

**AMPHIBIAN DIVERSITY IN SHIMBA HILLS NATIONAL RESERVE,  
KENYA: A COMPREHENSIVE LIST OF SPECIMENS AND SPECIES**

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**ABSTRACT**

We present the first annotated amphibian checklist of Shimba Hills National Reserve (SHNR). The list comprises of 30 currently known amphibians (28 anurans and two caecilians), which includes 11 families and 15 genera. In addition, individual records per species, distribution in the reserve and brief remarks about the species are presented. The checklist is based on information from museum collections, field guides, unpublished reports and newly collected field data. We are able to confirm the presence of two Eastern Afromontane species in the SHNR: *Scolecophorus* cf. *vittatus* and *Callulina* cf. *krefftii*. The latter has not been recorded since the original collection of a single specimen over 50 years ago. SHNR contains the highest number of amphibian species of any known locality in Kenya (about 30% of the country's total number); therefore it is of national conservation importance. Finally, we briefly

discuss the biogeography of the SHNR and its connections to nearby biogeographic regions.

**Keywords:** coastal forests, checklist, zoogeography, amphibians, Shimba Hills

## INTRODUCTION

The coastal forests of Kenya are part of the Coastal Forests of Eastern Africa biodiversity hotspot famed for its high species diversity and endemism (Burgess *et al.*, 1998; Myers, 2000) (see figure 1). Despite the apparent importance of the coastal forests, an assessment of the biological diversity has not been evenly conducted for all taxa across all areas. Some pivotal contributions have attempted to synthesize known information, *e.g.* Burgess & Clarke's monumental book (Burgess & Clarke, 2000) and a review of coastal forests (Burgess *et al.*, 1998) but these treatments all indicate the paucity of knowledge and the need to expand our understanding of the Coastal Forests of Eastern Africa hotspot. The lack of information is particularly true for specific countries in Eastern Africa such as Kenya and Mozambique. In Kenya, some taxonomic groups have attracted attention *e.g.* mammals (Hoft & Hoft, 1995; Ouge *et al.*, 2004; McDonald & Hamilton, 2010), butterflies (Rogo & Odulaja, 2001; Lehmann & Kioko, 2005), dragonflies (Clausnitzer, 2003) and plants (Schmidt, 1991; Luke, 2005) but most other groups have been largely ignored (*e.g.* non-flying insects, reptiles and amphibians). Furthermore, geographic sampling has been concentrated at only a few specific places *e.g.* Arabuko-Sokoke Forest, with other areas such as the Shimba Hills, being largely ignored.

Relatively few amphibian studies have been conducted in the coastal forests of Kenya, despite the fact that research was first initiated over 80 years ago (Loveridge, 1935; Howell, 1993). Loveridge's expedition of 1934 concentrated mainly on the northern coastal forest elements (*e.g.* Tana River and Witu), and a few areas further south such as Arabuko-Sokoke Forest (Loveridge, 1935). The oldest comprehensive reports of amphibians of any coastal Kenya forest, after Loveridge (1935), were prepared by Drewes (1992) and Chira (1993) both of which were focused on Arabuko-Sokoke and Gedi forests. Over ten years later Malonza *et al.* (2006) reported on the biogeography of amphibians and reptiles of the Tana River Primate National Reserve, a gallery forest along the Tana River. These two more recent studies are also based on the northern coastal forests with little comprehensive sampling in southern coastal Kenyan forests. Some preliminary surveys and new species descriptions alerted herpetologists to the potential value of southern Kenyan coastal forests (Schjøtz, 1975; Malonza & Measey, 2005), however, basic information is lacking on amphibians across Kenya. This lack of comprehensive studies on amphibians, in a region characterised by high levels of single locality endemism (Myers *et al.*, 2000) is of high concern, particularly given the alarming rate at which natural habitats are being modified due to human pressure (Tabor *et al.*, 2010). Increasing the knowledge of biodiversity in this area is a priority and of major importance to conservation efforts.

Shimba Hills National Reserve (SHNR), located on the south coast, is the second largest coastal forest in Kenya (figure 2). The area is a mixture of different forest types (Schmidt, 1991, Bennun & Njoroge, 1999; Luke, 2005) and savanna habitats (Burgess *et al.*, 2004). The area is particularly interesting because it is located between two biodiversity hotspots, the Coastal Forests of Eastern Africa and the Eastern Afromontane



Figure 1. Map of the historical coverage of the east African coastal forests showing the location of Shimba Hills National Reserve.

biodiversity hotspot, specifically the Eastern Arc Mountains (see figure 1). Amphibian collecting in SHNR began in the 1960's by Alex Duff-Mackay, RONALDA KEITH and ARNE SCHIÖTZ. These authors were mainly interested in “tree frogs” of the families Hyperoliidae and Arthroleptidae (genus *Leptopelis*). The herpetological collection of the National Museums of Kenya (NMK) indicates that several short period collections had been made in the reserve since then (P.K. Malonza, pers. comm.) but these efforts have not been consolidated into a comprehensive understanding of the amphibian fauna (Malonza & Measey, 2005). Some publications have made reference to SHNR amphibians but these are mainly selective based on the taxa of interest. Schiøtz (1974) revised the genus *Afrixalus* and described *Afrixalus sylvaticus*, while Schiøtz (1975) focused on “tree frogs” including the description of *Hyperolius rubrovermiculatus*. Loader *et al.* (2010) detailed the presence of a potentially undescribed brevipitid, *Callulina* sp. from SHNR collected in 1961 by RONALDA KEITH, the only known specimen.

The main objective of this paper is to consolidate all the amphibian records from SHNR throughout the years and present these in a single publication, which we hope will promote knowledge of the area. We use records from 1968–2015 from the NMK herpetological reference collection and other relevant natural history museums, including new data from field research conducted between 2012–2015. New sampling in 2013–2015 conducted by the authors of this study aimed to sample new sites or poorly surveyed places, in particular forested areas. We give an updated species list of SHNR amphibians and descriptions of new records. Confirmations of our identifications are made on the basis of morphological diagnoses and are complemented by molecular analysis (Bwong, unpublished data).

## MATERIAL AND METHODS

### Description of study area

The Shimba Hills are a dissected plateau located between 4°09'–4°21'S and 39°17'–39°30'E in Kwale County on the Kenyan coast (see figure 2). The hills are located about 30 km southwest of Mombasa city. The Shimba Hills were gazetted as forest reserve in 1903 (Bennun & Njoroge, 1999; Luke, 2005) and in 1956 the area was expanded and re-gazetted as a National Reserve (Davis, 1993). The hills rise from the coastal plain to form a table plateau between 120 and 450 m above sea level, and the underlying rock consists of upper Triassic Shimba grits and Pliocene Magarini sands (Davis, 1993; Bennun & Njoroge, 1999). The climate is hot and moist with a mean annual temperature of 24.2°C (Blackett, 1994). Rainfall ranges from 855–1682 mm per annum with a bimodal pattern from April–June and October–December (Schmidt, 1991). The vegetation is a mix of grassland, scrubland and exotic plantations and forests. Six major forest types occur within the reserve; *Milicia* forests at Makadara and Longomwagandi forests and the western escarpment; *Azelia* - *Erythrophleum* forests are found on the eastern and southern flanks of the escarpment; *Paramacrolobium* forests are found on the steep scarp slopes to the east and the west on the Makadara cliffs, Buffalo ridge and Upper Kivumoni and *Manilkara-Combretum* forests are found on the lower western side of the plateau (Davis, 1993; Luke, 2005).

### Field methods

The results presented here are based on field research, analysis of literature and museum collections. In total, 751 specimens were evaluated. New specimens were obtained from fieldwork in and around the SHNR conducted in January 2012, December 2013, April and December 2014 and

April–May 2015 (see table 1 for major sampling sites). Time-limited searches and Visual Encounter Surveys (VES) were conducted. Bucket pitfall traps with drift fences were also used. For each pitfall trap set, five buckets were used in an “X” shaped pattern where each bucket was placed at a distance of 5 m from each other, a modified array pattern derived from Heyer *et al.* (1994) and Rödel & Ernst (2004). The drift fence was made of transparent plastic sheeting 0.5 m high. Representative samples of all species recorded were euthanized using Tricaine mesalyte (TM MS-222) solution, then fixed in 10% formalin and later preserved in 70% ethanol. All the newly collected material is deposited at the National Museums of Kenya herpetology collection. Specimen identification was made using standard references (*e.g.* Schiøtz, 1999; Channing & Howell, 2006; Harper *et al.*, 2010). Taxonomy in the checklist follows Frost *et al.* (2006) and updates from Frost (2016). Museum abbreviations given in the text are for the following:

AMNH	American Museum of Natural History, New York, USA
BMNH	Natural History Museum, London, United Kingdom
CAS	California Academy of Sciences, San Francisco, USA
LACM	Natural History Museum of Los Angeles County, Los Angeles, USA
MVZ	Museum of Vertebrate Zoology, Berkeley, USA
NMK	National Museums of Kenya, Nairobi, Kenya
ZMUC	Zoological Museum - University of Copenhagen, Denmark

Table 1. Major sampling sites within SHNR.

