Journal of East African Natural History **108**(2): 81–98 (2019)

THE REPTILES OF MKOMAZI NATIONAL PARK, TANZANIA AN UPDATED CHECKLIST WITH SOME ASPECTS OF BIOGEOGRAPHY

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ABSTRACT

The Mkomazi National Park (MNP) is a protected area representing three major biomes, yet it remains poorly known from a herpetological perspective. Intensive surveys for reptiles were carried out in the MNP during dry and wet seasons in 2018, with the main focus of updating the existing data and assessing the influence of the three biomes on the park's species composition. Various methods were used to document 55 species, most of which were found during the dry season. The checklist of reptiles of MNP is now updated to 73 species, 97% of which are typical of the Somalia-Maasai biome, equivalent to 54% of all Somalia-Maasai biome species in Tanzania. The MNP was found to be the most discordant in species composition from the contiguous Pare and Usambara Mountains, the latter two areas harbouring Afromontane forest-dependent species. We recommend surveys at Kinondu, Ibaya and Maji Kununua hills and foothills along the West Usambara and South Pare Mountains in order to confirm Afromontane species in MNP.

Keywords: Herpetofauna, inventory, Somalia-Maasai, biodiversity, conservation

INTRODUCTION

Despite the alarming global trends on extinction and population decline in reptile species (Gibbons *et al.,* 2000; Vié *et al.,* 2009; Böhm *et al.,* 2013), several places in Tanzania remain poorly explored from a herpetological perspective (Howell, 1993; Lyakurwa, 2017; Lyakurwa *et al.,* 2019). It is therefore likely that the country's reptile records are underestimated. This under sampling has not only made it difficult to allocate conservation priorities (Pimm *et al.,* 2014), but it has also hindered the assessment of protected areas as endemic habitats for reptiles in the country (Meng *et al.,* 2016). Recently, new records (new species and/or range extensions) have been reported from several poorly surveyed localities in Tanzania (Menegon *et al.,* 2011; Menegon *et al.,* 2015; Lyakurwa, 2017; Lyakurwa *et al.,* 2019), indicating the need for continued surveys in such areas.

Mkomazi National Park (MNP) is among the protected areas in Tanzania with poorly known reptile fauna. The only available study on reptiles from MNP is by Flemming & Bates (1999). Since this study from 1999, the taxonomy and biogeography of African herpetology has changed dramatically through taxonomic revisions (*e.g.* Bates *et al.,* 2013; Broadley *et al.,* 2018; Freitas *et al.,* 2018; Wüster *et al.,* 2018; Keates *et al.,* 2019; Kilunda *et al.,* 2019; Malonza *et al.,* 2019). These taxonomic changes impact knowledge on the actual distribution of species, including whether newly recognised taxa still comply with what were recorded previously in the area. Updating the existing checklist for MNP was therefore necessary.

The MNP is found in the southern portion of the Somalia-Maasai regional centre of endemism (White, 1983), and this is reflected by plant and animal groups found there (Coe *et al.,* 1999a; Homewood & Brockington, 1999). A small portion of MNP in the eastern side enters the Zanzibar-Inhambane regional mosaic (White, 1983). The park also borders the Afromontane region, particularly the South Pare and the West Usambara Mountains (White, 1983; Homewood & Brockington, 1999). As a result several Afromontane reptiles occur in the park, including the Usambara dwarf gecko *Lygodactylus gravis* and the Usambara forest gecko *Cnemaspis africana* (Flemming & Bates, 1999). Due to these mosaics in vegetation types, it is possible to find unique species and/or species of conservation concern in the area. The MNP has also changed in both the protection and administration status (*i.e.* from game reserve in 1951 to national park in 2008; URT, 2008) making faunal surveys a higher priority towards establishing effective conservation strategies. The objectives of this study were twofold: (i) updating the existing checklist of reptiles of MNP, and (ii) examining whether reptiles of MNP are primarily of the Somalia-Maasai biome and evaluating the contribution of Afromontane and Zanzibar-Inhambane biomes to the park's reptile composition.

MATERIALS AND METHODS

Study area

Mkomazi National Park is among the 22 National Parks found in Tanzania (TANAPA, 2019). It is found in the northeastern part of the country, on the Tanzania-Kenya border (figure 1). It stretches between two administrative districts (Same and Lushoto), on the slopes of the Pare and Usambara Mountains, and is contiguous in the north with Tsavo West National Park, which is on the Kenyan side (figure 1; Krüger & McGavin, 1998; Homewood

& Brockington, 1999). With more than 3245 km^2 MNP is characterised by a semi-arid climate (Coe, 1995; Coe *et al.,* 1999a) with *Acacia-Commiphora* woodland, bush and wooded grassland being the most dominant vegetation types (Homewood & Brockington, 1999). Together with Tsavo West National Park, they form part of the greater Tsavo ecosystem (Coe *et al.,* 1999a; Homewood & Brockington, 1999). Annual rainfall in MNP ranges from 300–900 mm with the western part showing a bimodal pattern (long rains between March and mid-May and short rains between October and December) (Krüger & McGavin, 1998). Its long dry season is characterised by a relatively high temperature that ranges from 23.1–37.8°C (Krüger & McGavin, 1998).

