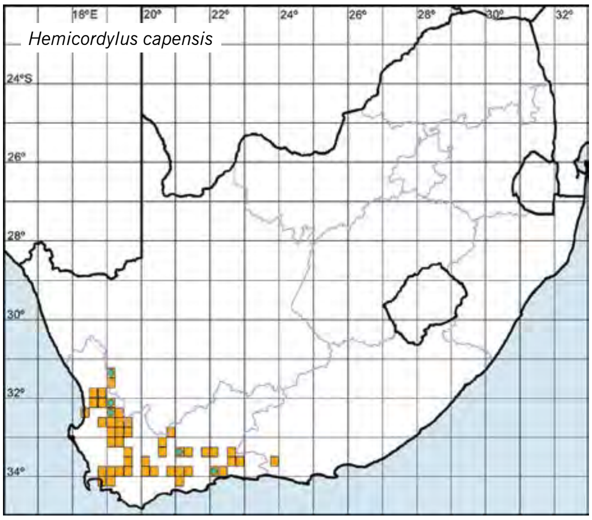
Endemic

Taxonomy: This species was previously contained within *Pseudocordylus* (Stanley *et al.* 2011). Loveridge (1944) recognised two species, *Pseudocordylus capensis* and *P. robertsi* (Van Dam 1921), but these were treated as subspecies of *P. capensis* by Branch (1981). The complex was later analysed by Herselman *et al.* (1992) who found that two morphotypes were identifiable in the northern (*robertsi*) and southwestern (*capensis*) parts of the range, but that these were connected by a continuum of variation. These authors therefore referred *P. robertsi* to the synonomy of *P. capensis*. A mitochondrial DNA analysis of *Hemicordylus* by Mabe (2009) revealed the existence of six genetically distinct lineages, which are for the most part geographically separated, and suggested a recent radiation in the genus. Three of these lineages are referable to described species, namely *H. capensis* (southwestern Cape), *P. robertsi* (Bokkeveld and Cederberg) and *H. nebulosus* (Landdroskop), while the others may represent undescribed species. Formal recognition of *H. robertsi* as a valid species and description of new taxa await further analysis of samples (Mabe 2009; M.J. Cunningham pers. comm.). In another multi-gene study, Stanley *et al.* (2011) also noted deep levels of divergence within *H. capensis*, indicating low levels of gene flow between populations, and suggested that cryptic species may be present.

Distribution: Endemic to South Africa and largely restricted to the Western Cape, occurring in a series of isolated montane populations from the Cederberg in the north to Landdroskop in the south, then eastwards through the Cape Fold Mountains from the Hottentots Holland Mountains to the Kammanassieberg. There are only a few marginal records in the Northern Cape (e.g. 3119AC) and Eastern Cape (easternmost locality is Kouga Mountains, 3323DB). The most inland locality is the Witteberg (3220BC, 1 052 m) near Matjiesfontein, and the species also occurs in the Piketberg and Skurweberg in the west (Herselman 1991).

Habitat: Found in small, diffuse colonies on high mountain tops and slopes where wary individuals run around on smooth, often vertical slopes, sheltering in rock cracks and crevices (FitzSimons 1943; Branch 1998). Occurs on Table Mountain Sandstone near Clanwilliam and Van Rhynsdorp (Loveridge 1944c). Found at altitudes as low as 360–455 m on the West Coast (Herselman 1991).

Biome: Fynbos; Succulent Karoo.



Hemicordylus capensis—Swartberg Range, WC M.F. Bates

Hemicordylus capensis—Swellendam, WC S. Nielsen

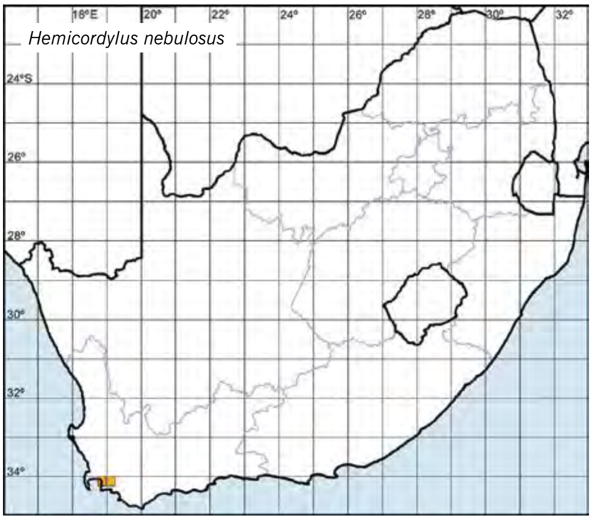
Assessment rationale: Although populations tend to occur as montane isolates (Herselman *et al.* 1992; Branch 1985), the species is widespread and common.

Conservation measures: The possible description and/or re-validation of cryptic species may require re-assessment of the conservation status of all (or some) populations.

Hemicordylus nebulosus (Mouton & Van Wyk, 1995)

DWARF CLIFF LIZARD; DWARF CRAG LIZARD

Michael F. Bates



Global: Vulnerable D1+2

Endemic

Taxonomy: The recent transfer of *Pseudocordylus nebulosus* to the genus *Cordylus* by Frost *et al.* (2001) was problematic because the new name *C. nebulosus* was preoccupied by *Cordylus nebulosus* A. Smith, 1838, a junior synonym of *Cordylus cataphractus* Boie, 1828. However, the resurrection of *Hemicordylus* (for *P. nebulosus* and *P. capensis*) by Stanley *et al.* (2011) removed the secondary homonymy. Its status as a separate species from *P. capensis* was confirmed by the molecular analyses of Mabe (2009) and Stanley *et al.* (2011).

Distribution: Endemic to the Hottentots Holland Mountain Range of the Western Cape, South Africa. Known only from the Landdroskop area.

EOO: 1 350 km^2 (confidence: high); AOO: 7 km^2 (confidence: medium).

Habitat: Rupicolous and found on vertical rock faces, piles of medium-sized boulders, or on the mountain summit, usually within 10 m of a stream or seepage (Costandius *et al.* 2006). Occurs at altitudes of 1 200–1 500 m in the mistbelt of the Western Cape in the Fynbos Biome (Costandius *et al.* 2006).

Vegetation type: FFa 4 Lourensford Alluvium Fynbos; FFs 11 Kogelberg Sandstone Fynbos.

Assessment rationale: Costandius *et al.* (2006) counted a total of only 131 individuals at 26 sites in the vicinity of the type locality (Landdroskop area), thus it is estimated that the population consists of fewer than 1 000 mature individuals [D1]. Furthermore, the AOO is less than 20 km^2 [D2]. This species is therefore considered Vulnerable.

Hemicordylus nebulosus—Hottentots Holland Mtns, WC P. le F.N. Mouton

Threats: *Hemicordylus nebulosus* may be restricted to a cold montane refugium, with nowhere to move if temperatures increase. In addition, warm-adapted species lower down the mountain may be able to expand into areas occupied by *H. nebulosus* and compete for shelter and food resources (Costandius *et al.* 2006). Changes in global temperatures will result in longer and more extreme droughts and cold spells, and might necessitate rapid adaptation to habitat changes. Inappropriate fire management is a threat because fires that are too infrequent result in overgrowth of vegetation with a resultant reduction in basking sites, whereas fires that are too frequent or too intense may reduce populations to levels from which they cannot recover (Costandius *et al.* 2006). Alien plant infestation is not currently a problem but should be monitored, because some alien plants burn at higher temperatures than natural vegetation. The species is also potentially threatened by its limited dispersal capabilities and very restricted range. A popular hiking trail passes through the only known population of this species, allowing easy access for illegal pet trade collecting (Costandius *et al.* 2006).

Conservation measures: Develop a BMP-S. Conduct research into population numbers and range, and biology and ecology. Also, monitor the population, control alien plants, maintain effective fire management, and manage human traffic and disturbance on hiking routes (perhaps by restricting the number of hikers per day).

Genus *Karusasaurus* Stanley, Bauer, Jackman, Branch & Mouton, 2011—karusa lizards

The genus *Karusasaurus* comprises two species, *K. polyzonus* and *K. jordani*, both widely distributed in the semi-arid regions of South Africa (*polyzonus*) and southern Namibia (*jordani*). These two species were previously contained in the genus *Cordylus* (Stanley *et al.* 2011). The genus name is derived from the Khoisan word 'karusa', which means dry, barren, thirstland (Stanley *et al.* 2011). 'Karoo' is also derived from 'karusa'. The validity of *K. jordani* as a full species has been questioned, but a recent molecular study confirmed its status (Stanley *et al.* 2011). These medium-sized cordylids are rupicolous and heliothermic baskers. Females lack both femoral and generation glands. Both species display well developed cranial kinesis and limited sexual size dimorphism, but no sexual dichromatism. *Karusasaurus polyzonus* also displays extensive geographical colour variation, including melanistic populations along the West Coast of South Africa. Only *K. polyzonus* occurs in the *Atlas* region and because of its extensive range, it is classified as Least Concern.

Karusasaurus polyzonus (A. Smith, 1838)

SOUTHERN KARUSA LIZARD;
KAROO GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Near-endemic

Taxonomy: Previously contained in the genus *Cordylus* (Stanley *et al.* 2011). The melanistic population in the Saldanha-Langebaan area was previously suspected to be a separate species (Mouton *et al.* 2002), but recent molecular analyses (Engelbrecht *et al.* 2011; Stanley *et al.* 2011) do not support this possibility.

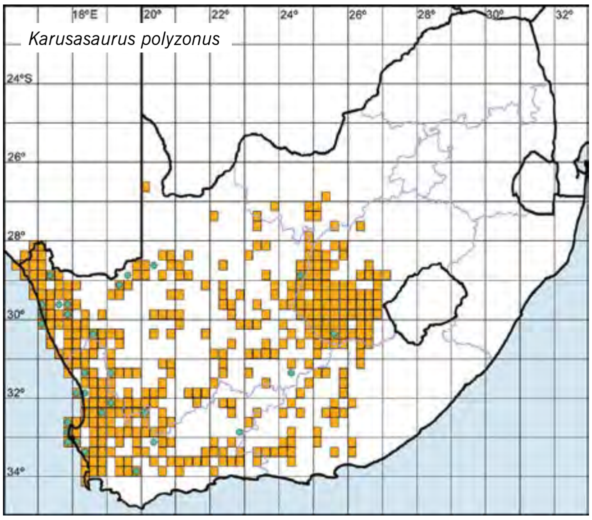
Distribution: Endemic to the western and central areas of South Africa and southern Namibia (Branch 1998). In the east, the distribution extends almost to the Lesotho border. Earlier records in Lesotho and along the KwaZulu-Natal border have not been confirmed. These lizards are absent from the southern coastal regions.

Habitat: This rock-dwelling species occurs over a wide range of habitats in arid western and central karroid areas. It inhabits rocky outcrops in lowland areas and on lower mountain slopes (pers. obs.). In the Free State it is common on dolerite rock outcrops on small koppies, occupying the lower slopes (De Waal 1978; M.F. Bates unpubl. obs.).

Biome: Fynbos; Succulent Karoo; Nama-Karoo; Savanna; Desert; Grassland; Albany Thicket.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Karusasaurus polyzonus—Steytlerville, EC W.R. Branch

Genus *Namazonurus* Stanley, Bauer, Jackman, Branch & Mouton, 2011—nama lizards

The genus *Namazonurus* comprises five species. Two of these are endemic to Namaqualand in South Africa, while the other three are restricted to southern and central Namibia. All five species were previously contained in the genus *Cordylus* (Stanley *et al.* 2011). The name *Namazonurus* is derived from Nama, referring to Namaqualand, which is occupied by Nama-speaking people, and *Zonurus* (the earlier name for *Cordylus* sensu lato) meaning girdle-tailed (Stanley *et al.* 2011). These small to medium-sized viviparous cordylids are rupicolous. They display limited sexual dimorphism in body size, but no sexual dichromatism. *Namazonurus peersi* is a melanistic species often found in small groups. All species display a prenuptial reproductive cycle and litter size varies from two to four (Branch 1998). Only two species occur in the *Atlas* region and both are considered to be Least Concern.

Namazonurus lawrenci (FitzSimons, 1939)

LAWRENCE'S NAMA LIZARD; LAWRENCE'S GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic

Taxonomy: Previously contained within the genus *Cordylus* (Stanley *et al.* 2011).

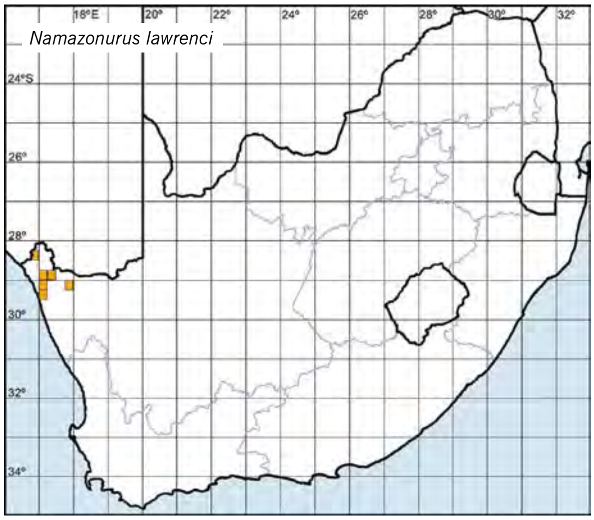
Distribution: Endemic to the Richtersveld of the Northern Cape, South Africa (Bauer & Branch 2003 [2001]).

Habitat: A rock-dwelling form that occurs in mesic habitats on the highest slopes and summits of mountains in the Richtersveld, although it is found at lower elevations (250 m) at Gemsbokvlei (Branch 1998; Bauer & Branch 2003 [2001]).

Vegetation type: SKr 12 Kosiesberg Succulent Shrubland; SKr 1 Central Richtersveld Mountain Shrubland; SKr 14 Southern Richtersveld Inselberg Shrubland; SKr 4 Lekkersing Succulent Shrubland; SKr 5 Vyftienmyl se Berge Succulent Shrubland.

Assessment rationale: Has a restricted distribution with range estimates below the Vulnerable thresholds (EOO = 5 628 km^2 [B1], AOO = 1 950 km^2 [B2]). However, there are no clear indications of current threats causing population reductions. Nevertheless, overgrazing, and over-collection of specimens at known localities, in combination with poor recruitment, may become a threat. This species prefers mesic microhabitats associated with fog belt and therefore may be affected by future climate change.

Conservation measures: Conservation authorities should exercise strict control and issue collecting permits only under exceptional circumstances. Perform field surveys to determine the true range and population size, and improve understanding of the biology, of the species.



Namazonurus lawrenci—Farm Ograbies, Namaqualand, NC W.D. Haacke

Namazonurus peersi (Hewitt, 1932)

PEERS' NAMA LIZARD; PEERS' GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic

Taxonomy: Previously contained in the genus *Cordylus* (Stanley *et al.* 2011).

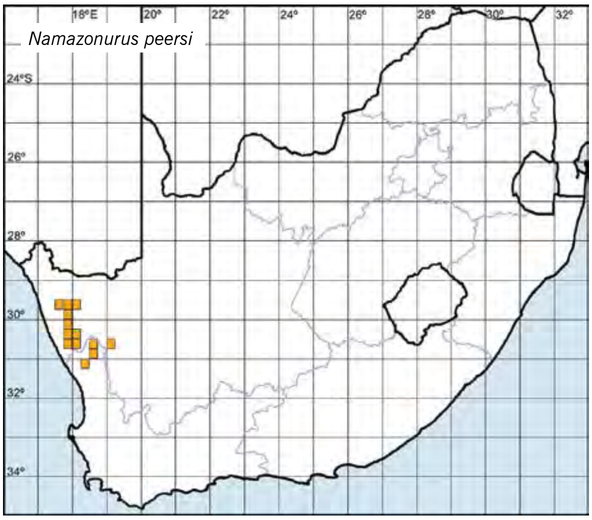
Distribution: Endemic to Namaqualand in the Northern and Western Cape provinces, South Africa, from Springbok in the north to Bitterfontein in the south (Branch 1998).

Habitat: A rock-dwelling species that often shelters in small groups beneath thin flakes on the huge granite boulders typical of Namaqualand (Branch 1998; Fell 2005). Restricted to the higher slopes of hills and mountains (P. le F.N. Mouton pers. obs.). Occurs in Succulent Karoo as well as fynbos habitat.

Vegetation type: SKn 1 Namaqualand Klipkoppe Shrubland; FFg 1 Kamiesberg Granite Fynbos; FRg 1 Namaqualand Granite Renosterveld; SKn 2 Namaqualand Shale Shrubland; SKn 3 Namaqualand Blomveld.

Assessment rationale: Has a restricted range but is abundant and not threatened.

Conservation measures: None recommended.



Namazonurus peersi—Springbok, NC W.R. Branch

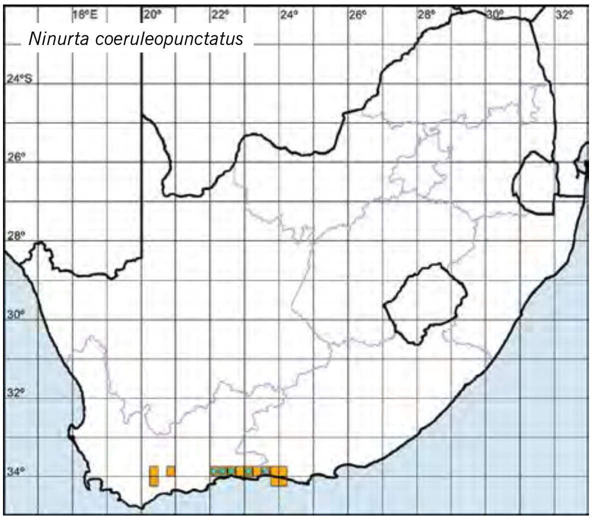
Genus *Ninurta* Stanley, Bauer, Jackman, Branch & Mouton, 2011—blue-spotted lizards

The genus name is derived from Ninurta, the god of rain and the south wind, in Summerian and Akkadian mythology (Stanley *et al.* 2011). The single species in the genus, *Ninurta coeruleopunctatus*, was previously considered to be closely related to *Hemicordylus capensis* and *H. nebulosus* (Branch 1981; Herselman 1991; Frost *et al.* 2001), and together with them was contained in the genus *Cordylus* (Frost *et al.* 2001). The phylogenetic analysis by Stanley *et al.* (2011) recovered *Ninurta* as sister to *Chamaesaura*, although this relationship was not strongly supported. *Ninurta coeruleopunctatus* is a rupicolous lizard endemic to the southern Cape Fold Mountains of South Africa. Like the two *Hemicordylus* species, it lacks occipital and caudal spines and has only weakly-developed body osteoderms, and like juvenile *H. capensis*, it has a colourful gular patch. It occurs in dense populations from mountain tops to the coast and is not considered threatened.

Ninurta coeruleopunctatus (Hewitt & Methuen, 1913)

BLUE-SPOTTED LIZARD;
BLUE-SPOTTED GIRDLED LIZARD

P. le Fras N. Mouton



Global: Least Concern

Endemic

Taxonomy: Previously contained within the genus *Cordylus* (Stanley *et al.* 2011). The taxonomic status of the Langeberg population should be investigated because there are distinct morphological differences between specimens from this area and the main population in the east (pers. obs.).

Distribution: Endemic to the southern Cape Fold Mountains of the Western and Eastern Cape, South Africa, from the Langeberg Mountains in the west to Witelsbos in the east (Branch 1998).

Habitat: Rupicolous; common in suitable moist habitat in fynbos and forest fringes; occurs on coastal cliffs and mountain tops (Branch 1998).

Bioregion: Eastern Fynbos-Renosterveld; Southern Fynbos; East Coast Renosterveld.

Assessment rationale: Has a restricted range but is abundant and not threatened.

Conservation measures: None recommended.

Ninurta coeruleopunctatus—Storms River Mouth, Tsitsikamma NP, EC
W.R. Branch

Genus *Ouroborus* Stanley, Bauer, Jackman, Branch & Mouton, 2011—armadillo lizards

This genus comprises a single species, *Ouroborus cataphractus*, which occurs in the semi-arid western regions of the Western Cape and Northern Cape provinces of South Africa. It was previously contained in the genus *Cordylus* (Stanley *et al.* 2011). The ouroborus is a symbol of a dragon biting or swallowing its own tail to form a circle. This heavily-armoured lizard displays the unusual defensive behaviour of grasping its spiny tail in its mouth and rolling into a tight ball when threatened, hence the common name 'armadillo lizard'. These are rupicolous, group-living lizards and termitophagy—the Southern Harvester Termite *Microhodotermes viator* is the most important prey—is believed to be the indirect cause of group-living in this species (Shuttleworth *et al.* 2008). Individuals have a very low resting metabolic rate (Mouton *et al.* 2000a) and females normally produce only one offspring per year (Flemming & Mouton 2002). The impact of the pet trade on *O. cataphractus* has been over-emphasized and, although previously categorised as Vulnerable by the IUCN (1996), it is here considered as Least Concern.

Ouroborus cataphractus (Boie, 1828)

ARMADILLO LIZARD;
ARMADILLO GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic

Taxonomy: Previously contained within the genus *Cordylus* (Stanley *et al.* 2011).

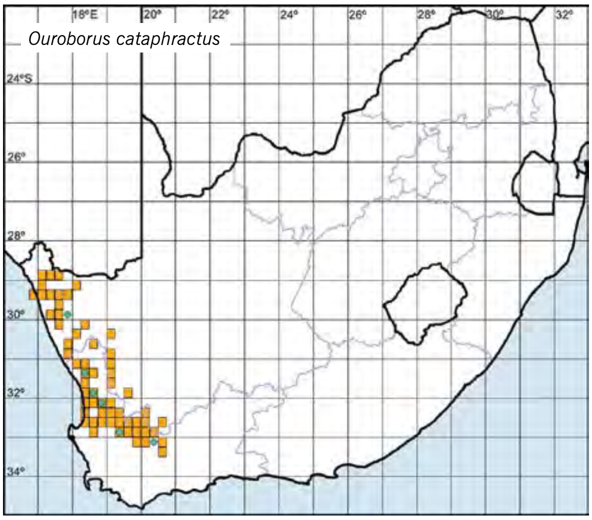
Distribution: Endemic to the Succulent Karoo Biome in the winter rainfall zone of the Northern and Western Cape provinces, South Africa. Occurs from the southern Richtersveld to the Piketberg Mountains and inland as far as the southern Tankwa Karoo and Matjiesfontein (Shuttleworth 2006).

Habitat: Group-living and found in rock crevices, especially sandstone. Particularly abundant on rock outcrops on the western coastal lowlands, but also on lower mountain slopes (Hayward & Mouton 2007; Shuttleworth *et al.* 2008). Preys mainly on the Southern Harvester Termite *Microhodotermes viator* (Mouton *et al.* 2000a).

Bioregion: Northwest Fynbos; Rainshadow Valley Karoo; Namaqualand Hardeveld; Richtersveld; Namaqualand Cape Shrublands; Knersvlakte; Namaqualand Sandveld; Trans-Escarpment Succulent Karoo; West Strandveld.

Assessment rationale: Widespread and common. Although previously thought to suffer from over-exploitation by the pet trade (Mouton 1988c), this threat is no longer considered significant.

Conservation measures: None recommended.



Ouroborus cataphractus—near Calvinia, WC J. Marais

Genus *Pseudocordylus* A. Smith, 1838—crag lizards

The genus *Pseudocordylus* is endemic to the *Atlas* region where it is restricted to the eastern and southern parts. There are five described species (eight taxa). The *P. melanotus* (Bates 2007a) and *P. microlepidotus* (Cunningham 2004; Makhubo 2009) species complexes are undergoing revision. Crag lizards are diurnal, rupicolous, high-altitude lizards that are seldom found far from the narrow crevices in which they hide. Females give birth to 1–7 young (Branch 1998) and at least some species display a postnuptial reproductive cycle (Flemming 1993a,b). Several individuals of some species (e.g. *P. m. subviridis*) are regularly found in close association and often in the same crevices, but others (e.g. *P. transvaalensis*) are usually found singly in crevices and at lower densities on rocky outcrops (Bates 2007a). *Pseudocordylus langi*, *P. spinosus*, *P. transvaalensis* and *P. microlepidotus namaquensis* have restricted ranges and all but the latter are considered Near Threatened. Both *P. spinosus* and *P. langi* were classified as Restricted in the South African Red Data Book (Branch 1988a) and as Near Threatened by the IUCN (1996). *Pseudocordylus langi* is restricted to very high altitudes and may be adversely affected by increasing temperatures. Eastern populations of *P. transvaalensis* may be negatively affected by afforestation.

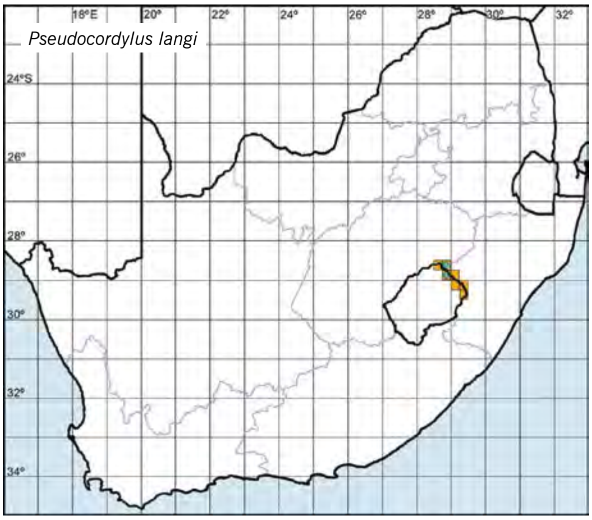
Pseudocordylus langi Loveridge, 1944

LANG'S CRAG LIZARD

Michael F. Bates & Michael J. Cunningham

Global: Near Threatened

Endemic



Taxonomy: The status of *Pseudocordylus langi* as a separate species was confirmed by Broadley (1964) and Bates (2007a). Molecular studies indicate that it is the basal species in the genus (Bates 2007a; Stanley *et al.* 2011) and not the most derived species as suggested by Broadley (1964). The phylogeography of *P. langi* was studied by Goedbloed & Cunningham (2006), who found that the species comprises a single historical lineage. Morphological variation and aspects of the ecology of this species are being investigated (M.F. Bates & M.J. Cunningham in prep.).

Distribution: Endemic to the Drakensberg range of KwaZulu-Natal, Free State and Lesotho. The majority of the range is between Giant's Castle and The Sentinel in KwaZulu-Natal, with a northwesterly extension into the Qwaqwa Drakensberg of the Free State, and a single record from Mechachaneng Peak in adjacent northern Lesotho.

EOO: 8 100 km^2 (confidence: high); AOO: 135 km^2 (confidence: high).

Habitat: Restricted to cliffs and crevices at the escarpment edge, on nearby rocky buttresses and on the adjacent summit, at extreme altitudes of 2 700–3 100 m. Occurs only in the Grassland Biome.

Vegetation type: Gd 7 uKhahlamba Basalt Grassland; Gd 8 Lesotho Highland Basalt Grassland; Gd 10 Drakensberg Afroalpine Heathland.

Assessment rationale: Despite an EOO <20 000 km^2 (below the Vulnerable threshold) and an AOO <500 km^2 (below the Endangered threshold), and although there are only six known subpopulations at a single location (climate change, in this case an increase in temperature, will affect all populations) [B1a+2a], there are no known habitat or population declines or fluctuations.

Threats: Although largely protected by its inhospitable rocky habitat, this species is potentially threatened by its limited dispersal capabilities due to restriction to a zone of about 400 m on the upper escarpment. This also means that global climate change (in this case warming) may be a serious threat. Hikers may cause disturbance to habitat in some limited areas around frequently visited sites.

Pseudocordylus langi—Chain Ladder, Drakensberg, FS M.F. Bates

Conservation measures: Ensure that legislating bodies treat this species as Near Threatened and afford it the necessary protection. Develop a BMP-S. Communicate with farmers and other locals and educate them about this species. Undertake research into population numbers and exact ranges, the status of available habitat, and biology and ecology of the species. Monitor populations in areas of high human traffic—this species may be affected by over-collecting and disturbance at some hiking trail passes up the Drakensberg escarpment. It may also be susceptible to climate change and potentially to catastrophic disease.

Pseudocordylus melanotus melanotus (A. Smith, 1838)

COMMON CRAG LIZARD

Michael F. Bates

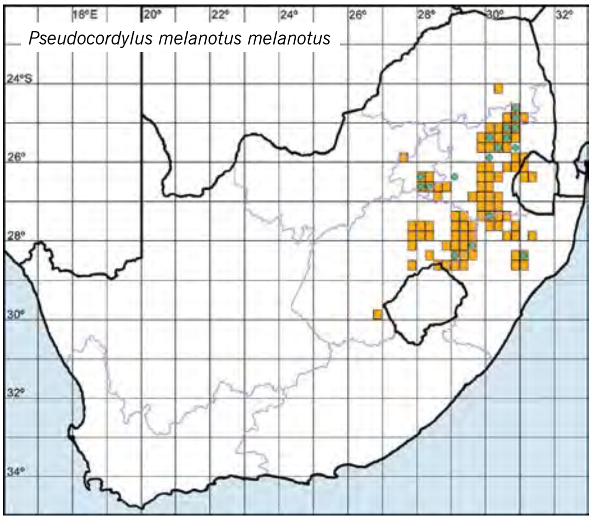
Global: Least Concern

Endemic

Taxonomy: Genetic and morphological data suggests that northern populations of *Pseudocordylus melanotus melanotus* (northern Mpumalanga and Swaziland), southern populations of *P. m. melanotus*, and *P. m. subviridis* are all sufficiently differentiated to be considered separate species (Bates 2007a). However, further analyses are being conducted (M.F. Bates *et al.* in prep.) in order to fully resolve the taxonomy of the *P. melanotus* species complex.

Distribution: Endemic to the *Atlas* region. In South Africa, it occurs in Mpumalanga, Gauteng, Free State and KwaZulu-Natal, with a single isolated record in Limpopo (2430AB). Also found in northwestern Swaziland. The southern Gauteng population (1 500–1 860 m) is isolated, as are populations in Nkandhla district in KwaZulu-Natal (1 100–1 500 m) and in the northeastern and southeastern Free State (Bates 2005a). This species was recently recorded from the Magaliesberg Range in western Gauteng (Bates & Whittington-Jones 2009), representing yet another isolated population. A locality at 2531DD in northeastern Swaziland (Bates 2005a) is questionable as it is situated well within the Lowveld—an unlikely area for this species—and it has therefore not been mapped here.

Habitat: Apart from a single record marginally within the Lowveld (2431CC), this species occurs only in the Grassland Biome of South Africa and Swaziland. It is largely restricted to Mesic Highveld Grassland and Sub-Escarpment Grassland, with only a couple of peripheral records in Dry Highveld Grassland (northeastern Free State), at altitudes of 1 100–2 300 m (Bates 2005a). Found on rock outcrops in montane and Highveld grassland (De Waal 1978; Jacobsen 1989). Occurs on the northern extension of the Drakensberg plateau and on the eastern escarpment of Mpumalanga, but not restricted to such areas, e.g. it also occurs at Suikerbosrand in Gauteng (Bates 2005a). Shelters in narrow crevices between rocks.



Pseudocordylus melanotus melanotus—W of Dullstroom, MPM M. Burger

Bioregion: Mesic Highveld Grassland; Sub-Escarpment Grassland; Dry Highveld Grassland.

Assessment rationale: Widespread and common. Because it is rupicolous, its habitat is generally unlikely to be destroyed by farming activities.

Conservation measures: None recommended.

Pseudocordylus melanotus subviridis (A. Smith, 1838)

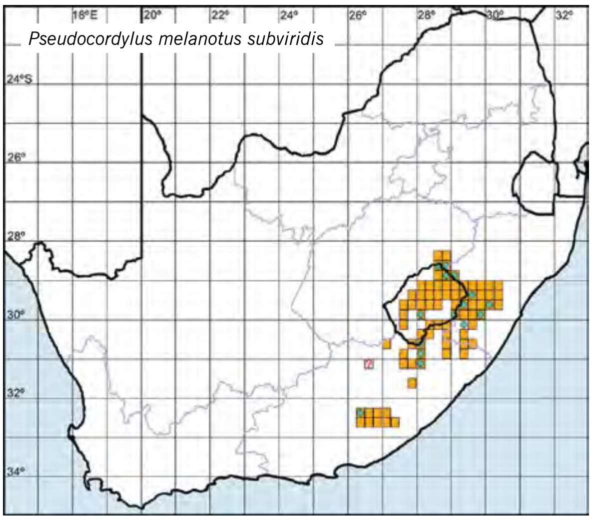
DRAKENSBERG CRAG LIZARD

Michael F. Bates

Global: Least Concern

Endemic

Taxonomy: Genetic and morphological evidence suggests that *P. melanotus subviridis* is sufficiently differentiated from northern and southern populations of *P. m. melanotus* (both may represent separate species) to be considered a separate species (Bates 2007a). In their multi-gene study, Stanley *et al.* (2011) found that *P. m. melanotus* and *P. transvaalensis* were closely related and constituted the sister clade of *P. m. subviridis*, and they therefore suggested that the latter be treated as a full species. However, their only *P. m. melanotus* sample was from the



same geographical area as *P. m. melanotus*-like populations that Bates (2007a) considered representative of an undescribed species. Bates (2007a) also found considerable sub-structuring within *P. m. subviridis*. An expanded phylogeographical analysis is currently being conducted in order to resolve the taxonomy of the *P. melanotus* species complex (M.F. Bates *et al.* in prep.).

Distribution: Endemic to Lesotho and South Africa. Occurs in at least two geographically isolated populations, one in the Maloti-Drakensberg Range (1 400–3 200 m) in Lesotho, northeastern Free State, southwestern KwaZulu-Natal and the northeastern part of the Eastern Cape, and the other in the Amatole and Great Winterberg mountains (1 400–1 600 m) in the Eastern Cape (Bates 2005a). The record at QDGC 3126BA is slightly out of range and requires confirmation as the specimens may be referable to *P. microlepidotus fasciatus*.

Habitat: Restricted to the Grassland Biome. Found in colonies among rocks and on steep cliffs in mountainous areas, where it shelters in narrow crevices. In some very high altitude areas, e.g. the top of Organ Pipes Pass, it is subject to considerable periods of misty, overcast weather.

Bioregion: Drakensberg Grassland; Sub-Escarpment Grassland.

Assessment rationale: Widespread and common. Found mostly in high-elevation areas where the primary farming activity, grazing of cattle or goats, does not impact significantly on its habitat.

Conservation measures: None recommended.

Pseudocordylus melanotus subviridis, male—about 20 km SW of Cedarville, EC M. Burger

Pseudocordylus melanotus subviridis, female—20 km SW of Cedarville, EC M. Burger

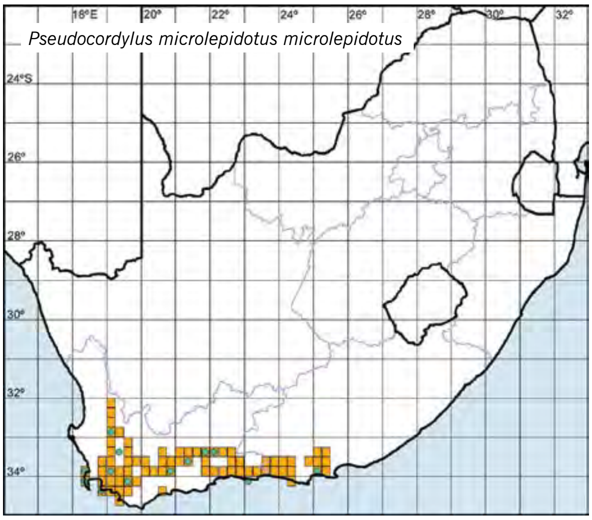
Pseudocordylus microlepidotus microlepidotus (Cuvier, 1829)

CAPE CRAG LIZARD

Michael F. Bates

Global: Least Concern

Endemic



Taxonomy: Although there are some morphological features that distinguish this subspecies from *P. microlepidotus fasciatus* and *P. m. namaquensis* (FitzSimons 1943; Bates 2005a), the taxonomic status of the latter two subspecies should be re-evaluated. A molecular analysis indicated that despite its fragmentary distribution in the Cape Fold Mountains, there is little indication of phylogenetic or geographical structuring in *P. m. microlepidotus* and no evidence of cryptic taxa, suggesting that this taxon is highly vagile with a historically large and stable population size (Makhubo 2009).

Pseudocordylus microlepidotus microlepidotus—Heuningvlei, Cederberg, WC P. le F.N. Mouton

Distribution: Endemic to the Western and Eastern Cape, South Africa (Bates 2005a). Found in all the main elements of the Cape Fold Mountains, including the Cederberg, Dutoitskloofberg, Riviersonderendberg, Hexrivierberg, Langeberg, Anysberg, Kammanassieberg, Rooiberg, Swartberg, Outeniqua, Tsitsikamma, Langkloof, Baviaanskloofberg, Kouga, Elandsberg, Great Winterhoekberg and Suurberg mountains (Bates 2005a).

Habitat: Found in montane regions (20–1 920 m) on rock outcrops and cliffs, usually in fynbos or on grassy slopes, sheltering in crevices or under rocks; known to use large crevices that are partly filled with soil, in which it may excavate a chamber (Branch 1998; Bates 2005a).

Biome: Fynbos; Succulent Karoo.

Assessment rationale: Widespread and abundant.

Conservation measures: None recommended.

Pseudocordylus microlepidotus fasciatus A. Smith, 1838

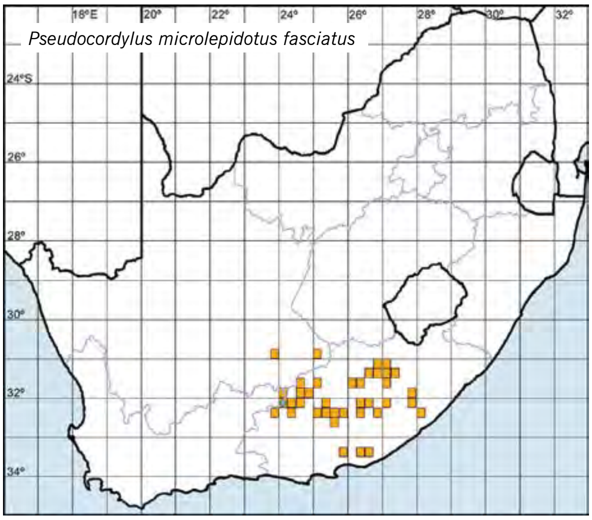
KAROO CRAG LIZARD

Michael F. Bates

Global: Least Concern

Endemic

Taxonomy: Although there are some morphological features that distinguish this subspecies from *Pseudocordylus microlepidotus microlepidotus* and *P. m. namaquensis* (FitzSimons 1943; Bates 2005a), its taxonomic status should be re-evaluated. Individuals from the Transkei region (3127DD, 3227BB, 3228AC) of the Eastern Cape have narrow dorsal bands on the back and may represent a separate species or subspecies (Hewitt 1927; Branch 1998), but because there are no other distinct morphological differences, this can only be clarified by molecular analysis. A mitochondrial DNA analysis (Makhubo 2009) indicated that *P. m. fasciatus* is probably a junior synonym of *P. m. microlepidotus*, but further studies, using more representative samples of the former taxon, are needed to resolve its taxonomic status. In the same study, a sample from the Transkei population was found to be nested within *P. m. microlepidotus*. Stanley *et al.* (2011) found that a sample from the Transkei was divergent from *P. m. microlepidotus* but they did not include samples of *P. m. fasciatus* or *P. m. namaquensis* in their analysis.



Pseudocordylus microlepidotus fasciatus—Asante Sana GR, EC
W. Conradie

Distribution: Endemic to South Africa. Found in the inland mountains of the Eastern Cape, with peripheral records in the Northern and Western Cape. Recorded from the Sneeuberg, Stormberg, Bamboesberg and Winterberg, as well as the Mount Arthur Range (Bates 2005a). Unlike *P. m. microlepidotus*, it is excluded from the Cape Fold Mountains, but occurs near the eastern end of the latter range in the Olifantskop Pass (3325BD) and Grahamstown areas, these being the most southerly records (Bates 2005a). The most northerly localities are near Colesberg (3025CC) and at Deelfontein near Richmond (3023DD). Bates (2005a) questioned the latter locality because Boulenger (1903) had described this area as barren and flat, but on a recent visit to the area (M.F. Bates pers. obs.), it was noted that small koppies with numerous rock crevices were present in the immediate vicinity of Deelfontein. This subspecies occurs as far west as the Kamdebooberg (3223BD) near Aberdeen, and as far east as Butterworth (3228AC), the latter being part of the range of the unusually marked Transkei population (Bates 2005a). *Pseudocordylus m. fasciatus* has been collected parapatrically with *P. m. subviridis* at a few localities, namely the farm Finella Falls (3226AD) in the Great Winterberg Range, near the adjacent Amatole Range, and in the Stormberg near Dordrecht (Bates 2005a).

Habitat: Occurs mainly in the Grassland and Nama-Karoo biomes. Inhabits rock outcrops, sheltering in crevices. In the inland mountains of the Eastern Cape, it is found at elevations of 440–1 900 m (Bates 2005a).

Bioregion: Drakensberg Grassland; Sub-Escarpment Grassland; Dry Highveld Grassland; Upper Karoo; Albany Thicket.

Assessment rationale: Fairly widespread and locally abundant.

Conservation measures: None recommended.

Pseudocordylus microlepidotus namaquensis Hewitt, 1927
NUWEVELDBERG CRAG LIZARD

Michael F. Bates

Global: Least Concern

Endemic

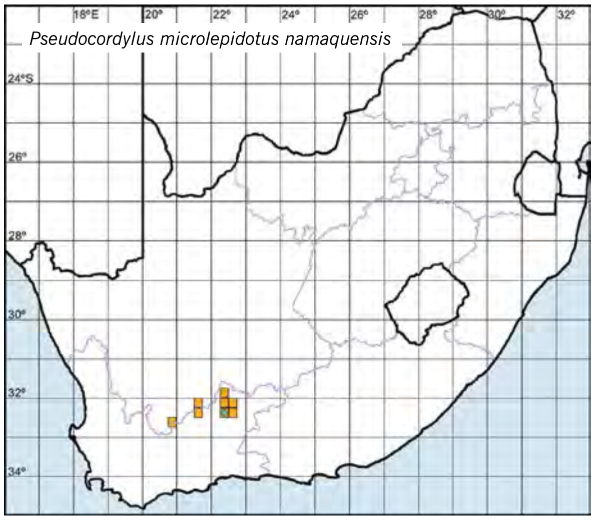
Taxonomy: Although Bates (2005a) indicated that there are small morphological differences between the three subspecies of *Pseudocordylus microlepidotus*, their taxonomic status remains unresolved. The phylogeography of *P. microlepidotus* is under investigation (Cunningham 2004). The studies of Makhubo (2009) and Stanley *et al.* (2011) did not include samples of this subspecies.

Distribution: Endemic to the Northern and Western Cape provinces, South Africa, where it is restricted to the Nuweveldberg and Komsberg mountain ranges in the Fraserburg, Sutherland and Beaufort West districts (Bates 2005a).

Habitat: Found in crevices amongst boulders on the upper slopes and summits of the Nuweveldberg and Komsberg mountains, in fynbos or montane grassland (Branch 1998; Bates 2005a), at altitudes of 1 526–1 784 m (M.F. Bates unpubl. data).

Bioregion: Karoo Renosterveld; Upper Karoo.

Assessment rationale: The taxon has a restricted range (EOO = 16 875 km^2, AOO = 1 080 km^2 [B1+2]) but is probably fairly common where it does occur, and there are currently no known major threats (minor threats include tourism, frequent fires and overgrazing) or indications of population declines or fluctuations, nor any significant changes in the quality of its habitat. It is therefore classified as Least Concern. However, it may be intrinsically at risk because of poor dispersal capabilities and a restricted range.



Pseudocordylus microlepidotus namaquensis—Komsberg, NC
P. le F.N. Mouton

Conservation measures: Obtain more information on biology and ecology, and gain more insight into the status of available habitat and threats facing the population. Monitor populations, especially those outside the Karoo National Park.

Pseudocordylus spinosus FitzSimons, 1947
SPINY CRAG LIZARD

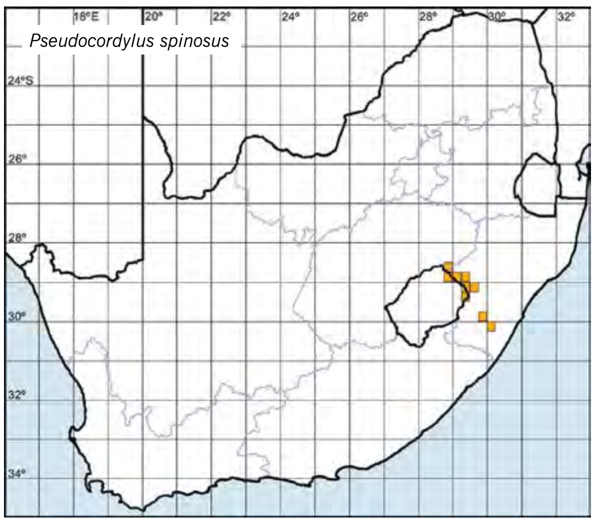
Michael F. Bates

Global: Near Threatened

Endemic

Taxonomy: Although morphologically quite distinct from *P. melanotus subviridis*, a series of high-elevation *P. spinosus* specimens from Goodoo Pass in the Drakensberg shared the same 16S haplotype as several *P. m. subviridis* specimens from different localities in the Drakensberg region (Bates 2007a). The multi-gene study of Stanley *et al.* (2011) also found only minor differentiation between these two taxa. Taxonomic status of the isolated populations in the Ixopo and Donnybrook areas of southern KwaZulu-Natal is under investigation (M.F. Bates *et al.* in prep.).

Distribution: Endemic to KwaZulu-Natal and Free State provinces, South Africa; found on the lower and middle slopes of the Drakensberg, with isolated populations near Donnybrook and Ixopo in southern KwaZulu-Natal (Bourquin 2004; Bates 2005a).



EOO: 14 850 km^2 (confidence: high); AOO: 1 316 km^2 (confidence: medium).

Habitat: Found on outcrops consisting of small rocks scattered in montane grassland in the Grassland Biome, at

Pseudocordylus spinosus—Goodoo Pass, KZN M.F. Bates

altitudes of 900–2 517 m; often occupies crevices at or near ground level (Bates 2005a).

Bioregion: Drakensberg Grassland; Sub-Escarpment Grassland.

Assessment rationale: Has a fairly small range below the Vulnerable thresholds (EOO <20 000 km^2, AOO <2 000 km^2), with a continuing decline in area, extent and quality of habitat [B1b(iii)+2b(iii)], e.g. populations in southern KwaZulu-Natal are isolated by exotic plantations. Only a small portion of the area of the QDGCs where the species has been recorded currently provide suitable habitat. Probably found at more than ten locations and the range is not known to be severely fragmented, although the isolated nature of populations in southern KwaZulu-Natal may not have been recognised previously. Fortunately, much of the main Drakensberg population is protected within the Ukhahlamba Drakensberg Park.

Threats: Afforestation (pines, bluegums) is a major threat, especially in the Ixopo-Donnybrook area of southern KwaZulu-Natal where at least two small, isolated populations occur. Fires are a minor threat because lizards will seek refuge and safety in rocky crevices. Human traffic on hiking trails in the Drakensberg is of minor concern. Threats are potentially magnified by the species' intrinsically poor dispersal capabilities and restricted range.

Conservation measures: Ensure that conservation organisations and legislating bodies treat this species as Near Threatened and afford it the necessary protection. Design a BMP-S. Communicate with farmers and other locals and educate them about this species. Measure population numbers and exact ranges, obtain more information on biology and ecology, investigate the status of available habitat, and ascertain the exact nature of threats. Protect the isolated populations in southern KwaZulu-Natal. Monitor populations in areas where there are hiking trails through suitable habitat. Prevent the establishment of exotic timber plantations in areas where the species occurs.

Pseudocordylus transvaalensis FitzSimons, 1943

NORTHERN CRAG LIZARD; TRANSVAAL CRAG LIZARD

Michael F. Bates

Global: Near Threatened

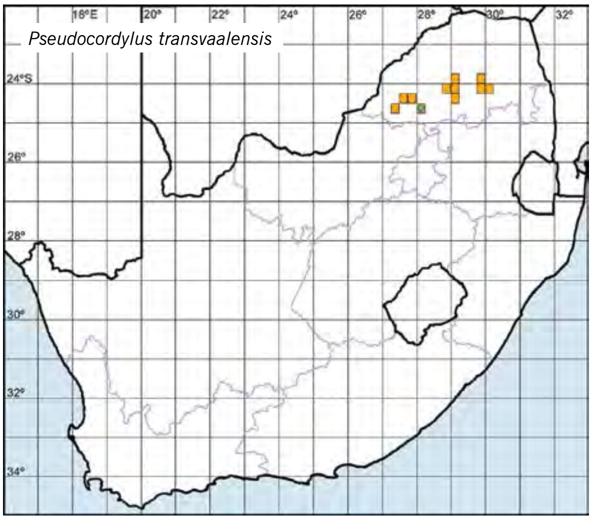
Endemic

Taxonomy: Based on morphological and molecular analyses, *Pseudocordylus transvaalensis* appears to be a valid species rather than a subspecies of *P. melanotus* (Jacobsen 1989; Bates 2005a, 2007a; Stanley *et al.* 2011). The three allopatric populations differ morphologically, but mitochondrial DNA sequence data for western and central populations indicate that they are conspecific (Bates 2007a).

Distribution: Endemic to Limpopo Province, South Africa. Occurs in three allopatric populations: western (Thabazimbi area), central (Mokopane area) and eastern (Woodbush/Haenertsburg area) (Jacobsen 1989; Bates 2005a).

EOO: 17 550 km^2 (confidence: high); AOO: 1 586 km^2 (confidence: medium).

Habitat: Found on large rock outcrops where it shelters in crevices or under rocks, on the upper slopes of hills or on ridges, in the Savanna and Grassland biomes, at altitudes of 1 700–2 000 m (Jacobsen 1989; Bates 2007a). The western population is associated with grassy, wooded hills (e.g. SVcb 17 Waterberg Mountain Bushveld), the central population occurs mainly in Central Bushveld, and the eastern population is associated with mixed Protea-grassland. Usually individuals occupy a crevice and lizard densities in rock outcrops are much lower than they are for the two subspecies of *P. melanotus* (Jacobsen 1989; Bates 2007a).



Pseudocordylus transvaalensis—10 km NW of Haenertsburg, LIMP M.F. Bates

Bioregion: Central Bushveld; Mesic Highveld Grassland.

Assessment rationale: This species has a fairly small range (EOO <20 000 km^2, AOO <2 000 km^2) with a continuing decline in area, extent and quality of habitat [B1b(iii)+2b(iii)] in at least some areas (e.g. near Haenertsburg in the eastern population) due to afforestation, the development of logging roads, fires and other human activities.

Threats: Afforestation (e.g. pines) is the main threat, especially in the area of the eastern population where it may have caused some habitat loss and prevented free association of local populations. Construction and the use of logging roads near known *P. transvaalensis* sites in the eastern population destroys some habitat (pers. obs.) and may restrict movement and result in road kills. It is likely that some plantations will become more extensive in future, although the negative impact on *P. transvaalensis* may not be considerable because such plantations are not usually established in extensively rocky areas. Future expansion of human settlements (e.g. Greater Polokwane area), roads and human activity on walking trails also pose a potential threat, although the lizard's habitat requirements will minimise this. Fires pose a small risk, but refuges in rock crevices will provide protection in most cases. *Pseudocordylus transvaalensis* is also potentially at risk because of its intrinsically low dispersal capabilities and restricted range.

Conservation measures: Ensure that conservation organisations and legislating bodies treat this species as Near Threatened and afford it the necessary protection. Develop a BMP-S. Communicate with farmers and other locals and educate them about this species, especially in the eastern parts of the range where afforestation occurs. Determine population numbers and exact ranges, obtain more information on biology and ecology, and gain more insight into the status of available habitat. Monitor population trends. Identify and establish protected areas for each of the three allopatric populations.

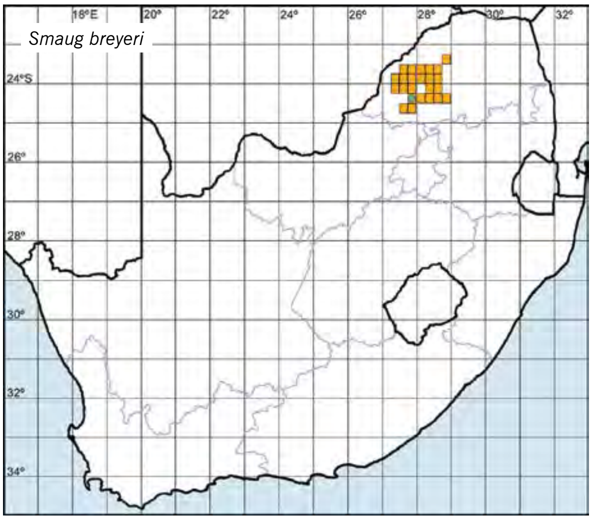
Genus *Smaug* Stanley, Bauer, Jackman, Branch & Mouton, 2011—dragon lizards

The genus *Smaug* comprises six species, one of which (*S. warreni*) consists of three subspecies. All taxa were previously contained within the genus *Cordylus* (Stanley *et al.* 2011). Relationships among the forms in the *S. warreni* complex (see Jacobsen 1989) are currently being investigated (E.L. Stanley & M.F. Bates in prep.). All species possess enlarged occipital and caudal spines, hence the appropriate common name 'dragon lizards' (*Smaug* is the name of a dragon in *The Hobbit* by J.R.R. Tolkien) (Stanley *et al.* 2011). Apart from *S. giganteus*, which is terrestrial in the grasslands of the central plateau of South Africa, all other taxa are rupicolous and distributed in the northeastern parts of South Africa and Swaziland. The genus includes the largest living cordylids (*S. giganteus* is the largest). Some members of the clade display a postnuptial reproductive cycle (Van Wyk 1995). Sexual size dimorphism is moderate, but two species (*S. mossambicus* and *S. regius*) display sexual dichromatism (Branch 1998). In the *Atlas* region, one taxon is classified as Vulnerable due to transformation and fragmentation of grasslands (*S. giganteus*) and the other five (*S. breyeri*, *S. vandami*, *S. w. warreni*, *S. w. barbertonensis* and *S. w. depressus*) are considered Least Concern.

Smaug breyeri (Van Dam, 1921)

WATERBERG DRAGON LIZARD; WATERBERG GIRDLED LIZARD

P. le Fras N. Mouton



Global: Least Concern

Endemic

Taxonomy: Previously contained within the genus *Cordylus* (Stanley *et al.* 2011). The taxonomic status of forms in the *Smaug warreni* species complex, to which *C. breyeri* belongs (see Jacobsen 1989), is currently being evaluated using molecular methods (E.L. Stanley & M.F. Bates in prep.).

Distribution: Endemic to the Waterberg and surrounding areas in Limpopo Province, South Africa (Jacobsen 1989).

Habitat: A rupicolous species that occurs at altitudes of 700–1 700 m and prefers rock outcrops in open savanna, where it shelters in deep-shaded cracks on the cool side of rock outcrops (Jacobsen 1989; Branch 1998).

Vegetation type: SVcb 17 Waterberg Mountain Bushveld; SVcb 12 Central Sandy Bushveld; SVcb 16 Western Sandy Bushveld; SVcb 19 Limpopo Sweet Bushveld.

Assessment rationale: Has a restricted range, but habitat fragmentation is negligible and there is no noticeable decline in extent or quality of habitat. There are also no known threats. Being rupicolous, this lizard's habitat is reasonably safe.

Conservation measures: Conduct basic research into population numbers, biology, ecology and habitat status.

Smaug breyeri—21 km SW of Lephalale, LIMP M. Burger

Smaug giganteus (A. Smith, 1844)

GIANT DRAGON LIZARD; GIANT GIRDLED LIZARD; SUNGAZER; OUVOLK

P. le Fras N. Mouton

Global: Vulnerable **A2c**

Endemic

Taxonomy: Previously contained within the genus *Cordylus* (Stanley *et al.* 2011).

Distribution: Endemic to South Africa, where it is found only in the grasslands of the northern Free State (De Waal 1978) and the southwestern parts of Mpumalanga (Jacobsen 1989). Records of this species in KwaZulu-Natal (e.g. Bourquin 2004) apparently all refer to introduced populations that did not become established, and there are no confirmed records of natural populations in this province (Armstrong 2011). A record for Witsieshoek (2828DB) in the Free State and two records for western Lesotho (Ambrose 2006) are considered doubtful (question marks on map).

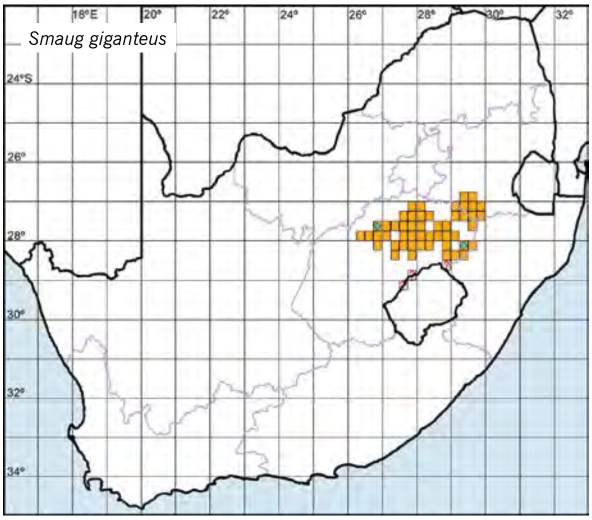
EOO: 39 296 km^2 (confidence: medium); AOO: 3 352 km^2 (confidence: medium).

Habitat: One of only a few terrestrial cordylids, inhabiting flat or sloping Highveld grassland where it lives in self-excavated burrows (Branch 1998). Diurnal and insectivorous, although plant material may also be consumed (Jacobsen 1989).

Bioregion: Mesic Highveld Grassland; Dry Highveld Grassland.

Assessment rationale: A reduction in population size of at least 30% during the last 27 years (three generations) is inferred from the continuous habitat destruction in the Grassland Biome [A2c]. In addition, it is likely that a large part of the population exists in fragmented islands of grassland habitat between croplands.

Threats: The areas inhabited by this species are suitable for agriculture, particularly maize and sunflower cultivation, and large areas have been planted, resulting in large-scale habitat loss (De Waal 1978; Newberry & Petersen 1982/3). Habitat loss due to agriculture is a continuing threat. Large portions of the grassland habitat are underlain by coal beds of varying quality and extent, and exploitation of coal for fuel has and will result in further habitat loss (Newberry & Petersen 1982/3). In the past this species has also been used by traditional healers (Newberry & Petersen 1982/3), but there is uncertainty over the extent of its present use in traditional medicine and witchcraft. Commercial exploitation for the pet trade is limited and contained (Jacobsen 1989) but remains a permanent threat. In the past, fumigating burrows for the control of Yellow Mongoose (*Cynictis penicillata*) and Suricate (*Suricata suricatta*) resulted in great losses (Newberry & Petersen 1982/3), and poisoning of this lizard remains a threat in agricultural areas. Losses are exacerbated by poor recruitment ability; females reproduce only every second year (Van Wyk 1991). Poor fire management may also affect this species.



Smaug giganteus—in captivity, Khamai Reptile Park, Hoedspruit J. Marais

Conservation measures: Continue with research to develop an effective translocation protocol (Van Wyk 1988). Continuously encourage farmers to protect these animals and to stop all forms of persecution by farm workers (Newberry & Petersen 1982/3). Prohibit the removal of lizards from natural populations. Draft a BMP-S.

Smaug vandami (FitzSimons, 1930)

VAN DAM'S DRAGON LIZARD;
VAN DAM'S GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic

Taxonomy: Previously contained within the genus *Cordylus* (Stanley *et al.* 2011). The taxonomic status of forms in the *Smaug warreni* species complex, to which *S. vandami* belongs (Jacobsen 1989), is currently being evaluated using molecular methods (E.L. Stanley & M.F. Bates in prep.).

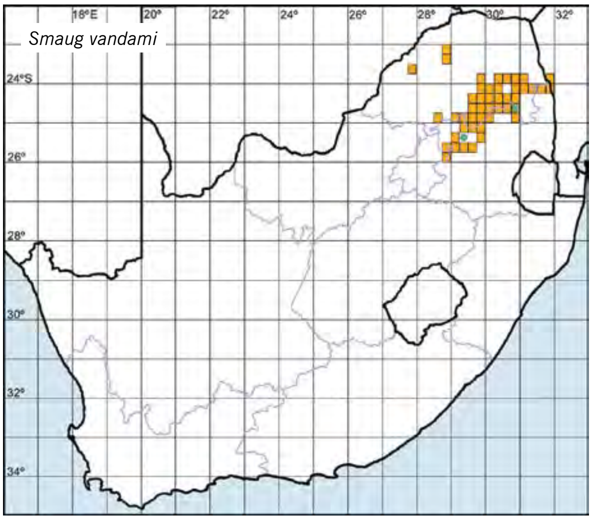
Distribution: Endemic to Limpopo and the eastern escarpment of Mpumalanga, South Africa, possibly extending into Mozambique (Jacobsen 1989; Branch 1998).

Habitat: Prefers mesic savanna where it occurs in large cracks in shaded outcrops (Jacobsen 1989; Branch 1998).

Bioregion: Central Bushveld; Lowveld; Mesic Highveld Grassland; Mopane.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Smaug vandami—Farm Mooiplaats 242, Middelburg distr., MPM M.F. Bates

Smaug warreni warreni (Boulenger, 1908)

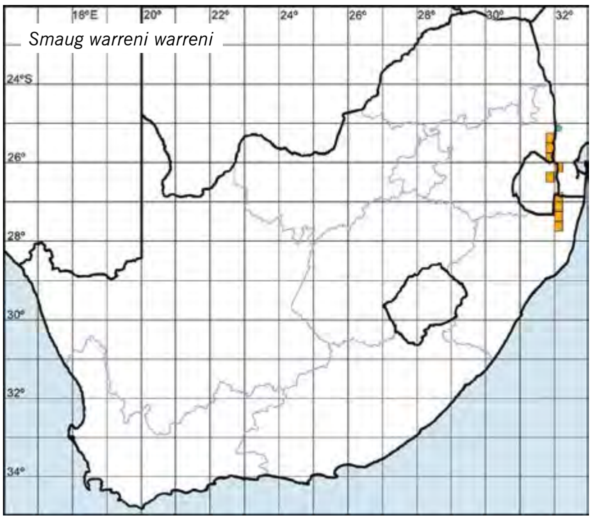
WARREN'S DRAGON LIZARD;
WARREN'S GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Near-endemic

Smaug warreni warreni J. Marais



Taxonomy: Previously contained within the genus *Cordylus* (Stanley *et al.* 2011). The taxonomic status of forms in the *Smaug warreni* species complex (Jacobsen 1989) is currently being evaluated using molecular methods (E.L. Stanley & M.F. Bates in prep.).

Distribution: Endemic to the Lebombo Mountains, occurring from northeastern KwaZulu-Natal through Swaziland to eastern Mpumalanga (Jacobsen 1989) and adjacent Mozambique (D.G. Broadley pers. comm.). A new Virtual Museum record represents a small northern range extension for the species.

Habitat: A rupicolous taxon found on rock outcrops along the Lebombo Mountains at elevations of 300–800 m (Jacobsen 1989).

Vegetation type: SVl 16 Southern Lebombo Bushveld; SVl 17 Lebombo Summit Sourveld; SVl 23 Zululand Lowveld; SVl 5 Tshokwane-Hlane Basalt Lowveld.

Assessment rationale: Has a restricted range but is not threatened. Habitat is secure and the species should remain Least Concern provided no large scale commercial harvesting takes place (Jacobsen 1989).

Conservation measures: None recommended.

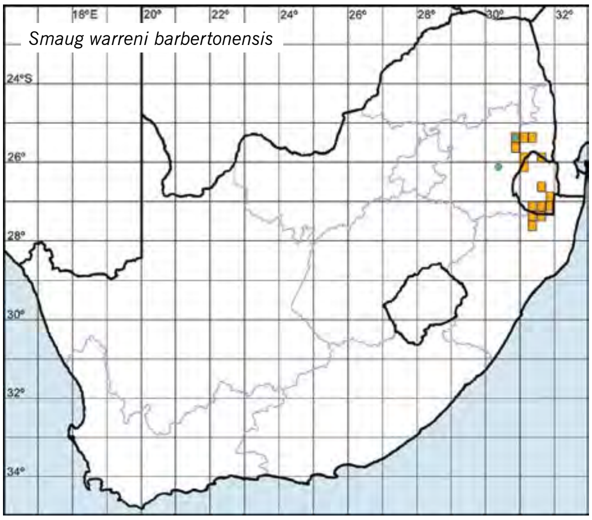
Smaug warreni barbertonensis (Van Dam, 1921)

BARBERTON DRAGON LIZARD; BARBERTON GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic



Taxonomy: Previously contained within the genus *Cordylus* (Stanley *et al.* 2011). The taxonomic status of forms in the *Smaug warreni* species complex (see Jacobsen 1989) is currently being evaluated using molecular methods (E.L. Stanley & M.F. Bates in prep.).

Distribution: Endemic to South Africa and Swaziland. Has a relatively restricted range extending from eastern Mpumalanga south through Swaziland to northern KwaZulu-Natal (Jacobsen 1989; Boycott 1992a; Bourquin 2004). The western limit is based on an isolated SARCA Virtual Museum record from the Ermelo district.

Habitat: Inhabits rock outcrops on hillsides, usually in the partial shade of trees (Jacobsen 1989).

Bioregion: Lowveld; Sub-Escarpment Grassland; Mesic Highveld Grassland.

Assessment rationale: Has a restricted range, but because of its rupicolous nature, the species should remain reasonably safe.

Conservation measures: None recommended, but research is needed to investigate the claim that removal of trees from the species' habitat could have a negative effect, because this lizard often selects crevices in the partial shade of trees (Jacobsen 1989).

Smaug warreni barbertonensis—Barberton, MPM E.L. Stanley

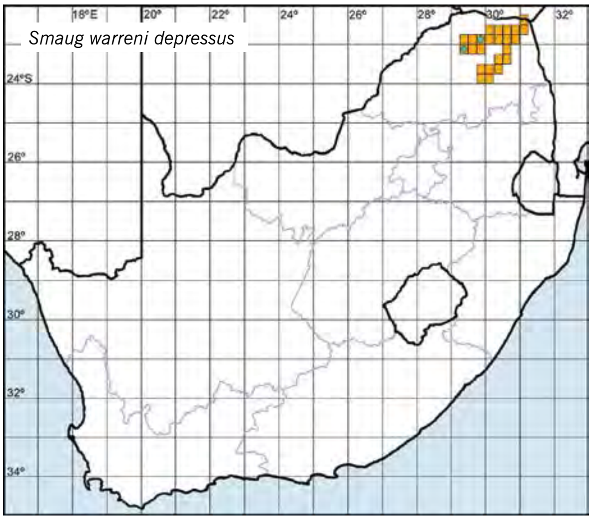
Smaug warreni depressus (FitzSimons, 1930)

FLAT DRAGON LIZARD; FLAT GIRDLED LIZARD

P. le Fras N. Mouton

Global: Least Concern

Endemic



Taxonomy: Previously contained within the genus *Cordylus* (Stanley *et al.* 2011). The molecular assessment of Stanley *et al.* (2011) found that *S. w. depressus* was the sister taxon to the other taxa in the complex, suggesting that it is a valid species. A detailed investigation into the taxonomic status of forms in the *Smaug warreni* species complex (Jacobsen 1989) is currently being conducted using molecular methods (E.L. Stanley & M.F. Bates in prep.).

Distribution: Endemic to Limpopo Province, South Africa, where it occurs along the Soutpansberg Range and on smaller ridges between this range and Woodbush in the south (Jacobsen 1989).

Habitat: A rupicolous species occurring on rock outcrops on hillsides and mountain summits, in savanna (Jacobsen 1989).

Bioregion: Central Bushveld; Lowveld; Mopane.

Assessment rationale: Although this taxon has a relatively restricted range, it is not threatened.

Conservation measures: None recommended.

Smaug warreni depressus—Soutpansberg, LIMP J. Marais

Smaug warreni depressus—Entabeni, Soutpansberg, LIMP M.F. Bates

SUBFAMILY PLATYSAURINAE

The recent taxonomic re-assessment of Stanley *et al.* (2011) divided the family Cordylidae into two subfamilies, Cordylinae and Platysaurinae. The latter contains a single genus, *Platysaurus*, with 15 species (Jacobsen 1989; Branch 1998; Adolphs 2006; Uetz 2012).

Genus *Platysaurus* A. Smith, 1844—flat lizards

The genus *Platysaurus* is currently being revised on the basis of molecular data (S. Keogh *et al.* in prep.) and major taxonomic changes are expected. It currently consists of 15 species—three of these have two subspecies each, and one (*P. intermedius*) has nine subspecies—many of which require revision (Jacobsen 1989; Branch 1998; Adolphs 2006). Most species are found in southeastern Africa, although *P. broadleyi* and *P. capensis* occur as far west as the Northern Cape and southern Namibia, respectively, while *P. maculatus maculatus* is found as far north as southern Tanzania. The remaining taxa are found in South Africa, Botswana, Zimbabwe, Malawi and Mozambique. Nine species (15 taxa) are found in the *Atlas* region. All are diurnal, rupicolous and dorso-ventrally compressed, allowing them to seek refuge in very narrow rock crevices (Broadley 1978; Scott *et al.* 2004). Most taxa exhibit sexual dichromatism, with brightly coloured adult males and dull, brownish, striped females. Females lay one or two clutches of two large eggs per clutch in a season (Branch 1998). *Platysaurus broadleyi* may be unique among lizards because males have an ultraviolet-reflective throat used to signal fighting ability (Whiting *et al.* 2006). *Platysaurus relictus* was previously considered a Lower Risk/near threatened (IUCN 1996) and 'restricted' (Branch 1988a) species. Two taxa with very restricted distributions are now considered Endangered (*P. intermedius inopinus*, *P. monotropis*) as a result of habitat transformation, and *P. orientalis fitzsimonsi* is classified as Near Threatened as a result of its restricted and highly fragmented distribution.

Platysaurus broadleyi Branch & Whiting, 1997

AUGRABIES FLAT LIZARD

Martin J. Whiting

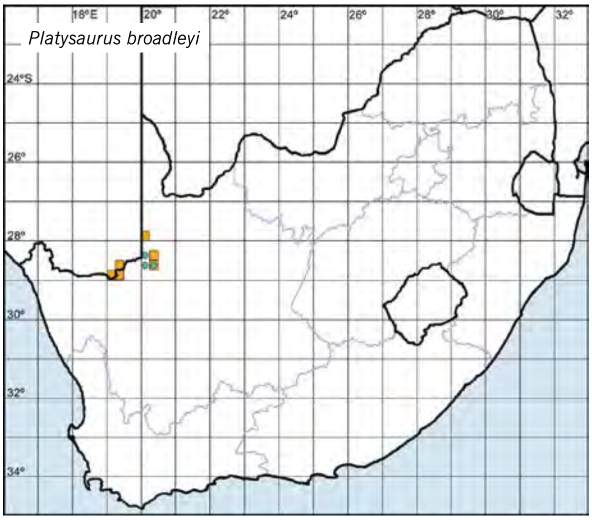
Global: Least Concern

Endemic

Taxonomy: Branch & Whiting (1997) showed that the eastern population (Gordonia and Kenhardt districts, Northern Cape) of *Platysaurus capensis* was distinct based on two unique traits, and it was therefore described as a new species, *P. broadleyi*.

Distribution: Endemic to the Gordonia and Kenhardt districts of the Northern Cape, South Africa. This species is patchily distributed along the Orange River, from Augrabies Falls National Park in the east to Pella in the west. Two records exist from Bak Putz River, a tributary of the Orange River. These records are about 45 km north of the Orange River, close to the border with Namibia. It is not known whether the Orange River and Bak Putz populations are contiguous. Although the species has been observed on both sides of the Orange River east and south of Namibia, it has yet to be recorded from that country.

Habitat: Associated with rock outcrops along the Orange River and its tributaries at elevations of 610–730 m (Branch & Whiting 1997). At Augrabies Falls National Park, where it is most abundant, it is found mainly on smooth granite, especially along the banks of the Orange River. Its distribution appears to be tied to water availability, because lizard density quickly declines with increasing distance from the river. *Platysaurus broadleyi* appears to favour narrow, deep rock crevices where it seeks refuge. Fig trees are used for shade and lizards feed on ripe figs when these are available (Whiting & Greeff 1997).



Platysaurus broadleyi, male—Augrabies Falls, NC M.F. Bates

Vegetation type: NKb 1 Lower Gariep Broken Veld. Augrabies Flat Lizards actually occur adjacent to this vegetation type, along the granitic banks of the Orange River. Most lizards are found in rocky habitat devoid of vegetation, except for the occasional Namaqua Fig Tree (*Ficus cordata*).

Assessment rationale: Has a restricted range (EOO = 6 832 km^2, below the Vulnerable threshold; AOO = 296 km^2, below the Endangered threshold), and the rapid expansion of viticulture along the Orange River could threaten local populations through ecosystem alteration and the use of insecticides. However, *P. broadleyi* is extremely abundant in a protected area, Augrabies Falls National Park, and there are other healthy populations along the Orange River. Although its range appears to be fragmented, it is unlikely that this fragmentation is severe.

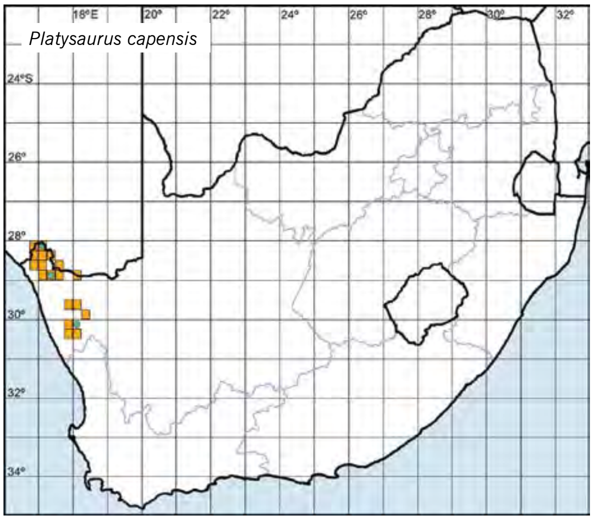
Conservation measures: No immediate actions are required. Preliminary observations suggest that several subpopulations are small and disjunct. A thorough survey of the Orange River and its tributaries would improve our understanding of the distribution and abundance of local subpopulations.

Platysaurus broadleyi, female—Augrabies Falls, NC M.F. Bates

Platysaurus capensis A. Smith, 1844

NAMAQUA FLAT LIZARD; CAPE FLAT LIZARD

Martin J. Whiting



Global: Least Concern

Taxonomy: This species previously included populations to the east (from Pella eastwards) now referred to as *P. broadleyi* (Branch & Whiting 1997; Scott *et al.* 2004). Current research into the molecular systematics of *P. capensis* suggests the existence of a species complex (S. Keogh *et al.* unpubl. data). Taxonomic studies reveal that the Richtersveld, Namaqualand and Fish River Canyon populations may all represent valid species (S. Keogh & M.J. Whiting unpubl. data).

Distribution: Endemic to southern Africa. In the *Atlas* region it is found in the Northern Cape, extending from Namaqualand in the south to the Richtersveld and Gariep Desert region in the north. North of the Orange River, in southern Namibia, the taxon is known from the Hunsberg, Huamsib and Ploegberg mountains, and the Fish River Canyon (Branch & Whiting 1997).

Habitat: Rupicolous, typically living on granite, gneiss and shale rock outcrops. Uses narrow crevices for refuge and frequently uses shelf rock such as exfoliation domes, in conjunction with large boulders. In dry areas it is typically associated with water (Orange River and Fish River Canyon). In the south it occupies the moister Succulent Karoo Biome. Typically found on relatively small rock outcrops or the lower slopes of mountains, at elevations of 40–1 000 m (Branch & Whiting 1997).

Bioregion: Richtersveld; Namaqualand Hardeveld; Gariep Desert; Bushmanland; Southern Namib Desert; Namaqualand Cape Shrublands.

Assessment rationale: Fairly widespread and common. However, if the Richtersveld, Namaqualand and Fish River Canyon populations are found to be valid species, their conservation status will have to be re-assessed.

Conservation measures: None recommended.

Platysaurus capensis, male—Richtersveld, NC J. Marais

Platysaurus guttatus A. Smith, 1849

DWARF FLAT LIZARD

Martin J. Whiting

Global: Least Concern

Endemic

Taxonomy: *Platysaurus guttatus* was rendered a monotypic species when *P. guttatus minor* was elevated to species status by Jacobsen & Newbery (1989).

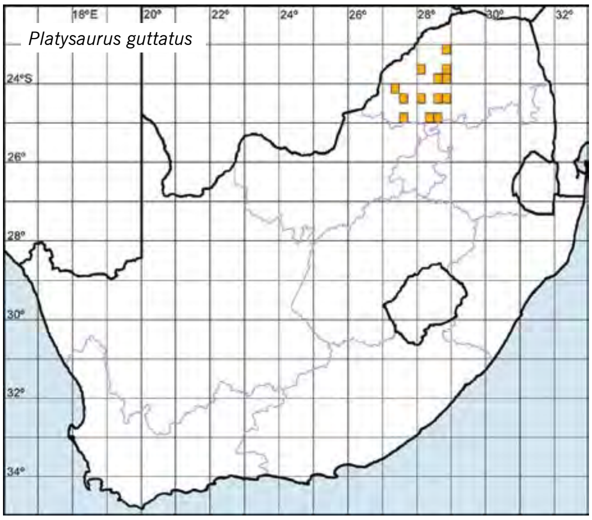
Distribution: Considered endemic to Limpopo, South Africa (Jacobsen 1989), although it may also occur in eastern Botswana.

Habitat: Rupicolous, inhabiting small rocky ridges and outcrops. Narrow (<5 mm high) crevices are important refuges; found at altitudes of 1 000–1 300 m (Jacobsen 1989).

Bioregion: Central Bushveld.

Assessment rationale: Widespread, with an EOO and AOO above the Vulnerable thresholds. Nevertheless, the range is severely fragmented and the species should be monitored in the future.

Conservation measures: None recommended.



Platysaurus guttatus, male—Farm Sweethome near Sebotane, LIMP
M. Whiting

Platysaurus intermedius intermedius Matschie, 1891

COMMON FLAT LIZARD

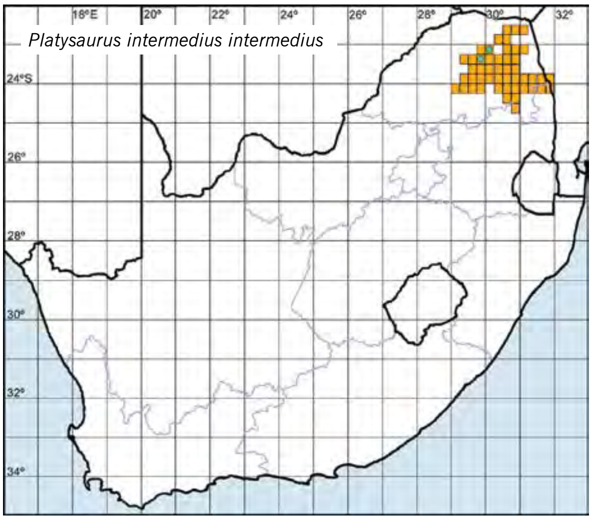
Martin J. Whiting

Global: Least Concern

Endemic

Taxonomy: Previous (Scott *et al.* 2004) and current (S. Keogh *et al.* unpubl. data) molecular work suggests that

Platysaurus intermedius intermedius, male—Cleveland NR, Phalaborwa, MPM
M. Burger



the *P. intermedius* complex will undergo significant taxonomic change, and *P. intermedius* may become a monotypic species.

Distribution: Endemic to South Africa. Most of the range is located in Limpopo, with peripheral localities in Mpumalanga.

Habitat: Rupicolous, occupying rocky hillsides, outcrops and bedrock away from hills (Jacobsen 1989). Narrow rock crevices provide important refuges. Occurs at altitudes of 390–1 200 m (Jacobsen 1989).

Bioregion: Central Bushveld; Lowveld; Mopane.

Assessment rationale: Widespread and common.

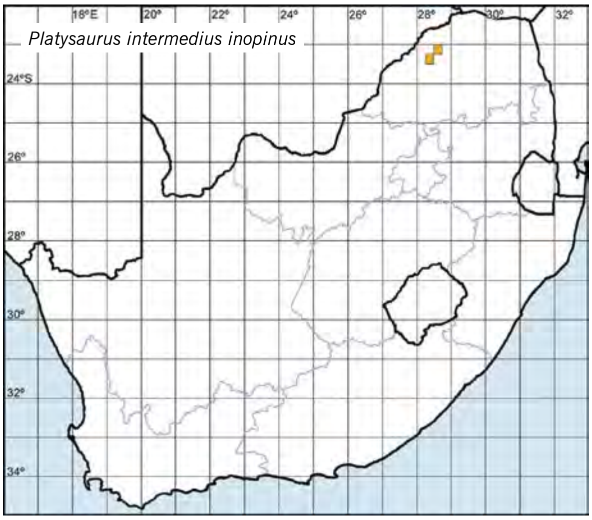
Conservation measures: None recommended.

Platysaurus intermedius intermedius, female—Cleveland NR, Phalaborwa, MPM M. Burger

Platysaurus intermedius inopinus Jacobsen, 1994

UNEXPECTED FLAT LIZARD

Martin J. Whiting



Global: Endangered **B1ab(iii)+2ab(iii)**

Endemic

Taxonomy: This subspecies is currently part of a molecular systematics and taxonomic study of the genus *Platysaurus* (S. Keogh *et al.* in prep.). It is likely to be elevated to species status.

Distribution: Endemic to the northwestern region of Limpopo Province, South Africa. Occurs in a very restricted area about 9 km southwest of Blouberg Mountain (Jacobsen 1994a).

EOO: 374 km^2 (confidence: medium); AOO: 127 km^2 (confidence: medium).

Habitat: Occupies low sandstone ridges and outcrops where it is dependent on narrow rock crevices for refuge; occurs at elevations of about 1 000 m (Jacobsen 1994a).

Vegetation type: SVcb 18 Roodeberg Bushveld; SVcb 19 Limpopo Sweet Bushveld; SVcb 20 Makhado Sweet Bushveld.

Assessment rationale: This species has an extremely restricted distribution (EOO and AOO less than Endangered thresholds [B1+2]). The subpopulations are all in relatively close proximity and thus occupy fewer than five locations [B1a+2a]. Although these lizards are rupicolous, they are probably dependent on surrounding habitat for insect prey. However, the area surrounding their rock outcrops is often overgrazed or planted over with crops. It is therefore likely that their habitat quality has decreased with increasing human habitation in the area [B1b(iii)+2b(iii)].

Threats: Although the taxon is rupicolous, it is likely to depend on productive land between rock outcrops for dispersal and for their role in supporting insect prey. The greatest threat is thus degradation of habitat through overgrazing and agriculture (crops). The use of insecticides at local settlements will reduce the prey population and result in incidental ingestion of toxins by lizards.

Platysaurus intermedius inopinus, male—Glen Alpine Dam, Bochum, LIMP M.J. Whiting

Platysaurus intermedius inopinus, female—Glen Alpine Dam, Bochum, LIMP M.J. Whiting

Conservation measures: Conduct a PHVA and establish a BMP-S. As a first step towards the management plan, survey all potential habitats consisting of Waterberg sandstone rock outcrops. Then, assess this habitat in the context of the surrounding vegetation in which insect prey lives. It is imperative to understand how vegetation and insect availability interact and in turn, affect the presence and abundance of *P. i. inopinus*. Furthermore, if the terrain surrounding rock outcrops is devoid of vegetation, this could impede lizard dispersal. Given the small size of outcrops, dispersal is likely to be an important factor regulating population growth in this taxon. Future conservation measures should thus address whether it is necessary to restore vegetation in the surrounding terrain for the purposes of population maintenance and growth.

Platysaurus intermedius natalensis FitzSimons, 1948

KWAZULU-NATAL FLAT LIZARD

Martin J. Whiting

Global: Least Concern

Endemic

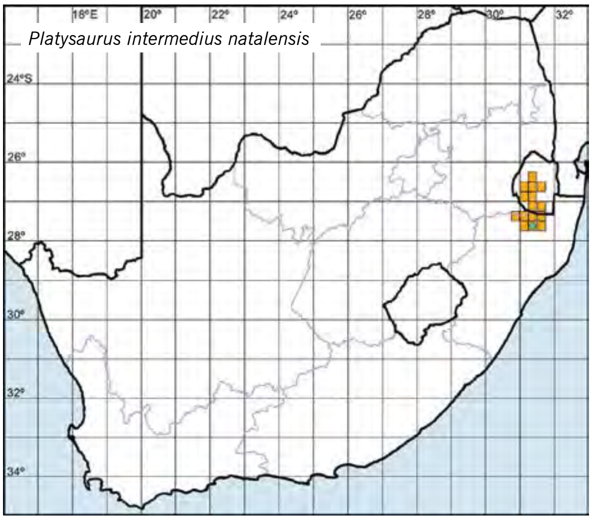
Taxonomy: Previous (Scott *et al.* 2004) and current (S. Keogh *et al.* unpubl. data) molecular work suggests that the *P. intermedius* complex will undergo significant taxonomic change. The possibility that *P. i. natalensis* is a full species is under consideration.

Distribution: Endemic to the *Atlas* region where it is found in southern Swaziland, southeastern Mpumalanga and northern KwaZulu-Natal.

Habitat: Occupies rock outcrops at altitudes of 600–900 m (Jacobsen 1989). Favours bedrock with exfoliating sheets and associated boulders. Crevices are important for refuge.

Bioregion: Lowveld; Sub-Escarpment Grassland.

Assessment rationale: There is no evidence of a population decline and this subspecies is currently considered Least Concern. However, EOO is small (13 015 km^2 [B1]) and the range is fragmented. Much of the land connecting the rocky outcrops inhabited by these lizards is being transformed and degraded by human activity, and the use of pesticides by local farmers may affect insect prey.



Conservation measures: Carry out baseline population sampling to assess current distribution and abundance. Many subpopulations exist in areas with high human densities, but because these lizards are rupicolous, their habitat is not particularly susceptible to land transformation.

Platysaurus intermedius natalensis, male—W of Pongola, KZN J. Marais

Platysaurus intermedius natalensis, female—Godlwayo Hill, N of Pongola, KZN W.R. Branch

Platysaurus intermedius parvus Broadley, 1976

BLOUBERG FLAT LIZARD

Martin J. Whiting

Global: Least Concern

Endemic

Taxonomy: Previous (Scott *et al.* 2004) and current (S. Keogh *et al.* unpubl. data) molecular work suggests that the *P. intermedius* complex will undergo significant taxonomic change. Jacobsen (1989) suggested that *P. i. parvus* could be a full species and this is under consideration.

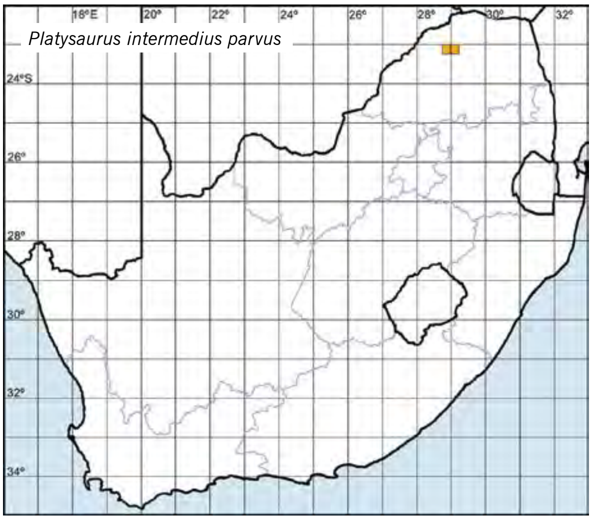
Distribution: Endemic to the Blouberg range in Limpopo Province, South Africa.

Habitat: Found on rocky slopes and outcrops consisting of Blouberg sandstone. Requires narrow rock crevices for refuge and occurs at altitudes of 1 000–1 200 m (Jacobsen 1989).

Vegetation type: SVcb 19 Limpopo Sweet Bushveld; SVcb 21 Soutpansberg Mountain Bushveld; SVcb 18 Roodeberg Bushveld.

Assessment rationale: EOO (168 km^2) and AOO (145 km^2) are lower than the Endangered thresholds. However, there is no information on population size or indications of population decline, and there are no indications of reduction in quality of habitat. Nevertheless, there are concerns about future collecting for the pet trade, and the damage caused to this lizard's habitat when crevices are broken open.

Conservation measures: Survey baseline population abundance and the extent of the species' distribution on the Blouberg range, and monitor the population. Provide protection from future collecting for the pet trade. Collecting of flat lizards often involves substantial damage to their habitat when crevices are broken open, so this should be discouraged. Protective legislation may be required.



Platysaurus intermedius parvus, male—Blouberg, LIMP M. Burger

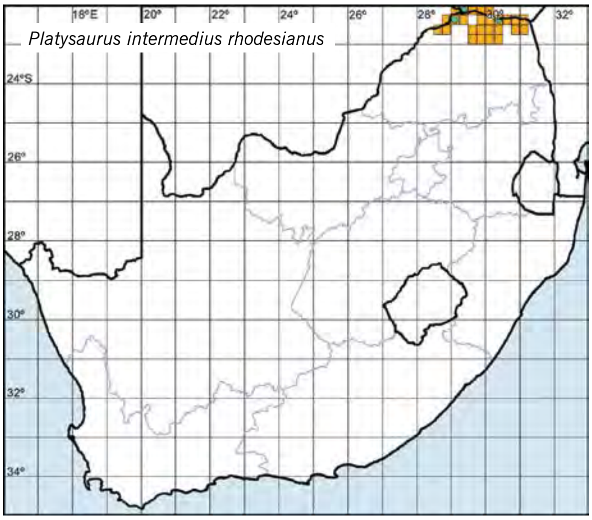
Platysaurus intermedius rhodesianus FitzSimons, 1941

ZIMBABWE FLAT LIZARD

Martin J. Whiting

Global: Least Concern

Taxonomy: Molecular data presented by Scott *et al.* (2004) placed *P. i. rhodesianus* in a separate clade with *P. imperator* and *P. torquatus,* rather than in a clade with *P. i. intermedius* and other *P. intermedius* subspecies, and *P. lebomboensis, P. minor, P. monotropis* and *P. orientalis.* This study, and current molecular work (S. Keogh *et al.* unpubl. data), suggest that the *P. intermedius* complex will undergo significant taxonomic change and it is likely that *P. i. rhodesianus* will be elevated to species status. Furthermore, *P. i. rhodesianus* is widespread, with some populations separated by significant physical barriers (e.g. Limpopo River) that are expected to constrain gene flow. Also, a number of populations show significant morphological variation, suggesting that *P. i. rhodesianus* may represent a species complex.



Distribution: Endemic to the southern African subregion. It occurs in the northern part of Limpopo Province in South

Africa, in eastern Botswana, southern Zimbabwe and the southern part of Manica Platform in Mozambique (Broadley 1978; Jacobsen 1989).

Habitat: Found in a wide range of rocky habitats including sandstone, granite and gneiss. Favours areas with exfoliating bedrock and associated free-standing boulders (Jacobsen 1989). Dependent on narrow crevices for refuge. Occurs at elevations of 300–800 m in South Africa (Jacobsen 1989) and up to about 1 100 m in Zimbabwe.

Bioregion: Mopane; Central Bushveld.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Platysaurus intermedius rhodesianus, male—near Musina, LIMP J. Marais

Platysaurus intermedius rhodesianus, female—Venetia Limpopo NR, LIMP M. Burger

Platysaurus intermedius wilhelmi Hewitt, 1909

WILHELM'S FLAT LIZARD

Martin J. Whiting

Global: Least Concern

Endemic

Taxonomy: Molecular data presented by Scott *et al.* (2004) placed *P. i. wilhelmi* in a separate clade with *P. lebomboensis,* far removed from *P. i. intermedius.* This study and current molecular work (S. Keogh *et al.* unpubl. data) suggest that the *P. intermedius* complex will undergo significant taxonomic change, and that *P. i. wilhelmi* is likely to be elevated to species status.

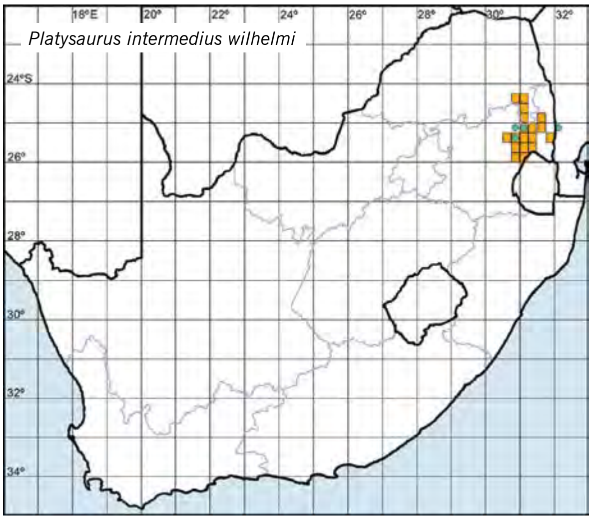
Distribution: Endemic to Mpumalanga and Limpopo provinces, South Africa. It may occur peripherally in Swaziland and Mozambique.

Habitat: Commonly occurs on granite outcrops and inselbergs where it uses open, exposed rock with associated boulders (Jacobsen 1989). Narrow rock crevices are important for refuge. Vegetation surrounding rock outcrops is frequently quite dense and juveniles may escape predators by running into it (M.J. Whiting *et al.* 2003).

Bioregion: Lowveld; Mesic Highveld Grassland.

Assessment rationale: Although the range is relatively fragmented, Wilhelm's Flat Lizard is sufficiently widespread and abundant not to be of conservation concern.

Conservation measures: Although this flat lizard is rupicolous, the intervening land connecting rock outcrops could be important for dispersal and for supporting insect prey. Where possible, therefore, maintain natural vegetation between rock outcrops and prevent overgrazing.



Platysaurus intermedius wilhelmi, male—Sabie, MPM W.R. Schmidt

Platysaurus lebomboensis Jacobsen, 1994

LEBOMBO FLAT LIZARD

Martin J. Whiting

Global: Least Concern

Near-endemic

Taxonomy: No notable issues.

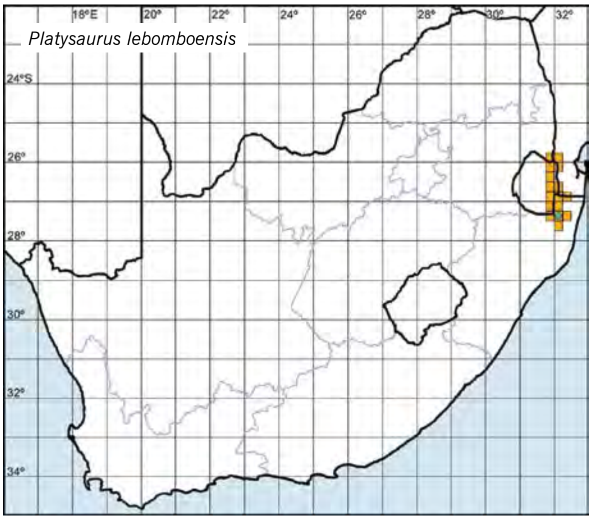
Distribution: Endemic to the southern African subregion. Occurs on the Lebombo Mountain Range in South Africa (eastern Mpumalanga, northeastern KwaZulu-Natal), Swaziland and Mozambique (Jacobsen 1994a).

Habitat: Occupies rock outcrops and rhyolite dwalas where it favours bedrock and associated boulders, taking refuge in rocky crevices. Occurs at altitudes of 600–800 m (Jacobsen 1989, 1994a).

Vegetation type: SVI 16 Southern Lebombo Bushveld; SVI 23 Zululand Lowveld; SVI 17 Lebombo Summit Sourveld; SVI 20 Western Maputaland Clay Bushveld; SVI 5 Tshokwane-Hlane Basalt Lowveld.

Assessment rationale: Although it has a small EOO of <5 000 km² [B1], this species occurs on the slopes of the Lebombo Mountains and is considered secure with no known immediate threats.

Conservation measures: None recommended.



Platysaurus lebomboensis, male—Manyiseni region, Lebombo Mtns, KZN
M. Burger

Platysaurus minor FitzSimons, 1930

WATERBERG FLAT LIZARD

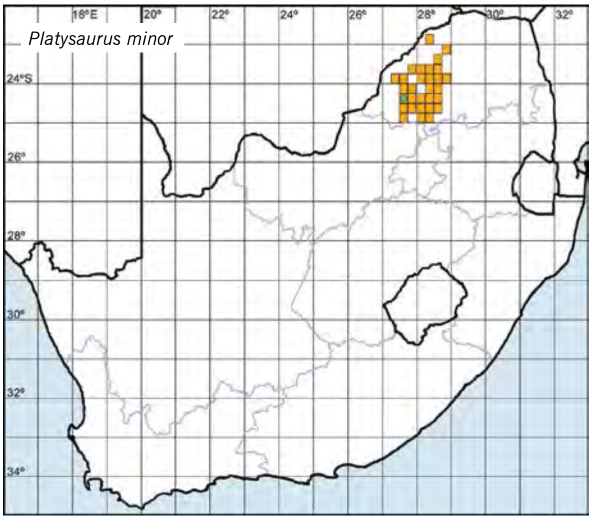
Martin J. Whiting

Global: Least Concern

Endemic

Taxonomy: First described as a subspecies of *Platysaurus guttatus*, but later elevated to species status by Jacobsen & Newbery (1989) mainly because the two forms had been found in sympatry with no obvious intergradation. Furthermore, these authors noted that *P. guttatus* sensu stricto had more variable lateral stripes, although the morphological differences between the two species appear to be minimal.

Platysaurus minor, male—30 km E of Sentrum, LIMP M. Burger



Distribution: Endemic to the western half of Limpopo, South Africa where it occurs throughout the Waterberg range, extending into the foothills of the Blouberg range to the north.

Habitat: Found on low-lying isolated rock outcrops and on the lower slopes of mountains, at elevations of 900–1 400 m. Prefers areas of rocky shelf with associated boulders and narrow crevices that can be used for refuge (Jacobsen 1989).

Bioregion: Central Bushveld.

Assessment rationale: Has a relatively wide distribution and is generally locally abundant.

Conservation measures: None recommended.

Platysaurus minor, female—30 km E of Sentrum, LIMP M. Burger

Platysaurus monotropis Jacobsen, 1994

ORANGE-THROATED FLAT LIZARD

Martin J. Whiting

Global: Endangered B1ab(iii)+2ab(iii)

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to Limpopo Province, South Africa. Has an extremely restricted distribution and is known from only two QDGCs (2328BB, 2328BD).

EOO: 185 km^2 (confidence: medium); AOO: 130 km^2 (confidence: medium).

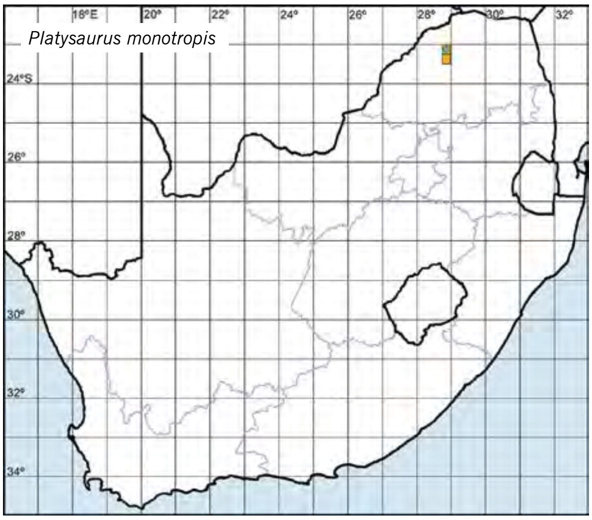
Habitat: Found on rocky outcrops of Waterberg sandstone at elevations of 1 200 m (Jacobsen 1989, 1994a). These outcrops are typically small and may range in size from <30 m in diameter to >500 m in diameter; they may be as close as 50 m apart or more than 1 km apart (Korner *et al.* 2000). The species is dependent on narrow rocky crevices for refuge.

Vegetation type: SVcb 18 Roodeberg Bushveld.

Assessment rationale: Has an extremely restricted distribution with EOO and AOO well below the Endangered thresholds. Subpopulations are all in relatively close proximity and comprise less than five locations [B1a+2a]. Although these lizards are rupicolous, they are probably dependent on healthy surrounding habitat for their insect prey. The area surrounding their rock outcrops is often heavily overgrazed or planted with crops. It is therefore likely that habitat quality has decreased with increasing human habitation in the area [B1b(iii)+2b(iii)].

Threats: Plausible threats are agriculture (crops), overgrazing and wood harvesting. Although these activities do not affect the lizards directly, they are likely to affect the availability of their insect prey. The future severity of these threats may depend upon human population growth rate at nearby communities. This lizard occurs on small isolated rock outcrops that in some cases may support fewer than 20 individuals (Korner *et al.* 2000). The size of subpopulations is likely to be a function of outcrop size and might also be affected by interspecific competition with *P. minor* (Korner *et al.* 2000). Small size of many subpopulations make them more susceptible to natural and anthropogenic environmental perturbations. Because of the small range of *P. monotropis*, and the vulnerability of its habitat of small rock outcrops, any future collection for commercial purposes could be greatly detrimental to the population.

Conservation measures: Conduct a PHVA and establish a BMP-S. As a first step to the latter, survey all potential habitat consisting of Waterberg sandstone rock outcrops (the species will be easily visible if present). Assess this habitat in the context of the surrounding vegetation in which the species' insect prey lives. It is imperative to gain an understanding of how vegetation and insect availability interact and affect the presence and abundance of *P. monotropis*. Furthermore, if the terrain surrounding rocky outcrops is devoid of vegetation, this could impede dispersal. Given the small size of occupied outcrops, dispersal is likely to be an important factor regulating population growth. Future conservation measures should therefore address the question of whether vegetation restoration in the surrounding terrain is important for population maintenance and growth.



Platysaurus monotropis, male—Makgabeng area, W of Senwabarwana (Bochum), LIMP M. Burger

Platysaurus orientalis orientalis FitzSimons, 1941

SEKHUKHUNE FLAT LIZARD

Martin J. Whiting

Global: Least Concern

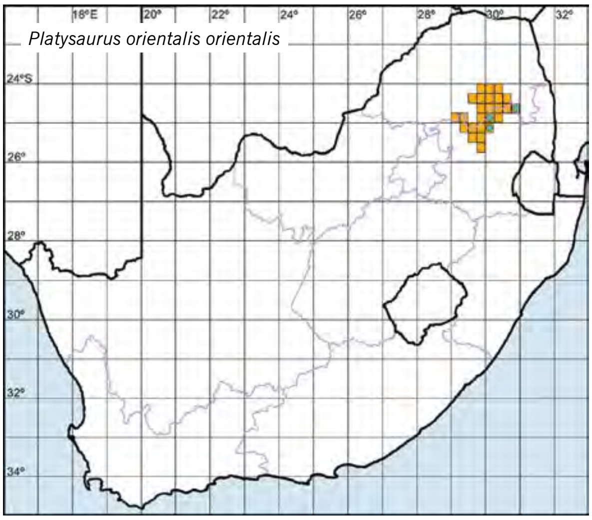
Endemic

Taxonomy: The genus *Platysaurus* is being revised. An analysis of molecular data will help resolve the status of *P. orientalis fitzsimonsi* (S. Keogh, M. Whiting & D.G. Broadley in prep.).

Distribution: Endemic to Mpumalanga and Limpopo provinces, South Africa, occurring along the eastern escarpment and associated mountain ranges, mainly in Sekhukhune district.

Habitat: Occupies rock outcrops typically composed of granites and quartzites (Jacobsen & Newbery 1989). Narrow vertical and horizontal crevices are important for refuge (Jacobsen 1989). Exposed bedrock with free-standing boulders is favoured. Occurs at altitudes of 700–1 700 m (Jacobsen 1989).

Bioregion: Central Bushveld; Mesic Highveld Grassland.



Assessment rationale: Widespread and common.

Conservation measures: Monitor the extent and intensity of granite mining within its range. Provide protection against commercial exploitation for the pet trade. Conduct research into basic biology and population trends.

Platysaurus orientalis orientalis, male—Abel Erasmus Pass, MPM
M. Burger

Platysaurus orientalis orientalis, female—Farm Kalkfontein, about 25 km SSE of Steelpoort, MPM
M. Burger

Platysaurus orientalis fitzsimonsi Loveridge, 1944

FITZSIMONS' FLAT LIZARD

Martin J. Whiting

Global: Near Threatened

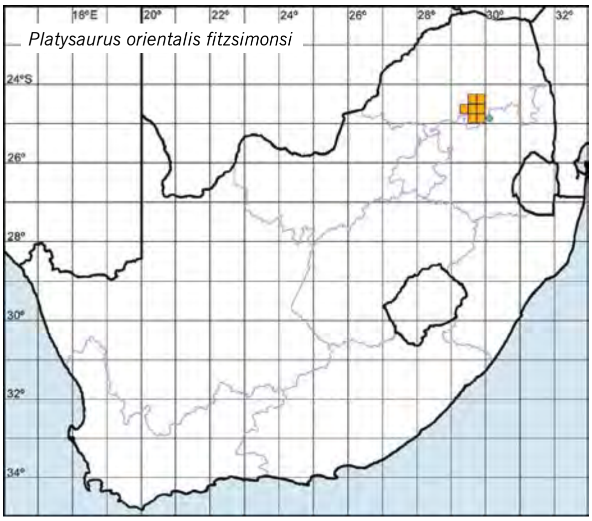
Endemic

Taxonomy: The genus *Platysaurus* is being revised. An analysis of molecular data will help resolve the status of this subspecies (S. Keogh *et al.* in prep.).

Distribution: Endemic to the Sekhukhuneland region of Mpumalanga and Limpopo Provinces, South Africa. The most easterly locality (2430CC) is represented by a Virtual Museum record.

EOO: 2 315 km^2 (confidence: high); AOO: 1 327 km^2 (confidence: medium).

Habitat: Found on low-lying rocky ridges, particularly where there is exfoliating granite with free-standing boul-



ders. Narrow crevices are important for refuge. Occurs at elevations of 900–1 500 m (Jacobsen 1989).

Vegetation type: SVcb 12 Central Sandy Bushveld; SVcb 27 Sekhukhune Plains Bushveld; SVcb 15 Springbokvlakte Thornveld.

Assessment rationale: This subspecies has a restricted range (EOO <5 000 km^2 and AOO <2 000 km^2) that is severely fragmented [B1a+2a] and it should therefore be considered Near Threatened. The reason for the fragmented distribution is not clear, but it may be partly the result of anthropogenic factors. There are no immediate threats, but mining could become a threat in the future.

Threats: Although most mines are situated further to the east, mining could become a threat in the future. Because of its limited distribution and dispersal capabilities, any habitat disturbance could have a major impact on this flat lizard.

Conservation measures: Assess distribution and abundance. Because of its localised distribution, *P. o. fitzsimonsi* would be best conserved by habitat protection; therefore, assess and manage the potential threat posed by mining. Conduct a BMP-S.

Platysaurus orientalis fitzsimonsi, male—about 3 km NE of Ga-Mahlanya, LIMP M. Burger

Platysaurus relictus Broadley, 1976

SOUTPANSBERG FLAT LIZARD

Martin J. Whiting

Global: Least Concern

Endemic

Taxonomy: No notable issues.

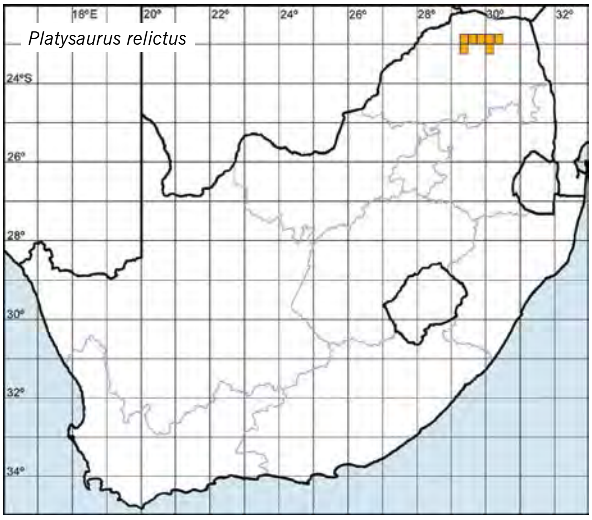
Distribution: Endemic to the Soutpansberg Range in Limpopo Province, South Africa. Within the Soutpansberg, it is most common on northern slopes where there is less rainfall and more exposed rock without big tracts of forests (Jacobsen 1989).

Habitat: Occurs on north-facing rocky slopes and the crowns of ridges on the Soutpansberg, where it is dependent on narrow rock crevices for refuge. Rocky areas with extensive sheet rock and loose boulders are particularly favoured (Jacobsen 1988e, 1989).

Vegetation type: SVmp 1 Musina Mopane Bushveld; SVcb 21 Soutpansberg Mountain Bushveld; SVl 8 Tzaneen Sour Bushveld.

Assessment rationale: Has a restricted range (EOO = 2 606 km^2 and AOO = 1 976 km^2) but there is no evidence of severe range fragmentation or a decline in habitat extent or quality, and there are no immediate threats. However, there may be an indirect threat from agricultural activity, particularly in the southern part of the range where the use of insecticides may impact local populations. Food availability may be reduced due to insecticide use and secondary ingestion of toxins. In the past, populations were threatened by collection for the pet trade, but this was later ameliorated through protective legislation (Jacobsen 1988e).

Conservation measures: Monitor the quality of surrounding habitat as this may influence insect prey availability which could be critical for the survival of the species.



Platysaurus relictus, male—Watwaterpoort, NW of Louis Trichardt, LIMP J. Marais

CHAPTER 13

Family Gerrhosauridae

Michael F. Bates

The Gerrhosauridae is one of seven scincomorph families. Together with the Cordylidae, it forms part of the Cordyliformes clade (Lang 1991). There is, however, a history of disagreement amongst authors as to whether the Cordyliformes comprises a single family, the Cordylidae Gray, 1837 (e.g. Odierna *et al.* 2002—molecular and karyological data), two families, namely Cordylidae and Gerrhosauridae Fitzinger, 1843 (e.g. Loveridge 1942; FitzSimons 1943; Lang 1991—morphology), or one family with two subfamilies, namely Cordylinae and Gerrhosaurinae (e.g. Wermuth 1968—morphology). Since Lang (1991), most authors have accepted or confirmed the monophyly of Gerrhosauridae (e.g. molecular analyses of Frost *et al.* 2001 and Lamb *et al.* 2003).

There are 38 gerrhosaurid species in seven genera. The Gerrhosauridae consists of two subfamilies, the Gerrhosaurinae from mainland sub-Saharan Africa, and the Zonosaurinae from Madagascar (including the offshore islands of Comoros, Gloriosa and Cosmoledo). The Gerrhosaurinae consists of five genera, namely *Tetradactylus* (eight species), *Gerrhosaurus* (eight species), *Matobosaurus* (two species), *Broadleysaurus* (one species) and *Cordylosaurus* (one species), whereas the Zonosaurinae contains two genera, namely *Zonosaurus* (17 species) and *Trachyloptychus* (two species) (Branch 1998; Broadley 2007; Glaw & Vences 2007). Within the *Atlas* region there are 13 species in five genera.

The mtDNA analyses of Lamb *et al.* (2003) and Lamb & Bauer (2013) indicated that the stout-bodied *G. major* constituted a lineage distinct from other *Gerrhosaurus*, and showed that *Cordylosaurus* and *Tetradactylus* were embedded within *Gerrhosaurus*. This suggested that a new genus may be required for *G. major* and that *Cordylosaurus* may be referable to the genus *Tetradactylus*. However, the latter groupings were not strongly supported. Lamb *et al.* (2003) and Lamb & Bauer (2013) also showed that the monotypic genus *Angolosaurus* (*A. skoogi*) was embedded within *Gerrhosaurus*, to which it was transferred. Nance's (2007) study of cranial osteology questioned the latter proposal but failed to provide any substantial evidence to the contrary. A subsequent molecular phylogeny (Bates *et al*. 2013) with better sampling, recognised *Cordylosaurus* and *Tetradactylus*, and determined that *Gerrhosaurus* was paraphyletic, consisting of three genera, including the newly-named *Broadleysaurus* (for '*G. major*') and *Matobosaurus* (for '*G. validus*'). The only recently described gerrhosaurid from the African mainland is *Tetradactylus udzungwensis* (Salvidio *et al.* 2004), but for Madagascar five species of *Zonosaurus* have been described in the last 20 years. An analysis of morphological variation in *Tetradactylus* is underway (M.F. Bates in prep.).

Gerrhosaurids are diurnal, usually solitary and mainly terrestrial, although both species of *Matobosaurus* form loosely-structured colonies and are entirely rupicolous (Jacobsen 1989; Branch 1998). *Gerrhosaurus* consists of medium to large robust-bodied lizards that often use burrows for shelter, whereas *Cordylosaurus* and *Tetradactylus* are both small, elongate lizards that shelter under stones or in tufts of grass (Branch 1998). *Gerrhosaurus skoogi* is a large species with a spade-like snout and is adapted to life in the dunes of the northern Namib Desert. Members of the genus *Tetradactylus* display varying degrees of limblessness, from *T. seps* with four well-developed but short limbs and pentadactyl feet, to *T. fitzsimonsi* with no forelimbs and spike-like hindlimbs. The most elongated and limbless forms are adapted to rapid serpentiform movement in low-growing grass, karoo and fynbos vegetation. Despite the morphological dissimilarity between the various forms, all gerrrhosaurids have a prominent granular lateral body fold.

Gerrhosaurids prey on a variety of insects such as grasshoppers, beetles and termites, but also take other arthropods such as scorpions, millipedes and snails, as well as fruits and flowers. Both *Broadleysaurus* and *Matobosaurus* occasionally eat smaller lizards (Jacobsen 1989; Branch 1998) and in the case of *M. validus*, even birds (G.J. Alexander pers. comm.). All species are considered oviparous, usually producing clutches of 1–9 eggs, although reproductive information for some species is lacking (Branch 1998). In some areas *Tetradactylus africanus* females display an interesting egg-laying/incubation strategy by using nests of the ant *Anochetus faurei* (Mason & Alexander 1996).

Most species in the *Atlas* region are widely distributed and fairly common, but in the genus *Tetradactylus* one species (*T. eastwoodae*) is now considered Extinct, while two (*T. breyeri*, *T. fitzsimonsi*) are classified as Vulnerable due to loss of habitat to afforestation and agricultural developments. *Tetradactylus breyeri* was previously classified as Rare (Branch 1988a) and Vulnerable (IUCN 1996). During the SARCA project *G. auritus* was recorded from the *Atlas* region for the first time—a Virtual Museum record—but because it is known locally only from this single locality, it was not assessed.

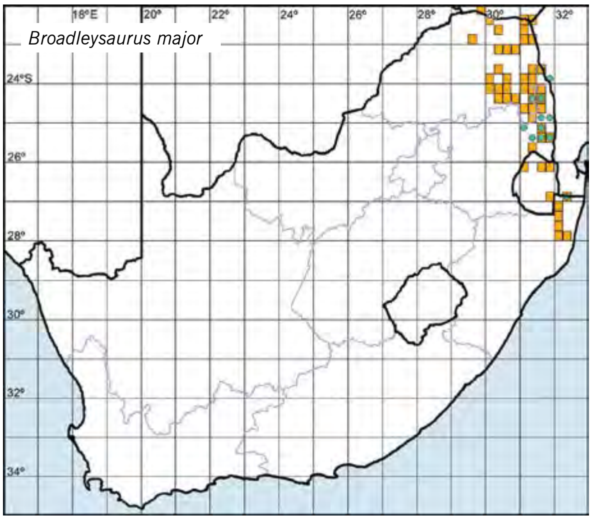
Genus *Broadleysaurus* Bates & Tolley, 2013—rough-scaled plated lizards

This recently-described genus (Bates *et al.* 2013) contains a single species, *Broadleysaurus major*. It has a very large range extending from the northeastern parts of the *Atlas* region through the eastern half of sub-Saharan Africa to southern Sudan, Somalia and Ethiopia, with scattered populations in Central and West Africa which were considered a subspecies (*Gerrhosaurus m. bottegoi*) by Broadley (1987). These large and stocky lizards (up to 245 mm SVL) are mainly terrestrial but often found in rocky situations (Jacobsen 1989; see Bates *et al.* 2013). They prey on insects, millipedes, small lizards and also take flowers and fruits; females lay 2–6 eggs (Branch 1998). The species is not of conservation concern.

Broadleysaurus major (Duméril, 1851)

ROUGH-SCALED PLATED LIZARD

Michael F. Bates



Regional: Least Concern

Taxonomy: Broadley (1987a) reviewed geographical variation in *Broadleysaurus* (as *Gerrhosaurus*) *major* and recognised two subspecies, *G. m. major* (eastern and south-eastern Africa) and *G. m. bottegoi* (western, central and northeastern Africa), distinguishable only on the basis of colour. *Gerrhosaurus m. bottegoi* is dark brown to black dorsally whereas *G. m. major* is buff to tawny, with variable amounts of black streaking in some areas. The dark-streaked *G. m. grandis*, to which southern African populations were referred in the past, is intermediate in colour pattern between *G. m. bottegoi* and *G. m. major* (Broadley 1987a). The molecular phylogeny of Bates *et al.* (2013) did not produce support for *G. m. bottegoi* as a separate taxon and they treated *B. major* as a monotypic species.

Distribution: Widely distributed in the eastern half of sub-Saharan Africa south of 6°N, from the southern parts of Sudan and Ethiopia southwards to the northeastern parts of the *Atlas* region, with scattered populations in Central and West Africa (Broadley 1987). Within the *Atlas* region it occurs in the eastern parts of Limpopo and Mpumalanga as well as northeastern KwaZulu-Natal, South Africa, and in Swaziland.

Habitat: Terrestrial, usually solitary and often found in small, well-vegetated rock outcrops in savanna, sheltering in crevices, mammal burrows and disused termite mounds (Jacobsen 1989; Branch 1998). It has a wide habitat tolerance and may be found in chambers under rocks and near buildings (Jacobsen 1989).

Bioregion: Lowveld; Mopane.

Assessment rationale: Widespread in the *Atlas* region and occurs extensively elsewhere in Africa.

Conservation measures: Jacobsen (1989) noted that in Limpopo and Mpumalanga this subspecies is uncommon. He suggested that populations should be monitored, surveys undertaken, and ecological studies conducted.

Broadleysaurus major, adult—Greater Kuduland Safaris, LIMP M. Burger

Broadleysaurus major, juvenile—Cleveland NR, Phalaborwa, MPM M. Burger

Genus *Cordylosaurus* Gray, 1865 [1866]—dwarf plated lizards

This is a monotypic genus restricted to the arid western parts of southern Africa, from southwestern Angola through western Namibia and into the western parts of South Africa (Branch 1998). *Cordylosaurus subtesselatus* is a small, elongate lizard that is similar in appearance and closely related to *Tetradactylus* (Lamb *et al.* 2003). It is oviparous (two eggs are laid in November), diurnal and terrestrial, and usually shelters under or between stones (Branch 1998). These lizards are widespread and occur in areas with limited threats, and are therefore not considered to be of conservation concern.

Cordylosaurus subtessellatus (A. Smith, 1844)

DWARF PLATED LIZARD

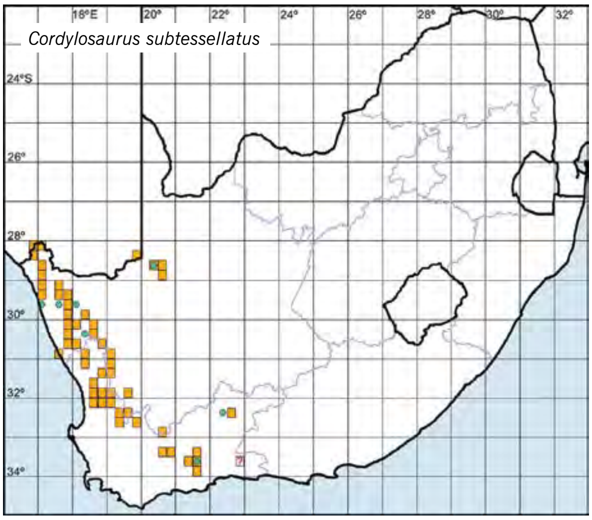
Michael F. Bates

Global: Least Concern

Taxonomy: Branch & Bauer (1995) noted considerable variation in most characters used by FitzSimons (1943) to separate the subspecies *C. trivittatus trivittatus* and *C. t. australis*, and supported Loveridge's (1942) contention that these taxa are referable to one variable species, namely *C. subtessellatus*. Most authors subsequent to FitzSimons (1943) have followed Loveridge's (1942) taxonomy (e.g. Branch 1988b, 1998).

Distribution: Occurs in the arid western parts of southern Africa, from southwestern Angola through western Namibia (excluding true deserts) to the Northern and Western Cape provinces of South Africa (Visser 1984g; Branch 1998; O'Connor *et al.* 2006), as far south as the Clanwilliam area and then slightly inland (excluding most of the fynbos region), with outlier records at Karoo National Park (3222BC) and possibly Mannetjiesberg (3322DB, questionable sight record). The *Atlas* map contains almost three times more occupied QDGCs than Visser's (1984g) map.

Habitat: Found among succulent and other karroid vegetation on small rocky outcrops in arid areas (Branch 1998). Shelters under stones in sandy areas but has also been found in a hole at the base of a Mopane tree, *Colophospermum mopane* (Loveridge 1942; Bauer & Branch 2003 [2001]). In the Little Karoo this species was collected on a north-facing mudstone ridge with karroid-fynbos transitional veld (Branch & Bauer 1995). Occurs from near sea level to about 1 200 m in Karoo National Park near Beaufort West (Branch & Braack 1989).



Biome: Succulent Karoo; Fynbos; Nama-Karoo.

Assessment rationale: Widespread and fairly common; no known threats.

Conservation measures: None recommended.

Cordylosaurus subtessellatus—N of Swakopmund, Namibia G.J. Alexander

Cordylosaurus subtessellatus—Springbok, NC J. Marais

Genus *Gerrhosaurus* Wiegmann, 1828—plated lizards

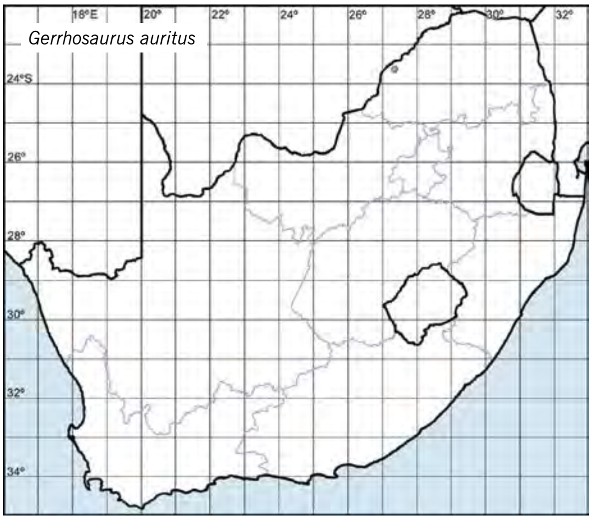
Following the transfer of *Gerrhosaurus major* to *Broadleysaurus*, and *G. validus* to *Matobosaurus*, and the resurrection of *G. intermedius*, there are now eight species in the genus *Gerrhosaurus* (*G. auritus*, *G. bulsi*, *G. flavigularis*, *G. intermedius*, *G. multilineatus*, *G. nigrolineatus*, *G. skoogi* and *G. typus*) (Broadley & Cotterill 2004; Broadley 2007; Bates *et al.* 2013). These lizards occur in central, eastern and southern Africa. Four species occur in the *Atlas* region and one, *G. typicus*, is endemic to South Africa.

Plated lizards are robust, medium-sized (occasionally over 200 mm SVL), diurnal, terrestrial and usually solitary. Females lay 4–12 eggs in a clutch (Branch 1998). All species are widely distributed and none are of conservation concern. *Gerrhosaurus typicus* was previously assessed as Rare in the South African Red Data Book (McLachlan 1988a) and Near Threatened by the IUCN (1996), but the species is now known to have a wide range in an area with limited threats.

Gerrhosaurus auritus Boettger, 1887

KALAHARI PLATED LIZARD;
GOLDEN PLATED LIZARD

Michael F. Bates



Not Applicable

Taxonomy: First described as *Gerrhosaurus auritus*, this taxon was treated as a subspecies of *G. nigrolineatus* by Loveridge (1942) but retained as a full species by FitzSimons (1943) and Mertens (1971). Broadley (1971c) was the first author to treat *auritus* as a subspecies of *G. multilineatus* (by default, using trinomials for *G. m. multilineatus* and referring southern material to *auritus*). This arrangement was subsequently followed by Broadley & Blake (1979), Auerbach (1987) and Branch (1988b, 1998). The taxon was revived as a valid species by Griffin (2003) and has been treated as such by most subsequent authors (e.g. Broadley & Cotterill 2004; Adolphs 2006; Broadley 2007; Bates *et al*. 2013).

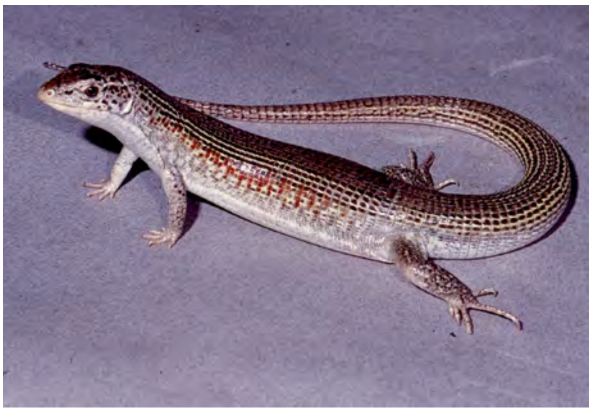
Distribution: Endemic to southern Africa. It occurs in the northern half of Namibia and most of Botswana, extending into the adjacent Hwange region of western Zimbabwe (Branch 1998). The SARCA Virtual Museum record (see photo) from Ellisras district in Limpopo represents the first record of this species in the *Atlas* region. This adult specimen (snout-to-vent lenght = 147 mm) was collected in 2008 by a team led by Andrew Cauldwell. The nearest recorded localities are in Botswana (Auerbach 1987), about 200 km to the west-south-west of the South African record.

Habitat: Found in holes that it digs around the roots of shrubs in bushveld and Kalahari sandveld (Branch 1998).

Bioregion: Central Bushveld.

Assessment rationale: Not assessed as it is known from only one record in the *Atlas* region.

Conservation measures: Conduct a detailed survey in the vicinity of the single known local record to establish the extent of this species' range in the *Atlas* region.



Gerrhosaurus auritus—near Kome Pan, Botswana W.D. Haacke

Gerrhosaurus auritus—Farm Groenfontein, 44 km WNW of Lephalale, LIMP
Natural Scientific Services

Gerrhosaurus flavigularis Wiegmann, 1828

YELLOW-THROATED PLATED LIZARD

Michael F. Bates

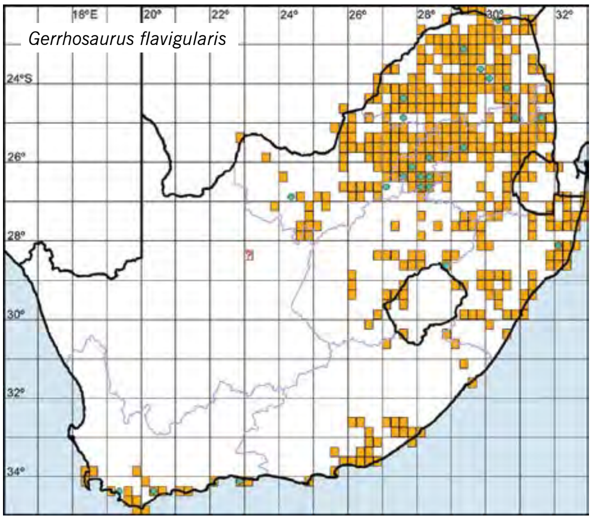
Regional: Least Concern

Taxonomy: A molecular study confirmed that *Gerrhosaurus flavigularis* is the sister group to the *G. nigrolineatus* species complex (see *G. intermedius* account below) and sub-structuring of its populations indicated that further investigations are required (Bates *et al.* 2013).

Distribution: Endemic to sub-Saharan Africa. Occurs in coastal areas in the Western and Eastern Cape, northwards through the eastern parts of southern Africa to Ethiopia and Sudan, with an isolated relict population near Gobabis in Namibia (Branch 1998; Uetz 2012). Populations in the Western and Eastern Cape appear to be isolated from one another and from the main population further north. This species is very widespread and commonly reported in the northeastern parts of the *Atlas* region. Visser's (1984g) records at 2823AC (question mark on map) and 3124AB (not plotted) in the Northern Cape are slightly out of the species' normal range and therefore require confirmation.

Habitat: Found in a variety of grassland, savanna and fynbos habitats as well as in low, open coastal forest, sheltering in burrows dug at the base of bushes and under rocks (Branch 1998). In the Free State Province it is found on rocky and grassy hillsides where it uses burrows situated under rocks (De Waal 1978). Individuals from the northern parts of South Africa have been recorded from both rocky hillsides and sandy flats, where they shelter in burrows in the soil and sometimes under rocks, and forage between grass tussocks and in leaf litter at the base of bushes (Jacobsen 1989).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Fynbos; Albany Thicket.



Gerrhosaurus flavigularis—Suikerbosrand NR, GP W.R. Schmidt

Assessment rationale: Widespread and common, occupying a variety of habitats (Jacobsen 1989; Branch 1998).

Conservation measures: None recommended.

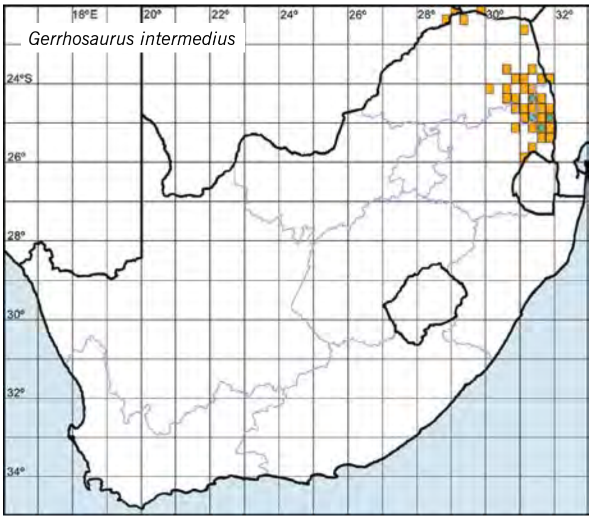
Gerrhosaurus intermedius Lönnberg, 1907

EASTERN BLACK-LINED PLATED LIZARD; BLACK-LINED PLATED LIZARD

Michael F. Bates

Regional: Least Concern

Taxonomy: A molecular phylogeny indicated that *Gerrhosaurus nigrolineatus* was restricted to Gabon and the lower Congo region in west-Central Africa, while most other populations currently identified under this name were referable to *G. intermedius*. *Gerrhosaurus intermedius* and *G. flavigularis* occur in close proximity and have been confused in the past because the two species are often similar in colour pattern. However, they differ with regard to size (*G. intermedius* grows to 183 mm SVL versus 142 mm SVL in *G. flavigularis*) and scalation (e.g. in *G. intermedius* scales under the feet are keeled and spinose and there are usually four supraciliaries; in *G. flavigularis* scales under feet are smooth and tubercular and there are usually five supraciliaries) (FitzSimons 1935a; Jacobsen 1989; Branch 1998). *Gerrhosaurus intermedius* is also a more robust species with a relatively larger



head. Nevertheless, Jacobsen (1989) noted that morphologically *flavigularis*-like specimens with *intermedius*-like colour patterns and blue throats occur in the northeast of Limpopo and southwest of North-West Province, and require further investigation. A morphology-based revision of the *G. nigrolineatus* species complex (*G. nigrolineatus*, *G. intermedius*, *G. auritus*, *G. bulsi* and *G. multilineatus*) is in progress (D.G. Broadley & M.F. Bates in prep.).

Distribution: Endemic to the eastern half of sub-Saharan Africa as far north as Kenya (Loveridge 1942; Spawls *et al.* 2002; Bates *et al.* 2013). In the *Atlas* region it is restricted to northern and eastern Limpopo and northeastern Mpumalanga, South Africa. While *G. nigrolineatus* appears to be restricted to Gabon and the lower Congo region (Bates *et al.* 2013), the status of *G. intermedius*-like populations elsewhere in central and southern Africa remains uncertain and is under investigation (D.G. Broadley & M.F. Bates in prep.).

Habitat: In the *Atlas* region it is restricted to low elevations (300–700 m) in the Savanna Biome (Jacobsen 1989). Found in open bushveld where it forages among grass, under bushes and in leaf litter at the base of trees, taking refuge in rodent and mongoose burrows and old termitaria (Jacobsen 1989; Branch 1998). Elsewhere in Africa it is found in savanna, coastal bush and grassland at altitudes ranging from sea level to about 1 600 m (Loveridge 1942; Spawls *et al.* 2002).

Bioregion: Lowveld; Mopane.

Assessment rationale: Reportedly uncommon and sparsely distributed in the *Atlas* region (Jacobsen 1989), but this

Gerrhosaurus intermedius—9 km S of Skukuza, Kruger NP, MPM W.R. Schmidt

may be at least partly because it is shy and fast-moving and therefore not easily observed or collected (FitzSimons 1935a; Spawls *et al.* 2002). Fairly widespread and not known to be threatened. Jacobsen (1989) commented that in Limpopo and Mpumalanga its conservation status is secure because it occurs in areas used for ranching, where habitat destruction is minimal.

Conservation measures: Determine population numbers and habitat status.

Gerrhosaurus typicus (A. Smith, 1837)

KAROO PLATED LIZARD; NAMAQUA PLATED LIZARD

Michael F. Bates

Global: Least Concern

Endemic

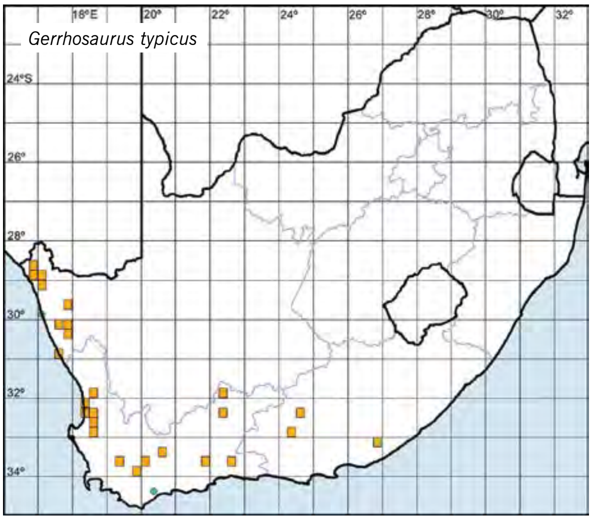
Taxonomy: No notable issues.

Distribution: Endemic to the Northern, Western and Eastern Cape provinces of South Africa. Found along the West Coast from the Richtersveld in the north to the southern Cape coast at De Hoop Nature Reserve near Bredasdorp (a Virtual Museum record), east to Kammanassieberg and along the inland escarpment to Karoo National Park at Beaufort West, Karoo Nature Reserve at Graaff Reinet, and near Glenmore (3326BB) between Port Elizabeth and East London. It may also occur in southern Namibia (Griffin 2003). When it was assessed by McLachlan (1988a) this species was known from only 12 QDGCs: six in Namaqualand, three in the southwestern Cape, and three in the central Nama-Karoo.

Habitat: Found in the Succulent and Nama-Karoo Biomes and the renosterveld part of the Fynbos Biome, occupying small burrows dug in the sand at the base of bushes (Loveridge 1942; Branch 1998). Recorded specifically from dry sandy areas, bare rocky hillsides and Acacia scrub in False Karroid Broken Veld (McLachlan 1988a). In the Little Karoo it is found on stony ground in succulent mountain scrub and in sandy areas in mountain renosterveld vegetation (Branch & Bauer 1995). Occurs mainly below the escarpment, from near sea level to about 900 m, with one record (Dunedin, 3122CD) as high as 1 497 m.

Biome: Succulent Karoo; Fynbos; Nama-Karoo; Albany Thicket.

Assessment rationale: Widespread and probably more common than literature and maps suggest, owing to its



Gerrhosaurus typicus—Worcester Valley, WC A.L. de Villiers

shy nature and habit of retreating rapidly to its burrow when approached, and the fact that much of the karroid region has been poorly sampled (Loveridge 1942; McLachlan 1988a; Branch & Bauer 1995).

Conservation measures: None recommended.

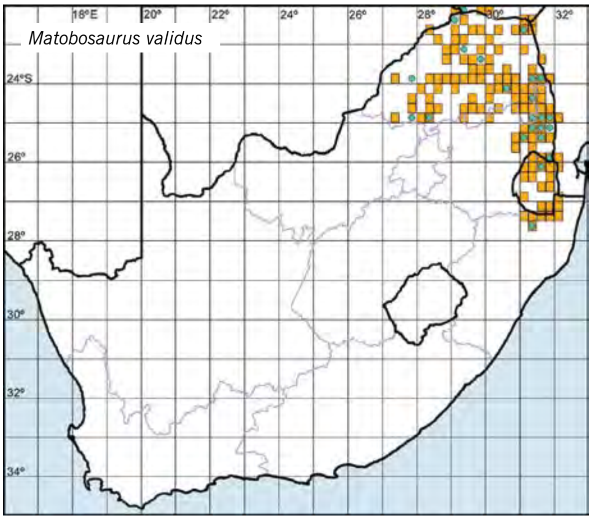
Genus *Matobosaurus* Bates & Tolley, 2013—giant plated lizards

This recently-described genus contains two species (Bates *et al.* 2013). *Matobosaurus validus* occurs from the north-eastern parts of the *Atlas* region northwards through eastern Botswana, Zimbabwe, Zambia, Malawi and Mozambique, while *M. maltzahni* is found only in northern Namibia and southern Angola (Branch 1998). These large and robust lizards (up to 285 mm SVL) are rupicolous and may form small colonies, often on wooded granite koppies (Branch 1998; see Bates *et al.* 2013). They prey on invertebrates and vegetable matter, and occasionally even eat small vertebrates; females lay 2–5 eggs (Branch 1998). Neither species is considered to be of conservation concern.

