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Uzungwa Scarp Nature Forest Reserve: a unique hotspot for reptiles in Tanzania

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Abstract. While knowledge of African vertebrate biodiversity has increased dramatically in recent years, the field of herpetology which encompasses many threatened and endemic species, has lagged behind, and many areas have not been adequately explored. Intensive field work was conducted during the rainy season from December 2017 to April 2018 to assess reptile occurrence mostly in previously unexplored areas of the Uzungwa Scarp Nature Forest Reserve (USNFR) which is part of the Udzungwa Mountain ranges in the Eastern Arc Mountains (EAM), and adjacent agricultural areas. Bucket pitfall traps, funnel traps, night transects and opportunistic search methods were used to sample reptiles across four zones: in lowland, submontane and montane forests of the USNFR, and in neighboring farmlands. Forty-five reptile species across 14 families were recorded, mostly concentrated on the lowland and submontane forests. The number of endemic and threatened species in the USNFR reaches 20 and 14 respectively, and most are found in the submontane forest. Nineteen species were new records for the USNFR, five of them representing range extensions. Reptile species richness, abundance and diversity differed significantly across the four zones, except between montane and farmland zones and between lowland and submontane. However, farmland zone was discordant from other zones in terms of species composition. This study adds to the importance of the EAM not only in harbouring large numbers of species but also as an important hotspot for endemic and threatened reptiles. It also calls for proper land-use practices in farms adjacent to protected areas for sustainable conservation of biodiversity.

Keywords. Eastern Arc Mountains, Farmland, Elevation, IUCN threatened species.

INTRODUCTION

In spite of the alarming trends on the loss of species (Lawton and May, 1995; Baillie et al., 2004; Pimm et al., 2014), little has been done to assess patterns of biodiversity and threats facing reptiles in Africa (Meng et al., 2016). A recent assessment by Meng et al. (2016) shows that 321 reptile species occur in Tanzania, of which about 13% and 28% are threatened with extinction and are endemic, respectively. Most of these highly fragile reptile populations are found in the Eastern Arc Mountains (EAM) (Meng et al., 2016; Spawls et al., 2018).

The Eastern Arc Mountains have faced a number of threats, with forest fires, agricultural encroachment, firewood collection, logging and climate change being the most important ones (Burgess et al., 2002; Newmark, 2002; Ehardt et al., 2005; Menegon and Salvidio, 2005; Meng et al., 2016). The mountains have lost over 70% of forest cover to agriculture within the last six decades (Newmark, 1998; Newmark, 2002; Hall et al., 2009) and

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currently support a large number of people (Ndangalasi et al., 2007; Platts et al., 2011). The same impacts have been reported from the Uzungwa Scarp Nature Forest Reserve (USNFR) (Zilihona et al., 1998; Menegon and Salvidio, 2005; Rovero et al., 2012), which encompasses the southern portion of the EAM. This reserve was recently upgraded from "forest reserve" to "nature reserve" category (URT, 2017), calling out for a higher protection status due to its unique biodiversity. Despite this upgrade, information regarding USNFR's biodiversity is extremely scant.

Since some reptile species possess very narrow distributional ranges and depend on highly-specific habitat requirements (Spawls et al., 2004; Meng et al., 2016), they become more vulnerable to the ongoing anthropogenic activities than wide-ranging species. Menegon and Salvidio (2005) showed that elevation determined distribution patterns of reptiles in the USNFR and reported most endemic species to be restricted to higher elevations. The same high elevation areas have faced severe agricultural expansion in the USNFR (Zilihona et al., 1998; Ehardt et al., 2005) and little is known on how reptiles utilize the transformed areas. As some of the farms are found on high elevations, the latter generally hosting more endemic species compared to lower elevations, these reptile species might extend to the farms close to the forest edge on the plateau side.

While there are several reports on reptiles of the USNFR (e.g., Menegon and Salvidio, 2005; Lyakurwa, 2017), most of these surveys were limited to the southern part of the reserve and to our knowledge, no study has ever investigated how reptiles utilize the agricultural areas bordering the USNFR. Since the previous reports examined both amphibians and reptiles simultaneously (except Lyakurwa, 2017), the surveys were limited to methods which could capture both species groups. A project on Uzungwa Scarp hyper-endemic amphibians has revealed a number of new records in the same area, especially with respect to the distribution extension of the hyper-endemic species and of new species of *Nectophryoides* (Tonelli et al., 2017), that were mostly found in the previously unexplored areas, and has emphasized the need for detailed surveys for reptiles. This study focused on assessing reptile occurrence in the least explored areas of the USNFR and adjacent agricultural lands. Our results on how endemic and threatened reptiles utilize the USNFR and the nearby areas dominated by human activities can be used for local and long-term conservation planning in this and other protected areas of Tanzania.