Locality	Coordinates	Altitude (m)
Kivumoni Gate swamp	4°13'S,39°29'E	159
Longomwagandi Forest	4°13'S,39°25'E	398
Makadara Forest	4°14'S,39°23'E	426
Marere Head works	4°12'S,39°23'E	206
Marere Hill	4°13'S,39°24'E	383
Mkongani West	4°20'S,39°18'E	359
Mwadabara Swamp	4°10'S,39°25'E	159
Mwele Forest	4°17'S,39°21'E	334
Pengo Hill	4°14'S,39°23'E	455
Reserve Headquarter compound	4°10'S,39°26'E	323
Risley Forest	4°14'S,39°25'E	342
Sable Bandas	4°13'S,39°27'E	352
Shimba Lodge	4°11'S,39°25'E	290
Sheldrick Falls	4°16'S,39°23'E	146

### Secondary data acquisition

In addition to the data from the field work, information on SHNR amphibians was obtained from unpublished field reports (Malonza & Measey, 2005), the herpetological collection at the NMK, BMNH, CAS, ZMUC, HerpNet ([www.herpnet.org](http://www.herpnet.org)) as well as field guides (Channing & Howell, 2006; Spawls *et al.*, 2006; Harper *et al.*, 2010). All specimens from museums outside Kenya with questionable labels (*e.g.* sp., cf.) and/or vague locality data were omitted from this list. This was mainly because we could not confirm their identification, especially given the often-confusing taxonomy of certain species and genera (*e.g.* Zimkus & Blackburn, 2008). All NMK specimens from SHNR collected prior to 2012 were examined by BAB and PKM to confirm their identity. Furthermore, we assembled data on sampling intensity in the SHNR based on the period of time visited by collectors from the specimens examined, these dates assume collections were carried out continuously.

## RESULTS

The list comprises 30 currently known amphibian species of SHNR (28 anurans and two caecilians), representing 11 families and 15 genera (see appendix 1 for all specimen records). Table 2 provides a summary of the amphibian collection efforts in SHNR and the number of species documented per sampling event. The table indicates in which year authors observed species. The current study recovered most of the species previously reported in the reserve and also added new records. We confirmed a new record of *Scolecophorus* cf. *vittatus*, for Kenya and also recovered *Callulina* cf. *kreffti* last collected in the reserve in 1961 by Ronald Keith. SHNR species available in other museums outside Kenya include 26 specimens at BMNH, 144 specimens at CAS, and about 50 specimens at ZMUC, (see table 2 for collector information and figure 2 for the spatial distribution of the common sampling).

Table 2. A record of amphibian species sampling effort in SHNR from 1968-2015.

Year	Date	Collector names	No. Species recorded
1968	2 Apr	A. Williams	2
1968	19–20 May	Alex Duff-Mackay & Arne Schiøtz	6
1977	No date	Alex Duff-Mackay	1
1977	Apr	L. P. Lounibos	1
1981	12 Apr	S. Reilly	6
1981	5–18 Jul	M. Tandy	10
1982	6 May	Alice Grandison	3
1984	Feb	Ryan	5
1998	5 Jun	Dan R. Buchholz et al	5
1998	3 Jul	A. Wise, Weatherby, C. & Ross, K.	3
2005	28–30 Sep	P.K. Malonza & J.G. Measey	12
2006	22–23 Apr	J.G. Measey, B. Bwong & Venu	4
2006	13–16 Sep	Jos Kielgast	11
2010	17–18 Dec	Miloslav Jirku	5
2012	2–10 Apr	V. Wasonga & J. Nyamache	8
2012	19–23 Jun	V. Wasonga & J. Nyamache	7
2012	12–16 Nov	J. Mueti & C. Ofori	2
2013	17–23 Dec	J. Nyamache & P. Mwasi	10
2014	30 Apr–4 May	J. Nyamache & P. Mwasi	13
2014	12–20 Jun	V. Wasonga, J. Ochong	12
2014	2 Sep	J. Nyamache	7
2015	27 Apr–1 May	B. Bwong & J. Nyamache	18
2015	12-14 May	J. Nyamache	14
2015	23–25 May	P.K Malonza & J. Nyamache	5

### The checklist

The checklist entries consist of four parts. Records: accession numbers for all individual records per species ever collected in SHNR (see appendix 1 for all specimens from SHNR together with their museum numbers, collection date, collector name and locality). Distribution: mentions the exact locality within SHNR where the species has been recorded. Habitat: describes the general habitat in which the species occurs. Remarks: mentions any other relevant information, including taxonomic status, IUCN red list status if not Least Concern and endemism where applicable.

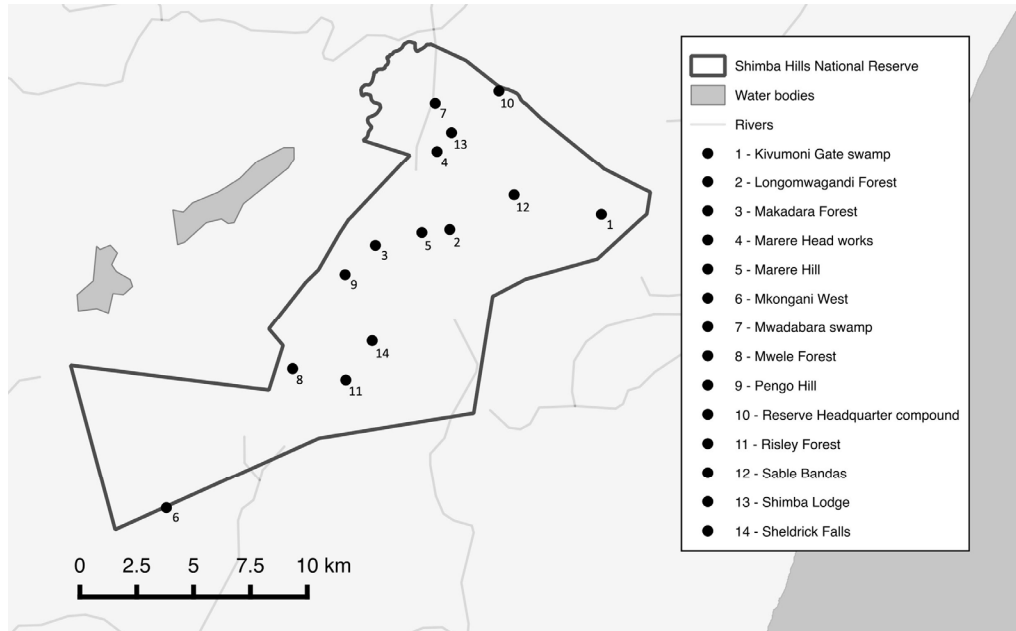


Figure 2. Map of Shimba Hills National Reserve showing major sampling sites.

### Anura

#### Arthroleptidae

*Arthroleptis stenodactylus* Pfeffer, 1893

Records: NMK A4401/1–6; NMK A4460/1–3; NMK A4613; NMK A4654/1–2; NMK A5256; NMK A5459/1–2; NMK A5501; NMK A5502; NMK A5505; NMK A5516; NMK A5912; NMK A5913; NMK A5815; NMK A5806; NMK A5849; NMK A5852; NMK A5853/1–3; NMK A58971–2; NMK A6040; NMK A6045; NMK A6048; NMK A6111; CAS 155671–77.

Distribution: Longomwagandi Forest, Makadara Forest, Mwele Forest, Pengo Forest, Sheldrick Falls, Shimba Lodge Swamp.

Habitat: forest, savanna and degraded habitats.

Remarks: the taxonomy of this species is confusing given the likelihood that this taxon consists of more than one species. Pickersgill (2007) named a montane form (*Arthroleptis lonnbergi* Nieden, 1915) as different from *A. stenodactylus*, a presumably more widespread form. The specific relationship of the SHNR population to these units awaits formal clarification.

*Arthroleptis xenodactyloides* Hewitt, 1933

Records: NMK A4448/1–6; NMK A4459/1–8; NMK A4653/1–2; NMK A5515; NMK A5631/1–2; NMK A5805/1–4; NMK A5809/1–3; NMK A5816; NMK A5820/1–3; NMK A5851/1–7; NMK A5902/1–2; NMK A6019/1–3; NMK A6031; NMK A6037/1–2; NMK A6041/1–3; NMK A6042; NMK A6049; NMK A6059/1–2; NMK A6070/1–2; NMK A6079/1–2; NMK A6114; CAS 155604.

Distribution: Kaya Forest, Longomwagandi Forest, Makadara Forest. Marere Hill, Pengo Hill, Risley Forest, Sheldrick Falls.

Habitat: submontane forest, swamp, woodland and wet grassland.

Remarks: first recorded in SHNR as *A. adolfriederici* Nieden, 1911 but the name later changed to *A. xenodactyloides* (see Blackburn, 2009). As with *A. stenodactylus*, the particular taxonomic name ascribed to the Shimba population is uncertain given the recognition of *A. stridens* Pickersgill, 2007, a similar form to *A. xenodactyloides*. Formal clarification will be required before this population can be assigned definitively to one of these species.

*Leptopelis concolor* Ahl, 1929

Records: NMK A4699/1–7; NMK A5845/1–12; NMK A5888/1–3; NMK A5089; NMK A6016/1–3; NMK A6051; NMK A6075; NMK A6084/1–2.

Distribution: Kivumoni Gate Swamp, Mwadabara Swamp, Shimba Lodge Swamp, Sheldrick Falls.

Habitat: Coastal savanna woodland and grassland.

Remarks: Channing & Howell, 2006 consider this a junior synonym of *L. argenteus*.