Matobosaurus validus (A. Smith, 1849)

COMMON GIANT PLATED LIZARD;
GIANT PLATED LIZARD

Michael F. Bates



Regional: Least Concern

Taxonomy: Bates *et al.* (2013) showed that '*Gerrhosaurus validus validus*' (southeastern Africa) and '*G. v. maltzahni*' (southern Angola and northern Namibia) were genetically well defined and represented valid species. These two taxa are geographically isolated and differ with regard to several scale characters (FitzSimons 1943; Branch 1998).

Distribution: Endemic to southeastern Africa. Distributed from Zambia and Malawi southwards to Zimbabwe and adjacent parts of Botswana and Mozambique, South Africa and Swaziland (Branch 1998). It occurs in the South African provinces of Limpopo, Mpumalanga (northern and eastern) and KwaZulu-Natal (northern), with a single record (2427CD) in extreme northern North-West Province. Jacobsen (1989) also recorded this lizard at 2626BD in North-West Province, but he noted that this outlier record was probably the result of a translocation, and it is therefore not plotted on the map nor considered in the current evaluation.

Habitat: Found in the Savanna and Grassland biomes, almost exclusively in bushveld areas. In the *Atlas* region it occurs at altitudes of 300–1 400 m (Jacobsen 1989). Lives communally in rocky outcrops, especially on the upper slopes of large granite hills, but may forage far from crevices (Jacobsen 1989; Branch 1998). It may enlarge its retreat if this is situated on soil under rocks (Jacobsen 1989).

Bioregion: Lowveld; Central Bushveld; Mopane; Mesic Highveld Grassland.

Assessment rationale: Widespread and generally common (Jacobsen 1989; Branch 1998). However, Jacobsen (1989) noted that some populations, like the one at Nylsvley Nature Reserve in Limpopo Province, are very small.

Conservation measures: None recommended.

Matobosaurus validus, adult—Greater Kuduland Safaris, E of Tshipise, LIMP
M. Burger

Matobosaurus validus, juvenile—Manyiseni region, Lebombo Mtns, KZN
M. Burger

Genus *Tetradactylus* Merrem, 1820—plated snake lizards

The eight species of *Tetradactylus* are restricted to the southern half of Africa (Uetz 2012, but including *T. fitzsimonsi*). All except *T. ellenbergeri* (Angola, Zambia and Tanzania) and *T. udzungwensis* (Tanzania) are endemic to the southern and eastern parts of the *Atlas* region. A taxonomic review of the genus is in progress (M.F. Bates in prep.). The elongated body, long tail and minute limbs (forelimbs absent in *T. fitzsimonsi*) allow for rapid movement in long grass; the minute limbs may provide support when at rest (Branch 1998). These serpentiform lizards are diurnal and terrestrial. Females lay small clutches of 1–5 eggs (Branch 1998). *Tetradactylus eastwoodae* is known from only one locality and has been considered as probably extinct since at least 1988 (Jacobsen 1988f; IUCN 1996), mainly as a result of afforestation that destroyed its grassland habitat. Its status as Extinct is now confirmed. *Tetradactylus breyeri* and *T. fitzsimonsi* have restricted ranges and are considered Vulnerable as a result of habitat loss to afforestation and agricultural developments. *Tetradactylus breyeri* was classified as Rare in the South African Red Data Book (Jacobsen 1988g) and Vulnerable by the IUCN (1996), but *T. fitzsimonsi* was not previously assessed on its own, as it was considered to be a subspecies of the wide-ranging *T. africanus*.

Tetradactylus africanus (Gray, 1838)

EASTERN LONG-TAILED SEPS

Michael F. Bates

Global: Least Concern

Endemic

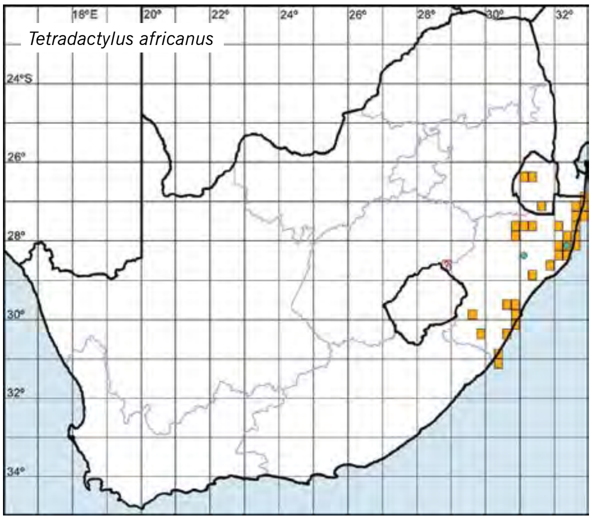
Taxonomy: This species reverts to binomials because *Tetradactylus fitzsimonsi*, generally considered a subspecies of *T. africanus* (e.g. FitzSimons 1943; Branch 1998), is here treated as a valid species (see discussion under *T. fitzsimonsi*).

Distribution: Endemic to Swaziland and KwaZulu-Natal, South Africa. Occurs at several localities along the KwaZulu-Natal coast, but with a concentration of sites in the northern part of the province, including Maputaland (Bourquin 2004). The southernmost record in KwaZulu-Natal is in the Port Edward area (3130AB; Bourquin 2004), but a National Museum specimen (NMB R209, identity verified; see also FitzSimons 1943) from 'Pondoland Coast' (too vague to plot on map) extends the species' range into the Eastern Cape. Only a single additional record (2631AD) for Swaziland has been obtained since Boycott's (1992a) study. The identity of a specimen supposedly from Witsieshoek (2828DB) in the eastern Free State, collected prior to 1915, was confirmed by Bates (1992), but no additional specimens of this species have since been collected anywhere nearby (e.g. De Waal 1978; Bourquin 2004) and this record is therefore viewed with suspicion. The species may also occur in southern Mozambique.

Habitat: Occurs in open and wooded grasslands (Bourquin 2004). In Maputaland it is found in dry, sandy grasslands near the coast and on the edges of forests and plantations (Bruton & Haacke 1980). At Vernon Crookes Nature Reserve near Scottburgh, in pure grassland, it exclusively utilises mounds of the ant *Anochetus faurei* as oviposition sites (Mason & Alexander 1996).

Bioregion: Indian Ocean Coastal Belt; Lowveld; Sub-Escarpment Grassland; Sub-Escarpment Savanna.

Assessment rationale: Fairly widespread, and common in at least some areas such as Maputaland (see Bruton & Haacke 1980).



Tetradactylus africanus—Mtunzini, KZN J. Marais

Conservation measures: Limit the frequency of fires in areas where this species occurs. Bruton & Haacke (1980) noted that *T. africanus* represented 16% of all reptiles (second most common after *Chamaesaura macrolepis*) found during the burning of dry grassland in Maputaland. In addition, parts of the range of this species are under cultivation (e.g. sugarcane and crops) or used for wood plantations (Rouget *et al.* 2006), so population monitoring may become necessary in the future.

Tetradactylus breyeri Roux, 1907

BREYER'S LONG-TAILED SEPS

Michael F. Bates

Global: Vulnerable A2c

Endemic

Taxonomy: A specimen collected in the Free State was considered by De Waal (1978) to be representative of a new subspecies. Bates (1996c) examined all available museum material of this species, including additional specimens from the Free State, and concluded that *T. breyeri* is a monotypic species.

Distribution: Endemic to the South African provinces of KwaZulu-Natal, Free State and Mpumalanga. The new Blyde River Canyon locality (2430DB) represents the northernmost extension of the range. This species is known from only 16 museum specimens (see Bates 1996c), one sight record at 2529DA (Jacobsen 1989) and two Virtual Museum records (2430DD, 2829BA).

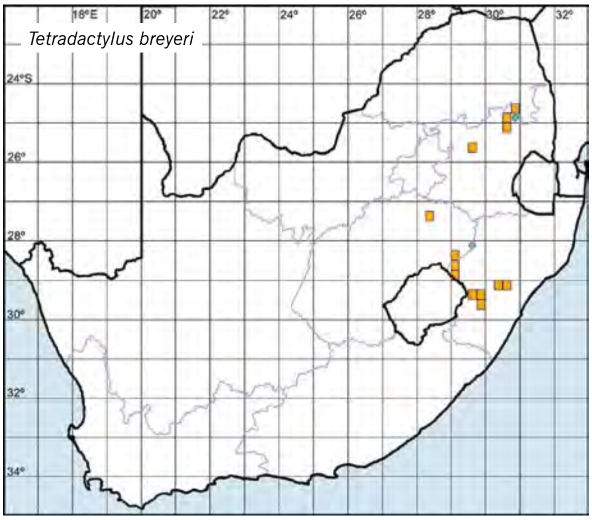
EOO: 101 250 km^2 (confidence: medium); AOO: 5 136 km^2 (confidence: medium).

Habitat: Found in montane and Highveld grasslands of the Grassland Biome at altitudes of 1 400–2 000 m (Bates 1996c). May take shelter on soil under stones or in moribund termitaria (Jacobsen 1989).

Bioregion: Mesic Highveld Grassland; Sub-Escarpment Grassland; Drakensberg Grassland.

Assessment rationale: Inferred population reduction of over 30% in the last 18 years (three generations) due to transformation of grasslands where the causes of reduction may not have ceased, based on a decline in AOO, EOO and habitat quality [A2c]; these declines are considered likely to continue into the future. Large parts of this species' habitat have been transformed for crop farming, heavy grazing of remaining areas has further reduced available sheltering sites, and further habitat destruction occurs when farmers frequently burn grasslands to produce green forage for livestock (Jacobsen 1988g). Farming practices have almost certainly fragmented the range of this species, preventing genetic exchange between populations. This is clearly evident when examining Google Earth images which indicate extensive transformation of grassland habitat for crop farming in many areas, e.g. the northeastern Free State.

Threats: Threatened by transformation of land for crops (especially in the case of the northeastern Free State population) and timber plantations (especially the central KwaZulu-Natal and northern Mpumalanga populations) (see Rouget *et al.* 2006), overgrazing by livestock causing depletion of sheltering sites and insect prey, infrastructure development in some areas, frequent fires, and the use of pesticides. Jacobsen (1988g, 1989) also noted the negative effects of cultivation, heavy grazing, regular anthropogenic fires and afforestation.



Tetradactylus breyeri—Mt Sheba, MPM W.D. Haacke

Conservation measures: Draft a BMP-S. Communicate with farmers and other locals and educate them about this species. Warn against the burning of grasslands, and encourage and monitor controlled fire management. Investigate population numbers and exact ranges, biology and ecology, status of available habitat, and threats. Monitor population trends, paying special attention to the extent of mortalities as a result of fires. Identify and establish more protected areas. Conduct further surveys that specifically aim to locate this species. Encourage farmers to provide corridors of suitable natural grassland between croplands and dissuade them from overgrazing cattle and small livestock.

Tetradactylus eastwoodae Hewitt & Methuen, 1913

EASTWOOD'S LONG-TAILED SEPS

Michael F. Bates & Niels H.G. Jacobsen

Global: Extinct

Endemic

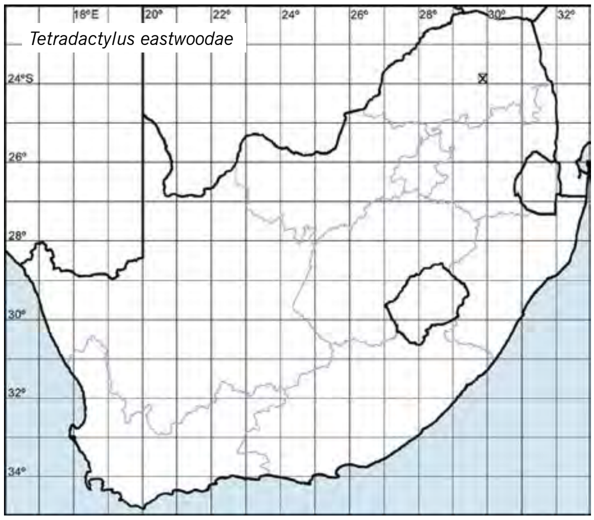
Taxonomy: This distinctive species has three digits per forelimb and two per hindlimb. It is known from only two specimens - the holotype collected by Mrs E.A. Eastwood in November 1911 and another specimen collected by Vincent A. Wager in December 1928. Both specimens were catalogued as being from 'Woodbush' and are in the collection of the Ditsong National Museum of Natural History (formerly Transvaal Museum), Pretoria.

Distribution: Endemic to the Woodbush-Haenertsburg area in Limpopo Province, South Africa. The type locality is "the Woodbush (Zoutpansberg District)" (Hewitt & Methuen 1913), but much of the Woodbush area is now under exotic (especially pine) plantations (Jacobsen 1988f, 1989). However, according to the book *Between Woodbush and Wolkberg: The Googoo Thompson's Story* (Wongtschowski 1990) the collector, Miss Eastwood (later Thompson), recalls collecting the holotype on the farm Clear Waters (the family's name for the farm Broedersdrift 958LS), which is situated a few kilometers southwest of Woodbush (indigenous) Forest. The term 'Woodbush' may have been used in a broad sense to mean the area in the vicinity of Woodbush Forest, but we here restrict the type locality of *T. eastwoodae* to the farm Broedersdrift 958, Pietersburg district (23°52'30"S, 29°57'E).

Habitat: Presumed to have occurred in open montane grassland. Photographs in the book by Wongtschowski (1990) illustrate that at the time the holotype was collected, the area consisted of open grassland. If the species still exists it would be most likely to occur in grassland remnants in the Woodbush, Haenertsburg and Wolkberg areas of the Grassland Biome, in one or more of the following vegetation types: Woodbush Granite Grassland (Gm 25), Northern Escarpment Quartzite Sourveld (Gm 23) and Wolkberg Dolomite Grassland (Gm 26) (Mucina *et al.* 2006). The area of the type locality was planted over with exotic plantations in about 1950.

Vegetation type: Gm 25 Woodbush Granite Grassland.

Assessment rationale: In the 1980s NHGJ and a team of collectors conducted several unsuccessful searches for *T. eastwoodae* using drift fences, pitfall and funnel traps, as well as active searching. The latter surveys were conducted in the last remaining patches of open grassland in the Haenertsburg-Woodbush area and on the Wolkberg Range, as identified from the 1: 50 000 topographic map of the area (see also Jacobsen 1988f, 1989), e.g. in a small, now-degraded area close to a stream between Woodbush Forest and Haenertsburg (this may have been where Wager collected a specimen), as well as an open area of grassland and fynbos-like vegetation adjacent to a forest that had not been burnt for about 20 years. Subsequently, in April 2008, a 10-day SARCA survey was conducted in grasslands in the Woodbush-Haenertsburg area employing both active searching and drift fence trapping,



Tetradactylus eastwoodae—near Woodbush, LIMP (holotype, TM 1496)
V. Egan

in a concerted but also unsuccessful attempt to re-discover this species (De Villiers & Burger 2008; M. Burger pers. comm.). Also, no known captive specimens have ever been reported or are suspected to exist, so Eastwood's Long-tailed Seps should now be considered Extinct.

Threats: The habitat of this species has been largely destroyed by afforestation (pines and bluegums). Woodbush Granite Grassland is a Critically Endangered vegetation type that is negatively affected by bush encroachment, worsened due to the exclusion of fires (Mucina *et al.* 2006). However, frequent and severe fires are also threats should any populations still survive. Jacobsen (1989) noted the destruction caused by the annual burning of remnant grasslands for firebreaks between plantations at Woodbush and Haenertsburg. Cultivation and urban development have played a minor role in land transformation in this vegetation type (Mucina *et al.* 2006).

Conservation measures: Conservation measures can only be instigated if a surviving population of this species is discovered. Thus, conduct more surveys in patches of surviving grassland in the Woodbush, Haenertsburg and Wolkberg areas (see Dzerefos 2004; Mucina *et al.* 2006) using drift fences with pitfall and funnel traps. Protect these grasslands as it is possible that one or more small populations of *T. eastwoodae* may still survive. Mucina *et al.* (2006) noted that there are no conservation areas protecting any part of the Woodbush Granite Grassland.

Tetradactylus fitzsimonsi Hewitt, 1915
FITZSIMONS' LONG-TAILED SEPS

Michael F. Bates

Global: Vulnerable B1ab(ii,iii)+2ab(ii,iii)

Endemic

Taxonomy: Loveridge (1942) considered *Tetradactylus fitzsimonsi* to be a valid species, with *T. boulengeri* as a subspecies. However, *T. f. boulengeri* and *T. f. simplex* were treated as junior synonyms of *T. ellenbergeri* by Broadley (1971c). FitzSimons (1943) treated *T. fitzsimonsi* as a subspecies of *T. africanus* and this arrangement was followed by most subsequent workers (e.g. Branch 1988b, 1990b), although Branch (1998) noted that it should probably be treated as a separate species. *Tetradactylus fitzsimonsi* differs from *T. africanus* in that it lacks forelimbs, and the two taxa are geographically separated by over 500 km. They are consequently treated here as separate species.

Distribution: Endemic to the Eastern and Western Cape provinces, South Africa. Recorded from only three areas, i.e. Port Elizabeth (3325CD & DC, 3425BA) and near Humansdorp (3324DC) in the Eastern Cape, and George (3322CD) in the Western Cape.

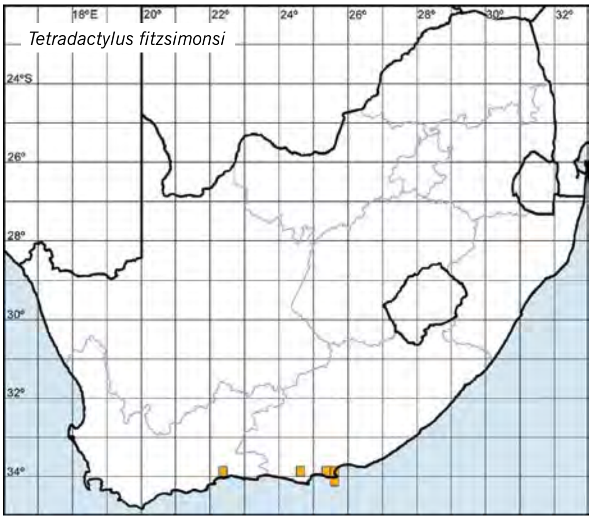
EOO: 12 150 km^2 (confidence: medium); AOO: 1 186 km^2 (confidence: medium).

Habitat: Unknown (see Branch 1990b) but may be similar to that of *T. africanus*.

Bioregion: Eastern Fynbos-Renosterveld; Albany Thicket.

Assessment rationale: EOO <20 000 km^2 [B1], AOO <2 000 km^2 [B2], severely fragmented [B1a+2a], and a continuing decline in AOO [b(ii)] and area, extent and quality of habitat [b(iii)]. The most recent specimen from the Port Elizabeth area was collected in 1991, the two Humansdorp (3324DC) specimens were collected in 1999 and the three George (3322CD) specimens were found in 1931.

Threats: Threats include transformation of land for crop farming and wood plantations, infrastructure development (industry, urbanisation, tourism, roads), invasive alien plants, fires and agricultural pollution. These threats are particularly severe in and around Port Elizabeth, a highly developed area. Threats are exacerbated because of the species' restricted range.



Tetradactylus fitzsimonsi—Lorraine, Port Elizabeth, EC W.R. Branch

Conservation measures: Ensure that conservation organisations and legislating bodies treat *T. fitzsimonsi* as Vulnerable and afford it the necessary protection. Develop a BMP-S. Determine population numbers and range, and monitor populations. Study the biology and ecology of the species, and determine habitat status and threats. Identify potential protected areas for all three populations and establish these where possible.

Tetradactylus seps (Linnaeus, 1758)
SHORT-LEGGED SEPS

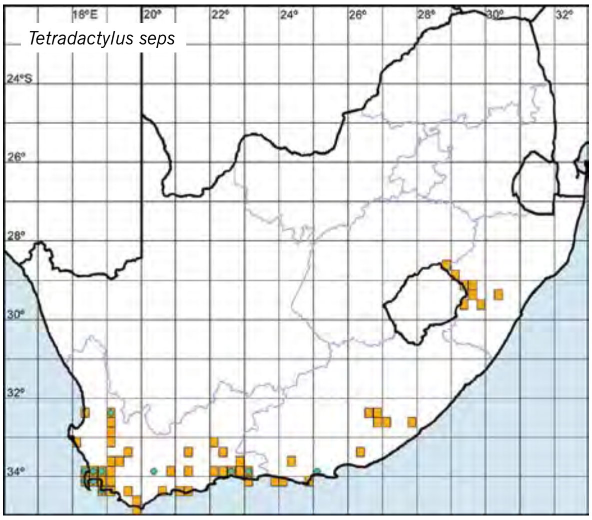
Michael F. Bates

Global: Least Concern

Endemic

Taxonomy: Branch (1990b) showed that *Tetradactylus laevicauda* (described from the KwaZulu-Natal Drakensberg), treated as a subspecies of *T. seps* by FitzSimons (1943), is a junior synonym of the latter. However, the KwaZulu-Natal and Cape populations are geographically well separated and a molecular analysis would be helpful to determine whether *T. laevicauda* (KwaZulu-Natal) is in fact a valid species. A morphology-based taxonomic review of the genus is in progress (M.F. Bates in prep.).

Distribution: Widespread and endemic to South Africa, where it occurs in two allopatric populations. One popula-



tion is in the Western and Eastern Cape provinces, where the species occurs mainly in the Fynbos and Grassland biomes, but with at least one record each in the Forest (Tsitsikamma, see Branch 1990b) and Nama-Karoo (3322AA) biomes. The other population is centred in the montane grasslands of the Drakensberg in KwaZulu-Natal.

Habitat: Often found in moist situations: marshy seepage zones with scattered stones and rotting logs in montane grassland (Katberg); valley bottoms with restioid mountain fynbos, often beside streams (Kammanassieberg and Cederberg); and open clearings in moist, cool, coastal forest (Tsitsikamma Coastal National Park) (Branch 1990b). Also observed in dense coastal fynbos at Llandudno (Cape Town) and in dense mountain fynbos near the top of Seweweekspoort Mountain near Ladismith (M.F. Bates pers. obs.). According to FitzSimons (1943) it is also found on grassy flats and the lower slopes of mountains, where it lives in piles of dead wood and leaves or under logs; it is common along roadsides and paths in coastal montane forests, where it moves about in open sunlit patches (FitzSimons 1943). In the Cape provinces it is found at elevations of about 20 m (Llandudno) to 1 400 m (Branch 1990b), but in KwaZulu-Natal it occurs at higher elevations of 1 520–1 800 m (Bourquin 2004).

Biome: Fynbos; Grassland; Albany Thicket (marginal); Nama-Karoo; Forests (marginal).

Assessment rationale: Widespread and seemingly abundant in places.

Conservation measures: Protect habitat within the range of the species. Although *T. seps* is apparently common in the Western Cape, the large-scale destruction of fynbos habitat in this region is of concern (see Le Roux 2002; Jonas *et al.* 2006; Rouget *et al.* 2006) and population monitoring may become necessary. This species is under less pressure in the Eastern Cape and KwaZulu-Natal. However, if the putative subspecies *T. s. laevicauda* in KwaZulu-Natal proves to be a valid taxon, it will require a separate assessment.

Tetradactylus seps—Algeria, Cederberg, WC P. le F.N. Mouton

Tetradactylus seps—Elandsberg, EC W.R. Branch

Tetradactylus tetradactylus (Daudin, 1802)

CAPE LONG-TAILED SEPS

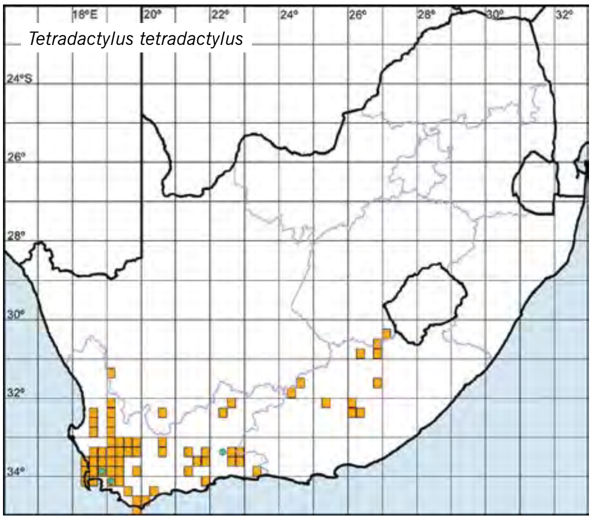
Michael F. Bates

Global: Least Concern

Endemic

Taxonomy: Although Loveridge (1942) and FitzSimons (1943) treated *Tetradactylus bilineatus* as a subspecies of *T. tetradactylus*, Branch (1990b) showed that it is a junior synonym of the latter.

Tetradactylus tetradactylus—Gondwana GR, E of Herbertsdale, WC M. Burger



Distribution: Endemic to South Africa, from the Western Cape eastwards to the northern part of the Eastern Cape and southeastern Free State. There are also two records in the Northern Cape, at Swaarweersberg (3220BC) near Sutherland, and near Nieuwoudtville (3119AC; Bates 2011) north of the Cederberg. This species may also occur in the low-lying grasslands of southwestern Lesotho, in areas adjacent to the Free State (see Bates 1996a), although there is virtually no natural habitat left in that part of Lesotho (Jonas *et al.* 2006; Rouget *et al.* 2006). Since the last evaluation of its distribution by Branch (1990b), it has been found at several additional localities, mainly in the Western Cape, including records as far south as Renosterkop at Agulhas (3419DD). It is now evident that *T. tetradactylus* is widely distributed and that many of the gaps between localities are probably artefacts of collecting.

Habitat: Found mainly in fynbos, montane grassland and scrub vegetation on mountain plateaus, e.g. montane *Merxmuellera* grassland with scattered rocks (Karoo National Park, Mountain Zebra National park, Sneeuberg, Winterberg) and sparse restioid mountain fynbos (Cederberg, Matroosberg, Kammanassieberg) (Branch 1990b). The northeasterly populations occur in dense grassland.

Biome: Fynbos; Grassland; Nama-Karoo; Succulent Karoo.

Assessment rationale: Widespread.

Conservation measures: Protect habitat within the range of the species. Although *T. tetradactylus* is apparently common in the Western Cape, the large-scale destruction of fynbos habitat in this region is of concern (see Le Roux 2002; Jonas *et al.* 2006; Rouget *et al.* 2006) and population monitoring may become necessary. In the Eastern Cape and southeastern Free State, part of the range falls in crop-growing areas.

CHAPTER 14

Family Scincidae

Aaron M. Bauer, Johan Marais, Gavin Masterson & James Harvey

The Scincidae is the most species-rich lizard family in the world and comprises approximately 1 560 species in 124 genera (Uetz 2012). It has traditionally been divided into four subfamilies (Greer 1970) but recent research suggests that these do not adequately reflect evolutionary lineages (Whiting *et al.* 2003; Brandley *et al.* 2005). Skinks are nearly global in their distribution, occurring from southern Europe, Central Asia and Japan south throughout all of Africa, tropical Asia, Australia, New Zealand and the islands of the Pacific, and from southern Canada to central Argentina and the West Indies. In Africa, skinks are particularly diverse and species-rich in the *Atlas* region and adjacent countries (FitzSimons 1943; Branch 1998), but there are other centres of diversity in the forests and savannas of East and West Africa (Spawls *et al.* 2002; Chirio & LeBreton 2007). Two skink genera in the *Atlas* region have been affected by taxonomic re-arrangement, with *Mochlus* (including *Lygosoma*) replacing African *Riopa* (Wagner *et al.* 2009), and *Afroablepharus* applicable for some '*Panaspis*', including the two species discussed below (Schmitz *et al.* 2005a; Jesus *et al.* 2007).

Within the *Atlas* region there are 59 recognised species of scincids (two with two subspecies each) in seven genera, representing three major lineages—acontines, scincines and lygosomines. Limb reduction and body attenuation has occurred many times within skinks (Greer 1991; Whiting *et al.* 2003; Wiens *et al.* 2006) and limbless and limb-reduced forms make up a large proportion of the regional scincid fauna. Several new species have been described recently, chiefly among the fossorial forms, and ongoing phylogenetic analyses have resulted in a series of changes in generic allocation of the acontines (Daniels *et al.* 2006; Lamb *et al.* 2010).

Skinks occur throughout the *Atlas* region but diversity is greatest in areas of sandy soils, which provide appropriate substrates for many of the burrowing acontines (*Acontias* and *Typhlosaurus*) and scincines (*Scelotes*). The fully-limbed *Trachylepis* occurs in almost all terrestrial habitat types and some species are rupicolous or arboreal. Skinks are absent only from very high elevations in montane regions. In the *Atlas* region, surface-active skinks are diurnal and most are heliothermic, but burrowing forms may be diurnal or nocturnal. Skinks feed almost exclusively on arthropods (Huey *et al.* 1974) but large species occasionally eat other lizards. Snails, slugs and other invertebrates are also included in the diet of some species. Termites are especially common prey for burrowing forms (Huey & Pianka 1977b; Pianka 1986). Both oviparous (e.g. *Mochlus*, *Afroablepharus*) and viviparous (most genera and species) reproductive modes occur in skinks in the *Atlas* region, with both modes reported to occur in *Trachylepis capensis* (Brown-Wessels 1989; Flemming 1994). A number of species are colonial and exhibit sexual dichromatism (Branch 1998). Most skinks, including all species in the *Atlas* region, have osteoderms imbedded in their skin and are covered by smooth or keeled overlapping scales.

The majority of terrestrial skinks have broad ranges and many are habitat generalists and/or occur in areas that are not subject to major anthropogenic or natural threats. As a consequence, most are classified as Least Concern. However, a number of fossorial skinks (*Acontias*, *Scelotes*) have quite limited distributions and several of these are here considered threatened, chiefly by mining activities and urbanisation. *Scelotes guentheri* is confirmed as being Extinct, *S. inornatus* is considered Critically Endangered, three taxa (*Acontias poecilus*, *A. rieppeli*, *Cryptoblepharus africanus*) are treated as Endangered, one (*S. bourquini*) as Vulnerable, and six (*A. richardi*, *Typhlosaurus lomiae*, *S. gronovii*, *S. kasneri*, *S. limpopoensis albiventris*, *S. montispectus*) as Near Threatened. *Acontias kgalagadi subtaeniatus* is considered Data Deficient on the basis of insufficient information.

SUBFAMILY ACONTINAE

This is a well supported group of legless, burrowing skinks characterised by a divided frontal bone in the skull. Acontinae is the sister group to all other skinks (Whiting *et al.* 2003). Only 28 species in two genera, *Acontias* and *Typhlosaurus*, are now recognised, the latter with greatly reduced content (Lamb *et al.* 2010). The subfamily is mainly restricted to southern Africa, with one species (*Acontias jappi*) in Zambia and another (*A. percivali*) isolated in Kenya and Tanzania.

Genus *Acontias* Cuvier, 1816 [1817]—legless skinks

A molecular analysis of the genus *Acontias* resulted in the transfer of the smaller species to a new genus, *Microacontias* (Daniels *et al.* 2006). However, a subsequent study including all *Typhlosaurus* species (Lamb *et al.* 2010) revealed that *Acontias*, as it was formerly construed (e.g. Broadley 1968a; Branch 1998), was rendered paraphyletic by *Microacontias*, *Acontophiops* and some *Typhlosaurus*. As a result, all acontines except the slender-bodied West Coast *Typhlosaurus* have been allocated to *Acontias* (Lamb *et al.* 2010). All five subspecies of *T. aurantiacus* (three allopatric, two parapatric) that were recognised by Broadley (1968, 1990a) are now treated as valid species, and a new, closely-related species is currently being described following a recent molecular systematic study (Pietersen *et al.* in prep.). Existing species and subspecies boundaries within some *Acontias* are in flux (Daniels *et al.* 2009). A total of 27 species, one with subspecies, are currently recognised; 20 species occur in the *Atlas* region and 12 of these are strictly endemic. These lizards range from South Africa northwards to Angola and Kenya. All species are elongate, limbless and viviparous (mostly litters of 1–4 young, but up to 14 in *A. plumbeus*) and occupy mesic microhabitats in leaf litter or beneath logs, stones and debris (Branch 1998). Two species, *A. poecilus* and *A. rieppeli*, are considered Endangered due to land conversion for agriculture and forestry, housing and recreation. In addition, *Acontias richardi* is considered Near Threatened and *A. kgalagadi subtaeniatus* is regarded as Data Deficient due to insufficient information. Both of the latter two taxa were previously listed as Restricted (Branch 1988a). Although some other species have restricted distributions, most are not under major threat, and no other taxa are of conservation concern.

Acontias breviceps Essex, 1925

SHORT-HEADED LEGLESS SKINK

Aaron M. Bauer

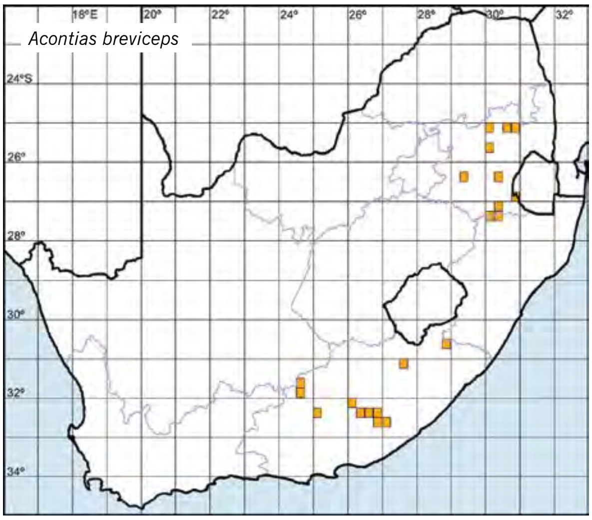
Global: Least Concern

Endemic

Taxonomy: Northern and southern populations of this species were investigated by Broadley & Greer (1969), who found average differences in scale counts. Daniels *et al.* (2006) investigated representatives of the northern population genetically and Lamb *et al.* (2010) sequenced a specimen from an intermediate locality in southern KwaZulu-Natal, but the most southerly population has yet to be evaluated in a molecular phylogenetic context. Further phylogenetic and phylogeographic research is needed to assess the monophyly of *Acontias breviceps* and the taxonomic status of the three apparently disjunct populations.

Distribution: Endemic to South Africa. Until recently, it was thought to occur in two disjunct populations, one in the Mpumalanga Highveld and the other in inland parts of the Eastern Cape. However, recent records, including one obtained during a SARCA survey in the Cedarville region, are located between these two populations. Not yet recorded in western Swaziland but likely to occur there.

Habitat: Found in montane grasslands and immediately adjacent habitats where it is fossorial, occupying relatively mesic microhabitats beneath logs, stones and debris. Found in soil under rocks embedded on slopes in the Amatole Range (M.C. Cunningham & M.F. Bates unpubl. obs.).



Acontias breviceps—Hogsback, EC W. Conradie

Occurs from altitudes of about 1 300 m to over 2 200 m (Branch 1998).

Biome: Grassland.

Assessment rationale: Relatively widespread and locally abundant. Threats from afforestation are limited to small parts of the range.

Conservation measures: None recommended.

Acontias cregoi (Boulenger, 1903)

CREGOI'S LEGLESS SKINK

Aaron M. Bauer

Regional: Least Concern

Near-endemic

Taxonomy: This taxon was recently transferred from *Typhlosaurus* to *Acontias* by Lamb *et al.* (2010) on the basis of molecular phylogenetic results. *Typhlosaurus cregoi bicolor*, endemic to Zimbabwe, was elevated to specific status as *Acontias bicolor*, rendering *A. cregoi* monotypic (Lamb *et al.* 2010).

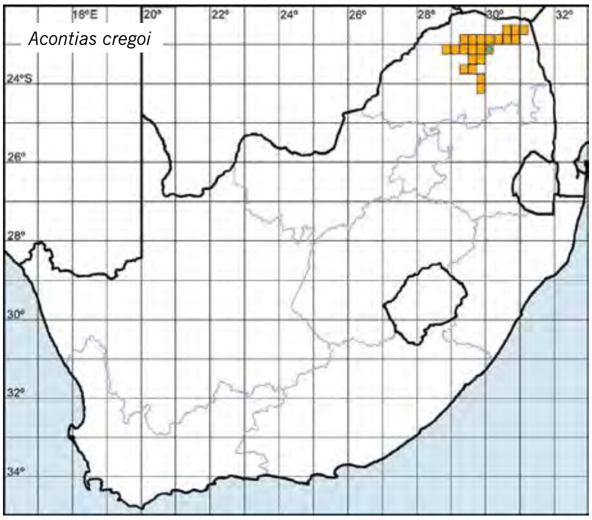
Distribution: Endemic to southern Africa, occurring in Limpopo, South Africa and adjacent southern Mozambique (Branch 1998).

Habitat: Fossorial, found in soils with rocky cover on hills at 650 to 1 700 m elevation (Jacobsen 1989).

Bioregion: Central Bushveld; Lowveld; Mopane.

Assessment rationale: Relatively widespread and common; no major extrinsic threats.

Conservation measures: None recommended.



Acontias cregoi—N of Soutpansberg, LIMP J. Marais

Acontias fitzsimonsi (Broadley, 1968)

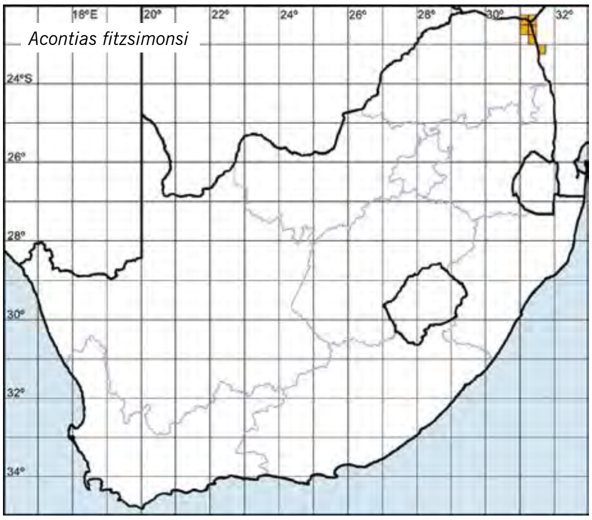
FITZSIMONS' LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

Endemic

Acontias fitzsimonsi—Wambia Sandveld, Kruger NP, LIMP W.D. Haacke



Taxonomy: *Typhlosaurus aurantiacus fitzsimonsi* was transferred to *Acontias* by Lamb *et al.* (2010). All five subspecies of *T.* (= *Acontias*) *aurantiacus* recognised by Broadley (1968, 1990a)—including *T.* (= *A.*) *a. fitzsi-*

monsi—are probably valid species (Pietersen *et al.* in prep.).

Distribution: Endemic to South Africa where it is limited to the northeastern Lowveld of Limpopo Province (Jacobsen 1989). Expected, but not yet recorded, from adjacent Mozambique and Zimbabwe.

Habitat: Fossorial, found in deep sandy soils in bushveld at about 400 m elevation (Jacobsen 1989).

Vegetation type: SVmp 2 Limpopo Ridge Bushveld; SVmp 3 Cathedral Mopane Bushveld; SVl 1 Makuleke Sandy Bushveld.

Assessment rationale: Has a restricted distribution, but all known records are situated within a protected area (Kruger National Park) and there are no known extrinsic threats.

Conservation measures: None recommended.

Acontias gariepensis (FitzSimons, 1941)

MIER KALAHARI LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

Taxonomy: Reviewed by Broadley (1968). Transferred from *Typhlosaurus* to *Acontias* by Lamb *et al.* (2010) on the basis of molecular phylogenetics.

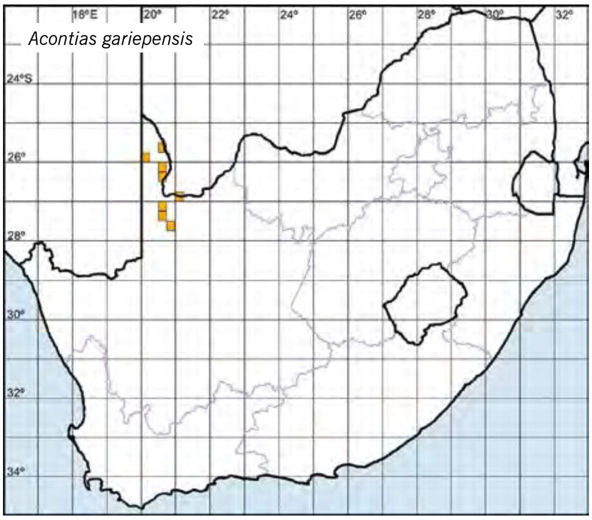
Distribution: Endemic to southern Africa, occurring in the Mier Kalahari region of the Northern Cape, South Africa, and adjacent southeastern Namibia and southwestern Botswana (Broadley 1968).

Habitat: Fossorial, found in association with vegetated dune ridges in Kalahari duneveld, chiefly at 800–1 000 m elevation.

Bioregion: Kalahari Duneveld.

Assessment rationale: Widespread and common; not subject to major extrinsic threats. Protected within the Kgalagadi Transfrontier Park.

Conservation measures: None recommended.



Acontias gariepensis—near Twee Riviere, NC J. Marais

Acontias gracilicauda Essex, 1925

THIN-TAILED LEGLESS SKINK

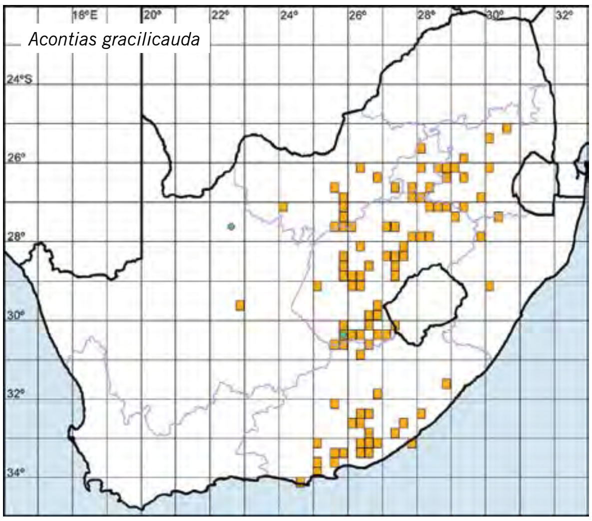
Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: Recent molecular phylogenetic studies have demonstrated that *A. gracilicauda gracilicauda* and *A. g. namaquensis* are not closely related. The latter has been raised to full species status (Lamb *et al.* 2010) despite only minor scalation differences between the two taxa (Broadley & Greer 1969).

Distribution: Endemic to South Africa, occurring in North-West Province, Gauteng, Mpumalanga, Free State, Eastern Cape and western KwaZulu-Natal (Broadley & Greer 1969). There are two somewhat isolated localities in the Northern Cape, representing the most westerly extent of the species' range: 2722DA refers to a Virtual Museum record near Olifantshoek, and 2922DB refers to a specimen collected in a garden at Prieska during a SARCA sur-



vey (see photo). A possible record from the Swartberg Pass in the Western Cape (not plotted here) is suspicious and requires confirmation (it may be referable to *A. meleagris*).

Habitat: Fossorial, usually occupying moderately mesic soils in open or partly-wooded habitats from sea level to at least 1 600 m (Branch 1998).

Biome: Grassland; Albany Thicket; Savanna; Fynbos; Nama-Karoo.

Assessment rationale: Widespread and common.

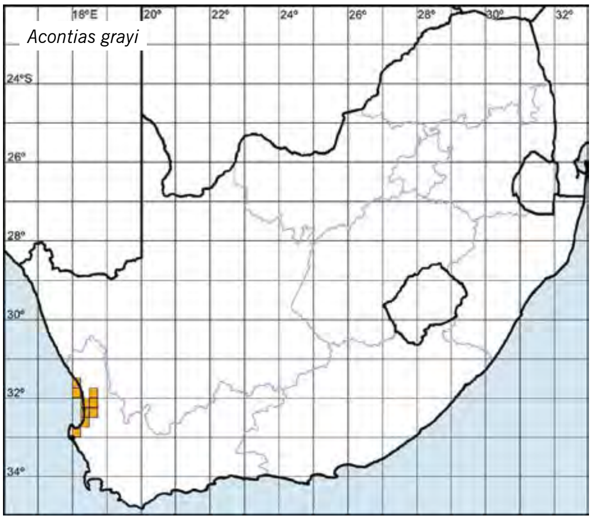
Conservation measures: None recommended.

Acontias gracilicauda—Prieska, NC M. Burger

Acontias grayi Boulenger, 1887

GRAY'S DWARF LEGLESS SKINK

Aaron M. Bauer



Global: Least Concern

Endemic

Taxonomy: The genus *Microacontias*, to which this species had been assigned (Daniels *et al.* 2006), was synonymised with *Acontias* by Lamb *et al.* (2010) based on molecular phylogenetic results. Another recent molecular phylogenetic study (Daniels *et al.* 2006) suggested that *A. litoralis* was derived from within a polytypic *A. lineatus*, making the latter paraphyletic. In a subsequent mitochondrial DNA phylogeny of '*Microacontias*' (Janse van Vuuren 2009), the four currently recognised taxa in this clade were found to interdigitate in the phylogram. However, because all taxa were found to be identifiable morphologically, it was suggested that all subspecies of *A. lineatus* retain their status, with *A. litoralis* treated as a fourth subspecies of *A. lineatus*. The findings of Lamb *et al.* (2010) were similar to those of Daniels *et al.* (2006) and, on this basis and with regard to the diagnostic differences described by Broadley & Greer (1969), they elevated *A. l. grayi* and *A. l. tristis* to full species status.

Distribution: Endemic to the Western Cape, South Africa, occurring only in the central-western coastal region (Broadley & Greer 1969). Apparent near-sympatry with *A. lineatus* in QDGC 3118DC requires further investigation.

Habitat: Fossorial, found in sandy soils in mesic conditions in fynbos or adjacent habitats (Branch 1998). Occurs from sea level to about 900 m elevation.

Bioregion: Northwest Fynbos; West Strandveld; Seashore Vegetation; Namaqualand Sandveld.

Assessment rationale: Has a restricted EOO (3 188 km^2, i.e. below the EN threshold) [B1] but is not threatened or experiencing decline.

Conservation measures: This species occurs in an area where future habitat alteration is likely. Therefore, conduct taxonomic research, estimate population size and distribution, and monitor abundance.

Acontias grayi—Lambert's Bay, WC J. Marais

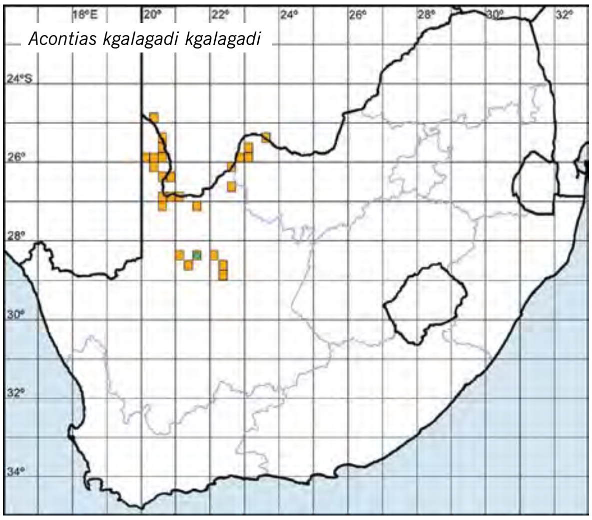
Acontias kgalagadi kgalagadi Lamb, Biswas & Bauer, 2010
KGALAGADI LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

Taxonomy: Originally described as *Typhlosaurus lineatus* Boulenger, 1887. The phylogenetic relationships of this skink were investigated recently using molecular techniques (Daniels *et al.* 2002, 2006). The most recent analysis of all acontines (Lamb *et al.* 2010) reveals that it is embedded within a clade of taxa now assigned to *Acontias*. Transfer to the genus *Acontias* results in the new combination *Acontias lineatus*, which is a junior secondary homonym of *A. lineatus* Peters, 1879. Lamb *et al.* (2010) proposed a replacement name, *A. kgalagadi*, for this species. Broadley (1968) reviewed this taxon and described two additional subspecies of (then) *Typhlosaurus lineatus*, namely *T. l. subtaeniatus* (now *Acontias kgalagadi subtaeniatus*) and *T. l. jappi*. The latter subspecies was subsequently elevated to specific status by Schneider & Bauer (2009) and then transferred to *Acontias* by Lamb *et al.* (2010). Jacobsen (1987a) also described an additional subspecies, *T. l. richardi* (now transferred to *Acontias* and accorded specific rank by Lamb *et al.* 2010). *Acontias k. kgalagadi*, *A. richardi* and *A. jappi* constitute a clade and it is likely that *A. k. subtaeniatus* also represents a full species within this group (Lamb *et al.* 2010).

Distribution: Endemic to southern Africa (South Africa, Namibia, Botswana; Broadley 1968) and southern Angola (Conradie & Bourquin 2013). In South Africa it occurs



in the northern parts of the Northern Cape and in western North-West Province. An unconfirmed record from the central portion of North-West Province is not included on the map.

Habitat: Fossorial, found in sandy soils in areas of Kalahari dunes and open savanna. Occurs at elevations of 800 m to about 1 200 m.

Biome: Savanna.

Assessment rationale: Widespread and common with no major threats.

Conservation measures: None recommended.

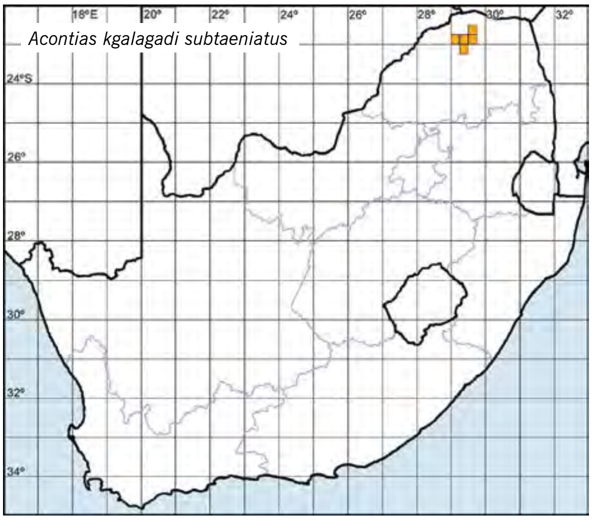
Acontias kgalagadi kgalagadi—Caprivi Strip, Namibia W.R. Branch

Acontias kgalagadi kgalagadi—Sasha, S Angola W. Conradie

Acontias kgalagadi subtaeniatus (Broadley, 1968)

STRIPE-BELLIED LEGLESS SKINK

Aaron M. Bauer



Global: Data Deficient

Endemic

Taxonomy: Originally described by Broadley (1968) and discussed by Jacobsen (1987a, 1989) as *Typhlosaurus lineatus subtaeniatus*. Lamb *et al.* (2010) transferred *T. lineatus* to *Acontias* resulting in secondary homonymy with *A. lineatus* Peters, 1879, and they therefore proposed the replacement name *A. kgalagadi* for this species. Although other subspecies of *T. lineatus* (= *A. kgalagadi*) were raised to specific status, Lamb *et al.* (2010) retained this form as a subspecies of *A. kgalagadi* pending further research (D. Pietersen in prep.), although they suggested that its disjunct distribution and distinctive morphology were probably reflective of full species status.

Distribution: Endemic to northern Limpopo, South Africa.

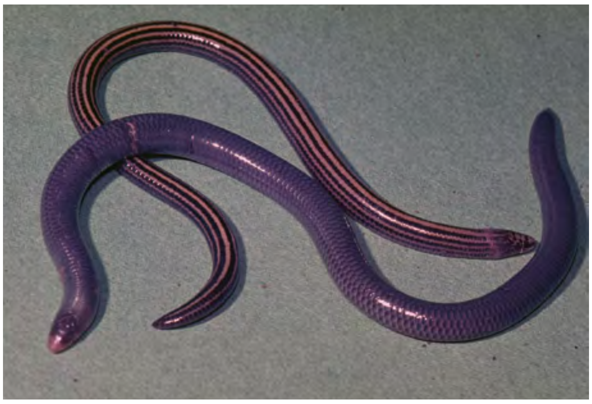
EOO: 5 400 km^2 (confidence: low); AOO: 2 136 km^2 (confidence: low).

Habitat: Occurs under rotting logs, rocks or other surface debris in deep sand at elevations of 650–1 000 m (Branch & Jacobsen 1988a; Jacobsen 1989).

Vegetation type: SVmp 1 Musina Mopane Bushveld; SVcb 19 Limpopo Sweet Bushveld; SVcb 20 Makhado Sweet Bushveld.

Assessment rationale: There are no documented extrinsic threats to this subspecies, but it has limited dispersal capabilities and appears to have an extremely restricted distribution. EOO is thought to be below the VU threshold but there is low confidence in range estimates. Habitat fragmentation is thought to be slight. Based on the available data, no information can be reliably inferred about population size or actual distribution range, and therefore this subspecies is considered Data Deficient on the basis of insufficient information.

Threats: Has limited dispersal capabilities and appears to have an extremely restricted distribution. No known extrinsic threats.



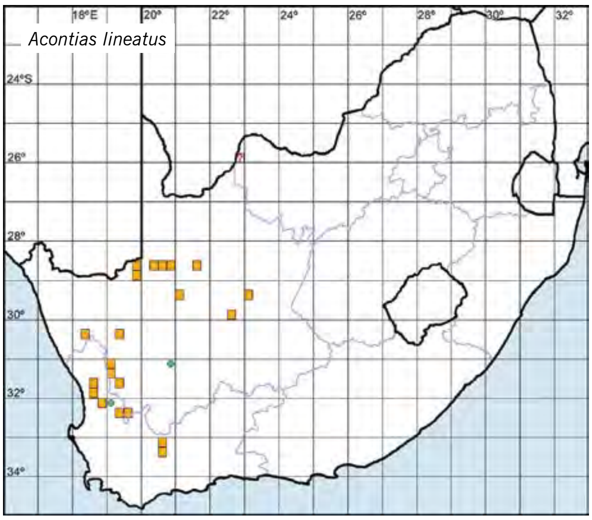
Acontias kgalagadi subtaeniatus—16 km E of Lang Jan NR, LIMP
W.D. Haacke

Conservation measures: Estimate population size as an essential first step. Critically assess the taxonomic status of the subspecies and collect information on range, biology and ecology. Assess the current status of the habitat and expand existing protected areas or establish new reserves. Draw up a BMP-S.

Acontias lineatus Peters, 1879

STRIPED DWARF LEGLESS SKINK; STRIPED LEGLESS SKINK

Aaron M. Bauer



Global: Least Concern

Taxonomy: The genus *Microacontias*, to which this species had previously been assigned (Daniels *et al.* 2006), was synonymised with *Acontias* by Lamb *et al.* (2010) based on molecular phylogenetic results. Daniels *et al.* (2006) suggested that *A. litoralis* was derived from within a polytypic *A. lineatus*, making the latter paraphyletic. In a subsequent mitochondrial DNA phylogeny of '*Microacontias*' (Janse van Vuuren 2009), the four currently recognised taxa in this clade were found to interdigitate in the phylogram. However, because all taxa were found to be identifiable morphologically, it was suggested that all subspecies of *A. lineatus* retain their status, with *A. litoralis* treated as a fourth subspecies of *A. lineatus*. The findings of Lamb *et al.* (2010) were similar to those of Daniels *et al.* (2006) and, on this basis and with regard to the diagnostic differences described by Broadley & Greer (1969), they elevated *A. l. grayi* and *A. l. tristis* to full species status, rendering *A. lineatus* monotypic.

Distribution: Endemic to South Africa and southern Namibia. Within the *Atlas* region it occurs in the Northern Cape and northern portions of the Western Cape (Broadley & Greer 1969). The identity of specimens collected at Molopo Nature Reserve (2522DD) in the western part of North-West Province requires confirmation.

Habitat: Fossorial, found in sandy soils in a wide variety of habitats, usually in association with plant roots or surface debris (Branch 1998). Occurs from about sea level to at least 1 200 m elevation.

Biome: Nama-Karoo; Succulent Karoo; Savanna; Fynbos.

Assessment rationale: Widespread and common, with no major extrinsic threats.

Conservation measures: None recommended.

Acontias lineatus—N of Pofadder, NC J. Marais

Acontias lineicauda Hewitt, 1937

ALGOA LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

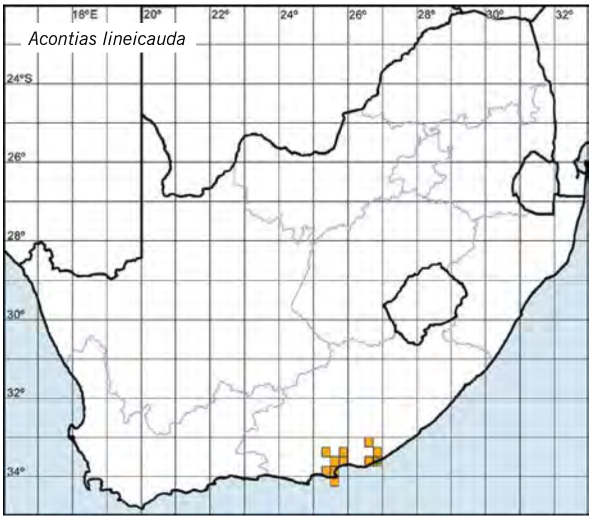
Endemic

Taxonomy: Until recently this taxon was considered as a slender, striped colour morph of *Acontias meleagris orientalis* (Broadley & Greer 1969; Daniels *et al.* 2002, 2005, 2006, 2009). Although easily diagnosable morphologically, *A. lineicauda* is neither monophyletic nor imbedded within *A. orientalis* (Daniels *et al.* 2005) and has been recognised as a paraphyletic species level taxon pending further study (Lamb *et al.* 2010). In a recent study of the biogeography of the *A. meleagris* complex, Engelbrecht *et al.* (2013) continued to recognise a *A. meleagris orientalis* 'lineicauda' morph, although restricting it to a clade distributed east of Algoa Bay (Alexandria to East London). Skinks from Port Elizabeth and Oyster Bay (not plotted here) display the 'lineicauda' morphology but were not assigned to any named clade (Engelbrecht *et al.* 2013). The taxonomic status of *A. lineicauda* remains problematic, particularly as topotypic material from Dunbrody (Hewitt 1937) within Algoa Bay and outside of the geographic area of the clade to which Engelbrecht *et al.* (2013) have applied the name, has not been assessed.

Distribution: Endemic to the Algoa Bay region and adjacent western Ciskei of the Eastern Cape, South Africa. Found from Port Elizabeth to the Hamburg area, chiefly along valleys such as those of the Sundays River and Great Fish River. Records indicated as questionable on the *A. orientalis* map may represent *A. lineicauda* (uncertainty due to overlap in ranges).

Habitat: Fossorial, found in coastal areas and alluvial soils in inland valleys, usually in relatively dry situations (Broadley & Greer 1969). Occurs from sea level to at least 500 m, but chiefly below 300 m.

Bioregion: Albany Thicket; Sub-Escarpment Savanna; Eastern Fynbos-Renosterveld; Seashore Vegetation; Lower Karoo.



Acontias lineicauda—Sundays River mouth, EC M. Burger

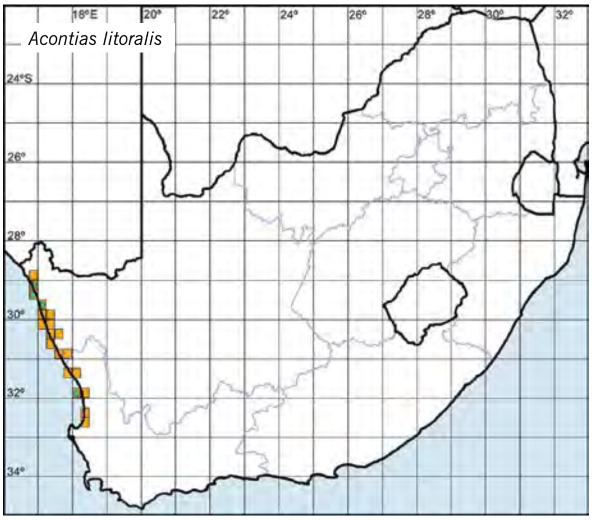
Assessment rationale: Locally abundant in much of its range, and tolerant of low-level habitat disturbance. Urbanisation, mining and agricultural activity are localised threats, but several portions of the range are protected in Addo Elephant National Park.

Conservation measures: None recommended.

Acontias litoralis Broadley & Greer, 1969

COASTAL DWARF LEGLESS SKINK; COASTAL LEGLESS SKINK

Aaron M. Bauer



Global: Least Concern

Endemic

Taxonomy: The genus *Microacontias*, to which this species had previously been assigned (Daniels *et al.* 2006), was synonymised with *Acontias* by Lamb *et al.* (2010) based on molecular phylogenetic results. Daniels *et al.* (2006) suggested that *A. litoralis* was derived from within a polytypic *A. lineatus*, making the latter paraphyletic. In a subsequent mitochondrial DNA phylogeny of '*Microacontias*' (Janse van Vuuren 2009), the four currently recognised taxa in this clade were found to interdigitate in the phylogram. However, because all taxa were found to be identifiable morphologically, it was suggested that all subspecies of *A. lineatus* retain their status, with *A. litoralis* treated as a fourth subspecies of *A. lineatus*. The findings of Lamb *et al.* (2010) were similar to those of Daniels *et al.* (2006) and, on this basis and with regard to the diagnostic differences described by Broadley & Greer (1969), they treated *A. litoralis*, and all subspecies of *A. lineatus*, as full species.

Distribution: Endemic to South Africa, occurring in the western coastal parts of Northern and Western Cape provinces.

Habitat: Fossorial, found in sandy soils in sparsely-vegetated coastal dunes, from sea level to approximately 100 m elevation (Mashinini 2004). Especially common under leaf litter at the base of *Ruschia crassisepala*, and occurs in densities of up to 33 specimens per hectare (Mashinini *et al.* 2011).

Bioregion: Namaqualand Sandveld; West Strandveld; Namaqualand Hardeveld; Richtersveld; Seashore Vegetation.

Assessment rationale: Has a restricted range but is abundant throughout and not subject to major extrinsic threats. Coastal development is a localised threat in a few areas.

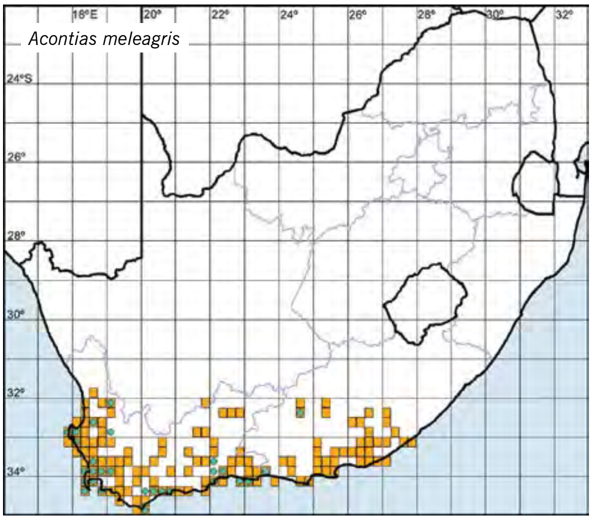
Conservation measures: None recommended.

Acontias litoralis—Noup, NC W.R. Branch

Acontias meleagris (Linnaeus, 1758)

CAPE LEGLESS SKINK

Aaron M. Bauer



Global: Least Concern

Endemic

Taxonomy: The taxonomic status of this species is in a state of flux (Daniels *et al.* 2009, Engelbrecht *et al*. 2013). It is notably variable with respect to colouration (Broadley & Greer 1969) and molecular phylogenetic and phylogeographic research has demonstrated that this taxon as presently construed is paraphyletic (Daniels *et al.* 2002, 2005, 2006, 2009; Lamb *et al.* 2010; Engelbrecht *et al*. 2013). Further molecular and morphological investigations are required.

Distribution: Endemic to South Africa, occurring throughout most of the Western Cape and the western and southern parts of the Eastern Cape (Broadley & Greer 1969). The identity of a specimen from De Aar in the southeastern Northern Cape (not plotted) requires confirmation.

Habitat: Fossorial, found in coastal areas in rich soils and in alluvial soils in inland valleys. Occurs from sea level to at least 1 400 m (Branch 1998).

Biome: Fynbos; Albany Thicket; Nama-Karoo; Succulent Karoo.

Assessment rationale: Widespread and common and not under significant threat.

Conservation measures: None recommended.

Acontias meleagris—Oyster Bay, EC W.R. Branch

Acontias meleagris—Vleesbaai region, WC M. Burger

Acontias namaquensis Hewitt, 1938

NAMAQUALAND LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: This taxon was considered a subspecies of *A. gracilicauda* (Broadley & Greer 1969) but was recently raised to full species status on the basis of a molecular phylogenetic study that showed that the two former subspecies are not sister taxa (Lamb *et al.* 2010).

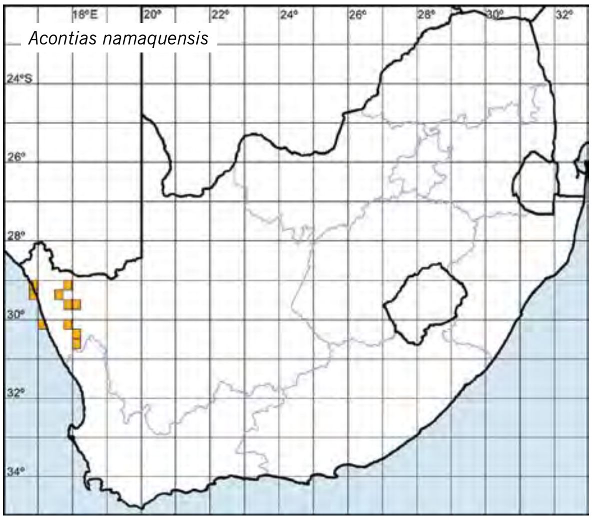
Distribution: Endemic to South Africa, occurring in the western portion of the Northern Cape (Little Namaqualand) (Broadley & Greer 1969).

Habitat: Fossorial, occurring in relatively mesic conditions in sandy soils from sea level to approximately 1 000 m elevation (Branch 1998).

Bioregion: Namaqualand Hardeveld; Namaqualand Sandveld; Richtersveld.

Assessment rationale: Has a restricted range but appears to be locally abundant and is not subject to major extrinsic threats.

Conservation measures: None recommended.



Acontias namaquensis—S of Garies, NC W.R. Branch

Acontias occidentalis FitzSimons, 1941

SAVANNA LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

Taxonomy: Previously considered a subspecies of *Acontias percivali*, an East African species. Recent molecular phylogenetic studies (Daniels *et al.* 2006; Lamb *et al.* 2010) have revealed that *Acontias occidentalis* is closely related to *A. percivali percivali*, but not to *A. percivali tasmani*, which Lamb *et al.* (2010) synonymised with *A. orientalis*. Lamb *et al.* (2010) also formally elevated *A. occidentalis* to full species status based on morphological diagnosability (Broadley & Greer 1969) and the 1 700 km disjunction between this form and its East African sister taxon, rendering *A. percivali* a monotypic species.

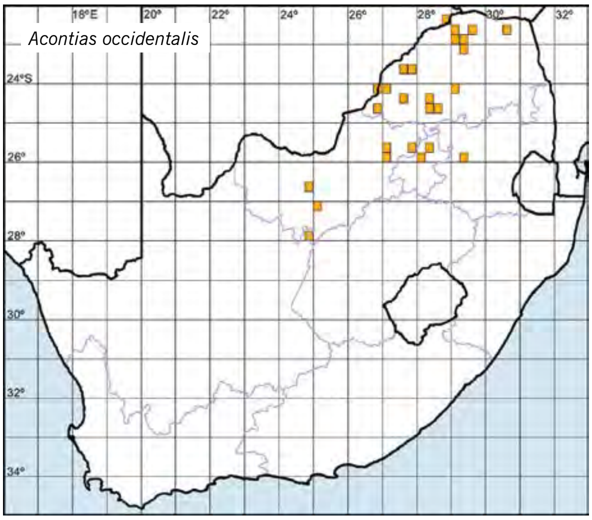
Distribution: Endemic to southern Africa and adjacent areas in southern Angola. Within southern Africa it occurs in north-central Namibia, southern Botswana and parts of Zimbabwe and South Africa (Broadley & Greer 1969). In the *Atlas* region it is found in parts of Limpopo, Mpumalanga, Gauteng and North-West Province.

Habitat: Fossorial, found in soil under leaf litter or other debris. Occurs from altitudes of about 600 m to 2 100 m (Jacobsen 1989).

Biome: Savanna; Grassland.

Assessment rationale: Widespread, especially outside the *Atlas* region, and not experiencing any major threats.

Conservation measures: None recommended.



Acontias occidentalis—Farm Zjoebaya, Musina, LIMP W.D. Haacke

Acontias orientalis Hewitt, 1937

EASTERN CAPE LEGLESS SKINK

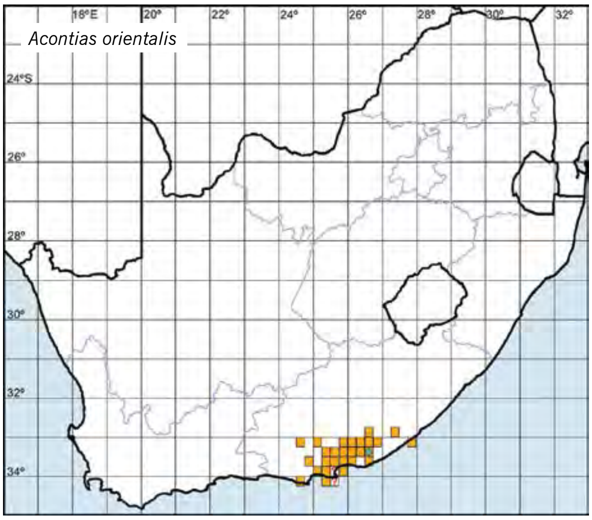
Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: This species was, until recently (Lamb *et al.* 2010), considered a subspecies of *Acontias meleagris*. Daniels *et al.* (2002, 2005, 2006, 2009) considered the status of this taxon to be highly unstable, partly because of the inclusion of the form *A. meleagris lineicauda*, long

Acontias orientalis—Great Fish River Reserve, EC W.R. Branch



regarded as a smaller, more slender morph of *A. meleagris orientalis* (Broadley & Greer 1969). Although easily diagnosed on morphological characters, *A. lineicauda* is neither monophyletic nor imbedded within *A. orientalis* (Daniels *et al.* 2005) and has been recognised (Lamb *et al.* 2010) as a paraphyletic species level taxon pending further study. *Acontias percivali tasmani* was synonymised with *A. orientalis* by Lamb *et al.* (2010), based on its minimal genetic differentiation (Daniels *et al.* 2005, 2006) and nearly complete morphological overlap (Broadley & Greer 1969).

Distribution: Endemic to the southern parts of the Eastern Cape, South Africa. There is an apparently isolated population at Xukulu in the eastern Transkei (Broadley & Greer 1969). Records indicated as questionable on the map may represent *A. lineicauda* (uncertainty due to overlap in ranges).

Habitat: Fossorial, found in coastal areas and alluvial soils in inland valleys in mesic to relatively dry situations. Occurs from sea level to at least 1 400 m (Branch 1998).

Bioregion: Albany Thicket; Sub-Escarpment Savanna; Eastern Fynbos-Renosterveld; Seashore Vegetation; Lower Karoo.

Assessment rationale: Relatively widespread and common and not subject to major threats throughout most of its range.

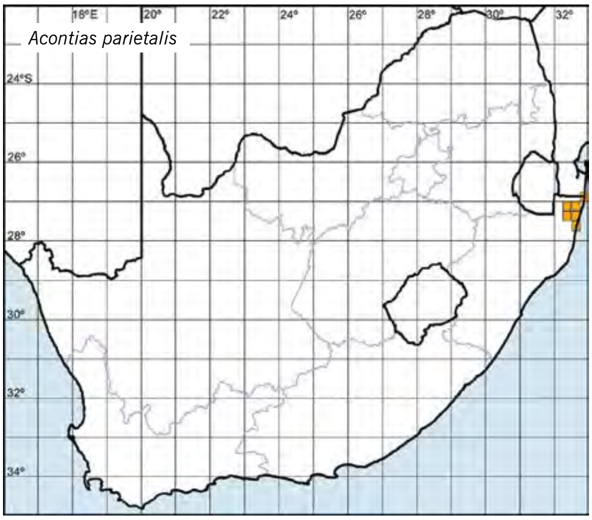
Conservation measures: None recommended.

Acontias orientalis—NE of Oyster Bay, EC M. Burger

Acontias parietalis (Broadley, 1990)

MAPUTALAND LEGLESS SKINK

Aaron M. Bauer



Global: Least Concern

Taxonomy: *Typhlosaurus aurantiacus parietalis* was transferred to *Acontias* by Lamb *et al.* (2010). All five subspecies of *T.* (= *Acontias*) *aurantiacus* recognised by Broadley (1968, 1990a)—including *T.* (= *A.*) *a. parietalis*—are now treated as valid species (Pietersen *et al.* in prep.). Although KwaZulu-Natal populations of this species have been referred to '*T. a. aurantiacus*' (e.g. Branch 1998), Broadley (1990a) clarified that these, along with specimens from Inhaca Island, Mozambique, were referable to '*T. a. parietalis*', with the former taxon restricted to southern coastal Mozambique.

Distribution: Endemic to southern Africa, occurring in coastal southern Mozambique and in northeastern KwaZulu-Natal, South Africa (Broadley 1968).

Habitat: Fossorial, found in sandy soils and mesic conditions in coastal sandveld and grassland areas. Occurs from sea level to 200 m elevation (Bourquin 2004).

Vegetation type: FOz 7 Northern Coastal Forest; SVl 18 Tembe Sandy Bushveld; CB 1 Maputaland Coastal Belt; CB 2 Maputaland Wooded Grassland.

Assessment rationale: Has a relatively widespread global distribution. Although some areas of appropriate habitat may be threatened by coastal development or recreational land use, much of the range is included in protected areas and other threats are minimal. Regional EOO is small but threats are highly localised and fragmentation is slight.

Conservation measures: None recommended.

Acontias parietalis—Kosi Bay, KZN J. Marais

Acontias plumbeus Bianconi, 1849

GIANT LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

Taxonomy: Earlier molecular phylogenetic results placed *Acontias plumbeus* with other robust species in a restricted *Acontias* (Daniels *et al.* 2006). More recent research (Lamb *et al.* 2010) demonstrates that it is also closely related to skinks formerly placed in *Acontophiops* and *Typhlosaurus* sensu lato. The taxonomic status of isolated populations near East London and on the eastern escarpment of Zimbabwe should be investigated further.

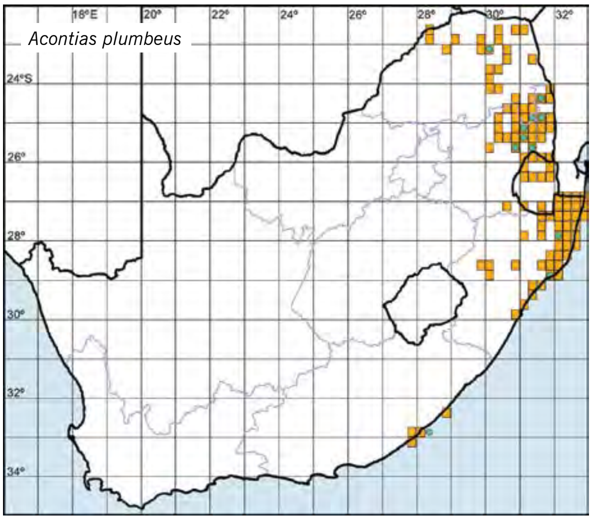
Distribution: Endemic to southern Africa. Occurs in Zimbabwe, Mozambique, Swaziland and South Africa (Broadley & Greer 1969). Within South Africa, it is widespread in the northern and eastern regions of Limpopo, in eastern Mpumalanga and throughout the lower elevations of KwaZulu-Natal. There are scattered coastal populations in the Eastern Cape, such as at Dwesa Nature Reserve and in the East London region.

Habitat: Found in mesic microhabitats under leaf litter or other cover in forested or partly-wooded habitats, grasslands or alluvial sands. Occurs from sea level to at least 1 500 m (Jacobsen 1989).

Biome: Savanna; Indian Ocean Coastal Belt; Forests; Grassland; Albany Thicket.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Acontias plumbeus—Mtubatuba, KZN J. Marais

Acontias poecilus Bourquin & Lambiris, 1996

VARIABLE LEGLESS SKINK

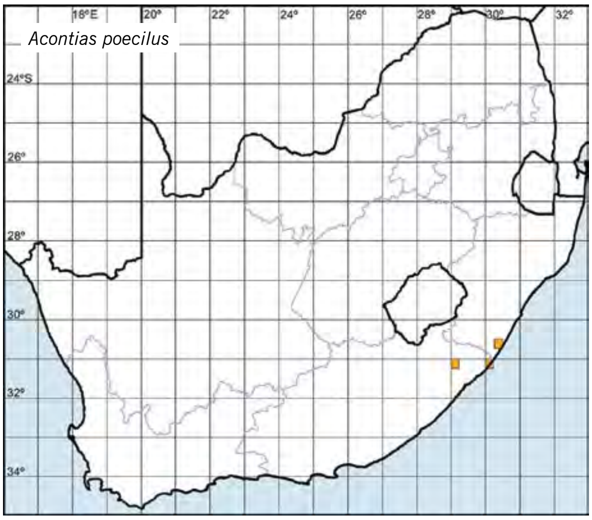
Aaron M. Bauer

Global: Endangered B1ab(ii,iii)+2ab(ii,iii)

Endemic

Taxonomy: This relatively recently described species was previously confused with the similar *Acontias plumbeus* (e.g. Broadley 1984), to which it is closely related (Lamb *et al.* 2010). Although it may be diagnosed from

Acontias poecilus—Port Edward, KZN J. Marais



A. plumbeus morphologically, its high genetic similarity to this species (Lamb *et al.* 2010) suggests that further work, incorporating broader sampling across both species, is required to clarify relationships further.

Distribution: Endemic to South Africa, occurring in coastal regions of the extreme southern part of KwaZulu-Natal and the adjacent eastern parts of the Eastern Cape.

EOO: 3 105 km^2 (confidence: high); AOO: 347 km^2 (confidence: medium).

Habitat: Found in moist situations in soil or under leaf litter in forested or shaded habitats. Occurs from sea level to approximately 300 m in KwaZulu-Natal (Bourquin 2004) and up to 900 m in the Eastern Cape.

Vegetation type: CB 4 Pondoland-Ugu Sandstone Coastal Sourveld; CB 3 KwaZulu-Natal Coastal Belt; Gs 12 East Griqualand Grassland.

Assessment rationale: Has a restricted EOO (<5 000 km^2) and AOO (<500 km^2). Most of the distribution is fragmented by intensive human land use and there are only five locations [B1a+2a]. Increasing human pressure for agricultural land, housing and coastal recreation imply a continuing decline in the AOO, and in quality and extent of suitable habitat [B1b(ii,iii)+2b(ii,iii)].

Threats: Threatened by land conversion for agriculture, housing and recreation, particularly in coastal areas. This skink has limited dispersal capabilities and a restricted range.

Conservation measures: Clarify the species' taxonomic status relative to adjacent populations of *A. plumbeus*. Determine population size, range, biology and ecology, habitat status and threats. Establish provincial legislation that protects the species. Ensure that it is protected in a reserve. Develop habitat corridors that link subpopulations. Prioritise a survey of Mkambati Nature Reserve in the Eastern Cape, where Branch & Haagner (1999) suggested that this skink might occur. Conduct directed searches in the area between the coast and Mount Frere, the only known inland locality for the species. Conduct a PHVA and draw up a BMP-S.

Acontias richardi (Jacobsen, 1987)

RICHARD'S LEGLESS SKINK

Aaron M. Bauer

Global: Near Threatened

Endemic

Taxonomy: The relationships of this skink were recently investigated using molecular techniques (Lamb *et al.* 2010), resulting in its transfer from *Typhlosaurus* to *Acontias* and its elevation from a subspecies of *T. lineatus* (now *A. kgalagadi*). *Acontias k. kgalagadi*, *A. richardi*, *A. jappi* and probably also *A. k. subtaeniatus*, constitute a clade. Relationships between this taxon and others formerly in the *Typhlosaurus lineatus* group are under review (D. Pietersen in prep.).

Distribution: Endemic to northern Limpopo Province, South Africa, where it has a highly restricted distribution in the Soutpansberg district. The record plotted at 2230CB was obtained during a SARCA survey.

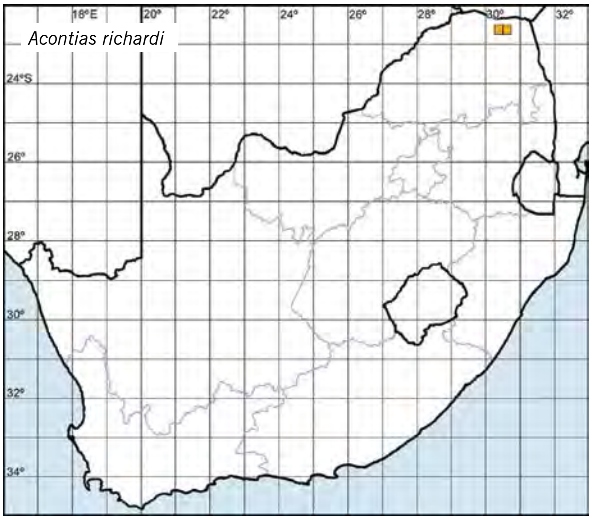
EOO: 1 427 km^2 (confidence: low); AOO: 856 km^2 (confidence: low).

Habitat: Found under rotting logs in deep aeolian sand deposits on the northern slopes of the Soutpansberg at about 800 m elevation (Jacobsen 1987a, 1989).

Vegetation type: SVl 1 Makuleke Sandy Bushveld; SVcb 21 Soutpansberg Mountain Bushveld; SVmp 1 Musina Mopane Bushveld.

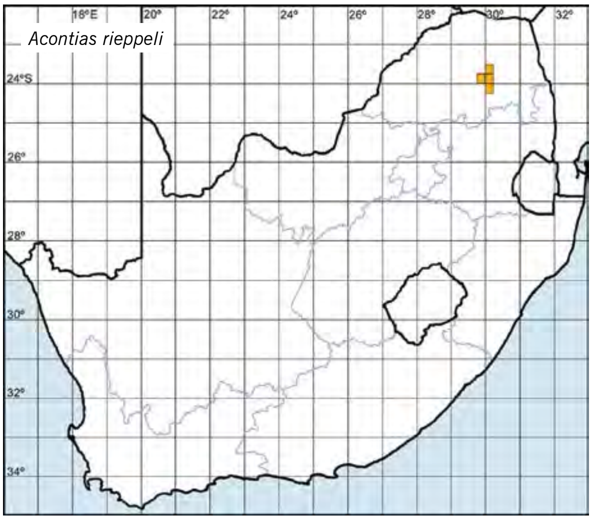
Assessment rationale: Has an extremely restricted EOO [B1] and AOO [B2]. Currently known from only two sites that are not in protected areas (Jacobsen 1988h; SARCA survey), and there is continuing decline in quality of habitat [B1b(iii)+2b(iii)] due to agricultural practices such as livestock grazing (Jacobsen 1989).

Threats: Has limited dispersal capabilities and appears to have an extremely restricted distribution. No serious extrinsic threats, but livestock grazing takes place within its range and if this is uncontrolled, it may impact the skink's food source. Fires may also be a threat to this species.



Acontias richardi—Greater Kuduland Safaris, E of Tshipise, LIMP M. Burger

Conservation measures: Collect information on range, population size, biology and ecology. Assess the current status of the habitat. Monitor the effects of livestock grazing, protect the area in which *A. richardi* occurs, and draft a BMP-S.



Acontias rieppeli—near Wolkberg hut, Wolkberg Wilderness Area, LIMP
M. Burger

Acontias rieppeli Lamb, Biswas & Bauer, 2010

WOODBUSH LEGLESS SKINK

Aaron M. Bauer & Michael F. Bates

Global: Endangered B1ab(iii)+2ab(iii)

Endemic

Taxonomy: Originally described as *Acontophiops lineatus* Sternfeld, 1912 (often incorrectly given as Sternfeld, 1911). The relationships of this skink were investigated recently using molecular techniques (Daniels *et al.* 2002, 2006). The most recent molecular analysis of all acontines (Lamb *et al.* 2010) reveals that this species is embedded within a clade of taxa now assigned to *Acontias*. Transfer to the genus *Acontias* results in the new combination, *Acontias lineatus*, which is a junior secondary homonym of *A. lineatus* Peters, 1879. Lamb *et al.* (2010) proposed the replacement name *A. rieppeli*, using a previously nomenclaturally-unavailable epithet proposed by Welch (1982a).

Distribution: Endemic to the Woodbush, Haenertsburg and Wolkberg areas of Limpopo Province, South Africa.

EOO: 879 km^2 (confidence: high); AOO: 283 km^2 (confidence: medium).

Habitat: Fossorial, found in mesic conditions in montane grassland, usually under stones. Occurs at elevations of 1 600–2 000 m (Jacobsen 1989). Near Haenertsburg it is found on soil under rocks imbedded on grassy slopes and ridges; also up to 20 cm below the surface in reddish-brown soil at the edges of pine plantations or even up to about 50 m within the forest (M.F. Bates unpubl. data).

Vegetation type: Gm 23 Northern Escarpment Quartzite Sourveld; Gm 25 Woodbush Granite Grassland.

Assessment rationale: This species has a restricted range (EOO <5 000 km^2 and AOO <500 km^2), is vulnerable to threats from afforestation, cultivation and infrastructural expansion, and has experienced severe habitat fragmentation [B1a+2a]. It is also experiencing a continuing decline in area, extent and quality of habitat in some portions of its range [b(iii)].

Threats: The primary extrinsic threat is afforestation; exotic pine plantations have apparently resulted in local decreases in abundance (Jacobsen 1988i). However, the recent discovery of specimens living in soils at the edges of a pine forest near Haenertsburg (M.F. Bates unpubl. data) suggests that this species is able to re-colonise such areas, or even that afforestation may not totally eradicate local populations. In the Haenertsburg area at least, grassland is also ploughed up and used for cultivation and even propagation of medicinal plants (M.F. Bates pers. obs.). *Acontias rieppeli* may also occur in and around the town of Haenertsburg and in the Ebenezer Dam area, so it could also be affected to a small extent by urbanisation and tourist/entertainment activities. Also, if this species is at all affected by roads (as is *Scelotes*), then ongoing construction of forest roads will create another negative impact. Also threatened by its limited dispersal capabilities and highly restricted range.

Conservation measures: Collect data on population size and range in order to establish a baseline for monitoring population status on a periodic basis. Study biology, ecology and habitat status in order to evaluate the particular requirements of the species and provide a basis for possible restoration of habitat in currently or formerly afforested areas in its range. Attempt to determine the extent to which the species occurs in soils within exotic plantations. Develop a BMP-S.

Acontias tristis Werner, 1911
NAMAQUALAND DWARF LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: The genus *Microacontias*, to which this species had been assigned (Daniels *et al.* 2006), was synonymised with *Acontias* by Lamb *et al.* (2010) based on molecular phylogenetic findings. A recent molecular phylogenetic study (Daniels *et al.* 2006) suggested that *A. litoralis* was derived from within a polytypic *A. lineatus*, making the latter paraphyletic. In a subsequent mitochondrial DNA phylogeny of '*Microacontias*' (Janse van Vuuren 2009), the four currently recognised taxa in this clade were found to interdigitate in the phylogram. However, because all taxa were found to be identifiable morphologically it was suggested that all subspecies of *A. lineatus* retain their status, with *A. litoralis* treated as a fourth subspecies of *A. lineatus*. The findings of Lamb *et al.* (2010) were similar to those of Daniels *et al.* (2006) and, on this basis and with regard to the diagnostic differences described by Broadley & Greer (1969), they elevated *A. l. tristis* and *A. l. grayi* to full species status.

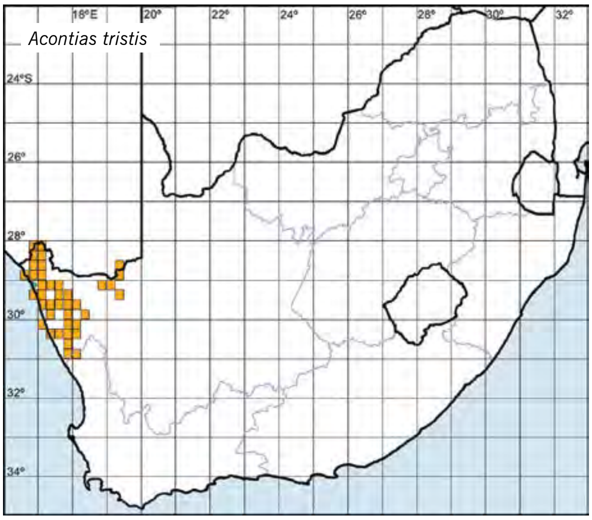
Distribution: Endemic to South Africa, occurring only in the western parts of the Northern Cape and in a small part of the adjoining Western Cape. Its proximity to the Namibian border suggests that it may also occur in that country.

Habitat: Fossorial, found in sandy soils in mesic microhabitats, in arid to semi-arid habitats (Bauer & Branch 2003 [2001]). Occurs from sea level to at least 1 000 m elevation.

Bioregion: Richtersveld; Namaqualand Hardeveld; Gariep Desert; Namaqualand Sandveld.

Assessment rationale: Widespread and common, with no major identifiable extrinsic threats.

Conservation measures: None recommended.



Acontias tristis—Namaqua NP, NC D. Maguire

Genus *Typhlosaurus* Wiegmann, 1834—blind legless skinks

A recent molecular phylogenetic study (Lamb *et al.* 2010) revealed that many species formerly assigned to *Typhlosaurus* (Broadley & Greer 1969; Branch 1998) were embedded within the genus *Acontias*. Consequently, Lamb *et al.* (2010) allocated these species, along with all species of *Microacontias* and the monotypic *Acontophiops*, to a more inclusive *Acontias*. *Typhlosaurus* is therefore restricted to five species distributed along the West Coast of southern Africa from the Cape Peninsula north to the Kuiseb River in central Namibia. Four species (three strictly endemic) occur in the *Atlas* region, in coastal and Namib sands and isolated sandveld areas. All taxa are elongate, limbless, burrowing insectivores that feed chiefly on termites (Branch 1998). They are active diurnally or nocturnally, largely depending on thermal conditions, and are viviparous (1–3 young in a litter) (Branch 1998). *Typhlosaurus lomiae* is considered Near Threatened mainly because of its extremely restricted distribution. All other taxa in the *Atlas* region are classified as Least Concern.

Typhlosaurus caecus (Cuvier, 1816 [1817])

SOUTHERN BLIND LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: This species was reviewed by Broadley (1968b), who considered *Typhlosaurus caecus* and *T. vermis* as two semispecies within a superspecies. Bates *et al.* (1998) demonstrated that the two taxa are distinct and should be considered full species. The latter authors also argued that Northern Cape specimens previously allocated to *T. caecus* by Broadley (1968b) and Branch (1998) are in fact *T. vermis*.

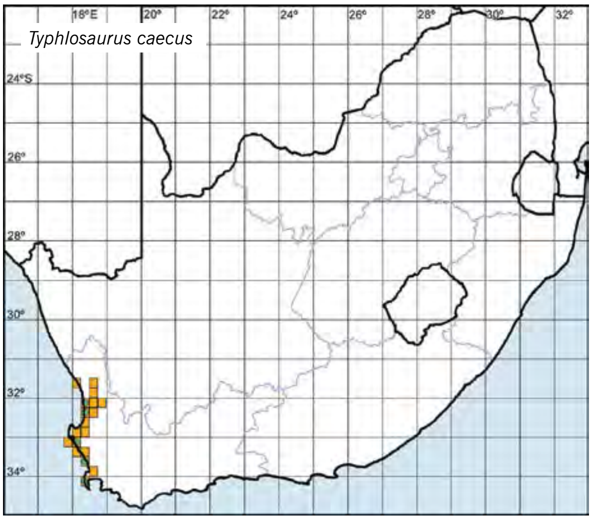
Distribution: Endemic to South Africa, occurring along the West Coast of the Western Cape (Bates *et al.* 1998). A recent record of *T. caecus* from the Richtersveld and another from nearby Koiingnaas (neither plotted) require confirmation.

Habitat: Fossorial, found in partly vegetated sandy soils in coastal and sandveld habitats from sea level to at least 500 m elevation.

Bioregion: West Strandveld; Southwest Fynbos; Northwest Fynbos; Namaqualand Sandveld.

Assessment rationale: Has a moderately restricted distribution but is common throughout and adequately protected. The only extrinsic threats are from housing and recreation, and these impact only a small portion of the range.

Conservation measures: None recommended.



Typhlosaurus caecus— Koeberg NR, WC W.R. Branch

Typhlosaurus lomiae Haacke, 1986

LOMI'S BLIND LEGLESS SKINK

Aaron M. Bauer

Global: Near Threatened

Endemic

Taxonomy: The original specific epithet '*lomii*' was corrected in accordance with the International Code of Zoological Nomenclature to '*lomiae*' by Michels & Bauer (2004), to match the gender of the person honoured by the epithet.

Distribution: Endemic to Namaqualand district in the West Coast region of the Northern Cape, South Africa.

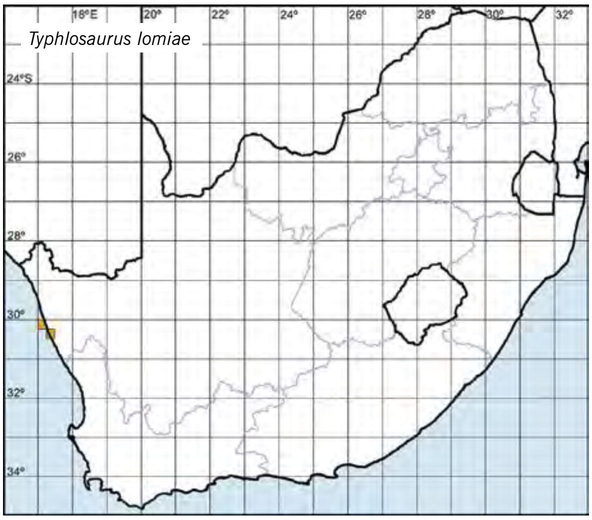
EOO: 876 km^2 (confidence: medium); AOO: 430 km^2 (confidence: medium).

Habitat: Fossorial, found in low vegetated sand dunes often in association with termitaria (Haacke 1986; Bauer *et al.* 2000), at elevations below 100 m.

Vegetation type: SKs 8 Namaqualand Coastal Duneveld.

Assessment rationale: Although there are currently no known threats, the species has a restricted distribution (EOO and AOO less than the EN thresholds) and occurs at only a few sites in an area that is not formally protected (Haacke 1988) and that might be affected by diamond mining in the future.

Threats: Has limited dispersal capabilities and appears to have an extremely restricted distribution. There are currently no documented extrinsic threats. Although not contained in any formal protected areas, the species occurs within the De Beers Consolidated Diamond Mines Ltd. concession area, so public access is restricted at this time (Haacke 1988a). In this area, the habitat used by the species (Bauer *et al.* 2000) is not currently impacted by mining activities, although this may change (Haacke 1988a).



Typhlosaurus lomiae—Noup, Namaqualand, NC J. Marais

Conservation measures: Obtain information on range, population size, biology and ecology, and assess the status of the habitat. Incorporate the area in which the species occurs into a formally protected area and draft a BMP-S.

Typhlosaurus meyeri Boettger, 1894

MEYER'S BLIND LEGLESS SKINK

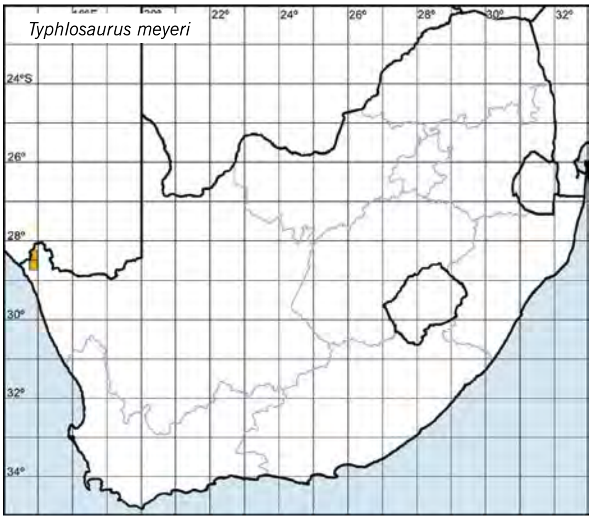
Aaron M. Bauer

Global: Least Concern

Taxonomy: No notable issues.

Distribution: Endemic to southern Namibia (Lüderitz district) and the adjacent northwestern Richtersveld of the Northern Cape, South Africa (Broadley 1968a; Haacke 1986; Bauer & Branch 2003 [2001]).

Typhlosaurus meyeri—Sperrgebiet, Namibia J. Marais



Habitat: Occurs in sparsely vegetated dunes and other areas of loose sand in the southern Namib (Bauer & Branch 2003 [2001]), chiefly below 500 m elevation.

Bioregion: Southern Namib Desert.

Assessment rationale: Although marginally represented in the *Atlas* region, with records in only two QDGCs, this represents more than 5% of the total range so the species was assessed. Fairly widespread in an area largely uninhabited by humans. Although parts of the range are intensively mined for diamonds, most of the distribution falls within Sperrgebiet buffer zones that are protected from public access and are not mined. Within the *Atlas* region AOO (5 711 km^2) and especially EOO (26 000 km^2) are small, but there is no evidence of decline. This species is therefore currently not considered to be of conservation concern.

Conservation measures: None recommended.

Typhlosaurus vermis Boulenger, 1887

PINK BLIND LEGLESS SKINK; BOULENGER'S BLIND LEGLESS SKINK

Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: Reviewed by Broadley (1968a), who was of the opinion that *Typhlosaurus caecus* and *T. vermis* might be two semispecies within a superspecies. Bates *et al.* (1998) demonstrated that the two are distinct and should be considered full species. These authors also argued that Northern Cape specimens previously allocated to *T. caecus* by Broadley (1968a) and Branch (1998) are in fact *T. vermis*.

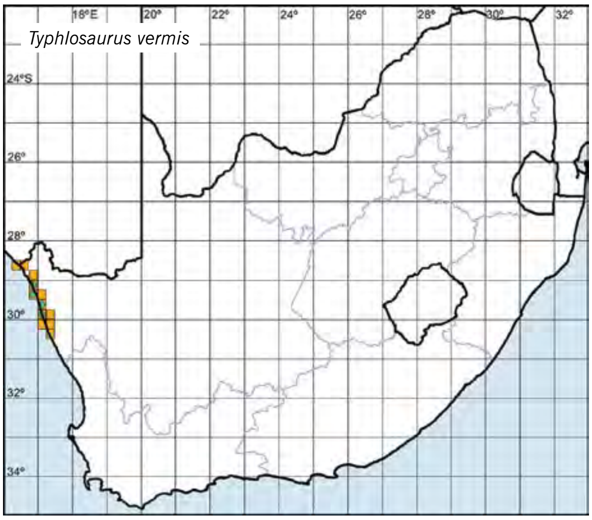
Distribution: Endemic to the Namaqualand district of the Northern Cape, South Africa. A record from Putzonderwater (2921BB) in the central Northern Cape (Broadley 1968a; Haacke 1986) is correctly identified (Bates *et al.* 1998) but the locality is almost certainly incorrect. Another set of records from Baievlei (3017BD), just south of Langstrand in the northern Western Cape, is unconfirmed and may be referable to *T. caecus*. These two sets of questionable records have not been included on the map. No records exist for Namibia, but the species may occur in the Oranjemund area.

Habitat: Fossorial, found in sparsely vegetated sandy soils in coastal and sandveld habitats, from sea level to at least 900 m elevation.

Bioregion: Namaqualand Sandveld; Southern Namib Desert; Richtersveld; Seashore Vegetation.

Assessment rationale: Has a moderately restricted distribution but is common throughout. Major extrinsic threats from housing and mining are limited to relatively small portions of the range.

Conservation measures: None recommended.



Typhlosaurus vermis—Noup, NC W.R. Branch

SUBFAMILY LYGOSOMINAE

This is the largest subfamily of skinks and includes many of the species familiar to most people. It is wide ranging, but particularly diverse in Africa and the Australasian region. There remains controversy over the monophyly of this subfamily (Whiting *et al.* 2003; Giovannottia *et al.* 2010) and the number of genera, their content and relationships (Honda *et al.* 2000; Whiting *et al.* 2003; Brandley *et al.* 2005; Austin & Arnold 2006; Sindaco *et al.* 2012). Four genera occur in southern Africa and all reach the *Atlas* region where they are represented by 17 species. The fact that three of the four genera have recently undergone name changes highlights the level of taxonomic confusion in this subfamily.

Genus *Afroablepharus* Greer, 1974—snake-eyed skinks

Snake-eyed skinks have a complicated taxonomic history. They were usually placed in the genus *Panaspis*. However, the concept and extent of *Panaspis* has undergone substantial changes since its creation by Cope in 1868 (see Boulenger 1887; Smith 1937; Mittleman 1952; Fuhn 1969; Perret 1973, 1975; Welch 1982a,b). Based on morphological characters, Greer (1974) described a new genus, *Afroablepharus*, for African species with an ablepharine (non-blinking) eye and contact between the frontal scale and just one subocular scale. Welch (1982a) proposed a tribe, Panaspinini, to include the African genera *Cophoscincopus*, *Panaspis*, *Afroablepharus*, *Lacertaspis* and *Leptosiaphos*, but this was largely ignored by subsequent workers. Broadley (1989) rejected Greer's (1974) arrangement and retained *Panaspis* for savanna species (although he also included *P. breviceps*, a rainforest inhabitant) with an ablepharine eye and returned *Afroablepharus* to the synonymy of *Panaspis*. Subsequent molecular studies (Schmitz *et al.* 2005a; Jesus *et al.* 2007) have confirmed the generic distinctness of the former subgenera (*Afroablepharus*, *Leptosiaphos* and *Lacertaspis*) within *Panaspis*. The latter genus is now restricted to a suite of 3–4 species from West and Central Africa. Five species of *Afroablepharus* are currently recognised (Uetz 2012), but an undescribed species from São Tomé awaits description (Jesus *et al.* 2007), and Medina *et al.* (2012) note that *A. wahlbergii* comprises a complex of cryptic species. Two species are found in the *Atlas* region, one of which was described relatively recently (*P. maculicollis*; Jacobsen & Broadley 2000). These are diurnal, terrestrial or semi-burrowing small- to medium-sized skinks with small but well-developed limbs. Females lay small clutches of 2–6 eggs (Branch 1998). Neither species in the *Atlas* region is of conservation concern.

Afroablepharus maculicollis (Jacobsen & Broadley, 2000)

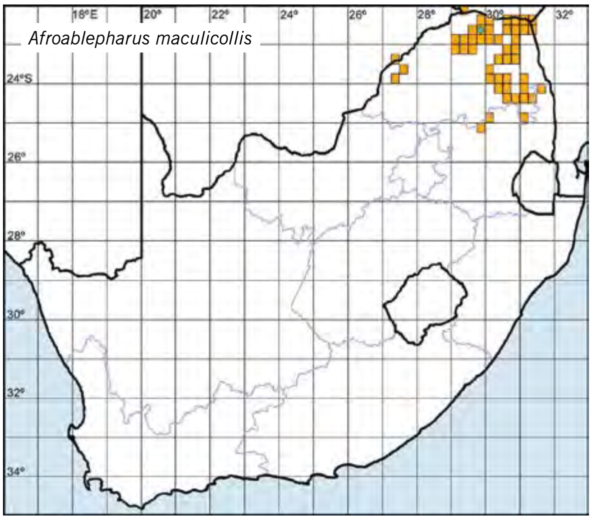
SPOTTED-NECK SNAKE-EYED SKINK

Gavin Masterson

Regional: Least Concern

Taxonomy: *Afroablepharus maculicollis* was first recognised by Jacobsen (1989) as a cryptic species related to *A. wahlbergii*. It was later described by Jacobsen & Broadley (2000) based on differences in the average number of scale rows at mid-body, body patterning (particularly on the neck) and male colouration during the breeding season. Taxonomy is stable but older specimen records and pre-2000 references to *A. wahlbergii* should be carefully checked using the key provided by Jacobsen & Broadley (2000). The relationship of this species and of *A. wahlbergii* to the isolated population in northern Namibia remains unresolved.

Distribution: Endemic to the southern half of Africa. Found in Zambia, Zimbabwe, northern Botswana, Caprivi Strip, South Africa and central Mozambique (Branch 1998; Jacobsen & Broadley 2000). Within the *Atlas* region it is restricted to Limpopo and northern Mpumalanga. It may occur in Angola, but this is unconfirmed.



Afroablepharus maculicollis—Alldays, LIMP J. Marais

Habitat: A terrestrial species, very similar in habits to *A. wahlbergii* and known to occur in sympatry with the latter in several areas. Found in open or rocky savanna at altitudes of 220–900 m (Jacobsen & Broadley 2000).

Bioregion: Central Bushveld; Lowveld; Mopane.

Assessment rationale: Widespread and found in several protected areas.

Conservation measures: None recommended.

Afroablepharus wahlbergii (A. Smith, 1849)
WAHLBERG'S SNAKE-EYED SKINK

Gavin Masterson

Regional: Least Concern

Taxonomy: Although Smith (1849) initially used '*walbergii*' as the specific epithet, he later corrected this to '*wahlbergii*' in an often overlooked errata slip (Ulber 1999). Such an inserted slip, under Article 32.5.1.1 of the ICZN (1999), is clear evidence of an inadvertent error that has been corrected. The absence of the errata slip from some copies of Smith's work has contributed to confusion on this point (e.g. Greenbaum *et al.* 2007). Jacobsen (1989) drew attention to the presence of a cryptic species in northern savanna areas of South Africa, which was later described by Jacobsen & Broadley (2000) as *Panaspis maculicollis*. Older specimen records of *A. wahlbergii* should therefore be checked using the key in Jacobsen & Broadley (2000), particularly in areas of known sympatry. The taxonomic status of the isolated Namibian population of this species is unresolved. According to Medina *et al.* (2012), '*A. wahlbergii*' is a complex of at least five species.

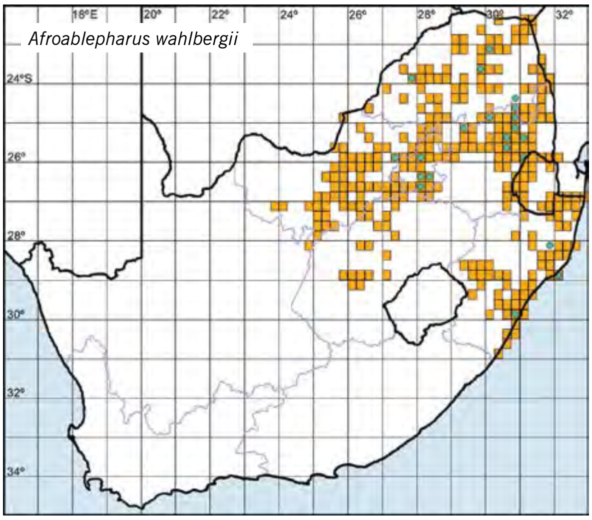
Distribution: Endemic to sub-Saharan Africa. Found in Namibia, South Africa, Zimbabwe, Zambia, Mozambique, Malawi, Democratic Republic of Congo, Ethiopia and Somalia (Branch 1998; Jacobsen & Broadley 2000). Within the *Atlas* region it is found in Free State, North-West Province, Gauteng, Limpopo, Mpumalanga, KwaZulu-Natal and Swaziland. There is one record in the Northern Cape, at Warrenton (2824BB).

Habitat: A ubiquitous terrestrial species found in a wide variety of habitats ranging from rocky outcrops to open Highveld grasslands, usually under suitable cover or in leaf litter, from the coast up to altitudes of 2 000 m (Branch 1998; Jacobsen & Broadley 2000; Masterson *et al.* 2008).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Afroablepharus wahlbergii—Durban, KZN J. Marais

Genus *Cryptoblepharus* Wiegmann, 1834—coral rag skinks

The genus *Cryptoblepharus* is a taxonomically complex group of skinks that appears to have spread throughout the Indo-Pacific region via transoceanic dispersal (Rocha *et al.* 2006; Horner 2007). There are 62 recognised taxa comprising 48 monotypic and six polytypic species (Horner 2007). These lizards are diurnal, and rupicolous or semi-arboreal. Clutch size is limited to 1–2 eggs (Horner 2007). *Cryptoblepharus africanus* has a patchy distribution along the east coast of Africa from Somalia southwards to South Africa. Within the *Atlas* region it occurs as a small population at one rocky point on the north-eastern coast of KwaZulu-Natal (Haacke 2002). Although listed as Vulnerable by Branch (1988a), it is now regarded as regionally Endangered.

Cryptoblepharus africanus (Sternfeld, 1918)

AFRICAN CORAL RAG SKINK

Gavin Masterson

Regional: Endangered **D**

Taxonomy: The taxonomy of the genus *Cryptoblepharus* is controversial and cannot be considered stable despite recent reviews by Rocha *et al.* (2006) and Horner (2007). Based on the results of their mitochondrial sequence analysis, Rocha *et al.* (2006) concluded that the subspecific assignments of the Western Indian Ocean *Cryptoblepharus* are the most appropriate. By contrast, Horner (2007) used morphological characteristics from a small sample to elevate *C. boutonii africanus* to species status. The taxonomy of Horner (2007) is followed in this assessment, in keeping with the adoption of a general evolutionary species paradigm in the *Atlas*. However, it is acknowledged that taxon allocation in allopatric, highly mobile populations, such as those of the *C. boutonii* species complex, is controversial.

Distribution: Endemic to Africa, occurring from South Africa northwards along the east coast to Tanzania, Kenya and Somalia (Rocha *et al.* 2006; Uetz 2012). Within the *Atlas* region it is found only at Black Rock near Kosi Bay in KwaZulu-Natal, South Africa.

EOO: 0.01 km^2 (confidence: high); AOO: 0.01 km^2 (confidence: high).

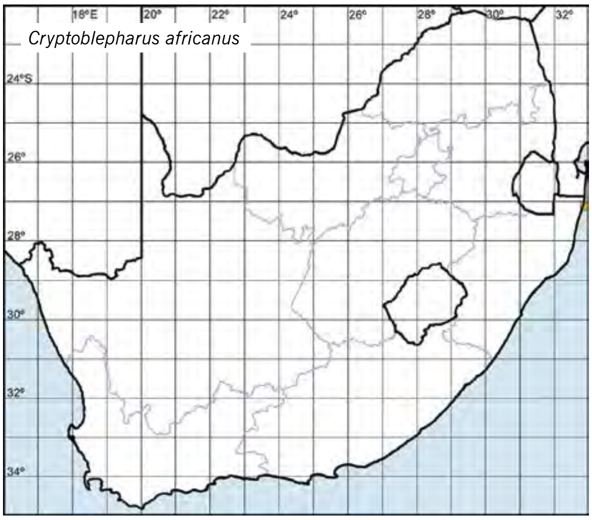
Habitat: Found in the supratidal and intertidal zones of a porous sandstone cliff. During suitable weather conditions it emerges from retreats in the supratidal, upper areas of the cliff to forage in intertidal pools, which it may also use to escape predators (Haacke 1988b, 2002).

Vegetation type: Not applicable.

Assessment rationale: Between 100 and 200 individuals occur at Black Rock (Haacke 2002) and this single, small and restricted regional population is not expected to experience any significant immigration, resulting in a listing of Endangered [D].

Threats: The most serious plausible threat is destruction of habitat via anthropogenic utilisation of the rock outcrop for recreation/tourism or fishing (Haacke 1988b), but there is also the possibility of sea level rise or tsunamis associated with climatic factors.

Conservation measures: Monitor population size, viability and threats. Furthermore, resolve the taxonomic status of the population at Black Rock. Ensure protection of Black Rock by excluding recreational visitors from this critical habitat.



Cryptoblepharus africanus—Black Rock, KZN J. Marais

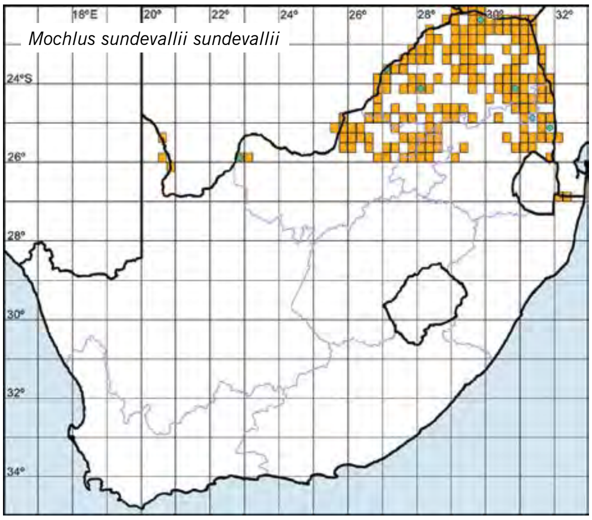
Genus *Mochlus* Günther, 1864—writhing skinks

Mochlus is a genus of 12 species distributed throughout much of sub-Saharan Africa (Uetz 2012). It was previously included in the genus *Lygosoma*, which is now restricted to Asia (Wagner *et al.* 2009). These are diurnal, semi-fossorial, small- to medium-sized skinks with very small but fully developed limbs. Females lay clutches of 2–6 soft-shelled eggs (Branch 1998). One subspecies, *M. sundevallii sundevallii*, enters the northern and northeastern parts of the *Atlas* region. It is not of conservation concern.

Mochlus sundevallii sundevallii (A. Smith, 1849)

SUNDEVALL'S WRITHING SKINK

Gavin Masterson



Regional: Least Concern

Taxonomy: There are two subspecies: the widespread *Mochlus sundevallii sundevallii* and the Somalian *M. sundevallii somalica*, which has a longer fifth toe (Branch 1998).

Distribution: Endemic to Africa. Found in southern Angola, Namibia, Zambia, Zimbabwe, northern and northeastern South Africa, Mozambique, Malawi, Tanzania, Kenya and Uganda (Broadley 1966b; Spawls *et al.* 2002). Within the *Atlas* region it is found mainly north of 26°S, in Swaziland, Mpumalanga, Limpopo, Gauteng, North-West Province and Northern Cape, but also in northeastern KwaZulu-Natal.

Habitat: A fossorial species found in arid, sandy conditions, usually under suitable surface cover such as logs, rocks or leaf litter, mainly in savanna but also in grassland, from 0–1 800 m (FitzSimons 1943; Jacobsen 1989; Branch 1998).

Biome: Savanna; Grassland.

Assessment rationale: Widespread and commonly found when searched for.

Conservation measures: None recommended.

Mochlus sundevallii sundevallii—Koanaka, W Botswana J. Marais

Genus *Trachylepis* Fitzinger, 1843—typical skinks

Although previously placed in the genus *Mabuya*, typical skinks from the Afro-Malagasy region were assigned to *Trachylepis* by Bauer (2003) following the work of Mausfeld *et al.* (2002). There are at least 78 species (Uetz 2012) occurring throughout Africa, Madagascar, parts of southwestern Asia and on Fernando de Noronha, an island off the coast of Brazil. Several additional species are in the process of being described. Thirteen species are found in the *Atlas* region, occupying all major biomes. Southern African species are small to large skinks with well-developed limbs. These lizards are diurnal, and terrestrial, rupicolous or arboreal. Most species are viviparous, but a few (e.g. *T. homalocephala*) are oviparous (Branch 1998), and both modes of reproduction have been recorded for *T. capensis* (Brown-Wessels 1989). None of the species in the *Atlas* region are of conservation concern.

Trachylepis capensis (Gray, 1831)

CAPE SKINK

Gavin Masterson

Regional: Least Concern

Taxonomy: No notable issues.

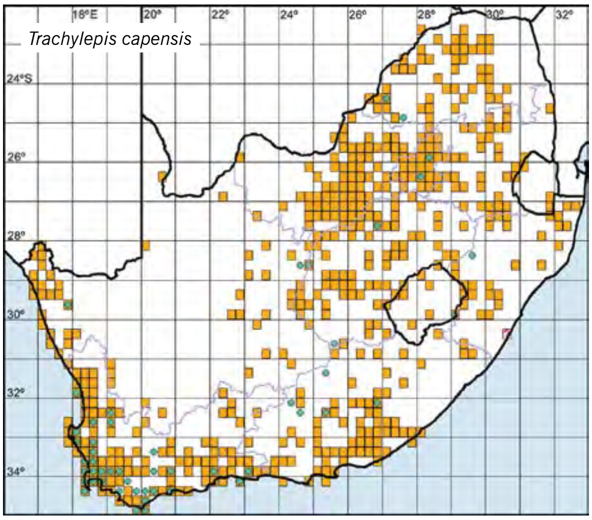
Distribution: Endemic to the southern parts of Africa. Found in South Africa, Lesotho, Swaziland, Zimbabwe, Botswana, Namibia and western Zambia (Branch 1998; Broadley 2000). Widespread in the *Atlas* region but absent from much of the central Northern Cape and Transkei. Populations on the Inyanga Mountains of Zimbabwe and the Liuwa Plain in Zambia appear to be isolated and relictual (Branch 1998; Broadley 2000).

Habitat: A ubiquitous, terrestrial species found in all major biomes of South Africa, although more abundant in grassland, savanna and fynbos at altitudes of 0–2 300 m (Jacobsen 1989; Branch 1998). Recorded from rocky areas, open veld, holes in disused termite mounds and around houses (De Waal 1978). May dig tunnels at the base of vegetation or rocks, and is also fond of areas with mats of dead leaves (Branch 1998).

Biome: Grassland; Fynbos; Savanna; Albany Thicket; Succulent Karoo; Nama-Karoo; Forests; Indian Ocean Coastal Belt; Desert.

Assessment rationale: Widespread and abundant.

Conservation measures: None recommended.



Trachylepis capensis—Springbok, NC J. Marais

Trachylepis depressa (Peters, 1854)

EASTERN SAND SKINK

Gavin Masterson

Regional: Least Concern

Taxonomy: Previously known as *Mabuya homalocephala depressa* (e.g. Branch 1988b). Recently recognised as a full species, *Trachylepis depressa*, with 5–7 keels per dorsal scale being diagnostic (Branch 1998; Broadley 2000). The identities of older records of *T. homalocephala* should be confirmed in light of this change.

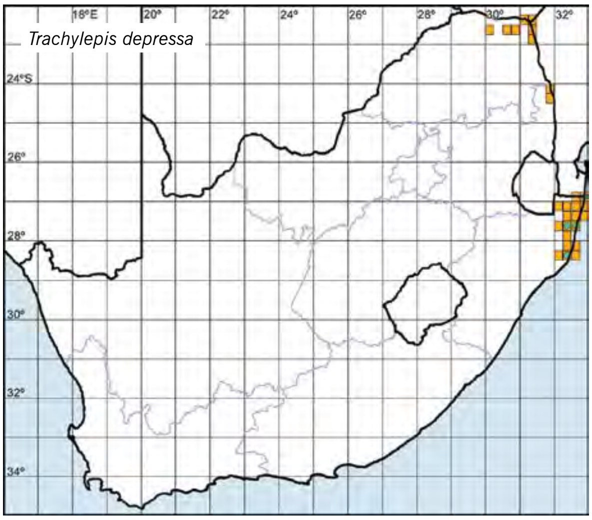
Distribution: Endemic to southern Africa. Found in Mozambique, south of the Zambezi, southeastern Zimbabwe and the eastern edge of South Africa (Branch 1998; Broadley 2000). Within the *Atlas* region it is found in the northeastern parts of KwaZulu-Natal, Mpumalanga and Limpopo provinces.

Habitat: A terrestrial species found on sandy soils in coastal scrub and in moist habitats fringing the Limpopo River (Branch 1998), at altitudes below 700 m.

Bioregion: Indian Ocean Coastal Belt; Lowveld; Zonal and Intrazonal Forests; Mopane; Seashore Vegetation; Central Bushveld.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Trachylepis depressa—Cape Vidal, KZN G.J. Alexander

Trachylepis homalocephala (Wiegmann, 1828)

RED-SIDED SKINK

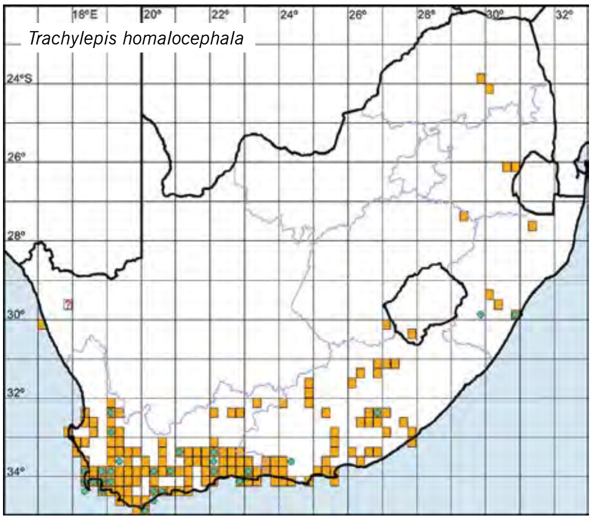
Gavin Masterson

Global: Least Concern

Endemic

Taxonomy: Previously recognised subspecies (*smithi* and *peringueyi*) were treated as junior synonyms of *Mabuya* (= *Trachylepis*) *homalocephala* by Branch (1998), who also elevated *T. depressa* to species status (see also Broadley 2000). The distribution of this species is quite fragmented, with several apparently isolated populations (e.g. Namaqualand; eastern escarpment). Sequence data for the Namaqualand population, referable to *T. h. peringueyi*, indicate that taxonomic revision is required (B. Maritz *et al.* in prep.). Jacobsen (1989) reported morphological differences between the escarpment populations of Mpumalanga/Limpopo and those in KwaZulu-Natal, but viewed this as a clinal phenomenon. Sequence data from these populations might indicate otherwise. The specific epithet

Trachylepis homalocephala—Koeberg NR, WC M. Burger



'homalocephala' is a recent spelling of the original 'homolocephalus' by Wiegmann (1828), but is maintained under Article 33.3.1 of the International Code of Zoological Nomenclature (Bauer 2000; Broadley 2000).

Distribution: Endemic to the *Atlas* region. Found in the Western and Eastern Cape provinces and KwaZulu-Natal, with isolated populations in southern Lesotho, eastern Free State, eastern escarpment in Mpumalanga and Limpopo, and in Namaqualand (De Waal 1978; Jacobsen 1989; Branch 1998; Broadley 2000).

Habitat: A terrestrial species found in moist sandy habitats usually fringing rivers and wetlands (Broadley 2000). Occurs mainly in lowlands and on lower mountain slopes, but occasionally on escarpments, at elevations of up to 1 500 m (Jacobsen 1989; Branch 1998).

Biome: Fynbos; Albany Thicket; Grassland; Succulent Karoo; Forests; Nama-Karoo; Savanna; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Trachylepis homalocephala, male—Port Elizabeth, EC W.R. Branch

Trachylepis margaritifer (Peters, 1854)

RAINBOW SKINK

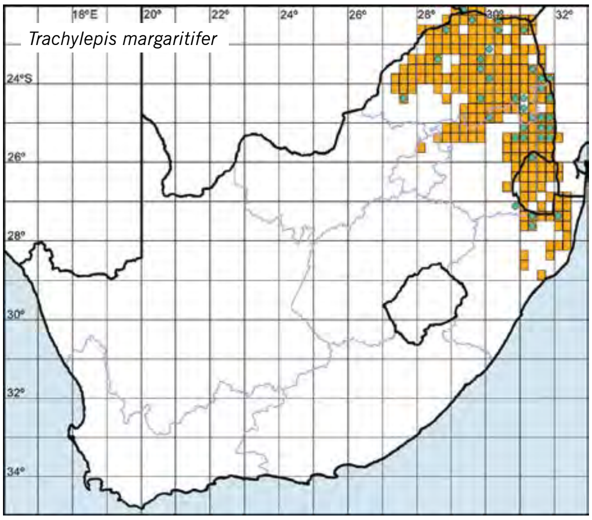
Gavin Masterson

Regional: Least Concern

Taxonomy: Broadley & Bauer's (1999) revision of the *Trachylepis quinquetaeniata* group in East Africa led to the re-instatement of *T. margaritifer* as a full species. The specific ending was incorrectly amended (as *T. margaritifera*) but subsequently corrected by Broadley (2001b). *Trachylepis margaritifer* differs consistently from *T. quinquetaeniata* with regard to colouration of juveniles and females, and it has higher midbody scale counts; the two taxa have also been found in sympatry in southeastern Kenya (Broadley & Bauer 1999).

Distribution: Endemic to Africa. Found in Kenya, Tanzania, southeastern Zambia, Malawi, Zimbabwe, Mozambique, Swaziland and northeastern South Africa (Broadley & Bauer 1999; Broadley 2000). In South Africa it occurs in northern KwaZulu-Natal, northern and eastern Mpumalanga, Limpopo and the northern parts of Gauteng.

Habitat: A rupicolous species that occurs in large colonies on rock outcrops or vertical structures such as houses and walls; occupies coastal scrub and mesic or arid savanna up to 1 500 m (Broadley & Bauer 1999; Broadley 2000).



Biome: Savanna; Grassland; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Trachylepis margaritifer, male—Greater Kuduland Safaris, E of Tshipise, LIMP M. Burger

Trachylepis margaritifer, female—N of Ingwavuma, Lebombo Mtns, KZN W.R. Branch

Trachylepis occidentalis (Peters, 1867)

WESTERN THREE-STRIPED SKINK

Gavin Masterson

Regional: Least Concern

Taxonomy: No notable issues.

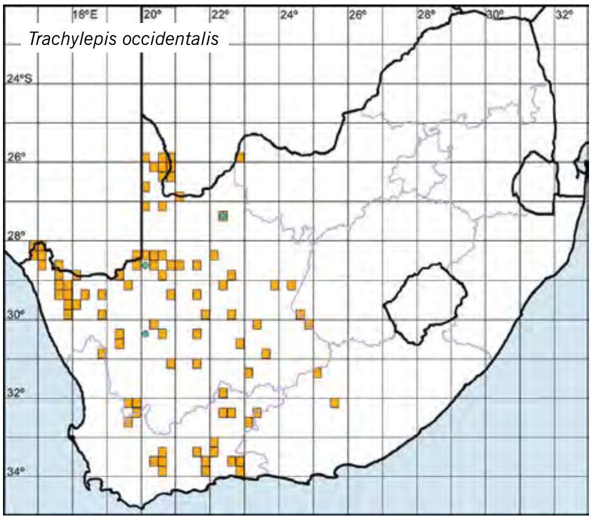
Distribution: Endemic to Africa. Found in western South Africa, Botswana, Namibia and southern Angola (Broadley 2000). Within the *Atlas* region it is found in the Northern and Western Cape provinces, adjacent parts of the Eastern Cape, and southwestern Free State.

Habitat: A terrestrial species found in arid scrub and karroid veld, from the coast to altitudes of 900 m in Namaqualand; uses tree clumps and bushes for refuge (Branch 1998; Broadley 2000).

Biome: Nama-Karoo; Savanna; Succulent Karoo; Fynbos; Desert.

Assessment rationale: Widespread, occurring in areas with low human density, and found in several protected areas in South Africa.

Conservation measures: None recommended.



Trachylepis occidentalis—S of Solitaire, Namibia W.R. Branch

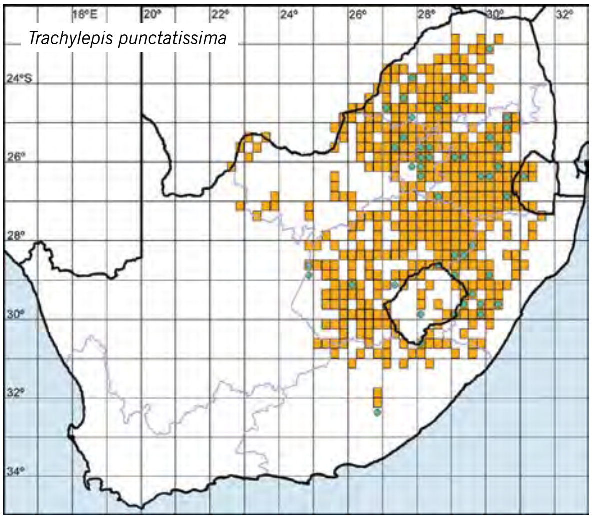
Trachylepis punctatissima (A. Smith, 1849)

SPECKLED ROCK SKINK; MONTANE SPECKLED SKINK

Gavin Masterson

Regional: Least Concern

Taxonomy: Elevated to species status by Broadley (2000), but intergrades between *Trachylepis punctatissima*, *T. striata* and *T. wahlbergii* have been reported from some parts of Botswana and Gauteng. Broadley (2000) recommended that the identity of these specimens be investigated to resolve the specific status of what were previously subspecies of *T. striata*. Older specimen records of the *T. striata* complex should be checked using the key in Broadley (2000).



Trachylepis punctatissima—Kempton Park, GP W.R. Schmidt

Distribution: Endemic to the southern half of Africa. Found in South Africa and Botswana, with isolated populations in eastern Zimbabwe and parts of Malawi; replaced in southern Malawi by *T. mlanjensis* (Broadley 2000). Within the *Atlas* region it is found in the northern half of the Eastern Cape, KwaZulu-Natal (excluding eastern and coastal areas), Lesotho, Free State, North-West Province, Gauteng, Mpumalanga, Limpopo and peripheral areas in the Northern Cape. The southernmost locality (3226BD) is a Virtual Museum record.

Habitat: Rupicolous and/or semi-arboreal, found on rock outcrops, trees and houses, predominantly along the escarpment and on the Highveld. It occurs from the KwaZulu-Natal Midlands (610 m) to elevations of 2 600 m on the Drakensberg escarpment (Branch 1998; Broadley 2000; Bourquin 2004).

Biome: Grassland; Savanna.

Assessment rationale: Widespread and abundant, occurring in numerous protected areas. Commensal with humans in urban habitat.

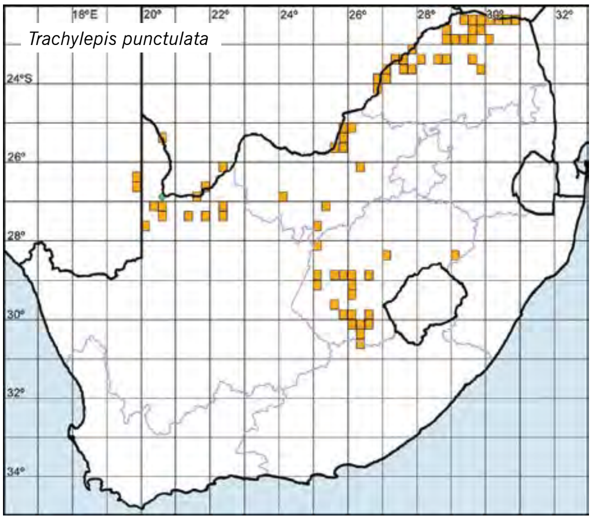
Conservation measures: None recommended.

Trachylepis punctatissima—De Berg Pass, MPM W.R. Branch

Trachylepis punctulata (Bocage, 1872)

SPECKLED SAND SKINK

Gavin Masterson



Regional: Least Concern

Taxonomy: *Trachylepis variegata punctulata* was assigned specific status by Broadley (2000) based on consistent morphological differences (keeling of dorsal scales and colour pattern) between it and the nominate form. The specific distinctiveness of this taxon was verified by Portik (2009) using molecular data. A subsequent molecular study by Portik & Bauer (2012) conservatively recognised *T. variegata* and *T. punctulata* as distinct species. The presence of two distinct lineages that conform to the described morphology of *T. punctulata* precluded confirmation of a sister taxon relationship between *T. variegata* and *T. punctulata*. Their study indicated that one of these lineages is distributed from northwestern Namibia to the Northern Cape, and the other lineage occurs in Zimbabwe and Limpopo Province. The type locality for this species is southwestern Angola and, although untested, is likely part of the Namibian lineage. As such, the lineage occurring in Zimbabwe and Limpopo Province may require a different name. Additional sampling is required to determine the extent of each lineage, particularly in Botswana and eastern Namibia, and it is unclear if and where the two lineages of *T. punctulata* come into contact.

Distribution: Endemic to the southern half of Africa. Found in Zambia, northwestern Zimbabwe, south of the Save River in Mozambique, southwestern Angola, Namibia, Botswana and South Africa (Branch 1998; Broadley 2000). Within the *Atlas* region it is found in northern Limpopo, North-West Province, the upper Northern Cape, and Free State. The distribution appears to overlap with that of *T. variegata* (e.g. 2722AD, 2825AA) but this may be due to incorrect identifications and requires further investigation.

Trachylepis punctulata—Leba Pass, SW Angola W.R. Branch

Habitat: A terrestrial species found in arid regions (less than 500 mm rainfall per annum), mainly on deep, sandy soils and occasionally on rocky outcrops (Branch 1998; Broadley 2000), at elevations as high as 1 300 m.

Biome: Grassland; Savanna; Nama-Karoo.

Assessment rationale: Widespread, common and not threatened.

Conservation measures: None recommended.

Trachylepis sparsa (Mertens, 1954)

KARASBURG TREE SKINK

Gavin Masterson

Regional: Least Concern

Taxonomy: Elevated to specific status by Broadley (2000), who found no evidence of intergrades between it and *Trachylepis striata*, *T. punctatissima* and *T. wahlbergii*. The status of old specimen records for the *T. striata* complex should be confirmed using the key in Broadley (2000).

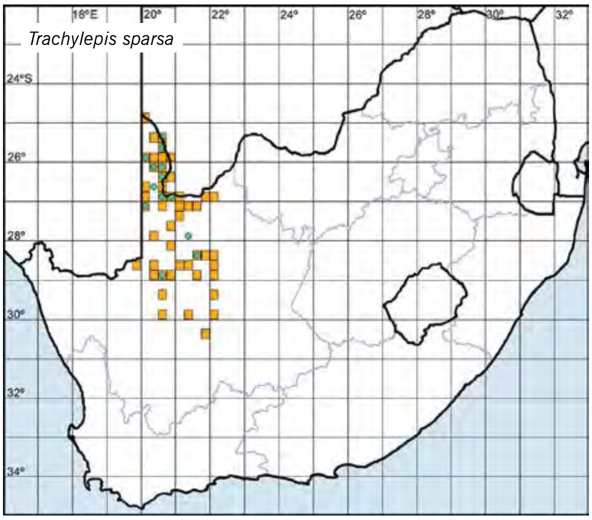
Distribution: Endemic to southern Africa. Found in southern Namibia and northwestern South Africa, just entering southwestern Botswana (Broadley 2000). Within the *Atlas* region it is found in the central and northern parts of the Northern Cape in a pattern that appears to track the Hartebees River Basin.

Habitat: A semi-arboreal species usually found on large trees in dry watercourses, but also found in Sociable Weaver (*Philetairus socius*) nests and on rock piles, in arid savanna and karroid veld (Broadley 2000), at altitudes of 300–1 000 m.

Bioregion: Kalahari Duneveld; Bushmanland; Inland Saline Vegetation; Eastern Kalahari Bushveld; Alluvial Vegetation.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Trachylepis sparsa—Askham, NC J. Marais

Trachylepis spilogaster (Peters, 1882)

KALAHARI TREE SKINK

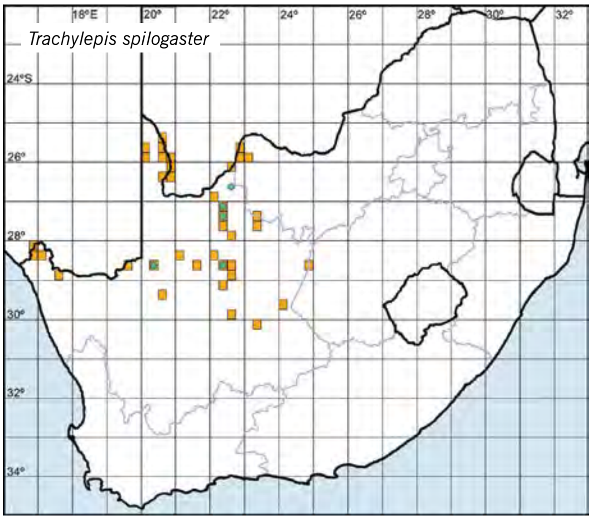
Gavin Masterson

Regional: Least Concern

Taxonomy: No notable issues.

Distribution: Endemic to South Africa, Namibia and Angola (Branch 1998; Broadley 2000). Within the *Atlas* region it occurs in the Northern Cape and extreme western North-West Province, along the Orange, Kuruman and Hartebees rivers and in surrounding habitat (Branch 1998; Broadley 2000). SARCA surveys recorded the southernmost distribution limits for the species in the Copperton (2922DC) and Omdraaisvlei (3023AB) regions.

Trachylepis spilogaster—Kamanjab, Namibia W.R.Branch



Habitat: An arboreal species found on trees and other vertical structures, even in close proximity to human habitation (Bauer *et al.* 1993). Often found along dry river courses in arid savanna, up to altitudes of 1 000 m, and occasionally in sympatry with the Karasburg Tree Skink, *T. sparsa* (Broadley 2000).

Bioregion: Eastern Kalahari Bushveld; Bushmanland; Kalahari Duneveld; Upper Karoo; Inland Saline Vegetation; Gariep Desert; Richtersveld; Alluvial Vegetation.

Assessment rationale: Widespread, occurring in areas of low human density where threats are at a minimum.

Conservation measures: None recommended.

