Biological Conservation xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/bioc

Conservation status and threats for African reptiles

Krystal A. Tolley [a,b,*], Graham J. Alexander [c], William R. Branch [d,e], Philip Bowles [f], Bryan Maritz [g]

[a] South African National Biodiversity Institute, Kirstenbosch Research Centre, Private Bag X7, Newlands, Cape Town 7945, South Africa
[b] Department of Botany and Zoology, Stellenbosch University, Private Bag X1, Matieland, 7602 Stellenbosch, South Africa
[c] School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg, P.O. Wits, 2050, South Africa
[d] Port Elizabeth Museum, P.O. Box 13147, Humewood 6013, South Africa
[e] Department of Zoology, P.O. Box 77000, Nelson Mandela Metropolitan University, Port Elizabeth 6031, South Africa
[f] IUCN-CI Biodiversity Assessment Unit, Global Species Programme, c/o Betty and Gordon Moore Center for Science & Oceans, Conservation International, 2011 Crystal Drive, Suite 500, Arlington, VA 22202, USA
[g] Department of Biodiversity and Conservation Biology, University of the Western Cape, Private Bag X17, Bellville, 7535 Cape Town, South Africa

ARTICLE INFO

Article history:
Received 25 November 2015
Received in revised form 2 April 2016
Accepted 5 April 2016
Available online xxxx

Keywords:
Biodiversity
Conservation
Global Reptile Assessment
Habitat loss
Species richness

ABSTRACT

The assimilation of information on taxonomy, distribution, basic ecology and conservation status of Africa's reptiles lags far behind that for most other continents. Many regions of mainland Africa are rarely surveyed, resulting in severe knowledge gaps that currently limit effective conservation of African reptiles. Here, we provide a précis on the knowledge gaps and conservation status of mainland African reptiles, and quantify the main threats based on IUCN Red List of Threatened Species assessments using publicly available distribution data. Our results show that these data are insufficient to confidently identify areas of high biodiversity, with large gaps in knowledge in the Horn of Africa, central Africa and West Africa. There is a strong overall taxonomic bias in extinction risk with 45% of families more threatened than expected by chance. Furthermore, Amphisbaenidae, Chameleonidae, Gerrhosauridae, Testudinidae, Viperidae all have a high percentage of their constituent species at risk. Overall, land transformation for agriculture, particularly subsistence farming, constitutes the primary threat to African reptiles, and our derived Threat Index based on socio-economic traits of African countries show that risk is high in Burundi, Ethiopia, Liberia, Malawi, Rwanda and Sierra Leone. These findings highlight important challenges facing the conservation of African reptiles, and we suggest that conservation priorities in mainland Africa be focussed on areas where the potential for overall loss of biodiversity is high, particularly in regions where knowledge is inadequate.

1. Introduction

Africa is a mega-continent with a land surface larger than China, India, North America and Western Europe combined. Its size and geographic position allows for considerable diversity of habitats ranging from true desert to impenetrable tropical rainforest. Nine of the world's 34 biodiversity hotspots are in Africa (Mittermeier et al., 2004). It is the only continent with an essentially intact, albeit heavily threatened, megafauna and it has a rich evolutionary history. Despite its historical, biological and economic significance, its biodiversity remains poorly known, particularly in comparison to temperate regions of the world (Deikumah et al., 2014).

Mainland Africa (i.e. excluding Madagascar and oceanic islands) is home to at least 1648 reptile species, which together with 378 endemic species known from the island of Madagascar, total ~20% of the world's reptiles (Uetz and Hošek, 2015). The species count in Africa continues to rise steadily, and the rate of discovery over recent decades shows no sign of abating (Fig. 1). Remarkably, this rapid rate of discovery is based on relatively scant survey coverage (Fig. 1). While Madagascar is well known for its mega-diversity, mainland Africa also hosts a substantial reptile fauna, particularly in the montane tropical Eastern Arc Mountains, Albertine Rift, Cameroon Highlands, and arid southern Africa (Böhm et al., 2013; Lewin et al., in review).

