Acta Herpetologica 3(2): 107-127, 2008
ISSN 1827-9643 (online)

The Nguru mountains of Tanzania, an outstanding hotspot of herpetofaunal diversity

Michele Menegon[1,2], Nike Doggart[3], Nisha Owen[4,5]

[1] *Sezione di Zoologia dei Vertebrati, Museo Tridentino di Scienze Naturali, Via Calepina 14, I–38100 Trento, Italy*
[2] *Udzungwa Mountains Monitoring Centre, c/o Udzungwa Mountains National Park, P.O. Box 99 Mang'ula, Tanzania*
[3] *Tanzania Forest Conservation Group, P.O. Box 23410, Dar es Salaam, Tanzania*
[4] *Frontier Tanzania Forest Research Program, P.O. Box 9473, Dar es Salaam, Tanzania*
[5] *Society for Environmental Exploration/Frontier, 50-52 Rivington Street, London EC2A 3QP*

Submitted on 2008, 7th March; revised on 2008, 22nd August; accepted on 2008, 30th September.

Abstract. Despite the vicinity of a major road, the rainforests of the South Nguru Mountains in eastern Tanzania were virtually unexplored until 2004, particularly from a herpetological point of view. Several surveys were conducted between 2004 and 2006 with the aim of providing a comprehensive list of the amphibian and reptile species of this overlooked hotspot of biological diversity. The surveys resulted in this assessment of the herpetofaunal diversity, with 92 species recorded, of which 15 represent new records for this area, and the discovery of 16 species new to science, all of which are likely to be strictly endemic to the Nguru Mountains. Pressure on the forests, particularly the lowland forests, remains high. A conservation planning process is now underway that is attempting to address the loss of these critically important forests. These results, documenting the high species richness and the outstanding number of putative endemics of the forests, strongly highlight the biological importance of the South Nguru Mountains and place them among the most important sites for the conservation of herpetofauna in Africa.

Keywords. Herpetofaunal diversity, new species, endemism, zoogeography, Eastern Arc Mountains.

INTRODUCTION

In the last few years increased interest in the forests of the Eastern Arc Mountains has resulted in the biological exploration of several poorly known mountain blocks. Previously unsurveyed montane ranges and forest reserves have recently been explored by different groups of researchers and faunal lists are being completed. Among the ranges explored in the last few years, the South Nguru Mountains stand out due to their exceptional amphibian and reptile species richness, number of undescribed species and endemism ratio. The present paper outlines the results of several surveys conducted by two different groups of researchers and highlights the richness and uniqueness of the South Nguru Mountains herpetofauna, furthermore it stresses the need for a rapid taxonomic and conservation assessment of the newly discovered and as yet undescribed species in order to properly assess the biological value of the South Nguru Mountains forests.

The South Nguru Mountains are part of the Eastern Arc Mountains of Tanzania and Kenya. This chain of isolated massifs is part of one of the world's most important biodiversity hotspots (Mittermeier et al., 2004). The Eastern Arc Mountain forests are biologically exceptional due to the high concentration of endemic species that have been recorded in the area (Howell, 1993; Lovett, 1993; Burgess et al., 1998; Burgess et al., 2007). The biodiversity of the South Nguru Mountains is less well known than some of the other Eastern Arc massifs, such as the East Usambara and Uluguru Mountains (Burgess et al., 2007). As stated by Lovett and Thomas (1988) the interest in the South Nguru Mountains is threefold: they are in the central part of the Eastern Arc Mountain chain and should possess many rare species; the mountains have continuous forest cover from less than 400 m to 2400 m altitude; and are still poorly known biologically.

At a national level, the South Nguru forests are important as the main catchment area for the Wami River which provides water for the town of Chalinze, the Mtibwa sugar plantation and many villages. Locally, the forests are important as a source of wood products, medicinal plants and for their cultural values.

Most biological research in the South Nguru Mountains has concentrated on plants. Lovett and Thomas (1988) surveyed both Kanga and Nguru South Forest Reserves providing a brief account of the vegetation. Botanical surveys conducted by Pócs et al. (1990) in the South Nguru Mountains provided additional data supplemented by subsequent surveys carried out by Lovett and Pócs (1993). These surveys indicated a high number of rare and endemic plants in Nguru South and Kanga Forest Reserves. Pócs (1998) recorded three endemic bryophyte species in the South Nguru Mountains. Results of several bird surveys were published in the past (Moreau, 1940; Sclater and Moreau, 1932-1933; Stuart and van der Willingen, 1978), but it was not until 1996 that Romdal (2001) carried out a systematic ornithological survey covering various altitudes in the Ngurus (Baker and Baker, 2002).

Until the publication of results of herpetological surveys carried out in the South Nguru Mountains by Emmrich (1994), very little information was available on the herpetofauna. Burgess et al. (1998) reported the collection of an undescribed *Rhampholeon* species, subsequently described by Mariaux and Tilbury (2006). Nine species of small mammals (shrews and small rodents), of which three are endemic to the Eastern Arc Mountains, were recorded in the South Nguru Mountains by Stanley et al. (1998). A few further records are available for other mammals. This paper demonstrates that the herpetofaunal value of the South Ngurus is exceptional, particularly given that the survey intensity remains low relative to other areas of the Eastern Arc Mountains such as the Uluguru and East Usambara Mountains.

STUDY AREA

The South Nguru Mountains lie between S 05°53'S-S 06°17' and E 037°27–E 037°45' in Mvomero District, Morogoro Region, Tanzania (Fig. 1). Nguru South Forest Reserve (see Fig. 2) was gazetted during the German colonial period and covers an area of 18 797 ha with an altitudinal range between 760 and 2400 m. It is contiguous with Mkindo Forest Reserve which covers 5244 ha and extends down to 380 m. The estimated mean rainfall on the eastern slopes of these mountains is around 2000 mm/year increasing up to 3000-4000 mm at 2000 m (Lovett and Pócs, 1993). Kanga Forest Reserve was gazetted in 1954 and covers an area of 6664 ha with an altitudinal range between 500 and 2019 m. The estimated rainfall is 1500-2000 mm/year (Lovett and Pócs, 1993). Within the South Nguru landscape, there are 56 villages. The majority of people in the South Nguru landscape depend on agriculture for their livelihood. At the base of the mountains, the Mtibwa sugar plantation covers an extensive area. Farmers are also involved in smallholder sugar and rice cultivation. At higher altitudes, farmers grow bananas, yams, sweet potatoes, maize and coffee. Many farmers also have plots within the Nguru South Forest Reserve where they are growing cardamom and yams. Cardamom is one of the main sources of cash income for the communities immediately adjacent to the reserves. Cardamom cultivation is now widespread within Nguru South Forest Reserve.