Trachylepis striata (Peters, 1844)

STRIPED SKINK; EASTERN STRIPED SKINK

Gavin Masterson

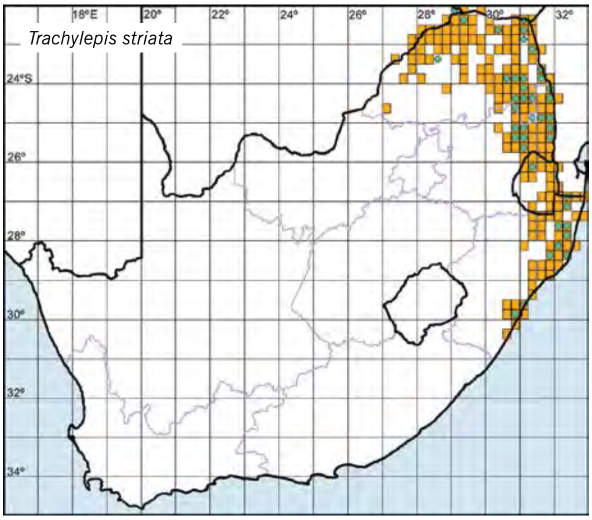
Regional: Least Concern

Taxonomy: Binomials are applicable following Broadley's (2000) elevation of *Trachylepis striata punctatissima*, *T. s. wahlbergii* and *T. s. sparsa* to species status. However, some confusion still exists regarding the status of these three taxa, as intergrades have been reported from some parts of their overlapping ranges. Molecular data suggest that the two most widespread members of the *T. striata* species complex, i.e. *T. striata* and *T. wahlbergii*, may not be reciprocally monophyletic (Castiglia *et al.* 2006). The entire complex requires re-examination at the phylogeographic scale. Older specimen records of the *T. striata* complex need to be confirmed using the key provided in Broadley (2000).

Distribution: Endemic to Africa. Found in South Sudan, Ethiopia, eastern Democratic Republic of Congo, Malawi, Zambia, Mozambique, Zimbabwe, eastern South Africa and Swaziland (Branch 1998; Broadley 2000). Within the *Atlas* region it is found in the eastern lowlands of KwaZulu-Natal, Swaziland (excluding Highveld), eastern Mpumalanga and Limpopo.

Habitat: Rupicolous or arboreal. Found on trees and other vertical structures such as huts and houses, in savanna woodland, from coastal plains and mangroves to low mountain slopes along the eastern escarpment of South Africa, up to 1 000 m (Jacobsen 1989; Broadley 2000; Bourquin 2004).

Trachylepis striata—Cleveland NR, S of Phalaborwa, LIMP M. Burger



Biome: Savanna; Grassland; Indian Ocean Coastal Belt.

Assessment rationale: Widespread, common and commensal with humans (Broadley 2000).

Conservation measures: None recommended.

Trachylepis striata—St Lucia, KZN W.R. Schmidt

Trachylepis sulcata sulcata Peters, 1867

WESTERN ROCK SKINK

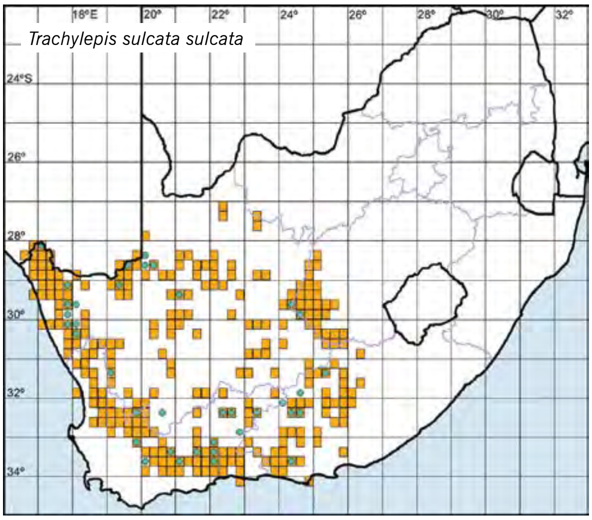
Gavin Masterson

Regional: Least Concern

Taxonomy: Three poorly defined subspecies of *Trachylepis sulcata* have been recognised, namely *T. s. sulcata*, *T. s. ansorgii* and *T. s. nigra* (Bauer *et al.* 1993; Branch 1998). In a morphology-based review of the African members of the genus *Mabuya* (= *Trachylepis*) by Broadley (2000), the taxonomic status of the subspecies of *T. sulcata* was not assessed (D.G. Broadley pers. comm.). In a recent molecular study, *T. s. nigra*—from Lüderitz, Namibia—was found to be merely a melanistic form which is not genetically distinct from the nominate subspecies (Portik *et al.* 2010, 2011). *Trachylepis s. ansorgi* occurs in Angola and possibly northern Namibia (Bauer *et al.* 1993; Portik 2009), but its status is uncertain.

Distribution: Endemic to Namibia and the western and central parts of South Africa (Broadley 2000). Within the *Atlas* region it is found in the Northern, Western and (western) Eastern Cape provinces, and southwestern Free State.

Habitat: A rupicolous skink found in groups on rock outcrops in arid savanna, karroid veld and desert (Branch 1998; Broadley 2000), from sea level to 1 000 m.



Biome: Succulent Karoo; Nama-Karoo; Fynbos; Grassland; Savanna; Desert.

Assessment rationale: Widespread and abundant.

Conservation measures: None recommended.

Trachylepis sulcata sulcata, male—Sperrgebiet, Nambia J. Marais

Trachylepis sulcata sulcata, female—Springbok, NC J. Marais

Trachylepis varia (Peters, 1867)

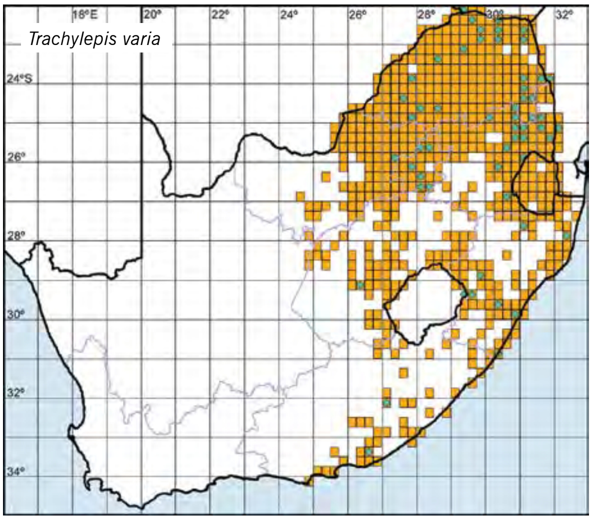
VARIABLE SKINK

Gavin Masterson

Regional: Least Concern

Taxonomy: There appear to be several cryptic species within the taxon currently known as *Trachylepis varia* (A.M. Bauer pers. comm.). Loveridge (1953) described *T. v. nyikae* from Malawi, but Broadley (2000) did not find support for this taxon. Jacobsen (1989) reported on specimens that he referred to as '*Mabuya* sp. nov. aff. *lacertiformis* (Peters)' and described as intermediate between *T. varia* and *T. lacertiformis*, based on lepidosis and colouration. He provided notes and a distribution map based on the 181 specimens of this form. However, the identity of these specimens remains unresolved and they are excluded from this assessment.

Distribution: Endemic to Africa. Found in Sudan, South Sudan, Somalia, throughout East Africa, Zambia, Democratic Republic of Congo, Mozambique, Zimbabwe,



Botswana, Namibia and eastern South Africa (Broadley 2000). Within the *Atlas* region it is found in the Eastern Cape, northeastern Northern Cape, Free State, North-West Province, Gauteng, Limpopo, Mpumalanga, KwaZulu-Natal, Swaziland and western Lesotho (Jacobsen 1989; Branch 1998; Broadley 2000).

Habitat: A terrestrial species commonly found in open, rocky habitat in coastal scrub, montane grassland and savanna, from sea level to 1 900 m, in areas with arid or wet climates (Jacobsen 1989; Branch 1998; Broadley 2000; Bourquin 2004).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Forests.

Assessment rationale: Widespread and abundant, occurring in several protected areas.

Conservation measures: Update this assessment once the unanswered taxonomic questions have been resolved.

Trachylepis varia—Cleveland NR, S of Phalaborwa, LIMP M. Burger

Trachylepis variegata (Peters, 1870)

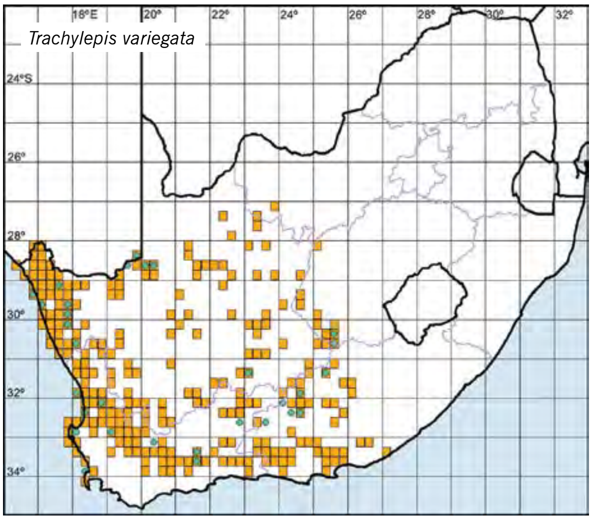
VARIEGATED SKINK

Gavin Masterson

Regional: Least Concern

Taxonomy: Broadley (2000) raised *Mabuya variegata punctulata* to species status on the basis of morphological differences between it and *M. v. variegata*. This is supported by molecular phylogenetic data (Portik 2009). *Trachylepis variegata* therefore reverts to binomials. A subsequent molecular study by Portik & Bauer (2012) showed that this species appears to be comprised of a single widespread lineage. However, additional sampling is needed, especially in south-central Namibia, to test whether the northwestern subclade is of any taxonomic significance.

Distribution: Endemic to southern Africa. Found in southern Angola, Namibia and the western half of South Africa (Branch 1998; Broadley 2000). Within the *Atlas* region it is found in the Northern, Western and Eastern Cape provinces, southwestern Free State, and peripherally in western North-West Province. The distribution appears to overlap with that of *T. punctulata* (e.g. at 2722AD, 2825AA), but this may be due to incorrect identifications and requires further investigation.



Habitat: A terrestrial species found in the dry western half of southern Africa, mainly in rocky areas but also in sandy gravel habitat (Broadley 2000).

Biome: Fynbos; Succulent Karoo; Nama-Karoo; Savanna; Grassland; Desert.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Trachylepis variegata—Augrabies, NC J. Marais

Trachylepis variegata—Farm Donkiedam, NW of Loeriesfontein, NC M. Burger

SUBFAMILY SCINCINAE

These mainly Old World skinks are characterised by divided frontal and nasal bones. They display great variation in body size and form, with numerous independent lineages developing a serpentine body and varying degrees of limb loss. The content and relationships of the subfamily remain problematic, with no support for the monophyly of the subfamilies Scincinae and Lygosominae (Whiting *et al.* 2003; Austin & Arnold 2006; Brandley *et al.* 2005). Around 30 genera are recognised, but their relationships are obscure (Whiting *et al.* 2004; Schmitz *et al.* 2004, 2005b). The scincines of sub-Saharan Africa form a well supported monophyletic group of 7–8 genera, which appears to be sister to a clade containing burrowing lizards of the genera *Typhlacontias*, *Melanoseps* and *Feylinia* (Whiting *et al*. 2003, 2004). Only a single genus, *Scelotes*, is represented in the *Atlas* region.

Genus *Scelotes* Fitzinger, 1826—dwarf burrowing skinks

There are reportedly 21–24 species in the genus *Scelotes* (Branch 1998; Bauer *et al.* 2003; Uetz 2012). However, confusion still exists in this regard because the monophyly of all species currently assigned to the genus has not been confirmed by phylogenetic analysis, and some have been assigned to other genera—e.g. *S. poensis* and *S. shebeni* have been referred to *Melanoseps* (Brygoo & Roux-Esteve 1982). The most recently described species are *S. montispectus* from the Western Cape (Bauer *et al.* 2003) and three species (*S. bourquini*, *S. fitzsimonsi*, *S. vestigifer*) from KwaZulu-Natal (Broadley 1994). *Scelotes* is largely restricted to southern Africa, with only one species found further north (*S. uluguruensis* in Tanzania). Eighteen species (one with two subspecies) occur in the *Atlas* region, but additional undescribed species may be present. These lizards are found primarily in coastal areas, although the ranges of several species extend inland, and the ranges of a few species (*S. capensis*, *S. bourquini*, *S. limpopoensis*, *S. mirus*) are situated entirely inland. *Scelotes* are small fossorial lizards with varying degrees of limb loss. They occur in leaf litter or in the subsurface of loamy and sandy soils. Females produce litters of 1–5 young (Branch 1998). Most species in the *Atlas* region are endemic and have restricted ranges. Four taxa were previously listed as Red Data species (Branch 1988a) but seven are currently considered to be of conservation concern: *S. guentheri* is regarded as being Extinct, *S. inornatus* is classified as Critically Endangered, *S. bourquini* is considered Vulnerable, and four taxa (*S. gronovii*, *S. kasneri*, *S. limpopoensis albiventris*, *S. montispectus*) are categorised as Near Threatened.

Scelotes anguineus (Boulenger, 1887)
ALGOA DWARF BURROWING SKINK

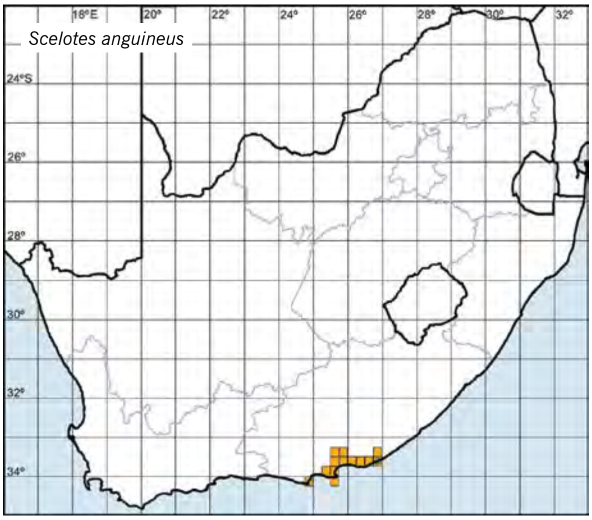
Johan Marais & Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to the Eastern Cape, South Africa. Largely restricted to the Algoa Bay region, from Cape St Francis (3424BB) in the west to Port Alfred (3326DB) in the east.



Scelotes anguineus—St Francis Bay, EC J. Marais

Scelotes anguineus—Port Elizabeth, EC W.R. Branch

Habitat: Inhabits coastal dunes and thickets (Branch & Braack 1987).

Bioregion: Albany Thicket; Estuarine Vegetation; Eastern Fynbos-Renosterveld; Alluvial Vegetation; Eastern Strandveld; Zonal and Intrazonal Forests; Seashore Vegetation.

Assessment rationale: Has a restricted range but is common (J. Marais pers. obs.) and not threatened.

Conservation measures: Conduct further research into population numbers, biology, ecology, threats and habitat status.

Scelotes arenicolus (Peters, 1854)

ZULULAND DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Least Concern

Taxonomy: The species was reviewed by Broadley (1994) and there are no outstanding issues.

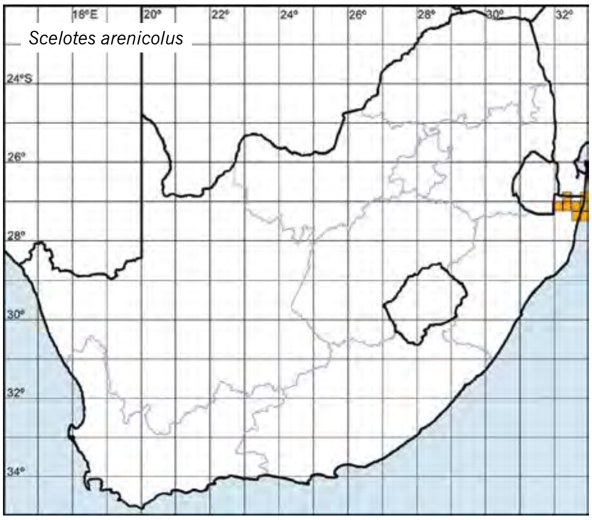
Distribution: A near-endemic occurring from Lake Sibaya in KwaZulu-Natal into southern Mozambique as far north as Inhambane (Broadley 1994). Records from St Lucia Village and Cape Vidal are doubtful and have been omitted from the map, following Broadley (1994) and Bourquin (2004).

Habitat: Inhabits vegetated coastal dunes and sandy coastal areas up to approximately 100 m elevation (Bourquin 2004).

Bioregion: Indian Ocean Coastal Belt; Lowveld; Zonal and Intrazonal Forests.

Assessment rationale: Has a restricted range but is fairly common and not threatened. Occurs in several protected areas such as Ndumo Game Reserve and iSimangaliso Wetland Park.

Conservation measures: None recommended.



Scelotes arenicolus—Kosi Bay, KZN J. Marais

Scelotes bidigittatus FitzSimons, 1930

LOWVELD DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

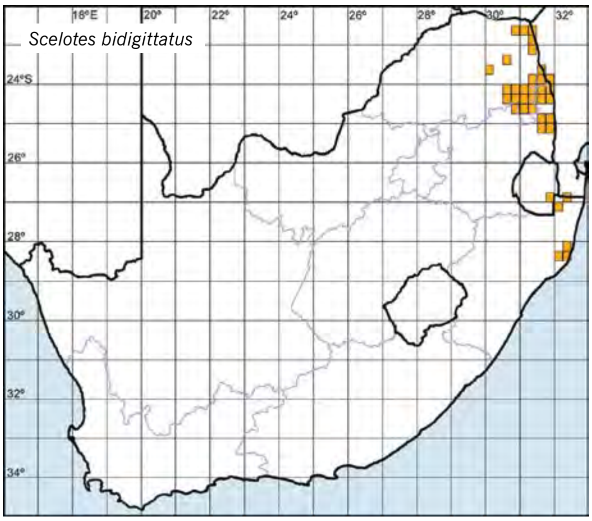
Global: Least Concern

Endemic

Taxonomy: This species was reviewed by Broadley (1994) and there are no outstanding issues.

Distribution: Endemic to the *Atlas* region. Found from St Lucia Village and Mtubatuba in KwaZulu-Natal, northwards into Swaziland and the eastern parts of Mpumalanga (including the Kruger National Park) and Limpopo. It is likely to occur in southern Mozambique but this has not been verified (Pienaar *et al.* 1983; Broadley 1994).

Habitat: Fossorial, occurring under debris in loose soil in Lowveld bush and savanna, from sea level to 1 100 m (Pienaar *et al.* 1983; Jacobsen 1989; Bourquin 2004).



Biome: Savanna; Forests; Indian Ocean Coastal Belt; Grassland.

Assessment rationale: Fairly widespread and common.

Conservation measures: None recommended.

Scelotes bidigittatus—Hoedspruit, LIMP J. Marais

Scelotes bipes (Linnaeus, 1766)

SILVERY DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: Branch (1998) treated *S. bipes sexlineatus* as a full species, rendering *S. bipes* monotypic. A molecular analysis by Heideman *et al*. (2011) confirmed the specific distinctness of the two taxa.

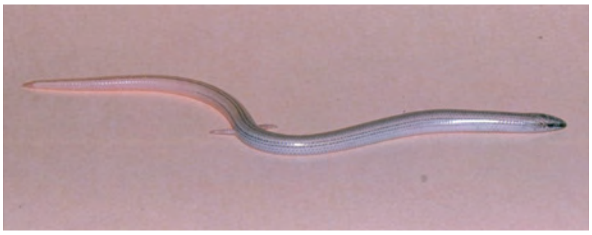
Distribution: A South African endemic that occurs in the Western Cape from Mossel Bay to near Saldanha Bay, and on Robben Island. There appear to be five distinct populations, with substantial gaps between some of them.

Habitat: Fossorial, occurring in areas of sandy soil (Branch 1998).

Bioregion: Southwest Fynbos; West Strandveld; South Coast Fynbos; West Coast Renosterveld; South Strandveld; Northwest Fynbos.

Assessment rationale: Has a fairly restricted range but is abundant and not threatened.

Conservation measures: None recommended.



Scelotes bipes—Cape Peninsula, WC A.L. de Villiers

Scelotes bipes—Koeberg NR, WC W.R. Branch

Scelotes bourquini Broadley, 1994

BOURQUIN'S DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Vulnerable B1ab(i,ii,iii,iv,v)

Endemic

Taxonomy: This species was incorrectly listed as *Scelotes guentheri* in the South African Red Data Book (Bourquin 1988).

Distribution: Endemic to KwaZulu-Natal, South Africa, where it is found in the Midlands between Howick and Nottingham Road.

EOO: 7 762 km^2 (confidence: medium); AOO: 3 771 km^2 (confidence: medium).

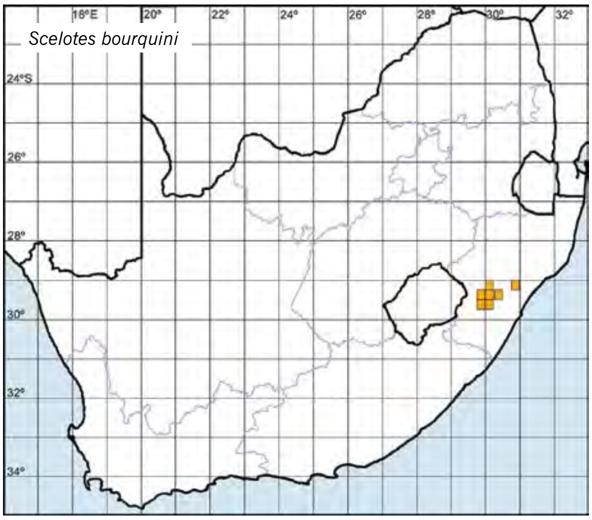
Habitat: Inhabits mesic areas in primary and secondary grasslands at elevations of 950–1 250 m (Bourquin 2004).

Vegetation type: Gs 9 Midlands Mistbelt Grassland.

Assessment rationale: EOO is below the Vulnerable threshold. The range is severely fragmented [B1a] and there is continuing decline in EOO and AOO [B1b(i,ii)] and area, extent and quality of habitat [B1b(iii)] due to urban development and agriculture (Bourquin 1988). There is probably an associated decline in number of locations/subpopulations [B1b(iv)] and mature individuals [B1b(v)].

Threats: Habitat is threatened by urban development, plantations of alien species, and habitat-destructive agricultural practices (Bourquin 1988). This species also has a restricted range and limited dispersal abilities.

Conservation measures: *Scelotes bourquini* is poorly represented in protected areas and there is severe habitat loss in the KwaZulu-Natal Midlands. Conduct further research into its distribution and natural history, and assess the extent of habitat destruction.



Scelotes bourquini—Nottingham Road, KZN J. Marais

Scelotes caffer (Peters, 1861)

CAPE DWARF BURROWING SKINK

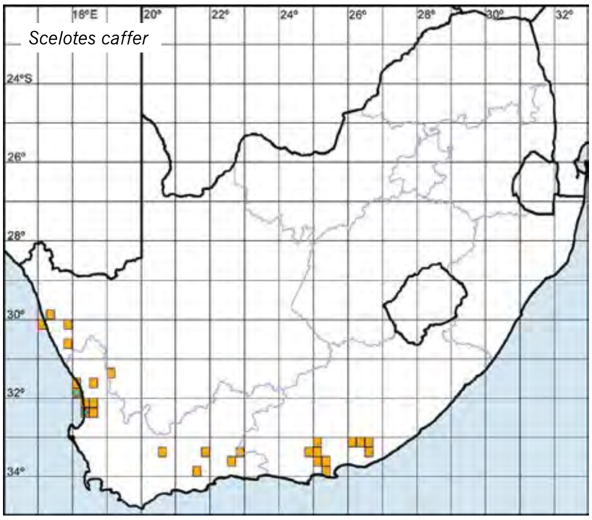
Johan Marais & Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: The highly disjunct distribution and significant morphological variation in this species suggest that more than one species is subsumed under this name. Further investigation of interpopulational variation is therefore necessary (Branch 1990a; Branch & Bauer 1995).

Scelotes caffer—Eland's Bay area, WC A.L. de Villiers



Distribution: Endemic to South Africa. Found in the western parts of the Northern Cape, Western Cape, and southern parts of the Eastern Cape. There are scattered populations near Grahamstown, in the Little Karoo, on the West Coast at Elandsberg, at Brandberg in Little Namaqualand, and near Calvinia in the western Karoo.

Habitat: Found under stones and amongst dead plants in the east, and usually under litter in flat sandy areas on the West Coast (Branch & Bauer 1995; Branch 1998).

Biome: Albany Thicket; Fynbos; Succulent Karoo.

Assessment rationale: Widespread and fairly common.

Conservation measures: None recommended.

Scelotes capensis A. Smith, 1849

WESTERN DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Least Concern

Taxonomy: No notable issues.

Distribution: Endemic to Namibia and the Northern Cape, South Africa. Found from southern and central Namibia to Lekkersing in the southern Richtersveld (Branch 1994a; Bauer & Branch 2003 [2001]; Griffin 2003).

Habitat: Inhabits mesic microhabitats on vegetated rocky slopes in succulent veld, and rocky areas in the southern Namib Desert (Berger-Dell'mour 1987; Branch 1994a; Bauer & Branch 2003 [2001]). Usually occurs on slopes at elevations up to 1 000 m.

Bioregion: Richtersveld; Gariep Desert; Southern Namib Desert.

Assessment rationale: Has a restricted range within the *Atlas* region but is abundant and not threatened.

Conservation measures: None recommended.

Scelotes capensis—Numees Mine, Richtersveld NP, NC W.R. Branch

Scelotes fitzsimonsi Broadley, 1994

FITZSIMONS' DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Least Concern

Endemic

Taxonomy: Specimens from Vernon Crookes Nature Reserve and Durban are probably incorrectly identified or represent undescribed species (Branch 1998).

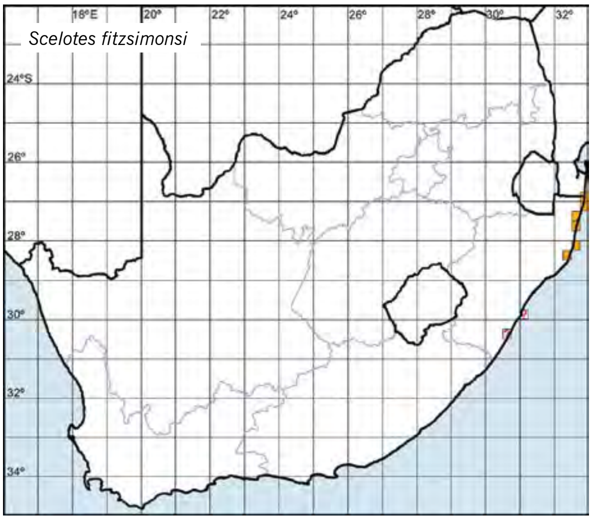
Distribution: Endemic to northeastern KwaZulu-Natal, South Africa. Found from the Mozambique border at Kosi Bay southwards to St Lucia Village. Specimens from Durban and Vernon Crookes Nature Reserve, marked as questionable on the map, were probably misidentified or may represent a new species.

Habitat: Occurs in sandy soil in, and adjacent to, coastal dune forest below 100 m (Bourquin 2004).

Bioregion: Zonal and Intrazonal Forests; Indian Ocean Coastal Belt.

Assessment rationale: Has a restricted range (EOO 6 750 km^2 [B1]) but is fairly common and not threatened. Most of its distribution falls within the protected iSimangaliso Wetland Park.

Conservation measures: Conduct research into population numbers, biology, ecology, habitat and potential threats.



Scelotes fitzsimonsi—St Lucia, KZN J. Marais

Scelotes gronovii (Daudin, 1802)

GRONOVI'S DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

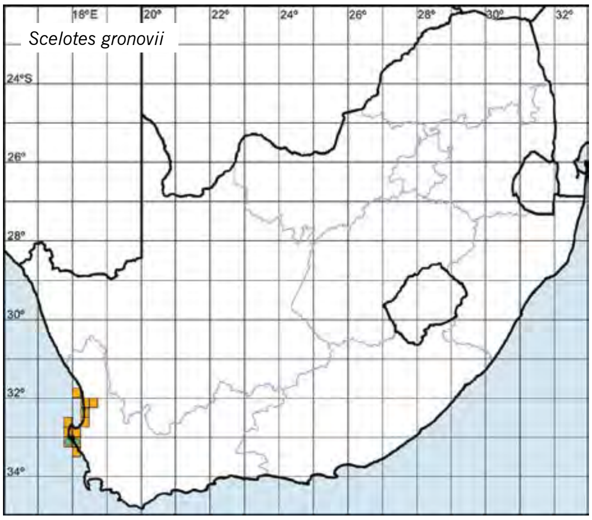
Global: Near Threatened

Endemic

Taxonomy: A molecular assessment by Heideman *et al.* (2011) determined that the population of *S. gronovii* at Elands Bay and the nearby Steenboksfontein Farm may represent a distinct species. The taxonomic status of these populations is under investigation (M.F. Bates in prep.).

Distribution: Endemic to the Western Cape, occurring from Doringbaai in the north to Robben Island in the south, and inland to Graafwater. Also occurs on Dassen Island (Branch 1998).

EOO: 11 250 km^2 (confidence: high); AOO: 5 940 km^2 (confidence: high).



Scelotes gronovii—Dassen Island, WC A.L. de Villiers

Habitat: Fossorial, inhabiting sparsely-vegetated coastal dunes and strandveld, chiefly at elevations below 100 m (Baard 1988a).

Bioregion: West Strandveld; Seashore Vegetation; Northwest Fynbos.

Assessment rationale: The EOO for this species is below the Vulnerable threshold [B1], and agricultural practices and human development continue to destroy suitable habitat [B1b(ii,iii)]. However, the distribution is not severely fragmented, the taxon occurs at more than 10 locations, and there is no evidence of severe fluctuations in population numbers. *Scelotes gronovii* is therefore considered Near Threatened.

Threats: Further research into potential threats is required. Development of the coastal zone for human settlement and recreation, as well as habitat destruction by off-road vehicles, agricultural practices, mining and human settlements, could pose threats in future (Baard 1988a).

Conservation measures: Conduct research into population numbers, biology, ecology, habitat status and potential threats. If the Elands Bay-Steenboksfontein population proves to be a distinct species, a separate assessment of this population and the other population further south will need to be conducted.

Scelotes guentheri Boulenger, 1887

GÜNTHER'S DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Extinct

Endemic

Taxonomy: There has been confusion regarding the identity of this species in the past. *Scelotes guentheri*, as discussed by Bourquin (1988), is the species now regarded as *S. bourquini* (Broadley 1994). Because *S. guentheri* is known from only a single specimen, its taxonomic status remains uncertain; however, most authors have considered it a valid species (e.g. FitzSimons 1943; Broadley 1994; Branch 1998).

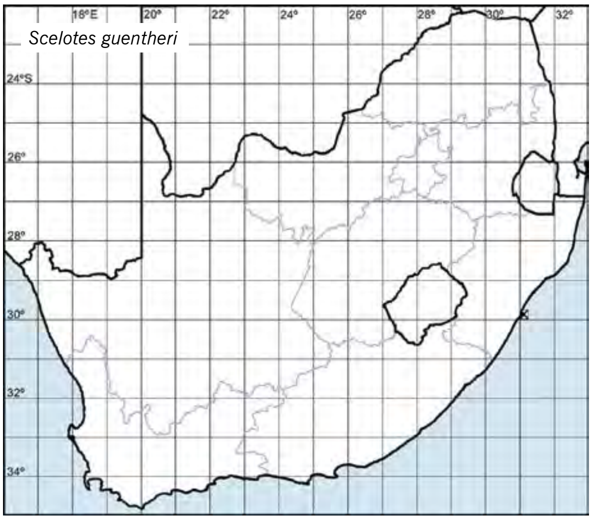
Distribution: Described by Boulenger in 1887 on the basis of a single specimen from 'Port Natal' somewhere near Durban. This species has not been found again in more than 125 years, despite recent intensive efforts. Extensive surveys in the greater Durban area failed to produce any specimens (J. Marais unpubl. data). These surveys included Marianhill, an area where the Reverend Henry Callaway may well have found the first and only specimen when travelling by ox-wagon from Pietermaritzburg.

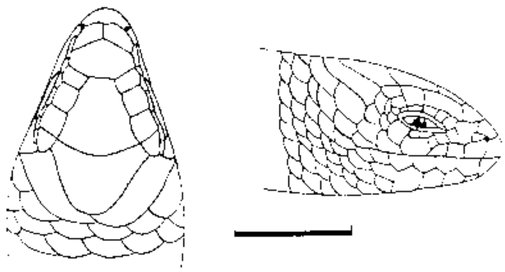
Habitat: Unknown.

Bioregion: Indian Ocean Coastal Belt. Locality description vague, therefore vegetation type unknown.

Assessment rationale: No specimens of this species have been found in over 120 years, despite directed searches near the type locality. There are also no known captive specimens, so the species' status as Extinct (see Broadley 1994) is now confirmed.

Threats: Apparently this species had limited dispersal capabilities and a restricted range. Conversion of habitat in the Durban area for agriculture and human settlement may have been a major cause of extinction (Bourquin 1988; Broadley 1994).





Scelotes guentheri—Durban, KZN, from Broadley 1994, after Boulenger 1887

Conservation measures: Not applicable as this species is deemed extinct.

Scelotes inornatus A. Smith, 1849

DURBAN DWARF BURROWING SKINK; SMITH'S DWARF BURROWING SKINK

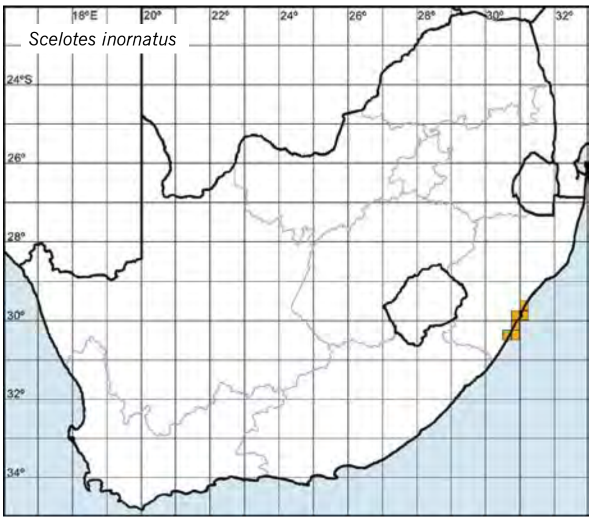
Johan Marais & Aaron M. Bauer

Global: Critically Endangered **B2ab(i,ii,iii,iv,v)**

Endemic

Taxonomy: This species was reviewed by Broadley (1994) and there are no outstanding issues.

Distribution: Endemic to South Africa and limited to the greater Durban area of KwaZulu-Natal, from the Durban beachfront (next to the old FitzSimons Snake Park) in the north to Scottburgh in the south, and as far inland as Woodlands/Montclair. The published localities (Broadley 1994) on the northern and southern banks of the Umgeni River (2931CC) are incorrect; no voucher specimens exist for these records and they probably represent *S. mossam-*



bicus. There are nevertheless several additional valid records of this species from that QDGC.

EOO: 142 km^2 (confidence: high); AOO: 4.7 km^2 (confidence: high).

Habitat: Found in Berea Red Sand associated with coastal forest below 70 m (Bourquin 2004) and within 4 km of the ocean.

Vegetation type: CB 3 KwaZulu-Natal Coastal Belt; FOz 7 Northern Coastal Forest.

Assessment rationale: EOO approaching, and AOO below, the Critically Endangered threshold. Severe fragmentation of range [B2a]. Development of roads, housing, industries and farmland has resulted in an observed and projected decline in EOO (apparently extirpated at Stamford Hill) [B2b(i)] and an observed and projected decline in AOO (e.g. Marlight Road) [B2b(ii)]. Such developments have also resulted in an observed and projected (and continuing) decline in the area, extent and quality of habitat [B2b(iii)], and a decrease in the number of subpopulations/locations [B2b(iv)] and mature individuals [B2b(v)].

Threats: Development of roads, housing, industries and farmland cause habitat destruction and severe fragmentation (J. Marais unpubl. data). Further fragmentation is projected.

Scelotes inornatus—Durban, KZN J. Marais

Conservation measures: It is likely that all localities at which this species occurs are known. Therefore, conduct a PHVA and establish a BMP-S to prevent further habitat destruction. Additionally, develop protective legislation and conduct further research into population numbers, biology, ecology, habitat quality and potential threats.

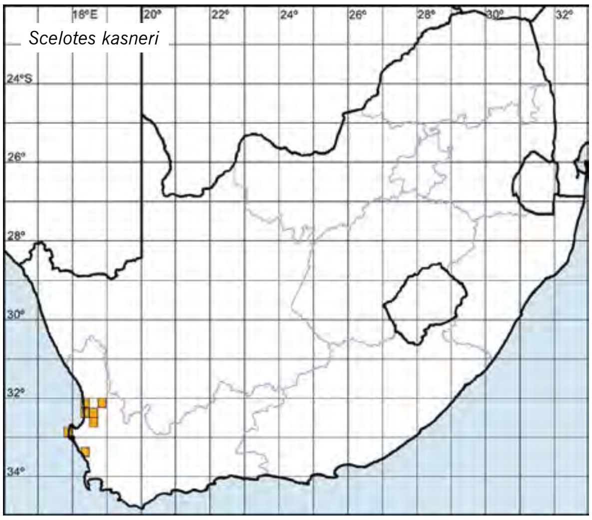
Scelotes kasneri FitzSimons, 1939

KASNER'S DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Near Threatened

Endemic



Taxonomy: Although there appears to be significant genetic divergence between this species and the morphologically similar *Scelotes montispectus* (Bauer *et al.* 2003), further investigation of species' boundaries in these taxa and related forms is required. A molecular assessment by Heideman *et al.* (2011) determined that the population of *S. kasneri* at Elands Bay may represent a distinct species. The taxonomic status of the latter population is under investigation (M.F. Bates in prep.).

Distribution: Endemic to the Western Cape, South Africa, occurring from Darling in the south to Lamberts Bay and Clanwilliam in the north.

EOO: 10 800 km^2 (confidence: high); AOO: 3 780 km^2 (confidence: medium).

Habitat: Occurs in coastal dunes, often under stones or other debris, or in association with the roots of plants, chiefly below 300 m (Baard 1988b).

Bioregion: Northwest Fynbos; West Strandveld; West Coast Renosterveld.

Assessment rationale: *Scelotes kasneri* meets the area requirements for Vulnerable under B1 (EOO <20 000 km^2), but fragmentation is moderate and there is no evidence to suggest extreme fluctuations in range or population numbers. Habitat destruction by urban development and agricultural practices could be problematic and the species is therefore regarded as Near Threatened.

Threats: Potential threats are related to developments and activities associated with mining, human settlement, agriculture and tourism, and include degradation of sand dune habitat and damage by off-road vehicles.

Scelotes kasneri—Clanwilliam, WC J. Marais

Conservation measures: Conduct further research into population numbers, biology, ecology and potential threats. If the Elands Bay population proves to be a separate species, a separate assessment of this population and the other population further north will need to be conducted.

Scelotes limpopoensis limpopoensis FitzSimons 1930

LIMPOPO DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Least Concern

Taxonomy: Two subspecies of *Scelotes limpopoensis* are currently recognised, namely *S. l. limpopoensis* and *S. l. albiventris*. Molecular phylogenetic investigations are needed to determine taxon boundaries and the taxonomic status of these two forms.

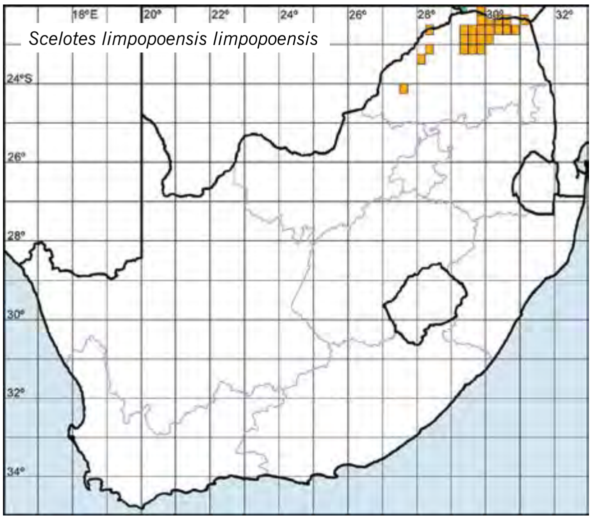
Distribution: A southern African endemic occurring in Limpopo, South Africa, from the northwestern Kruger National Park westwards to the foothills of the Soutpansberg and Waterberg, and northwards into adjacent Zimbabwe and Botswana (Jacobsen 1989; Branch 1998).

Habitat: A fossorial skink inhabiting aeolian sands in mesic savanna at altitudes of 300–1 100 m (Pienaar *et al.* 1983; Jacobsen 1987b, 1989).

Bioregion: Mopane; Central Bushveld; Lowveld; Zonal and Intrazonal Forests; Alluvial Vegetation.

Assessment rationale: Has a moderately restricted range but is fairly common and not threatened.

Conservation measures: None recommended.



Scelotes limpopoensis limpopoensis—Mapungubwe, LIMP J. Marais

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Scelotes limpopoensis albiventris Jacobsen, 1987

WHITE-BELLIED DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Near Threatened

Endemic

Taxonomy: Molecular phylogenetic investigations are required to evaluate the relationship between *S. l. limpopoensis* and *S. l. albiventris*.

Distribution: A South African endemic with an extremely limited range, from just west of the Blouberg Nature Reserve to Langjan Nature Reserve and vicinity, in the Soutpansberg district of Limpopo Province (Jacobsen 1987b).

EOO: 2 700 km^2 (confidence: high); AOO: 1 620 km^2 (confidence: medium).

Habitat: A fossorial skink, inhabiting deep aeolian sands in woodland at elevations of 800–1 050 m (Jacobsen 1987b, 1989; Branch & Jacobsen 1988b).

Vegetation type: SVcb 19 Limpopo Sweet Bushveld; SVmp 1 Musina Mopane Bushveld.

Assessment rationale: This taxon meets the area requirements for Endangered under B1 (EOO <5 000 km^2) and Vulnerable under B2 (AOO <2 000 km^2). There is a fair amount of agricultural activity within the area occupied, including irrigation for crops adjacent to available water, so a continued decline in area, extent and quality of habitat is inferred [B1b(iii), B2b(iii)]. However, there is no information on population size or trends, habitat fragmenta-

Scelotes limpopoensis albiventris— Malebogo NR, LIMP W.R. Branch tion is slight, and there is no observed decline in EOO or AOO. This skink is thus considered to be Near Threatened.

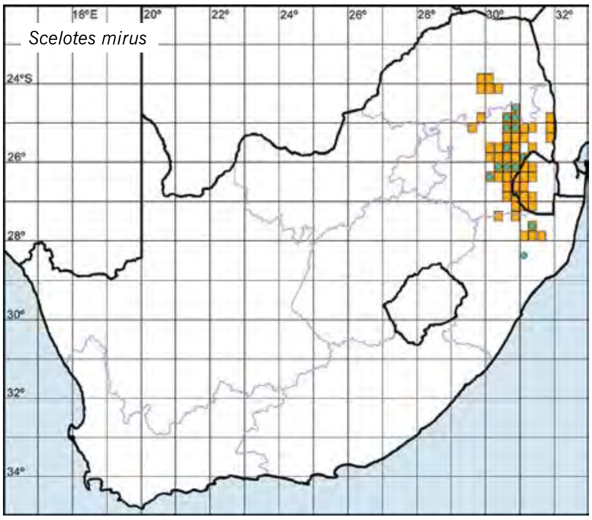
Threats: No serious extrinsic threats have been noted (Branch & Jacobsen 1988b) but the subspecies has limited dispersal abilities and a restricted range. A number of agricultural activities, including crop irrigation, take place within its range.

Conservation measures: Research should be conducted on taxonomy, population numbers, biology, ecology, habitat requirements and potential threats.

Scelotes mirus (Roux, 1907)

MONTANE DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer



Global: Least Concern

Endemic

Taxonomy: This species was reviewed by Broadley (1994) and there are no outstanding taxonomic issues.

Distribution: Endemic to the *Atlas* region, occurring from the northern half of KwaZulu-Natal northwards into Swaziland, Mpumalanga and southern Limpopo. It may also occur in southern Mozambique. The southernmost limit is based on a Virtual Museum record from near Babanango (2831AC).

Habitat: Inhabits rocky montane grasslands and scrub, at elevations of 800–2 000 m (Jacobsen 1989; Bourquin 2004).

Biome: Grassland; Savanna.

Assessment rationale: Fairly widespread and common.

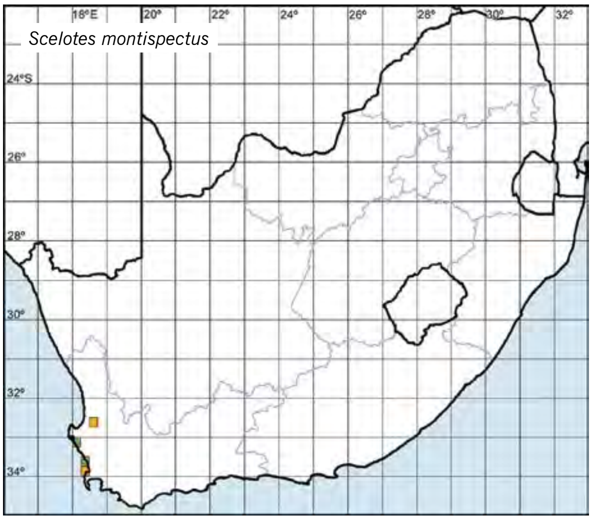
Conservation measures: None recommended.

Scelotes mirus—Barberton, MPM W.R. Schmidt

Scelotes montispectus Bauer, Whiting & Sadlier, 2003

BLOUBERGSTRAND DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer



Global: Near Threatened

Endemic

Taxonomy: Although Bauer *et al.* (2003) found a relatively large genetic divergence between *Scelotes montispectus* and the related *S. kasneri*, further investigations of the species' boundaries of these morphologically similar taxa are required. Heideman *et al.* (2011) recognised *S. montispectus* as distinct from *S. kasneri*, based on small morphological differences and geographical separation, but they did not find strong molecular support for this.

Distribution: Endemic to the Western Cape, South Africa, where it is known from Bloubergstrand, Blaauwberg Conservation Area, Koeberg Nature Reserve, Mamre Nature Reserve, Melkbosstrand, West Coast National Park, Langebaan and Tweekuilen.

EOO: 6 750 km^2 (confidence: high); AOO: 1 620 km^2 (confidence: medium).

Habitat: Inhabits sparsely-vegetated coastal dunes near sea level (Bauer *et al.* 2003).

Vegetation type: FS 6 Cape Flats Dune Strandveld.

Assessment rationale: This recently described species is known from only 10 specimens, most of which were collected during the course of the SARCA project. There is incomplete knowledge on distribution, habitat requirements, population size, population structure and threats. Most localities at which *S. montispectus* has been found are in protected areas. However, EOO and AOO fall below the Vulnerable thresholds [B1+2] and there are probably 6–10 locations [B1a, B2a]. There is also evidence of some habitat destruction within the range, but the extent and effects of this require more detailed evaluation. It seems most appropriate at this time to consider the species as Near Threatened.

Threats: Probably threatened by the transformation of coastal habitat for human habitation and recreation, and the use of off-road vehicles (Bauer *et al.* 2003). In addition, it has limited dispersal capabilities and a restricted range.

Conservation measures: Conduct more research into population numbers, biology, ecology, habitat quality and potential threats. Improve public awareness of the species. Draw up a BMP-S.

Scelotes montispectus—Koeberg, WC W.R. Branch

Scelotes montispectus—Koeberg NR, WC M. Burger

Scelotes mossambicus (Peters, 1882)

MOZAMBIQUE DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Least Concern

Near-endemic

Taxonomy: This species has been confused with *S. fitzsimonsi* (Broadley 1994) in the past. *Scelotes brevipes*, long regarded as a distinct species, was synonymised with *S. mossambicus* by Broadley (1994).

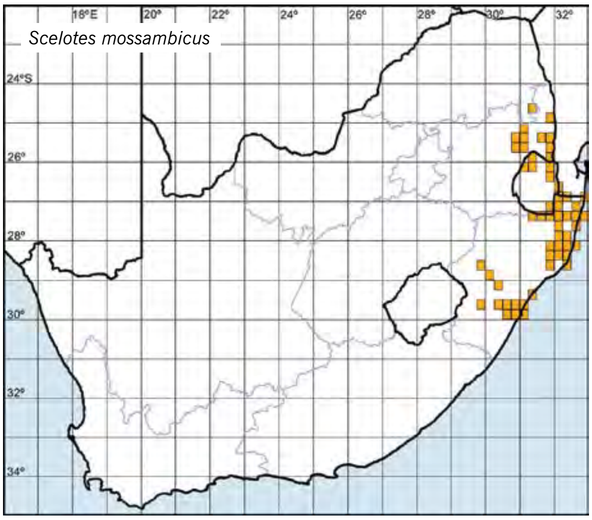
Distribution: A southern African endemic occurring from Durban in KwaZulu-Natal northwards into southern Mozambique (as far as Inhambane), Swaziland, northeastern Mpumalanga and peripherally in adjacent parts of Limpopo (Jacobsen 1989; Broadley 1994).

Habitat: Inhabits rocky grassland and alluvial sands from the coast to 1 300 m (Pienaar *et al.* 1983; Jacobsen 1989; Bourquin 2004). Some populations persist in disturbed areas (J. Marais unpubl. data).

Biome: Savanna; Indian Ocean Coastal Belt; Forests; Grassland.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Scelotes mossambicus—Mtubatuba, KZN J. Marais

Scelotes sexlineatus (Harlan, 1824)

STRIPED DWARF BURROWING SKINK

Johan Marais & Aaron M. Bauer

Global: Least Concern

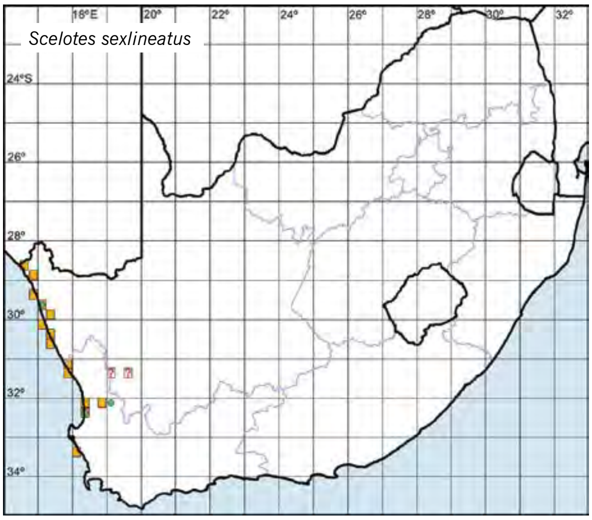
Endemic

Taxonomy: Previously considered a subspecies of *S. bipes* but treated as a full species by Branch (1998). A molecular analysis by Heideman *et al.* (2011) confirmed that *S. sexlineatus* is a distinct species.

Distribution: A South African endemic occurring along the West Coast from near Suurfontein (Western Cape) northwards to Alexander Bay (Northern Cape), with populations in the Clanwilliam, Calvinia and Nieuwoudtville areas. There is a possibility that this species may also occur in Namibia. Two old inland records are considered questionable as they are somewhat out-of-range and the specimen identifications require confirmation.

Habitat: Inhabits sandy soils in Succulent Karoo at elevations of 0–500 m (A.M. Bauer & J. Marais pers. obs.).

Biome: Succulent Karoo; Fynbos.



Assessment rationale: Fairly widespread and common.

Conservation measures: None recommended.

Scelotes sexlineatus—McDougall's Bay, S of Port Nolloth, NC J. Marais

Scelotes sexlineatus—McDougall's Bay, S of Port Nolloth, NC W.R. Branch

Scelotes vestigifer Broadley, 1994

COASTAL DWARF BURROWING SKINK

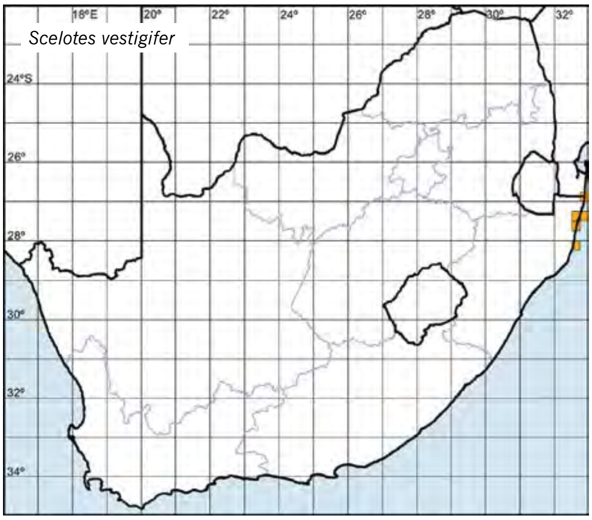
Johan Marais & Aaron M. Bauer

Global: Least Concern

Near-endemic

Taxonomy: The taxonomy of this species was reviewed by Broadley (1994).

Scelotes vestigifer—near Sodwana Bay, KZN J. Marais



Distribution: A southern African endemic that occurs along the KwaZulu-Natal coast from Cape Vidal northwards to Ponta do Ouro in southern Mozambique (Broadley 1994). A record from St Lucia Village is doubtful, could not be confirmed after detailed searches of the area (J. Marais unpubl. data), and is not plotted on the map.

Habitat: Found in sandy coastal dunes at elevations below 100 m (Bourquin 2004).

Vegetation type: FOz 7 Northern Coastal Forest; CB 1 Maputaland Coastal Belt.

Assessment rationale: Has a restricted range but is fairly common (J. Marais unpubl. obs.) and not threatened.

Conservation measures: Conduct research into population numbers, habitat, biology, ecology and threats.

Scelotes vestigifer—E shores, Lake St Lucia, KZN W.R. Branch

CHAPTER 15

Family Varanidae

William R. Branch & Graham J. Alexander

Varanidae is a small family of lizards that occurs through Africa and the Middle East, to India, Sri Lanka and China, extending down through Southeast Asia to Indonesia, the Philippines, New Guinea, Australia, and western Melanesia and Micronesia. Its range also includes many islands in the South China Sea and eastern Indian Ocean (but not Madagascar and adjacent islands). All living monitor lizards (73 species; Uetz 2012) are placed in the genus *Varanus,* with nine subgenera recognised. Four of the five African species, and *V. yemensis* from the Arabian Peninsula, are placed in the subgenus *Polydaedalus*, with the Desert Monitor (*V. griseus*) on its own in the subgenus *Psammosaurus* (King *et al.* 1991; Green & King 1993; Böhme 2003). Despite this group reaching its greatest diversity in Australasia, the earliest *Varanus* fossils were found in late Eocene and early Oligocene freshwater deposits in Egypt, indicating that the genus arose in Africa before dispersing to Australia and Asia (Holmes *et al.* 2010).

Varanids include the world's largest lizards. The Asian water monitor (*V. salvator*) grows to 3.21 m in length but reaches a maximum weight of only 25 kg. The Komodo Dragon (*V. komodoensis*) is fractionally shorter but much heavier; the largest verified wild specimen attained 3.13 m in length and weighed about 166 kg (Ciofi 1999). Even larger fossil species are known. *Varanus priscus* (also known as *Megalania prisca*) was a very large Australian species that became extinct 40 000 years BP, soon after modern humans entered that continent (Molnar 2004; Pianka *et al.* 2004). It has been calculated that large specimens may have reached over 7 m in length and weighed 1 940 kg (Molnar 2004).

Although varying greatly in adult size (from 120 mm to over 3 m), monitors are similar in appearance, having well-developed limbs and strong claws; a long tail that is usually laterally compressed and cannot be shed or regenerated; a long and flexible neck; small, polygonal, non-overlapping, bead-like scales that lack osteoderms; a single pair of pre-anal pores; and a long, smooth, retractile tongue similar to that of snakes.

Monitor lizards live in a wide variety of habitats, ranging from mangrove swamps and dense forests to savannas and arid deserts. Several species are semi-aquatic and many of these regularly undertake sea crossings. All except two fruit-eating Asian species (*V. prasinus* and *V. olivaceus*) are predatory, swallowing prey whole or first tearing it to bits with their strong claws. Small species eat insects while larger species take any prey that they can overcome. The Rock Monitor (*V. albigularis*) regularly consumes tortoises (Branch 2006a), while the Komodo Dragon has been reported eating monkeys, wild boar, goats, deer, horses and water buffalo (Auffenberg 1981). Human fatalities following attacks by Komodo Dragons are known (http://en.wikipedia.org/wiki/Komodo_dragon) and it has even been suggested that this species evolved to prey on pygmy elephants (Diamond 1987).

Recent studies have shown that some *Varanus*, such as the Komodo Dragon and Lace Monitor (*V. varius*), possess venom glands along their jawline and venom toxins in their saliva (Fry *et al.* 2006). It has been suggested that other varanids, including *V. priscus*, are likely to also have possessed similar glands. If this were true, it would make the latter species the largest venomous vertebrate ever known (Fry *et al.* 2009). The ecological function of venom in *Varanus* has been reviewed by Arbuckle (2009). The presence and significance of such venoms in smaller species, including those from Africa, remain unknown.

All varanids are oviparous, laying 7–37 large soft-shelled eggs in holes or termite nests (Cowles 1930). A form of parthenogenesis has been recorded in captive Komodo Dragons (Watts *et al.* 2006). Males of some species engage in ritualised wrestling contests to determine dominance and lay claim to territories.

Large numbers of Water Monitors (*V. niloticus*) are harvested for their meat and skins in the Lake Chad basin of West Africa (De Buffrénil & Hémery 2007), and although some species such as the Komodo Dragon are considered Vulnerable, neither of the two taxa (*V. albigularis albigularis*, *V. niloticus*) in the *Atlas* region is of conservation concern.

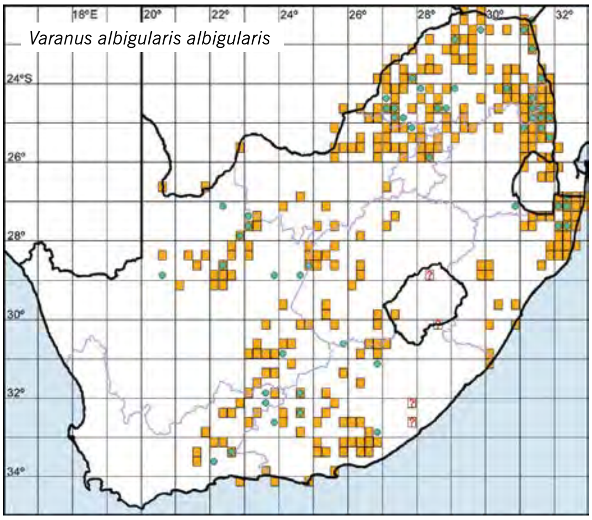
Genus *Varanus* Merrem, 1820—monitor lizards

The genus *Varanus* contains 73 species (Uetz 2012), of which only five occur in Africa (Bayless 2002), with an additional species (*V. yemenensis*) on the Arabian Peninsula (see Portik & Papenfuss 2012). Two species enter the *Atlas* region: *V. niloticus* is largely aquatic, whereas *V. albigularis* is terrestrial and often found on rocky hillsides. Female *V. a. albigularis* produce 8–51 eggs per clutch, deposited in a self-excavated hole in the ground which is then covered up, while *V. niloticus* females lay 20–60 eggs in a hole that they dig into a termite mound and which is subsequently closed up by the worker termites (Branch 1998). Both monitor species are more common in the eastern parts of the subcontinent. The two taxa in the *Atlas* region are widespread, abundant and not threatened.

Varanus albigularis albigularis (Daudin, 1802)

SOUTHERN ROCK MONITOR; ROCK MONITOR; WHITE-THROATED MONITOR

Graham J. Alexander



Regional: Least Concern

Taxonomy: A phylogeographic study throughout its range would be informative. Although Broadley & Howell (1991) rejected all subspecies of *A. albigularis*, trinomials are now required as Broadley & Cotterill (2004) revived *V. a. angolensis* for monitors from northern Angola and adjacent Zambia and the Democratic Republic of Congo.

Distribution: Occurs widely over the savannas of southern and eastern Africa (Broadley 1966a; Bayless 2002). In South Africa it is absent from the western parts of the Western Cape and the central and western portions of the Northern Cape, although there is some evidence of recent range expansion in the latter province (Alexander & Marais 2007). It is also largely absent from Highveld Grassland in the central parts of the *Atlas* region. Some records from Lesotho (Ambrose 2006) and Eastern Cape (Visser 1984h) require confirmation.

Habitat: Found mainly in savannas and arid areas over a wide range of altitudes. It has an affinity for rocky outcrops and will climb trees (Branch 1998).

Biome: Savanna; Grassland; Nama-Karoo; Albany Thicket; Indian Ocean Coastal Belt; Fynbos (marginal).

Assessment rationale: Widespread and common.

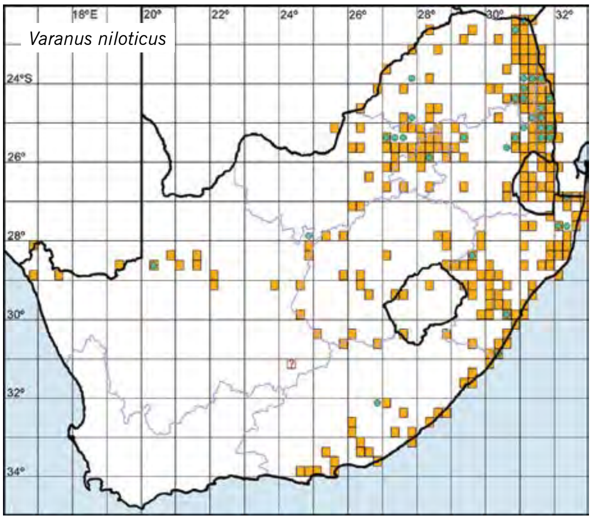
Conservation measures: None recommended.

Varanus albigularis albigularis—Hoedspruit, LIMP D. Pietersen

Varanus niloticus (Linnaeus, 1762)

NILE MONITOR; WATER MONITOR

Graham J. Alexander



Regional: Least Concern

Taxonomy: Böhme & Ziegler (1997) elevated *V. niloticus ornatus*, the large forest water monitor of the Congo Basin region, to full species status.

Distribution: Occurs over much of sub-Saharan Africa, from the Nile River southwards to South Africa (Branch 1998; Bayless 2002). In the *Atlas* region it is largely limited to the eastern half of South Africa, extending west along the Orange River to the West Coast, and it also occurs in Swaziland and Lesotho. Although there are few recorded localities along the Vaal River, this species is almost certainly common there (Bates 2010). It reaches the southern limit of its distribution at the Seekoei River in the Eastern Cape.

Habitat: Usually found close to, or in, water, but may be found some distance away when foraging. It occurs over a wide range of altitudes, from sea level to 1 700 m (Bourquin 2004).

Biome: Savanna; Grassland; Albany Thicket; Indian Ocean Coastal Belt; Forests; Nama-Karoo (marginal); Succulent Karoo (marginal).

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Varanus niloticus—Mala Mala, MPM W.R. Branch

CHAPTER 16

Family Chamaeleonidae

Krystal A. Tolley

The Chameleonidae, together with the Agamidae and Iguanidae, are placed in the infraorder Iguania. Chameleons occur mainly in Africa, Madagascar and their associated islands, with a few species in Arabia, India, Sri Lanka and along the fringes of the Mediterranean in southern Europe (Tolley & Burger 2007). There are currently 197 recognised species (Uetz 2012), with new species being described every year. Presently there are 11 genera: three in Madagascar (*Brookesia*, *Calumma*, *Furcifer*), one on the Seychelles (*Archaius*) and seven in Africa (*Bradypodion*, *Chamaeleo*, *Kinyongia*, *Nadzikambia*, *Rhampholeon*, *Rieppeleon*, *Trioceros*) (Tolley & Burger 2007; Townsend *et al.* 2011). *Chamaeleo* is the most widespread genus in Africa and currently contains 14 species (Uetz 2012). Previously, 36 species of *Chamaeleo* were referred to the subgenus *Trioceros*, but the latter was recently elevated to full genus status (Tilbury & Tolley 2009a).

Two genera occur in the *Atlas* region. Here there are only two species of *Chamaeleo* (*C. dilepis*, *C. namaquensis*), but all 17 described species of *Bradypodion* occur in the *Atlas* region and only two species (*B. setaroi*, *B. transvaalense*) are not strictly endemic to South Africa (their ranges extend into Mozambique and Swaziland respectively). Several introduced populations of *Bradypodion* have been recorded from various places in South Africa and Namibia. Until recently, *Bradypodion* also included several East African species and a single species from Malawi, but these were transferred to two new genera, *Kinyongia* and *Nadzikambia*, respectively (Tilbury *et al.* 2006).

Although Madagascar is considered hyper-diverse, a number of new African species have been described in the last decade and Africa now accounts for approximately 60% of all chameleon species. East Africa is especially diverse, with several species of *Chamaeleo*, *Trioceros*, *Rhampholeon* and *Rieppeleon*, and all known *Kinyongia* species. Approximately 18% of African chameleon species occur within the *Atlas* region, where diversity is highest in the Maputo-Pondo-Albany area and the Cape Floristic Region (Tolley *et al.* 2006, 2008). Chameleons occur across many different biomes and vegetation types (e.g. forests, fynbos, Indian Ocean coastal belt, grasslands, savanna), although only a few species occur in xeric habitats (e.g. desert and Karoo).

Most chameleons are arboreal but *Chamaeleo namaquensis*, which occurs in the *Atlas* region, is terrestrial and inhabits xeric environments with sparse vegetation. Chameleons generally prey upon insects, although the larger species are known to prey upon small mammals, reptiles and birds. All members of the genus *Bradypodion* are viviparous, with aseasonal reproduction. Females give birth to several litters of usually 10–15 young, although litter size varies (Branch 1998; Jackson 2007). *Bradypodion* are small chameleons with a total length not exceeding 150–180 mm. The two *Chamaeleo* species in the *Atlas* region are larger, with a total length of 200–300 mm. Both species are oviparous and females usually lay more than 20 eggs per clutch (Tolley & Burger 2007).

Chameleons are popular in the pet trade (Carpenter *et al.* 2004), although imports and exports are restricted throughout most of the *Atlas* region and trade is therefore not considered of major conservation concern in this area. Outside the region, legal exports of African chameleons to Europe and America are growing each year, most species originating in Tanzania and Madagascar (Carpenter *et al.* 2005). In the *Atlas* region, many species have small ranges, often covering only a few thousand square kilometres and occasionally limited to a few hundred square kilometres. In areas where anthropogenic land transformation is severe, species with limited ranges are typically of conservation concern. In the genus *Bradypodion*, three species (*B. caeruleogula*, *B. caffer*, *B. taeniabronchum*) were identified as Endangered, four species (*B. kentanicum*, *B. melanocephalum*, *B. pumilum*, *B. thamnobates*) as Vulnerable and three species (*B. dracomontanum B. nemorale*, *B. ngomeense*) as Near Threatened. Two species of *Bradypodion* (*B. setaroi*, *B. taeniabronchum*) are now considered to be less threatened than they were previously, mainly due to improved information on their distribution and biology.

Genus *Bradypodion* Fitzinger, 1843—dwarf chameleons

The genus *Bradypodion* contains 17 species (Uetz 2012) and is near-endemic to the *Atlas* region. Fifteen species are found only in South Africa, one (*B. transvaalense*) is found in South Africa and Swaziland and another (*B. setaroi*) extends from South Africa into adjacent southern Mozambique. All species are small (80–150 mm total length), arboreal and viviparous, usually giving birth to 10–15 young per litter (Jackson 2007). A number of species are of conservation concern due mainly to habitat fragmentation and transformation within very limited ranges. Three species are classified as Endangered, six as Vulnerable and two as Near Threatened. Two species have been downgraded, mainly due to improved information on their distribution and biology: *B. taeniabronchum* was classified as Critically Endangered (IUCN 1996) but is now considered Endangered, while *B. setaroi* was considered Endangered (IUCN 1996) but is now classified as Least Concern. Although molecular analyses (e.g. Tolley & Burger 2004a; Tilbury *et al.* 2006; Tolley *et al.* 2006) do not support speculation (Raw 1995, 2001) that a large number of undescribed *Bradypodion* species exist in the *Atlas* region, they do indicate that several undescribed species with restricted ranges (not included on any *Atlas* maps) are present (Tolley & Burger 2007). The conservation status of these forms will have to be assessed in due course.

Bradypodion atromontanum Branch, Tolley & Tilbury, 2006

SWARTBERG DWARF CHAMELEON

Krystal A. Tolley

Global: Least Concern

Endemic

Taxonomy: For many years a dwarf chameleon of undetermined taxonomic status was known from the Swartberg area (Branch 1988b, 1998). A subsequent phylogenetic study resulted in its description as a new species (Branch *et al.* 2006b). Morphologically it can be confused with *B. gutturale* (Tolley & Burger 2007) but the two species are allopatric.

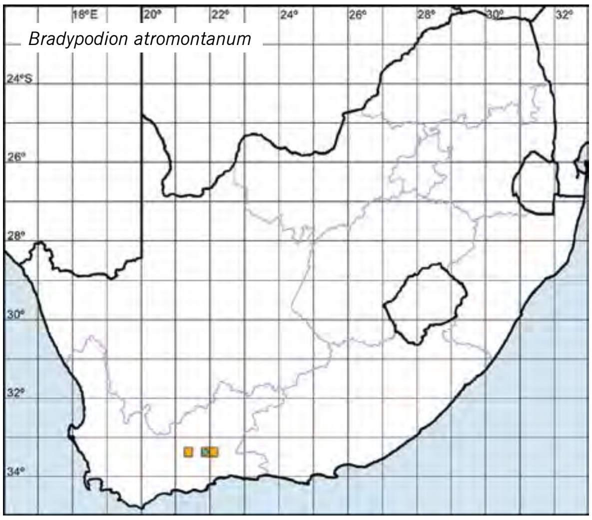
Distribution: Endemic to the Greater and Lesser Swartberg mountains, Western Cape, South Africa.

Habitat: Limited to the fynbos vegetation of the Groot and Klein Swartberg mountains (Branch *et al.* 2006b). Occurs at altitudes of 700–1800 m (Branch *et al.* 2006b; unpubl. data).

Bioregion: Western Fynbos-Renosterveld.

Assessment rationale: *Bradypodion atromontanum* has a restricted distribution with an EOO (2 700 km^2) below the Endangered threshold [B1]. However, its known distribution is within a protected area (Swartberg Nature Reserve) and it is unlikely that the species will experience any major habitat loss or population declines due to common threats such as land transformation. A large wild fire could have an impact on population numbers but, because fire is managed within the Swartberg, it is unlikely that this will severely impact the species.

Conservation measures: None recommended.



Bradypodion atromontanum—Greater Swartberg, WC K.A. Tolley

Bradypodion caeruleogula Raw & Brothers, 2008

UMLALAZI DWARF CHAMELEON

Krystal A. Tolley

Global: **Endangered B1ab(i,iii)+2ab(ii,iii)**

Endemic

Taxonomy: Recently described from Dlinza Forest (Raw & Brothers 2008). Genetic studies (Tilbury & Tolley 2009b) indicate that chameleons from two additional nearby forests (Entumeni and Ongoya) also belong to this taxon.

Distribution: Found in three forest patches (Dlinza, Entumeni and Ongoya) in KwaZulu-Natal, South Africa.

EOO: 1 300 km^2 (confidence: high); AOO: 38 km^2 (confidence: high).

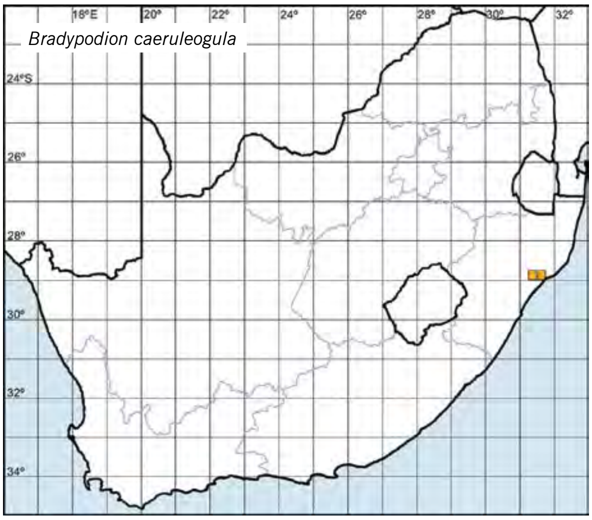
Habitat: Found in forests where it prefers the high canopy, or high perches in smaller trees (Tolley & Burger 2007).

Vegetation type: FOz 5 Scarp Forest.

Assessment rationale: Has a very limited distribution (EOO and AOO are below the Endangered thresholds) and occurs in only three forests (Entumeni, Dlinza and Ongoya). Entumeni (in a rural area) is fragmented—broken into small patches due to human activities, while Ongoya (in a rural area) and Dlinza (in the town of Eshowe) are not as heavily transformed but are nevertheless impacted and vulnerable to external pressures. Overall, the range is considered to be severely fragmented [B1a+2a]. The effects of fragmentation, and the disruption of landscape level processes, continue due to large human populations outside the forests, both within buffer zones and across the broader landscape (Berliner *et al.* 2006; D. Berliner pers. comm.). Human population densities are especially high near Dlinza and Ongoya (D. Berliner pers. comm.). Ongoya is formally protected but is nevertheless affected by human activities (Boudreu *et al.* 2005); Dlinza and Entumeni are partially protected but there is a serious threat of fragmentation and disturbance which could affect natural processes [B1b(i,iii), B2b(ii,iii)].

Threats: Threats generally relate to habitat degradation as a result of human activities. The broader landscape is heavily populated by a rural community (Driver *et al.* 2005), as are the buffer zones surrounding Dlinza and Ongoya. Entumeni and Dlinza have been particularly heavily transformed and the original forest matrix is no longer intact.

Conservation measures: Develop a BMP-S. Although all three forests are protected at some level, human impacts



Bradypodion caeruleogula, male—Dlinza Forest, Eshowe, KZN K.A. Tolley

in the area are expected to continue. Conservation of this species should therefore mainly ensure that the forests are properly protected and that encroachment is minimised. Restore degraded areas within the forests, and reduce population density in buffer zones, to help ensure that ecological processes are not further disrupted and that the forests remain healthy and intact. Perform additional surveys to determine whether chameleons use only pristine forest or are also found in degraded forest, and whether forest fragmentation has a seriously negative effect on gene flow.

Bradypodion caffer (Boettger, 1889)

PONDO DWARF CHAMELEON;
TRANSKEI DWARF CHAMELEON

Krystal A. Tolley

Global: Endangered B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)

Endemic

Taxonomy: No notable issues.

Distribution: Has a restricted range and is known only from a few coastal localities in the northeastern parts of the Eastern Cape, South Africa (Tolley & Burger 2007).

EOO: 1 950 km^2 (confidence: medium); AOO: 45 km^2 (confidence: medium).

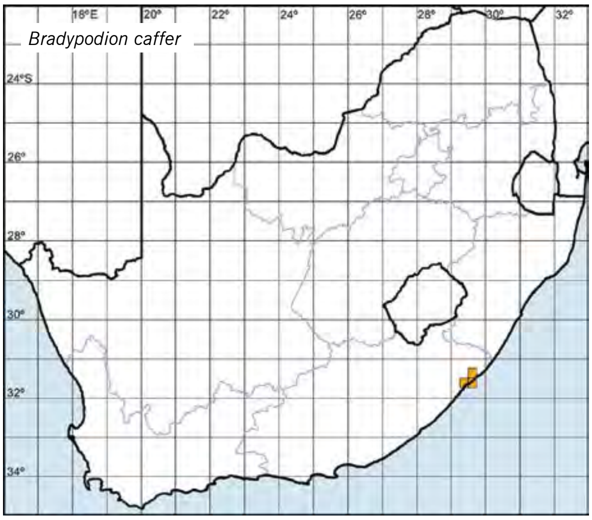
Habitat: Inhabits coastal forest where it is found high up in trees but also lower down on bushes and shrubs (Tolley & Burger 2007).

Vegetation type: FOz 5 Scarp Forest; CB 5 Transkei Coastal Belt.

Assessment rationale: It has a restricted range, occurring in only three QDGCs and having an EOO <5 000 km^2 [B1] and an AOO <500 km^2 [B2]. The species' preferred habitat of coastal forests is naturally patchy, but much of this habitat has been transformed and fragmented [B1a+2a]. The trend of transformation (both urban and rural) is ongoing (Driver *et al.* 2005), leading to a decline in EOO, AOO and quality of habitat [B1b(i,ii,iii)+2b(i,ii,iii)]. The number of locations is estimated at 5–10 but these are subject to decline [B1b(iv)+2b(iv)], and it is likely that the number of mature individuals is also declining [B1b(v)+2b(v)]. The species is thus assigned the category Endangered.

Threats: Occurs within a highly fragmented, vulnerable ecosystem (Driver *et al.* 2005). This area is heavily transformed, mainly through rural subsistence farming in a densely populated region. Predicted future threats centre on the growing human population and increased pressure for land use. Only 2.5 km^2 of the range is under formal protection in the Silaka Nature Reserve.

Conservation measures: Perform surveys to provide a better estimate of AOO, especially in previously unsurveyed areas. A better understanding of the occurrence of the species, with respect to fragmentation of habitat, is imperative. Examine populations in fragmented habitats for signs of genetic bottlenecks. This will allow for an understanding of whether the species is able to utilise a series of small land patches and/or corridors, and whether it can thrive in degraded habitat. Draft a BMP-S.



Bradypodion caffer, male—Port St Johns, KZN K.A. Tolley

Bradypodion damaranum (Boulenger, 1887)

KNYSNA DWARF CHAMELEON

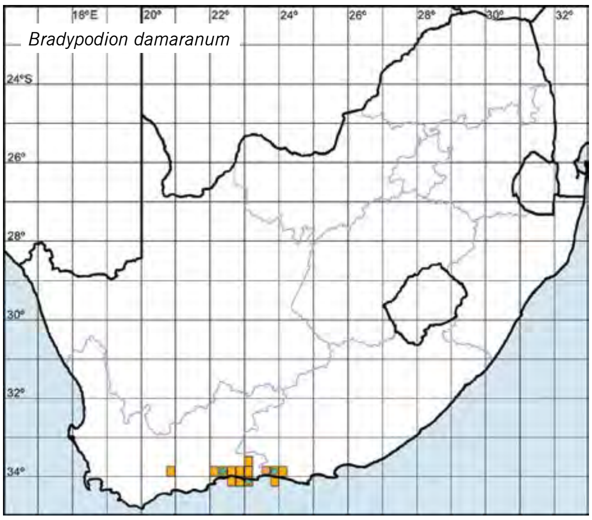
Krystal A. Tolley

Global: Least Concern

Endemic

Taxonomy: The taxonomic status of an isolated population of chameleons in Grootvadersbos Forest is uncertain. Although this chameleon is morphologically similar to *B. damaranum*, preliminary data suggests that it is genetically distinct (Tolley *et al.* 2006). However, this analysis was based on a single sample and more data are needed to determine the status of the Grootvadersbos population.

Distribution: Has a restricted range along the south-facing forested slopes of the Outeniqua and Tsitsikamma mountains in the Western and Eastern Cape provinces, South



Africa, from the George area eastwards to Witelsbos. There is a small isolated population (area of 0.6 km²) in Grootvadersbos Forest approximately 180 km west of the main distribution (Tolley *et al.* 2006; Tolley & Burger 2007).

Habitat: Restricted to moist coastal Afromontane forest (Tolley & Burger 2007). Often occurs high up in the canopy but sometimes found on smaller trees and bushes. Also inhabits well-vegetated urban gardens.

Vegetation type: FOz 1 Southern Afrotemperate Forest.

Assessment rationale: This species has a small AOO and EOO (estimated with high levels of confidence as 12 448 km² and 800 km² respectively), both below the Vulnerable thresholds [B1+2]). It is confined to indigenous Afromontane forest. Much of this forest was transformed into plantations in the past and is now patchy in some areas. However, the development of plantations has been largely halted and in some areas, rehabilitation back to indigenous forest is taking place.

Conservation measures: Not under immediate threat and therefore no conservation actions recommended. Nevertheless, it should be noted that any future land transformation of indigenous Afromontane forest could adversely affect this species.

Bradypodion damaranum—Knysna, WC W.R. Schmidt

Bradypodion dracomontanum Raw, 1976

DRAKENSBERG DWARF CHAMELEON

Krystal A. Tolley

Global: Near Threatened

Endemic

Taxonomy: There has been some confusion between *B. dracomontanum* and an undescribed species (the 'Emerald Dwarf'). Both occur in the Drakensberg Mountains but *B. dracomontanum* occurs from Cathedral Peak northwards, whereas the Emerald Dwarf occurs to the south of Cathedral Peak (Tolley & Burger 2007).

Distribution: Occurs in the Drakensberg Range of KwaZulu-Natal and the eastern Free State, South Africa. Found from Cathedral Peak northwards to Normandien Pass (2729DC), and as far west as Golden Gate Highlands National Park.

EOO: 6 771 km² (confidence: low); AOO: 3 000 km² (confidence: low).

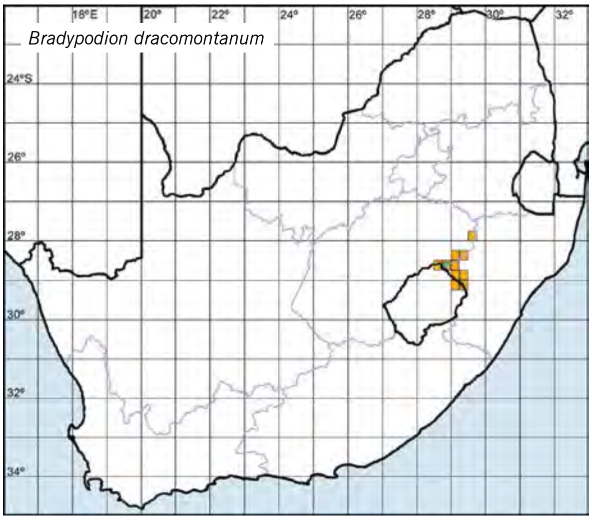
Habitat: Found mainly in small forest patches, but can extend into grassland, generally above 1 500 m.

Biome: Grassland; Forests.

Assessment rationale: Appears to have a moderately restricted distribution (EOO under the Vulnerable threshold [B1]). However, much of the potential available habitat has not been fully surveyed and it is possible that the distribution is wider than estimated. Approximately 20% of the known distribution is within protected areas, mainly the uKhahlamba-Drakensberg National Park. Most of the remaining range is poorly protected (Driver *et al.* 2005) and is moderately to highly fragmented [B1a]. The species is therefore considered Near Threatened. If additional information regarding AOO, EOO and quality of habitat becomes available, this species should be re-evaluated.

Threats: Although a large proportion of the AOO falls within protected areas, outside of these the habitat is moderately to highly fragmented by human activities (Driver *et al.* 2005). Most of the area within the range has high potential for afforestation and the planting of crops, and human population density is expected to increase.

Conservation measures: None recommended.



Bradypodion dracomontanum—Royal Natal NP, KZN K.A. Tolley

Bradypodion gutturale (A. Smith, 1849)

LITTLE KAROO DWARF CHAMELEON; ROBERTSON'S DWARF CHAMELEON

Krystal A. Tolley

Global: Least Concern

Endemic

Taxonomy: There are no major taxonomic issues, but it should be noted that considerable morphological variation exists across the range of this species (Tolley & Burger 2007) and this has caused confusion in the past. *Bradypodion* records from outside the general vicinity of Robertson in the Western Cape (Tolley & Burger 2004a,b; Tolley *et al.* 2004) were previously not included under *B. gutturale* (Branch 1998).

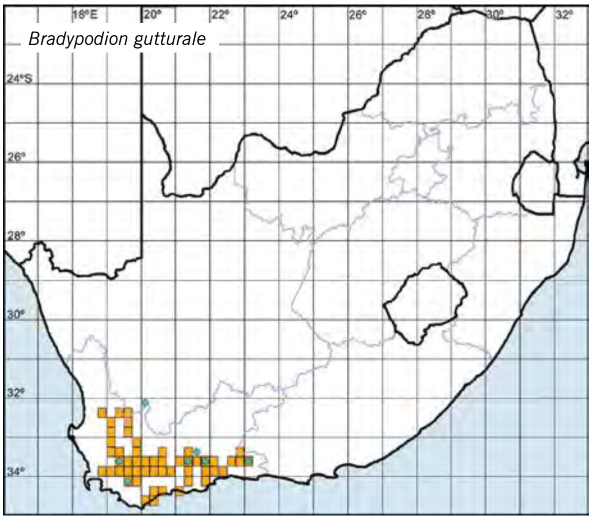
Distribution: Endemic to the southwestern part of South Africa (Tolley & Burger 2007). Most records are in the Western Cape, but the northernmost locality—represented by a Virtual Museum record—is at Gannaga Pass near Sutherland in the Northern Cape. The species occurs from the Worcester area to Uniondale, generally within the Cape Fold Mountains, but also in suitable vegetation patches in the Little Karoo and on the Agulhas Plain from Cape Agulhas eastwards to the Outeniqua Mountains near Mossel Bay (Tolley & Burger 2004b).

Habitat: Occurs mainly in fynbos, renosterveld and karroid vegetation (Tolley & Burger 2007).

Biome: Fynbos; Succulent Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended, but it should be noted that this chameleon is under threat from habitat loss through agricultural land transformation and habitat fragmentation. Information provided in the National Spatial Biodiversity Assessment (Driver *et al.* 2005) suggests that 25% of its historical natural habitat is presently transformed. This species does not generally tolerate altered environments such as urban gardens or agricultural fields.



Bradypodion gutturale—Ladismith, Little Karoo, WC K.A. Tolley

Bradypodion kentanicum (Hewitt, 1935)

KENTANI DWARF CHAMELEON

Krystal A. Tolley

Global: Vulnerable B1ab(i,ii,iii)+2ab(i,ii,iii)

Endemic

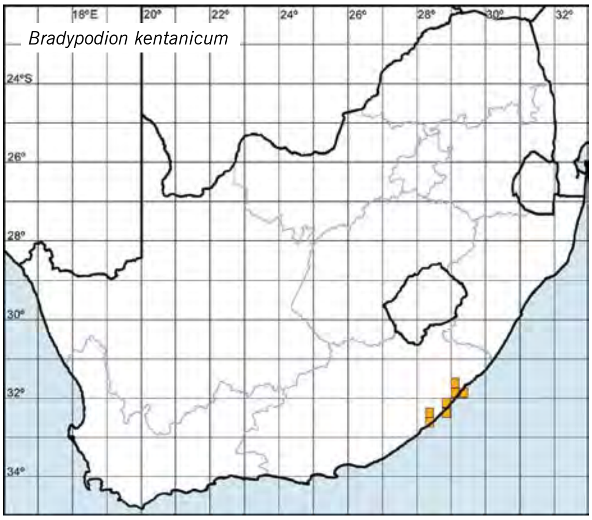
Taxonomy: Although there are no notable taxonomic issues (Tolley & Burger 2007; Tolley *et al.* 2004, 2006), this species is often confused with *B. caffer*, which occurs further north along the coastline.

Distribution: Endemic to the Eastern Cape, South Africa. Known from the vicinity of Kentani along the coast, northwards to Dwesa and Coffee Bay (Branch 1998; Tolley *et al.* 2006; Tolley & Burger 2007).

EOO: 5 850 km^2 (confidence: low); AOO: 600 km^2 (confidence: low).

Habitat: Found in the trees and bushes of coastal scarp forest (Tolley & Burger 2007). Also found inland from the coastal belt.

Vegetation type: SVs 7 Bhisho Thornveld; CB 5 Transkei Coastal Belt; FOz 5 Scarp Forest; SVs4 Ngongoni Veld.



Assessment rationale: Has a restricted range, with EOO and AOO below the Vulnerable thresholds. Habitat is severely fragmented [B1a+2a] and most of the AOO is within a vulnerable ecosystem classified as 'hardly protected'

(Driver *et al.* 2005). Occurs in only one small protected area (Dwesa Wildlife Reserve, 37 km^2). Overall, its range is currently heavily impacted by small-scale agriculture (Driver *et al.* 2005). There is a continuing decline in range and the extent and quality of habitat, as the area has high potential for increased agriculture, afforestation and alien plant invasions [B1b(i,ii,iii)+2b(i,ii,iii)]. The number of subpopulations and/or locations is unknown.

Threats: Habitat is severely fragmented by subsistence agriculture (Driver *et al.* 2005). The greatest threats are increased agriculture, afforestation and alien plant invasions.

Conservation measures: Develop a BMP-S that highlights research needs, such as distribution surveys and classification of relevant threats; this would allow for a re-assessment based on better data. Carry out population genetic studies to identify the number of subpopulations, determine whether or not gene flow is restricted, and establish if genetic bottlenecks occur. Population demographic analyses would be useful to quantify population declines. The greatest threat is present and future habitat fragmentation, and efforts should thus be made to protect and rehabilitate this species' habitat.

Bradypodion kentanicum—Dwesa NR, EC M. Burger

Bradypodion melanocephalum (Gray, 1865 "1864")

KWAZULU DWARF CHAMELEON; BLACK-HEADED DWARF CHAMELEON

Krystal A. Tolley

Global: **Vulnerable B1ab(i,ii,iii)+2ab(i,ii,iii)**

Endemic

Taxonomy: This species appears to be part of a larger species complex (comprising *B. melanocephalum* and *B. thamnobates*) in which genetic differentiation is low but obvious morphological differences exist (Raw 2001; Tolley & Burger 2007; Da Silva & Tolley 2013; K.A. Tolley unpubl. data). Additional work is needed on the taxonomic status of the morphological forms within this complex.

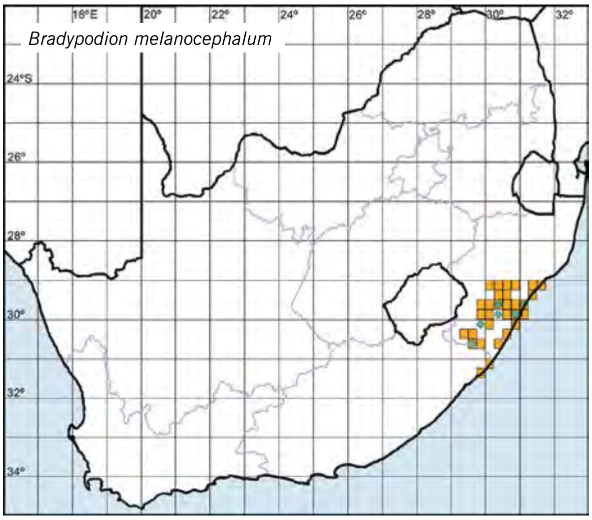
Distribution: Found in the coastal regions of KwaZulu-Natal, South Africa from just north of Durban southwards to Mkhambathi Nature Reserve in the Eastern Cape (Tolley & Burger 2007), but the range extends about 100 km inland except in the southern portion of the range where these chameleons appear to be confined to the coast. It is thought that the inland population is disjunct from the smaller coastal population (Armstrong 2009).

EOO: 15 000 km^2 (confidence: low); AOO: 1 500 km^2 (confidence: low).

Habitat: Appears to inhabit a number of vegetation types such as grasses, bushes, thickets, trees and roadside verges (Tolley & Burger 2007).

Biome: Grassland; Indian Ocean Coastal Belt; Savanna; Forests.

Assessment rationale: Occurs in one of the most anthropogenically fragmented regions of South Africa (Driver *et al.* 2005) [B2a], resulting in a reduced EOO (<20 000 km^2) and small AOO (150 km^2 for coastal, and 1 350 km^2 for inland, populations; A.J. Armstrong unpubl. data). Given the decline in habitat (Armstrong 2009) [B2b(i,ii,iii)] and the expectation that pressure for land transformation in this area is likely to continue due to projected human population density increases (Driver *et al.* 2005; Armstrong 2008, 2009), this species is considered Vulnerable. In addition, climate model projections using the Intergovernmental Panel on Climate Change A2 and B2 scenarios suggest that this species could suffer a 40% loss in climatically-suitable habitat in the next 100 years (Houniet *et al.* 2009).



Bradypodion melanocephalum—Redhill, Durban, KZN M. Burger

Threats: This species occurs in a severely fragmented habitat that is also under threat from alien invasive species (Driver *et al.* 2005; Armstrong 2009). The range is under heavy pressure for present and future land transformation, especially around the Durban municipal area (Armstrong 2008). Fragmentation could disrupt gene flow and increase the likelihood of genetic bottlenecks. This in turn could reduce the potential for recovery and population growth, even in areas that may be rehabilitated in the future (e.g. see Armstrong 2008).

Conservation measures: Conduct a full taxonomic assessment as a matter of priority, and update EOO and AOO estimates accordingly. Perform additional surveys. Assess the extent of habitat fragmentation and degradation due to alien invasive plants, and incorporate this information into a BMP-S.

Bradypodion nemorale Raw, 1978

QUDENI DWARF CHAMELEON;
ZULULAND DWARF CHAMELEON

Krystal A. Tolley

Global: Near Threatened

Endemic

Taxonomy: Originally described from Qudeni and Nkandla forests (Raw 1978). Later, Raw (2001) proposed that the Nkandla population should be assigned to a separate taxon and more recently, Raw & Brothers (2008) described this population as *B. nkandlae*. The latter description was based on juvenile specimens that lacked clear diagnostic morphological differences from *B. nemorale* from Qudeni Forest, aside from pigmentation. Furthermore, genetic studies of chameleons from these two forests suggest that the two populations are not distinct species, and *B. nkandlae* was therefore referred to the synonymy of *B. nemorale* (Tilbury & Tolley 2009b).

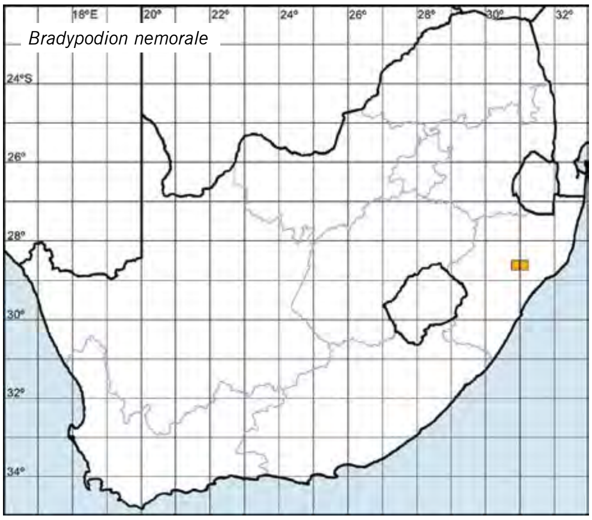
Distribution: Endemic to Qudeni and Nkandla forests, KwaZulu-Natal, South Africa (Tolley & Burger 2007).

EOO: 1 300 km^2 (confidence: high); AOO: 59 km^2 (confidence: high).

Habitat: Confined to isolated patches of Afromontane and scarp forest. Usually found high up in the canopy, although smaller individuals have been observed in the understorey (Tolley & Burger 2007).

Vegetation type: FOz 5 Scarp Forest; FOz 3 Southern Mistbelt Forest.

Assessment rationale: This species has a very restricted EOO and AOO (both below the Endangered threshold [B1+2]) but it appears to be locally abundant in two isolated forest patches, Qudeni and Nkandla. Nkandla Forest is formally protected, not presently under great threat (Geldenhuys 2000; Berliner *et al.* 2006) and relatively well managed (I. van der Merwe pers. comm.). Qudeni Forest is not formally protected (although it is managed as a Provincial State Forest) and the high anthropogenic pressure on surrounding areas (Driver *et al.* 2005) may lead to the disruption of ecological processes. It is considered degraded due to informal use of resources by a dense surrounding human population (Geldenhuys 2000). In combination with heavily transformed surrounding landscapes and resource extraction in buffer zones, this could lead to the disruption of natural processes in the forest. Considering the size of the chameleon's range and the nature of its threats, there are probably about 10–20 locations. Within both forests there appears to be no further decline in habitat quality or range size. The species should be considered Near Threatened, partly due to the tenuous nature of the protection of their habitat, especially at Qudeni.



Bradypodion nemorale—Nkandla Forest, KZN M. Burger

Threats: Although this species occurs as two isolated populations, this fragmentation is natural. However, considering its small range, the species is susceptible to natural and anthropogenic pressures. Much of the forest habitat in KwaZulu-Natal has been given over to wood plantations, but no additional pressure is expected on the two forest patches (Berliner *et al.* 2006).

Conservation measures: Monitor the situation, especially at Qudeni Forest, and manage it to prevent further encroachment by plantations and to ensure that the impacts of human resource use on the forest are minimised. In the event of further encroachment or habitat degradation, reevaluate the conservation status of this species. Tilbury & Tolley (2009) noted low levels of gene flow between the Qudeni and Nkandla populations and this, together with differences in body size, casque size and colouration, suggested that the two populations should be treated as separate management units.

Bradypodion ngomeense Tilbury & Tolley, 2009

NGOME DWARF CHAMELEON

Krystal A. Tolley

Global: Near Threatened

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to a single forest patch, Ngome Forest, in northern KwaZulu-Natal, South Africa (Tolley & Burger 2007; Tilbury & Tolley 2009b).

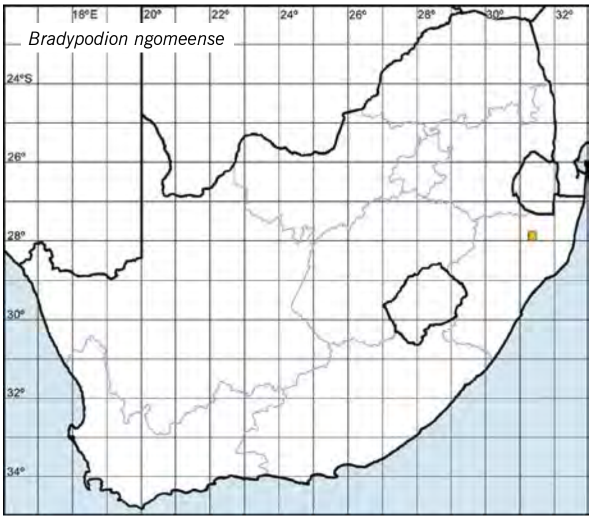
EOO: 650 km^2 (confidence: high); AOO: 37 km^2 (confidence: high).

Habitat: Usually found in forest canopies but sometimes also in the tops of smaller trees (Tolley & Burger 2007).

Vegetation type: FOz 3 Southern Mistbelt Forest.

Assessment rationale: This species occurs only in one small forest and has a very small AOO (<500 km^2). However, Ngome Forest is formally protected as it falls within the Ntendeka Wilderness Area. At present there is little encroachment from the surrounding human community (I. van der Merwe pers. comm.). Transformation of the forest into plantations is not a serious threat at this time because no additional licenses for water rights will be granted (I. van der Merwe pers. comm.). Although there are no immediate threats to the intact forest, this species is of concern due to its restricted range, coupled with the potential for transformation of the broader landscape in the future.

Threats: Most of Ngome Forest is intact and the human population density within the surrounding buffer area is low (Berliner *et al.* 2006). However, human density across the overall landscape is high and could pose a threat in the future. Encroachment of pine plantations into the buffer zone is possible and the forest edge is highly exposed.



Bradypodion ngomeense—Ngome Forest, KZN K.A. Tolley

Conservation measures: Monitor the situation at Ngome Forest to ensure that there is no further encroachment by plantations or transformation by human settlements. If any encroachment, degradation or transformation takes place, re-assess the species.

Bradypodion occidentale (Hewitt, 1935)

WESTERN DWARF CHAMELEON; NAMAQUA DWARF CHAMELEON

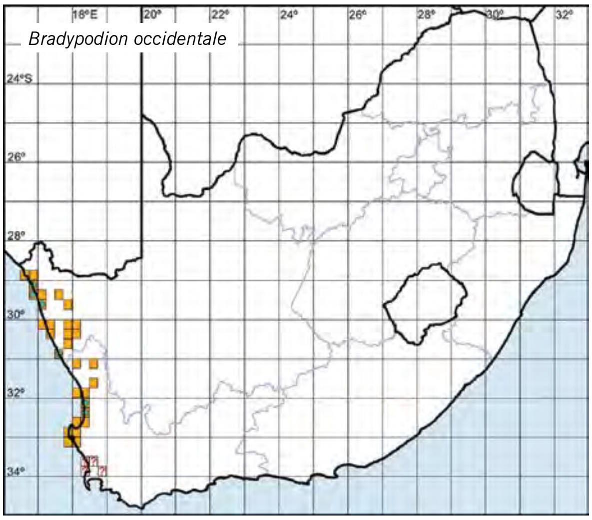
Krystal A. Tolley

Global: Least Concern

Endemic

Taxonomy: There are no substantial taxonomic issues, although a contact zone may exist between *Bradypodion occidentale* and *B. pumilum*. Chameleons with intermediate morphological characteristics have been found (Tolley & Burger 2007), suggesting that there are hybrids between the two species. It was initially thought that these individuals were a new ecomorph of *B. pumilum*, as they were genetically similar to that species (Tolley *et al.* 2006). Unfortunately, a lack of additional samples from this potential contact zone has prevented further investigation. Although *B. occidentale* is often confused with *B. ventrale* because they share some similar morphological features, genetic studies have clearly shown that two species are involved (Tolley *et al.* 2004).

Distribution: Endemic to the Western and Northern Cape provinces, South Africa. Distributed in a narrow belt along the West Coast, from around Langebaan in the south to



Alexander Bay in the north (Branch 1998; Tolley & Burger 2007). In some areas the species may reach 100 km inland, depending on the availability of appropriate vegetation. Records immediately north of Cape Town are unconfirmed (see question marks on map) and may represent *B.*

pumilum or a hybrid between *B. pumilum* and *B. occidentale*. There are reports of an isolated introduced population at Lüderitz, Namibia (Branch 1998).

Habitat: Typically found in undisturbed strandveld along the West Coast, and further inland in succulent Karoo (Tolley & Burger 2007). Also found in fynbos vegetation types, especially renosterveld.

Biome: Succulent Karoo; Fynbos.

Assessment rationale: Wide-ranging and common. Apart from the most southerly parts, most of its distribution is not greatly fragmented (Driver *et al.* 2005).

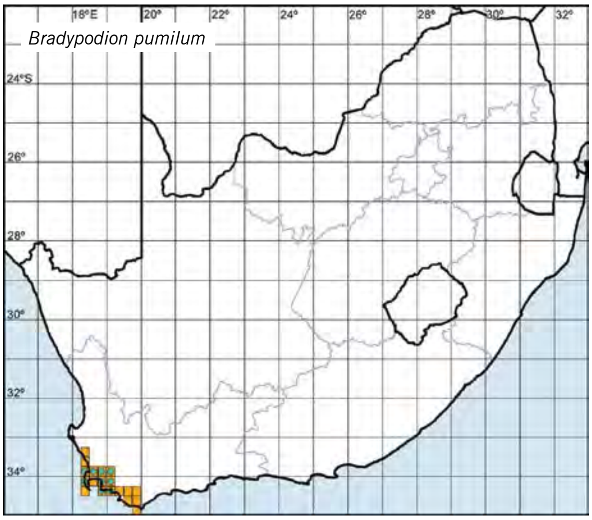
Conservation measures: Protection of suitable habitat in the southern portion of its range should be encouraged.

Bradypodion occidentale—Noup, NC K.A. Tolley

Bradypodion pumilum (Gmelin, 1789)

CAPE DWARF CHAMELEON

Krystal A. Tolley



Global: Vulnerable B1ab(i,ii,iii,v)

Endemic

Taxonomy: Until about a decade ago some authors were still of the opinion that most populations of *Bradypodion* were subspecies of *B. pumilum* (Klaver & Böhme 1997; Neças 2004). However, it is now commonly accepted that most of these subspecies are valid species (Branch 1998; Tolley *et al.* 2004; Tolley & Burger 2007). In addition, *B. pumilum* was considered to be represented only by the colourful morph typical of the Cape Town area. Other dwarf chameleons on the periphery of its distribution were of uncertain taxonomic status, but subsequent genetic studies (Tolley *et al.* 2006) showed that these should be considered as ecomorphs of *B. pumilum*. At least two ecomorphs exist: 'typical' (closed habitat) and 'fynbos' (open habitat). Hopkins & Tolley (2011) found that natural selection in open habitats limited body size as well as conspicuous features such as bright colours, while sexual selection in closed habitats favoured the development of ornamentation related to display. The 'renosterveld' morph (Tolley & Burger 2007) may actually be a hybrid between *B. pumilum* and *B. occidentale* (K.A. Tolley unpubl. data).

Distribution: Endemic to the southwestern parts of the Western Cape, South Africa, extending eastwards onto the Agulhas Plain (Tolley & Burger 2007). Introduced populations in Namibia and Clanwilliam (Branch 1998) have not been re-discovered in recent years.

EOO: 13 407 km^2 (confidence: high); AOO: 3 366 km^2 (confidence: high).

Habitat: Occurs in a variety of habitats including fynbos, renosterveld, thicket, riparian vegetation and some exotic and native trees. Ecomorphs inhabit different vegetation types. The typical colourful form is often found in urban gardens, in the canopy of forest patches, and in bushes and thickets. The fynbos form is associated with the montane and lowland fynbos of the Western Cape, while the renosterveld form is known from remnant patches of renosterveld north and west of Cape Town (Tolley & Burger 2007). This species is generally absent from agricultural landscapes (e.g. Tolley & Measey 2007).

Bioregion: Southwest Fynbos; West Coast Renosterveld; West Strandveld; South Strandveld.

Bradypodion pumilum—Stellenbosch, WC K.A. Tolley

Assessment rationale: Considered Vulnerable because of its restricted range (EOO <20 000 km^2), coupled with a continuing decline in size and quality of habitat and (by inference) the number of mature individuals [B1b(i,ii,iii,v)], and the fact that subpopulations in transformed areas are highly fragmented [B1a] and essentially isolated from subpopulations in protected areas. Chameleons in some fragmented areas are known to be genetically bottlenecked and gene flow between subpopulations is restricted (K.P. Hopkins & K.A. Tolley unpubl. data), decreasing the potential for recovery. In addition, climate model projections using the Intergovernmental Panel on Climate Change A2 and B2 scenarios suggest that this species could suffer a 60% loss in climatically suitable habitat in the next 100 years (Houniet *et al.* 2009). Although about 1 300 km^2 of its range is within protected areas (Driver *et al.* 2005), the remaining habitat is severely fragmented and transformed through urbanisation. In these impacted areas, some small, densely populated patches are known, but these probably represent refuges. Chameleons of this species also occur in some urban gardens. In the past, such records were numerous, but recent anecdotal information indicates that these occurrences have become relatively rare. This suggests that the majority of the urban environment (and thus, the majority of the distribution) is sparsely populated and that this species is in a population decline in these fragmented urban areas (although no quantitative assessment has been conducted).

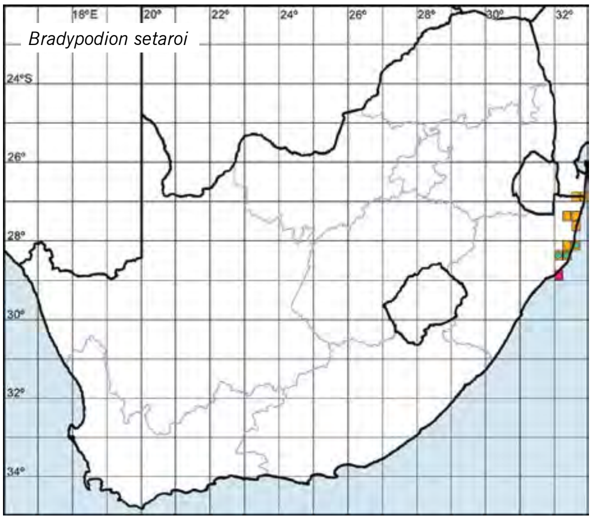
Threats: The greatest current threat to this species is environmental change, primarily in the form of habitat loss and transformation through urbanisation and agricultural sprawl. According to the National Spatial Biodiversity Assessment (Driver *et al.* 2005), well over 50% of the historical natural habitat of *B. pumilum* is presently transformed. Although this species can persist in some fragments of the urban setting, it generally does not tolerate altered environments (e.g. Tolley & Measey 2007). Global climatic change model predictions using the 'worst case scenario' predict that the species' range will be reduced by about 50% by 2050 (Houniet *et al.* 2009). Although part of the range is in fire-prone habitat, the increased frequency of fires due to anthropogenic influences will impact it negatively. This is compounded by other threats such as predation by domestic cats in urban and rural settings, and deliberate translocation of chameleons. *Bradypodion pumilum* is popular with the general public as a pet, despite this being prohibited by conservation legislation. Specimens are often captured at one locality and released elsewhere, sometimes within the range of another chameleon species. This practice is of particular conservation concern because it leads to the mixing of gene pools among subpopulations and may result in hybridisation.

Conservation measures: Formulate and implement a BMP-S. Given that habitat loss, fragmentation and transformation are the most serious threats to *B. pumilum*, manage its remaining habitat wisely. Its new status of Vulnerable should influence future environmental impact assessments and the design and management of urban green areas and larger nature reserves. Conduct baseline studies investigating the dispersal abilities of this chameleon; these will be useful for making recommendations regarding the linking of existing habitat fragments that promote dispersal and interbreeding. Conduct additional genetic studies mapping the presence and frequency of bottlenecked populations, to contribute to an understanding of the effects of fragmentation, and the formulation of a recovery plan within the urban environment. Focus public awareness on the negative impacts of translocating chameleons and encourage the planting of chameleon-friendly gardens to increase and link remaining suitable habitat. Extend this campaign to include public contributions of survey data to map the distribution (presence/absence) of chameleons in the urban environment.

Bradypodion setaroi Raw, 1976

SETARO'S DWARF CHAMELEON

Krystal A. Tolley



Global: Least Concern

Taxonomy: No notable issues.

Distribution: Occurs from the St Lucia estuary in coastal KwaZulu-Natal, South Africa, northwards into southern Mozambique (Tolley & Burger 2007). Specimens from Arboretum (2832CC) near Richards Bay were probably introduced to the area.

Habitat: Found in the trees and bushes of coastal forests (Tolley & Burger 2007).

Vegetation type: CB 1 Maputaland Coastal Belt; FOz 7 Northern Coastal Forest; FOa 3 Mangrove Forest.

Assessment rationale: Although the species has a relatively small EOO (5 600 km^2; less than the Vulnerable threshold), this is much larger than previously believed. The AOO is estimated to be 4 400 km^2, incorporating severely fragmented areas. The southern portion of the range is highly fragmented, but much of the rest is only moderately or slightly fragmented. Furthermore, continued decline in EOO/AOO or habitat quality is not projected at present. Increases in human population density within the species' range are expected to be low (Driver *et al.* 2005) and more than half of the range is located within the iSimangaliso Wetland Park.

Conservation measures: No conservation actions are recommended. However, future re-assessments of this species would be improved by additional information on distribution.

Bradypodion setaroi—Lake Sibaya, KZN K.A. Tolley

Bradypodion taeniabronchum (A. Smith, 1831)

ELANDSBERG DWARF CHAMELEON; SMITH'S DWARF CHAMELEON

Krystal A. Tolley

Global: Endangered B1ac(iv)+2ac(iv)

Endemic

Taxonomy: At the time of its South African Red Listing (Branch 1988a), this species was known from only one small area on Lady's Slipper, a peak in the Elandsberg Mountains. Subsequent surveys have revealed that it occurs widely in the fynbos vegetation of the Elandsberg (Tolley & Burger 2004a; Tolley *et al.* 2006). In 1992, a population was discovered on the Kareedouw Mountains (Burger & Smith 1992) but the taxonomic status of this population was uncertain (Tolley & Burger 2004a). A detailed genetic study has revealed that this population and the Elandsberg one represent separate genetic lineages, each of which has *B. ventrale* as its closest extant relative (Tolley *et al.* 2006). However, this latter study could not show conclusively that the two populations are separate species and, because they are morphologically indistinguishable, they are currently treated as two distinct populations of a single species.

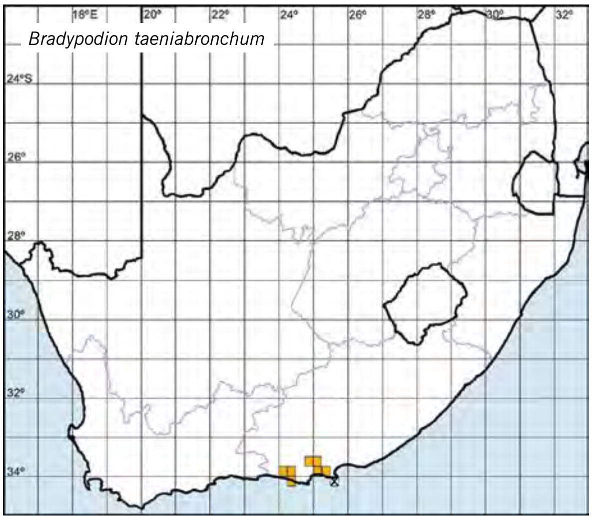
Distribution: Endemic to the southwestern parts of the Eastern Cape, South Africa. Found only in two disjunct mountain ranges, the Elandsberg (including the Vanstadensberg block) and the Kareedouw mountains, and in a wetland area near Cape St Francis. Some historical records suggest that the species previously inhabited suitable areas outside these known sites, e.g. Schoenmakerskop in Port Elizabeth and Van Stadens Wildflower Reserve near Port Elizabeth (Tolley & Burger 2004a). The species now appears to be absent from both of these localities (marked by a cross on the map). Schoenmakerskop was previously vegetated with fynbos but is now completely transformed. A recent survey of Van Stadens Wildflower Reserve produced no new records of this species (Tolley & Burger 2004a).

EOO: 5 850 km^2 (confidence: medium); AOO: 400 km^2 (confidence: medium).

Habitat: Montane fynbos, especially on mountain slopes at high altitude (Tolley & Burger 2007). A new population was discovered in 2009 in a wetland near Cape St Francis. The species is not found in intervening lowland fynbos or other vegetation types. It is not limited to *Protea* stands as was previously thought (Branch 1988b), but is often found on restios, ericas and Asteraceae.

Bioregion: Eastern Fynbos-Renosterveld.

Assessment rationale: This species has a small EOO and AOO (less than the Endangered threshold) and is known from only three locations [B1a+2a]. It is at risk due to large fluctuations in the number of mature individuals due to burning (both controlled and natural) of fire-prone fynbos [B1c(iv)+B2c(iv)]. One location (Elandsberg) is fragmented, particularly near Longmore Plantation. The second location (Kareedouw Mountains) is less fragmented and under protection by South African National Parks, but it requires management of alien invasive plants. The third location was discovered in 2009 and little is known about the extent of this population. Climate model projections using the Intergovernmental Panel on Climate Change A2 and B2 scenarios suggest that this species could suffer up



Bradypodion taeniabronchum—Lady's Slipper, Elandsberg, EC K.A. Tolley

to a 40% loss in climatically-suitable habitat in the next 100 years (Houniet *et al.* 2009). It has been extirpated in totally transformed parts of its range (e.g. Schoenmakerskop).

Threats: Some managed areas are under burn rotations for fynbos regeneration. Burn rotations on Longmore property are regimented and take into account the dispersal and re-colonisation potential (or lack thereof) of the chameleons, but such consideration is uncommon. Most of the remaining habitat in the Elandsberg is under provincial protection and burn rotations do not take chameleons into account. The number of locations is low and an uncontrolled fire could potentially decimate a large proportion of mature individuals. In 2005 an entire location (22 000 ha of pine and fynbos) in the Elandsberg was burned by two wildfires on subsequent days, leaving only small patches of vegetation surviving in ravines (K. Kirkman pers. comm.). The full effects of this fire on the chameleon population have not yet been assessed, although a brief survey in 2008 established that chameleons are present at the Van Stadensberg Natural Heritage Site in the Elandsberg (pers. obs.). Because each location has a unique genetic lineage (Tolley *et al.* 2006), the threat of natural or controlled fire is amplified.

Conservation measures: Restrict further habitat encroachment in protected areas and on private land. Take every opportunity to reclaim natural veld, and actively manage reclaimed areas. This should include the removal of invasive plants and regular control of encroachment. In areas where controlled burns are necessary for maintenance of fire-prone fynbos vegetation, limit the burn rotation to blocks that are as small as possible. Do not burn alternate blocks at intervals of less than four years, to allow for maturation of the veld and re-colonisation by chameleons (this rotation scheme is in place at Longmore Plantation). Another strategy at Longmore is to encourage fynbos growth in newly-planted pine compartments, until the fynbos is gradually shaded out by growing pines. This is done by strip-spraying with herbicides around the young trees, rather than blanket-spraying of the entire compartment (the latter would kill fynbos and promote grasses). For a period of approximately five years, the compartment comprises a mixture of fynbos and young pines. This practice could allow for additional temporary habitat for chameleons as compartments are rotated. Formulate a BMP-S that includes a plan for research and conservation actions.

Bradypodion thamnobates Raw, 1976

MIDLANDS DWARF CHAMELEON; NATAL MIDLANDS DWARF CHAMELEON

Krystal A. Tolley

Global: Vulnerable **B1ab(i,ii,iii)+2ab(i,ii,iii)**

Endemic

Taxonomy: Recent genetic studies show that this species is part of the *Bradypodion melanocephalum* species complex. Based on mitochondrial DNA markers, *B. melanocephalum* and *B. thamnobates* are poorly differentiated suggesting either a very recent evolutionary origin or continued gene flow between populations (Tolley *et al.* 2004). A fine-scale investigation using more sensitive genetic markers is needed. Morphological differences between the various forms in the complex were discussed by Da Silva & Tolley (2013).

Distribution: Endemic to KwaZulu-Natal, South Africa. It has a limited distribution and is generally found in the Midlands, particularly in the vicinity of Howick, Mooi River and Nottingham Road (Tolley & Burger 2007).

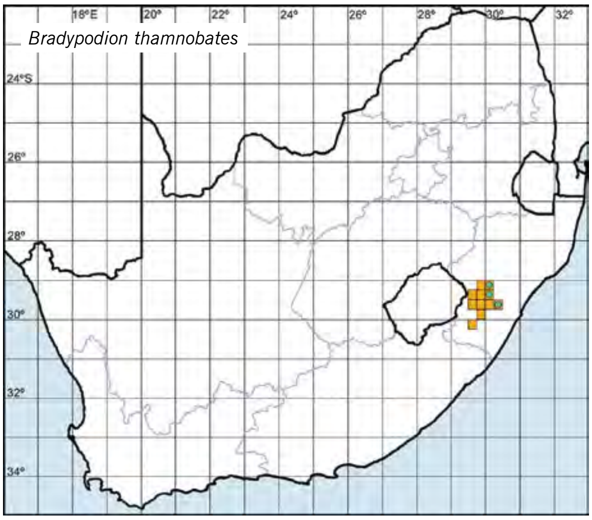
EOO: 7 150 km^2 (confidence: medium); AOO: 1 100 km^2 (confidence: medium).

Habitat: Found along road verges and in fragments of Southern Mistbelt Forest. Adults may inhabit any small patch of thick, structured vegetation, even if this comprises exotic plant species. Juveniles are often found in grassland and in more marginal habitat (Tolley & Burger 2007). This species is also found in gardens—especially those planted with trees and bushes—in small towns and on large estates.

Biome: Grassland; Forests.

Assessment rationale: Has a restricted range (EOO and AOO fall under the Vulnerable thresholds) but is locally common. Its current range is highly transformed and severely fragmented, under heavy anthropogenic pressure and poorly protected (Driver *et al.* 2005). It is considered Vulnerable under criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Threats: Much of the species' habitat has been given over to agriculture and large-scale wood plantations (pine and eucalyptus). Afforestation potential, with the associated risk of alien plant invasion, is high within the region



Bradypodion thamnobates—Howick, KZN M. Burger

(Rouget *et al.* 2004; Driver *et al.* 2005). Continuing land transformation could cause a further decline in the extent and quality of the remaining habitat.

Conservation measures: Conduct a full assessment of population structure and habitat use; this will contribute towards understanding the effects of habitat fragmentation on this species. Formulate a BMP-S that includes a plan for research and conservation actions.

Bradypodion transvaalense (FitzSimons, 1930)

NORTHERN DWARF CHAMELEON; WOLKBERG DWARF CHAMELEON; TRANSVAAL DWARF CHAMELEON

Krystal A. Tolley

Global: Least Concern

Endemic

Taxonomy: Considerable morphological variation exists within this species (Tolley & Burger 2007). Its taxonomy has been in question since Jacobsen (1989) suggested, on the basis of morphology, that it may contain up to nine different taxa. Although there have not been any phylogenetic studies on its taxonomy to date, limited data suggest that dwarf chameleons from within this species' distribution are monophyletic (Tolley *et al.* 2004). Despite this, there is some variation within this clade and this must still be assessed in a taxonomic framework.

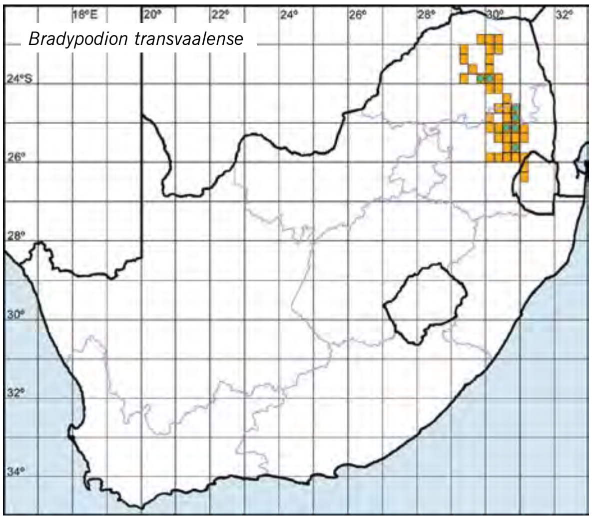
Distribution: Endemic to the *Atlas* region and found along the eastern escarpment and associated inselbergs. It occurs in South Africa from the Soutpansberg Range in the north, southwards through Limpopo and Mpumalanga provinces, to the Highveld of Swaziland (Tolley & Burger 2007).

Habitat: Found in forested patches along the eastern escarpment and associated areas (Tolley & Burger 2007), usually at high altitudes on mountain slopes and plateaus or in deep gorges. Jacobsen (1989) noted that this species also occurs in scrub-covered road verges near forests, and in gardens at Woodbush.

Biome: Forests.

Assessment rationale: Although *Bradypodion transvaalense* is geographically widespread, the area it occupies is restricted by its reliance on forested patches. It is abundant within these patches and is therefore of no conservation concern. However, this apparently large geographic range may actually contain several species rather than one. In addition, climate model projections using the Intergovernmental Panel on Climate Change A2 and B2 scenarios suggest that this species could suffer a 40% loss in climatically-suitable habitat in the next 100 years (Houniet *et al.* 2009). The species should therefore be re-assessed once a taxonomic or phylogenetic study has been completed and a climate model can be applied to any new taxonomy.

Conservation measures: Carry out a full taxonomic/phylogenetic assessment, as this species may include cryptic taxa represented by small populations of conservation importance.



Bradypodion transvaalense, female—Woodbush Forest, LIMP K.A. Tolley

Bradypodion transvaalense, male—Woodbush Forest, LIMP K.A. Tolley

Bradypodion transvaalense—Entabeni, Soutpansberg, LIMP K.A. Tolley

Bradypodion transvaalense—Bulembu border post, Swaziland D. Maguire

Bradypodion ventrale (Gray, 1845)

EASTERN CAPE DWARF CHAMELEON;
SOUTHERN DWARF CHAMELEON

Krystal A. Tolley

Global: Least Concern

Endemic

Taxonomy: Until recently there was confusion about the status of *B. ventrale* and *B. karooicum* (Branch 1998). Given the lack of clear morphological and genetic differences between these two species (Tolley *et al.* 2004), *B. karooicum* is now considered a junior synonym of *B. ventrale*. In some areas (e.g. near Uniondale and at Groendal Nature Reserve) there appear to be contact zones with other species and some individuals may be hybrids (Tolley *et al.* 2006).

Distribution: Endemic to South Africa. Has the widest range of all dwarf chameleons and is found across much of the Eastern Cape, southeastern Free State, eastern parts of the Western Cape (Uniondale and Beaufort West areas) and adjacent parts of the Northern Cape (Tolley & Burger 2007). Several introduced populations probably referable to this species occur in the Free State (Douglas 1992b), Gauteng and Northern Cape. It is likely that many specimens were translocated via the nursery plant trade.

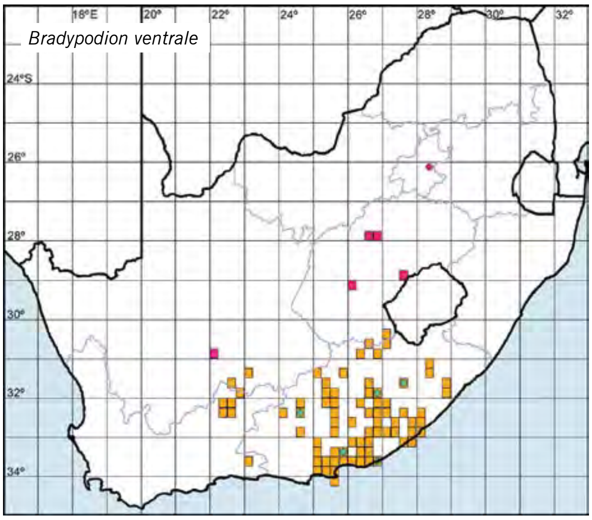
Habitat: Found across several biomes and considered a habitat generalist (Tolley & Burger 2007).

Biome: Grassland; Albany Thicket; Savanna; Nama-Karoo; Fynbos; Forests; Succulent Karoo.

Assessment rationale: Widespread and common. Climatic modelling suggests 15–20% loss of suitable habitat by 2080 (Houniet *et al.* 2009).

Conservation measures: None recommended.

Bradypodion ventrale—Cape Recife, Port Elizabeth, EC K.A. Tolley



Genus *Chamaeleo* Laurenti, 1768—typical chameleons

Chamaeleo is a widespread genus containing 14 species (Uetz 2012). Eleven species occur in Africa, although one species (*C. chameleon*) is found in northern Africa as well as southern Europe, and three species (*C. calyptratus*, *C. arabicus*, *C. zeylanicus*) are found from Arabia to Sri Lanka. The ranges of two species (*C. namaquensis*, *C. dilepis*) extend into the *Atlas* region. *Chamaeleo* are medium to large (200–300 mm total length), oviparous and mostly arboreal chameleons (Tolley & Burger 2007). Neither species in the *Atlas* region is of conservation concern.

Chamaeleo dilepis dilepis Leach, 1819

COMMON FLAP-NECK CHAMELEON

Krystal A. Tolley

Regional: Least Concern

Taxonomy: A number of subspecies of *C. dilepis* (*C. d. dilepis*, *C. d. idjwiensis*, *C. d. isabellinus*, *C. d. martensi*, *C. d. petersii*, *C. d. ruspolii*) are recognised, partly due to morphological variation across the species' very large geographic range (Klaver & Böhme 1997; Neças 2004). The validity of these subspecies is unclear and a detailed taxonomic revision of the species complex would be useful. A modern molecular assessment will probably elevate some subspecies to full species status, and show that others simply represent natural clinal variation. Included in the *C. dilepis* species complex are the extralimital species *C. roperi* and *C. quilensis*, but their taxonomic status also requires investigation. Tilbury (2010) considers all of the above-mentioned taxa, as well as *C. angusticoronatus*, as variants of a polymorphic *C. dilepis*. Only one subspecies is present in the *Atlas* region, namely *C. d. dilepis*.

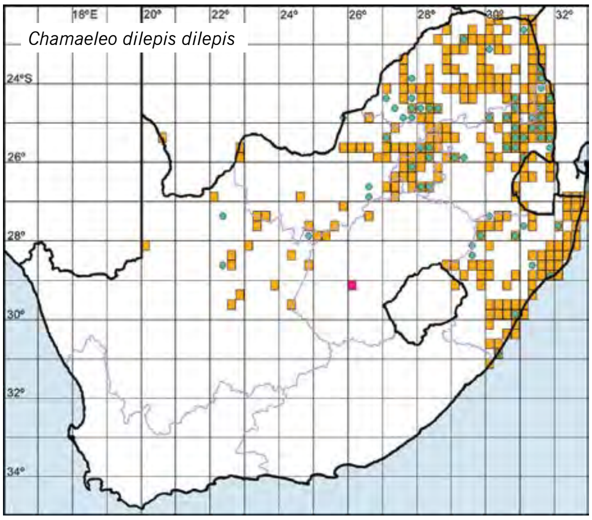
Distribution: This is one of the world's most widely distributed chameleons. It is found throughout southern, central and east Africa (Neças 2004), ranging from South Africa northwards to Ethiopia and westwards to Nigeria. In the *Atlas* region it occurs in Swaziland and the northern and eastern parts of South Africa, extending into savanna areas of the Northern Cape and northwestern Free State (Tolley & Burger 2007). Translocated specimens have been reported from gardens in Bloemfontein (Douglas 1992b).

Habitat: Occurs in a variety of habitats; usually found high up in bushes or trees (Tolley & Burger 2007).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Azonal Vegetation; Forests; Nama-Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Chamaeleo dilepis dilepis W.R. Schmidt

Chamaeleo namaquensis A. Smith, 1831

NAMAQUA CHAMELEON

Krystal A. Tolley

Regional: Least Concern

Taxonomy: This species represents a distinct phylogenetic lineage within *Chamaeleo* (Townsend & Larson 2002; Tolley *et al.* 2013). It diverged from other *Chamaeleo* approximately 38 mya (Tolley *et al.* 2013). Despite this, it is strongly supported as being in the *Chamaeleo* clade, and most other chameleon genera contain species or lineages of similar age. Therefore, although some suggestions have been made that this taxon could be representative of a separate genus (Townsend & Larson 2002; Tilbury 2010), the most parsimonious solution is to retain it within *Chamaeleo* in order to remain consistent within the context of the entire family.

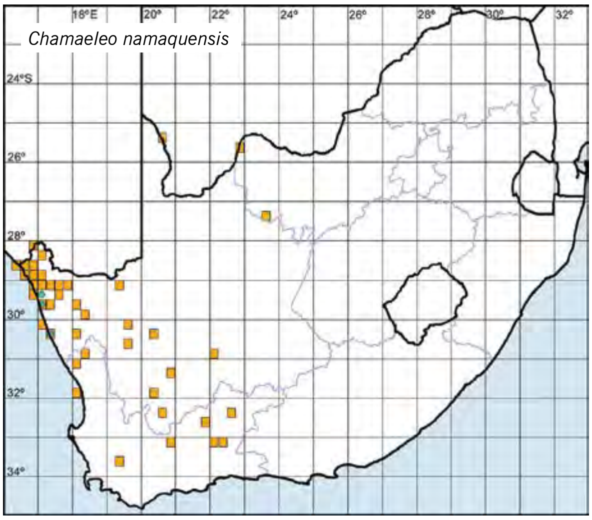
Distribution: Endemic to the southwestern parts of Africa, from southern Angola through western Namibia to the western half of South Africa (Tolley & Burger 2007). In South Africa it occurs in the Northern and Western Cape provinces and North-West Province. Found from the southwestern Karoo to Namaqualand. The southernmost record is near Worcester (3319CB), the most southwesterly record is near Prince Albert (3322AB), and the most inland record in the central Northern Cape is at Carnarvon (3022CC). Further surveys are required to confirm whether the disjunct records in the northern part of the Northern Cape and adjacent North-West Province represent one or more isolated populations. The latter records suggest that the species may also occur in Botswana.

Habitat: Terrestrial, living on gravel plains and sandy substrates in xeric regions (Neças 2004; Tolley & Burger 2007). Occasionally perches in bushes.

Biome: Succulent Karoo; Nama-Karoo; Savanna; Desert.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Chamaeleo namaquensis—Gaias, Namibia R. Babb

CHAPTER 17

Family Agamidae

Atherton L. de Villiers & Michael F. Bates

Previous classifications (e.g. Estes *et al.* 1988) placed the Agamidae as one of three families in the basal group Iguania, the others being the Iguanidae (iguanas) and Chamaeleonidae (chameleons). However, the recent molecular phylogeny of the Squamata (Vidal & Hedges 2009) recognises a derived clade, namely Toxicofera, that includes the Anguimorpha and Iguania of Estes *et al.* (1988) as well as snakes.

Agamidae is a large family distributed throughout most of the Old World, including mainland Africa, temperate and tropical Asia, southeastern Europe, Australia and some Indo-Australian islands (Pianka & Vitt 2003). The greatest diversity exists in Asia and Australia, where agamids are believed to have originated and from where they subsequently dispersed into Africa (Branch 1998; Amer & Kumazawa 2005). The family consists of 433 species in 53 genera (Uetz 2012). Subfamilial relationships within the family remain controversial, with up to six subfamilies being recognised by some authors. Only the Uromasticinae and Agaminae are represented in Africa, and only the latter is represented in the *Atlas* region.

In the *Atlas* region there are two genera, namely *Agama* and *Acanthocercus.* The genus *Agama* is widely distributed in Africa and consists of 47 species (Uetz 2012; Wagner *et al.* 2013; and including *A. knobeli*). Five species occur in the *Atlas* region: three terrestrial species (*A. aculeata*, *A. armata*, *A. hispida*), a rupicolous species (*A. atra*), and a species which could be regarded as being partly terrestrial and partly rupicolous (*A. anchietae*). *Acanthocercus* contains eight species of arboreal and rock-dwelling lizards found in the eastern half of sub-Saharan Africa and the Arabian Peninsula, but only one taxon (*A. a. atricolllis*) occurs in the *Atlas* region. The taxonomic status of some *Agama* in southern Africa is uncertain and new species are likely to be described. A recent preliminary study by Leaché *et al.* (2009) provided a phylogeny of African *Agama*, but further studies are needed to elucidate relationships (Branch *et al.* 2006a).

Agamids are small to large lizards that generally have a squat body, a large head with distinct neck, a relatively long tapering tail that cannot be autotomised or fully regenerated after being lost, and well-developed legs. Outside the *Atlas* region, bizarre forms with dorsal crests, colourful dewlaps and expandable appendages are common (FitzSimons 1943; Branch 1998; Pianka & Vitt 2003). One of the key distinguishing features of these lizards is their teeth, which are borne on the crest of the jawbones (arcodont) rather than on the inner side of the jaws (pleurodont) (Heying 2003).

As a group, agamid lizards are mainly terrestrial, but some are dependent on rocky (especially in Africa) or arboreal habitats. The family also includes semi-aquatic Asian forms that use water as a refuge (e.g. *Physignathus*—water dragons), as well as facultatively bipedal forms (e.g. *Chlamydosaurus*—frilled lizards) and gliding forms (e.g. *Draco*—flying dragons) (Pianka & Vitt 2003). Agamids are generally active during the day and have good vision. The diet of most species consists mainly of insects with some species apparently dependent on ants, but others are herbivores (e.g. *Hydrosaurus*—water lizards, *Uromastyx*—spiny-tail lizards) (Branch 1998; Pianka & Vitt 2003). Most African agamids (e.g. *Agama atra*) form social groups and are territorial. Males develop bright colours (e.g. blue head and throat) for courtship and territorial displays. Females of most species—including all African forms—are oviparous (4–18 eggs per clutch, often two clutches in a season; Branch 1998; Spawls *et al.* 2002), but females of a few species of the northern Eurasian genus *Phrynocephalus* give birth to young (Pianka & Vitt 2003).

None of the southern African taxa are of conservation concern.

Genus *Agama* Daudin, 1802—agamas

Agama is a large genus containing 47 species (Uetz 2012; Wagner *et al*. 2013; and including *A. knobeli*) of diurnal lizards that are widely distributed in Africa. Various species from the Arabian Peninsula were previously included in the genus *Agama* but have now been transferred to the genera *Acanthocercus*, *Laudakia*, *Trapelus* and *Pseudotrapelus* (Joger 1991; Spawls *et al.* 2002), rendering *Agama* an African endemic. A recent molecular phylogeny of the genus *Agama* identified monophyletic radiations in West, East and South Africa, as well as the Sahel (Leaché *et al.* 2009). Further research into phylogenetic relationships and biogeography in the genus are advanced (Leache 2012; S. Nielsen in prep.). There are 11 species in southern Africa and five of these occur in the *Atlas* region. One species has two subspecies, namely *A. aculeata aculeata* and *A. a. distanti*. Leaché *et al.* (2009) analysed representatives of all five species found in the *Atlas* region, and the study confirmed a close relationship between the largely rupicolous and communal species *A. atra* and *A. anchietae*, which together formed a sister group to the terrestrial and solitary (occasionally in pairs) ground agamas. Among the latter, *A. aculeata* and *A. armata* were more closely related to one another than either was to *A. hispida*. Females lay two or more clutches in a season, each clutch consisting of 5–18 eggs (Branch 1998). In just about every part of the *Atlas* region there is at least one, and in some places 2–3, species of *Agama. Agama hispida* is a near-endemic (its range extends peripherally into southern Namibia), whereas *A. armata* enters the *Atlas* region only in the northern parts of Limpopo Province. All taxa in the *Atlas* region are common and none are of conservation concern.

Agama aculeata aculeata Merrem, 1820

WESTERN GROUND AGAMA;
COMMON GROUND AGAMA

Michael F. Bates & Atherton L. de Villiers

Global: Least Concern

Taxonomy: The taxonomic status of the *Agama aculeata* species complex (*A. aculeata aculeata*, *A. a. distanti*, *A. armata*) should be investigated (Branch *et al.* 2006a). Taxa are currently based on morphological differentiation (McLachlan 1981) but a molecular analysis is required.