MATERIALS AND METHODS

Study site

This study was carried out in the Uzungwa Scarp Nature Forest Reserve (USNFR) and adjacent areas. The USNFR covers the southeastern part of the Udzungwa mountains and lies between 7°39'-7°51'S, and 35°51'-36°02' E (Ndangalasi, 2005). With an altitudinal range of 300 m.a.s.l to 2,068 m a.s.l it covers a total area of 207 km^2 (Shangali et al., 1998; Ndangalasi et al., 2007; URT, 2017). It borders the Chita River to the south, the Kidete River to the north and the Ruaha, Iwolo and Lukosi rivers to the west (Ndangalasi, 2005). Average rainfall in the USNFR is unimodal (from November to May) and ranges from 1,800 mm to 3,000 mm per year (Shangali et al., 1998; Ndangalasi, 2005). The average temperature varies seasonally and is estimated to range from 15 to 20 °C on the highlands and 19 to 27 °C in the lowlands (Ndangalasi, 2005). The nature reserve is comprised of lowland (< 800 m a.s.l), submontane (700-1,400 m a.s.l) and montane forests (> 1,400 m a.s.l), with areas of seasonally inundated grasslands and grassland with bushes (Shangali et al., 1998; Zilihona et al., 1988).

Data collection

Data were collected during day and night for five consecutive months in the wet season, from mid-December 2017 to the end of April 2018. Selection of sampling sites was primarily based on elevation, vegetation types (Shangali et al., 1998; Zilihona et al., 1998) and land use type. Other factors known to influence reptile abundance and distribution were also considered at each site. These factors included the amount of leaf litter, availability of rotten logs, distance from water bodies and from rock crevices, following Howell (2002) and McDiarmid et al. (2012). The study area was divided into four zones; three inside the USNFR, i.e., lowland forest, submontane forest and montane forest following Shangali et al. (1998) and Zilihona et al. (1998) with some slight modifications. The fourth zone was set in farmlands bordering the USNFR. These farms were located on the plateau side of the reserve (with elevation range similar to that of a montane zone) and were of interest to this study to verify if the observed pattern of endemism in the reserve would extend beyond the protected area. Each zone consisted of three sites (12 sites in total), each with a radius of 1 km, and placed at least 2 km apart. Data collection took place for ten days at each site (alternated between zones to reflect the timing and commonality of the season between sites throughout the data collection period), making a total of 120 days (90 and 30 days in and outside the USNFR, respectively). Several methods (bucket pitfall traps with drift fences, funnel traps, night transects and opportunistic searches) were used following Howell (2002) and McDiarmid et al. (2012) in order to maximize captures. One bucket pitfall trap line (Howell, 2002) consisted of a 55 m long drift fence, eleven 20-L buckets, set at an interval of 5 m and 10 double-ended funnel traps placed alternately between each bucket. Two bucket pitfall trap lines were established at each site, summing up to a total of six trap lines (66 buckets, and 60 funnels traps) per zone. Trapping was done for eight consecutive nights, in which trap monitoring was done immediately following sunrise and late afternoon, following Stanley et al. (1998) and Howell et al. (2012). A total of 176 bucket pitfall trap nights and 160 funnel trap nights were carried at each site leading to 2112 and 1920 bucket pitfall trap nights and funnel trap nights, respectively, for the entire study.

In addition, a total of four 50 m night transects were set at each site (total of 48 transects for the entire study), encompassing a range of micro-habitats (*sensu* Menegon et al., 2008). Each transect was located, marked in advance and searched thoroughly following Lyakurwa (2017). Since pitfall traps and night transects alone cannot adequately sample all species of reptiles, these methods were supplemented by opportunistic searching, during which reptiles were searched for in their possible hiding/basking places. All reptiles encountered casually or in locations apart from the 12 sampling sites but within the study area were also recorded as opportunistic encounters. Species identification followed Spawls et al. (2018) while threat status followed Meng et al. (2016). Grouping of endemic/near endemic species based on their dependency to the forest followed Burgess et al. (2007). Kruskal Wallis test (Kruskal and Wallis, 1952) with Dunn's multiple comparisons was used to compare the overall reptile species abundance in the four zones while diversity was compared using Hutcheson's t-test (Hutcheson, 1970). Shannon Wiener index was used for species diversity. Species composition among the four zones and between the surveyed sites was compared using the Bray-Curtis similarity index (Legendre, 1998; Greenacre and Primicerio, 2013). Data were analyzed using R software version 3.5.0 and Paleontological Statistics software (PAST) version 2.17 (Hammer et al., 2001). Statistical significance was considered when P was less than 0.05. Voucher materials were deposited at the Department of Zoology and Wildlife Conservation of the University of Dar es Salaam (Appendix 1).

