

Mammals of the Koanaka Hills Region in Ngamiland: A Provisional Checklist

*Adam W Ferguson**, *Molly M McDonough*[§], *Monte L Thies*[♣], *Patrick J Lewis*[♥] and *Mohutsiwa Gabadirwe*[♦]

The Koanaka Hills (also known as Nqcumtsa Hills) are part of a series of dolomitic uplifts in western Ngamiland, Botswana. These localised formations create contrasting habitats to the surrounding environment and provide some of the only topographic relief among the flat semi-arid bushveld characterising this region. As such, these dolomitic uplifts provide a unique suite of resources for regional flora and fauna. We surveyed the Koanaka Hills (Nqcumtsa Hills) mammalian community from 17 June – 2 July 2008 and 13 July – 28 July 2009. Survey methods encompassed a variety of techniques designed to document the maximum diversity of mammalian species during both daylight and nighttime hours. A total of 41 mammalian species representing 7 orders were documented during the survey periods. One additional carnivore species, serval (*Leptailurus serval*), plus sign of kudu (*Tragelaphus strepsiceros*) were sighted in June 2007 during preliminary surveys bringing the total number of species recorded to 43. Combining our data with data collected from nearby sites during the Smithsonian Institution African Mammal Project (1961-1972) and information gleaned from published literature, we compiled a provisional checklist of mammals likely to occur among the Koanaka Hills. These hills support a diverse assemblage of mammals, including species whose existence in this region most likely depends upon the presence of these geologic formations.

Together with the Aha and Gcwihaba (formerly Kwihabe) Hills, the remote Koanaka Hills form part of a series of dolomitic uplifts found in western Ngamiland which is 20° S, 21° E (Cooke 1975). These dolomitic uplifts form a significant geomorphological formation and provide some of the only topographic relief amongst the flat semi-arid bushveld of Ngamiland. The hills and their associated caves also serve as important cultural monuments, attracting tourists from all over the world. Although often grouped with the Gcwihaba Hills, the Koanaka Hills lie approximately 19 km southwest of Gcwihaba, forming a distinct set of three hills: Koanaka North, Koanaka South, and Koanaka West. Koanaka North (20°08'35.69" S, 21°12'33.53" E) and Koanaka South (20°09'28.84" S, 21°11'42.14" E) are separated by about 1.5 km with Koanaka South located 55 km south, 104 km west of Nokaneng. Koanaka West (20°09'17.53" S, 21°04'48.69" E) is located 12 km west of Koanaka South. Collecting efforts were concentrated around Koanaka South due to the presence of caves containing rich fossil deposits of microvertebrates (Pickford and Mein 1988; Pickford 1990). Additional species were recorded en route to Koanaka South and at the nearest water source located 4 km south, 9 km west of Koanaka South (see Appendix II). Despite their proximity to Gcwihaba and the presence of caves within Koanaka South, very little scientific research has been conducted at this site. The majority of paleontological and modern survey work has been conducted at Gcwihaba (formerly Drotsky's) Cave located within the Gcwihaba Hills (Robbins *et al* 1996).

In order to assemble a comparative osteological collection of microvertebrates and document the modern mammalian fauna of this understudied region, we surveyed mammals of the Koanaka Hills (Nqcumtsa Hills), Ngamiland, Botswana from 17 June – 2 July 2008 and 13 July – 28 July 2009. Survey methods encompassed a variety of techniques designed to document the maximum diversity of mammals during both daylight and nighttime hours. Survey methods included: small mammal trapping with Sherman and snap traps, Tomahawk box traps for mesomammals, drift fence arrays with pitfalls, spotlighting, motion

* Adam W Ferguson, Department of Biological Sciences, Texas Tech University, Lubbock, Texas. Email: adamwferguson@gmail.com

§ Molly M McDonough, Department of Biological Sciences, Texas Tech University, Lubbock, Texas.

♣ Monte L Thies, Department of Biological Sciences, Sam Houston State University, Huntsville, Texas.