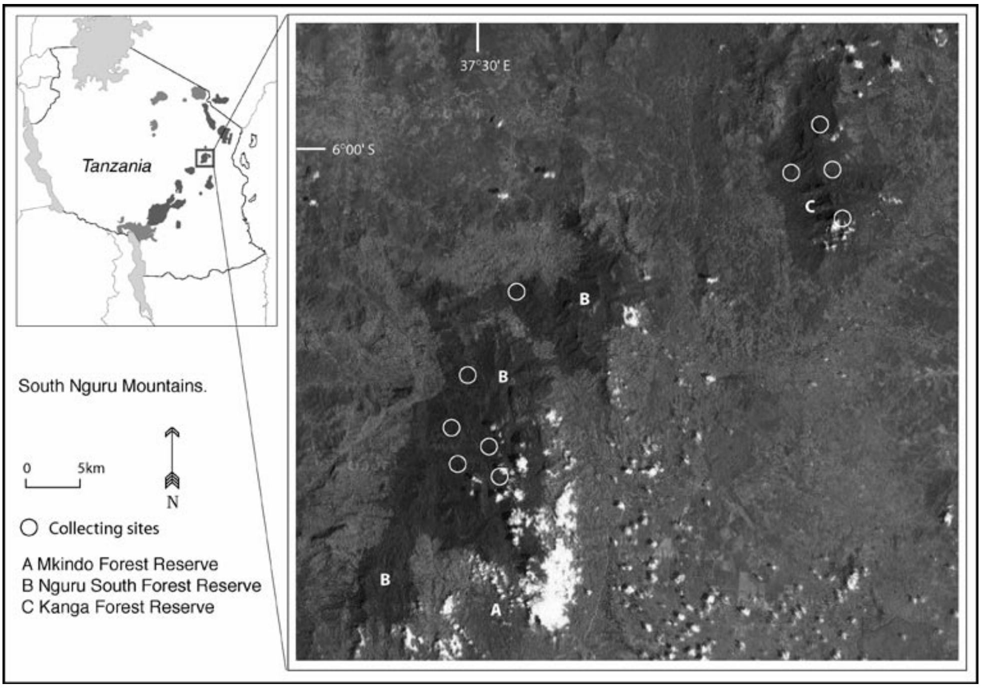

Fig. 1. Location of the sampling sites within the Nguru South and Kanga Forest Reserves.

Fig. 2. The montane rainforest of the Nguru South Mountains, one of the sampled habitats.

MATERIALS AND METHODS

Between October 2004 and August 2006 a total of 13 sites were surveyed in the South Nguru Mountain forests, seven sites in Nguru South Forest Reserve and six in Kanga Forest Reserve. Two additional sites were surveyed opportunistically in Nguru South Forest Reserve during January 2006 (see Table 1). Sampling sites were located in submontane and montane forests between 750 and 2200 m asl. Further records were obtained during random sampling in the village belt and from local people.

Sites were sampled by opportunistic search, visual and acoustical monitoring. Searches were conducted both during the day and night to sample the highest number of species. Sixteen Visual Encounter Survey (VES) quadrats were conducted within a 10x10 m area, requiring one man-hour each per unit. Four VES transects of 100 m were also conducted, each requiring four man-hours. Another sampling technique used was pitfall trapping with drift fences (Heyer et al., 1993). They consisted of three 50 m linear transects each containing eleven 10 litre plastic buckets positioned 5 m apart, sunk into the ground with a plastic sheet 'drift fence' stretching between each bucket. Each line was placed 50 m apart, encompassing a range of micro-habitats. A total of 264 bucket pitfall trap-nights were conducted in each work unit. Specimens have also been sampled opportunistically during forest walks. Further records (mainly concerning snakes) were obtained from local people living in the villages at the forest edge. A collection of specimens opportunistically killed by villagers in crop fields surrounding the forest, were identified by the authors and deposited in the collection. The abundance of individuals of different species was also recorded. Sampling intensity was comparable in sites 1-4. Voucher specimens were collected and, when possible, frog calls were recorded by means of a Sony TCM directional microphone and a Sharp Minidisc or an analogue Marantz PMD-222 audiocassette recorder and a Sennheiser K6-ME66 directional microphone. Specimens,

Table 1. Location and main characteristics of the sampling sites.

Sampling site	UTM co-ordinates	Elevation range m	Main vegetation type	Main habitats investigated
Nguru Site 1 'Maskati'	37M0333779 9329236	1900-2200	Montane and upper montane rain forest	Open canopy forest, small bogs
Nguru Site 2 'Pemba'	37M0336825 9333210	950-1050	Submontane forest	Closed canopy forest, small wetland, ecotone
Kanga Site 3 'Kanga'	37M0358812 9336174	750-900	Transitional and Submontane forest	Closed canopy forest,
Kanga Site 4 "Difinga"	37M0356024 9340888	1000-1300	Submontane rain forest	Closed canopy forest,
FT Kanga Site 5	37M0355845 9340733	1000-1100	Submontane rain forest	Closed canopy forest,
FT Kanga Site 6	37M0358539 9341552	800-950	Lowland and submontane forest	Half-closed, canopy forest
FT Kanga Site 7	37M0356729 9345887	1100-1250	Submontane rain forest	High dense closed-canopy forest
FT Kanga Site 8	37M0358571 9336368	800-900	Lowland and submontane forest	Half-closed canopy forest
FT Nguru Site 9	37M0333711 9329248	1950-2050	Montane and upper montane forest	Open canopy forest, small bogs
FT Nguru Site 10	37M0333540 9325622	1950-2020	Dry upper montane forest	Open canopy forest, heath
FT Nguru Site 11	37M0334554 9323454	1850-1950	Upper montane forest	Open canopy forest,
FT Nguru Site 12	37M0337300 9322700	1700-1850	Submontane and montane forest	Dense closed-canopy forest
FT Nguru Site 13	37M0361810 9324701	1800-1950	Montane forest	Dense closed-canopy forest
FT Nguru Site 14	37M0335146 9329820	1700	Montane forest	Closed canopy forest
FT Nguru Site 15	37M0336314 9332299	1180	Submontane forest	Open canopy forest
Village belt (two sites)		1000 – 2000	Farmland	Synanthropic habitats

photographs and sound recordings were deposited in both the Museo Tridentino di Scienze Naturali, Trento, Italy, and in the collections of the University of Dar es Salaam, Tanzania. The majority of species collected have been identified by the lead author, on the grounds of morphological, molecular and bioacoustic analysis and through comparison with material held in the herpetological collections of the University of Dar es Salaam, Tanzania, the Natural Sciences Museum of Trento, Italy and the Natural History Museum, London, UK. Molecular analysis were carried out at the Centre for Alpine Ecology, Trento, Italy; the Natural History Museum, London, UK and the Institute of Biogeography, Basel, Switzerland. Identifications or confirmation of identification were also provided by Simon Loader, Institute of Biogeography, Basel; John Poynton, Natural History Museum, London and Van Wallach, Museum of Comparative Zoology, Harvard University, Cambridge, USA.

The nonparametric species richness estimator based on abundance data Chao 1, computed along log-linear 95% confidence interval, and the abundance-based coverage estimator ACE, were used incorporating abundance data, represented by the number of individuals per species (Colwell and Coddington, 1994; Chao et al., 2000; Magurran, 2004). The shared species estimator *V* (Chao et al., 2000) has been used to estimate the number of shared species between sites. Analyses were performed using the sofware *EstimateS* (Magurran, 2004). The species complementarity between sites has been described as an expression of pattern diversity (Whittaker, 1972) by means of a Bray-Curtis similarity analysis expressed as a percentage (Legendre and Legendre, 1998; Magurran, 2004). The analysis of similarity has been performed using the software *Biodiversity Pro*. Only the records from the lead author's direct collections in sites 1-4 were used in the statistical analysis. Amphibian taxonomy follows Frost et al., (2006), Reptile taxonomy follows Spawls et al. (2004), except for Colubroidea taxonomy that follows Vidal et al. (2007) and Lawson et al. (2005) and Scincidae taxonomy that follows Brandley et al. (2005).