*Leptopelis flavomaculatus* (Günther, 1864)

Records: NMK A787; A5844/1–5; NMK A6022/1–4; NMK A6044; CAS 153633–40; CAS 155630–31.

Distribution: Kivumoni Swamp, Shimba Lodge Swamp, Makadara Forest, Marere head works, Mwadabara Swamp, Sheldrick Falls.

Habitat: forest in both Coastal East Africa and Eastern Afromontane region.

**Brevicipitidae***Callulina* cf. *krefftii* Nieden, 1911

Records: AMNH 72724; NMK A6060; NMK A6113.

Distribution: Makadara Forest about 10 m from the picnic site.

Habitat: only known from forest.

Remarks: the first record of *Callulina* cf. *krefftii* in SHNR was by Ronalda Keith in 1961. She collected the specimen in Makadara Forest. This specimen is deposited at the AMNH. The presence of this frog in SHNR, however, only came to light recently (Loader *et al.*, 2010). Two individuals were collected during the current study in April and May 2015. With the addition of new specimens, the population is currently undergoing taxonomic evaluation.

**Bufonidae***Sclerophrys gutturalis* (Power, 1927)

Records: NMK A5855/1–4; BMNH 1982.842.

Distribution: National Reserve Headquarters compound.

Habitat: savanna, grassland and agricultural area.



Remarks: The genus name was originally *Bufo* Laurenti, 1768 which later changed to *Amietophrynus* Frost *et al.* 2006 and recently to *Sclerophrys* Tschudi, 1938 (see Ohler & Dubois, 2016).

*Sclerophrys pusilla* (Mertens, 1937)

Records: NMK A5507; NMK A5917/1–4.

Distribution: Sheldrick Falls area, Shimba Lodge Swamp.

Habitat: forest edge and humid savanna.

Remarks: recently recognized as being distinct from *S. maculatus* Hallowell, 1854. *S. pusilla* is found in Central, East and South Africa. Therefore all populations from these areas previously assigned to *S. maculatus* are currently assignable to *S. pusilla* (Poynton *et al.*, 2016).

*Sclerophrys steindachneri* (Pfeffer, 1893)

Records: NMK A4452; NMK A5237; NMK A5366/1–5; NMK A5847.

Distribution: Kivumoni Gate Swamp, Sheldrick Falls, Shimba Lodge Swamp.

Habitat: humid grassland and woodland.

*Mertensophryne micranotis* (Loveridge, 1925)

Records: NMK A1150/1–9; NMK A5460; NMK A5464; NMK A5633; NMK A5911; NMK A5811; NMK A5819; NMK A5838/1–3; NMK A5898; NMK A6038/1–2; CAS 153698; BMNH 1980.195, BMNH 1980.197, BMNH 1982.395–396.

Distribution: Kaya Forest, Longomwagandi Forest, Makadara Forest, Sable bandas, Sheldrick Falls.

Habitat: lowland coastal forests and woodland.

### **Hyperoliidae**

*Afrixalus delicatus* Pickersgill, 1984

Records: NMK A6054; NMK A6055/1–4; NMK A6068/1–4, ZMUC-R 73855; ZMUC-R 73948; ZMUC-R 73949; ZMUC-R 77457; ZMUC-R 77458.

Distribution: Mwadabara Swamp.

Habitat: savanna and grassland.

*Afrixalus fornasini* (Bianconi, 1849)

Records: NMK A4458/1–4; NMK A4611/1–5; NMK A4690/1–7; NMK A5252; NMK A5571; NMK A5810/1–2; NMK A5903; NMK A5954; NMK A6062/1–2; NMK A6085; CAS 157492.

Distribution: Kivumoni Gate Swamp, Mwadabara Swamp, Sheldrick Falls, Shimba Lodge Swamp.

Habitat: dense savanna and dry forest.

*Afrixalus sylvaticus* Schiøtz, 1974

Records: NMK A3045/1–10; NMK A4440; NMK A4441/1–4; NMK A4703/1–6; NMK A5569/1–3; NMK A5814; NMK A5837; NMK A5902/1–3; NMK A5957/1–3; NMK A6028; NMK A6033/1–5; NMK A6043/1–4; CAS 155652–54; CAS 155947; MVZ 233824; MVZ 233825; BMNH 1982.857–859.

Distribution: Kivumoni Gate Swamp, Marere headworks, Sheldrick Falls, Shimba Lodge Swamp.

Habitat: lowland forest.

Remarks: this frog was first collected by Schiøtz in Kwale near SHNR in 1968. It was initially thought to be endemic to the type locality but has since been recorded in other coastal forest patches (Poynton, 2006). It is listed as vulnerable on the IUCN Red List of threatened species.

*Hyperolius cf. friedemanni* Channing *et al.*, 2013

Records: NMK A3012/1–24; ZMUC-R 73916-937; ZMUC-R 77483.

Distribution: Shimba Lodge Swamp.

Habitat: humid and dense savanna.

Remarks: this species belongs to the original *H. nasutus* super species. Initial molecular analysis (Bwong, unpublished data) shows that it is closest to *H. friedemanni* (0.9% pairwise divergence) only known from the shores of Lake Malawi (Channing *et al.*, 2013). Further investigations need to be done to confirm its taxonomic status.

*Hyperolius argus* Peters, 1854

Records: NMK A3041/1–2; NMK A4619/1–7; NMK A4700/1–6; NMK A4745/1–6; NMK A5508; NMK A5513; NMK A5568; NMK A5812/1–6; NMK A5904/1–2; NMK A6023/1–7; NMK A6053; NMK A6065.

Distribution: Kivumoni Gate Swamp, Mwadabara Swamp, Shimba Lodge Swamp.

Habitat: dense coastal savanna.

*Hyperolius mariae* Barbour & Loveridge, 1928

Records: NMK A3096/1–39; NMK A3168; NMK A5899; NMK A6027/1–2; NMK A6056; NMK A6067/1–2; NMK A6076/1–2; NMK A6086; NMK A6110; CAS 157496–98.

Distribution: Kivumoni Gate Swamp, Mwadabara Swamp, Shimba Lodge Swamp.

Habitat: bushland, savanna and grassland.

*Hyperolius parkeri* Loveridge, 1933

Records: MVZ 233910; MVZ 233909.

Distribution: Mwadabara Swamp.

Habitat: coastal savanna.

*Hyperolius pusillus* (Cope, 1862)

Records: NMK A/4449.

Distribution: Kivumoni Gate Swamp.

Habitat: coastal lowland savanna and bushland.

Remarks: this species was recorded in 2005–2006 (Malonza & Measey, 2005) but was not recorded in recent studies (2012–2015).

*Hyperolius rubrovermiculatus* Schiøtz, 1975

Records: NMK A788; NMK A2076/1–10; NMK A3169; NMK A4445, NMK A4447/1–3; NMK A4623/1–2; NMK A4704; NMK A5268; NMK A5488; NMK A5506; NMK A5801/1–5; NMK A5848; NMK A5900/1–2; NMK A5909; NMK A5958/1–3; NMK A6024/1–9; NMK A6034; NMK A6034; NMK A6050/1–2; NMK A6064/1; LACM 50633, MVZ 233935; CAS 155635–46; CAS 155932–46; BMNH 1982.860–887.

Distribution: Kivumoni Gate Swamp, Mwadabara Swamp, Marere Head works, Shimba lodge Swamp, Sheldrick Falls.

Habitat: dry forest, dense humid savannah and farm bush.

Remarks: the only known endemic amphibian to SHNR and Kwale area. This frog is currently listed as endangered on the IUCN Red List (Schlötter & Drewes, 2004). It was abundant at the Shimba Lodge and Mwadabara swamps, both of which are within the reserve. However a population at the Kivumoni Swamp is facing habitat destruction as the swamp is being drained for agricultural expansion.

*Hyperolius tuberilinguis* Smith, 1849

Records: NMK A4450/1–5; NMK A4601/1–6; NMK A5269; NMK A5514; NMK A5961/1–4; NMK A6030/1–4; NMK A6058/1–2; NMK A6063/1–9; NMK A6083/1–8; CAS 153709–11.

Distribution: Kivumoni Gate Swamp, Mwadabara Swamp, Sheldrick Falls, Shimba Lodge Swamp.

Habitat: coastal savanna, woodland, bushland, grassland and thicket.

*Kassina maculata* (Duméril, 1853)

Records: NMK A739/1–9; NMK A3003/1–5; NMK A4455/1–2; NMK A4697/1–4; NMK A5736/1–4; NMK A5960; NMK A6057.

Distribution: Sheldrick Falls Reserve compound, Mwadabara Swamp, Shimba Lodge Swamp.

Habitat: savanna, bushland, grassland and farm bush.

*Kassina senegalensis* (Duméril and Bibron, 1841)

Records: NMK A/4696; CAS 153695.

Distribution: Kivumoni Gate Swamp.

Habitat: savanna.

Remarks: this species was last collected in 2006 but has not been recorded since, though one specimen was collected in 2014 just outside the reserve in a pit fall trap in Mukurumudzi dam.

### **Rhacophoridae**

*Chiromantis xerampelina* Peters, 1854

Records: NMK A4705/1–5; NMK A5451; NMK A5462; NMK A5841; NMK A5956; NMK A6021.

Distribution: Mkongani West Forest, Mwadabara Swamp, Sable Bandas, Shimba Lodge Swamp, Sheldrick Falls.

