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Preliminary herpetological survey of Ngonye Falls and surrounding regions in south-western Zambia

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***Abstract.*—The herpetofauna of Zambia has been relatively well-studied, although most surveys were conducted decades ago. In western Zambia in particular, surveys were largely restricted to a few centers, particularly those along the Zambezi River. We here report on the herpetofauna of the Ngonye Falls and surrounding regions in south-western Zambia. We recorded 18 amphibian, one crocodile, two chelonian, 22 lizard, and 19 snake species, although a number of additional species are expected to occur in the region based on their known distribution and habitat preferences. We also provide three new reptile country records for Zambia (Long-tailed Worm Lizard, *Dalophia longicauda*, Anchieta's Worm Lizard, *Monopeltis anchietae*, and Zambezi Rough-scaled Lizard, *Ichnotropis grandiceps*), and report on the second specimen of Schmitz's Legless Skink, *Acontias schmitzi*, a species described in 2012 and until now known only from the holotype. This record also represents a 140 km southward range extension for the species.**

Keywords. Sioma Ngwezi National Park, Barotseland, Western Province, Africa, distribution, reptiles, lizards, amphibians

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Introduction

Despite the herpetofauna of Zambia being relatively well-studied (e.g., Broadley 1971a), large areas of the country remain poorly surveyed (Broadley 2000a; Poynton and Broadley 1985a). Most collecting was conducted prior to 1970, although important subsequent contributions were made by Broadley (1991a,b, 2000a), Branch and Haagner (1993), Haagner et al. (2000), Chansa and Wagner (2006) and Wagner et al. (2012a,b,c, 2013). The last systematic review of Zambia's herpetofauna was undertaken by Broadley (1971a), at which time there were 65 amphibian, two crocodile, nine chelonian, 54 lizard, and 75 snake species recorded. The amphibians of Zambia have been dealt with in detail by Poynton and Broadley (1985a,b, 1987, 1988, 1991a), while snakes were covered by Broadley et al. (2003). Since these publications a number of taxonomic changes have occurred, new species described (Broadley 2014; Wagner et al. 2012a,b), and species recorded from Zambia for the first time (Broadley and van Daele 2003; Wagner et al. 2013). Currently the Zambian herpetofauna comprises 85 amphibian, two crocodile, 10 chelonian, 75 lizard, and 91 snake species (AmphibiaWeb 2016; Broadley 1971a; Broadley and van Daele 2003; Uetz et al. 2017). Of these, 35 amphibian, one crocodile, three chelonian, 27 lizard, and 39 snake species are known from the Barotse Floodplains and surroundings (Broadley 2000a).

Barotseland lies at the junction of three broad zoogeographic zones, viz. mesic Angolan/Congolian Zone, arid Kalahari Zone, and the East African coastal zone, and the region is thus expected to support high herpetofaunal diversity (Timberlake 2000). Western Zambia remains one of the neglected regions of Zambia from a biodiversity perspective, although it received attention during the cross-border Zambezi Basin Wetland survey conducted in the late 1990s (Broadley 2000a; Channing 2000; Timberlake 2000). Targeted surveys of the Barotse Floodplains led to the description of a new frog species, *Hemisus barotseensis* (Channing and Broadley 2002).

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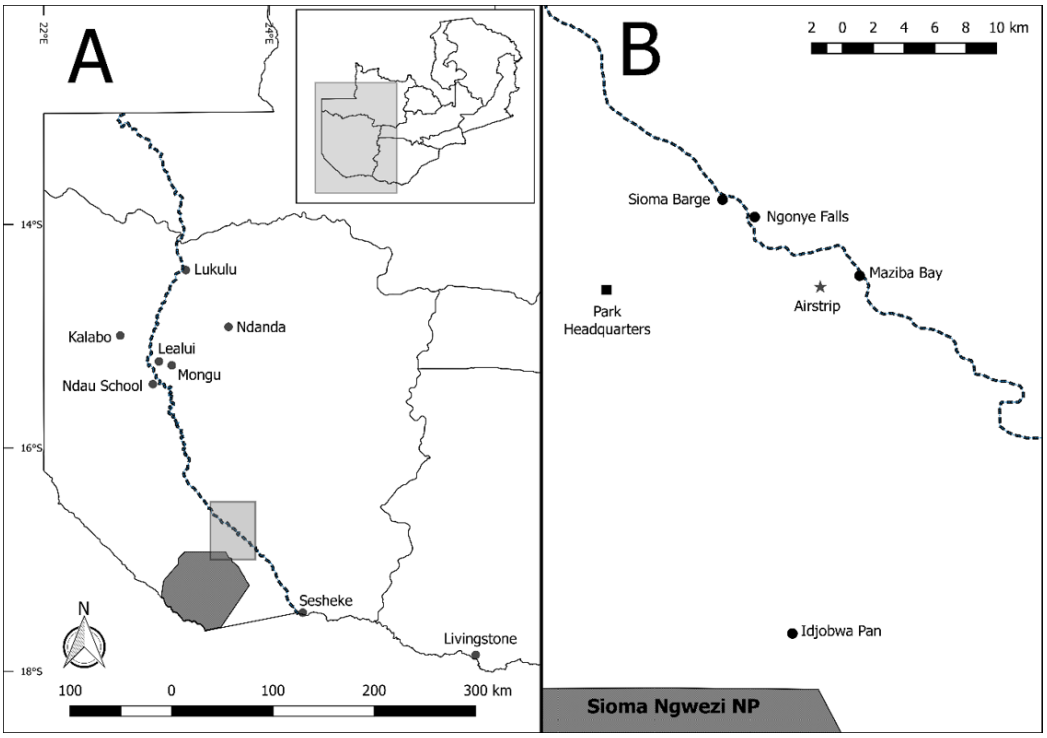

Fig. 1. (A) Map of western Zambia indicating major localities mentioned in the text, including Sioma Ngwezi National Park (dark grey polygon). The light grey rectangle indicates the study site, and the dotted line indicates the Zambezi River. Inset: Map of Zambia indicating the enlarged region. **(B)** Enlarged study site with locality names. The Ngonye Falls campsite and visitor's center are both within 1 km of Ngonye Falls and are therefore not indicated on the map.

Prior to this, small collections from western Zambia were reported on by Roux (1907), Angel (1920, 1921, 1922) and Broadley (1968a, 1971a), which led to the descriptions of various snakes and lizards from the region, including *Dalophia ellenbergeri* (Angel, 1920); *Tetradactylus ellenbergeri* (Angel, 1922); *Typhlacontias gracilis* Roux, 1907; *T. rohani* Angel, 1923; *Acontias jappi* (Broadley, 1968); *Amblyodipsas ventrimaculata* (Roux, 1907); *Crotaphopeltis barotseensis* Broadley, 1968 and *Zygaspis nigra* Broadley and Gans, 1969.

We had the opportunity over a period of three-and-a-half-years to document the herpetofauna of the Ngonye Falls region in western Zambia, and present here an initial inventory.

Methods

Study area

The Ngonye Falls are located in the Western Province in south-western Zambia (Fig. 1). A tourist attraction in its own right (Fig. 2a), it is also the location of the administrative headquarters of Sioma Ngwezi National Park, which is situated to the south-west. The Ngonye Falls form a northern extension of the Sioma Ngwezi National Park, and as such the falls and a small area surrounding it are afforded official protection. The vegetation falls into the Flora Zambesiaca bioregion and is dominated by Baikiaea woodland on deep Kalahari soils, although intense settlement and subsistence agriculture prevail in the vicinity of the Zambezi River. Rupicolous habitat is restricted to the immediate vicinity of the Zambezi River. Geographical coordinates for the main localities mentioned in the species accounts are presented in Table 1.

Data collection

One of us (EWP) was stationed permanently at Ngonye Falls from 8 February 2013 to 30 August 2016. During this time reptiles and amphibians were recorded incidentally, with some active searching. Herpetofauna were actively searched for on the western bank of the Zambezi River by DWP, John Davies, and EWP from 21 to 28 April 2013, on the eastern shore by WC from 17 to 27 October 2015, and Roger Bills from 7 to 11 October 2017. Voucher specimens were not collected in the early stages of this survey due to the lack of collecting permits, but in these instances photographic records were obtained, as has also been done in other surveys and regional works (e.g., Tuberville et al. 2005; Gooley et al. 2011; Bates et al. 2014).