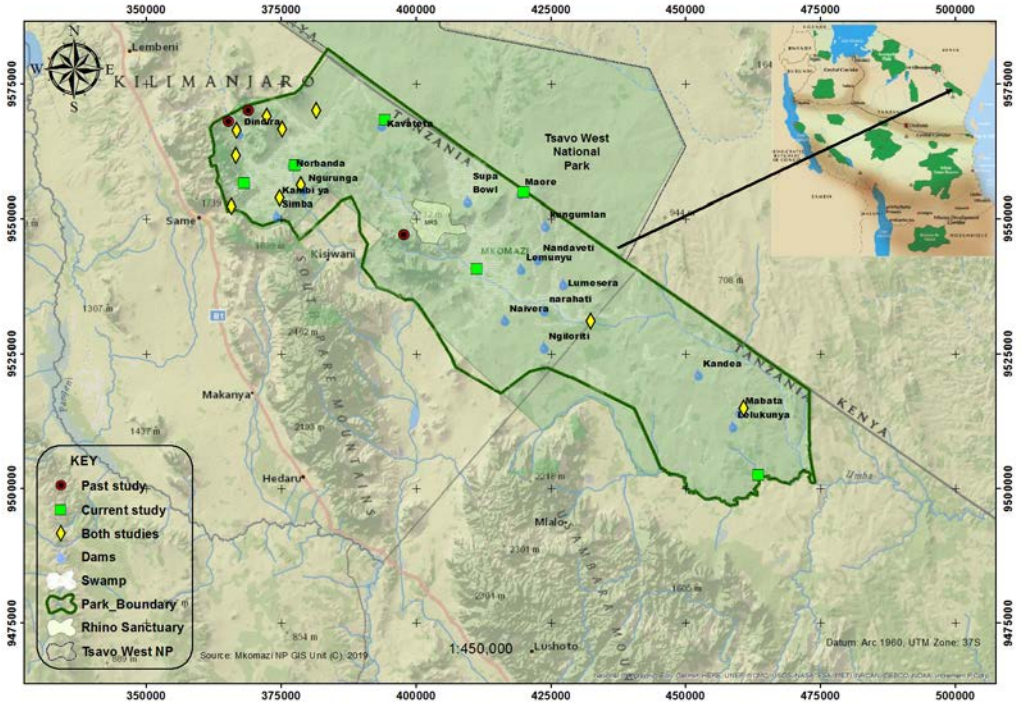

Figure 1: Location of the Mkomazi National Park with the surveyed sites indicated. Black dots indicate sites that were surveyed only by Flemming & Bates (1999), diamond shapes indicate sites visited by both this study and by Flemming & Bates (1999) and squares indicate sites visited only by this study. Note the connectivity with Tsavo West National Park and the South Pare and West Usambara Mountains.

Data collection

Data were collected during both the day and night in the wet (April to June) and dry seasons (August to October) in 2018. Selection of sampling sites was primarily based on vegetation and habitat types in the park (Coe *et al.,* 1999b). All sites sampled previously by Flemming & Bates (1999) were also considered during this study with the exception of three sites (figure 1). To increase coverage, six new sites were established, making a total of 19 sites for the entire study (figure 1). Bucket pitfall traps with drift fences, funnel traps, night transects, time constrained searches, coverboards and opportunistic searches were used

following Howell (2002) and McDiarmid *et al.* (2012) in order to maximize captures. Species identification and nomenclature follow Spawls *et al.* (2018) except for the genera *Mochlus, Psammophylax, Panaspis*, and *Lygodactylus* for which Freitas *et al.* (2018), Keates *et al.* (2019), Kilunda *et al.* (2019) and Malonza *et al.* (2019) were considered, respectively. Scale counts, colouration and body measurements aided identification of most species, but for the ones that were not caught (see appendix 1), colouration, behaviour and body size estimates were used. All captured individuals were released back in the wild. Photographs of species were taken and uploaded to https://www.inaturalist.org (appendix 1).

Bucket pitfall traps, funnel traps and a drift fence

Ten sites of varying habitats were selected (out of the 19 sites) and sampled both during dry and wet seasons. Eleven 20 litre buckets were sunk into the ground at an interval of 5 m in a straight line with their rims flush to ground level. A fifty-metre-long drift fence was set to bisect each bucket. One double-ended funnel trap was set alternately between each bucket (*sensu* Lyakurwa *et al.,* 2019). This made one trap line to consist of a 50 m drift fence, eleven 20 litre buckets and 10 double-ended funnel traps. One trap line was set at each site making a total of 220 buckets, and 200 funnel traps for the entire study (half of them for each season). Trapping at each site was done for seven consecutive nights, in which trap monitoring was done immediately following sunrise and late afternoon. A total of 1540 bucket pitfall trap nights and 1400 funnel trap nights were established during the entire study.

Night surveys

This method involved "road riding" (Sullivan, 2000) at a speed of about 15 km per hour while looking for reptiles along roads and adjacent areas. The roads were selected to cover range of habitats (see Coe *et al.,* 1999b). Searches took place between 19:00h to 22:00h and involved seven people (assisted by head torches) in an open car looking for reptiles while driving along a road for two hours at a particular habitat. Searching involved looking on the road, on the roadsides, on trees close to the road, and other nearby vegetation. A total of 28 night transects were surveyed making a total of 392 person-hours. Four additional transects (56 personal-hours) were searched during dry season. These additional data were used for compilation of the checklist.

