# THE MAMMALS OF MALAWI

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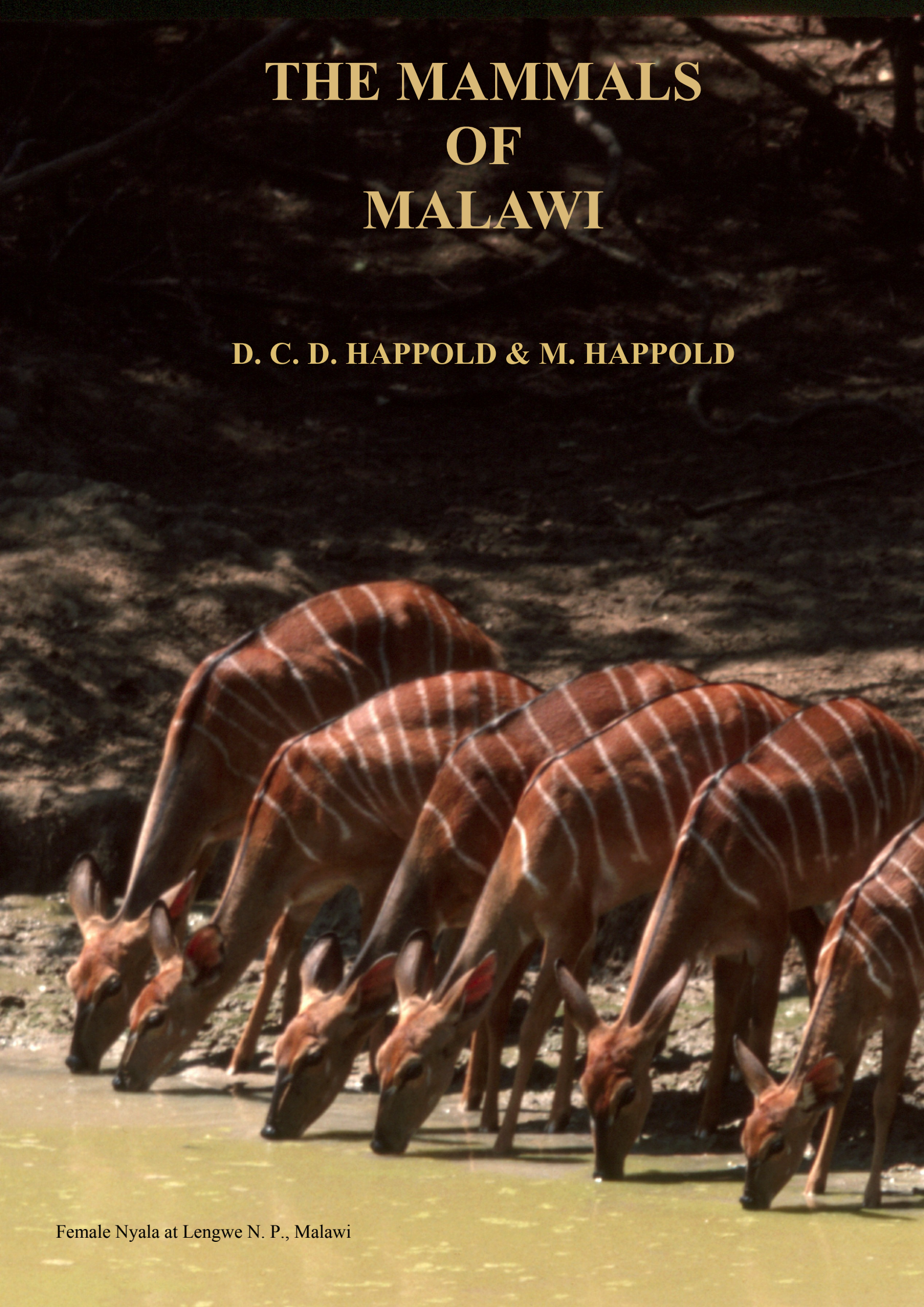

Female Nyala at Lengwe N. P., Malawi

# THE MAMMALS OF MALAWI

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# PREFACE

It was not by chance that we came to Malawi – the Warm Heart of Africa – in 1984. We came because David, who had already studied African mammals in semidesert in Sudan and in the rainforest and northern savannas in Nigeria, was keen to work in other African biotic zones – the southern savanna and mountains. He had a year of sabbatical leave from the Australian National University in Canberra and thought it would be interesting to compare the ecology and demography of small mammals at three very different altitudes at approximately the same latitude. Malawi provided an ideal study area. We arranged to be based at Chancellor College in Zomba and we planned to trap, mark and release small mammals at monthly intervals at three localities – Zomba Plateau at 1900 m, Liwonde N. P. at 500 m, and Lengwe N. P. at 100 m. Meredith intended to collaborate with this research, and also to catch bats to add to the locality records for these mammals whose distributions in Malawi were not well known at the time.

But chance played a significant role in what happened next. There was a long-lasting shortage of petrol in Malawi and it looked as though it would be impossible to get to our study areas as often as necessary. We did not want to waste our study leave, so we embarked on four projects on bats in Zomba. And we were lucky. We managed to get to our study areas at monthly intervals despite the petrol crisis, and we were also able to continue the bat projects at Zomba as well as starting bat projects at Liwonde N. P. and Lengwe N. P. We also spent as much time as possible observing and making notes on any of the large mammals that we encountered.

In the intervals between visits to our major study areas, we conducted short surveys of small mammals and bats in pine plantations near Zomba, and also in Kasungu N. P., Lake Malawi N. P., Nyika Plateau, Viphya Plateau and Mulanje Mountain, and we studied the collections of mammals at the Museum of Malawi, Blantyre.

After this year in Malawi, we realised that Malawi has an exceptionally rich mammalian fauna. It has more species than predicted based on its area – there are at least 206 species. They represent about 18% of the species known from Africa although Malawi occupies only 0.4% of the area of the continent. There seems to be two main reasons for this. Firstly, an extension of the Western Rift Valley runs through Malawi so this country has eight very diverse biogeographic areas and 15 major biotic communities as well as farmlands, plantations and urban areas, and consequently it has a great many habitats and ecological niches for mammals to exploit. Secondly, the position of Malawi is such that the biogeographic distributions of several East African mammals extend southwards into Malawi and similarly Malawi is at the eastern edges of the biogeographic distributions of several Central African species and the northern edges of the distributions of several Southern African species. In fact, Malawi is at the edges of the distributions of 13% of its species of large mammals, 51% of its small mammals and 60% of its species of bats.

We published 16 papers after our year in Malawi, but we were left with a huge list of unanswered questions – mainly about bats – which inspired us to spend another year in Malawi. This time, from mid-1993 to mid-1994, we lived on Kapalasa Farm, a tobacco and maize estate near Namadzi with remnants of miombo woodland, riverine forest, rocky hills, dambos, streams and dams, and we able to assess the importance of this farm as a means of conserving native mammals. We were also able carry out a detailed study of the biology of *Pipistrellus nanus* (the Banana Pipistrelle) which roosted in the furled leaves of banana plants in a plantation on the farm. We also studied echolocation, wing-morphology, flying abilities, diet and foraging, domiciles and other aspects of the natural history of bats which enable many species to co-exist in communities such as those at Kapalasa Farm, Zomba, Zomba Plateau, Liwonde N. P. and Chiromo at <100m in the Lower Shire Valley. We subsequently published five more papers on the results of this work, and Meredith wrote a book which, *inter alia*, described what it was like working on animals in Malawi. (See Bibliography).

Not long after our second year in Malawi, we became involved as co-editors and writers of profiles for a definitive series of six volumes - *Mammals of Africa* (eds. Kingdon *et al.* 2013). We were involved to some extent with the whole series, but David wrote/edited the profiles of the sengis (in Volume I), the rodents and lagomorphs (Volume III) and the shrews (Volume IV), and Meredith did likewise for the bats (Volume IV). The profiles were written by mammalogists who had worked on many aspects of the biology of their chosen species. Because of the years we had devoted to the study of Malawian small mammals and bats, it was inevitable that the profiles of most of these species were written by us.

However, having written profiles of Malawian mammals for this Pan-African series, we

realised that we had accumulated a considerable amount of information specific to Malawi which was not published in *Mammals of Africa*. We don't want this information to be wasted, so we have put it into this book which focusses entirely on the mammals of Malawi. We also felt that there was a need for keys and photographs that would help people to identify each species. We hope you find these mammals as interesting and delightful as we have found them.

# ACKNOWLEDGEMENTS

It has taken us about forty years to gather information for this book and more kind people have helped and supported us during this time than we can possibly mention individually by name – but we hope they will never forget how sincerely grateful we are. They include all the people in Malawi who helped us with field-work, house-work, accommodation, hospitality, transport and equipment, and especially the late Sven Gruner who allowed us to stay on Kapalasa Farm during our second year in Malawi. We are also very grateful to the staff of the following museums who assisted with the work we needed to do there: in particular Paul Bates (Harrison Zoological Museum, Sevenoaks, Kent, UK.), the late Fritz Dieterlen (Staatliches Museum für Naturkunde, Stuttgart, Germany), Judith Eger (Royal Ontario Museum, Toronto, Canada), the late David Harrison (Harrison Zoological Museum, Sevenoaks, Kent, UK.), Anke Hoffmann (Museum für Naturkunde, Berlin, Germany), Rainer Hutterer (Museum Alexander Koenig, Bonn, Germany), Paula Jenkins (Natural History Museum, London UK), Teresa Kearney (Ditsong National Museum of Natural History, Pretoria, South Africa), the late Dieter Kock (Naturmuseum Senckenberg, Frankfurt, Germany), the late François Petter (Musée National d'Histoire Naturelle, Paris, France), Paul Webela (National Museums of Kenya, Nairobi, Kenya), Wim Wendelen (Royal Museum of Central Africa, Tervuren, Belgium) and the staff at the National Museum of Malawi, Blantyre, Malawi.

We are also very grateful to the Australian National University, Canberra, Australia, and the University of Malawi (Chancellor College), Zomba, Malawi with which were affiliated, and to the Malawi Department of National Parks and Wildlife for permission to work in the National Parks and other protected areas of Malawi.

While actually writing this book, many people have provided extra information and advice about particular taxa, and checked sections of the manuscript, and they too have our heartfelt gratitude – Hynek Burda, Tom Butynski, Riccardo Castigia, Cornell Dudley, Julian Fennessy, Hopi Hoekstra, Elisabeth Larsen, Phyllis Lee, Rebecca Lewson, the late Judith Masters, Clare Mateke, Brian Morris, Bruce Patterson, James Patton, Darren Pietersen, Craig Reid, Earnest Seamark, Chris and Mathilde Stuart, Radim Šumbera and Victor Van Cakenberghe.

Furthermore, we could not have managed without the help of Pam Cohen and Peter Olsen who kept our computers running – thank you so much.

We are also extremely grateful to Bentley Palmer (Blantyre, Malawi) who most generously allowed us to use his wonderful photographs of Malawian mammals, and to Chris and Mathilde Stuart who also provided many wonderful photographs and so kindly prepared *The Mammals of Malawi* for publication as a pdf document.

Above all, we thank Paula Jenkins for the enormous amount of assistance and encouragement she has given us for more than forty years, (especially while we have been writing this book), and our children, Lena and Jonathan, and grandchildren, James. Savannah, Jack, Joshua and Hannah, who have had to put up with us.

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## THE MAMMALS OF MALAWI

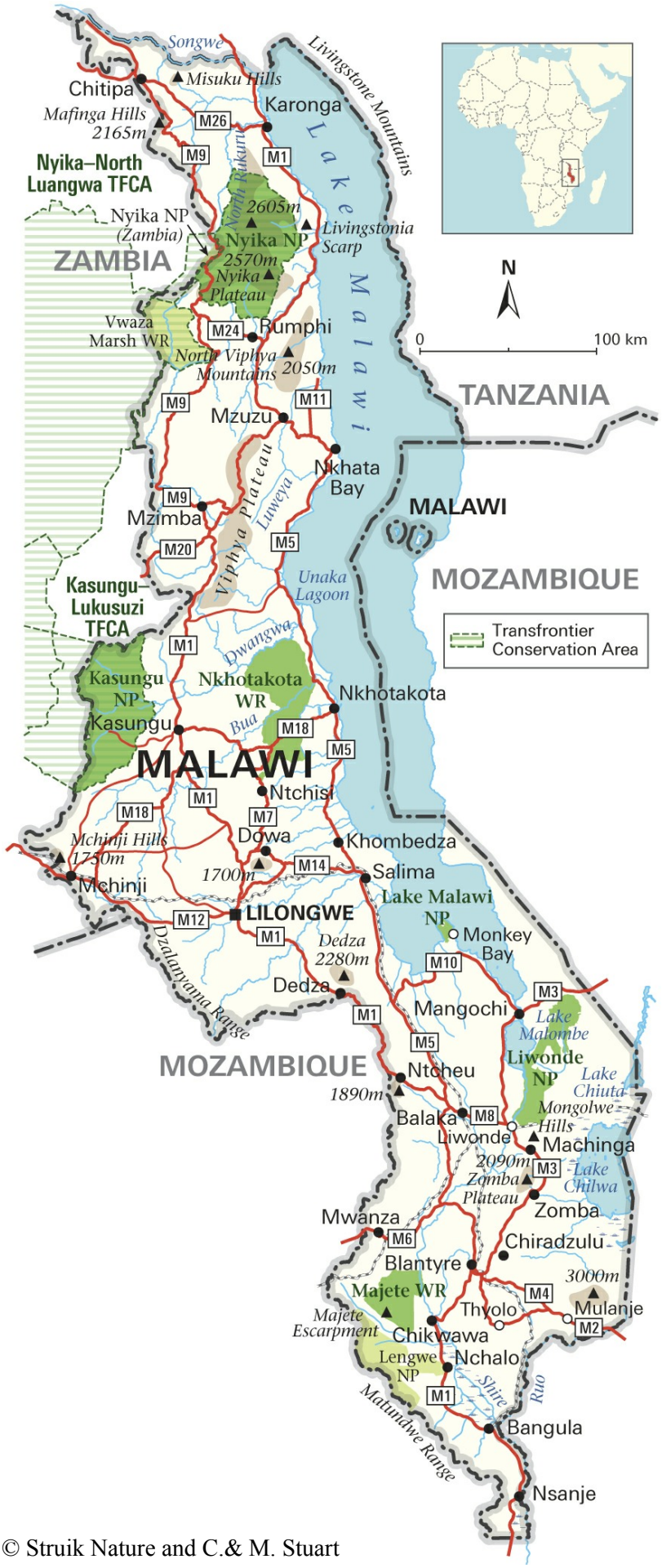
The mammal fauna of Malawi (see table above) is remarkably rich, diverse and very interesting. There are at least 206 species, but this includes one species which probably contains two cryptic species in Malawi, and a group of four closely related species whose occurrence is not yet fully resolved. A total of 208 may be more accurate. However, further fieldwork may uncover species hitherto overlooked, species from adjacent countries may move into Malawi, new species might be described, and taxonomists will probably decide to split some species and lump others together (as they do with very annoying frequency!).