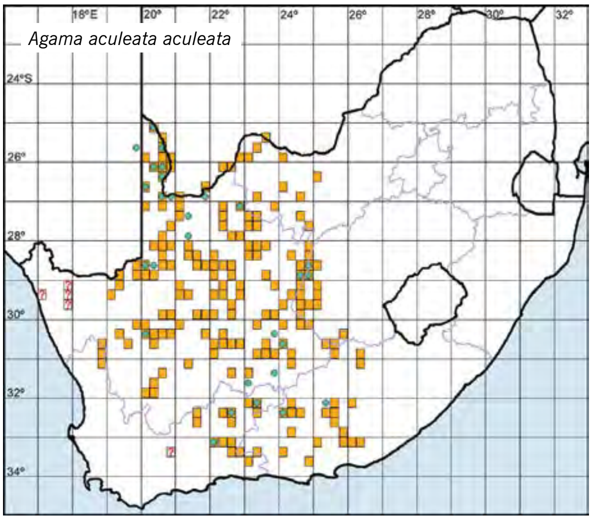
Distribution: Endemic to southern Africa where it has an extensive range. Occurs in southern Angola, most of Namibia except the Namib Desert, most of Botswana (but replaced in the east by *A. armata*), and the western half of South Africa (McLachlan 1981; Visser 1984i). In the latter region it is widely distributed in the Northern Cape, the western parts of North-West Province, Free State and Eastern Cape provinces, and the eastern parts of the Western Cape. A few records in the western Northern Cape and another in the Western Cape, indicated by question marks on the map, require confirmation. This subspecies is largely replaced in the western parts of the country by *A. hispida*.

Habitat: A largely terrestrial lowland agama often found in dry sandy areas where it takes refuge under thorny bushes such as Buffalo Thorn (*Ziziphus mucronata*) (De Waal 1978). It occasionally basks in the branches of bushes or trees, and retreats into burrows of small mammals or short self-excavated holes at the bases of bushes or under stones (Visser 1984i; Branch 1998).

Biome: Savanna; Nama-Karoo; Grassland; Albany Thicket; Succulent Karoo; Fynbos.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Agama aculeata aculeata—Farm Good Hope, 30 km SW of Prieska, NC
M. Burger

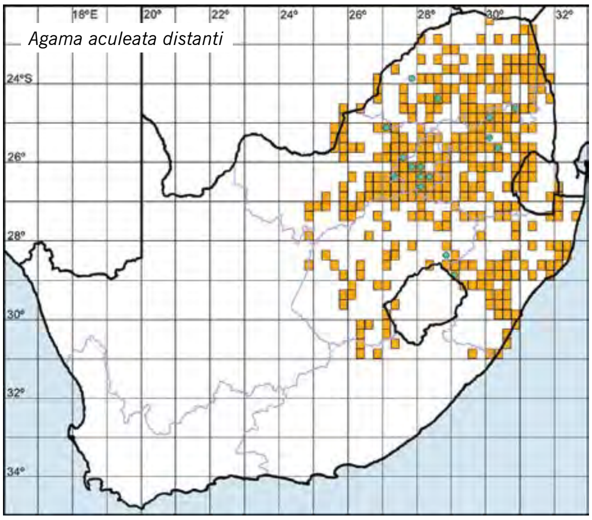
Agama aculeata distanti Boulenger, 1902

EASTERN GROUND AGAMA; DISTANT'S GROUND AGAMA

Michael F. Bates & Atherton L. de Villiers

Global: Least Concern

Endemic



Taxonomy: The taxonomic status of the *Agama aculeata* species complex (*A. aculeata aculeata*, *A. a. distanti*, *A. armata*) should be investigated (Branch *et al.* 2006a). Taxa are currently based on morphological differences (McLachlan 1981), but a molecular analysis is required. Although McLachlan (1981) referred ground agamas from KwaZulu-Natal to *A. a. armata*, we follow Jacobsen (1989) and Bourquin (2004) and treat these populations as *A. a. distanti*.

Distribution: Endemic to South Africa and Swaziland. This subspecies has an extensive range in the northeastern parts of the *Atlas* region where it occurs in Limpopo, Mpumalanga, Gauteng, much of North-West Province, Free State (excluding the southwest), KwaZulu-Natal and the northern parts of the Eastern Cape. There are no records in the Northern Cape, where *A. a. distanti* is replaced by *A. a. aculeata*. It may also occur in eastern Botswana, southern Mozambique and the western half of Lesotho.

Agama aculeata distanti—Schoemanskloof region, MPM M. Burger

Habitat: Found in grassland and woodland habitat, and sometimes in rocky areas, at altitudes of 20–1 800 m (Jacobsen 1989; Bourquin 2004). Mainly terrestrial but may climb into the branches of bushes or onto rocks, poles or termitaria, using these as vantage points, display platforms or for basking in the sun (De Waal 1978; Jacobsen 1989; Branch 1998). Often found at the fringes of shrubs or foraging among grass tussocks, and less commonly under stones partly buried in the soil; takes refuge in mammal burrows, the branches of shrubs, and holes in old termite mounds (Jacobsen 1989).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and fairly common.

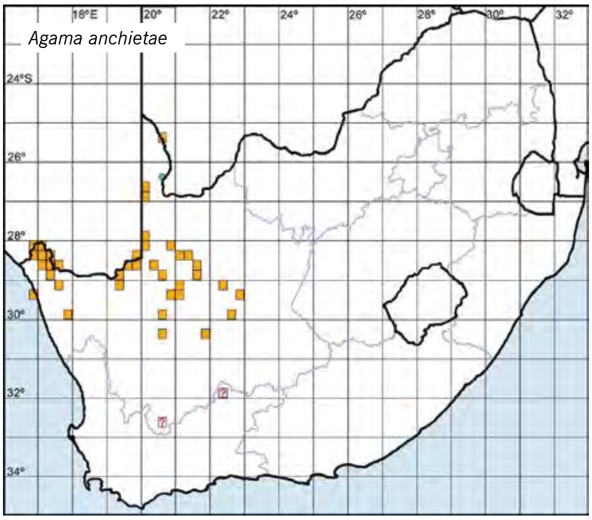
Conservation measures: None recommended.

Agama anchietae Bocage, 1896

ANCHIETA'S AGAMA

Atherton L. de Villiers & Michael F. Bates

Regional: Least Concern



Taxonomy: A comprehensive phylogeny of African *Agama* is required and the taxonomic status of various taxa should be investigated (Branch *et al.* 2006a). Some molecular work has been done on phylogenetic relationships among southern African *Agama*, and the status of *A. anchietae* as a species distinct from *A. atra* was confirmed by Matthee & Flemming (2002) using sequence data. Morphologically, however, this species may be confused with *A. atra*, *A. hispida* and *A. aculeata*.

Distribution: This species has an extensive geographical range that extends from the northwestern part of South Africa northwards through Namibia and Angola to the southern Democratic Republic of the Congo (McLachlan 1981; Visser 1984i; Branch 1998). In South Africa, it apparently occurs only in the Northern Cape. However, there are two questionable southerly records, one near Sutherland (3220DA) in the Northern Cape and another at Dunedin (3122CD) in the Western Cape. Because this species is easily confused with other agamas (*A. atra*, *A. hispida*, *A. aculeata*), the identity of the specimens involved requires confirmation.

Habitat: A partly terrestrial and partly rupicolous lizard that occurs in flat, dry, sparsely-vegetated areas. Typically associated with bedrock, small piles of rocks and broken ground; one was found in the lower branches of a tree (Branch 1994a, 1998; Bauer & Branch 2003 [2001]). Prefers small rubble fields and low rock outcrops (W.R. Branch pers. comm.).

Biome: Nama-Karoo; Desert; Succulent Karoo; Savanna.

Assessment rationale: Has a widespread distribution in fairly remote areas where land transformation is generally not a threat.

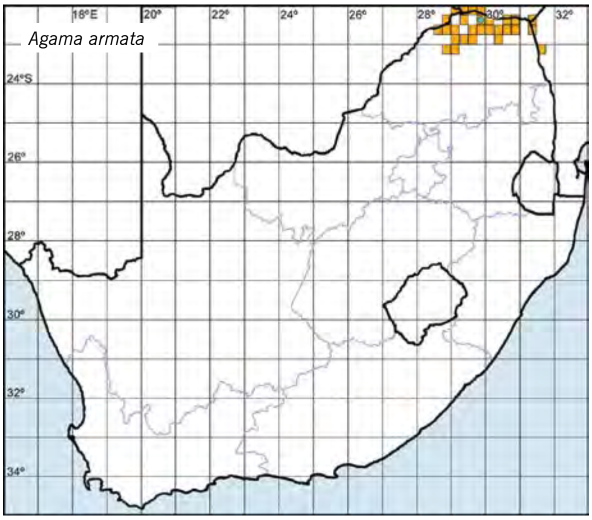
Conservation measures: None recommended.

Agama anchietae—S of Grootdrink, NC M. Burger

Agama armata Peters, 1854

NORTHERN GROUND AGAMA; PETERS' GROUND AGAMA

Atherton L. de Villiers & Michael F. Bates



Regional: Least Concern

Taxonomy: The taxonomic status of the *A. aculeata* species complex (*A. aculeata aculeata*, *A. a. distanti*, *A. armata*) requires investigation (Branch *et al.* 2006a). There has been much confusion about the identification and geographical range of *A. armata* (e.g. Branch 1998), a species that is easily confused with *A. aculeata distanti*. *Agama armata* was considered a subspecies of *A. aculeata* by McLachlan (1981). However, a taxonomic study by Jacobsen (1992c) determined that *A. armata*, sometimes sympatric with *A. aculeata distanti*, has a different gular pattern. According to Jacobsen (1992c) the distribution of *A. armata* in the *Atlas* region is restricted to the northern half of Limpopo, with the exception of a Swaziland record (not plotted here) which is considered to probably be referable to *A. aculeata distanti*. The findings of Jacobsen (1992c) are accepted for the time being because there is no contradictory evidence.

Distribution: Has an extensive distribution that ranges southwards from Kenya and Tanzania (Spawls *et al.* 2002) to Zambia, Malawi, Mozambique, Zimbabwe, Caprivi Strip of Namibia, eastern Botswana (FitzSimons 1943; McLachlan 1981; Branch 1998) and South Africa, where it is restricted to the northern half of Limpopo (Jacobsen 1992c).

Habitat: A terrestrial and mainly solitary species associated with areas of deep sand, calcrete flats and open woodland (Jacobsen 1989; Branch 1998, 2005). Often shelters under flat, partially-buried rocks (Jacobsen 1989) and uses a short burrow dug into sandy soil at the base of a bush, or a rodent tunnel, for temporary shelter (Branch 1998, 2005). In South Africa it is found at altitudes of 400–800 m (Jacobsen 1989). In East Africa the species occurs on open plains, in rock outcrops and sheet rock, and shelters in crevices, under rocks or in holes; also known to climb bushes and trees to bask in the sun (Spawls *et al.* 2002).

Agama armata—Greater Kuduland Safaris, E of Tshipise, LIMP M. Burger

Bioregion: Mopane.

Assessment rationale: Widespread and apparently relatively common.

Conservation measures: None recommended.

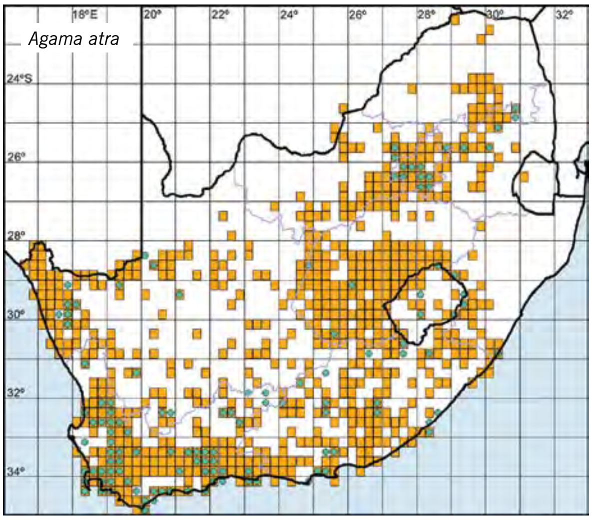
Agama atra Daudin, 1802

SOUTHERN ROCK AGAMA;
SOUTH AFRICAN ROCK (OR MOUNTAIN) AGAMA

Atherton L. de Villiers & Michael F. Bates

Global: Least Concern

Near-endemic



Taxonomy: A phylogeny of all African *Agama* is required and the taxonomic status of various taxa needs further investigation (Branch *et al.* 2006a). Some work has been done on the phylogenetic relationships among southern African *Agama*. One such study indicated the existence of three main clades in the *A. atra* complex, namely a southern-eastern clade, a northern-central clade (including Namaqualand) and a Namibian clade (comprising *A. atra knobeli*) (Matthee & Flemming 2002). A subsequent phylogeographic study of *A. atra* in the Cape Floristic Region (part of the southern-eastern clade) revealed the existence of four geographically distinct clades of unresolved taxonomic status in this region (Swart *et al.* 2009). This study also confirmed that the Northern Cape and Namibian populations were genetically distinct from one another, with the Namibian population being recognised as a full species, namely *A. knobeli*. The taxonomic status of the large-bodied Northern Cape populations (see Flemming 1996) is currently being investigated (M.F. Bates *et al.* in prep.). *Agama atra knobeli* was recorded from the Richtersveld area of Namaqualand (as far south as the Knersvlakte), apparently based on a larger caudal crest than in *A. atra* and medially-oriented dorsal imbrication (Branch 1988b, 1998; Bauer & Branch 2003 [2001]). However, both of these characters are likely to be variable and interpreted subjectively, so for now *A. knobeli* is considered a Namibian endemic, based on the molecular analyses discussed above.

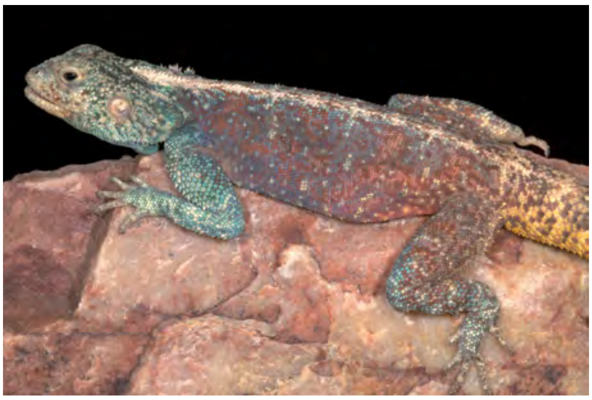
Distribution: Endemic to southern Africa. Occurs virtually throughout South Africa and Lesotho, southeastern Namibia, southeastern Botswana and western Swaziland, wherever there is suitable rocky habitat. However, it is absent from most of KwaZulu-Natal except the Drakensberg and southeastern parts (Bourquin 2004), and is inexplicably absent from large parts of the northern Free State, even where apparently suitable rocky habitat is available (De Waal 1978). Some records in the Northern Cape could represent an undescribed species (M.F. Bates *et al.* in prep.).

Habitat: A rupicolous lizard found in a variety of rocky habitats, ranging from seashore rocks to rocky hillsides to mountain tops (De Waal 1978; Jacobsen 1989, Branch 1998), from sea level (e.g. Llandudno) to at least 2 200 m (Monontsa Pass) (M.F. Bates pers. obs.). Shelters in rock crevices and under rocks.

Biome: Fynbos; Grassland; Succulent Karoo; Savanna; Nama-Karoo; Albany Thicket; Desert; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common, often abundant.

Conservation measures: If it is determined that this species consists of various cryptic species, a re-appraisal of conservation status may be necessary.



Agama atra—34 km SE of Kanye, E Botswana W.R. Branch

Agama atra, gravid female—W of Groblershoop, NC M. Burger

Agama hispida (Kaup, 1827)

SOUTHERN SPINY AGAMA; CAPE SPINY AGAMA

Michael F. Bates & Atherton L. de Villiers

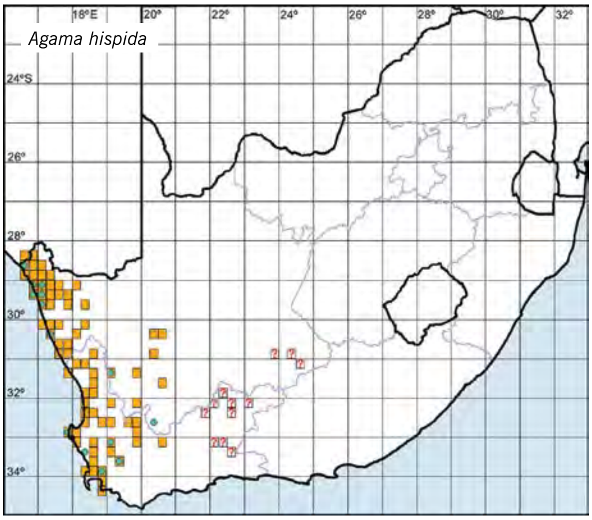
Global: Least Concern

Near-endemic

Taxonomy: A comprehensive molecular phylogeny of all southern African agamas is needed to determine relationships. The taxonomic status of populations in the northwestern Free State previously assigned to this species (De Waal 1978; Bates 1992, 1996a) is being re-investigated (M.F. Bates in prep.), and some other easterly records (e.g. McLachlan 1981) may be referable to *A. a. aculeata* or a similar agamid. Therefore, most records east of 20° longitude should be investigated and the identity of lizards in these areas established.

Distribution: Endemic to South Africa and adjacent southwestern Namibia (McLachlan 1981). In South Africa it occurs mainly along the West Coast in the winter rainfall areas of the Northern and Western Cape provinces. Several records (question marks on map) from the Nama-Karoo, including the De Aar-Hanover and Beaufort West areas, may refer to *A. a. aculeata*. Two isolated populations in grassland habitat in the northwestern Free State (not plotted on map) may represent a cryptic taxon (M.F. Bates in prep.).

Habitat: Found in flat sparsely-vegetated areas of the Fynbos Biome in the southwestern parts of South Africa, and the Succulent Karoo Biome in Namaqualand and adjacent areas, particularly in the sandy coastal lowlands. In the rest of its range it occurs mainly in flat sparsely-vegetated



karroid habitats. Terrestrial and solitary, seeking refuge in holes under large tufts of grass, small bushes or shrubs (FitzSimons 1943; Visser 1984i). Individuals construct short tunnels at the base of bushes, or use small mammal burrows (Branch 1998).

Biome: Succulent Karoo; Fynbos; Nama-Karoo; Desert (marginally).

Assessment rationale: Widespread and fairly common.

Conservation measures: If the Free State populations are referable to a new taxon, then a separate assessment will be needed.

Agama hispidal, male—Strandfontein, West Coast, WC T. Fouché

Agama hispida, female—near Sutherland, NC J. Marais

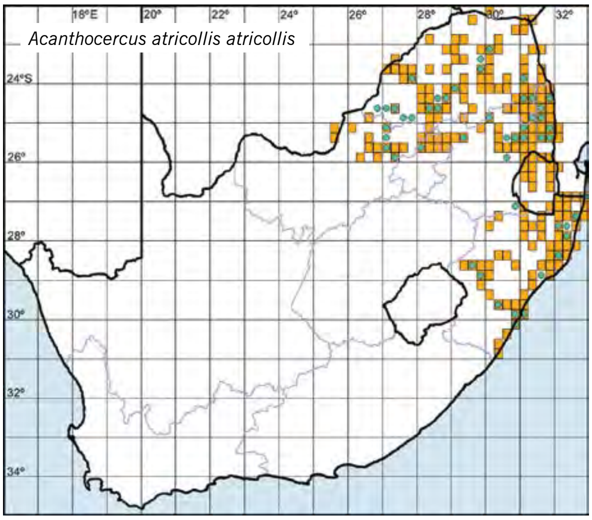
Genus *Acanthocercus* Fitzinger, 1843—tree and rock agamas

Moody (1980) partitioned the genus *Agama* into five genera, including *Stellio*. Although the name *Stellio* is sometimes still applied to agamas, it is unavailable because it was first used for a monitor lizard (*Stellio saurus* Laurenti, 1768—a junior synonym of *Varanus niloticus* Linnaeus, 1766). *Stellio*, as used by Moody (1980), included Eurasian and African agamids, but these were later separated and the name *Acanthocercus* was applied only to African species and two Arabian species (Baig & Böhme 1997). *Acanthocercus* currently contains eight species (Uetz 2012), five of which are restricted to the Horn of Africa and two to the Arabian Peninsula. The remaining species, *A. atricollis* (including a few subspecies), is found mainly in the eastern half of sub-Saharan Africa, entering the *Atlas* region in the northeastern and eastern parts. Preliminary results of a molecular and morphological analysis of *Acanthocercus* indicate that it consists of several distinct genera (Wagner & Bauer 2012). Up to three species of *Acanthocercus* may occur in southern Africa, including *A. atricollis*, the recently described *A. branchi* (Wagner *et al.* 2012b), and another species in Namibia, Angola and Zambia (P. Wagner pers. comm. 2012). Tree and rock agamas are large, diurnal, communal agamids. Some species are rock-dwelling but others, like *A. a. atricollis*, are primarily arboreal. Females lay 4–15 eggs per clutch (Spawls *et al.* 2002). In the *Atlas* region this subspecies is widespread and common, and not of conservation concern.

Acanthocercus atricollis atricollis (A. Smith, 1849)

SOUTHERN TREE AGAMA; TREE AGAMA; BLACK-NECKED AGAMA

Michael F. Bates & Atherton L. de Villiers



Regional: Least Concern

Taxonomy: Further investigation of the taxonomic status of this species is required. Klausewitz (1957) established six subspecies but the species was treated as being monotypic by Broadley & Howell (1991). The status of these poorly-defined subspecies, of which only *A. a. atricollis* occurs in southern Africa (Branch 1998), is being re-investigated (P. Wagner pers. comm.). Preliminary results indicate that several subspecies should be elevated to species rank (Wagner & Bauer 2012).

Distribution: Has an extensive but somewhat fragmented distribution, ranging southwards and southwestwards from Ethiopia through East Africa and Angola into southern Africa, where it occurs in parts of Namibia, Botswana, Zimbabwe, Mozambique, South Africa and Swaziland (FitzSimons 1943; Branch 1998; Clauss & Clauss 2002; Branch 2005). In the *Atlas* region it has a relatively wide distribution in Limpopo, the northern and eastern parts of Mpumalanga, northern Gauteng, northeastern North-West Province, KwaZulu-Natal and Swaziland. There are some records within the Grassland Biome (e.g. 2730CA, 2830AD), but it may be that these areas are wooded or

Acanthocercus atricollis atricollis, male—Skukuza, Kruger NP, MPM
J. Marais

Acanthocercus atricollis atricollis, female—Lower Sabie, Kruger NP, MPM
W.R. Schmidt

that the lizards there are living on buildings and/or trees in gardens.

Habitat: Largely arboreal and typically associated with large trees, but sometimes found among rocks (Spawls *et al.* 2002; Jacobsen 2005) or on walls. Individuals cross open ground only when moving between trees, but may forage at or around the tree base and bury their eggs in moist soil (Jacobsen 1989, 2005; Branch 1998). They take refuge and sleep under loose bark, in hollow branches, or in holes or crevices in tree trunks (Branch 1998; Jacobsen 2005). Found in woodlands and wooded grasslands in KwaZulu-Natal (Bourquin 2004).

Biome: Savanna; Indian Ocean Coastal Belt; Grassland.

Assessment rationale: Widespread and very common in certain parts of its range, especially in bushveld areas (FitzSimons 1943; Jacobsen 1989).

Conservation measures: None recommended.

CHAPTER 18

Family Typhlopidae

G. John Measey & William R. Branch

Relationships between the main basal groups within snakes have yet to be resolved. One lineage, the scolecophidians, comprises a number of families of so-called 'blind snakes'. A recent phylogeny of scolecophidians (Vidal *et al.* 2010) reveals a long Gondwanan history and an initial diversification of the group following the separation of East and West Gondwana. Subsequent radiation was accompanied by several oceanic dispersal events, while their exceptional diversification in the Cenozoic was probably linked to a parallel radiation of prey (ants and termites). The main clades of scolecophidians diverged in the Jurassic and Cretaceous between 159 and 97 million years ago, and the very deep genetic divergence between these clades has necessitated the recognition of two new scolecophidian families; the Xenotyphlopidae from Madagascar and the Gerrhopilidae from Sri Lanka to Papua New Guinea (Vidal *et al.* 2010).

The Typhlopidae is the most diverse scolecophidian family and comprises small- to large-bodied snakes (252 species in 10 genera, Uetz 2012). Scolecophidians typically have conservative morphologies and it is therefore often difficult to distinguish between species. This has probably led to an under-appreciation of their diversity. A preliminary phylogeny of the family (Vidal *et al.* 2010) recovered multiple examples of paraphyly that will require nomenclatural revision.

The two new genera *Afrotyphlops* and *Megatyphlops*, and the genus *Rhinotyphlops*, proposed for African typhlopids (Broadley & Wallach 2009) appear to form monophyletic lineages (Vidal *et al.* 2010). However, greater taxon sampling is required to assess species assignments and to compare levels of genetic divergence within and between the identified clades. Where molecular phylogenetic techniques have been used, extensive cryptic radiations have been described (e.g. West Indies, Thomas & Hedges 2007). Current assignments of typhlopids within the *Atlas* region are based on morphological studies, with molecular phylogenetic analysis at a preliminary stage. It is likely that such assessments will greatly increase the number of African genera and species, as they have done for Australian and Caribbean typhlopids and African leptotyphlopids (Adalsteinsson *et al.* 2009).

Typhlopids are cosmopolitan, with their core distribution in the tropics. Few species occur in temperate areas in either hemisphere. Within the *Atlas* region, four genera are known. One of these, *Ramphotyphlops*, has a single species (Brahminy Blind Snake, *R. braminus*) introduced from Asia. It is not assessed here although an account is presented. *Ramphotyphlops braminus* is parthenogenetic and has apparently spread around the world with horticultural products such as potted plants. The other three genera are *Afrotyphlops* (16 species, two in the *Atlas* region), *Megatyphlops* (four species, two in the *Atlas* region) and *Rhinotyphlops* (four species, two in the *Atlas* region). Some species are widespread (e.g. *R. lalandei*) while others (e.g. *A. fornasinii*) have restricted ranges.

Blind snakes are characterised by tubular bodies, very short tails, uniform scalation around the body, and reduced eyes covered by head shields. Most species are pink or brown, often with irregular dark blotches. Although most species in the family are small, two of the species in the *Atlas* region, namely *M. schlegelii* and *M. mucruso*, are among the largest blind snakes, growing to 1 m in length. This is reflected in their new generic name, *Megatyphlops* (Broadley & Wallach 2009). The mouths of blind snakes are characteristically very small and they use the toothed maxillary bones of their upper jaws to rake in large numbers of small prey very quickly (Webb & Shine 1993; Kley 2001). These harmless snakes are non-venomous and live underground where they prey on social insects such as ants and termites (Webb *et al.* 2001). In most species, females lay 4–25 eggs per clutch in late summer and these hatch in autumn (Webb *et al.* 2001). Bibron's Blind Snake (*A. bibronii*), however, lays thin-shelled eggs at an advanced stage of development, which hatch in 5–8 days (Erasmus & Branch 1983).

Globally there are currently 61 taxa in this poorly-known family on the Red List, 30 of which are listed as Data Deficient and seven of which are in threatened categories (IUCN 2010b). The species in the *Atlas* region are mostly widespread and common and none are considered to be of conservation concern. However, little is known about the ecology of most species, including how they might be impacted by alien invasives such as the Argentine Ant *Linepithema humile*.

Genus *Afrotyphlops* Broadley & Wallach, 2009—African blind snakes

Afrotyphlops is a genus of sub-Saharan blind snakes containing 16 species (Broadley & Wallach 2009). The two local species (*A. bibronii*, *A. fornasinii*) both occur in the eastern half of the *Atlas* region. They live underground and feed mostly on ant pupae, which are raided from nests (Webb *et al.* 2001). Females lay 5–14 eggs per clutch; eggs of *A. bibronii* hatch after only 5–8 days (Erasmus & Branch 1983; Branch 1998). Both species are common and wide-ranging and are thus not considered threatened.

Afrotyphlops bibronii (A. Smith, 1846)

BIBRON'S BLIND SNAKE

G. John Measey

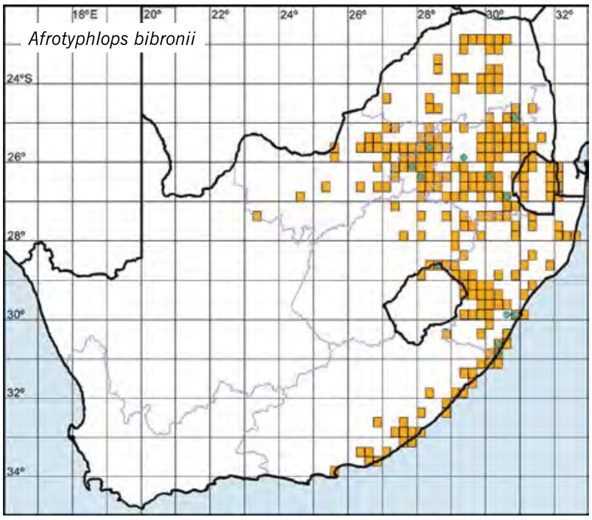
Global: Least Concern

Near-endemic

Taxonomy: Previously known as *Typhlops bibronii*, but placed in the new endemic African genus *Afrotyphlops* by Broadley & Wallach (2009). The taxonomic status of the isolated population in eastern Zimbabwe should be investigated using molecular techniques.

Distribution: Endemic to southern Africa, occurring mainly in the eastern half of the *Atlas* region and in extreme eastern Botswana (Broadley & Wallach 2009). A relict population exists in eastern Zimbabwe and another may be present in adjacent Mozambique (Broadley 1990b). *Atlas* data suggest that this species also occurs in the southernmost parts of Mozambique.

Habitat: Burrows in loose soil and apparently moves into surface soils in search of macro-invertebrate prey items, especially after rain (Broadley 1990b). Found in old termitaria, and in or on soil under rocks and rotting logs (De Waal 1978; Jacobsen 1989). Occurs at altitudes of 0–2 000 m (Broadley & Wallach 2009).



Biome: Grassland; Savanna; Indian Ocean Coastal Belt; Albany Thicket.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Afrotyphlops bibronii—near Wolkberg hut, Wolkberg Wilderness Area, LIMP
M. Burger

Afrotyphlops bibronii—Pretoria, GP J. Marais

Afrotyphlops fornasinii (Bianconi, 1849)
FORNASINI'S BLIND SNAKE

G. John Measey

Regional: Least Concern

Taxonomy: Previously known as *Typhlops fornasinii*, but placed in the endemic African genus *Afrotyphlops* by Broadley & Wallach (2009). The taxonomic status of the insular populations off the coast of Mozambique should be investigated using molecular techniques, as should the population in southeastern Zimbabwe.

Distribution: Endemic to southern Africa. Found on the coastal plains of northern KwaZulu-Natal and southern Mozambique as far north as Maputo and the adjacent offshore islands. An isolated population occurs in southeastern Zimbabwe (Broadley 1990b; Branch 1998; Broadley & Wallach 2009).

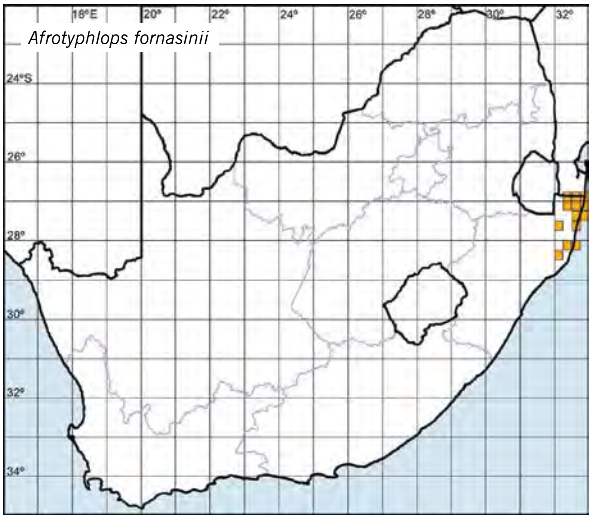
Habitat: Found in coastal sand associated with leaf litter (Branch 1998), at altitudes of 0–100 m (Broadley & Wallach 2009).

Bioregion: Indian Ocean Coastal Belt; Lowveld.

Assessment rationale: This species has a small EOO (5 000 km^2, on the Endangered threshold) and fairly small AOO (4 000 km^2) within the *Atlas* region (both estimates made with a low level of confidence). However, it is common and appears to be tolerant of moderate habitat change.

Conservation measures: None recommended.

Afrotyphlops fornasinii—St Lucia, KZN J. Marais



Genus *Megatyphlops* Broadley & Wallach, 2009—giant blind snakes

Megatyphlops is an African genus comprising four species (Broadley & Wallach 2009), two (*M. schlegelii*, *M. mucruso*) of which are present in the *Atlas* region. As their name suggests these are large snakes (up to 1 m long), and *M. mucruso* is the largest of all blind snakes. The other members of the genus occur elsewhere in eastern and southern Africa. These snakes live much deeper underground than other scolecophidians and are seldom seen. Females usually lay clutches of 12–40 eggs (Branch 1998). They are widespread and not considered to be threatened.

Megatyphlops mucruso (Peters, 1854)

ZAMBEZI GIANT BLIND SNAKE;
ZAMBEZI BEAKED BLIND SNAKE

G. John Measey

Regional: Least Concern

Taxonomy: Previously known by the name *Rhinotyphlops schlegelii mucruso*, but elevated to full species status and placed in the new genus *Megatyphlops* by Broadley & Wallach (2009).

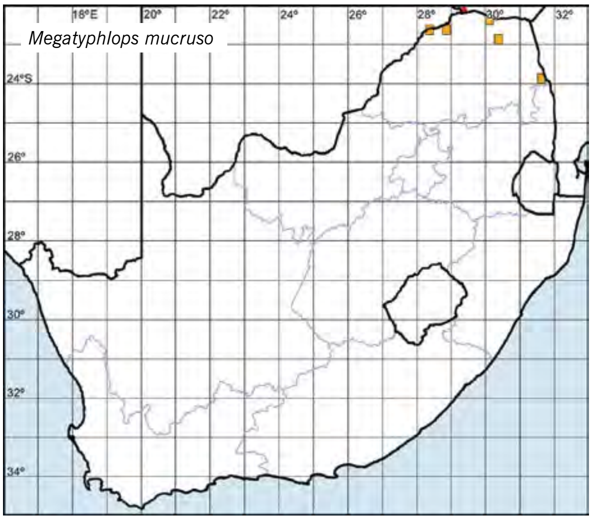
Distribution: Found in northern Limpopo, South Africa, extending northwards through Zimbabwe, central and northern Mozambique, to coastal Kenya and into the southern Congo basin, including northeastern Angola (Broadley 1990b; Broadley & Wallach 2009). The record in QDGC 2331DC should be checked as it falls within the range of the closely-related *M. schlegelii*.

Habitat: Uses its horny beak to penetrate hard substrates, including termitaria. Occurs at altitudes of 250–900 m in Limpopo (Jacobsen 1989), and elsewhere at 0–1 740 m (Broadley & Wallach 2009).

Bioregion: Mopane; Lowveld.

Assessment rationale: Has a fairly restricted range within the *Atlas* region but is probably common and does not appear to be threatened. Outside this region it is also likely to be Least Concern.

Conservation measures: None recommended.



Megatyphlops mucruso—Waterpoort, LIMP W.D. Haacke

Megatyphlops schlegelii (Bianconi, 1847)

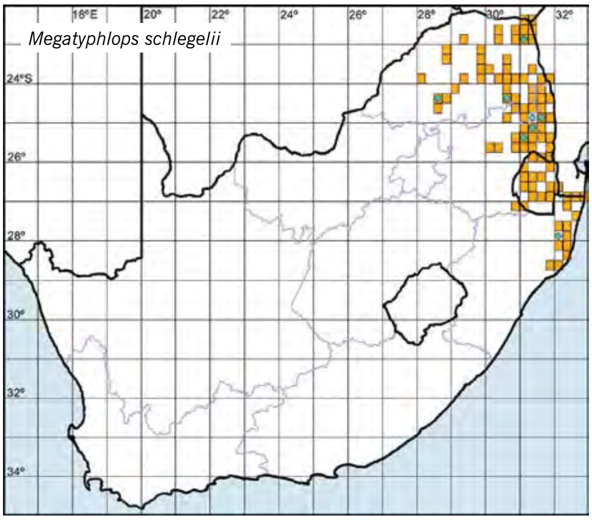
SCHLEGEL'S GIANT BLIND SNAKE;
SCHLEGEL'S BEAKED BLIND SNAKE

G. John Measey

Regional: Least Concern

Taxonomy: Until recently, four subspecies were recognised under the name *Rhinotyphlops schlegelii* (*schlegelii*, *petersii*, *mucruso*, *brevis*; see Hahn 1980), but the latter two have now been elevated to species status within the genus *Megatyphlops* (Broadley & Wallach 2009). *Rhinotyphlops s. petersii* is considered a junior synonym of *M. schlegelii* (Broadley & Wallach 2009). It would be worthwhile to test the hypotheses proposed in the morphology-based taxonomic revision by means of a molecular investigation of all species in the genus.

Distribution: Endemic to the southern half of Africa. Found in Limpopo, eastern Mpumalanga, Swaziland and north-



eastern KwaZulu-Natal, as well as southern Mozambique, eastern Botswana, northern Namibia and southern Angola (Broadley & Wallach 2009). Broadley & Wallach (2009) omitted an isolated cluster of records from Gauteng (see Broadley 1990b) and these records have also been excluded from the current assessment. They may, however, require further investigation.

Habitat: Uses its hardened beak to burrow into compact soil, including termitaria, in search of its social macro-invertebrate adult and larval prey (Kley 2001). Most often seen when crossing roads after rain; occurs at altitudes of 200–1 200 m in Limpopo and Mpumalanga (Jacobsen 1989) and 0–200 m in KwaZulu-Natal (Bourquin 2004).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Megatyphlops schlegelii—Klaserie, LIMP D. Pietersen

Genus *Ramphotyphlops* Fitzinger, 1843—Australasian blind snakes

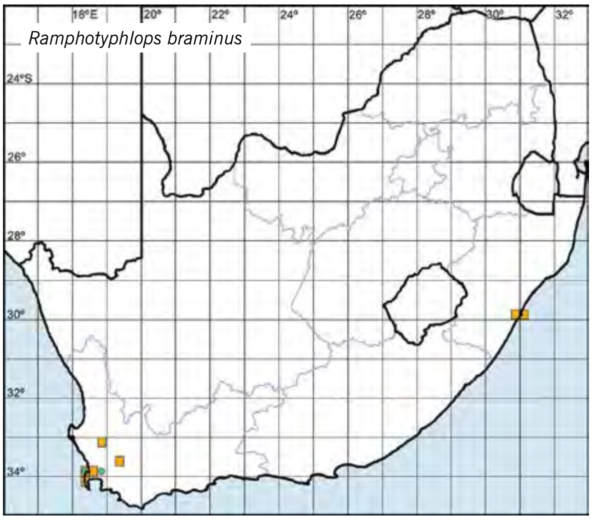
Ramphotyphlops is a genus of Australasian blind snakes currently containing 27 species (Uetz 2012), most of which occur in Australia. These snakes are restricted to Southeastern Asia, the Philippines, Indonesia, Papua New Guinea, and islands of the Indian and western Pacific Oceans, except for *R. braminus* (see below) which has been introduced throughout tropical and subtropical regions of the world (Broadley & Wallach 2009). Males are characterised by an unusual hemipenis with a solid terminal awn (McDowell 1974), while females of all species—except the all-female parthenogenetic *R. braminus*—are oviparous and lay small clutches of eggs, usually about 13 but exceptionally up to 34 (Shine & Webb 1990).

Ramphotyphlops braminus (Daudin, 1803)

BRAHMINY BLIND SNAKE; FLOWERPOT SNAKE

William R. Branch

Ramphotyphlops braminus—Durban, KZN J. Marais



Not Applicable

Taxonomy: Paradoxically, this was one of the first snake species to be recorded from South Africa (as *Onychocephalus Capensis* Smith, 1838). It was first recognised as being referable to *Typhlops* (= *Ramphotyphlops*) *braminus* by McLachlan (1978b) based on the existence of a population on the Cape Peninsula.

Distribution: Found in South East Asia from Philippines to northern Australia and now also known to have been transported to numerous other countries (Broadley & Wallach 2009). Found on the East African coastal plain from Somalia to Beira in Mozambique, with isolated populations now established in Durban and Cape Town. Recently introduced into Egypt (Baha el Din 1996), Central African Republic (Chirio & Ineich 1997) and Libya (Joger *et al.* 2008). In most areas it is restricted to the coastal plain (Branch 1998), but in Tanzania it is known from localities almost 200 km inland (Loveridge 1955). Reported from Cape Town by McLachlan (1978b) and subsequently from Durban by Alexander (1987). Recently found inland in the Western Cape, at Worcester (3319CB) in 1997, and Porterville (3318BB) in 2002 (Turner *et al.* 2007).

Habitat: Usually found in urban gardens where it burrows in moist soil under rocks and rotting logs (Branch 1998). McDowell (1974) first demonstrated that this is an all-female species and the only known parthenogenetic, triploid snake.

Biome: Fynbos, Indian Ocean Coastal Belt.

Assessment rationale: Not assessed as it is an introduced species.

Conservation measures: None recommended.

Genus *Rhinotyphlops* Fitzinger, 1843—beaked blind snakes

Rhinotyphlops is endemic to central, eastern and southern Africa, and contains four species (*R. lalandei*, *R. schinzi*, *R. boylei*, *R. leucocephalus*). The first two species occur in the *Atlas* region, whereas *R. boylei* is restricted to Namibia and Botswana, and *R. leucocephalus* is restricted to Somalia (Broadley & Wallach 2009). *Rhinotyphlops boylei* may occur in the Mier-Kalahari of the Northern Cape. These harmless snakes live underground and feed on termites and ant brood (Webb *et al.* 2001). Females lay small clutches of 2–4 eggs (Branch 1998). Neither species in the *Atlas* region is considered to be threatened.

Rhinotyphlops lalandei (Schlegel, 1839)

DELALANDE'S BEAKED BLIND SNAKE

G. John Measey

Regional: Least Concern

Taxonomy: The taxonomy would be improved by a molecular-based revision of the relict populations in Namibia.

Distribution: Widespread but endemic to southern Africa, occurring from northern Zimbabwe southwards to the Western Cape in South Africa. Also found in Swaziland, western Lesotho, southern Namibia, eastern Botswana and western Mozambique, with isolated populations in central Namibia (Broadley & Wallach 2009). In the *Atlas* region it appears to be absent from Kalahari sands and east of the Drakensberg. Some records in western Lesotho require confirmation.

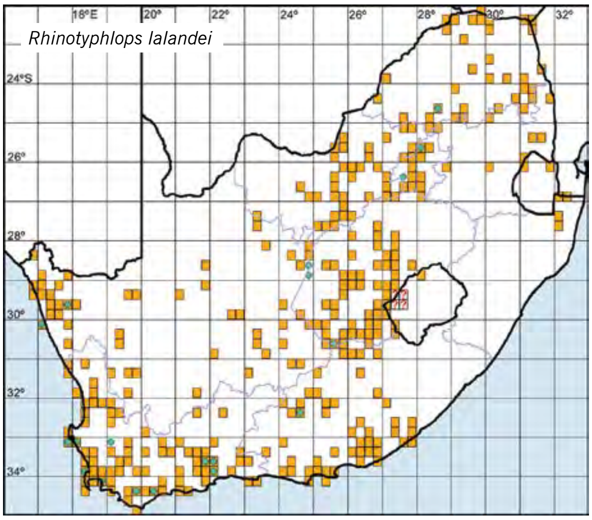
Habitat: Fossorial, using its hard beak to burrow into firm substrates. It has been found under rocks and rotting logs and in moribund termitaria (De Waal 1978; Jacobsen 1989).

Biome: Grassland; Fynbos; Savanna; Succulent Karoo; Nama-Karoo; Albany Thicket.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Rhinotyphlops lalandei—Farm Kalkfontein, about 25 km SSE of Steelpoort, MPM M. Burger



Rhinotyphlops lalandei—Kimberley, NC D. Maguire

Rhinotyphlops lalandei—near Alldays, LIMP J. Marais

Rhinotyphlops schinzi (Boettger, 1887)

SCHINZ'S BEAKED BLIND SNAKE

G. John Measey

Regional: Least Concern

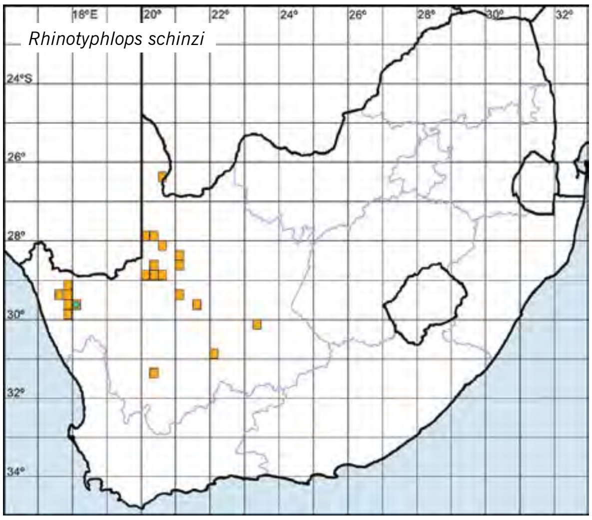
Taxonomy: No notable issues.

Distribution: Endemic to Namibia, western Botswana and northwestern South Africa (Broadley 1990a; Broadley & Wallach 2009). Within the *Atlas* region it occurs only in the Northern Cape. Although not commonly encountered, it is likely to be more widespread than *Atlas* records suggest because the Northern Cape has not been comprehensively surveyed.

Habitat: The beak of this snake suggests that it is capable of burrowing into hard ground in the arid zones that it inhabits.

Bioregion: Bushmanland, Namaqualand Hardeveld, Upper Karoo.

Assessment rationale: Widespread and found in an area with relatively low-impact agricultural practices.



Conservation measures: Conduct surveys to discover the true range of the species.

Rhinotyphlops schinzi—Farm Botterkraal, about 37 km SW of Strydenburg, NC M. Burger

Rhinotyphlops schinzi—Springbok, NC J. Marais

CHAPTER 19

Family Leptotyphlopidae

William R. Branch & Graham J. Alexander

Thread snakes are small slender snakes that share the following features with other members of the infraorder Scolecophidia: a cylindrical body, reduced ventral scales, reduced eyes covered by head shields, a single visual cell type in the retina, and the complete absence of neural spines on the vertebrae. They are sometimes less appropriately called worm snakes. These snakes have solidly constructed skulls with teeth restricted to the lower jaws. They lack a left lung, a tracheal lung and a left oviduct (Vitt & Caldwell 2009). Except for two species that have 16 midbody scale rows and two others that have 14–16 rows, all other members of the family have 14 midbody scale rows (Broadley & Wallach 2007a). The family includes the world's smallest known snake (*Leptotyphlops carlae*, 104 mm total length; Hedges 2008), but the West African species *Rhinoleptus koniagui* can grow as long as 460 mm (Adalsteinsson *et al.* 2009).

Until recently, all but one (*Rhinoleptus koniagui*) of the 117 known leptotyphlopid species (Hedges 2008) were placed in the large and widely distributed genus *Leptotyphlops*. However, recent molecular studies (Adalsteinsson *et al.* 2009) have revealed deep genetic divergences between morphologically conservative lineages. To better reflect the evolutionary history of the family, it has been subdivided with the description of new subfamilies, tribes and genera. The revised classification recognises two subfamilies, namely Leptotyphlopinae (Africa, Arabia and southwest Asia) and the new subfamily Epictinae (New World and Africa north of the equator). Three tribes are recognised within the Leptotyphlopinae, with the Myriopholini and Leptotyphlopini having representatives in the *Atlas* region. Within the former, one local species (*L. longicaudus*) is transferred to the new genus *Myriopholis.* Most other local species remain in the genus *Leptotyphlops*, excluding *L. occidentalis* and *L. gracilior*, which are both transferred to the new genus *Namibiana*. Significant non-monophyly within some species complexes, and the estimated long period of time (tens of millions of years) separating populations of currently recognised species, indicate that an unusually large number of cryptic species await description.

The family has a curious distribution in the New and Old World that probably reflects its West Gondwanan origin, with divergences among living lineages occurring as early as the mid-Cretaceous, 92 (113–75) million years ago (Adalsteinsson *et al.* 2009; Hedges & Vidal 2009). In the New World it occurs from North America south through Middle and South America (exclusive of the high Andes) to Uruguay and Argentina on the Atlantic side. It also occurs on numerous Caribbean islands. In the Old World leptotyphlopinids are distributed throughout Africa (north and south of the Sahara Desert), the Arabian Peninsula and in southwestern Asia (Turkey, Iran, Pakistan and northwestern India) (Adalsteinsson *et al.* 2009).

All thread snakes live underground and feed almost exclusively on the eggs, larvae and workers of social insects (Webb *et al.* 2000b). Although often referred to as fossorial, they display few adaptations for burrowing and probably wiggle through existing cracks and insect burrows in the soil. Their minute, slender bodies are vulnerable to attack by the soldier castes of ants and termites, and they therefore probably depend on chemical camouflage to avoid detection. These chemicals may be acquired passively, or secondarily modified, from their food. Such dependence on specific chemical camouflage may result in co-dependence of different thread snakes on specific prey species. This may in turn account for the existence of numerous cryptic taxa within morphologically conservative species complexes. All species are oviparous, laying a small number (1–7) of minute elongate eggs that are unusually attached like a string of sausages (Branch 1998).

Most of the 10 thread snake species in the *Atlas* region are classified as Least Concern, but *L. telloi* has a restricted range and is considered Near Threatened, while *L. sylvicolus* is treated as Data Deficient because its taxonomic status and range boundaries are uncertain. The conservation status of the undescribed species alluded to by Adalsteinsson *et al.* (2009) is unknown.

Genus *Leptotyphlops* Fitzinger, 1843—typical thread snakes

The greatly reduced nominate genus *Leptotyphlops* is retained for a group of 18–22 species (Broadley & Broadley 1999; Adalsteinsson *et al.* 2009; Uetz 2012) that occur in southern and East Africa. Detailed morphological studies of local species (Broadley & Watson 1976; Broadley & Broadley 1999; Broadley & Wallach 1997a,b) have only partially uncovered the extent of thread snake diversity in the *Atlas* region. This existing taxonomy has nevertheless been used for the current assessment pending fuller molecular studies (W.R. Branch & S.B. Hedges in prep.).

These small, slender, harmless snakes live underground and feed mostly on ant pupae (Webb *et al.* 2000b). Females lay small clutches of 3–7 eggs (Branch 1998). Most of the seven described species in the *Atlas* region are listed as Least Concern, but *L. telloi* has a restricted range and is considered Near Threatened, while *L. sylvicolus* is treated as Data Deficient because its taxonomic status and distribution are uncertain. The latter species may in fact consist of a few highly restricted cryptic species that could be of conservation concern.

Leptotyphlops distanti Boulenger, 1892

DISTANT'S THREAD SNAKE;
DISTANT'S WORM SNAKE

Graham J. Alexander

Global: Least Concern

Near-endemic

Taxonomy: This species formed part of the *Leptotyphlops scutifrons* species complex (Broadley & Wallach 2007a). However, Adalsteinsson *et al.* (2009) noted that many species groups recognised previously are paraphyletic, and they therefore refrained from recognising such groups. The status of the apparently isolated population in KwaZulu-Natal should be investigated.

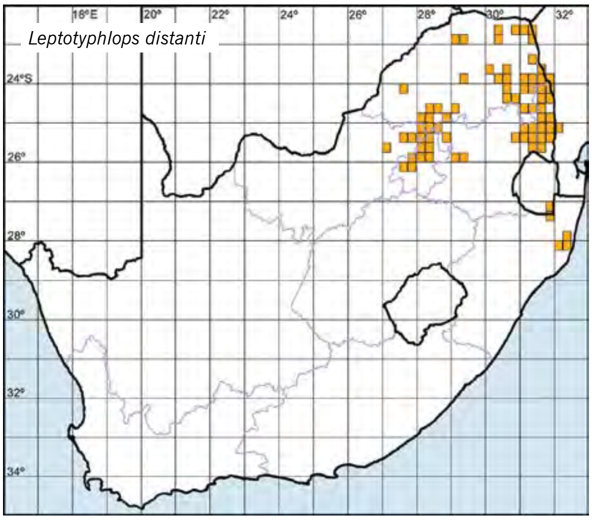
Distribution: Endemic to southern Africa and limited to the northeastern and eastern parts of South Africa and adjacent Mozambique, possibly extending into Swaziland (Branch 1998). There is an isolated population in northeastern KwaZulu-Natal.

Habitat: Occurs in mesic habitats, ranging from sea level to the Highveld. Found under logs and stones and among the roots of grasses, at altitudes of 250–1 600 m (Jacobsen 1989).

Bioregion: Lowveld; Central Bushveld; Mopane; Mesic Highveld Grassland; Dry Highveld Grassland (marginal).

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Leptotyphlops distanti—near Middelburg, MPM W.R. Branch

Leptotyphlops incognitus Broadley & Watson, 1976

INCOGNITO THREAD SNAKE; INCOGNITO WORM SNAKE

Graham J. Alexander

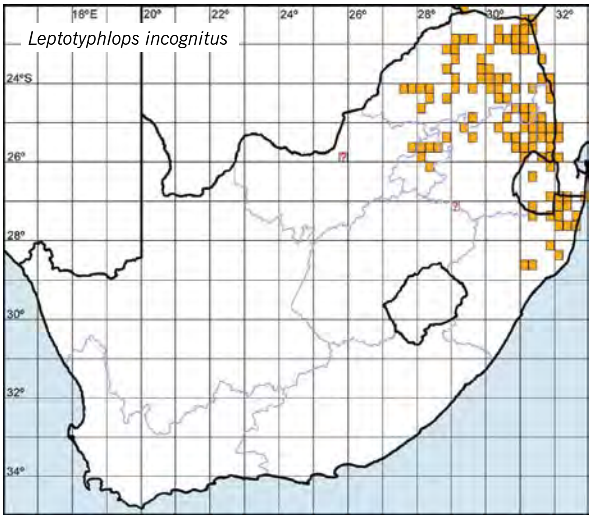
Global: Least Concern

Taxonomy: This species has a complicated taxonomic history. It was initially described as a subspecies of *Leptotyphlops conjunctus* (Broadley & Watson 1976), which itself has been treated as either a full species or a subspecies of the widespread *L. scutifrons*. It was raised to species status within the *L. scutifrons* species complex by Broadley & Broadley (1999). Recent molecular studies (Adalsteinsson *et al.* 2009) revealed numerous cryptic species within the *L. scutifrons/conjunctus* complex, including *L. incognitus*. Further studies, including those using DNA sequences from topotypic material (Mutare, Zimbabwe), are required to determine whether *L. incognitus* is composite. The current assessment is conservative and based on the latest concept of the species (Broadley & Broadley 1999).

Distribution: Occurs from southern Zambia, southern Malawi, northern and eastern Zimbabwe, and central and southern Mozambique, southwards to Swaziland and the northeastern parts of South Africa, including the provinces of Limpopo, Gauteng, Mpumalanga and KwaZulu-Natal (Broadley & Broadley 1999). Two outlier records shown on the map, at QDGSs 2525DD and 2729AA (see Jacobsen 1989), require confirmation.

Habitat: Found mainly in mesic environments, under rocks and rotting logs and amongst the roots of grasses adjacent to boulders, at elevations of 200–1 600 m (Jacobsen 1989).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt.



Leptotyphlops incognitus—Farm Hippo, Komati River Valley, MPM W.R. Branch

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Leptotyphlops jacobseni Broadley & Broadley, 1999

JACOBSEN'S THREAD SNAKE; JACOBSEN'S WORM SNAKE

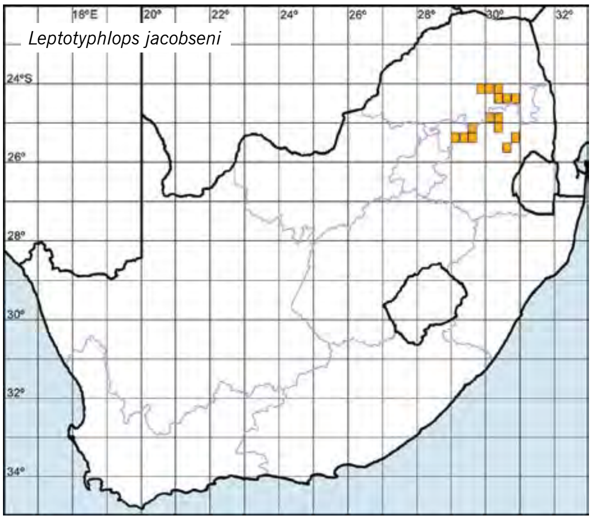
Graham J. Alexander

Global: Least Concern

Endemic

Taxonomy: Previously treated as a northern population of *Leptotyphlops nigricans* (Broadley 1990b) but since described as a separate species (Broadley & Broadley 1999).

Leptotyphlops jacobseni—The Downs, LIMP W.D. Haacke



Distribution: Endemic to northern Mpumalanga and southern Limpopo, South Africa (Broadley & Broadley 1999).

Habitat: Restricted to the grasslands of the Afromontane region (1 300–1 700 m) where it has been found under stones and in old termitaria (Jacobsen 1989; Broadley & Broadley 1999).

Bioregion: Mesic Highveld Grassland; Central Bushveld.

Assessment rationale: Has a relatively restricted range but is abundant and not threatened.

Conservation measures: None recommended.

Leptotyphlops nigricans (Schlegel, 1839)

BLACK THREAD SNAKE; BLACK WORM SNAKE

Graham J. Alexander

Global: Least Concern

Endemic

Taxonomy: Broadley & Broadley (1999) recognised that the disjunct northern populations previously assigned to *Leptotyphlops nigricans* (e.g. Broadley & Watson 1976; Branch 1998) represented different species which they described as *L. jacobseni* and *L. kafue*. They also restricted *L. nigricans* to the two southern Cape provinces. However, recent molecular studies have revealed deep genetic divergence between Western and Eastern Cape populations that may indicate separate species status (Adalsteinsson *et al.* 2009). The area of separation or overlap between the putative Cape species is unknown and the *Atlas* assessment is based on the current concept of the species (i.e. Broadley & Broadley 1999).

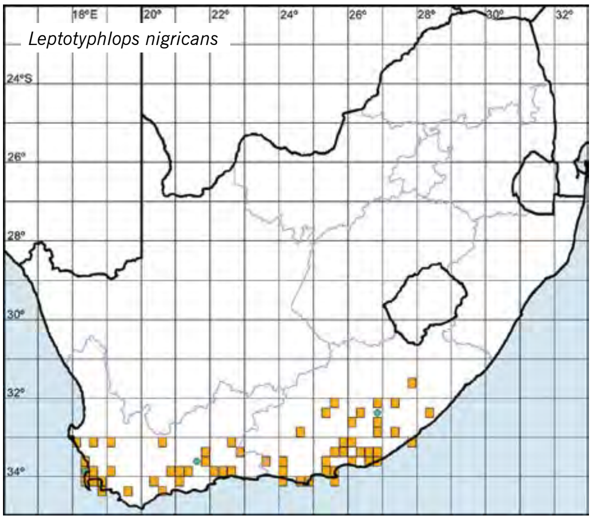
Distribution: Endemic to the Western and Eastern Cape provinces, South Africa (Broadley & Broadley 1999).

Habitat: Strictly subterranean in habits, but little is known about its habitat.

Biome: Fynbos; Albany Thicket; Forests; Grassland; Savanna (marginal).

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Leptotyphlops nigricans—Commonage, Grahamstown, EC W.R. Branch

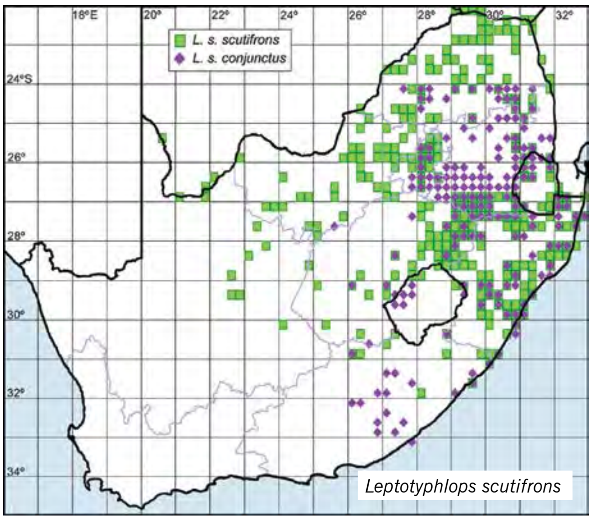
Leptotyphlops scutifrons (Peters, 1854)

PETERS' THREAD SNAKE;
PETERS' WORM SNAKE

William R. Branch & Graham J. Alexander

Regional: Least Concern

Taxonomy: The species complex to which these snakes belong has a convoluted taxonomic history. Taxonomy of the group is only now being unravelled with the aid of molecular analyses (Adalsteinsson *et al.* 2009). Previously, *Leptotyphlops conjunctus* and *L. incognitus* were treated as full species, or as subspecies of *L. scutifrons* (Broadley & Watson 1976; Broadley & Broadley 1999; Broadley & Wallach 2007a). Moreover, additional subspecies of *L. scutifrons* are recognised in East Africa (Broadley & Wallach 2007a) and the status of old, poorly known names such as *L. conjunctus lepezi* remain unresolved. A preliminary molecular phylogeny (Adalsteinsson *et al.* 2009) has also identified numerous undescribed cryptic species within the *L. scutifrons/conjunctus/incognitus* complex that require fuller analysis. For this assessment, we follow Broadley & Broadley (1999) in recognising two subspecies (*L. s. scutifrons*, *L. s. conjunctus*) in the *Atlas* region.



Distribution: Occurs from Tanzania in the north, through Zimbabwe and Botswana, as far south as the Eastern Cape in South Africa. It occurs in the eastern and central parts of the *Atlas* region, including Swaziland and western Lesotho (Broadley & Broadley 1999; Broadley & Wallach 2007a).

Leptotyphlops scutifrons scutifrons—E of Tshipise, LIMP M. Burger

Leptotyphlops scutifrons conjunctus—Hogsback, EC W.R. Branch

The extensive overlap in distributions of the putative subspecies emphasises the unsatisfactory nature of the current taxonomy, but also indicates that museum curators and researchers have difficulty distinguishing between the two taxa using the supposedly diagnostic characters.

Habitat: Strictly subterranean in habits and found in a wide variety of soil types (Branch 1998). A specialist that feeds on ant eggs and their larvae (Webb *et al.* 2000b).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Nama-Karoo (marginal).

Assessment rationale: Widespread and common.

Conservation measures: Some of the populations identified by Adalsteinsson *et al.* (2009) as possible new species may have restricted ranges and may later require separate conservation assessments.

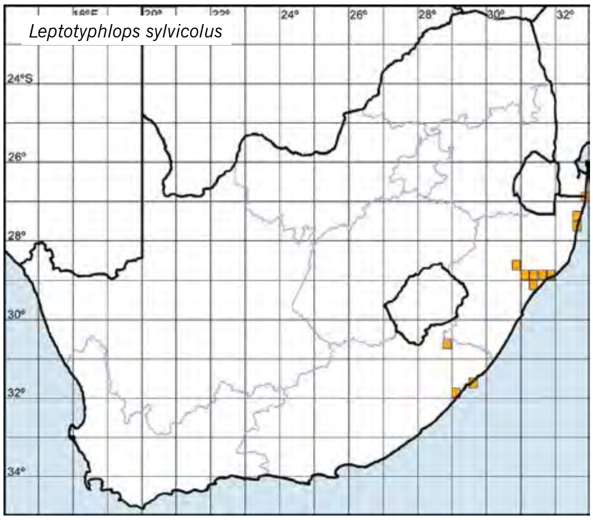
Leptotyphlops sylvicolus Broadley & Wallach, 1997

FOREST THREAD SNAKE; SOUTHERN FOREST WORM SNAKE

Graham J. Alexander

Global: Data Deficient

Endemic



Taxonomy: Broadley & Broadley (1999) recorded *L. sylvicolus* from three isolated populations in forest habitats on the east coast of South Africa. Recent *Atlas* records from grassland habitat in the former Transkei are of specimens that do not fully conform to the morphology of this species, and the deep genetic divergence within this species complex (Adalsteinsson *et al.* 2009) indicates the presence of a number of undescribed species that may have more restricted ranges and that may be of significant conservation concern.

Distribution: Endemic to South Africa. Occurs in coastal northeastern KwaZulu-Natal, central-eastern KwaZulu-Natal and coastal Transkei, Eastern Cape (Broadley & Wallach 2009). Specimens from the Matatiele area (QDGS 3028DB) of inland Eastern Cape, collected during a SARCA field trip, were provisionally assigned to this species by Adalsteinsson *et al.* (2009) and this locality has been included on the map.

EOO: 57 200 km^2 (confidence: low); AOO: 296 km^2 (confidence: low).

Habitat: Subterranean in habits. Eastern populations inhabit forested areas (Broadley & Broadley 1999) but specimens from the Matatiele area of the Eastern Cape were collected in montane grassland.

Vegetation type: FOz 5 Scarp Forest; FOz 3 Southern Mistbelt Forest; CB 1 Maputaland Coastal Belt; Gs 10 Drakensberg Foothill Moist Grassland.

Leptotyphlops sylvicolus—near Fever village, about 25 km SW of Cedarville, EC M. Burger

Assessment rationale: There is concern over the taxonomic status of the different populations of *Leptotyphlops sylvicolus* and for this reason, it is assessed as Data Deficient. It appears to be restricted to forest patches (excluding the Matatiele population), most of which are small and isolated. Because of this, it is thought to have a restricted range with an AOO below the Endangered threshold [B2]. The range may also be severely fragmented [B2a] and under threat from deforestation, often for coastal development, resulting in a continuing decline in habitat and population size [B2b(ii,iii,iv,v)].

Threats: In KwaZulu-Natal the species is restricted to a few indigenous forest patches along the coast, many of which are undergoing rapid transformation (CSIR 2008). There is little potential for dispersal between patches of suitable habitat.

Conservation measures: Protect suitable habitat. If the four isolated populations prove to be separate species, and/or if additional cryptic species are present, these will have very restricted ranges and their conservation status should be re-evaluated.

Leptotyphlops telloi Broadley & Watson, 1976

TELLO'S THREAD SNAKE; TELLO'S WORM SNAKE

Graham J. Alexander

Global: Near Threatened

Taxonomy: The relationships of this species to other populations in the *Leptotyphlops scutifrons/conjunctus* complex requires further study.

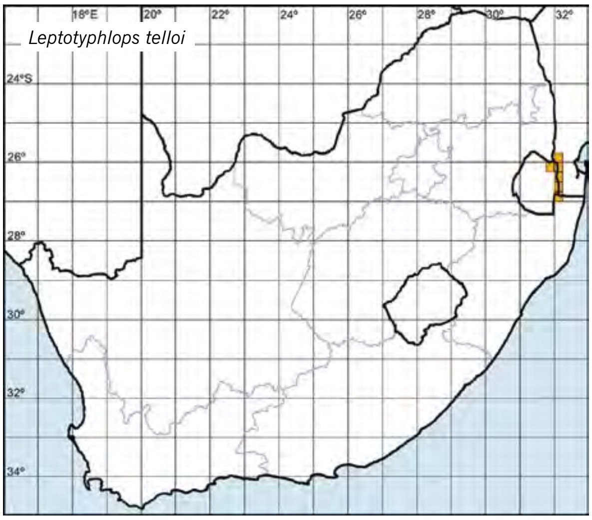
Distribution: Endemic to the Lebombo Mountains on the border between Swaziland and Mozambique (Broadley & Broadley 1999). Boycott (1992b) confirmed the presence of this species in Swaziland (Mambane and Umbuluzi Gorge), but it has not yet been recorded from South Africa.

EOO: 5 400 km^2 (confidence: medium); AOO: 3 038 km^2 (confidence: medium).

Habitat: Strictly subterranean in habits and restricted to mountainous areas (Broadley & Broadley 1999).

Vegetation type: SVI 16 Southern Lebombo Bushveld; SVI 5 Tshokwane-Hlane Basalt Lowveld.

Assessment rationale: Has a restricted range (EOO approaches the Endangered threshold) and is rarely found. It is also likely to be experiencing some reduction in AOO as well as population size due to reduction in quality of habitat. The species is therefore classified as Near Threatened.



Threats: Threats include extensive sugarcane farming within the range, and transformation of land due to subsistence farming and development of rural villages.

Conservation measures: Protect suitable habitat within the range.

Leptotyphlops telloi—N of Umbuluzi Gorge, Swaziland (TM 55433)
W.R. Schmidt

Leptotyphlops telloi—N of Umbuluzi Gorge, Swaziland (TM 55433)
W.R. Schmidt

Genus *Myriopholis* Hedges, Adalsteinsson & Branch, 2009 —many-scaled thread snakes

The genus *Myriopholis* contains 24 species, most from the former *Leptotyphlops longicaudus* group (Broadley & Wallach 2007a; Uetz 2012), with three isolated species from Socotra Island included provisionally. The various species are distributed throughout Africa (north and south of the Sahara Desert), the Arabian Peninsula and southwestern Asia (Turkey, Iran, Pakistan and northwestern India). Members of this genus are distinguished from *Leptotyphlops* and *Namibiana* by their higher numbers of subcaudals, a (usually) white ventrum and semilunate cloacal shield. Females lay two or more eggs in summer (Branch 1998). The only species in the *Atlas* region (*M. longicauda*) is widespread and common and not of conservation concern.

Myriopholis longicauda (Peters, 1854)

LONG-TAILED THREAD SNAKE; LONG-TAILED WORM SNAKE

Graham J. Alexander

Regional: Least Concern

Taxonomy: Molecular studies have revealed deep genetic divergence between leptotyphlopid species, and the *Leptotyphlops longicaudus* species complex has been transferred to the new genus *Myriopholis* (Adalsteinsson *et al.* 2009). Some northern populations in East Africa have been assigned to new or revived species (Broadley & Wallach 2007a) but further cryptic species await description (W.R. Branch pers. comm.).

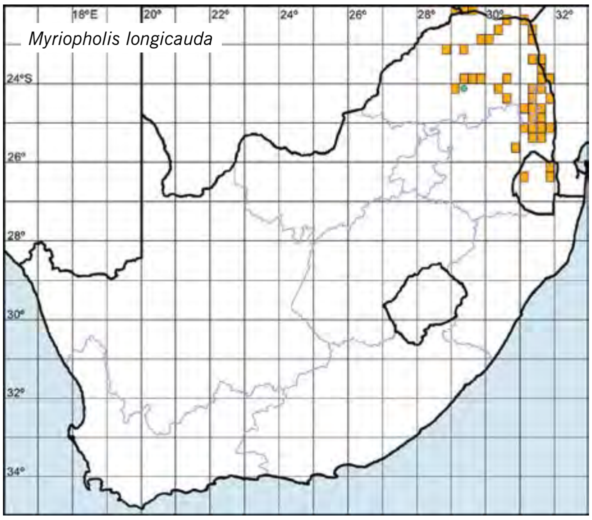
Distribution: Distributed from Zambia and Malawi southwards to South Africa (Limpopo and eastern Mpumalanga) and Swaziland, reaching its western limits in Zimbabwe and eastern Botswana (Broadley & Broadley 1999).

Habitat: Subterranean in habits, occurring in a wide range of mesic soils. Found under rocks on soil at altitudes of 200–1 400 m (Jacobsen 1989).

Biome: Savanna.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Myriopholis longicauda—Orpen Gate, Kruger NP, MPM W.R. Branch

Genus *Namibiana* Hedges, Adalsteinsson & Branch, 2009—Namib thread snakes

The five species in the genus *Namibiana* occur in southwestern Africa, including South Africa (two species), Namibia (two species) and Angola (two species) (Adalsteinsson *et al.* 2009). These snakes are distinguished from *Leptotyphlops* and *Myriopholis* by the combination of a semilunate cloacal shield, higher mid-dorsal scale counts and a more elongate body. In the *Atlas* region, *N. gracilior* and *N. occidentalis* are widespread and common and not of conservation concern.

Namibiana gracilior (Boulenger, 1910)

SLENDER THREAD SNAKE; SLENDER WORM SNAKE

Graham J. Alexander

Global: Least Concern

Near-endemic

Taxonomy: Molecular studies (Adalsteinsson *et al.* 2009) indicate deep genetic divergence between many leptotyphlopid species. Members of the *Leptotyphlops rostratus* group (*sensu* Broadley & Broadley 1999, i.e. *L. rostratus*, *L. occidentalis*, *L. gracilior*, *L. labialis*, *L. latifrons*) have been placed in the new genus *Namibiana*. The status of the isolated population in southern Namibia should be investigated using molecular data.

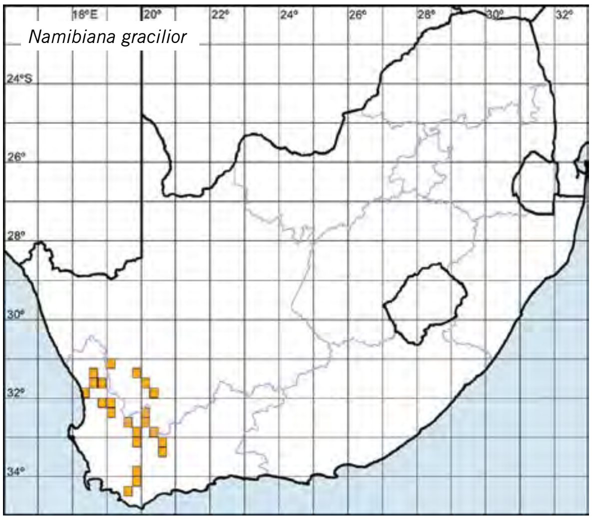
Distribution: Endemic to the southwestern parts of southern Africa. Occurs in the western half of the Western Cape and the adjacent southwestern parts of the Northern Cape, with an isolated population in southern Namibia (Broadley & Broadley 1999).

Habitat: Subterranean in habits but often found in old termitaria (Branch 1998).

Biome: Succulent Karoo; Fynbos.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Namibiana gracilior—Clanwilliam district, WC W.D. Haacke

Namibiana occidentalis (FitzSimons, 1962)

WESTERN THREAD SNAKE; WESTERN WORM SNAKE

Graham J. Alexander

Global: Least Concern

Taxonomy: Molecular studies (Adalsteinsson *et al.* 2009) indicate deep genetic divergences between many leptotyphlopid species. Members of the *Leptotyphlops rostratus* group (*sensu* Broadley & Broadley 1999, i.e. *L. rostratus*, *L. occidentalis*, *L. gracilior*, *L. labialis*, *L. latifrons*) have been placed in the new genus *Namibiana*.

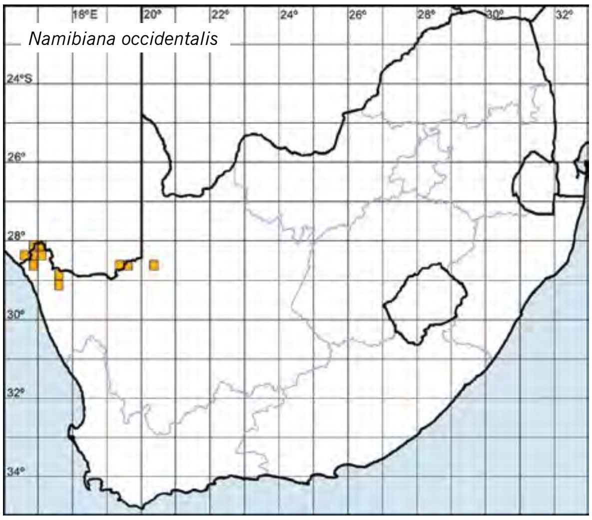
Distribution: Occurs in western and southern Namibia, just entering the Northern Cape, South Africa (Broadley & Broadley 1999).

Habitat: Strictly subterranean in habits and restricted to arid environments.

Bioregion: Richtersveld; Southern Namib Desert; Bushmanland; Gariep Desert; Kalahari Duneveld.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Namibiana occidentalis—Klein Spitzkoppe, Namibia W.D. Haacke

CHAPTER 20

Family Pythonidae

James Harvey & Graham J. Alexander

The pythons form a clade that is well supported by morphological and molecular data (Underwood & Stimson 1990; Kluge 1991; Lawson *et al.* 2004; Noonan & Chippindale 2006; Vidal *et al.* 2007b). Although previously considered to be part of the Boidae, several recent molecular studies have shown Pythonidae to be only distantly related to boids. Pythonidae appears to form a monophyletic clade with the families Loxocemidae and Xenopeltidae, with Loxocemidae the closest relative to Pythonidae (Slowinski & Lawson 2002; Wilcox *et al.* 2002; Vidal & Hedges 2004; Lee *et al.* 2007; Vidal *et al.* 2007b). Noonan & Chippindale (2006) also recovered Loxocemidae as a sister taxon to Pythonidae, but found *Xenopeltis* (Xenopeltidae) to be more closely allied to Asian anilioids and to the Caenophidia.

Pythons are found throughout much of sub-Saharan Africa, Southeast Asia, Papua New Guinea and Australia. There are 41 recognised species in nine genera (Kluge 1993b; Rawlings *et al.* 2008; Schleip 2008; Schleip & O'Shea 2010; Uetz 2012). These include new species recently identified in the genera *Python* (Keogh *et al.* 2001), *Morelia* (Harvey *et al.* 2000; Rawlings & Donellan 2003) and *Leiopython* (Schleip 2008). *Python reticulatus* and *P. timoriensis* have been transferred to the genus *Broghammerus* (Rawlings *et al.* 2008). Most python genera and species are restricted to the Australo-Papuan region, with seven genera occurring there (Rawlings *et al.* 2008). Only one genus, namely *Python*, is found in Africa, where four species occur. *Python natalensis* is the only species that occurs within the *Atlas* region.

In the *Atlas* region, *P. natalensis* is widespread in warm, mesic habitats, including woodland and forest, and particularly in rocky and riverine areas. It is active at night and during the day, frequently basking in winter. Pythons are terrestrial, but will take to water to seek refuge or to capture prey. This is the largest snake species in the *Atlas* region, where it reaches lengths of nearly 5 m. Adult pythons usually ambush their prey, but young snakes may hunt more actively. A variety of prey items are taken by *P. natalensis*, including antelope, monkeys, birds, fish and lizards. Even crocodiles may be taken and these, like all other prey, are killed by constriction (Alexander & Marais 2007). The killing of humans by pythons has been recorded but is rare (Branch & Haacke 1980). Mating in *P. natalensis* takes place from June to September, and females lay 30–100 eggs (Alexander & Marais 2007). Female pythons coil around their eggs and rely on basking to warm their bodies and thus effectively keep their eggs warm. As a result, the distribution of this species is limited to areas with adequate ambient temperatures that support hatching success (Alexander 2007).

Python natalensis was previously considered as Vulnerable (Branch 1988a) and is currently listed as a CITES II species. In this assessment it is classified as Least Concern.

Genus *Python* Daudin, 1803—pythons

The genus *Python* is distributed throughout sub-Saharan Africa and Southeast Asia. There are 10 extant species in the genus (Uetz 2012). *Python natalensis*, *P. breitensteini* and *P. brongersmai* are now all recognised as valid species (Broadley 1999a; Keogh *et al.* 2001; Schleip & O'Shea 2010), while *P. reticulatus* and *P. timoriensis* were recently transferred to *Broghammerus* (Rawlings *et al.* 2008). Four species are found in Africa, namely *P. anchietae*, *P. regius*, *P. sebae* and *P. natalenis*, but only the latter occurs in the *Atlas* region where it is restricted to the north and east. It occurs in mesic habitats, particularly in rocky and riparian areas, where it feeds on a variety of mammals, birds, reptiles and fish. From 30 to 100 eggs are laid in spring (Alexander 2007). *Python natalensis* was previously listed as Vulnerable (Branch 1988a) but it currently does not meet the criteria to be considered threatened or even Near Threatened.

Python natalensis A. Smith, 1840

SOUTHERN AFRICAN PYTHON

Graham J. Alexander

Regional: Least Concern

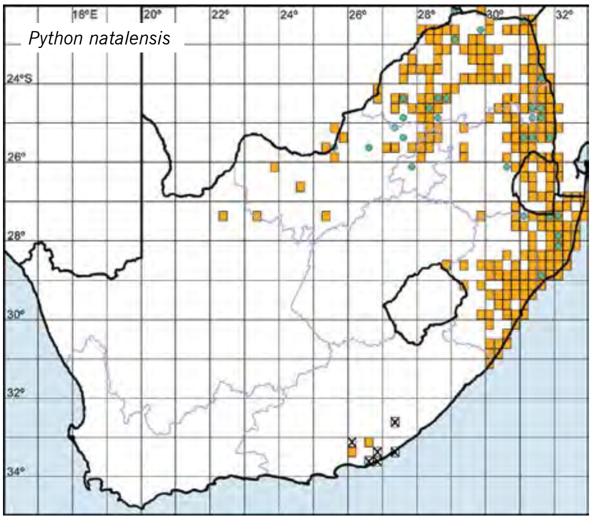
Taxonomy: Raised to specific status by Broadley (1999a) based on morphological characters. Although the current taxonomic arrangement appears appropriate, a genetic analysis is needed to conclusively resolve the relationship between *Python natalensis* and *P. sebae* (Alexander 2007). The exact ranges of the two species, particularly in areas of possible sympatry in East and Central Africa, have not yet been accurately delineated.

Distribution: Endemic to the southern half of Africa. Occurs from the equator southwards to the northern and eastern parts of South Africa (Alexander 2007), including the northeastern parts of the Northern Cape, and Swaziland. In the west the species only reaches as far north as the northern border of Angola, but appears to penetrate farther north in the east at elevated altitudes on the eastern and western arcs of the Rift Valley (Broadley 1999a). The southernmost population, in the Eastern Cape, is isolated from other populations by a distance of more than 350 km. This population was thought to have been extirpated in the early part of the twentieth century (FitzSimons 1962), but occasional records from the region (e.g. Alicedale 3326AC, 1980s, W.R. Branch unpubl. data) indicate that small populations may still survive there. Specimens were introduced into the Andries Vosloo Kudu Reserve (3326BA) in the early 1980s, and subsequent records, including records of hatchlings, indicate that the introduction was successful, at least in the short term (W.R. Branch unpubl. data). Apart from the Alicedale and Andries Vosloo populations, all other populations in the Eastern Cape are now considered extirpated, as there have not been any reports of their continued existence within the last 50 years.

Habitat: Found in a wide variety of habitats but usually in riverine or rocky areas, and often in association with large animal burrows. Although more abundant in low-lying areas, it may occur on lower mountain slopes if suitable rocky refugia are available (Alexander 2007).

Biome: Savanna; Indian Ocean Coastal Belt; Albany Thicket; Grassland.

Assessment rationale: Although the species is widespread, the large size of individuals, the relatively low densities of populations, and its status as a top predator, make *P. natalensis* especially sensitive to habitat transformation and fragmentation. This has resulted in declines or extirpation of several populations (FitzSimons 1962; Alexander 1990), but these have not been sufficiently extensive for the species to be classified as threatened. Furthermore, significant immigration of reproductively mature individuals from surrounding areas into the *Atlas* region is expected. This regional assessment is therefore Least Concern.



Python natalensis W.R. Schmidt

Conservation measures: Measure population densities and investigate the species' spatial ecology in order to estimate the minimum area needed to sustain populations.

CHAPTER 21

Family Viperidae

Andrew A. Turner & William R. Branch

The family Viperidae is monophyletic (Wüster *et al.* 2008) and consists of 38 genera and 315 species (Uetz 2012). Studies on Asian and Neotropical crotalines have resulted in the recognition of numerous new genera, some of which remain controversial. Representatives of the family occur on all continents except Australia and Antarctica. The family comprises two well-defined radiations: pit vipers (Crotalinae) distributed mainly in Asia and the Americas, and Old World adders (Viperinae) restricted mainly to the western Palaearctic and Africa. African night adders (*Causus*) share a number of putatively primitive features, e.g. oviparity and enlarged head shields, that have led to the assumption by McDiarmid *et al.* (1999) that they are basal viperids, sometimes placed in a separate subfamily Causinae. However, recent molecular phylogenetic studies (Nagy *et al.* 2005; Wüster *et al.* 2008) have shown that *Causus* is nested within the viperines, obviating the need for a separate subfamily. Only the Viperinae occur in Africa.

Viperidae is represented in Africa by 11 genera: *Bitis*, *Causus*, *Atheris*, *Montatheris*, *Proatheris*, *Echis*, *Cerastes*, *Pseudocerastes*, *Daboia*, *Vipera* and *Macrovipera* (Spawls & Branch 1995; Lenk *et al.* 2001). The monotypic genus *Adenorhinos* has been placed in the synonymy of *Atheris* (Lenk *et al*. 2001; Wüster *et al.* 2008; Branch & Bayliss 2009). In the *Atlas* region there are currently 11 species of *Bitis* and two species of *Causus*. An additional genus, *Proatheris*, occurs elsewhere in southern Africa and beyond. Distinct phylogenetic clades have been identified within *Bitis* and a number of subgenera recognised (see Chapter 2).

Members of this family all have highly enlarged tubular fangs that are positioned towards the front of the mouth. They can rotate forward during biting and swallowing, but lie flat against the roof of the mouth when not in use. Most species have thick-set, or at least short, bodies compared to typical colubrids, and a wide head that is distinct from the neck. The night adders, *Causus,* have smaller fangs, enlarged head shields, narrower heads and more slender bodies than *Bitis*.

Female *Bitis* give birth to young (usually 16–43 per litter in the large species *B. arietans* and *B. gabonica*; 3–15 per litter in the other, smaller species), whereas female *Causus* lay 6–26 eggs per clutch (Branch 1998). The Puff Adder (*B. arietans*) is unusual in that very large Ugandan females can give birth to extremely large litters of up to 156 young (Janecek 1976). Many of the smaller species of *Bitis* feed largely on lizards, while the larger species feed primarily on rodents. Their large gape and body girth allow adders to consume very large meals in relation to their body size (see Branch *et al.* 2002). Night adders (*Causus*) prey mainly on frogs.

All African viperids have very long fangs and produce venom capable of causing serious injury to humans. Because the larger *Bitis* species can inflict fatal bites, they are often persecuted by humans. The larger species, such as *B. arietans* and *B. gabonica*, are harvested for food in some parts of Africa (e.g. Fa & Gracia Yuste 2001; Mawoung 2006). Despite this, *B. arietans* is a very common snake in the *Atlas* region and *B. gabonica* is very widespread outside the *Atlas* region (Spawls *et al.* 2002). Several *Bitis* species are popular in the pet trade and this is a cause of concern for species with limited distributions, such as *B. albanica*.

Neither species of *Causus* is of conservation concern. *Bitis albanica* is regarded as Critically Endangered, *B. inornata* as Endangered, *B. armata* as Vulnerable and *B. gabonica* as Near Threatened. The main threat to these species is habitat loss. *Bitis schneideri* was treated as Vulnerable by the IUCN (1996), while *B. xeropaga* was classified as Peripheral in the Red Data Book (Branch 1988a), but both species are now classified as Least Concern.

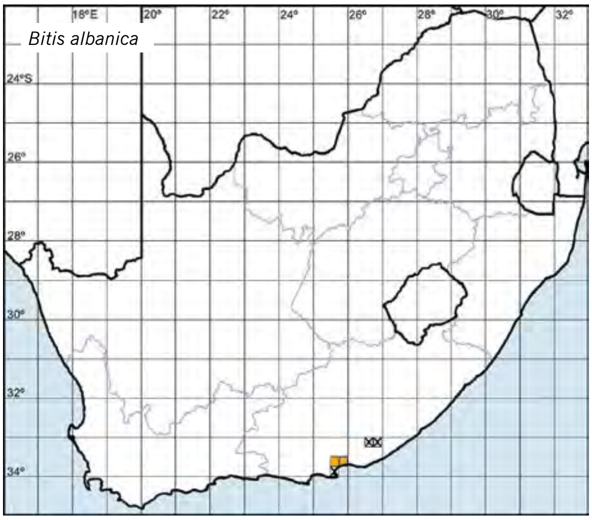
Genus *Bitis* Gray, 1842—African adders

Bitis is a diverse genus containing 17 species (Uetz 2012). All of these are endemic to Africa except *B. arietans*, which extends marginally into the Arabian Peninsula. There are five main clades in this genus: i) Puff Adder (*B. arietans*), ii) large bodied-taxa (*Bitis gabonica*, *B. rhinoceros*, *B. nasicornis*), iii) dwarf adders (*B. albanica*, *B. armata*, *B. atropos*, *B. inornata*, *B. rubida*, *B. xeropaga*), iv) desert adders (*B. caudalis*, *B. cornuta*, *B. peringueyi*, *B. schneideri*), and v) Kenya Horned Viper (*B. worthingtoni*) (Lenk *et al.* 1999). A number of subgenera have been proposed for these clades (see discussion in Chapter 2). The phylogenetic positions of *B. heraldica* from Angola and *B. parviocula* from Ethiopia are unknown. Several of these species show substantial genetic and morphological divergence across their ranges. Taxonomic amendments are in progress and are likely to increase the number of described species. Currently 11 species of *Bitis* are known from the *Atlas* area, but cryptic taxa within *B. atropos* are likely to increase this count (Kelly *et al.* 2009a). Four species (*B. armata*, *B. albanica*, *B. rubida*, *B. inornata*) are endemic to the Cape provinces of South Africa and all except *B. rubida* have small ranges, appear to be habitat specialists and are seldom encountered. The diet of *Bitis* is varied and includes an assortment of small vertebrates. Females of the two large *Bitis* (*B. arietans*, *B. gabonica*) in the *Atlas* region give birth to large litters of 16–43 young (the very large Ugandan *B. a. arietans* may give birth to 156 young; Janecek 1976). Females of smaller species produce only 3–15 young per litter (Branch 1998). All dwarf adders are valued in the pet trade and related collecting is a threat especially to *B. albanica*, *B. armata* and *B. inornata*. *Bitis albanica* is considered Critically Endangered, *B. inornata* is treated as Endangered, *B. armata* as Vulnerable and *B. gabonica* as Near Threatened. The main threats to these species are habitat loss due to rural and urban development, and habitat degradation due to poor land management which may result in increasing numbers of invasive plant species and increased risk of severe fires. *Bitis schneideri* was treated as Vulnerable by the IUCN (1996), while *B. xerogapa* was classified as Peripheral in the Red Data Book (Branch 1988a), but both species are now considered Least Concern.

Bitis albanica Hewitt, 1937

ALBANY ADDER

William R. Branch & Andrew A. Turner



Global: **Critically Endangered** **B1ab(ii,iii,v)**

Endemic

Taxonomy: Until recently, several taxa were included under the name *Bitis cornuta*, either as synonyms or subspecies. These included *B. albanica*, *B. armata* and *B. inornata*, which are all now recognised as full species (Branch 1998, 1999; Marais 2004; Alexander & Marais 2007; Phelps 2009). Ongoing genetic studies (A. Barlow pers. comm.) may affect this arrangement.

Distribution: Endemic to South Africa and restricted to inland areas of Albany Bay in the Eastern Cape (Branch 1998). Probably extinct at several historical localities (see crosses on map) and currently considered to occur in only two adjacent QDGCs.

EOO: 95 km^2 (confidence: medium); AOO: 50 km^2 (confidence: medium).

Habitat: Found in bontveld vegetation (or Coega Bontveld following Mucina & Rutherford 2006) and occurs northeast of Port Elizabeth on limestone (Nanaga formation) and calcareous paleodunes (Cenozoic Algoa Group). Altitudes range from sea level to 400 m. The area receives bimodal rainfall with maxima in March and October. It is a semi-arid landscape with precipitation ranging from 400 mm per annum inland to 550 mm per annum closer to the coast. The mean maximum and minimum monthly temperatures are 32.1°C and 3.4°C and frost is rare, occurring on average only three days per year (see Mucina & Rutherford 2006).

Bioregion: Albany Thicket.

Assessment rationale: Has a very restricted distribution (EOO below the Critically Endangered threshold [B1] and AOO 50 km^2), the single known surviving population constitutes one location [B1a], and critical habitat is currently being extensively strip-mined for limestone pavement [B1b(ii,iii,v)]. The range of *B. albanica* appears to have undergone considerable contraction, as no specimens have been collected from two historical areas (Die Dune, Port Elizabeth; and Brak Kloof and Kleinpoort, Graham-

Bitis albanica, male—Grassyridge, EC T. Phelps stown) despite directed searches in these areas. All recent records (12 specimens since 1995) are restricted to a 10 km strip currently being mined for limestone pavement. Coega Bontveld habitat is poorly protected and more than 60% of this vegetation type falls within the PPC Grassridge mine and may be strip-mined for limestone in the next 10–20 years, i.e. 3–6 generations for this species.

Threats: Habitat destruction is the main threat. Coega Bontveld has a total area of 24 622 ha and 93% of this was untransformed when the habitat was last assessed (around 2005; Mucina & Rutherford 2006). However, the development of limestone strip mining and the Coega Industrial Development Zone are likely to push this vegetation type to near extinction, and it is likely that in 20 years time a maximum of only 15% of this vegetation type will remain.

Conservation measures: Draw up a BMP-S as a matter of urgency, and conduct a PHVA. Conduct surveys to establish whether this adder is present in the Greater Addo Elephant National Park. Conduct research to improve knowledge of biology, population numbers and habitat requirements. Provide protection through local and national legislation. Attempt to quantify the extent of the removal of this species from the wild for the commercial pet trade. Provide formal protection for at least one locality known to harbour populations of the species. This should encompass sufficient unmined Bontveld habitat (i.e. intact limestone pavement) to protect a sustainable population of at least 200 mature adult snakes.

Bitis arietans arietans (Merrem, 1820)

PUFF ADDER

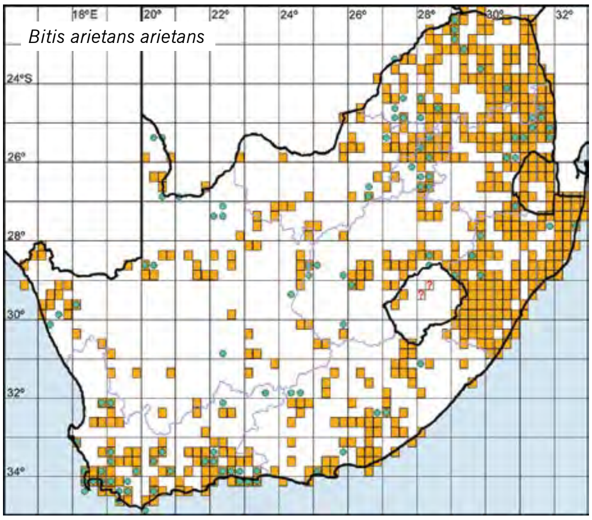
Andrew A. Turner

Regional: Least Concern

Taxonomy: *Bitis arietans* contains significant phylogeographic structure (Lenk *et al.* 1999). The implications of this for the systematics of this taxon are being investigated. Barlow *et al.* (2013) studied the molecular phylogeography of *B. arietans* thoughout Africa (but excluding Somalia where *B. a. somalica* occurs) and determined that there were several parapatric mitochondrial clades, including a widespread southern African clade subdivided into four separate subclades. While the taxonomic status of the various African clades requires further investigation, evidence of secondary admixture of genes among previously isolated refugial populations suggested that southern African subclades do not represent cryptic species. A complex history of refugial isolation and secondary expansion associated with climatic cycles was indicated for southern Africa (Barlow *et al.* 2013). Two subspecies are currently recognised, namely *B. a. arietans* (widespread in sub-Saharan Africa) and *B. a. somalica* (restricted to Somalia) (Branch 1999b).

Distribution: Occurs throughout most of sub-Saharan Africa and extends to the Arabian Peninsula (Broadley 1990b; Spawls & Branch 1995). Very widespread in the *Atlas* region, avoiding only the driest deserts and the highest mountains (Branch 1998).

Habitat: Occurs in a wide variety of habitats but is absent from alpine areas, dense forests and true deserts (Branch 1998). Although it can be described as a habitat generalist,



population densities vary throughout its range; where it is abundant, it appears to prefer bushy cover (Phelps 2009).

Biome: Savanna; Grassland; Fynbos; Indian Ocean Coastal Belt; Albany Thicket; Succulent Karoo; Nama-Karoo.

Assessment rationale: Widespread and abundant across the entire *Atlas* region (Branch 1998; Marais 2004). However, there are systematic issues that need attention and that may result in the recognition of additional taxa. Nevertheless, and despite fear-driven persecution of this snake by humans, its threat status is likely to remain Least Concern.

Conservation measures: None recommended.

Bitis arietans arietans—near Venetia Limpopo NR, LIMP M. Burger

Bitis arietans arietans—Table Mountain, Cape Town, WC T. Phelps

Bitis armata (A. Smith, 1826)

SOUTHERN ADDER

Andrew A. Turner

Global: Vulnerable B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv)

Endemic

Taxonomy: Until recently, several taxa were included under the name *Bitis cornuta*. These included *B. armata*, *B. albanica*, *B. inornata* and *B. rubida*, which are all now recognised as full species (Branch 1997, 1998, 1999a; Marais 2004; Alexander & Marais 2007; Phelps 2009). The taxonomic status of the isolated population around Langebaan is worth investigating. However, judging by the intermediate location of the extirpated population around Cape Town and a single recent record nearby, the Langebaan population was probably isolated only recently.

Distribution: Endemic to the Western Cape, South Africa. Found in two disjunct coastal regions: around Langebaan Peninsula on the West Coast, and from the Bot River area to the Breede River mouth on the south coast. There may also be very small remnant populations between Somerset West and Danger Point. Branch's (1999) Potberg record (3420BC) for *B. cornuta* is considered to be referable to *B. armata* as there are recent records of this species from that locality.

EOO: 12 945 km^2 (confidence: high); AOO: 830 km^2 (confidence: high).

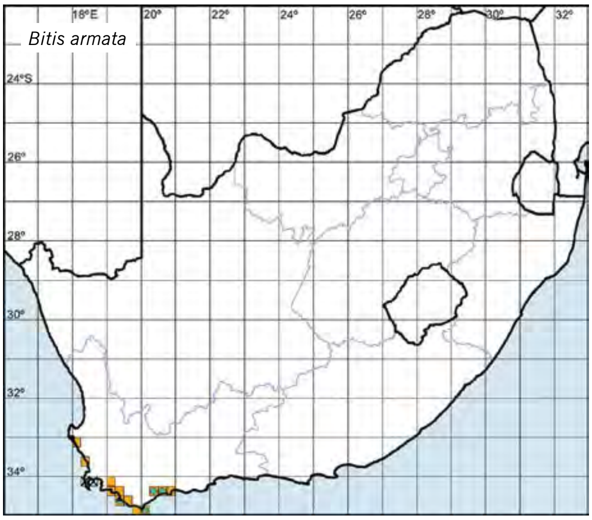
Habitat: Occurs mainly in coastal fynbos associated with limestone geology. Shelters under limestone rock slabs between dense shrubs on coastal plains (Branch 1998). Has pronounced arboreal habits and has been found in bushes 1.5–2 m above the ground (Phelps 2006). Although typically a snake of low-lying fynbos, one individual near Gansbaai was found at an altitude of 300 m (Phelps 2009).

Bioregion: South Strandveld; South Coast Fynbos; Dune Thicket; East Coast Renosterveld; Southwest Fynbos; West Strandveld; Estuarine Vegetation.

Assessment rationale: Has a restricted range (EOO and AOO below the Vulnerable thresholds) which is severely fragmented [B1a+2a]. The Southern Adder is confined to a particular habitat type, which, outside of protected areas, is threatened by housing and other developments. It is also collected for the pet trade and has suffered extirpation in several areas near Cape Town (Branch 1999a). Because the range continues to decrease in size and quality [B1b(i,ii,iii)+2b(i,ii,iii)], and because the number of subpopulations is also decreasing [B1b(iv)+2b(iv)], this species is considered Vulnerable.

Threats: Threatened primarily by residential and other developments. It is vulnerable to further loss of habitat and population declines because of its restricted distribution and confinement to a particular habitat type in coastal areas that are targeted for housing developments. In many areas the habitat is also affected by invasive alien trees that change the habitat structure and diversity of indigenous vegetation, impact negatively on water regimes, and increase the severity of fires. This species is also collected for the pet trade.

Conservation measures: Protect populations that currently fall outside conservation areas. This may take the form of private conservation initiatives and will be most effective if corridors between protected areas are established and protected. Perform population size estimates for populations in protected areas. Ensure that this species is covered by regional and national legislation. Develop a BMP-S for those populations outside of formally conserved areas so as to galvanise conservation action for the most threatened populations.



Bitis armata, adult female—De Hoop NR, WC T. Phelps

Bitis armata, male—De Hoop NR, WC T. Phelps

Bitis atropos (Linnaeus, 1758)

BERG ADDER

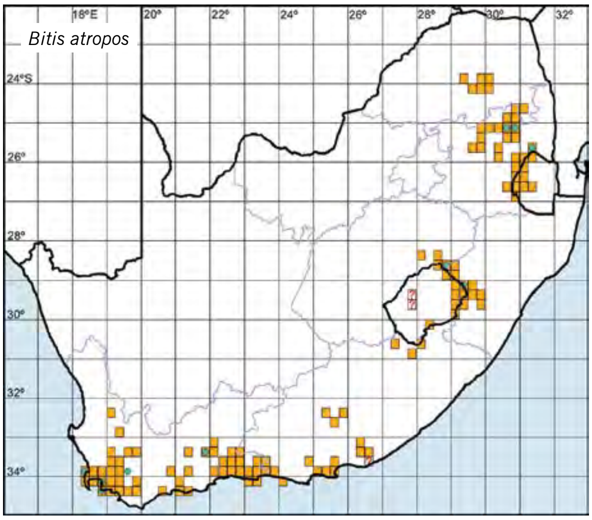
Andrew A. Turner

Global: Least Concern

Near-endemic

Taxonomy: Several discrete populations occur along the southern African escarpment. Molecular analysis supports morphological differences between these isolates, indicating that at least three cryptic taxa are subsumed under this name (W.R. Branch & C. Kelly pers. comm.). Although FitzSimons (1959) described the subspecies *B. a. unicolor* on the basis of patternless specimens from Belfast, the applicability of this name to the Mpumalanga escarpment populations requires further assessment.

Distribution: Endemic to southern Africa. Occurs in at least four disjunct populations: i) Cape Fold Mountains in the Western and Eastern Cape, ii) Maloti-Drakensberg of Lesotho and adjacent parts of KwaZulu-Natal, Free State and Eastern Cape, iii) Mpumalanga and Limpopo escarpment, and iv) eastern highlands of Zimbabwe and adjacent Mozambique (Broadley 1990a; Branch 1998; Marais 2004; Alexander & Marais 2007; Phelps 2009). Old records from East London (3327BB) and Whitney (3326DA) are considered unlikely, as is an old record from Swaershoek (3225AD; FitzSimons 1962). However, the latter is supported by a specimen (TM 35635, may be lost) collected in 1968 on the farm Mt. Marlow near Swaershoek (3225DA) and a more recent specimen from Petersburg (3225BD) that was found in *Themeda* grassland associated with isolated mountains of the inland escarpment (W.R. Branch pers. comm.). The species has never been recorded from the montane grasslands of the



Amatole Range in the Eastern Cape, even though other montane reptiles (e.g. *Afroedura*, *Pseudocordylus melanotus subviridis*) from the Drakensberg are known from the region. Old records of *B. atropos* from the Suurberg around Grahamstown (Hewitt 1937a; FitzSimons 1962), and from the coastal Marine Drive area of Port Elizabeth (FitzSimons 1962), have not been supported by additional material during the last 25–50 years, and these populations may therefore have been extirpated (W.R. Branch pers. obs.). Records in central Lesotho require confirmation.

Habitat: Occupies grass- or restio-covered mountain slopes and summits. Takes refuge under rock slabs and tussocks of grass (Jacobsen 1989). Some populations

Bitis atropos—WC J. Marais

Bitis atropos—Mt Sheba, MPM J. Marais

Bitis atropos—Wolkberg near Tzaneen, LIMP J. Marais

Bitis atropos—Finsbury near Lydenburg, MPM J. Marais in the Western and Eastern Cape provinces occur at sea level. Syntopic with *Bitis cornuta* and *B. rubida* in the Cederberg Range, and with *B. rubida* in the Swartberg Range (Phelps 2009).

Biome: Grassland; Fynbos.

Assessment rationale: Widespread, occurring in several protected areas including mountains not easily accessible to humans. However, the Berg Adder is collected for the pet trade, and is negatively affected by high intensity grazing and associated fires. Fires in some parts of Mpumalanga result in snakes being burnt while sheltering under flat stones (N.H.G. Jacobsen pers. comm.).

Conservation measures: Once the current systematic revision (W.R. Branch & C. Kelly in prep.) has been completed, the conservation status of all resultant taxa should be assessed.

Bitis atropos—Klein Swartberg, WC W.R. Branch

Bitis caudalis (A. Smith, 1839)

HORNED ADDER

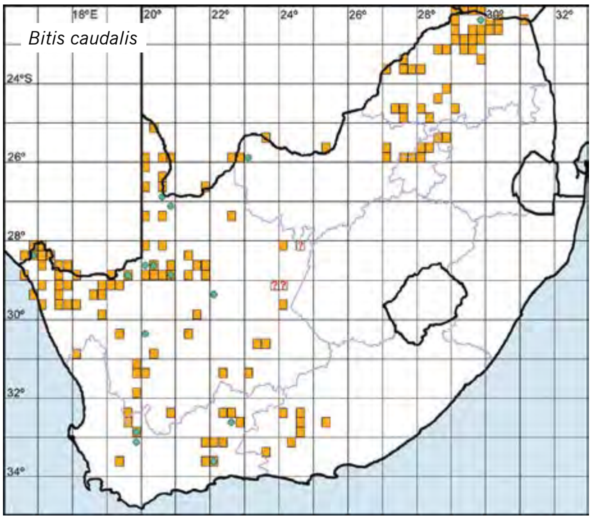
Andrew A. Turner

Regional: Least Concern

Taxonomy: Preliminary phylogeographic analysis indicates appreciable regional divergence (A. Barlow *et al.* unpubl. data).

Distribution: Occurs from southern Angola eastwards to southern Zimbabwe and southwards through Limpopo to the western half of South Africa, including the southeastern Karoo of the Eastern Cape (Branch 1998; Broadley 1990b; Alexander & Marais 2007). Widespread in the northern and western parts of South Africa but absent from the southern coastal region. Further study is required to determine whether recent records from the Oudtshoorn area in the Little Karoo (e.g. Phelps & Els 2006) represent recent range extensions or general rarity of the taxon in the region. A few old records from the eastern Great Karoo also require confirmation.

Habitat: Prefers hot, dry, open areas. May bury itself in sand with only the top of the head exposed, but also seeks refuge under rocks and vegetation; occurs at elevations of 300–1 600 m in the northern parts of the region (Jacobsen 1989).



Biome: Savanna; Nama-Karoo; Succulent Karoo; Desert.

Assessment rationale: Widely distributed, common in suitable habitats and found in several protected areas. In parts of its range habitat destruction is evident, and there is an unknown level of harvesting for the pet trade.

Conservation measures: None recommended.

Bitis caudalis—NE of Tshipise, LIMP M. Burger

Bitis caudalis—Oudtshoorn, WC T. Phelps

Bitis cornuta (Daudin, 1803)

MANY-HORNED ADDER

Andrew A. Turner

Global: Least Concern

Taxonomy: Until recently, several taxa were included under the name *Bitis cornuta*. These included *B. albanica*, *B. armata*, *B. inornata* and *B. rubida*, which are all now recognised as full species (Branch 1998, 1999a; Marais 2004; Alexander & Marais 2007; Phelps 2009).

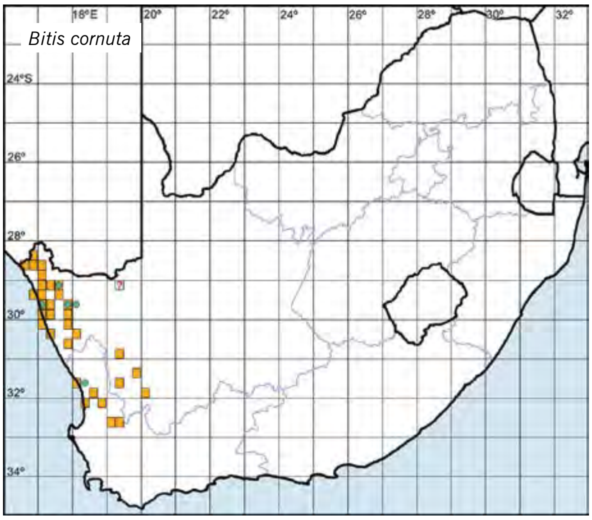
Distribution: Endemic to southwestern Africa. Recorded from Moeb Bay in Namibia southwards along the West Coast of South Africa (Broadley 1990b). In the *Atlas* region it occurs in the western parts of Northern Cape and northwestern parts of Western Cape, as far south as Graafwater. There is still some uncertainty regarding the southernmost extent of its range. Old records from Porterville and Bredasdorp (Branch 1999a) may be referable to other species of dwarf adder (e.g. *Bitis rubida*, *B. armata*), but have been excluded from all maps pending confirmation. Branch's (1999a) Potberg record (3420BC) is considered to be referable to *B. armata* as there are recent records of this species from that locality.

Habitat: Found mainly in dry to very dry rocky habitat and gravel plains with low shrub vegetation. Syntopic with *Bitis rubida* and *B. atropos* in the Cederberg Range (Phelps 2009).

Biome: Succulent Karoo; Fynbos; Desert.

Assessment rationale: Widespread and found in areas that are generally sparsely inhabited by humans. The status of Least Concern may change, however, as the species is illegally traded and does not occur in many protected areas in South Africa or Namibia.

Conservation measures: Conduct surveys to determine the extent of its range, especially in the south.




Bitis cornuta—Noup, Namaqualand, NC J. Marais

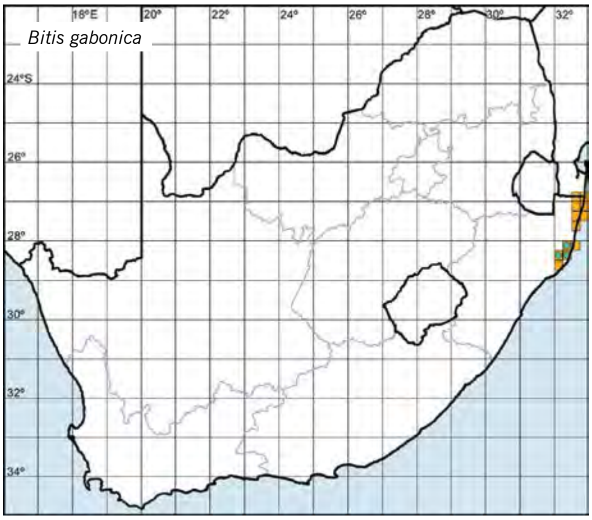
Bitis gabonica (Duméril, Bibron & Duméril, 1854)

GABOON ADDER; GABOON VIPER

Andrew A. Turner

Regional: Near Threatened


Bitis gabonica—Monzi, KZN T. Phelps



Taxonomy: Molecular studies have indicated that the disjunct South African population has not diverged from populations to the north (W. Wüster & A. Barlow unpubl. data). The South African population is also morphologically similar to the closest population in Zimbabwe/Mozambique (e.g. Broadley 1990b). The lack of genetic differentiation suggests that *B. gabonica* once had a large and continuous distribution that was fragmented only relatively recently, resulting in various isolated populations such as the one in the *Atlas* region (W. Wüster & A. Barlow unpubl. data). This population should be considered regionally important in terms of the overall conservation of the species and the maintenance of genetic variability. *Bitis rhinoceros* of West Africa is now treated as a full species and not a subspecies of *B. gabonica*, rendering the latter monotypic (Lenk *et al.* 2001).

Distribution: Widespread in the Congo Basin, extending marginally into adjacent areas such as southern Nigeria and northern Zambia, with isolated populations in South Sudan and eastern and southern Africa, the southernmost occurring in northeastern KwaZulu-Natal. Upper Guinea populations are now referred to *B. rhinoceros.* The population in South Africa is geographically isolated, with the nearest population in the forests of the eastern escarpment of Zimbabwe and adjacent forests in Mozambique (Broadley 1990b; Spawls & Branch 1995; Branch 1998; Phelps 2009).

EOO: 6 075 km^2 (confidence: medium); AOO: 1 080 km^2 (confidence: medium).

Habitat: In southern Africa this species is restricted to the subtropical northeastern coastal plain where it occupies moist coastal forests and surrounding moist grasslands and thickets; often found in the ecotone between forests and grassland (Branch 1998; Alexander & Marais 2007; Phelps 2009). The habitat has been described as 'forest-thicket-grassland mosaic' (Perrin & Bodbijl 2001), but according to Warner (2009) these snakes occur mainly in coastal dune forest which occurs as a strip of up to a few kilometres wide along the coastline. They occasionally move onto frontal dunes near the seashore (Phelps 2003).

Bioregion: Indian Ocean Coastal Belt; Zonal and Intrazonal Forests; Freshwater Wetlands; Lowveld.

Assessment rationale: Has a restricted and fragmented distribution within the *Atlas* region, where EEO and AOO fall below the VU threshold and there is a continuing decline in area, extent and quality of habitat [B1b(iii)+2b(iii)]. There is extensive habitat fragmentation in the south of the range, mainly the result of dune mining, but most of the regional distribution (in the north) is situated within the iSimangaliso Wetland Park, where a strip of up to a few kilometres wide of suitable coastal dune forest habitat is continuously protected for over 200 km along the coastline. Threats to this species have not abated and at least one locality (Dukuduku Forest) has been 'decimated' (Alexander & Marais 2007). Because the South African breeding population is unlikely to receive significant immigration from outside the *Atlas* region, this regional assessment of Near Threatened is not downgraded.

Threats: This species has a restricted distribution in the *Atlas* region and is largely dependent on forests which are constantly being degraded. It is threatened due to habitat loss, collection for the pet and muti (traditional medicine) trades, and road mortality, and is indiscriminately killed by locals in areas of forest encroachment outside protected areas.

Conservation measures: Monitor and compare populations inside and outside the iSimangaliso Wetland Park. Draft a BMP-S that addresses the issues of populations outside protected areas, re-introductions and translocations. Determine the phylogenetic position of the South African population relative to the Zimbabwe/Mozambique population, thus allowing management actions to be relevant from an evolutionary perspective. Conduct a PHVA.

Bitis inornata (A. Smith, 1838)

PLAIN MOUNTAIN ADDER

Andrew A. Turner

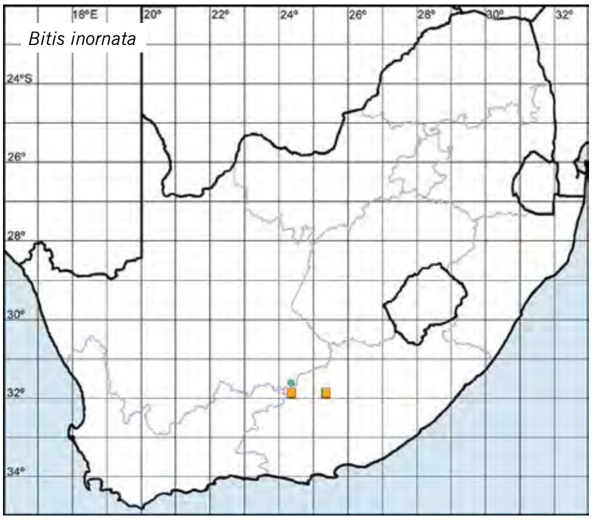
Global: Endangered B1ab(iii)+2ab(iii)

Endemic

Taxonomy: Until recently several taxa were included under the name *Bitis cornuta*. These included *B. inornata*, *B. albanica*, *B. armata* and *B. rubida*, which are all now recognised as full species (Branch 1998, 1999a; Marais 2004; Alexander & Marais 2007; Phelps 2009).

Distribution: Endemic to the Eastern Cape, South Africa, where it is limited to the Sneeuberg Range and surrounding mountains near Graaff-Reinet. The northernmost locality (3124CB) is a Virtual Museum record.

Bitis inornata—Compassberg region, EC M. Burger



EOO: 4 050 km^2 (confidence: low); AOO: 1 620 km^2 (confidence: low).

Habitat: Occurs at high altitudes (>1 500 m) in grassland areas. Takes cover in tussocks of grass and under slabs of rock on the tops of mountains (Branch 1998).

Bioregion: Upper Karoo.

Assessment rationale: Occurs in a restricted area (EOO <5 000 km^2) and is known from only two locations [B1a]. Its habitat has undergone significant transformation [B1b(iii)], mostly through agricultural development. Although this adder prefers higher lying areas that are less subject to intensive agriculture (mostly grazing), altered fire regimes are likely to have a detrimental effect. The extent to which this habitat transformation has fragmented populations is unknown. Specimens are seldom encountered, indicating that the species is naturally rare and possibly becoming increasingly scarce (Marais 2004; W.R. Branch pers. comm.).

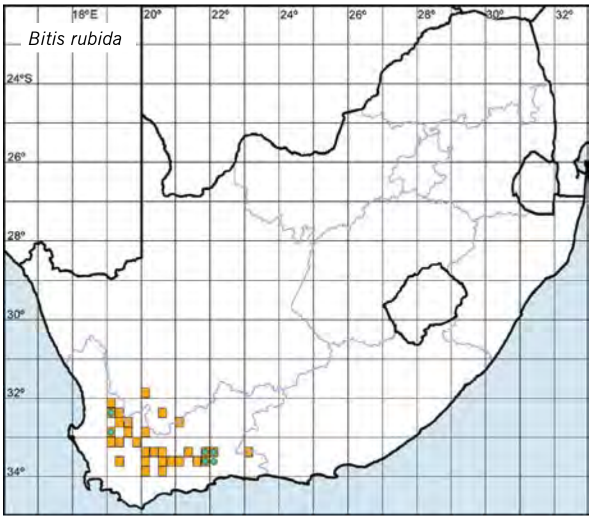
Threats: There is increasing agricultural impact on the habitat of this species, ranging from grazing to the setting of regular fires.

Conservation measures: Design a BMP-S. Manage specific areas within the range to protect this snake from the negative impacts of agriculture and fire. Conduct a study aimed at gathering data on distribution and habitat requirements.

Bitis rubida Branch, 1997

RED ADDER

Andrew A. Turner



Global: Least Concern

Endemic

Taxonomy: Until recently several taxa were included under the name *Bitis cornuta*. These included *B. rubida*, *B. albanica*, *B. armata* and *B. inornata*, which are all now recognised as full species (Branch 1998, 1999a; Marais 2004; Alexander & Marais 2007; Phelps 2009). There are still uncertainties as to the extent of phylogeographic differences within *B. rubida*.

Distribution: Endemic to the Western Cape and adjacent parts of the southern Northern Cape and western Eastern Cape, South Africa. Occurs from the Cederberg Mountains southwards through the Cape Fold Mountains around Ceres and eastwards through the Little Karoo to Willowmore (Branch 1999a; Marais 2004).

Habitat: Found on rocky mountain slopes in the Succulent Karoo and Fynbos (including renosterveld) biomes. Takes shelter under rock slabs on the slopes or tops of mountains (Branch 1998). Syntopic with *B. cornuta* and *B. atropos* in the Cederberg Range, and with *B. atropos* in the Swartberg Range (Phelps 2009). Several populations in the vicinity of Ladismith in the Western Cape occur on sparsely-vegetated gravel plains (T. Phelps pers. obs.).

Bioregion: Western Fynbos-Renosterveld; Northwest Fynbos; Rainshadow Valley Karoo; Karoo Renosterveld; Southwest Fynbos; Trans-Escarpment Succulent Karoo.

Assessment rationale: Fairly widely distributed and found in several protected areas (Anysberg, Cederberg, Gamkaberg, Groenefontein, Rooiberg, Tanqua and Swartberg nature reserves, and Grootwinterhoek Wilderness Area). Not known to be threatened.

Conservation measures: None recommended.

Bitis rubida—Cederberg, WC W.R. Branch

Bitis rubida—Komsberg near Sutherland, NC W.R. Branch

Bitis schneideri (Boettger, 1886)

NAMAQUA DWARF ADDER

Andrew A. Turner & Bryan Maritz

Global: Least Concern

Taxonomy: Revived from the synonymy of *B. caudalis* by Haacke (1975). The relationships of populations on either side of the Orange River, and relationships to adjacent populations of *B. caudalis* and *B. peringueyi*, require further investigation.

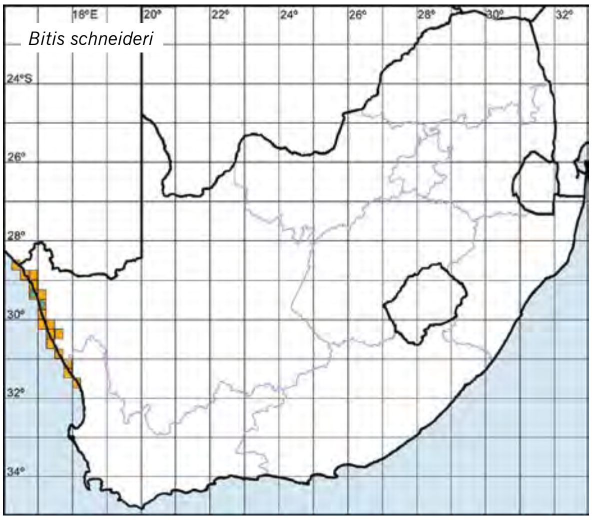
Distribution: Endemic to southern Africa. Found from the mouth of the Olifants River in the Western Cape, South Africa, northwards to Lüderitz Bay in southwestern Namibia (Branch 1998).

Habitat: Inhabits semi-vegetated sandy desert areas, mostly close to the coast.

Bioregion: Namaqualand Sandveld; Inland Saline Vegetation; Richtersveld; Namaqualand Hardeveld; Bushmanland.

Assessment rationale: Previously treated as Vulnerable (Branch 1988a; IUCN 1996). It occupies a fairly large, sparsely inhabited area (EOO 28 491 km^2) but is limited to loose sands that generally occur near the coast (AOO 10 684 km^2). These areas are threatened by mining and other activities that destroy its habitat. Illegal collection for the pet trade also poses a threat to the species, but this probably only affects a few populations. It is now considered Least Concern, pending analyses of population size and threats.

Conservation measures: Develop local conservation initiatives along the Northern Cape coast to improve the chances of long-term survival of the species. These initiatives should include the expansion of formal conservation areas and the inclusion of private landowners who protect a percentage of the land for conservation purposes. This approach will be needed to create effective corridors between populations.



Bitis schneideri—McDougal's Bay, Port Nolloth, NC J. Marais

Bitis schneideri—Farm Gemsbokvlakte, Namaqualand, NC W.D. Haacke

Bitis schneideri—Port Nolloth, NC W.R. Branch

Bitis xeropaga Haacke, 1975

DESERT MOUNTAIN ADDER

Andrew A. Turner

Global: Least Concern

Taxonomy: No notable issues.

Distribution: Endemic to South Africa and Namibia. Restricted to the lower Orange River, from Augrabies Falls to the Richtersveld (Northern Cape), and northwards into Namibia as far as Aus (Branch 1998).

Habitat: Found on sparsely-vegetated rocky desert slopes (Branch 1998), generally associated with mountains fringing major drainages.

Bioregion: Richtersveld; Gariep Desert; Bushmanland; Alluvial Vegetation.

Assessment rationale: Previously treated as Peripheral (Branch 1988a) as it has a limited range in South Africa and is habitat-specific. However, much of the range is inhospitable to people and populations are formally protected in the Augrabies and Richtersveld national parks. There is an unquantified demand for this species in the pet trade, but because the size of wild populations is unknown, the impact of collecting is difficult to gauge. However, although the snakes are sparsely distributed, global distribution is large and the species is therefore classified as Least Concern.

Conservation measures: Consider the expansion of formally protected areas along the lower Orange River. This would not only protect this species, but also a number of other reptiles and plants unique to this area. A more detailed understanding of the ecological requirements of this snake will be useful for assessing suitable habitat. Quantification of collection for the pet trade will allow for a sensible response to this threat.

Bitis xeropaga—Aggeneys, NC D. Maguire

Bitis xeropaga—between Augrabies Falls and Onseepkans, NC E. le Roux

Bitis xeropaga—near Aggeneys, NC J. Marais

Genus *Causus* Wagler, 1830—night adders

Causus is a small genus consisting of six species (Rasmussen 2005) distributed throughout sub-Saharan Africa. These snakes are generally found in moist regions because they prey mainly on frogs. Despite their vernacular English name, they may be active by day or night. Females lay clutches of 3–26 eggs (Spawls *et al.* 2002). Two species are represented in the *Atlas* region and both also occur elsewhere. *Causus defilippii* is not as common and widespread in the region as *C. rhombeatus* but neither species is considered threatened.

Causus defilippii (Jan, 1862)

SNOUTED NIGHT ADDER

Andrew A. Turner

Regional: Least Concern

Taxonomy: No notable issues.

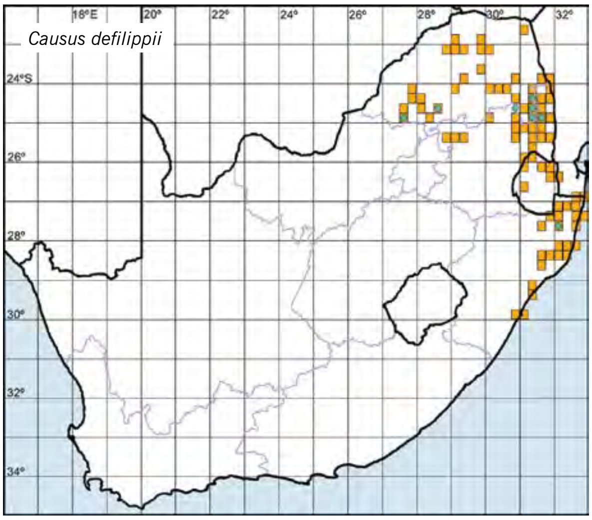
Distribution: Occurs from coastal southern Kenya southwards to eastern Tanzania, eastern Zambia, Zimbabwe, Mozambique, South Africa and Swaziland (Spawls & Branch 1995; Branch 1998; Rasmussen 2005). In South Africa it is found in Limpopo, northern and eastern Mpumalanga and northeastern and coastal KwaZulu-Natal.

Habitat: Occupies mesic to dry low-lying savanna.

Biome: Savanna; Indian Ocean Coastal Belt.

Assessment rationale: Has a large range in South Africa and is not known to be threatened. Occurs in several protected areas.

Conservation measures: None recommended.



Causus defilippii—Frischgewaagd (Bobididi) Resettlement, about 20 km S of Steelpoort, MPM M. Burger

Causus rhombeatus (Lichtenstein, 1823)

RHOMBIC NIGHT ADDER;
COMMON NIGHT ADDER

Andrew A. Turner

Regional: Least Concern

Taxonomy: No notable issues.

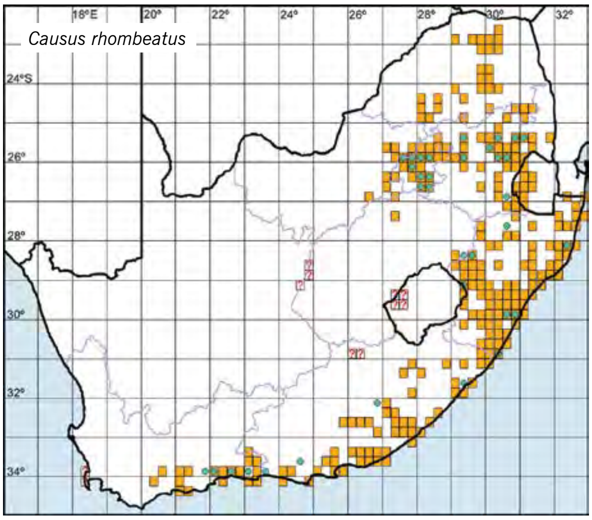
Distribution: Occurs widely throughout sub-Saharan Africa from eastern Nigeria, southern Sudan and Ethiopia southwards to the Swellendam area in the Western Cape, South Africa, but absent from the arid western half, and much of the central part, of southern Africa (Broadley 1990b; Spawls & Branch 1995; Branch 1998; Rasmussen 2005). In the *Atlas* region it occurs in the western half of Swaziland and in the eastern and extreme southern parts of South Africa. Three old records from the Cape Town area probably represent incorrect localities or possible accidental introductions and are indicated by question marks (they were excluded from the map in Rasmussen 2005), as are records from the Kimberley, Colesberg and Maseru (Lesotho) areas which also require confirmation.

Habitat: Found in mesic habitats, generally near water.

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Albany Thicket; Fynbos; Forests.

Assessment rationale: Widely distributed and regularly encountered in spite of some persecution. This species may benefit from certain land-use changes such as the construction of dams and pastures, because of its reliance on frogs as prey. It occurs in many protected areas.

Conservation measures: None recommended.



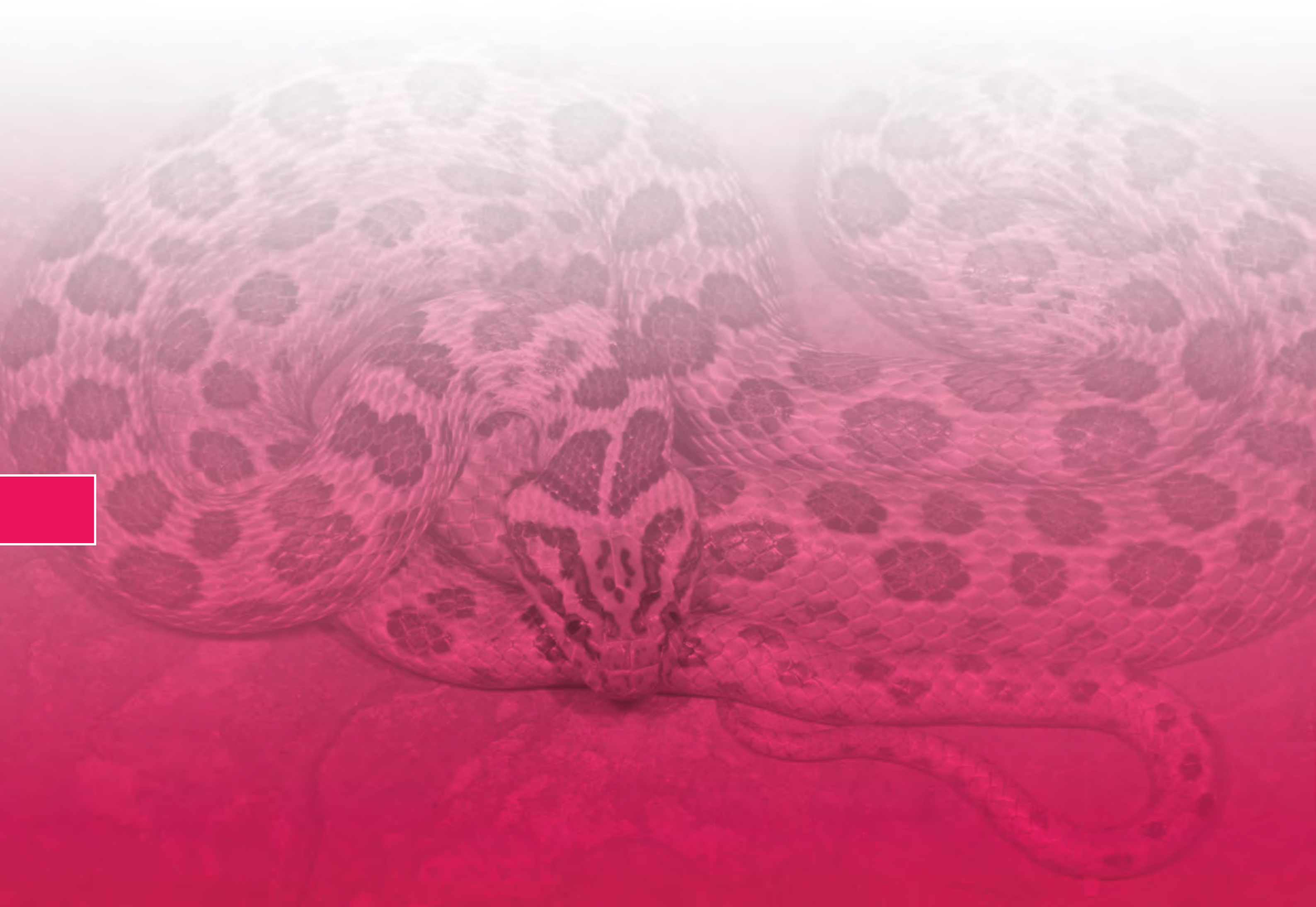
Causus rhombeatus—Port Elizabeth, EC W.R. Branch

CHAPTER 22

Family Lamprophiidae

William R. Branch, James Harvey, Bryan Maritz, Johan Marais, Marius Burger, Gavin Masterson & *Michael F. Bates*

Advanced snakes (Caenophidia) make up 82.4% (2 782) of the approximately 3 378 living species of snakes (Uetz 2012). Recent molecular studies have helped to clarify interfamilial relationships within Caenophidia, with recognition of a superfamily (Elapoidea) comprising the traditional Family Elapidae and a sister clade often informally referred to as the 'African Radiation' (Lawson *et al.* 2005; Vidal *et al.* 2007a; Vidal *et al.* 2008a; Kelly *et al.* 2009b). This large clade (approximately 60 genera and 280 species), here referred to the Lamprophiidae (Vidal *et al.* 2007a), includes four major groups treated as subfamilies (Atractaspidiinae, Lamprophiinae, Pseudoxyrhophiinae, Psammophiinae) by many recent researchers, e.g. Vidal *et al.* (2007a, 2008a), Fry *et al.* (2008) and Vonk *et al.* (2008). These have all been treated as families by some authors (Kelly *et al.* 2008, 2009), while two additional families—Prosymnidae (*Prosymna*) and Pseudaspididae (*Pseudaspis* and *Pythonodipsas*)—were recently proposed by Kelly *et al.* (2009b). The Lamprophiidae comprises mostly African (including Madagascan) snakes that appear to have undergone an explosive diversification in the Late Eocene (Kelly *et al.* 2009b). The evolutionary relationships of a number of genera (e.g. *Buhoma*, *Prosymna*, *Pseudaspis* and *Pythonodipsas*) within the Lamprophiidae remain problematic and they are considered *incertae sedis* (of uncertain placement). Other caenophidian genera within the *Atlas* region are now considered either as members of a restricted family Colubridae or of the family Natricidae (i.e. *Natriciteres*).



SUBFAMILY ATRACTASPIDINAE

The atractaspidines are primarily African snakes and are represented by approximately 11 genera and 67 species (see Uetz 2012, but minus *Macrelaps*; Vidal *et al.* 2008a). They occur throughout most of Africa, with one genus entering the Near East (Branch 1998; Shine *et al.* 2006). Two tribes are recognised (Nagy *et al.* 2005; Vidal *et al.* 2008a), with the Atractaspidini including the genera *Homoroselaps* and *Atractaspis*, and the Aparallactini including the remaining genera. Both tribes occur in the *Atlas* region and are represented by 13 species in six genera (*Amblyodipsas, Aparallactus, Atractaspis*, *Homoroselaps*, *Macrelaps* and *Xenocalamus*), two of which are endemic to the *Atlas* region (*i.e. Homoroselaps* and *Macrelaps*).

Homoroselaps, previously placed in *Elaps* (type genus of the Elapidae), has had a complicated taxonomic history and its familial assignment has oscillated between elapids and atractaspidines (McDowell 1968; Underwood & Kochva 1993). However, the most recent molecular studies have firmly nested *Homoroselaps* within the Atractaspidinae (Nagy *et al.* 2005; Vidal *et al.* 2008a).

Atractaspidines are fossorial and generally nocturnal, they lack a loreal scale, have smooth shiny scales, slender bodies with relatively small heads, indistinct necks, small eyes and short tails; all species are oviparous (Shine *et al.* 2006). Many have specialised diets, e.g. *Aparallactus* eats primarily centipedes, and *Xenocalamus* eats mainly amphisbaenids (Branch 1998).

Some species appear to be naturally rare (*Homoroselaps dorsalis* and *Xenocalamus transvaalensis*) or have restricted ranges (*Amblyodipsas microphthalma nigra*), but only two taxa are considered to be of conservation concern, both Near Threatened: *Homoroselaps dorsalis* because its range lies within prime agricultural land, and *Macrelaps microlepidotus* because of ongoing habitat destruction.

Genus *Amblyodipsas* Peters, 1857—purple-glossed snakes

The genus *Amblyodipsas* is confined to sub-Saharan Africa, with most species occurring in the southern and eastern portions of the continent. Nine species are currently recognised (Branch 1998; Uetz 2012), but two subspecies—*A. katangensis ionidesi* and *A. microphthalma nigra*—may represent distinct species (Broadley & Cotterill 2004; Branch 2006b). Three species occur in the *Atlas* region, where they are confined to the northeast and eastern coastal region. One of these, *A. concolor*, is endemic.

These snakes are fossorial, primarily nocturnal and occur in moist woodland, forests and grassland. They prey mainly on lizards and other snakes (Shine *et al.* 2006). Two to twelve eggs are laid, but a female *A. concolor* was once recorded as having given birth to 12 young (Haacke 1982; Broadley 1990b; Branch 1998). *Amblyodipsas m. microphthalma* and *A. m. nigra* were previously listed as Peripheral and Restricted respectively (Branch 1988a), but both are now considered Least Concern.

Amblyodipsas concolor (A. Smith, 1849)

KWAZULU-NATAL PURPLE-GLOSSED SNAKE

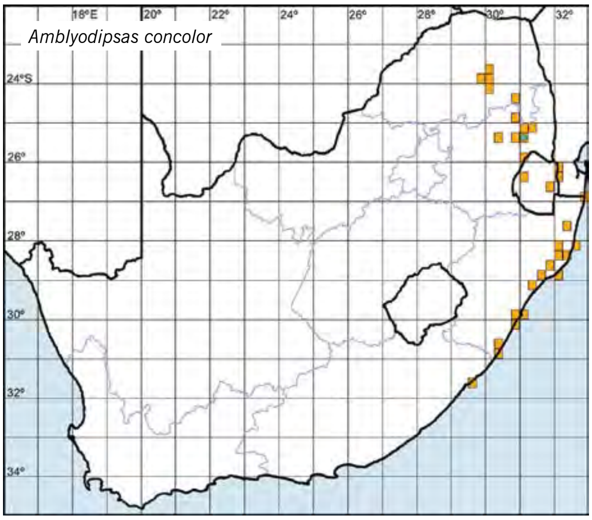
Marius Burger

Global: Least Concern

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to the *Atlas* region. Restricted to the northeastern and eastern parts, from the Duiwelskloof area in Limpopo, southwards through Mpumalanga, Swaziland and coastal KwaZulu-Natal, reaching its southern limits at Mtumbane in the northeastern Eastern Cape. It probably also occurs in southern Mozambique.