Coverboards

Coverboards are among the most effective methods for estimating herpetofauna biodiversity (Grant *et al.,* 1992). The method involves certain sized plywood or any other flat wooden materials that are usually laid on the ground to create artificial refugia that attract different kinds of herpetofauna (McDiarmid *et al.,* 2012). Six sampling sites (Zange, Mbula, Babu's plain, Ibaya, Dindira and Kifukua) were selected in which two lines of 2 x 1 m coverboards were established in a straight line. The lines were established 25 m apart and each had 5 coverboards set at an interval of 10 m. The boards were allowed to stay undisturbed for a period of 1 month before being monitored once per month for 3 consecutive months in each season.

Time constrained and opportunistic searching

Pitfall/funnel traps, coverboards and night transects alone cannot adequately sample all species, and therefore these methods were supplemented by time constrained searching (Howell, 2002) and opportunistic encounter methods (McDiarmid *et al.,* 2012). Time

constrained searching involved seven people looking for reptiles in their possible hiding/basking places *e.g.* in rotten logs, on trees, on rocks, under stones, around termite mounds and along/around water bodies. Searching was done for two hours in a range of habitats summing up to 406 person-hours for the two seasons. Species that were found casually in the park were recorded as opportunistic encounters. Species that were found dead on the road, or those that were reported by other people apart from the sampling team, were also recorded as opportunistic encounters.

Data analysis

Species were grouped to a particular biome (White, 1983), depending on their known distribution ranges (Spawls *et al.,* 2018). Rarefaction curves (McDiarmid *et al.,* 2012) were plotted to investigate the adequacy of the sampling effort. The Chao species estimator was also computed in addition to the rarefaction curves. Species composition for MNP was compared to that of North and South Pare and East and West Usambara Mountains using the Sørensen similarity index (*sensu* Rovero *et al.,* 2014). Species from these other sites were compiled from Burgess *et al.* (2007), Menegon (2008), Rovero *et al.* (2014) and Spawls *et al.* (2018). Analyses were done using R software version 3.6.0 (R Core Team 2019) and paleontological statistics software (PAST) version 3.20 (Hammer *et al.,* 2001).

RESULTS

A total of 468 individuals across 55 species and 18 families were recorded (appendix 1). Twenty-two species were found only during the dry season, 13 only in the wet season, and 20 were found in both seasons. Twelve species were represented by a single individual, five were represented by two individuals, and all other species were represented by at least three individuals (appendix 1). Twenty-four species are new records for MNP, and four represent range extensions (*Homopholis fasciata*, *Lygodactylus tsavoensis, Psammophylax kellyi* and *Naja ashei*). *Lygodactylus tsavoensis* (figure 2) was described recently and, prior to this study, was considered endemic to Kenya (Spawls *et al.,* 2018; Malonza *et al.,* 2019).

Figure 2: (A) Lygodactylus tsavoensis. *(B)* Lygodactylus tsavoensis *throat pattern from the Mkomazi National Park. This species was described recently and previously assumed to be endemic to Kenya (Spawls* et al.*, 2018).*

Thirty-one species recorded previously in the park by Flemming & Bates (1999) were confirmed by this study while 18 species reported by the same authors were not found during our study (appendix 1). With previous records, the checklist of reptiles of MNP is now 73 species (appendix 1). *Lygodactylus gravis* and *Hemidactylus tanganicus* are endemic to Tanzania, the latter being only known from Mkomazi and Dutumi (Spawls *et al.,* 2018). *Lygodactylus manni* and *Cnemaspis africana* are endemic to East Africa (Spawls *et al.,* 2018). Except for *Lygodactylus gravis* and *Malacochersus tornieri,* which are listed as Vulnerable, and *Hemidactylus tanganicus,* which is recorded as Data Deficient (Meng *et al.,* 2016; Spawls *et al.,* 2018), all other species are considered to be in the "Least Concern" IUCN category.

Despite the large number of species recorded for the area, species rarefaction curves (figure 3) did not asymptote, indicating the possibility of recording additional species with increased survey efforts. This is also supported by the Chao species estimator, which showed more expected species in the area compared to what our study has recorded (Table 1).

The similarity clustering showed that MNP was the most discordant in species composition from Pare and Usambara Mountains (figure 4). As expected, the greatest representation of the recorded species is from Somalia-Maasai biome (97.3% of the species) with the rest of the species coming from Zanzibar-Inhambane and Afromontane biomes. The Somalia-Maasai reptile species in Mkomazi accounts for 53.8% of all Somalia-Maasai reptile species known to occur in Tanzania.

Table 1. Number of species observed and the Chao species richness estimator (±SE) for the two sampling seasons (opportunistic encounters are excluded).

	Dry season	Wet season
Species observed	34	31
Chao estimator	46.07±9.687	34.995±3.738

DISCUSSION

Our study has increased the number of reptile species in MNP by 49%, from the previous 49 species (Flemming & Bates, 1999) to the current 73 species. However, four reptile species endemic to East Africa that were reported to occur in the park previously, are yet to be confirmed. Fifteen species (20.55%) are at the southernmost part of their range (Spawls *et al.,* 2018). The same has been reported for birds, in which some bird species in MNP have been reported to be on the edge of their distributional range (Lack, 1999). These patterns make MNP a unique park in Tanzania, because it harbours a large number of species whose distributional ranges are predominantly to the north. Our study also demonstrates the importance of MNP in harbouring Tanzanian semi-arid (especially Somali semi-arid belt) reptiles. This is in contrast to the findings of Homewood & Brockington (1999), who reported the park to not be outstanding regarding the richness or endemism of herpetofauna and mammals.