RESULTS

A total of 358 individual reptiles were recorded, representing 45 species in 14 families (Appendix 1). Thirty-three species were found in the USNFR alone, two in farmland alone, and 10 in both (Appendix 1). Seven species (*Kinyongia sp*, *Trioceros deremensis*, *Broadleysaurus major*, *Crotaphopeltis tornieri*, *Dendroaspis angusticeps*, *Gonionotophis nyassae* and *Lycophidion uzungwense*) were single observations while three were double observations (*Urocotyledon wolterstorffi*, *Trioceros tempeli* and *Afrotyphlops nigrocandidus*). Most individuals were found on trees (40.3%), understorey (25.5%), underground (9.1%), dead logs (6.6%), rocks (3.3%) and in farmlands, some individuals were found on house walls (0.8%). Among reptiles which were found above the ground (n = 177), 52.0% were found at 50-100 cm height, 32.2% between 100-300 cm height, and 15.8 % above 300 cm from the ground.

Nineteen species were new records for the USNFR, five of them representing range extensions (Appendix 1) from previously known distributional ranges. This raised the number of species in the USNFR and surrounding areas to 60 species across 16 families (Table 1 and Appendix 1). We documented that the USNFR harbours about 21% (20 species) of reptiles that are endemic/near endemic to Tanzania (Appendix 1). About 69% of reptiles endemic/near endemic to EAM are now confirmed to occur in the USNFR (Appendix 1). A large number of these endemics were chameleons (7 species), a number which is equivalent to 29% of all Tanzanian endemic chameleons.

Table 1. Total number of reptiles species, number of IUCN threatened species, per families found in and around USNFR (Sources: Menegon and Salvidio 2005; Lyakurwa 2017, this study). NT = Near threatened, VU = Vulnerable, EN = Endangered

Family	Total	Endemic	NT	VU	EN
Agamidae	1	0	0	0	0
Atractaspidae	2	0	0	0	0
Chamaeleonidae	9	7	2	0	1
Colubridae	12	2	1	0	1
Elapidae	2	0	0	0	0
Gekkonidae	8	2	0	2	0
Gerrhosauridae	1	0	0	0	0
Lamprophiidae	3	1	0	0	0
Natricidae	1	0	0	0	0
Psammophiidae	2	0	0	0	0
Pseudoxyrhophiidae	2	0	0	1	0
Pythonidae	1	0	0	0	0
Scincidae	9	2	0	1	1
Typhlopidae	1	1	0	1	0
Varanidae	1	0	0	0	0
Viperidae	5	1	0	3	0

The number of species considered as globally threatened/ near threatened with extinction (Near Threatened, Vulnerable, Endangered or Critically Endangered) reached 14 in the USNFR (Appendix 1), equivalent to 33% of all reported threatened/ near threatened reptile species in Tanzania. Most of these species were found in the submontane forest (Appendix 1; Fig. 1 and 2).

Except for *Afrotyphlops nigrocandidus*, all strictly forest dependent endemic/ near endemic species were found only in the protected areas of the USNFR (Appendix 1). Similarly, other endemic reptiles were found in areas inside the USNFR with the exception of *Trioceros tempeli* and *T.werneri* which were found both inside and outside the reserve and *Lycophidion uzungwense* which was only found outside the reserve (Appendix 1). Outside the USNFR, *A. nigrocandidus* was found in a farm plot while *T. tempeli*, *T.werneri* and *L. uzungwense* were found in natural forest fragments, in fruit trees (the former two)