The species in Malawi are placed in 14 orders, 42 families and 121 genera (see above), but the genera *Tadarida* and *Pipistrellus* are considered here to include, as subgenera, taxa that are treated as distinct genera by other authors. Small mammals (hedgehog, shrews, sengis, bats, rodents and lagomorphs) make up 67% of the mammals; bats make up about 32% and rodents about 27%.

In the 1990s, it was suggested (based on molecular evidence) that the species in the orders Proboscidea (Elephants), Hyracoidea (Hyraxes), Tubulidentata (Aardvark) and Macroscelidea (Sengis) which are represented in Malawi, and those of three other extant orders, had a monophyletic origin in Africa. In other words, it was suggested that all the mammals in these orders evolved from one ancestral form and therefore were more closely related to each other than to mammals in other orders although, superficially, they did not resemble each other at all. In 1998, it was proposed that these orders should be grouped in a superorder, appropriately named Afrotheria – "African wild beasts" (Stanhope *et al.* 1998). Since then, the validity of the Afrotheria has been closely scrutinized and is now generally accepted. The oldest Afrotherian fossils are from NW Africa and are from the Palaeocene epoch (ca. 66 to 56 million years ago), but the evolution of the Afrotheria appears to have started in the mid-Cretaceous - at least 90 million years ago and perhaps as long ago as 105 million years - at which time Africa was an isolated island continent. Evolution from the ancestral Afrotherian has resulted in a very extensive adaptive radiation, with the result that the seven orders of Afrotherians contain species as different as Elephants and Sengis, Golden Moles and Manatees. There has also been convergent evolution during the history of the Afrotherians.

This book is not a taxonomic work, so the profiles of the orders are arranged to reflect the observation that most readers are either mainly interested in the large mammals that they can easily see during day-time visits to National Parks and other protected areas, or mainly interested in the small mammals which they might be studying professionally. Consequently, the small mammals are profiled first and the large mammals last, and Afrotherian orders and other orders are not segregated. But to understand the natural history of the mammals of Malawi, one needs to understand the physiography, climate and vegetation of the country and its position in Africa.

# THE PHYSIOGRAPHY AND BIOGEOGRAPHIC AREAS OF MALAWI

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Malawi is situated in Central Africa, between 9° 50' S and 17° 00' S, and between 33°00' E and 36°00' E. It is bounded by Tanzania in the north-east, Zambia in the north-west, and Mozambique in the south-east, south and south-west. It is a small country by African standards; only about 900 km from north to south and 80-160 km from east to west, and it covers approximately 118,500 km$^2$. Its dominant feature is Lake Malawi (23,000 km$^2$) which flanks most of the eastern boundary. Lake Malawi lies in the Malawi Rift Valley (an extension of the Western Rift Valley) and is drained by the Shire River which runs southwards through an extension of the Rift Valley referred to as the Shire Valley. West of Lake Malawi, the land rises steeply to form part of the Central African Plateau. Within Malawi, the Central Plateau is fairly flat except for four regions, the Nyika Plateau (1800-2500 m), the Viphya Plateau (1500-1800 m), Dedza Mountain (2198 m) and the Kirk Range (1400-1600 m), all of which are high enough to support montane grasslands and relic montane evergreen forest. South of the lake, the Shire Valley is flanked to the east by the Mangochi Highlands (1000-1500 m), the Shire Highlands (900-1200 m) which are dominated by the high massif of Zomba Plateau (1500-2000 m), the Phalombe Plain (700-900 m), and Mulanje Mountain (1000-3000 m). Because of the plateaux and the Rift Valley, Malawi has a very diverse physiography and a wide range of habitats with varying climates and vegetation (Pike and Rimmington 1965).

Based on the physiography of Malawi, eight biogeographic areas are recognized and referred to in the Distribution sections of the profiles of species in this book. These are - from north to south:

1- High Plateaux of the Northern Region

High Plateaux of Northern Region. Nyika N. P. Montane grasslands on the Nyika Plateau, ca, 2300 m. Cool dry season, May 1985.

High Plateaux of Northern Region. Nyika N. P. Montane evergreen forest in a sheltered fold of the hills on the Nyika Plateau, ca. 2300m. May 1985.

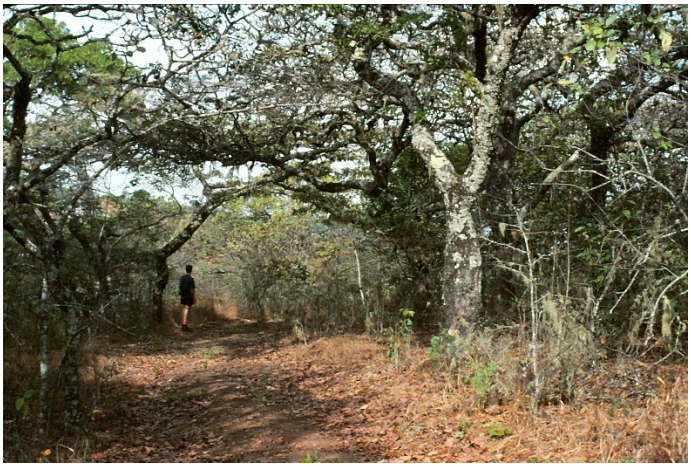
High Plateaux of Northern Region. Viphya Plateau. Submontane grassland and riverine forest. Cool dry season, May 1994.

Left: High Plateaux of Northern Region. Nyika N. P. Juniper Forest dominated by *Juniperus procera*. May 1985.

2 - Central Plateau (referred to as Angoniland in old literature)

Central Plateau. Nkhotakota W. R. Canopy of montane evergreen forest (mid-altitude montane rainforest) on top of Chipata Mountain, 1614 m. November 1993.

Central Plateau. Ntchisi Mountain F. R. Submontane seasonal rainforest on top of Ntchisi Mountain, 1642 m. November 1993.



Central Plateau. Ntchisi Mountain F. R. Open canopy miombo woodland on lower slopes of Ntchisi Mountain. End of hot dry season, November 1993.

Central Plateau. Kasungu N. P. View from a rocky hill (Black Rock) across open canopy miombo woodland of plateaux, with a dambo in the middle distance. Beginning of cool dry season, April 1985.

Central Plateau. Kasungu N. P. Open canopy miombo woodland of plateaux with *Brachystegia* and *Julbernardia* trees (coppiced by elephants) and understorey grasses. April 1985.

Central Plateau. Kasungu N. P. A dambo (seasonally wet grassland) with open canopy miombo woodland and Black Rock in the distance. April 1985.

Central Plateau. The Bua River which crosses the Central Plateau before eventually flowing into Lake Malawi. April 1985.

Central Plateau. Lilongwe Plain with Bunda Mountain. An area with no remaining natural woodland, now used for subsistence farming and grazing cattle. Cool dry season, April 1994.

Central Plateau. Dedza Mountain, 2198 m. View from the slopes looking across the Central Plateau. November 1993.

Central Plateau. A small village on the Central Plateau in an area cleared for grazing cattle.

Central Plateau. Dzalanyama F. R. Open canopy miombo woodland of plateaux. April 1994.

3 - Lake Shore

Lake Shore. Monkey Bay Lowland Plains near Lake Malawi N. P. on southern shore of Lake Malawi. Woodland of fertile areas with baobabs (*Adansonia digitata*). Early wet season, December 1984.

4 - Upper Shire Valley

Upper Shire Valley. Liwonde N. P., ca. 500 m. Mopane woodland in the hot dry season. October 1984.

Upper Shire Valley. Liwonde N. P., ca. 500 m. Open canopy miombo woodland of hills and scarps, dominated by *Brachstegia and Kirkia* with understorey of tall grasses (including *Hyparrhenia*) on Chiunguni Hill close to the southern end of the park. The deciduous miombo trees are leafless and the tall grasses are devoid of moisture. Late hot dry season, October 1984. The demography of small terrestrial mammals was studied here (Happold & Happold 1990b).

Upper Shire Valley. Liwonde N. P. Open canopy miombo woodland on Chiunguni Hill with grasses beginning to shoot at beginning of hot wet season, in a patch that had been burned during the dry season. November 1984.

Upper Shire Valley. Liwonde N. P. Open canopy miombo woodland on Chiunguni Hill in the hot wet season, January 1985. The dense green grasses are ca. 1.5 m in height, and the miombo trees are in full leaf.

Upper Shire Valley. Liwonde N. P. Open canopy miombo woodland on Chiunguni Hill in the cool dry season, by which time the grasses have reached 2-3 m in height and have started to dry and wither. June 1985.

5 - Shire Highlands

Shire Highlands. Zomba Plateau. The east face viewed from the Zomba-Liwonde Road, showing subsistence farmland in the foreground, forests of closed canopy miombo woodland, introduced *Pinus patula* and montane evergreen forest at the base, and the almost bare, granite syenite walls of the massif. June 1985.

Shire Highlands. Zomba Plateau. Mosaic of montane grassland and montane evergreen forest at 1900 m near Chingwe's Hole, in the dry season. October 1984. The stakes mark a grid where the demography of small terrestrial mammals was studied (Happold & Happold 1989c).

Shire Highlands. Zomba Plateau. Mosaic of montane grassland and montane evergreen forest near Chingwe's Hole on Zomba Plateau, in the wet season. January 1985.

Shire Highlands. View of the Shire Highlands from slopes of Zomba Plateau. May 1994.

Shire Highlands. A village surrounded by subsistence farmlands near Zomba, in the dry season. October 1984.

Shire Highlands. Mpalanganga Dam – a farm dam on Mpalanganga Estate, a tobacco and maize farm near Thondwe, at 1100 m. Many bats were found here. January 1985.

Shire Highlands. Kapalasa Farm in the Namadzi District, 1000 m. This thriving tobacco and seed-corn farm was of significant conservation value because remnant miombo woodland was protected on rocky hills and the cultivated fields were crossed by undisturbed grassy bunds linking patches of natural habitat (Happold & Happold 1997a). Hot dry season, September 1993.

Shire Highlands. Kapalasa Farm in the Namadzi District, 1000 m. Undisturbed remnant miombo woodland trees growing on old termitaria, surrounded by recently cut grassland on a fallow field. Cool dry season, May 1994.

6 - Phalombe Plain and 7 - Mulanje Mountain

Phalombe Plain. Satemwa Estate near Thyolo, 1000 m. A dam with tea plantations in the distance, where the African Trident Bat was first recorded in Malawi.

Mulanje Mountain. The Lichenya Plateau (1975 m). Montane grassland on the upper slopes of this plateau with rock-loving plants such as the grass *Coleochloa setifera* and the shrub *Vellozia splendans,* and patches of yellow everlasting daisies (*Helichrysum* spp.). There are isolated patches of montane evergreen forest with the endemic Mulanje Cedar (*Widdringtonia whytei*) in the distance.

Phalombe Plain and Mulanje Mountain. The view across tea plantations on the Phalombe Plain to the foothills and almost vertical walls of this granite syenite massif (highest peak, Sapitwa, 3002 m). Likhuabula (750 m) is at the base of the massif near the cleft which allows walkers access to the plateaux on top.

8 - Lower Shire Valley

Lower Shire Valley. Lengwe N. P., 100 m. Thicket savanna of poorer areas (thicket-clump savanna) in the hot dry season, October 1984. The thickets are leafless and almost all of the grass has been taken underground by very large termites (*Macrotermes* spp.) or grazed by artiodactyls.

Lower Shire Valley. Lengwe N. P., 100 m. Thicket-clump savanna in the hot dry season, October 1984 – part of the grid where the demography of small terrestrial mammals was studied (Happold & Happold 1991).

Lower Shire Valley. Lengwe N. P., 100 m. Thicket-clump savanna in the hot wet season, January 1985 – part of the grid where small mammals were studied (Happold & Happold 1991). The grasses reached up to two metres in height by the end of the wet season in February.

Lower Shire Valley. Chiromo District, ca. 60 m. Perennially wet grassland and swamp at the southern end of Elephant Marsh, between Chiromo and Bangula. April 1994.

## THE CLIMATE OF MALAWI

The climate of Malawi shows seasonal rhythms in rainfall and temperature resulting in a hot wet season from mid-October to early April, a cool dry season from April to July, and a hot dry season from August to mid-October. The duration of each season varies with latitude, the Lower Shire Valley in the south having the shortest wet season and the longest hot dry season. Mean annual rainfall varies from 775mm in the Upper Shire Valley, to 2164mm at the base of Mulanje Mountain, and temperature regimes range from extremely hot in the Rift Valley, to cool on the high plateaux. Further information about the climate of Malawi is given by Pike and Rimmington (1965), and Torrance (1972).

## THE VEGETATION AND BIOTIC COMMUNITIES OF MALAWI

The vegetation and biotic communities of Malawi can be broadly classified into fifteen major types (based on Malawi Government 1983) and, in addition, there are farmlands and plantations, and urban areas. Some of the vegetation types are defined by particular species, including Acacias and *Brachystegia* spp. African Acacias were formerly in the genus *Acacia* but are currently placed in *Senegalia, Vachellia* and *Faidherbia:* for convenience, they are referred to as Acacias here. In Malawi, *Brachystegia* spp. are known as miombo.

The major biotic communities are listed below together with some of the key localities within each.

**Montane evergreen forest**. Found on some of the higher mountains throughout Malawi. e.g. Misuku Hills, Nyika Plateau, Viphya Plateau, Ntchisi Mountain, Dedza Mountain, Zomba Plateau, Thyolo Mountain and Mount Mulanje.

**Montane grassland**. The most extensive areas are found on Nyika Plateau, Viphya Plateau, Zomba Plateau and Mount Mulanje. Some areas may be maintained and/or extended by burning, but the species composition of small mammals in these isolated montane grasslands suggests that there has always been a forest-grassland mosaic on each of these mountain tops, but the boundaries have moved up and down the mountains (and sometimes even lower) in response to changing climates in the past (Happold & Happold 1989a).

**Semi-evergreen forest**. Often has a canopy of *Brachystegia spiciformis* and a dense evergreen understorey which suppresses grasses. Found, for example, on parts of Zomba Plateau, Thyolo Mountain and south-facing gullies on Mount Mulanje, and also (as riverine forests) along river and streams throughout Malawi.

**Closed canopy miombo woodlands** of the wetter uplands. Most extensive on Viphya mountains where rainfall exceeds 1300 mm, but patches exist on Thyolo Mountain and the southern lower fringes of Mount Mulanje. Dominated by *Brachystegia spiciformis* and *B. longifolia* which grow taller and denser than the trees in other miombo woodlands.