Habitat: savanna, shrubland, disturbed forest and agricultural land.

### **Hemisotidae**

*Hemisis marmoratus* (Peters, 1854)

Records: NMK A5453/1–2; NMK A5511; NMK A5570.

Distribution: Mkongani West Forest, Sheldrick Falls.

Habitat: savanna and gallery forest.

### **Phrynobatrachidae**

*Phrynobatrachus acridoides* (Cope, 1867)

Records: NMK A5808; NMK A5813/1–7; NMK A5804/1–2; NMK A5843; NMK A5846; NMK A5906/1–2; NMK A6029/1–5; NMK A6035/1–4; NMK A6046/1–4; NMK

A6052/1–3; NMK A6069/1–2; NMK A6071; CAS 155621–23, CAS 155632–34; CAS 157494–95.

Distribution: Kivumoni Gate Swamp, Marere head works, Mwadabara Swamp, National Reserve compound, Shimba Lodge Swamp, Sheldrick Falls.

Habitat: dry and humid savanna, shrubland, grassland and coastal habitat.

Remarks: first collected in 2005. In 2006 a specimen identified as *P. natalensis* Smith, 1849 was later re-identified as *P. acridoides* by PKM. This species displays diverse dorsal colour patterns with males having a bright green or brown mid-dorsal band, while females lack the bands.

### **Ptychadenidae**

*Ptychadena anchietae* (Bocage, 1868)

Records: NMK A3550/1–7; NMK A4443/1–5; NMK A4686/1–3; NMK A5241; NMK A5243; NMK A5452; NMK A5461; NMK A5463; NMK A5818/1–4; NMK A5807/1–5; NMK A5834; NMK A5835; NMK A5896/1–5; NMK A5953/1–2; NMK A6025; NMK A6026/1–4; NMK A6032; NMK A6074; CAS 153697; CAS 155624; CAS 157491.

Distribution: Buffalo River, Kivumoni Gate Swamp, Marere circuit, Mkongani West Forest, National Reserve compound, Sheldrick Falls, Shimba Lodge Swamp.

Habitat: woodland, savanna, residential and agricultural areas.

*Ptychadena oxyrhynchus* (Smith, 1849)

Records: NMK A6073; NMK A6108.

Distribution: Mwadabara Swamp, Shimba Lodge Swamp, Kivumoni Gate Swamp.

Habitat: degraded forest, humid savanna, woodlands and farmland.

*Ptychadena* sp.

Records: NMK A73/1-3; NMK A5800.

Distribution: Shimba Lodge Swamp.

Habitat: moist grassland, savanna and forest.

Remarks: the taxonomic status of this frog is currently unknown. The dorsal colour pattern resembles *P. mascareniensis* but preliminary molecular analysis (Bwong, unpublished data) places it closer to *P. porosissima*. Further study on this taxon is required to reveal its true identity.

### **Pipidae**

*Xenopus muelleri* (Peters, 1844)

Records: NMK A737/1–2; NMK A3553/1–6; NMK A4442; NMK A4693/1–4; NMK A4694; NMK A4698/1–5; NMK A5572/1–5; NMK A5840; NMK A5842; CAS 153694, CAS 155626–29, CAS 155668–69.

Distribution: Kivumoni Gate Swamp, Marere head works, Shimba Lodge Swamp, National reserve compound.

Habitat: aquatic habitat in dry savanna and humid savanna, and forest.

### **Gymnophiona**

#### **Herpelidae**

*Boulengerula changamwensis* Loveridge, 1932

Records: NMK A4395/1–11; NMK A4750; NMK A5465; NMK A5504; NMK A5510;

NMK A5918/1–3; NMK A5803/1–2; NMK A5817/1–2; NMK A5850; NMK A5908/1–2; NMK A6020; NMK A6039/1–6; NMK A6047/1–2; NMK A6061/1–2; NMK A6078; NMK A6080/1–2; NMK A6112/1–2; NMK A6061/1–2; NMK L/1887 (see Nussbaum and Hinkel, 1994).

Distribution: Longomwagandi, Makadara Forest, Pengo Forest, Kivumoni Forest, Mwele Forest, Marere Hill, Sheldrick Falls.

Habitat: lowland moist forest and plantation.

Remarks: IUCN Endangered, (IUCN, 2013a) with the only protected population in the Buda Forest and SHNR. Nussbaum & Hinkel (1994) first noted the presence of this species in the Shimba Hills on the basis of a dried misidentified amphisbaenid held in NMK.

### **Scolecophoridae**

*Scolecophorus* cf. *vittatus* Boulenger, 1895

Records: NMK A5458, BMNH 1909.6.5.6 (?) see comment below.

Distribution: Makadara Forest.

Habitat: montane, submontane and lowland forest also in cultivated land.

Remarks: the single specimen (NMK A5458) was collected in May 2014 under a decaying log. The 15 cm long individual was coloured black dorsally with a yellow pinkish lateral and ventral side. The single specimen represents the first *bona fide* record for Kenya. Previously it was only known from the Eastern Arc Mountains (Nussbaum, 1985; IUCN, 2015) but Nussbaum (1985) noted a single specimen from Mombasa (BM 1909.6.5.6) collected by Hinde in 1895. Nussbaum questioned the precise provenance of this specimen (see figure 10; p.46 in Nussbaum, 1985). The wider distribution of this species in Kenya will need to be evaluated by more extensive sampling.

## **DISCUSSION**

The thirty amphibian species of SHNR presented in this checklist is more than double the number that was reported in the preliminary study of Malonza & Measey (2005). The increase is clearly linked to the relative paucity of sampling in the area previously, following a classic pattern of increasing species discovery over time. In terms of numbers of species, the SHNR shows a comparatively elevated level of diversity to surrounding areas. For example, Arabuko-Sokoke Forest, the largest coastal forest in East Africa, has 26 recorded species (Drewes, 1992), Taita Hills, the only Eastern Arc Mountain in Kenya, also has 26 species (Malonza, *et al.*, 2010). Such comparisons show, based on the current sampling, that the SHNR has the highest amphibian diversity in Kenya. Neighbouring areas in Tanzania, such as the West Usambara and Pare Mountains are also comparable (see table 1 in Loader *et al.*, 2011). This differs from areas further south such as the East Usambara, Nguru and Uluguru Mountains, which show substantially higher species diversity (Poynton *et al.*, 2007; Menegon *et al.*, 2008).

The high diversity in SHNR compared to other Kenyan localities may be attributed to a number of factors, but direct comparisons are hindered by the relatively different sizes of areas and intensities of sampling conducted in each area. However, one key aspect appears to be the heterogeneous habitats in the SHNR, the area consists of six forest types and woodland and grassland habitats within the reserve (Davis, 1993; Luke, 2005) allowing for a variety of species from different biogeographic zones. The amphibian fauna of SHNR consists of a combination of species from the Eastern Afromontane Region, and Coastal

Forests of Eastern Africa, in addition to the numerous widespread species occurring in varying types of savanna habitats. Within the SHNR, we therefore have a broad representation of all possible habitats found across Kenya unlike other comparable regions.

There are a few amphibian species of particular note to be found in the Shimba Hills. One species appears to be endemic to the reserve, *Hyperolius rubrovermiculatus*, although the taxonomy of this taxon is currently unresolved (see Channing & Howell, 2006). Furthermore, one taxon, *Scolecophorus* cf. *vittatus*, might be recognized as being distinct from other Eastern Arc populations. This level of endemism (2–3 species) may be considered low when compared to the East Usambara Mountains where eight amphibian species (Poynton *et al.*, 2007) are endemic. However, as far as vertebrate fauna is concerned, this may be considered relatively high, as no endemic bird or mammal species have been recorded in the reserve to date ([cca.kws.go.ke/shimbaHills.html](http://cca.kws.go.ke/shimbaHills.html); Bennun & Njoroge, 1999). Only 20% of the amphibians in SHNR belong to the Coastal Forest ecoregion, including species such as *Mertensophryne micranotis*, *Afrixalus sylvaticus* and *Hyperolius rubrovermiculatus* (Poynton, 1999; Schiøtz, 1999; Burgess & Clarke, 2000). Eastern Afromontane species are represented by *Scolecophorus* cf. *vittatus* and *Callulina* cf. *krefftii* indicating some association of SHNR with this region. However, the majority of the SHNR amphibian fauna belong to the widespread fauna found in savanna regions forming a mosaic of fragmented habitats intermixing with coastal forest. These extend inland into drier areas, stretching along the coast from southern Somalia through Kenya, Tanzania and Mozambique to the eastern coast of South Africa. These include savanna living species as well as those confined to the dry semi-deciduous forest (bushland savanna) (Schiøtz, 1999). About 23 species (76%) occur here including *Afrixalus fornasini*, *Hyperolius parkeri*, *H. pusillus*, *H. tuberinguis*, *H. argus*, *Leptopelis concolor*, *Kassina maculata* and *Xenopus muelleri*. Even further, wide-ranging species are represented by *Hemisus marmoratus*, *Kassina senegalensis*, *Phrynobatrachus acridoides*, *Ptychadena anchietae*, and *P. oxyrhynchus*. However, it should be noted that taxonomy of many of these species is poorly known and might reveal more taxonomic units and further divisions to their currently rather large distributions.