Our study did not detect 18 species from previous studies. This could be partly attributed to the secretive nature and/or low population densities for some of these species (*e.g. Hemidactylus tanganicus* and *Malacocherus tornieri*; Spawls *et al.,* 2018) making it difficult to detect them in the two survey seasons. For example, most of the species that we failed to

detect were represented by only a single individual during previous surveys (Flemming & Bates, 1999). We also did not conduct extensive surveys at Maji Kununua, Kinondu and Ibaya hills and near the West Usambara and South Pare Mountains, where several of the 18 species had been recorded. Additional surveys will likely improve these records, as is predicted by the rarefaction curves and the Chao species estimators. We recommend three to five years of subsequent surveys in order to document rare or secretive species (McDiarmid *et al.,* 2012). Based on updated distributional records (Spawls *et al.,* 2018), several species previously reported in the park (*Afrotyphlops mucruso*, *Adolfus jacksoni*, *Lygodactylus manni*, *Psammophis lineatus, Trioceros bitaeniatus* and *Trachylepis margaritifer*) are not expected to occur in MNP. These records might be due to mistaken identity during previous surveys. For example, the details given for *Psammophis lineatus* by Flemming & Bates (1999) do not agree with the description of the species by Spawls *et al*. (2004) and Spawls *et al*. (2018). It is also possible that some records by Flemming & Bates (1999) were collected outside the current MNP boundary. For example, *Trachylepis maculilabris* and *T. margaritifera* were collected at Lake Chala and South Pare (near Kisiwani) respectively, localities that are not actually within the park boundaries. Several species are also shown to be collected from South/North Pare by Flemming & Bates (1999), which means they may have sampled deep in these Afromontane sites.

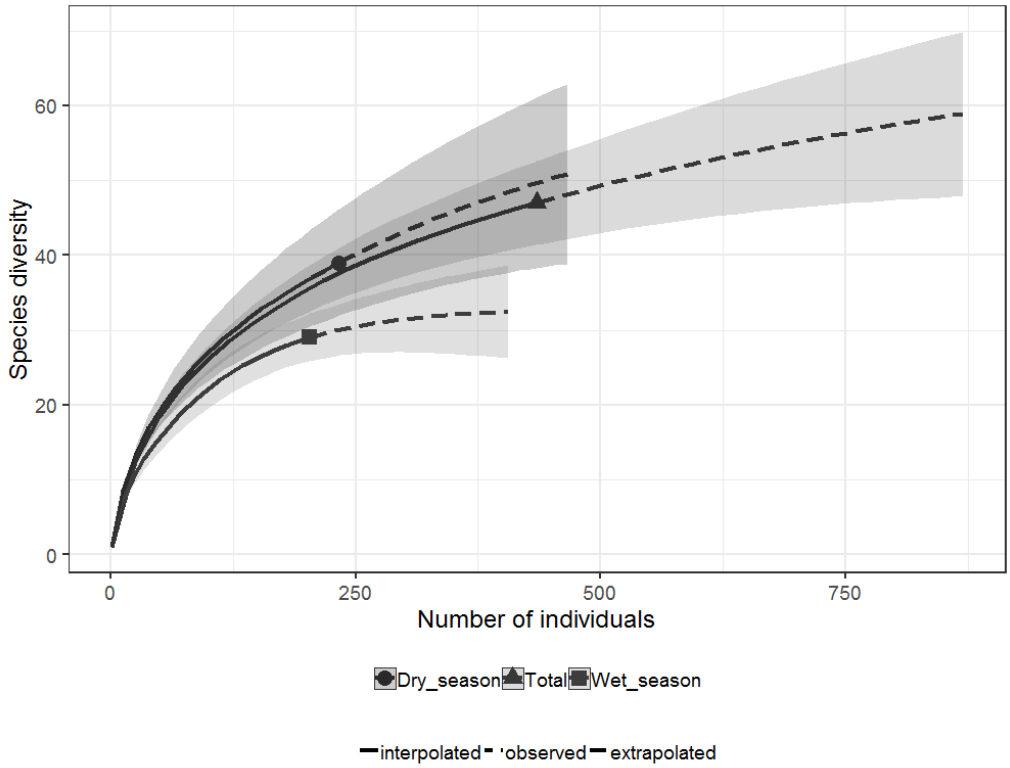

Figure 3: Rarefaction curves for species recorded in the Mkomazi National Park in 2018. The curve with the circle symbol represents dry season, that with the rectangle symbol represents the wet season and the curve with a triangle symbol represents the combined data from the dry and wet seasons. Shaded regions surrounding each line represent the 95% confidence levels.