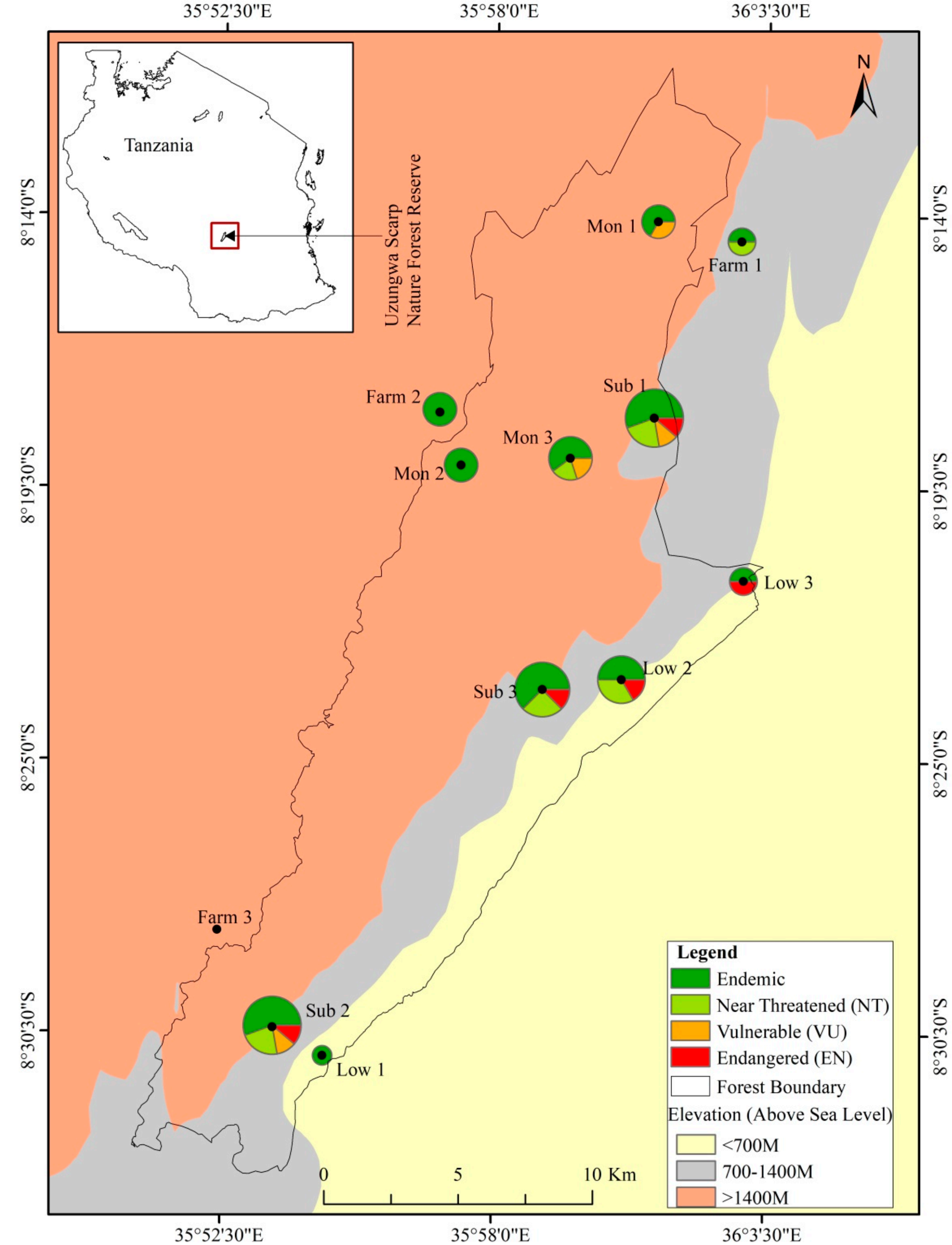

Fig. 1. Distribution of endemic, Vulnerable, Near Threatened and Endangered reptile species in the Uzungwa Scarp Nature Forest Reserve and adjacent areas as assessed from December 2017 to April 2018. Low 1,2,3 = Lowland sites, Farm1,2,3 = Farmland sites, Sub1,2,3 = Sub-montane sites, Mon 1,2,3= Montane sites.

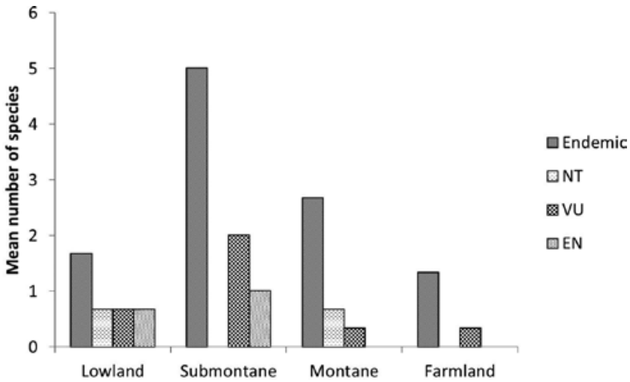

Fig. 2. Mean number of endemic, Near Threaterned (NT), Vulnerable (VU) and Endangered (EN) reptile species in the four surveyed zones of the Uzungwa Scarp Forest Nature Reserve and adjacent agricultural areas.

and commercial forests dominated by *Cupressus sp.* and *Pinus sp*. Maize and bean fields were poor in reptile species, with only *Philothamnus hoplogaster*, *Lygodactylus grotei* and *Trachylepis varia* being the common residents.