**Open canopy miombo woodlands of plateaux**. Widespread, particularly in the medium to high rainfall areas west of the Viphya mountains, on the Kasungu-Lilongwe peneplain, the Dedza-Ntcheu escarpment, and the Shire Highlands. e.g. Kasungu N. P., Mzuzu, Zomba, Thondwe, Namadzi.

**Open canopy miombo woodlands of hills and scarps**. Found on the escarpments of the Rift Valley. Dominated by species of *Brachystegia* and *Uapaca kirkiana*. e.g. Nkhotakota W. R. (Chipata Camp), Ntchisi Mountain F. R. (rest house), Liwonde N. P.

**Open canopy miombo woodlands of fertile areas**. Found mainly on the Lilongwe plain and in the Malindi and Namwera areas. Much has been cleared for cultivation. Dominated by *Combretum*, *Pilostigma* and Acacias rather than by *Brachystegia* spp.

**Mixed thicket woodland-savanna of the drier uplands**. Found mainly in Northern Region on the plains W and NW of Rumphi, around Vwaza Marsh and on the Zambian border at Manda. A combination of grassland and low thickets dominated by Acacias and *Combretum*. Now heavily cultivated.

**Mopane woodland**. A woodland dominated by *Colophospermum mopane*, associated with alkaline soils unsuited for cultivation. Almost pure stands are found in the Upper Shire Valley. e.g. Liwonde N. P.

**Woodlands of fertile areas**. Heavily cultivated areas with isolated patches of relict woodland and isolated trees. Baobabs (*Adansonia digitata*) and palms (*Hyphaene ventricose*) are common, and other common trees include *Acacia albida* (now *Faidherbia alba*), *Cordyla africana* and *Sterculia* spp. Found on the lakeshore plain N and S of Karonga, around Salima, and in isolated belts around the southern shores of Lake Malawi. Also found along

the southern edge of Elephant Marsh in the Lower Shire Valley.

**Thicket Savanna of poorer areas**. Combines grasses with thorny scrub and trees and palms including Baobabs, *Hyphaene* palms, *Combretum* and Acacias which are often stunted. Found in areas along the shore of Lake Malawi and in parts of the Lower Shire Valley. e.g. Lengwe N. P.

**Woodland/Savanna-mixed species**. A woodland which is often scrubby regrowth on previously cultivated land, dominated by *Brachystegia* spp. but also contains *Combretum*, *Pterocarpus* and mopane in varying proportions. Widespread in the Shire Valley.

**Woodlands of wet fringes**. One wet fringe woodland, dominated by *Terminalia sericea*, occurs on the margins of wetlands on the Phalombe Plain, on sandy soils which are seasonally flooded. Other wet fringe woodlands, dominated by Acacias and *Combretum* spp., occur along the moist soils of riverbanks including the Mulunguzi and Rivirivi rivers which are tributaries of the Shire River.

**Seasonally wet grasslands and dambos**. These are dominated by potentially tall grasses with a few water-tolerant Acacias. They occur along broad valley floors and are flooded in the wet season but dry out in the dry seasons. e.g. Kasungu N. P., Vwaza Marsh, Liwonde N. P, and in some places along the shore of Lake Malawi and around Lake Chilwa.

**Perennially wet grasslands and swamps**. Occur in areas where the water table is always high. e.g. the northern part of Vwaza Marsh G. R., Limphasa Dambo on the shore of Lake Malawi, the wettest areas of Lake Chilwa, Elephant Marsh and Ndinde Marsh.

**Farmlands and Plantations**. These include areas on large estates cultivated for growing crops and plantations (including tobacco, maize, cotton, sugarcane, groundnuts, rice, tung, tea and coffee) and smaller subsistence farms on which maize, bananas, mangoes, avocados and various vegetables are grown. There are also areas where livestock are farmed as well as crops, some areas which are only suitable for grazing livestock, and some areas where plantations of exotic trees – especially *Pinus patula* and *Eucalyptus* spp. – have been established. e.g. there are pine plantations at Chelinda on Nyika Plateau, on the Viphya Plateaux and on Zomba Plateau.

**Urban Areas**. The ten largest urban areas are Lilongwe (the capital city), Blantyre, Mzuzu, Zomba, Kasungu, Mangochi, Karonga, Salima, Nkhotakota and Liwonde. In many of these cities, trees have been planted along roads and there are many gardens where trees, shrubs and flowers provide food and shelter for some mammals, and the buildings supply roosts for some species of bats and shelters for some species of rodents. Other native mammals, such as some species of jackals, mongooses and monkeys, also exploit urban areas.

## PROTECTED AREAS IN MALAWI

Malawi has five National Parks, three Wildlife Reserves, one Game Reserve and 72 Forestry Reserves. All play major roles in the conservation of the mammals of Malawi, especially the National Parks. The distribution of large mammals in these nine protected areas is given in the Appendix.

**Kasungu National Park**. An area of more than 2000 $km^2$ which conserves habitats typical of the Central Plateau biogeographic area. The terrain is undulating with drainage systems and isolated rocky inselbergs. Most of the park is covered by open canopy Miombo woodland typical of plateaux, with seasonally wet grasslands (dambos) along the drainage systems. Throughout the park, the *Brachystegia* and *Julbernardia* trees have been severely coppiced by elephants.

**Lake Malawi National Park**. An area of 94 $km^2$ located on a peninsula of steep rocky hills projecting into the southern part of Lake Malawi. The hills are covered by open canopy Miombo woodland. The main objective of this national park is the conservation of the unique and very diverse tropical fish found in Lake Malawi and nowhere else. It does not play a major role in the conservation of mammals.

**Lengwe National Park**. An area of 887 $km^2$ located on an area of flat alluvial country at the edge of the Shire River flood plain west of the Shire River in the Lower Shire Valley. The climate is semi-arid. The park conserves the biotic community referred to as thicket savanna of poorer areas but, on a finer scale, the vegetation includes areas of riverine forest, thickets, thicket-clump savanna, woodland savanna and grassland savanna. An artificial waterhole with a hide attracts many mammals, especially in the dry season.

**Liwonde National Park**. An area of 548 km$^2$ which conserves habitats typical of the Shire River, the Upper Shire Valley and the shores of Lake Malombe. This is flat alluvial country with isolated rocky inselbergs such as Chiunguni Hill near the Administration Camp in the Southern Entrance Area. The vegetation is varied and includes reed swamps, seasonally wet grasslands on the flood plains of the Shire River, mopane woodland, woodlands of wet fringes dominated by *Terminalia*, *Combretum*, *Lonchocarpus* and Acacias with an understorey of tall grasses, and open canopy miombo woodland typical of hills and scarps, dominated by *Brachystegia*, *Kirkia* and *Stercularia* with an understorey of tall grasses.

**Nyika National Park**. An area of more than 3000 km$^2$ which conserves the highest and most extensive plateau in Central Africa and part of its surrounding escarpment. Most of the Nyika Plateau lies between 1800 m and 2400 m and the highest peak is 2607 m. Ninety percent of the plateau is undulating montane grassland. Isolated patches of montane evergreen forest occur in the folds of the hills, and montane swamps occur along the drainage systems. There are also a few patches of forest dominated by juniper, *Juniperus procera,* and at Chelinda, there are some mature plantations of exotic *Pinus patula* and *Eucalyptus.* The plateau is bounded by steep escarpments with open canopy miombo woodlands typical of hills and scarps, dominated by *Brachystegia*, *Julbernardia* and *Isoberlina*. The climate is dramatically different from that of lower-lying parts of Malawi. The rainfall is not unusually high, the plateau is frequently cloudy and comparatively cool, and frosts occasionally occur in the coolest months.

**Majete Wildlife Reserve**. An area of 691 km$^2$ in the Lower Shire Valley with riverine forest on the west bank of the Shire River, woodland/savanna – mixed species, and open canopy Miombo woodland of hills and scarps. Although established as a protected area in 1955, the vegetation and wildlife were not effectively protected until 2003 and its large mammals were almost exterminated. Since then, it has been fenced and many large mammals have been reintroduced.

**Mwabvi Wildlife Reserve**. An area of 135 km$^2$ in the southernmost part of the Lower Shire Valley with a wide variety of habitats including woodlands of fertile areas, woodland/savanna – mixed species, mopane woodland, seasonally wet grasslands and riverine areas along the Mwabvi River.

**Nkhotakota Wildlife Reserve**. An area of 1800 km$^2$ on the edge of the Central Plateau and extending down the escarpment as far as the lakeshore plain, from 1614 m to 500 m. Very hilly terrain with diverse vegetation and biotic communities including montane evergreen forest on the top of Chipata Mountain, open canopy miombo woodlands of hills and scarps, seasonally wet grasslands and dambos.

**Vwaza Marsh Game Reserve**. An area of 1000 km$^2$ on the Central Plateau southwest of the Nyika Plateau and north of the floodplain of the South Rukuru River. It is mostly flat and includes Lake Kazuni on the South Rukuru River, perennially wet grasslands and swamps, seasonally wet grasslands and dambos, woodlands of wet fringes and mixed thicket woodland savanna of drier uplands.

Malawi has 72 forest reserves of which nine are either mentioned as such in this book or they protect forests of the same name which are mentioned.

**Chongoni Forest Reserve**. Covers 126.4 km$^2$ near the southern edge of the Central Plateau (NW of Dedza) and includes Chencherere Hill, a steep granite outcrop. Open canopy woodland with some plantations.

**Dzalanyama Forest Reserve**. Covers 989.4 km$^2$ of country with a range of steep-sided hills (1100-1650 m) at the southern edge of the Central Plateau. Mostly open canopy miombo woodland with patches of montane evergreen forest. Streams and pools present. The rest house is ca. 1200 m, near a stream.

**Kongwe Forest Reserve**. Covers 19.5 km$^2$ on the Central Plateau (13.35 S 33.55 E, 1428 m). Includes Chungwe Hill (1439 m) and Kongwe Hill (1662 m). Open canopy miombo woodland.

**Mughese Forest Reserve**. Covers 7.7 km$^2$ on a ridge of the Misuku Hills in the far north. The Misuku Hill are included in the High Plateaux of the Northern Region. Includes Mughese Peak (1909m). Montane evergreen forest, montane grassland (at highest altitudes) and closed canopy miombo woodlands.

**Mulanje Mountain Forest Reserve**. Covers 563 km$^2$ of Mulanje Mountain in the far south-east.

It is an isolated massif, arising abruptly from the Phalombe Plain (700-900 m), which reaches 3002 m. It has steep escarpments and near-vertical rocky precipices, with open canopy miombo woodland on the slopes, and these level out to form a series of dissected plateaux (including Lichenya Plateau). Most of the plateaux (at 1800-2000 m) are covered by montane grassland with montane evergreen forest in the valleys which dissect the plateaux.

**Namizimu Forest Reserve**. Covers 889 km$^2$ from the Lake Shore at the south-east end of Lake Malawi to the Namizimu Hills, between the lake and the border of Mozambique, which are part of the eastern escarpment of the Malawi Rift Valley. Altitudes: 500-1800 m, with ten hills reaching above 1500 m. Vegetation: thicket savanna along lake shore, Woodland/Savanna-mixed species, closed canopy miombo woodland near streams and small patches of montane evergreen forest.

**Ntchisi Mountain Forest Reserve**. Covers 87 km$^2$ on the eastern edge of the Central Plateau. Includes Ntchisi Mountain one of the several isolated mountains arising from the Central Plateau which has montane evergreen forest between 1500-1700 m. The forest is surrounded by open canopy miombo woodland of hills and scarps.

**Perekezi Forest Reserve**. Covers 144 km$^2$ of gently undulating terrain at ca. 1557 m, on the western edge of the South Viphya Plateau. A catchment for various streams including the South Rukuru River. Mostly closed canopy miombo woodland with montane evergreen forest in sheltered gullies.

**Wilindi Forest Reserve**. Covers 9.4 km$^2$ on a ridge of the Misuku Hills south-west of the Mughese F. R. The Misuku Hill is included in the High Plateaux of the Northern Region. Includes Misuku Mountain (1934 m). Montane evergreen forest, montane grassland (at highest altitudes) and closed canopy miombo woodlands. Matipa F. R. is located a little further west on the same ridge.

## HOW TO USE THIS BOOK

This guide to the mammals of Malawi is comprised mainly of profiles of the species, but there are short profiles of the higher taxa.

**Profiles of higher taxa.** These usually begin with a list of relevant taxa in a box with a blue background. E.g. For profiles of orders, these boxes contain the families, genera (and number of species in Malawi), the vernacular name for each genus and the page on which the genus profile begins. Vernacular names are in the plural if the genus contains more than one species in Africa, even if there is only one species in Malawi. These profiles focus on how to recognise orders, families, genera and species within one genus. In many of these profiles, use is made of table-keys.

Table-keys should be read from left to right. In the first column on the left, is information about a particular character. Find the information that best fits the animal or taxon you wish to identify; it might be found in one row or several rows. If the information is only found in one row, follow that row across the table-key to the far right column where the answer (species or taxon) will be given. If the relevant information is repeated in more than one row, follow that block of rows only (block A) into the second column where information about another character is given. Choose which information best fits from the possibilities listed only in the rows of block A. If that information is found in only one row, follow that row across the table to the last column, and read the answer. If it occurs in more than one row, follow that block (block B) into the third column and repeat the process of selecting the rows which contain the relevant information and following only those rows into the next column. Repeat this process until only one row remains and that will usually lead to the answer in the last column. In some cases, the table-key might be unable to distinguish two or more very similar species, in which case the Similar Species sections in the profiles of those species will give further information.

When only two taxa are involved, or when a table-key is not appropriate, the most important diagnostic information is given in a box with a yellow background (referred to as yellow boxes).

Orders are not presented in any sort of taxonomic sequence. Instead, to suit the interests of most readers, those containing small mammals are profiled first. All taxa are referred to by their scientific names and also by the vernacular names as given in Kingdon, J., Happold, D., Butynsky, T., Hoffman, M., Happold, M., & Kalina, J. (eds.) 2013. *Mammals of Africa* (6 vols); Bloomsbury Publishing, London. Within orders, families are presented in conventional sequence. Within families, genera and species are presented in alphabetical order based on their scientific names.

## Species profiles.

All species profiles have the following sections:

**Malawian names**. Derived from sources such as Hayes (1978), Hough (1989), Lawrence & Loveridge (1953), Morris (1992), Sweeney (1959) and R. C. Wood in Kershaw (1922). The selected names are from four of the languages spoken in Malawi – Chewa, Nyenga, Tumbuka and Yao. They are listed alphabetically. The names for many of the smaller mammals are not species specific. Some names cover two or more species in the same genus. Some names cover a variety of species which simply look somewhat similar, e.g. the Slender Mongoose, Sun Squirrel and Bush Squirrel are all called Likongwe (Chewa) and Kandindi (Yao).