All surveys involved opportunistic visual encounters. Diurnal surveys involved actively searching specific microhabitats, particularly beneath rocks and decaying logs. Nocturnal surveys for amphibians were undertaken in wetlands and surrounding woodland. Two standard Y-shape trap arrays were deployed on the eastern bank of the Zambezi River in October 2015, with each array consisting of three drift fences (10 m long and 50 cm high), with four pitfall traps (one at the center and at each fence

Fig. 2. Selection of amphibians and reptiles photographed in the vicinity of Ngonye Falls, south-western Zambia. **(A)** View of Ngonye Falls from the eastern side of the Zambezi River. **(B)** Mapacha Grass Frog (*Ptychadena* cf. *mapacha*, VMUS 5990), Sioma Ngwezi National Park Headquarters. **(C)** Long-tailed Worm Lizard (*Dalophia longicauda*), Sioma Ngwezi National Park Headquarters. **(D)** Zambezi Rough-scaled Lizard (*Ichnotropis grandiceps*, TM 86237), Sioma Ngwezi National Park Headquarters. **(E)** Barotse Blind Legless Skink (*Acontias jappi*, TM 86232), Sioma Ngwezi National Park Headquarters. **(F)** Eastern Black-lined Plated Lizard (*Gerrhosaurus intermedius*), Sioma Ngwezi National Park Headquarters.

tip, respectively) and six one-way funnel traps placed on opposite sides of the fences in the center of each arm.

Specimens retained for subsequent study were humanely euthanized by injecting tricaine methanesulfonate (MS222) solution into the intracoelomic cavity for reptiles (Conroy et al. 2009), and submerging frogs in a MS222 solution, after which they were formalin-fixed for 48 hours and then transferred to alcohol for long-term storage. Prior to fixing, tissue samples (either liver or muscle) were preserved in 96% ethanol for use in genetic analyses. Voucher specimens (Appendix 1) are held in the herpetological collections of the Port Elizabeth Museum (PEM), Ditsong National Museum of Natural History, Pretoria (TM), and South African Aquatic Biodiversity Institute, Grahamstown (SAIAB). Reptile and amphibian photographic records were submitted to the Animal Demography Unit Virtual Museum (Available: http://vmus.adu.org.za) on the platforms ReptileMAP and FrogMAP, respectively. Ventral scales were counted from the first scale posterior to the mental up to (but excluding) the cloacal shield. Subcaudal scales were counted from the first scale posterior to the cloacal shield up to, but excluding, the terminal scale. For amphisbaenids, dorsal annuli were counted along the dorsal midline from the first whole annulus posterior to the head up to the last annulus anterior to the cloacal shield. Caudal annuli were counted along the dorsal midline starting at the first complete annulus posterior to the cloacal shield, up to (but excluding) the terminal pad.

Relevant field guides (Branch 1998; Broadley 1983; Broadley et al. 2003; Channing 2001; du Preez and Carruthers 2009) were used for species identification.

Table 1. Coordinates for the main localities at and around Ngonye Falls and Sioma Ngwezi National Park, as mentioned in the text.

Locality	Latitude	Longitude
Ngonye Falls airstrip	16° 41' 40" S	23° 36' 49" E
Ngonye Falls campsite	16° 39' 41" S	23° 34' 23" E
Park Headquarters	16° 40' 08" S	23° 34' 03" E
Visitor's center	16° 39' 24" S	23° 34' 11" E
Maziba Bay	16° 41' 16" S	23° 38' 12" E
East bank of Zambezi River opposite Ngonye Falls	16° 39' 20" S	23° 34' 35" E
West bank of Zambezi River opposite Ngonye Falls	16° 39' 11" S	23° 34' 14" E
Idjobwa Pan	16° 53' 48" S	23° 35' 50" E
Sioma Barge	16° 38' 35" S	23° 33' 25" E

Nomenclature was based on established online databases (amphibians: Frost 2016; reptiles: Uetz et al. 2017), updated where appropriate. Vernacular names follow du Preez and Carruthers (2009) for amphibians and Branch (1998) for reptiles, updated from Frost (2016) and Uetz et al. (2017) for those taxa not covered by these guides. No regional conservation assessment has been undertaken for Zambian amphibians and reptiles as yet, but where global conservation assessments are available (IUCN 2017) these are noted. Endemic (defined as species with ranges restricted to Zambia) and near-endemic species (>90% of distribution within Zambia) are also indicated.

Species accounts

Amphibia

Breviceptidae

Breviceps adspersus adspersus Peters, 1882

Bushveld Rain Frog

Photograph: VMUS 5982

Individuals were photographed in Ngonye Falls campsite, and were heard calling from this area, from the visitor's center and from the vicinity of Park Headquarters. This species is distinguished from *B. poweri* on the basis of call, having a series of pale paravertebral and dorsolateral patches, absence of a continuous pale line from the upper lip to the forearm, and having a less intense dark throat that is medially divided by a white line (du Preez and Carruthers 2009; Poynton and Broadley 1985a, 1991). In Zambia, this species has been collected only in the vicinity of Kalabo, about 200 km to the NNW (Channing 2001; Poynton and Broadley 1985a, 1991).

Breviceps poweri Parker, 1934

Power's Rain Frog

Photograph: VMUS 5983

This species was often heard, and photographed, in the vicinity of Ngonye Falls campsite, visitor's center and Park Headquarters. It is distinguished from *B. adspersus* on the basis of call, absence of paravertebral patches (usually present in *B. adspersus*); presence of a pale patch above the vent (usually absent in *B. adspersus*); uniformly dark throat (usually mottled in *B. adspersus*); continuous pale band from upper lip to forearm; and presence of a short, dark band between the nostrils and mouth (usually not well developed in *B. adspersus*; du Preez and Carruthers 2009; Poynton and Broadley 1985a). At present only *B. a. adspersus* is known to occur west of the Zambezi River in south-western Zambia, with *B. poweri* largely restricted to east of the Zambezi River, although both species have been recorded occurring sympatrically at Kalabo (Broadley 1971a; Channing 2001; du Preez and Carruthers 2009; Poynton and Broadley 1985a, 1991). This record extends the distribution of the species by about 200 km SSE from Kalabo.

Bufonidae

Poyntonophrynus fenoulheti (Hewitt and Methuen, 1913)

Northern Pygmy Toad

Photograph: VMUS 5989

A single individual was photographed at Ngonye Falls campsite. It was distinguished from *P. kavangensis* on the basis of the tympanum being distinctly visible, and the presence of small tubercles on the dorsal surface of the snout (du Preez and Carruthers 2009). The only previous Zambian records are from the northern shore of Lake Kariba and the Zambian bank of the Victoria Falls (Broadley 1971a; Channing 2001; Poynton and Broadley 1988, 1991), while the nearest locality is Katima Mulilo in the Zambezi Region of Namibia (Channing 2001; Poynton and Broadley 1991). This record extends the known range of this species 110 km north-west.

Schismaderma carens (Smith, 1848)

Red Toad

Material: SAIAB 205361, 205631

Photographs: VMUS 5992, 5993

Individuals were recorded at Ngonye Falls campsite,

at the airstrip, and on the eastern banks of the Zambezi River below Ngonye Falls. This species was previously recorded at Livingstone and Kalabo in Western Province (Broadley 1971a; Channing 2001; Poynton and Broadley 1988, 1991).

Sclerophrys gutturalis (Power, 1927)

Guttural Toad

Photograph: VMUS 5994

Seen at Ngonye Falls campsite, and common throughout Zambia (Broadley 1971a; Channing 2001; Poynton and Broadley 1988, 1991).

Sclerophrys poweri (Hewitt, 1935)

Western Olive Toad

Material: SAIAB 205356

Photographs: VMUS 5996, 5997

Observed and photographed at Ngonye Falls campsite, and collected on the eastern banks of the Zambezi River below Ngonye Falls. These records extend the known distribution of this species about 110 km north-west from the nearest records at Sesheke (Channing 2001; Poynton and Broadley 1988, 1991), although Broadley (2000a) records it from the "Barotse floodplains."

Sclerophrys pusilla (Hallowell, 1855)

Flat-backed Toad

Material: PEM A11719, 11720; SAIAB 205360

Photographs: VMUS 5995, 5998

Individuals were seen at Ngonye Falls campsite, as well as on the eastern bank of the Zambezi River opposite Ngonye Falls. In Western Province it has been collected only at Kalabo (Broadley 1971a; Channing 2001; Poynton and Broadley 1991).

Hemisotidae

Hemisus marmoratus (Peters, 1854)

Mottled Shovel-nosed Frog

Photograph: VMUS 5985

One individual was photographed in Ngonye Falls campsite. It was distinguished from *H. guineensis* on the basis of coloration (dorsum mottled light and dark in *H. marmoratus* and dark with small yellow, orange or white spots in *H. guineensis*; Channing 2001; du Preez and Carruthers 2009). It was distinguished from *H. barotseensis* by having the upper eyelid length exceeding the eye-nostril distance (Channing 2001; Channing and Broadley 2002). The only previous record of this species in Western Province is at Livingstone, although also recorded from Katima Mulilo in Namibia (Poynton and Broadley 1985a, 1991).