RESULTS

Species composition and richness.

A total of 41 species of amphibian from 12 families and 51 species of reptile from 11 families were recorded in Nguru South Forest Reserve, Kanga Forest Reserve and farmland adjacent to the two forest reserves during the survey activity. Three species previously documented for the area were not found during this study. By combining previous species records with those from the present study, the total number of amphibian and reptile species recorded from the South Nguru Mountains is 92 species, from 23 families (appendix 1). The majority, 76 species out of a total of 89 species collected during this survey, were recorded from forest, and of these, based on the known information on their ecology, 67 species are considered forest associated based upon available literature (Howell, 1993, Menegon and Salvidio, 2005; Burgess et al., 2007). The remaining species were collected from the village belt.

Biological notes

During the surveys we observed the activities of some species whose behaviour is poorly known. These observations are summarised as follows: *Hoplophryne* sp. nov. was active during and immediately after heavy rain in undisturbed forest during the day. At these times, individuals of *Hoplophryne* sp. nov. move around on soft soil and under the leaf litter, they can be detected by searching gently with a stick among the leaf litter. Female *Hyperolius spinigularis* were observed returning to their egg clutches and squirting water over the eggs. This was previously observed by Stevens (1971), and may be done to avoid desiccation and possibly parasitism of the eggs (J. Vonesh, pers. comm.). The geckos *Urocotyledon wolterstorffii* and *Cnemaspis africana* were observed sharing an egg-laying site on dry, sandy soil under a large overhanging rock. Two eggs of *Urocotyledon wolterstorffii* and several eggs of *Cnemaspis africana* were found under wood debris. Several females *Cnemaspis africana* were probably using the site. One of the eggs of *Urocotyledon* was 12 mm in length. After 16 days in controlled conditions a hatchling 21.25 + 23.37 mm long (Head body + Tail length) emerged.

Range extensions of species endemic to the Eastern Arc Mountains

The known distributions of 15 species endemic or near endemic to the Eastern Arc were extended by our findings (see Table 2).

New species

The present study recorded 15 amphibian taxa and one reptile taxon that are sufficiently distinct from the other known taxa that they may be considered new species based upon the available data (see Table 3). The discovery of numerous species new to science,

Table 2. Reptile and amphibian species endemic to the Eastern Arc whose documented ranges have been extended by the present study.

Species	Known distribution prior to the present study	References for previous records
Amietophrynus brauni	Usambara, Uluguru and Udzungwa Mountains	Channing and Howell, 2006
Hyperolius spinigularis	Usambara and Uluguru and Udzungwa Mountains and Mulanje Mts. Malawi	Channing and Howell, 2006
Leptopelis vermiculatus	Usambara, Udzungwa and Rungwe Mountains	Channing and Howell, 2006
Leptopelis cf. *parkeri*	Usambaras, Uluguru and Udzungwa Mts.	Channing and Howell, 2006
Phrynobatrachus uzungwensis	Nguu, Uluguru and Udzungwa Mountains	Menegon et al., 2003; Channing and Howell, 2006
*Probreviceps macrodactylus macrodactylus**	Usambara Mountains	Channing and Howell, 2006
Urocotyledon wolterstorffii	East Usambara and Uluguru Mountains	Spawls et al., 2004
Kinyongia oxyrhina	Uluguru and Udzungwa Mountains	Klaver and Böhme, 1988; Spawls et al., 2002
Chamaeleo werneri	Uluguru and Udzungwa Mountains	Spawls et al., 2004
Rhinotyphlops gierrai	East and West Usambara Mountains	Broadley and Wallach, 2000
Buhoma vauerocegae	Usambara and Uluguru Mountains	Spawls et al., 2004
Dipsadoboa werneri	Usambara Mountains and the Uzungwa Scarp Forest Reserve in the southern Udzungwa Mountains	Rasmussen, 1997; Menegon and Salvidio, 2005
Xyeledontophis uluguruensis	Uluguru Mountains	Broadley and Wallach (2002)
Elapsoidea nigra	North Pare, Usambara, Magrotto and Uluguru Mountains	Broadley and Howell, 1991; Spawls et al. 2004
Atheris ceratophorus	East Usambara, Uluguru and Udzungwa Mountains	Spawls et al., 2004

* The record of this species from North Pare Mountains (Channing and Howell, 2006) is actually due to a misidentification of an undescribed species of *Callulina*.

Table 3. Reptile and amphibian taxa considered new species based upon the available data. The occurrence and occupancy areas were made without considering elevational constraints, in some cases the area may be an over-estimate.

Taxa	Range based on current information	Estimated maximum area of occupancy	Estimated maximum extent of occurrence
Amphibia			
Anura			
Arthroleptidae			
Arthroleptis sp. nov.	Nguru South and Mkindo Forest Reserves (278 km2)	240.3 km^2	240.3 km^2
Leptopelis sp. nov.	Kanga Forest Reserve	66 km^2	66 km^2
Bufonidae			
Nectophrynoides sp. nov. 1	Nguru South and Mkindo Forest Reserves	240.3 km^2	240.3 km^2
Nectophrynoides sp. nov. 2	Nguru South and Mkindo Forest Reserves	240.3 km^2	240.3 km^2
Nectophrynoides sp. nov. 3	Nguru South and Mkindo Forest Reserves	240.3 km^2	240.3 km^2
Nectophrynoides sp. nov. 4	Kanga Forest Reserve	66 km^2	66 km^2
Brevicipitidae			
Callulina sp. nov. 1	Nguru South and Mkindo Forest Reserves	240.3 km^2	240.3 km^2
Callulina sp. nov. 2	Nguru South and Mkindo Forest Reserves	240.3 km^2	240.3 km^2
Callulina sp. nov. 3	Nguru South and Mkindo Forest Reserves	240.3 km^2	240.3 km^2
Callulina sp. nov. 4	Kanga Forest Reserve	66 km^2	66 km^2
Probreviceps sp. nov.	Nguru South and Mkindo Forest Reserves	240.3 km^2	240.3 km^2
Microhylidae			
Hoplophryne sp. nov.	Nguru South and Mkindo Forest Reserves	240.3 km^2	240.3 km^2
Petropedetidae			
Petropedetes sp. nov.	Nguru South, Mkindo and Kanga Forest Reserves	306.3 km^2	57 km^2
GYMNOPHIONA			
Caecilidae			
Boulengerula sp. nov.	Nguru South, Mkindo and Kanga Forest Reserves	306.3 km^2	57 km^2
Scolecomorphus sp. nov.	Nguru South and Mkindo Forest Reserves	278 km^2	278 km^2
Reptilia			
Sauria			
Chamaleonidae			
Rhampholeon sp. nov.	Nguru South and Mkindo Forest Reserves	240.3 km^2	240.3 km^2

which are likely to be narrowly endemic to the Nguru Mountains only, is among the most interesting results of this study and make the South Nguru Mountains one of the most important ranges for herpetofaunal diversity and conservation in Africa. The taxonomic status of all the species collected during the surveys has been assessed in the context of a more extensive work on the genera, involving molecular, osteological, bioacoustic and morphological analysis conducted between 2005 and 2008 (Loader et al. unpublished; Poynton et al. unpublished; Menegon et al. unpublished). Formal description of some of the unnamed taxa has started.