♥ Patrick J Lewis, Department of Biological Sciences, Sam Houston State University, Huntsville, Texas.

♦ Mohutsiwa Gabadirwe, Department of National Museum, Monuments and Art Gallery, Gaborone.

sensor cameras, incidental observations of mammals, and recording mammalian sign. A total of 41 mammalian species representing 7 orders were documented during the survey periods. One additional carnivore species, serval (*Leptailurus serval*), plus sign of kudu (*Tragelaphus strepsiceros*) were sighted in June 2007 during preliminary surveys of Koanaka South bringing the total number of species recorded to 43 (table 1). A majority of the recorded species (39 of 43), were documented within a 90 km² area. Based on collecting localities recorded with a handheld Geographic Position System (GPS) in the field, only three species (*Acinonyx jubatus*, *Mungos mungo*, and *Hyaena brunnea*) were recorded farther than 10 km from the Koanaka South cave site as determined by calculations in ArcGIS v. 9.0 (ESRI, Redlands, California).

The objective of this report is to combine data from this survey with historical literature records and vouchered specimens of previously collected mammals to generate a provisional checklist of mammals of the Koanaka Hills (Nqcumtsa Hills), Botswana (table 1 & appendix I). In addition, comparisons with past survey work conducted in neighbouring localities during the 1960s by the Smithsonian National Museum (Schmidt Ludwig & Carleton 2008) help provide contextual information on mammalian richness in this remote region of Botswana (table 1).

Under the direction of Harry W Setzer, curator in the Division of Mammals, US National Museum of Natural History, the Smithsonian Institution African Mammal Project (1961-1972) initiated a series of small mammal surveys across 20 African countries totaling over 785 cardinal collection localities (Schmidt Ludwig & Carleton 2008). Surveys in Botswana encompassed 90 collection localities and included four sites located in close proximity (less than 50 km) to Koanaka South (Schmidt Ludwig & Carleton 2008). These sites, taken verbatim from Schmidt Ludwig and Carleton (2008), included 'Aha Hills, 10 miles N' (16.1 km north of Aha Hills); 'Kai Kai' (village of XaiXai); 'Drotsky's Caves, 10 miles NW' (16.1 km northwest of Gwihaba Caves); and 'Drotsky's (Drotsky's) Caves' (Gwihaba Caves). Parenthetical descriptions are provided by authors. The focus of the Smithsonian collections was to obtain voucher specimens, and typically efforts were geared towards small mammals, such as rodents and bats (Schmidt Ludwig & Carleton 2008).

Identification of small mammals for the present study was undertaken at the Natural Sciences Research Laboratory at Texas Tech University, USA. Species identifications presented in table 1 are based on morphological characteristics alone, although molecular verification of all morphological identifications is currently under way. Taxonomy follows Wilson and Reeder (2005). Vouchered specimens of the small mammals were deposited at the Museum of Texas Tech's Natural Sciences Research Laboratory and the Botswana National Museum.

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Table 1: Results of mammal surveys at Koanaka Hills (Nqcumtsa Hills), Ngamiland, Botswana from 17 June – 2 July 2008 and 13 July – 28 July 2009, with records from the Smithsonian survey (1961-1972) from adjacent locations included.