Hyperoliidae

Hyperolius angolensis Steindachner, 1867

Angolan Reed Frog

Photograph: VMUS 5986

A single individual, which we tentatively refer to *H. angolensis*, was photographed at Ngonye Falls campsite. This species is likely to be more common and is probably found in pans and other temporary wetlands in Sioma Ngwezi National Park, as well as other wetlands associated with the Zambezi and Cuando Rivers. The only previous Zambian records are from the western shore of the Upper Zambezi at Sandaula Plain, Kalabo and Kalenga (Broadley 1971a; Poynton and Broadley 1987), although it is fairly widespread in the Okavango Swamps of Botswana and the Zambezi Region of northern Namibia (Poynton and Broadley 1987, 1991) as well as south-eastern Angola (Conradie et al. 2016). This record partially bridges the gap between the Namibian and Upper Zambezi records. The taxonomic status of this species remains unresolved and it is considered part of the larger unresolved *H. parallelus* Günther, 1858 group which is widespread across Angola and adjacent countries (Frost 2016). Many regional color patterns exist, the specimen from Ngonye Falls conforms best to that of *H. angolensis* (*fide* Schiøtz 1999).

Phrynobatrachidae

Phrynobatrachus natalensis (Smith, 1849)

Snoring Puddle Frog

Material: SAIAB 205351

Photograph: VMUS 5987

This species was recorded on the west bank of the Zambezi River in the vicinity of Ngonye Falls and campsite, as well as on the eastern bank of the Zambezi River opposite Ngonye Falls. It is widespread in Zambia (Broadley 1971a; Channing 2001; Poynton and Broadley 1985b, 1991).

Phrynobatrachus parvulus (Boulenger, 1905)

Small Puddle Frog

Photograph: VMUS 5988

An individual was photographed at Ngonye Falls campsite. The only previous record for Western Province is Ngambwe Rapids, about 90 km to the south-east (Channing 2001; Poynton and Broadley 1985b, 1991).

Pipidae

Xenopus muelleri (Peters, 1844)

Müller's Platanna

Material: SAIAB 202357

One male and one female were collected in sympatry with *X. poweri* in an eastern tributary (16°39'07"S, 23°37'43"E) flowing into the Zambezi River. Conradie et al. (2016) also recorded these two species in sympatry in south-eastern Angola.

Xenopus poweri Hewitt, 1927

Power's Platanna

Material: SAIAB 202355

One male and one female were collected in sympatry with *X. muelleri* in an eastern tributary of the Zambezi River (see above).

Ptychadenidae

Ptychadena cf. *mapacha* Channing, 1993

Mapacha Grass Frog

Material: TM 86255

Photograph: VMUS 5990

One individual (TM 86255) was collected at Park Headquarters after being killed by a vehicle, while a second individual (VMUS 5990, Fig. 2b) was photographed at the same site. Individuals are provisionally assigned to this species based on external morphology and coloration, however molecular analyses and/or call recordings are required to unequivocally confirm these identifications. For many years this species was only known from the type locality, viz. Mapacha Airfield and the area surrounding Katima Mulilo in the Zambezi Region of Namibia (Channing 1993; du Preez and Carruthers 2009), although expected to occur in south-western Zambia, south-eastern Angola and northern Botswana as well (Channing 2001). Haacke (1999) collected four individuals along the Ojmatako River about 80 km east of Rundu (this record has largely been overlooked in the literature), while most recently Ceríaco et al. (2016) recorded it from Rundu District in Kavango-East Region, northern Namibia. Conradie et al. (2016) collected a series of *Ptychadena* at Jamba in neighboring south-eastern Angola which they provisionally assigned to *P.* cf. *mossambica*, although noting that their specimens may be referable to *P. mapacha*. The records reported here are the first for Zambia and the first outside Namibia. These records extend the known distribution of this Data Deficient species 120 km NNW into Zambia, and 320 km NNE into south-eastern Angola, which could have positive conservation implications (IUCN SSC Amphibian Specialist Group, SA-FRoG 2017).

Ptychadena oxyrhynchus (Smith, 1849)

Sharp-nosed Grass Frog

Material: SAIAB 205353, 205354

Photograph: VMUS 5991

An individual was photographed at Ngonye Falls campsite, and individuals were also heard calling from the western bank of the Zambezi River in the vicinity of Ngonye Falls. Additional material was collected from the eastern bank of the Zambezi River below Ngonye Falls. This species is widespread in Zambia (Broadley 1971a; Channing 2001), although the only other published record for Western Province is Sesheke (Channing 2001; Poynton and Broadley 1985b, 1991), 110 km to the south-east.

Ptychadena subpunctata (Bocage, 1866)

Speckled-bellied Grass Frog

Material: PEM A11717, 11718; SAIAB 205358, 205365

This species was recorded from the eastern shore of the Zambezi River, opposite Ngonye Falls. It is widespread in Zambia, including Upper Zambezi Region (Broadley 1971a; Channing 2001; Poynton and Broadley 1985b, 1991).

Pyxicephalidae

Tomopterna cf. *cryptotis* (Boulenger, 1907)

Tremolo Sand Frog

Material: SAIAB 205362

Photographs: VMUS 5999, 6000

Recorded at Ngonye Falls campsite and on the eastern banks of the Zambezi River below Ngonye Falls. Previously collected in Western Province at Kalabo, Sandaula Plain and Sesheke (Channing 2001; Poynton and Broadley 1985b, 1991), and our records partially fill the gap between these localities. We provisionally assign our records to *T. cryptotis* based on distribution, but note that species delineation in this genus is problematic when based solely on external morphology, and these specimens may in fact refer to the similar Tandy's Sand Frog *T. tandyi* Channing and Bogart, 1996.

Rhacophoridae

Chiromantis xerampelina Peters, 1854

Southern Foam Nest Frog

Photograph: VMUS 5984

An individual was photographed at the airstrip. Although widespread in Zambia, the only previous records from Western Province are Sesheke and Lukulu (Broadley 1971a; Channing 2001; Poynton and Broadley 1987, 1991).

Reptilia

Squamata

Sauria

Agamidae

Agama armata Peters, 1855

Peter's Ground Agama

Material: PEM R22017, 22018

Photographs: VMUS 158866–158869
Recorded regularly at Ngonye Falls campsite and visitor's center, and the vicinity of the airstrip. It is widespread in Zambia (Broadley 1971a).

Amphisbaenidae

Dalophia longicauda (Werner, 1915)

Long-tailed Worm Lizard

Photograph: VMUS 163523

A single individual (Fig. 2c) was found on the soil surface in the vicinity of Park Headquarters. It is uniform flesh-pink in color with 326 dorsal and 37 caudal annuli, with the tail ending in a calloused pad. There is no constricted caudal autotomy site, and the dorsal caudal annuli form a "herring-bone" pattern. The cephalic shield consists of a single large plate, with lateral sulci. This individual is distinguished from *D. angolensis* and *D. ellenbergeri* by the absence of a constricted caudal autotomy site (Broadley et al. 1976). It is further distinguished from both *D. angolensis* and *D. pistillum* by the high subcaudal counts (usually 20–27 caudal annuli in *D. angolensis* and 19–33 in *D. pistillum*). It is distinguished from *D. angolensis*, *D. ellenbergeri*, and *D. pistillum* by the dorsal caudal annuli forming a "herring-bone" pattern (Broadley et al. 1976). This represents the first record of this fossorial species in Zambia (Branch 1998; Broadley 1971a; Broadley et al. 1976; Uetz et al. 2017).

Dalophia pistillum (Boettger, 1895)

Blunt-tailed Worm Lizard

Material: PEM R22925

A single individual was collected on the eastern bank of the Zambezi River below Ngonye Falls. This species is distinguished from other *Dalophia* in Zambia by the absence of a constricted caudal autotomy annulus (present in *D. angolensis* and *D. ellenbergeri*), lower numbers of caudal annuli (27 versus 33–42 in *D. longicauda*), and absence of a "herring-bone" pattern on the dorsal caudal annuli (present in *D. longicauda*; Broadley et al. 1976). It is fairly widespread in southern and western Zambia, although records are sparse due to its predominantly fossorial habits (Broadley et al. 1976).