Zoogeography

As with other Eastern Arc Mountains, the herpetofauna of the South Nguru Mountains contains a combination of Afromontane (Eastern Arc forests endemic and near endemic species), lowland/coastal and widespread species associated with savannah and woodland (see Table 4). While this is a strong indication that the forests of these areas were once connected, more detailed taxonomic work is still needed to fully understand the historical biogeography of the Eastern Arc Mountains.

Endemism

The proportion of amphibian and reptile species from the South Nguru Mountains that are endemic to these mountains is extremely high. Based on the results of this study, 23% (n = 18) of the herpetofauna species are strictly endemic to the South Nguru Mountains, of which only two were described. A further 33.3 % (n = 26) of the species have ranges restricted to the Eastern Arc Mountains. The percentage of endemic or near endemic species is directly related to elevation, a pattern that has also been documented for other Eastern Arc forest localities (Menegon and Salvidio, 2005). Based on three collecting localities, endemic species values at different elevation are as follows: Kanga, 750 m = 55.1%; Pemba, 1000 m = 59.4%; Maskati, 2000 m = 72.7%. This highlights the uniqueness of the montane herpetofauna community.

Species richness and pattern diversity

Nonparametric estimators were used to estimate the species richness of sites and the number of shared species between sites in order to assess the total richness of the area and the differential diversity across sites and along an altitudinal gradient. In order to avoid biases due to different collecting methods and timing, only records compiled from the lead author's direct sampling were used to calculate relative abundance and diversity estimates.

Kanga is estimated to be the richest site (59.26 ± 2.49 ACE mean; 54.5 ± 2.79 Chao 1 95% CI lower bound), followed by Pemba (48.46 ± 1.61 ACE mean, 43.05 ± 2.68 Chao 1 95% CI lower bound) and Maskati (30.73 ± 2.49 ACE mean, 26.11 ± 2.79 Chao 1 95% CI lower bound), this result is probably due to the low elevation component of the Kanga species assemblage, following the assumption that species richness decreases with increas-

Table 4. Biogeographic affinities of the recorded species. Bibliographic records and species collected by authors were considered. Five species not yet identified to species level have not been included in the table, species identified as undescribed are included.

Nguru south and Kanga forest endemics no. of species 18 % on total recorded 23	*Arthroleptis* sp. nov., *Nectophrynoides* sp. nov. 1, *Nectophrynoides* sp. nov. 2, *Nectophrynoides* sp. nov. 3, *Nectophrynoides* sp. nov. 4, *Leptopelis* sp. nov., *Callulina* sp. nov. 1, *Callulina* sp. nov. 2, *Callulina* sp. nov. 3, *Callulina* sp. nov. 4, *Probreviceps* sp. nov., *Hoplophryne* sp. nov., *Petropedetes* sp. nov., *Scolecomorphus* sp. nov., *Boulengerula* sp. nov, *Rhampholeon acuminatus*. *Rhampholeon* sp. nov., *Kinyongia fisheri*
Eastern Arc forest endemics or near-endemics no. of species 26 % on total recorded 33.3	*Arthroleptis affinis*, *Amietophrynus brauni*, *Afrixalus uluguruensis*, *Hyperolius mitchelli*, *Hyperolius spinigularis*, *Hyperolius* sp. (*puncticulatus-like*), *Leptopelis* cf. *parkeri*, *Leptopelis* cf. *uluguruensis*, *Leptopelis vermiculatus*, *Probreviceps macrodactylus macrodactylus*, *Phrynobatrachus uzungwensis*, *Chamaeleo werneri*, *Chamaeleo deremensis*, *Kinyongia oxyrhina*, *Agama montana*, *Urocotyledon wolterstorffii*, *Scelotes uluguruensis*, *Proscelotes* cf. *eggeli*, *Leptosiaphos kilimensis*, *Typhlops gierrai*, *Buhoma vauerocegae*, *Rhinotyphlops gierrai*, *Thelotornis usambaricus*, *Crotaphopeltis tornieri*, *Dipsadoboa werneri*, *Elapsoidea nigra*, *Atheris ceratophorus*
East African coastal mosaic species no. of species 18 % on total recorded 23	*Arthroleptis xenodactylus*, *Arthroleptis xenodactyloides*, *Afrixalus stuhlmanni complex*. *Afrixalus stuhlmanni stuhlmanni*, *Afrixalus fornasinii**, *Leptopelis flavomaculatus*, *Gastropholis prasina**, *Chamaeleo melleri*, *Rieppeleon brevicaudatus*, *Rieppeleon brachyurus*, *Cnemaspis africana*, *Holaspis laevis*, *Melanoseps loveridgei**, *Aparallactus guentheri*, *Lycophidion capense loveridgei*, *Natriciteres sylvatica*, *Philothamnus macrops*, *Dendroaspis angusticeps*.
West African forest and savannah species no. of species 2 % on total recorded 2.5	*Lycophidion meleagre*, *Bitis gabonica*
East/south African savannah species no. of species 8 % on total recorded 10.2	*Schismaderma carens*, *Ptychadena anchietae*, *Chiromantis xerampelina Xenopus* cf. *petersii*, *Lygosoma afrum**, *Rhinotyplops mucruso*, *Aparallactus jacksoni*, *Atractaspis bibroni*, *Philothamnus punctatus*,
Widely distributed savannah species no. of species 15 % on total recorded 19.2	*Amietophrynus gutturalis*, *Amietia angolensis*, *Phrynobatrachus parvulus*, *Chamaeleo dilepis*, *Agama agama*, *Trachylepis varia*, *Trachylepis maculilabris*, *Trachylepis striata*, *Varanus niloticus*, *Typhlops lineolatus*, *Crotaphopeltis hotamboeia*, *Dispholidus typus*, *Lamprophis fuliginosus*, *Prosymna stuhlmanni*, *Philothamnus hoplogaster*, *Bitis arietans*.

* Bibliographic records

ing elevation (MacArthur, 1972; Stevens, 1992). The same pattern of species richness is obtained by considering the Simpson index of diversity: Simpson Mean (D): Kanga = 33.43; Pemba = 24.93; Maskati = 14.29.

According to the Bray-Curtis indices of similarity the site at highest elevation (Maskati) shows the greatest difference from other sites (25% of similarity), with medium altitude sites Pemba and Kanga showing closer faunal similarities (38% of similarity), in spite of the latter two being positioned on two separate massifs (see Fig. 4). This pattern of diversity highlights the unique nature of the montane and upper montane forest herpetofauna and demonstrates how altitude influences the composition of assemblages in Eastern Arc forests. Based upon predictions of species richness, estimates suggest an extremely diverse forest associated herpetofauna (possibly > 110 species for the entire landscape). Further comparisons with other Eastern Arc Mountains will be necessary to see how significant these estimates are, but it is likely to be higher than most areas based on our current understanding of other Eastern Arc Mountains.