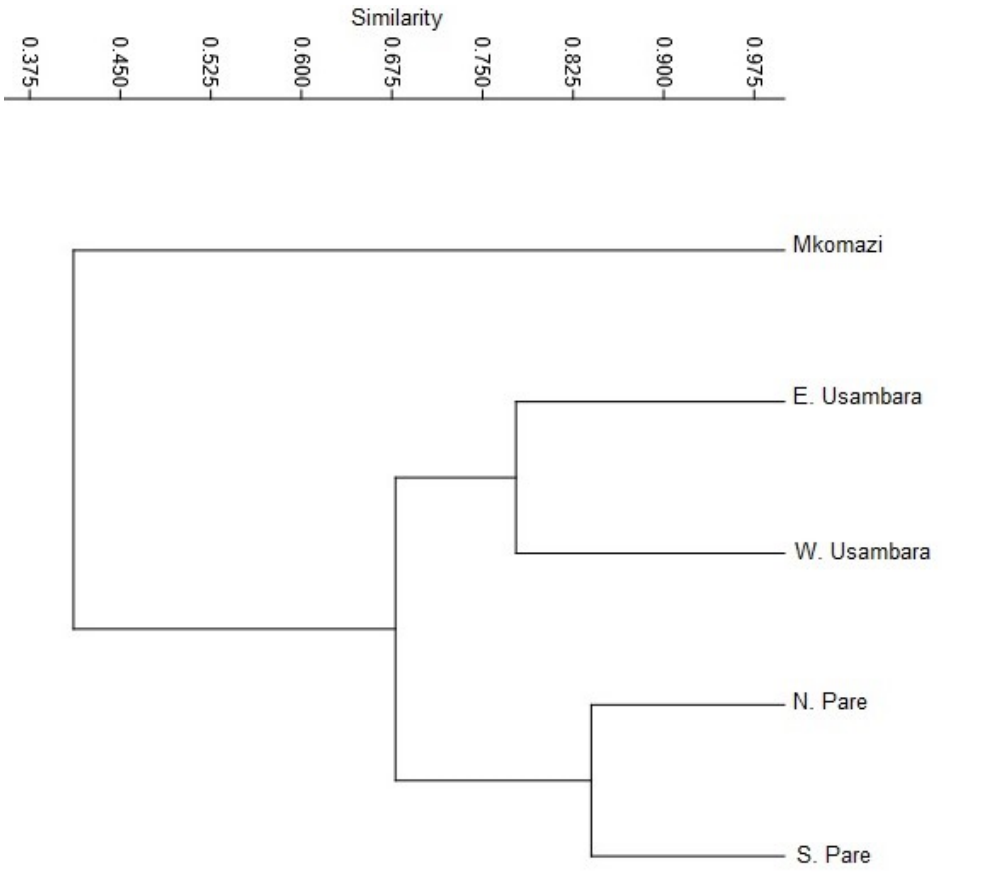

Figure 4: Similarity clustering between Mkomazi National Park and nearby areas based on the Sørensen similarity index (Single Average Link). Species for Usambara and Pare Mountains were compiled from Burgess et al*. (2007), Menegon (2008), Rovero* et al*. (2014) and Spawls* et al*. (2018).*

The high representation of the Somalia-Maasai biome in the total reptile species found in MNP was expected, and due to this biome covering most of the park (White 1983; Homewood & Brockington 1999). The higher similarity in species composition between North Pare and South Pare and the West and East Usambaras agrees with Rovero *et al.* (2014), who demonstrated the same general clustering patterns. The MNP's reptiles are mostly dry savanna, semiarid and semi desert adapted species, making the park discordant from the contiguous Afromontane sites (Pare and Usambara) that are rich in forest-dependent species (Burgess *et al.,* 2007; Rovero *et al.,* 2014; Spawls *et al.,* 2018).

Our study demonstrates the need for updating the existing records in protected areas such as the MNP, similar to Rovero *et al.* (2014), Menegon *et al.* (2015), Meng *et al.* (2016) and Tolley *et al.* (2016). These previous studies also highlight the need to refine faunal checklists with updated distributional records, and more generally demonstrate the lack of complete data in Tanzania's protected areas. Most recent herpetofauna studies in Tanzania have focused on forests (*e.g.* Menegon & Salvidio 2005; Menegon *et al.,* 2008; Shirk *et al.* 2014; Lyakurwa, 2017; Lyakurwa *et al.,* 2019) with relatively little effort dedicated to open, dry

country (*e.g.* Caro *et al.,* 2011), despite the conservation potential of the latter (Caro *et al.,* 2011; Meng *et al.,* 2016). Compiling such faunal information in these regions is now urgent due to increasing threats from agriculture, especially subsistence farming (Tolley *et al.,* 2016). Updated information on species occurrences and distribution is crucial in setting conservation priorities and recommendations (Rovero *et al.,* 2014; Tolley *et al.,* 2016). Intensive surveys in other areas of the country will make it possible to develop reliable national biodiversity strategies and action plans that are currently imperfect (Meng *et al.,* 2016), mostly due to limited data. These efforts will not only improve the long-term conservation plans for the country, but can also reduce the risk of undetected extinction (Pimm *et al.,* 2014; Tolley *et al.,* 2016).

We recommend long-term surveys at Ibaya, Kinondu and Maji Kununua hills and along the West Usambara and South Pare Mountains so as to document Afromontane reptile species that might be shared across these two eco-regions.