Monopeltis anchietae (Bocage, 1873)

Anchieta's Worm Lizard

Material: TM 86250

One individual (Fig. 3a,b) was found beneath an elephant carcass at Idjobwa Pan in the buffer zone to the north of Sioma Ngwezi National Park, while a juvenile (TM 86250) was unearthed during construction at Park Headquarters. Members of the genus *Monopeltis* generally inhabit deep Kalahari sands, only coming to the surface after their burrows have been flooded by heavy rains (Branch 1998, DWP pers. obs.). These are the first records of this species in Zambia. Previously known from northern Botswana, northern Namibia and southern Angola (Broadley 1971a; Broadley et al. 1976; Uetz et al. 2017).

Zygaspis nigra Broadley and Gans, 1969

Black Round-headed Worm Lizard

Material: TM 86209

Photograph: VMUS 158938

This small fossorial species was collected with *Z. quadrifrons* in Baikiaea woodland at the airstrip. Known from Zambia, Angola, and northern Namibia, with most Zambian specimens collected at Kalabo, the type locality, with a subsequent record from Ndau School (ca. 25 km south-west of Mongu on the western side of the Zambezi River; Broadley 2000a). The new record partially fills the gap between the Ndau School, eastern Angola and Namibia records.

Zygaspis quadrifrons (Peters, 1862)

Kalahari Round-headed Worm Lizard

Material: TM 86208

Photograph: VMUS 158939

One individual was found in Baikiaea woodland at the airstrip, while a second was found near Ngonye Falls campsite. This species is probably quite common and widespread throughout the area (see also Broadley 1971a), being overlooked due to its fossorial nature.

Chamaeleonidae

Chamaeleo dilepis Leach, 1819

Flap-neck Chameleon

Photographs: VMUS 158873, 158876, 158877

Recorded regularly around Park Headquarters, visitor's center, and Ngonye Falls campsite.

Gekkonidae

Pachydactylus wahlbergii wahlbergii (Peters, 1869)

Kalahari Thick-toed Gecko

Photographs: VMUS 163521, 163522

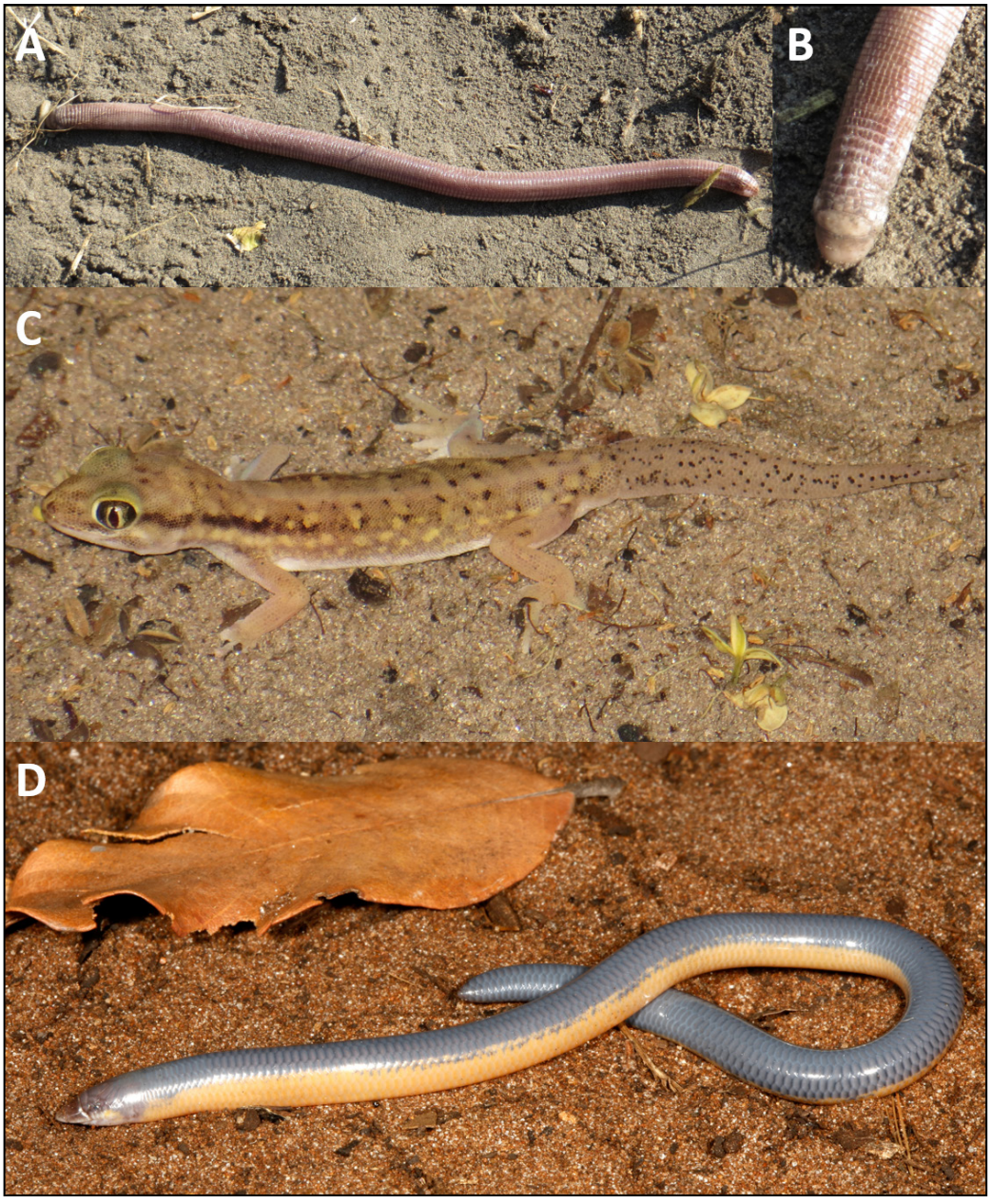

Fig. 3. Selection of reptiles photographed in the vicinity of Sioma Ngwezi National Park and Ngonye Falls in south-western Zambia. **(A)** Anchieta's Worm Lizard (*Monopeltis anchietae*), Idjobwa Pan, northern buffer zone of Sioma Ngwezi National Park and **(B)** close-up of the head, showing the double head shields. **(C)** Wahlberg's Kalahari Gecko (*Pachydactylus wahlbergii wahlbergii*), Ngonye Falls campsite. **(D)** Schmitz's Blind Legless Skink (*Acontias schmitzi*, PEM R22015), east bank of the Zambezi River opposite Ngonye Falls.

An individual (SVL 56.3 mm) was photographed (Fig. 3c) at Ngonye Falls campsite on 21 April 2013, while a second was photographed at the same site on 13 February 2014. This species has been recorded only once before in Zambia, in the extreme south at Kalamba Station on the old Zambezi Sawmill Railway (Broadley and Daele 2003). These new records are only the second and third confirmed records of this species in Zambia. This species was previously placed in the genus *Colopus*, but was transferred to *Pachydactylus* by Heinicke et al. (2017).

Hemidactylus mabouia (Moreau De Jonnès, 1818)

Common Tropical House Gecko

Material: PEM R22019, 22020; TM 86251, 86252

Photographs: VMUS 158888–158890, 158892

Seen on the walls of the visitor's center, Park Headquarters, and Ngonye Falls campsite. This species is common and widespread throughout Zambia (Broadley 1971a).

Lygodactylus chobiensis FitzSimons, 1932

Chobe Dwarf Gecko

Material: PEM R22026; TM 86253

Photographs: VMUS 158901, 158903–158906

The most common gecko species, seen on trees and walls in the vicinity of Ngonye Falls campsite, visitor's center, and Park Headquarters. Largely restricted to the Zambezi Valley (Branch 1998; Broadley 1971a), but should be searched for along the banks of the Cuando River.

Gerrhosauridae

Gerrhosaurus auritus Boettger, 1887

Kalahari Plated Lizard

Photograph: VMUS 158885

Individuals were photographed at Ngonye Falls visitor's center and Park Headquarters. We refer our individuals from Ngonye Falls to *G. auritus* on the basis of non-mucronate dorsal scales, the proximal caudal scales lacking spines, the large tympanum covering a large portion of the ear opening, and coloration. The only previous Zambian specimens are from Lealui, 170 km NNW, although it is also recorded 130 km to the south in the Zambezi Region of Namibia (Broadley 1971a).