Amblyodipsas concolor—Wolkberg Wilderness Area, about 15 km SE of Haenertsburg, LIMP M. Burger

Habitat: Generally associated with moist, well-wooded or forested regions (Jacobsen 1989; Broadley 1990b; Branch 1998), but records for the Wolkberg are from grassland (M. Burger pers. obs.). Found from near sea level (14 m at Mtumbane; Haagner 1994) to 1 650 m in the Wolkberg. Apparently mostly fossorial, burrowing in humic soils and sheltering under rocks and rotting logs (Jacobsen 1989; Branch 1998).

Bioregion: Lowveld; Indian Ocean Coastal Belt; Mesic Highveld Grassland; Zonal and Intrazonal Forests; Central Bushveld.

Assessment rationale: Fairly widespread. Although Jacobsen (1989) considered this species to be vulnerable and it is generally thought to be rare (Broadley 1990b; Branch 1998), this perceived rarity is probably due mainly to its secretive fossorial habits.

Conservation measures: None recommended.

Amblyodipsas microphthalma microphthalma (Bianconi, 1850)

EASTERN PURPLE-GLOSSED SNAKE

Marius Burger

Global: Least Concern

Taxonomy: A molecular assessment should be made of the relationship between the two subspecies, *A. m. microphthalma* and *A. m. nigra*. Likewise, the systematic placement of these two taxa needs to be assessed in relation to the genus *Xenocalamus*.

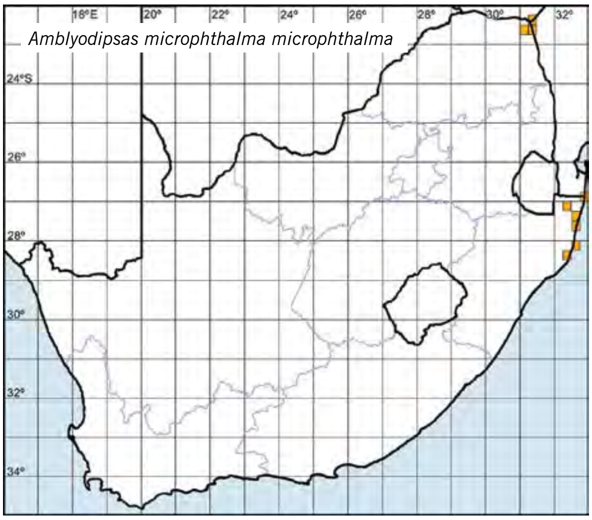
Distribution: Most of the species' range is within southern Mozambique, with the northeastern limit at QDGC 2335CD (Broadley 1990b). This subspecies is peripheral in South Africa (Jacobsen 1988j), where it reaches its western limit in the Pafuri region of Kruger National Park in Limpopo Province, and its southern limit at St Lucia in northeastern KwaZulu-Natal. It may also occur in Swaziland and Zimbabwe but no records are currently known from these countries.

Habitat: A fossorial species inhabiting deep aeolian sands and coastal alluvium, including Wambia and Pumbe sandveld of northeastern Kruger National Park (Jacobsen 1989). Occurs from near sea level to about 350 m in the Kruger National Park.

Bioregion: Indian Ocean Coastal Belt; Lowveld; Mopane.

Assessment rationale: Probably affected by the mining of sand dunes in northeastern KwaZulu-Natal, but the extent of the threat is unknown. Likewise, timber and sugarcane industries in this region might have had a detrimental effect, but the taxon might have been relatively unaffected because of its fossorial habits. However, within the *Atlas* region it occurs largely within protected areas. Threats in southern Mozambique are unknown.

Conservation measures: Conduct surveys in the known range, including Mozambique. This will improve EOO and AOO estimates, help to evaluate major threats, and be useful for gathering material for a molecule-based taxonomic assessment.

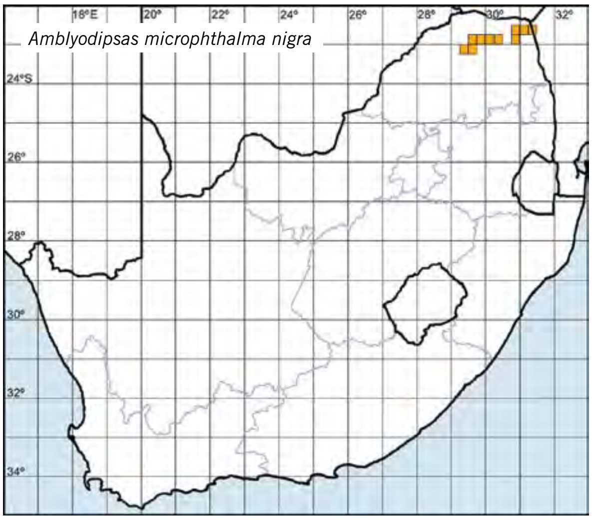


Amblyodipsas microphthalma microphthalma—Kosi Bay, KZN J. Marais

Amblyodipsas microphthalma nigra Jacobsen, 1986

SOUTPANSBERG PURPLE-GLOSSED SNAKE; BLACK WHITE-LIPPED SNAKE

Marius Burger



Global: Least Concern

Endemic

Taxonomy: This taxon was originally considered to be a melanistic form of *Amblyodipsas microphthalma* (e.g. FitzSimons 1962; Pienaar 1966, 1978; Broadley 1971b, 1983), until Jacobsen (1986) described it as a subspecies. Its taxonomic status should be re-evaluated by means of morphological and genetic analyses. Likewise, its relationship to the genus *Xenocalamus* should be assessed.

Distribution: Endemic to Limpopo Province, South Africa. Its distribution is centered in the Soutpansberg area, from where it extends eastwards to the Pafuri region of the Kruger National Park. The Pafuri area (2231CB) is the only QDGC from which both subspecies of *A. microphthalma* have been recorded, but they apparently remain parapatric where the Saselondonga Gorge crosses the northern sandveld (Jacobsen 1986). The distribution map contains all the QDGC records from Jacobsen (1986, 1989), including the discrepancies between these two reports. This taxon may also occur in Mozambique and Zimbabwe, but no records are currently known for these countries.

Habitat: Apparently it has an association with rocky, broken terrain, as most individuals have been recorded from under rocks and logs. This subspecies is seemingly less inclined to burrow into sand than *A. m. microphthalma*, but specimens have also been unearthed from sandy substrates (Jacobsen 1986).

Vegetation type: SVcb 21 Soutpansberg Mountain Bushveld; SVl 1 Makuleke Sandy Bushveld; SVmp 1 Musina Mopane Bushveld.

Assessment rationale: This snake is rarely found (<15 museum specimens known) and has a restricted range (EOO 9 750 km^2, below the Vulnerable threshold, and AOO 5 400 km^2). However, there are no known threats and the species is here considered Least Concern. It was previously classified as Restricted (Branch 1988a).

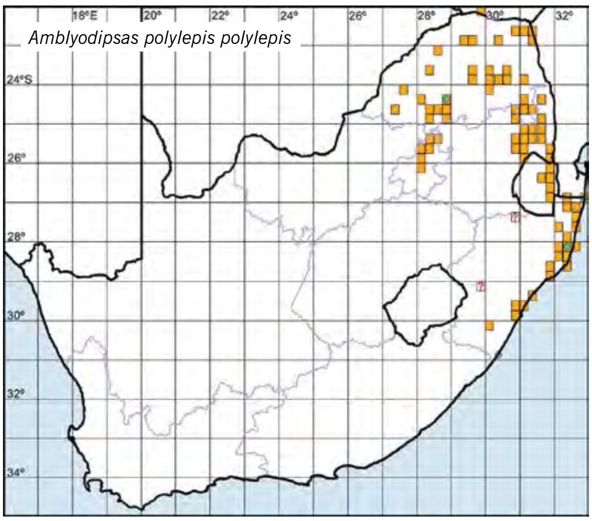
Amblyodipsas microphthalma nigra—E of Tshipise, LIMP M. Burger

Conservation measures: Conduct surveys within the known range and in adjacent areas to improve estimates of EOO and AOO, and to evaluate population trends, habitat requirements and major threats. Gather material for a molecular phylogeny.

Amblyodipsas polylepis polylepis (Bocage, 1873)

COMMON PURPLE-GLOSSED SNAKE

Marius Burger



Global: Least Concern

Taxonomy: The taxonomic status of the East African subspecies *A. polylepis hildebrandtii* should be re-evaluated.

Distribution: Widely distributed in African countries between latitudes 10° and 31° south of the equator, inclusive of northeastern and eastern South Africa, Swaziland, southern Mozambique, Zimbabwe, northern Botswana, northern Namibia, Zambia, Malawi, Angola and southern Democratic Republic of Congo (Broadley 1971b, 1990b; Jacobsen 1989; Branch 1998). In South Africa it occurs in Limpopo, eastern Mpumalanga, Gauteng and eastern KwaZulu-Natal. Two questionable outlier localities on the map (see also Broadley 1990b) require confirmation. The southernmost limit of the species is Uvongo (3030CD) in KwaZulu-Natal, based on a Virtual Museum record.

Habitat: Primarily fossorial, occurring in a variety of vegetation types. In South Africa it is found from near sea level to 1 300 m (Jacobsen 1989; Broadley 1990b; Branch 1998).

Biome: Savanna; Indian Ocean Coastal Belt; Grassland; Forests.

Assessment rationale: Has a wide distribution stretching over several countries and is probably common, although seldom encountered.

Conservation measures: None recommended.

Amblyodipsas polylepis polylepis—St Lucia, KZN J. Marais

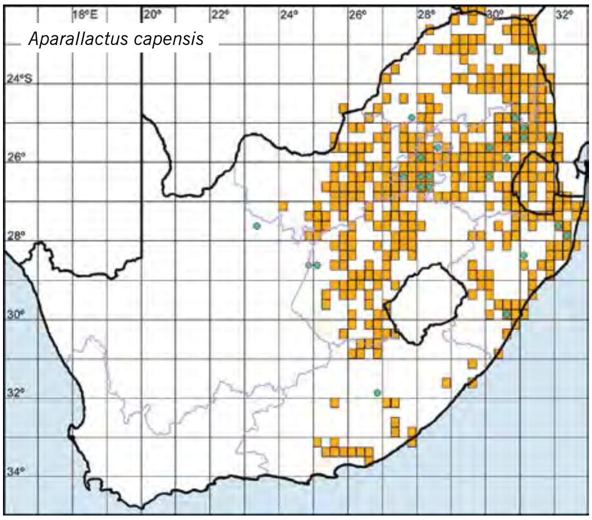
Genus *Aparallactus* Smith, 1849—centipede-eaters

The genus *Aparallactus* occurs throughout much of sub-Saharan Africa and contains 11 species (Branch 1998; Uetz 2012). Two species occur in the eastern half of the *Atlas* region. They are slender nocturnal snakes occurring under rocks and in old termitaria in mesic habitats. Prey consists of centipedes and other invertebrates (Spawls *et al.* 2002). Females of most species lay clutches of 2–4 eggs, but *A. jacksoni* gives birth to 2–3 offspring (Branch 1998; Spawls *et al.* 2002). Neither species in the *Atlas* region is of conservation concern.

Aparallactus capensis (A. Smith, 1849)

BLACK-HEADED CENTIPEDE-EATER;
CAPE CENTIPEDE-EATER

Marius Burger



Regional: Least Concern

Taxonomy: The relationship between *A. capensis* and *A. nigriceps* (of southern Mozambique) should be investigated.

Distribution: An eastern African species ranging from the Eastern Cape of South Africa to Tanzania in the north. The distribution extends westwards through southeastern Democratic Republic of Congo and Zambia to Angola and northern Namibia (Broadley 1990b). An historical record from central Namibia, between Omaruru and Okahandja (Sternfeld 1910), has not been verified by new material. The species is apparently absent from southern Mozambique (Broadley 1990b; Branch 1998). In the *Atlas* region it occurs in the eastern half of South Africa and throughout Swaziland. Within South Africa it is widely distributed and occurs in North-West Province, Gauteng, Limpopo, Mpumalanga, KwaZulu-Natal, Free State and the Eastern Cape. Its range extends marginally into the Northern Cape in the Kimberley and Jan Kempdorp (Andalusia) regions. Three SARCA Virtual Museum records extend the known range westwards. Two isolated records from the Western Cape require confirmation and were regarded as suspicious and omitted from the map because they are situated well outside the main distribution. These records are for Prince Albert (3322AA) and Bredasdorp (3420CA) and are based on voucher specimens in the Port Elizabeth Museum (see also Broadley 1990b) and Field Museum of Natural History, respectively.

Habitat: A terrestrial species that may be partially fossorial, with an affinity for old termitaria. Present in a wide variety of habitat types from near sea level up to 2 300 m (Jacobsen 1989; Broadley 1990b; Branch 1998).

Biome: Grassland; Savanna; Albany Thicket; Indian Ocean Coastal Belt; Nama-Karoo (marginal); Fynbos (marginal).

Aparallactus capensis—Johannesburg, GP G.J. Alexander

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Aparallactus lunulatus lunulatus (Peters, 1854)

PLUMBEOUS CENTIPEDE-EATER; RETICULATED CENTIPEDE-EATER

Marius Burger

Regional: Least Concern

Taxonomy: The *Aparallactus lunulatus* complex should be revised in order to evaluate the taxonomic status of the various subspecies (*A. l. lunulatus*, *A. l. scortecci* and *A. l. nigrocollaris*).

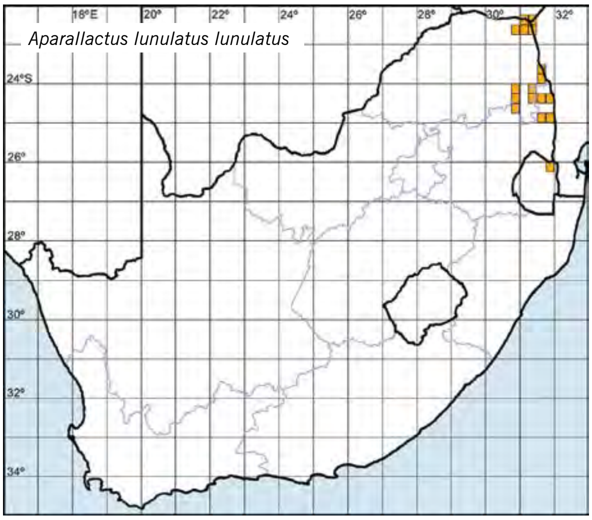
Distribution: Enters the *Atlas* region in the northeast, but is widely distributed northwards through southern Mozambique and Zimbabwe into eastern Africa as far north as South Sudan, and westwards into the Democratic Republic of Congo (Broadley 1990b; Branch 1998). Occurs in the South African provinces of Limpopo and Mpumalanga; the single record from northeastern Swaziland (Boycott 1992a) represents the southernmost limit of the range.

Habitat: In South Africa it shelters under rocks and rotting logs in sandy terrain at altitudes of 300–800 m; in eastern Africa it apparently has an affinity for stony country in moist savanna and semi-desert from sea level to 2 200 m (Jacobsen 1989; Broadley 1990b; Branch 1998; Spawls *et al.* 2002).

Bioregion: Lowveld; Mopane.

Assessment rationale: Widely distributed over several countries. Probably common although not often encountered.

Conservation measures: None recommended.



Aparallactus lunulatus lunulatus—Hoedspruit, LIMP J. Marais

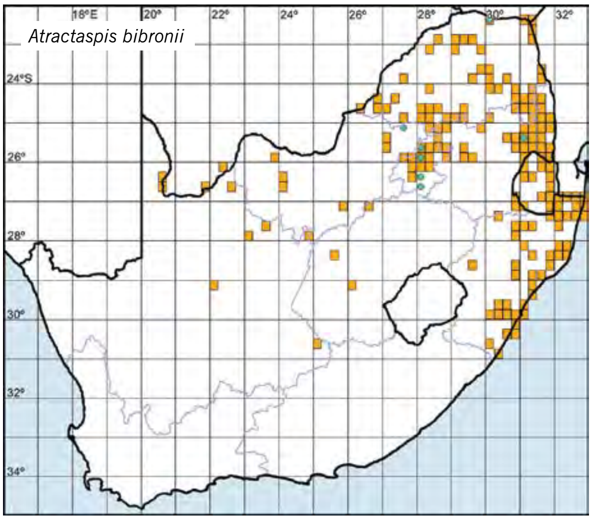
Genus *Atractaspis* Smith, 1849—stiletto snakes

The genus *Atractaspis* is distributed widely across sub-Saharan Africa, with one species (*A. microlepidota*) reaching the Middle East. Although 21 species are currently recognised (Uetz 2012; see also Dobiey & Vogel 2007), the taxonomic status of several species is uncertain (e.g. Spawls & Branch 1995). A morphology-based phylogeny of 14 species in the genus *Atractaspis* was conducted by Moyer & Jackson (2011), but *A. duerdeni* was not included in their analysis. The ranges of two species (*A. bibronii*, *A. duerdeni*) extend into the *Atlas* region, where these snakes occur in a variety of habitats, mainly in the northeast. Members of the genus *Atractaspis* are fossorial, mainly nocturnal, and feed on reptiles, amphibians and small mammals (Shine *et al.* 2006). Females lay clutches of 3–11 eggs (Branch 1998; Alexander & Marais 2007). Their venom is primarily cytotoxic and of medical significance. *Atractaspis bibronii* is responsible for a substantial proportion of dangerous snakebites in South Africa (Tilbury & Branch 1989). Fatalities have been recorded after bites from *Atractaspis* species that occur outside the *Atlas* region (Corkhill & Kirk 1954; Ismail *et al.* 2007). Both species in the *Atlas* region are widespread and not of conservation concern.

Atractaspis bibronii A. Smith, 1849

BIBRON'S STILETTO SNAKE; SOUTHERN STILETTO SNAKE; BIBRON'S BURROWING ASP

Marius Burger



Regional: Least Concern

Taxonomy: It seems likely that several cryptic taxa are currently subsumed under the name *Atractaspis bibronii* (Nagy *et al.* 2005). Morphological and genetic techniques should be employed to conduct a major revision of this species across its entire range.

Distribution: Widely distributed in sub-Saharan Africa, extending from Kenya and southern Somalia southwards to Tanzania, Democratic Republic of Congo, Zambia, Malawi, Mozambique, Zimbabwe, Botswana, Namibia, South Africa and Swaziland; there is also a disjunct population in central-western Angola (Broadley 1990b, 1991; Spawls & Branch 1995; Dobiey & Vogel 2007). In the *Atlas* region this species appears to be most abundant in the northeast, i.e. Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal and Swaziland. There are scattered records in North-West Province, Free State and Northern Cape. The southwesterly limits of the species' range (2922AA) are represented by a specimen collected during a SARCA field survey.

Habitat: Primarily fossorial. Often found in termitaria or on soil under logs or rocks, in a variety of habitat types, from about sea level to at least 1 600 m (Jacobsen 1989).

Bioregion: Lowveld; Central Bushveld; Mesic Highveld Grassland; Indian Ocean Coastal Belt; Dry Highveld Grassland; Mopane; Sub-Escarpment Savanna; Eastern Kalahari Bushveld; Sub-Escarpment Grassland; Kalahari Duneveld; Upper Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Atractaspis bibronii—E of Tshipise, LIMP M. Burger

Atractaspis duerdeni Gough, 1907

DUERDEN'S STILETTO SNAKE; BEAKED STILETTO SNAKE; BEAKED BURROWING ASP

Marius Burger

Regional: Least Concern

Taxonomy: For a long time this species was confused with *Atractaspis bibronii* (e.g. Broadley 1983). The taxonomy of the species as a whole (including the status of the disjunct Namibian population) and its relationship to *A. bibronii* should be investigated by means of a molecular assessment.

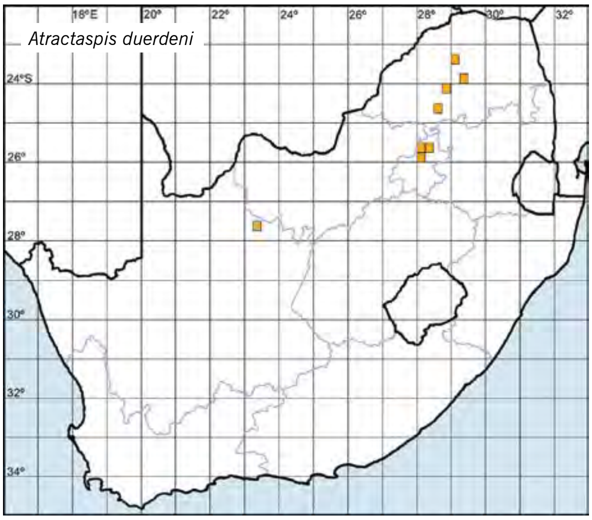
Distribution: A southern African endemic with two widely separated populations, one in north-central Namibia and the other in southeastern Botswana, extending into South Africa (Broadley 1990b, 1991; Spawls & Branch 1995; Branch 1998; Marais 2004; Dobiey & Vogel 2007). Most of the records in the *Atlas* region are in Limpopo and Gauteng provinces, but the southernmost record (2723CB, obtained during a SARCA field survey) is from the Kuruman region of the Northern Cape. It is likely that the species also occurs in North-West Province.

Habitat: A poorly-known fossorial snake that inhabits sandy soil. The altitudinal range in South Africa is 1 250 to 1 500 m (Jacobsen 1989).

Bioregion: Central Bushveld; Mesic Highveld Grassland; Eastern Kalahari Bushveld.

Assessment rationale: Widespread and common, especially outside the *Atlas* region.

Conservation measures: None recommended.



Atractaspis duerdeni—Bela Bela, LIMP W.R. Schmidt

Genus *Homoroselaps* Jan, 1858—harlequin snakes

The genus *Homoroselaps* is endemic to the *Atlas* region and contains two species that occur in the south and east. *Homoroselaps* has a convoluted taxonomic history: these snakes were previously considered to be elapids (Underwood & Kochva 1993) but were recently classified as atractaspidines (Nagy *et al.* 2005; Kelly *et al.* 2009b). The two known species are slender, fossorial and occur in grassland, mesic savanna and fynbos. They feed on burrowing lizards and snakes (Alexander & Marais 2007). Females lay clutches of 2–16 eggs (Branch 1998). *Homoroselaps dorsalis* was listed as Rare (Branch 1988c) and Lower Risk/near threatened (IUCN 1996), and is now considered Near Threatened.

Homoroselaps dorsalis (A. Smith, 1849)

STRIPED HARLEQUIN SNAKE

Marius Burger

Global: Near Threatened

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to the *Atlas* region. This species has a patchy distribution, with records in western Swaziland and the South African provinces of Limpopo, Mpumalanga, Gauteng, Free State and KwaZulu-Natal. Two records in the northern part of the Eastern Cape (see Branch 1988c) were incorrectly plotted (W.R. Branch pers. comm.) and are not included on the map here.

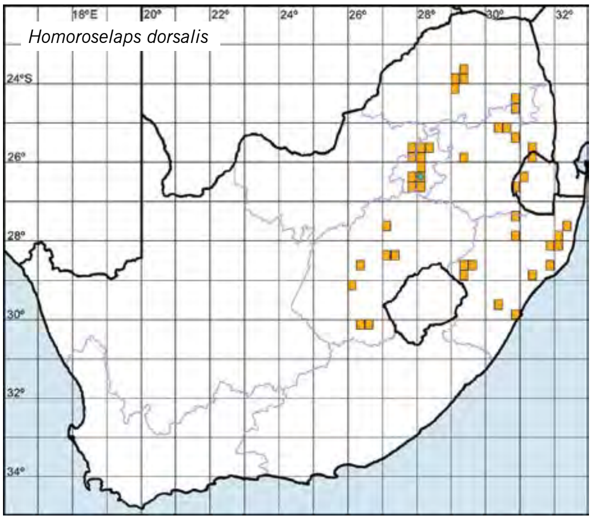
EOO: 276 670 km^2 (confidence: high); AOO: 3 915 km^2 (confidence: low).

Habitat: Partially fossorial and known to inhabit old termitaria in grassland habitat. Most of its range is at moderately high altitudes, reaching 1 800 m in Mpumalanga and Swaziland, but it is also found at elevations as low as about 100 m in KwaZulu-Natal (De Waal 1978; Branch 1988c, 1998; Jacobsen 1989; Broadley 1990b; Bourquin 2004; Marais 2004).

Bioregion: Mesic Highveld Grassland; Central Bushveld; Dry Highveld Grassland; Lowveld; Sub-Escarpment Grassland; Indian Ocean Coastal Belt.

Assessment rationale: *Homoroselaps dorsalis* does not meet the criteria for threatened status, mostly because of its fairly large EOO and AOO. However, the population is severely fragmented and there are continuing declines in AOO, quality of habitat and number of mature individuals. This species is therefore of conservation concern and considered to be Near Threatened.

Threats: Threats are varied but ultimately they all relate to loss, degradation and/or fragmentation of habitat. Grasslands in South Africa, particularly in the montane regions, are under severe pressure primarily as a result of afforestation and overly frequent burns (CSIR 2008). Urban, industrial and mining developments in the Gauteng Highveld have transformed much of the former habitat of this species, and these threats continue unabated. Likewise, large-scale crop farming in the Free State and Gauteng is likely to have had, and continues to have, a significantly detrimental impact on the habitat of this species.



Homoroselaps dorsalis—Suikerbosrand NR, GP B. Maritz

Conservation measures: Protect substantial units of grassland habitat where the species occurs. Regulate burning at unprotected grassland sites by means of legislation.

Homoroselaps lacteus (Linnaeus, 1758)
SPOTTED HARLEQUIN SNAKE

Marius Burger

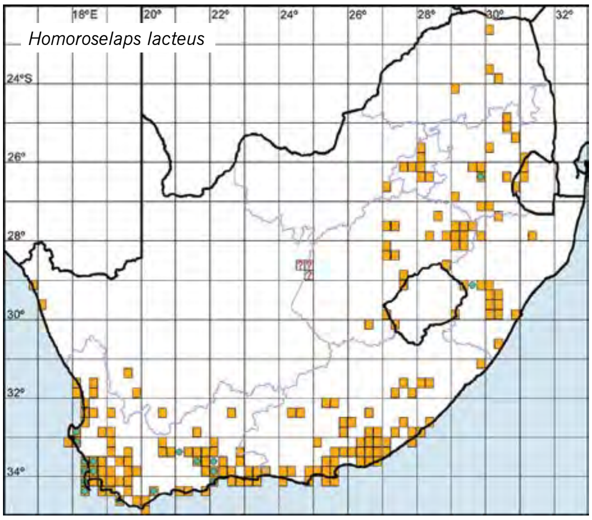
Global: Least Concern

Endemic

Taxonomy: A taxonomic investigation of the various colour pattern morphs within this species is in preparation (W.R. Branch unpubl. data).

Distribution: Endemic to the *Atlas* region. Found in South Africa and western Swaziland, but also on the borders of western Lesotho, suggesting that it may also occur there. Widespread in the *Atlas* region but generally absent from arid areas. The range includes most of the Western and Eastern Cape provinces, KwaZulu-Natal, eastern half of the Free State, southeastern North-West Province, Gauteng, Mpumalanga and Limpopo as far north as the Tshipise area (De Waal 1978; Jacobsen 1989; Broadley 1990b; Bourquin 2004). There are also a few scattered records in the southern parts of the Northern Cape, an isolated population in the Port Nolloth/Kleinsee area, and a few questionable old records from around Kimberley.

Habitat: A semi-fossorial species found in sandy substrates, old termitaria and under rocks, from near sea level to elevations of 1 800 m (De Waal 1978; Jacobsen 1989; Spawls & Branch 1995; Branch 1998; Bourquin 2004).



Biome: Fynbos; Grassland; Albany Thicket; Savanna; Succulent Karoo; Indian Ocean Coastal Belt; Nama-Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Homoroselaps lacteus—Greytown, KZN J. Harvey

Homoroselaps lacteus—De Hoop NR, WC T. Phelps

Genus *Macrelaps* Boulenger, 1896—KwaZulu-Natal black snakes

Macrelaps is a monotypic genus endemic to the *Atlas* region. The only known species, *M. microlepidotus*, is restricted to central and eastern KwaZulu-Natal and the eastern parts of the Eastern Cape. It is a fossorial species that is found in forests and occasionally in grasslands. These snakes are mostly nocturnal and feed on reptiles, frogs and mammals (Marais 2004; Shine *et al.* 2006). Females lay clutches of 3–19 eggs in summer (Branch 1998; Shine *et al.* 2006). *Macrelaps microlepidotus* was not previously considered to be of conservation concern but it is now classified as Near Threatened as a result of ongoing habitat destruction.

Macrelaps microlepidotus (Günther, 1860)

KWAZULU-NATAL BLACK SNAKE

Marius Burger

Global: Near Threatened

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to the eastern parts of the *Atlas* region, from Kosi Bay in northeastern KwaZulu-Natal, southwards to East London in the Eastern Cape. It occurs as far inland as the Estcourt area in KwaZulu-Natal (Bourquin 2004), and the Amatole Mountains in the Eastern Cape (Conradie *et al.* 2012). This species may also occur in southern Mozambique.

EOO: 109 415 km^2 (confidence: medium); AOO: 2 305 km^2 (confidence: low).

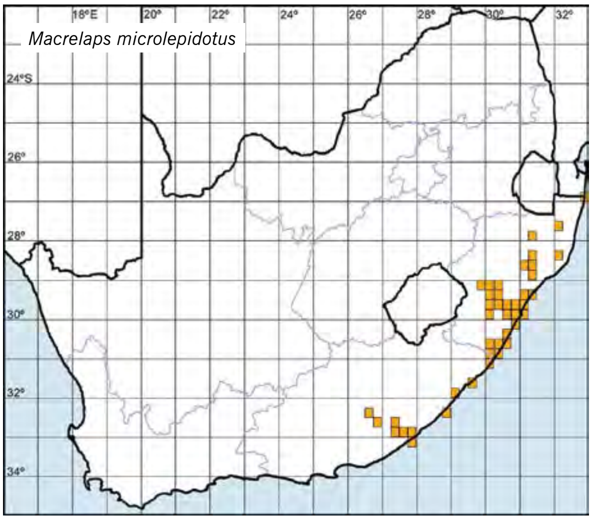
Habitat: A semi-fossorial species with an affinity for forests, where it tends to frequent moist leaf litter and humic soil. In coastal bush it is associated with damp localities near water (Broadley 1990b; Branch 1998; Marais 2004). Altitude ranges from near sea level to about 1 300 m at Nkandla and Estcourt.

Bioregion: Indian Ocean Coastal Belt; Sub-Escarpment Savanna; Lowveld; Sub-Escarpment Grassland; Albany Thicket; Zonal and Intrazonal Forests.

Assessment rationale: AOO approaches the Vulnerable threshold and there is ongoing habitat destruction [B2b(iii)], but habitat fragmentation is moderate and there are more than 10 locations. The species is classified as Near Threatened.

Threats: Coastal developments and ongoing destruction of forests.

Conservation measures: Protect forest habitat.



Macrelaps microlepidotus—Hillcrest, KZN G.J. Alexander

Genus *Xenocalamus* Günther, 1868—quill-snouted snakes

The genus *Xenocalamus* is confined to southern and central Africa and contains five species (Uetz 2012). Three species are found in the *Atlas* region where they are confined to the north and east, while two (*X. mechowii* and *X. mitchellii*) are extralimital (Branch 1998; Uetz 2012). *Xenocalamus* and *Amblyodipsas* appear to be closely related (Nagy *et al.* 2005; Vidal *et al.* 2008a). These are slender, fossorial snakes found on sandy substrates. They feed on other fossorial reptiles, particularly amphisbaenians (Shine *et al.* 2006). Females lay small clutches of 2–4 eggs (Branch 1998). *Xenocalamus transvaalensis* was previously listed as Rare (Branch 1988a) and Data Deficient (IUCN 1996) but is here considered Least Concern, whereas *X. sabiensis* was not assessed as its range within the *Atlas* area is peripheral.

Xenocalamus bicolor bicolor Günther, 1868

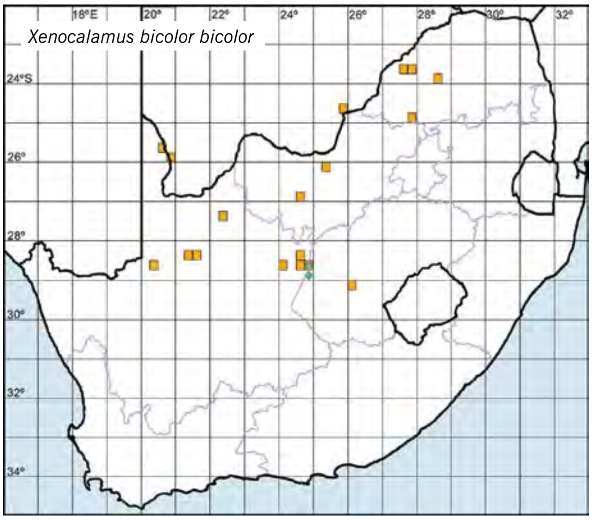
BICOLOURED QUILL-SNOUTED SNAKE

Johan Marais

Global: Least Concern

Taxonomy: Jacobsen (1989) cast some doubt on the validity of the subspecies of *Xenocalamus bicolor* due to the occurrence of intermediate specimens, and suggested that more material was needed to clarify the situation. After examining additional material, Bates (1991) confirmed that *X. b. concavorostralis*, from Bloemfontein, is a junior synonym of *X. b. bicolor*. A molecular analysis of relationships among the various subspecies of *X. bicolor* is required.

Distribution: Widespread and endemic to southern Africa. Occurs from South Africa northwards into Namibia, western and central Botswana, northern Zimbabwe and Mozambique (Broadley 1990b). In the *Atlas* region it occurs from Augrabies in the west to the extreme northern part of the Northern Cape, eastwards through North-West Province to Lephalale in Limpopo, and then south to Bloemfontein in the Free State. Two Virtual Museum records were obtained for the Kimberley area.



Habitat: Inhabits mainly Kalahari sands at altitudes of 1 000–1 200 m (Jacobsen 1989).

Biome: Savanna; Grassland; Nama-Karoo.

Assessment rationale: Although seldom encountered, this fossorial snake has a wide distribution.

Conservation measures: None recommended.

Xenocalamus bicolor bicolor—between Kimberley and Rooipoort NR, NC W.R. Branch

Xenocalamus bicolor bicolor—Lephalale, LIMP W.R. Branch

Xenocalamus bicolor australis FitzSimons, 1946

WATERBERG QUILL-SNOUTED SNAKE

Johan Marais

Global: Least Concern

Endemic

Taxonomy: Jacobsen (1989) cast some doubt on the validity of the subspecies of *Xenocalamus bicolor* due to the occurrence of intermediate specimens, and suggested that more material was needed to clarify the situation. A molecular analysis of relationships among the various subspecies of *X. bicolor* is required.

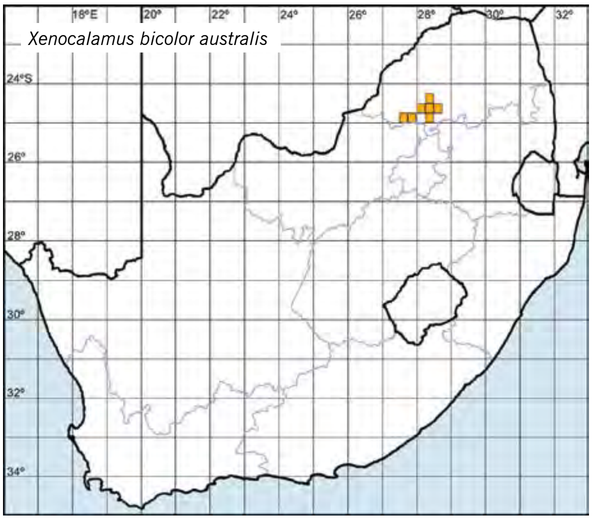
Distribution: Endemic to the Waterberg Range of Limpopo Province, South Africa. Found mainly in the vicinity of Nylsvley and Bela-Bela (Jacobsen 1989; Broadley 1990b; Branch 1998).

Habitat: Inhabits deep alluvial sands (Jacobsen 1989; Branch 1998) in bushveld. Found at altitudes of 1 100–1 400 m (Jacobsen 1989).

Bioregion: Central Bushveld.

Assessment rationale: This subspecies is not often encountered within its restricted range, probably because of its fossorial habits (it lives in deep sand). It is not known to experience any major threats.

Conservation measures: None recommended.



Xenocalamus bicolor australis—24 km NE of Sentrum, LIMP M. Burger

Xenocalamus bicolor lineatus Roux, 1907

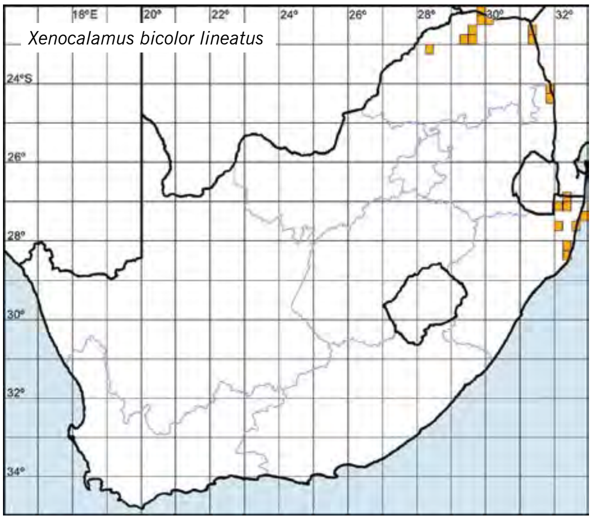
STRIPED QUILL-SNOUTED SNAKE

Johan Marais

Global: Least Concern

Taxonomy: Jacobsen (1989) cast some doubt on the validity of the subspecies of *Xenocalamus bicolor* due to the occurrence of intermediate specimens, and suggested that more material was needed to clarify the situation. A molecular analysis of relationships among the various subspecies of *X. bicolor* is required. This taxon was treated as a full species, *X. lineatus*, by Broadley & Blaylock (2013), without explanation.

Xenocalamus bicolor lineatus—LIMP W.D. Haacke



Distribution: Occurs from northeastern KwaZulu-Natal, South Africa into southern Mozambique, northeastern Mpumalanga, northern Limpopo and southern Zimbabwe (Broadley 1990b). May also occur in Swaziland.

Habitat: Inhabits deep aeolian sands in savanna habitats at altitudes of 200–1 100 m (Jabobsen 1989).

Bioregion: Mopane, Lowveld, Central Bushveld, Indian Ocean Coastal Belt.

Assessment rationale: Widespread, fossorial and not threatened.

Conservation measures: None recommended.

Xenocalamus sabiensis Broadley, 1971

SAVE QUILL-SNOUTED SNAKE

Johan Marais

Not Applicable

Taxonomy: No notable issues.

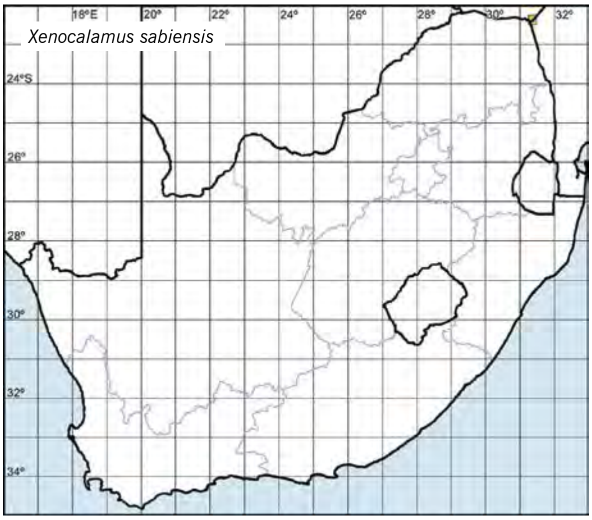
Distribution: Endemic to southern Africa. Found in south-eastern Zimbabwe and adjacent Mozambique (Broadley 1990b), with a single record (near Pafuri in northeastern Limpopo Province) in the *Atlas* region.

Habitat: Inhabits alluvial sands (Broadley 1990b; Branch 1998).

Bioregion: Mopane.

Assessment rationale: A fossorial snake that is seldom seen. In the *Atlas* region it is known from only a single locality in South Africa, representing less than 5% of the total range of the species, and it was therefore not assessed.

Conservation measures: Conduct research into population numbers, biology, ecology, habitat status and potential threats.



Xenocalamus sabiensis—Birchenough Bridge, Zimbabwe
P. Coates Palgrave

Xenocalamus sabiensis, dark phase—Chibaki River, Zimbabwe (paratype, TM 29115)
W.R. Schmidt

Xenocalamus transvaalensis Methuen, 1919

SPECKLED QUILL-SNOUTED SNAKE; TRANSVAAL QUILL-SNOUTED SNAKE

Johan Marais

Global: Least Concern

Near-endemic

Taxonomy: The relationship of the two apparently disjunct populations (see map) should be assessed.

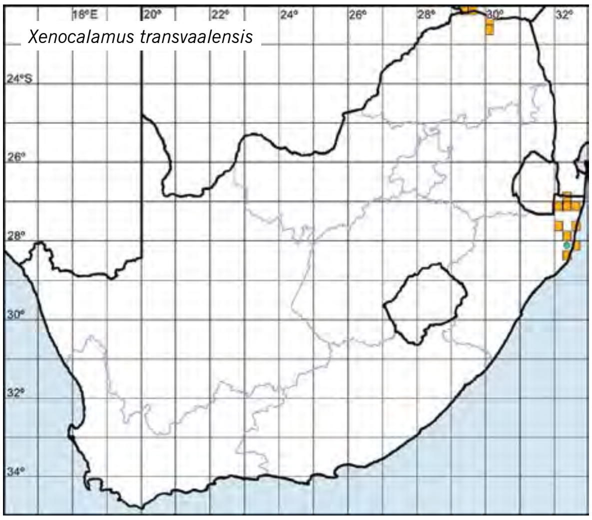
Distribution: Endemic to southern Africa. Found in two disjunct populations: one reaching from Mapelane, north-eastern KwaZulu-Natal, into southern Mozambique; and the other located in northern Limpopo and possibly extreme eastern Botswana (Broadley 1990b). It may also occur in southern Zimbabwe.

Habitat: Inhabits deep Kalahari and alluvial sands (Jacobsen 1987; Branch 1998).

Bioregion: Lowveld; Indian Ocean Coastal Belt; Mopane.

Assessment rationale: Fairly widespread but seldom seen because of its fossorial habits.

Conservation measures: Conduct research into population numbers, biology, ecology, habitat status, taxonomy and potential threats.



Xenocalamus transvaalensis—Malala Lodge, S of Hluhluwe, KZN J. Harvey

SUBFAMILY LAMPROPHIINAE

Generic boundaries and species content within the subfamily Lamprophiinae remain problematic. This subfamily contains many of the characteristic and common species of African snakes, including the house snakes and relatives (*Bothrolycus*, *Bothrophthalmus*, *Boaedon*, *Lamprophis*, *Lycodonomorphus*, *Pseudoboodon*), and a number of smaller genera usually associated with the wolf snake and file snake genera. Following the detailed study of Kelly *et al.* (2010), a number of important generic re-arrangements were proposed (see below), and a new genus described to accommodate the Swazi Rock Snake.

Lamprophiines lack fangs but may have enlarged, non-grooved teeth at the front of the maxilla for prey capture and manipulation. These snakes prey on vertebrates such as rodents and lizards (Branch 1998), which they kill by constriction. They are oviparous and mainly nocturnal. Most are terrestrial, although many clades include rupicolous species, while others are fully or partially aquatic.

Of the 12 genera and 68 species in the subfamily, six genera and at least 15 species occur in the *Atlas* region. Although some species are rare (e.g. *Lamprophis fiskii*) and others have restricted ranges, only *Lycophidion pygmaeum* (Near Threatened) is of conservation concern.

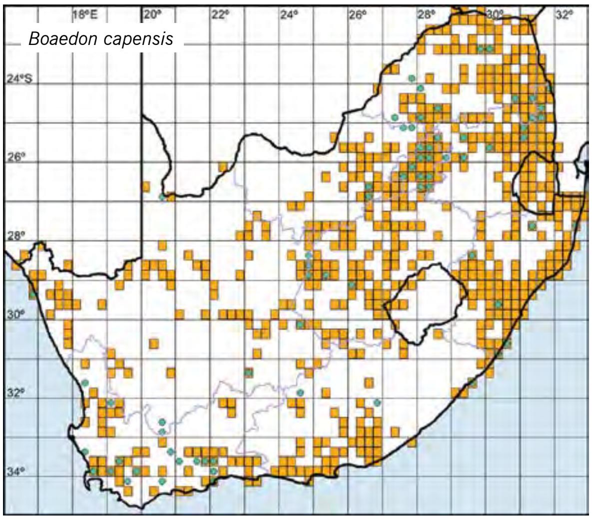
Genus *Boaedon* Duméril, Bibron & Duméril, 1854—house snakes

This genus includes the large common house snakes of Africa, provisionally 6–8 species, including *B. fuliginosus*, *B. capensis, B. lineatus, B. olivaceus* and *B. virgatus*. Several extralimital species may also belong to the genus, including *B. geometricus* of the Seychelles and *B. erlangeri* and *B. abyssinicus* of Ethiopia (Kelly *et al.* 2011), but further research is required to validate this. Only a single, common and widespread species (*B. capensis*) occurs in the *Atlas* region.

Boaedon capensis (Duméril, Bibron & Duméril, 1854)

COMMON HOUSE SNAKE; BROWN HOUSE SNAKE

Bryan Maritz



Regional: Least Concern

Taxonomy: Hughes (1997) validated *Lamprophis capensis* for southern populations previously referred to *Lamprophis fuliginosus*. Both of these, along with many other house snake species, were transferred to *Boaedon* by Kelly *et al.* (2011). Recent molecular analyses have indicated that the *B. fuliginosus-capensis* species complex contains a number of divergent lineages (Brassine *et al.* 2008; Kelly *et al.* 2011), some occurring in the *Atlas* region. The status and distribution of these, including the well-known 'mentalis' morphotype of the western arid region of the subcontinent (Branch 1998), remains problematic.

Distribution: The confused taxonomy of species and populations allied to *B. capensis* make an assessment of dis-

Boaedon capensis—between Pofadder and Aggeneys, NC W.R. Branch

Boaedon capensis—Oudtshoorn, WC T. Phelps tribution difficult at this stage. As currently understood (e.g. Broadley 1990b; Branch 1998; as *L. fuliginosus*), the species occurs ubiquitously across southern Africa, although it appears to be absent in the highlands of Lesotho and in large parts of the Eastern Cape.

Habitat: Inhabits a wide range of terrestrial habitats and appears to be tolerant of considerable habitat transformation.

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Nama-Karoo; Fynbos; Albany Thicket; Succulent Karoo; Forests; Desert.

Assessment rationale: Widespread and common throughout its range.

Conservation measures: None recommended.

Genus *Gonionotophis* Boulenger, 1893—file snakes

Loveridge (1939) noted the close relationship between the file snake genera *Mehelya* and *Gonionotophis.* Molecular studies (Vidal *et al.* 2008a; Kelly *et al.* 2011) showed that *Gonionotophis* is nested within *Mehelya* so in order to maintain monophyletic genera, all species currently placed in *Mehelya* Csiki, 1903 were transferred to *Gonionotophis* Boulenger, 1893, which has priority over all other potential names. The generic name *Simocephalus* Günther, 1858, under which many early file snake species were described, is unavailable because it was initially applied by Schoedler, 1858 to a new crustacean genus and is still in widespread use in this context. *Gonionotophis* now comprises 15 species distributed across most of sub-Saharan Africa (Branch 1998; Uetz 2012), but it is likely that future research will result in dissection of the genus (Kelly *et al.* 2011). Two species occur in the moist northeastern and eastern parts of the *Atlas* region but neither is endemic. *Gonionotophis capensis* is a large snake that feeds primarily on other snakes, while *G. nyassae* is smaller and preys mainly on lizards. Both species are terrestrial, nocturnal and oviparous (5–13 eggs) (Branch 1998). Neither species is of conservation concern.

Gonionotophis capensis capensis (A. Smith, 1847)

COMMON FILE SNAKE; CAPE FILE SNAKE

Bryan Maritz

Regional: Least Concern

Taxonomy: Three subspecies are recognised, namely *Gonionotophis capensis capensis*, *G. c. savorgnani* (Kenya to Cameroon) and *G. c. fiechteri* (Somalia). The status of these subspecies is currently being investigated (C.M.R. Kelly pers. comm.).

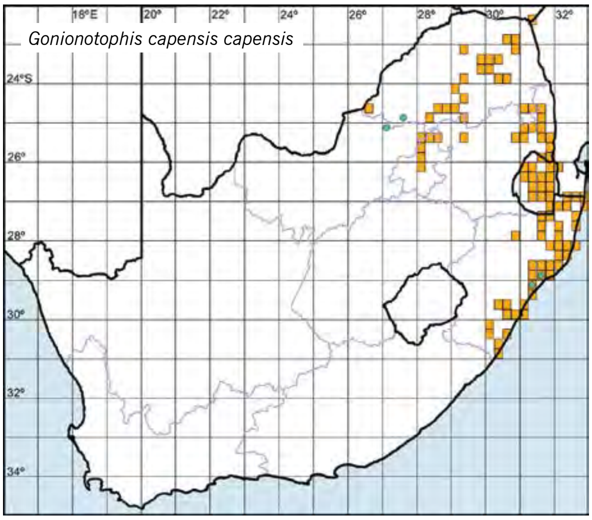
Distribution: Widespread, occurring from Tanzania in the north, southwards to southern Africa (Branch 1998). In the *Atlas* region it occurs in the South African provinces of Limpopo, Gauteng, northern Mpumalanga and KwaZulu-Natal, and in Swaziland. A record (2929CC; Broadley 1990b) on the border of KwaZulu-Natal and Lesotho is considered erroneous and is not included on the map here.

Habitat: Inhabits primarily savanna habitats but enters forests and even some arid areas in parts of its range (Branch 1998). May be found under rocks or logs (Jacobsen 1989). A telemetered specimen spent considerable periods of time underground within termitaria (G.J. Alexander unpubl. obs.).

Bioregion: Lowveld; Central Bushveld; Indian Ocean Coastal Belt; Sub-Escarpment Savanna; Freshwater Wetlands; Mesic Highveld Grassland; Sub-Escarpment Grassland; Zonal and Intrazonal Forests; Mopane.

Assessment rationale: Widespread and common in some areas, but considered 'very rare' in the northeastern parts of South Africa by Jacobsen (1989).

Conservation measures: None recommended.



Gonionotophis capensis capensis—Hammanskraal, GP G.J. Alexander

Gonionotophis nyassae (Günther, 1888)

BLACK FILE SNAKE

Bryan Maritz

Regional: Least Concern

Taxonomy: No notable issues.

Distribution: Widespread, occurring from Kenya southwards to southern Africa (Broadley 1990b). In the *Atlas* region it is known from Limpopo, northern Gauteng, the northern and eastern parts of Mpumalanga and KwaZulu-Natal, and Swaziland.

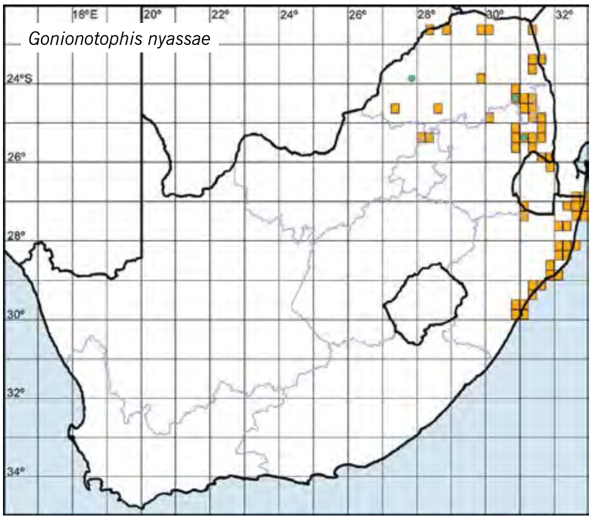
Habitat: Found in savanna and forested habitats. Occurs from near sea level in the coastal lowlands of KwaZulu-Natal to higher altitude (up to 1 500 m) savanna habitats in Limpopo; may be found in holes in the ground, in moribund termitaria and under rocks on soil (Jacobsen 1989; Branch 1998).

Bioregion: Lowveld; Central Bushveld; Indian Ocean Coastal Belt; Mopane; Mesic Highveld Grassland; Zonal and Intrazonal Forests; Sub-Escarpment Grasslands.

Assessment rationale: Widespread and common in places.

Conservation measures: None recommended.

Gonionotophis nyassae—Schoemanskloof region, MPM M. Burger



Genus *Inyoka* Branch & Kelly, 2010—Swazi rock snakes

The genus *Inyoka* is monotypic and endemic to the *Atlas* region. It was recently erected (Kelly *et al.* 2011) for the Swazi Rock Snake. *Inyoka* is sister to the Forest Wolf Snake (*Hormonotus modestus*) which has similar physical characteristics, including large eyes, but which differs in many other respects. *Inyoka swazicus* is considered Least Concern.

Inyoka swazicus (Schaefer, 1970)

SWAZI ROCK SNAKE

Bryan Maritz

Global: Least Concern

Endemic

Taxonomy: Ever since its description (Schaefer 1970) there has been debate concerning the generic placement of this species. Visser (1979) suggested that it had greater affinities with the boigine genus *Telescopus*, but despite the superficially similar appearance, hemipenial morphology mitigated against this association (W.R. Branch unpubl. data). A subsequent molecular phylogeny of the Lamprophiidae (Vidal *et al.* 2008a) demonstrated that *swazicus* clustered with the monotypic genus *Hormonotus.* A detailed molecular analysis (Kelly *et al.* 2011) confirmed this sister relationship, but sufficient morphological and molecular divergence merited the description of a new genus for the species.

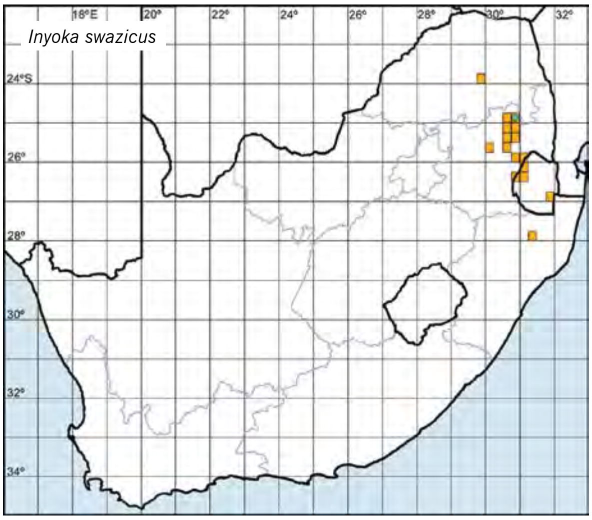
Distribution: Endemic to the *Atlas* region. Found from central Limpopo in the north, southwards through Mpumalanga and Swaziland, reaching northern KwaZulu-Natal.

Habitat: Inhabits rock outcrops in grassland and savanna (Branch 1998). Shelters under rocks on rock, or in crevices, at altitudes of 1 400–1 900 m (Jacobsen 1989).

Bioregion: Mesic Highveld Grassland; Central Bushveld; Lowveld; Sub-Escarpment Grassland.

Assessment rationale: Although this species is rarely encountered, it occurs over a fairly wide area in rocky habitats that do not appear to be significantly impacted by anthropogenic habitat transformation. However, afforestation in the northern parts of the range has almost certainly destroyed or altered some habitat.

Conservation measures: Conserve suitable habitats. Carry out research into biology and ecology.



Inyoka swazicus—foothills of Iron Crown, about 4 km S of Haenertsburg, LIMP M. Burger

Genus *Lamprophis* Fitzinger, 1843—dwarf house snakes

The genus *Lamprophis* is now restricted to a group of four small house snakes (Kelly *et al.* 2011) that are either endemic to the *Atlas* region or, in the case of *L. guttatus*, also found in southern Namibia. These snakes are small to medium-sized constrictors. All species are terrestrial, nocturnal, oviparous and prey on small vertebrates. In the *Atlas* region, all species are considered Least Concern.

Lamprophis aurora (Linnaeus, 1758)

AURORA SNAKE; AURORA HOUSE SNAKE

Bryan Maritz

Global: Least Concern

Endemic

Taxonomy: No notable issues.

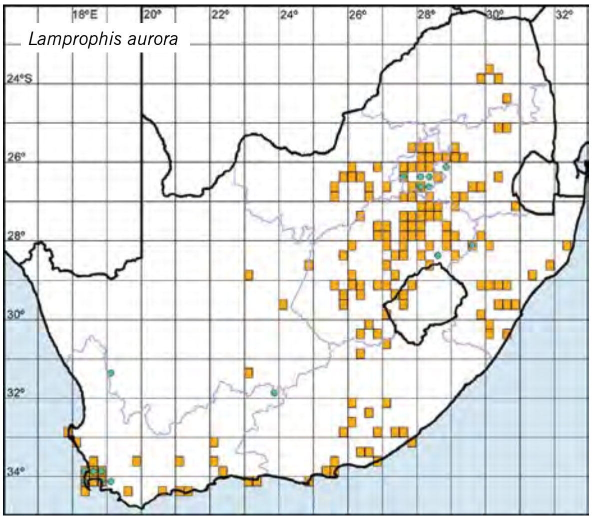
Distribution: Endemic to the *Atlas* region. Widespread in South Africa, inhabiting suitable habitat in all provinces but absent from most of the Northern Cape. Records extend from the Cape Peninsula through the Western and Eastern Cape, KwaZulu-Natal, western Lesotho, Free State, eastern parts of the Northern Cape, North-West Province, Gauteng, Mpumalanga, and as far north as 2330CA in Limpopo. The isolated Virtual Museum record from Nieuwoudtville (3119AC) may be based on a translocated specimen.

Habitat: Occurs in grassland, fynbos and moist savanna habitats. Specimens are known from the coast up to the plateau (1 700 m) of the Highveld. Often found near streams and under rocks, occasionally in old termitaria (De Waal 1978; Jacobsen 1989).

Biome: Grassland; Savanna; Fynbos; Albany Thicket; Nama-Karoo; Indian Ocean Coastal Belt; Succulent Karoo; Forests.

Assessment rationale: Widespread and common in suitable habitat.

Conservation measures: This species is closely associated with grassland habitats, which are part of a highly transformed ecosystem (Le Roux 2002). Promote the protection of remaining grassland habitat.



Lamprophis aurora—Johannesburg, GP G.J. Alexander

Lamprophis fiskii Boulenger, 1887

FISK'S SNAKE; FISK'S HOUSE SNAKE

Bryan Maritz

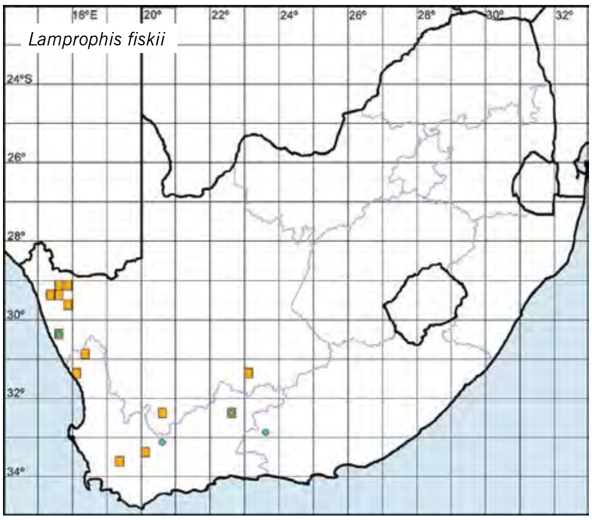
Global: Least Concern

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to South Africa where it is known only from the Northern, Western and Eastern Cape provinces (Barts *et al.* 2012). The range extends from near Steinkopf in the western Northern Cape, southwards to near Worcester in the Western Cape, then eastwards to near Aberdeen (3223DC) in the Eastern Cape. The latter QDGC refers to a Virtual Museum record and represents the first record of the species in the Eastern Cape. It may also occur north of the Orange River in southern Namibia.

Habitat: Found in a wide variety of terrestrial habitats throughout western South Africa, especially rocky and



sandy areas in arid regions (Branch 1998; Barts *et al.* 2012), and may be associated with temporary water bodies in some places (S. Thomas pers. comm.).

Bioregion: Namaqualand Hardeveld; Upper Karoo; Gariep Desert; Richtersveld; Southwest Fynbos; Namaqualand Sandveld; Rainshadow Valley Karoo; Karoo Renosterveld; Lower Karoo.

Assessment rationale: Apparently widely distributed in an area of low human population density and few threats. In a few areas it may be affected by habitat loss due to agriculture and mining. This species is very poorly known. For example, there is only a single record on reproduction: a captive female laid three eggs (J. Marais pers. comm.). Even basic distribution data are lacking, making it difficult to assess this species based on habitat type.

Conservation measures: Survey the species' range. Collect detailed information on habitat associations and demographics. Initiate research into the ecology of the species.

Lamprophis fiskii—N of Matjiesfontein on R354, WC C. & S. Dorse

Lamprophis fuscus Boulenger, 1893

YELLOW-BELLIED SNAKE;
YELLOW-BELLIED HOUSE SNAKE

Bryan Maritz

Global: Least Concern

Endemic

Taxonomy: No notable issues.

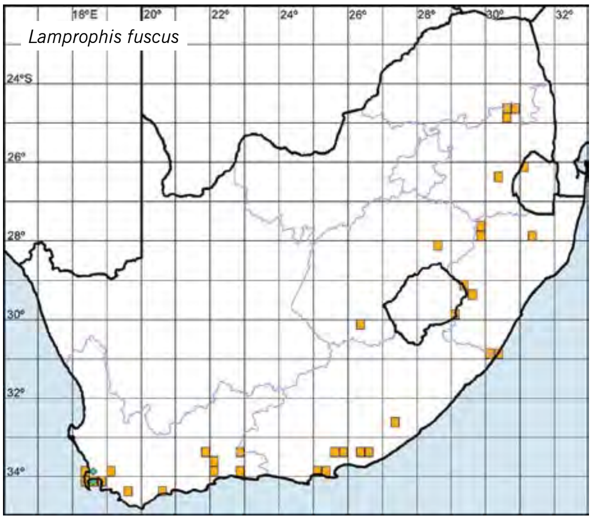
Distribution: Endemic to South Africa and Swaziland. Localities are widely scattered, indicating a fragmented distribution. Known from the Cape Peninsula, extending eastwards through the Eastern Cape, eastern Free State, KwaZulu-Natal, western Swaziland and Mpumalanga. It may also occur in western Lesotho and Limpopo Province.

Habitat: A poorly known snake, usually found in moribund termitaria (De Waal 1978; Jacobsen 1989; Branch 1998).

Biome: Fynbos; Grassland; Albany Thicket; Indian Ocean Coastal Belt.

Assessment rationale: This species is widespread and therefore considered to be of Least Concern. However, it inhabits mainly grassland and fynbos habitats (Branch 1998) and these declined in extent by 7% and 9% respectively during the period 1996–2000 (Rouget *et al.* 2003; O'Connor & Kuyler 2009) and continue to decline (CSIR 2008), partly as a result of crop farming, afforestation and changes in fire regimes. Further habitat transformation could result in additional population fragmentation, increasing vulnerability and pushing the species towards a threatened category.

Conservation measures: Monitor the population for potential declines resulting from further habitat transformation. Focus on the protection of suitable grassland and fynbos habitat where the species has been recorded. Conduct basic research on distribution, biology and habitat preferences.



Lamprophis fuscus—Amatole Mtns, EC J. Harvey

Lamprophis guttatus (A. Smith, 1843)

SPOTTED ROCK SNAKE; SPOTTED HOUSE SNAKE

Bryan Maritz

Global: Least Concern

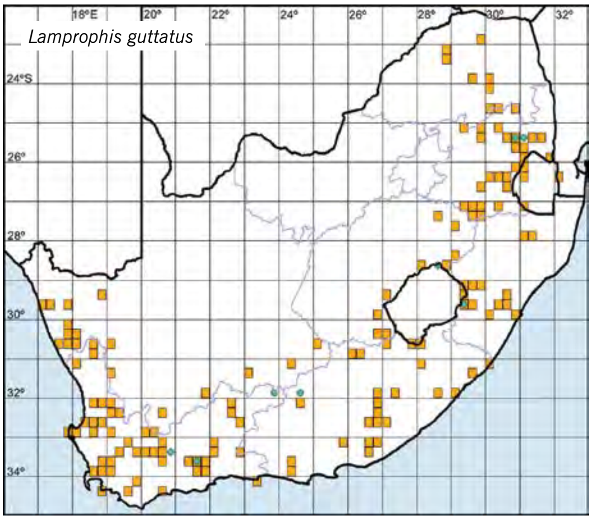
Near-endemic

Taxonomy: There is considerable variation in colour pattern (see Branch 1998), habits and behaviour across the range of this species. This is accompanied by significant genetic divergence (Kelly *et al.* 2011) and it is therefore possible that '*L. guttatus*' contains a number of taxa.

Distribution: Endemic to southern Africa and recorded from Namibia, South Africa and Swaziland. It is also likely to occur in Lesotho and Mozambique, although no records are currently known from these countries. The distribution appears to generally follow the Great Escarpment, running southwards from southern Namibia, through Namaqualand to the Cape Fold Mountains and then northeast to Limpopo.

Habitat: Found in rocky habitats throughout its range. Shelters under rocks or in crevices at altitudes as high as 2 300 m (Jacobsen 1989).

Biome: Grassland; Fynbos; Savanna; Succulent Karoo; Nama-Karoo; Indian Ocean Coastal Belt; Albany Thicket.



Assessment rationale: Widespread in rocky habitats that are not significantly prone to anthropogenic influence. In addition, these snakes are often abundant.

Conservation measures: As this species is easily collected in suitable habitat, its presence in the pet trade should be monitored.

Lamprophis guttatus—Kloof, KZN J. Marais

Lamprophis guttatus—Steytlerville, EC W.R. Branch

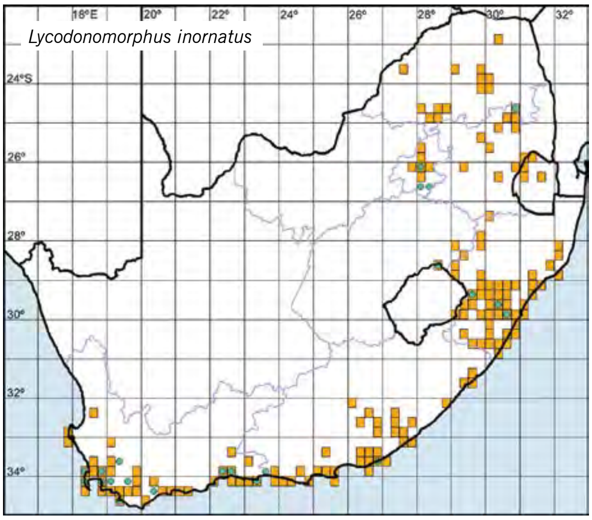
Genus *Lycodonomorphus* Fitzinger, 1843—water and ground snakes

Lycodonomorphus is a small genus closely related to *Lamprophis*. It now contains eight species (with the transfer of *Lycodonomorphus inornatus* from *Lamprophis*) which occur throughout Central and East Africa and the eastern parts of Southern Africa (Branch 1998). Four species occur in the *Atlas* region, all in areas with high rainfall. They are predominately aquatic snakes that prey mainly on frogs which they subdue by constriction. One large species (*L. inornatus*) is terrestrial and feeds on rodents, lizards and even snakes. These non-venomous constrictors are generally nocturnal but may forage during the day. Females lay clutches of 6–23 eggs (Branch 1998). *Lycodonomorphus obscuriventris* was listed as Peripheral by Branch (1988a) but all species in the region are now considered Least Concern.

Lycodonomorphus inornatus (Duméril, Bibron & Duméril, 1854)

OLIVE GROUND SNAKE; BLACK HOUSE SNAKE; OLIVE HOUSE SNAKE

Bryan Maritz



Global: Least Concern

Endemic

Taxonomy: Until recently this species was known as *Lamprophis inornatus*. Northern and southern populations differ with regard to body proportions and scalation and are genetically divergent, indicating that two taxa may be present (Kelly *et al.* 2011).

Distribution: Endemic to South Africa and Swaziland. This is a predominantly temperate species that occurs from the southwestern Cape eastwards through the Eastern Cape, KwaZulu-Natal, northeastern Free State, Mpumalanga, Gauteng, Limpopo and Swaziland.

Habitat: Inhabits grassland, savanna, fynbos and forest habitats across its distribution (Branch 1998). Shelters under rocks on soil and in or under rotting logs (Jacobsen 1989).

Biome: Grassland; Fynbos; Savanna; Albany Thicket; Indian Ocean Coastal Belt; Forests.

Assessment rationale: Widespread, and common in parts of its range.

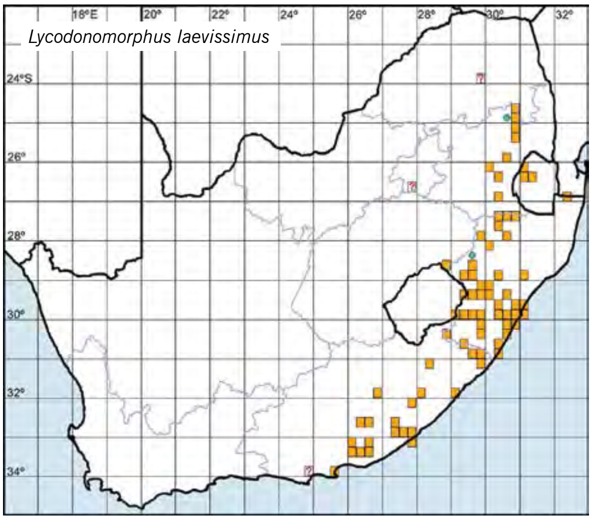
Conservation measures: None recommended.

Lycodonomorphus inornatus—Duiwelskloof, LIMP J. Marais

Lycodonomorphus laevissimus (Günther, 1862)

DUSKY-BELLIED WATER SNAKE

Bryan Maritz



Global: Least Concern

Endemic

Taxonomy: Raw (1973) described two subspecies (*L. l. fitzsimonsi*, *L. l. natalensis*) but these are no longer recognised (Haagner & Branch 1994; Branch 1998). A phylogeographic study of populations from different drainage basins may be informative with regard to gene flow.

Distribution: Endemic to the *Atlas* region, occurring from the Eastern Cape northwards through KwaZulu-Natal, Mpumalanga and Swaziland. The possible northern limits of the range are represented by a questionable isolated record in Limpopo (2329DD). An isolated population exists around Vereeniging (2627DB) on the Gauteng/Free State border and probably originated from specimens washed down the Vaal River (Jacobsen 1989; Bates 1996a), but the permanency of this population requires confirmation. This species may also occur in southern Mozambique.

Habitat: Inhabits riverine and other aquatic habitats, favouring well-wooded streams (Branch 1998). Often found along perennial streams in grassland; occurs from near sea level to at least 1 700 m (Jacobsen 1989).

Bioregion: Sub-Escarpment Grassland; Albany Thicket; Mesic Highveld Grassland ; Sub-Escarpment Savanna; Indian Ocean Coastal Belt; Drakensberg Grassland; Lowveld; Eastern Fynbos-Renosterveld; Lower Karoo; Zonal and Intrazonal Forests; Central Bushveld; Estuarine Vegetation.

Assessment rationale: Widespread and generally abundant in suitable habitat.

Conservation measures: None recommended.

Lycodonomorphus laevissimus—Mooi River, KZN J. Marais

Lycodonomorphus obscuriventris FitzSimons, 1964

FLOODPLAIN WATER SNAKE

Bryan Maritz

Regional: Least Concern

Taxonomy: Previously considered a subspecies of *Lycodonomorphus whytii* but raised to species status by Broadley (1995a). The relationship between these two taxa should be investigated by means of a molecular analysis.

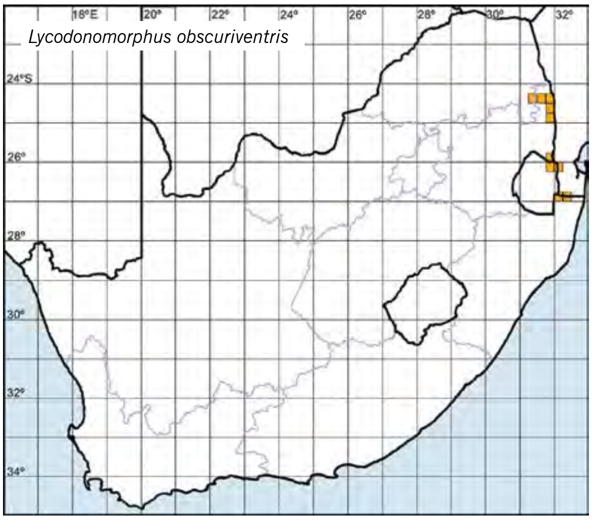
Distribution: Endemic to southern Africa. Ranges from Mozambique southwards, entering southern Zimbabwe and the eastern parts of Limpopo, Mpumalanga and Swaziland, as well as northeastern KwaZulu-Natal (Broadley 1990b; Bourquin 2004).

Habitat: Inhabits lowland swamps and floodplains (Broadley 1990b).

Vegetation type: SVI 5 Tshokwane-Hlane Basalt Lowveld; SVI 18 Tembe Sandy Bushveld; SVI 16 Southern Lebombo Bushveld; SVI 3 Granite Lowveld; SVI 23 Zululand Lowveld.

Assessment rationale: Has a limited distribution in the *Atlas* region, with an estimated AOO of 600 km^2 (approaching the Endangered threshold [B2]). However, it occurs primarily in the Kruger National Park as well as other protected areas in eastern Mpumalanga, and there do not appear to be any major threats. Nevertheless, its habitat is likely to be threatened by changes in water regimes caused by anthropogenic extraction of water or changing climatic trends. Habitat loss resulting from industrial and agricultural development could also threaten this species.

Conservation measures: Initiate research on biology, ecology and habitat status.



Lycodonomorphus obscuriventris—Swaziland W.D. Haacke

Lycodonomorphus rufulus (Lichtenstein, 1823)

BROWN WATER SNAKE;
COMMON WATER SNAKE

Bryan Maritz

Global: Least Concern

Taxonomy: Broadley (1967) treated *L. rufulus mlanjensis* as a subspecies of *L. leleupi*, rendering *L. rufulus* a monotypic species. *Lycodonomorphus leleupi mlanjensis* was later raised to species status by Broadley & Cotterill (2004). The status of the isolated population of *L. rufulus* on the eastern highlands of Zimbabwe, and phylogenetic relationships within the genus, are under investigation (C.M.R. Kelly pers. comm.).

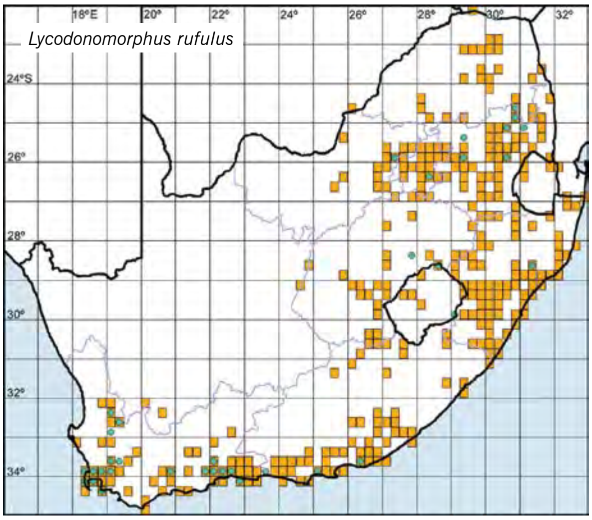
Distribution: Endemic to southern Africa. The species has a largely temperate distribution pattern and is widespread in the eastern and southern parts of the *Atlas* region. Occurs in Swaziland, Lesotho and all provinces of South Africa, but is notably absent from most parts of the drier Northern Cape. The range extends to the Limpopo Valley and, after a disjunction, the taxon is again found in the eastern parts of Zimbabwe and adjacent Mozambique (Broadley 1990b; Branch 1998).

Habitat: Associated with aquatic habitats including dams, streams and rivers (Branch 1998).

Biome: Grassland; Savanna; Fynbos; Indian Ocean Coastal Belt; Albany Thicket; Forests; Nama-Karoo; Succulent Karoo; Waterbodies.

Assessment rationale: Widespread and common throughout its range.

Conservation measures: None recommended.



Lycodonomorphus rufulus—Suikerbosrand NR, GP G.J. Alexander

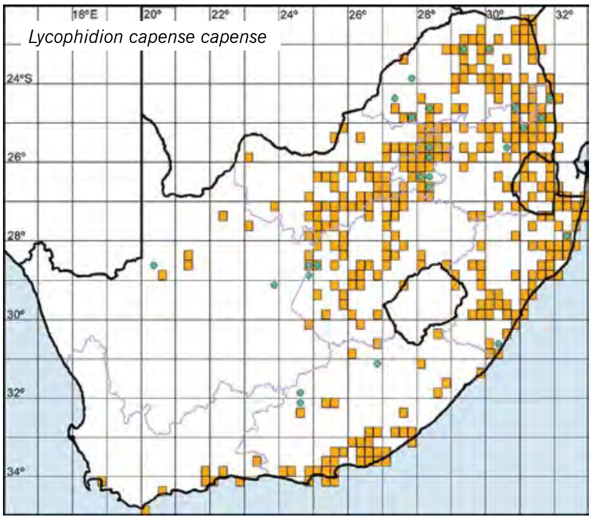
Genus *Lycophidion* Fitzinger, 1843—wolf snakes

The genus *Lycophidion* comprises 19 species (Uetz 2012) distributed across sub-Saharan Africa (Branch 1998). Three species occur in the eastern parts of the *Atlas* region and one of these, *L. pygmaeum*, is endemic. *Lycophidion semiannule*, recorded from northeastern KwaZulu-Natal by Broadley (1990), is now considered restricted to Benguerra Island and possibly Inhambane, both in southeastern Mozambique (Broadley 1996). These small non-venomous terrestrial snakes forage at night for lizards, which they kill by constriction. Females in the *Atlas* region lay small clutches of 3–9 eggs (Branch 1998). The most recently described species, *L. pygmaeum*, is considered Near Threatened given its limited distribution and habitat loss within its range. *Lycophidion variegatum* was formerly listed as Rare (Branch 1988) but is now classified as Least Concern.

Lycophidion capense capense (A. Smith, 1831)

CAPE WOLF SNAKE

Bryan Maritz



Regional: Least Concern

Taxonomy: The validity of the two additional subspecies *L. c. loveridgei* and *L. c. jacksoni*, both from northeastern and eastern Africa, should be subjected to a modern taxonomic analysis.

Distribution: Widespread throughout the southeastern regions of Africa. Occurs from Zambia southwards to the *Atlas* region, where it is known from Swaziland and all provinces of South Africa, although it is apparently absent from large parts of the Northern and Western Cape provinces (Branch 1998).

Habitat: Occurs from coastal regions to higher elevations in the central portions of South Africa. Often found under rocks or logs and in old termitaria (Jacobsen 1989).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Albany Thicket; Fynbos; Forests; Nama-Karoo.

Assessment rationale: Widespread and common throughout its range.

Conservation measures: None recommended.

Lycophidion capense capense—Umhlanga Rocks, KZN J. Marais

Lycophidion pygmaeum Broadley, 1996

PYGMY WOLF SNAKE

Bryan Maritz

Global: Near Threatened

Endemic

Taxonomy: No notable issues.

Distribution: Endemic to South Africa where it is restricted to the northeastern parts of KwaZulu-Natal, from the Mozambique border southwards to St Lucia Village. It is likely to occur in southern Mozambique and possibly in the eastern parts of Swaziland.

EOO: 20 250 km^2 (confidence: medium); AOO: 4 050 km^2 (confidence: medium).

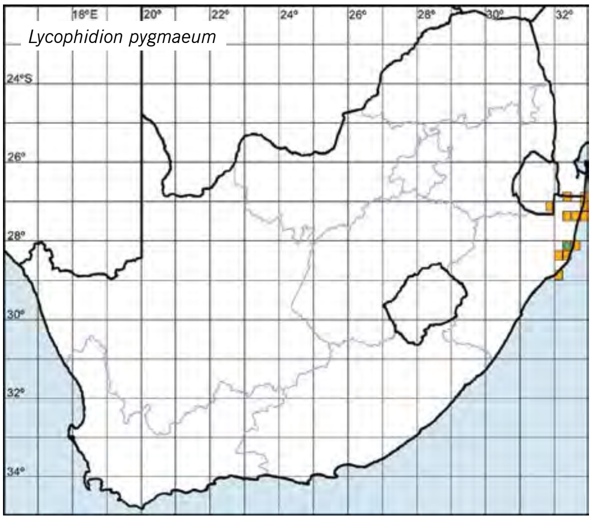
Habitat: Inhabits lowland forests, grasslands and mesic savanna habitats. Has also been recorded from pine plantations (Branch 1998).

Vegetation type: CB 1 Maputaland Coastal Belt; FOz 7 Northern Coastal Forest; SVl 18 Tembe Sandy Bushveld; SVl 23 Zululand Lowveld; SVl 24 Zululand Coastal Thornveld; CB2 Maputaland Wooded Grassland; SVl 20 Western Maputaland Clay Bushveld.

Assessment rationale: Has a restricted distribution (EOO close to the VU threshold) in an area with numerous anthropogenic impacts. Afforestation, human settlement and small-scale agriculture are likely to have severely fragmented the range. There are no extralimital records (i.e. Mozambique) so it is improbable that migration from adjacent reservoirs will mitigate habitat loss.

Threats: Threatened by habitat transformation caused by plantations, agriculture and expanding human settlement. Habitat transformation is taking place across much of its range (Driver *et al.* 2005).

Conservation measures: This species is poorly known; carry out research on its habits and habitat utilisation. Prioritise the conservation of its habitat.




Lycophidion pygmaeum—St Lucia, KZN J. Marais

Lycophidion variegatum Broadley, 1969

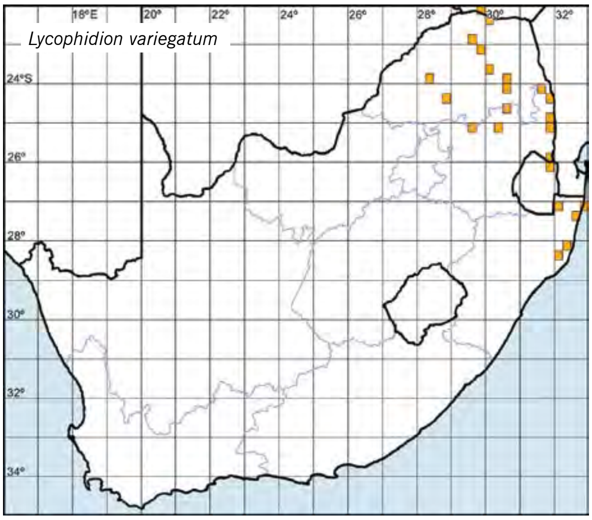
VARIEGATED WOLF SNAKE

Bryan Maritz

Regional: Least Concern

Taxonomy: No notable issues.


Lycophidion variegatum—Mokopane, LIMP W.D. Haacke



Distribution: Endemic to southern Africa, occurring along the eastern and western sides of Zimbabwe, southwards through Limpopo, the northern half of Mpumalanga, eastern Swaziland and northeastern KwaZulu-Natal (Broadley 1990b). The QDGC records along the KwaZulu-Natal coast require confirmation. Broadley (1990) recorded *Lycophidion semiannule* from these QDGCs (and 2632DD), but Broadley (1996) subsequently restricted the latter species to the Bazaruto Archipelago in Mozambique. According to Broadley (1996) and Bourquin (2004), *L. variegatum* does not occur further south than the Ngwavuma area (2732AA).

Habitat: Found in savanna and grassland habitats as well as rocky areas throughout its range. Recorded from rock outcrops, under rocks on rock or soil, and under dead plants or logs, at elevations of 300–1 200 m (Jacobsen 1989).

Bioregion: Lowveld; Central Bushveld; Mopane; Mesic Highveld Grassland.

Assessment rationale: Although of rare occurrence, this species is widespread in South Africa.

Conservation measures: Collect information on biology and ecology.

SUBFAMILY PSAMMOPHIINAE

The subfamily Psammophiinae represents a monophyletic group that was formerly considered part of the family Colubridae (see Chapter 24; Brandstätter 1996; Vidal & Hedges 2002). It was recently proposed that this group of snakes should be elevated to family level (Kelly *et al.* 2008, 2009).

The Psammophiinae comprises seven genera and approximately 50 species (Kelly *et al.* 2008). These taxa are distributed throughout southern Europe, the Middle East, south-central Asia, mainland Africa and Madagascar (Branch 1998; Kelly *et al.* 2008). This subfamily is ubiquitous in the *Atlas* region, where five genera (*Dipsina*, *Hemirhagerrhis*, *Psammophis*, *Psammophylax*, *Rhamphiophis*) and 16 species occur.

Members of the Psammophiinae inhabit a wide variety of habitats, from deserts to grassland, fynbos, savanna and woodland. These snakes are generally diurnal and terrestrial, although *Hemirhagerrhis nototaenia* could be considered arboreal (Branch 1998). They actively hunt for their prey, which consists primarily of small vertebrates (Branch 1998; Alexander & Marais 2007). All species in the *Atlas* region are oviparous, and *Psammophylax rhombeatus* exhibits egg-guarding behaviour (Broadley 1990b). The venom of *Psammophis mossambicus* is relatively potent and may be of clinical importance (Fry *et al.* 2003).

Branch (1988a) listed *Psammophis leightoni* as Vulnerable (it retains this status here) and *P. jallae* as Peripheral (now Least Concern). These snakes are apparently not threatened by commercial trade for skins or pets. The main threat facing *P. leightoni* is habitat loss to coastal developments and agriculture, and habitat deterioration with an associated increased incidence of fire as a result of alien invasive plants.

Genus *Dipsina* Jan, 1863—dwarf beaked snakes

Dipsina is a monotypic genus endemic to southern Africa. It is the sister group to the genus *Psammophis* (Kelly *et al.* 2008). These small (maximum 320 mm snout–vent length) snakes are diurnal and terrestrial, they prey on lizards, and females lay clutches of 2–4 eggs (Branch 1998). The only known species, *D. multimaculata*, is not of conservation concern.

Dipsina multimaculata (A. Smith, 1847)

DWARF BEAKED SNAKE

Gavin Masterson

Regional: Least Concern

Taxonomy: No notable issues.

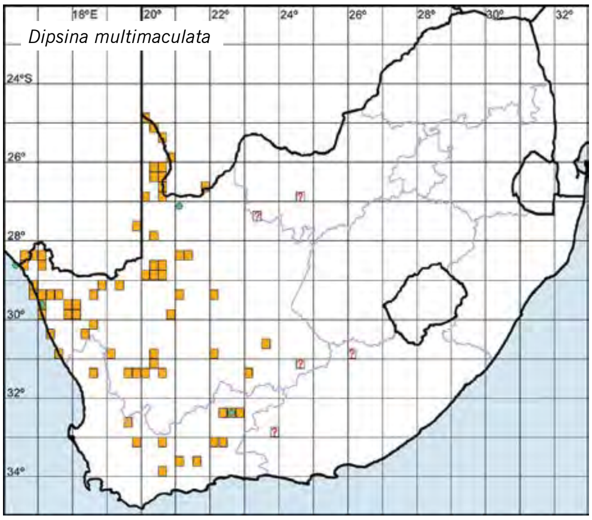
Distribution: Endemic to southern Africa. Found in Namibia, southwestern Botswana and western South Africa (Broadley 1990b; Branch 1998). Within the *Atlas* region it occurs in the Northern and Western Cape provinces. Some old records (question marks on map) from the Eastern Cape, Northern Cape and North-West Province (mainly from Broadley 1990b) require confirmation.

Habitat: Terrestrial, found in arid sandy areas or dry watercourses, using burrows for refuge and bushes for cover (Branch 1998).

Biome: Nama-Karoo; Succulent Karoo; Savanna; Desert.

Assessment rationale: Widespread, without significant threats.

Conservation measures: None recommended.



Dipsina multimaculata—Springbok, NC J. Marais

Genus *Hemirhagerrhis* Boettger, 1896—bark snakes

Hemirhagerrhis contains four species found throughout sub-Saharan Africa (Broadley & Hughes 2000). Only one species (*H. nototaenia*) occurs in the *Atlas* region and it is not of conservation concern. These small snakes are diurnal, arboreal or rupicolous, and feed primarily on geckos (Broadley & Hughes 2000). Females lay clutches of 2–8 eggs (Branch 1998).

Hemirhagerrhis nototaenia (Günther, 1864)

EASTERN BARK SNAKE; MOPANE SNAKE

Gavin Masterson

Regional: Least Concern

Taxonomy: *Hemirhagerrhis viperina* from north-central Namibia was previously considered a subspecies of *H. nototaenia* (Branch 1998).

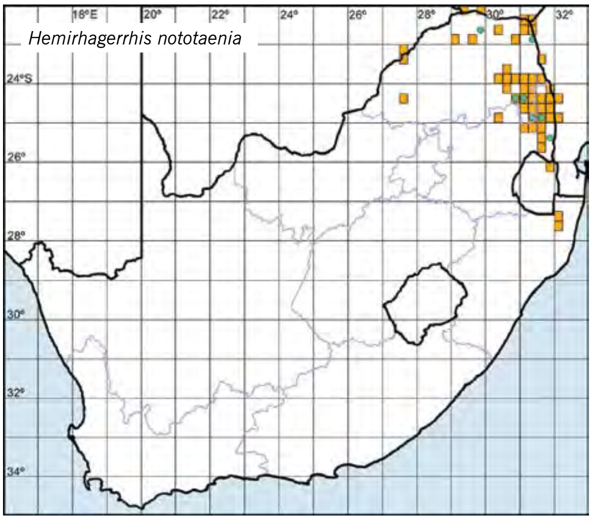
Distribution: Endemic to sub-Saharan Africa. Found in southeastern Kenya, Tanzania, Democratic Republic of the Congo, Botswana, Zimbabwe, Mozambique and north-eastern South Africa (Broadley 1990b; Branch 1998; Broadley & Hughes 2000). Scattered records extend the range westwards from Sudan to Burkina Faso (Broadley & Hughes 2000). Within the *Atlas* region it is found in Limpopo and the northeastern parts of Mpumalanga, Swaziland and KwaZulu-Natal.

Habitat: A semi-arboreal species found mainly in savanna, often sheltering under loose bark and cracks in trees, up to altitudes of 1 200 m (Broadley 1990b; Branch 1998; Broadley & Hughes 2000).

Bioregion: Lowveld; Mopane; Central Bushveld.

Assessment rationale: Widespread and probably more common than records suggest due to its cryptic colouration and secretive habits. No known threats.

Conservation measures: None recommended.



Hemirhagerrhis nototaenia—Hoedspruit, LIMP D. Pietersen

Genus *Psammophis* Boie, 1825—sand and grass snakes

The widespread genus *Psammophis* comprises 33 species (Uetz 2012) found throughout Africa and parts of Asia. Eleven species occur in the *Atlas* region. Most of these are widely distributed in the region but only one, *P. leightoni*, is endemic. These diurnal snakes actively hunt for small vertebrates such as lizards and small rodents. Females of most species lay clutches of 3–15 eggs, but *P. mossambicus* females may lay as many as 30 eggs per clutch (Branch 1998). The venom of most species is mild and considered harmless to humans, but that of *P. mossambicus* is more potent (Branch 1998) and requires further study. Branch (1988a) listed *P. leightoni* as Vulnerable and this status is retained as the species is threatened by habitat loss associated with agriculture and human settlement throughout its small range. *Psammophis jallae* was listed as Peripheral by Branch (1988a) but this species is no longer considered to be of conservation concern.

Psammophis angolensis (Bocage, 1872)

DWARF SAND SNAKE; PYGMY SAND SNAKE

Bryan Maritz

Regional: Least Concern

Taxonomy: No notable issues.

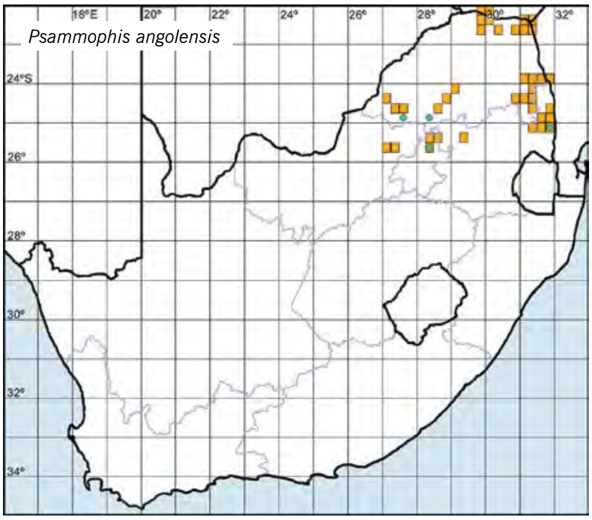
Distribution: Widespread in sub-Saharan Africa, ranging from Tanzania and the Democratic Republic of the Congo, through Zambia, Malawi, Mozambique, westwards to Angola and southwards through Zimbabwe to South Africa (Broadley 2002). In the *Atlas* region it occurs in Limpopo and the adjacent northern parts of North-West Province, Gauteng and Mpumalanga.

Habitat: Found in savanna habitats, sheltering under stones (Jacobsen 1989).

Bioregion: Central Bushveld; Lowveld; Mopane.

Assessment rationale: Although of apparently rare occurrence, it is widespread in the *Atlas* region and elsewhere in Africa.

Conservation measures: None recommended.



Psammophis angolensis—near Alldays, LIMP J. Marais

Psammophis brevirostris Peters, 1881

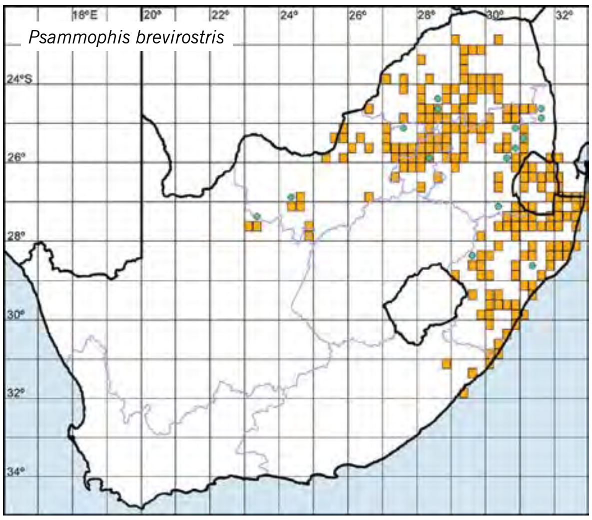
SHORT-SNOUTED GRASS SNAKE

Bryan Maritz

Global: Least Concern

Taxonomy: The taxonomic status of this species—which is part of the *Psammophis* '*phillipsii*' species complex—has been investigated by Kelly *et al.* (2008). *Psammophis brevirostris leopardinus* from southern Angola and Namibia is now considered a valid species (Broadley 2002, validated by Kelly *et al.* 2008). The taxonomic status of several apparently relict populations requires further assessment.

Distribution: Endemic to southern Africa. Widespread in the *Atlas* region, occurring in Limpopo, North-West Province, Gauteng, Mpumalanga, KwaZulu-Natal, the adjacent northeastern parts of the Eastern Cape, and Swaziland.



First recorded from the Kuruman region during a SARCA survey and by means of a Virtual Museum record. These records define the westernmost limit within the *Atlas* region and are the first records for the Northern Cape. Relict populations are known from eastern Namibia, Botswana and eastern Zimbabwe (Broadley 2002).

Habitat: Inhabits grassland and savanna habitats from coastal regions to higher altitudes in the Drakensberg, central Highveld and highlands of eastern Zimbabwe. Shelters in holes in the ground, under rocks and in old termitaria (Jacobsen 1989).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Forests.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Psammophis brevirostris—near Nelspruit, MPM J. Marais

Psammophis crucifer (Daudin, 1803)

CROSS-MARKED GRASS SNAKE; MONTANE GRASS SNAKE

Bryan Maritz

Global: Least Concern

Near-endemic

Taxonomy: In certain parts of its range, this species exhibits colour polymorphism. However, limited sampling by Kelly *et al.* (2008), which included the isolated population in eastern Zimbabwe, suggested that the different populations are not sufficiently divergent to justify separate taxonomic status.

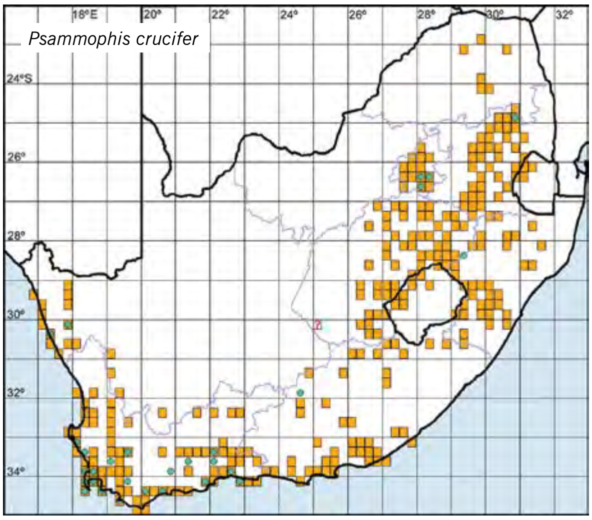
Distribution: A largely temperate species endemic to southern Africa. Widespread in the *Atlas* region and also occurring as a relict population in the highlands of eastern Zimbabwe (Broadley 2002). Occurs in the western and southern parts of the Northern Cape, across the Western and Eastern Cape provinces, the eastern half of the Free State, Gauteng, high-lying regions of KwaZulu-Natal and Mpumalanga, and northwestern Swaziland, with isolated records in Limpopo. It is likely to be far more widespread in Lesotho than current records indicate.

Habitat: Fynbos, and montane and Highveld grasslands, from coastal areas to higher altitudes, perhaps as high as 3 000 m (Branch 1998). Shelters under rocks on soil, in old termitaria and occasionally in rock crevices or low-growing shrubs (Jacobsen 1989).

Biome: Grassland; Fynbos; Savanna; Albany Thicket; Succulent Karoo; Nama-Karoo; Forests; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

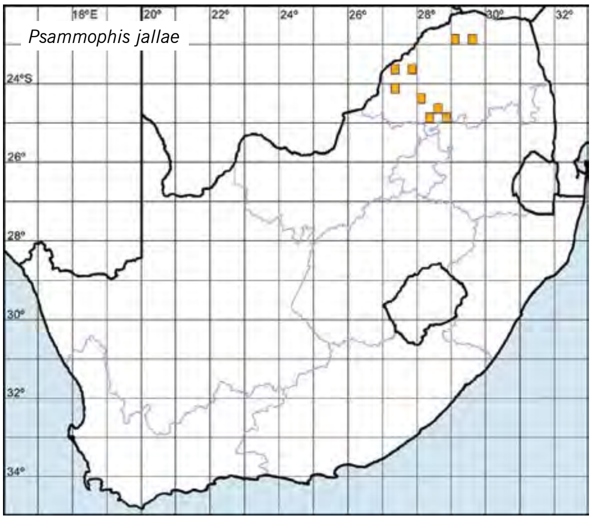


Psammophis crucifer—Gondwana GR, E of Herbertsdale, WC M. Burger

Psammophis jallae Peracca, 1896

JALLA'S SAND SNAKE

Bryan Maritz



Regional: Least Concern

Taxonomy: No notable issues.

Distribution: Widespread in the northern parts of southern Africa. Recorded from Angola, Zambia, Namibia, Botswana, Zimbabwe and South Africa (Broadley 2002). In the *Atlas* region it is known from the western parts of Limpopo, reaching Waterpoort in the north.

Habitat: Inhabits grassland and arid savanna habitats at altitudes of 750–1 500 m (Broadley 2002).

Bioregion: Central Bushveld; Mopane.

Assessment rationale: Although this sand snake is not common, it has a fairly wide distribution in the *Atlas* region and is likely to occur in numerous conservation areas in the western parts of Limpopo Province.

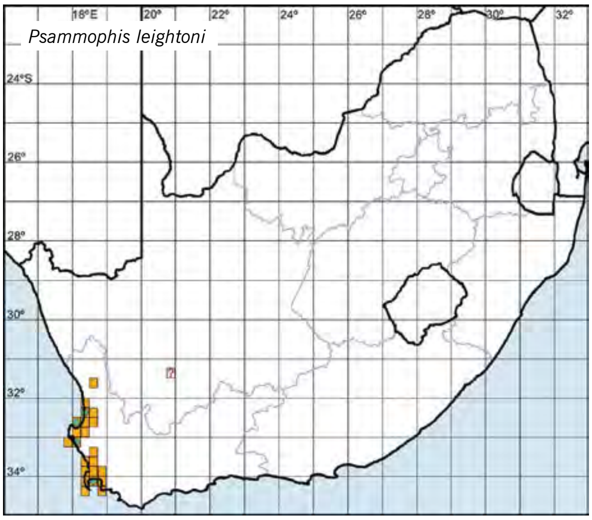
Conservation measures: None recommended.

Psammophis jallae—Vaalwater, LIMP W.D. Haacke

Psammophis leightoni Boulenger, 1902

CAPE SAND SNAKE; CAPE WHIP SNAKE

Bryan Maritz



Global: Vulnerable B1ab(iii)

Endemic

Taxonomy: Broadley (2002) elevated *P. leightoni namibensis* and *P. l. trinasalis* to species status, rendering *P. leightoni* a monotypic species. However, the validity of these changes has been questioned (Kelly *et al.* 2008) and further research is necessary to investigate this issue.

Distribution: Endemic to the western regions of the Western Cape, South Africa. Broadley (2002) plotted an isolated record (3120BD) in the Northern Cape and this is considered questionable and in need of confirmation.

EOO: 18 755 km^2 (confidence: medium); AOO: 3 849 km^2 (confidence: low).

Habitat: Found in sand fynbos and strandveld habitats throughout its range.

Vegetation type: FFd2 Leipoldtville Sand Fynbos; FRs9 Swartland Shale Renosterveld; FFs2 Graafwater Sandstone Fynbos; FS5 Langebaan Dune Strandveld; FRg2 Swartland Granite Renosterveld; FFd3 Hopefield Sand Fynbos; FS3 Saldanha Flats Strandveld; FFs9 Peninsula Sandstone Fynbos; FFg3 Peninsula Granite Fynbos; FFg2 Boland Granite Fynbos; FFd6 Hangklip Sand Fynbos; FS1 Lambert's Bay Strandveld.

Assessment rationale: Has a limited distribution (EOO <20 000 km^2) in a region that is characterised by high levels of habitat transformation. Average habitat transformation within the Cape Floristic Region is estimated at approximately 30%, while certain vegetation types (e.g. Renosterveld) in which this species is known to occur have been reduced by up to 80% in extent (Rouget *et al.* 2003) [B1b(iii)]. Habitat transformation is expected to increase (Rouget *et al.* 2003). Additionally, remaining habitats within the range are likely to be severely fragmented [B1a]. There are very few large tracts of undisturbed habitat remaining for this species, which occurs in few protected areas. It is likely that the majority of populations are isolated and although this snake is capable of long distance movement, altered habitats and roads will act as barriers.

Threats: Threatened primarily by habitat loss associated with agriculture and development of human settlements throughout its range.

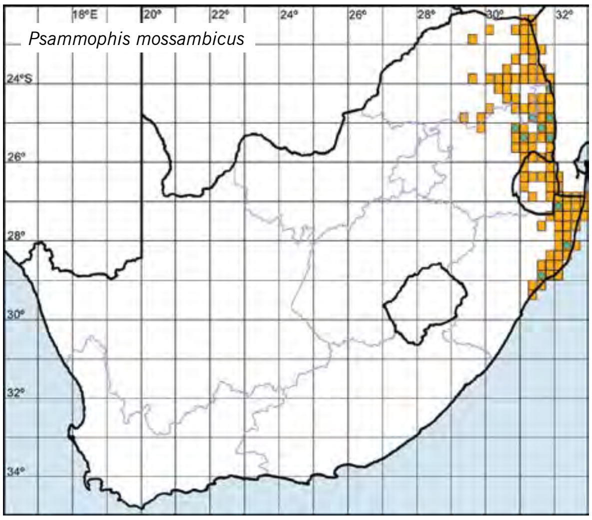
Conservation measures: Conserve existing habitat. Assess the occurrence of the species within transformed areas. Clarify the taxonomic status of *P. leightoni* relative to *P. namibensis* and *P. trinasalis*.

Psammophis leightoni—WC M. Burger

Psammophis mossambicus Peters, 1882

OLIVE GRASS SNAKE

Bryan Maritz



Regional: Least Concern

Taxonomy: Kelly *et al.* (2008) reported that there appears to be little support for the separation of *Psammophis phillipsii phillipsii* and *P. mossambicus*, and that the latter may be a junior synonym of *P. phillipsii*. However, larger samples and a more detailed investigation are required to settle this question.

Distribution: Widespread in sub-Saharan Africa but the exact range is difficult to define given the taxonomic issue discussed above. According to Branch (1998) and Broadley (2002), the species occurs from South Sudan southwards to Angola, Namibia, Botswana, Zimbabwe, Mozambique, South Africa and Swaziland. Within the *Atlas* region it is known from the Lowveld of Limpopo and Mpumalanga, southwards through Swaziland and KwaZulu-Natal. It appears to be absent from the high-lying regions of Mpumalanga. Broadley (2002) recorded the southernmost limit at 2931BA but it is now known to occur further south at 2931AD. Although Bourquin (2004) plotted several records throughout KwaZulu-Natal, including one as far south as 3130AA on the Eastern Cape border, many of these require confirmation. All records west of 31°E and at loci 2831AB, 2831BA and 2931CA (from Bourquin 2004 and other sources) are excluded from the map here, as these were considered too far removed from the range determined by Broadley (2002). These records are probably referable to *P. brevirostris*.

Psammophis mossambicus—Cleveland NR, S of Phalaborwa, LIMP M. Burger

Habitat: Inhabits savanna and grasslands from sea level to approximately 1 500 m, and is often associated with moist habitats (Broadley 2002).

Bioregion: Lowveld; Indian Ocean Coastal Belt; Central Bushveld; Mopane; Zonal and Intrazonal Forests; Mesic Highveld Grassland; Freshwater Wetlands; Alluvial Vegetation.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Psammophis namibensis Broadley, 1975

NAMIB SAND SNAKE; NAMIB WHIP SNAKE

Bryan Maritz

Regional: Least Concern

Taxonomy: Broadley (2002) elevated *Psammophis leightoni namibensis* to species status, but Kelley *et al.* (2008) indicated that *P. namibensis* and *P. leightoni* may represent a single species and called for further molecular work to investigate this.

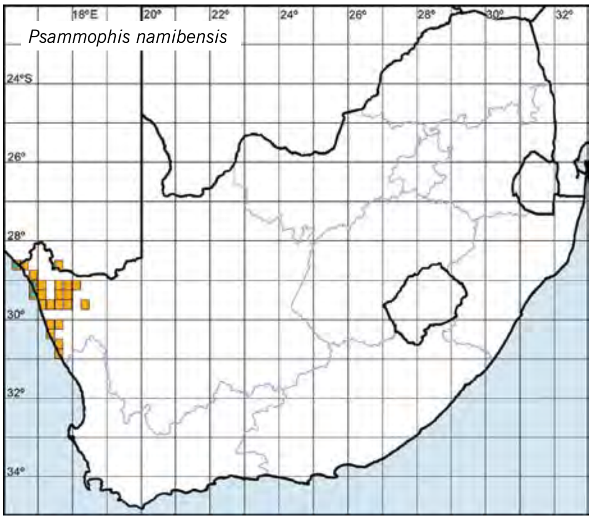
Distribution: Occurs along the western portions of southern Africa, from Angola through Namibia, south to Namaqualand in the Northern Cape, South Africa (Branch 1998).

Habitat: Inhabits arid regions, including desert and succulent scrubland (Branch 1998).

Bioregion: Namaqualand Sandveld; Richtersveld; Namaqualand Hardeveld; Bushmanland; Southern Namib Desert; Gariep Desert.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Psammophis namibensis—Sossusvlei, Namibia W.R. Branch

Psammophis namibensis—Gaias, Namibia J. Marais

Psammophis notostictus Peters, 1867

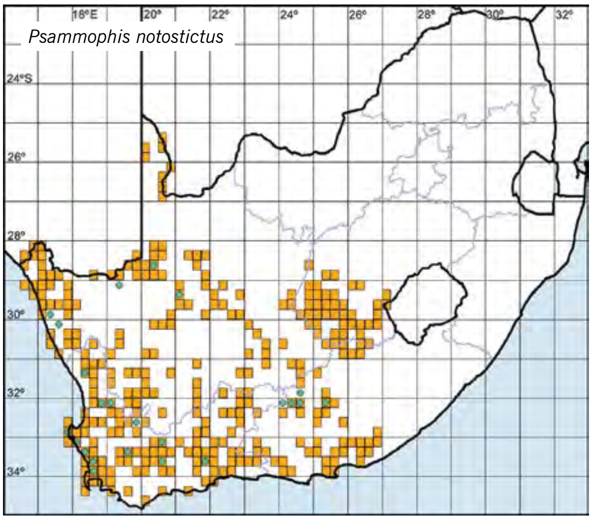
KAROO SAND SNAKE; KAROO WHIP SNAKE

Bryan Maritz

Regional: Least Concern

Taxonomy: No notable issues.

Distribution: A widespread species that occurs from southern Angola through Namibia to South Africa (Broadley 2002). In the *Atlas* region it occurs throughout the Northern and Western Cape provinces, the western half of the Eastern Cape and the southern half of the Free State.



Psammophis notostictus—De Hoop NR, WC T. Phelps

Habitat: Inhabits arid scrubland, karroid bushveld and fynbos habitats. May be found in old termitaria, under rocks or in open veld (De Waal 1978).

Biome: Nama-Karoo; Fynbos; Succulent Karoo; Grassland; Albany Thicket; Desert; Savanna.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Psammophis subtaeniatus Peters, 1882

WESTERN YELLOW-BELLIED SAND SNAKE; WESTERN STRIPE-BELLIED SAND SNAKE

Bryan Maritz

Regional: Least Concern

Taxonomy: *Psammophis subtaeniatus orientalis* from east and southeast Africa was elevated to species status by Broadley (2002) (validated by Kelly *et al.* 2008), rendering *P. subtaeniatus* a monotypic species.

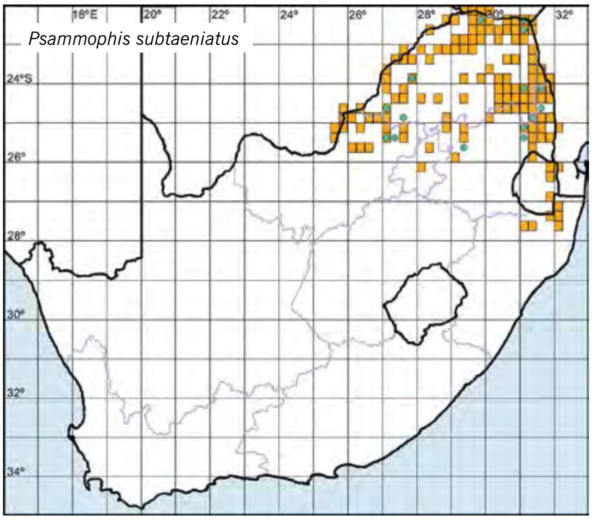
Distribution: Occurs from southern Angola through northern Namibia, Botswana, southern Zambia, Zimbabwe, western Mozambique and Swaziland (Branch 1998). In South Africa it is known from Limpopo, northern North-West Province, Gauteng, parts of the northern half of Mpumalanga and northern KwaZulu-Natal.

Habitat: Inhabits dry savannas at altitudes of 100–1 500 m (Broadley 2002). Recorded on rocky hillsides, in rock crevices and large, old termitaria, as well as under bark, logs or rocks; may take refuge in bushes up to 1.2 m high (Jacobsen 1989).

Bioregion: Central Bushveld; Lowveld; Mopane; Mesic Highveld Grassland; Alluvial Vegetation; Sub-Escarpment Grassland.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Psammophis subtaeniatus—Cleveland NR, S of Phalaborwa, LIMP
M. Burger

Psammophis trigrammus Günther, 1865

WESTERN SAND SNAKE; WESTERN WHIP SNAKE

Michael F. Bates

Global: Least Concern

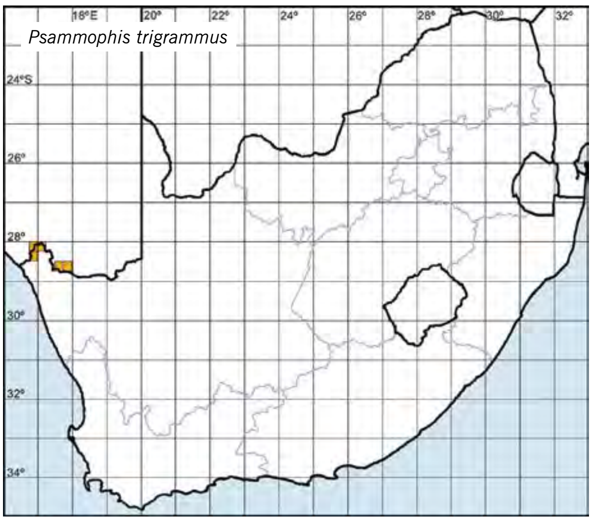
Taxonomy: No notable issues.

Distribution: Endemic to southwestern Africa. Found in southern Angola, northern and western Namibia and the northern Richtersveld of the Northern Cape, South Africa (Broadley 1990b, 2002; Branch 1998; Bauer & Branch 2003 [2001]).

Habitat: Recorded from rocky patches on sandy soil near river valleys at elevations of about 60–320 m in the Richtersveld National Park (Bauer & Branch 2003 [2001]).

Bioregion: Richtersveld; Gariep Desert; Southern Namib Desert.

Assessment rationale: Although restricted to a small area in the extreme northwestern part of the Northern Cape,



this species is widespread and common elsewhere in southwestern Africa. There are no known threats in the *Atlas* region, where much of the range is protected within the Richtersveld National Park, and therefore the regional assessment is also Least Concern.

Conservation measures: None recommended.

Psammophis trigrammus—Langer Hinreich, Namibia W. Conradie

Psammophis trinasalis Werner, 1902

FORK-MARKED SAND SNAKE;
KALAHARI SAND SNAKE

Bryan Maritz

Regional: Least Concern

Taxonomy: Previously regarded as a subspecies of *P. leightoni* but elevated to species status by Broadley (2002). Kelly *et al.* (2008) did not include *P. trinasalis* in their analysis, but concern over the validity of *P. namibensis* (also formerly considered a subspecies of *P. leightoni*) should prompt verification of the validity of *P. trinasalis*.

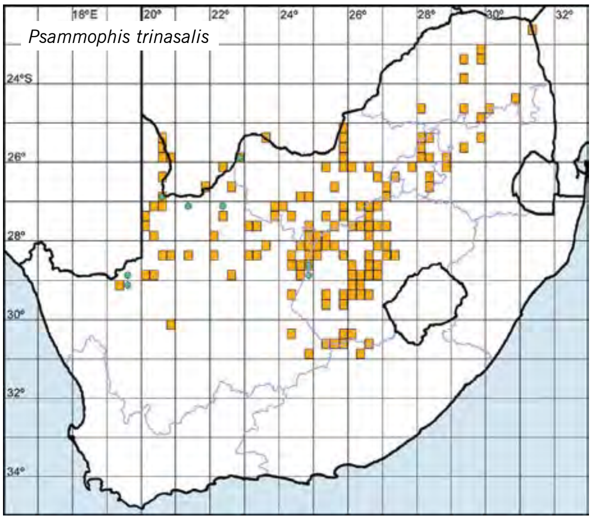
Distribution: Endemic to southern Africa, this species is known from the Namibian plateau, Botswana and the northern and central parts of South Africa (Branch 1998). It may also occur peripherally in adjacent Zimbabwe and Mozambique. In the *Atlas* region it is found in the Northern Cape, Free State, North-West Province, Gauteng, Limpopo and western Mpumalanga.

Habitat: Inhabits arid savannas and grasslands at elevations of 200–1 700 m; often found in old termitaria and occasionally under rocks (De Waal 1978; Jacobsen 1989; Broadley 2002).

Bioregion: Dry Highveld Grassland; Eastern Kalahari Bushveld; Central Bushveld; Mesic Highveld Grassland; Upper Karoo; Kalahari Duneveld; Alluvial Vegetation; Bushmanland; Lowveld.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Psammophis trinasalis—Aroab, Namibia W.R. Branch

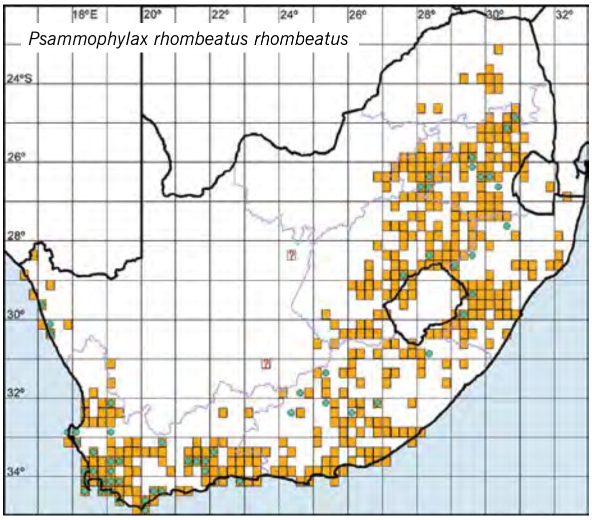
Genus *Psammophylax* Fitzinger, 1843—African grass snakes

This genus now contains five species following the transfer of *Rhamphiophis acutus* (and its subspecies) to the genus *Psammophylax* by Kelly *et al.* (2008). The likelihood of cryptic species-level diversity in the East African *P. variabilis* and *P. multisquamis* species complexes means that species numbers will probably increase further in future (C.M.R. Kelly pers. comm.). These snakes are found throughout Africa but only two species (*P. rhombeatus*, *P. tritaeniatus*) occur in the *Atlas* region. They are diurnal, terrestrial, active foragers that prey mainly on small mammals and lizards (Branch 1998). Females of *P. r. rhombeatus* guard their eggs (up to 30 per clutch) while they incubate, remaining with them until they hatch; *P. tritaeniatus* females produce clutches of 5–18 eggs (Broadley 1990b; Branch 1998). Neither species is of conservation concern.

Psammophylax rhombeatus rhombeatus (Linnaeus, 1758)

SPOTTED GRASS SNAKE; SPOTTED SKAAPSTEKER

Gavin Masterson



Regional: Least Concern

Taxonomy: Trinomials are retained as *Psammophylax rhombeatus ocellatus* of southern Angola was considered a valid subspecies by Broadley (1977b). The latter subspecies and the population of *P. r. rhombeatus* on the northwest coast of South Africa are disjunct and are currently being investigated (C.M.R. Kelly pers. comm.).

Distribution: Endemic to southern Africa and found in South Africa, Swaziland, Lesotho and Namibia (Broadley 1990b; Branch 1998). Found in all nine provinces of South Africa but absent from most of the North-West Province, western Free State and central Northern Cape. Two QDGC records in the eastern part of the Northern Cape are somewhat out of range and considered questionable. If the three scattered QDGC records in Namibia (see Broadley 1990b; Branch 1998) merely represent relict populations of this subspecies, then it could be considered a near-endemic in the *Atlas* region.

Habitat: Very common, found in savanna, grassland, fynbos and desert, from the coast up to about 2 300 m; shelters under rocks on soil, in rock crevices, old termitaria and holes in the ground (De Waal 1978; Jacobsen 1989; Broadley 1990b; Branch 1998).

Biome: Grassland; Fynbos; Savanna; Albany Thicket; Succulent Karoo; Nama-Karoo; Forests; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Psammophylax rhombeatus rhombeatus—Gondwana GR, E of Herbertsdale, WC M. Burger

Psammophylax rhombeatus rhombeatus—Mooi River, KZN J. Marais

Psammophylax tritaeniatus (Günther, 1868)

STRIPED GRASS SNAKE; STRIPED SKAAPSTEKER

Gavin Masterson

Regional: Least Concern

Taxonomy: No notable issues.

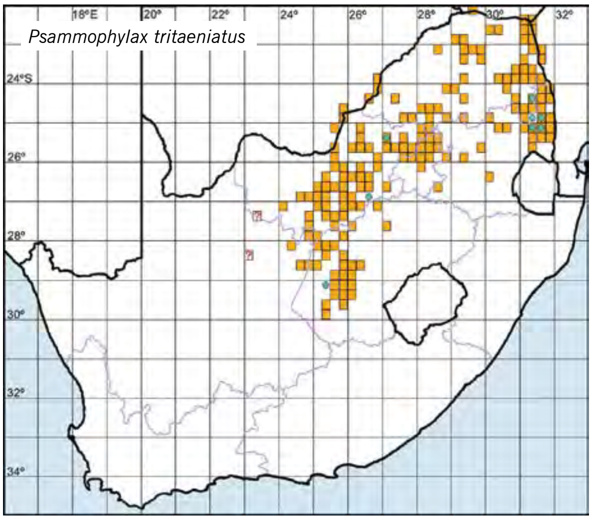
Distribution: Endemic to sub-Saharan Africa. Found in Tanzania, Zimbabwe, western Mozambique, Botswana, Angola, Namibia and South Africa (Broadley 1990b; Branch 1998). Within the *Atlas* region it is found in Limpopo, Mpumalanga, Gauteng, North-West Province, adjacent northeastern Northern Cape and western Free State. Two records plotted on the map are old (one dating to 1896) and out of range, and are here considered questionable.

Habitat: Found throughout savanna and Highveld grassland areas (Broadley 1990b; Branch 1998) at altitudes of 200–1 600 m. Terrestrial, taking refuge under rocks and in old termitaria (De Waal 1978; Jacobsen 1989).

Biome: Savanna; Grassland; Nama-Karoo (marginal).

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Psammophylax tritaeniatus—Namibia J. Marais

Genus *Rhamphiophis* Peters, 1854—beaked snakes

The genus *Rhamphiophis* occurs throughout Africa. It now contains only four species (Uetz 2012) following the recent transfer of *R. acutus* to the genus *Psammophylax* by Kelly *et al.* (2008). These diurnal and terrestrial snakes have short re-inforced skulls that allow them to dig in soil (Kelly *et al.* 2008). Only one species (*R. rostratus*) occurs in the *Atlas* region and it is not of conservation concern. Adults of this species prey on small vertebrates, including other snakes, while juveniles are known to include insects in their diet; females lay clutches of 8–17 eggs (Branch 1998).

Rhamphiophis rostratus Peters, 1854

RUFOUS BEAKED SNAKE

Gavin Masterson

Regional: Least Concern

Taxonomy: No notable issues.

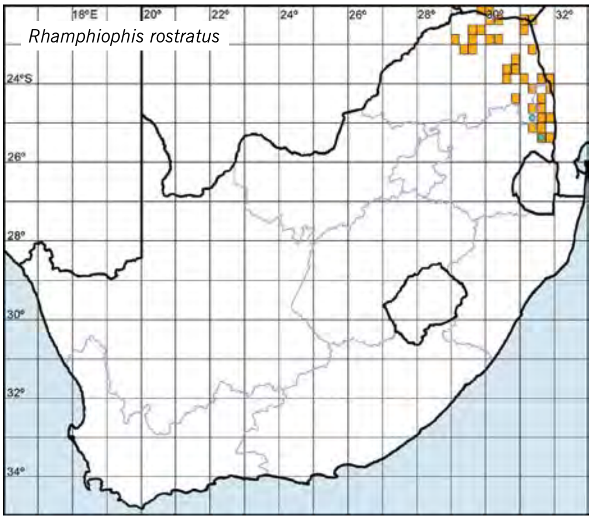
Distribution: Endemic to sub-Saharan Africa. Found in northeastern South Africa, Mozambique, Zimbabwe, Botswana, Malawi, Tanzania, Kenya, Ethiopia and South Sudan (Broadley 1990b; Branch 1998). Within the *Atlas* region it is restricted to the northern and eastern parts of Limpopo, and northeastern Mpumalanga.

Habitat: A terrestrial species that is found in moist and arid savanna, often in gerbil burrows or termite mounds (Broadley 1990b; Branch 1998), at altitudes of 400–1 000 m.

Bioregion: Mopane; Lowveld; Central Bushveld; Alluvial Vegetation.

Assessment rationale: Widespread and well protected within its regional range, primarily within the Kruger National Park.

Conservation measures: None recommended.



Rhamphiophis rostratus—Hoedspruit, LIMP J. Marais

SUBFAMILY PSEUDOXYRHOPHIINAE

The pseudoxyrhophiines comprise approximately 20 genera and 80 species (Glaw & Vences 2007) that are found mainly in Madagascar, with one genus (*Ditypophis*) endemic to Socotra Island and two genera (*Duberria* and *Amplorhinus*) restricted to mainland Africa (Lawson *et al.* 2005; Kelly *et al.* 2009). One additional African genus (*Montaspis*) is likely to belong in this subfamily (Kelly *et al.* 2009) and is provisionally considered a pseudoxyrhophiine, but further research is necessary to validate this.

The various species demonstrate a broad variety of lifestyles and include terrestrial and arboreal snakes, as well as nocturnal and diurnal species. Prey specialisation is evident in some genera, e.g. *Duberria* eat only slugs and snails, while some *Liopholidophis* consume frog eggs. Bites from some of the larger species (e.g. *Leioheterodon*, *Ithycyphus*, *Madagascarophis*) may cause mild envenomation (Glaw & Vences 2007), as may bites from southern African *Amplorhinus* (Spawls & Branch 1995). Most Malagasy species for which reproductive data are known are oviparous (exceptions include some viviparous *Stenophis* and *Liopholidophis*; Glaw & Vences 2007) while the African genera *Duberria* and *Amplorhinus* are viviparous (reproduction in *Montaspis* is unknown).

Three genera and four species are found in the *Atlas* region. One of these, *Duberria variegata*, is restricted to the coastal forests of Maputaland but it is not currently threatened. *Montaspis gilvomaculata* is known from only four specimens and its conservation status cannot be assessed adequately; it is considered to be Data Deficient on the basis of insufficient information.

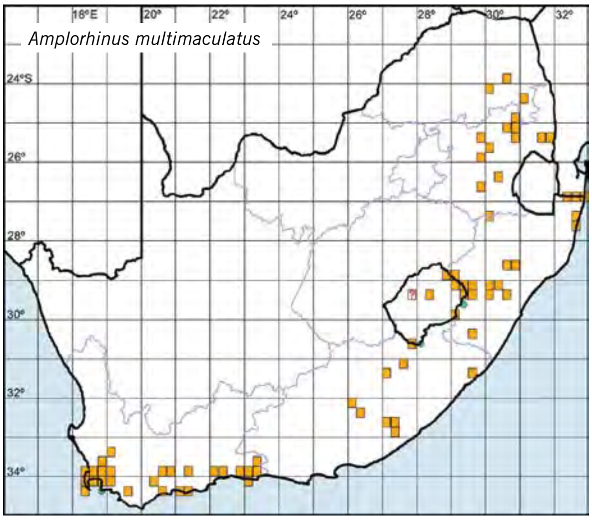
Genus *Amplorhinus* A. Smith, 1847—many-spotted snakes

The genus *Amplorhinus* contains a single species that occurs in a series of isolated populations extending along the eastern side of southern Africa, from the southern Cape to eastern Zimbabwe in the north. These terrestrial snakes are usually found in the vicinity of rivers, seepage areas and other wetlands in mountainous regions. They prey on frogs and lizards, and females give birth to 4–12 young (Branch 1998). *Amplorhinus multimaculatus* is not of conservation concern.

Amplorhinus multimaculatus A. Smith, 1847

MANY-SPOTTED SNAKE; CAPE MANY-SPOTTED SNAKE

Johan Marais



Global: Least Concern

Near-endemic

Taxonomy: The Zimbabwean and South African populations are geographically well separated, and are substantially divergent genetically (Kelly *et al.* 2009b). These populations, and perhaps also the two major regional populations in South Africa, i.e. Western Cape and eastern parts of the *Atlas* region, may all represent separate species (C.M.R. Kelly pers. comm.).

Distribution: Occurs in scattered populations from the Western Cape into the Eastern Cape, KwaZulu-Natal, Lesotho, Mpumalanga and southeastern Limpopo. The population in the Western Cape is clearly isolated from other populations. There is also an isolated population in eastern Zimbabwe (Broadley 1990b). Records from the Irene area in Gauteng are dubious (Jacobsen 1989) and are not shown on the map.

Amplorhinus multimaculatus—Jonkershoek Valley, Stellenbosch, WC
A.L. de Villiers

Habitat: Occurs in reed beds, vleis and riverside vegetation in fynbos, grassland and montane forests (Broadley 1990b; Branch 1998).

Biome: Grassland; Fynbos; Savanna; Forests; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common throughout much of its range (Broadley 1990b), but appears to be vulnerable to habitat destruction in some areas (Jacobsen 1989).

Conservation measures: None recommended.

Genus *Duberria* Fitzinger, 1826—slug-eaters

The genus *Duberria* is widespread in southern and eastern sub-Saharan Africa, and currently contains three species (Uetz 2012). *Duberria lutrix shirana* was recently elevated to species status (Broadley *et al.* 2003). Two species occur in the eastern and southern parts of the *Atlas* region. These small, non-venomous, terrestrial snakes are found in moist habitats and feed exclusively on terrestrial snails and slugs. Females give birth to 6–22 young (Branch 1998). In the *Atlas* region, one species (*D. variegata*) has a restricted distribution but neither of the two taxa is of conservation concern.

Duberria lutrix lutrix (Linnaeus, 1758)

SOUTH AFRICAN SLUG-EATER;
COMMON SLUG-EATER

Johan Marais

Global: Least Concern

Endemic

Taxonomy: Two allopatric subspecies of *Duberria lutrix* are recognised in southern Africa, namely *D. l. lutrix* (*Atlas* region) and *D. l. rhodesiana* (Zimbabwe and Mozambique), but they are genetically deeply divergent and probably represent separate species (C.M.R. Kelly unpubl. data). Broadley & Blaylock (2013) noted that molecular data suggests that most recognised subspecies of *D. lutrix*, extending from the Cape to Ethiopia—including *D. l. rhodesiana*—probably represent good evolutionary species.

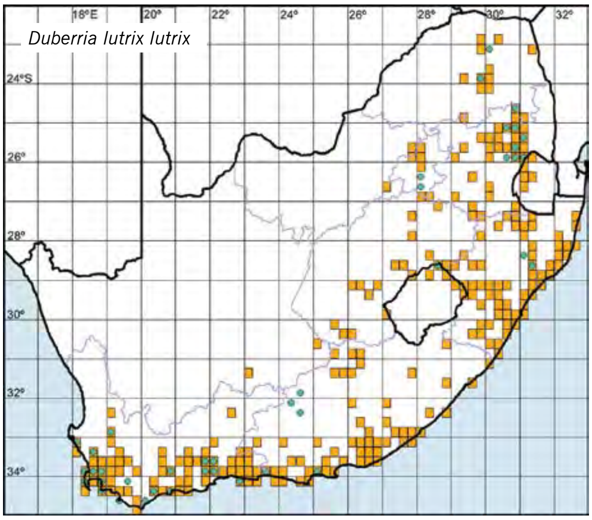
Distribution: Endemic to the eastern and southern parts of the *Atlas* region, including Swaziland and Lesotho. The Virtual Museum records in the Graaff-Reinet area are the first records of this species in the northwestern part of the Eastern Cape.

Habitat: Favours damp localities in grassland, moist savanna, lowland forests and fynbos (Marais 2004).

Biome: Fynbos; Grassland; Albany Thicket; Savanna; Forests; Indian Ocean Coastal Belt; Nama-Karoo; Succulent Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Duberria lutrix lutrix—Wolkberg, LIMP J. Marais

Duberria variegata (Peters, 1854)

VARIEGATED SLUG-EATER;
SPOTTED SLUG-EATER

Johan Marais

Global: Least Concern

Taxonomy: No notable issues.

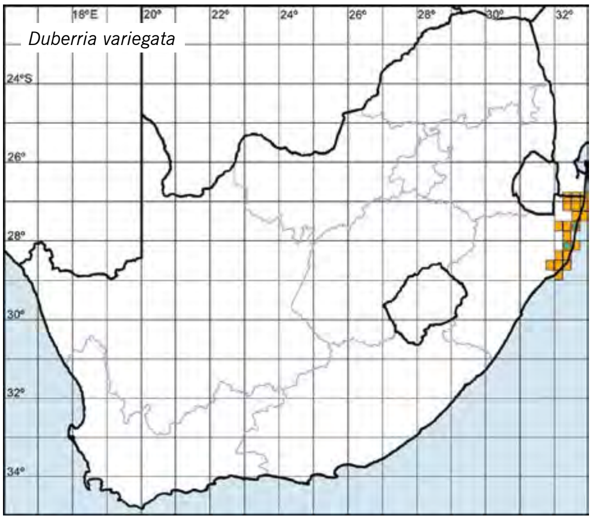
Distribution: Endemic to South Africa and Mozambique. Restricted to an area stretching from Inhambane in southern Mozambique to Richards Bay in northeastern KwaZulu-Natal (Broadley 1990b).

Habitat: Found in lowland coastal forests and savanna (Branch 1998).

Bioregion: Indian Ocean Coastal Belt; Zonal and Intrazonal Forests; Freshwater Wetlands; Lowveld.

Assessment rationale: Although it has a restricted distribution in northeastern KwaZulu-Natal and adjacent southern Mozambique, this species is fairly common where it occurs (pers. obs.) and a large part of its range falls within protected areas, notably iSimangaliso Wetland Park.

Conservation measures: A poorly-known species: investigate its biology, ecology and population size.



Duberria variegata—St Lucia, KZN J. Marais

Genus *Montaspis* Bourquin, 1991—cream-spotted mountain snakes

Montaspis is a monotypic genus endemic to South Africa. It is confined to high altitudes in the Drakensberg Range of KwaZulu-Natal, including the upper parts of Sani Pass bordering Lesotho. *Montaspis gilvomaculata* is known from only four specimens and its natural history is virtually unknown (Branch *et al.* 2003). It is a medium-sized terrestrial species found in the vicinity of aquatic habitats in grassland where it feeds on frogs (Branch 1998). The species has a restricted distribution and its conservation status is uncertain because of a lack of data; it is considered to be Data Deficient on the basis of insufficient information.

Montaspis gilvomaculata Bourquin, 1991

CREAM-SPOTTED MOUNTAIN SNAKE

Johan Marais

Global: Data Deficient

Endemic

Taxonomy: The relationship of this species to other snakes remains uncertain, although its morphology suggests a close relationship with *Amplorhinus*, and it has accordingly been provisionally included in the Pseudoxyrhophiinae (Vidal *et al.* 2008a; Kelly *et al.* 2009b).

Distribution: Drakensberg Mountains of KwaZulu-Natal, South Africa (Bourquin 1991, 2004; Branch *et al.* 1993; Branch 1998; Marais 2004).

EOO: 7 087 km^2 (confidence: high); AOO: 1 618 km^2 (confidence: low).

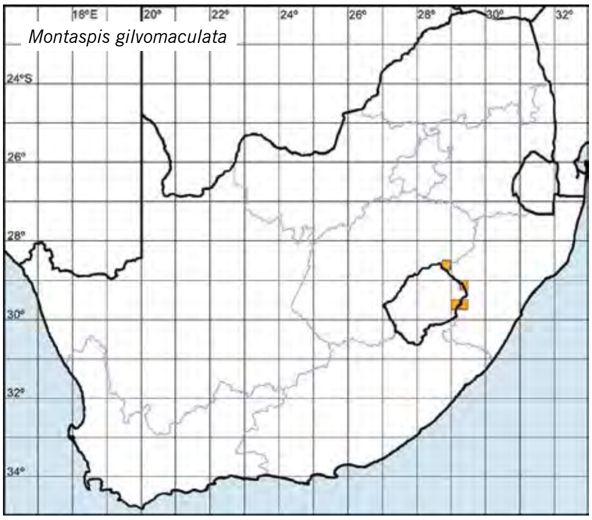
Habitat: Thought to inhabit areas near mountain streams and vleis in high altitude grassland (1 800–3 000 m) (Bourquin 1991; Marais 2004).

Vegetation type: Gd 7 uKhahlamba Basalt Grassland; Gd 8 Lesotho Highland Basalt Grassland; Gd 5 Northern Drakensberg Highland Grassland.

Assessment rationale: A rare and poorly known snake that has been recorded only at high altitudes in the KwaZulu-Natal Drakensberg and is known from only four specimens (Branch *et al.* 1993). Almost nothing is known about abundance, microhabitat and natural history. The species is thus regarded as Data Deficient.

Threats: Unknown.

Conservation measures: No specific conservation measures are suggested as most of its range is protected within the uKhahlamba/Drakensberg Park. Conduct research on range and population sizes, habitat status, threats, biology and ecology.



Montaspis gilvomaculata—Drakensberg, KZN J. Marais

SUBFAMILY LAMPROPHIIDAE: *INCERTAE SEDIS*

Kelly *et al.* (2009b) revived the family Pseudaspididae Dowling & Duellman, 1978 for two monotypic genera, *Pseudaspis* (*P. cana*) and *Pythonodipsas* (*P. carinata*; Namibia and Angola). These authors also created the family Prosymnidae for the enigmatic genus *Prosymna*. The familial status and relationships of these three genera has not been resolved, and they are included here in the Lamprophiidae, but not assigned to subfamilies. Seven species (*Pseudaspis*, *Prosymna*) occur in the *Atlas* region.