**Description**. Descriptions focus on external characters and dental characters than can be seen easily. As often as possible, the descriptions are of Malawian individuals. Descriptions begin with a short sentence covering the most important diagnostic characters of the species. Use is made of both relative and comparative sizes, and the terms "relatively" and "comparatively". Relative size describes the size of a character relative to the size of another character of the same individual and is expressed as a percentage, e.g. Tail relatively long (129% of HB) where HB is head-body length. Comparative size describes the size of a character compared to the size of the same character in another species. Sizes are described as small, medium or large if the range is divided into three, or very small, small, medium, large or very large, if the range is divided into five.

**Similar Species**. Lists species which (a) share a given character, (b) end up next to each other in table-keys to species or (c) cannot be distinguished by the characters given in those table-keys. The information given for a similar species is only that which will most easily distinguish that species from the profiled species.

**Distribution.** This section begins with the distribution of the profiled species in Malawi. The biogeographic areas in which the species has been found are given, and then a list of some or all of the localities from which it has been recorded. The biogeographic areas of Malawi are given above, and a gazetteer of localities is given at the end of the book. The distribution in Malawi is followed by the distribution elsewhere, where "elsewhere" refers to the biogeographic range of the species in African countries other than Malawi.

**Habitat.** This section includes the biotic communities exploited by the species, and information about microhabitats exploited or created by the species.

**Abundance**. The abundance of most species is poorly known, especially that of species which are nocturnal, found in hard-to-see places such as tree canopies, and hard to capture or record in other ways. For some species, abundance has been assessed by counting the number of animals seen by an observer or observers walking or driving along a transect. The comparative abundance of bats in Malawi has been roughly assessed from the from the number of individuals recorded in reports published prior to 1997 together with the number of specimens, collected prior to 1997, in four museums which have good collections of Malawian bats. The comparative abundance of more abundant species was based on the number of captures made during nearly two years of intensive fieldwork conducted by D. & M. Happold in mid-1980s and mid-1990s. Further details are given in the Order Chiroptera profile.

**Habits**. The contents of this section varies from order to order, but include topics such as activity patterns, locomotion, food and foraging, domiciles, torpor and hibernation, migratory behaviour, social behaviour and vocalisations.

**Reproduction**. Includes litter-sizes (the number of young a female gives birth to at any one time), the number of litters a female can give birth to during one year or one breeding season, and the timing of reproductive events such as spermatogenesis (the production of sperm in the testes of males), sperm storage, mating, ovulation (the release of ova from the ovaries of females), fertilisation, gestation (including events which lengthen the period between mating and birth) and birth. The timing of these events in relation to climatic seasons is often discussed.

**Conservation**. The IUCN Category is given, followed by issues that threaten the conservation of this species. The IUCN Categories are Not Evaluated, Data Deficient, Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild and Extinct. The criteria for each category, and the IUCN Categories of species, are given in the

IUCN Red List of Threatened Species: https://www.iucnredlist.org.

**Taxonomic Notes.** These begin with the scientific name of the species followed by the name of the describer(s) and the year in which the description was published. Brackets are significant. No brackets indicates that the species was originally placed in the genus it is currently considered to represent. Brackets indicate that the species is currently considered to represent another genus. Taxonomic controversies are discussed briefly, and the names of species given in the most important books about Malawian mammals are mentioned if they are different to those used here. With few exceptions, the taxonomy followed here follows that in Kingdon, J., Happold, D., Butynski, T., Hoffman, M., Happold, M., & Kalina, J. (eds.) 2013. *Mammals of Africa* (6 vols). Bloomsbury Publishing, London. This is a conservative approach based mainly on classical morphological and anatomical characters. In recent years, there have been many other studies based on molecular and genetic characters. Where relevant, these are mentioned.

**Measurements**. For the species within each order, the standard body measurements are listed, together with the greatest skull length which is approximately the same as the length of the head. The parameters differ from order to order. For each parameter, the mean and range are given, and also the number of individuals (n) in the sample. Measurements from Malawi have been given if possible. However, if sample sizes are too small for these measurements to be a useful means of identifying species, measurements from adjacent countries are included, or measurements from other countries or from the whole biogeographic range. Sources of measurements are given. If the measurements are of museum specimens, the relevant museums are listed by their acronymns (see below).

**References**. Because this is primarily a guide for a general readership, references are seldom given in the profiles, but key references are given at the end of each profile.

# MUSEUM ACRONYMS

| ACRONYM | MUSEUM NAME |
|---|---|
| AM | Amatole Museum, King William's Town, South Africa. [formerly Kaffrarian Museum]. |
| AMNH | American Museum of Natural History, New York, USA. |
| DNMNH | Ditsong National Museum of Natural History, Pretoria, South Africa. Formerly Transvaal Museum. |
| DNSM | Durban Natural Sciences Museum, Durban, South Africa. |
| FMNH | Field Museum of Natural History, Chicago, USA. |
| HC | Happold Collection (now at Natural History Museum, London, UK). |
| HZM | Harrison Zoological Museum, Sevenoaks, Kent, UK. |
| KU | Kansas Museum of Natural History, Lawrence, USA. |
| IRSN | Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium. |
| LACM | Los Angeles County Museum, Los Angeles, USA. |
| MCZ | Museum of Comparative Zoology, Harvard University, Cambridge, USA |
| MNHN | Musée National d'Histoire Naturelle, Paris, France. |
| NHMUK | Natural History Museum, London, UK. (Formerly British Museum of Natural History). |
| NHMZ | Natural History Museum of Zimbabwe, Bulawayo, Zimbabwe. |
| NMK | National Museums of Kenya, Nairobi, Kenya |
| NMMB | National Museum of Malawi, Blantyre, Malawi. |
| NMZB | Natural History Museum of Zimbabwe, Bulawayo, Zimbabwe. |
| RMCA | Royal Museum for Central Africa, Tervuren, Belgium. |
| RMNH | Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands. |
| ROM | Royal Ontario Museum, Toronto, Canada. |
| SMF | Naturmuseum Senckenberg, Frankfurt, Germany. |
| SMNS | Staatliches Museum für Naturkunde, Stuttgart, Germany. |
| TM | Transvaal Museum, Pretoria, South Africa. |
| USNM | United States National Museum of Natural History, Smithsonian Institution, Washington, USA. |
| WRUK | Wildlife Research Unit, Kasungu N. P., Malawi. |
| ZFMK | Museum Alexander Koenig, Bonn, Germany. |
| ZMA | Zoologisch Museum, Amsterdam, the Netherlands. |

# ORDER ERINACEOMORPHA - HEDGEHOGS

| Family Erinacidae | *Atelerix* (1 species) | Hedgehogs | p. 23 |
|---|---|---|---|

Hedgehogs are well known animals in Africa and Eurasia. They belong to just one family, ten genera and 20 species, of which three genera and six species occur in Africa, but only one species in Malawi. In the past, hedgehogs were placed in the order Insectivora together with shrews, moonrats, moles, golden-moles, otter-shrews, tenrecs, sengis (elephant-shrews), tree-shrews and colugos. Currently, however, the golden-moles, sengis and tenrecs are placed in three orders in the super-order Afrotheria, and the hedgehogs and shrews (the only "Insectivora" represented in Malawi) are also placed in separate orders, the Erinaceomorpha and Soricomorpha respectively.

## FAMILY ERINACIDAE - Hedgehogs

The family Erinacidae contains two subfamilies – the Galericinae or Hairy Hedgehogs and the better-known Erinaceinae or Spiny Hedgehogs. The latter have short, pointed spines which densely cover their backs and flanks and, if disturbed or threatened, they curl up into a tight ball with the spines bristling out in all directions. There is only one genus in Malawi.

## Genus *Atelerix* - Hedgehogs

The genus *Atelerix* contains four species which are endemic to Africa, but only one species occurs in Malawi. These mammals cannot be confused with any other mammals in Malawi.

### *Atelerix albiventris*

### White-bellied Hedgehog

### (Four-toed Hedgehog)

**Malawian Names** Chanasa, Chisoni, Kanungu, Shoni, Soni

Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Description** An unmistakable mammal with hairs modified into spines on the back of the neck, back and flanks. Dorsal pelage, including crown of head between the ears, with hairs modified into blackish-brown spines with white tips. There is considerable variation in banding pattern on spines. Ventral pelage short, coarse, pure white, not spiny. Head with white hairs on the cheeks and forehead forming a conspicuous white brow-band. Muzzle, lips, chin and around eyes almost naked with black pigmentation. Throat white. Face pointed with black eyes. Vibrissae black. Ears small, rounded, almost naked, with black pigmentation, shorter than adjacent spines. Limbs short. Forelimbs with sparse blackish-brown hairs dorsally; palms naked and unpigmented; five very short digits each with a small claw. Hindlimbs with sparse blackish-brown hairs dorsally; soles naked and unpigmented; four very short digits each with a small claw. Tail very short (ca. 8% of HB), inconspicuous, with a few sparse bristles.

**Similar Species** None. In Malawi, the only other animal with spines is the Cape Crested Porcupine (*Hystrix africaeaustralis*) (HB 655 mm, WT 18-22 kg) which is very much larger and has prominent incisor teeth in the front of the upper and lower jaws.

**Distribution** Recorded throughout Malawi but mostly in the southern half. Localities include Balaka, Blantyre, Dedza District, Dowa, Karonga, Kasungu N. P., Lilongwe, Liwonde N. P., Malosa, Mulanje District, Mwabvi W. R., Namadzi District, Thondwe District, Zomba, Zomba Plateau. Elsewhere: Senegal to Sudan and southwards in East Africa to Malawi (not recorded south of the Zambezi

River). The most widespread of the six species of hedgehogs in Africa. Malawi is at the southernmost end of the biogeographic range of the species.

**Habitat** Woodland savannas, including rocky inselbergs. Tends to avoid waterlogged habitats, marshes and swamps. Often found in suburban gardens and cultivated fields.

**Abundance** Uncertain. Hedgehogs are rarely seen and may be more common than records suggest.

**Habits** Terrestrial and nocturnal**.** During the day, hedgehogs rest in dark secluded places. They forage at night and feed on a wide variety of insects, earthworms, snails, slugs and fruits. If disturbed or threatened, hedgehogs curl into a ball of bristling spines so the vulnerable head and belly are protected. Probably aestivate in the dry season. Hedgehogs are mostly solitary animals and the only social behaviour is during courtship and when a female is looking after her young. Audio recordings have identified five sorts of vocal sounds: (1) Twitter – a very quiet sound often accompanied by sniffing; usually associated with unfamiliar situations. (2) Hiss – a short noise of lower pitch than the twitter, emitted during stressful situations. (3) Snort – similar to the hiss, but louder and emitted when severely stressed or attacked, often repeated rapidly. (4) Scream – a rare sound, emitted under extreme stress. (5) Serenade – a series of low-pitched sounds ranging from a pure whistle to a course squawk, emitted during courtship. Hedgehogs are hosts to many ectoparasites (mostly fleas) and also endoparasites (tapeworms, nematodes).

**Reproduction** No information for Malawi, except that young hedgehogs (WT 120 g, i.e. one quarter of adult weight) were recorded on Shire Highlands in Dec (early wet season). In the highlands of Kenya (Nairobi), pregnant females have been recorded Jul and Aug, litters in Apr and May, and young (less than one half adult weight) in Jan to Jul, suggesting that reproduction occurs throughout most of the year. Litter-size (in captivity): 3.1 (1-6). Neonates are altricial, and without any spines at birth. Growth is rapid and young attain maturity by ca. 5-6 months.

**Conservation IUCN Category:** Least Concern.

**Taxonomic Notes** *Atelerix albiventris* (Wagner, 1841). Referred to as *Erinaceus pruneri* by Sweeney (1959) and Hayes (1978).

**Key Reference** Happold, D. C. D. (2013a).

**Measurements**
*Atelerix albiventris*

| | |
|---|---|
| HB: | 136 (110-210) mm, n = 4 |
| T: | 10.5 (8-13) mm, n = 4 |
| HF: | 24.8 (24-26) mm, n = 4 |
| E: | 17.5 (15-21) mm, n = 4 |
| WT: | 422 (270-680) g, n = 10* |
| GLS: | 43.5 (41.9-44.8) mm, n = 10* |

Malawi (NMMB, D. C. D. Happold *pers. obs.*).
*Senegal (ZFMK).

# ORDER SORICOMORPHA – SHREWS ETC.

| | | | |
|---|---|---|---|
| Family Soricidae | *Crocidura* (7 species) | Shrews | p. 27 |
| | *Myosorex* (1 species) | Shrews | p. 35 |
| | *Suncus* (3 species) | Dwarf Shrews | p. 36 |

This order includes a variety of mammals which feed on invertebrates such as insects, other arthropods, earthworms. slugs and snails. These include shrews, moles, mole shrews, desmans and solenodons of which only shrews (family Soricidae) occur in Malawi.

## FAMILY SORICIDAE - Shrews

Shrews are very small mammals which look a little like House Mice except that they have long, pointed snouts and many have a distinctive pungent odour. They are sometimes brought in by domestic cats. They are by far the most numerous and widespread of the terrestrial insectivorous mammals found in Africa. They are a very difficult group to work on, and the number of genera and species in Africa is often revised as new information comes to light. An approximate estimate is that there are nine genera and 150 species in Africa, of which three genera and 11 species occur in Malawi. Most are terrestrial but one is scansorial (meaning that is adapted for climbing – in this case, into shrubs and up grasses). An interesting behavioural characteristic of shrews is that young shrews (when fully furred and with their eyes open) form a line behind their mother with each young holding on to the rump of the one in front. This is called caravanning. In this way, the young follow their mother whenever she leaves the nest.

Folklore has it that shrews die if they cross paths. In fact, shrews can die anywhere but the only ones likely to be found by people are those which happen to die on or next to a path where they are easily seen.

Shrews are best distinguished from skull and dental characters, chromosome numbers and molecular/genetic data, but these data are not usually covered here. The external characters that best distinguish species of shrews, in addition to colour of pelage and measurements, are pilosity and the relative length of the tail.

Pilosity is the percentage of the tail (measured from its base) which has long, pale, often bristle-like, hairs. 0% = no long hairs.

Relative length of tail is T as percentage of HB (where T is the length of the tail and HB is the combined length of the head and body). If possible, the means and ranges are derived from the measurements of individual animals. If these data are unavailable, approximate relative lengths are taken from profiles in *Mammals of Africa.* For shrews of Malawi, the range is 54-77%, with the exception of *Suncus megalura* which is the only shrew whose tail is longer than its HB. The range 54-77% is divided into three increments, so short = ca. 54-62% of HB, medium = 63-69% of HB, long = 70-77% of HB. The tail of *Suncus megalura* is extremely long = 121% of HB.