Gerrhosaurus intermedius Lönnberg, 1907

Eastern Black-lined Plated Lizard

Photograph: VMUS 158887

A number of individuals suspected to be referable to *G. intermedius* were seen, however only a single individual was photographed and the scalation details later determined from this photograph (Fig. 2f). A narrow, pale dorsolateral line is present, bordered on each side by a dark line. A pale vertebral stripe, flanked on either side by a dark stripe, originates on the nape and extends to the base of the tail as discrete, evenly-spaced dashes. The frontonasal is divided into a large, heart-shaped anterior portion and a smaller posterior "inter-frontonasal," which is in contact with the frontal thus separating the prefrontals. The dorsal scales are arranged in 22 longitudinal and approximately 56 transverse rows. The flank scales are keeled and weakly mucronate and the head length is contained in the body length approximately 4.14 times.

Despite the prefrontals being separated, this individual is distinguished from *G. flavigularis* by the presence of four supraciliaries, the keeled and weakly mucronate lateral scales, head length into snout-vent length ratio and coloration (Bates et al. 2013; Branch 1998; FitzSimons 1943). It is distinguished from *G. auritus* by the number of longitudinal and transverse scale rows and the keeled and weakly mucronate lateral scales. We refer this individual to *G. intermedius* rather than *G. nigrolineatus sensu stricto* based predominantly on coloration. In *G. nigrolineatus* the dark stripes bordering the pale dorsolateral stripes are often ragged, while the pale vertebral stripe (and flanking dark stripes) may be continuous or absent, but are usually better-developed than in *G. intermedius* (Bates et al. 2013). When present, the dark markings surrounding the discontinuous vertebral stripe appear to be more extensive (Bates et al. 2013; Hallowell 1857). This record is about 110 km NNW of the nearest previous reported locality at Sesheke (Broadley 1971a).

Lacertidae

Ichnotropis capensis (Smith, 1838)

Cape Rough-scaled Lizard

Material: PEM R22021–22024

Photographs: VMUS 158896, 158902

Individuals were recorded in the vicinity of Park Headquarters, Ngonye Falls campsite, visitor's center, eastern bank of the Zambezi River opposite Ngonye Falls, and also in Sioma Ngwezi National Park. It is widespread in western Zambia (Broadley 1971a).

Ichnotropis grandiceps Broadley, 1967

Zambezi Rough-scaled Lizard

Material: TM 86237

A number of individuals were encountered in Baikiaea woodland in the vicinity of Park Headquarters (Fig. 2d). All observed individuals were judged to be adult based on their size, and were seen in April and May. TM 86237 has a snout-vent length of 49.6 mm and a tail length of 101.8 mm. The frontonasal is entire, the occipital does not project beyond the parietals, and there are five supralabials anterior to the subocular, which borders the lip. The dorsal scales are strongly keeled and overlapping, and arranged in 47 rows at midbody. In all these characters our specimen closely resembles the type description by Broadley (1967). Furthermore, there are 14 femoral pores present on each thigh. In coloration, the specimen and photographed individuals closely resemble the holotype (USNM 163989, available: http://inaturalist.ca/taxa/35953-Ichnotropis-grandiceps; Accessed 5 December 2017). All individuals are similar in coloration with the head and back pale grey-brown to olive-brown anteriorly, becoming olive-yellow posteriorly, usually with scattered darker spots throughout. The limbs are reddish-orange, with small pale spots sometimes present on the hind limbs. A rust-red lateral stripe originates just behind the eye and extends for the entire length of the body, fading on the base of the tail. Below the lateral stripe the flanks are light grey, frequently with large white spots. The tail is uniformly grey-brown to pinkish, with a series of paired dorsolateral dark and white spots. The ventrum is white. This is the first record of this Data Deficient species in Zambia (Turner 2010), and these are the first specimens reported since Haacke (1970).

Meroles squamulosus (Peters, 1854)

Common Rough-scaled Sand Lizard

Photograph: VMUS 158907

An individual was photographed in a dry marsh in open woodland between Ngonye Falls campsite and visitor's center, while a second individual was photographed at the visitor's center. This species was also observed in Sioma Ngwezi National Park. These are the first records of this species in Western Province (Broadley 1971a), although it is known from northern Namibia (Branch 1998) and was recently recorded from south-eastern Angola (Conradie et al. 2016).

Scincidae

Acontias jappi (Broadley, 1968)

Barotse Legless Skink

Material: TM 86232–34, TM 86254

Individuals were collected in soil under bush clumps near Ngonye Falls campsite, airstrip and Park Headquarters (Fig. 2e). Numerous additional individuals were unearthed during the construction of Park Headquarters. Originally described as a subspecies of *Acontias kgalagadi* (previously *Typhlosaurus lineatus* [Boulenger, 1887]), Schneider and Bauer (2009) elevated this taxon to species status on morphological grounds. Specimens were distinguished from *A. k. kgalagadi* on the basis of being significantly more robust, having only two longitudinal dark stripes which fade out on the tail (typically 4–8 in *A. k. kgalagadi*); 24–25 subcaudal scales (26–35 in *A. k. kgalagadi*), the ocular scale being longer than high (as long as high in *A. k. kgalagadi*), and only three sublingual scales border the mental (usually four in *A. k. kgalagadi*; Broadley 1968b; Branch 1998). TM 86232–34 have four supralabials and three infralabials on each side, while TM 86233 has the mental longitudinally divided into two subequal parts (undivided in the remaining specimens). The superior border of the ocular scale is incompletely fused with the anterior supraciliary on both sides in all four specimens, resulting in a narrow slit that is apparently continuous with the eye (i.e., an immovable lower eyelid). Most other members of *Acontias* have the eye either completely covered by an ocular scale or have a moveable lower eyelid (Branch 1998), with only *A. riepelli* having an immovable lower eyelid (Branch 1998). *Acontias jappi* is restricted to south-western Zambia and adjacent Angola (Broadley 1968b, 1971a; Schneider and Bauer 2009).

Acontias schmitzi Wagner, Broadley and Bauer, 2012

Schmitz's Legless Skink

Material: PEM R22015

A single specimen was collected on the east bank of the Zambezi River, opposite Ngonye Falls (Fig. 3d). It was found under a large log in deep sand in Miombo (*Brachystegia* spp.) woodland. Head scalation conforms to the type specimen. The new specimen measures 138 mm snout-vent length and 21 mm tail length, has 14 mid-body scale rows, 178 ventrals and 26 subcaudals. Color in life is light orange ventrally and blue-grey dorsally, with the anterior two-thirds of the tail darkly pigmented ventrally. This is only the second record of this species and the most southerly locality. The holotype was collected in the Kataba Reserve, south of Mongu, Western Province, Zambia (15°23'00.9"S, 23°23'43.7"E; Wagner et al. 2012a), and this record is 140 km south of the type locality. Both records are on the eastern side of the Zambezi River in deep Kalahari sands. Based on morphological features, Wagner et al. (2012a) place *A. schmitzi* in a clade with *A. jappi*. Considering their distribution, it is expected that these two species are most probably sister taxa, and that the Zambezi River acts as a barrier to dispersal, thus facilitating their independent evolution and parapatric distribution. This species is endemic to Zambia.

Mochlus sundevallii (Smith, 1849)

Sundevall's Writhing Skink

Material: PEM R22027

Photograph: VMUS 158908

This semi-fossorial species was found at Ngonye Falls visitor's center as well as on the east bank of the Zambezi River opposite Ngonye Falls. It is widespread in Zambia (Broadley 1971a).

Panaspis maculicollis Jacobsen and Broadley, 2000

Spotted-neck Snake-eyed Skink

Photograph: VMUS 158911

Photographed in the vicinity of Ngonye Falls visitor's center. *A Panaspis* seen on the east bank of the Zambezi River opposite Ngonye Falls is provisionally also assigned to this species. These records are situated between the previous records at Sesheke and Ndanda (Broadley 1971a; Jacobsen and Broadley 2000).

Typhlacontias rohani Angel, 1923

Kalahari Burrowing Skink

Material: TM 86235–36, 86248

Three specimens were collected during the construction of Park Headquarters, while additional individuals were photographed at the same locality as well as at Ngonye Falls campsite and the vicinity of the airstrip. All three specimens have five supralabials on either side of the head, with the second contacting the eye. On the right side of TM 86235, the prefrontal is separated from the frontoparietal by the enlarged third supraocular, while the prefrontal and frontoparietal are in contact on the left side of TM 86235 and on both sides of TM 86236. In Zambia this species was previously recorded only at

Kalabo in Western Province, where it is sympatric with *T. gracilis*, although it is widespread in north-western Zimbabwe, northern Botswana and Namibia, and south-eastern Angola (Branch 1998; Broadley 2000a; Conradie et al. 2016; Haacke 1997; Uetz et al. 2017).