Species richness comparison

The South Nguru Mountain forests support a rich forest associated herpetofauna of about 67 species. This value is higher than all the considered sites in Africa (see Table 5)

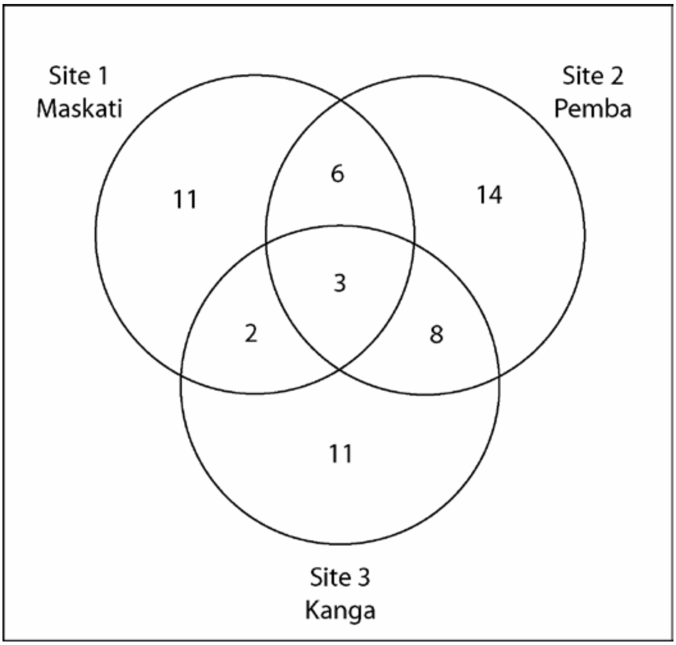

Fig. 4. Species overlap among sampled sites. The graph shows the high complementarity of the species composition in the sampled sites and how sites at same altitude on different mountain blocks (Kanga and Pemba) have a more similar species composition than sites at different altitudes on the same mountain block.

Table 5. Comparison of the "forest-associated" herpetofauna species richness in some tropical mid-elevation-montane forests of Africa, Central America, and the Philippines (modified from Vonesh 1998).

Site	Elevation m	Area (ha)	Amphibians	Reptiles	Total	Spp /area	Reference
Usambara Mts., Tanzania	600-2286	22100	23	29	52	0.23	Howell, 1993; Poynton et al., 2007
Uzungwa Scarp FR, Tanzania	600-2000	21000	28	29	57	0.27	Menegon and Salvidio, 2005
Kibale N.P., Uganda[a]	1400-1550	56000	15	29	44	0.07	Vonesh, 1998
Bwindi N.P., Uganda	1200-2600	31000	20	21	41	0.13	Drewes, 1991
Virungas N.P., Congo[c]	1300-3000	300000	27	40	67	0.022	DeWitte, 1941
Korup N.P., Cameroon[d]	1080-1768	124000	33	11	44	0.035	Lawson, 1993
Monteverde, Costa Rica[e]	1300-1470	12000	25	36	61	0.5	Timmerman, 1981
Cuernos de Negros, Philippine	1050-1350	10000	7	13	20	0.2	Brown and Alcala, 1961
Nguru South, Tanzania	750 - 2200	12000	33	34	67	0.55	This paper

a) only Kibale species restricted to the forest interior are included; b) species listed as extralimital by Drewes and Vindum (1991) are excluded; c) only forest species found above 1300 m are included; d) only species found at Mt. Yuhan (to 1079 m); Rumpi Hills (1000-1768 m) and Nta Ali (to 1200 m) are included. Lawson (1993) comments that these elevations were under sampled; e only species restricted to Timmerman's (1981) pre-montane and lower montane zones (2-5) are included; f only specimens in submontane and montane forest zones are included from Brown and Alcala (1961), the source for closed forest area in East Usambara and South Nguru Mountains is Newmark (2002) for the Uzungwa Scarp the closed forest area is assumed to be the same of the gazetted area.

and comparable with the one recorded for the Virunga National Park (De Witte, 1941), but in an area about more than 20 times smaller. Detailed comparison between sites is complicated by the differences in: total area and elevational ranges of the available sites, and biases in data collecting effort. Despite this, a preliminary comparison between sites with similar geographic features places Nguru South as being among the richest sites in Africa, comparable with the Mesoamerican site of Monteverde in Costa Rica.

DISCUSSION

Before the surveys described in this paper, the South Nguru Mountains were believed to have no narrow endemic species (Burgess et al., 2007); the results presented in this paper stress the need for a rapid taxonomic assessment of the newly discovered species in order to further define the biological value of South Nguru Mountain forests where 16 out of 18 strictly endemic species have no name or IUCN Red List assessment. Nguru South, Kanga and Mkindo are categorised as National Protection Forest Reserves. As such they are reserved 'for the purposes of protection of water sheds, soil conservation and the protection of wild plants' (Government of Tanzania, 2002). Kanga and Nguru South Forest Reserves are managed directly by the Morogoro Regional Catchment Forest Office while Mkindo is managed jointly by the four surrounding communities and the Morogoro Regional Catchment Forest Office. The miombo woodland in the lowlands between Kanga and Nguru South is on village land and does not lie within a protected area. Although it is intended that all forest reserves will have a management plan, only Mkindo has one at present. However, despite the legal protection afforded by the Forest Act (2002) enforcement is weak and sporadic.

Some of the key threats to the herpetofauna of the South Ngurus are forest loss and degradation as a result of fire, selective logging, encroachment from agricultural land and the removal of the forest shrub and herb layer for the cultivation of cardamom and yams. Many of the species of reptile and amphibian recorded during the survey are associated with forests and several species are associated with the shrub layer of the forest. This includes *Callulina* spp., *Nectophrynoides* spp. and *Rhampholeon* sp. that were only found in the shrub layer of undisturbed forest. While the clearance of the forest is likely to have the most significant negative impact on all forest species in the Ngurus, cardamom cultivation is particularly problematic in the forest close to Ubiri, Mafuta, Kwelikwiji, Mhonda, Digoma, Digarama, Maskati, Pemba and Kigugu villages. Cardamom cultivation could therefore potentially also have a significant impact, as this agricultural practice will affect many endemic species closely associated with the forest shrub layer. The long term impacts of cardamom cultivation in forest areas are not fully understood, but are likely to impede regeneration of forest plants.

The distinct nature of the herpetofauna species assemblages at high altitude and the remarkable number of putative endemics in the South Nguru Mountains, highlights the conservation importance of the South Nguru Mountain forests within the Eastern Arc Mountains. The high elevational turnover of species indicates the importance of conserving forest at all altitudes. Areas of forest or marginal habitats, even at low elevation, might also be vital in generating high species diversity, and need to be considered in the development of a conservation strategy for the area. Differences also exist between assemblages at sites at similar altitudes in adjoining mountain fragments within the South Nguru Mountain forests indicating the fine scale geographic turnover in the herpetofauna of the area (Fig. 3). This suggests that not only is it important to conserve the forest along the elevational gradient but it is also important to conserve fragments in geographically complex terrains, where isolated populations and therefore potentially new species may exist.

Since 2004, the Tanzania Forest Conservation Group (TFCG), a Tanzanian non-governmental organisation, has been working with stakeholders to improve conservation planning in the South Ngurus. TFCG, through a partnership programme known as PEMA, has facilitated a dialogue between communities and the government to develop a vision for natural resource management in the South Nguru landscape. Villagers and government have identified a series of actions required to address the issue of forest loss. This includes a combination of direct forest management activities such as developing and implementing forest management plans and boundary demarcation; and activities aimed at reducing local people's dependence on unsustainable activities such as the current methods of cultivating

Fig. 3. Some species recorded during the present study. Clockwise: *Rhampholeon acuminatus*; *Kinyongia fisheri fisheri; Dipsadoboa werneri*; an undescribed species of *Callulina*; an undescribed species of *Leptopelis* and an undescribed giant species of *Nectophrynoides.*

cardamom. The programme represents an opportunity to reverse the current trend of forest loss and degradation. To succeed the programme will need sustained commitment from the Government of Tanzania, civil society organisations, the local communities and development partners to conserve the unique biodiversity of this area.