ACKNOWLEDGMENTS

We are grateful to Allan Kijazi, the Conservation Commissioner for the Tanzania National Parks for funding this work through TANAPA Ecologists Research Grant. Special thanks also to MNP management especially Abel Mtui, Assistant Conservation Commissioner and Marco Meoli, the former Chief Park Warden for their support during data collection, analysis and manuscript writing. This work could have been extremely difficult without the commitment of our drivers (Goodluck Urio, Mohamed Kizulwa and Hassan Mwinjuma), game rangers (Catherine Masanja, Medadi Gidohay and Raymond Laban) and field assistants (Emmanuel Msemo, Eva Johnson, Heriel Thomas, Idd Kawawa, Jamali Thomas, Mohamed Kitoy, Mussa Kawawa and Salma Rauna) to whom we are highly grateful. Map of the study area was drawn by Christopher Mahande. Thanks also to Stephen Spawls, Michele Menegon and Kim Howell for confirming identification of some of the species.

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Appendix 1. Reptile species, threat category, and endemism per families recorded in Mkomazi National Park.

Species	Red list category †	Notes
Agamidae		
Kenya red-headed agama *Agama lionotus* Boulenger 1896*	LC	Widely distributed across the park. Common on house walls at Zange offices and Kamakota kopjes. https://www.inaturalist.org/observations/34053338
Somali painted agama *Agama persimilis* Parker 1942*	LC	Common at Maore and nearby areas. https://www.inaturalist.org/observations/34053481
Chamaeleonidae		
Side striped chameleon *Trioceros bitaeniatus* (Fischer 1884)+	LC	This was reported previously from Vitewini Ridge by Flemming & Bates (1999) but does not occur in this range according to current distribution maps.
Flap-necked chameleon *Chamaeleo dilepis* (Leach 1819)*	LC	Widely distributed across the park. Very common around Zange airstrip. https://www.inaturalist.org/observations/34053712
Kenya pygmy chameleon *Rhampholeon kerstenii* (Peters 1868)*	LC	One individual was found during wet season at Mbula during the day. https://www.inaturalist.org/observations/34054308
Eublepharidae		
Somali-Maasai clawed gecko *Holodactylus africanus* Boettger 1893	LC	Two individuals were found at Zange airstrip (one during wet and one during dry season). One was found near Zange office during wet season. https://www.inaturalist.org/observations/34055338
Gekkonidae		
Usambara forest gecko *Cnemaspis africana* (Werner 1896)+	LC	East African endemic. Recorded by Flemming & Bates (1999) at Maji kununua and Ibaya.
East African house gecko *Hemidactylus angulatus* Hallowell 1854*	LC	Recorded at Vitewini-Dindira and at Zange during wet season. https://www.inaturalist.org/observations/34055368
Tropical house gecko *Hemidactylus mabouia* (Moreau De Jonnès 1818)*	LC	Widely distributed across the park.
Tree gecko *Hemidactylus platycephalus* Peters 1854*	LC	Widely distributed across the park. https://www.inaturalist.org/observations/34055472
Nyika gecko *Hemidactylus squamulatus* Tornier 1896*	LC	Widely distributed across the park. Easily found along the park roads during the night. https://www.inaturalist.org/observations/34055498

Species	Red list category †	Notes
Tanzanian tropical gecko *Hemidactylus tanganicus* Loveridge 1929+	DD	Tanzanian endemic. Found by Flemming & Bates (1999) at Ibaya and Pangaro.
Banded velvet gecko *Homopholis fasciata* (Boulenger 1890)	LC	One individual was found in a bucket pitfall trap in Njiro during dry season. https://www.inaturalist.org/observations/34055597
Tsavo dwarf gecko *Lygodactylus tsavoensis* Malonza, Bauer, Granthon, Williams & Wojnowski 2019	Unknown	Widely distributed across the park, very common around Zange offices. https://www.inaturalist.org/observations/34055695
Usambara dwarf gecko *Lygodactylus gravis* Pasteur 1965+	VU	Tanzanian endemic. Reported previously by Flemming & Bates (1999) at Maji Kununua.
Mann's dwarf gecko *Lygodactylus manni* Loveridge 1928+	LC	One individual reported by Flemming & Bates (1999) at Maji Kununua. Does not occur in this range according to the current distribution maps.
Yellow-headed dwarf gecko *Lygodactylus picturatus* (Peters 1870)*	LC	Widely distributed across the park. https://www.inaturalist.org/observations/34055850
Gerrhosauridae		
Great plated lizard *Broadleysaurus major* (Duméril 1851)	LC	Recorded at Kamakota kopjes. https://www.inaturalist.org/observations/34055942
Yellow-throated plated lizard *Gerrhosaurus flavigularis* Wiegmann 1828+	LC	Recorded at Dindira, Ibaya and kisima hill by Flemming & Bates (1999).
Black-lined plated lizard *Gerrhosaurus nigrolineatus* Hallowell 1857	LC	Recorded at Kamakota, Mitomingi, Umba, Dindira and Ngurunga. https://www.inaturalist.org/observations/34055998
Lacertidae		
Jackson's forest lizard *Adolfus jacksoni* (Boulenger 1899)+	LC	One individual reported by Flemming & Bates (1999) at Kisiwani. Does not occur in this range according to current distribution maps.
Speke's sand Lizard *Heliobolus spekii* (Günther 1872)*	LC	Widely distributed across the park. https://www.inaturalist.org/observations/34056069
Southern long tailed lizard *Latastia longicaudata* (Reuss 1834*	LC	Widely distributed across the park. Very common at Kamakota. https://www.inaturalist.org/observations/34056140
Boulenger's scrub lizard *Nucras boulengeri* Neumann 1900*	LC	Found during day search and in pitfall traps at Zange, Maore and Mbula. https://www.inaturalist.org/observations/34056238
Scincidae		
Loveridge's limbless skink *Melanoseps loveridgei* Brygoo & Roux-Estève 1982+	LC	One individual was recorded by Flemming & Bates (1999) at Ibaya.
Somali writhing skink *Mochlus* cf. *somalicum* (Parker 1942)+	LC	One individual was recorded by Flemming & Bates (1999) at Ibaya.