Genus *Prosymna* Gray, 1849—shovel-snouted snakes

The genus *Prosymna* currently contains 16 species (Uetz 2012) following the elevation to species level of *P. lineata* from *P. sundevallii* (Broadley 1999b) and *P. greigerti* from *P. meleagris* (Chiro *et al.* 2011). Kelly *et al.* (2009b) proposed a monogeneric family Prosymnidae for African shovel-snouted snakes within the Elapoidea, but this has not been widely accepted. These small, fossorial snakes are confined to sub-Saharan Africa, with six species occurring in the *Atlas* region. They feed almost exclusively on reptile eggs, with some species adapted to take the hard-shelled eggs of geckos. Females lay small clutches of 3–6 eggs (Branch 1998). Two species, *P. frontalis* and *P. janni*, have restricted distributions and were previously listed as Peripheral (Branch 1988a), but no species are currently considered to be of conservation concern.

Prosymna bivittata Werner, 1903

TWO-STRIPED SHOVEL-SNOUT

Johan Marais

Global: Least Concern

Taxonomy: No notable issues.

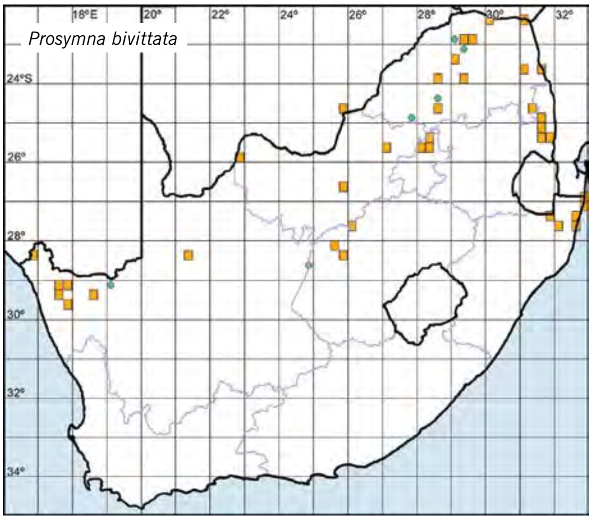
Distribution: Endemic to southern Africa. Found in southern Zimbabwe, Botswana, Namibia and South Africa (Broadley 1990b). Patchily but widely distributed in the *Atlas* region. It occurs in northeastern KwaZulu-Natal, northeastern Mpumalanga, northern Gauteng, Limpopo, North-West Province, western Free State and the northern half of Northern Cape. It probably also occurs in Swaziland and Mozambique.

Habitat: Found in moist and dry savanna and also in karoo scrub and sandveld in the west of South Africa. In Zimbabwe it seems to prefer open habitats in grassland and sparse thornveld (Broadley 1990b; Branch 1998). Found under rocks on soil and under logs at altitudes of 200–1 400 m (Jacobsen 1989).

Biome: Savanna; Grassland; Succulent Karoo; Nama-Karoo; Indian Ocean Coastal Belt; Desert.

Assessment rationale: Patchily distributed but widespread.

Conservation measures: None recommended.



Prosymna bivittata—E Shores, Lake St Lucia, KZN W.R. Branch

Prosymna frontalis (Peters, 1867)

SOUTHWESTERN SHOVEL-SNOUT

Johan Marais

Global: Least Concern

Taxonomy: No notable issues.

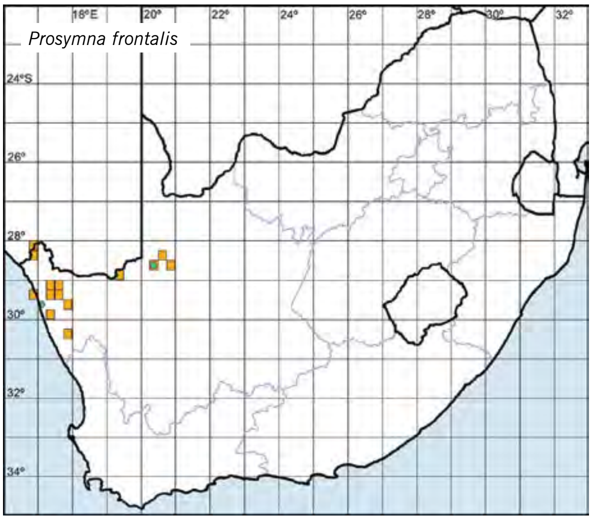
Distribution: Endemic to southern Africa. The range extends from southern Angola to Namibia and then southwards to the Namaqualand, Kenhardt and Gordonia districts in the Northern Cape, South Africa (Broadley 1990b). Recorded as far south as Kakamas and as far east as Keimoes and Augrabies.

Habitat: Inhabits rocky areas in arid regions (Broadley 1990b; Branch 1998).

Biome: Succulent Karoo; Nama-Karoo; Desert.

Assessment rationale: Although previously known from only a single locality in South Africa and listed as Peripheral (Branch 1988a), it is now known to be fairly widespread and common in the *Atlas* region. It also has a large extralimital range.

Conservation measures: None recommended.



Prosymna frontalis—Aus, Namibia W.R. Branch

Prosymna janii Bianconi, 1862

MOZAMBIQUE SHOVEL-SNOUT; JAN'S SHOVEL-SNOUT

Johan Marais

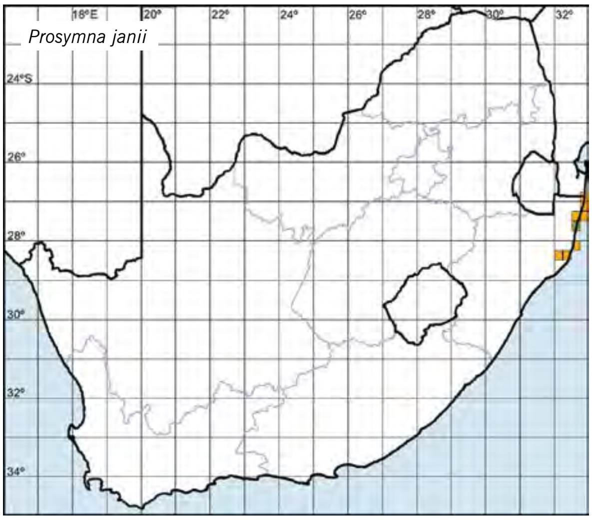
Global: Least Concern

Taxonomy: No notable issues.

Distribution: Distributed from St Lucia and Mtubatuba in northeastern KwaZulu-Natal, northwards into southern Mozambique (Broadley 1990b).

Habitat: Inhabits loose sandy soil in coastal dune forests, coastal forests and woodland (Broadley 1990b).

Prosymna janii—St Lucia, KZN W.R. Schmidt



Bioregion: Indian Ocean Coastal Belt; Zonal and Intrazonal Forests.

Assessment rationale: Has a restricted range but is abundant and not threatened. Much of the distribution within South Africa falls within the protected iSimangaliso Wetland Park.

Conservation measures: Conduct research into population numbers, biology, ecology, range, habitat status and threats.

Prosymna lineata (Peters, 1871)

LINED SHOVEL-SNOUT

Johan Marais

Global: Least Concern

Taxonomy: Previously considered a subspecies of *P. sundevallii* but elevated to species status by Broadley (1999b).

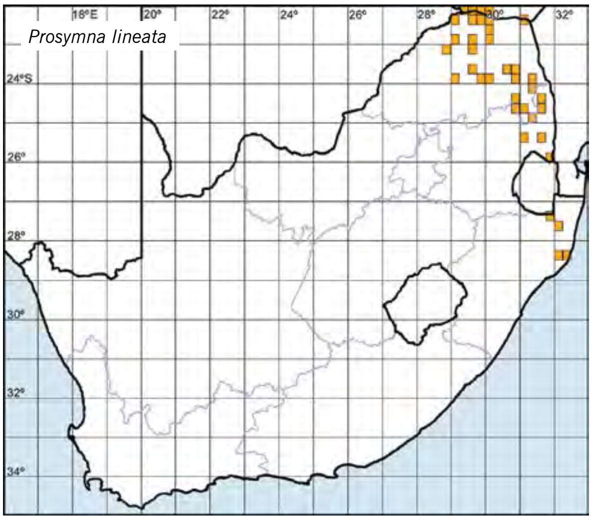
Distribution: Endemic to southern Africa. Recorded from Dukuduku Forest in northeastern KwaZulu-Natal, northwards into northeastern Swaziland, northeastern Mpumalanga and Limpopo, as well as Mozambique, Zimbabwe and northeastern Botswana (Broadley 1990b).

Habitat: Inhabits sandveld areas and miombo woodland (Broadley 1990b). Found under rocks on rock or soil, and under rotting logs, at altitudes of 300–1 400 m (Jacobsen 1989).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Forests.

Assessment rationale: Fairly widespread.

Conservation measures: None recommended.



Prosymna lineata—Malebogo NR, near Blouberg, LIMP M. Burger

Prosymna stuhlmannii (Pfeffer, 1893)

EAST AFRICAN SHOVEL-SNOUT

Johan Marais

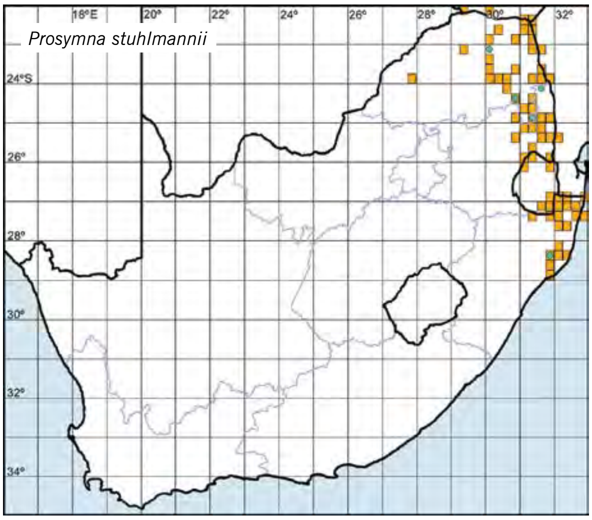
Regional: Least Concern

Taxonomy: Previously treated as a southern subspecies of *Prosymna ambigua* (Branch 1998).

Distribution: Found from South Africa and Swaziland northwards through Zimbabwe, eastern Zambia and further north to southern Somalia (Broadley 1990b). In the *Atlas* region it is found from Empangeni in northeastern KwaZulu-Natal northwards to Swaziland, eastern Mpumalanga and Limpopo where it occurs as far west as the Mokolo Dam near Lephalale.

Habitat: Found in lowland forests, wooded hills and moist savanna (Branch 1998; Marais 2004). More-or-less fossorial and usually found under rotting logs and stones, in decaying plant matter, and in deserted termite mounds (Jacobsen 1989; Marais 2004).

Prosymna stuhlmannii—Skukuza, Kruger NP, MPM G.J. Alexander



Biome: Savanna; Indian Ocean Coastal Belt; Grassland; Forests.

Assessment rationale: Fairly widespread and not threatened.

Conservation measures: None recommended.

Prosymna sundevallii (A. Smith, 1849)

SUNDEVALL'S SHOVEL-SNOUT

Johan Marais

Global: Least Concern

Near-endemic

Taxonomy: Treated as monotypic since *P. sundevallii lineata* was elevated to species status by Broadley (1999b).

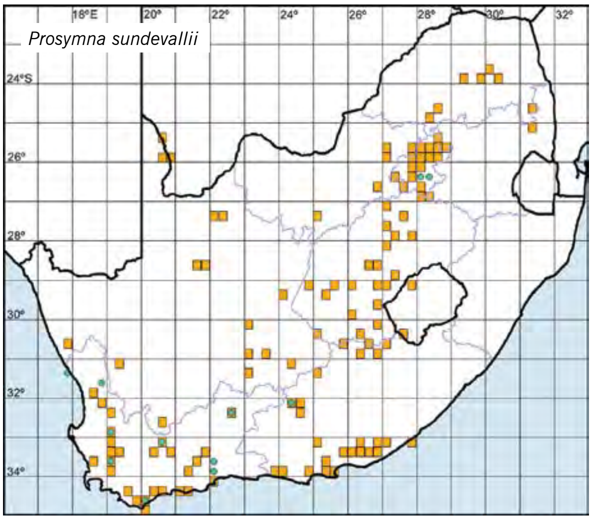
Distribution: Endemic to South Africa, Lesotho and southern Botswana (Broadley 1990b). Widespread but absent from KwaZulu-Natal and large parts of the Eastern Cape and Mpumalanga.

Habitat: Occurs in fynbos and mesic thicket in the Western Cape, and elsewhere in moist and dry savanna and karroid areas where it is often found in old termitaria and under rocks (Broadley 1990b).

Biome: Grassland; Savanna; Fynbos; Nama-Karoo; Albany Thicket; Succulent Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Prosymna sundevallii—Farm De Put, about 26 km SE of Britstown, NC
M. Burger

Genus *Pseudaspis* Fitzinger, 1826—mole snakes

The genus *Pseudaspis* contains a single species (*P. cana*) that is widely distributed across sub-Saharan Africa. It occurs virtually throughout the *Atlas* region in savanna, grassland and semi-desert, and is not of conservation concern. These large constrictors spend much of their time underground. They prey mainly on rodents and females give birth to large litters of 25–40 (but up to 95) young (Branch 1998).

Pseudaspis cana (Linnaeus, 1758)

MOLE SNAKE

Johan Marais

Regional: Least Concern

Taxonomy: Visser (2010) noted that males of the brown phase from northern Namibia have much shorter and morphologically different hemipenes compared to specimens of the larger black phase in the Western and Northern Cape provinces. He therefore suggested that the northern subspecies *P. cana anchietae* may be valid.

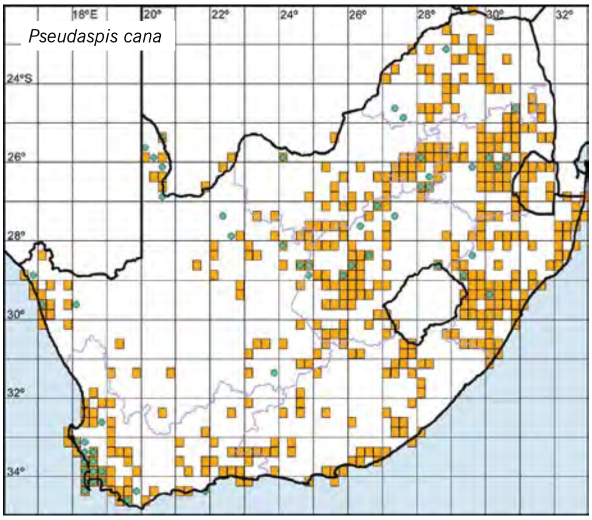
Distribution: Common throughout most of South Africa and Swaziland, extending northwards into Namibia, Angola, Botswana, Zimbabwe, Mozambique, Zambia, Tanzania and Kenya (Broadley 1990b).

Habitat: Occupies a variety of habitats, including mountainous regions and even deserts (Broadley 1990b), but not found in forests. Particularly common in sandy, scrub-covered areas (Branch 1998) and in grasslands, where it spends most of its life underground in deserted animal burrows (Broadley 1990b).

Biome: Grassland; Savanna; Fynbos; Succulent Karoo; Indian Ocean Coastal Belt; Nama-Karoo; Albany Thicket; Desert.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Pseudaspis cana—Kimberley, NC D. Maguire

Pseudaspis cana—Rietvlei area, about 40 km NW of Nelspruit, MPM M. Burger

Pseudaspis cana, juvenile—Cape Town, WC T. Phelps

CHAPTER 23

Family Elapidae

William R. Branch, Graham J. Alexander & Bryan Maritz

Together with the Lamprophiidae, elapids form the Elapoidea, a group of advanced snakes with a mainly Old World distribution. Most representatives are easily assigned to the Elapidae by virtue of their fixed and hollow front fangs and the lack of a loreal scale. The Atractaspidiinae are also characterised by the absence of a loreal, and harlequin snakes (*Homoroselaps*) have fixed front fangs. *Homoroselaps*, formerly included in the Elapidae, is now considered referable to the Atractaspidiinae. Molecular studies of elapids have also revealed that both the African water cobras (*Boulengerina*) and Burrowing Cobra (*Paranaja*) are nested within typical cobras (*Naja*), with which they are now merged (Branch 2005; Nagy *et al.* 2005; Wüster *et al.* 2007; Vidal *et al.* 2008a). Wallach *et al.* (2009) resurrected *Boulengerina* as a subgenus of *Naja*. With the exception of *Naja*, for which numerous new species have been described or await description (Broadley 1995b; Wüster & Broadley 2003, 2007; Broadley & Wüster 2004; Wüster *et al.* 2007), the taxonomy of the other African elapids is relatively stable.

A number of elapid subfamilies have been recognised, including the Elapinae (cobras and mambas), Hydrophiinae (sea snakes), Micrurinae (coral snakes), Acanthophiinae (Australian elapids) and Laticaudinae (sea kraits). However, none are universally recognised. Molecular evidence indicates that there are two subfamilies: the Elapinae of Africa, Asia and the New World, and the Hydrophiinae of Australasia and various marine habitats (Slowinski & Keogh 2000). This means that Australian terrestrial elapids are 'hydrophiines' even though they are not marine species. It is believed that both the oviparous sea kraits (*Laticauda*) and the 'true' viviparous sea snakes evolved separately from Australasian terrestrial hydrophiines (Slowinski & Keogh 2000).

Elapids are distributed throughout tropical and subtropical regions, including sub-Saharan Africa and Australasia. Globally, there are about 354 species in over 60 genera (Uetz 2012). In Africa there are only seven terrestrial genera (*Aspidelaps*, *Dendroaspis*, *Elapsoidea*, *Hemachatus*, *Naja*, *Pseudohaje*, *Walterinnesia*) and one marine genus (*Pelamis*), and approximately 30 species (Spawls & Branch 1995; Wallach *et al.* 2009). The *Atlas* region contains six genera and 13 species.

Although there are genera of small elapids (e.g. in Australia), these snakes are usually medium to large in size (reaching almost 6 m in the King Cobra, *Ophiophagus hannah*) and are often brightly banded, particularly the juveniles. They are mostly terrestrial but there are many burrowing forms (e.g. neotropical [*Micrurus*] coral snakes and African [*Elapsoidea*] garter snakes), while some are arboreal (e.g. *Pseudohaje*) and others are aquatic (particularly the sea snake and sea krait radiations, and the African Water Cobra *Naja annulata*). Some species have very generalised diets but many taxa have narrow prey preferences with correlated morphological specialisations, e.g. specialisations for feeding on other snakes, elongate burrowing lizards, reptile eggs, mammals, birds, frogs or fish. All African terrestrial elapids lay eggs (from 2–8 in *Elapsoidea* to over 25 in large forest cobras like *Naja melanoleuca*), with the exception of the Rinkhals (*Hemachatus haemachatus*) which is viviparous and produces litters of up to 60 young (Spawls & Branch 1995).

The family includes many of the world's most venomous snakes. In some areas these are common enough to cause high incidences of snakebites, e.g. cobras in parts of southeast Asia and West Africa, kraits in southeast Asia and taipans in New Guinea. Bigger species are 'confident' of their abilities and will stand their ground when they feel threatened. Many have characteristic defensive displays to warn potential predators. These displays include rearing the forebody and inflating the neck region, often in association with elongated neck ribs, to form a hood. Within the *Atlas* region the Mozambique Spitting Cobra (*N. mossambica*), Black Spitting Cobra (*N. nigricincta woodi*) and Rinkhals (*H. haemachatus*) have the ability to spit venom.

Most species are widespread and common in the *Atlas* region, but the Green Mamba (*Dendroaspis angusticeps*) is classified as Vulnerable. It occurs as an isolated population on the southeast African coast (KwaZulu-Natal and adjacent parts of the Eastern Cape and Mozambique) in an area where its forest habitat has been fragmented and destroyed to make way for housing and other developments.

SUBFAMILY ELAPINAE

Molecular evidence indicates that two subfamilies of Elapidae should be recognised: the Elapinae of Africa, Asia and the New World, and the Hydrophiinae of Australasia and various marine habitats (Slowinski & Keogh 2000). In the *Atlas* region there are five genera (*Aspidelaps*, *Dendroaspis*, *Elapsoidea*, *Hemachatus*, *Naja*) and 12 species (one with two subspecies) of elapines.

Genus *Aspidelaps* A. Smith, 1849—shield cobras

Shield cobras are mainly endemic to southern Africa, but the range of one species (*A. lubricus*) extends into southern Angola. The genus contains two species (each consisting of a number of subspecies), both of which occur in the *Atlas* region. Both *Aspidelaps lubricus* (western and southern parts of the *Atlas* region) and *A. scutatus* (northern parts) are terrestrial and often burrow into sandy soil using their enlarged rostral shield. These snakes prey on small vertebrates, especially rodents, but also reptiles and frogs; females lay clutches of 3–11 eggs (Branch 1998; Broadley & Baldwin 2006). Neither species is considered to have potent venom but a few human deaths have been recorded. Both species are classified as Least Concern.

Aspidelaps lubricus lubricus (Laurenti, 1768)

CORAL SHIELD COBRA; CORAL SNAKE

Graham J. Alexander

Global: Least Concern

Taxonomy: Broadley & Baldwin (2006) referred *A. lubricus infuscatus* to the synonymy of *A. lubricus cowlesi* (Namibia and southwestern Angola). However, relationships between the subspecies should also be investigated using molecular methods.

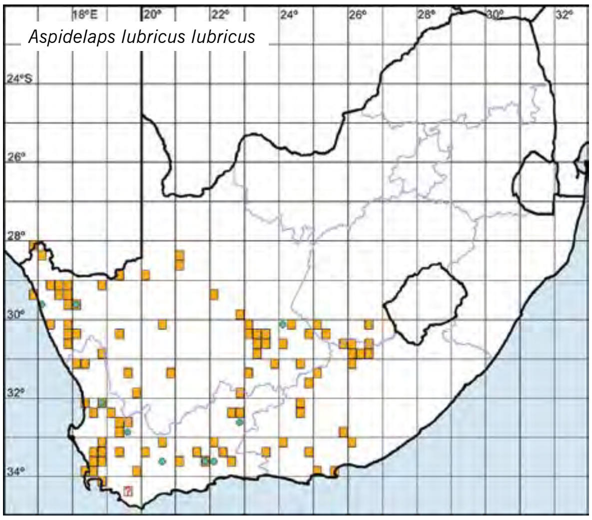
Distribution: Found from southwestern Namibia southwards through the western parts of South Africa (Broadley & Baldwin 2006). In the *Atlas* region it is widespread in the Northern and Western Cape provinces, the western half of the Eastern Cape, and the southern Free State. It reaches its southeastern limits in Port Elizabeth. Close to being classified as near-endemic.

Habitat: Found in rock outcrops, stony and dry sandy regions (Marais 2004) and arid plains in valleys (Branch 1998).

Biome: Fynbos; Nama-Karoo; Succulent Karoo; Albany Thicket; Grassland; Savanna.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Aspidelaps lubricus lubricus—near Springbok, NC B. Wilson

Aspidelaps scutatus scutatus (A. Smith, 1849)

COMMON SHIELD COBRA; SHIELD-NOSE SNAKE

Graham J. Alexander

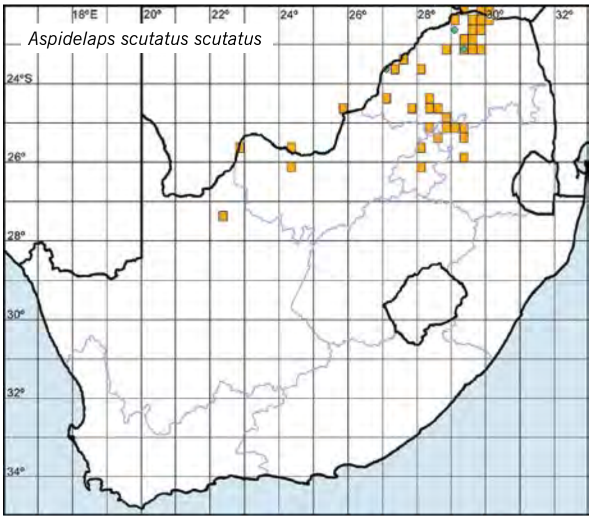
Global: Least Concern

Taxonomy: Three subspecies are recognised, namely *Aspidelaps scutatus scutatus*, *A. s. intermedius* and *A. s. fulafula*. According to Broadley & Baldwin (2006) the latter two subspecies may together represent a single evolutionary species (*A. s. fulafula* is the older name). A molecular analysis would help resolve the taxonomy.

Distribution: Endemic to southern Africa. Found from central Namibia eastwards to Botswana, southern and western Zimbabwe, and the northern parts of South Africa (Boycott 1992a; Broadley & Baldwin 2006). In the *Atlas* region it occurs in the northeastern part of the Northern Cape, northern North-West Province, western half of Limpopo, northwestern Mpumalanga, and northern Gauteng. Records south of the currently delineated range have been rejected but may represent populations that were isolated in patches with suitable substrates (Broadley 1968c; Broadley & Baldwin 2006). *Aspidelaps s. scutatus* is widespread, but in South Africa it is replaced east of about 30° longitude—in the eastern parts of Mpumalanga and Limpopo—by *A. s. intermedius*. In southern Mozambique and southeastern Zimbabwe, it is replaced by *A. s. fulafula* (Broadley & Baldwin 2006).

Habitat: Semi-fossorial and nocturnal, found primarily in sandy areas (Marais 2004). In South Africa *A. s. scutatus* is found in stony and sandy areas at altitudes of 500–1 300 m; one specimen was observed at night emerging from loose sand and leaf litter at the base of a tree (Jacobsen 1989). May take refuge in rodent burrows by day (Broadley & Baldwin 2006).

Bioregion: Mopane; Central Bushveld; Mesic Highveld Grassland; Eastern Kalahari Bushveld; Dry Highveld Grassland (marginal).



Aspidelaps scutatus scutatus—Marble Hall, MPM J. Marais

Assessment rationale: Widespread and common in parts of its range.

Conservation measures: None recommended.

Aspidelaps scutatus intermedius Broadley, 1968

INTERMEDIATE SHIELD COBRA; SHIELD-NOSE SNAKE

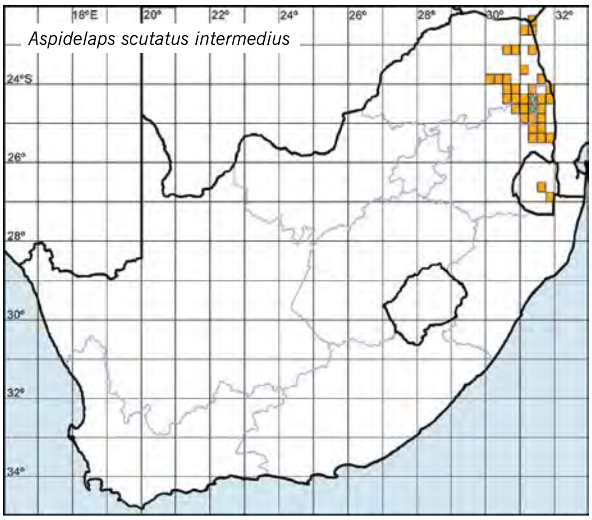
Graham J. Alexander

Global: Least Concern

Endemic

Taxonomy: According to Broadley & Baldwin (2006), *A. s. intermedius* and *A. s. fulafula* may together represent a single evolutionary species (*A. s. fulafula* is the older name). The distributions of the two subspecies in the *Atlas* region do not abut, indicating isolation. A molecular analysis would help resolve the taxonomy but, pending further work, the two subspecies are still recognised and the name *intermedius* is employed for populations in the *Atlas* region.

Distribution: Endemic to the *Atlas* region. Found in Swaziland, eastern Limpopo and the northeastern parts of Mpumalanga. In southern Mozambique and southeastern Zimbabwe, it is replaced by *A. s. fulafula* (Broadley & Baldwin 2006).



Habitat: Semi-fossorial and nocturnal, found primarily in sandy areas (Marais 2004) at altitudes of 90–1 400 m (Jacobsen 1989; Boycott 1992a). May take refuge in rodent burrows by day (Broadley & Baldwin 2006).

Bioregion: Lowveld; Mopane.

Assessment rationale: Widespread and common in parts of its range.

Conservation measures: None recommended.

Aspidelaps scutatus intermedius—Hoedspruit, LIMP D. Maguire

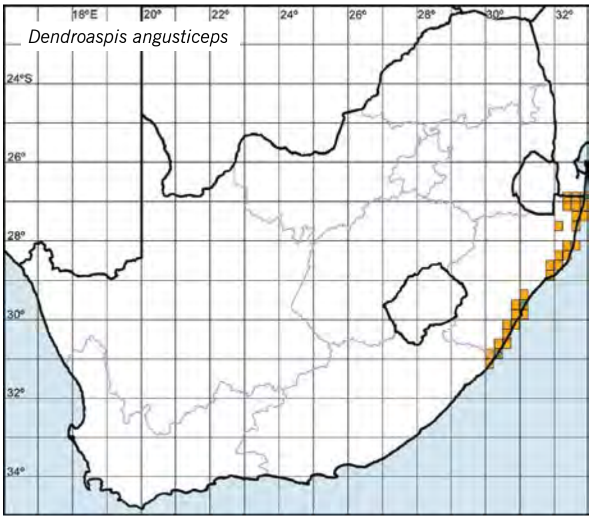
Genus *Dendroaspis* Schlegel, 1848—mambas

There are four species in the genus *Dendroaspis*, which is distributed throughout most of tropical Africa (Branch 1998). Two species occur in the *Atlas* region. These large, agile, highly venomous, diurnal elapids have long, flat-sided heads and elongate bodies with long tails. All except the terrestrial Black Mamba (*Dendroaspis polylepis*) are strictly arboreal. They actively pursue their prey of small mammals and birds (juvenile Green Mambas, *D. angusticeps*, also eat chameleons), striking rapidly and often repeatedly until the victim succumbs to the toxic venom. Female *D. polylepis* lay clutches of 12–17 eggs, whereas female *D. angusticeps* lay smaller clutches of up to 10 eggs (Branch 1998). These are probably the most feared of all African snakes, but only the Black Mamba regularly bites humans. Two species enter the subcontinent, including the *Atlas* region. *Dendroaspis angusticeps* is considered regionally Vulnerable because it has a restricted distribution—mainly along the coast of KwaZulu-Natal—and its habitat is under threat because of coastal developments. The other species, *D. polylepis*, is uncommon but widespread in savanna areas and not of conservation concern.

Dendroaspis angusticeps (A. Smith, 1849)

EASTERN GREEN MAMBA; GREEN MAMBA

Graham J. Alexander



Regional: Vulnerable B2ab(ii,iii,iv,v)

Taxonomy: Populations from the southern part of the range (South Africa and southern Mozambique) differ genetically from Tanzanian specimens (Pook *et al.* 2005). Because *Dendroaspis angusticeps* was described from specimens collected in an area between KwaZulu-Natal and Maputo (Mozambique), northern populations may require a new name. D.G. Broadley (in litt.) is currently assembling meristic data (ventral and subcaudal counts) for *D. angusticeps* throughout its range to investigate whether the name *D. intermedius* Guenther, 1865 (described from the Zambezi River) can be applied to northern populations. Nevertheless, Broadley & Blaylock (2013) have already used the latter name for populations from central Mozambique northwards, while referring the South African population to *D. angusticeps*.

Distribution: Found from coastal Kenya southwards and westwards into Tanzania, Mozambique and South Africa (Spawls & Branch 1995). In the *Atlas* region it is restricted to low altitude forests along the KwaZulu-Natal coastline, extending as far south as the extreme northeastern part of the Eastern Cape (Broadley 1990b; Alexander & Marais 2007). The South African population, together with one locality (2532DB) in southern Mozambique, is considered as an isolated unit for the purposes of this assessment.

EOO: 40 000 km² (confidence: high); AOO: 1 044 km² (confidence: medium).

Habitat: Strictly arboreal and restricted to forests, occurring from sea level to 200 m (Bourquin 2004).

Vegetation type: FOz 7 Northern Coastal Forest; FOa 2 Swamp Forest.

Dendroaspis angusticeps—Umkomaas, KZN J. Marais

Assessment rationale: Has an AOO of less than 2 000 km², distribution is severely fragmented [B2a] and habitat is undergoing reduction in area and quality [B2b(iii)]. Natural vegetation in this snake's habitat is highly threatened (Mucina & Rutherford 2006). The AOO [B2b(ii)] and number of subpopulations [B2b(iv)] is being reduced as fragments of forest are transformed. This is also likely to result in a reduction in the number of mature individuals [B2b(v)]. The only known locality in southern Mozambique (2532DB) is considered genetically connected to the South African population. Other localities in Mozambique are far to the north and these populations are not considered to be contiguous with the Mozambique-South Africa population. It is therefore unlikely that there is significant gene flow between north and south. Consequently, it is not considered necessary to downgrade this regional classification. It should also be noted that the population in the *Atlas* region may represent a separate species from populations found further north (see Taxonomy above).

Threats: A strict habitat specialist that is restricted to Northern Coastal Forest and Swamp Forest, both of which are restricted in extent in South Africa, and both of which are under threat of transformation (Mucina & Rutherford

2006). The range is highly fragmented and is becoming more so through land transformation (e.g. coastal housing developments).

Conservation measures: Draft a BMP-S. Protect suitable habitat, and monitor and measure the population densities of subpopulations.

Dendroaspis polylepis Günther, 1864

BLACK MAMBA

Graham J. Alexander

Regional: Least Concern

Taxonomy: No notable issues.

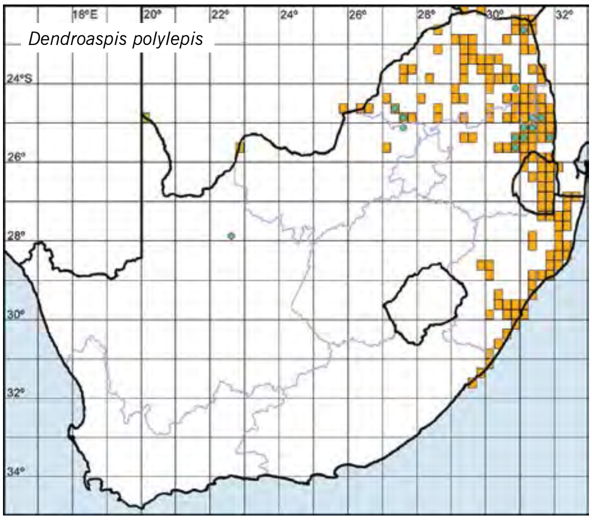
Distribution: Occurs from Senegal eastwards to Somalia, then south to the Eastern Cape in South Africa, and west to Namibia and Angola (Jacobsen 1989), but absent from the equatorial forests of West and Central Africa (Broadley 1990b). In the *Atlas* region it is mostly restricted to the northern and eastern parts, from the northern parts of North-West Province to Limpopo, the northern and eastern parts of Mpumalanga, Swaziland, KwaZulu-Natal and the northeastern parts of the Eastern Cape. Haacke (1984) reported a visual sighting at Union's End (2420CC) in the Kgalagadi Transfrontier Park in the extreme northern part of the Northern Cape, and a Virtual Museum record (2722DC) extends the species' range further south in this province.

Habitat: Found in a wide variety of habitat types, especially rocky hillsides and outcrops (Jacobsen 1989). Takes shelter in rock crevices, old termitaria and hollow logs (Branch 1998).

Biome: Savanna; Indian Ocean Coastal Belt.

Assessment rationale: Widespread but mostly uncommon, occurring at low densities (Jacobsen 1989).

Conservation measures: Educate the public to discourage persecution of this species. Details of local abundance are needed (Jacobsen 1989) to assess spatial requirements for the conservation of sustainable populations.



Dendroaspis polylepis—Schoemanskloof, MPM M. Burger

Genus *Elapsoidea* Bocage, 1866—garter snakes

The genus *Elapsoidea* is widely distributed throughout sub-Saharan Africa and contains 10 species (Broadley 1971a, 1998; Uetz 2012). Four species occur in southern Africa and two of these occur in the eastern and central parts of the *Atlas* region. These are small to medium-sized burrowing elapids that have a small head, short tail, and 13 scale rows at midbody. Their dorsal surfaces are often brightly banded, especially in juvenile snakes. It is often difficult to distinguish between species and subspecies because various scale counts are similar, and different juvenile and adult colour patterns add to the confusion. Garter snakes burrow in sandy or humic soils and appear on the surface at night. Most species prey on fossorial reptiles, although frogs and occasionally small mammals are also taken (Broadley 1990b). All species of *Elapsoidea* are oviparous: females in the *Atlas* region lay clutches of 4–10 eggs (Branch 1998). Neither species in the *Atlas* region is of conservation concern.

Elapsoidea boulengeri Boettger, 1895

BOULENGER'S GARTER SNAKE;
ZAMBEZI GARTER SNAKE

Graham J. Alexander

Regional: Least Concern

Taxonomy: Previously treated as a subspecies of *E. semiannulata* (Broadley 1971a, 1990b), but later revived as a full species (Broadley 1998).

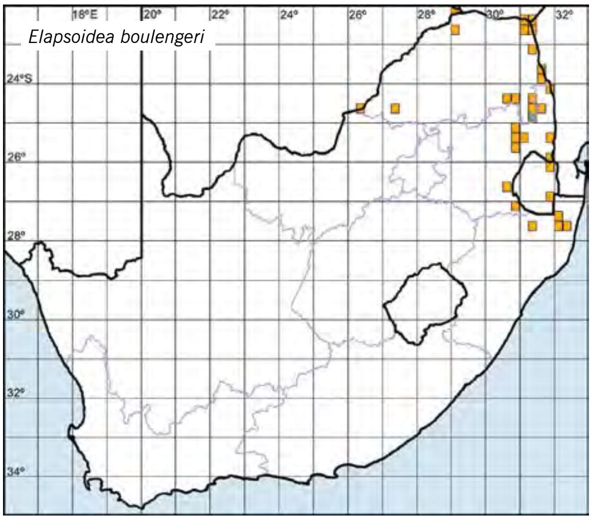
Distribution: Restricted to southeastern Africa, from Tanzania south to the northeastern parts of South Africa (Broadley 1971a). In the *Atlas* region it is restricted to the northern parts of KwaZulu-Natal, Swaziland, eastern Mpumalanga and Limpopo.

Habitat: Found in mesic habitats and may be associated with open flood plains (Broadley 1971a). Shelters under rocks and rotting logs (Jacobsen 1989).

Bioregion: Lowveld; Mopane; Central Bushveld; Alluvial Vegetation.

Assessment rationale: Widespread but apparently of naturally rare occurrence (Jacobsen 1989).

Conservation measures: None recommended.



Elapsoidea boulengeri G.J. Alexander

Elapsoidea boulengeri—Cleveland NR, Phalaborwa, LIMP M. Burger

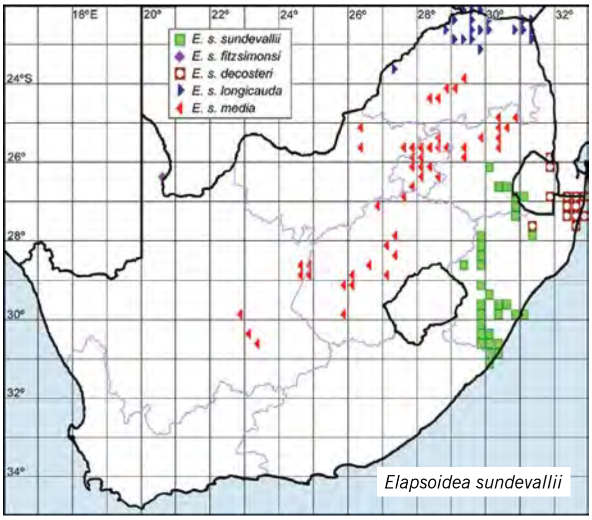
Elapsoidea sundevallii (A. Smith, 1848)
SUNDEVALL'S GARTER SNAKE

Graham J. Alexander

Global: Least Concern

Taxonomy: The various subspecies of *Elapsoidea sundevallii* are often difficult to distinguish morphologically (Broadley 1971a) and there is therefore a need to investigate their status by means of a molecular analysis.

Distribution: Endemic to southern Africa, occurring mainly in the northern and eastern parts, from central Namibia in the west, through Botswana, the southern extremes of Zimbabwe, northern and eastern South Africa, Swaziland and southern Mozambique (Broadley 1971a; Branch 1998). *Elapsoidea s. sundevallii* is restricted to western Swaziland, southeastern Mpumalanga and KwaZulu-Natal, possibly entering the northeastern parts of the Eastern Cape. *Elapsoidea s. decosteri* occurs in northeastern KwaZulu-Natal, eastern Swaziland and the southern tip of Mozambique. *Elapsoidea s. longicauda* occurs in northern Limpopo and the southern parts of Zimbabwe and Mozambique. *Elapsoidea s. media* occurs in southern Limpopo, northern and western Mpumalanga, Gauteng, eastern North-West Province, Free State and eastern parts of the Northern Cape. SARCA surveys in the Prieska/Britstown region substantially extend its range to the southwest. *Elapsoidea s. fitzsimonsi* occurs in Namibia and Botswana and only just enters South Africa in the Mier Kalahari of the Northern Cape.



Habitat: Found in a wide variety of habitats but appears to favour alluvial and aeolian sands (Broadley 1971a). Refugia of *E. s. media* include old termitaria and the underside of rocks (De Waal 1978). Occurs from sea level to 1 800 m.

Biome: Grassland; Savanna; Indian Ocean Coastal Belt; Nama-Karoo.

Assessment rationale: Widespread but rarely encountered throughout its range.

Conservation measures: None recommended.

Elapsoidea sundevallii sundevallii, adult J. Marais

Elapsoidea sundevallii decosteri—Tongaland, KZN W.D. Haacke

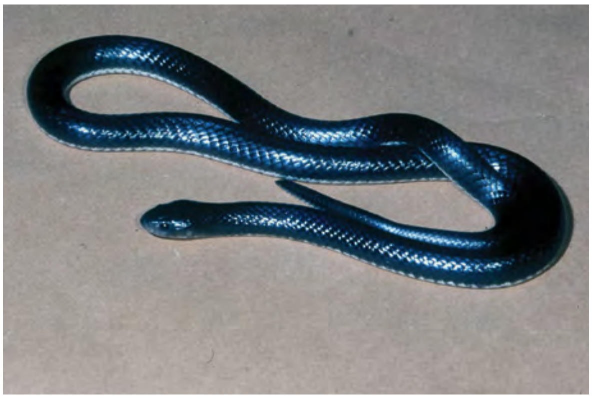
Elapsoidea sundevallii sundevallii, subadult J. Marais

Elapsoidea sundevallii longicauda, adult J. Marais

Elapsoidea sundevallii media, adult—about 35 km NW of Britstown, NC M. Burger

Elapsoidea sundevallii media, subadult—about 20 km E of Kimberley, NC M. Burger

Elapsoidea sundevallii media, subadult—Kempton Park, GP W.R. Schmidt



Elapsoidea sundevallii fitzsimonsi—Waterberg Canal, Namibia W.D. Haacke

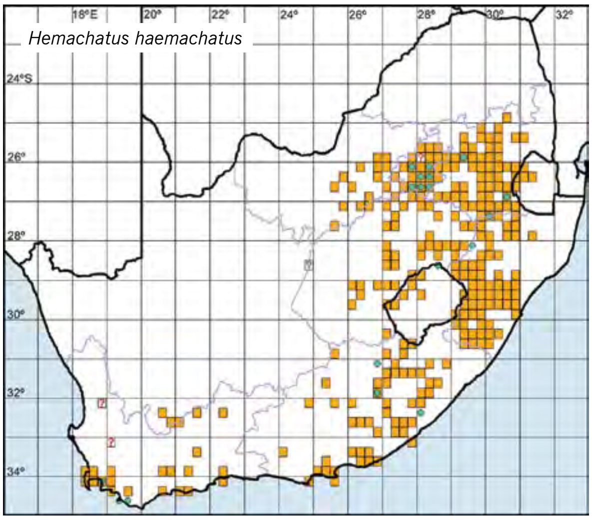
Genus *Hemachatus* Fleming, 1822—Rinkhals

The Rinkhals is a close relative of the true cobras (*Naja*), but it has keeled scales, lacks solid teeth on the maxilla, and is viviparous (usually 20–30 young in a litter but occasionally many more). The single species in the genus, *Hemachatus haemachatus*, is endemic to the moist eastern and southern parts of the *Atlas* region, with an isolated population on the eastern highlands of Zimbabwe. It is mostly nocturnal or crepuscular and preys mainly on rodents and frogs, particularly toads. Although common in some places, many populations are declining due to road mortalities, increased incidence of fires, wanton killings and urbanisation (especially in Gauteng). However, the species is currently not of conservation concern.

Hemachatus haemachatus (Bonnaterre, 1790)

RINKHALS

Graham J. Alexander



Global: Least Concern

Near-endemic

Taxonomy: This species displays regional variation in size and colouration, and there are isolated populations in the Cape escarpment region and the eastern highlands of Zimbabwe (Alexander 1996). Molecular data analysed for South African populations indicates limited phylogeographic structuring (A. Barlow & W. Wüster pers. comm.). Although there is no molecular data available for the relict population in the Nyanga District of Zimbabwe, snakes from this area appear to have lower ventral and subcaudal counts than those in South Africa, and meristic data from throughout the range of the species is currently being assembled to see whether this population is taxonomically distinct (D.G. Broadley, pers. comm.).

Distribution: A southern African endemic with a temperate distribution (Alexander & Marais 2007). It occurs from sea level in the Western Cape, through the Cape Fold Mountains into the Eastern Cape, northwards along the eastern escarpment, through KwaZulu-Natal and the Free State and Lesotho grasslands into Gauteng, eastern North-West Province, Mpumalanga and western Swaziland. The seemingly isolated records in the Sutherland and Beaufort West areas are of zoogeographical interest. Historical records plotted by Broadley (1990b) in the northwestern parts of the Western Cape have not been confirmed in recent years, and the same applies to the Kimberley (2824DB) locality. A relict population occurs in the Inyanga highlands of Zimbabwe (Broadley 1974).

Habitat: Normally restricted to open grassland, rocky outcrops and the margins of wetlands (Dawson *et al.* 1991). These snakes may be very common at some localities, even in peri-urban areas (Alexander 1996).

Bioregion: Mesic Highveld Grassland; Sub-Escarpment Grassland; Dry Highveld Grassland; Central Bushveld; Sub-Escarpment Savanna; Albany Thicket; Drakensberg Grassland; Southwest Fynbos; Eastern Fynbos-Renosterveld.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Hemachatus haemachatus—Port Elizabeth, EC J. Marais

Hemachatus haemachatus—W of Johannesburg, GP G.J. Alexander

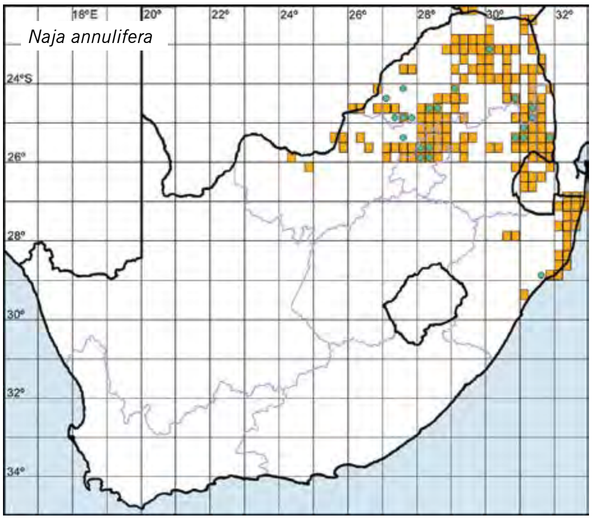
Genus *Naja* Laurenti, 1768—cobras

The 28 recognised species of *Naja* are widely distributed in Africa and Asia (Uetz 2012). Upper Miocene fossils are known from France. Fifteen species occur in Africa (Wallach *et al.* 2009), but possible additional cryptic species exist within the forest cobra (*N. melanoleuca*) species complex, while *N. melanoleuca subfulva* Laurent 1955 may be re-instated as a full species (D.G. Broadley pers. comm.). Six species of *Naja* occur in southern Africa, with five entering the *Atlas* region. The genus *Naja* was divided into four subgenera, three of which are restricted to Africa and Arabia (Wallach *et al*. 2009). The subgenus *Afronaja* contains seven species (*N. ashei*, *N. katiensis*, *N. mossambica*, *N. nigricollis*, *N. nigricincta*, *N. nubiae* and *N. pallida*) from mainland Africa which all have modified fangs and can 'spit' venom for a distance of up to 3 m. Of these, only *N. mossambica* and *N. nigricincta woodi* occur in the *Atlas* region. Another subgenus, *Uraeus*, contains six species, including two (*N. nivea* and *N. annulifera*) from the *Atlas* region, while the subgenus *Boulengerina* contains four species, including the local species *N. melanoleuca*. Cobras are large, stocky, terrestrial snakes with smooth scales. They are alert, active foragers, pursuing and capturing a variety of small vertebrates (Branch 1998). When threatened they lift their forebody and spread a characteristic hood. Bites from spitters and non-spitters present different symptoms but all are potentially fatal to humans. All cobras are oviparous and in the *Atlas* region females produce clutches of 8–33 eggs (Branch 1998). Although *N. melanoleuca* was previously classified as Restricted and *N. nigricincta woodi* was considered Rare (Branch 1988a), none of the species in the *Atlas* region are currently of conservation concern.

Naja annulifera Peters, 1854

SNOUTED COBRA

Bryan Maritz & Graham J. Alexander



Regional: Least Concern

Taxonomy: Previously considered a subspecies of *Naja haje* but elevated to species status (as *N. annulifera annulifera*) by Broadley (1995b). Broadley & Wüster (2004) later showed that *N. annulifera anchietae* was a valid species, rendering *N. annulifera* monotypic.

Distribution: Known from southern Zambia and Malawi, extending southwards through Zimbabwe and central and southern Mozambique, and entering South Africa and Swaziland (Broadley 1990b). In the *Atlas* region it occurs in the northern half of North-West Province, Limpopo, Gauteng, Mpumulanga, Swaziland and northern and coastal KwaZulu-Natal.

Habitat: Inhabits savanna, entering coastal scrubland and forest, from near sea level to 1 400 m. Takes refuge in holes in the ground, old termite mounds and rocky outcrops, and basks in the sun near its retreat (Jacobsen 1989).

Bioregion: Central Bushveld; Lowveld; Indian Ocean Coastal Belt; Mesic Highveld Grassland; Mopane; Dry Highveld Grassland; Alluvial Vegetation; Sub-Escarpment Grassland; Eastern Kalahari Bushveld.

Assessment rationale: Widespread and often abundant.

Conservation measures: None recommended.

Naja annulifera—N Swaziland J. Marais

Naja annulifera—Zeerust, NW W.R. Schmidt

Naja melanoleuca Hallowell, 1857
FOREST COBRA

Bryan Maritz & Graham J. Alexander

Regional: Least Concern

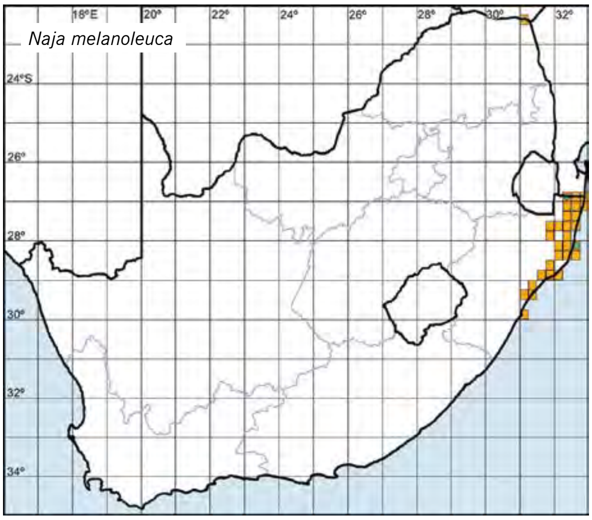
Taxonomy: Current research suggests that there is significant genetic structure in this species. It has been referred to as a 'species complex' by Broadley & Cotterill (2004) and may contain several cryptic species (D.G. Broadley *et al.* in prep.). Eastern populations, including those of the *Atlas* region, have sometimes been referred to as *N. m. subfulva* Laurent, 1955 (e.g. Broadley & Blaylock 2013), and Chirio & Ineich (2006) even recognized this as a separate species, *N. subfulva*. While *N. subfulva* now appears to represent a distinct species, it does not include populations on the east and southeast African lowlands, whose status is still under investigation (D.G. Broadley pers. comm.).

Distribution: Widespread throughout forests and forest/savanna mosaic in sub-Saharan Africa, from Senegal east to southern Sudan and Kenya, south to Angola, Zambia, eastern Zimbabwe, Mozambique and northeastern South Africa (Spawls & Branch 1995; Broadley & Blaylock 2013; D.G. Broadley pers. comm.). In the *Atlas* region it is found mainly in the coastal parts of KwaZulu-Natal, from Kosi Bay southwards to Durban, with a single record from Limpopo Province at Pafuri Camp in the Kruger National Park (Marais & Jubber 2010).

Habitat: Inhabits forests and moist savanna habitats. Often found in or near water and may climb into low bushes (Branch 1998).

Vegetation type: CB 1 Maputaland Coastal Belt; CB 2 Maputaland Wooded Grassland; SVl 16 Southern Lebombo Bushveld; SVl 23 Zululand Lowveld; SVl 24 Zululand Coastal Thornveld; AZf 6 Subtropical Freshwater Wetlands; CB 3 KwaZulu-Natal Coastal Belt; FOz 7 Northern Coastal Forest; SVl 18 Tembe Sandy Bushveld; SVs 6 Eastern Valley Bushveld; FOa 2 Swamp Forest; FOa 3 Mangrove Forest.

Assessment rationale: Although this large predator has a limited distribution in the *Atlas* region (previously classified as Restricted, Branch 1988a), it is abundant within parts of its range and has been found in transformed habitats (B. Maritz pers. obs.). Nevertheless, it is often unnecessarily persecuted and is threatened by habitat transformation throughout its range in the *Atlas* region.



Naja melanoleuca—Gingindlovu, KZN B. Maritz

Conservation measures: Educate the public about the role this species plays in the ecosystem. Habitat preservation is crucial to its well-being, therefore monitor the destruction of forests for coastal housing developments.

Naja mossambica Peters, 1854
MOZAMBIQUE SPITTING COBRA; M'FEZI

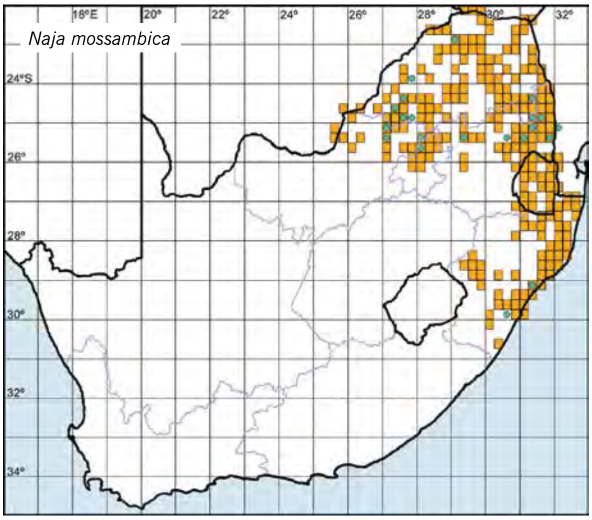
Bryan Maritz & Graham J. Alexander

Regional: Least Concern

Taxonomy: No notable issues.

Distribution: Widespread in eastern and southern Africa. Occurs from southern Tanzania westwards to southern Angola and northern Namibia, and southwards to South Africa and Swaziland in the *Atlas* region (Broadley 1990b). In South Africa it is known from Limpopo, Mpumalanga, Gauteng, KwaZulu-Natal, and the northeastern part of North-West Province.

Habitat: Inhabits moist savanna and lowland forests. Shelters in holes in the ground, under rocks on rock or soil, and in rock crevices, at altitudes of 200–1 750 m (Jacobsen 1989). Occurs at lower altitudes on the KwaZulu-Natal coast, even at sea level (Bourquin 2004).



Bioregion: Lowveld; Central Bushveld; Indian Ocean Coastal Belt; Mesic Highveld Grassland; Mopane; Sub-Escarpment Savanna; Sub-Escarpment Grassland; Dry Highveld Grassland; Zonal and Intrazonal Forests; Alluvial Vegetation; Azonal Forests.

Assessment rationale: Widespread and abundant.

Conservation measures: None recommended.

Naja mossambica—Kwalata Game Ranch near Hammanskraal, GP
B. Maritz

Naja nigricincta woodi Pringle, 1955

BLACK SPITTING COBRA

Bryan Maritz & Graham J. Alexander

Regional: Least Concern

Taxonomy: Wüster *et al.* (2007) considered *Naja nigricollis woodi* to be a subspecies of *N. nigricinta*, although they cautioned that the taxonomy of the *N. nigricollis-nigricincta* complex still requires further study.

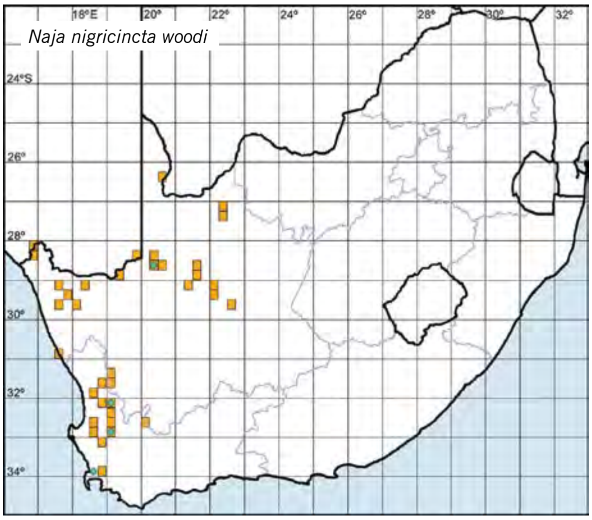
Distribution: Endemic to southern Africa. Occurs from southern Namibia into the arid regions of western South Africa (Branch 1998). In the *Atlas* region it is found in the Northern Cape and western half of the Western Cape. Its range extends as far east as Prieska and as far south as Paarl.

Habitat: Inhabits arid rocky regions throughout its range.

Bioregion: Northwest Fynbos; Bushmanland; Alluvial Vegetation; West Coast Renosterveld; Knersvlakte; Namaqualand Hardeveld; Rainshadow Valley Karoo; Richtersveld; Gariep Desert; Southern Namib Desert; Inland Saline Vegetation; Kalahari Duneveld; Eastern Kalahari Bushveld.

Assessment rationale: Previously classified as Restricted (Branch 1988a), but now know to be widespread with only minor habitat transformation within its range.

Conservation measures: None recommended.



Naja nigricincta woodi—Fish River Canyon, Namibia B. Maritz

Naja nivea (Linnaeus, 1758)
CAPE COBRA

Bryan Maritz & Graham J. Alexander

Regional: Least Concern

Taxonomy: No notable issues.

Distribution: Endemic to southern Africa. Known from the southern half of Namibia, southern half of Botswana, and western, southern and central parts of South Africa (Broadley & Wüster 2004). In the *Atlas* region it is widespread in the Northern, Western and Eastern Cape provinces, western and southern Free State, and North-West Province. It may marginally enter southwestern Lesotho, but this requires confirmation. Its occurrence in the north-eastern part of the Eastern Cape also requires confirmation.

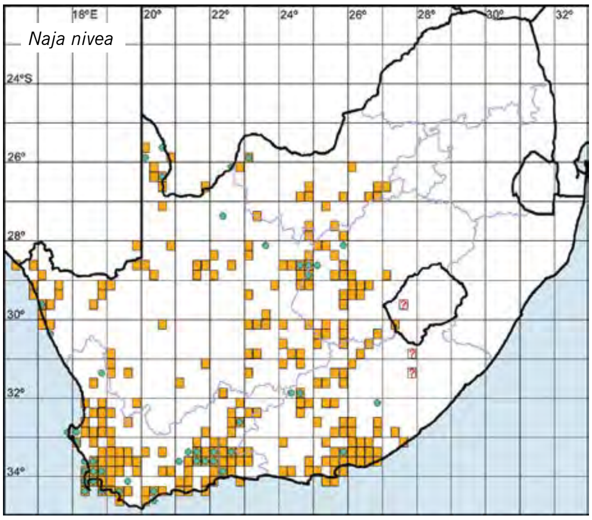
Habitat: Inhabits arid karoo, open fynbos and grassland habitats throughout its range (Branch 1998). Found in old mammal burrows and under rocks at altitudes as high as 1 600 m (De Waal 1978; Jacobsen 1989). Within its range it is a habitat generalist which adapts well to urban environments if sufficient remnant natural habitat is available; it is often found within town and city limits (T. Phelps pers. comm.). In the Western Cape, adults establish permanent refugia (burrows) which are used for as long as four years (Phelps 2007).

Biome: Fynbos; Grassland; Nama-Karoo; Albany Thicket; Succulent Karoo; Savanna.

Assessment rationale: Widespread and abundant.

Conservation measures: None recommended.

Naja nivea, subadult—Farm Botterkraal, about 37 km SW of Strydenburg, NC M. Burger



Naja nivea, adult male—De Hoop NR, WC T. Phelps

Naja nivea, adult—Port Nolloth, NC B. Maritz

SUBFAMILY HYDROPHIINAE

Almost from their first discovery sea snakes were placed in a separate family, the Hydrophiidae, although they shared with terrestrial elapids fixed front fangs. McDowell (1970) first showed that Australian and Melanesian terrestrial elapids and sea snakes shared a similar kinesis of the palatine bone. Subsequent molecular studies (e.g. Keogh 1998; Slowinski & Keogh 2000) confirmed the monophyly of this group and treated it as a subfamily (Hydrophiinae) of the Elapidae. Molecular studies have shown that the sea kraits (*Laticauda*), although not sharing the same palatine kinesis, group with hydrophiines. Nested within the terrestrial Australo-Melanesian hydrophiines is a monophyletic group containing the viviparous sea snakes (Hydrophiini), which excludes the amphibious sea kraits. Sanders *et al.* (2012), in a phylogeny of the Hydrophiini, noted that within a 'core *Hydrophis* group', *Hydrophis* was recovered as broadly paraphyletic, with several other genera nested within it (*Pelamis, Enhydrina*, *Astrotia*, *Thalassophina*, *Acalyptophis*, *Kerilia*, *Lapemis*, *Disteira*). Instead of erecting multiple new genera, they recommended dismantling the latter (mostly monotypic) genera and recognised a single genus, *Hydrophis* Latreille 1802. The only hydrophine representative in African and *Atlas* waters is the Yellow-bellied Sea Snake (*Hydrophis platurus*).

Genus *Hydrophis* Latreille, 1802—sea snakes

The genus *Hydrophis* contains 46 species (Uetz 2012), distributed mainly within the warm coastal waters of Australasia. Only a single species, the Yellow-bellied Sea Snake (*H. platurus*), enters the *Atlas* region. *Hydrophis platurus* is closely related to other sea snakes, with the exception of the sea kraits, and to Australian terrestrial elapids. It has the widest distribution of any snake in the world and is found throughout the tropical and sub-tropical waters of the Indo-Pacific, with occasional vagrants being carried around the Cape of Good Hope into the southern Atlantic Ocean as far north as Swakopmund, Namibia (Griffin 2003). This highly venomous species is pelagic, drifting in warm ocean currents and feeding on small fish (Branch 1998), often in association with drift lines. Females give birth to 3–8 young from March to October (Branch 1998). This species is a vagrant in the *Atlas* region and is neither regionally nor globally (IUCN 2009) of conservation concern.

Hydrophis platurus (Linnaeus, 1766)

YELLOW-BELLIED SEA SNAKE

Graham J. Alexander

Regional: Least Concern

Taxonomy: Previously know as *Pelamis platurus*. Sanders *et al.* (2012), in a phylogeny of the hydrophines, showed that *Pelamis* was nested within *Hydrophis*, necessitating the transfer of *P. platurus* to *Hydrophis.*

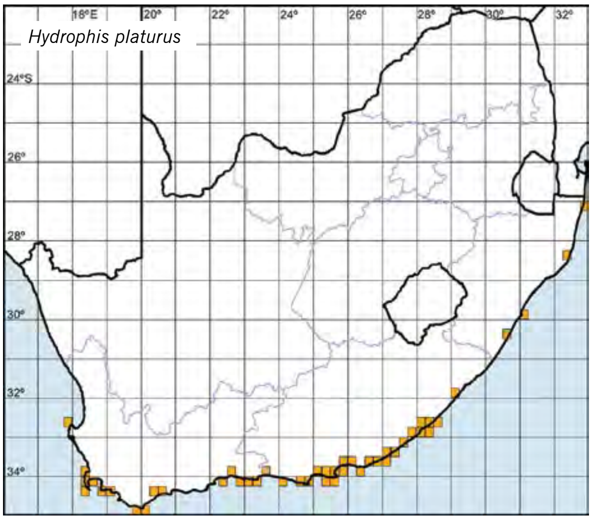
Distribution: Occurs throughout the Indian and Pacific oceans, from the east coast of Africa to the west coast of the Americas (Alexander & Marais 2007). In the *Atlas* region it occasionally washes up on the shores of KwaZulu-Natal and the Eastern and Western Cape provinces.

Habitat: Found in the open ocean within 50 m of the surface; spends most of its time underwater (Branch 1998).

Biome: Marine oceanic-epipelagic (0–200 m).

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Hydrophis platurus—King's Beach, Port Elizabeth, EC W.R. Branch

CHAPTER 24

Family Colubridae

Bryan Maritz, William R. Branch, Johan Marais & *James Harvey*

Historically, the family Colubridae represented a morphologically and ecologically diverse group of species with a near-global distribution. For many years these snakes were defined more by what they lacked, i.e. the front fangs of elapids and viperids, than by what they shared. Their relationships have remained intractable for nearly 100 years. Recent molecular studies on caenophidian ('advanced') snakes reveal deep divergences, with Asian families such as the Xenodermatidae, Pareatidae and Homalopsidae, along with the cosmopolitan Viperidae, forming basal clades (Vidal & Hedges 2009). The Elapoidea (families Lamprophiidae, Chapter 22; and Elapidae, Chapter 23) are sister to a clade of derived families that together form the Colubroidea (*sensu stricto*, see comments in Chapter 2). This includes the Dipsadidiae (New World), Pseudoxenodontidae (Asia), Colubridae and Natricidae (both cosmopolitan but mainly Palaearctic).

In the *Atlas* region, a restricted Colubridae (*sensu* Vidal *et al.* 2007, 2010; Zaher *et al.* 2009) now comprises only 14 species in the following eight genera: *Philothamnus*, *Meizodon*, *Dasypeltis*, *Telescopus*, *Dipsadoboa*, *Crotaphopeltis*, *Thelotornis* and *Dispholidus*. These taxa are ubiquitous in the region, although species richness is higher in the mesic eastern half of South Africa, corresponding to overall reptile species richness patterns (Maritz 2007).

The various species in the region occur in a diverse array of habitats, from arid rocky areas, through arid and mesic savannas, to moist coastal forest (Branch 1998; Alexander & Marais 2007). Some species are semi-aquatic (*Philothamnus hoplogaster*) while others are strongly arboreal (*Thelotornis*, *Dispholidus* and most *Philothamnus*) (Branch 1998). They inhabit very wide altitudinal ranges, from sea level to over 2 500 m (e.g. *Dasypeltis*). All are oviparous, with both nocturnal and diurnal representatives (Alexander & Marais 2007). They generally prey on small vertebrates, which are actively hunted. In Africa, *Dasypeltis* is unique in that its members feed exclusively on bird eggs (Gans 1959; Bates & Little 2013). These are engulfed and broken, their contents swallowed and the shells regurgitated (Broadley 1990b). Most species have back fangs and relatively weak venom, except *Dasypeltis*, *Philothamnus* and *Meizodon* which are fangless and non-venomous. Some species (e.g. *Thelotornis* and *Dispholidus*) possess potent, clinically-important venoms.

Although the range of some species is peripheral in the *Atlas* region, none are currently considered to be of conservation concern.

Genus *Crotaphopeltis* Fitzinger, 1843—herald snakes

The genus *Crotaphopeltis* contains six species, all confined to sub-Saharan Africa (Uetz 2012). A single species, *C. hotamboeia*, is widespread in the *Atlas* region, except in the drier western parts. These are terrestrial and nocturnal snakes that are generally found in moist habitats. They feed almost exclusively on frogs (Keogh *et al.* 2000). Females in the *Atlas* region lay clutches of 6–19 eggs in early summer (Branch 1998). *Crotaphopeltis hotamboeia* is not considered to be of conservation concern.

Crotaphopeltis hotamboeia (Laurenti, 1768)

RED-LIPPED SNAKE; HERALD SNAKE

Johan Marais

Regional: Least Concern

Taxonomy: This species has a wide distribution in sub-Saharan Africa and a phylogeographic analysis is therefore desirable to investigate the possibility of cryptic species.

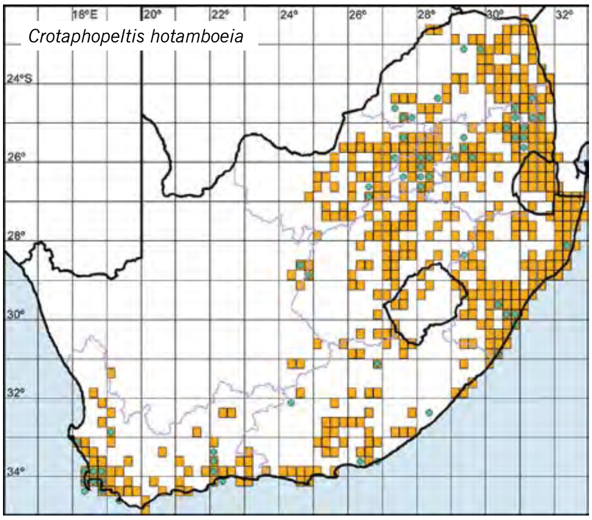
Distribution: Widespread in the eastern and southern parts of southern Africa, extending northwards to Tropical Africa (Broadley 1990b; Branch 1998). In the *Atlas* region it is found in the South African provinces of Western and Eastern Cape, KwaZulu-Natal, Free State, Mpumalanga, Gauteng, North-West and Limpopo. It also occurs in Lesotho and Swaziland. The species has been recorded marginally in the southern and eastern parts of the Northern Cape, but is notably absent from most of the drier parts of the province.

Habitat: Generally occupies damp areas in fynbos, lowland forest, moist savanna and grassland (Branch 1998). Commonly found sheltering under rocks and in old termitaria (De Waal 1978; Jacobsen 1989).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Fynbos; Albany Thicket; Forests; Nama-Karoo; Succulent Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Crotaphopeltis hotamboeia—Reddersburg, FS W.R. Branch

Genus *Dasypeltis* Wagler, 1830—egg-eaters

The taxonomy of *Dasypeltis* is unsettled, with 12 species currently recognised (Uetz 2012, plus *D. palmarum*). Five new taxa (*D. confusa*, *D. gansi*, *D. latericia*, *D. sahelensis* and *D. parascabra*) were described recently and two others (*D. abyssina* and *D. palmarum*) resurrected from synonymy with *D. scabra* (Trape & Mané 2006; Trape *et al.* 2012). Members of this genus are confined to Africa and the Arabian Peninsula (Gans 1959). The genus is widespread in the *Atlas* region, where there are at least three, but possibly as many as six or more, species (Bates *et al.* 2011, 2012). These nocturnal snakes are found in a variety of habitats and feed exclusively on bird eggs. Clutches of 6–28 eggs are laid (Alexander & Marais 2007). One species (*D. medici*) is restricted to northeastern KwaZulu-Natal and was previously listed as Peripheral in the *Atlas* region. Another species (*D. inornata*) is endemic to the *Atlas* region. None of the species in this genus are currently considered to be of conservation concern.

Dasypeltis inornata A. Smith, 1849

SOUTHERN BROWN EGG-EATER

Johan Marais

Global: Least Concern

Endemic

Taxonomy: No notable issues.

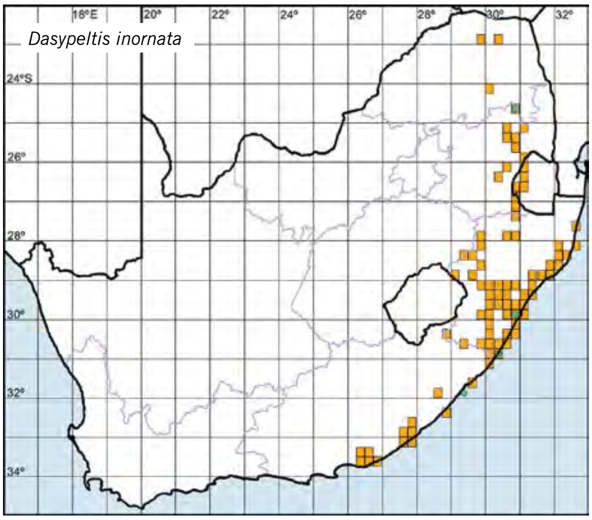
Distribution: Endemic to the *Atlas* region. Found from the Alexandria area in the southern part of the Eastern Cape northwards through KwaZulu-Natal, western Swaziland, eastern Mpumalanga and up to northern Limpopo. The northernmost population is isolated in the Soutpansberg Range (Jacobsen 1989), but a SARCA survey record from the Wolkberg (2430AA) partly fills a large gap between this population and those further south in northern Mpumalanga.

Habitat: Prefers open coastal woodland and moist savanna, sheltering under rocks on rock or soil, from near sea level to over 1 600 m (Jacobsen 1989; Branch 1998).

Biome: Indian Ocean Coastal Belt; Savanna; Grassland; Forests; Albany Thicket.

Assessment rationale: Widespread and common in the *Atlas* region as a whole, but considered Near Threatened in Swaziland (Monadjem *et al.* 2003).

Conservation measures: None recommended.



Dasypeltis inornata—Pietermaritzburg, KZN J. Marais

Dasypeltis medici medici (Bianconi, 1859)

EAST AFRICAN EGG-EATER

Johan Marais

Regional: Least Concern

Taxonomy: The taxonomic status of *Dasypeltis medici lamuensis* (found from Somalia to Tanzania) is being investigated by D.G. Broadley & M.F. Bates (in prep.).

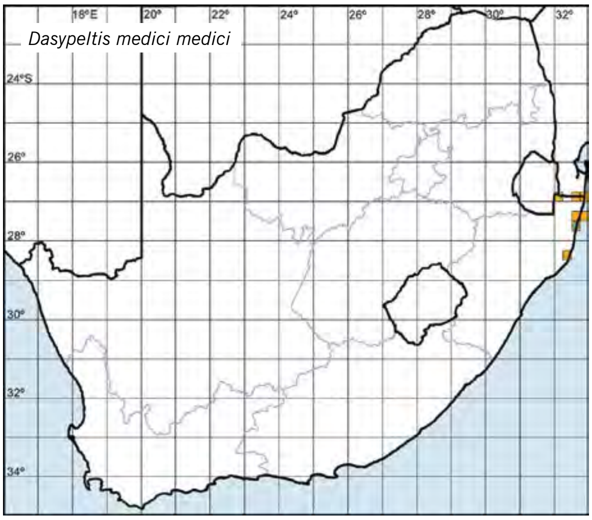
Distribution: Occurs from St Lucia Village in northeastern KwaZulu-Natal northwards into Mozambique, eastern Zimbabwe and elsewhere further north to Kenya (Broadley 1990b; Branch 1998).

Habitat: Found in lowland evergreen forest and moist savanna (Broadley 1990b; Marais 2004).

Bioregion: Indian Ocean Coastal Belt; Zonal and Intrazonal Forests; Freshwater Wetlands; Lowveld.

Assessment rationale: Has a restricted range in the *Atlas* region but is common elsewhere and is not threatened. Occurs in only one protected area in the *Atlas* region, namely the iSimangaliso Wetland Park, but this reserve is large, well-managed and provides adequate protection.

Conservation measures: None recommended.



Dasypeltis medici medici—St Lucia, KZN B. Maritz

Dasypeltis scabra (Linnaeus, 1758)

RHOMBIC EGG-EATER; COMMON EGG-EATER

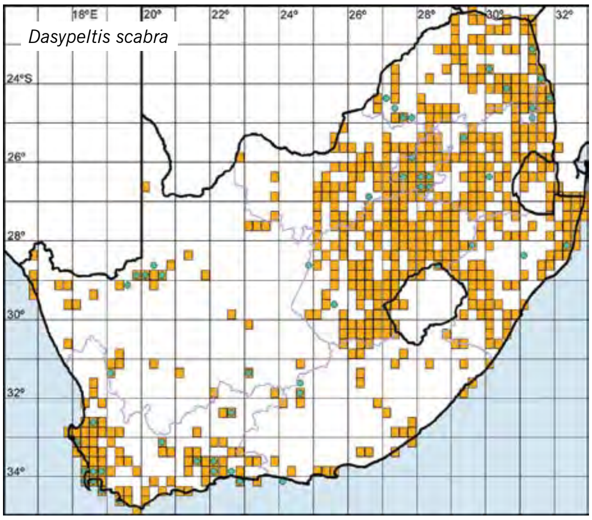
Johan Marais

Regional: Least Concern

Taxonomy: The taxonomy of this species in southern Africa is being investigated, and the presence of cryptic taxa has been suggested (Bates *et al.* 2011, 2012).

Distribution: Widespread throughout most of the *Atlas* region, but with a patchy distribution in parts of the Eastern

Dasypeltis scabra—Gondwana GR, E of Herbertsdale, WC M.Burger



and Northern Cape provinces. Its range extends to South Sudan in the north and to at least Republic of the Congo in the west (Gans 1959; Branch 1998; Trape & Mané 2006; Trape *et al.* 2012).

Habitat: Occurs in a variety of habitats, but not in true deserts and closed-canopy forests. Often found in deserted termitaria, under rocks, in rock crevices, under the bark of trees and in rotting logs (De Waal 1978; Jacobsen 1989; Marais 2004).

Biome: Grassland; Savanna; Fynbos; Nama-Karoo; Indian Ocean Coastal Belt; Succulent Karoo; Albany Thicket; Forests.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Dasypeltis scabra, plain phase—Suikerbosrand NR, GP B. Maritz

Genus *Dipsadoboa* Günther, 1858—cat-eyed tree snakes

The genus *Dipsadoboa* contains 10 species confined to sub-Saharan Africa (Branch 1998; Uetz 2012). These arboreal and nocturnal snakes occur in lowland forest and moist savanna. They feed primarily on geckos and arboreal frogs (Broadley 1990b). Females lay clutches of 7–9 eggs in summer (Alexander & Marais 2007). Only one species, *Dipsadoboa aulica*, occurs in the *Atlas* region, where it is restricted to the eastern parts of the country. It is not considered to be of conservation concern.

Dipsadoboa aulica (Günther, 1864)

MARBLED TREE SNAKE

Johan Marais

Regional: Least Concern

Taxonomy: No notable issues.

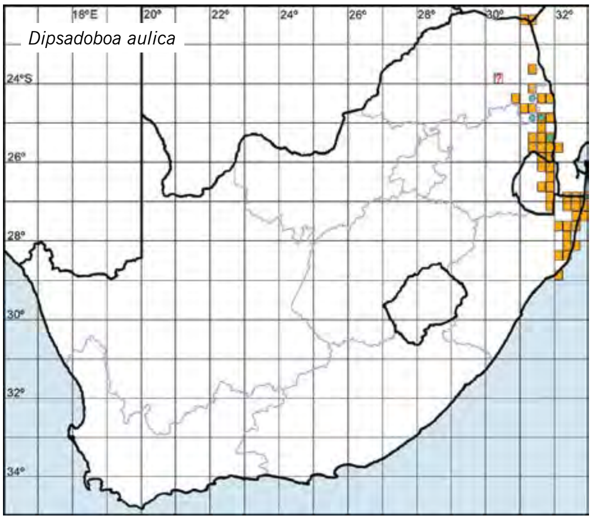
Distribution: Occurs from northeastern KwaZulu-Natal through eastern Swaziland and into the northeastern parts of Mpumalanga and eastern Limpopo, then into Mozambique and Zimbabwe. There are few records north of the Zambezi, with one unconfirmed record from Tanzania (Rasmussen 1989).

Habitat: Found in lowland riverine forests and moist savanna, from near sea level to at least 300 m (Jacobsen 1989; Marais 2004). Shelters by day in hollow logs, under bark and in thatched roofs; known to hunt frogs in reed beds (Branch 1998).

Biome: Savanna; Indian Ocean Coastal Belt; Forests.

Assessment rationale: Has a moderate range within the *Atlas* region but is common and widespread elsewhere (Spawls *et al.* 2002; Marais 2004).

Conservation measures: None recommended.



Dipsadoboa aulica—Malala Lodge, S of Hluhluwe, KZN J. Harvey

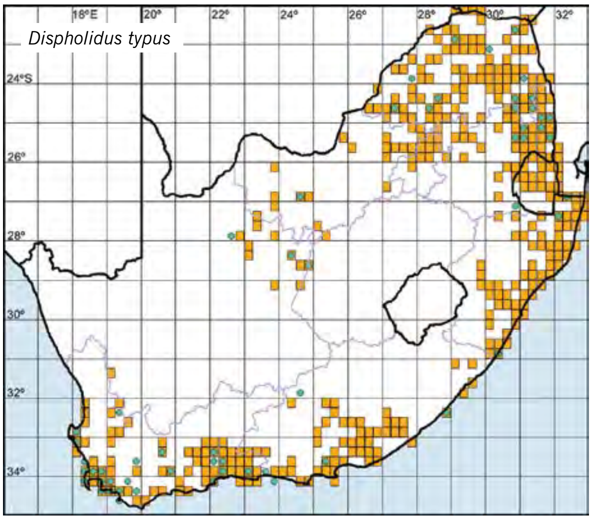
Genus *Dispholidus* Duvernoy, 1832—Boomslang

The genus *Dispholidus* contains a single species (*D. typus*) that is widespread across sub-Saharan Africa. Up to four subspecies (*D. t. typus*, *D. t. viridis*, *D. t. kivuensis*, *D. t. punctatus*) were recognised in the past (Laurent 1956), with only *D. t. typus* recorded from the *Atlas* region. All of these taxa appear to intergrade morphologically and only a monotypic *D. typus* is currently recognised (Broadley & Wallach 2002; Broadley & Cotterill 2004). However, preliminary genetic data indicate that multiple distinct lineages with unique histories may be present, some of which may best be treated as separate species (T.G. Eimermacher, D.G. Broadley, A. Barlow, Z. Nagy, E. Greenbaum & B.Y. Wilson in prep.). *Dispholidus typus* occurs in wooded habitats throughout the southern, eastern and north-central parts of the *Atlas* region. These are large arboreal snakes with variable colouration and potent haemotoxic venom. They feed primarily on arboreal lizards such as chameleons, but also take birds, their nestlings and eggs (Haagner 1990; Alexander & Marais 2007). Females lay 8–27 eggs in late spring to mid-summer (Marais 2004). This species is not of conservation concern.

Dispholidus typus (A. Smith, 1828)

BOOMSLANG

Johan Marais



Regional: Least Concern

Taxonomy: Four subspecies (*D. t. typus*, *D. t. viridis*, *D. t. kivuensis*, *D. t. punctatus*) have been recognised in the past, but morphologically the latter three are weakly defined and considered invalid (Broadley & Cotterill 2004). However, molecular studies indicate significant differences between populations, some of which may represent new species; the genus is currently being revised (T.G. Eimermacher & D.G. Broadley in prep.). Broadley & Blaylock (2013) considered populations in (mainly) the Western and Eastern Cape provinces as being referable to *D. t. typus*, while populations elsewhere in the range (where males are usually mainly green dorsally) were treated as *D. t. viridis*.

Distribution: Endemic to sub-Saharan Africa and widespread in the southern, eastern and north-central parts of the *Atlas* region (Branch 1998). Found in the Western and Eastern Cape, KwaZulu-Natal, Swaziland, Mpumalanga, Limpopo, northern Gauteng, North-West Province and the adjacent parts of the Northern Cape and western Free State. Also recorded at one locality (3119AC) in the southern part of the Northern Cape. The range extends further north into Kenya and westwards to Senegal (Spawls *et al.* 2002). Largely absent from much of the drier western parts of the *Atlas* region, and not found on the grassy plains of the central Highveld or in Lesotho. An old record (2926BC) from the Free State is not plotted on the map because it probably represents a translocation (Bates 1996a). Similarly, an isolated historical record from the Burgersdorp area (3026CC; Broadley 1990b) is omitted.

Habitat: Largely arboreal in a variety of habitats including Karoo scrub, arid savanna, moist savanna, lowland forest, grassland and fynbos (Marais 2004). Often found moving over open ground, but quickly takes refuge in trees and bushes (Jacobsen 1989).

Biome: Savanna; Fynbos; Grassland; Indian Ocean Coastal Belt; Albany Thicket; Forests; Nama-Karoo; Succulent Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Dispholidus typus, male (speckled phase)—Port Elizabeth, EC J. Marais

Dispholidus typus, hatchling—Hoedspruit, LIMP J. Marais

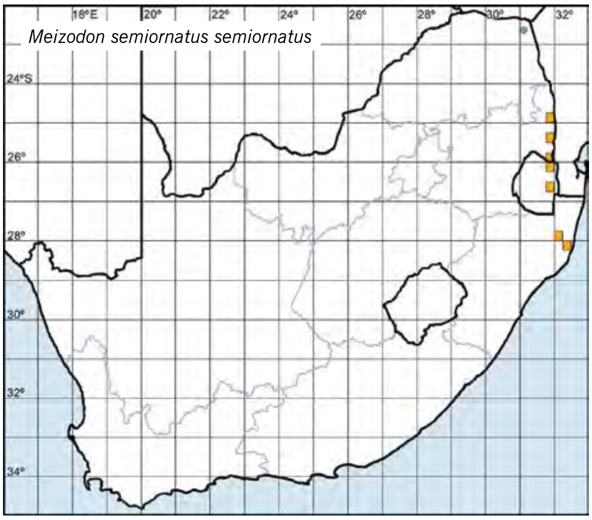
Genus *Meizodon* Fischer, 1856—African smooth snakes

The genus *Meizodon* is confined mainly to sub-Saharan Africa (a record of *M. semiornatus* from Yemen is probably inaccurate, Branch *et al.* 2010) and consists of five species (Branch 1998; Uetz 2012). The only representative in the *Atlas* region is *M. semiornatus semiornatus*, which occurs in northeastern South Africa at the periphery of its large African range. These are small, secretive, diurnal snakes that live in thick vegetation and rotting material in savannas. They feed on small frogs and lizards (Broadley 1988; Branch 1998). Females lay small clutches of 2–3 large eggs in spring (Broadley *et al.* 2003). Although previously listed as Peripheral with a localised range in the *Atlas* region, *M. s. semiornatus* is no longer considered to be of conservation concern.

Meizodon semiornatus semiornatus (Peters, 1854)

SEMIORNATE SNAKE

Johan Marais



Regional: Least Concern

Taxonomy: There are two recognised subspecies, namely *Meizodon semiornatus semiornatus* and *M. s. tchadensis*, the latter from Sudan and Chad (Branch 1998).

Distribution: Endemic to eastern and southeastern Africa. Its distribution extends from near Hluhluwe in northeastern KwaZulu-Natal, northwards into the eastern parts of Swaziland and Mpumalanga, with an isolated locality (2231CA) in northeastern Limpopo (SARCA Virtual Museum record; see also Swanepoel 2010). Elsewhere, it occurs from Mozambique and Zimbabwe northwards to Uganda and Kenya (Broadley 1990b).

Habitat: Found in wooded areas in arid and mesic savannas, as well as in marshy areas (Jacobsen 1987; Broadley 1990b).

Bioregion: Lowveld; Indian Ocean Coastal Belt.

Assessment rationale: Although this secretive snake has quite a localised distribution in the *Atlas* region, it is fairly widespread elsewhere. In Swaziland it is considered Near Threatened (Monadjem *et al.* 2003) but in the *Atlas* region it is assessed as Least Concern.

Conservation measures: None recommended.

Meizodon semiornatus semiornatus—Swaziland W.D. Haacke

Meizodon semiornatus semiornatus, dark phase—Hluhluwe, KZN J. Marais

Genus *Philothamnus* Smith, 1840—green snakes

The genus *Philothamnus* currently contains 19 species (Uetz 2012) restricted to sub-Saharan Africa. However, several taxonomic issues remain unresolved (e.g. Spawls *et al.* 2002). Four species occur in the *Atlas* region. *Philothamnus hoplogaster* and the two subspecies of *P. natalensis* are similar in appearance and behaviour and may be confused with one another. These diurnal and arboreal snakes are found in thick vegetation in forests and moist savanna, often near water. They are active hunters, feeding on lizards, frogs, fish, and nestling birds (Broadley 1990b). All green snakes are oviparous and produce clutches of 3–16 eggs (Alexander & Marais 2007). *Philothamnus angolensis* was previously listed as Peripheral (Branch 1988a) and has a restricted distribution in the *Atlas* region, but no members of the genus are currently considered to be of conservation concern.

Philothamnus angolensis Bocage, 1882

ANGOLA GREEN SNAKE

Johan Marais

Regional: Least Concern

Taxonomy: No notable issues.

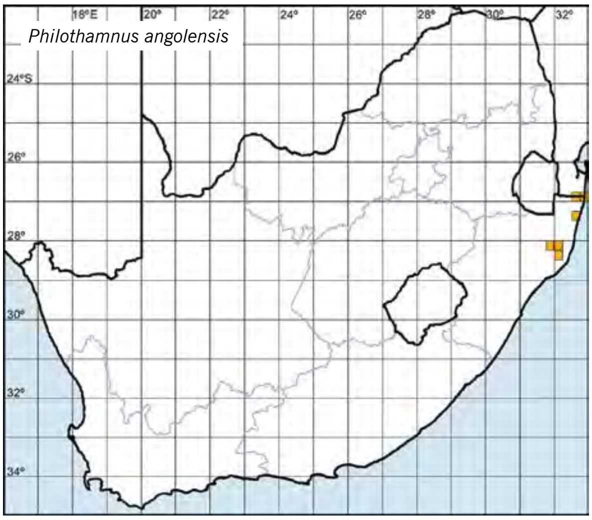
Distribution: Found from northeastern KwaZulu-Natal, South Africa, northwards into Mozambique, Zimbabwe, Botswana, and Namibia, and elsewhere further north to Tanzania (Broadley 1990b). Within the *Atlas* region it has a patchy distribution, with populations in Hhluhluwe Game Reserve, the Sibaya area, and Mangusi Forest near Kosi Bay.

Habitat: Found in forests, wooded grassland and the margins of arid savanna, where it climbs into reed beds, bushes and trees (Marais 2004).

Bioregion: Lowveld; Indian Ocean Coastal Belt.

Assessment rationale: Has a restricted range within the *Atlas* region but is widespread and abundant elsewhere. This snake is highly mobile and faces no significant threats.

Conservation measures: None recommended.



Philothamnus angolensis—Malawi J. Marais

Philothamnus hoplogaster (Günther, 1863)

SOUTHEASTERN GREEN SNAKE; GREEN WATER SNAKE

Johan Marais

Regional: Least Concern

Taxonomy: No notable issues.

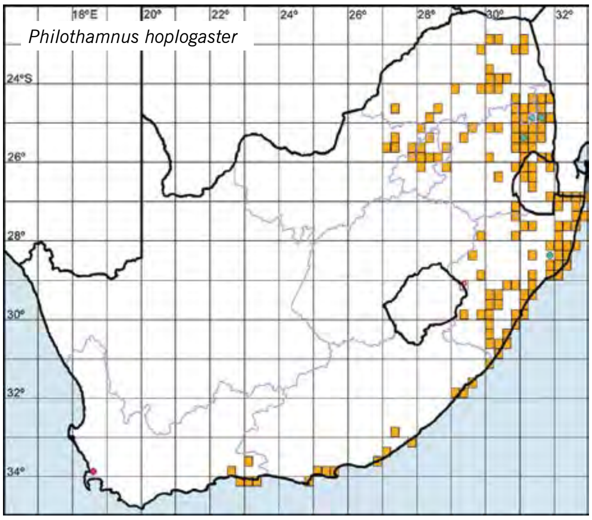
Distribution: Widespread in sub-Saharan Africa. Found in South Africa, Swaziland, Mozambique, Zimbabwe and north to Kenya, Sudan and Cameroon (Broadley 1990b; Spawls *et al.* 2002). Occurs in the eastern part of the *Atlas* region, in Limpopo, Mpumalanga, Gauteng, eastern North-West Province and KwaZulu-Natal, extending southwards down the Eastern Cape coast to the eastern parts of the Western Cape. It apparently occurs as scattered subpopulations in the Eastern and Western Cape provinces. Two Virtual Museum records from the Cape Peninsula are well separated to the west of the main distribution and may represent introductions.

Habitat: Found in a variety of habitats, but common in moist savanna, wooded grassland and lowland forest, usually near water; it is an excellent swimmer (Branch 1998). It is also a good climber, at home in trees and shrubs (Marais 2004).

Biome: Savanna; Indian Ocean Coastal Belt; Grassland; Forests; Albany Thicket; Fynbos.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Philothamnus hoplogaster—Oyster Bay, EC W.R. Branch

Philothamnus natalensis natalensis (A. Smith, 1848)

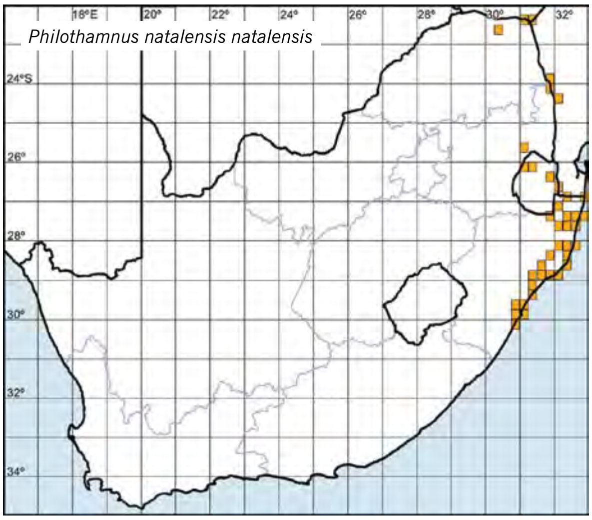
EASTERN NATAL GREEN SNAKE

Johan Marais

Global: Least Concern

Taxonomy: Alexander (1987) suggested that *Philothamnus natalensis occidentalis* should be elevated to full species status on the basis of certain morphological and behavioural differences when compared with *P. n. natalensis*.

Philothamnus natalensis natalensis—Umhlanga Rocks, KZN J. Marais



Distribution: Endemic to southern Africa. Found from Amanzimtoti in southern KwaZulu-Natal northwards into Swaziland, the eastern parts of Mpumalanga and Limpopo, southern Mozambique and eastern Zimbabwe (Broadley 1990b).

Habitat: Inhabits mainly lowland forest and moist savanna, often along forested river valleys, and is an excellent climber (Marais 2004).

Biome: Forests; Savanna; Indian Ocean Coastal Belt.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Philothamnus natalensis occidentalis Broadley, 1966

WESTERN NATAL GREEN SNAKE

Johan Marais

Global: Least Concern

Endemic

Taxonomy: Alexander (1987) suggested that this subspecies should be elevated to full species status on the basis of morphological and behavioural differences.

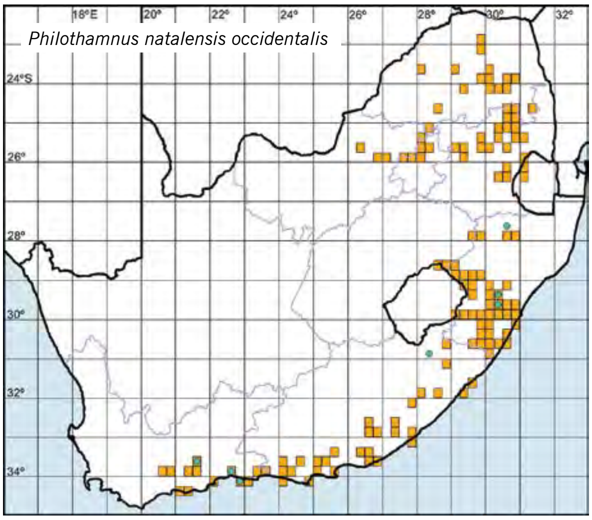
Distribution: Endemic to the *Atlas* region. Occurs from the eastern parts of the Western Cape (east of Montagu) to the Eastern Cape, KwaZulu-Natal, northeastern Free State, western Swaziland, Mpumalanga, Limpopo, northern Gauteng, and the adjacent northeastern North-West Province.

Habitat: Occurs in lowland forest, wooded grassland and forest edge (Bourquin 2004; Marais 2004). Often found in trees and shrubs near water, at altitudes as high as 2000 m (Jacobsen 1989).

Biome: Grassland; Savanna; Albany Thicket; Fynbos; Indian Ocean Coastal Belt; Forests.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Philothamnus natalensis occidentalis—Mariepskop, LIMP D. Pietersen

Philothamnus semivariegatus (A. Smith, 1847)

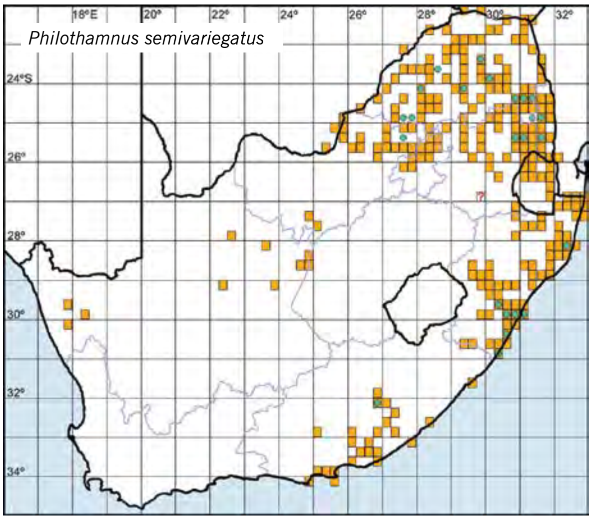
SPOTTED BUSH SNAKE

Johan Marais

Regional: Least Concern

Taxonomy: Although trinomials were used for the species by some recent authors (e.g. Broadley 1990b), Hughes (1985) had shown earlier that *P. s. dorsalis* from Central Africa is a valid species.

Distribution: Endemic to sub-Saharan Africa, from Senegal to South Africa, but absent in Gabon and peripheral to the Congo basin of Democratic Republic of the Congo (Hughes 1985). Widespread in the eastern half of southern Africa, from Humansdorp in the Eastern Cape to KwaZulu-Natal, Mpumalanga, Swaziland, Gauteng, Limpopo, North-West Province and the Northern Cape as far west as Springbok and Kamieskroon in Namaqualand. It also oc-



curs in Mozambique, Zimbabwe, Botswana, Namibia and further north to Sudan and Guinea (Branch 1998). There are scattered populations in the Northern Cape, some of which may represent natural range expansions by snakes washing down rivers (e.g. Vaal and Orange Rivers) during floods, or using riverine vegetation as corridors.

Habitat: Inhabits moist savanna, lowland forest and riverbanks, as well as shrubby vegetation and rocky regions in the Karoo. It is an excellent climber and forages in shrubs and bushes (Branch 1998; Marais 2004). Occupies crevices in rock outcrops, holes in trees, and large old termitaria, and is also found under tree bark, at altitudes as high as 2 000 m (Jacobsen 1989).

Biome: Savanna; Indian Ocean Coastal Belt; Grassland; Albany Thicket; Fynbos; Forests; Succulent Karoo; Nama-Karoo.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Philothamnus semivariegatus—Durban, KZN J. Marais

Genus *Telescopus* Wagler, 1830—tiger snakes

Telescopus contains 13 species (Uetz 2012), eight of which occur in Africa. The other five species are found in southern Europe and southwestern Asia. An additional species from Namibia has been identified but has not yet been described (W.D. Haacke pers comm.; Alexander & Marais 2007). These are slender, nocturnal snakes found in savanna, forest and semi-desert. Their diet includes a variety of lizards, fledgling birds and small mammals (Broadley 1990b). Females lay clutches of 3–20 eggs (Alexander & Marais 2007). There are two species in the *Atlas* region, neither of which is of conservation concern.

Telescopus beetzii (Barbour, 1922)

BEETZ'S TIGER SNAKE

Johan Marais

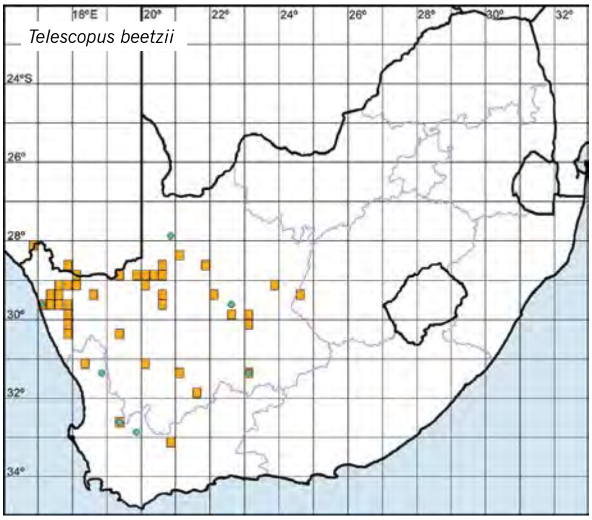
Global: Least Concern

Taxonomy: A revision of *Telescopus* in southwestern Africa is in progress (W.D. Haacke in prep.).

Distribution: Endemic to southwestern Africa. Occurs from near Windhoek in Namibia southwards to the Western Cape of South Africa (Branch 1998). In the *Atlas* region it is found from Namaqualand (Northern Cape) to the western Free State, and southwards into the central Karoo as far as Ceres district (3219DD, Virtual Museum record) and Laingsburg (3320BB) in the Western Cape. The northernmost limit (2720DD) in the *Atlas* region is represented by a Virtual Museum record.

Habitat: Found in arid regions in the Karoo where it lives in rocky outcrops, sheltering in crevices (Branch 1998). It has also been collected from old termite mounds in the Free State (De Waal 1978).

Biome: Succulent Karoo; Nama-Karoo.



Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Telescopus beetzii—about 22 km SW of Prieska, NC M. Burger

Telescopus beetzii—Aus, Namibia W.R. Branch

Telescopus semiannulatus semiannulatus A. Smith, 1849

EASTERN TIGER SNAKE

Johan Marais

Regional: Least Concern

Taxonomy: There are currently two recognised subspecies, namely *T. s. semiannulatus* and *T. s. polystictus*. At least one additional Namibian species, apparently closely allied to *T. semiannulatus*, has been identified but has not yet been described (W.D. Haacke pers. comm.).

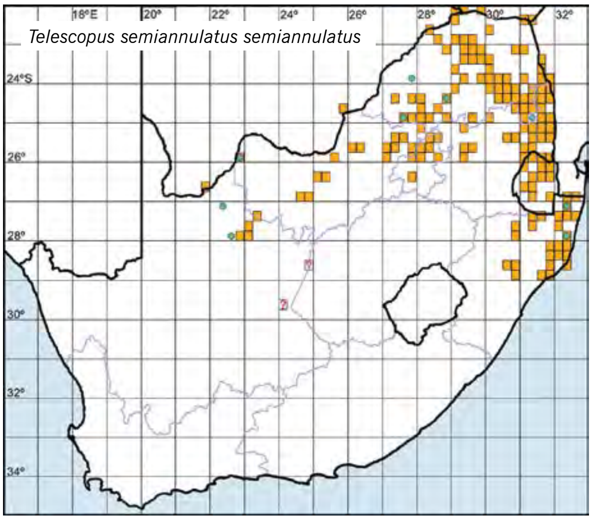
Distribution: Endemic to the southern half of Africa. Occurs in South Africa, Swaziland, Mozambique, Zimbabwe, Botswana, Namibia and northwards to Democratic Republic of the Congo and Kenya (Broadley 1990b; Branch 1998). In the *Atlas* region it is found in northern KwaZulu-Natal, Swaziland, Mpumalanga, Limpopo, Gauteng, North-West Province and the northeastern parts of Northern Cape. The southwestern range limits are represented by two Virtual Museum records. Old records (Broadley 1990b) near the western border of the Free State are considered to be dubious.

Habitat: Found in arid and moist savanna and lowland forest, where it shelters under bark, loose flakes of rock and in rock crevices (Marais 2004). It is also known to climb trees (Broadley 1990b).

Biome: Savanna; Grassland; Indian Ocean Coastal Belt; Forests.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.



Telescopus semiannulatus semiannulatus—Skukuza, Kruger NP, MPM
B. Maritz

Telescopus semiannulatus polystictus Mertens, 1954

DAMARA TIGER SNAKE

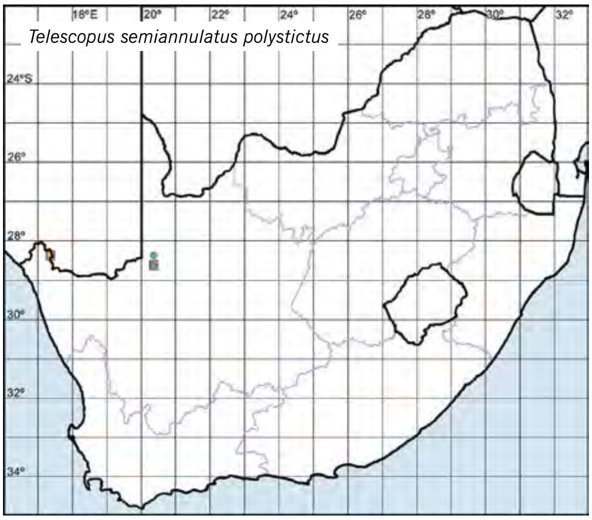
Johan Marais

Global: Least Concern

Taxonomy: There are currently two recognised subspecies, namely *T. s. semiannulatus* and *T. s. polystictus*. At least one additional Namibian species, apparently closely allied to *T. semiannulatus*, has yet to be described (W.D. Haacke pers. comm.).

Distribution: Endemic to southwestern Africa. Found in the Northern Cape, South Africa, in the Richtersveld and Augrabies National Park, northwards through the central parts of Namibia almost as far as Ovamboland (Broadley 1990b; Branch 1998).

Habitat: Occurs in rocky, high-lying regions (Branch 1998). In Namibia it is found in mopane savanna, dwarf shrub savanna, highland savanna, thornbush savanna and marginally in semi-desert and mixed tree and shrub savanna (A.M. Bauer pers. comm.).



Biome: Desert; Nama-Karoo.

Assessment rationale: Only the southern edge of its range falls within the *Atlas* region. There are few threats in this area where it is protected in the Richtersveld and Augrabies National Parks. It has a widespread distribution in Namibia to the north. It is considered to be both globally and regionally of Least Concern.

Conservation measures: None recommended.

Telescopus semiannulatus polystictus—Angola W.R. Branch

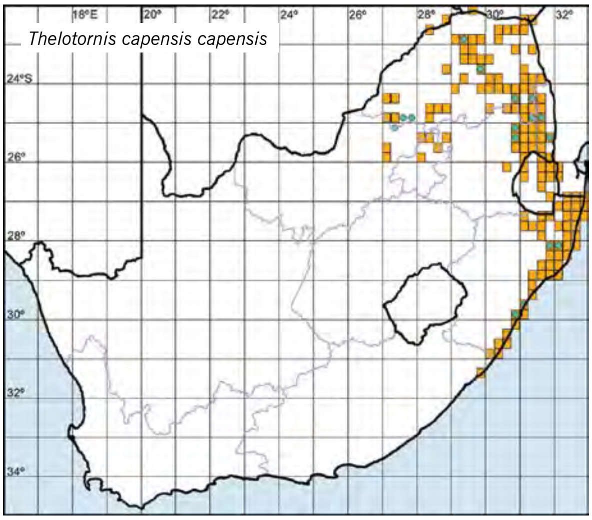
Genus *Thelotornis* A. Smith, 1849—twig snakes

The genus *Thelotornis* is widespread across sub-Saharan Africa and contains four species (Uetz 2012). *Thelotornis usambaricus* from the Usambara Mountains of Tanzania and Vamizi Island, northern Mozambique is the most recently described species (Broadley 2001c; Broadley & Farooq 2013). One representative of the genus, *T. capensis capensis*, occurs within the *Atlas* region where it is found in the eastern savannas. These slender, arboreal, cryptically-patterned snakes feed primarily on lizards—especially arboreal species—and frogs (Shine *et al.* 1996). Females of *T. c. capensis* lay clutches of 4–18 eggs in summer (Branch 1998). This subspecies is not of conservation concern.

Thelotornis capensis capensis A. Smith, 1849

SOUTHERN TWIG SNAKE;
SOUTH-EASTERN SAVANNA VINE SNAKE

Johan Marais



Global: Least Concern

Taxonomy: Two subspecies are recognised, namely *Thelotornis capensis capensis* and *T. c. oatesii* (Zimbabwe, central Mozambique, northern Botswana, northern Namibia).

Distribution: Endemic to southern Africa. In the *Atlas* region it occurs along the east coast and in the northern parts of KwaZulu-Natal, northwards through Swaziland, northern and eastern Mpumalanga, Limpopo, northern Gauteng and northeastern North-West Province. The southernmost record is at Mkhambathi Nature Reserve in the Eastern Cape. Extralimitally it is found in southern Mozambique, southern Zimbabwe and southeastern Botswana (Broadley 2001c).

Habitat: Inhabits trees and shrubs in coastal thicket, forest fringes and savanna (Broadley 1990b; Branch 1998).

Biome: Savanna; Indian Ocean Coastal Belt; Grassland; Forests.

Assessment rationale: Widespread and common.

Conservation measures: None recommended.

Thelotornis capensis capensis—Hoedspruit, LIMP J. Marais

CHAPTER 25

Family Natricidae

William R. Branch, Johan Marais & *James Harvey*

The Natricidae, commonly called Old World Water Snakes, have often been treated as a separate subfamily within the historically large family Colubridae (see Chapter 24). Molecular studies on caenophidian ('advanced') snakes indicate that they group with a clade of derived families that together form the Colubroidea (Vidal & Hedges 2009). The latter group comprises the Dipsadidiae (New World), Pseudoxenodontidae (Asia), Natricidae and Colubridae (both cosmopolitan but mainly Palaearctic). Natricids are found in North and Central America, Africa, Eurasia and northern Australia, where they are often some of the commonest and most conspicuous snakes. Approximately 40 genera and nearly 200 species are recognised (Uetz 2012), but the African radiation is the most poorly known.

The Natricidae comprises small to medium-sized, aquatic to semi-aquatic snakes. They are mostly harmless although a number of Asian species have potent, even fatal, venoms (Sawai *et al.* 2002). The hemipenis is characterised by a centripetal sulcus (Branch 1986).

The family is poorly represented in sub-Saharan Africa, with four genera (*Afronatrix*, *Hydraethiops*, *Limnophis*, *Natriciteres*) containing only 11 species (Branch 1998; Zaher *et al.* 2009). There are six species of the semi-aquatic, mainly frog-eating, oviparous genus *Natriciteres*, but only two species occur within the *Atlas* region. The ranges of both species extend peripherally into eastern mesic habitats. Both species have wide distributions to the north of the *Atlas* region, and a modern taxonomic revision of the genus is required.

Natriciteres sylvatica was previously classified as Peripheral but is no longer considered of regional conservation concern. *Natriciteres olivacea* has a marginal distribution in the *Atlas* area and was therefore not assessed.

Genus *Natriciteres* Loveridge, 1953—marsh snakes

The genus *Natriciteres* is restricted to sub-Saharan Africa and contains six species. Until recently, three of these (*N. bipostocularis*, *N. pembana* and *N. sylvatica*) were considered to be subspecies of *N. variegata* (Spawls *et al.* 2002; Broadley & Cotterill 2004). These small diurnal snakes inhabit wetland areas in forests and savannas. They feed on frogs and fish (Broadley 1990b) and 3–11 eggs are laid in summer (Marais 2004). These snakes have the ability to shed their tails as a defense mechanism (Broadley 1987b). Two species enter the eastern edge of South Africa and both have restricted ranges in the *Atlas* region. *Natriciteres sylvatica* was previously classified as Peripheral but is no longer considered of regional conservation concern. In the *Atlas* region *N. olivacea* is known from only a single specimen from Kosi Bay and it is therefore not assessed.

Natriciteres olivacea (Peters, 1854)

OLIVE MARSH SNAKE

Johan Marais

Not Applicable

Taxonomy: No notable issues.

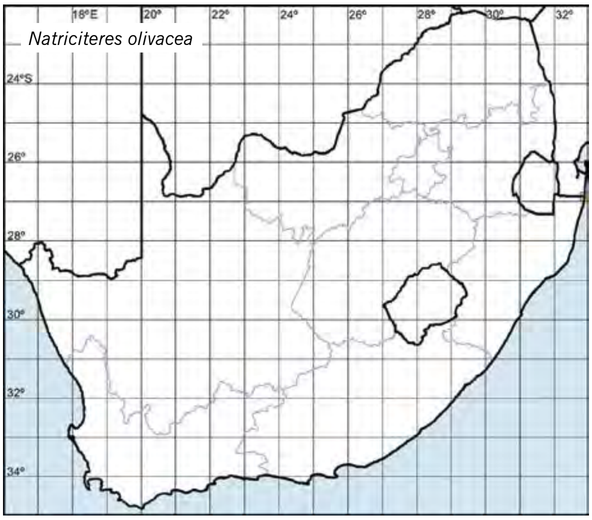
Distribution: In the *Atlas* region this species is known from only a single specimen collected in 2005 in the Kosi Bay region of northeastern KwaZulu-Natal. Its range extends through southern Mozambique to Zimbabwe and northern Botswana, and elsewhere further north to Sudan and West Africa (Branch 1998).

Habitat: Inhabits pans and vleis in coastal forest and savanna (Branch 1998).

Vegetation type: FOz 7 Northern Coastal Forest.

Assessment rationale: The range just enters the *Atlas* region at Kosi Bay, but the species is widespread further north. The single known specimen from KwaZulu-Natal was found within the iSimangaliso Wetland Park where no known threats exist.

Conservation measures: Conduct research into population numbers, habitat status, range, biology and ecology.



Natriciteres olivacea—Malawi W.D. Haacke

Natriciteres sylvatica Broadley, 1966

FOREST MARSH SNAKE; SOUTHERN FOREST MARSH SNAKE

Johan Marais

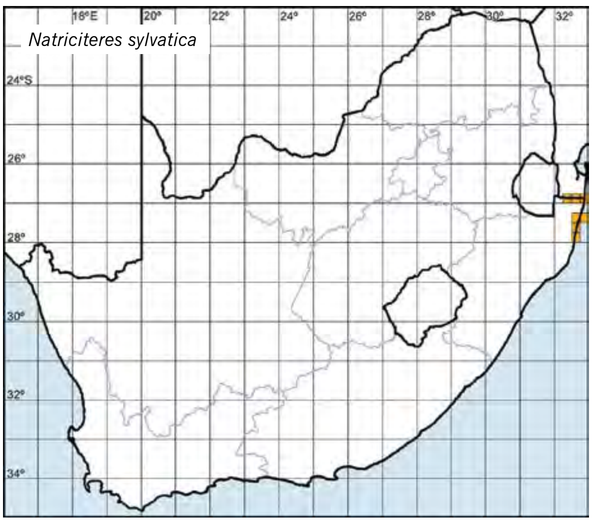
Regional: Least Concern

Taxonomy: Previously considered a subspecies of *Natriciteres variegata*, but treated as a full species by Spawls *et al.* (2002) and Broadley *et al.* (2003).

Distribution: Occurs from northeastern KwaZulu-Natal, South Africa northwards into Mozambique and further north to Tanzania (Broadley 1990b).

Habitat: Found in lowland and montane evergreen forests where it shelters under cover at forest fringes, and hunts in pools (Branch 1998).

Bioregion: Indian Ocean Coastal Belt; Lowveld; Zonal and Intrazonal Forests.



Assessment rationale: Has a restricted range in South Africa but is not threatened and occurs largely within the iSimangaliso Wetland Park.

Conservation measures: None recommended.

Natriciteres sylvatica—N Mozambique J. Marais

REFERENCE LIST

ABREU-GROBOIS, A. & PLOTKIN, P. 2008. *Lepidochelys olivacea*. In IUCN 2010, *IUCN Red List of Threatened Species. Version 2010.1.* www.iucnredlist.org.

ADALSTEINSSON, S.A., BRANCH, W.R., TRAPE, S., VITT, L.J. & HEDGES, S.B. 2009. Molecular phylogeny, classification, and biogeography of snakes of the family Leptotyphlopidae (Squamata, Scolecophidia). *Zootaxa* 2244: 1–50.

ADOLPHS, K. 2006. *Bibliotheca Cordyliformium. Neues Quellenverzeichnis der Gürtelschweife und Schildeschen (Reptilia, Cordylidae & Gerrhosauridae).* Squamata Verlag, Sankt Augustin.

AGAPOW, P.M. 2005. Species: demarcation and diversity. In A. Purvis, J.L. Gittleman & T. Brooks (eds), *Phylogeny and Conservation. Conservation Biology* 8: 57–75. Cambridge University Press, Cambridge.

ALEXANDER, G.J. 1987. *The Herpetofauna of Municipal Durban: A Biogeographical Review.* M.Sc. thesis, University of Natal, Durban.

ALEXANDER, G.J. 1990. Reptiles and amphibians of Durban. *Durban Museum Novitates* 15: 1–41.

ALEXANDER, G.J. 1996. *Thermal Physiology of* Hemachatus haemachatus *and its Implications to Range Limitation.* Ph.D. thesis, University of Natal, Durban.

ALEXANDER, G.J. 2007. Thermal biology of the Southern African Python (*Python natalensis*): Does temperature limit its distribution? In R.W. Henderson & R. Powell (eds), *Biology of the Boas and Pythons*: 50–75. Eagle Mountain Publishing, Eagle Mountain.

ALEXANDER, G.J. & MARAIS, J. 2007. *A Guide to Reptiles of Southern Africa.* Struik, Cape Town.

ALEXANDER, G.J., HORNE, D. & HANRAHAN, S.A. 2002. An evaluation of the effects of deltamethrin on two non-target lizard species in the Karoo, South Africa. *Journal of Arid Environments* 50(1): 121–133.

ALLENTOFT, M.E. & O'BRIEN, J. 2010. Global amphibian declines, loss of genetic diversity and fitness: a review. *Diversity* 2(1): 47–71.

AMBROSE, D. 2006. *Lesotho Annotated Bibliography Section 166: Reptiles Including Annotated Checklist.* Mamhlongo Productions, Roma.

AMER, S.A.M. & KUMAZAWA, Y. 2005. Mitochondrial genome of *Pogona vitticepes* (Reptilia; Agamidae): control region duplication and the origin of Australasian agamids. *Gene* 346: 249–256.

ANDREWS, K.M. & GIBBONS, J.W. 2005. How do highways influence snake movement? Behavioral responses to roads and vehicles. *Copeia* 2005: 772–782.

ANONYMOUS. 2001. Memorandum of understanding on the conservation and management of marine turtles and their habitats of the Indian Ocean and South-East Asia. *Convention on the Conservation of Migratory Species of Wild Animals.* Manila.

ANONYMOUS. 2007. Rehabilitation of mined Bontveld. *Algoa Branch of the Botanical Society of South Africa, Newsletter, 3rd Quarter*: 2–3. www.botanicalsociety.org.za/branches/Alg.

ARBUCKLE, K. 2009. Ecological function of venom in *Varanus*, with a compilation of dietary records from the literature. *Biawak* 3(2): 46–56.

ARENA, P.C., STEEDMAN, C. & WARWICK, C. 2012. Amphibian and Reptile Pet Markets in the EU: an Investigation and Assessment. Private report commissioned and circulated by the Animal Protection Agency (UK) and others, 52 pp. (available at www.apa.org.uk).

ARMSTRONG, A.J. 2008. Translocation of black-headed dwarf chameleons *Bradypodion melanocephalum* in Durban, KwaZulu-Natal, South Africa. *African Journal of Herpetology* 57: 29–41.

ARMSTRONG, A.J. 2009. Distribution and conservation of the coastal population of the black-headed dwarf chameleon *Bradypodion melanocephalum* in KwaZulu-Natal. *African Journal of Herpetology* 58: 85–97.

ARMSTRONG, A.J. 2011. Status of the Sungazer *Smaug giganteus* in KwaZulu-Natal Province, South Africa. *African Herp News* 54: 1–4.

ARMSTRONG, A.J., BENN, G., BOWLAND, A.E., GOODMAN, P.S., JOHNSON, D.N., MADDOCK, A.H. & SCOTT-SHAW, C.R. 1998. Plantation forestry in South Africa and its impact on biodiversity. *South African Forestry Journal* 182: 59–65.

ARNOLD, E.N. 1989. Towards a phylogeny and biogeography of the Lacertidae: relationships within an Old-World family of lizards derived from morphology. *Bulletin of the British Museum of Natural History (Zoology)* 55: 209–257.

ARNOLD, E.N., ARRIBAS, O. & CARRANZA, S. 2007. Systematics of the Palaearctic and Oriental lizard tribe Lacertini (Squamata: Lacertidae: Lacertinae), with descriptions of eight new genera. *Zootaxa* 1430: 1–86.

AUERBACH, R.D. 1987. *The Amphibians and Reptiles of Botswana.* Mokwepa Consultants, Gaborone.

AUFFENBERG, W. 1981. *The Behavioral Ecology of the Komodo Monitor.* University Presses of Florida, Gainesville.

AULIYA, M. 2003. *Hot Trade in Cool Creatures: a Review of the Live Reptile Trade in the European Union in the 1990's with a Focus on Germany.* TRAFFIC Europe, Brussels.

AUST, P., BOYLE, B., FERGUSSON, R. & COULSON, T. 2009. The impact of Nile crocodiles on rural livelihoods in north-eastern Namibia. *South African Journal of Wildlife Research* 39(1): 57–69.

AUSTIN, J.J. & ARNOLD, E.N. 2006. Using ancient and recent DNA to explore relationships of extinct and endangered *Leiolopisma* skinks (Reptilia: Scincidae) in the Mascarene islands. *Molecular Phylogenetics and Evolution* 39: 503–511.

AUSTIN, J.J., ARNOLD, E.N. & JONES, C.G. 2004. Reconstructing an island radiation using ancient and recent DNA: the extinct and living day geckos (*Phelsuma*) of the Mascarene islands. *Molecular Phylogenetics and Evolution* 31: 109–122.

AVERY, G., KANDEL, A.W., KLEIN, R.G., CONARD, N.J. & CRUZ-URIBE, K. 2004. Tortoises as food and taphonomic elements in palaeo "landscapes". In de J.-P. Brugal & J. Desse (eds), *Petits Animaux et Sociétés Humaines: Du complement Alimentaire aux Resources Utilitaires*: 147–161. Association Pour la Promotion et la Diffusion des Connaissances Archéologiques (APDCA), Antibes.

BAARD, E.H.W. 1988a. *Scelotes gronovii*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 154–155. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.

BAARD, E.H.W. 1988b. *Scelotes kasneri*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 152–153. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.

BAARD, E.H.W. 1991. A review of the taxonomic history of and some literature on the geometric tortoise, *Psammobates geometricus* (Linnaeus, 1758). *Journal of the Herpetological Association of Africa* 39: 8–12.

BAARD, E.H.W. 1993a. Distribution and status of the geometric tortoise *Psammobates geometricus* in South Africa. *Biological Conservation* 63: 235–239.

BAARD, E.H.W. 1993b. A conservation strategy for the geometric tortoise, *Psammobates geometricus* in the southwestern Cape Province, South Africa. *Internal Report* 11: 1–64. Chief Directorate Nature and Environmental Conservation (C.P.A.), Cape Town.

BAARD, E.H.W. 1995. A preliminary analysis of the habitat of the geometric tortoise, *Psammobates geometricus*. *South African Journal of Wildlife Research* 25(1): 8–13.

BAARD, E.H.W. 1997. A conservation strategy for the geometric tortoise, *Psammobates geometricus*. In J. Van Abbema (ed.), *Proceedings: Conservation, Restoration and Management of Turtles and Tortoises—An International Conference*: 324–329. New York Turtle and Tortoise Society, New York.

BAHA EL DIN, S. 1996. *Ramphotyphlops braminus* (Daudin 1803). A new addition to the Egyptian herpetofauna. *Casopis Narodniho Muzea, Rada Priodovedna* 1. 65: 130.

BAIG, K.J. & BÖHME, W. 1997. Partition of the "*Stellio*" group of *Agama* into two distinct genera: *Acanthocercus* FITZINGER 1843, and *Laudakia* GRAY 1845 (Sauria: Agamidae). In W. Bischoff, W. Böhme & T. Ziegler (eds), *Herpetologia Bonnensis.* Societas Europaea Herpetologica, Bonn.

BAILLIE, J.E.M., GRIFFITHS, J., TURVEY, S.T., LOH, J. & COLLEN, B. 2010. *Evolution Lost. Status and Trends of the World's Vertebrates.* Zoological Society of London, London.

BALDWIN, R., HUGHES, G.R. & PRINCE, R.I.T. 2003. Loggerhead turtles in the Indian Ocean. In A.B. Bolten & B.E. Witherington (eds), *Loggerhead Sea Turtles*: 218–232. Smithsonian Books, Washington.

BALSAMO JR., R.A., HOFMEYR, M.D., HENEN, B.T. & BAUER, A.M. 2004. Leaf biomechanics as a potential tool to predict feeding preferences of *Psammobates geometricus* (geometric tortoise). *African Zoology* 39(2): 175–181.

BANKS, P.B. & BRYANT, J.V. 2007. Four-legged friend or foe? Dog walking displaces native birds from natural areas. *Biology Letters* 3: 611–613.

BARLOW, A., PHELPS, T., BAKER, K.H., PEPPIN, L., HENDRY, C.R. & WÜSTER, W. 2010. The genetic signature of past climatic change in a widespread African viper: Phylogeography of the puff adder, *Bitis arietans* (abstract). In M.A.L. Zuffi (ed.), *Abstract Book: 3rd Biology of the Vipers Conference Calci (Pisa, Italy), 31st March–2nd April 2010*: 56. Pisa.

BARTS, M. 2002. Die Dickfingergeckos des südlichen Afrikas. Teil III. *Pachydactylus haackei* Branch, Bauer & Good, 1996. *Sauria* 24(3): 13–18.

BARTS, M. 2005. Die Dickfingergeckos des südlichen Afrikas. Teil IV. *Pachydactylus tigrinus* Van Dam, 1921. *Sauria* 27(2): 3–11.

BARTS, M., HULBERT, F. & BOONE, J. 2005. A new locality record for *Pachydactylus haackei* Branch, Bauer and Good, 1996 at Augrabies National Park, Republic of South Africa. *Russian Journal of Herpetology* 12(3): 237–239.

BARTS, M., SCHNEIDER, C., BOONE, J., MARAIS, J., BRANCH, W.R. & HAACKE, W.D. 2012. *Lamprophis fiskii* Boulenger, 1887 (Ophidia, Colubroidea, Lamprophiidae: Lamprophiinae), eine selten gefundene Hausschlange aus Südafrika. *Sauria* 34(2): 41–51.

BATES, M.F. 1989. The flat geckos of Thaba Phatshwa Mountain. *National Museum News* 36: 33–34.

BATES. M.F. 1991. A re-evaluation of the taxonomic status of *Xenocalamus bicolor concavorostralis* Hoffman, 1940 (Serpentes: Atractaspidinae). *South African Journal of Zoology* 26(2): 78–81.

BATES, M.F. 1992. *The Herpetofauna of the Orange Free State—with Special Emphasis on Biogeographical Patterning.* M.Sc. thesis, University of Natal, Durban.

BATES, M.F. 1996a. New reptile distribution records for the Free State Province of South Africa. *Navorsinge van die Nasionale Museum, Bloemfontein* 12(1): 1–47.

BATES, M.F. 1996b. In search of the elusive flat geckos of the eastern Free State. *Culna* 51: 13–15.

BATES, M.F. 1996c. Taxonomic status and distribution of the South African lizard *Tetradactylus breyeri* Roux (Gerrhosauridae). *South African Journal of Zoology* 31(4): 214–218.

BATES, M.F. 1997. Herpetofauna of the nature reserves and national parks of the Free State province of South Africa. *African Journal of Herpetology* 46(1): 13–29.

BATES, M.F. 2005a. Taxonomic history and geographical distribution of the *Pseudocordylus melanotus* (A. Smith, 1838) and *P. microlepidotus* (Cuvier, 1829) complexes (Sauria: Cordylidae). *Navorsinge van die Nasionale Museum, Bloemfontein* 21(4): 37–112.

BATES, M.F. 2005b. Dwarf geckos have invaded Bloemfontein. *Culna* 60: 6–7.

BATES, M.F. 2005c. Thar be Dragons. *Nouveau* 12: 56–58.

BATES, M.F. 2007a. *An Analysis of the Pseudocordylus melanotus Complex (Sauria: Cordylidae).* Ph.D. thesis, University of Stellenbosch, Stellenbosch.

BATES, M.F. 2007b. First records of the Cape Girdled Lizard, *Cordylus cordylus* (Linnaeus, 1758), in Lesotho. *Navorsinge van die Nasionale Museum, Bloemfontein* 23: 185–195.

BATES, M.F. 2010. Geographical Distribution: *Varanus niloticus*. *African Herp News* 52: 25–26.

BATES, M.F. 2011. Geographical Distribution: *Tetradactylus tetradactylus*. *African Herp News* 53: 52–53.

BATES, M.F. 2013. Geographical distributions: *Tropidosaura cottrelli. African Herp News* 60: 25–27.

BATES, M.F. & BROADLEY, D.G. 2012. Geographical distributions: *Cordylus vittifer*. *African Herp News* 56: 34–35.

BATES, M.F. & LITTLE, I.T. 2013. Predation on the eggs of ground-nesting birds by *Dasypeltis scabra* (Linnaeus, 1758) in the moist highland grasslands of South Africa. *African Journal of Herpetology* 62(2): 125–134.

BATES, M.F. & MAGUIRE, D. 2009. Geographical distribution: *Zygaspis vandami arenicola*. *African Herp News* 47: 43–44.

BATES, M.F. & WHITTINGTON-JONES, C. 2009. Geographical distribution: *Pseudocordylus melanotus melanotus*. *African Herp News* 48: 23–25.

BATES, M.F., BARLOW, A., WÜSTER, W., TOLLEY, K.A. & BROADLEY, D.G. 2011. A taxonomic revision of the genus *Dasypeltis* in the western half of southern Africa. Abstracts: *Proceedings of the 10th conference of the Herpetological Association of Africa, 12–14 January 2011*: 11. Cape Town, South Africa.

BATES, M.[F.], BROADLEY, D.[G.], BARLOW, A., WÜSTER, W. & TOLLEY, K.[A.] 2012. Taxonomy and distribution of the African egg-eating snakes of the genus *Dasypeltis.* Abstract: Seventh World Congress of Herpetology, Vancouver, Canada, 8–14 August 2012 (www.wch2012vancouver.com/abstract-download; see also *African Herp News* 58: 27–28, 2012).

BATES, M.F., HEIDEMAN, N.J.L., WILSON, B.A., HENDRICKS, M.G.J., DON, N. & MOSES, C. 1998. Morphological variation and geographical distribution in the South African lizards *Typhlosaurus caecus* (Cuvier 1817) and *Typhlosaurus vermis* Boulenger 1887 (Scincidae: Acontinae). *African Journal of Herpetology* 47: 35–41.

BATES, M.F., PIETERSEN, D. & MEASEY, G.J. 2010. New amphisbaenian records for the Northern Cape, South Africa. *Navorsinge van die Nasionale Museum, Bloemfontein* 26(3): 61–72.

BATES, M.F., TOLLEY, K.A., EDWARDS, S., DAVIDS, Z., DA SILVA, J. & BRANCH, W.R. 2013. A molecular phylogeny of the African plated lizards, genus *Gerrhosaurus* Wiegmann, 1828 (Squamata: Gerrhosauridae), with the description of two new genera. *Zootaxa* 3750(5): 465–493.

BAUER, A.M. 1990. *Pachydactylus mariquensis latirostris* [natural history note]. *Journal of the Herpetological Association of Africa* 37: 57.

BAUER, A.M. 1993. African-South American relationships: a perspective from the Reptilia. In P. Goldblatt (ed.), *Biological Relationships Between Africa and South America*: 245–288. Yale University Press, New Haven.

BAUER, A.M. 1993 [1992]. *Pachydactylus punctatus punctatus* [distributional note]. *Journal of the Herpetological Association of Africa* 41: 37–38.

BAUER, A.M. 2000. Comments on the types and type localities of South African reptiles collected by Heinrich Bergius and Ludwig Krebs. *African Journal of Herpetology* 49(1): 53–60.

BAUER, A.M. 2000 [1999]. Evolutionary scenarios in the *Pachydactylus*-group geckos of southern Africa: new hypotheses. *African Journal of Herpetology* 48: 53–62.

BAUER, A.M. 2003. On the identity of *Lacerta punctata* Linnaeus, 1758, the type species of the genus *Euprepis* Wagler, 1830, and the generic assignment of Afro-Malagasy skinks. *African Journal of Herpetology* 52: 1–7.

BAUER, A.M. & BRANCH, W.R. 1995. Geographic variation in western populations of the *Pachydactylus punctatus* complex (Reptilia: Gekkonidae). *Tropical Zoology* 8: 69–84.

BAUER, A.M. & BRANCH, W.R. 1997. South African lizards: Gekkonidae. The genus: *Phyllodactylus*. In J.H. Van Wyk (ed.), *Proceedings of the FitzSimons Commemorative Symposium (3nd HAA Symposium on African Herpetology). South African Lizards: 50 years of Progress*: 24–28. Herpetological Association of Africa, Stellenbosch.

BAUER, A.M. & BRANCH, W.R. 2003 [2001]. The herpetofauna of the Richtersveld National Park and the adjacent northern Richtersveld, Northern Cape Province, Republic of South Africa. *Herpetological Natural History* 8: 111–160.

BAUER, A.M. & BRANCH, W.R. 2004. An accidental translocation of *Gekko monarchus* into Africa. *Hamadryad* 28(1–2): 122–123.

BAUER, A.M. & LAMB, T. 2002. Phylogenetic relationships among members of the *Pachydactylus capensis* group of southern African geckos. *African Zoology* 37: 209–220.

BAUER, A.M. & LAMB, T. 2005. Phylogenetic relationships of southern African geckos in the *Pachydactylus* Group (Squamata: Gekkonidae). *African Journal of Herpetology* 54: 105–129.

BAUER, A.M., BARTS, M. & HULBERT, F. 2006a. A new species of the *Pachydactylus weberi* group (Reptila: Squamata: Gekkonidae) from the Orange River, with comments on its natural history. *Salamandra* 42: 83–92.

BAUER, A.M., BRANCH, W.R. & GOOD, D.A. 1996. A new species of rock-dwelling *Phyllodactylus* (Squamata: Gekkonidae) from the Richtersveld, South Africa. *Occasional Papers of the Museum of Natural Sciences, Louisiana State University* 71: 1–13.

BAUER, A.M., BRANCH, W.R. & HAACKE, W.D. 1993. The herpetofauna of the Kamanjab area and adjacent Damaraland, Namibia. *Madoqua* 18(2): 117–145.

BAUER, A.M., GOOD, D.A. & BRANCH, W.R. 1997. The taxonomy of the southern African leaf-toed geckos, with a review of Old World "*Phyllodactylus*" (Squamata: Gekkonidae) and the description of five new genera. *Proceedings of the California Academy of Sciences* 49(14): 447–497.

BAUER, A.M., HEINICKE, M.P., JACKMAN, T.R. & BRANCH, W.R. 2011. Systematics of the *Pachydactylus mariquensis* group of geckos (Reptilia: Squamata: Gekkonidae): Status of *P. mariquensis latirostris*, *P. m. macrolepis* and *P. amoenus*. *Navorsinge van die Nasionale Museum, Bloemfontein* 27(4): 85–108.

BAUER, A.M., LAMB, T. & BRANCH, W.R. 2006b. A revision of the *Pachydactylus serval* and *P. weberi* groups (Reptilia: Gekkota: Gekkonidae) of southern Africa, with the description of eight new species. *Proceedings of the California Academy of Sciences* 57: 595–709.

BAUER, A.M., SCHNEIDER, V., LAMB, T., MOLER, P.E. & BABB, R.D. 2000. New data on the South African skink *Typhlosaurus lomii* Haacke 1986 (Squamata: Scincidae). *African Journal of Herpetology* 48: 21–25.

BAUER, A.M., WHITING, A.S. & SADLIER, R.A. 2003. A new species of *Scelotes* from near Cape Town, Western Cape Province, South Africa. *Proceedings of the California Academy of Sciences* 54(13): 231–237.

BAYLESS, M.K. 2002. Monitor lizards: a pan-African check-list of their zoogeography (Sauria: Varanidae: Polydaedalus). *Journal of Biogeography* 29: 1643–1701.

BENYR, G. 1995. *Systematik und Taxonomie der Geckos des* Pachydactylus bibronii-laevigatus *Komplexes (Reptilia: Squamata: Gekkonidae).* Diplomarbeit, Universiteit Wien, Vienna.

BERGER-DELL'MOUR, H. 1987. Some new data on the herpetology of South West Africa. *Journal of the Herpetological Association of Africa* 33: 5–8.

BERLINER, D.D., VAN DER MERWE, I., BENN, G. & ROUGET, M. 2006. *Systematic Conservation Planning for the Forest Biome of South Africa. Approach, Methods and Results of the Selection of Priority Forests for Conservation Action.* UK DFID for the Department of Water Affairs and Forestry, Pretoria.

BICKHAM, J.W., IVERSON, J.B., PARHAM, J.F., PHILIPPEN, H., RHODIN, A.G.J., SHAFFER, H.B., SPINKS, P.Q., *et al*. 2007. An annotated list of modern turtle terminal taxa with comments on areas of taxonomic instability and recent change. *Chelonian Research Monographs* 4: 173–199.