All reptiles observed by Lyakurwa (2017) were also recorded during this study, except for *Buhoma procterae*, *Natriciteres variegata*, *Python natalensis* and *Xyelodontophis uluguruensis* (Appendix 1). Nine species recorded by Menegon and Salvidio (2005) in the same area were not found during this study (Appendix 1). *Lycophidion uzungwense*, previously found inside the USNFR by Menegon and Salvido (2005), was only found in a natural forest patch outside the USNFR. These patches, together with commercial forests and fruit trees in agricultural lands, also proved to be important for chameleons (especially *Trioceros tempeli* and *T. werneri*) (Fig. 3A). *Kinyon-*

Fig. 3. Some of the reptile species recorded in the USNFR from December 2017 to April 2018. A male *Trioceros werneri* on a commercial plant outside the USFNR (A), *Kinyongia sp* (B), *Aparallactus sp* (C), *Cnemaspis sp* (D), Male (A) and Female (B) *Urocotyledon wolterstorffi*. The above *Cnemaspis, Aparallactus and Kinyongia* could not be identified with certain to species level using Spawls et al. (2018).

gia sp (Fig. 3B) is believed to be a new species similar to *Kinyongia fischeri* based on morphological grounds. Similarly, *Aparallactus sp* (Fig. 3C) needs further studies as the currently available identification key by Spawls et al. (2018) was not sufficient to identify it to species level. The genera *Lygodactylus*, *Cnemaspis* (Fig. 3D) and *Urocotyledon* (Fig. 3E and 3F) encompass individuals with highly varying morphology and our findings likely represent more than one cryptic species in these genera.

Lowland and submontane forests contained a similar number of species, which decreased more than half towards montane forest and farmlands (Appendix 1). Overall reptile abundance differed significantly across the zones ($H = 18.187$, $P = 0.0004$). Further analysis using Dunn's multiple comparison showed no significant difference between farmland and montane forest and between lowland and submontane forests (Table 2). All other pairs were significantly different in overall reptile abundance (Table 2). However, Bray-Curtis similarity index showed farmland to be the most discordant zone (Fig. 4), with lowland and submontane zones being more similar in species composition. Lowland, submontane and montane zones contained more forest dependent species than farmland zone (Appendix 1). Sites in the farmland zone were very similar in species composition than when compared with sites in the protected area (Appendix 2). Also, sites close to each other were more similar in species composition than distant sites, whereby some distant sites showed complete dissimilarity (Appendix 2). Species

Table 3. Hutchesons' t test summary of species diversity for the four surveyed zones of the USNFR and the surrounding areas.

Comparison	t value	DF	P value
Farmland vs Lowland	8.854	181	<0.001
Farmland vs Montane	1.678	124	0.096
Farmland vs Submontane	8.148	179	<0.001
Lowland vs Montane	5.971	98	<0.001
Lowland vs Submontane	0.912	196	0.363
Montane vs Submontane	5.324	97	<0.001

Table 4. Species richness, diversity and Chao richness estimator (±SE) for the four sampled zones

	Lowland	Submontane	Montane	Farmland
Species observed	26	24	9	11
Chao Estimator	32.17±5.13	43.97±17.26	9.98±2.22	17.19±7.48
Shannon diversity	2.23	2.16	1.17	0.79

Table 2. Dunn's multiple comparison of overall reptile abundance in the four sampled zones of the USNFR and surrounding areas

Comparison	P value
Farmland vs Lowland	0.001
Farmland vs Montane	0.467
Farmland vs Submontane	0.004
Lowland vs Montane	0.001
Lowland vs Submontane	0.281
Montane vs Submontane	0.003

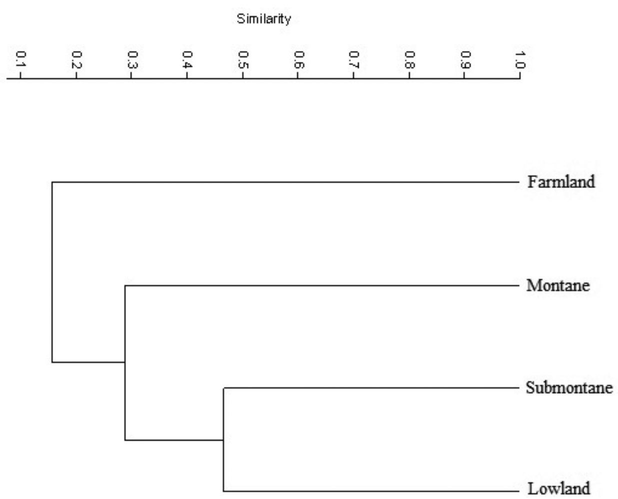

Fig. 4. Similarity cluster among the four zones of the Uzungwa Scarp Nature Forest Reserve and adjacent areas based on Bray-Curtis similarity index (Single Average Link) as per the current study.