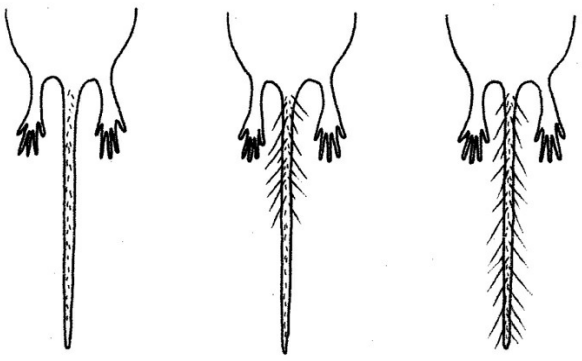


Fig. 1. Pilosity of the tails of shrews; from left to right, 0%, 50% and 100%.

The measurements given for each species include CI (condyloincisive length), the length of the skull from anterior end of the longest incisor to the posterior part of the skull. The length of the head, from the front of the incisors to the back of the head is approximately the same as the CI length.

There are no external characters which clearly distinguish the three genera of shrews found in Malawi, but most of the species can be identified from the data in Table-key 1. Two species are best distinguished by their chromosome numbers. If accurate identification of a shrew is important, a specimen should be sent to experts at the Alexander Koenig Museum in Bonn or the Natural History Museum in London, where good collections of Malawian shrews are available for comparison.

Table-key 1 to the shrews (family Soricidae) found in Malawi.

| HB | Relative length of tail | Pilosity | CI | Miscellaneous | Species |
|---|---|---|---|---|---|
| >100 mm | medium | 50-60% | 32.0-34.3 mm | Northern and southern Malawi. | *Crocidura* cf. *oliveri* |
| <100 mm | short | 100% | 23.2 (22-24) mm | Widespread. Dorsal and ventral colour merge. | *Crocidura hirta* |
| <100 mm | short | 100% | 16.2 (15.1–17.0) mm | Nyika Plateau. HB: 55.8 (44-68) mm. Dorsal and ventral colours clearly delineated. | *Suncus varilla* |
| <100 mm | short | 0% | 20.5 mm | Nyika Plateau. | *Myosorex gnoskei* |
| <100 mm | medium | 100% | 22.6 (20-25) mm | Widespread. HB: 80.1 (75-86) mm. Dorsal and ventral pelage colours merge. | *Crocidura luna* |
| <100 mm | medium | 80-100% | 19.7 (19.2-20.7) mm | Nyika Plateau and/or Misuku Hills. HB: 72.0 (68-75) mm. Dorsal and ventral pelage colours merge. | *Suncus lixus* |
| <100 mm | medium | ca. 75% | 16.2 (15.1-17.4) mm | Ventral pelage silvery-grey, sometimes with yellowish tinge. Dorsal and ventral colours clearly delineated. | *Crocidura fuscomurina* |
| <100 mm | long | 67% | 19.7 (19.0-20.3) mm | Southern Malawi: Zomba Plateau, Mount Mulanje. Ventral pelage pale grey with brown tinge. Dorsal and ventral colours merge. | *Crocidura silacea* |
| <100 mm | long | 54-75% | 18.8 (18.2-19.3) mm | N, C and S Malawi. Ventral pelage brownish-grey. Dorsal and ventral colours merge. | *Crocidura* cf. *hildegardeae* |
| <100 mm | long | 100% | 23.9 mm, n = 2 | Northern Malawi: Nyika Plateau, Viphya Plateau, Misuku Hills. Dorsal and ventral colours merge. | *Crocidura nigrofusca* |
| <100 mm | extremely long | 0% | 18.0 (16.8-18.6) mm | | *Suncus megalura* |

Relative length of tail = T as %age of HB; based on mean relative length if available, or approximate relative length (from Mammals of Africa). Short = ca. 54-62% of HB, medium = 63-69% of HB, long = 70-77% of HB. The range 54-77% applies only to shrews from Malawi (but excludes *Suncus megalura*, the only species whose tail is longer than its HB. The tail of this species is relatively extremely long, 121-138% of HB).

Pilosity = percentage of tail (measured from its base) which has long, pale, often bristle-like, hairs. 0% = no long hairs.

CI = condyle-incisive length, length of skull from anterior end of the longest incisor to the posterior part of the skull. The length of the head, from the front of the incisors to the back of the head is approximately the same as the CI length.

# Genus *Crocidura* - Shrews

There are at least 170 species of *Crocidura* worldwide of which 62% (105 species) occur in Africa and seven occur in Malawi. To distinguish the species known to occur in Malawi, see Table-key 1. The profiles of these species are presented in the alphabetical order of their scientific names.

## *Crocidura fuscomurina*

## Bicoloured Shrew

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.

Limpopo Province, South Africa © C. & M. Stuart

**Description** Very small shrew (second smallest in Malawi). Dorsal pelage grey-brown; hairs slate-grey at base, brown or buffy-brown at tip. Ventral pelage silvery-grey, sometimes with yellowish tinge; hairs slate-grey at base, white or off-white at tip. Dorsal and ventral colours clearly delineated on flanks. Fore- and hind feet pale brown to off-white. Tail medium (ca. 65% HB), darker above, paler below, with long white hairs on basal three-quarters (i.e. pilosity 75%).

**Similar Species** Only one other shrew in Malawi has the dorsal and ventral pelage colours clearly delineated (see Table-key 1):

*Suncus varilla*: on average, smaller (HB: 55.8 [44-68] mm). Tail relatively shorter (ca. 54% of HB); pilosity 100%. In Malawi, only known from Nyika Plateau.

**Distribution** In Malawi, recorded from Livingstonia and Nyika Plateau. There is also an unconfirmed record from Lake Chilwa (DNMNH). Elsewhere: widespread in savannas in West Africa, East Africa, East-Central Africa and the northern part of southern Africa.

**Habitat** Grasslands, woodland savannas and semi-arid regions.

**Abundance** Widespread in Africa although rarely recorded. Abundance uncertain.

**Habits** Nocturnal, terrestrial. In other parts of Africa, recorded in termite mounds, fallen logs and marshy areas. Appears to have a wide habitat tolerance. Insectivorous, feeding on moths and other insects (in captivity). Assumed to be solitary.

**Reproduction** In southern Africa, reproductive activity takes place during the wet season (Nov–Apr). Mean litter-size: 3.4 (range 2-5). Development is rapid; eyes open on Day 12 and they are weaned and fully active by ca. Day 17. Young caravan behind mother from Day 6 until weaning.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Crocidura fuscomurina* (Heuglin, 1865). Seven subspecies names recognized in the past are now considered to be synonyms. These include *bicolor* in S Malawi and *hendersoni* in N Malawi. Referred to as *C. suaveolens* by Sweeney (1959).

**Key Reference** Dippenaar & Baxter (2013).

**Measurements**
*Crocidura fuscomurina*

| | |
|---|---|
| HB: | 57.9 (48-75) mm, n = 11 |
| T: | 38.5 (27-48) mm, n = 11 |
| HF: | 9.8 (8-11) mm, n = 11 |
| E: | 7.6 (6.5–9) mm, n = 10 |
| WT: | 3.7 (2-5) g, n = 11 |
| CI: | 16.2 (15.1-17.4), n = 10 |

Southern Africa (Meester 1963).

## *Crocidura* cf. *hildegardeae*

## Hildegarde's Shrew

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.

**Description** Small-medium very dark blackish-brown shrew not easily distinguished from *C. nigrofusca*. Pelage short and dense, velvety with sheen. Dorsal pelage very dark blackish-brown; hairs dark blackish-brown, dark grey at base. Ventral pelage brownish-grey; hairs dark grey at base, paler brownish-grey at tip. Dorsal and ventral colours merge. Ears round and flattened against the head (and relatively large for a shrew), with blackish-brown pigmentation. Fore- and hindfeet with blackish-brown pigmentation, and well covered with very short blackish-brown hairs. Tail relatively long (76.7 [68-89]% of HB, n = 3), thin, tapering towards tip, well covered with very short blackish-brown bristles, and with long black and pale grey hairs on basal half or three-quarters, (i.e. pilosity 54%, n = 1 from Nyika Plateau, or 70% and 75%, n = 2 from Mulanje Mountain). Chromosome number 2n = 52.

**Similar Species** (See Table-key 1)

*C. nigrofusca*: pilosity 80-90%. In Malawi, known only from Nyika Plateau, Viphya Plateau, Misuku Hills. Best distinguished by chromosome number (2n = 48).

*C. silacea*: Pilosity 67%. Dorsal pelage buffy-brown to brown grizzled with pale grey. In Malawi, distributions possibly only overlap on Zomba Plateau and Mulanje Mountain.

**Distribution** Recorded in about six areas in north, central and south Malawi (Mulanje Mountain, Nyika Plateau, Viphya Plateau [Chikangawa] and Zomba Plateau). Elsewhere: known from SE Cameroun, CAR, northern parts of DRC and most of East Africa.

**Habitat** Dry and moist forests and grasslands in montane and highland areas. A specimen from Chelinda on Nyika Plateau was collected in grassland associated with abundant *Helichrysum* sp. May also occur in cultivated habitats and moist savannas.

**Abundance** No information. Abundance varies according to habitat and altitude. In Tanzania, it was the most abundant species [78% of 47 shrews of 4 species] in one study area at 1100 m, but less abundant (30% of 10 shrews of 4 species) at another study area at 2000 m.

**Habits** Terrestrial and nocturnal.

**Reproduction** Embryo number: 2 (n = 3). In Tanzania, 64% of shrews in a sample in August were juveniles, suggesting that some births occurred in the early dry season or the end of the wet season (no information for every month of the year).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Crocidura hildegardeae* Thomas, 1904. Referred to, incorrectly, as *Crocidura gracilipes* in some previous publications. *Crocidura hildegardeae* is currently being revised and may consist of several distinct species. Therefore, pending further information, we refer to the Malawian form as *C.* cf. *hildegardeae*.

**Key Reference** Stanley (2013).

**Measurements**
*Crocidura* cf. *hildegardeae*

HB: 71.5 (64-77) mm, n = 25. (62, 61 mm)*
T: 50.1 (39-56) mm, n = 25. (52, 53 mm)*
HF: 13.0 (12-14) mm, n = 17. (12, 12 mm)*
E: 9.0 (8-11) mm, n = 25. (6.5, 6 mm)*
WT: 6.3 (4.6-7.7) g, n = 25
CI: 18.8 (18.2-19.3) mm, n = 25

Tanzania (Stanley 2013). *In brackets, measurements of two specimens from Mulanje Mountain at 2000 m.

## *Crocidura hirta*

## Lesser Red Shrew

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.

**Description** Medium-sized shrew with soft short velvet-like pelage and slight to very strong musky odour. Dorsal pelage grey suffused with sepia to reddish-brown: hairs grey with terminal third sepia or red-brown. Some individuals less reddish-brown than others. Ventral pelage similar to dorsal pelage but with less brown: hairs grey at base with silvery-grey, creamy-grey or brown tips. Dorsal and ventral pelage colours merge. Ears small, rounded, with sparse, very short red-brown hairs. Adults may have lateral scent glands on each flank, indicated by bare patch between fore- and hindlimbs. Limbs short and slender. Fore- and hindfeet lightly pigmented, dorsal side covered with short brown hairs, soles naked. Tail relatively short (62 [53-75]% of HB, n = 18), fairly wide at base, tapering towards tip, well covered dorsally with short brown bristles, ventrally with short creamy-grey bristles; entire length with numerous stiff, long white hairs (i.e. pilosity 100%). In some specimens, both dorsal and ventral sides of the tail are covered with red-brown bristles.

**Similar Species** None, see Table-key 1.

**Distribution** Recorded throughout Malawi but mostly in the north and south. Localities include Kasungu N. P., Lengwe N. P., Namadzi District and Nyika N. P. (and many others not confirmed). Elsewhere: widespread in Tanzania, southwards through Zambia, Mozambique, Zimbabwe, Botswana, SE DR Congo, SE Angola, and northern South Africa.

**Habitat** Primarily savanna habitats, but has wide habitat tolerance. Recorded from thicket-clump savanna (Lengwe N. P.), under piles of dead grass, at base of banana plants, under piles of debris, under logs, and other places where there is cover to hide under. On Nyika Plateau, found in open canopy miombo woodland with tall grasses and shrubs near a stream. Sometimes commensal with humans.

**Abundance** Uncertain. Assumed to be comparatively common throughout biogeographic range.

Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Habits** Nocturnal, active mostly at dusk and dawn. Insectivorous. Scent glands are used for marking, and piles of faeces have a strong odour, perhaps suggesting some form of territoriality. In southern Africa, nests for young are placed at the end of a tunnel hidden beneath a rock. Preyed upon by Grass Owls (*Tyto capenis*) and Barn Owls (*Tyto alba*).

**Reproduction** No information for Malawi. In South Africa, pregnancies recorded in wet and dry seasons (Sep–May). Mean litter size: 3.6 (Zimbabwe), 4.1 (2-5) (South Africa). Development is rapid - eyes open on Day 12 and weaning occurs on ca. Day 18. Young caravan behind mother from Day 6 until weaned.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Crocidura hirta* Peters, 1852. Four subspecies; one in Malawi, *C. h. hirta (*as suggested by Ansell & Dowsett [1988]).

**Key Reference** Baxter & Dippenaar (2013a).

**Measurements**
*Crocidura hirta*

| | |
|---|---|
| HB: | 89.2 (78-104 mm), n = 18 |
| T: | 55.3 (45-65) mm, n = 18 |
| HF: | 14.3 (13-15) mm, n = 18 |
| E: | 10.2 (9-12) mm, n = 16 |
| WT: | 15.7 (10-24) g, n = 15 |
| CI: | 23.2 (22-24) mm, n = 23* |

Malawi (HC and others).
*South Africa (Meester 1960 in Baxter & Dippenaar 2013a).

## *Crocidura luna*

## Moonshine Shrew

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.

**Description** Medium-sized dark shrew with a slight musky odour. Pelage short, silky and very dense. Dorsal pelage ranging from dark smoke-grey with a silvery sheen to silver-grey slightly suffused with pale brown. Some individuals have sparse white flecking. Dorsal hairs dark grey at base with silver-grey or brown tip. Ventral pelage dark to pale grey: hairs dark to pale grey with silver-grey tip. Dorsal and ventral pelage colours merge on flanks. Snout long and pointed with black, grey and white vibrissae. Ears rounded, with pale grey pigmentation and a few dark bristles on edge of the pinnae. Limbs small and short. Feet unpigmented with sparse short white hairs. Tail of medium relative length (69 [61-81]% of HB, n = 12), wide at base and tapering towards tip, with numerous very small scales, numerous very small black, grey-brown or grey bristles, and scattered long grey-white or black hairs (6-7 mm) along entire length (i.e. pilosity 100%); dorsal side sometimes with black pigmentation; ventral side usually paler than dorsal side.

**Similar Species** See Table-key 1.
*Suncus lixus:* on average smaller (HB: 72.0 (68-75) mm). In Malawi, known only from Nyika Plateau and/or Misuku Hills.