Trachylepis damarana (Peters, 1870)

Damara Variable Skink

Material: PEM R22030, 22031

Photographs: VMUS 158929, 158930, 158933–158935

The most common skink in the area, seen at Ngonye Falls campsite, vicinity of the visitor's center, Park Headquarters, vicinity of the airstrip, and on the east bank of the Zambezi River opposite Ngonye Falls. It is common throughout Zambia (Broadley 1971a). Recently split from the larger *Trachylepis varia* complex by Weinell and Bauer (2018).

Trachylepis wahlbergii (Peters, 1869)

Wahlberg's Striped Skink

Material: PEM R22029

Photographs: VMUS 158931, 158936

Common throughout the area, seen at Ngonye Falls campsite, visitor's center, Park Headquarters, and on the east bank of the Zambezi River opposite Ngonye Falls. This species is common and widespread throughout Zambia, extending into Botswana and Namibia (Branch 1998; Broadley 1971a). Castiglia et al. (2006), using karyotypic and genetic data, suggest that *T. wahlbergii* is conspecific with *T. striata*, despite the morphological differences which prompted Broadley (2000b) to treat them as separate species.

Serpentes

Colubridae

Telescopus semiannulatus semiannulatus Smith, 1849

Eastern Tiger Snake

Photograph: VMUS 158924

Recorded on a number of occasions in the vicinity of Ngonye Falls campsite and visitor's center. This species appears to be widespread throughout Zambia (Broadley 1971a).

Dispholidus typus viridis (Smith, 1828)

Green Boomslang

Photographs: VMUS 158882, 158884

Regularly recorded at Ngonye Falls campsite, around the visitor's center, as well as at Idjobwa Pan in the northern buffer zone of Sioma Ngwezi National Park. Widespread in the southern provinces of Zambia (Broadley 1971a).

Thelotornis capensis oatesii (Günther, 1881)

Oates's Vine Snake

Photograph: VMUS 158925, 158926, 158928

Commonly encountered at Ngonye Falls campsite, and widespread in Zambia (Broadley 1971a).

Philothamnus angolensis Bocage, 1882

Western Green Snake

Material: PEM R22028; TM 86231

Photograph: VMUS 158913

A common, diurnal species seen regularly along the banks of the Zambezi River. One individual (VMUS 158913) was photographed at Ngonye Falls campsite, one (TM 86231) had drowned in the Zambezi River and one (PEM R22028) was collected on the eastern bank of the Zambezi River below Ngonye Falls. It is widespread in Western Province, as well as in the northern provinces of Zambia (Broadley 1971a).

Natricidae

Limnophis bangweolicus (Mertens, 1936)

Eastern Striped Swamp Snake

Material: PEM R22926; TM 86203, 86249

One individual (TM 86203) was found emerging from the Zambezi River at dusk at Ngonye Falls campsite; a second individual (TM 86249) was found dead and partially desiccated at the same site; while a third was found partially consumed on the east bank of the Zambezi River just below Ngonye Falls. Near-endemic.

Elapidae

Dendroaspis polylepis Günther, 1864

Black Mamba

Photographs: VMUS 158880, 158881, 158883

Regularly observed at Ngonye Falls campsite and visitor's center. The species is widespread in Zambia (Broadley 1971a).

Naja nigricollis Reinhardt, 1843

Black-necked Spitting Cobra

Photographs: VMUS 158909, 158910

Individuals were encountered regularly at Ngonye Falls campsite and near the visitor's center. This species occurs widely in central and northern Zambia, but is largely replaced by *N. mossambica* in the south (Broadley 1971a; Broadley et al. 2003).

Lamprophiidae

Amblyodipsas polylepis (Bocage, 1873)

Common Purple-glossed Snake

Photograph: VMUS 158870

Individuals were photographed at Ngonye Falls campsite and Park Headquarters. This species is widespread in Zambia, and is particularly common in sandy regions (Branch 1998; Broadley 1971a,c; Broadley et al. 2003).

Hemirhagerrhis nototaenia (Günther, 1864)

Eastern Bark Snake

Photographs: VMUS 158891, 158893–158895, 158900

Observed frequently at Ngonye Falls campsite, around the visitor's center, and at Park Headquarters. The species is widespread in Zambia (Broadley 1971a).

Lycophidion multimaculatum Boettger, 1888

Spotted Wolf Snake

Photograph: VMUS 158898

An individual was photographed at Ngonye Falls campsite. The species is widely distributed in western and northern Zambia (Broadley 1971a; Broadley et al. 2003).

Psammophis mossambicus Peters, 1882

Olive Sand Snake

Photographs: VMUS 158914–158916

Commonly encountered at Ngonye Falls campsite, visitor's center, Park Headquarters and on the roads in the vicinity. The species is common and widespread throughout Zambia (Broadley 1971a, 2002).

Psammophis subtaeniatus Peters, 1882

Western Stripe-bellied Sand Snake

Photograph: VMUS 158917

This diurnal species was often encountered at Ngonye Falls campsite, around the visitor's center, at Park Headquarters, Maziba Bay, and vicinity. Individuals were identified by coloration (including presence of a broad yellow mid-ventral band flanked on each side by a dark longitudinal stripe) and having the preocular in contact with the frontal (well-separated in *P. mossambicus*). This species has not previously been recorded from Western Province (Broadley 1971a, 2002; Broadley et al. 2003), having been recorded peripherally in Southern and Central Provinces, although more widespread in Eastern Province (Broadley 1971a, 2002). It is widespread in adjacent northern Namibia (Branch 1998; Broadley 2002). These records extend the known distribution by about 110 km to the north-west.

Pseudaspis cana (Linnaeus, 1758)

Mole Snake

Photographs: VMUS 158918, 158919, 158922, 158923

This common, diurnal snake was regularly seen in the vicinity of Ngonye Falls campsite, visitor's center, Park Headquarters, and surrounding area. A number of individuals were also killed by passing traffic on the tarred road running parallel to the Zambezi River. It is widespread in Zambia (Broadley 1971a).

Xenocalamus mechowii Peters, 1881

Elongate Quill-snouted Snake

Material: TM 86247

Photograph: VMUS 158937

Individuals were recorded at Ngonye Falls campsite and Park Headquarters, where a number of individuals (e.g., TM 86247) were unearthed during construction. Two subspecies have been historically recognized, which were separated on distribution and ventral and subcaudal scale counts (Peters 1881, Witte and Laurent 1947; Broadley 1971c). Broadley (1971c) notes a population of apparent intergrades in northern Zambia and this, together with the overlap in the supposedly diagnostic characters, lead us to not recognize these subspecies until a thorough review of these taxa has been undertaken.

Leptotyphlopidae

Leptotyphlops scutifrons (Peters, 1854)

Peters' Thread Snake

Material: PEM R22025

A single individual was collected in a pitfall trap on the east bank of the Zambezi River, opposite Ngonye Falls. The only previous Zambian locality is Kalichero in Eastern Province, although it has been recorded in Namibia at Katima Mulilo (Broadley and Broadley 1999).

Pythonidae

Python natalensis Smith, 1840

Southern African Python

Photograph: VMUS 158927

A number of individuals were seen around Ngonye Falls visitor's center and campsite, and locals also report the presence of this species in the vicinity. This species is widespread throughout Zambia (Broadley 1971a).

Typhlopidae

Afrotyphlops mucruso (Peters, 1854)

Zambezi Beaked Blind Snake

Material: TM 81409

Although not recorded by ourselves, this species has been collected at Ngonye Falls (TM 81409; Broadley and

Wallach 2009). This species is widespread in Zambia, while its sister species *A. schlegelii* has been collected south of the Zambezi River at Katima Mulilo (Broadley and Wallach 2009).

Afrotyphlops schmidti (Laurent, 1956)

Schmidt's Beaked Blind Snake

Material: PEM R22016; TM 86246

Photograph: VMUS 158865

A juvenile specimen (PEM R22016) was collected in a pitfall trap on the eastern bank of the Zambezi River just above Ngonye Falls, while another specimen (TM 86246) was found dead on the dirt road leading to Sioma Barge. Individuals were regularly encountered around Ngonye Falls campsite and visitor's center, especially after rains. The nearest published locality is Kalabo (Broadley and Wallach 2009), about 210 km to the NNW.

Viperidae

Bitis arietans arietans Merrem, 1820

Puff Adder

Photographs: VMUS 158871, 158872, 158874

This species was often encountered at Ngonye Falls campsite and visitor's center, and is widespread in southern and central Zambia (Broadley 1971a).

Crocodylia

Crocodylidae

Crocodylus niloticus Laurenti, 1768

Nile Crocodile

Photographs: VMUS 158875, 158878, 158879

Observed in the Zambezi River both above and below Ngonye Falls, including at Maziba Bay and at Sioma Barge. It is widespread in Zambia and adjacent regions (Broadley 1971a).