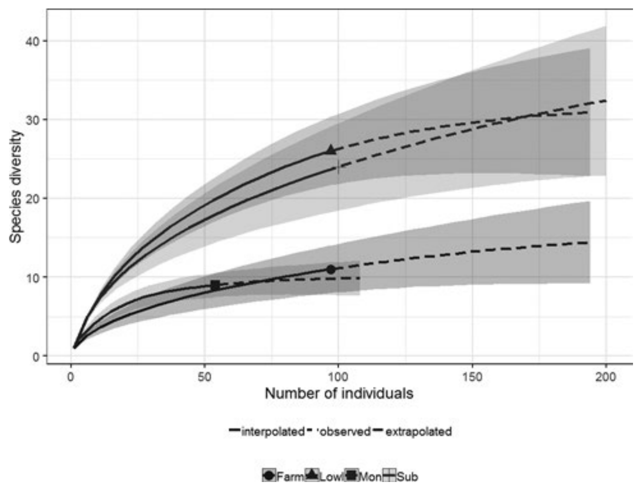

Fig. 5. Rarefaction curves for species recorded in the four sampled zones of the USNFR and surrounding areas from December 2017 to April 2018. Farm= Farmland (circle), Low=Lowland (triangle), Mon=Montane (square), Sub=Submontane (plus sign). Shaded region surrounding each line represent 95 % confidence levels

diversity in lowland and submontane was significantly higher than farmland and montane (Table 3). However, species rarefaction curves for the zones did not reach an asymptote (Fig. 5). The mean (±SE) number of species for Chao estimator was higher than the observed species in all zones (Table 4).

DISCUSSION

With our study, we were able to almost double the number of reptile species for the USNFR, from 33 species (Menegon and Salvidio, 2005) and 38 species (Lyakurwa, 2017) to 60 species. Such a result pinpoints the Udzungwa mountains as biologically the richest mountain block in the EAM in terms of herpetofauna, harboring the highest number of endemic and near endemic reptile species (34), followed by East Usambara (32), Uluguru (29) and Nguru (19) (Burgess et al., 2007). Previously, in terms of herpetofauna, this mountain range was ranked after Usambara and Uluguru mountains (Howell, 1993; Burgess et al., 2007). Three species out of the nine classified as globally threatened, endemic to Tanzania and climate change-vulnerable by Meng et al. (2016), are now confirmed to occur in the USNFR. This result highlights the importance of protecting these mountains and calls out for more long-term surveys in other parts of the Udzungwa and the EAM.

Although faunal surveys are recognized as one of the most critical steps in assessing forest biodiversity (Stanley et al., 1998), little attention has been given to African herpetology (Spawls et al., 2004; Largen and Spawls, 2010; Meng et al., 2016; Tolley et al., 2016). There are many areas in East Africa which are yet to be explored in a herpetological context (Spawls et al., 2004) and this study shows the need for detailed surveys even in previously visited areas, supporting Howell (1993) and Spawls et al. (2004), who showed the possibility of getting new records in most areas of East Africa, due to lack of intensive surveys in most parts of the region. The overall shortage of information adds more risk to the conservation of African biodiversity (Tolley et al., 2016), particularly herpetofauna and may lead to misallocated conservation priorities (Pimm et al., 2014), especially in a biodiversity hotspot country like Tanzania.

Contrary to previous studies, we found that most endemic, near endemic and IUCN threatened species were concentrated in the submontane forest of the USNFR. Menegon and Salvidio (2005) and Menegon et al. (2008) reported that the number of endemic and near endemic reptile species increases with altitude. Similarly, Burgess et al. (2002) reported more endemic vertebrates in montane forests of the EAM and fewer in lowland, submontane and upper montane forests. A large number of endemic and threatened species in the submontane forest areas might be due to the intermediate environmental conditions in the mid-elevation zones, which accommodate both high and low elevation specialists (McCain, 2010). However, the same zone has suffered from severe forest loss in recent years (Burgess et al., 2002) and it is not clear how this has been affecting reptiles. We hope that the recent upgrading of the protection status of the reserve will reduce the destruction activities that have been going on in submontane forests.

Farmland zone had fewer forest dependent species compared to other zones which agree with Burgess et al. (2007) who reported most EAM endemic species as specialists of dense forests. Our findings also highlight how the type of farming (e.g commercial tree plantation and some natural vegetation around/in the farm plots) might influence reptile assemblage and shows the potential of the farms surrounding the USNFR in buffering the montane forests. Some strictly forest-dependent species were found at the forest edge and can act as important indicators of ecosystem health following more studies. Therefore, land-use planning is highly important, particularly in the farmlands as the endemic species were found mainly in natural forest patches, fruit trees and commercial tree plantations near the USNFR, of which the species might decline in the future without proper land management.