**Distribution** Recorded from scattered localities throughout Malawi (including Chiromo, Kasungu, Mangochi Mountain, Mulanje Mountain, Nyika Plateau, Viphya Plateau and Zomba Plateau). Chiromo is the type locality of *C. fumosa johnstoni* which is currently considered to be a synonym of *C. luna*. Elsewhere: recorded from southern Uganda, southern Kenya, Tanzania SE DR Congo, Zambia, and WC Mozambique.

**Habitat** Mainly at high altitudes (mostly above 1000 m), especially montane forests, and thick grassy habitats along the edges of forests, in areas where mean annual rainfall is 100 cm or more. At Chiromo and Kasungu, and also in adjacent Zambia, it occurs at lower altitudes in areas of lower rainfall. Also recorded from plantations at higher altitudes (e.g. Zomba Plateau) and among grass tussocks on mountain slopes. The only species of shrew known to occur in both natural habitats and pine plantations on Zomba Plateau.

**Abundance** Uncertain.

**Habits** Solitary, nocturnal and terrestrial. Very agile when foraging; individuals burrow under leaf litter and debris, so (to a human observer) progress can be followed by the rustling and movement of leaves above the animal. In Malawi, animals captured prey (termites, bugs and grubs) rapidly in the mouth and then ran to a covered place to eat. When disturbed, emits high-pitched squeaks, often in quick succession (especially when disturbed by a rodent such as *Lophuromys*). (Observations on captive animals in Malawi.)

**Reproduction** Litter-size: 3.5 (3-4). In Zimbabwe, young are born in November and October (no data for other months).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Crocidura luna* Dollman, 1910. Referred to as *C. pilosa johnstoni* by Sweeney (1959).

**Key Reference** Baxter & Dippenaar (2013b).

**Measurements**
*Crocidura luna*

| | |
|---|---|
| HB: | 80.1 (70-90) mm, n = 13 |
| T: | 54.8 (50-60) mm, n = 12 |
| HF: | 14.3 (9-16) mm, n = 13 |
| E: | 9.7 (7-11) mm, n = 13 |
| WT: | 13.2 (11-15) g, n = 13 |
| CI: | 22.6 (20-25) mm, n = 9* |

Malawi (Zomba Plateau, D. C. D. Happold, *pers. obs.).*
*Throughout biogeographic range.

## *Crocidura nigrofusca*

## African Black Shrew


Kasanka N. P., Zambia © C. & M. Stuart

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.

**Description** Medium-sized very dark shrew not easily distinguished from *C. hildegardeae*. Pelage dense, soft with a silky sheen. Dorsal pelage black or brownish-black; hair grey at base with black or brownish tips; hairs 6-7 mm. Ventral pelage similar to dorsal pelage, sometimes slightly paler. Dorsal and ventral pelage colours merge on flanks. Snout long and pointed with black vibrissae. Eyes very small. Ears rounded, darkly pigmented with short brown hairs. Feet with dark grey-brown pigmentation and short pale or brown hairs. Tail relatively long (ca. 75 % of HB), wide at base, tapering towards tip; not bicoloured; well covered with brown bristles, and with scattered long brown or beige hairs along most of its length (i.e. pilosity 80-90%). Chromosome number 2n = 48.

**Similar Species** (see Table-key 1).
*C.* cf. *hildegardeae*: pilosity 54-75%. Not known from Zomba Plateau and Mulanje Mountain but distribution overlaps on Nyika Plateau and Viphya Plateau. Best distinguished by chromosome number (2n = 52).

**Distribution** Recorded only in three localities in northern Malawi: Misuku Hills, Nyika Plateau (including Chelinda), and Viphya Plateau (13 km N of Chikangawa), as *C. zaodon*. Elsewhere: widespread in Kenya, Uganda, Tanzania, S DR Congo, E Angola and Zambia.

**Habitat** Swampy areas near watercourses, mostly in montane habitats. May also occur in forest patches and montane forests.

**Abundance** Uncertain. Rarely encountered in surveys (e.g. near Chelinda on Nyika Plateau) only one *C. nigrofusca* was found amongst six shrews of 5 species. In SE Kenya, comprised only 2% of 302 shrews found in 13 different forests.

**Habits** No information.

**Reproduction** Mean litter size: 3.3.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Crocidura nigrofusca* Matschie, 1895**.** Formerly referred to by different names, including *C. turba nyikae* and *C. zaodon* (e.g. by Ansell & Dowsett 1988). No subspecies.

**Key Reference** Hutterer (2013).

**Measurements**
*Crocidura nigrofusca*

| | |
|---|---|
| HB: | 83.7 (65-95) mm, n = 3 |
| T: | 64.3 (55-72) mm, n = 3 |
| HF: | 15 (14-16) mm, n = 3 |
| E: | 9.4 (9-10) mm, n = 3 |
| WT: | 16.8 (13-24) g, n = 3 |
| CI: | 23.9, 23.9 mm, n = 2 |

SE Kenya (Oguge *et al.* 2004 in Hutterer 2013).

## *Crocidura* cf. *olivieri*

## African Giant Shrew

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.


Zomba Plateau, Malawi © DCD & M. Happold

**Description** The largest of the shrews in Malawi (and Africa). Large shrew with dense soft velvety pelage and a very strong musky odour. Dorsal pelage grey-brown to blackish-brown, sparsely flecked with white in some individuals: hairs dark grey on basal half, brown or blackish-brown on terminal half; 4.5 mm in length. Ventral pelage paler than dorsal pelage, hairs grey with grey-brown tip. Dorsal and ventral colours merge on flanks. Snout long and pointed, with black and grey vibrissae. Limbs short. Forefeet unpigmented, with sparse short hairs. Hind-feet small and slender, with dark pigmentation except on digits, and short dark hairs. Tail of medium relative length (68 [60-88]% of HB, n = 13), slightly tapering, with very small scales and numerous small dark bristles; scattered long white hairs on ca. basal half (i.e. pilosity 50-60%, n = 6).

**Similar Species** None. All other species of shrews are smaller (see Table-key 1).

**Distribution** Recorded in northern and southern Malawi. There are no records from the central plateau area; it is not known whether this is a real break in distribution or the result of inadequate investigation. Localities include Misuku Hills and Nyika N. P. in the north, and Blantyre, Chididi Mission, Thyolo Mountain, Zomba and Zomba Plateau in the south. Elsewhere: very widespread throughout all of Africa south of the Sahara to about 20˚S (i.e. N Namibia, N Botswana, N Zimbabwe and S Mozambique).

**Habitat** Well vegetated moist habitats, including forest, riverine habitats, flood plains, scrub, farmlands and grasslands including montane grasslands. Also known to occur in plantations (e.g. *Pinus patula*), food stores and houses. The most commonly encountered shrew in human habitations.

**Abundance** No data for Malawi. Abundance varies greatly according to habitat; e.g. from 0% (e.g. West African rainforests) to 80% (Uganda) of shrews captured in surveys.

**Habits** Terrestrial, solitary, and mostly nocturnal. Very adaptable and capable of surviving in many habitats (see above) except in rainforests. Although most shrews are timid and secretive, African Giant Shrews are considered to be rather aggressive. Well-developed lateral glands on flanks exude a strong musky odour. Feeds on a wide variety of insects, including ants, termites, beetles, grasshoppers and insect larvae. Predators include owls, mongooses, genets and wild cats.

**Reproduction** No information for Malawi. In Zambia and DR Congo, pregnant females are found in all months of the year with high rates of reproduction in the wet season compared with the dry season. Embryo number: 4 (1-5).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Crocidura olivieri* (Lesson, 1827). Referred to as *Crocidura flavescens* (by Sweeney 1959) and *Crocidura occidentalis* by Ansell & Dowsett (1988). *Crocidura olivieri* is currently thought to contain several species and is in need of revision (Jaquet *et al.* 2015). Pending resolution, we refer to the Malawian form as *C.* cf. *olivieri.*

**Key Reference** Churchfield & Hutterer (2013).

**Measurements**
*Crocidura olivieri*

| | |
|---|---|
| HB: | 119.3 (113-137) mm, n = 13 |
| T: | 80.3 (69-99) mm, n = 13 |
| HF: | 19.6 (18-21) mm, n = 13 |
| E: | 11.2 (7-13) mm, n = 11 |
| WT: | 37.3 (30-41) g, n = 3 |
| CI: | 29.4 (27-31) mm, n = 7 |

Malawi (NHMUK, HC, MCZ, NMMB).

## *Crocidura silacea*

## Lesser Grey-brown Shrew

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.

Limpopo Province, South Africa © C. & M. Stuart

**Description** Small to small-medium shrew. Dorsal pelage buffy-brown to brown grizzled with pale grey; hairs slate-grey at base with pale grey subterminal band and brown tip. Ventral pelage pale grey with brown tinge; hairs slate-grey at base and pale grey or brown at tip. Dorsal and ventral pelage colours merge on flanks. Some individuals have very dark pelage, with black feet and black tail (Zomba Plateau). Fore- and hindfeet brown, sometimes with white hairs. Tail relatively long (77 [65-85]% of HB, n = 7). Sparse long hairs over the basal two-thirds of the tail, which are long, slightly bristly, pale brown and lighter more translucent towards the tips. i.e. Pilosity 67%.

**Similar Species** See Table-key 1.

*C.* cf. *hildegardeae*: pilosity 54-75%. Dorsal pelage very dark blackish-brown. In Malawi, distributions probably only overlap on Zomba Plateau and Mulanje Mountain.

**Distribution** In Malawi, recorded only from Mulanje Mountain and Zomba Plateau. Elsewhere: recorded from South Africa and Zimbabwe, and some authorities consider that the species may occur further north to Kenya and Uganda.

**Habitat** In Malawi, only known, from higher altitudes. Specimens from Zomba Plateau were caught by a domestic cat near 'The Stables' (ca. 1500 m) and were probably caught in or near montane forest or thickets along the forest edge. Elsewhere: known from montane forest, savanna woodland, bush, grassland and rocky areas. The species appears to have a wide habitat tolerance, at least in the southern parts of its biogeographic range (see above).

**Abundance** Uncertain. Presumed to be rare or uncommon.

**Habits** No information; probably similar to *C. luna* which lives in the same habitat on Zomba Plateau. Builds nests with 3-4 entrances. Preyed upon by Barn Owls in South Africa.

**Reproduction** Embryo number: 4 (n = 1) (Zomba Plateau, Sep).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Crocidura silacea* Thomas, 1895. Previously included within *C. gracilipes* and/or *C. cyanea* but now considered to be a distinct species. The species was not listed by Ansell & Dowsett (1988).

**Key Reference** Baxter & Dippenaar (2013c).

**Measurements**
*Crocidura silacea*

| | |
|---|---|
| HB: | 69.3 (62-77) mm, (n = 7) |
| T: | 53.1 (50-55) mm, (n = 7) |
| HF: | 12.6 (11-14) mm, (n = 7) |
| E: | 9.0 (8-10) mm, (n = 7) |
| WT: | 7.3 (6-9) g, (n = 7) |
| CI: | 19.7 (19.0-20.3) mm, (n = 14) * |

Malawi (Zomba Plateau, HC). * South Africa (Meester 1963 in Baxter & Dippenaar 2013c).

# Genus *Myosorex* - Mouse Shrews

There are only 14 species of mouse shrews. They are endemic to Africa and occur mainly in isolated mountain forests in central and south-east Africa. Only one species occurs in Malawi.

## *Myosorex gnoskei*

## Nyika Burrowing Mouse Shrew

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.

**Description** Small-medium sized shrew with a relatively short tail. Dorsal pelage brownish, mottled with paler flecks; dorsal hairs long (7 mm), slate grey with subterminal yellow band and dark brown tip. Ventral pelage yellowish-grey; hairs grey with yellow tips. Tail thin and relatively short (55% of HB, n = 1), bicoloured – dark above and pale below; without long bristle hairs (i.e. pilosity 0%) (cf. *Crocidura* spp.). Short claws on fore- and hindfeet.

**Similar Species** None. This is the only species of shrew in Malawi with a relatively short tail and pilosity 0% (i.e. without long white hairs on the tail). See Table-key 1.

**Distribution** Known only from Chelinda on the Nyika Plateau.

**Habitat** Low subalpine heathland with grasses and bracken beside a small stream.

**Abundance** Very rare; known only from one specimen.

**Habits** Probably nocturnal (as are most small shrews). Most (if not all) species in the genus burrow in litter and dead vegetation, so it assumed that this species has the same habit. Co-exists with four other species of shrews.

**Reproduction** No information.

**Conservation** IUCN Category**:** Endangered.

**Taxonomic Notes** *Myosorex gnoskei* Kerbis Peterhans, Hutterer, Kaliba and Mazibuko 2008. This species is known only from a single specimen.

**Key Reference** Kerbis Peterhans *et al.* (2008).

**Measurements**
*Myosorex gnoskei*

| | |
|---|---|
| HB: | 75 mm, n = 1 |
| T: | 41 mm, n = 1 |
| HF: | 14 mm, n = 1 |
| E: | 9 mm, n = 1 |
| WT: | 8 g, n = 1 |
| CI: | 20.47 mm, n = 1 |

Malawi (Nyika Plateau).

# Genus *Suncus* - Dwarf Shrews

This genus contains 18 species worldwide of which nine occur in Africa and three in Malawi. To distinguish the Malawian species, see Table-key 1.

## *Suncus lixus*

## Greater Dwarf Shrew

Limpopo Province, South Africa © C. & M. Stuart

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.

**Description** Small shrew. Dorsal pelage greyish-brown. Ventral pelage pale grey. Dorsal and ventral pelage colours merge on flanks. Fore- and hindfeet whitish. Tail of medium relative length (69 [59-78]% of HB, n = 7), brown above, whitish or yellowish below, covered with sparse short hairs. Most of the tail (80-100% measured from base of tail) also has long pale hairs (i.e. pilosity 80-100%).

**Similar Species**

*Crocidura luna*: on average larger (HB: 80.1 (70-90) mm). Found at scattered localities throughout Malawi; likely to overlap only on Nyika Plateau and/or Misuku Hills.

**Distribution** In Malawi, known only from two specimens from the type locality which is given as 'N. Nyasa, Nyika or Masuku' (see also Habitat). Elsewhere: recorded from SE DR Congo, Zambia, Zimbabwe, NE Botswana, eSwatini (formerly Swaziland) and a few localities in NE South Africa.

**Habitat** Probably lives in a variety of habitats. Although the only known specimens from Malawi came from a highland area (Nyika Plateau or Masuku = ? Misuku Hills), the species has also been recorded, in other countries, at lower altitudes and from riverine forests, savanna woodlands and grasslands.

**Abundance** Very rare. Although recorded over quite a large biogeographic area (see above), individual records are few in number and only a very few specimens (e.g. often only one or two) have been found at each locality.