Testudines

Testudinidae

Kinixys spekii Gray, 1863

Speke's Hinged Tortoise

Photograph: VMUS 158897

Seen around Park Headquarters and visitor's center. This species is widespread in Zambia (Broadley 1971a). These records are about 100 km north of the nearest known population in the Zambezi Region of Namibia (Branch 1998).

Stigmochelys pardalis (Bell, 1828)

Leopard Tortoise

Photograph: VMUS 158920

Seen in the vicinity of Park Headquarters, while a fresh carapace was confiscated from a poacher in Sioma Ngwezi National Park. Additional carapaces are on display in the visitor's center, and these may have been collected in the general vicinity of the study area. This species is most common in the Eastern Province of Zambia, but has also been recorded from Livingstone (Broadley 1971a).

Discussion

We report on three new reptile country records and one potentially new amphibian country record for Zambia, bringing the known herpetofauna to 86 amphibian, two crocodile, 10 chelonian, 78 lizard, and 91 snake species.

The herpetofauna of Ngonye Falls and surroundings is similar to that of south-eastern Angola (Conradie et al. 2016), with 13 amphibian and 34 reptile species in common. There are an additional 10 reptile and one amphibian species with closely related species in Angola. This is not surprising considering the similarity in habitat. However, the list of species in common is largely devoid of habitat specialists, suggesting that this apparent connectivity may not apply to all taxa. Although this may be an artifact of the relatively small sample sizes to date, these results also suggest that there are barriers to some species, most likely posed by the drainage basins. This was observed for some species (e.g., *Acontias* spp.: this study; *Elapsoidea* spp.: Broadley 1971b), for which the Zambezi River apparently acts as a dispersal barrier. Fossorial taxa are also largely absent in central Zambia (Wagner et al. 2012a), largely as a result of the Kalahari sands reaching their eastern limit not far beyond the Zambezi River. Vegetation, geology and natural barriers therefore all appear to play a role in shaping the herpetofauna of western Zambia.

Based on our present knowledge it would appear that members of the genus *Acontias* have parapatric distributions, with *A. k. kgalagadi* occurring west of the Cuando River and south of the Kavango River, *A. jappi* occurring between the Cuando and Zambezi Rivers, and *A. schmitzi* occurring east of the Zambezi River. The Zambezi River is likely to pose a formidable barrier to subterranean species such as *Acontias* and it is thus likely that this river effectively separates *A. jappi* and *A. schmitzi*. Furthermore, considering their distribution, it is probable that these two taxa are sister species (see also Wagner et al. 2012a). It will be informative to construct a dated phylogeny of these taxa to investigate whether the Zambezi River may have played a role in their speciation. The factors separating the distributions of *A. jappi* and *A. k. kgalagadi* are less clear. Although *A. k. kgalagadi* has thus far been recorded only west of the Cuando River, and *A. jappi* only to the east, the Kalahari sands extend beyond the source of the Cuando River, and this river may there-

fore only pose a local barrier between these two species. Additional sampling is required to more accurately determine the distribution of these two fossorial taxa, to investigate the probable barriers between them, and to determine whether they do in fact occur sympatrically anywhere.

Broadley (1967) described *Ichnotropis grandiceps* from three specimens collected 40 km west of Mohembo, Botswana, near the Botswana-Caprivi Strip (now the Zambezi Region of Namibia) border (ca. 18°19'03"S, 21°12'03"E). Haacke (1970) subsequently collected this species at Ndobe on the Namibia-Botswana border (ca. 19°34'41"S, 20°59'58"E, TM 30822), the farm Deo Volente near Grootfontein, Namibia (ca. 19°02'01"S, 18°46'29"E, TM 38309 and 38310) and on the Caprivi Strip-Botswana border 16 km east of the 21° corner beacon (i.e., approximately at the type locality). To the best of our knowledge, this species has not been seen or collected since Haacke (1970). In our experience *I. grandiceps* was a relatively common and active, diurnal species and it seems intriguing that it has not been recorded for more than four decades. The type specimens were collected in open woodland on Kalahari sands (Broadley 1967), while Haacke (1970) collected one specimen on hard limy soil in Combretum-Acacia bushveld, and three specimens on white sand in open bushveld. We found individuals in open to relatively closed Baikiaea woodland on pale, deep Kalahari sands. The type series consists of two adult males and a "juvenile," but measurements are only provided for the largest individual (Broadley 1967). Based on measurements presented in the article, three of the specimens collected by Haacke (1970) were adults, while the fourth individual was a subadult. Interestingly, all of the specimens collected to date have been taken in either April or May (Broadley 1967; Haacke 1970; this study). These are the first published records of this species in Zambia, with all previous records from south-west of the Kavango River. The presence of this species between the Cuando and Zambezi Rivers suggests that it may also occur in adjacent south-eastern Angola. However, to date, the only *Ichnotropis* species collected in south-eastern Angola do not match the description of *I. grandiceps* and appear to represent undescribed taxa (Conradie et al. 2016).

Our results suggest that western Zambia, and the region around Ngonye Falls in particular, has a suite of taxa in common with adjoining regions of Zambia and south-eastern Angola, as well as a suite of apparently unique taxa. However, most surveys to data have been restricted to the regions immediately adjacent to the Zambezi River, probably because of easy access, and it would be insightful to conduct surveys away from the Zambezi River to gain a better understanding of the entire herpetological assemblage in this region.

Our list should be regarded as preliminary, as numerous additional species are known from the general vicinity and are likely to be recorded here in the future. There are unconfirmed sightings of *Acanthocercus atricollis atricollis* (Smith, 1849) from the east bank of the Zambezi River opposite Ngonye Falls, while we also observed an *Aparallactus capensis capensis* Smith, 1849 in Ngonye Falls campsite and *Crotaphopeltis hotamboeia* (Laurenti, 1768) individuals in the northern buffer zone of Sioma Ngwezi National Park at Idjobwa Pan, as well as in Ngonye Falls campsite, but did not secure photographic evidence or voucher specimens. *Varanus niloticus* (Linnaeus, 1766) was commonly observed in the Zambezi River in the vicinity of Ngonye Falls, while three juvenile lacertids with a striped dorsal pattern which were seen at Ngonye Falls campsite may be referable to *Nucras ornata* (Gray, 1864), but this remains to be verified. There are carapaces of *Pelomedusa subrufa* (Bonnaterre, 1789) and *Pelusios bechuanicus* FitzSimons, 1932 on display in the visitor's center, and although these are suspected to have been sourced from the vicinity of Ngonye Falls and/or Sioma Ngwezi National Park, this could not be verified.

Based on their occurrence in similar habitat in nearby areas, the following additional amphibian species are expected to occur in the region: *Leptopelis bocagii* (Günther, 1865); *Sclerophrys lemairii* (Boulenger, 1901); *Hyperolius nasutus* Günther, 1865; *Kassina senegalensis* (Duméril and Bibron, 1841); *Phrynomantis affinis* Boulenger, 1901; *P. bifasciatus* (Smith, 1847); Hildebrandtia ornata (Peters, 1876); *Phrynobatrachus mababiensis* FitzSimons, 1932; *Ptychadena grandisonae* Laurent, 1954; *P. nilotica* (Seetzen, 1855); *P. porosissima* (Steindachner, 1867); *P. taenioscelis* Laurent, 1954; *Pyxicephalus adspersus* Tschudi, 1838; and *Amnirana darlingi* (Boulenger, 1902) (Channing 2001; Conradie et al. 2016; Furman et al. 2015; Poynton and Broadley 1985a,b, 1987, 1988, 1991).

A number of additional reptile species are also expected to occur in the region based on their presence at nearby locations, including: *Pelusios rhodesianus* Hewitt, 1927; *Lygodactylus angolensis* Bocage, 1896; *Pachydactylus punctatus* Peters, 1854; *Varanus albigularis* Daudin, 1802; *Monopeltis mauricei* Parker, 1935; *Amblyodipsas ventrimaculata* (Roux, 1907), *Boaedon capensis* Duméril, Bibron and Duméril, 1854; *Crotaphopeltis barotseensis* Broadley, 1968; *Philothamnus semivariegatus* (Smith, 1840); *Psammophis lineatus* (Duméril, Bibron and Duméril, 1854); *P. angolensis* (Bocage, 1872); *Dasypeltis scabra* (Linnaeus, 1758), *Naja anchietae* Bocage, 1879; *Atractaspis bibronii* Smith, 1849 and *Causus rhombeatus* (Lichtenstein, 1823) (Bayless 2002; Branch 1998; Broadley 1968, 1971a,c, 1991b, 1995, 2000a, 2002, 2014; Broadley et al. 1976; Conradie et al. 2016; Haagner et al. 2000; Hughes 2004; Loveridge 1958; Rasmussen 1997, 2005; Roux 1907).