While we have gathered data on reptiles from many more sites and over a prolonged period in the wet season compared to any other study in the Udzungwa mountains, there is still a need for subsequent surveys in the area, both in the dry and wet seasons. This is especially important, as the current species accumulation curves have not yet reached an asymptote showing the possibilities of getting new records. Some reptile species are highly secretive, have low population densities and/or are locally distributed (Spawls et al., 2004; Meng et al., 2016), making it possible to miss them when sampling only in one season. Since we found only a few reptiles (especially chameleons in the genus *Trioceros*) more than 10 m high, we recommend more efforts on sampling canopy dwellers (e.g., use of arboreal traps in future studies). Similarly, sampling all zones simultaneously might provide more meaningful data, which, was not possible in our study due to logistical constraints. Three to five years of consecutive trapping (McDiarmid et al., 2012) across various seasons (Stanley, 1998; Howell, 2002) has been recommended in order to increase the probability of recording rare species. Subsequent surveys will also enable documenting species that this study failed, adding to the conservation value of not only the USNFR and Udzungwa mountains but the entire EAM region. This article has shown the importance of re-assessing the herpetofauna of EAM, and adds to the importance of conserving these mountains.

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APPENDICES

Appendix 1. Reptile species, threat category, and endemism per families recorded in Uzungwa Scarp Nature Forest Reserve and surrounding areas. Note; * = species that were recorded by Menegon and Salvidio 2005, φ = recorded by Menegon and Salvidio but not surely in USFNR (either from general bibliography or from surrounding villages); ‡ = collected by Lyakurwa 2017 and not found by this study, Y = endemic, f = forest visitor, F= mainly forest, FF= strictly confined to forest.

Species	Voucher	Low-land	Sub-mon-tane	Mon-tane	Farm-land	Threat category	Forest depend-ency	Endemic/ Near endemic
Agamidae								
Agama mossambica Peters, 1854		X				LC		
Chamaeleonidae								
Kinyongia sp	JVL 1709		X			NT	FF	Y
Kinyongia oxyrhina (Klaver & Böhme, 1988)			X	X		NT	FF	Y
Rhampholeon moyeri Menegon, Salvidio & Tilbury, 2002			X	X		LC	FF	Y
Rieppeleon brevicaudatus (Matschie, 1892)		X	X			LC		
Trioceros deremensis (Matschie, 1892)	JVL 1718		X			LC	FF	Y
Trioceros laterispinis (Loveridge, 1932) φ						EN	F	Y
Trioceros tempeli (Tornier, 1899)				X	X	LC	F	Y
Trioceros werneri (Tornier, 1899)				X	X	LC	F	Y
GEKKONIDAE								
Cnemaspis cf dickersonae (Schmidt, 1919)	JVL 1735, JVL 1733, JVL 1733		X			LC		
Cnemaspis uzungwae Perret, 1986	JVL 1712	X	X			VU	FF	Y
Hemidactylus mabouia (Moreau de Jonnès, 1818)	JVL 1724	X				LC		
Hemidactylus platycephalus Peters, 1854	JVL 1725	X				LC		
Hemidactylus sp	JVL 1723	X						
Lygodactylus capensis (Smith, 1849)		X			X	LC		
Lygodactylus cf angularis Günther, 1893	JVL 1701,	X	X		X	LC		
Lygodactylus grotei Sternfeld, 1911		X			X	LC		
Urocotyledon wolterstorffi (Tornier, 1900)	JVL 1737, JVL 1722	X	X			VU	FF	Y
Gerrhosauridae								
Broadleysaurus major (Duméril, 1851)	JVL 1727				X	LC		
	Opportunistic in lowland farms							
Scincidae								
Leptosiaphos kilimensis (Stejneger, 1891)	JVL 1707, JVL 1706		X			LC		
Melanoseps loveridgei Brygoo & Roux-Estève, 1982 *						LC		
Melanoseps uzungwensis Loveridge, 1942	JVL 1710, JVL 1711, JVL 1731, JVL 1732, JVL 1731, JVL 1732	X	X			EN	FF	Y
Mochlus afer (Peters, 1854)	JVL 1715, JVL 1716		X			LC		
Mochlus sp	JVL 1719	X						
Scelotes uluguruensis Barbour & Loveridge, 1928 *						VU	FF	Y
Trachylepis maculilabris (Gray, 1845)	JVL 1719	X	X			LC		
Trachylepis striata (Peters, 1844)		X				LC		
Trachylepis varia (Peters, 1867)			X	X	X	LC		
Varanidae								
Varanus niloticus (Linnaeus, 1766)		X				LC		
Atractaspidae								
Aparallactus sp	JVL 1729, JVL 1721	X	X					
Atractaspis aterrima Günther, 1863	JVL 1708, JVL 1720	X	X			LC		