Species	Red list category †	Notes
Sundevall's writhing skink *Mochlus sundevallii* (Smith 1849)*	LC	Found in bucket pitfall traps at Maore and Zange in dry season. https://www.inaturalist.org/observations/34060279
Wahlberg's snake eyed skink *Panaspis tsavoensis* (Kilunda, Conradie, Wasonga, Jin, Peng, Murphy, Malonza & Che)*	LC	Recorded in a bucket pitfall trap at Maore during dry season, and during day searches at Umba (wet season) and Zange (dry season). https://www.inaturalist.org/observations/34060329
Short-necked skink *Trachylepis brevicollis* (Wiegmann 1837)*	LC	Recorded at Zange, Kamakota, Ngurunga and Maore. https://www.inaturalist.org/observations/34060681
Speckle-lipped skink *Trachylepis maculilabris* (Gray 1845)+	LC	One individual recorded by Flemming & Bates (1999) at Lake Chala. The lake is not found within Mkomazi.
Rainbow skink *Trachylepis margaritifera* (Peters 1854)+	LC	Recorded by Flemming & Bates (1999) at South Pare, near Kisiwani. The location is not within MNP.
Tree skink *Trachylepis planifrons* (Peters 1878)*	LC	Widely distributed across the park, very common on trees near Zange office. https://www.inaturalist.org/observations/34060708
Striped skink *Trachylepis striata* (Peters 1844)*	LC	Widely distributed across the park. https://www.inaturalist.org/observations/34167288
Variable skink *Trachylepis varia (Peters 1867)**	LC	Widely distributed across the park. https://www.inaturalist.org/observations/34060892
Varanidae		
White-throated savanna monitor *Varanus albigularis* (Daudin 1802) *	LC	Widely distributed across the park. https://www.inaturalist.org/observations/34061668
Nile monitor *Varanus niloticus* (Linnaeus 1766) +	LC	Recorded by Flemming & Bates (1999) at Ngurunga.
Booidae		
Kenya sand boa *Eryx colubrinus* (Linnaeus 1758)	LC	Two individuals were found under coverboards during wet season at Zange and another two in night transects at Nobanda-Kisima and Maore-Kifukua during dry season. https://www.inaturalist.org/observations/34053590
Colubridae		
White-lipped snake *Crotaphopeltis hotamboeia* (Laurenti 1768)	LC	Widely distributed across the park. Individuals were found during night transects at Njiro-babus, Kajificheni and Dindira. Also reported opportunistically from other parts of the park. https://www.inaturalist.org/observations/34054353
Common egg eater *Dasypeltis scabra* (Linnaeus 1758)*	LC	Widely distributed across the park. Recorded from Vitewini-Dindira, Maore-Kifukua, Nobanda-Kisima, Maore-Mpakani and Ngurunga. https://www.inaturalist.org/observations/34054445

Species	Red list category †	Notes
Boomslang *Dispholidus typus* (Smith 1828)+	LC	One individual was observed by Flemming & Bates (1999) near Kisima hill.
Semi-ornate snake *Meizodon semiornatus* (Peters 1854)	LC	Two individuals were recorded opportunistically at Zange during dry season. https://www.inaturalist.org/observations/34054503
Spotted bush snake *Philothamnus semivariegatus* (Smith 1840)*	LC	Widely distributed across the park. Recorded from Maore-Makuti, Maore Kifukua, Zange and Superbowl during day search and opportunistic surveys. https://www.inaturalist.org/observations/34054562
Smith's racer *Platyceps brevis* (Boulenger 1895)	LC	One individual was found under a coverboard at Kifukua. https://www.inaturalist.org/observations/34054602
Large-eyed snake *Telescopus dhara* (Forskal 1775)	LC	One individual was found at Zange airstrip during dry season on a night transect. https://www.inaturalist.org/observations/34054719
Eastern vine snake *Thelotornis mossambicanus* (Bocage 1895)+	LC	One individual recorded by Flemming & Bates (1999) at Ibaya.
Elapidae		
Black mamba *Dendroaspis polylepis* Günther 1864	LC	One individual was found on a grassland at Mbula-Korongo during dry season.
Ashe's spitting cobra *Naja ashei* Wüster & Broadley 2007	LC	One individual was found basking on road at Kavateta, and another one was found dead on road at Kajificheni both during dry season. https://www.inaturalist.org/observations/34054779
Red spitting cobra *Naja pallida* Boulenger 1896*	LC	Recorded from Zange and Ibaya during both seasons. https://www.inaturalist.org/observations/34055294
Lamprophiidae		
Jackson's centipede eater *Aparallactus jacksoni* (Günther 1888)*	LC	One individual was found in bucket pitfall trap at Maore during dry season. https://www.inaturalist.org/observations/34061948
Plumbeous centipede eater *Aparallactus lunulatus* (Peters 1854)*	LC	Two individuals were found during day search at Dindira and Kamakota. Another individual was found dead on road near Zange. Both during wet season. https://www.inaturalist.org/observations/34057142
Brown house snake *Boaedon fuliginosus* (Boie 1827)*	LC	Three individuals were found under coverboards; two at Zange during wet season, and one at Dindira during dry season. https://www.inaturalist.org/observations/34057339
Kenyan bark snake *Hemirhagerrhis hildebrandtii* (Peters 1878)	LC	One individual was found at Ngurunga during day search in dry season. https://www.inaturalist.org/observations/34058235