ACKNOWLEDGEMENTS

Thanks to Abrahaman Mndeme, David Loserian and Ernest Benson. Moses Mwangoka kindly provided information on vegetation of the sampled sites, Simon Loader provided results of preliminary molecular investigation on some of the species collected and useful suggestions on an early draft of this manuscript, John Poynton confirmed the identification of some of the amphibian specimens, Van Wallach kindly provided identifications for the Typhlopidae, Joe Beraducci kindly provided data on some snakes species, David Moyer, Aaron Bauer, Neil Burgess and Kim Howell helped us in many ways. Thanks to an anonymous referee for his valuable comments on our work. Finally we would like to thank the Government of Tanzania, the Tanzania Commission for Science and Technology (COSTECH) for providing permission to study Reptiles and Amphibians of the Eastern Arc Mountains (COSTECH permit NO 2004-335-ER-98-13 MM), the CITES management authority in Tanzania and the Wildlife Division, who issued the necessary permits for the export of the specimens. The surveys were financed by DANIDA through the PEMA Programme and by the Museo Tridentino di Scienze Naturali and by the Critical Ecosystem Partnership Fund (CEPF).

REFERENCES

Baker, N.E., Baker, E.M. (2002). Important Bird Areas of Tanzania. Wildlife Conservation Society of Tanzania, Dar es Salaam.

Brandley, M.C., Schmitz, A., Reeder, T.W. (2005): Partitioned Bayesian Analyses, Partition Choice, and the phylogenetic relationships of Scincid lizards. Syst. Biol. **54**: 373-390.

Broadley, D.G., Howell, K.M. (1991): A check list of the reptiles of Tanzania, with synoptic keys. Syntarsus **1**: 170.

Broadley, D.G., Wallach, V. (2000): A new blind snake (Serpentes: Typhlopidae) from montane forest of the Eastern Arc Mountains in Tanzania. Afr. J. Herpetol. **49**: 165-168.

Broadley, D.G., Wallach, V. (2002): Review of the Dispholidini, with the description of a new genus and species from Tanzania. Bull. Nat. Hist. Museum London (Zoology) **68**: 57-74.

Brown, W. C., Alcala, A.C. (1961): Populations of amphibians and reptiles in submontane and montane forests of Cuernos de Negros, Philippine Islands. Ecology **42**: 28-636.

Burgess, N.D., Fieldsä, J., Botterweg, R. (1998): Faunal importance of the Eastern Arc Mountains of Kenya and Tanzania. J. East Afr.. Nat. Hist. Soc. **87**: 37-58.

Burgess, N.D., Kilahama, F. (2005): Is enough being invested in Tanzania's Eastern Arc Mountains? Arc J. **17**: 2-5. www.tfcg.org

Burgess, N.D., Butynski, T.M., Cordeiro, N.J., Doggart, N., Fjeldså, J., Howell, K.M., Kilahama, F., Loader, S.P., Lovett, J.C., Mbilinyi, B., Menegon, M., Moyer, D.C., Nashanda, E., Perkin, A., Rovero, F., Stanley, W.T., Stuart, S.N. (2007): The biological importance of the Eastern Arc Mountains of Tanzania and Kenya. Biol. Conserv. **134**: 209-231.

Channing, A., Howell, K.M. (2006): Amphibians of East Africa. Chimaira/Cornell University Press, 432 pp.

Chao, A., Hwang, W.H., Chen, Y.C., Kuo, C.Y. (2000): Estimating the number of shared species in two communities. Statistica Sinica **10**: 227-246.

Colwell, R.K., Coddington, J.A. (1994): Estimating terrestrial biodiversity through extrapolation. Philos. Trans. Roy. Soc. London Ser. B **345**: 101-118.

De Witte, G.F. (1941): Batraciens et Reptiles. Exploration du Parc National Albert, Mission G. F. De Witte (1933-1935), **33**. Institut des parcs nationaux du Congo Belge, Bruxelles, Belgium.

Drewes, R.C., Vindum, J.V. (1991): Amphibians of the impenetrable forest, southwest Uganda. J. Afr. Zool. **108**: 55-70.

Emmrich, D. (1994): Herpetological results of some expeditions to the Nguru Mountains, Tanzania. Mitt. Zool. Mus. Berl. **2**: 281-300.

Frost, D.R., Grant, T., Faivovich, J., Bain, H.B., Haas, A., Haddad, C.F.B., De Sa, R.O., Channing, A., Wilkinson, M., Donnellan, S.C., Raxworthy, J., Campbell, J.A., Blotto, B.L., Moler, P., Drewes, R.C., Nussbaum, R.A., Lynch, J.D., Green, D.M., Wheeler, W.C. (2006): The Amphibian Tree of Life. Bull. Am. Mus. Nat. Hist. **297**: 1-370.

Government of Tanzania (2002): The Forest Act. Gazette of the United Republic of Tanzania. 83 (23).

Heyer, R.H., Donnelly, M.A., McDiarmid, R.W., Hayek, L.C., Foster, M.S. (Eds) (1993): Measuring and monitoring biological diversity, standard methods for Amphibians. Smithsonian Institution Press, Washington, DC. 364 pp.

Howell, K.M. (1993): Herpetofauna of the Eastern African forests. In: Biogeography and Ecology of the Rain Forests of Eastern Africa, p. 173–202. Lovett, J.C., Wasser, S.K., Eds. Cambridge University Press, New York.

Klaver, C., Böhme, W. (1988): Systematics of Bradypodion tenue (Matschie, 1892) (Sauria: Chamaeleonidae) with a description of a new species from the Uluguru and Uzungwe Mountains, Tanzania. Bonner zoologische Beiträge **39**: 381-393.

Lawson, D.P. (1993): The reptiles and amphibians of the Korup National Park project, Cameroon. Herpetol. Nat. Hist. **1**: 27-90.

Lawson, R., Slowinski, J.B., Crother, B.I., Burbrink, F.T. (2005): Phylogeny of the Colubroidea (Serpentes): New evidence from mitochondrial and nuclear genes. Mol. Phylog. Evol. **37**: 581-601.

Lee, S., Zippel, K., Ramos, L., Searle, J. (2006): Captive-breeding programme for the Kihansi spray toad *Nectophrynoides asperginis* at the Wildlife Conservation Society, Bronx, New York, Int. Zoo Yb. **40**: 241-253.

Legendre, P., Legendre, L. (1998): Numerical Ecology. Second English Edition. Elsevier. 853 pp.

Lovett, J.C. (1993): Climatic history and forest distribution in eastern Africa. In: Biogeography and ecology of the rain forests of Eastern Africa, p. 23–29 Lovett, J., Wasser, S., Eds, Cambridge, Cambridge University Press.

Lovett, J.C., Pócs, T. (1993): Assessment of the condition of the Catchment Forest Reserves, a botanical appraisal. Catchment Forestry Report **93.3**, Dar es Salaam. 300 pp.