Order Scientific Name	Common Name	Present Study		Smithsonian Surveys			
		Koanaka Hills 2008	Koanaka Hills 2009	Kai Kai (XaiXai)*	Aha Hills, 10 miles N*	Drotsky's Cave*	Drotsky's Cave 10 miles NW*
Macroscelidea							
<i>Elephantulus intufi</i> (T)	Bushveld elephant shrew	X	X				
Proboscidea							
<i>Loxodonta africana</i> (P)	African bush elephant	X					
Primates							
<i>Galago moholi</i>	Moholi bushbaby				X		
Lagomorpha							
<i>Lepus saxatilis</i> [†]	Scrub hare				X [†]		
Soricomorpha (Eulipotyphla)							
<i>Crocidura fuscomurina</i>	Bicolored musk shrew					X	
<i>Crocidura hirta</i> (T)	Lesser red musk shrew	X	X		X	X	
Chiroptera							
<i>Hipposideros commersoni</i> (T)	Commerson's leaf-nosed bat	X	X			X	
<i>Hipposideros vittatus</i>	Striped leaf-nosed bat					X	
<i>Neoromicia capensis</i> (T)	Cape serotine bat	X	X				
<i>Nycteris thebaica</i> (T)	Egyptian slit-faced bat	X	X			X	
<i>Rhinolophus denti</i> (T)	Dent's horseshoe bat	X	X		X	X	
<i>Rhinolophus simulator</i>	Bushveld horseshoe bat					X	
<i>Tadarida aegyptiaca</i> (T)	Egyptian free-tailed bat	X					
Carnivora							
<i>Acinonyx jubatus</i> (S)	Cheetah	X					
<i>Canis mesomelas</i> (S)	Black-backed jackal	X	X				
<i>Cynictis penicillata</i> (T)	Yellow mongoose		X				
<i>Felis silvestris</i> (S)	Wildcat		X			X	
<i>Galerella sanguinea</i> (T)	Slender mongoose	X	X	X			

Order Scientific Name	Common Name	Present Study		Smithsonian Surveys			
		Koanaka Hills 2008	Koanaka Hills 2009	Kai Kai (XaiXai)*	Aha Hills, 10 miles N*	Drotsky's Cave*	Drotsky's Cave 10 miles NW*
<i>Genetta genetta</i> (T)	Small-spotted genet		X				
<i>Leptailurus serval</i> (S, 2007)	Serval	2007					
<i>Mellivora capensis</i> (S, 2007; T, 2009)	Honey badger	2007	X				
<i>Mungos mungo</i> (R)	Banded mongoose	X			X		
<i>Otocyon megalotis</i> (S)	Bat-eared fox	X			X		
<i>Panthera pardus</i> (K)	Leopard	X					
<i>Panthera leo</i>	Lion				X		
<i>Hyaena brunnea</i> (R)	Brown hyaena	X					
<i>Vulpes chama</i> (P)	Cape fox	X	X				
Artiodactyla							
<i>Connochaetes taurinus</i> (S)	Blue wildebeest	X					
<i>Oryx gazella</i> (P)	Gemsbok	X	X				
<i>Phacochoerus africanus</i> (P)	Common wart-hog	X					
<i>Raphicerus campestris</i> (P)	Steenbok	X	X		X	X	
<i>Sylvicapra grimmia</i> (K, 2008; S, 2009) Bush Duiker	X	X					
<i>Tragelaphus strepsiceros</i> (Sl, 2007)	Greater Kudu	2007					
Rodentia							
<i>Aethomys chrysophilus</i> (T)	Red veld rat	X	X		X	X	
<i>Cryptomys damarensis</i> (T)	Damara mole-rat	X	X				
<i>Dendromus melanotis</i> (T)	Gray African climbing mouse	X			X	X	
<i>Gerbillurus paeba</i> (T)	Paeba hairy-footed gerbil	X	X		X	X	
<i>Graphiurus murinus</i>	Forest African dormouse				X	X	
<i>Hystrix africaeaustralis</i> (P, 2008; T, 2009)	Cape porcupine	X	X				
<i>Lemniscomys rosalia</i> (T)	Single-striped grass mouse	X	X				
<i>Mastomys natalensis</i> (T) [†]	Natal multimammate mouse	X	X		X [†]	X [†]	