**Habits** No information from Malawi. Elsewhere: known to inhabit termite mounds. Insectivorous. May exhibit torpor at some seasons of the year. Preyed upon by Barn Owls in South Africa and eSwatini.

**Reproduction** In South Africa, reproductive activity has been recorded in the wet season. Litter size: 3 (one record only).

**Conservation** IUCN Category**:** Least Concern.

**Taxonomic Notes** *Suncus lixus* (Thomas, 1898). No subspecies.

**Key Reference** Baxter & Dippenaar (2013d).

**Measurements**
*Suncus lixus*

| | |
|---|---|
| HB: | 80.1 (70-90) mm, n = 7 |
| T: | 49.9 (44-56) mm, n = 7 |
| HF: | 12.1 (11-13) mm, n = 7 |
| E: | 9.4 (9-10) mm, n = 7 |
| WT: | 4.1, 8 g, n = 2 |
| CI: | 19.7 (19.2 – 20.7) mm, n = 10* |

Zambia and Zimbabwe (NHMUK).
*South Africa (Taylor 1998 in Baxter & Dippenaar 2013d).

## *Suncus megalura*

## Climbing Dwarf Shrew

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.

**Description** Small shrew with rather long, soft, smooth pelage and long tail. Dorsal pelage dark smoky-grey suffused with dark cinnamon-brown; hairs silvery-grey at base, brown at tip. Ventral pelage pale grey: hairs with basal half pale grey, terminal half white. Dorsal and ventral pelage colours merge on flanks. Snout long and pointed with dark vibrissae (5-15 mm). Limbs short. Forefeet with dense short pale and cinnamon hairs. Hindfeet with dense short dark cinnamon hairs. Digits on forefeet and hindfeet comparatively longer than in (non-climbing) shrews belonging to this and other genera: longest digit 5 mm (longer than in other species of *Suncus*). Tail relatively extremely long (130 [121-138]% of HB, n = 4) – the only species of shrew in Malawi with T longer than HB); dorsal side with dark brown pigmentation and very short dark bristles, ventral side pale, especially near base, with very short pale bristles; without any long hairs (i.e. pilosity 0%).

**Similar Species** None. The only shrew in Malawi with T longer than HB (see Table-key 1).

**Distribution** Recorded from only a few localities (including Misuku Hills, Salima, Zomba Plateau and ?Dedza) but maybe more widespread than the records indicate. Elsewhere: widespread at low and high altitudes from West Africa to East Africa, and southwards to Zimbabwe in moist savanna (see Habitat).

**Habitat** Very varied according to location. Recorded in thick scrub, tall grass, elephant grass, young forest plantations and secondary forest.

**Abundance** No information for Malawi. In other parts of Africa where there have been extensive studies, comprised 0% (coffee plantations), 5.2% (n = 303 shrews) in young forest plantations, and 26% (n = 272 shrews) in fields.

**Habits** Climbs tall grasses and bushes. The long tail is prehensile and is used extensively when climbing. When climbing and clambering amongst grasses and twigs, the body is supported by the tail and hindlimbs so the forelimbs can reach across to reach the next grass stem or twig (in much the same way as the small rodents *Dendromus* spp.). Insectivorous; also recorded to feed on centipedes. In Zimbabwe, a spherical nest was built of broad-leaved grasses in a bush.

**Reproduction** No information for Malawi. Near Lake Kivu (E DR Congo, reproductive activity has been recorded near in March, June, August and November. Mean litter-size: 1.8 (n = 5).

**Conservation** IUCN Category: Least Concern. Widely distributed; survives well in disturbed habitats**.**

**Taxonomic Notes** *Suncus megalura* (Jentink, 1888). Previously placed in the genus *Sylvisorex* (e.g. by Ansell & Dowsett 1988).

**Key Reference** Baxter & Dippenaar (2013e).

**Measurements**
*Suncus megalura*

| | |
|---|---|
| HB: | 60.8 (50-65) mm, n = 36 |
| T: | 88.8 (82-97) mm, n = 36 |
| HF: | 15.5 (14-17) mm, n = 36 |
| E: | 8.3 (6-10) mm, n = 36 |
| WT: | 5.5 (3-8) g, n = 36 |
| CI: | 18.0 (16.8-18.6) mm, n = 12 |

Kivu District, DR Congo (Dieterlen & Heim de Balsac 1979 in Baxter & Dippenaar 2013e).

## *Suncus varilla*

## Lesser Dwarf Shrew

**Malawian Names** Chingaluwe, Sonche, Sunje, Swiswili, Swiswiri. Not confined to this species.


Western Cape, South Africa © C. & M. Stuart

**Description** Very small shrew; the smallest species of shrew in Malawi. Dorsal pelage grey-brown to cinnamon-brown: hairs brown or grey with silvery-grey subterminal band and brownish tip. Ventral pelage whitish-grey: hairs slaty-grey at base with white tip. Dorsal and ventral colours clearly delineated on flanks. Snout long and pointed. Fore- and hindfeet with short white hairs. Tail thin, short and relatively short (54% of HB, n = 1), brown above, paler below, and with scattered long grey hairs from base to tip (i.e. pilosity 100%).

**Similar Species** Only one other shrew in Malawi has the dorsal and ventral pelage colours clearly delineated (see Table-key 1).

*Crocidura fuscomurina*: On average, smaller (HB: 79.5 (48-75) mm. Tail relatively longer (ca. 65% of HB); pilosity 75%. In Malawi, only known from Livingstonia.

**Distribution** In Malawi, recorded only on the Nyika Plateau. Elsewhere: widely distributed in South Africa with a few scattered localities in Zimbabwe, Zambia, SE DR Congo and W Tanzania. Records are widely separated and disjunct.

**Habitat** Terrestrial**.** Recorded in many habitats throughout its biogeographic range. In South Africa, found in grasslands, under piles of wood, in gardens, and on the edges of coastal forests.

**Abundance** No information for Malawi. Elsewhere: thought to be uncommon.

**Habits** No information for Malawi. In South Africa, individuals often live in the mounds of Harvester Termites (especially *Trinervitermes trinervoides*). Spherical nests are built in termite mounds, where there is a stable microclimate. For such a small mammal, a stable environment (without the increases and decreases in daily temperature which occur outside the termite mound) helps to reduce the cost of thermoregulation and energy expenditure. Insectivorous, feeding (in captivity) on grasshoppers, crickets and termites. Preyed upon by Barn Owls in South Africa.

**Reproduction** No information for Malawi. In South Africa, reproductive activity has been recorded in the wet and late dry seasons. Embryo number: 3.7 (range 2-7). Litter-size: 3.3 (2-7). Longevity is estimated to be 24-30 months, during which time a female can produce up to three litters. Young caravan behind the mother, and the young may accompany the mother until ca. nine months of age.

**Conservation** IUCN Category: Least Concern. Potential threats include a lack of termite mounds, and the reduction of suitable grasslands.

**Taxonomic Notes** *Suncus varilla* (Thomas, 1895). Originally described as *Crocidura varilla*. Referred to as *Suncus etruscus varilla* by Sweeney (1959).

**Key Reference** Baxter & Dippenaar (2013f)

**Measurements**
*Suncus varilla*

| | |
|---|---|
| HB: | 55.8 (44-68) mm, n = 79 |
| T: | 33.3 (25-45) mm, n = 79 |
| HF: | 9 (9-10) mm, n = 22 |
| E: | 8 (7-9) mm, n = 19 |
| WT: | 6.5 g, n = 1 |
| CI: | 16.2 (15.1-17.0) mm, n = 65 |

South Africa (Meester & Lambrechts 1971 in Baxter & Dippenaar 2013f).

# ORDER MACROSCELIDAE – SENGIS



The order Macroscelidae contains the Sengis or Elephant-shrews which used to be placed in the family Macroscelididae in the old order Insectivora until it was recognized that they belong to the super-order Afrotheria. The order Macroscelidae contains only one family, the family Macroscelididae, and the family is endemic to Africa and found nowhere else.

## FAMILY MACROSCELIDIDAE - Sengis

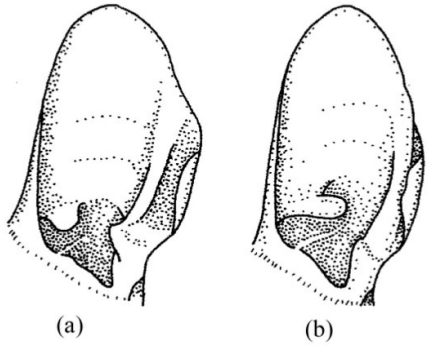
The family Macroscelididae contains four genera and 15 species of which three genera and four species occur in Malawi. Sengis used to be called elephant-shrews because each has an elongated, almost trunk-like snout which is very mobile, but they are not related to shrews.

The species in Malawi can be distinguished by their head-body lengths, the presence or absence of lines, stripes or other patterns on the dorsal pelage, the presence or absence of a white ring around each eye, and the shape of the supratragus which is a fleshy lobe on the inner lower surface of the outer ear, situated above the tragus. In some species, the supratragus is twisted backwards. The four species of sengis which occur in Malawi can be identified from the data in Table-key 2. They are profiled in alphabetical order based on their scientific names.

Table-key 2 to the sengis (order Macroscelidae) found in Malawi.

| HB | Dorsal pelage. Eye-ring. | Supratragus | Distribution | Species |
|---|---|---|---|---|
| <135 mm | Without lines or stripes. White and conspicuous. | Not twisted backwards | Northern Malawi to ca. 12˚S. | *Elephantulus brachyrhynchus* |
| < 135 mm | Without lines or stripes. White and conspicuous. | Twisted backwards | Southern Malawi from ca. 15˚S to 17˚S | *Elephantulus fuscus* |
| 145-186 mm | Without 5-6 dark lines punctuated with creamy-white spots. Sometimes present. | No information | Widespread throughout Malawi | *Petrodromus tetradactylus* |
| 229-253 mm | With 5-6 dark lines punctuated with creamy-white spots. Absent. | No information | Widespread throughout Malawi | *Rhynchocyon cirnei* |

## Genus *Elephantulus* - Sengis




Two species of *Elephantulus* occur in Malawi. *Elephantus brachyrhynchus* is found in northern Malawi, and its supratragus is not twisted backwards. *Elephantulus fuscus* is found in southern Malawi and its supratragus is twisted back-

Fig. 2. Left ear of (a) *Elephantulus brachyrhynchus* showing the small, semicircular supratragus which is not twisted backwards and (b) *Elephantulus fuscus* showing the more elongated supratragus which is twisted backwards.

## *Elephantulus brachyrhynchus*

## Short-snouted Sengi

**Malawian Names** Deng'a, Litawala, Zoro, Zumbi, Zumbwi. Not confined to this species.

Mozambique © C. & M. Stuart

**Description** Small grey-brown sengi with a very conspicuous white ring around each eye. Pelage soft, long, dense, silky with no sheen. Dorsal pelage greyish-brown suffused with cinnamon on forehead and back, becoming greyish-brown laterally and without lines or stripes; dorsal hairs long (ca. 10 mm), grey with cinnamon terminal band and black tip (or grey with cinnamon tip). Ventral pelage white: ventral hairs dark grey, white at tip. Head large. Eyes very large, black, with conspicuous white ring around each eye. Nose and upper lip very elongated, narrow and mobile, covered dorsally with very short light brown hairs and ventrally with white hairs. Vibrissae long, black and white. Ears large and erect, rounded, with light brown pigmentation; inner surface with sparse, short, white hairs; with small supratragus, not twisted backwards (cf. *E. fuscus*). Chin and throat white. No pectoral gland or bare patch at centre of thorax. Limbs long and slender, modified for saltatorial locomotion. Forefeet with light brown pigmentation dorsally and numerous short white hairs; five digits each with a long claw; digits two to five same length, first digit set well back. Hindfeet very elongated (longer than forelimbs) with light brown pigmentation and numerous white hairs dorsally: sole naked, lightly pigmented, with three well-developed palmar pads. Digits two to five elongated, each with a long claw; first digit much smaller and set well back. Tail scaly, relatively long (ca. 86% of HB) and distinctly bicoloured; dorsal side with dark brown pigmentation and numerous short black and cream bristles; ventral side with light brown pigmentation and numerous cream bristles.

**Similar Species**

*Elephantulus fuscus.* Very similar; supratragus twisted backwards; different biogeographic range, including Upper and Lower Shire valleys in Malawi.

**Distribution** Northern part of the country southwards to ca. 12˚S; recorded from Chintheche, Nyika Plateau, Viphya Plateau and Vwaza Marsh G. R. Elsewhere: Uganda, W Kenya, S and C Tanzania, S DR Congo, E and C Angola, Zambia, Zimbabwe, S Mozambique and N South Africa. Allopatric with *E. fuscus*.

**Habitat** Savanna grasslands and thickets where there is plenty of cover. Prefers hard or sandy soils; does not live on rocks or inselbergs. On Nyika Plateau, at Sawi River, found in high grasses with shrubs near stream, at ca. 1500 m. Occurs up to 7000 ft (ca. 2130 m) on Nyika Plateau.

**Abundance** Uncertain. Rarely recorded in Malawi; elsewhere seems to be locally common.

**Habits** Terrestrial, diurnal and crepuscular. Runs swiftly along paths, dashing from cover to cover. Sunbathes in the morning to increase body temperature. Skin glands on many parts of the body produce secretions; these as well as foot-drumming and vocal calls are used for communication with conspecifics. Insectivorous; in Zimbabwe, ants and termites are the principal foods with a small amount of plant material. In Tanzania, two studies showed that the proportions of invertebrates and green plant material in the diet differed; one was composed of 47% invertebrates and 51% green plant material, and the other 40% invertebrates and 47% green plant material. Small amounts of fruits and seeds comprised the rest of the diet.

**Reproduction** No information for Malawi. In Zimbabwe, young are born throughout the year; but litter frequency is reduced in the cool winter moths (ca. Jun–Sep). Pregnancy rates for females range from 40% (Feb) to 100% (Oct and Nov), both in the wet season. Mean embryo number varies with season: 1.40 (cool dry season) to 1.74 (hot dry season) and 1.76 (warm wet season). Neonates are precocial, fully furred, and with the eyes open.

**Conservation** IUCN Category: Least Concern. A widely distributed sengi; however the destruction or modification of the habitat and reduction in area of suitable habitat are of concern.

**Taxonomic Notes** *Elephantulus brachyrhynchus* (A. Smith, 1836). No subspecies are recognised although there is geographic variation in pelage colour. The taxonomy of the species in the genus is uncertain. Ansell & Dowsett (1988) refer to two species in Malawi (*E. brachyrhynchus* and *E. fuscus)*. However, these authors also map another possible species, which they refer to as '*Elephantulus* sp. indet.' – this 'species' has been recorded in the area between the known biogeographic ranges of *E. brachyrhynchus* and *E. fuscus*. Further studies are required to determine if this 'species' is new to science, a hybrid, or whether it is either *E. brachyrhynchus* or *E. fuscus*.