Lovett, J.C., Thomas, D.W. (1998): A report on a visit to the Nguru Mountains, Tanzania. East Afr. Nat. Hist. Society Bull. **18**: 19-22.

MacArthur, R.H. (1972): Geographical ecology. Princeton Univ. Press.

Magurran, A. (2004): Measuring Biological Diversity. Blackwell Publishing, Oxford, UK.

Mariaux, J., Tilbury, C.R. (2006): The Pygmy chameleons of the eastern arc range (Tanzania): Evolutionary relationships and the description of three new species of *Rhampholeon* (Sauria: Chamaeleonidae). Herpetol. J. **16**: 315-331.

Menegon, M., Salvidio, S., Moyer, D.C. (2003): Reptiles and Amphibians of Nguu North Forest Reserve, Tanzania: first contribution. Afr. Herps News **36**: 2-8. .

Menegon, M., Salvidio, S. (2005): Amphibian and Reptile diversity in the southern Uzungwa Scarp Forest Reserve, South-Eastern Tanzania. In: African Biodiversity:

Molecules, Organisms, Ecosystems. Proceedings of the 5th International Symposium on Tropical Biology, p. 205-212. Huber, B.A., Sinclair, B.J., Lampe, K.H., Eds, Museum Koenig, Bonn.

Mittermeier, R.A., Robles Gil, P., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J., da Fonseca, G.A.B. (2004): Hotspots Revisited, Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions, pp. 391, Conservation International.

Moreau, R.E. (1940): Distributional notes on East African birds. Ibis **14**: 454-463.

Newmark, W.D. (2002): Conserving biodiversity in East African Forest, a study of the Eastern Arc Mountains, Ecol. Stud. 155. Springer, Berlin, Germany.

Pócs, T. (1998): Bryophyte diversity along the Eastern Arc. J. East Afr. Nat. Hist. **87**: 75-84.

Pocs, T., Temu, R.P.C., Minja, T.R.A. (1990): Survey of the natural vegetation and flora of the Nguru mountains. In: Research for conservation of Tanzanian catchment forests. Hedberg, I., Persson, E., Eds, Proceedings from a workshop held in Morogoro, Tanzania, March 13-17 1989, p. 135-149. Tanzania.

Poynton, J.C., Loader, S.P., Sherratt, E., Clarke, B.T. (2007): Amphibian diversity in East African biodiversity hotspots: altitudinal and latitudinal patterns. Biodiv. Conserv. **16**: 1103-1118.

Rasmussen, J.B. (1997): Afrikanske slanger (12). *Dipsadoboa werneri*. Nord. Herpetol. Foren. **40**: 173-177.

Romdal, T. (2001): An ornithological survey of the Nguru Mountains, Tanzania. Scopus **22**: 49-62.

Sclater, W.L., Moreau, R.E. (1932-33): Taxonomic field notes on some birds of northeastern Tanganyika Territory. Ibis **2**: 487-522, 656-683; **3**: 1-33, 187-219, 399.

Spawls, S., Howell, K.M., Drewes, R., Ashe, J. (2004): A field guide to the Reptiles of East Africa. Academic Press, San Diego, California.

Stanley, W.T., Kihaule, P.M., Hutterer, R., Howell, R., Howell, K.M. (1998): Small mammals of the Eastern Arc Mountains, Tanzania. J. East Afr. Nat. Hist. Soc. **87**: 91-100.

Stevens, G.C. (1992): The elevational gradient in altitudinal range: an extension of Rapoport's latitudinal rule to altitude. Am. Nat. **140**: 893-911.

Stevens, R.A. (1971): A new treefrog from Malawi. Zool. Afr. **6**: 313-320.

Stuart, S.N., van der Willingen, T.A. (1978): Report of the Cambridge ecological expedition to Tanzania. Unpublished report.

Timmerman, W.W. (1981): The reptiles and amphibians of Monteverde, Costa Rica: An annotated checklist to the herpetofauna of Monteverde. Tropical Science Center, San Jose, Costa Rica.

Vidal, N., Delmas, A.-S., David, P., Cruaud, C., Couloux, A., Hedges, S.B. (2007): The phylogeny and classification of caenophidian snakes inferred from seven nuclear protein-coding genes. C.R. Biol. **330**: 182-187.

Vonesh, J.R. (1998): The Amphibians and Reptiles of Kibale Forest, Uganda: herpetofaunal survey and ecological study of the forest floor litter community. A thesis presented to the graduate school of the university of Florida. Available on line at: http://purl.fcla.edu/fcla/etd/amd0037

Whittaker, R.H. (1972): Evolution and measurement of species diversity. Taxon **21**: 213-251.

Appendix 1. Check list of the Amphibians and Reptiles of the Nguru South Mts. based on findings presented in this paper and bibliographic records.

AMPHIBIA
ANURA
Arthroleptidae
Arthroleptinae
Arthroleptis affinis Ahl, 1939
Arthroleptis xenodactyloides (Hewitt, 1933)
Arthroleptis xenodactylus Boulenger, 1909
Arthroleptis sp.
Arthroleptis sp. nov.
Leptopelinae
Leptopelis sp. nov.
Leptopelis uluguruensis Barbour and Loveridge, 1928
Leptopelis flavomaculatus (Günther, 1864)
Leptopelis vermiculatus (Boulenger, 1909)
Leptopelis cf. *parkeri*
Bufonidae
Amietophrynus brauni (Nieden, 1910)
Amietophrynus gutturalis (Power, 1927)
Nectophrynoides sp. nov. 1
Nectophrynoides sp. nov. 2
Nectophrynoides sp. nov. 3
Nectophrynoides sp. nov. 4
Schismaderma carens (Smith, 1848)
Hyperolidae
Afrixalus uluguruensis (Barbour and Loveridge, 1928)
Afrixalus stuhlmanni stuhlmanni (Pfeffer, 1893)
Afrixalus stuhlmanni complex
Afrixalus fornasinii (Bianconi, 1940)
Hyperolius mitchelli (Loveridge, 1953)
Hyperolius spinigularis (Stevens, 1971)
Hyperolius sp. (*puncticulatus* – like)
Hyperolius sp.
Brevicipitidae
Callulina sp. nov. 1
Callulina sp. nov. 2
Callulina sp. nov. 3
Callulina sp. nov. 4
Probreviceps macrodactylus macrodactylus Nieden, 1926
Probreviceps sp. nov.
Microhylidae
Hoplophryninae
Hoplophryne sp. nov.
Rhacophoridae
Rhacophorinae
Chiromantis xerampelina Peters, 1854
Pyxicephalidae
Cacosterninae
Amietia angolensis (Bocage, 1866)
Ptychadenidae
Ptychadena anchietae (Bocage, 1868)

Petropedetidae
Petropedetes sp. nov.
Phrynobatrachidae
Phrynobatrachus uzungwensis Grandison and Howell, 1983
Phrynobatrachus parvulus (Boulenger, 1905)
Phrynobatrachus sp.
Pipidae
Xenopus cf. *petersii*
GYMNOPHIONA
Caecilidae
Boulengerula sp. nov.
Scolecomorphus sp. nov.