Order Scientific Name	Common Name	Present Study		Smithsonian Surveys			
		Koanaka Hills 2008	Koanaka Hills 2009	Kai Kai (XaiXai)*	Aha Hills, 10 miles N*	Drotsky's Cave*	Drotsky's Cave 10 miles NW*
<i>Micaelamys namaquensis</i> (T)	Namaqua rock mouse	X	X		X	X	
<i>Mus indutus</i> (T)†	Desert pygmy mouse	X	X		X†	X	
<i>Paraxerus cepapi</i>	Smith's bush squirrel				X		
<i>Pedetes capensis</i> (S, P)	Springhare	X	X		X	X	
<i>Saccostomus campestris</i> (T)	Southern African Pouched mouse	X	X			X	
<i>Steatomys parvus</i> (T)	Tiny fat mouse		X				
<i>Gerbilliscus brantsii</i> (T)†	Highveld gerbil	X	X		X†	X†	
<i>Gerbilliscus leucogaster</i> (T)†	Bushveld gerbil	X	X		X†	X†	
<i>Xerus inauris</i> (T)	South African ground squirrel	X		X			X
<i>Zelotomys woosnami</i> (T)	Woosnam's desert mouse	X	X		X	X	

†Recorded as *Lepus microtis*, *Gerbilliscus* sp., *Mastomys* sp., *Mus indutus* and *Mus* sp. in Smithsonian National Museum of Natural History Mammal Database
 *Data gathered from Schmidt, Ludwig, & Carleton (2008) and the Smithsonian National Museum of Natural History Mammal Database (<http://nhb-acsmith2.si.edu/emuwebvzmammalsweb/pages/nmnh/vz/QueryMammals.php>)- see location descriptions in text.
 Codes for records from present study: (T) = Trapped, (P) = Photographed, (S) = Sighted, (R) = Road-kill, (SI) Sign (e.g. tracks, burrows, or feces), (K) = Skeletal remains

**Appendix I: Other Species Likely to Occur at Koanaka Hills (Nqcumtsa Hills) as Per
Distributinal and Habitat Information (Skinner & Chimimba 2005; Smithers 1971).**

Macroscelidea

- *Elephantulus brachyrhynchus* (Short-snouted elephant shrew) – associated with denser grass cover but marked by southern boundary of Okavango Delta

Tubidentata

- *Orycteropus afer* (Aardvark) – burrows were located in general area, but no individuals sighted.

Lagomorpha

- *Lepus saxatilis* (Scrub hare) – savanna woodlands and scrubland with open grass; may be active during daylight

Rodentia

- *Paraxerus cepapi* (Tree squirrel) – associated with mopane and *Acacia* – existing woodlands may be too limited
- *Graphiurus murinus* (Woodland dormouse) – may have been hibernating during 2008 collections, may be there based on Smithsonian collections at Qcwihaba

- *Rhabdomys pumilio* (Four-striped grass mouse) – associated with grassland and *Acacia*, more likely with cultivated areas
- *Thallomys paedulus/nigricauda* (Acacia rats) – *Acacia*/camelthorn scrub
- *Desmodillus auricularis* (Cape short-tailed gerbil) – prefers semi-hard open areas surrounding pans, potential habitat occurs in the vicinity of Koanaka Hills
- *Steatomys pratensis* (Fat mouse) – generally occur in arid terrain associated with fringes of rivers and swamps, sandy substrates, and sparse to tall and dense grass cover

Primates

- *Galago moholi* (South African galago) – associated heavily with *Acacia*, may be insufficient vegetative cover
- *Papio ursinus* (Chacma baboon) – may be seasonal, distribution depends more on water access

Soricimorpha

- *Crociodura fuscomarina* (Tiny musk shrew) – may be present in areas with sufficient moisture and heavy, matted “litindi” grass

Chiroptera

- *Miniopterus schreibersii* (Schreibers’ long-fingered bat) – may be present, although seems to be associated with moist environments

Pholidata

- *Manis temminckii* (Ground pangolin) – occur in areas of scrub and bushveld, can occur in areas where water is only available seasonally