Species	Red list category †	Notes
Striped bark snake *Hemirhagerrhis kelleri* Boettger 1893	LC	One individual was found in a bucket pitfall at Zange during dry season. https://www.inaturalist.org/observations/34058429
Guinea-fowl snake *Micrelaps vaillanti* (Mocquard 1888)	LC	Two individuals were found during the dry season. One under a coverboard at Ndea and another in a bucket pitfall trap at Maore. https://www.inaturalist.org/observations/34058775
Prince Ruspoli's shovel-snout *Prosymna ruspolii* (Boulenger 1896)	LC	One individual was found during night search at Ndea-Kavateta during wet season. https://www.inaturalist.org/observations/34059057
Link-marked sand snake *Psammophis biseriatus* Peters 1881	LC	One individual was found during opportunistic searches at Maore in the dry season. https://www.inaturalist.org/observations/34059278
Striped olympic sand snake *Psammophis lineatus* (Duméril, Bibron & Duméril, 1854)+	LC	One individual reported by Flemming & Bates (1999) from Ibaya. Does not occur in this range according to current distribution maps.
Speckled sand snake *Psammophis punctulatus* Duméril, Bibron & Duméril 1854	LC	Three individuals were found during day searches in dry season, one at Zange, Mbula and Mitomingi. https://www.inaturalist.org/observations/34059633
Northern stripe-bellied sand snake *Psammophis sudanensis* Werner 1919	LC	Widely distributed across the Park. https://www.inaturalist.org/observations/34059657
Tanzanian skaapsteker *Psammophylax kellyi* (Conradie, Keates & Edwards 2018)	LC	One individual was recorded during day search at Maore during wet season.
Rufous beaked snake *Rhamphiophis rostratus* Peters 1854	LC	One individual was recorded opportunistically during dry season at Maore. https://www.inaturalist.org/observations/34059885
Red-spotted beaked snake *Rhamphiophis rubropunctatus* (Fischer 1884)	LC	Three individuals recorded opportunistically from Zange in wet season and one during day search from Mbula-Korongo. https://www.inaturalist.org/observations/34059870
Leptotyphlopidae		
Merker's worm snake *Leptotyphlops merkeri* (Werner 1909)+	LC	One individual was found by Flemming & Bates (1999) west of Kisiwani.
Pythonidae		
Southern African rock python *Python natalensis* Smith 1840*	LC	Recorded in the dry season during day search at Dindira and Mitomingi. Also reported opportunistically from Mbula, Njiro and Kisima. https://www.inaturalist.org/observations/34060246

Species	Red list category †	Notes
Typhlopidae		
Lineolate blind snake *Afrotyphlops lineolatus* (Jan 1864)	LC	One individual was found dead on road near Zange during wet season. https://www.inaturalist.org/observations/34061313
Zambezi giant blind snake *Afrotyphlops mucroso* (Peters 1854)+	Unknown	Flemming & Bates (1999) recorded it at Ibaya.
Yellow-striped blind snake *Rhinotyphlops unitaeniatus* (Peters 1878)*	LC	One individual was found at Zange, and another at Njiro both during dry season. https://www.inaturalist.org/observations/34061197
Viperidae		
Puff adder *Bitis arietans* (Merrem 1820) *	LC	Widely distributed across the park. https://www.inaturalist.org/observations/34061806
Pelomedusidae		
Helmeted terrapin *Pelomedusa* cf. *subrufa* (Bonnaterre 1789)*	LC	Widely distributed across the park. Common at Dindira, Vitewini-Mbuyuni, Ndea and Maore dams. https://www.inaturalist.org/observations/34060070
Testudinidae		
Bell's hinged tortoise *Kinixys belliana* Gray 1831	LC	Recorded at Zange during dry season.
Speke's hinged tortoise *Kinixys spekii* Gray 1863 *	LC	Recorded opportunistically at Zange during dry season. https://www.inaturalist.org/observations/34162393
Pancake tortoise *Malacochersus tornieri* (Siebenrock 1903)+	VU	Reported previously by Flemming & Bates (1999) at Kamakota kopjes.
Leopard tortoise *Stigmochelys pardalis* (Bell 1828)*	LC	Widely distributed across the park. https://www.inaturalist.org/observations/34061104

Notes: * = species that were recorded both by this study and by Flemming and Bates (1999); + = recorded by Flemming and Bates (1999) but not found during this study; † Red list category (LC: Least Concern; DD: Data Deficient; NT: Near Threatened; VU: Vulnerable).