REPTILIA
SAURIA
Chamaleonidae
Chamaeleoninae
Chamaeleo werneri (Tornier, 1899)
Chamaeleo deremensis Matschie, 1892
Chameleo melleri Gray, 1865
Chamaeleo dilepis Leach, 1819
Kinyongia fischeri (Reichenow, 1887)
Kinyongia oxyrhina (Klaver and Böhme, 1988)
Brookesiinae
Rieppeleon brachyurus (Günther, 1893)
Rieppeleon brevicaudatus (Matschie, 1892)
Rhampholeon acuminatus Mariaux and Tilbury, 2006
Rhampholeon sp. nov.
Agamidae
Agama montana Barbour and Loveridge, 1928
Agama agama (Linnaeus, 1758)
Gekkonidae
Cnemaspis africana Werner, 1895
Urocotyledon wolterstorffi (Tornier, 1900)
Lacertidae
Holaspis laevis Werner, 1895
Gastropholis prasina Werner 1904
Scincidae
Lygosominae
Leptosiaphos kilimensis Stejneger 1891
Lygosoma afrum Peters 1854
Trachylepis varia (Peters, 1867)
Trachylepis maculilabris (Gray, 1845)
Trachylepis striata (Peters, 1844)
Scincinae
Scelotes uluguruensis (Barbour and Loveridge, 1928)
Proscelotes cf. eggeli Tornier 1902
Melanoseps loveridgei Brygoo and Roux-Estève, 1982
Varanidae
Varanus niloticus Linnaeus, 1758
SERPENTES
Typhlopidae
Rhinotyphlops mucruso (Peters, 1854)

Typhlops lineolatus Jan, 1864
Typhlops gierrai Mocquard, 1897
Colubridae
Colubrinae
Crotaphopeltis tornieri (Werner, 1897)
Crotaphopeltis hotamboeia Laurent, 1968
Dipsadoboa werneri Boulenger, 1897
Thelotornis usambaricus Broadley, 2001
Xyeledontophis uluguruensis Broadley and Wallach, 2002
Dispholidus typus Smith, 1829
Philothamnus hoplogaster Günther, 1863
Philothamnus punctatus Peters,, 1867
Philothamnus macrops (Boulenger, 1895)
Lamprophiidae
Lamprophinae
Lamprophis fuliginosus Boie, 1827
Lycophidion capense loveridgei Laurent, 1968
Lycophidion meleagre Boulenger, 1893
Atractaspidinae
Aparallactus jacksoni Günther, 1888
Aparallactus guentheri Boulenger, 1895
Atractaspis bibronii Smith,1849
Incertae sedis
Buhoma vauerocegae Tornier, 1902
Prosymna stuhlmanni (Pfeffer, 1893)
Natricidae
Natriciteres sylvatica Broadley, 1966
Elapidae
Elapinae
Elapsoidea nigra Günther, 1888
Dendroaspis angusticeps Smith,1849
Viperidae
Viperinae
Atheris ceratophora Werner, 1895
Bitis arietans (Merrem, 1820)
Bitis gabonica Duméril, Bibron and Duméril, 1854

Appendix 2. Voucher specimens collection number

Amphibia

Arthroleptis sp.1 – MTSN8135; *Arthroleptis xenodactyloides* – MTSN8529; *Arthroleptis* sp. 2 – MTSN8168; *Arthroleptis* sp. nov – MTSN8142; *Leptopelis* cf. *barbouri* – MTSN8494; *Leptopelis uluguruensis* – MTSN8227; *Leptopelis flavomaculatus* – MTSN8239, *Leptopelis vermiculatus* – MTSN8230; *Amietophrynus brauni* – MTSN8251; *Amietophrynus gutturalis* – MTSN8355; *Nectophrynoides tornieri* – MTSN8344; *Nectophrynoides* sp. nov. 1 – MTSN8199; *Nectophrynoides* sp. nov. 2 – MTSN8547; *Nectophrynoides* sp. nov. 3 - KMH35971; *Nectophrynoides* sp. nov. 4 - *Schismaderma carens* – MTSN8231; *Afrixalus* sp. – MTSN8375; *Afrixalus uluguruensis* – MTSN8163; *Afrixalus stuhlmanni stuhlmanni* – MTSN8275; *Hyperolius mitchelli* – MTSN8277; *Hyperolius spinigularis* – MTSN8265; *Hyperolius puncticulatus* MTSN8438; Chiromantis xerampelina KMH26922; *Hyperolius* sp. – MTSN8361; *Cal-*

lulina sp. nov. 1 – MTSN8131; *Callulina* sp. nov. 2 – MTSN8138; *Callulina* sp. nov. 3 – MTSN8205; *Callulina* sp. nov 4 – *Probreviceps* sp. nov. KMH26923; MTSN8242; *Probreviceps macrodactylus macrodactylus* – MTSN8507; *Hoplophryne uluguruensis* – MTSN8144, *Amietia angolensis* – MTSN8174; *Ptychadena anchietae* – MTSN8339; *Petropedetes* sp. nov. – MTSN8364; *Phrynobatrachus uzungwensis* – MTSN8371, *Phrynobatrachus* cf. *parvulus* – MTSN8372; *Phrynobatrachus* sp. – MTSNpending, *Xenopus* cf. *petersii* – MTSN8249; *Boulengerula* sp. – MTSN8302; *Scolecomorphus* sp. – MTSN8421.

Reptilia

Chamaeleo werneri – MTSN8451*; Chamaeleo deremensis* – MTSN8195; *Chameleo melleri* – pictured and released; *Chamaeleo dilepis* - pictured and released; *Bradypodion fischeri* - MTSN8318*; Bradypodion oxyrhinum* – MTSN8416*; Rieppeleon brachyurus* – MTSN8431; *Rieppeleon brevicaudatus* – MTSN8220*; Rhampholeon* sp. nov. – MTSN pending; *Rhampholeon* sp. – MTSN8539; *Agama montana* – MTSN8186; *Agama agama* – MTSN8346, *Cnemaspis africana* – MTSN8214; *Urocotyledon wolterstorffi* – MTSN8222; *Holaspis laevis* – obs. and pictured; *Trachylepis varia* – obs. and pictured*; Trachylepis maculilabris* – obs. and pictured*; Trachylepis striata* – MTSNpending; *Proscelotes eggeli* - KMH26709; *Scelotes uluguruensis* – MTSN8423*; Varanus niloticus* – obs.; *Rhinotyphlops mucruso* – MTSN8335*; Typhlops gierrai* – MTSN8433; *Thelotornis usambaricus* – MTSN8400, *Buhoma vauerocegae* - KMH26702; *Dipsadoboa werneri* – MTSN8505; *Crotaphopeltis tornieri* – MTSN8235*; Crotaphopeltis hotamboeia* - 8334; *Dispholidus typus* – MTSN8410, *Lamprophis fuliginosus* – MTSN8387; *Lycophidion capense loveridgei* – MTSN8345*; Lycophidion meleagre* – MTSN8414; *Natriciteres sylvatica* – MTSN8439; *Philothamnus* cf. *hoplogaster* – MTSN8178*; Philothamnus punctatus* – MTSN8190*; Philothamnus macrops* – MTSN8200*; Prosymna stuhlmanni* – MTSN8343*; Aparallactus jacksoni* – MTSN8352; *Aparallactus guentheri* – MTSN8341; *Atractaspis bibronii* – MTSN8354; *Elapsoidea nigra* – MTSN8349*; Dendroaspis angusticeps – Atheris ceratophorus* - KMH23977; MTSN8206; *Bitis arietans* – MTSN8209.