BIRDLIFE INTERNATIONAL. 2010. *Important Bird Areas (IBAs)*. www.birdlife.org/action/science/sites/

BISHOP, J.M., LESLIE, A.J., BOURQUIN, S. & O'RYAN, C. 2009. Reduced effective population size in an overexploited population of the Nile Crocodile (*Crocodylus niloticus*). *Biological Conservation* 142: 2335–2341.

BJÖRNDAL, K.A. 1996. Foraging ecology and nutrition of sea turtles. In P.L. Lutz & J.A. Musick (eds), *The Biology of Sea Turtles*: 199–232. CRC Press, Boca Raton.

BLAKE, D.K. & JACOBSEN, N.H.G. 1992. The conservation status of the Nile Crocodile (*Crocodylus niloticus*) in South Africa. In G.A. Smith & J. Marais (eds), *Conservation and Utilization of the Nile Crocodile in South Africa: Handbook on Crocodile Farming*: 11–21. Crocodilian Study Group of Southern Africa, Pretoria.

BLAUSTEIN, A.R. & KIESECKER, J.M. 2002. Complexity in conservation: lessons from the global decline of amphibian populations. *Ecology Letters* 5: 597–608.

BLAUSTEIN, A.R. & WAKE, D.B. 1990a. Declining amphibian populations. A global phenomenon? *Trends in Ecology & Evolution* 5: 203–204.

BLAUSTEIN, A.R. & WAKE, D.B. 1990b. The puzzle of declining amphibian populations. *Scientific American* 1995(April): 56–61.

BÖHME, W. 2003. Checklist of the living monitor lizards of the world. *Zoologische Verhandelingen, Leiden* 341: 4–43.

BÖHME, W., JOGER, U. & SCHATTI, B. 1989. A new monitor lizard (Reptilia: Varanidae) from Yemen, with notes on ecology, phylogeny and zoogeography. *Fauna Saudi Arabia* 10: 433–448.

BÖHME, W. & ZIEGLER, T. 1997. A taxonomic review of the *Varanus* (*Polydaedalus*) *niloticus* (Linnaeus, 1766) species complex. *Herpetological Journal* 7: 155–162.

BÖHM, M., COLLEN, B., BAILLIE, J.E.M., BOWLES, P., CHANSON, J., COX, N., HAMMERSON, G. *et al.* 2013. The conservation status of the world's reptiles. *Biological Conservation* 157: 372–385.

BONNATERRE, P.J. 1789. Tableau encyclopédique et méthodique des trois règnes de la nature. Erpétologie: j-xxviij [= 1–28], 1–70, [1], Pl. 1–7, Pl. 1–6, Pl. 1–6, 6 (2), 7–12. Panckoucke, Paris.

BOOTH, W., MILLION, L.R., REYNOLDS, G., BURGHARDT, G.M., VARGO, E.J., SCHAL, C., TZIKA, A.C. & SCHUETT, G.W. 2011a. Consecutive Virgin Births in the New World Boid Snake, the Colombian Rainbow Boa, *Epicrates maurus*. *Journal of Heredity* 102(6): 759–763.

BOOTH, W., SMITH, C.F., ESKRIDGE, P.H., HOSS, S.K., MENDELSON, J.R. &.SCHUETT, G.W. 2011b. Evidence for viable, non-clonal but fatherless Boa constrictors. *Biology Letters* 7(2): 253–256.

BOOTH, W., SMITH, C.F., ESKRIDGE, P.H., HOSS, S.K., MENDELSON, J.R. &.SCHUETT, G.W. 2012. Facultative parthenogenesis discovered in wild vertebrates. *Biology Letters* (published online 12 Sept 2012; doi: 10.1098/rsbl.2012.0666).

BOTHA, H., VAN HOVEN, W. & GUILLETTE Jr., L.J. 2011. The decline of the Nile crocodile population in Loskop Dam, Olifants River, South Africa. *Water SA* 37(1): 103–108.

BOUDREAU, S., LAWES, M.J., PIPER, S.E. & PHADIMA, L.J. 2005. Subsistence harvesting of pole-size understorey species from Ongoye Forest Reserve, South Africa: Species preference, harvest intensity, and social correlates. *Forest Ecology and Management* 21: 149–165.

BOULENGER, G.A. 1885. *Catalogue of the Lizards in the British Museum (Natural History)*. Second Edition. Vol. 1. Geckonidae, Eublepharidae, Uroplatidae, Pygopodidae, Agamidae. British Museum (Natural History), London.

BOULENGER, G.A. 1887. *Catalogue of the Lizards in the British Museum (Natural History).* Vol. III. British Museum of Natural History, London.

BOULENGER, G.A. 1903. On a collection of batrachians and reptiles from the interior of Cape Colony. *Annals and Magazine of Natural History, Seventh Series* 12: 215–217.

BOUR, R. 1988. Taxonomic and nomenclatural status of *Homopus signatus* (Gmelin, 1789) (Reptilia: Chelonii). *Journal of the Herpetological Association of Africa* 35: 1–7.

BOUR, R. 2008. The type specimens of *Testudo angulata* Schweigger, 1812 and *Testudo bellii* Gray, 1828. *Emys* 15(1): 28–34.

BOUR, R. & OHLER, A. 2008. *Chersine* Merrem, 1820 and *Chersina* Gray, 1831: A nomenclatural survey. *Zootaxa* 1752: 66–68.

BOURGEOIS, M. 1968. Contribution à la morphologie comparée du crâne des Ophidiens de l'Afrique Centrale. *Publications de l'Université Officielle du Congo* 18: 1–293.

BOURJEA, J., LAPÈGUE, S., GAGNEVIN, L., BRODERICK, D., MORTIMER, J.A., CICCIONE, S., ROOS, D., TAQUET, C. & GRIZEL, H. 2007a. Phylogeography of the green turtle, *Chelonia mydas*, in the Southwest Indian Ocean. *Molecular Ecology* 16(1): 175–186.

BOURJEA, J., FRAPPIER, J., QUILLARD, M., CICCIOINE, S., ROOS, D., HUGHES, G.R. & GRIEZEL, H. 2007b. Mayotte Island: another important green turtle nesting site in the southwest Indian Ocean. *Endangered Species Research* 3: 273–282.

BOURQUIN, O. 1987. The recent geographical range extension of *Hemidactylus mabouia mabouia*. *Lammergeyer* 38: 12–14.

BOURQUIN, O. 1988. *Scelotes guentheri*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 105–106. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.

BOURQUIN, O. 1991. A new genus and species of snake from the Natal Drakensberg, South Africa. *Annals of the Transvaal Museum* 35(12): 199–203.

BOURQUIN, O. 2004. Reptiles (Reptilia) in KwaZulu-Natal: 1—diversity and distribution. *Durban Museum Novitates* 29: 57–103.

BOWEN, B.W., GRANT, W.S., HILLIS-STARR, Z., SHAVER, D.J., BJORNDAL, K.A., BOLTEN, A.B. & BASS, A.L. 2007. Mixed-stock analysis reveals the migrations of juvenile hawksbill turtles (*Eretmochelys imbricata*) in the Caribbean Sea. *Molecular Ecology* 16(1): 49–60.

BOWEN, B.W., KAMEZAKI, N., LIMPUS, C.J., HUGHES, G.R., MEYLAN, A.B., & AVISE, J.C. 1994. Global phylogeography of the loggerhead turtle (*Caretta caretta*) as indicated by mitochondrial DNA haplotypes. *Evolution* 48(6): 1820–1328.

BOWEN, B.W., NELSON, W.S. & AVISE, J.C. 1993. A molecular phylogeny for marine turtles: trait mapping, rate assessment, and conservation relevance. *Proceedings of the National Academy of Sciences of the USA* 90: 5574–5577.

BOYCOTT, R.C. 1986. A review of *Homopus signatus* (Schoepff) with notes on related species (Cryptodira: Testudinidae). *Journal of the Herpetological Association of Africa* 32: 10–16.

BOYCOTT, R.C. 1988. *Homopus signatus cafer*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 127–128. South African National Programme Report No. 151. CSIR, Pretoria.

BOYCOTT, R.C. 1989. *Homopus signatus*. In I.R. Swingland & M.W. Klemens (eds), *The Conservation Biology of Tortoises*: 82–84. Occasional papers of the IUCN Species Survival Commission No. 5, Gland.

BOYCOTT, R.C. 1990. *Chamaesaura anguina*: Size, reproduction and susceptibility to fire. *Journal of the Herpetological Association of Africa* 37: 49.

BOYCOTT, R.C. 1992a. *A Herpetofaunal Survey of Swaziland.* M.Sc. thesis, University of Natal, Durban.

BOYCOTT, R.C. 1992b. *An Annotated Checklist of the Amphibians and Reptiles of Swaziland.* The Conservation Trust of Swaziland, Mbabane.

BOYCOTT, R.C. 2001. The terrapins and tortoises (Chelonia: Pelomedusidae and Testudinidae) of Swaziland. *Durban Museum Novitates* 26: 25–37.

BOYCOTT, R.C. & BOURQUIN, O. 2000. *The Southern African Tortoise Book: A Guide to Southern African Tortoises, Terrapins and Turtles.* O. Bourquin, Hilton.

BOYCOTT, R.C. & BOURQUIN, O. 2008. *Pelomedusa subrufa* (Bonnaterre, 1789)—Helmeted Terrapin. In A.G.J. Rhodin, P.C.H. Pritchard, P.P. Van Dijk, R.A. Saumune, K.A. Buhlmann & J.B. Iverson (eds), *Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group*: 007.1–007.6. Chelonian Research Monographs Number 5. Chelonian Research Foundation, www.iucn-tftsg.org/cbftt/.

BOYCOTT, R.C. & BRANCH, W. 1989. *Psammobates oculifer*. In I.R. Swingland & M.W. Klemens (eds), *The Conservation Biology of Tortoises*: 88–90. Occasional papers of the IUCN Species Survival Commission No. 5, Gland.

BOYCOTT, R.C., FORRESTER, B., LOFFLER, L. & MONADJEM, A. 2007. *Wild Swaziland—Common Animals and Plants.* P. & J. Perry, Mbabane.

BRAIN, C.K. 1962. A review of the gecko genus *Ptenopus* with the description of a new species. *Cimbebasia* 1: 1–18.

BRANCH, W.R. 1981. An annotated checklist of the lizards of the Cape Province, South Africa. *Annals of the Cape Provincial Museums (Natural History)* 13: 141–167.

BRANCH, W.R. [B]. 1985. Cape lizards. VIII. Girdled lizards and their relatives. *The Naturalist* 29(3): 10–18.

BRANCH, W.R. 1986. Hemipenial morphology of African snakes: a taxonomic review. Part 1. Scolecophidia and Boidae. *Journal of Herpetology* 20(3): 285–299.

BRANCH, W.R. 1988a. *South African Red Data Book—Reptiles and Amphibians.* South African National Scientific Programmes Report No. 151. CSIR, Pretoria.

BRANCH, W.R. 1988b. *Field Guide to the Snakes and other Reptiles of Southern Africa. First Edition.* Struik, Cape Town.

BRANCH, W.R. 1988c. *Homoroselaps dorsalis*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 99–100. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.

BRANCH, W.R. 1989. *Chersina angulata*. In I.R. Swingland & M.W. Klemens (eds), *The Conservation Biology of Tortoises*: 68–71. Occasional papers of the IUCN Species Survival Commission No. 5, Gland.

BRANCH, W.R. 1990a. The herpetofauna of the Cape Province, South Africa: New distribution records and zoogeography. *Journal of the Herpetological Association of Africa* 37: 17–44.

BRANCH, W.R. 1990b. The genus *Tetradactylus* (Sauria: Gerrhosaurinae) in the Cape Province, South Africa: New records and their taxonomic status. *Journal of the Herpetological Association of Africa* 37: 13–16.

BRANCH, W.R. 1991. The herpetofauna of the offshore islands of South Africa. *Annals of the Cape Provincial Museums* 18(10): 205–225.

BRANCH, W.R. 1994a. Herpetofauna of the Sperrgebeit region of southern Namibia. *Herpetological Natural History* 2(1): 1–11.

BRANCH, W.R. 1994b. *Field Guide to the Snakes and Other Reptiles of Southern Africa.* Struik, Cape Town.

BRANCH, W.R. 1997. A new adder (*Bitis*; Viperidae) from the Western Cape Province, South Africa. *South African Journal of Zoology* 32: 37–42.

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

BRANCH, W.R. 1999a. Dwarf adders of the *Bitis cornuta-inornata* complex (Serpentes: Viperidae). *Kaupia (Darmstadt)* 8: 39–63.

BRANCH, W.R. 1999b. *Bitis arietans peghullae* Stewart 1973 (Serpentes: Viperidae): a valid race of puff adder? *African Journal of Herpetology* 48(1 & 2): 15–19.

BRANCH, W.R. 2005. *A Photoguide to the Snakes and other Reptiles and Amphibians of East Africa.* Struik, Cape Town.

BRANCH, W.R. 2006a. Natural history note. *Varanus albigularis* (Daudin, 1802), rock monitor, diet. *African Herp News* 40: 19–20.

BRANCH, W.R. 2006b. Priorities for systematic studies on southern African reptiles. In W.R. Branch, K.A. Tolley, M. Cunningham, A.M. Bauer, G. Alexander, J.A. Harrison, A.A. Turner & M.F. Bates (eds), *A Plan for Phylogenetic Studies of Southern African Reptiles: Proceedings of a Workshop Held at Kirstenbosch, February 2006. Biodiversity Series No. 5*: 2–20. South African National Biodiversity Institute, Pretoria.

BRANCH, W.R. 2007. A new species of tortoise of the genus *Homopus* (Chelonia: Testudinidae) from southern Namibia. *African Journal of Herpetology* 56: 1–21.

BRANCH, W.R. 2008. *Tortoises, Terrapins and Turtles of Africa.* Struik, Cape Town.

BRANCH, W.R. 2010. Recent studies on African snakes and chelonians: a personal perspective. *African Herp News* 50: 2–10.

BRANCH, W.R. 2013. Geographical distribution: *Meroles ctenodactylus*. *African Herp News* 59: 54–56.

BRANCH, W.R. & BAUER, A.M. 1994. *Phyllodactylus peringueyi* (Reptilia: Gekkonidae): Its taxonomic history, rediscovery, and phylogenetic affinities. *Annals of the South African Museum* 104(2): 13–30.

BRANCH, W.R. & BAUER, A.M. 1995. Herpetofauna of the Little Karoo, Western Cape, South Africa with notes on life history and taxonomy. *Herpetological Natural History* 3(1): 47–89.

BRANCH, W.R. & BAUER, A.M. 1996 [1997]. Notes on two poorly-known *Phyllodactylus* (Squamata: Gekkonidae) from South Africa. *Herpetological Natural History* 4(2): 127–134.

BRANCH, W.R. & BAYLISS, J. 2009. A new species of *Atheris* (Serpentes: Viperidae) from northern Mozambique. *Zootaxa* 2113: 41–54.

BRANCH, W.R. & BRAACK, H.H. 1987. Reptiles and amphibians of the Addo Elephant National Park. *Koedoe* 30: 61–111.

BRANCH, W.R. & BRAACK, H.H. 1989. Reptiles and amphibians in the Karoo National Park: A surprising diversity. In W.R. Branch (ed.), Proceedings of the First HAA Conference. *Journal of the Herpetological Association of Africa* 36: 26–35.

BRANCH, W.R. & BURGER, M. 2009. *Nucras taeniolata* Smith, 1838 (Striped Sandveld Lizard) (Sauria, Lacertidae): Additional records. *Herpetological Bulletin* 107: 40–41.

BRANCH, W.R. & ERASMUS, H. 1984. Captive Breeding of Pythons, with details of an interspecific hybrid (*Python molurus bivitattus* x *P. sebae natalensis*). *Journal of the Herpetological Association of Africa* 30: 1–10.

BRANCH, W.R. & HAACKE, W.D. 1980. A fatal attack on a young boy by an African Rock Python *Python sebae*. *Journal of Herpetology* 14(3): 305–306.

BRANCH, W.R. & HAAGNER, G.V. 1999. Life history note: *Psammophis brevirostris* and *Acontias* sp.: The value of road kills. *African Herp News* 30: 28.

BRANCH, W.R. & HANEKOM, N. 1987. The herpetofauna of the Tsitsikamma Coastal and Forest National Parks. *Koedoe* 30: 49–60.

BRANCH, W.R. & HARRISON, J.A. 2004. Conservation Status and Threats. In L.R. Minter, M. Burger, J.A. Harrison, H.H. Braack, P.J. Bishop & D. Kloepfer (eds), *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland*: 13–29. SI/MAB Series 9. Smithsonian Institute, Washington.

BRANCH, W.R. & JACOBSEN, N.H.G. 1988a. *Typhlosaurus lineatus subtaeniatus*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 107–108. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.

BRANCH, W.R. & JACOBSEN, N.H.G. 1988b. *Scelotes limpopoensis albiventris*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 156–157. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.

BRANCH, W.R. & KELLY, C.R. 2008. Taxonomic assessment of the geographical isolates of the Berg Adder (*Bitis atropos*) In. *Programme & Abstracts of the 9th Herpetological Association of Africa Conference, 24–27 November 2008*: 12. Sterkfontein Dam, South Africa.

BRANCH, W.R. & TOLLEY, K.A. 2010. A new chameleon (Sauria: Chamaeleonidae: *Nadzikambia*) from Mount Mabu, Northern Mozambique. *African Journal of Herpetology* 59(2): 157–172.

BRANCH, W.R. & WHITING, M.J. 1997. A new *Platysaurus* (Squamata: Cordylidae) from the Northern Cape Province, South Africa. *African Journal of Herpetology* 46: 124–136.

BRANCH, W.R., BAARD, E.H.W., HAACKE, W.D., JACOBSEN, N., POYNTON, J.C. & BROADLEY, D.G. 1988. A provisional and annotated checklist of the herpetofauna of southern Africa. *Journal of the Herpetological Association of Africa* 34: 1–19.

BRANCH, W.R., BAUER, A.M. & GOOD, D.A. 1995a. Species limits in the *Phyllodactylus lineatus* complex (Reptilia: Gekkonidae), with the elevation of two taxa to specific status and the description of two new species. *Journal of the Herpetological Association of Africa* 44(2): 33–54.

BRANCH, W.R., BENN, G.A. & LOMBARD, A.T. 1995b. The tortoises (Testudinidae) and terrapins (Pelomedusidae) of southern Africa: Their diversity, distribution and conservation. *South African Journal of Zoology* 30: 91–102.

BRANCH, W.R., BAUER, A.M. & GOOD, D.A. 1996. A review of the Namaqua gecko, *Pachydactylus namaquensis* (Reptilia: Gekkonidae) from southern Africa, with the description of two new species. *South African Journal of Zoology* 31(2): 53–69.

BRANCH, W.R., BAUER, A.M., & LAMB, T. 2002. Natural history note. *Bitis caudalis* (horned adder). Prey size. *Herpetological Review* 33: 137–138.

BRANCH, W.R., BAUER, A.M., JACKMAN, T. & MARAIS, J. 2007. Geographical distribution: *Homopus signatus* subsp. *African Herp News* 43: 26–27.

BRANCH, W.R., EGAN, D. & EDMONDS, J. (eds). 2010. *Proceedings of the 9th Conservation Workshop for the Fauna of Arabia, 3–5 February 2008. Conservation Status of the Terrestrial Snakes of the Arabian Peninsula.* Breeding Centre for Endangered Arabian Wildlife, Sharjah.

BRANCH, W.R., HAAGNER, G.V. & BOURQUIN, O. 1993. Further specimens of the cream-spotted mountain snake *Montaspis gilvomaculata* from Natal. *Lammergeyer* 42: 50–52.

BRANCH, W.R., HAAGNER, G.V., HALL, R.J. & CRAIG, G. 1992. Geographical Distribution: *Phyllodactylus peringueyi*. *Journal of the Herpetological Association of Africa* 41: 38.

BRANCH, W.R., TOLLEY, K.A., CUNNINGHAM, M., BAUER, A.M., ALEXANDER, G., HARRISON, J.A., TURNER, A.A. & BATES, M.F. (eds). 2006a. *A Plan for Phylogenetic Studies of Southern African Reptiles: Proceedings of a Workshop held at Kirstenbosch, February 2006.* SANBI Biodiversity Series 5. South African National Biodiversity Institute, Pretoria.

BRANCH, W.R., TOLLEY, K.A. & TILBURY, C.R. 2006b. A new Dwarf Chameleon (Sauria: *Bradypodion* Fitzinger, 1843) from the Cape Fold Mountains, South Africa. *African Journal of Herpetology* 55(2): 123–141.

BRANDLEY, M.C., SCHMITZ, A. & REEDER, T.W. 2005. Partitioned Bayesian analyses, partition choice, and the phylogenetic relationships of scincid lizards. *Systematic Biology* 54: 373–390.

BRANDSTÄTTER, F. 1996. *Die Sandrennattern: Genus* Psammophis*.* Westarp Wissenschaften, Magdeburg.

BRASSINE, M.C., KELLY, C.M.R., BARKER, N.P. & VILLET, M.H. 2008. The phylogenetics of the *Lamprophis fuliginosus/capensis* species complex in southern Africa. Abstract: *Proceedings of the 9th Conference of the Herpetological Association of Africa, 26–30 November 2008*: 13. Sterkfontein Dam, South Africa.

BROADLEY, D.G. 1964. A review of the crag lizards (Genus *Pseudocordylus*) of Natal. *Annals of the Natal Museum* 16: 99–110.

BROADLEY, D.G. 1966a. *The Herpetology of South-East Africa.* Ph.D. thesis, University of Natal, Pietermaritzburg.

BROADLEY, D.G. 1966b. A review of the *Riopa sundevalli* group (Sauria: Scincidae) in southern Africa. *Arnoldia (Rhodesia)* 2(34): 1–7.

BROADLEY, D.G. 1967. A review of the genus *Lycodonomorphus* Fitzinger (Serpentes: Colubridae) in southeastern Africa, with a key to the genus. *Arnoldia* 3(16): 1–9.

BROADLEY, D.G. 1968a. A review of the African cobras of the genus *Naja* (Serpentes: Elapinae). *Arnoldia (Rhodesia)* 3(29): 1–14.

BROADLEY, D.G. 1968b. A revision of the African genus *Typhlosaurus* Wiegmann (Sauria: Scincidae). *Arnoldia (Rhodesia)* 3(36): 1–20.

BROADLEY, D.G. 1968c. A revision of *Aspidelaps scutatus* (A. Smith) (Serpentes: Elapinae). *Arnoldia (Rhodesia)* 4(2): 1–9.

BROADLEY, D.G. 1971a. The reptiles and amphibians of Zambia. *The Puku* 6: 1–143.

BROADLEY, D.G. 1971b. A revision of the African snake genera *Amblyodipsas* and *Xenocalamus*. *Occasional Papers of the National Museums and Monuments of Rhodesia, Series B, Natural Sciences* 4: 629–697.

BROADLEY, D.G. 1971c. A revision of the African snake genus *Elapsoidea* Bocage (Elapidae). *Occasional Papers of the National Museums and Monuments of Rhodesia, Series B, Natural Sciences* 4: 577–626.

BROADLEY, D.G. 1972. A review of the *Nucras tessellata* group (Sauria: Lacertidae). *Arnoldia (Rhodesia)* 5(20): 1–36.

BROADLEY, D.G. 1974. Current research projects of the Department of Herpetology, Umtali Museum. *The Rhodesian Science News* 8: 304–306.

BROADLEY, D.G. 1977a. A review of the northeastern forms of the *Pachydactylus capensis* complex (Sauria: Gekkonidae). *Arnoldia (Rhodesia)* 8(18): 1–19.

BROADLEY, D.G. 1977b. A revision of the African snakes of the genus *Psammophylax* Fitzinger (Colubridae). *Occasional Papers of the National Museums and Monuments of Rhodesia, Series B, Natural Sciences* 6: 1–44.

BROADLEY, D.G. 1978. A revision of the genus *Platysaurus* A. Smith (Sauria: Cordylidae). *Occasional Papers of the National Museums and Monuments of Rhodesia, Series B, Natural Sciences* 6: 129–185.

BROADLEY, D.G. 1979. A field study of two sympatric ‘annual’ lizards (genus *Ichnotropis*) in Rhodesia. *South African Journal of Zoology* 14: 133–138.

BROADLEY, D.G. 1981a. A review of the genus *Pelusios* Wagler in southern Africa (Pleurodira: Pelomedusidae). *Occasional Papers of the National Museums and Monuments of Rhodesia, Series B, Natural Sciences* 6: 633–686.

BROADLEY, D.G. 1981b. A review of the populations of *Kinixys* (Testudinidae) occurring in south-eastern Africa. *Annals of the Cape Provincial Museums (Natural History)* 13: 195–216.

BROADLEY, D.G. 1983. *FitzSimons' Snakes of Southern Africa.* Delta Books, Cape Town.

BROADLEY, D.G. 1984. An atypical specimen of *Acontias plumbeus* from Umtentweni. *Lammergeyer* 32: 52.

BROADLEY, D.G. 1987a. A review of geographical variation in *Gerrhosaurus major* Duméril (Sauria: Cordylidae). *Herpetological Journal* 1: 194–198.

BROADLEY, D.G. 1987b. Caudal autotomy in African snakes of the genera *Natriciteres* Loveridge and *Psammophis* Boie. *Journal of the Herpetological Association of Africa* 33: 18–19.

BROADLEY, D.G. 1988. Life history notes: *Meizodon semiornatus semiornatus*: Habitat, diet and distribution. *Journal of the Herpetological Association of Africa* 34: 44.

BROADLEY, D.G. 1989a. A reappraisal of the genus *Panaspis* Cope, with the description of a new species of *Leptosiaphos* (Reptilia: Scincidae) from Tanzania. *Arnoldia (Zimbabwe)* 9(32): 439–449.

BROADLEY, D.G. 1989b. *Kinixys belliana* Bell's Hinged Tortoise. In I.R. Swingland & M.W. Klemens (eds), *The Conservation Biology of Tortoises*: 49–55. Occasional Papers IUCN Species Survival Commission No. 5, Gland.

BROADLEY, D.G. 1989c. *Geochelone pardalis*. In I.R. Swingland & M.W. Klemens (eds), *The Conservation Biology of Tortoises*: 43–46. Occasional papers of the IUCN Species Survival Commission No. 5, Gland.

BROADLEY, D.G. 1990a. The herpetofaunas of the islands off the coast of South Moçambique. *Arnoldia (Zimbabwe)* 9: 469–493.

BROADLEY, D.G. 1990b. *FitzSimons' Snakes of Southern Africa.* Jonathan Ball and Ad. Donker Publishers, Parklands.

BROADLEY, D.G. 1991. A review of the southern African stiletto snakes of the genus *Atractaspis* A. Smith (Serpentes: Atractaspididae). *Arnoldia (Zimbabwe)* 9(36): 495–517.

BROADLEY, D.G. 1993. A review of southern African species of *Kinixys* Bell (Reptilia: Testudinidae). *Annals of the Transvaal Museum* 46: 41–52.

BROADLEY, D.G. 1994. The genus *Scelotes* Fitzinger (Reptilia: Scincidae) in Mozambique, Swaziland and Natal, South Africa. *Annals of the Natal Museum* 35: 237–259.

BROADLEY, D.G. 1995a. A small collection of reptiles and amphibians from central and southern Malawi. *African Herp News* 24: 16–18.

BROADLEY, D.G. 1995b. The Snouted Cobra, *Naja annulifera*, a valid species in southern Africa. *Journal of the Herpetological Association of Africa* 44: 26–32.

BROADLEY, D.G. 1996. A Revision of the Genus *Lycophidion* Fitzinger (Serpentes: Colubridae) in Africa south of the Equator. *Syntarsus* 3: 1–33.

BROADLEY, D.G. 1997. A review of the *Monopeltis capensis* complex in southern Africa (Reptilia: Amphisbaenidae). *African Journal of Herpetology* 46(1): 1–12.

BROADLEY, D.G. 1998. A review of the African *Elapsoidea semiannulata* complex (Serpentes: Elapidae). *African Journal of Herpetology* 47(1): 13–24.

BROADLEY, D.G. 1999a. The Southern African Python, *Python natalensis* A. Smith 1840 is a valid species. *African Herp News* 29: 31–32.

BROADLEY, D.G. 1999b. Geographical distribution notes, Serpentes, Colubridae. *Prosymna lineata* (Peters, 1871): Lined Shovel-snout. *African Herp News* 30: 36–37.

BROADLEY, D.G. 2000. A review of the genus *Mabuya* in southeastern Africa (Sauria: Scincidae). *African Journal of Herpetology* 49(2): 87–110.

BROADLEY, D.G. 2001a. Geographical distribution: *Monopeltis sphenorhynchus*. *African Herp News* 32: 23.

BROADLEY, D.G. 2001b. An annotated checklist of the herpetofauna of Mulanje Mountain. *Nyala* 21: 29–36.

BROADLEY, D.G. 2001c. A review of the genus *Thelotornis* A. Smith in eastern Africa with the description of a new species from the Usamabara Mountains. (Serpentes: Colubridae: Dispholidini). *African Journal of Herpetology* 50(2): 53–70.

BROADLEY, D.G. 2002. A review of the species of *Psammophis* Boie found south of Latitude 12°S (Serpentes: Psammophiinae). *African Journal of Herpetology* 51(2): 83–119.

BROADLEY, D.G. 2007. Book review: *Bibliotheca Cordyliformium. Neues Quellenverzeichnis der Gurtelschweife und Schildechsen (Reptilia, Cordylidae* & *Gerrhosauridae)* by Klaus Adolphs. *African Journal of Herpetology* 56(1): 99–100.

BROADLEY, D.G. 2008. *A guide to the reptiles of southern Africa*. By Graham Alexander and Johan Marais. *African Journal of Herpetology* 57(1): 51–56.

BROADLEY, D.G. 2012. Book review: *Turtles of the World. Vol. 1: Africa, Europe and Western Asia* by Holger Vetter. *African Herp News* 57: 1–3.

BROADLEY, D.G. & BALDWIN, A.S. 2006. Taxonomy, natural history, and zoogeography of the southern African Shield Cobras, Genus *Aspidelaps* (Serpentes: Elapidae). *Herpetological Natural History* 9(2): 163–176.

BROADLEY, D.G. & BAUER, A.M. 1999. A review of the *Mabuya quinquetaeniata* complex in East Africa (Sauria: Scincidae). *African Journal of Herpetology* 47: 43–58.

BROADLEY, D.G. & BLAKE, D.K. 1979. A check list of the reptiles of the National Parks and other conservation areas of Zimbabwe Rhodesia. *Arnoldia (Rhodesia)* 8(35): 1–15.

BROADLEY, D.G. & BLAYLOCK, R. 2013. *The Snakes of Zimbabwe and Botswana*. Edition Chimaira, Frankfurt am Main.

BROADLEY, D.G. & BOYCOTT, R.C. 2008. *Pelusios rhodesianus* (Hewitt, 1927)—Variable Mud Turtle, Variable Hinged Terrapin. In A.G.J. Rhodin, P.C.H. Pritchard, P.P. van Dijk, R.A. Saumure, K.A. Buhlmann, J.B. Iverson & R.A. Mittermeier (eds), *Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group*: 004.1–004.3. Chelonian Research Monographs Number 5. Chelonian Research Foundation, http://www.iucn-tftsg.org/cbftt/.

BROADLEY, D.G. & BRANCH, W.R. 2002. A review of the small East African *Cordylus* (Sauria: Cordylidae), with the description of a new species. *African Journal of Herpetology* 51: 9–34.

BROADLEY, D.G. & BROADLEY, S. 1997. A revision of the African genus *Zygapsis* Cope (Reptilia: Amphisbaenia). *Syntarsus* 4: 1–23.

BROADLEY, D.G. & BROADLEY, S. 1999. A review of the African worm snakes from south of the latitude 12°S (Serpentes: Leptotyphlopidae). *Syntarsus* 5: 1–36.

BROADLEY, D.G. & COTTERILL, F.P.D. 2004. The reptiles of southeast Katanga, an overlooked 'hot spot'. *African Journal of Herpetology* 53(1): 35–61.

BROADLEY, D.G. & FAROOQ, H.O.M. 2013. Geographical distributions: *Thelotornis usambaricus. African Herp News* 59: 48–50.

BROADLEY, D.G. & GREER, A.E. 1969. A revision of the genus *Acontias* Cuvier (Sauria: Scincidae). *Arnoldia (Rhodesia)* 4: 1–27.

BROADLEY, D.G. & HOWELL, K.M. 1991. A checklist of the reptiles of Tanzania, with synoptic keys. *Syntarsus* 1: 1–70.

BROADLEY, D.G. & HUGHES, B. 2000. A revision of the African genus *Hemirhagerrhis* Boettger 1893 (Serpentes: Colubridae). *Syntarsus* 6: 1–17.

BROADLEY, D.G. & MOUTON, P. LE F.N. 2000. A new species of rupicolous *Cordylus* Laurenti from Malawi (Sauria: Cordylidae). *African Journal of Herpetology* 49(2): 169–172.

BROADLEY, D.G. & RASMUSSEN, G.S.A. 1995. Geographical distribution, Reptilia, Sauria, Gekkonidae: *Colopus w. wahlbergii* Peters. *African Herp News 22: 52.*

BROADLEY, D.G. & VAN DAELE, P. 2003. Geographical distribution: *Colopus wahlbergi*. *African Herp News* 36: 20.

BROADLEY, D.G. & WALLACH, V. 1997a. A review of the worm snakes of Mozambique (Serpentes: Leptotyphlopidae) with the description of a new species. *Arnoldia (Zimbabwe)* 10(11): 111–119.

BROADLEY, D.G. & WALLACH, V. 1997b. A review of the genus *Leptotyphlops* (Serpentes: Leptotyphlopidae) in KwaZulu-Natal, South Africa, with the description of a new forest-dwelling species. *Durban Museum Novitates* 22: 37–42.

BROADLEY, D.G. & WALLACH, V. 2000. A new blind snake (Serpentes: Typhlopidae) from montane forests of the Eastern Arc Mountains in Tanzania. *African Journal of Herpetology* 49(2): 165–168.

BROADLEY, D.G. & WALLACH, V. 2002. Review of the Dispholidini, with the description of a new genus and species from Tanzania (Serpentes, Colubridae). *Bulletin of the British Museum of Natural History (Zoology)* 68(2): 57–74.

BROADLEY, D.G. & WALLACH, V. 2007a. A revision of the genus *Leptotyphlops* in northeastern Africa and southwestern Arabia (Serpentes: Leptotyphlopidae). *Zootaxa* 1408: 1–78.

BROADLEY, D.G. & WALLACH, V. 2007b. A review of East and Central African species of *Letheobia* Cope, revived from the synonymy of *Rhinotyphlops* Fitzinger, with descriptions of five new species (Serpentes: Typhlopidae). *Zootaxa* 1515: 31–68.
BROADLEY, D.G. & WALLACH, V. 2009. A review of the eastern and southern African blind-snakes (Serpentes: Typhlopidae), excluding *Letheobia* Cope, with the description of two new genera and a new species. *Zootaxa* 2255: 1–100.
BROADLEY, D.G. & WATSON, C. 1976. A revision of the Worm Snakes of southeastern Africa (Serpentes: Leptotyphlopidae). *Occasional Papers National Museums and Monuments, Rhodesia, B. Natural Sciences* 5(8): 465–510.
BROADLEY, D.G. & WÜSTER, W. 2004. A review of the southern African 'non-spitting' cobras (Serpentes: Elapidae: *Naja*). *African Journal of Herpetology* 53(2): 101–122.
BROADLEY, D.G., DORIA, C.T. & WIGGE, J. 2003. *Snakes of Zambia. An Atlas and Field Guide.* Edition Chimaira, Frankfurt am Main.
BROADLEY, D.G., GANS, C. & VISSER, J. 1976. Studies on amphisbaenians (Amphisbaenia, Reptilia) 6. The genera *Monopeltis* and *Dalophia* in southern Africa. *Bulletin of the American Museum of Natural History* 157(5): 311–485.
BROADLEY, D.G., HUNT, J. & CANTLE, G. 2010. Geographical Distribution: *Psammobates oculifer* Kuhl, 1820 - Serrated Tortoise. *African Herp News* 51: 24–25.
BROCHU, C.A. 2000. Phylogenetic relationships and divergence timing of *Crocodylus* based on morphology and the fossil record. *Copeia* 2000: 657–673.
BROCHU, C.A. 2003. Phylogenetic approaches toward crocodylian history. *Annual Review of Earth Planet Science* 31: 357–397.
BRODERICK, D. 2001. Genetic differentiation among marine turtle rookeries in the Indian Ocean as inferred from MtDNA sequence variation. In S. Ciccione, D. Roos, D. & J-Y. Le Gall (eds), *Knowledge and Conservation of Sea Turtles in South-West Indian Ocean.* Editions du Centre d'Etude et de Decouverte des Tortues Marine de La Réunion (CEDTM), No. 1: 26. La Réunion.
BROOKS, T.M., MITTERMEIER, R.A., MITTERMEIER, C.G., DA FONSECA, G.A.B., RYLANDS, A.B., KONSTANT, W.R., FLICK, P., *et al*. 2002. Habitat loss and extinction in the hotspots of biodiversity. *Conservation Biology* 16(4): 909–923.
BROWN-WESSELS, H.I. 1989. Bimodal reproductive strategy in *Mabuya capensis* (Gray) (Squamata: Scincidae). *Journal of the Herpetological Association of Africa* 36: 46–50.
BRUTON, M.N. & HAACKE, W.D. 1980. The reptiles of Maputaland. In M.N. Bruton & K.H. Cooper (eds), *Studies on the Ecology of Maputaland*: 251–287. Rhodes University, Grahamstown.
BRUTON, M.N., HUGHES, G.R., BUXTON, C.D. & STOBBS, R.E. 1989. *Recommendations on Marine Conservation in the Federal Republic of the Comores.* Investigational Report 34, JLB Smith Institute of Icthyology, Grahamstown.
BRYGOO, E R. & ROUX-ESTEVE, R. 1982. Un genre de lezards scincines d'Afrique: *Melanoseps*. *Bulletin du Museum national d'histoire Naturelle section a Zoologie Biologie et Ecologie Animales* 3(4) 1981[1982]: 1169–1191.
BURGER, M. 1993. The herpetofauna of Anysberg Nature Reserve, Cape Province, South Africa. *Journal of the Herpetological Association of Africa* 42: 1–12.
BURGER, M. & HAHNDIEK, Q. 1993. Geographical distribution: *Nucras tessellata livida*. *Journal of the Herpetological Association of Africa* 42: 41.
BURGER, M. & SMITH, R.B.T. 1992. Geographical distribution: *Bradypodion taeniabronchum*. *Journal of the Herpetological Association of Africa* 41: 37.
BURRAGE, B.R. 1978. Reptiles collected from the west coast of the Cape Province, South Africa. *Transactions of the Kansas Academy of Science* 81(3): 265–271.
BUTCHART, S.H.M., WALPOLE, M., COLLEN, B. VAN STRIEN, A., SCHARLEMANN, J.P.W., ALMOND, R.E.E., BAILLIE, J.E.M., *et al*. 2010. Global biodiversity: indicators of recent declines. *Science* 328: 1164–1168.
CABRERA-PÉREZ, M.A., GALLO-BARNETO, R., ESTEVE, I., PATIÑO-MARTÍNEZ, C. & LÓPEZ-JURADO, L.P. 2012. The management and control of the California kingsnake in Gran Canaria (Canary Islands): Project LIFE+ *Lampropeltis*. *Aliens: The Invasive Species Bulletin* 32: 20-28.
CADLE, J.E. 1994. The colubrid radiation in Africa (Serpentes: Colubridae): phylogenetic relationships and evolutionary patterns based on immunological data. *Zoological Journal of the Linnaean Society* 110: 103–140.
CALVETE, J.J., ESCOLANO, J. & SANZ, L. 2007. Snake venomics of *Bitis* species reveals large intragenus venom toxin composition variation: Application to taxonomy of congeneric genera. *Journal of Proteome Research* 6: 2732–2745.
CAMP, C.L. 1923. Classification of the lizards. *Bulletin of The American Museum of Natural History* 48: 289–481.
CARPENTER, A.I., ROBSON, O., ROWCLIFFE, J.M. & WATKINSON, A.R. 2005. The impacts of international and national governance changes on a traded resource: a case study of Madagascar and its chameleon trade. *Biological Conservation* 123: 279–287.
CARPENTER, A.I., ROWCLIFFE, J.M. & WATKINSON, A.R. 2004. The dynamics of the global trade in chameleons. *Biological Conservation* 120: 291–301.
CARR, A. 1952. *The Handbook of Turtles.* Cornell University Press, Ithaca.
CARRANZA, S. & ARNOLD, E.N. 2006. Systematics, biogeography, and evolution of *Hemidactylus* geckos (Reptilia: Gekkonidae) elucidated using mitochondrial DNA sequences. *Molecular Phylogenetics and Evolution* 38(2): 531–545.
CASTIGLIA, R., COSTI, M. & ANNESI, F. 2006. Molecular and karyological homogeneity in *Trachylepis striata* (Peters 1844) and *T. wahlbergii* (Peters 1869) (Scincidae Reptilia). *Tropical Zoology* 19(1): 119–128.
CASTLEY, J.G. 1997. V*ertebrate diversity in indigenous forests of the Eastern Cape*. Ph.D. thesis, University of Port Elizabeth.
CHIRIO, L. & INEICH, I. 1997. *Ramphotyphlops braminus* (Braminy Blind Snake). Central African Republic. *Herpetological Review* 28(1): 52.
CHIRIO, L. & INEICH, I. 2006. Biogeography of the reptiles of the Central African Republic. *African Journal of Herpetology* 55(1): 23–59.
CHIRIO, L. & LEBRETON, M. 2007. *Atlas des Reptiles du Cameroun.* Muséum National d'Histoire Naturelle & IRD Editions, Paris.
CHIRIO, L., INEICH, I., SCHMITZ, A., & TRAPE, J.-F. 2011. Note sur la systématique de quelques espèces du genre *Prosymna* Gray, 1849 en Afrique au nord de l'équateur (Serpentes, Prosymnidae). *Revue Suisse de Zoologie* 118 (1): 157–17.
CHOWN, S.L. 2010. Temporal biodiversity change in transformed landscapes: A southern African perspective. *Philosophical Transactions of the Royal Society B* 365: 3729–3742.
CIOFI, C. 1999. The Komodo Dragon. *Scientific American* 280(3): 84–92.
CLAUSS, B. & CLAUSS, R. 2002. *Common Amphibians and Reptiles of Botswana.* Gamsberg Macmillan Publishers, Windhoek.
COLE, D.N. 1993. *Trampling Effects on Mountain Vegetation in Washington, Colorado, New Hampshire, and North Carolina. Research Report*. United States Department of Agriculture, Intermountain Research Station, Ogden.
COLLAR, N.J. 1986. Species are a measure of man's freedom: reflections after writing a Red Data Book on African birds. *Oryx* 20(1): 15–19.
COMBRINK, X., KORRÛBEL, J.L., KYLE, R., TAYLOR, R. & ROSS, P. 2011. Evidence of a declining Nile Crocodile (*Crocodylus niloticus*) population at Lake Sibaya, South Africa. *South African Journal of Wildlife Research* 41(2): 145–157.
CONRAD, J.L. 2008. Phylogeny and systematics of Squamata (Reptilia) based on morphology. *Bulletin of the American Museum of Natural History* 310: 1–183.
CONRADIE, W. 2012. Geographical Distribution: *Nucras taeniolata*. *African Herp News* 58: 21–22.
CONRADIE, W. & BOURQUIN, S. 2013. Geographical distributions: Acontias kgalagadi kgalagadi. African Herp News 60: 28–29.
CONRADIE, W., DOUCETTE-RIISE, S., VANHOOYDONCK, B., ENGELBRECHT, H., MEASEY, J. & TOLLEY, K. 2011. Herpetological Survey of Rooipoort Nature Reserve, Northern Cape Province, South Africa. *African Herp News* 53: 35–41.
CONRADIE, W., MEASEY, G.J., BRANCH, W.R. & TOLLEY, K.A. 2012. Revised phylogeny of African sand lizards (*Pedioplanis*),

with the description of two new species from south-western Angola. *African Journal of Herpetology* 61(2): 91–112.

CONRADIE, W., VENTER, J. & NICOLAU, J.R. 2012. Geographical Distribution: *Macrelaps microlepidotus*. *African Herp News* 58: 19–21.

CORDES, I.G. & MOUTON, P. LE F.N. 1996. The Saldanha-Langebaan area as a refugium for cool-adapted lizard populations: Conservation priorities. *Koedoe* 39: 71–83.

CORKHILL, N.L. & KIRK, R. 1954. Poisoning by the Sudan mole viper *Atractaspis microlepidota* Günther. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 48(5): 376–384.

COSTANDIUS, E., MOUTON, P. LE F.N. & BOUCHER, C. 2006. Conservation status of the dwarf crag lizard, *Pseudocordylus nebulosus*, from the Hottentot Holland Mountains, South Africa. *South African Journal of Wildlife Research* 36(2): 123–132.

COTT, H.B. 1934. The Zoological Society's Expedition to the Zambesi. 1927: No. 5. On a collection of Lizards mainly from Portuguese East Africa, with descriptions of new species of *Zonurus, Monopeltis* & *Chirindia*. *Proceedings of the Zoological Society, London* 1: 145–173.

COWLES, R.B. 1930. The life history of *Varanus niloticus* (Lin.) as observed in Natal, South Africa. *Journal of Entomology and Zoology* 22(1): 3–31.

CSIR. 2008. *Land Use Data for Agriculture, Forestry and other Land Uses (AFOLU) Sector: Input into Greenhouse Inventory report of South Africa. Draft 2.1.* Unpublished Report, CSIR, Pretoria.

CUNNINGHAM, J., BAARD, E.H.W., HARLEY, E.H. & O'RYAN, C. 2002. Investigation of genetic diversity in fragmented geometric tortoise (*Psammobates geometricus*) populations. *Conservation Genetics* 3: 215–223.

CUNNINGHAM, M. 2004. Moving among montane islands: a comparative phylogeographic history of Cape Fold Mountain crag lizards (*Cordylus 'Pseudocordylus' capensis* group and *Cordylus 'Pseudocordylus' microlepidotus microlepidotus*). *Programme and Abstracts of the Seventh Herpetological Association of Africa Symposium 6–9 October 2004*: 13–14. Herpetological Association of Africa, Bayworld, Port Elizabeth.

CUNNINGHAM, M., HENDERSON, C.L. & TOLLEY, K.A. 2003. Herpetological surveys: Cockscomb (T'Numqa) mountain. *African Herp News* 36: 22–25.

DANIELS, S.R., HEIDEMAN, N.[J.L.] & HENDRICKS, M.[G.J.] 2009. Examination of evolutionary relationships in the Cape fossorial skink species complex (Acontinae: *Acontias meleagris meleagris*) reveals the presence of five cryptic lineages. *Zoologica Scripta* 38(5): 449–463.

DANIELS, S.R., HEIDEMAN, N.[J.L.], HENDRICKS, M.[G.J.] & CRANDALL, K.A. 2006. Taxonomic subdivisions within the fossorial skink subfamily Acontinae (Squamata: Scincidae) reconsidered: a multilocus perspective. *Zoologica Scripta* 35(4): 353–362.

DANIELS, S.R., HEIDEMAN, N.[J.L.], HENDRICKS, M.[G.J.] & WILSON, B. 2002. A molecular phylogeny for the South African limbless lizard taxa of the subfamily Acontinae (Sauria: Scincidae) with special emphasis on relationships within *Acontias*. *Molecular Phylogenetics and Evolution* 24: 315–323.

DANIELS, S.R., HEIDEMAN, N.[J.L.], HENDRICKS, M.[G.J.], MOKONE, M.E. & CRANDALL, K.A. 2005. Unraveling evolutionary lineages in the limbless fossorial skink genus *Acontias*: are subspecies equivalent systematic units? *Molecular Phylogenetics and Evolution* 34: 645–654.

DANIELS, S.R., HOFMEYR, M.D., HENEN, B.T. & BAARD, E.H.W. 2010. Systematics and phylogeography of a threatened tortoise, the speckled padloper. *Animal Conservation* 13: 237–246.

DANIELS, S.R., HOFMEYR, M.D., HENEN, B.T. & CRANDALL, K.A. 2007. Living with the genetic signature of Miocene induced change: evidence from the phylogeographic structure of the endemic angulate tortoise *Chersina angulata*. *Molecular Phylogenetics and Evolution* 45: 915–926.

DANIELS, S.R., MOUTON, P. LE F.N. & DU TOIT, D.A. 2004. Molecular data suggest that melanistic ectotherms at the south-western tip of Africa are the products of Miocene climatic events: evidence from cordylid lizards. *Journal of Zoology, London* 263: 373–383.

DA SILVA, J.M. & TOLLEY, K.A. 2013. Ecomorphological variation and sexual dimorphism in a recent radiation of dwarf chameleons (*Bradypodion*). *Biological Journal of the Linnean Society* 109: 113–130.

DAWSON, P., ALEXANDER, G.J. & NICHOLLS, S. 1991. The rinkhals (*Hemachatus haemachatus*) a southern African venomous snake—housing, husbandry and maintenance. *Animal Technology* 42: 71–76.

DE BUFFRÉNIL, V. & HÉMERY, G. 2007. Harvest of the Nile Monitor, *Varanus niloticus*, in Sahelian Africa. Part I: Impact of intensive harvest on local stocks. *Mertensiella* 16: 181–194.

DE VILLLIERS, A.L. 2006. Geographical Distribution: *Lygodactylus capensis capensis*. *African Herp News* 40: 29–30.

DE VILLIERS, M.S. & BURGER, M. 2008. The Southern African Reptile Conservation Assessment: Win Some, Lose Some. *Threatened Species Newsletter (Aug 2008).* SANBI, Pretoria.

DE VILLIERS, M.S., BATES, M.F., BURGER, M., HARRISON, J.A. & NAVARRO, R. 2010. The Southern African Reptile Conservation Assessment, 2005–2009. *African Herp News* 50: 10–13.

DE VILLIERS, M.S., BURGER, M., HARRISON, J.A. & NAVARRO, R. 2008. Virtually First: An Online Museum of Reptiles of South Africa, Lesotho and Swaziland. 6th World Congress of Herpetology, 17–22 August 2008, Manaus.

DE WAAL, S.W.P. 1978. The Squamata (Reptilia) of the Orange Free State, South Africa. *Memoirs van die Nasionale Museum, Bloemfontein* 11: 1–160.

DE WITTE, G. 1953. *Reptiles. Exploration du Parc National de l'Upemba, Mission G.-F. de Witte, Fasc. 6.* 322pp. + pls. I–XLI, map. Institut des Parcs Nationaux du Congo Belge, Bruxelles.

DIAMOND, A.W. 1976. Breeding biology and conservation of hawksbill turtles, *Eretmochelys imbricata* L. on Cousine Island, Seychelles. *Biology Conservation* 9: 119–215.

DIAMOND, J.M. 1987. Did Komodo dragons evolve to eat pygmy elephants? *Nature* 326 (6116): 832.

DICKERSON, L.M. 1939. The problem of wildlife destruction by automobile traffic. *Journal of Wildlife Management* 3: 104–116.

DIXON, R., BOUWMAN, H., OSTHOFF, G., GOVENDER, D. & PIENAAR, D. 2010. Crocodile deaths in the Kruger National Park. The death of an ecosystem. *www.sanparks.org/parks/kruger/conservation/scientific/noticeboard/science_network_meeting_2010/Presentations/DixonRD.pdf*

DOBIEY, M. & VOGEL, G. 2007. *Venomous Snakes of Africa.* Edition Chimaira, Frankfurt am Main.

DOUGLAS, R.M. 1992a. *Investigations into the Ecology of the Herpetofauna of Florisbad Research Station, Central Orange Free State, South Africa.* M.Sc. thesis, University of Natal, Durban.

DOUGLAS, R.M. 1992b. The genera *Bradypodion* and *Chamaeleo* in the Orange Free State, South Africa. *Journal of the Herpetological Association of Africa* 40: 19–20.

DREYER, W.A. 1935. The question of wildlife destruction by the automobile. *Science* 82: 439–440.

DRIVER, A., MAZE, K., ROUGET, M., LOMBARD, A.T., NEL, J., TURPIE, J.K., COWLING, R.M., *et al*. 2005. National Spatial Biodiversity Assessment 2004: Priorities for Biodiversity Conservation in South Africa. *Strelitzia* 17, South African National Biodiversity Institute, Pretoria.

DUBOIS, A., CROCHET, P-A., DICKINSON, E.C., NEMÉSIO, A., AESCHT, E., BAUER, A.M., BLAGODEROV, V., *et al*. 2013. Nomenclatural and taxonomic problems related to the electronic publication of new nomina and nomenclatural acts in zoology, with brief comments on optical discs and on the situation in botany. *Zootaxa* 3735(1): 1–94.

DUDLEY, S.F.J. & CLIFF, G. 1993. Some effects of shark nets in the Natal nearshore environment. *Environmental Biology of Fishes* 36(3): 243–255.

DUNHAM, K.M., GHIURGHI, A., CUMBI, R. & URBANO, F. 2010. Human-wildlife conflict in Mozambique: a national perspective, with emphasis on wildlife attacks on humans. *Oryx* 44(2): 185–193.

DU PREEZ, L. 2007. *Why Grass Lizards Attempt to Flee from Fire.* Honours dissertation, University of Stellenbosch, Stellenbosch.

DU TOIT, A., MOUTON, P. LE F.N. & FLEMMING, A.F. 2003. Aseasonal reproduction and high fecundity in the Cape grass

lizard, *Cordylus anguinus*, in a fire-prone habitat. *Amphibia-Reptilia* 24(4): 471–482.
DU TOIT, D.A. & ALBLAS, A. 2003. Geographical distribution: *Nucras livida*. *African Herp News* 36: 15–16.
DUTTON, P.H. 2006. Geographic variation in foraging strategies of leatherbacks: a hedge against catastrophe? In M. Frick, A. Panagopoulou, F. Rees & K. Williams (eds), *Book of Abstracts. Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation International Sea Turtle Society*: 189. Athens, Greece.
DUTTON, P.H., BOWEN, B.W., OWENS, D.W., BARRAGAN, A. & DAVIS, S.K. 1999. Global phylogeography of the leatherback turtle (*Dermochelys coriacea*). *Journal of Zoology* 248: 397–409.
DZEREFOS, C. 2004. Yesterday, today and tomorrow: The story of the Haenertsburg Grasslands of Limpopo. *Veld and Flora* 90(1): 18–19.
EATON, M.J., MARTIN, A., THORBJARNARSON, J. & AMATO, G. 2009. Species-level diversification of African dwarf crocodiles (Genus *Osteolaemus*): a geographic and phylogenetic perspective. *Molecular Phylogenetics and Evolution* 50: 496–506.
EDWARDS, S. 2013. *Patterns and processes of adaptation in lacertid lizards to environments in southern Africa*. Ph.D. dissertation, University of Stellenbosch, Stellenbosch.
EDWARDS, S., VANHOOYDONCK, B., HERREL, A., MEASEY, G.J. & TOLLEY, K.A. 2012. Convergent Evolution Associated with Habitat Decouples Phenotype from Phylogeny in a Clade of Lizards. *PLoS One*: 7(12): e51636. doi: 10.1371/journal.pone.0051636.
EDWARDS, S., BRANCH, W.R., VANHOOYDONCK, B., HERREL, A., MEASEY, G.J. & TOLLEY, K.A. 2013a. Taxonomic adjustments in the systematics of the southern African lacertid lizards (Sauria: Lacertidae). *Zootaxa* 3669(2): 101–114.
EDWARDS, S., TOLLEY, K.A., VANHOOYDONCK, B., MEASEY, G.J. & HERREL, A. 2013b. Is dietary niche breadth linked to morphology and performance in Sandveld lizards *Nucras* (Sauria: Lacertidae)? *Biological Journal of the Linnean Society* (doi: 10.1111/bij.12148).
EIDENMÜLLER, B. & PHILIPPEN, H-D. 2008. *Varanoid Lizards*. Terralog 6, Edition Chimaria, Frankfurt am Main.
ENGELBRECHT, H.M., MOUTON, P. LE F.N. & DANIELS, S.R. 2011. Are melanistic populations of the Karoo girdled lizard, *Karusasaurus polyzonus,* relics or ecotypes? A molecular investigation. *African Zoology* 46(1): 146–155.
ENGELBRECHT, H.M., VAN NIEKERK, A., HEIDEMAN, N.J.L. & DANIELS, S.R. 2013. Tracking the impact of Pliocene/Pleistocene sea level and climatic oscillations on the cladogenesis of the Cape legless skink, *Acontias meleagris* species complex, in South Africa. *Journal of Biogeography* 40: 492–506.
ENGLEDER, A., HARING, E., KIRCHHOF, S. & MAYER, W. 2013. Multiple nuclear and mitochondrial DNA sequences provide new insights into the phylogeny of South African Lacertids (Lacertidae, Eremiadinae). *Journal of Zoological Systematics and Evolutionary Research* 51(1): 1–12.
ERASMUS, H. & BRANCH, W.R. 1983. Egg retention in the South African Blind Snake *Typhlops bibroni*. *Journal of Herpetology* 17 (1): 97–99.
ESTES, R., DE QUEIROZ, K. & GAUTHIER, J. 1988. Phylogenetic relationships within Squamata. In R. Estes & G. Pregill (eds), *Phylogenetic Relationships of the Lizard Families: Essays Commemorating Charles L. Camp*: 119–281. Stanford University Press, Stanford.
FA, J.E. & GRACÍA YUSTE, J.E. 2001. Commercial bushmeat hunting in the Monte Mitra forests, Equatorial Guinea: Extent and impact. *Animal Biodiversity and Conservation* 24(1): 31–52.
FABRICIUS, C., PALMER, A.R. & BURGER, M. 2002. Landscape diversity in a conservation area and commercial and communal rangeland in xeric succulent thicket, South Africa. *Landscape Ecology* 17: 531–537.
FAO. 2006. *Report of the Workshop on Assessing the Relative Importance of Sea Turtle Mortality due to Fisheries; Zanzibar, United Republic of Tanzania 25–28 April 2008. GCP/INT/919/JPN Meeting Report No. 1, 1–58.* Food and Agriculture Organization of the United Nations, Rome, Italy.
FAO. 2009. Guidelines to reduce sea turtle mortality in fishing operations. Rome, FAO. Fisheries and Aquaculture Department.
FELL, R. 2005. *Aggregating Behaviour in Peers' Girdled Lizard, Cordylus peersi.* M.Sc. thesis, University of York, York.
FENG, G., WU, X., YAN, P. & LI, X. 2010. Two complete mitochondrial genes of and implications for crocodilians phylogeny. *Amphibia-Reptilia* 31: 299–309.
FENNESY, S.T. & ISAKSEN, B. 2007. Can bycatch reduction devices be implemented successfully on prawn trawlers in the Western Indian Ocean? *African Journal of Marine Science* 29(3): 453–463.
FERGUSSON, R.A. 2010. Wildlife survey phase 2 and management of human-wildlife conflicts in Mozambique. Final Report for Agreco: Part 3—Survey of Crocodile Populations in Mozambique—2010. Executive summary.
FERREIRA, S.M. & PIENAAR, D. 2011. The degradation of the crocodile population in the Olifants River Gorge of Kruger National Park, South Africa. *Aquatic Conservation: Marine and Freshwater Ecosystems* 21: 155–164.
FITTER, R. & FITTER, M. (eds). 1987. *The Road to Extinction: Problems of Categorizing the Status of Taxa Threatened with Extinction.* IUCN and UNEP, Gland, Switzerland and Cambridge, UK.
FITZSIMONS, V.F.M. 1935a. Scientific results of the Vernay-Lang Kalahari Expedition, March to September, 1930. Reptilia and Amphibia. *Annals of the Transvaal Museum* 16(2): 295–397.
FITZSIMONS, V.F.M. 1935b. Notes on a collection of reptiles and amphibians made in the southern Kalahari, Bushmanland and Great and Little Namaqualand. *Annals of the Transvaal Museum* 15: 519–550.
FITZSIMONS, V.F.M. 1938. Transvaal Museum expedition to South-West Africa and Little Namaqualand, May to August 1937. Reptiles and amphibians. *Annals of the Transvaal Museum* 19: 153–209.
FITZSIMONS, V.F.M. 1941. Descriptions of some new lizards from South Africa and a frog from southern Rhodesia. *Annals of the Transvaal Museum* 20: 273–281.
FITZSIMONS, V.F.M. 1943. The lizards of South Africa. *Memoirs of the Transvaal Museum* 1: i–xv, 1–528.
FITZSIMONS, V.F.M. 1946. An account of the reptiles and amphibians collected on an expedition to the Cape Province, October to December, 1940. *Annals of the Transvaal Museum* 20: 351–377.
FITZSIMONS, V.F.M. 1947. Descriptions of new species and subspecies of reptiles and amphibians from Natal, together with notes on some other little known species. *Annals of the Natal Museum* 11: 111–140.
FITZSIMONS, V.F.M. 1959. Some new reptiles from southern Africa and southern Angola. *Annals of the Transvaal Museum* 23: 405–409.
FITZSIMONS, V.F.M. 1962. *Snakes of Southern Africa.* Purnell & Sons, Cape Town.
FLEMMING, A.F. 1993a. The female reproductive cycle of the viviparous lizard *Pseudocordylus m. melanotus* (Sauria: Cordylidae). *Journal of Herpetology* 27(1): 103–107.
FLEMMING, A.F. 1993b. The male reproductive cycle of the lizard *Pseudocordylus m. melanotus* (Sauria: Cordylidae). *Journal of Herpetology* 27(4): 473–478.
FLEMMING, A.F. 1994. Male and female reproductive cycles of the viviparous lizard, *Mabuya capensis* (Sauria: Scincidae) from South Africa. *Journal of Herpetology* 28: 334–341.
FLEMMING, A.F. 1996. *An Analysis of the Agama atra Complex (Reptilia: Agamidae) in Namaqualand and Southern Namibia.* Ph.D. thesis, University of Stellenbosch, Stellenbosch.
FLEMMING, A.F. & MOUTON, P. LE F.N. 2002. Reproduction in a group-living lizard from South Africa. *Journal of Herpetology* 36: 691–696.
FRANKE, J. & TELECKY, T.M. 2001. *Reptiles as pets. An examination of the trade in live reptiles in the United States*. The Humane Society of the United States.
FRAZIER, J. 1975. Marine turtles of the Western Indian Ocean. *Oryx* 13(2): 164–175.
FRAZIER, J. 1980. Exploitation of marine turtles in the Indian Ocean. *Human Ecology* 8(4): 329–370.
FRAZIER, J. 1985. *Marine Turtles in the Comoro Archipelago*. North Holland Publishing, Amsterdam.
FRITZ, U. & BININDA-EMONDS, O.R.P. 2007. When genes meet nomenclature: tortoise phylogeny and the shifting genetic concepts of *Testudo* and *Geochelone*. *Zoology* 110: 298–307.

FRITZ, U. & HAVAŠ, P. 2007. Checklist of chelonians of the world. *Vertebrate Zoology* 57(2): 148–368.

FRITZ, U., BRANCH, W.R., HOFMEYR, M., MARAN, J., PROKOP, H., SCHLEICHER, A., ŠIROKÝ, P., *et al*. 2011. Molecular phylogeny of African hinged and helmeted terrapins (Testudines: Pelomedusidae: *Pelusios* and *Pelomedusa*). *Zoologica Scripta* 40: 115–125.

FRITZ, U., DANIELS, S.R., HOFMEYR, M.D., GONZÁLEZ, J., BARRIO-AMORÓS, C.L., ŠIROKY, P., HUNDSDÖRFER, A.K. & STUCKAS, H. 2010. Mitochondrial phylogeography and subspecies of the wide-ranging, sub-Saharan leopard tortoise *Stigmochelys pardalis* (Testudines: Testudinidae)—a case study for the pitfalls of pseudogenes and GenBank sequences. *Journal of Zoological Systematics and Evolutionary Research* 48: 348–359.

FROST D.R. & HILLIS, D.M. 1990. Species in concept and practice: Herpetological applications. *Herpetologica* 46: 87–104.

FROST, D., JANIES, D., MOUTON, P. LE F.N. & TITUS, T. 2001. A molecular perspective on the phylogeny of the girdled lizards (Cordylidae, Squamata). *American Museum Novitates* 3310: 1–10.

FROST, D.E. & ETHERIDGE, R.E. 1989. A phylogenetic analysis and taxonomy of iguanian lizards (Reptilia: Squamata). *University of Kansas Museum of Natural History, Miscellaneous Publications* 81: 1–65.

FRY, B.G., SCHEIB, H., VAN DE WEERD, L., YOUNG, B., MCNAUGHTAN, J., RYAN RAMJAN, S.F., VIDAL, N., *et al*. 2008. Evolution of an arsenal: structural and functional diversification of the venom system in the advanced snakes. *Molecular and Cellular Proteomics* 7: 215–246.

FRY, B.G., VIDAL, N., NORMAN, J.A., VONK, F.J., SCHEIB, H., RAMJAN, S.F.R., KURUPPU, S., *et al*. 2006. Early evolution of the venom system in lizards and snakes. *Nature* 439: 584–588.

FRY, B.G., WROE, S., TEEUWISSE, W., VAN OSCH, J.P., MORENO, K., INGLE, J., MCHENRY, C., *et al*. 2009. A central role for venom in predation by *Varanus komodoensis* (Komodo dragon) and the extinct giant *Varanus* (*Megalania*) *priscus*. *Proceedings of the National Academy of Sciences of the USA* 106(22): 8969–8974.

FRY, B.G., WÜSTER, W., RAMJAN, S.F.R., JACKSON, T., MARTELLI, P. & KINI, R.M. 2003. Analysis of Colubroidea snake venoms by liquid chromatography with mass spectrometry: evolutionary and toxinological implications. *Rapid Communications in Mass Spectrometry* 17: 2047–2062.

FUHN, I.E. 1969. Revision and redefinition of the genus *Ablepharus* Lichtenstein, 1823 (Reptilia, Scincidae). *Revue Roumaine de Biologie (Zoologie)* 14: 23–41.

GAFFNEY, E. 1991. The fossil turtles of Australia. In P. Vickers-Rich, J. Monaghan, R. Baird, R. & T.H. Rich (eds), *Vertebrate Paleontology of Australia*: 704–720. Pioneer Design Studio, Lilydale.

GAMBLE, T., BAUER, A.M., GREENBAUM, E. & JACKMAN, T.R. 2008a. Evidence for Gondwanan vicariance in an ancient clade of gecko lizards. *Journal of Biogeography* 35: 88–104.

GAMBLE, T., BAUER, A.M., GREENBAUM, E. & JACKMAN, T.R. 2008b. Out of the blue: A novel, trans-Atlantic clade of geckos (Gekkota, Squamata). *Zoologica Scripta* 37(4): 355–366.

GANS, C. 1959. A Taxonomic revision of the African Snake Genus *Dasypeltis* (Reptila : Serpentes). *Annales du Musée Royal du Congo Belge*, Ser. 8, 74: 1–237.

GANS, C. 1974. *Biomechanics.* University of Michigan Press, Ann Arbor.

GANS, C. 2005. Checklist and bibliography of the amphisbaenia of the world. *Bulletin of the American Museum of Natural History* 289: 1–130.

GARBER, S.D. & BURGER J. 1995. A 20-yr study documenting the relationship between turtle decline and human recreation. *Ecological Applications* 5(4): 1151–1162.

GÄRDENFORS, U., HILTON-TAYLOR, C., MACE, G. & RODRIGUEZ, J.P. 2001. The application of IUCN Red List criteria at regional levels. *Conservation Biology* 15(5): 1206–1212.

GARNER, T. & PEARMAN, P. 2001. Reduced genetic diversity in Swiss populations of the Italian Agile Frog, *Rana latastei*. *FrogLog* 46: 3.

GELDENHUYS, C.J. 1994. Bergwind fires and the location pattern of forest patches in the southern Cape landscape, South Africa. *Journal of Biogeography* 21: 49–62.

GELDENHUYS, C.J. 2000. *Assessment of State Forests Managed by Provincal Authorities: KwaZulu-Natal Nature Conservation Services.* Report Number FW-02/00, Department of Water Affairs and Forestry, Pretoria.

GERLACH, J. 2001. Tortoise phylogeny and the '*Geochelone*' problem. *Phelsuma* 9(A): 1–24.

GIBBONS, J.W., SCOTT, D.E., RYAN, T.J., BUHLMANN, K.A., TUBERVILLE, T.D., METTS, B.S., GREENE, J.L., *et al*. 2000. The global decline of reptiles, *déjá vu* amphibians. *Bioscience* 50: 653–666.

GIOVANNOTTIA, M., CAPUTOB, V., O'BRIENA, P.C.M., LOVELLA, F.L., TRIFONOVA, V., NISI CERIONIB, P., OLMO, E., *et al*. 2010. Skinks (Reptilia: Scincidae) have highly conserved karyotypes as revealed by chromosome painting. *Cytogenetic and Genome Research* 127: 224–231.

GLAW, F. & VENCES, M. 2007. *A Field Guide to the Amphibians and Reptiles of Madagascar.* Third Edition. Vences & Glaw Verlag, Cologne.

GLOBAL INVASIVE SPECIES DATABASE. 2010. *www.issg.org/database/species/search.asp.*

GOEDBLOED, D. & CUNNINGHAM, M. 2006. Distribution and phylogeography of *Pseudocordylus langi*, a montane endemic lizard from the Drakensberg Mountains. In *Programme & Abstracts of the 8th Herpetological Association of Africa Symposium, 24–27 November 2006*: 48. North-West University, Potchefstroom, South Africa.

GOOD, D.A. & BAUER, A.M. 1995. The Namaqua day gecko revisited: allozyme evidence for the affinities of *Phelsuma ocellata*. *Journal of the Herpetological Association of Africa* 44: 1–9.

GOOD, D.A., BAUER, A.M. & BRANCH, W.R. 1996. A new species of *Phyllodactylus* (Squamata: Gekkonidae) from the Karoo National Park, South Africa. *African Journal of Herpetology* 45(2): 49–58.

GOODE, E.V., FOLEY, K.E. & BAARD, E.H.W. 2012. The Geometric Tortoise: Quietly 'Slipping' into Extinction. *The Tortoise* 1(1): 40–49.

GRAVLUND, P. 2001. Radiation within the advanced snakes (Caenophidia) with special emphasis on African opistoglyph colubrids, based on mitochondrial sequence data. *Biological Journal of the Linnean Society* 72: 99–114.

GREEN, B. & KING, D. 1993. *Goanna. The Biology of Varanid Lizards.* Australian Natural History Series. New South Wales University Press, Kensington, Australia.

GREENBAUM, E., BAUER, A.M. & JACKMAN, T.R. 2007. *Homopholis* and *Blaesodactylus* (Squamata: Gekkonidae) revisited: New insights from a molecular phylogeny. *African Journal of Herpetology* 56: 101–114.

GREENBAUM, E., STANLEY, E.L., KUSAMBA, C., MONINGA, W.M., GOLDBERG, S.R. & BURSEY, C.R. 2012. A new species of *Cordylus* (Squamata: Cordylidae) from the Marungu Plateau of south-eastern Democratic Republic of the Congo. *African Journal of Herpetology* 61(1): 14–39.

GREER, A.E. 1970. A subfamilial classification of scincid lizards. *Bulletin of the Museum of Comparative Zoology* 139: 151–183.

GREER, A.E. 1974. The generic relationships of the scincid lizard genus *Leiolopisma* and its relatives. *Australian Journal of Zoology, Supplemetary Series* 31: 1–67.

GREER, A.E. 1991. Limb reduction in squamates: identification of the lineages and discussion of the trends. *Journal of Herpetology* 25: 166–173.

GREIG, J.C. & BURDETT, P.D. 1976. Patterns in the distribution of southern African terrestrial tortoises (Cryptodira: Testudinidae). *Zoologica Africana* 11(2): 249–273.

GRIFFIN, M. 2003. *Annotated Checklist and Provisional National Conservation Status of Namibian Reptiles.* Namibia Scientific Society, Windhoek.

GROOMBRIDGE, B. 1994. IUCN Red List of Threatened Animals. IUCN, Gland.

HAACKE, W.D. 1969. The call of the barking geckos. *Scientific Papers of the Namib Desert Research Station* 46: 83–93.

HAACKE, W.D. 1975. The burrowing geckos of southern Africa, 1 (Reptilia: Gekkonidae). *Annals of the Transvaal Museum* 29(12):197–243, pls 10 & 11.

HAACKE, W.D. 1976a. The burrowing geckos of southern Africa, 5 (Reptilia: Gekkonidae). *Annals of the Transvaal Museum* 30: 71–89.

HAACKE, W.D. 1976b. The burrowing geckos of southern Africa, 4 (Reptilia: Gekkonidae). *Annals of the Transvaal Museum* 30: 53–70.
HAACKE, W.D. 1976c. The burrowing geckos of southern Africa, 3 (Reptilia: Gekkonidae). *Annals of the Transvaal Museum* 30: 29–39.
HAACKE, W.D. 1976d. The burrowing geckos of southern Africa, 2 (Reptilia: Gekkonidae). *Annals of the Transvaal Museum* 30: 13–28.
HAACKE, W.D. 1982. Further notes on reproduction and distribution of the Natal purple-glossed snake *Amblyodipsas concolor* (A.Smith). *Journal of the Herpetological Association of Africa* 28: 24–25.
HAACKE, W.D. 1984. The herpetology of the southern Kalahari domain. In Proc. Symp. Kalahari Ecosystems. *Koedoe* (Suppl.) 1984: 171–186.
HAACKE, W.D. 1986. Description of a new species of *Typhlosaurus* Wiegmann, 1834 (Reptilia: Scincidae) from the west coast of southern Africa, with new records of related species. *Annals of the Transvaal Museum* 34: 227–235.
HAACKE, W.D. 1988a. *Typhlosaurus lomii*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 146–147. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
HAACKE, W.D. 1988b. *Cryptoblepharus boutonii africanus*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 75–77. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
HAACKE, W.D. 1996. Description of a new species of *Phyllodactylus* Gray (Reptilia: Gekkonidae) from the Cape Fold Mountains, South Africa. *Annals of the Transvaal Museum* 36: 229–237.
HAACKE, W.D. 2002. Variation in population size of Bouton's snake-eyed skink (Reptilia: Scincidae) at Black Rock in northern KwaZulu-Natal, South Africa. *Koedoe* 45(1): 93–100.
HAACKE, W.D. 2008. A new leaf-toed gecko (Reptilia: Gekkonidae) from south-western Angola. *African Journal of Herpetology* 57(2): 85–92.
HAAGNER, G., BRANCH, W.R. & HAAGNER, A. 2000. Notes on a collection of reptiles from Zambia and adjacent areas of the Democratic Republic of the Congo. *Annals of the Eastern Cape Museums* 1: 1–25.
HAAGNER, G.V. 1990. Life history notes: *Dispholidus typus typus* Boomslang. Ophiophagy. *Journal of the Herpetological Association of Africa* 37: 47.
HAAGNER, G.V. 1994. Geographical distribution: *Amblyodipsas concolor*. *African Herp News* 21: 26.
HAAGNER, G.V. & BRANCH, W.R. 1994. A taxonomic revision of the dusky-bellied water snake, *Lycodonomorphus laevissimus* (Serpentes: Colubridae). *Journal of African Zoology* 108: 237–250.
HAHN, D.E. 1980. Liste der rezenten Amphibien und Reptilien. Anomalepididae, Leptotyphlopidae, Typhlopidae. *Das Tierreich* 101: 1–93.
HAILEY, A., CHIDAVAENZI, R.L. & LOVERIDGE, J.P. 1998. Diet mixing in the omnivorous tortoise *Kinixys spekii*. *Functional Ecology* 12: 373–385.
HALKETT, D., HART, T., YATES, R., VOLMAN, T.P., PARKINGTON, J.E., ORTON, J., KLEIN, R.G., *et al*. 2003. First excavation of intact Middle Stone Age layers at Ysterfontein, Western Cape Province, South Africa: Implications for Middle Stone Age ecology. *Journal of Archaeological Science* 30: 955–971.
HAMANN, M., LIMPUS, C., HUGHES, G., MORTIMER, J. & PILCHER, N. 2006. *Assessment of the Conservation Status of the Leatherback Turtle in the Indian Ocean and South East Asia.* IOSEA Marine Turtle MoU Secretariat, Bangkok.
HAN, D., ZHOU, K. & BAUER, A.M. 2004. Phylogenetic relationships among the higher taxonomic categories of gekkotan lizards inferred from C-mos nuclear DNA sequences and a new classification of the Gekkota. *Biological Journal of the Linnaean Society* 83: 353–368.
HANSEN, M.C., STEHMAN, S.V. & POTAPOV, P.V. 2010. Quantification of global gross forest cover loss. *Proceedings of the National Academy of Sciences of the USA* 107(19): 8650–8655.
HARRIS, D.J., ARNOLD, E.N. & THOMAS, R.H. 1998. Relationships of lacertid lizards (Reptilia: Lacertidae) estimated from mitochondrial DNA sequences and morphology. *Proceedings of the Royal Society of London B* 265: 1939–1948.
HARRIS, D.J., MARSHALL, J.C. & CRANDALL, K.A. 2001. Squamate relationships based on C-mos nuclear DNA sequences: Increased taxon sampling improves bootstrap support. *Amphibia-Reptilia* 22: 235–242.
HARRISON, J.A. & BURGER, M. (eds). 1998. *Frogs and Frog Atlasing in Southern Africa. ADU Guide 4.* Animal Demography Unit, Cape Town.
HARRISON, J.A., BURGER, M., MINTER, L.R., DE VILLIERS, A.L., BAARD, E.H.W., SCOTT, E., BISHOP, P.J., *et al.* 2001. *Conservation Assessment and Management Plan for Southern African Frogs. Final Report.* IUCN/SSC Conservation Breeding Specialist Group, Apple Valley.
HARVEY, M.B., BARKER, D.G., AMMERMAN, L.K. & CHIPPINDALE, P.T. 2000. Systematics of pythons of the *Morelia amethistina* complex (Serpentes: Boidae) with the description of three new species. *Herpetological Monographs* 14: 139–185.
HAYWARD, J. & MOUTON, P. LE F.N. 2007. Group location in the group-living lizard, *Cordylus cataphractus*: The significance of occupancy and a group signal. *Amphibia-Reptilia* 28: 329–335.
HEDGES, S.B. 2008. At the lower limit of size in snakes: Two new species of threadsnakes (Squamata: Leptotyphlopidae: *Leptotyphlops*) from the Lesser Antilles. *Zootaxa* 1841: 1–30.
HEDGES, S.B. & KUMAR, S. (eds). 2009. *The Timetree of Life.* Oxford University Press, Oxford.
HEDGES, S.B. & VIDAL, N. 2009. Lizards, snakes, and amphisbaenians (Squamata). In S.B. Hedges & S. Kumar (eds), *The Timetree of Life*: 383–389. Oxford University Press, Oxford.
HEINZ, H.M. 2011. *Comparative phylogeography of two widespread geckos from the typically narrow-ranging* Pachydactylus *group in southern Africa*. M.Sc. dissertation, Villanova University, Villanova.
HEKKALA, E.R., AMATO, G., DESALLE, R. & BLUM, M.J. 2010. Molecular assessment of population differentiation and individual assignment potential of Nile crocodile (*Crocodylus niloticus*) populations. *Conservation Genetics* 11: 1435–1443.
HENEN, B.T., HOFMEYR, M.D., BALSAMO, R.A. & WEITZ, F.M. 2005. Lessons from the food choices of the endangered geometric tortoise *Psammobates geometricus*. *South African Journal of Science* 101: 435–438.
HERMANN, H-W. & JOGER, U. 1997. Evolution of viperine snakes. In R. Thorpe, W. Wüster & A. Malhotra (eds), *Venomous Snakes: Ecology, Evolution and Snakebite*: 43–61. Oxford University Press, London.
HERSELMAN, Y.M. 1991. *A Revision of the Taxonomic Status of Pseudocordylus capensis (Reptilia: Cordylidae).* M.Sc. thesis, University of Stellenbosch, Stellenbosch.
HERSELMAN, Y.M., MOUTON, P. LE F.N. & VAN WYK, J.H. 1992. The status of the races of the graceful crag lizard, *Pseudocordylus capensis*, from South Africa. *Amphibia-Reptilia* 13(2): 109–119.
HEWITT, J. 1925. On some new species of reptiles and amphibians from South Africa. *Records of the Albany Museum* 3: 343–368, xv–xix.
HEWITT, J. 1926. Some new or little-known reptiles and batrachians from South Africa. *Annals of the South African Museum* 20: 473–490.
HEWITT, J. 1927. Further descriptions of reptiles and batrachians from South Africa. *Records of the Albany Museum* 3: 371–415.
HEWITT, J. 1931. Descriptions of some African tortoises. *Annals of the Natal Museum* 6: 461–506.
HEWITT, J. 1933. On the Cape species and subspecies of the genus *Chersinella* Gray. Part I. *Annals of the Natal Museum* 7(2): 255–297.
HEWITT, J. 1934. On the Cape species and subspecies of the genus *Chersinella* Gray. Part II. *Annals of the Natal Museum* 7(3): 303–352.
HEWITT, J. 1935. Some new forms of batrachians and reptiles from South Africa. *Records of the Albany Museum* 4: 283–357.
HEWITT, J. 1937a. *A Guide to the Vertebrate Fauna of the Eastern Cape Province, South Africa. Part II. Reptiles, Amphibians and Freshwater Fishes.* Albany Museum, Grahamstown.

HEWITT, J. 1937b. A note on the relationships of the Cape genera of land tortoises. *South African Journal of Science* 33: 788–796.

HEWITT, J. 1937c. Descriptions of South African lizards. *Annals of the Natal Museum* 8(2): 199–209.

HEWITT, J. & METHUEN, P.A. 1913. Descriptions of some new Batrachia and Lacertilia from South Africa. *Transactions of the Royal Society of South Africa* 3: 107–111.

HEYING, H. 2003. Family Agamidae. *Animal Diversity Web (University of Michigan Museum of Zoology).* http://animaldiversity.ummz.umich.edu/site/accounts/information/Agamidae.html.

HIBBITTS, T.J., WHITING, M.J. & STUART-FOX, D.M. 2007. Shouting the odds: vocalization signals status in a lizard. *Behavioral Ecology and Sociobiology* 61: 1169–1176.

HILTON-TAYLOR, C. 2000. *2000 IUCN Red List of Threatened Species.* IUCN Species Survival Commission, Cambridge.

HIPSLEY, C.A., HIMMELMANN, L., METZLER, D. & MÜLLER, J. 2011. Integration of Bayesian molecular clock methods and fossil based soft-bounds reveals an early Cenozoic origin of African lacertid lizards. *BMC Evolutionary Biology* 9: 151.

HIRTH, H. & CARR, A. 1970. *The Green Turtle in the Gulf of Aden and the Seychelles Islands.* North-Holland Publishing Company, Amsterdam.

HIRTH, H.F. 1969. *Marine Turtles in the Seychelles and Aldabra (British Indian Ocean Territory).* Proceedings of the Working Meeting of Marine Turtle Specialists, IUCN, Morges.

HIRTH, H.F. 1997. Synopsis of the Biological Data on the Green Turtle, *Chelonia mydas* (Linnaeus 1758). US Fish & Wildlife Service Biological Report 97(1): 1–120.

HITCHINGS, S.P. & BEEBEE, T.J.C. 1997. Genetic substructuring as a result of barriers to gene flow in urban *Rana temporaria* (common frog) populations: implications for biodiversity conservation. *Heredity* 79: 117–127.

HITCHINS, P.M., BOURQUIN, O. & HITCHINS, S. 2004. Nesting success of hawksbill turtles (*Eretmochelys imbricata*) on Cousine Island, Seychelles. *Journal of Zoology, London* 264: 383–389.

HOARE, D.B., MUCINA, L., RUTHERFORD, M.C., VLOK, J.H.J., EUSTON-BROWN, D.I.W., PALMER, A.R., POWRIE, L.W., *et al*. 2006. Albany Thicket Biome. In L. Mucina & M.C. Rutherford (eds), *The Vegetation of South Africa, Lesotho and Swaziland*: 541–567. South African National Biodiversity Institute, Pretoria.

HOFFMAN, D. & VAN DER BANK, H. 2001. Geographical distribution: *Pelusios subniger subniger*. *African Herp News* 32: 24.

HOFFMAN, T.S. & O'RIAIN, M.J. 2011. The spatial ecology of Chacma baboons (*Papio ursinus*) in a human-modified environment. *International Journal of Primatology* 32: 308–328.

HOFFMANN, M., HILTON-TAYLOR, C., ANGULO, A., BOHM, M., BROOKS, T.M., BUTCHART, S.H.M., CARPENTER, K.E., *et al*. 2010. The impact of conservation on the status of the world's vertebrates. *Science* 330 (6010): 1503–1509.

HOFMEYR, M.D. 2004. Egg production in *Chersina angulata*: an unusual pattern in a Mediterranean climate. *Journal of Herpetology* 38: 172–179.

HOFMEYR, M.D. 2009. *Chersina angulata* (Schweigger 1812)—angulate tortoise, South African bowsprit tortoise. In A.G.J. Rhodin, P.C.H. Pritchard, P.P. van Dijk, R.A. Saumure, K.A. Buhlmann, J.B. Iverson & R.A. Mittermeier (eds.), *Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group*: 030.1–030.6. Chelonian Research Monographs No. 5, www.iucn-tftsg.org/cbftt/.

HOFMEYR, M.D., HENEN, B.T. & BAARD, E.H.W. 2006. Conservation action plan for the Endangered geometric tortoise. *Chelonii* 4: 101–105.

HOFMEYR, M.D., HENEN, B.T. & LOEHR, V.J.T. 2005. Overcoming environmental and morphological constraints: Egg size and pelvic kinesis in the smallest tortoise, *Homopus signatus*. *Canadian Journal of Zoology, London* 83: 1343–1352.

HOLMES, R.B., MURRAY, A.M., ATTIA, Y.S., SIMONS, E.L. & CHATRATH, P. 2010. Oldest known *Varanus* (Squamata: Varanidae) from the Upper Eocene and Lower Oligocene of Egypt: Support for an African origin of the genus. *Palaeontology* 53(5): 1099–1110.

HONDA, M., OTA, H., KOBAYASHI, M., NABHITABHATA, J., YONG, H.S. & HIKIDA, T. 2000. Phylogenetic relationships, character evolution, and biogeography of the subfamily Lygosominae (Reptilia: Scincidae) inferred from mitochondrial DNA sequences. *Molecular Phylogenetics and Evolution* 15: 452–461.

HOOGMOED, M.S. & CRUMLY, C.R. 1984. Land tortoise types in the Rijksmuseum van Natuurlijke Historie with comments on nomenclature and systematics (Reptilia: Testudines: Testudinidae). *Zoologishe Mededelingen* 58(15): 241–259.

HOPKINS, K.P. & TOLLEY, K.A. 2011. Morphological variation in the Cape Dwarf Chameleon (*Bradypodion pumilum*) as a consequence of spatially explicit habitat structure differences. *Biological Journal of the Linnean Society* 102: 878–888.

HORNER, P. 2007. Systematics of the snake-eyed skinks, *Cryptoblepharus* Wiegmann (Reptilia: Squamata: Scincidae)—an Australian based review. *The Beagle (Supplement)* 3: 21–198.

HOSER, R. 2009. A reclassification of the true cobras; species formerly referred to the genera *Naja*, *Boulengerina* and *Paranaja*. *Australasian Journal of Herpetology* 7: 1–15.

HOUGHTON, J.D.R., DOYLE, T.K., WILSON, M.W., DAVENPORT, J. & HAYS, G.C. 2006. Jellyfish aggregations and leatherback turtle foraging patterns in a temperate coastal environment. *Ecology* 87(8): 1967–1972.

HOULAHAN, J.E., FINDLAY, C.S., SCHMIDT, B.R., MEYER, A.H. & KUZMIN, S.L. 2000. Quantitative evidence for global amphibian population declines. *Nature* 404: 752–755.

HOUNIET, D.T., THUILLER, W. & TOLLEY, K.A. 2009. Potential effects of predicted climate change on the endemic South African dwarf chameleons, *Bradypodion*. *African Journal of Herpetology* 59: 28–35.

HUEY, R.B. & PIANKA, E.R. 1977a. Natural selection for juvenile lizards mimicking noxious beetles. *Science* 195(4274): 201–203.

HUEY, R.B. & PIANKA, E.R. 1977b. Patterns of niche overlap among broadly sympatric versus narrowly sympatric Kalahari lizards (Scincidae: *Mabuya*). *Ecology* 58: 119–128.

HUEY, R.B., PIANKA, E.R., EGAN, M.E. & COONS, L.W. 1974. Ecological shifts in sympatry: Kalahari fossorial lizards (*Typhlosaurus*). *Ecology* 55: 304–316.

HUGHES, B. 1985: Progress on a taxonomic revision of African green tree snakes (*Philothamnus* spp.). In Schuchmann, K.L. (ed.). Proceedings of the International Symposium on African Vertebrates. ZFMK, Bonn.

HUGHES, G.R. 1971. Sea turtle research and conservation in South East Africa. *IUCN Publications New Series Supplementary Papers* 20: 56–66.

HUGHES, G.R. 1972. The olive ridley sea-turtle (*Lepidochelys olivacea*) in South-east Africa. *Biological Conservation* 4: 128–134.

HUGHES, G.R. 1974a. *The Sea Turtles of South-East Africa. I. Status, Morphology and Distributions.* Investigational Report 35. Oceanographic Research Institute, Durban, South Africa.

HUGHES, G.R. 1974b. *The Sea Turtles of South-East Africa. II. The Biology of the Tongaland Loggerhead Turtle Caretta caretta L. with comments on the Leatherback Turtle Dermochelys coriacea L. and the Green Turtle Chelonia midas L. in the study region.* Investigational Report 37. Oceanographic Research Institute, Durban.

HUGHES, G.R. 1974c. *The Sea Turtles of South East Africa.* Ph.D. thesis, University of Natal, Durban.

HUGHES, G.R. 1976. *Sea Turtles in South East Africa.* Proceedings of the Symposium on Endangered Wildlife in Southern Africa. University of Pretoria, Pretoria.

HUGHES, G.R. 1978. Marine Turtles. In A.E.F. Heydorn (ed.), Ecology of the Agulhas Current region: An assessment of biological responses to environmental parameters in the south-west Indian Ocean. *Transactions of the Royal Society of South Africa* 43(2): 151–190.

HUGHES, G.R. 1980. *Sea Turtles: A Guide.* Natal Parks Board, Pietermaritzburg.

HUGHES, G.R. 1989. Sea turtles. In D. Pelletier & R.J.M. Crawford (eds), *Oceans of Life off Southern Africa*: 230–243. Vlaeberg, Cape Town.

HUGHES, G.R. 1996. Nesting of the leatherback turtle (*Dermochelys coriacea*) in Tongaland, KwaZulu-Natal, South Af-

rica, 1963–1995. *Chelonian Conservation and Biology* 2(2): 153–158.
HUGHES, G.R. 2010. Loggerheads and leatherbacks in the western Indian Ocean. *Indian Ocean Turtle Newsletter* 11: 24–31.
HUGHES, G.R. & MENTIS, M.T. 1967. Further studies on marine turtles in Tongaland II. *Lammergeyer* 7: 55–72.
HUGHES, G.R., LUSCHI, P., MENCACCI, R. & PAPI, F. 1998. The 7000-km oceanic journey of a leatherback turtle tracked by satellite. *Journal of Experimental Marine Biology and Ecology* 229: 209–217.
ICZN (INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE). 1999. *International Code of Zoological Nomenclature, Fourth Edition*. International Trust for Zoological Nomenclature, London.
ICZN (INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE). 2005. Opinion 2104 (Case 3226). Lacepède, B.G.É. de la V., 1788, Histoire Naturelle des Quadrupèdes Ovipares: rejected as a non-binominal work. *Bulletin of Zoological Nomenclature* 62(1): 55.
IOSEA. 2009. Online Reporting Facility IOSEA MoU. *www.ioseaturtles.org/report.php.*
ISMAIL, M., AL-AHAIDIB, M.S., ABDOON, N. & ABD-ELSALAM, M.A. 2007. Preparation of a novel antivenom against *Atractaspis and Walterinnesia venoms. Toxicon* 49(1): 8–18.
IUCN. 1996. *1996 IUCN Red List of Threatened Animals.* IUCN, Gland, Switzerland and Cambridge, UK.
IUCN. 2001. *IUCN Red List Categories and Criteria.* Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
IUCN. 2003. *Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0.* IUCN Species Survival Commission, IUCN, Gland, Switzerland and Cambridge, UK.
IUCN. 2008. *Guidelines for Using the IUCN Red List Categories and Criteria, Version 7.0 (August 2008)*. IUCN Species Survival Commission, IUCN, Gland, Switzerland and Cambridge, UK.
IUCN. 2009. *The IUCN Red List of Threatened Species, 2009*. www.iucnredlist.org/.
IUCN. 2010a. *Nature's backbone at risk*. www.iucn.org/about/work/programmes/species/news_events/?6333/Natures-backbone-at-risk.
IUCN. 2010b. *The IUCN Red List of Threatened Species, 2010.4*. www.iucnredlist.org/.
IUCN. 2012a. *IUCN Red List of Categories and Criteria: Version 3.1*. Second edition. IUCN, Gland, Switzerland and Cambridge, UK.
IUCN. 2012b. *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels: Version 4.0*. IUCN, Gland, Switzerland and Cambridge, UK.
IUCN STANDARDS AND PETITIONS SUBCOMMITTEE. 2010. *Guidelines for Using the IUCN Red List categories and Criteria. Version 8.1*. Prepared by the Standards and Petitions Subcommittee in August 2010, http://www.iucnredlist.org/documents/RedListGuidelines.pdf.
IVERSON, J.B. 1992. *A Revised Checklist with Distribution Maps of the Turtles of the World.* Iverson Publishers, Richmond.
JACKSON, J.C. 2007. *Reproduction in Dwarf Chameleons (Bradypodion) with particular reference to B. pumilum occurring in Fire-prone Fynbos Habitat.* Ph.D. thesis, University of Stellenbosch, Stellenbosch.
JACOBSEN, N.H.G. 1984. A new subspecies of *Chirindia langi* (Reptilia: Amphisbaenia) from southern Africa, with notes on the ecology of the species. *Annals of the Transvaal Museum* 33: 391–398.
JACOBSEN, N.H.G. 1986. A new subspecies of *Amblyodipsas microphthalma* (Bianconi, 1850) (Serpentes: Colubridae) from the Transvaal. *Annals of the Transvaal Museum* 34(5): 123–127.
JACOBSEN, N.H.G. 1987a. A new subspecies of *Typhlosaurus lineatus* Boulenger 1887 (Reptilia: Scincidae) from Venda, southern Africa. *South African Journal of Zoology* 22: 318–320.
JACOBSEN, N.H.G. 1987b. A new subspecies of *Scelotes limpopoensis* FitzSimons, 1930 (Sauria: Scincidae), with notes on the distribution of the genus *Scelotes* in the Transvaal. *Annals of the Transvaal Musuem* 34: 371–376.
JACOBSEN, N.H.G. 1988a. *Afroedura pondolia multiporis*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 138–139. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
JACOBSEN, N.H.G. 1988b. *Lygodactylus methueni*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 73–74. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
JACOBSEN, N.H.G. 1988c. *Lacerta rupicola*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 159–160. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
JACOBSEN, N.H.G. 1988d. *Nucras caesicaudata*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 200–201. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
JACOBSEN, N.H.G. 1988e. *Platysaurus relictus*: species account. In W.R. Branch, W.R. (ed.), *South African Red Data Book—Reptiles and Amphibians*: 166–167. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
JACOBSEN, N.H.G. 1988f. *Tetradactylus eastwoodae*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 23–24. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
JACOBSEN, N.H.G. 1988g. *Tetradactylus breyeri*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 107–108. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
JACOBSEN, N.H.G. 1988h. *Typhlosaurus lineatus richardi*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 147–148. South African National Scientific Programmes Report No. 51. CSIR, Pretoria.
JACOBSEN, N.H.G. 1988i. *Acontophiops lineatus*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 150–151. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
JACOBSEN, N.H.G. 1988j. *Amblyodipsas microphthalma microphthalma*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 184–185. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
JACOBSEN, N.H.G. 1989. *The Distribution and Conservation Status of Reptiles and Amphibians in the Transvaal. Final Report Project TN 6/4/1/30.* Chief Directorate of Nature and Environmental Conservation, Pretoria.
JACOBSEN, N.H.G. 1992a. New *Lygodactylus* taxa (Reptilia: Gekkonidae) from the Transvaal. *Bonner Zoologische Beiträge* 43: 527–542.
JACOBSEN, N.H.G. 1992b. Flat geckos (genus *Afroedura*) in the Transvaal. *Journal of the Herpetological Association of Africa* 40: 22–25.
JACOBSEN, N.H.G. 1992c. The status of *Agama aculeata armata* Peters 1854, (Reptilia: Agamidae). *Journal of the Herpetological Association of Africa* 41: 30–34.
JACOBSEN, N.H.G. 1994a. The *Platysaurus intermedius* complex (Sauria: Cordylidae) in the Transvaal, South Africa, with descriptions of three new taxa. *South African Journal of Zoology* 29(2): 132–143.
JACOBSEN, N.H.G. 1994b. A new subspecies of *Lygodactylus ocellatus* (Roux) (Lacertilia: Gekkonidae) from the Soutpansberg, South Africa. *Journal of African Zoology* 108: 231–236.
JACOBSEN, N.H.G. 1995. *Chamaesaura macrolepis macrolepis*: Geographical distribution. *African Herp News* 23: 48.
JACOBSEN, N.H.G. 2005. *Remarkable Reptiles of South Africa.* Briza, Pretoria.
JACOBSEN, N.H.G. 2011. The distribution of *Lygodactylus bradfieldi* Hewitt 1932 in Limpopo Province, South Africa. *African Herp News* 53: 21–27.
JACOBSEN, N.H.G. 2012. Geographical Distribution: *Lygodactylus capensis capensis*. *African Herp News* 56: 37–38.
JACOBSEN, N.H.G. & BROADLEY, D.G. 2000. A new species of *Panaspis* Cope (Reptilia: Scincidae) from southern Africa. *African Journal of Herpetology* 49(1): 61–71.
JACOBSEN, N.H.G. & NEWBERY, R.E. 1989. The genus *Platysaurus* A. Smith 1844 in the Transvaal. *Journal of the Herpetological Association of Africa* 36: 51–63.

JACOBSEN, N.H.G., PIETERSEN, E.W. & PIETERSEN, D.W. 2010. A preliminary herpetological survey of the Vilanculos Coastal Wildlife Sanctuary on the San Sebastian Peninsula, Vilankulo, Mozambique. *Herpetology Notes* 3: 181–193.

JANECEK, J. 1976. An exceptionally lathe puff adder brood, *Bitis arietans* at Dvur Kralove Zoo. *International Zoo Yearbook* 16: 85–86.

JANKE, A., GULLBERG, A., HUGHES, S., AGGARWAL, R.K. & ARNASON, U. 2005. Mitogenomic analyses place the Gharial (*Gavialis gangeticus*) on the crocodile tree and provide Pre-K/T divergence times for most crocodilians. *Journal of Molecular Evolution* 61(5): 620–626.

JANSE VAN RENSBURG, D.A. 2009. *Morphological and Behavioural Correlates of Melanism in Cordylid Lizards: Conservation Implications for Melanistic Lizards in the Greater Cederberg Biodiversity Corridor.* Ph.D. thesis, University of Stellenbosch, Stellenbosch.

JANSE VAN RENSBURG, D.A., MOUTON, P. LE F.N. & VAN NIEKERK, A. 2009. Why cordylid lizards are black at the south-western tip of Africa. *Journal of Zoology, London* 278(4): 333–341.

JANSE VAN VUUREN, L.C. 2009. *A Taxonomic Study of the Genus Microacontias (Reptillia: Acontinae) using DNA and Morphometric Data.* M.Sc. thesis, University of the Free State, Bloemfontein, South Africa.

JENSEN, M.P., ABREY-GROBOIS, F.A., FRYDENBERG, J. & LOESCHCKE, V. 2006. Microsatellites provide insight into contrasting mating patterns in arribada vs. non-arribada olive ridley sea turtle rookeries. *Molecular Ecology* 15: 2567–2575.

JESUS, J., HARRIS, J.D. & BREHM, A. 2007. Relationships of *Afroablepharus* Greer, 1974 skinks from the Gulf of Guinea islands based on mitochondrial and nuclear DNA: Patterns of colonization and comments on taxonomy. *Molecular Phylogenetics and Evolution* 45: 904–914.

JOGER, U. 1985. The African gekkonine radiation—preliminary phylogenetic results, based on quantitative immunological comparisons of serum albumins. In K.L. Schuchmann (ed.), *Proceedings of the International Symposium on African Vertebrates*: 479–494. Zoologisches Forschungsinstitute und Museum Koenig, Bonn.

JOGER, U. 1991. A molecular phylogeny of agamid lizards. *Copeia* 1991(3): 616–622.

JOGER, U., BSHENA, I. & ESSGHAIER, F. 2008. First record of the parthenogenetic Brahminy blind snake, *Ramphotyphlops braminus* (Daudin, 1803), from Libya (Serpentes: Typhlopidae). *Herpetology Notes* 1: 13–16.

JONAS, Z., ROUGET, M., REYERS, B., MOHAMED, B., RUTHERFORD, M.C., MUCINA, L. & POWRIE, L.W. 2006. Vulnerability assessment of vegetation types. In L. Mucina & M.C. Rutherford (eds), The Vegetation of South Africa, Lesotho and Swaziland: 738–747. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.

JONES, J., COLLEN, B., ATKINSON, G., BAXTER, P., BUBB, P., ILLIAN, J., KATZNER, T., *et al*. 2011. The why, what, and how of global biodiversity indicators beyond the 2010 target. *Conservation Biology* 25(3): 450–457.

JOSHUA, Q.I., HOFMEYR, M.D. & HENEN, B.T. 2010. Seasonal and site variation in Angulate Tortoise diet and activity. *Journal of Herpetology* 44(1): 124–134.

JOSWIG, N. & IZABER, F. 2012. Terrarium Fairs and Terrarium Keeping in the European Union. A Presentation of Facts by the Organizers of the TERRARISTIKA Hamm in Reply to the Paper, "Amphibian and Reptile Pet Markets in the EU: an Investigation and Assessment" (2012) by Phillip C. Arena, Catrina Steedman & Clifford Warwick. (available at http://www.terraristikahamm.de/images/richtigstellung.pdf)

KAISER, H., CROTHER, B.I., KELLY, C.M.R., LUSELLI, L., O'SHEA, M., OTA, H., PASSOS, P., SCHLEIP, W.D. & WÜSTER, W. 2013. Best Practices: In the 21st Century, taxonomic decisions in herpetology are acceptable only when supported by a body of evidence and published via peer review. *Herpetological Review* 44(1): 8–23.

KASELOO, P.A. & TYSON, K.O. 2004. *Synthesis of noise effects on wildlife populations*. Report DOT F 1700.7 (8–72), Office of Research and Technology Services Federal Highway Administration, Virginia.

KEARNEY, M. 2003. Systematics of the Amphisbaenia (Lepidosauria: Squamata) based on morphological evidence from recent and fossil forms. *Herpetological Monographs* 17: 1–74.

KEARNEY, M. & STUART, B.L. 2004. Repeated evolution of limblessness and digging heads in worm lizards revealed by DNA from old bones. *Proceedings of the Royal Society of London B* 271: 1677–1683.

KELLY, C.M.R., BARKER, N.P. & VILLET, M.H. 2003. Phylogenetics of advanced snakes (Caenophidia) based on four mitochondrial genes. *Systematic Biology* 52: 439–459.

KELLY, C.M.R., BRANCH, W.R., VILLET, M.H. & BARKER, N.P. 2009a. Berg adders and montane biogeography: a study of the southern African *Bitis atropos* species complex. In *Programme & Abstracts of the 10th Anniversary Conference, Southern African Society for Systematic Biology, Illovo Beach, 22–27 July 2009*: 39. Illovo Beach, South Africa.

KELLY, C.M.R., BARKER, N.P., VILLET, M.H. & BROADLEY, D.G. 2009b. Phylogeny, biogeography and classification of the snake superfamily Elapoidea: a rapid radiation in the late Eocene. *Cladistics* 25(1): 38–63.

KELLY, C.M.R., BARKER, N.P., VILLET, M.H., BROADLEY, D.G. & BRANCH, W.R. 2008. The snake family Psammophiidae (Reptilia: Serpentes): Phylogenetics and species delimitation in the African sand snakes (*Psammophis* Boie, 1825) and allied genera. *Molecular Phylogenetics and Evolution* 47: 1045–1060.

KELLY, C.M.R., BRANCH, W.R., BROADLEY, D.G., BARKER, N.P. & VILLET, M.H. 2011. Molecular systematics of the African snake family Lamprophiidae Fitzinger, 1843 (Serpentes: Elapoidea), with particular focus on the genera *Lamprophis* Fitzinger 1843 and *Mehelya* Csiki 1903. *Molecular Phylogenetics and Evolution* 58(3):415–26.

KEOGH, J.S. 1998. Molecular phylogeny of elapid snakes and a consideration of their biogeographic history. *Biological Journal of the Linnean Society* 63: 177–203.

KEOGH, J.S., BARKER, D.G. & SHINE, R. 2001. Heavily exploited but poorly known: systematics and biogeography of commercially harvested pythons (*Python curtus* group) in Southeast Asia. *Biological Journal of the Linnean Society* 73: 113–129.

KEOGH, J.S., BRANCH, W.R. & SHINE, S. 2000. Feeding ecology, reproduction and sexual dimorphism in the colubrid snake *Crotaphopeltis hotamboeia* in southern Africa. *African Journal of Herpetology* 49(2): 129–137.

KETTUNEN, M., GENOVESI, P., GOLLASCH, S., PAGAD, S. & STARFINGER, U. 2009. *Technical Support to EU Strategy on Invasive Alien Species (IAS) Assessment of the impacts of IAS in Europe and the EU.* Institute for European Environmental Policy, London and Brussels.

KIMAKWA, E. & NGUSARU, A. 2008. Report of the first meeting of the Western Indian Ocean Marine Turtle Task Force. In D. Hykle & R. Nel (eds), *A Workshop to promote Implementation of the IOSEA Marine Turtle Conservation and Management Plan in the Western Indian Ocean. 27–29 February 2008, Dar es Salaam, Tanzania*: 1–33. IOSEA/WWF.

KINDLER, C., BRANCH, W.R., HOFMEYR, M.D., MARAN, J., ŠIROKÝ, P., VENCES, M., HARVEY, J., *et al*. 2012. Molecular phylogeny of African hinge-back tortoises (*Kinixys*): implications for phylogeography and taxonomy (Testudines: Testudinidae). *Journal of Zoological Systematics and Evolutionary Research* 50(3): 192–201.

KING, D., KING, M. & BAVERSTOCK, P. 1991. A new phylogeny of the Varanidae. *Mertensiella* 2: 211–219.

KING, F.W. & BURKE, R.L. 1997. *Crocodilian, Tuatara and Turtle Species of the World.* An Online Taxonomic and Geographic Reference, www.flmnh.ufl.edu/natsci/herpetology/turtcr.

KIRCHHOF, S. & RICHTER, K. 2009. Eine kaum bekannte Eidechse: die Soutpansberg-Felseidechse *Australolacerta rupicola* (FitzSimons, 1933). *Die Eidechse* 20: 33–40.

KIRCHHOF, S, KRÄMER, M., LINDEN, J. & RICHTER, K. 2010. The reptile species assemblage of the Soutpansberg (Limpopo Province, South Africa) and its characteristics. *Salamandra* 46(3): 147–166.

KISS, A. 2004. Is community-based ecotourism a good use of biodiversity conservation funds? *Trends in Ecology and Evolution* 19(5): 232–237.

KLAUSEWITZ, W. 1957. Eidonomische Untersuchungen über die Rassenkreise *Agama cyanogaster* und *Agama atricollis*. Die

Unterarten von *Agama atricollis*. *Senckenbergiana Biologica* 38: 157–174.
KLAVER, C. & BÖHME, W. 1997. Chamaeleonidae. *Das Tierreich* 112: 1–85.
KLAVER, C. & BÖHME, W. 1986. Phylogeny and classification of the Chamaeleonidae (Sauria) with special reference to hemipenis morphology. *Bonner Zoologische Monographien* 22: 5–60.
KLEIN, R.G. & CRUZ-URIBE, K. 2000. Middle and Later Stone Age large mammal and tortoise remains from Die Kelders Cave 1, Western Cape Province, South Africa. *Journal of Human Evolution* 38: 169–195.
KLEY, N.J. 2001. Prey transport mechanisms in blindsnakes and the evolution of unilateral feeding systems in snakes. *American Zoologist* 41: 1321–1337.
KLUGE, A.G. 1991. Boine phylogeny and research cycles. *Miscellaneous Publications, Museum of Zoology, University of Michigan* 178: 1–58.
KLUGE, A.G. 1993a. *Calabaria* and the phylogeny of erycine snakes. *Zoological Journal Linnaean Society* 107: 293–351.
KLUGE, A.G. 1993b. *Aspidites* and the phylogeny of pythonine snakes. *Records of the Australian Museum* (Supplement 19): 1–77.
KLUGE, A.G. 2001. Gekkotan lizard taxonomy. *Hamadryad* 26: 1–209.
KLUGE, A.G. & Eckardt, M.J. 1969. *Hemidactylus garnotii* Duméril and Bibron, a triploid all-female species of gekkonid lizard. *Copeia* 1969: 651–664.
KOCH, C. 1962. The Tenebrionidae of Southern Africa XXI. *Scientific Papers of the Namib Desert Research Station* 5: 61–106.
KORNER, P., WHITING, M.J. & FERGUSON, J.W.H. 2000. Interspecific aggression in flat lizards suggests poor species recognition. *African Journal of Herpetology* 49: 139–146.
KRAUS, F. 2009. *Alien Reptiles and Amphibians—A Scientific Compendium and Analysis.* Springer, Dordrecht.
KRUGER, F.J., FORSYTH, G.G., KRUGER, L.M., SLATER, K., LE MAITRE, D.C. & MATSHATE, J. 2006. Classification of veldfire risk in South Africa for the administration of the legislation regarding fire management. In D.X. Viegas (ed.), *Fifth International Conference on Forest Fire Research, 27 to 20 November 2006.* Figuiera da Foz, Portugal.
KÖHLER, J., VIETIES, D.R., BONETT, R.M., HITA-GARCIA, F., GLAW, F., STEINKE, D. & VENCES, M. 2005. Boost in species discoveries in a highly endangered vertebrate group: amphibians and global conservation. *BioScience* 55: 693–606.
KUHN, A., BAUER, A. & JACKMAN, T. Molecular phylogenetics of South African flat geckos (Gekkonidae: *Afroedura*) Loveridge, 1944 and the recognition of seven new species. Seventh World Congress of Herpetology, Vancouver, Canada, 8–14 August 2012 (www.wch2012vancouver.com/abstractdownload; see also *African Herp News* 58: 48–49).
KYLE, R. 1999. Gillnetting in nature reserves: a case study from the Kosi Lakes, South Africa. *Biological Conservation* 88: 183–192.
KYLE, R. 2008. A July 2008 update on Nile crocodile numbers in and around the Kosi Bay lakes. Unpublished Internal Report, Ezemvelo KZN Wildlife.
LACEPEDE, B.G.É. de la V. 1788. Histoire Naturelle Des Quadrupedes Ovipares.
LAMB, T. & BAUER, A.M. 2000a. Relationships of the *Pachydactylus rugosus* group of geckos (Reptilia: Squamata: Gekkonidae). *African Zoology* 35: 55–67.
LAMB, T. & BAUER, A.M. 2000b. Systematics of the *Pachydactylus rugosus* complex of southern African geckos (Squamata: Gekkonidae). *African Zoology* 35: 55–67.
LAMB, T. & BAUER, A.M. 2003. *Meroles* revisited: Complementary systematic inference from additional mitochondrial genes and complete taxon sampling of southern Africa's desert lizards. *Molecular Phylogenetics and Evolution* 29: 360–364.
LAMB, T. & BAUER, A.M. 2006. Footprints in the sand: Independent reduction of subdigital lamellae in the Kalahari-Namib ground geckos. *Proceedings of the Royal Society of London B* 273: 855–864.
LAMB, T. & BAUER, A.M. 2013. To be or not to be *Angolosaurus*: a multilocus perspective on the phylogenetic position of Africa's desert plated lizard (Gerrhosauridae). *Zoologica Scripta* 42: 381–388.
LAMB, T., BISWAS, S. & BAUER, A.M. 2010. A phylogenetic reassessment of African fossorial skinks in the subfamily Acontinae (Squamata: Scincidae): evidence for parallelism and polyphyly. *Zootaxa* 2657: 33–46.
LAMB, T., MEEKER, A.M., BAUER, A.M. & BRANCH, W.R. 2003. On the systematic status of the desert plated lizard (*Angolosaurus skoogi*): Phylogenetic inference from DNA sequence analysis of the African Gerrhosauridae. *Biological Journal of the Linnean Society* 78: 253–261.
LAMBARDI, P., LUTJEHARMS, J.R.E., MENCACCI, R., HAYS, G.C. & LUSCHI, P. 2008. Influence of ocean currents on long-distance movement of leatherback sea turtles in the South-west Indian Ocean. *Marine Ecology Progress Series* 353: 289–301.
LAMBARDI, P., MENCACCI, R., LUTJEHARMS, J., HUGHES, G.R., BENVENUTI, S. & LUSCHI, P. 2006. The influence of oceanographic conditions on the migratory behaviour of South African leatherbacks. In M. Frick, A. Panagalopolou, A. Rees & K. Williams (compilers), *Proceedings of the 26th Annual Symposium on Sea Turtle Biology and Conservation*: 98, Heraklion, Greece.
LAMBIRIS, A.J.L., LAMBIRIS, J.C. & MATHER, S. 1989. A field study of the hinged tortoise *Kinixys spekii* Gray (Chelonii: Testudinidae). *Journal of the Herpetological Association of Africa* 36: 68–71.
LANG, M. 1991. Generic relationships within Cordyliformes (Reptilia: Squamata). *Bulletin de l'Institut recherches sciences naturelles de Belgique* 61: 121–188.
LANGEN, T.A., MACHNIAK, A., CROWE, E.K., MANGAN, C., MARKER, D.F., LIDDLE, N. & RODEN, B. 2007. Methodologies for surveying herpetofauna mortality on rural highways. *Journal of Wildlife Management* 71(4): 1361–1368.
LANGTON, T.E.S. (ed.). 1989. Amphibians on Roads. Proceedings of the Toad Tunnel Conference, ACO Polymers, Shefford, United Kingdom.
LANGTON, T.E.S., ATKINS, W. & HERBERT, C. 2011. On the distribution, ecology and management of non-native reptiles and amphibians in the London Area. Part 1. Distribution and predator/prey impacts. *The London Naturalist* 90: 83–155.
LANGTON, T.E.S. & HERBERT, C. 2011. On the distribution, ecology and management of non-native reptiles and amphibians in the London Area. Part 2. Disease impacts, perspectives, trade exploitation and finding ethical solutions. *The London Naturalist* 90: 157-177.
LANZA, B. & BOSCHERINI, S. 2000. The gender of the genera *Podarcis* Wagler 1839 (Lacertidae), *Pelamis* Daudin 1803 (Hydrophiidae) and *Uropeltis* Cuvier 1829 (Uropeltidae). *Tropical Zoology* 13: 327–329.
LAPPARENT DE BROIN, F. 2000. African chelonians from the Jurassic to the present: phases of development and preliminary catalogue of the fossil record. *Paleontologia Africana* 36: 43–82.
LAPPARENT DE BROIN, F. 2003. Miocene chelonians from southern Namibia. *Memoirs of the Geological Survey of Namibia* 19: 67–102.
LAURANCE, W.F. & USECHE, D.C. 2009. Environmental synergisms and extinctions of tropical species. *Conservation Biology* 23: 1427–1437.
LAURANCE, W.F., CAMARGO, J.L.C., LUIZÃO, R.C.C., LAURANCE, S.G., PIMM, S.L., BRUNA, E.M., STOUFFER, P.C., *et al*. 2011. The fate of Amazonian forest fragments: A 32-year investigation. *Biological Conservation* 144(1): 56–67.
LAURENT, R.L. 1956. Contribution à l'Herpetologie de la Region des Grands Lacs de l'Afrique Centrale. *Annales du Musée Royal du Congo Belge*, Sér. 8, 48: 1–390.
LAURENT, R.L. 1964. Reptiles et amphibiens de l`Angola. *Companhia de Diamantes de Angola, Publicações Culturais* 67: 1–165.
LAURET-STEPLER, M., BOURJEA, J., ROOS, D., PELLETIER, D., RYAN, P.G., CICCIONE, S. & GRIEZEL, H. 2007. Reproductive seasonality and trend of *Chelonia mydas* in the SW Indian Ocean: A 20-year study based on track counts. *Endangered Species Research* 3: 217–227.
LAWES, M.J., EVERARD, D. & EELEY, H.A.C. 1999. Developing environmental criteria and indicators for sustainable plantation management: the South African perspective. *South African Journal of Science* 95: 461–469.

LAWSON, R., SLOWINSKI, J.B. & BURBRINK, F.T. 2004. A molecular approach to discerning the phylogenetic placement of the enigmatic snake *Xenophidion schaeferi* among the Alethinophidia. *Journal of Zoology* 263: 285–294.
LAWSON, R., SLOWINSKI, J.B., CROTHER, B.I. & BURBRINK, F.T. 2005. Phylogeny of the Colubroidea (Serpentes): new evidence from mitochondrial and nuclear genes. *Molecular Phylogenetics and Evolution* 37: 581–601.
LE, M., RAXWORTHY, C.J., MCCORD, W.P. & MERTZ, L. 2006. A molecular phylogeny of tortoises (Testudines: Testudinidae) based on mitochondrial and nuclear genes. *Molecular Phylogenetics and Evolution* 40(2): 517–531.
LE GALL, J.Y. 1988. Biologie et évaluation des populations de Tortue Verte *Chelonia mydas* de atolls Tromelin et Europa. (Oceéan Indien S.O.). *Mésogée* 48: 33–42.
LE ROUX, J. 2002. *The Biodiversity of South Africa 2002: Indicators, Trends and Human Impacts.* Struik, Cape Town.
LEACHÉ, A.[D.]. 2012. Biogeography of African *Agama* lizards. Seventh World Congress of Herpetology, Vancouver, Canada, 8–14 August 2012 (www.wch2012vancouver.com/abstract-download; see also *African Herp News* 58: 49).
LEACHÉ, A.D., CHONG, R.A., PAPENFUS, T.J., WAGNER, P., BÖHME, W., SCHMIDZ, A., RÖDEL, M-O., *et al*. 2009. Phylogeny of the genus *Agama* based on mitochondrial DNA sequence data. *Bonner zoologische Beiträge* 56(4): 273–278.
LEE, M.S.Y. 1998. Convergent evolution and character correlation in burrowing reptiles: Towards a resolution of squamate relationships. *Biological Journal of the Linnean Society* 65: 369–453.
LEE, M.S.Y. 2000. Soft anatomy, diffuse homoplasy, and the relationships of lizards and snakes. *Zoologica Scripta* 29(1): 101–130.
LEE, M.S.Y., HUGALL, A.F., LAWSON, R. & SCANLON, J.D. 2007. Phylogeny of snakes (Serpentes): Combining morphological and molecular data in likelihood, Bayesian and parsimony analyses. *Systematics and Biodiversity* 5(4): 371–389.
LENK, P., HERRMANN, H-W., JOGER, U. & WINK, M. 1999. Phylogeny and taxonomic subdivision of *Bitis* (Reptilia: Viperidae) based on molecular evidence. *Kaupia* 8: 31–38.
LENK, P., KALYABINA, S., WINK, M. & JOGER, U. 2001. Evolutionary relationships among the true vipers (Reptilia: Viperidae) inferred from mitochondrial DNA sequences. *Molecular Phylogenetics and Evolution* 19: 94–104.
LESLIE, A.J & SPOTILA, J.R. 2000. Osmoregulation of the Nile Crocodile, *Crocodylus niloticus*, in Lake St Lucia, KwaZulu-Natal, South Africa. *Comparative Biochemistry and Physiology.* 126(3): 351–365.
LESLIE, A.J., PENICK, D.N., SPOTILA, J.R. & PALADINO, F.V. 1996. Leatherback turtle, *Dermochelys coriacea*, nesting and nesting success at Tortuhuero, Costa Rica, in 1990–1991. *Chelonian Conservation and Biology* 2: 159–168.
LEUTERITZ, T.E.J. & HOFMEYR, M.D. 2007. The extended reproductive season of tent tortoises: a response to an arid and unpredictable environment. *Journal of Arid Environments* 68(4): 546–563.
LEVER, C. 2003. *Naturalized Reptiles and Amphibians of the World.* Oxford University Press, Oxford.
LIMPUS, C. 2009. *A Biological Review of Australian Marine Turtles.* Queensland Environmental Agency, Brisbane.
LINNAEUS, C. 1758. *Systema Naturae, 10th Edition.* Salvius, Stockholm.
LITSCHKA, T., KOEN, C. & MONADJEM, A. 2008. Geographical distribution: *Zygaspis vandami arenicola*. *African Herp News* 46: 24–25.
LLOYD, J.W., VAN DEN BERG, E.C. & PALMER, A.R. 2002. *Patterns of Transformation and Degradation in the Thicket Biome, South Africa. Final Report. Subtropical Thicket Ecosystem Planning Project. Report Number GW/A/2002/30.* ARC-ISCW, Pretoria.
LOEHR, V.J.T. 2006. Natural diet of the Namaqualand speckled padloper (*Homopus signatus signatus*). *Chelonian Conservation and Biology* 5: 149–152.
LOEHR, V.J.T. 2008. *The Ecology of the World's Smallest Tortoise, Homopus signatus signatus: Effects of Rainfall.* Ph.D. thesis, University of the Western Cape, Bellville.
LOEHR, V.J.T. 2010. Der Rooiberg-Gürtelschweif, *Cordylus imkeae* Mouton & van Wyk, 1994: Freilandbeobachtungen, Pflege und Zucht. *Sauria* 32(4): 53–60.
LOEHR, V.J.T., HENEN, B.T. & HOFMEYR, M.D. 2004. Reproduction of the smallest tortoise, the Namaqualand speckled padloper, *Homopus signatus signatus*. *Herpetologica* 60(4): 44–54.
LOEHR, V.J.T., HOFMEYR, M.D. & HENEN, B.T. 2007a. Annual variation in the body condition of a small, arid-zone tortoise, *Homopus signatus signatus*. *Journal of Arid Environments* 71: 337–349.
LOEHR, V.J.T., HOFMEYR, M.D. & HENEN, B.T. 2007b. Growing and shrinking in the smallest tortoise, *Homopus signatus*: the importance of rain. *Oecologia* 153: 479–488.
LOMBARD, P. 2006. *Marine turtle Monitoring and Conservation in Southern Mozambique: Update 2005/2006.* Unpublished report.
LOURO, C., PEREIRA, M. & COSTA, A. 2006. *The Conservation Status of Marine Turtles in Mozambique.* República De Moçambique Ministério Para a Coordenação da Acção Ambiental, Centro de Desenvolvimento Sustentável Para as Zonas Costeiras, Maputo.
LOVERIDGE, A. 1939. Revision of the African snakes of the genera *Mehelya* and *Gonionotophis*. *Bulletin of the Museum of Comparative Zoology* 86: 131–162.
LOVERIDGE, A. 1941. Revision of the African terrapin of the Family Pelomedusidae. *Bulletin of the Museum of Comparative Zoology* 88(6): 465–524.
LOVERIDGE, A. 1942. Revision of the African lizards of the family Gerrhosauridae. *Bulletin of the Museum of Comparative Zoology* 89(11): 485–543.
LOVERIDGE, A. 1944a. New geckos of the genera *Afroedura*, new genus, and *Pachydactylus* from Angola. *American Museum Novitates* 1254: 1–4.
LOVERIDGE, A. 1944b. Remarks on the gekkonid genera *Homopholis* and *Platypholis* with description of a new race. *Proceedings of the Biological Society of Washington* 57: 1–4.
LOVERIDGE, A. 1944c. Revision of the African lizards of the family Cordylidae. *Bulletin of the Museum of Comparative Zoology* 95: 1–118.
LOVERIDGE, A. 1947. Revision of the African lizards of the Family Gekkonidae. *Bulletin of the Museum of Comparative Zoology* 98: 1–469, pls. 1–7.
LOVERIDGE, A. 1953. Zoological results of a fifth expedition to East Africa. III. Reptiles from Nyassaland and Tete. *Bulletin of the Museum of Comparative Zoology* 110: 143–322.
LOVERIDGE, A. 1955. On a second collection of reptiles and amphibians taken in Tanganyika Territory by C.J.P. Ionides. *Journal of East African Natural History Society* 22: 168–198.
LOVERIDGE, A. & WILLIAMS, E.E. 1957. Revision of the African tortoises and turtles of the suborder Cryptodira. *Bulletin of the Museum of Comparative Zoology* 115: 163–557.
LUSCHI, P., HAYS, G.C. & PAPI, F. 2003a. A review of long-distance movements by marine turtles, and the possible role of ocean currents. *Oikos* 103: 293–302.
LUSCHI, P., SALE, E., MENCACCI, R., HUGHES, G.R., LUTJEHARMS, J.R.E., & PAPI, F. 2003b. Current transport of leatherback sea turtles (*Dermochelys coriacea*) in the ocean. *Proceedings of the Royal Society of London B* 270: 129–132.
LUSCHI, P., LUTJEHARM, J.R.E., LAMBARDI, R., MENCACCI, R., HUGHES, G.R. & HAYS, G.C. 2006. A review of migratory behaviour of sea turtles off Southeastern Africa. *South African Journal of Science* 102: 51–58.
LUTZ, P.L. & MUSICK, J.A. (eds). 1996. *The Biology of Sea Turtles. Volume I.* CRC Press, Boca Raton.
MABE, L.T. 2009. *Graceful Crag Lizards (Cordylidae:* Pseudocordylus capensis*) are a Recent Species Radiation in the Cape Fold Mountains.* B.Sc. Honours thesis, University of the Free State, Qwaqwa Campus, Qwaqwa.
MACE, G.M. 2000. Summary of the results of the review of IUCN Red List categories and criteria 1996–2000. In C. Hilton-Taylor, *2000 IUCN Red List of Threatened Species*: (annex 7)57–61. IUCN Species Survival Commission, Cambridge.
MACE, G.M. & LANDE, R. 1991. Assessing extinction threats: towards a re-evaluation of IUCN threatened species categories. *Conservation Biology* 5: 148–157.
MACE, G.M. & STUART, S.N. 1994. Draft IUCN Red List Categories, Version 2.2. *Species* 21–22: 13–24.
MACE, G.M., COLLAR, N.J., COOKE, J., GASTON, K., GINSBERG, J., LEADER, I., WILLIAMS, N., *et al*. 1992. The de-

velopment of new criteria for listing species on the IUCN Red List. *Species* 19: 16–22.
MACEY, J.R., PAPENFUSS, T.J., KUEHL, J.V., FOURCADE, H.M. & BOORE, J.L. 2004. Phylogenetic relationships among amphisbaenian reptiles based on complete mitochondrial genomic sequences. *Molecular Phylogenetics and Evolution* 33: 22–31.
MAKHUBO, B.G. 2009. *Cape Crag Lizards (Cordylidae:* Pseudocordylus microlepidotus*) show extensive Gene Flow across the Cape Floristic Region.* B.Sc. Honours thesis, University of the Free State, Qwaqwa Campus, Qwaqwa.
MAKHUBO, B.G., TOLLEY, K.A. & BATES, M.F. 2012. Phylogenetic relationships among members of the *Afroedura nivaria* species complex in South Africa. Seventh World Congress of Herpetology, Vancouver, Canada, 8–14 August 2012 (www.wch2012vancouver.com/abstractdownload; see also *African Herp News* 58: 51, 2012).
MAKOKHA, J.S., BAUER, A.M., MAYER, W. & MATTHEE, C.A. 2007. Nuclear and mtDNA-based phylogeny of southern African sand lizards, *Pedioplanis* (Sauria: Lacertidae). *Molecular Phylogenetics and Evolution* 44(2): 622–633.
MARAIS, J. 2004. *A Complete Guide to the Snakes of Southern Africa.* Struik, Cape Town.
MARAIS, J. & JUBBER, W. 2010. Geographical distribution: *Naja melanoleuca*. *African Herp News* 52: 24–25.
MARITZ, B. 2007. *The Distribution and Abundance of Herpetofauna on a Quaternary Aeolian Dune Deposit: Implications for Strip Mining.* M.Sc. thesis, University of the Witwatersrand, Johannesburg.
MARITZ, B. & ALEXANDER, G.J. 2007. Herpetofaunal utilisation of riparian buffer zones in an agricultural landscape, in Mtunzini, South Africa. *African Journal of Herpetology* 56(2): 163–169.
MARITZ, B., MASTERSON, G., MACKAY, D. & ALEXANDER, G. 2007. The effect of funnel trap type and size of pitfall trap on trap success: implications for ecological field studies. *Amphibia-Reptilia* 28: 321–328.
MARQUEZ-M., R. 1994. *Sinopsis de datos biológicos sobre la Tortuga Lora, Lepidochelys kempi (Garman, 1880).* FAO Sinopsis No. 152, Food and Agriculture Organisation of the United Nations, sobre la Pesca, Mexico City.
MASHININI, P.L. 2004. *An Ecological Study of Acontias litoralis along the Cape West Coast of South Africa.* M.Sc. thesis, University of the Free State, Bloemfontein.
MASHININI, P.L., HEIDEMAN, N.J.L. & MOUTON, P. LE F.N. 2011. On some ecological aspects of the coastal legless lizard *Acontias litoralis* (Scincidae: Acontinae). *African Herp News* 53: 16–21.
MASON, M.C. & ALEXANDER, G.J. 1996. Oviposition site selection in *Tetradactylus africanus africanus*: A relationship with the ant *Anochetus faurei*. *African Journal of Herpetology* 45(1): 31–37.
MASTERSON, G.[P.R.] 2008. Species richness estimation: the how and why. Abstract: *Proceedings of the 9th Conference of the Herpetological Association of Africa, 26–30 November 2008*. Sterkfontein Dam, South Africa.
MASTERSON, G.P.R., MARITZ, B. & ALEXANDER, G.J. 2008. Effect of fire history and vegetation structure on herpetofauna in a South African grassland. *Applied Herpetology* 5: 129–143.
MASTERSON, G.P.R., MARITZ, B., MACKAY, D. & ALEXANDER, G.J. 2009. The impacts of past cultivation on the reptiles in a South African grassland. *African Journal of Herpetology* 58(2): 71–84.
MATTHEE, C.A. & FLEMMING, A.F. 2002. Population fragmentation in the southern rock agama, *Agama atra*: More evidence for vicariance in southern Africa. *Molecular Ecology* 11(3): 465–471.
MATTHEE, C.A., TILBURY, C.R. & TOWNSEND, T. 2004. A phylogenetic review of the African leaf chameleons: Genus *Rhampholeon* (Chamaeleonidae): The role of vicariance and climate change in speciation. *Proceedings of the Royal Society of London B* 271: 1967–1975.
MATTHEWS, W.S. 1994. *Hippo and Crocodile Counts in the Northern KwaZulu Region. Winter 1994.* Unpublished Report, Bureau of Natural Resources, Pietermaritzburg.
MAUSFELD, P., SCHMITZ, A., BÖHME, W., MISOF, B., VRCIBRADIC, D. & ROCHA, C.F.D. 2002. Phylogenetic affinities of *Mabuya atlantica* Schmidt, 1945, endemic to the Atlantic Ocean archipelago of Fernando de Noronha (Brazil): Necessity of partitioning the genus *Mabuya* Fitzinger, 1826 (Scincidae: Lygosominae). *Zoologischer Anzeiger* 241: 281–293.
MAWOUNG, G.N. 2006. Perception of hunting, gathering and fishing techniques of the Bakola of the coastal region, southern Cameroon. *African Study Monographs (Supplement)* 33: 49–69.
MAYER, W. & PAVLICEV, M. 2007. The phylogeny of the family Lacertidae (Reptilia) based on nuclear DNA sequences: Convergent adaptations to arid habitats within the subfamily Eremiadinae. *Molecular Phylogenetics and Evolution* 44: 1155–1163.
MCALILEY, L.R., WILLIS, R.E., RAY, D.A., WHITE, P.S., BROCHU, C.A. & DENSMORE III, J.D. 2006. Are crocodiles really monophyletic? Evidence for subdivisions from sequence and morphological data. *Molecular Phylogenetics and Evolution* 39: 16–32.
MCALLISTER, H.J., BASS, A.J. & VAN SCHOOR, H.J. 1965. Marine turtles on the coast of Tongaland, Natal. *Lammergeyer* 3(2): 10–40.
MCCALLUM, M.L. 2007. Amphibian decline or extinction? Current declines dwarf background extinction rate. *Journal of Herpetology* 41(3): 483–491.
MCCORD, W.P., JOSEPH-OUNI, M. & TABAKA, C. 2005. Chelonian Illustrations No. 18. African Hinge-Back Tortoises. *Reptilia* 38: 71–74.
MCDIARMID, R.W., CAMPBELL, J.A. & TOURÉ, T.A. 1999. *Snake Species of the World. A Taxonomic and Geographic Reference. Volume 1.* Herpetologists' League, Washington DC.
MCDOWELL, S.B. 1970. On the status and relationships of the Solomon Island elapid snakes. *Journal of Zoology, London* 151: 145–190.
MCDOWELL, S.B. 1974. A catalogue of the snakes of New Guinea and the Solomons, with special reference to those in the Bernice Bishop Museum. Part I. Scolecophidia. *Journal of Herpetology* 8: 1–57.
MCDOWELL, S.M. 1968. Affinities of the snakes usually called *Elaps lacteus* and *E. dorsalis*. *Zoological Journal of the Linnean Society* 47: 561–578.
MCLACHLAN, G.R. 1978a. *South African Red Data Book—Reptiles and Amphibians.* South African National Scientific Programmes Report No. 23. CSIR, Pretoria.
MCLACHLAN, G.R. 1978b. A population of *Typhlops braminus* (Daudin) on the Cape Peninsula (Reptilia; Typhlopidae). *Zoologica Africana* 13(2): 353–354.
MCLACHLAN, G.R. 1979. The taxonomy of *Pachydactylus rugosus*. *Journal of the Herpetological Association of Africa* 21: 4–7.
MCLACHLAN, G.R. 1988a. *Gerrhosaurus typicus*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 109–110. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
MCLACHLAN, G.R. 1988b. *Palmatogecko rangei*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 199–200. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.
MCLACHLAN, G.R. & SPENCE, J.M. 1966. The genus *Pachydactylus* (Part 1). *Annals of the Cape Provincial Museums* 5: 149–156.
MCMAHON, C.R. & HAYS, G.C. 2006. Thermal niche, large-scale movements and implications of climate change for a critically endangered marine vertebrate. *Global Change Biology* 12: 1330–1338.
MEASEY, G.J. (ed). 2011. Ensuring a future for South Africa's frogs: a strategy for conservation research. *SANBI Biodiversity Series* 19. South African National Biodiversity Institute, Pretoria.
MEASY, G.J. & TOLLEY, K.A. 2013. A molecular phylogeny for sub-Saharan amphisbaenians. *African Journal of Herpetology* 62(2): 100–108.
MEASEY, G.J., ARMSTRONG, A.J. & HANEKOM, C. 2009. Subterranean herpetofauna show a decline after 34 years in Ndumu Game Reserve, South Africa. *Oryx* 43: 284–287.
MECENERO, S. & DE VILLIERS, M.S. 2007. Virtual firsts. *CREW* 4 (Dec 2007): 13–14.
MECENERO, S., BALL, J.B., EDGE, D.A., HAMER, M.L., HENNING, G.A., KRÜGER, M., PRINGLE, E.L., TERBLANCHE,

R.F. & WILLIAMS, M.C. 2013. *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas*. Saftronics, Johannesburg & Animal Demography Unit, University of Cape Town, Cape Town.

MEDINA, M.F., GREENBAUM, E., BAUER, A.M. & BRANCH, W.R. 2012. Systematics of African Skinks in the *Panaspis wahlbergi* Complex. Abstract: Seventh World Congress of Herpetology, Vancouver, Canada, 8–14 August 2012 (www.wch-2012vancouver.com/abstractdownload; see also *African Herp News* 58: 53, 2012).

MEGANATHAN, P.R., DUBEY, B., BATZER, M.A., RAY, D.A. & HAQUE, I. 2010. Molecular phylogenetic analyses of genus *Crocodylus* (Eusuchia, Crocodylia, Crocodylidae) and the taxonomic position of *Crocodylus porosus*. *Molecular Phylogenetics and Evolution* 57: 393–402.

MEIRTE, D. 1992. Cles de determination des serpents d'Afrique. *Museum Royal d'Afrique Centrale, Tervuren, Belgique, Annual Series Octavo Science Zoologique* 267: 1–152.

MEREDITH, R.W., HEKKALA, E.R., AMATO, G. & GATESY, J. 2011. A phylogenetic hypothesis for *Crocodylus* (Crocodylia) based on mitochondrial DNA: Evidence for a trans-Atlantic voyage from Africa to the New World. *Molecular Phylogenetics and Evolution* 60: 183–191.

MERTENS, R. 1955. Die Amphibien und Reptilien Südwestafrikas. *Abhandlungen der Senckenbergische Naturforschende Gesellschaft* 490: 1–172.

MERTENS, R. 1971. Die Herpetofauna Südwest-Afrikas. *Abhandlungen der Senckenbergischen naturforschenden Gesellschaft* 529: 1–110.

MESHAKA, W.E., Jr. 2011. A Runaway Train in the Making: The Exotic Amphibians, Reptiles, Turtles, and Crocodilians of Florida. Monograph 1. *Herpetological Conservation and Biology* 6: 1–101.