Despite having a large proportion of the world's reptiles, Africa's fauna is poorly documented in terms of distribution and taxonomy, especially in tropical Central Africa, the Sahel, the Horn of Africa (Böhm et al., 2013) and Afrotropical forests (Deikumah et al., 2014), although this many not hold for other areas of research, e.g. reptile community ecology (Luiselli, 2008). Southern Africa and East Africa are comparatively well explored, but even within these regions significant gaps remain. Of the nearly 2.5 million reptile records (>9400 species) in the Global Biodiversity Information Facility (GBIF), only ~104,000 are from Africa. When compared to other mega-diverse reptile faunas, Africa is obviously sparsely sampled and understudied. For example, publicly accessible databases show that Mexico has ~380,000 records covering ~800 squamate reptiles (at an average of 475 records per

* Corresponding author at: South African National Biodiversity Institute, Kirstenbosch Research Centre, Private Bag X7, Newlands, Cape Town 7945, South Africa.
E-mail address: k.tolley@sanbi.org.za (K.A. Tolley).

http://dx.doi.org/10.1016/j.biocon.2016.04.006
0006-3207/

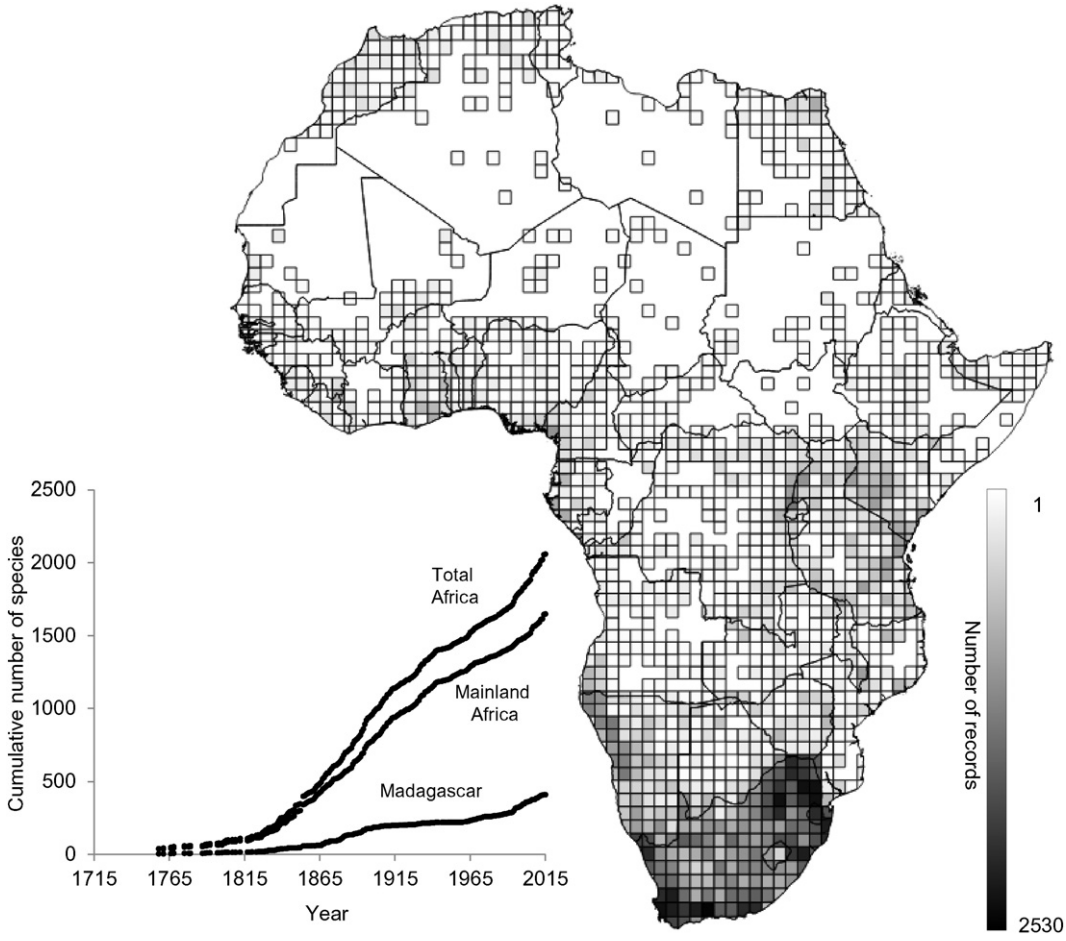

Fig. 1. Distribution of ca. 84,000 records available from publicly accessible databases (see Materials and methods) for reptiles from mainland Africa, with the cumulative number of described species of reptiles from mainland Africa, Madagascar, and combined, since 1750 (inset).

species), while Australia has ~700,000 covering ~900 species (Chapman, 2009; Wilson et al., 2013) averaging nearly 780 records per species. Conversely, the coverage in Africa averages just over 60 records per species. This dearth of knowledge increases the risk to the long-term sustainability of African biodiversity and undetected extinctions, and is likely to result in misdirected conservation priorities at country and local levels (e.g. Pimm et al., 2014; Jenkins et al., 2013, 2015). Prioritisation exercises are often aimed at protection of habitat in regions with high species richness because this strategy results in the 'biggest bang for buck' by protecting the greatest number of species (e.g. Fleishman et al., 2006; Murdoch et al., 2007; Myers et al., 2000; Scott et al., 1987). Species richness is also a valuable metric because it is a proxy for other important dimensions of biodiversity, such as phylogenetic diversity and ecosystem functioning (Chiarucci et al., 2011; Davies and Buckley, 2011; Forest et al., 2007; Maritz et al., in this issue; Petchey and Gaston, 2002). However, it is likely that inference of richness patterns from the present knowledge-base is biased by regional difference in sampling effort (e.g. Engemann et al., 2015).