This checklist contains all the amphibians of SHNR as currently known. This does not preclude the possibility that new discoveries will not be made in the future. The following species were expected from the reserve given that they have been recorded very close to the reserve or their IUCN red list presumed range includes SHNR: *Phrynobatrachus mababiensis* FitzSimons, 1932; *Phrynomantis bifasciatus* Smith, 1847; *Pyxicephalus angusticeps* Parry, 1982; *Ptychadena mossambica* Peters, 1854; *Ptychadena schillukorum* Werner, 1908 (Channing & Howell, 2006; Harper *et al.*, 2010, IUCN, 2013b). Further sampling across the area is required to understand if these species occur. Furthermore, as can be seen from figure 2, surveys have been relatively concentrated in some parts and large areas await sampling. These areas include both higher elevation forest areas, which might produce more specimens of typical Eastern Afromontane amphibians such as those already collected, and potentially new undescribed species. Further sampling of such areas are required if a complete list of the area is to be made.

## CONCLUSION

SHNR has the highest amphibian diversity in Kenya, accounting for about 30% of the country's amphibians. Fortunately, the area is relatively well protected being a National Reserve and is frequently visited by tourists, who provide solid economic revenue. These

features suggest its long-term future is relatively well secured. The area could provide an important basis for understanding amphibians in Kenya more broadly and promote their conservation. The amphibians in the reserve represent a mix of both Eastern Afromontane, widespread Coastal Forest species and pan African species, potentially therefore making it an important area for further expanding our knowledge on various biological questions including phylogeography, behaviour and community ecology.

One major biological question will be interpreting the biogeographic history of SHNR given the various species that can be found within the reserve. At present, it remains unclear whether the observed diversity and endemism is the result of habitat stability within coastal forest or recent colonization from other areas such as the Eastern Arc Mountains. To address these questions a more detailed understanding of the historical biogeography of all lineages in SHNR and other neighbouring coastal forests is required. Key to any kind of understanding of such questions though is the establishment of baseline data as outlined in this publication.

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Appendix 1. A list of all known amphibian records from Shimba Hills National Reserve indicating museum number, collector name, date and locality. Records with stars were obtained from the HerpNet.

Museum ID	Species	Collection date	Collector	Locality
*LACM 50633	<i>Hyperolius rubrovermiculatus</i>	2 Apr 1968	A. Williams	Shimba Hills Rainforest
NMK A737/1-2	<i>Xenopus muelleri</i>	May 1968	A. D. Mackay	Shimba Hills
NMK A739/1-9	<i>Kassina maculata</i>	Jun 1968	A. D. Mackay	Shimba Hills
NMK A3003/1-5	<i>Kassina maculata</i>	20 May 1968	A. Schiøtz & A. D. Mackay	Shimba Hills
NMK A787	<i>Leptopelis flavomaculatus</i>	Nov 1968	D. Sheldrick	Near Giriama point
NMK A788	<i>Hyperolius rubrovermiculatus</i>	Dec 1968	D. Sheldrick	Near Giriama point
NMK A3041/1-2	<i>Hyperolius argus</i>	20 May 1968	A. Schiøtz & A. D. Mackay	Shimba Hills
NMK A3096/1-39	<i>Hyperolius mariae</i>	20 Jun 1968	A. Schiøtz & A. D. Mackay	Shimba Hills
ZMUC-R 73916-937	<i>Hyperolius acuticeps</i>	20 May 1968	A. Schiøtz	Shimba Hills
ZMUC-R73854	<i>Hyperolius rubrovermiculatus</i>	20 May 1968	A Schiøtz	Shimba Hills
ZMUC-R73855	<i>Afrivalus delicatus</i>	20 May 1968	A. Schiøtz	Shimba Hills
ZMUC-R73948/49	<i>Afrivalus delicatus</i>	20 May 1968	A. Schiøtz	Shimba Hills
ZMUC-R77457/458	<i>Afrivalus delicatus</i>	20 May 1968	A. Schiøtz	Shimba Hills
NMK A3169	<i>Hyperolius rubrovermiculatus</i>	no date	A. D. Mackay,	Sheldrick Falls
NMK A1150/1-9	<i>Mertensophryne micranotis</i>	Apr-Jun 1977	A. D. Mackay	Makadara Forest
BMNH 1980.195	<i>Mertensophryne micranotis</i>	1977	?	Shimba Hills
BMNH 1980.197	<i>Mertensophryne micranotis</i>	1977	L. P. Lounibos	Shimba Hills
BMNH 1982.395-396	<i>Mertensophryne micranotis</i>	Apr 1977	L. P. Lounibos	Makadara Forest
*CAS 153633-40	<i>Leptopelis flavomaculatus</i>	12 Apr 1981	S. Reilly	Makadara Forest, picnic site
*CAS 153694	<i>Xenopus muelleri</i>	13 Apr 1981	S. Reilly	Shimba Hills
*CAS 153695	<i>Kassina senegalensis</i>	14 Apr 1981	S. Reilly	200 m. S of Risley's Ridge turnaround
*CAS 153697	<i>Ptychadena anchietae</i>	15 Apr 1981	S. Reilly	200 m. S of Risley's Ridge turnaround
*CAS 153698	<i>Mertensophryne micranotis</i>	16 Apr 1981	S. Reilly	Shimba Hills, campsite 1
*CAS 153709-11	<i>Hyperolius tuberilinguis</i>	17 Apr 1981	S. Reilly	Shimba Hills
BMNH 1982.842	<i>Sclerophrys gutturalis</i>	6 May 1981	A. Grandison	Shimba Hills

Museum ID	Species	Collection date	Collector	Locality
BMNH1982.857-859	<i>Afrivalus sylvaticus</i>	6 May 1981	A. Grandison	Sheldrick Falls
BMNH 1982.860-887	<i>Hyperolius rubrovermiculatus</i>	6 May 1981	A. Grandison	Sheldrick Falls
*CAS 155604	<i>Arthroleptis xenodactyloides</i>	6 Jul 1981	M. Tandy	Makadara Forest
*CAS 155606	<i>Sclerophrys pusilla</i>	6 Jul 1981	M. Tandy	Marere head works
*CAS 155613-20	<i>Sclerophrys pusilla</i>	6 Jul 1981	M. Tandy	Marere head works
*CAS 155621-23	<i>Phrynobatrachus acridoides</i>	6 Jul 1981	M. Tandy	Marere head works
*CAS 155624	<i>Ptychadena anchietae</i>	6 Jul 1981	M. Tandy	Marere head works
*CAS 155626-29	<i>Xenopus muelleri</i>	6 Jul 1981	M. Tandy	Shimba Hills National Reserve
*CAS 155630-31	<i>Leptopelis flavomaculatus</i>	6 Jul 1981	M. Tandy	Marere head works
*CAS 155632-34	<i>Phrynobatrachus acridoides</i>	6 Jul 1981	M. Tandy	Marere head works
*CAS 155635-46	<i>Hyperolius rubrovermiculatus</i>	12 Jul 1981	M. Tandy	Marere head works
*CAS 155647-50	<i>Sclerophrys pusilla</i>	12 Jul 1981	M. Tandy	Marere head works
*CAS 155652-54	<i>Afrivalus sylvaticus</i>	13 Jul 1981	M. Tandy	Marere head works
*CAS 155655-67	<i>Sclerophrys pusilla</i>	17 Jul 1981	M. Tandy	Marere head works
*CAS 155668-69	<i>Xenopus muelleri</i>	17 Jul 1981	M. Tandy	Marere head works
*CAS 155671-77	<i>Arthroleptis stenodactylus</i>	18 Jul 1981	M. Tandy	Makadara forest
*CAS 155883	<i>Sclerophrys pusilla</i>	17 Jul 1981	M. Tandy	Marere head works
*CAS 155932-46	<i>Hyperolius rubrovermiculatus</i>	11 Jul 1981	M. Tandy	Below Marere head works
*CAS 155947	<i>Afrivalus sylvaticus</i>	11 Jul 1981	M. Tandy	5 km N main gate - Kwale entrance into SHNR
*CAS 157491	<i>Ptychadena anchietae</i>	Feb 1984	M. Ryan	6 km N main gate - Kwale entrance into SHNR
*CAS 157492	<i>Afrivalus fornasini</i>	Feb 1984	M. Ryan	7 km N main gate - Kwale entrance into SHNR
*CAS 157493	<i>Sclerophrys pusilla</i>	Feb 1984	M. Ryan	8 km N main gate - Kwale entrance into SHNR
*CAS 157494-95	<i>Phrynobatrachus acridoides</i>	Feb 1984	M. Ryan	9 km N main gate - Kwale entrance into SHNR
*CAS 157496-98	<i>Hyperolius mariae</i>	Feb 1984	M. Ryan	10 km N main gate - Kwale entrance into SHNR