Carnivora

- *Proteles cristatus* (Aardwolf) – grassland and scrubs
- *Crocuta crocuta* (Spotted hyaena) – identified as a wanderer that tends to follow big game, recorded at Drotsky’s Cave, occurrence may be limited by presence of sufficient game animals
- *Panthera leo* (African lion) – probable occasional transient – lone male sighted in 2007 by Botswana Defense Force personnel
- *Caracal caracal* (Caracal) – prefers open savanna habitat
- *Felis nigripes* (Black-footed cat) – uncommon across entire range, associated in open habitat with some cover in areas with 100-500 mm rainfall
- *Suricata suricatta* (Suricate) – habitat and occurrence of *Xerus* may provide adequate habitat but may be too isolated to support a permanent population
- *Lycan pictus* (African wild dog) – historically in the area, may move through seasonally following game species
- *Ictonyx striatus* (Striped polecat) – widely distributed, reported in region by local inhabitants but considered locally uncommon

Perissodactyla

- *Equus burchelli* (Burchell’s zebra) – probably only occurs in the area during the wet season, lack of water and forage prevents occurrence during dry season.

Artiodactyla (Ruminantia)

- *Taurotragus oryx* (Common eland) - widely dispersed during winter with densities below 1 animal per 50 ha, forms larger herds during rainy season
- *Antidorcas marsupialis* (Springbok) – on margin of species’ range, habitat appears suitable but herd size reduced during dry season

Appendix II: Major Sampling Locations Surveyed for Mammals from 17 June – 2 July 2008 and 13 July – 28 July 2009 at the Koanaka Hills (Nqcumtsa Hills), Ngamiland, Botswana

Road from Xai-Xai (Zai-Zai, Xa-Xa) to Namibia/Botswana Border

Coordinates: 20°06'10.8"S, 21°32'46.5"E

Collectors: Steve Thompson and Monte L Thies

Habitat: 'Grassy bushveld on sandy, loose soil (Adam W Ferguson).

Remarks: This male was accidentally run over as its troop moved across the road. Although located a good distance from the major study area (~ 38 km), the habitat was very similar to that surrounding Koanaka, and thus this species was recorded as present for the study area.

Species: *Mungos mungo*

Namibian/Botswana border road, 153 km W of Tsao

Coordinates: 20°00'31.1"S, 20°59'46.5"E

Collectors: Monte L Thies, Adam W Ferguson, Molly M McDonough, Chris W Kroll

Habitat: 'Bushveld with extensive grass cover, sandy soils', (Adam W Ferguson)

Species: *Hyaena brunnea*

Road from Koanaka Hills (Nqcumtsa Hills) to Namibia/Botswana Border Road

Coordinates: 20°12'04.9" S, 21°01'26.7" E

Collectors: Monte L Thies, Adam W Ferguson, Molly M McDonough, Chris W Kroll

Habitat: 'Bushveld with extensive grass cover, sandy soils', (Adam W Ferguson)

Species: *Acinonyx jubatus*

Waterhole on road from Namibia border to Koanaka Hills (Nqcumtsa Hills)

Coordinates: 20°11'37.8"S, 21°06'34.4"E

Collectors: Monte L Thies, Adam W Ferguson, Molly M McDonough, Chris W Kroll

Habitat: 'Acacia grassland surrounding small waterhole. Thick grass cover often trampled by elephants', (Adam W Ferguson)

Species: *Connochaetes taurinus*, *Crocidura hirta*, *Gerbilliscus brantsii*, *Gerbilliscus leucogaster*, *Gerbillurus paeba*, *Hystrix africae australis*, *Lemniscomys rosalia*, *Loxodonta africana*, *Mastomys natalensis*, *Mellivora capensis*, *Micaelamys namaquensis*, *Neoromicia capensis*, *Oryx gazella*, *Pedetes campensis*, *Phacochoerus africanus*, *Raphicerus campestris*, *Saccostomus campestris*, *Tadarida aegyptiaca*, *Vulpes chama*

Road between waterhole and main camp

Coordinates: 20°10'34.7"S, 21°08'24.0"E

Collectors: Chris Wilson, Melissa Marais, and Adam W Ferguson

Habitat: Sandy foothills with large mongongo trees (*Schinziophyton rautanenii*) and thick shrub cover.