Species	Voucher	Low-land	Sub-mon-tane	Mon-tane	Farm-land	Threat category	Forest depend-ency	Endemic/ Near endemic
Colubridae								
Boaedon fuliginosus (Boie, 1827)		X		X	X	LC		
Crotaphopeltis tornieri (Werner, 1908)			X			LC	FF	Y
Dasypeltis medici Bianconi, 1859 *						LC		
Dipsadoboa werneri (Boulenger, 1897) *						NT	FF	Y
Philothamnus hoplogaster (Günther, 1863)	JVL 1703	X	X	X	X	LC		
Philothamnus macrops (Boulenger, 1895)		X	X			LC	F	Y
Philothamnus punctatus Peters, 1867			X			LC		
Philothamnus semivariegatus (Smith, 1840) φ						LC		
Telescopus semiannulatus Smith, 1849		X				LC		
Thelotornis kirtlandii (Hallowell, 1844) *						LC		
Thelotornis mossambicanus (Bocage, 1895)		X	X			LC		
Xyelodontophis uluguruensis Broadley & Wallach, 2002 ‡						EN	FF	Y
Elapidae								
Dendroaspis angusticeps (Smith, 1849)		X				LC		
Naja cf melanoleuca Hallowell, 1857		X	X			LC		
Lamprophiidae								
Gonionotophis nyassae (Günther, 1888)	JVL 1724	X				LC		
Lycodonomorphus whytii (Boulenger, 1897)	JVL 1713			X	X	LC		
Lycophidion uzungwense Loveridge, 1932					X	LC	F	Y
Natricidae								
Natriciteres variegata (PETERS, 1861) †						LC		
Psammophiidae								
Psammophis tanganicus Loveridge, 1940		X				LC		
Psammophylax variabilis Günther, 1893	JVL 1704, JVL 1705		X	X	LC			
Pseudoxyrhophiidae								
Buhoma procterae (Loveridge, 1922) †						VU	FF	Y
Duberria lutrix (Linnaeus, 1758)				X		LC		
Pythonidae								
Python natalensis Smith, 1840 ‡						LC		
Typhlopidae								
Afrotyphlops nigrocandidus (Broadley & Wallach, 2000)	JVL 1702		X		X	VU	FF	Y
Viperidae								
Atheris barbouri Loveridge, 1930 φ						VU	F	Y
Atheris ceratophora Werner, 1896			X	X		VU	F	Y
Bitis arietans Merrem, 1820 φ						LC		
Bitis gabonica Duméril, Bibron & Duméril, 1854 φ						VU		
Causus defilippii (Jan, 1863) φ						LC		

Appendix 2. Bray-Curtis species similarity index summary for the 12 sites surveyed in the Uzungwa Scarp Nature Forest Reserve and adjacent areas from December 2017 to April 2018. Note; 0 represents no similarity (100% dissimilarity) while 1 represents 100% similarity. Low=Lowland, Sub = Submontane, Mon= Montane, Farm= Farmland. Numbers in bold indicate more strongly related sites (>50%) while those italicized indicate 100% dissimilarity.

	Farm 1	Farm 2	Farm 3	Mon 1	Mon 2	Mon 3	Sub 1	Sub 2	Sub 3	Low 1	Low 2
Farm 2	**0.5634**										
Farm 3	**0.8400**	**0.6575**									
Mon 1	0.0625	0.0364	0.0588								
Mon 2	0.1951	0.2813	0.1861	0.3200							
Mon 3	0.0377	0.0264	0.0364	0.2703	0.3044						
Sub 1	0.0364	0.0513	0.0351	0.2051	0.2083	0.4333					
Sub 2	0.0615	*0.0000*	*0.0000*	0.0408	*0.0000*	0.0286	0.2222				
Sub 3	0.1200	0.0882	0.0769	0.2353	0.2791	0.2182	**0.5263**	0.2887			
Low 1	0.0377	0.1316	0.0364	0.0541	0.0435	0.0345	0.0333	0.1714	0.1091		
Low 2	0.0526	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	0.2169	**0.5591**	0.2308	0.2716	
Low 3	0.1000	0.0317	0.0952	0.0833	0.0606	0.0444	0.1277	0.1053	0.0952	0.2667	0.1765