Museum ID	Species	Collection date	Collector	Locality
MVZ 233935	<i>Hyperolius rubrovermiculatus</i>	5 Jun 1998	Dan R. Buchholz et al	Shimba Hills
MVZ 233824	<i>Afrixalus sylvaticus</i>	5 Jun 1998	Dan R. Buchholz et al	Shimba Hills
MVZ 233910	<i>Hyperolius parkeri</i>	5 Jun 1998	Dan R. Buchholz et al	Shimba Hills
MVZ 233825	<i>Afrixalus sylvaticus</i>	5 Jun 1998	Dan R. Buchholz et al	Shimba Hills
MVZ 233909	<i>Hyperolius parkeri</i>	5 Jun 1998	Dan R. Buchholz et al	Shimba Hills
NMK A3550/1-7	<i>Ptychadena anchietae</i>	3 Jul 1998	A. Wise, Weatherby, C. & Ross, K.	Shimba Hills
NMK A3553/1-6	<i>Xenopus muelleri</i>	3 Jul 1998	A. Wise, Weatherby, C. & Ross, K.	Shimba Hills
NMK A3582/1-2	<i>Sclerophrys pusilla</i>	3 Jul 1998	A. Wise, Weatherby, C. & Ross, K.	Shimba Hills
NMK A4448/1-6	<i>Arthroleptis xenodactyloides</i> <i>Boulengerula</i>	29-30 Nov 2005	P. K. Malonza & J.G. Measey	Longomwagandi Forest
NMK A4395/1-11	<i>changamwensis</i>	29-30 Nov 2005	P. K. Malonza & J.G. Measey	Longomwagandi Forest
NMK A4401/1-6	<i>Arthroleptis stenodactylus</i>	29-30 Nov 2005	P. K. Malonza & J.G. Measey	Longomwagandi Forest
NMK A4440	<i>Afrixalus sylvaticus</i>	28 Nov 2005	P. K. Malonza & J.G. Measey	Sheldrick Falls
NMK A4442	<i>Xenopus muelleri</i>	29 Nov 2005	P. K. Malonza & J.G. Measey	Kivuroni Swamp
NMK A4443/1-5	<i>Ptychadena anchietae</i>	28 Nov 2005	P. K. Malonza & J.G. Measey	Bufallo River
NMK A4448/1-6	<i>Arthroleptis xenodactyloides</i>	29-30 Nov 2005	P. K. Malonza & J.G. Measey	Longomwagandi Forest
NMK A4449	<i>Hyperolius pusillus</i>	29 Nov 2005	P. K. Malonza & J.G. Measey	Kivuroni Gate Swamp
NMK A4452	<i>Sclerophrys steindachneri</i>	28 Nov 2005	P. K. Malonza & J.G. Measey	Sheldrick Falls
NMK A4455/1-2	<i>Kassina maculata</i>	29 Nov 2005	P. K. Malonza & J.G. Measey	Kivuroni Gate Swamp
NMK A4458/1-4	<i>Afrixalus fornasini</i>	29 Nov 2005	P. K. Malonza & J.G. Measey	Kivuroni Gate Swamp
NMK A4459/1-8	<i>Arthroleptis xenodactyloides</i>	28-29 Nov 2005	P. K. Malonza & J.G. Measey	Makadara Forest
NMK A4461	<i>Sclerophrys steindachneri</i>	28-29 Nov 2005	P. K. Malonza & J.G. Measey	Kivuroni Gate Swamp
NMK A4450/1-5	<i>Hyperolius tuberilinguis</i>	29 Nov 2005	P. K. Malonza & J.G. Measey	Kivuroni Gate Swamp
NMK A4653/1-2	<i>Arthroleptis xenodactyloides</i>	29 Nov 2005	P. K. Malonza & J.G. Measey	Makadara Forest
NMK A4653/1-2	<i>Arthroleptis stenodactylus</i>	30 Nov 2005	P. K. Malonza & J.G. Measey	Longomwagandi Forest
NMK A4460/1-3	<i>Arthroleptis stenodactylus</i>	30 Nov 2005	P. K. Malonza & J.G. Measey	Longomwagandi Forest
NMK A4445	<i>Hyperolius rubrovermiculatus</i>	28 Nov 2005	P. K. Malonza & J.G. Measey	Sheldrick Falls

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NMK A4447/1-3	<i>Hyperolius rubrovermiculatus</i>	29 Nov 2005	P. K. Malonza & J.G. Measey	Kivumoni Gate Swamp
NMK A4450/1-5	<i>Hyperolius tuberilinguis</i>	29 Nov 2005	P. K. Malonza & J.G. Measey	Kivumoni Gate Swamp
NMK A4615/1-6	<i>Afraxalus fornasini</i>	22 Apr 2006	B. Bwong, J.G. Measey & Venu	Kivumoni Gate Swamp
NMK A4613	<i>Arthroleptis stenodactylus</i>	22 Apr 2006	B. Bwong, J.G. Measey & Venu	Longomwagandi Forest
NMK A4619/1-7	<i>Hyperolius argus</i>	23 Apr 2006	B. Bwong, J.G. Measey & Venu	Kivumoni Gate Swamp
NMK A4686/1-3	<i>Ptychadena anchietae</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4689/1	<i>Sclerophrys steindachneri</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4690/1-7	<i>Afraxalus fornasini</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4693/1-4	<i>Xenopus muelleri</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4694	<i>Xenopus muelleri</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4696	<i>Kassina senegalensis</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4697/1-4	<i>Kassina maculatus</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4698/1-35	<i>Xenopus muelleri</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4699/1-7	<i>Leptopelis concolor</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4745/1-6	<i>Hyperolius argus</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4703/1-7	<i>Afraxalus sylvaticus</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4705/1-5	<i>Chiromantis xerampelina</i>	13 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4700/1-6	<i>Hyperolius argus</i>	13 Sep 2006	Jos Kielgast	Shimba Hills
NMK A4623/1-2	<i>Hyperolius rubrovermiculatus</i>	22 Apr 2006	B. Bwong & J.G. Measey	Kivumoni Gate Swamp
NMK A4704	<i>Hyperolius rubrovermiculatus</i>	13-16 Sep 2006	Jos Kielgast	Shimba Hills
NMK A5241	<i>Ptychadena anchietae</i>	17-18 Dec 2010	Miloslav Jirku	Shimba Lodge Swamp
NMK A5252	<i>Afraxalus fornasini</i>	17-18 Dec 2010	Miloslav Jirku	Shimba Lodge Swamp
NMK A5256	<i>Arthroleptis stenodactylus</i>	17-19 Dec 2010	Miloslav Jirku	Shimba Lodge Swamp
NMK A5243	<i>Ptychadena anchietae</i>	18 Dec 2010	Miloslav Jirku	Shimba Hills National Reserve
NMK A5269	<i>Hyperolius tuberilinguis</i>	17-18 Dec 2010	Miloslav Jirku	Shimba Lodge Swamp
NMK A5268	<i>Hyperolius rubrovermiculatus</i>	17-18 Dec 2010	Miloslav Jirku	Shimba Lodge Swamp

Museum ID	Species	Collection date	Collector	Locality
NMK A5451	<i>Chiromantis xerampelina</i>	7 Apr 2012	V. Wasonga & J. Nyamache	Mkongani west Forest
NMK A5452	<i>Ptychadena anchietae</i>	10 Apr 2012	V. Wasonga & J. Nyamache	Marere circuit
NMK A5453/1-2	<i>Hemisus marmoratus</i>	8 Apr 2012	V. Wasonga & J. Nyamache	Mkongani west Forest
NMK A5459/1-2	<i>Arthroleptis stenodactylus</i>	5 Apr 2012	V. Wasonga & J. Nyamache	Sheldrick Falls
NMK A5460	<i>Mertensophryne micranotis</i>	4 Apr 2012	V. Wasonga & J. Nyamache	Sable Bandas
NMK A5461	<i>Ptychadena anchietae</i>	9 Apr 2012	V. Wasonga & J. Nyamache	Mkongani west Forest
NMK A5462	<i>Chiromantis xerampelina</i>	2 Apr 2012	V. Wasonga & J. Nyamache	Sable Bandas
NMK A5463	<i>Ptychadena anchietae</i>	5 Apr 2012	V. Wasonga & J. Nyamache	Sheldrick Falls
NMK A5464	<i>Mertensophryne micranotis</i>	4 Apr 2012	V. Wasonga & J. Nyamache	Longomwagandi Forest
NMK A5501	<i>Arthroleptis stenodactylus</i>	21 Jun 2012	V. Wasonga & J. Nyamache	Mwele Forest
NMK A5502	<i>Arthroleptis stenodactylus</i>	23 Jun 2012	V. Wasonga & J. Nyamache	Sheldrick Falls
NMK A5465	<i>Boulengerula changamwensis</i>	3 Apr 2012	V. Wasonga & J. Nyamache	Sheldrick Falls
NMK A5505	<i>Arthroleptis stenodactylus</i>	3 Apr 2012	V. Wasonga & J. Nyamache	Mwele Forest
NMK A5507/1-2	<i>Sclerophrys pusilla</i> <i>Boulengerula</i>	23 Jun 2012	V. Wasonga & J. Nyamache	Sheldrick Falls
NMK A5504	<i>changamwensis</i>	24 Jun 2012	V. Wasonga & J. Nyamache	Sheldrick Falls
NMK A5511	<i>Hemisus marmoratus</i>	23 Jun 2012	V. Wasonga & J. Nyamache	Sheldrick Falls
NMK A5513	<i>Hyperolius argus</i>	19 Apr 2012	V. Wasonga & J. Nyamache	Shimba Lodge Swamp
NMK A5515	<i>Arthroleptis xenodactyloides</i>	5 Jun 2012	V. Wasonga & J. Nyamache	Sheldrick Falls
NMK A5514	<i>Hyperolius tuberilinguis</i>	19 Jun 2012	V. Wasonga & J. Nyamache	Shimba Lodge Swamp
NMK A5633	<i>Mertensophryne micranotis</i>	12-16 Nov 2012	J. Mueti & C. Ofori	Kaya Forest
NMK A5458	<i>Mertensophryne micranotis</i>	5 Nov 2012	V. Wasonga & J. Nyamache	Sheldrick Falls
NMK A5631/1-2	<i>Arthroleptis xenodactyloides</i> <i>Boulengerula</i>	12-16 Nov 2012	J. Mueti & C. Ofori	Kaya Forest
NMK A5510	<i>changamwensis</i>	19 Jun 2012	V. Wasonga & J. Nyamache	Mwele Forest
NMK A5506	<i>Hyperolius rubrovermiculatus</i>	19 Jun 2012	V. Wasonga & J. Nyamache	Shimba Lodge Swamp
NMK A5809/1-3	<i>Arthroleptis xenodactyloides</i>	18 Dec 2013	J. Nyamache & P. Mwasi	Longomwagandi Forest
NMK A5805/1-4	<i>Arthroleptis xenodactyloides</i>	17 Dec 2013	J. Nyamache & P. Mwasi	Makadara Forest