Species: *Hystrix africaeaustralis*, *Felis silvestris*

Southwestern side of Koanaka Hills (Nqcumtsa Hills), approximately 0.6 km west, 0.4 km south of southern tip of Koanaka South

Coordinates: 20°09'47.3''S, 21°12'00.4''E

Collectors: Adam W Ferguson

Habitat: 'Sandy foothills with scattered mongongo trees (*Schinziophyton rautanenii*) and open understory' (Adam W Ferguson)

Species: *Mellivora capensis*, *Galerella sanguinea*

Koanaka Hills (Nqcumtsa Hills), 150 km W Tsao, Main Camp and vicinity

Coordinates: 20°09'30.9''S, 21°11'36.2''E

Collectors: Monte L Thies, Adam W Ferguson, Molly M McDonough, Chris W Kroll

Habitat: 'Grassy bushveld on sandy soils. Dolomite rock outcroppings with 3-5 m tall trees interspersed across the ridges. A few large mongongo trees, *Schinziophyton rautanenii* were mostly scattered on the southeastern side of the dolomite uplifts, in the sandy lowlands. All of the bats were collected from inside the caves of the dolomite uplifts', (Adam W Ferguson).

Species: *Aethomys chrysophilus*, *Crocidura hirta*, *Dendromus melanotis*, *Elephantulus intufi*, *Felis silvestris*, *Galerella sanguinea*, *Gerbilliscus brantsii*, *Gerbilliscus leucogaster*, *Hipposideros commersoni*, *Leptailurus serval*, *Mastomys natalensis*, *Mellivora capensis*, *Micaelamys namaquensis*, *Mus indutus*, *Nycteris thebaica*, *Otocyon megalotis*, *Panthera pardus*, *Rhinolophus denti*, *Steatomys parvus*

Road from Camp to Xerus Colony

Coordinates: 20°08'49.7''S, 21°11'56.5''E

Collectors: Monte L Thies, Adam W Ferguson, Molly M McDonough, Chris W Kroll, Jobe Marenga

Habitat: 'A sandy band of grass dominated bushveld between the dolomite uplifts and the barren *Xerus* colony. Very few trees or shrubs over 4 m tall' (Adam W Ferguson).

Species: *Cryptomys damarensis*, *Galerella sanguinea*, *Gerbillurus paeba*, *Lemniscomys rosalia*, *Zelotomys woosnami*

Dry pan, SW of Koanaka Hills (Nqcumtsa Hills)

Coordinates: 20°08'23.6''S, 21°11'38.0''E

Collectors: Monte L Thies, Adam W Ferguson, Molly M McDonough, Chris W Kroll, Jobe Marenga.

Habitat: 'Distinct, hard, clay like soils with little to no grass cover. Small stunted *Acacia* interspersed with smaller, herbaceous plants. Grass cover did not appear until the edges of the hard, rock like soil met more sandy, softer soils' (Adam W Ferguson).

Species: *Aethomys chrysophilus*, *Canis mesomelas*, *Elephantulus intufi*, *Gerbilliscus brantsii*, *Gerbilliscus leucogaster*, *Mastomys natalensis*, *Micaelamys namaquensis*, *Xerus inauris*

Gwihaba Caves and Vicinity

Coordinates: 20°01'29.3"S, 21°21'16.9"E

Habitat: 'Rocky outcrops along edge of Gwihaba caves and surrounding bushveld with sandy soils' (Adam W Ferguson).

Species: *Aethomys chrysophilus*, *Cryptomys damarensis*, *Elephantulus intufi*, *Galerella sanguinea*, *Gerbilliscus leucogaster*, *Hipposideros commersoni*, *Mastomys natalensis*, *Micaelamys namaquensis*, *Mus indutus*, *Neoromicia capensis*, *Nycteris thebaica*, *Rhinolophus denti*

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