METHUEN, P.A. & HEWITT, J. 1914. The Percy Sladen Memorial Expedition to Great Namaqualand, 1912–1913. Records and descriptions of the Reptilia and Batrachia. *Annals of the Transvaal Museum* 4: 118–145.

MEYLAN, A. 1988. Spongivory in hawksbill turtles: a diet of glass. *Science* 239(4838): 393–395.

MEYLAN, P. & AUFFENBERG, W. 1986. New land tortoises (Testudines: Testudinidae) from the Miocene of Africa. *Zoological Journal of the Linnean Society* 86: 279–307.

MICHELS, J.P. & BAUER, A.M. 2004. Some corrections to the scientific names of amphibians and reptiles. *Bonner zoologische Beiträge* 52: 83–94.

MIDGLEY, G.F. & THUILLER, W. 2011. Potential responses of terrestrial biodiversity in Southern Africa to anthropogenic climate change. *Regional Environmental Change* 11, Supplement 1: 127–135.

MIDGLEY, G.F., CHAPMAN, R.A., HEWITSON, B., JOHNSTON, P., DE WIT, M., ZIERVOGEL, G., MUKHEIBIR, P., *et al*. 2005. *A Status Quo, Vulnerability and Adaptation Assessment of the Physical and Socio-economic effects of Climate Change in the Western Cape. Report to the Western Cape Government, Cape Town, South Africa.* CSIR Report No. ENV-S-C 2005-073, Stellenbosch.

MIDGLEY, G.F., HANNAH, L., MILLAR, D., RUTHERFORD, M.C. & POWRIE, L.W. 2002. Assessing the vulnerability of species richness to anthropogenic climate change in a biodiversity hotspot. *Global Ecology and Biogeography* 11: 445–451.

MIDGLEY, G.[F.], RUTHERFORD, M.[C.] & BOND, W. 2001. *The Heat is On. Impacts of Climate Change on Plant Diversity in South Africa.* National Botanic Institute, Cape Town.

MILLS, M.G.L. 2002. South African carnivores. In *"The State of South Africa's Species" Proceedings of a conference held at the Rosebank Hotel in Johannesburg 4–7 September 2001*: 169–176. Endangered Wildlife Trust and WWF-SA.

MILTON, S.J. 1992. Plants eaten and dispersed by adult leopard tortoises *Geochelone pardalis* (Reptilia: Chelonii) in the southern Karoo. *South African Journal of Zoology* 27: 45–49.

MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. & KLOEPFER, D. (eds). 2004. *Atlas and Red Data book of the Frogs of South Africa, Lesotho and Swaziland.* SI/MAB Series #9: Smithsonian Institution, Washington, and Avian Demography Unit, University of Cape Town, Cape Town.

MITTLEMAN, M.B. 1952. A generic synopsis of the lizards of the subfamily Lygosominae. *Smithsonian Institution Miscellaneous Collections* 117: 1–35.

MOLNAR, R.E. 2004. *Dragons in the Dust: The Paleobiology of the Giant Monitor Lizard Megalania.* Indiana University Press, Bloomington.

MONADJEM, A., BOYCOTT, R.C., PARKER, V. & CULVERWELL, J. 2003. *Threatened Vertebrates of Swaziland. Swaziland Red Data Book: Fishes, Amphibians, Reptiles, Birds and Mammals.* Ministry of Tourism, Environment and Communications, Mbabane.

MOODY, S.M. 1980. *Phylogenetic and Historical Bogeographical Relationships of the Genera in the Family Agamidae (Reptilia: Lacertilia).* Ph.D. thesis, University of Michigan, Ann Arbor.

MORTIMER, J.A. 1984. *Marine Turtles in the Republic of the Seychelles.* International Union for the Conservation of Nature, Gland.

MORTIMER, J.A. 1995. Feeding ecology of sea turtles. In K.A. Bjorndal (ed), *Biology and Conservation of Sea Turtles*: 103–109. Smithsonian Institution Press, Washington.

MORTIMER, J.A. & DONNELLY, M. 2008. *Red List Status Assessment for the Hawksbill Turtle* (Eretmochelys imbricata). IUCN, Gland.

MOTT, T. & VIEITES, D.R. 2009. Molecular phylogenetics reveals extreme morphological homoplasy in Brazilian worm lizards challenging current taxonomy. *Molecular Phylogenetics and Evolution* 51(2): 190–200.

MOUTON, P. LE F.N. 1986. Description of a new species of *Cordylus* Laurenti (Reptilia: Cordylidae) from the south-western Cape, South Africa. *South African Journal of Zoology* 21: 319–324.

MOUTON, P. LE F. N. 1987. Phenotypic variation among populations of *Cordylus cordylus* (Reptilia: Cordylidae) in the south-western Cape Province, South Africa. *South African Journal of Zoology* 22(2): 119–129.

MOUTON, P. LE F.N. 1988a. *Afroedura hawequensis*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 139–140. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.

MOUTON, P. LE F.N. 1988b. *Lacerta australis*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 157–158. South African National Scientific Programmes Report No. 151. CSIR, Pretoria.

MOUTON, P. LE F.N. 1988c. *Cordylus cataphractus*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 81–82. National Scientific Programmes Report No. 151. CSIR, Pretoria.

MOUTON, P. LE F.N. & HERSELMAN, Y.M. 1994. Paradoxical reproduction and body size in the rock lizard, *Agama atra atra*, in Namaqualand, South Africa. *South African Journal of Zoology* 29(3): 199–203.

MOUTON, P. LE F.N. & MOSTERT, D.P. 1985. Description of a new species of *Afroedura* (Loveridge) (Reptilia: Gekkonidae) from the south-western Cape. *South African Journal of Zoology* 20: 246–249.

MOUTON, P. LE F.N. & VAN WYK, H. 1994. Taxonomic status of geographic isolates in the *Cordylus minor* complex (Reptilia: Cordylidae): A description of three new species. *Journal of the Herpetological Association of Africa* 43: 6–18.

MOUTON, P. LE F.N. & VAN WYK, J.H. 1989. *Cordylus minor*: A valid species of South African lizard (Reptilia: Cordylidae). *South African Journal of Zoology* 24: 322–328.

MOUTON, P. LE F.N. & VAN WYK, J.H. 1990. Taxonomic status of the melanistic forms of the *Cordylus cordylus* complex (Reptilia: Cordylidae) in the south-western Cape, South Africa. *South African Journal of Zoology* 25(1): 31–38.

MOUTON, P. LE F.N. & VAN WYK, J.H. 1993. Sexual dimorphism in cordylid lizards: A case study of the Drakensberg crag lizard, *Pseudocordylus melanotus*. *Canadian Journal of Zoology* 71: 1715–1723.

MOUTON, P. LE F.N. & VAN WYK, J.H. 1995. A new crag lizard from the Cape Folded Mountains in South Africa. *Amphibia-Reptilia* 16: 389–399.

MOUTON, P. LE F.N. & VAN WYK, J.H. 1997. Adaptive radiation in cordyliform lizards: An overview. *African Journal of Herpetology* 46: 78–88.

MOUTON, P. LE F.N., FLEMMING, A.F. & KANGA, E.M. 1999. Grouping behaviour, tail biting behaviour, and sexual dimorphism in the armadillo lizard (*Cordylus cataphractus*) from South Africa. *Journal of Zoology* 249: 1–10.

MOUTON, P. LE F.N., FLEMMING, A.F. & NIEUWOUDT, C.J. 2000b. Sexual dimorphism and sex ratio in a terrestrial girdled lizard, *Cordylus macropholis*. *Journal of Herpetology* 34: 379–386.

MOUTON, P. LE F.N., GEERTSEMA, H. & VISAGIE, L. 2000a. Foraging mode of a group-living lizard, *Cordylus cataphractus* (Cordylidae). *African Zoology* 35: 1–7.

MOUTON, P. LE F.N., JANSE VAN RENSBURG, D.A. & VAN WYK, J.H. 2010. Epidermal glands in cordylid lizards with special reference to generation glands. *Zoological Journal of the Linnean Society* 158: 312–324.

MOUTON, P. LE F.N., NIEUWOUDT, C.J., BADENHORST, N.C. & FLEMMING, A.F. 2002. Melanistic *Cordylus polyzonus* (Sauria: Cordylidae) populations in the Western Cape, South Africa: Relics or ecotypes? *Journal of Herpetology* 36: 526–531.

MOUTON, P. LE F.N., OELOFSEN, B.W. & MOSTERT, D.P. 1987. New Data on threatened lizard species in the south-western Cape, South Africa. *South African Journal of Science* 83: 48–52.

MOUTON, P. LE F.N., VISSER, J.D. & VAN WYK, J.H. 1992. Morphological variation in the girdled lizard *Cordylus mclachlani* Mouton 1986 from South Africa. *South African Journal of Zoology* 27: 35–37.

MOYER, K. & JACKSON, K. 2011. Phylogenetic relationships among the Stiletto Snakes (genus *Atractaspis*) based on external morphology. *African Journal of Herpetology* 60(1): 1–17.

MROSOVSKY, N. 2003. *Predicting Extinction: Fundamental Flaws in IUCN's Redlist System, as exemplified by the case of Sea Turtles.* University of Toronto Press, Toronto.

MUCINA, L. & RUTHERFORD, M.C. 2006. The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19: South African National Biodiversity Institute, Pretoria.

MUCINA, L., HOARE, D.B., LÖTTER, M.C., DU PREEZ, J., RUTHERFORD, M.C., SCOTT-SHAW, C.R., BREDENKAMP, G.J., *et al*. 2006. Grassland Biome. In L. Mucina & M.C. Rutherford (eds), The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19: 348–437. South African National Biodiversity Institute, Pretoria.

MULLER, J. 1997. Reproduction in sea turtles, In P.L. Lutz & J.A. Musick (eds.), *The Biology of Sea Turtles*: 51–82. CRC Press, Boca Raton.

MUSICK, J.A. & LIMPUS, C.J. 1996. Habitat utilization and migration in juvenile sea turtles. In P.L. Lutz & J.A. Musick (eds), *The Biology of Sea Turtles. Volume I*: 137–163. CRC Press, Boca Raton.

NAGY, Z.T., JOGER, U., WINK, M., GLAW, F. & VENCES, M. 2003. Multiple colonization of Madagascar and Socotra by colubrid snakes: evidence from nuclear and mitochondrial gene phylogenies. *Proceedings of the Royal Society, London Series B* 270: 2613–2621.

NAGY, Z.T., VIDAL, N., VENCES, M., BRANCH, W.R., PAUWELS, O.S.G., WINK, M. & JOGER, U. 2005. Molecular systematics of African Colubroidea (Squamata: Serpentes). In B.A. Huber, B.J. Sinclair & K.-H. Lampe (eds), *African Biodiversity: Molecules, Organisms, Ecosystems. Proceedings of the 5th International Symposium on Tropical Biology*: 221–228. Museum Koenig, Bonn.

NANCE, H.A. 2007. Cranial osteology of the African gerrhosaurid *Angolosaurus skoogi* (Squamata; Gerrhosauridae). *African Journal of Herpetology* 56(1): 39–75.

NEÇAS, P. 2004. *Chameleons—Nature's Hidden Jewels.* Edition Chimaira, Frankfurt am Main.

NEL, R. 2008. *Sea Turtles of KwaZulu-Natal: Data Report for 2007/8 Season.* Report for Ezemvelo KwaZulu-Natal Wildlife, Pietermaritzburg.

NEL, R. 2009. *Sea Turtles of KwaZulu-Natal: Data Report for 2008/9 season.* Nelson Mandela Metropolitan University, Port Elizabeth.

NEWBERY, R. 1984. The American red-eared terrapin in South Africa. *African Wildlife* 38(5): 186–189.

NEWBERRY, R.E. & PETERSEN, W. 1982/3. *Management Proposals: Cordylus giganteus. Internal Report.* Transvaal Division Nature Conservation, Pretoria.

NICHOLSON, L. 1978. The effects of roads on desert tortoise populations. In M. Trotter (ed.), *The Desert Tortoise Council Proceedings of the 1978 Symposium*: 127–129. San Diego, USA.

NOONAN, B.P. & CHIPPINDALE, P.T. 2006. Dispersal and vicariance: The complex evolutionary history of boid snakes. *Molecular Phylogenetics and Evolution* 40: 347–358.

NORDMOE, E.D., SIEG, A.E., SOTHERLAND, P.R., SPOTILA, J.R., PALADINO, F.V. & REINA, R.D. 2004. Nest site fidelity of leatherback turtles at Playa Grande, Costa Rica. *Animal Behaviour* 68: 387–394.

O'CONNOR, T.G. & KUYLER, P. 2009. Impact of land use on the biodiversity integrity of the moist sub-biome of the grassland biome, South Africa. *Journal of Environmental Management* 90: 384–395.

O'CONNOR, D.E., STUART-FOX, D. & WHITING, M.J. 2006. Geographical distribution: *Cordylosaurus subtesselatus*. *African Herp News* 39: 16–17.

ODIERNA, G., CANAPA, A., ANDREONE, F., APREA, G., BARUCCA, M., CAPRIGLIONE, T. & OLMO, E. 2002. A phylogenetic analysis of Cordyliformes (Reptilia: Squamata): Comparison of molecular and karyological data. *Molecular Phylogenetics and Evolution* 23: 37–42.

ONDERSTALL, D. 1984. Descriptions of two new subspecies of *Afroedura pondolia* (Hewitt) and a discussion of species groups within the genus (Reptilia: Gekkonidae). *Annals of the Transvaal Museum* 33: 497–509.

PADIAL, J.M. & DE LA RIVA, J.D.L. 2006. Taxonomic inflation and the stability of species lists: The perils of ostrich's behaviour. *Systematic Biology* 55(5): 859–867.

PARKER, H.W. 1935. A new species of amphisbaenid lizard from Bechuanaland. *Annals of the Magazine of Natural History, Ser. 10* 15: 582–583.

PASTEUR, G. 1965. Recherches sur l'Évolution des lygodactyles, lezards afro-malgaches actuels. *Travaux de l'Institut Scientifique Chérifien, Série Zoologie* 29: 1–132.

PAULI, B.D., MONEY, S. & SPARLING, D.W. 2010. Ecotoxicology of Pesticides in Reptiles, In D.W. Sparling, G. Linder, C.A. Bishop & S.K. Krest (eds), *Ecotoxicology of Amphibians and Reptiles*: 203–224. CRC Press, Boca Raton.

PAVLICEV, M. & MAYER, W. 2009. Fast radiation of the subfamily Lacertinae (Reptilia: Lacertidae): History or methodological artefact? *Molecular Phylogenetics and Evolution* 52: 727–734.

PERERA, S.J., RATNAYAKE-PERERA, D. & PROCHES, Ş. 2011. Vertebrate distributions indicate a greater Maputaland-Pondoland-Albany region of endemism. *South African Journal of Science* 107(7/8): 1–15.

PERRET, J-L. 1973. Contribution à l'étude des *Panaspis* (Reptilia, Scincidae) d'Afrique occidentale avec la description de deux espèces nouvelles. *Revue Suisse de Zoologie* 80: 595–630.

PERRET, J-L. 1975. La différenciation dans le genre *Panapis* Cope (Reptilia, Scincidae). *Bulletin de la Société des Sciences Naturelles de Neuchâtel* 98: 5–16.

PERRIN, M.R. & BODBIJL, T. 2001. Habitat selection and small mammal prey availability of the gaboon adder in Zululand (KwaZulu-Natal), South Africa. *South African Journal of Wildlife Research* 31(3&4): 115–126.

PERRY, G., BUCHANAN, B.W., FISHER, R.N., SALMON, M. & WISE, S.E. 2008. Effects of artificial night lighting on amphibians and reptiles in urban environments. *Urban Herpetology* 3: 239–256.

PERRY, G. & FARMER, M. 2011. Reducing the risk of biological invasion by creating incentives for pet sellers and owners to do the right thing. *Journal of Herpetology* 45(1): 134–141.

PERRY, G. & FISHER, R.N. 2006. Night lights and reptiles: observed and potential effects. In C. Rich and T. Longcore (eds.), *Ecological Consequences of Artificial Night Lighting*: 169–191. Island Press, Washington DC.

PETERS, W. 1854. Diagnosen neuer Batrachier, welche zusammen mit der früher (24 Juli und 17 August) gegebenen Übersicht der Schlangen und Eidechsen mitgetheilt werden. *Monatsberichte der königlichen Akademie der Wissenschaften zu Berlin* 1854: 614–628.

PETERSEN, S.L. 2008. *Understanding and Mitigating Vulnerable Bycatch in Southern African Trawl and Longline Fisheries.* Ph.D. thesis, University of Cape Town, Cape Town.

PHARAOH, A.M., FANNING, E. & SAID, A. 2003. Observations of sea turtles nesting on Misali Island, Pemba. *Journal of East African Natural History* 92(1): 127–134.

PHELPS, T. 2003. *Bitis gabonica* (Gaboon Adder): Unusual mortality. *The Herpetological Bulletin* 86: 26–27.
PHELPS, T. 2006. Southern Adder, *Bitis armata* (Smith, 1826). Arboreal behaviour. *African Herp News* 39: 14–16.
PHELPS, T. 2007. Observations of the Cape cobra, *Naja nivea* (Serpentes: Elapidae) in the De Hoop Nature Reserve, Western Cape Province, South Africa. *Herpetological Bulletin* 99: 29–35.
PHELPS, T. 2009. *Old World Vipers. A natural history of the Azemiopinae and Viperinae.* Chimaira, Frankfurt am Main.
PHELPS, T. & ELS, J. 2006. Horned Adder. *Bitis caudalis* (Smith, 1830). Geographical distribution. *African Herp News* 40: 30–31.
PHELPS, R.I., FOCARDI, S., FOSSI, C, LEONZIO, C. & RENZONI, A. 1986. Clorinated hydrocarbons and heavy metals in crocodile eggs from Zimbabwe. *Transactions of the Zimbabwe Scientific Association* 63: 8–15.
PIANKA, E.R. 1986. *Ecology and Natural History of Desert Lizards.* Princeton University Press, Princeton.
PIANKA, E.R. & HUEY, R.B. 1978. Comparative ecology, resource utilization and niche segregation among gekkonid lizards in the southern Kalahari. *Copeia* 1978: 691–701.
PIANKA, E.R. & VITT, L.J. 2003. *Lizards: Windows to the Evolution of Diversity.* University of California Press, Berkeley.
PIANKA, E.R., HUEY, R.B. & LAWLOR, L.R. 1979. Niche segregation in desert lizards. In D.J. Horn, G.R. Stairs & R.D. Mitchell (eds), *Analysis of Ecological Systems*: 67–115. Ohio State University Press, Columbus.
PIANKA, E.R., KING, D. & ALLEN KING, R. (eds). 2004. *Varanoid Lizards of the World.* Indiana University Press, Bloomington.
PIENAAR, U. DE V. 1966. The reptiles of the Kruger National Park. *Koedoe Monograph* 1: 1–223.
PIENAAR, U. DE V. 1978. *The Reptile Fauna of the Kruger National Park.* National Parks Board of Trustees, Pretoria.
PIENAAR, U. DE V., HAACKE, W.D. & JACOBSEN, N.H.G. 1983. *The Reptiles of the Kruger National Park.* National Parks Board, Pretoria.
PIMENTEL, D., ZUNIGA, R. & MORRISON, D. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics* 52: 273–288.
PIRAS, P., COLANGELO, P., ADAMS, D.C., BUSCALIONI, A., CUBO, J., KOTSAKIS, T., MELORO, C., *et al*. 2010. The *Gavialis-Tomistoma* debate: The contribution of skull ontogenetic allometry and growth trajectories to the study of crocodilian relationships. *Evolution & Development* 12(6): 568–579.
PISO, W. 1658. Historiae Naturalis & Medicae Indiae Occidentalis. Libri Quinque. *De Indiae Utriusque re naturali et medica. Libri Quat ordecim.* Amstelaedami [Amsterdam].
POOK, C.E., FRY, B.G., LAMBERT, M., FAVREAU, P., DOLJANSKY, Y. & WÜSTER, W. 2005. A phylogeny of *Dendroaspis* (Elapidae), according to mitochondrial DNA and toxin amino acid sequence data. *Book of Abstracts, 5th World congress of Herpetology; 19–24 June 2005 Stellenbosch*: 82. Stellenbosch.
POOLEY, A.C. 1982. Further observations on the Nile Crocodile *Crocodylus niloticus* in the St Lucia Lake System. In R.H. Taylor (ed.), *St Lucia Research Review*: 144–161. Natal Parks Board.
POOLEY, A.C., POOLEY, E., HADLEY, W.F. & GANS, C. 1973. Ecological aspects of the distribution of subsoil herpetofauna in Ndumu Game Reserve. *Annals of the Carnegie Museum* 44: 103–115.
PORTIK, D. 2009. *Comparative Phylogeography of Two Skink Species in Southern Africa.* M.Sc. thesis, Villanova University, Villanova.
PORTIK, D.M. & PAPENFUSS, T.J. 2012. Monitors cross the Red Sea: The biogeographic history of *Varanus yemenensis*. *Molecular Phylogenetics and Evolution* 62(1): 561–565.
PORTIK, D.[M.], BAUER, A.M. & JACKMAN, T.R. 2010. The phylogenetic affinities of *Trachylepis sulcata nigra* and the intraspecific evolution of coastal melanism in the western rock skink. *African Zoology* 45: 147–159.
PORTIK, D.M., BAUER, A.M. & JACKMAN, T.R. 2011. Bridging the gap: western rock skinks (*Trachylepis sulcata*) have a short history in South Africa. *Molecular Ecology* 20: 1744–1758.
POWER, J.H. 1931. On the herpetological fauna of the Lobatsi-Linokana area. Part II—Linokana. *Transactions of the Royal Society of South Africa* 20: 39–49.
PRITCHARD, P.C.H. 1979. *Encyclopedia of Turtles.* T.F.H. Publications, Neptune City.
PUENTE, M., THOMAS, M. & VENCES, M. 2005. Phylogeny and biogeography of Malagasy dwarf geckos, *Lygodactylus* Gray, 1864: Preliminary data from mitochondrial DNA sequences (Squamata: Gekkonidae). In B.A. Huber, B.J. Sinclair & K-H. Lampe (eds), *Biodiversity: Molecules, Organisms, Ecosystems*: 229–235. Proceedings of the 5th International Symposium of Tropical Biology, Museum Koenig, Bonn, Germany.
PYRON, R.A., BURBRINK, F.T., COLLI, G.R., MONTES DE OCA, A.N., VITT, L.J., KUCZYNSKI, C.A. & WIENS, J.J. 2011. The phylogeny of advanced snakes (Coluroidea), with discovery of a new subfamily and comparison of support methods for likelihood trees. *Molecular Phylogenetics and Evolution* 58(2): 329–342.
RAKOTONIRINA, B. & COOKE, A. 1994. Sea turtles of Madagascar—their status, exploitation and conservation. *Oryx* 28: 51–61.
RALL, M. & FAIRALL, N. 1993. Diets and food preferences of two South African tortoises *Geochelone pardalis* and *Psammobates oculifer*. *South African Journal of Wildlife Research* 23: 63–70.
RASMUSSEN, J.B. 1989. On the taxonomic status of *Dipsadoboa aulica aulica* Gunther and *D. aulica flavida* Broadley & Stevens, with the description of a new subspecies of *D. flavida* Broadley & Stevens (Boiginae, Serpentes). *Amphibia-Reptilia* 10: 35–62.
RASMUSSEN, J.B. 2005. On the identification and distribution of the Two-Striped Night Adder (*Causus bilineatus*) and related forms. *African Journal of Herpetology* 54(1): 1–15.
RAU, R. 1971. Weitere Angaben über die Geometrische Landschildkröte, *Testudo geometrica*. *Salamandra* 7(3–4): 123–136.
RAW, L.R.G. 1973. A review of the Dusky-bellied Water Snake, *Lycodonomorphus laevissimus* (Gunther), with descriptions of two new subspecies. *Annals of the Natal Museum* 21(3): 713–718.
RAW, L.G.R. 1978. A further new dwarf chameleon from Natal, South Africa (Chamaelonidae: Sauria). *Durban Museum Novitates* 11(15): 265–269.
RAW, L.R.G. 1995. Biodiversity, biogeography and conservation of South Africa's endemic dwarf chameleons. *Institute of Natural Resources Investigational Report No. 177.* Institute of Natural Resources, Scottsville.
RAW, L.R.G. 2001. *Revision of some Dwarf Chameleons (Sauria: Chamaeleonidae: Bradypodion) from Eastern South Africa.* M.Sc. thesis, University of Natal, Pietermaritzburg.
RAW, L.R.G. & BROTHERS, D.J. 2008. Redescription of the South African dwarf chameleon, *Bradypodion nemorale* Raw 1978 (Sauria: Chamaeleonidae), and description of two new species. *ZooNova* 1(1): 1–7.
RAWLINGS, L.H. & DONNELLAN, S.C. 2003. Phylogeographic analysis of the green python, *Morelia viridis*, reveals cryptic diversity. *Molecular Phylogenetics and Evolution* 27: 36–44.
RAWLINGS, L.H., RABOSKY, D.L., DONNELLAN, S.C. & HUTCHINSON, M.N. 2008. Python phylogenetics: Inference from morphology and mitochondrial DNA. *Biological Journal of the Linnean Society* 93: 603–619.
READING, C.J., LUISELLI, L.M., AKANI, G.C., BONNET, X., AMORI, G., BALLOUARD, J.M., FILIPPI, E., *et al*. 2010. Are snake populations in widespread decline? *Biology Letters* 6: 777–780.
REBELO, A.G., BOUCHER, C., HELME, N., MUCINA, L. & RUTHERFORD, M.C. 2006. Fynbos Biome. In L. Mucina & M.C. Rutherford (eds), The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia* 19: 52–219. South African National Biodiversity Institute, Pretoria.
REED, S.E. & MERENLENDER, A.M. 2008. Quiet, nonconsumptive recreation reduces protected area effectiveness. *Conservation Letters* 1: 146–154.
REICHART, H.A. 1993. *Synopsis of Biological Data on the Olive Ridley Sea Turtle* Lepidochelys olivacea *(Eschscholtz,1829) in the Western Atlantic.* NOAA Technical Memorandum 336, National Marine Fisheries Service, Miami.

REMIE, S. & MORTIMER, J.A. 2007. First records of Olive Ridley Turtles (*Lepidochelys olivacea*) in Seychelles. *Marine Turtle Newsletter* 117: 9.

REYNOLDS, R.G., BOOTH, W., SCHUETT, G.W., FITZPATRICK, B.M. & BURGHARDT, G.M. 2012. Successive virgin births of viable male progeny in the checkered gartersnake, *Thamnophis marcianus. Biological Journal of the Linnean Society* 107(3): 566–572.

RICHARDSON, D.M. & VAN WILGEN, B.W. 2004. Invasive alien plants in South Africa: How well do we understand the ecological impacts? *South African Journal of Science* 100(1/2): 45–52.

ROBERTS, M.A., SCHWARTZ, T.S. & KARL, S.A. 2004. Global population genetic structure and male mediated gene flow in the green sea turtle (*Chelonia mydas*): Analysis of microsatellite loci. *Genetics* 166: 1857–1870.

ROCHA, S., CARRETERO, M.A. & HARRIS, D.J. 2005. Diversity and phylogenetic relationships of *Hemidactylus* geckos from the Comoro islands. *Molecular Phylogenetics and Evolution* 35: 292–299.

ROCHA, S., CARRETERO, M.A., VENCES, M., GLAW, F. & HARRIS, D.J. 2006. Deciphering patterns of transoceanic dispersal: The evolutionary origin and biogeography of coastal lizards (*Cryptoblepharus*) in the Western Indian Ocean Region. *Journal of Biogeography* 33(1): 13–22.

ROCHA, S., ROSLER, H., GEHRING, P.-S, GLAW, F., POSADA, D., HARRIS, D.J. & VENCES, M. 2010. Phylogenetic systematics of day geckos, genus *Phelsuma*, based on molecular and morphological data (Squamata: Gekkonidae). *Zootaxa* 2429: 1–28.

RODRIGUES, A.S.L., GRAY, C.L., CROWTER, B.J., EWERS, R.M., STUART, S.N., WHITTEN, T. & MANICA, A. 2010. A global assessment of amphibian taxonomic effort and expertise. *Bioscience* 60: 798–806.

RÖLL, B. 1999. Biochemical and morphological aspects of the relationship of the Namaqua day gecko to *Phelsuma* and *Rhoptropus* (Reptilia, Gekkonidae). *Zoology—Analysis of Complex Systems* 102: 50–60.

ROOS, J., AGGARWAL, R.K. & JANKE, A. 2007. Extended mitogenomic phylogenetic analyses yield new insight into crocodylian evolution and their survival of the Cretaceous-Tertiary boundary. *Molecular Phylogenetics and Evolution* 45: 663–673.

ROUGET, M., JONAS, Z., COWLING, R.M., DESMET, P.G., DRIVER, A., MOHAMED, B., MUCINA, L., *et al*. 2006. Ecosystem status and protection levels of vegetation types. In L.. Mucina & M.C. Rutherford (eds), The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19: 725–737, South African National Biodiversity Institute, Pretoria.

ROUGET, M., RICHARDSON, D.M., COWLING, R.M., LLOYD, J.W. & LOMBARD, A.T. 2003. Current patterns of habitat transformation and future threats to biodiversity in terrestrial ecosystems of the Cape Floristic Region, South Africa. *Biological Conservation* 112: 63–85.

ROUGET, M., RICHARDSON, D.M., NEL, J.L., LE MAITRE, D.C., EGOH B. & MGIDI, T. 2004. Mapping the potential ranges of major plant invaders in South Africa, Lesotho and Swaziland using climatic suitability. *Diversity and Distributions* 10: 475–484.

ROUX, J. 1907. Beiträge zur Kenntnis der Fauna von Süd-Afrika. Ergebnisse einer Reise von Prof. Max Weber im Jahre 1894. VII. Lacertilia (Eidechsen). *Zoologische Jahrbücher, Abteilung für Systematik, Geographie und Biologie der Tiere* 25: 403–444.

ROWE, G., BEEBEE T.J.C. & BURKE, T. 1999. Microsatellite heterozygosity, fitness, and demography in natterjack toads *Bufo calamita*. *Animal Conservation* 2: 85–92.

RUDOLPH, D.C., BURGDORF, S.J., CONNER, R.N. & SCHAEFER, R.R. 1999. Preliminary evaluation of the impact of roads and associated vehicular traffic on snake populations in eastern Texas. In G.L. Evink, P. Garrett & D. Ziegler (eds.), *Proceedings of the Third International Symposium on Wildlife Ecology and Transportation*: 129–136. Florida Department of Transportation, Tallahassee, FL. Report No. FL-ER-73-99.

RUSSELL, A.P. 1972. *The Foot of Gekkonid Lizards: A Study in Comparative and Functional Anatomy*. Ph.D. Dissertation, University of London, London.

RUSSELL, A.P. 1976. Some comments concerning interrelationships amongst gekkonine geckos. In A, d'A. Bellairs & C.B. Cox (eds), *Morphology and Biology of Reptiles*: 217–244. Academic Press, London.

RUSSELL, A.P. 1977. The genera *Rhoptropus* and *Phelsuma* (Reptilia Gekkonidae) in southern Africa: a case of convergence and a reconsideration of the biogeography of *Phelsuma*. *Zoologica Africana* 12: 393–408.

RUSSELL, A.P. & BAUER, A.M. 1990. Hypertrophied phalangeal chondroepiphyses in the gekkonid lizard genus *Phelsuma*: Their structure and relation to the adhesive mechanism. *Journal of Zoology, London* 221: 205–217.

SAIFF, E.I. 1970. Geographical variation in the genus *Zygaspis* (Amphisbaenia: Reptilia). *Herpetologica* 26: 86–119.

SAINT, K.M., AUSTIN, C.C., DONNELLAN, S.C. & HUTCHINSON, M.N. 1998. C-mos, a nuclear marker useful for squamate phylogenetic analysis. *Molecular Phylogenetics and Evolution* 10: 259–263.

SALAFSKY, N., SALZER, D., STATTERSFIELD, A.J., HILTON-TAYLOR, C., NEUGARTEN, R., BUTCHART, S.H.M., COLLEN, B., *et al*. 2008. A standard lexicon for biodiversity conservation: Unified classifications of threats and action. *Conservation Biology* 22: 897–911.

SALE, A., LUSCHI, P., MENCACCI, R., HUGHES, G.R., LUTJEHARMS, J.R.E. & PAPI, F. 2006. Long-term monitoring of leatherback turtle diving behaviour during oceanic movements. *Journal of Experimental Marine Biology and Ecology* 328: 197–210.

SALVI, D., BOMBI, P. & VIGNOLI, L. 2011. Phylogenetic position of the southern rock lizard *Australolacerta australis* within the Lacertidae radiation. *African Journal of Herpetology* 60(1): 60–69.

SALVIDIO, S., MENEGON, M., SINDACO, R. & MOYER, D. 2004. A new species of elongate seps from Udzungwa grasslands, southern Tanzania (Reptilia, Gerrhosauridae, *Tetradactylus* Merrem, 1820). *Amphibia-Reptilia* 25(1): 19–27.

SANDERS, K.L., LEE, M.S.Y., MUMPUNI, BERTOZZI, T. & RASMUSSEN, A.R. 2012. Multilocus phylogeny and recent rapid radiation of the viviparous sea snakes (Elapidae: Hydrophiinae). *Molecular Phylogenetics and Evolution* 66 (3): 575–591

SAVAGE, J.A. 2003. Lacepéde, B.G.É. de la V., 1788, Histoire Naturelle des Quadrupédes Ovipares: Proposed rejection as a non-binomial work. *Bulletin of Zoological Nomenclature* 60 (2): 138.

SAWAI, Y., HONMA, M., KAWAMURA, Y., SAKI, A. & HATSUSE, M. 2002. *Rhabdophis tigrinus* in Japan: Pathogenesis of envenomation and production of antivenom. *Journal of Toxicology; Toxin Reviews* 21(1–2): 181–201.

SCHÄTTI, B. & CHARVET, C. 2003. Systematics of *Platyceps brevis* (Boulenger 1895) and related East African racers (Serpentes Colubrinae). *Tropical Zoology* 16: 93–111.

SCHÄTTI, B. & TRAPE, J.-F. 2008: *Bamanophis*, a new genus for the West African colubrid *Periops dorri* Lataste, 1888 (Reptilia: Squamata: Colubrinae). *Revue Suisse de Zoologie* 115(4): 595–615.

SCHAEFER, N. 1970. A new species of House Snake from Swaziland, with notes on the status of the two genera *Lamprophis* and *Boaedon*. *Annals of the Cape Provincial Museums (Natural History)* 8(14): 205–208.

SCHLEIP, W.D. 2008. Revision of the genus *Leiopython* Hubrecht 1879 (Serpentes: Pythonidae) with the redescription of taxa recently described by Hoser (2000) and the description of new species. *Journal of Herpetology* 42(4): 645–667.

SCHLEIP, W.D. & O'SHEA, M. 2010. Annotated checklist of the recent and extinct pythons (Serpentes, Pythonidae), with notes on nomenclature, taxonomy, and distribution. *ZooKeys* 66: 29–79.

SCHMIDT, A. 2004. *Mimikry zwischen Eidechsen und Laufkäfern.* Edition Chimaira, Frankfurt.

SCHMIDT, K.P. 1933. The reptiles of the Pulitzer Angola expedition. *Annals of the Carnegie Museum* 22(1): 1–15.

SCHMIDT-NIELSEN, K. & FANGE, R. 1958. Salt glands in marine reptiles. *Nature* 182 (4638): 783–785.

SCHMITZ, A., BRANDLEY, M.C., MAUSFELD, P., VENCES, M., GLAW, F., NUSSBAUM R.A. & REEDER, T.W. 2005b. Opening the black box: Phylogenetics and morphological evolution of the Malagasy fossorial lizards of the subfamily "Scincinae". *Molecular Phylogenetics and Evolution* 34: 118–133.

SCHMITZ, A., INEICH, I. & CHIRIO, L. 2005a. Molecular review of the genus *Panaspis sensu lato* (Reptilia: Scincidae) in Cameroon, with special reference to the status of the proposed subgenera. *Zootaxa* 863: 1–28.

SCHMITZ, A., MANSFELD, P., HEKKALA, E., SHINE, T., NICKEL, H., AMATO, G. & BÖHME, W. 2003. Molecular evidence for species level divergence in African Nile Crocodiles *Crocodylus niloticus* (Laurenti, 1786). *Comptes Rendus Palevol* 2: 703–712.

SCHMITZ, A., MAUSFELD, P. & EMBERT, D. 2004. Molecular studies on the genus *Eumeces* Wiegmann, 1834: Phylogenetic relationships and taxonomic implications. *Hamadryad* 28: 73–89.

SCHNEIDER, V. & BAUER, A.M. 2009. *Typhlosaurus jappi* Broadley, 1968, a valid species of acontine skink. *African Journal of Herpetology* 58: 56–58.

SCLATER, W.L. 1898. List of the reptiles and amphibians of South Africa, with descriptions of new species. *Annals of the South African Museum* 1: 95–111.

SCOTT, I.A.W., KEOGH, J.S. & WHITING, M.J. 2004. Shifting sands and shifty lizards: Molecular phylogeny and biogeography of African flat lizards (*Platysaurus*). *Molecular Phylogenetics and Evolution* 31: 618–629.

SCOTT, P., BRUTON, J.A. & FITTER, R. 1987. Red Data Books: The historical background. In R. Fitter & M. Fitter (eds), *The Road to Extinction: Problems of Categorizing the Status of Taxa Threatened with Extinction*: 1–5. IUCN and UNEP, Gland, Switzerland and Cambridge, UK.

SCOTT, T., BAUER, A.M. & JACKMAN, T. 2012. Diversification of an African dwarf: Molecular phylogenetics, species limits, and historical biogeography of southern African dwarf geckos (Gekkonidae: *Lygodactylus*). Seventh World Congress of Herpetology, Vancouver, Canada, 8–14 August 2012 (www.wch-2012vancouver.com/abstractdownload; see also *African Herp News* 58: 76, 2012).

SEMINOFF, J.A. 2004. *2004 Global Status Assessment: Green turtle* (Chelonia mydas). Marine Turtle Specialist Group Review, Red List Programme, Species Survival Commission, World Conservation Union (IUCN), Gland.

SEMLITSCH, R.D. 2000. Size does matter: The value of small isolated wetlands. *National Wetlands Newsletter* 22: 5–7. Environmental Law Institute, Washington DC.

SHINE, R. & WEBB, J.K. 1990. Natural history of Australian typhlopid snakes. *Journal of Herpetolology* 24: 357–363.

SHINE, R., BRANCH, W.R., HARLOW, P.S., WEBB, J.K. & SHINE, T. 2006. Biology of burrowing asps (Atractaspididae) from southern Africa. *Copeia* 2006(1): 103–115.

SHINE, R., HARLOW, P.S., BRANCH, W.R. & WEBB, J.K. 1996. Life on the lowest branch: Sexual dimorphism, diet and reproductive biology of an African Twig Snake, *Thelotornis capensis* (Serpentes, Colubridae). *Copeia* 1996(2): 290–299.

SHUTTLEWORTH, C. 2006. *Ecological Relationships between the Armadillo Lizard* Cordylus cataphractus *and the Southern Harvester Termite* Microhodotermes viator. M.Sc. thesis, Stellenbosch University, Stellenbosch.

SHUTTLEWORTH, C., MOUTON, P. LE F.N. & VAN WYK, J.H. 2008. Group size and termite consumption in the armadillo lizard, *Cordylus cataphractus*. *Amphibia-Reptilia* 29: 171–176.

SILVA, A., ROCHA, S., GERLACH, J., ROCAMORA, G., DUFRENNE, A. & HARRIS, D.J. 2010. Assessment of mtDNA genetic diversity within the terrapins *Pelusios subniger* and *Pelusios castanoides* across the Seychelles islands. *Amphibia-Reptilia* 31(4): 583–588(6).

SINERVO, B., MENDEZ-DE LA CRUZ, F., MILES, D.B., HEULIN, B., BASTIAANS, E., VILLAGRAN-SANTA CRUZ, M., LARA-RESENDIZ, R., *et al*. 2010. Erosion of lizard diversity by climate change and altered thermal niches. *Science* 328: 894–899.

SINDACO, R., METALLINOU, M., PUPIN, F. FASOLA, M. & CARRANZA, S. 2012. Forgotten in the ocean: systematics, biogeography and evolution of the *Trachylepis* skinks of the Socotra Archipelago. *Zoologica scripta* 41(4): .346–362, App. 1–8.

SLOWINSKI, J.B. & KEOGH, J.S. 2000. Phylogenetic relationships of elapid snakes based on cytochrome b mtDNA sequences. *Molecular Phylogenetics and Evolution* 15(1): 157–164.

SLOWINSKI, J.B. & LAWSON, R. 2002. Snake phylogeny: Evidence from nuclear and mitochondrial genes. *Molecular Phylogenetics and Evolution* 24: 194–202.

SMART, R., WHITING, M.J. & TWINE, W. 2005. Lizards and landscapes: integrating field surveys and interviews to assess the impact of human disturbance on lizard assemblages and selected reptiles in a savanna in South Africa. *Biological Conservation* 122: 23–31.

SMITH, A. 1838–1847. *Illustrations of the Zoology of South Africa; consisting chiefly of figures and descriptions of the objects of natural history collected during an expedition to the interior of South Africa in 1834–1836.* Smith, Elder & Co., London.

SMITH, M.A. 1937. A review of the genus *Lygosoma* (Scincidae: Reptilia) and its allies. *Records of the Indian Museum* 39: 213–234.

SNOW, R.W., KRYSKO, K.L., ENGE, K.M., OBERHOFER, L., WARREN-BRADLEY, A. & WILKINS, L. 2007. Introduced populations of *Boa constrictor* (Boidae) and *Python molurus bivitattus* (Pythonidae) in southern Florida. In R.W. Henderson & R. Powell (eds), *The Biology of Boas and Pythons*: 417–438. Eagle Mountain Publishers, Eagle Mountain.

SOUND, P., KOSUCH, J., VENCES, M., SEITZL, A. & VEITH, M. 2006. Preliminary molecular relationships of Comoran day geckos (*Phelsuma*). In M. Vences, J. Köhler, T. Ziegler & W. Böhme (eds), *Herpetologia Bonnensis II. Proceedings of the 13th Congress of the Societas Europaea Herpetologica*: 175–179. Zoologisches Forschungsmuseum A. Koenig and Societas Europaea Herpetologica, Bonn, Germany.

SOUTHWOOD, A.L., ANDREWS, R.D., LUTCAVAGE, M.E., PALADINO, F.V., WEST, N.H., GEORGE, R.H. & JONES, D.R. 1999. Heart rates and diving behaviour of leatherback sea turtles in the eastern Pacific Ocean. *Journal of Experimental Biology* 202: 1115–1125.

SPAWLS, S. & BRANCH, B.[W.R] 1995. *The Dangerous Snakes of Africa.* Southern Book Publishers, Halfway House.

SPAWLS, S., HOWELL, K., DREWES, R. & ASHE, J. 2002. *A Field Guide to the Reptiles of East Africa.* Academic Press, London and San Diego.

SPEYBROEK, J., HEUKEMA, W. & CROCHET, P.-A. 2010. A tentative species list of the European herpetofauna (Amphibia and Reptilia) – an update. *Zootaxa* 2492: 1–27.

STANLEY, E.L., BAUER, A.M., JACKMAN, T.R., BRANCH, W.R. & MOUTON, P. LE F.N. 2011. Between a rock and a hard polytomy: Rapid radiation in the rupicolous Girdled Lizards (Squamata: Cordylidae). *Molecular Phylogenetics and Evolution* 58(1): 53–70.

STEENKAMP, Y., VAN WYK, A.E., VICTOR, J.E., HOARE, D., SMITH, G., DOLD, T. & COWLING, R. 2004. Maputaland-Pondoland-Albany. In R.A. Mittermeier, P. Robles-Gil, M. Hoffmann, J.D. Pilgrim, T.M. Brooks, C.G. Mittermeier & G.A.B. Fonseca (eds), *Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions*: 218–229. CEMEX, Mexico City.

STERNFELD, R. 1910. Zur Schlangenfauna Deutsch-Südwestafrikas. *Mitteilungen aus dem Zoologischen Museum in Berlin* 5(1): 67–70.

STEWART, G. 2001. The Maloti-Drakensberg Mountains; conservation challenges in a region of international significance. *The Journal of the Mountain Club of South Africa* 2000: 146–159.

STONER, D. 1925. The toll of the automobile. *Science* 61: 56–58.

STUART, S.N., CHANSON, J.S., COX, N.A., YOUNG, B.E., RODRIGUES, A.S.L., FISCHMAN, D.L. & WALLER, R.W. 2004. Status and trends of amphibian declines and extinctions worldwide. *Science* 306: 1783–1786.

SWANEPOEL, S.-M. 2010. Geographical distribution: *Meizodon semiornatus semiornatus*. *African Herp News* 50: 40–41.

SWART, B.L., TOLLEY, K.A. & MATTHEE, C.A. 2009. Climate change drives speciation in the southern rock agama (*Agama atra*) in the Cape Floristic Region, South Africa. *Journal of Biogeography* 36(1): 78–87.

THOMAS, G.D. 2006. Human-crocodile conflict (Nile crocodile: *Crocodylus niloticus*) in the Okavango Delta, Botswana. M.Sc. thesis, University of Stellenbosch, Stellenbosch.

THOMAS, R. & HEDGES, B.S. 2007. Eleven new species of snakes of the genus *Typhlops* (Serpentes: Typhlopidae) from Hispaniola and Cuba. *Zootaxa* 1400: 1–26.
TILBURY, C.[R.] 2010. *Chameleons of Africa: An Atlas including the Chameleons of Europe, the Middle East and Asia*. Frankfurt Contributions to Natural History Vol. 37. Edition Chimaira, Frankfurt.
TILBURY, C.R. & BRANCH, W.R. 1989. Observations on the bite of the southern burrowing asp (*Atractaspis bibronii*) in Natal. *South African Medical Journal* 75: 327–331.
TILBURY, C.R. & TOLLEY, K.A. 2009a. A re-appraisal of the systematics of the African genus *Chamaeleo* (Reptilia: Chamaeleonidae). *Zootaxa* 2079: 57–68.
TILBURY, C.R. & TOLLEY, K.A. 2009b. A new species of dwarf chameleon (Sauria; Chamaeleonidae, *Bradypodion* Fitzinger) from KwaZulu Natal South Africa with notes on recent climatic shifts and their influence on speciation in the genus. *Zootaxa* 2226: 43–57.
TILBURY, C.R., TOLLEY, K.A. & BRANCH, W.R. 2006. A review of the systematics of the genus *Bradypodion* (Sauria: Chamaeleonidae), with the description of two new genera. *Zootaxa* 1363: 23–38.
TOLLEY, K.A. & BURGER, M. 2004b. Geographical distribution: *Bradypodion gutturale*. *African Herp News* 37: 29–32.
TOLLEY, K.A. & BURGER, M. 2004a. Distribution of *Bradypodion taeniabronchum* (Smith 1831) and other dwarf chameleons in the eastern Cape Floristic Region of South Africa. *African Journal of Herpetology* 52(2): 123–133.
TOLLEY, K.A. & BURGER, M. 2007. *Chameleons of Southern Africa.* Struik, Cape Town.
TOLLEY, K.A. & MEASEY, G.J. 2007. Chameleons and vineyards in the Western Cape of South Africa: Is automated grape harvesting a threat to the Cape Dwarf Chameleon (*Bradypodion pumilum*)? *African Journal of Herpetology* 56(1): 85–89.
TOLLEY, K.A., BURGER, M., TURNER, A.A. & MATTHEE, C.A. 2006. Biogeographic patterns and phylogeography of dwarf chameleons (*Bradypodion*) in an African biodiversity hotspot. *Molecular Ecology* 15: 781–793.
TOLLEY, K.A., CHASE, B.M. & FOREST, F. 2008. Speciation and radiations track climate transitions since the Miocene Climatic Optimum: A case study of southern African chameleons. *Journal of Biogeography* 35: 1402–1414.
TOLLEY, K.A., MAKOKHA, J.S., HOUNIET, D.T., SWART, B.L. & MATTHEE, C.A. 2009. The potential for predicted climate shifts to impact genetic landscapes of lizards in the South African Cape Floristic Region. *Molecular Phylogenetics and Evolution* 51: 120–130.
TOLLEY, K.A., TILBURY, C.R., BRANCH, W.R. & MATTHEE, C.A. 2004. Phylogenetics of the southern African dwarf chameleons, *Bradypodion* (Squamata: Chamaeleonidae). *Molecular Phylogenetics and Evolution* 30: 354–365.
TOWNSEND, T.[M.] & LARSON, A. 2002. Molecular phylogenetics and mitochondrial genomic evolution in the Chamaeleonidae (Reptilia, Squamata). *Molecular Phylogenetics and Evolution* 23(1): 22–36.
TOWNSEND, T.M., LARSON, A., LOUIS, E. & MACEY, J.R. 2004. Molecular phylogenetics of Squamata: The position of snakes, amphisbaenians, and dibamids, and the root of the squamate tree. *Systematic Biology* 53: 735–757.
TOWNSEND, T.M., TOLLEY, K.A., GLAW, F., BÖHME, W. & VENCES, M. 2011. Eastwards from Africa: Palaeocurrent-mediated chameleon dispersal to the Seychelles islands. *Biology Letters* 7: 225–228.
TRAPE, J.-F. & MANÉ, Y. 2006. Le genre *Dasypeltis* Wagler (Serpentes : Colubridae) en Afrique de l'Ouest : description de trois espèces et d'une sous-espèce nouvelles. *Bulletin de la Société Herpétologique de France* 119: 27–56.
TRAVERS, S.L. 2012. *Molecular phylogenetics, species limits, and historical biogeography of southern African dwarf geckos,* Lygodactylus *Gray 1864 (Squamata: Gekkonidae)*. M.Sc. dissertation, Villanova University, Villanova.
TROËNG, S. & DREWS, C. 2004. *Money Talks: Economic Aspects of Sea Turtle Use and Conservation.* WWF-International, Gland.
TURNER, A.A., DE VILLIERS, A.L. & BAARD, E.H.W. 2007. Reptiles. In A.A. Turner (ed.), *Western Cape Province. State of Biodiversity 2007*: 55–74. CapeNature Scientific Services, Cape Town.
TURTLE TAXONOMY WORKING GROUP [RHODIN, A.G.J., VAN DIJK, P.P., IVERSON, J.B., AND SHAFFER, H.B.]. 2010. Turtles of the world, 2010 update: annotated checklist of taxonomy, synonymy, distribution, and conservation status. In A.G.J. Rhodin, P.C.H. Pritchard, P.P. van Dijk, R.A. Saumure, K.A. Buhlmann, J.B. Iverson & R.A. Mittermeier (eds), Conservation Biology of Freshwater Turtles and Tortoises: A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. *Chelonian Research Monographs* 5: 000.85–000.164.
UETZ, P. 2000. How many Reptile Species? *Herpetological Review* 31(1): 13–15.
UETZ, P. 2010. The original descriptions of reptiles. *Zootaxa* 2334: 59–68.
UETZ, P. 2011. *The Reptile Database*. http://www.reptile-database.org/.
UETZ, P. 2012. (ed.). *The Reptile Database*. http://www.reptile-database.org/.
ULBER, T.M. 1999. Sir Andrew Smith's "Illustrations of the Zoology of South Africa" An annotated Table of Contents for the "Reptilia" Volume. Smithsonian Herpetological Information Service. No 129: 1–17.
UNDERWOOD, G. 1968. On the status of some South African vipers. *Annals of the Cape Provincial Museum* 6(9): 81–85.
UNDERWOOD, G. & KOCHVA, E. 1993. On the affinities of the burrowing asps *Atractaspis* (Serpentes: Atractaspididae). *Zoological Journal of the Linnean Society* 107: 3–64.
UNDERWOOD, G. & STIMSON, A.F. 1990. A classification of pythons (Serpentes, Pythoninae). *Journal of Zoology, London* 221: 565–603.
VALLAN, D. 2002. Effects of anthropogenic environmental changes on amphibian diversity in the rain forests of eastern Madagascar. *Journal of Tropical Ecology* 18: 725–742.
VAN DAM, G.P.F. 1921. Description of a new variety of a South African lizard of the family Gekkonidae. *Annals of the Transvaal Museum* 7(4): 244.
VAN DOORN, A.C. 2009. The interface between socioecology and management of Chacma baboons (*Papio ursinus*) in the Cape Peninsula, South Africa. PhD thesis, University of Cape Town, Cape Town.
VAN DER MEER, M.J., WHITING, M.J. & BRANCH, W.R. 2010. Ecology of Southern African Sandveld Lizards (Lacertidae, *Nucras*). *Copeia* 2010(4): 568–577.
VAN RENSBURG, B.J., WEYL, O.L.F., DAVIES, S.J., VAN WILGEN, L.J., PEACOCK, D.S., SPEAR, D. & CHIMIMBA, C.T. 2011. In D. Pimentel (ed.), Invasive Vertebrates of South Africa. In: *Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal, and Microbe Species*: 326–378. CRC Press, Boca Raton.
VAN WILGEN, B.W., RICHARDSON, D.M., KRUGER, F.J. & VAN HENSBERGEN, H.J. (eds) 1992. *Fire in South African Mountain Fynbos: Species, Community and Ecosystem Response in Swartboskloof*. Springer-Verlag, Heidelberg.
VAN WILGEN, N.J., RICHARDSON, D.M. & BAARD, E.H.W. 2008. Alien reptiles and amphibians in South Africa: Towards a pragmatic management strategy. *South African Journal of Science* 104: 13–20.
VAN WILGEN, N.J., WILSON, J.R.U., ELITH, J., WINTLE, B.A. & RICHARDSON, D.M. 2010. Alien invaders and reptile traders: What drives the live animal trade in South Africa? *Animal Conservation* 13, Suppl. 1: 24–32.
VAN WYK, J.H. 1988. *Cordylus giganteus*: species account. In W.R. Branch (ed.), *South African Red Data Book—Reptiles and Amphibians*: 77–80. South African National Programme Report No. 151. CSIR, Pretoria.
VAN WYK, J.H. 1991. Biennial reproduction in the female viviparous lizard, *Cordylus giganteus*. *Amphibia-Reptilia* 12: 329–342.
VAN WYK, J.H. 1995. The male reproductive cycle of the viviparous lizard, *Cordylus giganteus* (Sauria: Cordylidae). *Journal of Herpetology* 29: 522–535.
VARGAS-RAMÍREZ, M., VENCES, M., BRANCH, W.R., DANIELS, S.R., GLAW, F., HOFMEYR, M.D., KUCHLING, G., *et al*. 2010. Deep genealogical lineages in the widely distributed African helmeted terrapin: Evidence from mitochondrial and nuclear DNA (Testudines: Pelomedusidae: *Pelomedusa subrufa*). *Molecular Phylogenetics and Evolution* 56: 428–440.

VENCES, M., WANKE, S., VIEITES, D.R., BRANCH, W.R., GLAW, F. & MEYER, A. 2004. Natural colonization or introduction? Phylogeographical relationships and morphological differentiation of house geckos (*Hemidactylus*) from Madagascar. *Biological Journal of the Linnean Society* 83: 115–130.

VIDAL, N. & HEDGES, S.B. 2002. Higher-level relationships of caenophidian snakes inferred from four nuclear and mitochondrial genes. *Comptes Rendus Biologies* 325: 987–995.

VIDAL, N. & HEDGES, S.B. 2004. Molecular evidence for a terrestrial origin of snakes. *Proceedings of the Royal Society of London B* 271 (Supplement): 226–229.

VIDAL, N. & HEDGES, S.B. 2005. The phylogeny of squamate reptiles (lizards, snakes, and amphisbaenians) inferred from nine nuclear protein-coding genes. *Comptes Rendus Biologies* 328: 1000–1008.

VIDAL, N. & HEDGES, S.B. 2009. The molecular evolutionary tree of lizards, snakes, and amphisbaenians. *Comptes Rendus Biologies* 332(2–3): 129–139.

VIDAL, N., AZVOLINSKY, A., CRUAUD, C. & HEDGES, S.B. 2008b. Origin of tropical American burrowing reptiles by transatlantic rafting. *Biology Letters* 4: 115–118.

VIDAL, N., BRANCH, W.R., PAUWELS, O.S.G., HEDGES, S.B., BROADLEY, D.G., WINK, M., CRUAUD, C., *et al*. 2008a. Dissecting the major African snake radiation: A molecular phylogeny of the Lamprophiidae Fitzinger (Serpentes, Caenophidia). *Zootaxa* 1945: 51–66.

VIDAL, N., DELMAS, A.-S. & HEDGES, S.B. 2007b. The higher-level relationships of alethinophidian snakes inferred from seven nuclear and mitochondrial genes. In R.W. Henderson & R. Powell (eds), *Biology of the Boas and Pythons*: 27–33. Eagle Mountain Publishing, Eagle Mountain.

VIDAL, N., DELMAS, A.-S., DAVID, P., CRUAUD, C., COULOUX, A. & HEDGES, S.B. 2007a. The phylogeny and classification of caenophidian snakes inferred from seven nuclear protein-coding genes. *Comptes Rendus Biologies* 330: 182–187.

VIDAL, N., DEWYNTER, M. & GOWER, D.J. 2010. Dissecting the major American snake radiation: a molecular phylogeny of the Dipsadidae Bonaparte (Serpentes, Caenophidia). *Comptes Rendus Biologies* 333: 48–55.

VIDAL, N., MARIN, J., MORINI, M., DONNELLAN, S., BRANCH, W.R., THOMAS, R., VENCES, M., *et al*. 2010. Blindsnake evolutionary tree reveals long history on Gondwana. *Biology Letters* 6(4): 558–561.

VIDAL, N., MARIN, J., SASSI, J., BATTISTUZZI, F.U., DONNELLAN, S., FITCH, A.J., FRY, B.J. *et al.* 2012. Molecular evidence for an Asian origin of monitor lizards followed by Tertiary dispersals to Africa and Australasia. *Biology Letters* 8: 853–855.

VISSER, J. 1979. Notes on two rare House Snakes—Part 2. The generic status of *Lamprophis fiskii* Boulengeri (1887) and *Lamprophis swazicus* Schaefer (1970). *Journal of the Herpetological Association of Africa* 21: 31–37.

VISSER, J. 1984a. Akkedisse van Suider-Afrika 14. Diksterte sukkel nie met blyplek. *Landbouweekblad* 22 June 1984: 60–61, 63.

VISSER, J. 1984b. Akkedisse van Suider-Afrika 16. Blaartone se spore lê in baie lande. *Landbouweekblad* 6 July 1984: 48–49, 51–52.

VISSER, J. 1984c. Akkedisse van Suider-Afrika 7. Kalahari-geitje kan ook warm kry! *Landbouweekblad* 4 May 1984: 48–49, 51.

VISSER, J. 1984d. Akkedisse van Suider-Afrika 2. Gevlekte geitjies is lief vir die grond. *Landbouweekblad* 30 March 1984: 48–49, 51, 53.

VISSER, J. 1984e. Akkedisse van Suider-Afrika 4. Die skrikwekkende skurwe geitjie. *Landbouweekblad* 13 April 1984: 46–47, 49.

VISSER, J. 1984f. Akkedisse van Suider-Afrika. 33. Akkedisfamilie van die Ou Wêreld. *Landbouweekblad* 2 November 1984: 64–65, 67, 69.

VISSER, J. 1984g. Akkedisse van Suider-Afrika 32. Gepantserde akkedisse—geslepe klein bloustert 'n kulkunstenaar. *Landbouweekblad* 26 October 1984: 72–73, 75.

VISSER, J. 1984h. Akkedisse van Suider-Afrika 31. Gepantserde Akkedisse: Net dinamiet sal dié kêrel laat roer. *Landbouweekblad* 19 October 1984: 66–67, 69, 71.

VISSER, J. 1984i. Akkedisse van Suider-Afrika 24. Stekel-koggelmanders boer maklik ondergronds. *Landbouweekblad* 31 August 1984: 58–59, 61, 63.

VISSER, J. 1987. A new *Homopholis* (Sauria: Gekkonidae) from the northern Transvaal with a discussion of some generic characters. *South African Journal of Zoology* 22(2): 110–114.

VISSER, J. 2010. Variation in hemipenes of different colour phases of *Pseudaspis cana* (Linnaeus) warrants re-evaluation of the species. *African Herp News* 51: 2–3.

VITT, L.J. & CALDWELL, J.P. 2009. *Herpetology.* Academic Press, New York.

VONK, F.J., ADMIRAAL, J.F., JACKSON, K., RESHEF, R., DE BAKKER, M.A.G., VANDERSHOOT, K., VAN DEN BERGE, I., *et al*. 2008. Evolutionary origin and development of snake fangs. *Nature* 454: 630–633.

WAGNER, P. & BAUER, A.M. 2012. Out of the blue: a preliminary review of the African whorl-tailed agamas (Agamidae: *Acanthocercus*). Abstract: Seventh World Congress of Herpetology, Vancouver, Canada, 8-14 August 2012 (www.wch-2012vancouver.com/abstractdownload; see also *African Herp News* 58: 79, 2012).

WAGNER, P., BÖHME, W., PAUWELS, O.S.G. & SCHMITZ, A. 2009. A review of the African red-flanked skinks of the *Lygosoma fernandi* (BURTON, 1836) species group (Squamata: Scincidae) and the role of climate change in their speciation. *Zootaxa* 2050: 1–30.

WAGNER, P., BROADLEY, D.G. & BAUER, A.M. 2012a. A New Acontine Skink from Zambia (Scincidae: *Acontias* Cuvier, 1817). *Journal of Herpetology* 46: 494–502.

WAGNER, P., GREENBAUM, E. & BAUER, A.M. 2012b. A new species of the *Acanthocercus atricollis* complex (Squamata: Agamidae) from Zambia. *Salamandra* 48(1): 21-30.

WAKE, D.B. 1991. Declining amphibian populations. *Science* 253: 860.

WALKER, R.C.J., ROBERTS, E. & FANNING, E. 2004. The trade of marine turtles in the Toliara region, South West Madagascar. *Marine Turtle Newslettter* 106: 7–10.

WALLACE, K.M. & LESLIE, A.J. 2008. Diet of the Nile Crocodile (*Crocodylus niloticus*) in the Okavango Delta, Botswana. *Journal of Herpetology* 42(2): 361–368.

WALLACH, V. 1998. The lungs of snakes. In C. Gans & A.S. Gaunt (eds), *Biology of the Reptilia. Volume 19 (Morphology G). Visceral Organs*: 93–295. Society for the Study of Amphibians and Reptiles, Ithaca.

WALLACH, V., WÜSTER, W. & BROADLEY, D.G. 2009. In praise of subgenera: Taxonomic status of cobras of the genus *Naja* Laurenti (Serpentes: Elapidae). *Zootaxa* 2236: 26–36.

WALLIN, L. 1977. The Linnaean type-specimen of *Testudo geometrica*. *Zoon* 5: 77–78.

WARNER, J.K. 2009. *Conservation Biology of the Gaboon Adder (*Bitis gabonica*) in South Africa.* M.Sc. thesis, University of the Witwatersrand, Johannesburg.

WATTS, P.C., BULEY, K.R., SANDERSON, S., BOARDMAN, W., CIOFI, C. & GIBSON, R. 2006. Parthenogenesis in Komodo Dragons. *Nature* 444(7122): 1021–1022.

WEBB, J.K. & SHINE, R. 1993. Prey-size selection, gape limitation and predator vulnerability in Australian blindsnakes (Typhlopidae). *Animal Behaviour* 45: 1117–1126.

WEBB, J.K., BRANCH, W.R. & SHINE, R. 2001. Dietary habits and reproductive biology of typhlopid snakes from southern Africa. *Journal of Herpetology* 35: 558–567.

WEBB, J.K., SHINE, R., BRANCH, W.R. & HARLOW, P.S. 2000a. Life underground: Food habits and reproductive biology of two amphisbaenian species from southern Africa. *Journal of Herpetology* 34: 510–516.

WEBB. J.K., SHINE, R., BRANCH, W.R. & HARLOW, P.S. 2000b. Life history strategies in basal snakes: reproduction and dietary habits of the African thread snake, *Leptotyphlops scutifrons* (Serpentes, Leptotyphlopidae). *Journal of Zoology, London* 250: 321–327.

WELCH, K.R.G. 1982a. Herpetology of the Old World II. Preliminary comments on the classification of skinks (Family Scincidae) with specific reference to those genera found in Africa, Europe and Southwest Asia. *Herptile* 7(4): 25–27.

WELCH, K.R.G. 1982b. *Herpetology of Africa: A Checklist and Bibliography of the Orders Amphisbaenia, Sauria and Serpentes.* Robert E. Krieger Publishing Company, Malabar.

WERMUTH, H. 1965. Liste der rezenten Amphibien und Reptilien, Gekkonidae, Pygopodidae, Xantusiidae. *Das Tierreich* 80: 1–246.

WERMUTH, H. 1968. Liste der rezenten Amphibien und Reptilien. Cordylidae (Subfam. Cordylinae et Gerrhosaurinae). *Das Tierreich* 87: viii–x, 1–30.

WERNER, Y.L. 1972. Observations on eggs of eublepharid lizards, with comments on the evolution of the Gekkonoidea. *Zoologische Mededelingen* 47: 211–224, pl. 1.

WHITING, M.J. & GREEFF, J.M. 1997. Facultative frugivory in the Cape flat lizard, *Platysaurus capensis* (Sauria: Cordylidae). *Copeia* 1997(4): 811–818.

WHITING, A.S., BAUER, A.M. & SITES, J.W. Jr. 2003. Phylogenetic relationships and limb loss in sub-Saharan African scincine lizards (Squamata: Scincidae). *Molecular Phylogenetics and Evolution* 29: 582–598.

WHITING, A.S., SITES J.W. Jr & BAUER, A.M. 2004. Molecular phylogenetics of Malagasy skinks (Squamata: Scincidae). *African Journal of Herpetology* 53(2): 135–146.

WHITING, M.J., LAILVAUX, S.P., REANEY, L.T. & WYMANN, M. 2003. To run or hide? Age-dependent escape behaviour in the common flat lizard (*Platysaurus intermedius wilhelmi*). *Journal of Zoology, London* 260: 123–128.

WHITING, M.J., WILLIAMS, V.L. & HIBBITTS, T.J. 2011. Animals traded for traditional medicine at the Faraday market in South Africa: species diversity and conservation. *Journal of Zoology* 283: 1–13.

WHITING, M.J., STUART-FOX, D.M., O'CONNOR, D., FIRTH, D., BENNETT, N.C. & BLOMBERG, S.P. 2006. Ultraviolet signals ultra-aggression in a lizard. *Animal Behaviour* 72: 353–363.

WHITTINGTON-JONES, C., WEST, S., MATABANE, A., KOKO, R., MOLABA, W., MOTSAMAI, J., MAKOLA, J., *et al*. 2008. *The Herpetofauna of Gauteng: Volume 1: Distribution and Status of Reptiles.* Fauna Unit, Directorate of Nature Conservation, Gauteng Provincial Government, Johannesburg.

WIEGMANN, A.F.A. 1828. Beyträge zur Amphibienkunde. *Isis von Oken* 21: columns 364–383.

WIENS, J.J., BRANDLEY, M.C. & REEDER, T.W. 2006. Why does a trait evolve multiple times within a clade? Repeated evolution of snake-like body form in squamate reptiles. *Evolution* 60: 123–141.

WIENS, J.J., HUTTER, C.R., MULCAHY, D.G., NOONAN, B.P., TOWNSEND, T.M., SITES, J.W. & REEDER, T.W. 2012. Resolving the phylogeny of lizards and snakes (Squamata) with extensive sampling of genes and species. *Biology Letters* 8: 1043–1046.

WILCOX, T.P., ZWICK, D.J., HEATH, T.A. & HILLIS, D.M. 2002. Phylogenetic relationships of the dwarf boas and a comparison of Bayesian and bootstrap measures of phylogenetic support. *Molecular Phylogenetics and Evolution* 25: 361–371.

WILLIS, R.E., MCALILEY, L.R., NEELEY, E.D. & DENSMORE, L.D. 2007. Evidence for placing the false gharial (*Tomistoma schlegelii*) into the family Gavialidae: Inferences from nuclear gene sequences. *Molecular Phylogenetics and Evolution* 43(3): 787–794.

WITBERG, M. & VAN ZYL, R. 2008. Geographical Distribution: *Lygodactylus capensis capensis*. *African Herp News* 46: 23–24.

WITHERINGTON, B.E. & MARTIN, R.E. 1996. Understanding, assessing, and resolving light-pollution problems on sea turtle nesting beaches. Florida Marine Research Institute Technical Report TR-2, Florida Marine Research Institute, St. Petersburg.

WITZELL, W.N. 1983. *Synopsis of biological data on the hawksbill turtle* Eretmochelys imbricata *(Linnaeus, 1766).* FAO Fisheries Synopsis No. 137, Food and Agriculture Organisation of the United Nations, Rome.

WOLTZ, H.W., GIBBS, J.P. & DUCEY, P.K. 2008. Road crossing structures for amphibians and reptiles: Informing design through behavioral analysis. *Biological Conservation* 141(11): 2745–2750.

WONGTSCHOWSKI, B. 1990. *Between Woodbush and Wolkberg: Googoo Thompson's Story.* B.E.H. Wongtschowski, Haenertsburg.

WÜSTER, W. & BROADLEY, D.G. 2003. A new species of spitting cobra (*Naja*) from north-eastern Africa (Serpentes: Elapidae). *Journal of Zoology, London* 259: 345–359.

WÜSTER, W. & BROADLEY, D.G. 2007. Get an eyeful of this: A new species of giant spitting cobra from eastern and north-eastern Africa (Squamata: Serpentes: Elapidae: *Naja*). *Zootaxa* 1532: 51–68.

WÜSTER, W., CROOKES, S., INEICH, I., MANÉ, Y., POOK, C.E., TRAPE, J.-F. & BROADLEY, D.G. 2007. The phylogeny of cobras inferred from mitochondrial DNA sequences: Evolution of venom spitting and the phylogeography of the African spitting cobras (Serpentes: Elapidae: *Naja nigricollis* complex). *Molecular Phylogenetics and Evolution* 45: 437–453.

WÜSTER, W., PEPPIN, L., POOK, C.E. & WALKER, D.E. 2008. A nesting of vipers: Phylogeny and historical biogeography of the Viperidae (Squamata: Serpentes). *Molecular Phylogenetics and Evolution* 49: 445–459.

ZAHER, H. 1999. Hemipenial morphology of the South American xenodontine snakes, with a proposal for a monophyletic Xenodontinae and a reappraisal of colubroid hemipenes. *Bulletin of the American Museum of Natural History* 240: 1–168.

ZAHER, H., GRAZZIOTIN, F.G., CADLE, J.E., MURPHY, R.W., MOURA-LEITE, J.C.D. & BONATTO, S.L. 2009. Molecular phylogeny of advanced snakes (Serpentes, Caenophidia) with an emphasis on South American Xenodontines: A revised classification and descriptions of new taxa. *Papéis Avulsos de Zoologia (São Paulo)* 49: 115–153.

ZANRE, R. 2005. *Report on Watamu Turtle Watch's Sea Turtle Bycatch Release Programme, Watamu, Kenya*: April 1998—May 2004. Unpublished report. www.watamuturtles.com/reports.htm.

ZHANG, M., WANG, Y., YAN, P. & WU, X. 2011. Crocodilian phylogeny inferred from twelve mitochondrial protein-coding genes, with new complete mitochondrial genomic sequences for *Crocodylus acutus* and *Crocodylus novaeguineae. Molecular Phylogenetics and Evolution* 60: 62–67.

ZUG, G.R. & PARHAM, J.F. 1996. Age and growth in the leatherback turtles, *Dermochelys coriacea* (Testudines: Dermochelyidae): A skeletochronological analysis. *Chelonian Conservation and Biology* 2(2): 244–249.

Abbreviations and Glossary

Compiled by Graham J. Alexander

Abbreviations

ADU—Animal Demography Unit, University of Cape Town

AOO—Area of occupancy, used in IUCN Conservation Assessments and defined as the area within the extent of occurrence (EOO, see below) which is occupied by a taxon.

BMP-S—Biodiversity Management Plan for Species

CITES—An acronym for the Convention on International Trade in Endangered Species of Wild Fauna and Flora, an international agreement between governments; South Africa is a signatory.

CMS—Convention on Migratory Species

EOO—Extent of occurrence, used in IUCN Conservation Assessments and defined as the minimum convex hull that includes all current distribution records (excluding records of vagrants) of a taxon.

GPS—Geographic positioning system

HAA—Herpetological Association of Africa

IAS—Invasive Alien Species

ICZN—International commission on Zoological Nomenclature

in prep.—in preparation, not yet submitted to a journal for peer review.

IOSEA—Indian Ocean – South-East Asian Marine Turtle Memorandum of Understanding

IOTC—Indian Ocean Tuna Commission

IUCN—International Union for Conservation of Nature

MoU—Memorandum of Understanding

pers. comm.—personal communication

pers. obs.—personal observation

PHVA—Population and Habitat Viability Assessment

QDGC—quarter-degree grid cell. In southern Africa, a QDGC has an area of approximately 676 km^2 on average, but this varies with latitude.

RDB—Red Data Book

SABIF—South African Biodiversity Information Facility

SAFAP—Southern African Frog Atlas Project

SANBI—South African National Biodiversity Institute

SARCA—Southern African Reptile Conservation Assessment

sp.—species (singular)

spp.—species (plural)

TED—Turtle Excluder Device

TSP—Transvaal Snake Park

UCT—University of Cape Town

unpubl. data—unpublished data

unpubl. obs.—unpublished observation

VM—Virtual Museum

WIO—Western Indian Ocean

Wits—University of the Witwatersrand

Glossary

A

Active foraging—a hunting strategy that relies primarily on active searching for prey.

Aeolian—produced or carried by the wind. Aeolian sands have been transported and deposited by wind.

Allopatric—having geographically separate populations, usually of the same species.

Alpha taxonomy—the science of finding, describing and naming species.

Anterior—the front.

Aquatic—living in water.

Arboreal—living in trees.

Autotomy—self-induced releasing of a body part (e.g. tail).

B

Biodiversity hotspot—an area high in species richness and endemism.

Biogeography—the study of the distribution of organisms.

Biome—a major biological community characterised by distinctive plant and animal species and maintained under the climatic and other environmental conditions of the region.

C

Carapace—the dorsal half of a tortoise, terrapin or turtle shell.

Casque—anatomical structure on the head suggestive of a helmet.

Caudal—with reference to the tail.

Cline—a geographically-based gradient in the morphology, physiology or genetics of a species.

Cloaca—the chamber through which the urine, faeces and reproductive cells pass from the body of a reptile.

Commensal—usually in reference to animals occurring in association with humans.

Communal—living together or sharing a rescource such as a nesting site.

Conservation Assessment—an evaluation process conducted using the IUCN Red List Categories and Criteria to ascertain the level of extinction risk to a taxon.

Conspecific—of, or belonging to, the same species.

Crepuscular—active at dusk and dawn.

Critically Endangered—the most severe threat level for a threatened taxon, defined by the IUCN as "facing an extremely high risk of extinction in the wild".

Cryptic—well hidden and difficult to detect.

Cryptic species—a species that is morphologically similar to one or more other species.

Cytotoxic—a venom that is damaging to tissue.

D

Data Deficient—a category used by the IUCN for a taxon for which inadequate information exists to make a direct or indirect assessment of its risk of extinction.

Disjunct—separate, usually with reference to allopatric populations.

Diurnal—active during the day.

Dorsal—the upper surface.

Dorsolateral—the sides of the upper surface; between the vertebral region and the flanks.

Dorsum—the back of the animal.

E

Ecomorph—a local variety of a species whose appearance is influenced by local conditions.

Ecotone—a zone or edge between two ecosystems or biomes which has elements of both.

Endangered—a specific threat level for a threatened taxon, defined by the IUCN as "facing a very high risk of extinction in the wild".

Endemic—limited in distribution to a particular area.

Extinct—a specific threat category defined by the IUCN for a taxon where "no reasonable doubt exists that the last individual has died".

Extrinsic—originating from the outside.

F

Family—taxonomic group of related genera.

Flagship species—a species that represents an environmental cause, such as the conservation of a particular ecosystem.

Fossorial—living underground, often able to burrow.

G

Genus (plural genera)—a taxonomic group of closely related species.

Gondwana—a once contiguous landmass of the southern continents, composed of current-day South America, Africa, Madagascar, India, Australia, Antarctica, New Zealand, New Caledonia and New Guinea.

Gular—relating to the throat.

H

Haemotoxic—a venom that adversely affects the blood.

Heliothermic—regulating body temperature primarily by means of heat gain from direct solar radiation.

Hemipenes—the paired copulatory organs of male squamate reptiles.

I

Incertae sedis—of uncertain placement (in a taxonomic category).

Insectivorous—feeding primarily on insects.

L

Lepidosis—the character and arrangement of scales.

Loreal scale—a scale between the nasal and preocular scales.

M

Maxillary bone—a bone in the upper jaw which, in venomous snakes, carries the fangs.

Melanism—excessive development of dark pigment in the skin.

Mesic—moderately moist.

Monitoring—measuring the state of a system.

Monophyletic—an inclusive group of taxa that evolved from a common ancestor.

Monospecific or monotypic—a taxon that contains only one representative (e.g. a genus with one species; a species without subspecies).

Myotoxic—a venom that adversely affects the muscles.

N

Near Threatened—a category defined by the IUCN for a taxon that does not qualify as threatened, but is close to qualifying or is likely to qualify in the future.

Neurotoxic—a venom that adversely affects the nerves.

Nocturnal—active during the night.

O

Occipital—referring to an area near the back of the head.

Occurrant—occurs in an area.

Osteoderm—bony deposits forming plates or other structures in the dermal layers of the skin.

Oviparous—lays eggs.

P

Parapatric—where the geographical ranges of two or more populations or species abut one another.

Paraphyletic—pertaining to a taxon which contains an ancestral species together with some, but not all, of its descendants.

Parthenogenetic—form of reproduction where an egg develops into a new individual without the need for a male gamete; copulation does not occur and all offspring are clones of the mother.

Phylogenetic—of, or relating to, phylogeny.

Phylogeny—the evolutionary relationships between organisms.

Plastron—the lower surface of a tortoise, terrapin or turtle shell.

Polymorphic—two or more forms within a species or population.

Polytypic—a taxonomic unit with two or more subgroups.

Posterior—the rear.

Postocular—behind the eye.

Prehensile—capable of grasping.

Prenuptial—existing or occurring before mating.

Preocular—in front of the eye.

R

Refugium (plural refugia)—an area that has escaped ecological changes, thereby providing an enclave where populations may persist.

Relict—a remnant of a species or population.

Robust—stout, having a strong physique.

Rostrum—a scale and/or beak-like projection on the anterior part of the head.

Rugose—wrinkled or rough.

Rupicolous—rock-living, sometimes also referred to as saxicolous.

S

Scansorial—specialised for climbing.

Scute—scale.

Serpentine—snake-like.

Sexual dichromatism—a phenomenon where males and females differ in terms of colour.

Sibling species—two species that are very similar in appearance, behaviour and other characteristics, but that cannot (or seldom) interbreed.

Sit-and-wait foraging (ambush foraging)—a hunting strategy that relies primarily on ambush of prey.

Species—a genetically distinct group of interbreeding individuals.

Species richness—the number of species in a given area.

Speciose—having many species.

Spinous—spiny.

Subcaudal—beneath the tail.

Subdigital lamellae—the scansors or pads beneath the toes of many geckos.

Supraciliary—above the eye.

Sylvicolous—inhabiting forest.

Sympatric—two or more species whose ranges overlap.

Syntopic—occurring in the same habitat within an area of sympatry.

Systematics—biological classification and the study of relationships between organisms.

T

Taxon (plural taxa)—any monophyletic taxonomic unit (e.g. subspecies, species, genus, family, order, class).

Taxonomy—the study of classification, including the delineation and description of species.

Termitarium (plural termitaria)—a mound-like, and/or subterranean, termite nest.

Terrestrial—living on the ground.

Threatened—a category defined by the IUCN that comprises Critically Endangered, Endangered and Vulnerable threat levels. This term is also used to describe a taxon that is of conservation concern.

Torpor—a state of dormancy that is usually associated with decreased body temperature.

Translocate—to move an individual from one location to another.

Tubercle—a small protuberance, often used to describe enlarged granular scales on the skin of a reptile.

V

Vagile—disperses easily.

Venom—a toxic secretion of an animal.

Ventrum/venter—the underside.

Viviparous—gives birth to young.

Vulnerable—a specific threat level for a threatened taxon, defined by the IUCN as “facing a high risk of extinction in the wild”.

APPENDIX 1

IUCN Red List definitions and Categories and Criteria

1.1 IUCN Red List definitions (reproduced courtesy of IUCN, from IUCN 2012a)

1. Population and Population Size (Criteria A, C and D)

The term 'population' is used in a specific sense in the Red List Criteria that is different to its common biological usage. Population is here defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life forms, population size is measured as numbers of mature individuals only. In the case of taxa obligately dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used.

2. Subpopulations (Criteria B and C)

Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less).

3. Mature individuals (Criteria A, B, C and D)

The number of mature individuals is the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity, the following points should be borne in mind:

- Mature individuals that will never produce new recruits should not be counted (e.g. densities are too low for fertilisation).
- In the case of populations with biased adult or breeding sex ratios, it is appropriate to use lower estimates for the number of mature individuals, which take this into account.
- Where the population size fluctuates, use a lower estimate. In most cases this will be much less than the mean.
- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g. corals).
- In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.
- Re-introduced individuals must have produced viable offspring before they are counted as mature individuals.

4. Generation (Criteria A, C and E)

Generation length is the average age of parents of the current cohort (i.e. newborn individuals in the population). Generation length therefore reflects the turnover rate of breeding individuals in a population. Generation length is greater than the age at first breeding and less than the age of the oldest breeding individual, except in taxa that breed only once. Where generation length varies under threat, the more natural, i.e. pre-disturbance, generation length should be used.

5. Reduction (Criterion A)

A reduction is a decline in the number of mature individuals of at least the amount (%) stated under the criterion over the time period (years) specified, although the decline need not be continuing. A reduction should not be interpreted as part of a fluctuation unless there is good evidence for this. The downward phase of a fluctuation will not normally count as a reduction.

6. Continuing decline (Criteria B and C)

A continuing decline is a recent, current or projected future decline (which may be smooth, irregular or sporadic) which is liable to continue unless remedial measures are taken. Fluctuations will not normally count as continuing declines, but an observed decline should not be considered as a fluctuation unless there is evidence for this.

7. Extreme fluctuations (Criteria B and C)

Extreme fluctuations can be said to occur in a number of taxa when population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude (i.e. a tenfold increase or decrease).

8. Severely fragmented (Criterion B)

The phrase 'severely fragmented' refers to the situation in which increased extinction risk to the taxon results from the fact that most of its individuals are found in small and relatively isolated subpopulations (in certain circumstances this may be inferred from habitat information). These small subpopulations may go extinct, with a reduced probability of recolonisation.

9. Extent of occurrence (Criteria A and B)

Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary, which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy (see Figure 1). This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g. large areas of obviously unsuitable habitat) (but see 'area of occupancy', point 10 below). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

10. Area of occupancy (Criteria A, B and D)

Area of occupancy is defined as the area within its 'extent of occurrence' (see point 9 above) which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases (e.g. irreplaceable colonial nesting sites, crucial feeding sites for migratory taxa) the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon. The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon, the nature of threats and the available data. To avoid inconsistencies and bias in assessments caused by estimating area of occupancy at different scales, it may be necessary to standardise estimates by applying a scale-correction factor. It is difficult to give strict guidance on how standardisation should be done because different types of taxa have different scale-area relationships.

11. Location (Criteria B and D)

The term 'location' defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a taxon is affected by more than one threatening event, location should be defined by considering the most serious plausible threat.

12. Quantitative analysis (Criterion E)

A quantitative analysis is defined here as any form of analysis which estimates the extinction probability of a taxon based on known life history, habitat requirements, threats and any specified management options. Population viability analysis (PVA) is one such technique. Quantitative analyses should make full use of all relevant available data. In a situation in which there is limited information, such data as are available can be used to provide an estimate of extinction risk (for instance, estimating the impact of stochastic events on habitat). In presenting the results of quantitative analyses, the assumptions (which must be appropriate and defensible), the data used and the uncertainty in the data or quantitative model must be documented.

For further guidance on the terms above please see the *Guidelines for Using the IUCN Red List Categories and Criteria* produced by the IUCN Standards and Petitions Subcommittee (2013) (http://www.iucnredlist.org/documents/RedListGuidelines.pdf).

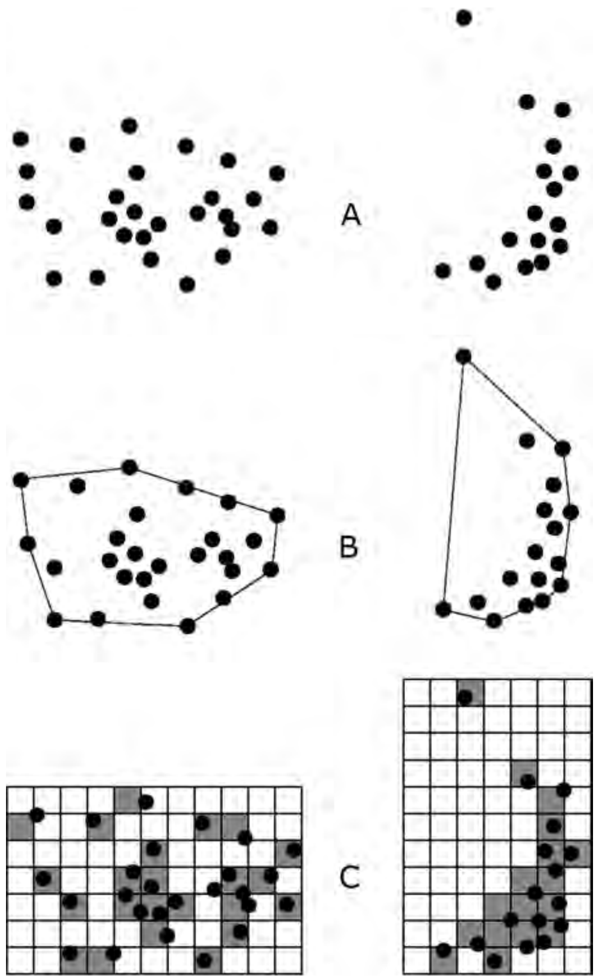


Figure 1.—Two examples of the distinction between extent of occurrence and area of occupancy. (A) is the spatial distribution of known, inferred or projected sites of present occurrence. (B) shows one possible boundary to the extent of occurrence, which is the measured area within this boundary. (C) shows one measure of area of occupancy which can be achieved by the sum of the occupied grid cells.

1.2 IUCN Red List Categories (reproduced courtesy of IUCN, from IUCN 2012a)

EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the historic range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between Data Deficient and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

1.3 Structure of the IUCN Red List Categories (reproduced courtesy of IUCN, from IUCN 2012a)

The Red List Categories is summarised in Figure 2.

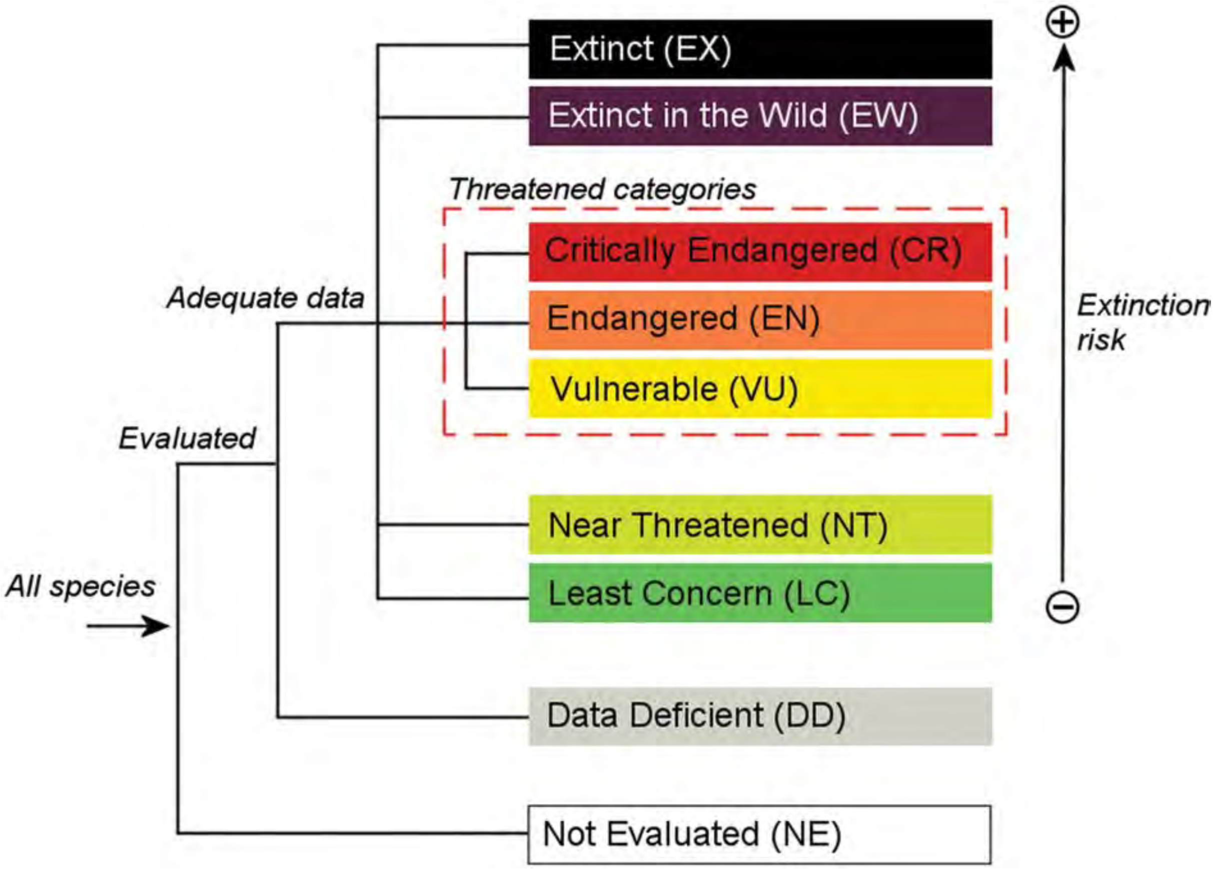


Figure 2.—Structure of IUCN categories.

1.4 Summary of the Red List Criteria (Table 1; reproduced courtesy of IUCN, from IUCN 2012a)

Summary of the five criteria (A–E) used to evaluate if a taxon belongs in an IUCN Red List threatened category (Critically Endangered, Endangered or Vulnerable)[1]

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered	**Endangered**	**Vulnerable**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3 & A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 **Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years).** *[(a) cannot be used for A3]*

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality
(d) actual or potential levels of exploitation
(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)			
	Critically Endangered	**Endangered**	**Vulnerable**
B1. Extent of occurrence (EOO)	< 100 km²	< 5 000 km²	< 20 000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2 000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10

(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals

(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals

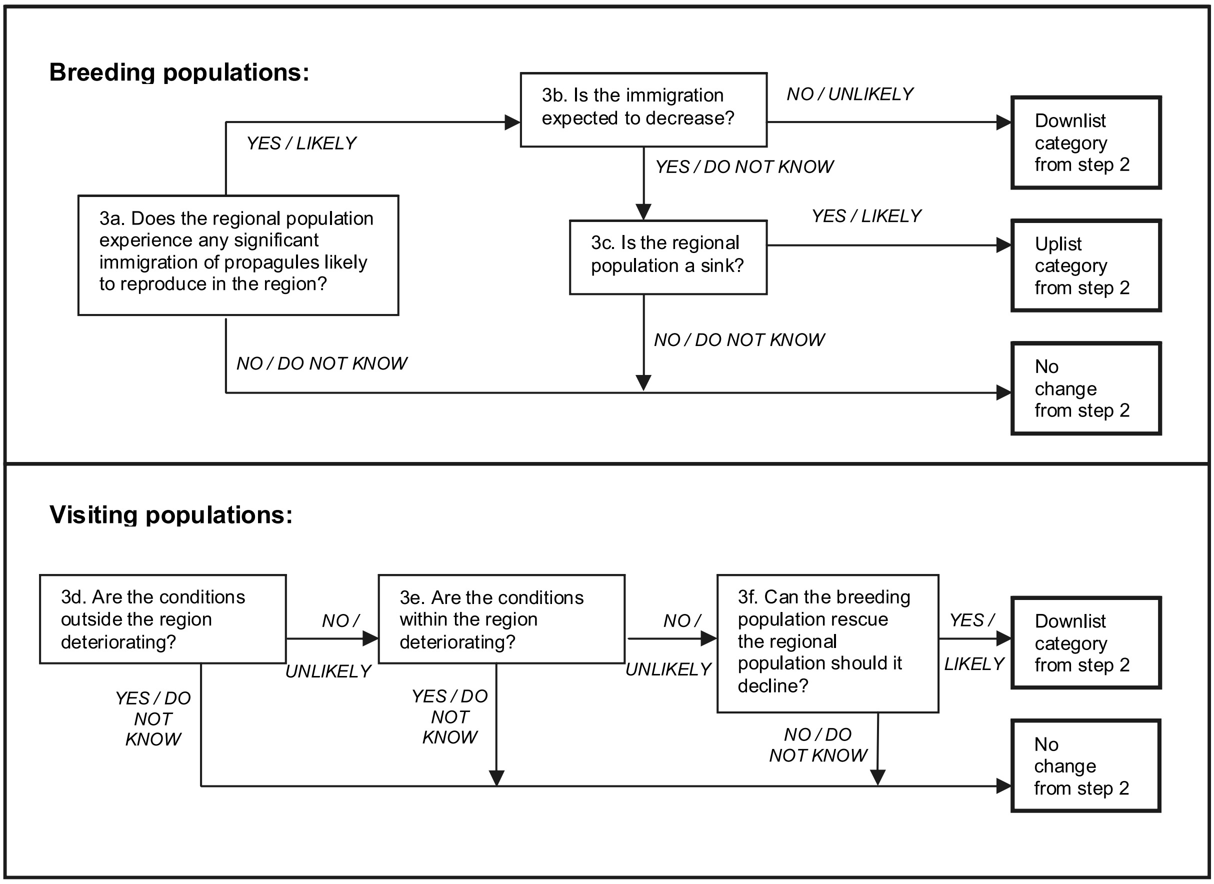
C. Small population size and decline			
	Critically Endangered	**Endangered**	**Vulnerable**
Number of mature individuals	< 250	< 2 500	< 10 000
AND at least one of C1 or C2:			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) **(i)** Number of mature individuals in each subpopulation:	≤ 50	≤ 250	≤ 1 000
(ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population			
	Critically Endangered	**Endangered**	**Vulnerable**
D. Number of mature individuals	< 50	< 250	< 1 000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	D2. typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative analysis			
	Critically Endangered	**Endangered**	**Vulnerable**
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

[1] Use of this summary sheet requires full understanding of the *IUCN Red List Categories and Criteria*, and *Guidelines for Using the IUCN Red List Categories and Criteria*. Please refer to both documents for explanations of terms and concepts used here.

1.5 Conceptual scheme for adjusting the preliminary IUCN Red List Category to the final regional Red List Category (reproduced courtesy of IUCN, from IUCN 2012b)



Note: For SARCA, the region is South Africa, Lesotho and Swaziland.
Note: Downlist refers to reduced extinction risk, and uplist to increased extinction risk.

APPENDIX 2

Current and past conservation status of select reptile taxa assessed, including all taxa of conservation concern

Compiled by William R. Branch & Michael F. Bates

IUCN

THE IUCN RED LIST THREAT CATEGORIES

Colour Chart

The IUCN Red List Threat Category	PMS	Red	Green	Blue	HTML	Colour
Not Applicable (NA)	401	193	181	165	#C1B5A5	
Not Evaluated (NE)	White	255	255	255	#FFFFFF	
Data Deficient (DD)	441	209	209	198	#D1D1C6	
Least Concern (LC)	360	96	198	89	#60C659	
Near Threatened (NT)	381	204	226	38	#CCE226	
Vulnerable (VU)	102	249	232	20	#F9E814	
Endangered (EN)	164	252	127	63	#FC7F3F	
Critically Endangered (CR)	485	216	30	5	#D81E05	
Regionally Extinct (RE)	258	155	79	150	#9B4F96	
Extinct in the Wild (EW)	262	84	35	68	#542344	
Extinct (EX)	Black	0	0	0	#000000	

THE IUCN RED LIST OF THREATENED SPECIES™

Note: The Lower risk/conservation dependent (LR/cd) category is not to be used. If there is ever any need to include LR/cd then it should be portrayed as NT and be accompanied by an explanation in a footnote.

™ The IUCN Red List of Threatened Species is a trade mark of IUCN, International Union for Conservation of Nature and Natural Resources.

Group	Species	Scope	SARCA	IUCN 2009	SA RDB 1988	Swaziland RDB 2003	CITES	Endemic* and Near-endemic**
Lizards	*Scelotes guentheri*	GLOBAL	Extinct	Vulnerable	Rare			Endemic
	Tetradactylus eastwoodae	GLOBAL	Extinct	Extinct	Extinct			Endemic
Chelonia	*Psammobates geometricus*	GLOBAL	Critically Endangered	Endangered	Endangered		Appendix I	Endemic
Lizards	*Cryptactites peringueyi*	GLOBAL	Critically Endangered	Data Deficient	Indeterminate			Endemic
	Pachydactylus rangei	REGIONAL	Critically Endangered		Peripheral			
	Scelotes inornatus	GLOBAL	Critically Endangered					Endemic
Snakes	*Bitis albanica*	GLOBAL	Critically Endangered					Endemic
Chelonia	*Dermochelys coriacea*	REGIONAL	Endangered ^	Critically Endangered	Endangered		Appendix I	
Lizards	*Bradypodion caeruleogula*	GLOBAL	Endangered					Endemic
	Bradypodion caffer	GLOBAL	Endangered				Appendix II	Endemic
	Bradypodion taeniabronchum	GLOBAL	Endangered	Critically Endangered	Endangered		Appendix II	Endemic
	Platysaurus intermedius inopinus	GLOBAL	Endangered					Endemic
	Platysaurus monotropis	GLOBAL	Endangered					Endemic
	Acontias poecillus	GLOBAL	Endangered					Endemic
	Acontias riepelli	GLOBAL	Endangered	Vulnerable	Restricted			Endemic
	Cryptoblepharus africanus	REGIONAL	Endangered		Vulnerable			
Snakes	*Bitis inornata*	GLOBAL	Endangered	Vulnerable	Restricted			Endemic
Chelonia	*Pelusios rhodesianus*	REGIONAL	Vulnerable		Peripheral		Appendix II	
	Caretta caretta	REGIONAL	Vulnerable ^	Endangered	Vulnerable		Appendix I	
	Homopus signatus	GLOBAL	Vulnerable	Near Threatened	Restricted		Appendix II	Endemic
Crocodile	*Crocodylus niloticus*	REGIONAL	Vulnerable	Near Threatened	Vulnerable	Vulnerable	Appendix II	
Lizards	*Chirindia langi occidentalis*	GLOBAL	Vulnerable					Endemic
	Bradypodion kentanicum	GLOBAL	Vulnerable				Appendix II	Endemic
	Bradypodion melanocephalum	GLOBAL	Vulnerable				Appendix II	Endemic
	Bradypodion pumilum	GLOBAL	Vulnerable				Appendix II	Endemic
	Bradypodion thamnobates	GLOBAL	Vulnerable	Near Threatened			Appendix II	Endemic
	Hemicordylus nebulosus	GLOBAL	Vulnerable	Vulnerable			Appendix II	Endemic
	Smaug giganteus	GLOBAL	Vulnerable	Vulnerable	Vulnerable		Appendix II	Endemic
	Afroedura multiporis multiporis	GLOBAL	Vulnerable		Restricted			Endemic

Group	Species	Scope	SARCA	IUCN 2009	SA RDB 1988	Swaziland RDB 2003	CITES	Endemic* and Near-endemic**
	Homopholis mulleri	GLOBAL	Vulnerable	Near Threatened	Restricted			Endemic
	Lygodactylus methueni	GLOBAL	Vulnerable	Vulnerable	Vulnerable			Endemic
	Pachydactylus goodi	GLOBAL	Vulnerable					Endemic
	Tetradactylus breyeri	GLOBAL	Vulnerable		Rare			Endemic
	Tetradactylus fitzsimonsi	GLOBAL	Vulnerable					Endemic
	Scelotes bourquini	GLOBAL	Vulnerable		Rare			Endemic
Snakes	*Dendroaspis angusticeps*	REGIONAL	Vulnerable					
	Psammophis leightoni	GLOBAL	Vulnerable		Vulnerable			Endemic
	Bitis armata	GLOBAL	Vulnerable					Endemic
Chelonia	*Chelonia mydas*	REGIONAL	Near Threatened [A]	Endangered	Vulnerable		Appendix I	
	Eretmochelys imbricata	REGIONAL	Near Threatened [A]	Critically Endan-gered	Vulnerable		Appendix I	
	Homopus boulengeri	GLOBAL	Near Threatened				Appendix II	Endemic
Lizards	*Bradypodion dracomontanum*	GLOBAL	Near Threatened				Appendix II	Endemic
	Bradypodion nemorale	GLOBAL	Near Threatened	Near Threatened			Appendix II	Endemic
	Bradypodion ngomeense	GLOBAL	Near Threatened					Endemic
	Chamaesaura aenea	GLOBAL	Near Threatened			Near Threatened		Endemic
	Chamaesaura macrolepis	GLOBAL	Near Threatened					Near-endemic
	Cordylus imkeae	GLOBAL	Near Threatened				Appendix II	Endemic
	Cordylus macropholis	GLOBAL	Near Threatened				Appendix II	Endemic
	Cordylus niger	GLOBAL	Near Threatened				Appendix II	Endemic
	Cordylus oelofseni	GLOBAL	Near Threatened				Appendix II	Endemic
	Platysaurus orientalis fitzsimonsi	GLOBAL	Near Threatened					Endemic
	Pseudocordylus langi	GLOBAL	Near Threatened	Near Threatened	Restricted		Appendix II	Endemic
	Pseudocordylus spinosus	GLOBAL	Near Threatened	Near Threatened	Restricted		Appendix II	Endemic
	Pseudocordylus transvaalensis	GLOBAL	Near Threatened				Appendix II	Endemic
	Afroedura hawequensis	GLOBAL	Near Threatened	Near Threatened	Restricted			Endemic
	Afroedura major	GLOBAL	Near Threatened			Near Threatened		Endemic
	Goggia braacki	GLOBAL	Near Threatened					Endemic
	Goggia gemmula	GLOBAL	Near Threatened					Near-endemic
	Lygodactylus graniticolus	GLOBAL	Near Threatened					Endemic
	Lygodactylus ocellatus soutpansbergensis	GLOBAL	Near Threatened					Endemic
	Lygodactylus waterbergensis	GLOBAL	Near Threatened					Endemic
	Australolacerta rupicola	GLOBAL	Near Threatened	Near Threatened	Restricted			Endemic

Group	Species	Scope	SARCA	IUCN 2009	SA RDB 1988	Swaziland RDB 2003	CITES	Endemic* and Near-endemic**
	Nucras taeniolata	GLOBAL	Near Threatened					Endemic
	Tropidosaura cottrelli	GLOBAL	Near Threatened					Endemic
	Acontias richardi	GLOBAL	Near Threatened		Restricted			Endemic
	Scelotes gronovii	GLOBAL	Near Threatened	Near Threatened	Restricted			Endemic
	Scelotes kasneri	GLOBAL	Near Threatened	Vulnerable	Restricted			Endemic
	Scelotes limpopoensis albiventris	GLOBAL	Near Threatened		Restricted			Endemic
	Scelotes montispectus	GLOBAL	Near Threatened					Endemic
	Typhlosaurus lomiae	GLOBAL	Near Threatened	Vulnerable	Restricted			Endemic
Snakes	*Homoroselaps dorsalis*	GLOBAL	Near Threatened	Near Threatened	Rare	Data Deficient		Endemic
	Macrelaps microlepidotus	GLOBAL	Near Threatened					Endemic
	Lycophidion pygmaeum	GLOBAL	Near Threatened					
	Leptotyphlops telloi	GLOBAL	Near Threatened					
	Bitis gabonica	REGIONAL	Near Threatened		Vulnerable			
Chelonia	*Lepidochelys olivacea*	REGIONAL	Data Deficient [A]	Vulnerable	Vulnerable		Appendix I	
Lizards	*Lygodactylus nigropunctatus incognitus*	GLOBAL	Data Deficient					Endemic
	Lygodactylus nigropunctatus montiscaeruli	GLOBAL	Data Deficient					Endemic
	Acontias kgalagadi subtaeniatus	GLOBAL	Data Deficient		Restricted			Endemic
Snakes	*Leptotyphlops sylvicolus*	GLOBAL	Data Deficient					Endemic
	Montaspis gilvomaculata	GLOBAL	Data Deficient					Endemic
Chelonia	*Pelusios castanoides*	REGIONAL	Least Concern [B]		Peripheral		Appendix II	
	Kinixys natalensis	GLOBAL	Least Concern	Near Threatened	Rare	Near Threatened	Appendix II	Endemic
Lizards	*Bradypodion setaroi*	GLOBAL	Least Concern	Endangered			Appendix II	Endemic
	Chamaesaura anguina anguina	GLOBAL	Least Concern			Near Threatened		Endemic
	Cordylus mclachlani	GLOBAL	Least Concern	Vulnerable			Appendix II	Endemic
	Ouroborus cataphractus	GLOBAL	Least Concern	Vulnerable	Vulnerable		Appendix II	Endemic
	Namazonurus lawrenci	GLOBAL	Least Concern	Near Threatened	Restricted		Appendix II	Endemic
	Platysaurus relictus	GLOBAL	Least Concern	Near Threatened	Restricted			Endemic
	Afroedura multiporis haackei	GLOBAL	Least Concern		Restricted			Endemic
	Goggia microlepidota	GLOBAL	Least Concern		Restricted			Endemic
	Phelsuma ocellata	GLOBAL	Least Concern	Near Threatened	Restricted		Appendix II	Near-endemic
	Gerrhosaurus typicus	GLOBAL	Least Concern	Near Threatened	Rare			Endemic
	Australolacerta australis	GLOBAL	Least Concern		Restricted			Endemic
	Nucras lalandii	GLOBAL	Least Concern			Near Threatened		Endemic

Group	Species	Scope	SARCA	IUCN 2009	SA RDB 1988	Swaziland RDB 2003	CITES	Endemic* and Near-endemic**
Snakes	*Rhinotyphlops schinzi*	REGIONAL	Least Concern		Peripheral			
	Namibiana occidentalis	GLOBAL	Least Concern		Peripheral			
	Python natalensis	REGIONAL	Least Concern		Vulnerable	Vulnerable	Appendix II	
	Xenocalamus transvaalensis	GLOBAL	Least Concern	Data Deficient	Rare			Near-endemic
	Amblyodipsas microphthalma microphthalma	GLOBAL	Least Concern		Peripheral			
	Amblyodipsas microphthalma nigra	GLOBAL	Least Concern		Restricted			Endemic
	Lamprophis fiskii	GLOBAL	Least Concern	Vulnerable	Rare			Endemic
	Lamprophis fuscus	GLOBAL	Least Concern	Near Threatened	Rare	Data Deficient		Endemic
	Lycodonomorphus obscuriventris	REGIONAL	Least Concern		Peripheral	Near Threatened		
	Inyoka swazicus	GLOBAL	Least Concern	Near Threatened	Rare	Data Deficient		Endemic
	Lycophidion variegatum	REGIONAL	Least Concern		Peripheral	Data Deficient		
	Prosymna frontalis	GLOBAL	Least Concern		Peripheral			
	Prosymna janii	GLOBAL	Least Concern		Peripheral			
	Psammophis jallae	REGIONAL	Least Concern		Peripheral			
	Dasypeltis inornata	GLOBAL	Least Concern			Near Threatened		Endemic
	Dasypeltis medici medici	REGIONAL	Least Concern		Peripheral			
	Meizodon semiornatus semiornatus	REGIONAL	Least Concern		Peripheral	Near Threatened		
	Philothamnus angolensis	REGIONAL	Least Concern		Peripheral			
	Natriciteres sylvatica	REGIONAL	Least Concern		Peripheral			
	Naja melanoleuca	REGIONAL	Least Concern		Peripheral			
	Naja nigricincta woodi	REGIONAL	Least Concern		Rare			
	Bitis schneideri	GLOBAL	Least Concern	Vulnerable	Vulnerable			
	Bitis xeropaga	GLOBAL	Least Concern		Peripheral			
Chelonians	*Psammobates tentorius trimeni*		NOT ASSESSED [C]					Near-endemic
	Psammobates tentorius verroxii		NOT ASSESSED [C]					
Lizards	*Monopeltis leonhardi*		NOT ASSESSED [D]					
	Zygaspis vandami arenicola		NOT ASSESSED [C]					
	Chondrodactylus angulifer namibensis		NOT ASSESSED [D]					
	Gerrhosaurus auritus		NOT ASSESSED [D]					
	Nucras caesicaudata		NOT ASSESSED [D]		Peripheral			
	Tropidosaura montana natalensis		NOT ASSESSED [C]					Endemic
	Tropidosaura montana rangeri		NOT ASSESSED [C]					Endemic
Snakes	*Leptotyphlops scutifrons conjunctus*		NOT ASSESSED [C]					Endemic
	Ramphotyphlops braminus		NOT ASSESSED [E]					

Group	Species	Scope	SARCA	IUCN 2009	SA RDB 1988	Swaziland RDB 2003	CITES	Endemic* and Near-endemic**
	Xenocalamus sabiensis		NOT ASSESSED [D]					
	Elapsoidea sundevallii decosteri		NOT ASSESSED [C]					
	Elapsoidea sundevallii fitzsimonsi		NOT ASSESSED [C]					
	Elapsoidea sundevallii longicauda		NOT ASSESSED [C]					
	Elapsoidea sundevallii media		NOT ASSESSED [C]					Endemic
	Natriciteres olivacea		NOT ASSESSED [D]					

** Endemic = entire range within Atlas region (South Africa, Lesotho, Swaziland)*
*** Near-endemic = estimated 90% or more of range within Atlas region*
[A] *Downgrade is due to Regional Assessment (see IUCN 2009 for Global status)*
[B] *Only Least Concern taxa whose status has changed from previous assessments are shown*
[C] *Not assessed due to uncertain taxonomic status of subspecies*
[D] *Not assessed as it is peripheral to the Atlas region*
[E] *Introduced*

APPENDIX 3

Endemic and near-endemic reptile taxa in the *Atlas* region

Compiled by Michael F. Bates & William R. Branch

Endemic (190) and near-endemic (38) species and subspecies in the *Atlas* region based on SARCA maps and literature cited in species accounts. Taxa are listed alphabetically within families and subfamilies according to their appearance in the *Atlas*. Endemic: entire natural range within *Atlas* region (South Africa, Lesotho, Swaziland), Near-endemic: estimated 90% or more of natural range within *Atlas* region. * = Assessed at species level in the *Atlas*.

GENUS	SPECIES	SUBSPECIES	ENDEMISM	ENDEMIC SP. & SSP.	NEAR-ENDEMIC SP. & SSP.
CHELONIANS				6	4
Testudinidae				6	4
Chersina	*angulata*		Near-endemic		
Homopus	*areolatus*		Endemic		
Homopus	*boulengeri*		Endemic		
Homopus	*femoralis*		Endemic		
Homopus	*signatus*		Endemic		
Kinixys	*lobatsiana*		Near-endemic		
Kinixys	*natalensis*		Near-endemic		
Psammobates	*geometricus*		Endemic		
**Psammobates*	*tentorius*	*tentorius*	Endemic		
**Psammobates*	*tentorius*	*trimeni*	Near-endemic		
LIZARDS				155	24
Gekkonidae				42	8
Afroedura	*africana*	*namaquensis*	Endemic		
Afroedura	*amatolica*		Endemic		
Afroedura	*halli*		Endemic		
Afroedura	*hawequensis*		Endemic		
Afroedura	*karroica*		Endemic		
Afroedura	*langi*		Near-endemic		
Afroedura	*major*		Endemic		
Afroedura	*marleyi*		Endemic		
Afroedura	*multiporus*	*multiporus*	Endemic		
Afroedura	*multiporus*	*haackei*	Endemic		
Afroedura	*nivaria*		Endemic		
Afroedura	*pondolia*		Endemic		
Afroedura	*tembulica*		Endemic		
Afrogecko	*porphyreus*		Endemic		
Afrogecko	*swartbergensis*		Endemic		
Cryptactites	*peringueyi*		Endemic		
Goggia	*braacki*		Endemic		
Goggia	*essexi*		Endemic		
Goggia	*gemmula*		Near-endemic		
Goggia	*hewitti*		Endemic		
Goggia	*hexapora*		Endemic		
Goggia	*lineata*		Near-endemic		

GENUS	SPECIES	SUBSPECIES	ENDEMISM	ENDEMIC SP. & SSP.	NEAR-ENDEMIC SP. & SSP.
Goggia	*microlepidota*		Endemic		
Goggia	*rupicola*		Endemic		
Homopholis	*mulleri*		Endemic		
Lygodactylus	*graniticolus*		Endemic		
Lygodactylus	*methueni*		Endemic		
Lygodactylus	*nigropunctatus*	*nigropunctatus*	Endemic		
Lygodactylus	*nigropunctatus*	*incognitus*	Endemic		
Lygodactylus	*nigropunctatus*	*montiscaeruli*	Endemic		
Lygodactylus	*ocellatus*	*ocellatus*	Endemic		
Lygodactylus	*ocellatus*	*soutpansbergensis*	Endemic		
Lygodactylus	*waterbergensis*		Endemic		
Pachydactylus	*affinis*		Endemic		
Pachydactylus	*amoenus*		Endemic		
Pachydactylus	*austeni*		Endemic		
Pachydactylus	*barnardi*		Endemic		
Pachydactylus	*formosus*		Endemic		
Pachydactylus	*geitje*		Endemic		
Pachydactylus	*goodi*		Endemic		
Pachydactylus	*kladaroderma*		Endemic		
Pachydactylus	*labialis*		Endemic		
Pachydactylus	*macrolepis*		Endemic		
Pachydactylus	*maculatus*		Near-endemic		
Pachydactylus	*mariquensis*		Endemic		
Pachydactulus	*namaquensis*		Near-endemic		
Pachydactylus	*oculatus*		Endemic		
Pachydactylus	*vansoni*		Near-endemic		
Pachydactylus	*weberi*		Near-endemic		
Phelsuma	*ocellata*		Near-endemic		
Amphisbaenidae				2	2
Chirindia	*langi*	*langi*	Near-endemic		
Chirindia	*langi*	*occidentalis*	Endemic		
Monopeltis	*capensis*		Near-endemic		
**Zygaspis*	*vandami*	*vandami*	Endemic		
Lacertidae				13	2
Australolacerta	*australis*		Endemic		
Meroles	*knoxii*		Near-endemic		
Nucras	*lalandii*		Endemic		
Nucras	*livida*		Endemic		
Nucras	*taeniolata*		Endemic		
Pedioplanis	*burchelli*		Endemic		
Pedioplanis	*laticeps*		Endemic		
Pedioplanis	*lineoocellata*	*pulchella*	Near-endemic		
Tropidosaura	*cottrelli*		Endemic		
Tropidosaura	*essexi*		Endemic		
Tropidosaura	*gularis*		Endemic		
Tropidosaura	*montana*	*montana*	Endemic		
**Tropidosaura*	*montana*	*natalensis*	Endemic		
**Tropidosaura*	*montana*	*rangeri*	Endemic		
Vhembelacerta	*rupicola*		Endemic		
Cordylidae				42	5
Cordylinae				30	4
Chamaesaura	*aenea*		Endemic		
Chamaesaura	*anguina*	*anguina*	Endemic		
Chamaesaura	*macrolepis*		Near-endemic		
Cordylus	*aridus*		Endemic		

GENUS	SPECIES	SUBSPECIES	ENDEMISM	ENDEMIC SP. & SSP.	NEAR-ENDEMIC SP. & SSP.
Cordylus	*cloetei*		Endemic		
Cordylus	*cordylus*		Endemic		
Cordylus	*imkeae*		Endemic		
Cordylus	*macropholis*		Endemic		
Cordylus	*mclachlani*		Endemic		
Cordylus	*minor*		Endemic		
Cordylus	*niger*		Endemic		
Cordylus	*oelofseni*		Endemic		
Cordylus	*vittifer*		Near-endemic		
Hemicordylus	*capensis*		Endemic		
Hemicordylus	*nebulosus*		Endemic		
Karusasaurus	*polyzonus*		Near-endemic		
Namazonurus	*lawrenci*		Endemic		
Namazonurus	*peersi*		Endemic		
Ninurta	*coeruleopunctatus*		Endemic		
Ouroborus	*cataphractus*		Endemic		
Pseudocordylus	*langi*		Endemic		
Pseudocordylus	*melanotus*	*melanotus*	Endemic		
Pseudocordylus	*melanotus*	*subviridis*	Endemic		
Pseudocordylus	*microlepidotus*	*microlepidotus*	Endemic		
Pseudocordylus	*microlepidotus*	*fasciatus*	Endemic		
Pseudocordylus	*microlepidotus*	*namaquensis*	Endemic		
Pseudocordylus	*spinosus*		Endemic		
Pseudocordylus	*transvaalensis*		Endemic		
Smaug	*breyeri*		Endemic		
Smaug	*giganteus*		Endemic		
Smaug	*vandami*		Endemic		
Smaug	*warreni*	*warreni*	Near-endemic		
Smaug	*warreni*	*barbertonensis*	Endemic		
Smaug	*warreni*	*depressus*	Endemic		
Platysaurinae				12	1
Platysaurus	*broadleyi*		Endemic		
Platysaurus	*guttatus*		Endemic		
Platysaurus	*intermedius*	*intermedius*	Endemic		
Platysaurus	*intermedius*	*inopinus*	Endemic		
Platysaurus	*intermedius*	*natalensis*	Endemic		
Platysaurus	*intermedius*	*parvus*	Endemic		
Platysaurus	*intermedius*	*wilhelmi*	Endemic		
Platysaurus	*lebomboensis*		Near-endemic		
Platysaurus	*minor*		Endemic		
Platysaurus	*monotropis*		Endemic		
Platysaurus	*orientalis*	*orientalis*	Endemic		
Platysaurus	*orientalis*	*fitzsimonsi*	Endemic		
Platysaurus	*relictus*		Endemic		
Gerrhosauridae				7	0
Gerrhosaurus	*typicus*		Endemic		
Tetradactylus	*africanus*		Endemic		
Tetradactylus	*breyeri*		Endemic		
Tetradactylus	*eastwoodae*		Endemic		
Tetradactylus	*fitzsimonsi*		Endemic		
Tetradactylus	*seps*		Endemic		
Tetradactylus	*tetradactylus*		Endemic		
Scincidae				32	4
Acontinae				17	1
Acontias	*breviceps*		Endemic		

GENUS	SPECIES	SUBSPECIES	ENDEMISM	ENDEMIC SP. & SSP.	NEAR-ENDEMIC SP. & SSP.
Acontias	*cregoi*		Near-endemic		
Acontias	*fitzsimonsi*		Endemic		
Acontias	*gracilicauda*		Endemic		
Acontias	*grayi*		Endemic		
Acontias	*kgalagadi*	*subtaeniatus*	Endemic		
Acontias	*lineicauda*		Endemic		
Acontias	*litoralis*		Endemic		
Acontias	*meleagris*		Endemic		
Acontias	*namaquensis*		Endemic		
Acontias	*orientalis*		Endemic		
Acontias	*poecilus*		Endemic		
Acontias	*richardi*		Endemic		
Acontias	*rieppeli*		Endemic		
Acontias	*tristis*		Endemic		
Typhlosaurus	*caecus*		Endemic		
Typhlosaurus	*lomiae*		Endemic		
Typhlosaurus	*vermis*		Endemic		
Lygosominae				1	0
Trachylepis	*homalocephala*		Endemic		
Scincinae				14	3
Scelotes	*anguineus*		Endemic		
Scelotes	*bidigittatus*		Endemic		
Scelotes	*bipes*		Endemic		
Scelotes	*bourquini*		Endemic		
Scelotes	*caffer*		Endemic		
Scelotes	*fitzsimonsi*		Endemic		
Scelotes	*gronovii*		Endemic		
Scelotes	*guentheri*		Endemic		
Scelotes	*inornatus*		Endemic		
Scelotes	*kasneri*		Endemic		
Scelotes	*limpopoensis*	*limpopoensis*	Near-endemic		
Scelotes	*limpopoensis*	*albiventris*	Endemic		
Scelotes	*mirus*		Endemic		
Scelotes	*montispectus*		Endemic		
Scelotes	*mossambicus*		Near-endemic		
Scelotes	*sexlineatus*		Endemic		
Scelotes	*vestigifer*		Near-endemic		
Chamaeleonidae				16	1
Bradypodion	*atromontanum*		Endemic		
Bradypodion	*caeruleogula*		Endemic		
Bradypodion	*caffer*		Endemic		
Bradypodion	*damaranum*		Endemic		
Bradypodion	*dracomontanum*		Endemic		
Bradypodion	*gutturale*		Endemic		
Bradypodion	*kentanicum*		Endemic		
Bradypodion	*melanocephalum*		Endemic		
Bradypodion	*nemorale*		Endemic		
Bradypodion	*ngomeense*		Endemic		
Bradypodion	*occidentale*		Endemic		
Bradypodion	*pumilum*		Endemic		
Bradypodion	*setaroi*		Near-endemic		
Bradypodion	*taeniabronchum*		Endemic		
Bradypodion	*thamnobates*		Endemic		
Bradypodion	*transvaalense*		Endemic		
Bradypodion	*ventrale*		Endemic		

GENUS	SPECIES	SUBSPECIES	ENDEMISM	ENDEMIC SP. & SSP.	NEAR-ENDEMIC SP. & SSP.
Agamidae				1	2
Agama	*aculeata*	*distanti*	Endemic		
Agama	*atra*		Near-endemic		
Agama	*hispida*		Near-endemic		
SNAKES				29	10
Typhlopidae					1
Afrotyphlops	*bibronii*		Near-endemic		
Leptotyphlopidae				4	2
Leptotyphlops	*distanti*		Near-endemic		
Leptotyphlops	*jacobseni*		Endemic		
Leptotyphlops	*nigricans*		Endemic		
**Leptotyphlops*	*scutifrons*	*conjunctus*	Endemic		
Leptotyphlops	*sylvicolus*		Endemic		
Namibiana	*gracilior*		Near-endemic		
Viperidae				4	1
Bitis	*albanica*		Endemic		
Bitis	*armata*		Endemic		
Bitis	*atropos*		Near-endemic		
Bitis	*inornata*		Endemic		
Bitis	*rubida*		Endemic		
Lamprophiidae				16	5
Atractaspidinae				6	1
Amblyodipsas	*concolor*		Endemic		
Amblyodipsas	*microphthalma*	*nigra*	Endemic		
Homoroselaps	*dorsalis*		Endemic		
Homoroselaps	*lacteus*		Endemic		
Macrelaps	*microlepidotus*		Endemic		
Xenocalamus	*bicolor*	*australis*	Endemic		
Xenocalamus	*transvaalensis*		Near-endemic		
Lamprophiinae				7	1
Inyoka	*swazicus*		Endemic		
Lamprophis	*aurora*		Endemic		
Lamprophis	*fiskii*		Endemic		
Lamprophis	*fuscus*		Endemic		
Lamprophis	*guttatus*		Near-endemic		
Lycodonomorphus	*inornatus*		Endemic		
Lycodonomorphus	*laevissimus*		Endemic		
Lycophidion	*pygmaeum*		Endemic		
Pseudoxyrhophiinae				2	1
Amphlorhinus	*multimaculatus*		Near-endemic		
Duberria	*lutrix*	*lutrix*	Endemic		
Montaspis	*gilvomaculata*		Endemic		
Psammophiinae				1	1
Psammophis	*crucifer*		Near-endemic		
Psammophis	*leightoni*		Endemic		
Lamprophiidae *incertae sedis*					1
Prosymna	*sundevallii*		Near-endemic		1
Elapidae				3	1
Aspidelaps	*scutatus*	*intermedius*	Endemic		
**Elapsoidea*	*sundevallii*	*media*	Endemic		
**Elapsoidea*	*sundevallii*	*sundevallii*	Endemic		
Hemachatus	*haemachatus*		Near-endemic		
Colubridae				2	
Dasypeltis	*inornata*		Endemic		
Philothamnus	*natalensis*	*occidentalis*	Endemic		

APPENDIX 4

Alien reptiles recorded in the wild in the *Atlas* region

(None are known to represent established breeding populations)

Compiled by William R. Branch

SPECIES	SCIENTIFIC NAME	DATE	QDGC	LOCATION	Observer	CONTACT	SIGHTING	Fate	Voucher	Length (mm)
LIZARDS										
Common Agama	*Agama agama*	2004/06/29	3318CD	Cape Town harbour, Western Cape	E.H.W. Baard	A. Turner	Captured in docks	Killed	Specimen	
Namibian Rock Agama	*Agama planiceps*	2000/01/01	3318BB	Porterville, Western Cape	J. van Deventer	A. Turner	Jumped off a vehicle carrying wood from Namibia		Specimen	
Asian Gecko	*Gekko monarchus*	2002/07/01	3325DC	Port Elizabeth harbour, Eastern Cape	W.R. Branch	W.R. Branch	Captured in warehouse	Killed	Specimen (PEM R5412)	
Angulate Dwarf Gecko	*Lygodactylus angularis*	1992/08/10	3325DC	Main street, Walmer, Port Eliza-beth, Eastern Cape	G. Craig	W.R. Branch	On townhouse	Killed	Specimen (PEM R7337)	
Bearded Dragon	*Pogona vitticeps*	c. 2011	2628AA	Melville Koppies, Johannesburg, Gauteng		G.J. Alexander	Identified from a photo	Fate unknown, specimen not captured	Photo	
Bearded Dragon	*Pogona vitticeps*	2011	2628AA	Germiston, Gauteng		G.J. Alexander	Captured gravid female	Retained in captivity, now in pet trade		
Green Iguana	*Iguana iguana*	c. 2005	2628AA	Melville Koppies, Johannesburg, Gauteng		G.J. Alexander	Captured	Kept in captiv-ity, died two years later		
SNAKES										
Boa Constrictor	*Boa constrictor*	2010/02/19	3227DD	East London beach, Bonza Bay to Danger Point, Eastern Cape	C. Vernon	C. Vernon	Dead on beach	Dead	Photo	
Boa Constrictor	*Boa constrictor*	2007/07/21	3418AB	28 Hancock Road, Plumstead, Cape Town, Western Cape	M. Witberg	M. Witberg		Retained in captivity		-
Boa Constrictor	*Boa constrictor*		2628AA	Primrose, Gauteng		J. Marais				2 000
Burmese Python	*Python molurus bivittatus*	2012/03/29	2931CA	Verulam, north of Durban, KwaZulu-Natal	http://www.news24.com/SouthAfrica/News/Durban-guards-nab-3m-long-python-20120329	J. Marais	In garage and reported to have been around for three years	Released in adjacent bush	Photo	3 000
Burmese Python	*Python molurus bivittatus*	1997/04/01	3030DA	Southport, South Coast, KwaZulu-Natal	South Coast Herald, April 4, 1997, p. 8	W.R. Schmidt	Caught in garage	Released at Oribi Gorge	Newspaper article	Small adult

SPECIES	SCIENTIFIC NAME	DATE	QDGC	LOCATION	Observer	CONTACT	SIGHTING	Fate	Voucher	Length (mm)
Reticulated Python	*Python reticulatus*	2012/03/28	2628AA	Sandton, Johannesburg, Gauteng	http://www.news24.com/SouthAfrica/News/Two-large-pythons-on-the-loose-in-Sandton-20120328		Escaped from house	Fate unknown	News report	Two large albino captives
Californian King Snake	*Lampropeltis californiae*	2008/04/11	3325DC	69 Forest Hill Drive, Forest Hill, Port Elizabeth, Eastern Cape		W. Conradie		Fate unknown	M. Marshall	
Californian King Snake	*Lampropeltis californiae*	2010/02/23	3325CD	Plot 55, Seaview Road, Little Chelsea, Port Elizabeth, Eastern Cape		W. Conradie	Albino	Fate unknown	M. Marshall	
Californian King Snake	*Lampropeltis californiae*	1996/10/22	2628AA	Kensington, Johannesburg, Gauteng	W.R. Schmidt	W.R. Schmidt	Banded, black, caught in postbox	Transvaal Snake Park	Photograph	Juvenile
Californian King Snake	*Lampropeltis californiae*	2008/10/22	2628AA	31 Osten Road, Delville, Germiston, Gauteng	W.R. Schmidt	W.R. Schmidt	Albino, caught in garden during the day in residential area	Kept in captivity for two years, then donated to reptile keeper	Photograph	Male, 800
Sinaloan king Snake	*Lampropeltis triangulum sinaloae*		2628AC	Rosettenville, Gauteng		J. Marais		Fate unknown		
Sinaloan king Snake	*Lampropeltis triangulum sinaloae*		2628AA	Fourways, Gauteng		J. Marais		Fate unknown		
Sinaloan king Snake	*Lampropeltis triangulum sinaloae*	1995/11/24	2628AA	Edenvale, Gauteng	W.R. Schmidt	W.R. Schmidt	Caught basking on garden water feature	Donated to Transvaal Snake Park	Photograph	
Taiwanese Rat Snake	*Orthriophis taeniurus freisei*	2009/03	3318DC	35 Grieve Street, Durbanville, Western Cape	R. Albertyn	M. Witberg		Killed in garden		2 160
Taiwanese Rat Snake	*Orthriophis taeniurus freisei*	1993/11/30	2628AA	Highlands North, Johannesburg, Gauteng	W.R. Schmidt	W.R. Schmidt	Caught in aviary in garden feeding on exotic birds	Kept in captivity for several years	Photograph	Adult
Corn Snake	*Pantherophis guttatus*	2007/05/29	3318CD	67 Regent Road, Seapoint, Cape Town, Western Cape	M. Witberg	A. Turner		Fate unknown	Photograph	
Corn Snake	*Pantherophis guttatus*	2010/11/14	2528CD	Menlo Park, Pretoria, Gauteng	L. Pretorius	M. Burger	Striped colour morph	Released in wild	Photograph	

SPECIES	SCIENTIFIC NAME	DATE	QDGC	LOCATION	Observer	CONTACT	SIGHTING	Fate	Voucher	Length (mm)
Corn Snake	*Pantherophis guttatus*	2010/11/04	3326DB	Port Alfred, Eastern Cape	F. Fouche	W. Conradie	Xanthic colour morph	Handed live to Nature Conservation and donated to Bayworld Snake Park	Specimen	300
Corn Snake	*Pantherophis guttatus*	2010/11	3318DD	Pniel area, Western Cape	M. Witberg	M. Witberg		Killed in garden		-
Corn Snake	*Pantherophis guttatus*	2007/09	3418BB	Somerset West, Western Cape	Handed in by N. Wilson (Cape Nature)	M. Witberg		Not released		1 050
Corn Snake	*Pantherophis guttatus*	2007/05	3318CD	67 Regent Road, Seapoint, Cape Town, Western Cape	Morris	M. Witberg		Not released		
Corn Snake	*Pantherophis guttatus*	2009	3030BB	Amanzimtoti, KwaZulu-Natal	R. Deans	R. Deans		Donated to reptile keepers	Specimen	Mature
Corn Snake	*Pantherophis guttatus*		2628AB	Brakpan, Gauteng		J. Marais		Fate unknown		
Corn Snake	*Pantherophis guttatus*		2628AA	Primrose, Gauteng		J. Marais		Fate unknown		
Corn Snake	*Pantherophis guttatus*		2628AC	Rosettenville, Gauteng		J. Marais		Fate unknown		
Yellow Rat Snake	*Pantherophis obsoletus*		2628AA	Fourways, Gauteng		J. Marais		Fate unknown		
Yellow Rat Snake	*Pantherophis obsoletus*		2628AB	Benoni, Gauteng		J. Marais		Fate unknown		
Eastern Rat Snake	*Pantherophis alleghaniensis*	2005/12/24	2628AA	Anitahof Townhouse Complex, Vosloo Street, Birchleigh, Kempton Park, Gauteng	W.R. Schmidt	W.R. Schmidt	Caught in aviary feeding on caged birds	Donated to responsible keeper	Photograph	Male: 985
Eastern Rat Snake	*Pantherophis alleghaniensis*	2011/12/15	2628AA	18 Croton Road, Primrose, Germiston, Gauteng	W.R. Schmidt	W.R. Schmidt	Caught on garage roof in crevice alongside house	Donated to responsible keeper	Photograph	1 400
Pine Snake	*Pituophis melanoleucus*		2930DD	Umbilo, Durban, KwaZulu-Natal		J. Marais		Fate unknown		
Forest Cobra	*Naja melanoleuca*	2010/03/31	3418AB	Cape Town harbour, Western Cape		M. Burger	In shipment of tree trunks from West Africa	Kept in captivity	Photo	

SPECIES	SCIENTIFIC NAME	DATE	QDGC	LOCATION	Observer	CONTACT	SIGHTING	Fate	Voucher	Length (mm)
CHELONIANS								Fate unknown		
Common Snapping Turtle	*Chelydra serpentina*	2002/09/27	3322CD	George Crocodile Farm, George, Western Cape	E.H.W. Baard	A. Turner	Donated to Cango Wildlife Ranch	Fate unknown	Photograph	
Common Snapping Turtle	*Chelydra serpentina*	2005/10/01	3322CA	Downstream in river below Cango Wildlife Ranch, Oudt-shoorn, Western Cape	E.H.W. Baard	A. Turner	Same individ-ual as in previ-ous record. Returned to reptile park	Fate unknown	Photograph	
Chinese Soft-shelled Terrapin	*Pelodiscus sinensis*		2528CC	Midrand, Gauteng		J. Marais		Fate unknown		
Red-eared Terrapin	*Trachemys scripta*	2009/04/01	3318CD	In garden stream, 30 Oak Avenue, Kenilworth, Cape Town, Western Cape	Z. Khan	A. Turner	Adult. Sent to SAM	Fate unknown	Specimen	
Red-eared Terrapin	*Trachemys scripta*	2005/07/02	3030BB	Clansthal, Umkomaas area, South Coast, KwaZulu-Natal		J. Marais		Killed	Specimen	
Red-eared Terrapin	*Trachemys scripta*		3030BB	Bird Park, Umkomaas, South Coast, KwaZulu-Natal		J. Marais		Fate unknown		
Ornate Box Turtle	*Terrapene ornata*	1995	2628AA	Greenside/Emmerentia area, Johannesburg, Gauteng	W.R. Schmidt	W.R. Schmidt	Found walking on pavement	Transvaal Snake Park captive	Photograph	Adult

Additional information supplied by Graham J. Alexander, Marius Burger, Werner Conradie, Rob Deans, Johan Marais, Warren R. Schmidt, Andrew Turner, Carl Vernon and Marcel Witberg.

Index to scientific names

Index to common names

SURICATA

1. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. 2014 (reprint 2014). M.F. Bates, W.R. Branch, A.M. Bauer, M. Burger, J. Marais, G.J. Alexander & M.S. de Villiers. ISBN 978-1-919976-84-6. Also available on CD: ISBN 978-1-919976-96-9.

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Summary of the Red List Criteria
(Reproduced courtesy of IUCN, from IUCN 2012a)

Summary of the five criteria (A–E) used to evaluate if a taxon belongs in an IUCN Red List threatened category (Critically Endangered, Endangered or Vulnerable)[1]

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3 & A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1	Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.	based on any of the following:	**(a)** direct observation *[except A3]* **(b) an index of abundance appropriate to the taxon** **(c)** a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality **(d)** actual or potential levels of exploitation **(e)** effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites
A2	Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.		
A3	**Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years).** *[(a) cannot be used for A3]*		
A4	An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.		

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)

	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5 000 km²	< 20 000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2 000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented **OR** Number of locations	= 1	≤ 5	≤ 10

(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals

(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals

C. Small population size and decline

	Critically Endangered	Endangered	Vulnerable
Number of mature individuals	< 250	< 2 500	< 10 000
AND at least one of C1 or C2:			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation:	≤ 50	≤ 250	≤ 1 000
(ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals			

D. Very small or restricted population

	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	< 1 000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	D2. typically: AOO < 20 km² or number of locations ≤ 5

E. Quantitative analysis

	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

[1] Use of this summary sheet requires full understanding of the *IUCN Red List Categories and Criteria*, and *Guidelines for Using the IUCN Red List Categories and Criteria*. Please refer to both documents for explanations of terms and concepts used here.


BRASIL


















GOODYEAR


This **Atlas and Red List** details the outcomes of the Southern African Reptile Conservation Assessment (SARCA), the most thorough reptile assessment project ever conducted in Africa. The conservation status of the 422 recognised species and subspecies of reptiles of South Africa, Lesotho and Swaziland was evaluated against IUCN guidelines, based on detailed distribution maps, published literature and the collective expertise of leading herpetologists. Maps were based on records from museums, conservation agencies, published literature, targeted fieldwork, and an online virtual museum.

The assessment revealed that one-fifth of all species and subspecies are of conservation concern, mainly because of habitat alteration. Two species are now extinct, whereas 36 are classified as threatened (five Critically Endangered, 10 Endangered and 21 Vulnerable). As much as 45% of the region's 421 indigenous taxa are endemic, including most taxa of conservation concern.

This important publication includes, for the first time, colour photographs of all snakes, lizards, tortoises, terrapins, turtles and crocodiles of the region, as well as detailed maps illustrating their ranges. Accounts for each taxon also include details on taxonomic and conservation status, habitat, and threats. Introductory chapters discuss project design, data management, taxonomy, evolutionary relationships, conservation status, endemism, threats, and diversity hotspots.

The **Atlas** will appeal not only to herpetologists, but also to other biologists, naturalists, conservation planners and managers, environmental consultants, legislators, and members of the public.

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