The lack of baseline data for Africa is compounded by a comparatively low proportion of published IUCN extinction risk assessments for the continent (IUCN, 2015; Meiri and Chapple, in this issue). A recent ongoing global initiative to assess all reptiles (IUCN Global Reptile Assessment, GRA) has substantially increased the number of species assessed (IUCN, 2015). For example, all reptiles in Meso-America, North America and Europe have been assessed in the last decade, as have all snakes in Southeast Asia. Despite the GRA initiative, only ~50% of the described reptiles in mainland Africa currently have published assessments, and 15% of these are classified as Data Deficient (Bates et al., 2014; IUCN, 2015). This is in stark contrast to Madagascar for which all but recently described species have been assessed (Jenkins et al., 2014), although the percentage of Data Deficient species is high for Madagascar (Bland and Böhm, in this issue).

In this study, we investigated the patterns of diversity, conservation status and threats of mainland African reptiles using existing publicly available datasets. Quantification of biodiversity (in its simplest metric, species richness) increasingly relies on "Big Data" meta-analyses using publicly available databases (e.g. Böhm et al., 2013; Engemann et al., 2015). Given that many species are habitat specialists, have small distributions and are sensitive to habit transformation (Jenkins et al., 2014), we used existing IUCN conservation assessments for African reptiles to investigate the underlying threats that trigger the IUCN threat status under Criterion B (reduction in extent and quality of habitat). We therefore expected extinction risk status to be taxonomically biased, with a higher proportion of Threatened species in families with habitat specialists. We then quantified the emerging patterns in threat categories for these species. We also identified regions with the highest risk of biodiversity loss by creating a Threat Index based on socio-economic traits (e.g. Polasky, 2008), because we expected that fast-emerging economies with high human population growth would be under the most pressure for land utilisation. Finally, we provide some guidance for prioritising work, particularly in terms of data that have been collected, but is not available in publicly accessible databases.

2. Materials and methods

Point locality data for reptiles from mainland Africa were accessioned from the publicly accessible online data sources GBIF, Herpnet, and downloadable records from the Natural History Museum,

Please cite this article as: Tolley, K.A., et al., Conservation status and threats for African reptiles, Biological Conservation (2016), http://dx.doi.org/10.1016/j.biocon.2016.04.006