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Appendix 1. List of amphibian and reptile species recorded at Ngonye Falls and surrounding regions in south-western Zambia, indicating voucher type and accession number. Museum acronyms are: PEM: Port Elizabeth Museum; SAIAB: South African Aquatic Biodiversity Institute, Grahamstown and TM: Ditsong National Museum of Natural History, Pretoria. All photographs are accessioned into the FrogMAP and ReptileMAP platforms of the Virtual Museum, Animal Demography Unit, University of Cape Town (available: vmus.adu.org.za).

Species	Voucher Number	Virtual Museum Number
ORDER: ANURA		**FrogMAP**
BREVICEPTIDAE		
Breviceps adspersus adspersus Peters, 1882		5982
Breviceps poweri Parker, 1934		5983
BUFONIDAE		
Poyntonophrynus fenoulheti (Hewitt and Methuen, 1913)		5989
Schismaderma carens (Smith, 1848)	SAIAB 205361, 205631	5992–93
Sclerophrys gutturalis (Power, 1927)		5994
Sclerophrys poweri (Hewitt, 1935)	SAIAB 205356	5996–97
Sclerophrys pusilla (Hallowell, 1855)	PEM A11719–20; SAIAB 205360	5995, 5998
HEMISOTIDAE		
Hemisus marmoratus (Peters, 1854)		5985
HYPEROLIIDAE		
Hyperolius angolensis Steindachner, 1867		5986
PHRYNOBATRACHIDAE		
Phrynobatrachus natalensis (Smith, 1849)	SAIAB 205351	5987
Phrynobatrachus parvulus (Boulenger, 1905)		5988
PIPIDAE		
Xenopus muelleri (Peters, 1844)	SAIAB 202357	
Xenopus poweri Hewitt, 1927	SAIAB 202355	
PTYCHADENIDAE		
Ptychadena cf. *mapacha* Channing, 1993	TM 86255	5990
Ptychadena oxyrhynchus (Smith, 1849)	SAIAB 205353–54	5991
Ptychadena subpunctata (Bocage, 1866)	PEM A11717–18; SAIAB 205358, 205365	
PYXICEPHALIDAE		
Tomopterna cf. *cryptotis* (Boulenger, 1907)	SAIAB 205362	5999, 6000
RHACOPHORIDAE		
Chiromantis xerampelina Peters, 1854		5984
ORDER: SQUAMATA		**ReptileMAP**
SAURIA – AGAMIDAE		
Agama armata Peters, 1855	PEM R22017–18	158866–69
AMPHISBAENIDAE		
Dalophia longicauda (Werner, 1915)		163523
Dalophia pistillum (Boettger, 1895)	PEM R22925	
Monopeltis anchietae (Bocage, 1873)	TM 86250	
Zygaspis nigra Broadley and Gans, 1969	TM 86209	158938
Zygaspis quadrifrons (Peters, 1862)	TM 86208	158939
CHAMAELEONIDAE		
Chamaeleo dilepis Leach, 1819		158873, 158876–77

Appendix 1 (continued). List of amphibian and reptile species recorded at Ngonye Falls and surrounding regions in south-western Zambia, indicating voucher type and accession number. Museum acronyms are: PEM: Port Elizabeth Museum; SAIAB: South African Aquatic Biodiversity Institute, Grahamstown and TM: Ditsong National Museum of Natural History, Pretoria. All photographs are accessioned into the FrogMAP and ReptileMAP platforms of the Virtual Museum, Animal Demography Unit, University of Cape Town (available: vmus.adu.org.za).

Species	Voucher Number	Virtual Museum Number
GEKKONIDAE		
Pachydactylus wahlbergii wahlbergii (Peters, 1869)		163521–22
Hemidactylus mabouia (Moreau De Jonnès, 1818)	PEM R22019–20; TM 86251–52	158888–90, 158892
Lygodactylus chobiensis FitzSimons, 1932	PEM R22026; TM 86253	158901, 158903–06
GERRHOSAURIDAE		
Gerrhosaurus auritus Boettger, 1887		158885
Gerrhosaurus intermedius Lönnberg, 1907		158887
LACERTIDAE		
Ichnotropis capensis (Smith, 1838)	PEM R22021–24	158896, 158902
Ichnotropis grandiceps Broadley, 1967	TM 86237	
Meroles squamulosus (Peters, 1854)		158907
SCINCIDAE		
Acontias jappi (Broadley, 1968)	TM 86232–34, TM 86254	
Acontias schmitzi Wagner, Broadley and Bauer, 2012	PEM R22015	
Mochlus sundevallii (Smith, 1849)	PEM R22027	158908
Panaspis maculicollis Jacobsen and Broadley, 2000		158911
Typhlacontias rohani Angel, 1923	TM 86235–36, 86248	
Trachylepis damarana (Peters, 1870)	PEM R22030–31	158929–30, 158933–35
Trachylepis wahlbergii (Peters, 1869)	PEM R22029	158931, 158936
SERPENTES – COLUBRIDAE		
Telescopus semiannulatus semiannulatus Smith, 1849		158924
Dispholidus typus viridis (Smith, 1828)		158882, 158884
Thelotornis capensis oatesii (Günther, 1881)		158925–26, 158928
Philothamnus angolensis Bocage, 1882	PEM R22028; TM 86231	158913
NATRICIDAE		
Limnophis bangweolicus (Mertens, 1936)	TM 86203, 86249; PEM R22926	
ELAPIDAE		
Dendroaspis polylepis Günther, 1864		158880–81, 158883
Naja nigricollis Reinhardt, 1843		158909–10
LAMPROPHIIDAE		
Amblyodipsas polylepis (Bocage, 1873)		158870
Hemirhagerrhis nototaenia (Günther, 1864)		158891, 158893–95, 158900
Lycophidion multimaculatum Boettger, 1888		158898
Psammophis mossambicus Peters, 1882		158914–16
Psammophis subtaeniatus Peters, 1882		158917
Pseudaspis cana (Linnaeus, 1758)		158918–19, 158922–23
Xenocalamus mechowii Peters, 1881	TM 86247	158937
LEPTOTYPHLOPIDAE		
Leptotyphlops scutifrons (Peters, 1854)	PEM R22025	

Appendix 1 (continued). List of amphibian and reptile species recorded at Ngonye Falls and surrounding regions in south-western Zambia, indicating voucher type and accession number. Museum acronyms are: PEM: Port Elizabeth Museum; SAIAB: South African Aquatic Biodiversity Institute, Grahamstown and TM: Ditsong National Museum of Natural History, Pretoria. All photographs are accessioned into the FrogMAP and ReptileMAP platforms of the Virtual Museum, Animal Demography Unit, University of Cape Town (available: vmus.adu.org.za).

Species	Voucher Number	Virtual Museum Number
PYTHONIDAE		
Python natalensis Smith, 1840		158927
TYPHLOPIDAE		
Afrotyphlops mucruso (Peters, 1854)	TM 81409	
Afrotyphlops schmidti (Laurent, 1956)	PEM R22016; TM 86246	158865
VIPERIDAE		
Bitis arietans arietans Merrem, 1820		158871–72, 158874
ORDER: CROCODYLIA		
CROCODYLIDAE		
Crocodylus niloticus Laurenti, 1768		158875, 158878–79
ORDER: TESTUDINES		
TESTUDINIDAE		
Kinixys spekii Gray, 1863		158897
Stigmochelys pardalis (Bell, 1828)		158920

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Errol Pietersen is a conservationist with a passion for reptiles and amphibians. His work has taken him to various interesting locations in Africa, where he has contributed to the knowledge of the herpetofauna of these regions. Errol has co-authored various popular articles on reptiles and amphibians, in particular on the diversity of these taxa at various sites in Mozambique.

Werner Conradie has ten years of experience in southern African herpetofauna, with his main research interests focusing on taxonomy, conservation, and ecology of amphibians and reptiles. He has published numerous principal and collaborative scientific papers and has served on a number of conservation and scientific panels, including the Reptile Atlas Committee and Amphibian IUCN Workshop. Werner has represented his field on television and in numerous field guides and has participated in expeditions in various countries including Namibia, Botswana, Zimbabwe, Mozambique, Angola, Malawi, Lesotho, and Zambia. He is currently the Curator of Herpetology at the Port Elizabeth Museum (Bayworld), South Africa.