Museum ID	Species	Collection date	Collector	Locality
NMK A5803/1-2	<i>Boulengerula changamwensis</i>	17 Dec 2013	J. Nyamache & P. Mwasi	Longomwagandi Forest
NMK A5818/1-4	<i>Ptychadena anchietae</i>	20 Dec 2013	J. Nyamache & P. Mwasi	Shimba Lodge Swamp
NMK A5800	<i>Ptychadena</i> sp.	18 Dec 2013	J. Nyamache & P. Mwasi	Shimba Lodge Swamp
NMK A5812/1-6	<i>Hyperolius argus</i>	18 Dec 2013	J. Nyamache & P. Mwasi	Shimba Lodge Swamp
NMK A5801/1-5	<i>Hyperolius rubrovermiculatus</i>	18 Dec 2013	J. Nyamache & P. Mwasi	Shimba Lodge Swamp
NMK A5810/1-2	<i>Arixalus formasini</i>	18 Dec 2013	J. Nyamache & P. Mwasi	Shimba Lodge Swamp
NMK A5808	<i>Phrynobatrachus acridoides</i>	18 Dec 2013	J. Nyamache & P. Mwasi	Shimba Lodge Swamp
NMK A5819	<i>Mertensophryne micranotis</i>	20 Dec 2013	J. Nyamache & P. Mwasi	Longomwagandi Forest
NMK A5820/1-3	<i>Arthroleptis xenodactyloides</i>	20 Dec 2013	J. Nyamache & P. Mwasi	Longomwagandi Forest
NMK A5817/1-2	<i>Boulengerula changamwensis</i>	20 Dec 2013	J. Nyamache & P. Mwasi	Longomwagandi Forest
NMK A5816	<i>Arthroleptis xenodactyloides</i>	20 Dec 2013	J. Nyamache & P. Mwasi	Makadara Forest
NMK A5811	<i>Mertensophryne micranotis</i>	23 Dec 2013	J. Nyamache & P. Mwasi	Sheldrick Falls
NMK A5802/1-2	<i>Ptychadena anchietae</i>	23 Dec 2013	J. Nyamache & P. Mwasi	Sheldrick Falls
NMK A5806	<i>Arthroleptis stenodactylus</i>	23 Dec 2013	J. Nyamache & P. Mwasi	Sheldrick Falls
NMK A5804/1-2	<i>Phrynobatrachus acridoides</i>	23 Dec 2013	J. Nyamache & P. Mwasi	Sheldrick Falls
NMK A5917/1-4	<i>Sclerophrys pusilla</i>	19 Jun 2014	V. Wasonga & J. Ochong	Shimba Hills National Reserve
NMK A5911	<i>Mertensophryne micranotis</i>	19 Jun 2014	V. Wasonga & J. Ochong	Makadara Forest
NMK A5915	<i>Arthroleptis xenodactyloides</i>	16 Jun 2014	V. Wasonga & J. Ochong	Mkanda River, Lokore Forest
NMK A5913	<i>Arthroleptis stenodactylus</i>	14 Jun 2014	V. Wasonga & J. Ochong	Mwele Grassland
NMK A5912	<i>Arthroleptis xenodactyloides</i>	18 Jun 2014	V. Wasonga & J. Ochong	Sable Bandas
NMK A5953/1-2	<i>Ptychadena anchietae</i>	2 Sep 2014	J. Nyamache	Sheldrick Falls
NMK A5844/1-5	<i>Leptopelis flavomaculatus</i>	30 Apr 2014	J. Nyamache & P. Mwasi	Shimba Lodge Swamp
NMK A5848	<i>Hyperolius rubrovermiculatus</i>	30 Apr 2014	J. Nyamache & P. Mwasi	Shimba Lodge Swamp
NMK A5835	<i>Ptychadena anchietae</i>	30 Apr 2014	J. Nyamache & P. Mwasi	Shimba Lodge Swamp
NMK A5838/1-3	<i>Mertensophryne micranotis</i>	3 May 2014	J. Nyamache & P. Mwasi	Longomwagandi Forest
NMK A5851/1-2	<i>Arthroleptis xenodactyloides</i>	3 May 2014	J. Nyamache & P. Mwasi	Longomwagandi Forest
NMK A5855/1-4	<i>Sclerophrys gutturalis</i>	3 May 2014	J. Nyamache & P. Mwasi	Shimba Hills National Reserve HQ



Museum ID	Species	Collection date	Collector	Locality
NMK A5846	<i>Phrynobatrachus acridooides</i>	3 May 2014	J. Nyamache & P. Mwasi	Shimba Hills National Reserve HQ
NMK A5840	<i>Xenopus muelleri</i>	3 May 2014	J. Nyamache & P. Mwasi	Shimba Hills National Reserve HQ
NMK A5837	<i>Afraxalus sylvaticus</i>	3 May 2014	J. Nyamache & P. Mwasi	Shimba Hills National Reserve HQ
NMK A5850	<i>Boulengerula changamwensis</i>	4 May 2014	J. Nyamache & P. Mwasi	Longomwagandi Forest
NMK A5849	<i>Arthroleptis stenodactylus</i>	4 May 2014	J. Nyamache & P. Mwasi	Longomwagandi Forest
NMK A5854	<i>Scolecophorphus vittatus</i>	4 May 2014	J. Nyamache & P. Mwasi	Makadara Forest
NMK A5896/1-5	<i>Ptychadena anchietae</i>	12 Jun 2014	J. Nyamache & J. Ochong	Shimba Lodge Swamp
NMK A5904/1-2	<i>Hyperolius argus</i>	12 Jun 2014	J. Nyamache & J. Ochong	Shimba Lodge Swamp
NMK A5907/1-3	<i>Hyperolius puncticulatus</i>	12 Jun 2014	J. Nyamache & J. Ochong	Shimba Lodge Swamp
NMK A5899	<i>Hyperolius mariae</i>	12 Jun 2014	J. Nyamache & J. Ochong	Shimba Lodge Swamp
NMK A5900/1-2	<i>Hyperolius rubrovermiculatus</i>	12 Jun 2014	J. Nyamache & J. Ochong	Shimba Lodge Swamp
NMK A5897	<i>Arthroleptis stenodactylus</i>	12 Jun 2014	J. Nyamache & J. Ochong	Shimba Lodge Swamp
NMK A5905	<i>Hyperolius rubrovermiculatus</i>	12 Jun 2014	J. Nyamache & J. Ochong	Shimba Lodge Swamp
NMK A5901/1-2	<i>Arthroleptis xenodactyloides</i>	13 Jun 2014	J. Nyamache & J. Ochong	Shimba Lodge Swamp
NMK A5898	<i>Mertensophryne micranotis</i>	13 Jun 2014	J. Nyamache & J. Ochong	Kivumoni Forest
NMK A5908/1-2	<i>Boulengerula changamwensis</i>	13 Jun 2014	J. Nyamache & J. Ochong	Kivumoni Forest
NMK A5903	<i>Afraxalus fornasini</i>	13 Jun 2014	J. Nyamache & J. Ochong	Kivumoni Gate Swamp
NMK A5902/1-3	<i>Afraxalus sylvaticus</i>	14 Jun 2014	J. Nyamache & J. Ochong	Kivumoni Gate Swamp
NMK A5909	<i>Hyperolius rubrovermiculatus</i>	14 Jun 2014	J. Nyamache & J. Ochong	Kivumoni Gate Swamp
NMK A5906/1-2	<i>Phrynobatrachus acridooides</i>	14 Jun 2014	J. Nyamache & J. Ochong	Kivumoni Gate Swamp
NMK A5961/1-4	<i>Hyperolius tuberiinguis</i>	2 Sep 2014	J. Nyamache & J. Ochong	Sheldrick Falls
NMK A5958/1-3	<i>Hyperolius rubrovermiculatus</i>	2 Sep 2014	J. Nyamache & J. Ochong	Sheldrick Falls
NMK A5957/1-3	<i>Afraxalus sylvaticus</i>	2 Sep 2014	J. Nyamache	Sheldrick Falls
NMK A5953/1-2	<i>Ptychadena anchietae</i>	2 Sep 2014	J. Nyamache	Sheldrick Falls
NMK A5960	<i>Kassina maculata</i>	2 Sep 2014	J. Nyamache	Sheldrick Falls
NMK A5956	<i>Chiromantis xerampelina</i>	2 Sep 2014	J. Nyamache	Sheldrick Falls
NMK A5954	<i>Afraxalus fornasini</i>	2 Sep 2014	J. Nyamache	Sheldrick Falls

Museum ID	Species	Collection date	Collector	Locality
NMK A5918/1-3	<i>Boulengerula changamwensis</i>	19-20 Jun 2014	V. Wasonga & J. Ochong	Makadara Forest and picnic site
NMK A6019/1-3	<i>Arthroleptis xenodactyloides Boulengerula changamwensis</i>	27 Apr 2015	B. Bwong & J. Nyamache	Longomwagandi Forest
NMK A6020	<i>Chiromanitis xerampelina</i>	27 Apr 2015	B. Bwong & J. Nyamache	Longomwagandi Forest
NMK A6021	<i>Leptopelis flavomaculatus</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6022/1-4	<i>Ptychadena anchietae</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6026/1-4	<i>Ptychadena anchietae</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6025	<i>Hyperolius argus</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6023/1-7	<i>Hyperolius rubrovermiculatus</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6024/1-9	<i>Hyperolius tuberculiguis</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6030/1-4	<i>Hyperolius mariae</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6027/1-2	<i>Afraxalus sylvaticus</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6028	<i>Phrynobatrachus acridoides</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6029/1-5	<i>Arthroleptis xenodactyloides</i>	27 Apr 2015	B. Bwong & J. Nyamache	Shimba Lodge Swamp
NMK A6031	<i>Mertensophryne micranotis</i>	28 Apr 2015	B. Bwong & J. Nyamache	Makadara Forest
NMK A6038/1-2	<i>Arthroleptis xenodactyloides</i>	28 Apr 2015	B. Bwong & J. Nyamache	Makadara Forest
NMK A6037/1-2	<i>Boulengerula changamwensis</i>	28 Apr 2015	B. Bwong & J. Nyamache	Makadara Forest
NMK A6039/1-6	<i>Ptychadena anchietae</i>	28 Apr 2015	B. Bwong & J. Nyamache	Makadara Forest
NMK A6032	<i>Phrynobatrachus acridoides</i>	28 Apr 2015	B. Bwong & J. Nyamache	Kivumoni Gate Swamp
NMK A6035/1-4	<i>Afraxalus sylvaticus</i>	28 Apr 2015	B. Bwong & J. Nyamache	Kivumoni Gate Swamp
NMK A6033/1-5	<i>Hyperolius rubrovermiculatus</i>	28 Apr 2015	B. Bwong & J. Nyamache	Kivumoni Gate Swamp
NMK A6034	<i>Arthroleptis stenodactylus</i>	29 Apr 2015	B. Bwong & J. Nyamache	Kivumoni Gate Swamp
NMK A6040	<i>Arthroleptis xenodactyloides</i>	29 Apr 2015	B. Bwong & J. Nyamache	Makadara Forest
NMK A6041/1-3	<i>Arthroleptis xenodactyloides</i>	30 Apr 2015	B. Bwong & J. Nyamache	Makadara Forest
NMK A6042	<i>Leptopelis flavomaculatus</i>	30 Apr 2015	B. Bwong & J. Nyamache	Marere Hill
NMK A6044	<i>Afraxalus sylvaticus</i>	30 Apr 2015	B. Bwong & J. Nyamache	Sheldrick Falls
NMK A6043/1-4	<i>Phrynobatrachus acridoides</i>	30 Apr 2015	B. Bwong & J. Nyamache	Sheldrick Falls
NMK A6046/1-5		30 Apr 2015	B. Bwong & J. Nyamache	Sheldrick Falls

Museum ID	Species	Collection date	Collector	Locality
NMK A6045	<i>Arthroleptis stenodactylus</i>	30 Apr 2015	B. Bwong & J. Nyamache	Sheldrick Falls
NMK A6048	<i>Arthroleptis stenodactylus</i>	1 May 2015	B. Bwong & J. Nyamache	Pengo Forest
NMK A6049	<i>Arthroleptis xenodactyloides</i>	1 May 2015	B. Bwong & J. Nyamache	Risley Forest
NMK A6047/1-2	<i>Boulengerula changamwensis</i>	1 May 2015	B. Bwong & J. Nyamache	Pengo Forest
NMK A6057	<i>Kassina maculata</i>	1 May 2015	B. Bwong & J. Nyamache	Mwadabara Swamp
NMK A 6055/1-4	<i>Afraxalus delicatus</i>	1 May 2015	B. Bwong & J. Nyamache	Mwadabara Swamp
NMK A6054	<i>Afraxalus delicatus</i>	1 May 2015	B. Bwong & J. Nyamache	Mwadabara Swamp
NMK A6052/1-3	<i>Phrynobatrachus acridoides</i>	1 May 2015	B. Bwong & J. Nyamache	Mwadabara Swamp
NMK A6053	<i>Hyperolius argus</i>	1 May 2015	B. Bwong & J. Nyamache	Mwadabara Swamp
NMK A6051	<i>Leptopelis concolor</i>	1 May 2015	B. Bwong & J. Nyamache	Mwadabara Swamp
NMK A6050/1-5	<i>Hyperolius rubrovermiculatus</i>	1 May 2015	B. Bwong & J. Nyamache	Mwandabara Swamp
NMK A6056	<i>Hyperolius mariae</i>	1 May 2015	B. Bwong & J. Nyamache	Mwadabara Swamp
NMK A6058/1-2	<i>Hyperolius tuberilinguis</i>	1 May 2015	B. Bwong & J. Nyamache	Mwadabara Swamp
NMK A6059/1-2	<i>Arthroleptis xenodactyloides</i>	2 May 2015	B. Bwong & J. Nyamache	Makadara Forest
NMK A6062/1-2	<i>Afraxalus forasini</i>	12 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6065	<i>Hyperolius argus</i>	12 May 2015	J. Nyamache	Mwadambara Swamp
NMK A6064/1-2	<i>Hyperolius rubrovermiculatus</i>	12 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6066/1-3	<i>Hyperolius rubrovermiculatus</i>	12 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6063/1-9	<i>Hyperolius tuberilinguis</i>	12 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6067/1-2	<i>Hyperolius mariae</i>	12 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6068/1-4	<i>Afraxalus delicatus</i>	12 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6069/1-2	<i>Phrynobatrachus acridoides</i>	12 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6071	<i>Phrynobatrachus acridoides</i>	12 May 2015	J. Nyamache	Makadara Forest
NMK A6070/1-3	<i>Arthroleptis xenodactyloides</i>	12 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6072	<i>Xenopus muelleri</i>	12 May 2015	J. Nyamache	Makadara Forest
NMK A6073	<i>Ptychadena oxyrhynchus</i>	13 May 2015	J. Nyamache	Kivumoni Gate Swamp
NMK A6074	<i>Ptychadena anchietae</i>	13 May 2015	J. Nyamache	Kivumoni Gate Swamp

Museum ID	Species	Collection date	Collector	Locality
NMK A6075	<i>Leptopelis concolor</i>	13 May 2015	J. Nyamache	Kivumoni Gate Swamp
NMK A6076/1-2	<i>Hyperolius mariae</i>	13 May 2015	J. Nyamache	Kivumoni Gate Swamp
NMK A6077	<i>Hyperolius rubrovermiculatus</i> <i>Boulengerula</i>	13 May 2015	J. Nyamache	Kivumoni Gate Swamp
NMK A6078	<i>changamwensis</i>	13 May 2015	J. Nyamache	Makadara Forest
NMK A6079/1-3	<i>Arthroleptis xenodactyloides</i> <i>Boulengerula</i>	13 May 2015	J. Nyamache	Kivumoni Gate Swamp
NMK A6080/1-2	<i>changamwensis</i>	13 May 2015	J. Nyamache	Kivumoni Tower
NMK A6081/1-4	<i>Hyperolius rubrovermiculatus</i>	14 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6083/1-8	<i>Hyperolius tuberilinguis</i>	14 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6082/1-2	<i>Hyperolius rubrovermiculatus</i>	14 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6084/1-2	<i>Leptopelis concolor</i>	14 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6085	<i>Afraxalus formasini</i>	14 May 2015	J. Nyamache	Mwadabara Swamp
NMKA 6086/1-2	<i>Hyperolius mariae</i>	14 May 2015	J. Nyamache	Mwadabara Swamp
NMK A6109	<i>Hyperolius rubrovermiculatus</i>	23 May 2015	J. Nyamache & P. K. Malonza	Mwadabara Swamp
NMK A6111	<i>Arthroleptis stenodactylus</i> <i>Boulengerula</i>	24 May 2015	J. Nyamache & P. K. Malonza	Mwele Forest
NMK A6112/1-2	<i>changamwensis</i>	24 May 2015	J. Nyamache & P. K. Malonza	Mwele Forest
NMK A6108	<i>Ptychadena oxyrhynchus</i>	23 May 2015	J. Nyamache & P. K. Malonza	Mwadabara Swamp
NMK A6113	<i>Callulina</i> sp. <i>Boulengerula</i>	25 May 2015	J. Nyamache & P. K. Malonza	Makadara Forest
NMK A6061/1-2	<i>changamwensis</i>	30 Apr 2015	B. Bwong & J. Nyamache	Marere Hill
NMK A6060	<i>Callulina</i> sp.	30 Apr 2015	B. Bwong & J. Nyamache	Makadara Forest