**Key Reference** Perrin (2013a).

**Measurements**
*Elephantulus brachyrhynchus*

Males (females are slightly smaller)

| | |
|---|---|
| TL: | 213.8 (202-225) mm, n = 9 |
| T: | 98.9 (91-110) mm, n = 9 |
| HF: | 29.9 (29-31) mm, n = 9 |
| E: | 21.1 (20-24) mm, n = 9 |
| WT: | n. d. |
| GLS: | 33.5 (32.4-34.3) mm, n = 9 |

Southern Africa (Rautenbach & Schlitter 1977 in Perrin 2013a).

## *Elephantulus fuscus*

## Dusky Sengi

**Malawian Names** Deng'a, Litawala, Naliyeye, Sakwi zumbi. Not confined to this species.

Liwonde N. P., Malawi © DCD & M. Happold

**Description** Small grey-brown sengi with a very conspicuous white ring around each eye. Pelage soft, long, dense, silky with no sheen. Dorsal pelage dull light brown suffused with dark grey, and without lines or stripes; dorsal hairs long (ca. 10 mm), grey with light brown terminal band and black tip. Ventral pelage white: hairs grey, white at tip. Head large. Eyes large, black, with conspicuous white ring around each eye. Nose and upper lip very elongated, 10 mm from mouth to tip of nostril, covered dorsally with very short light brown hairs and ventrally with white hairs. Vibrissae long, black and white. Ears medium length, rounded, with light brown pigmentation, inner surface with sparse, short, white hairs, with small supratragus on a short stalk and twisted backwards (cf. *E. brachyrhynchus*). Chin and throat white. No pectoral gland or bare patch at centre of thorax. Limbs long and slender, modified for saltatorial locomotion. Forefeet with light brown pigmentation dorsally and numerous short white hairs; five digits each with a long claw; digits two to five level, first digit set well back. Hindfeet very elongated with light brown pigmentation and numerous white hairs dorsally. Sole naked, lightly pigmented, with three well-developed palmar pads. Digits two to five elongated, each with a long claw; first digit much smaller and set well back. Tail long (ca. 88% of HB), scaly and distinctly bicoloured; dorsal side with dark brown pigmentation and numerous short black; ventral side with light brown pigmentation and numerous cream bristles.

**Similar Species**

*Elephantulus brachyrhynchus.* Very similar; supratragus not twisted backwards; different biogeographic range, including northern Malawi.

**Distribution** Recorded from ca. 15˚S southwards to 17˚S; specimens known from Blantyre, Chiromo, Liwonde N. P., Mt Malosa and Zomba. Elsewhere: SE Zambia (through S Malawi) to S Mozambique just north of Beira. Allopatric with *E. brachyrhynchus.*

**Habitat** Savanna woodland, forest and thicket scrub where there is plenty of cover.

**Abundance** Uncertain. Rarely recorded in Malawi. Elsewhere: seems to be locally common.

**Habits** Presumed to be similar to *E. brachyrhynchus*. Terrestrial, cursorial, and active during the day and at dawn and dusk. A captive female individual (from Liwonde N. P.) was quiet and inactive at night until ca. 04:30 h when she began to move around her enclosure. When disturbed or frightened, she 'froze' and was motionless except for the long muzzle which was waved rapidly from left to right and up and down. Movement of the ears was much less conspicuous. Vocalizations included a series of short 'squeaks', 5-20 of them uttered in sequence, with decreasing pitch and loudness over time. In captivity, ate cockroaches, ants (and banana); refused to eat millipedes and praying-mantises. In the wild, maybe seen, often on cooler days, walking or running on pathways.

**Reproduction** Presumed to be similar to *E. brachyrhynchus.* One female at Blantyre in March had two embryos.

**Conservation** IUCN Category: Data Deficient. Presumed to be similar to *E. brachyrhynchus*; the destruction or modification of the habitat and reduction in the area of suitable habitat are concerns.

**Taxonomic Notes** *Elephantulus fuscus* (Peters, 1852). This species is very similar to *E. brachyrhynchus* and many specimens of *E. fuscus* have been erroneously allocated to *E. brachyrynchus* in the past. Hence the biogeographic limits of the species are uncertain. See also *E. brachyrynchus:* Taxonomic Notes.

**Key Reference** Perrin (2013b).

**Measurements**
*Elephantulus fuscus*

| | |
|---|---|
| HB: | 114 (105-125) mm, n = 5 |
| T: | 102.8 (86-116) mm, n = 5 |
| HF: | 28.6 (28-30) mm, n = 5 |
| E: | 19.9 (19.5-20) mm, n = 5 |
| WT: | 45, 46 g, n = 2 |
| GLS: | 33.9 (32.7-35.5) mm, n = 5 |

Malawi and Zambia (NHMUK, D. C. D. Happold *unpubl*.).

# Genus *Petrodromus* – Four-toed Sengi

There is only one species of *Petrodromus.* The Four-toed Sengi is the smallest of the two larger sengis in Malawi and is easily recognized because it has no dark lines punctuated by creamy-white spots on its dorsal pelage (cf. *Rhynchocyon*).

## *Petrodromus tetradactylus*

## Four-toed Sengi

**Malawian Name** Namitumbi, Sakwi. Sakhwi. Not confined to this species.

Mutinondo, Zambia © F. Willems

**Description** Medium-sized sengi without conspicuous markings on the back (cf. *Rhynchocyon cirnei*). Pelage soft, fairly long and dense. Dorsal pelage grey suffused with chestnut, becoming grey speckled with beige and black laterally. Mid-dorsal hairs 15-17 mm, very dark grey with terminal band of chestnut tipped with black; guard hairs very dark grey tipped with black. Lateral hairs very dark grey tipped with beige and orange. Ventral pelage white, sometimes lightly suffused with orange: hairs grey at base, white tip. White stripe above eye which may extend to base of ear and may form a complete ring around eye. White patch at base of ear. Dark chestnut or black band between eye and base of ear. Nose and upper lip black, very elongated, narrow and mobile. Vibrissae long, black and white. Eyes large, very dark brown. Ears erect, tall, rounded, with short chestnut hairs on back of ear. Chin and throat white. Limbs long and slender, modified for cursorial locomotion, with very short orange or ochre hairs. Forefeet with four toes of equal length, each with a short claw; the fifth digit (pollux) is minute or absent. Hindfeet with four elongated digits, each with a long curved claw; soles with black pigmentation. Tail scaly (ca. 85% of HB), with black pigmentation and short black bristles dorsally, paler ventrally and laterally near base of tail where the bristles are ochre. Juveniles same colour as adults.

**Similar Species**

*Rhynchocyon cirnei.* Larger in all dimensions; dark stripes (and white spots) on back and flanks.

*Elephantulus brachyrhynchus* and *E. fuscus.* Much smaller.

**Distribution** Widespread throughout Malawi. Localities include Chididi, Chiradzulu Mountain, Chiromo, Lengwe N. P., Liwonde N. P., Matope, Mulanje Mountain (Lichenya Plateau), Mwabvi W. R., Nyika N. P., Thyolo, Viphya Plateau (Chikagawa), Vwaza Marsh G. R. and Zoa Tea Estate. Elsewhere: recorded in C DR Congo (south of the Ubangi River) and SE DR Congo, NE Angola, SE Kenya, Tanzania, Zimbabwe, Mozambique, and NE South Africa.

**Habitat** Dense woody thickets, open woodland, riverine vegetation, rocky habitats where there is dense cover. Also recorded in farmlands where there are patches of natural vegetation.

**Abundance** Not known; rarely seen or encountered.

**Habits** Terrestrial, diurnal and crepuscular. Long fore- and hindlimbs enable these sengis to walk and run rapidly through the undergrowth. They make a network of narrow paths through the undergrowth, which they maintain by brushing the leaf litter with their forefeet. They rest and groom on the paths, and do not build nests. Omnivorous – in Kenya, the diet consists of beetles, termites, plant material, centipedes, crickets, millipedes and spiders. Live singly or in pairs; possibly they are monogamous.

**Reproduction** In Malawi, pregnancies have been recorded in Mar and Sep. In East Africa, young have been recorded in most months of the year, and in Zambia pregnancies have been recorded in Jan, Jul and Oct. Neonates are precocial and able to walk within a few hours of birth.

**Conservation** IUCN Category: Least Concern (because of large geographic range and many locality records). Habitat loss is the main cause of reduction in population size and biogeographic

range. In some localities, these sengis are hunted by humans for 'bushmeat'.

**Taxonomic Notes** *Petrodromus tetradactylus* Peters, 1846. Nine subspecies are recognised currently, but some may prove to be distinct species. Only one subspecies, *P. t. tetradactylus,* occurs in Malawi.

**Key Reference** Rathbun (2013a).

**Measurements**
*Petrodromus tetradactylus tetradactylus*

| | |
|---|---|
| HB: | 175.5 (145-186) mm, n = 13 |
| T: | 157.5 (129-187) mm, n = 13 |
| HF: | 52.1 (50-55) mm, n = 13 |
| E: | 30.9 (25-35) mm, n = 13 |
| WT: | 186 g, n = 1 |
| GLS: | 49.3 (49-53), n = 6 |

Malawi (HC, NMMB)

## Genus *Rhynchocyon* – Giant Sengis

There are three species of *Rhynchocyon* but only one is found in Malawi. This, the Chequered Giant Sengi, is the largest sengi in Malawi and is easily recognized because it has conspicuous dark lines punctuated by creamy-white spots on its dorsal pelage (cf. *Petrodromus*).

### *Rhynchocyon cirnei*

### Chequered Giant Sengi

**Malawian Name** Namitumbi, Sakwe, Sakhwimbala. Not confined to this species.

Mutinondo, Zambia © F. Willems

**Description** (*R. c. reichardi* from N. Malawi). Large sengi, unique in having a conspicuous pattern of stripes and blotches on its back. Pelage moderately short, slightly coarse, sleek. Dorsal pelage grizzled dark grey and ochre: hairs dark grey with ochre band tipped with black. Guard hairs black. Three black or rusty-black stripes on either side of the mid-dorsal line from shoulder to rump, each stripe usually punctuated with five to six spots of creamy-white. Ventral pelage creamy-yellow: hairs creamy-yellow. Crown and cheeks grizzled dark grey and ochre. No stripes on head or neck, no white around ears or eyes. Ears comparatively small, densely covered with short ochre and black hairs. Eyes large. Nose and upper lip very elongated to form elephant-like trunk in front of mouth. Limbs long and slender, modified for cursorial locomotion. Forefeet with three elongated digits, each with a claw; first digit absent, fifth digit vestigial. Hindfeet with four elongated digits each with a sharp, curved claw. Tail long (ca. 90% of HB), distinctly bicoloured, black dorsally, ochre ventrally, with pale tip.

**Similar Species**

*Petrodromus tetradactylus.* Smaller HB, tail shorter (ca. 85% of HB). Dorsal pelage dark (perhaps with single dark mid-dorsal line but without 5-6 dark lines and whitish spots.

**Distribution** Recorded throughout most of the country except the Central Plateau. Localities include Chikangawa, Chiradzulu Mountain, Chiromo, Chitipa, Lengwe N. P., Likhubula River, Livingstonia, Misuku, Mulanje, Mulanje Mountain (Lichenya Plateau), Mwabvi W. R., Nyika N. P., Thyolo, Viphya Plateau, Zomba and Zomba Plateau. May be locally extinct now in some of these localities.

Elsewhere: NE DR Congo (between the Congo and Ubangi rivers), W Uganda, S Tanzania and N Mozambique. (See Taxonomic Notes below).

**Habitat** Montane and lowland forests, dense woodlands and thickets where there is plenty of cover and undergrowth and a thick layer of leaf litter.

**Abundance** Widespread but rarely seen or encountered.

**Habits** Terrestrial, cursorial and nocturnal. Long limbs enable these sengis to run rapidly through the undergrowth on their long legs, keeping the body well above the substrate. They build leaf nests on the forest floor. In Zambia, all sightings of this species (except for one pair) were of solitary individuals. Preyed upon by small cats, and by humans (for 'bushmeat'). In Zambia, stomach contents contained beetles, bees or wasps, fly larvae and bugs.

**Reproduction** Very little information. Litter-size usually one; occasionally two.

**Conservation** IUCN Category: Least Concern (previously Near Threatened). Habitat destruction is the greatest threat.

**Taxonomic Notes** *Rhynchocyon cirnei* Peters, 1847. Six subspecies recognized; three subspecies occur in Malawi. (1) *R. c. hendersoni* (originally described as *Rhynchocyon hendersoni)*; recorded from near Livingstonia, distinguished by very dark pelage and

poorly-defined creamy-white spots. (2) *R. c. reichardi* recorded on the Misuku Hills, Nyika Plateau and Viphya Plateau, distinguished by clearly defined black lines and creamy-white spots - see Description above. (3) *R. c. shirensis* recorded from Mulanje Mountain and parts of the Upper Shire Valley and the Lower Shire Valley; distinguished by the absence of white spots.

**Key Reference** Rathbun (2013b).

**Measurements**
*Rhynchocyon cirnei reichardi*

| | |
|---|---|
| HB: | 242.0 (229-253) mm, n = 10 |
| T: | 213.8 (196-234) mm, n = 10 |
| HF: | 66.7 (63-70) mm, n = 10 |
| E: | 29.4 (28-31) mm, n = 10 |
| WT: | 352.0 (320-420) g, n = 10 |
| GLS: | 67.6 (62.2-70.8) mm, n = 39* |

NE Zambia (Ansell & Ansell 1973).
**R. c. stuhlmanni,* DR Congo (Allen, J. 1922 in Rathbun 2013b).

# ORDER CHIROPTERA – BATS

| | | | |
|---|---|---|---|
| Family Pteropodidae | *Eidolon* (1 species) | Straw-coloured Fruit Bats | p. 57 |
| | *Epomophorus* (5 species) | Epauletted Fruit Bats | p. 59 |
| | *Myonycteris* (1 species) | Collared Fruit Bats | p. 69 |
| | *Plerotes* (1 species) | Broad-faced Fruit Bat | p. 71 |
| | *Rousettus* (2 species) | Rousettes | p. 72 |
| Family Rhinolophidae | *Rhinolophus* (8-9 species) | Horseshoe Bats | p. 76 |
| Family Hipposideridae | *Hipposideros* (2 species) | Leaf-nosed Bats | p. 92 |
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| Family Emballonuridae | *Taphozous* (1 species) | Tomb Bats | p. 103 |
| Family Nycteridae | *Nycteris* (5 species) | Slit-faced Bats | p. 105 |
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| | *Laephotis* (1 species) | African Long-eared Bats | p. 141 |
| | *Myotis* (3 species) | Myotises | p. 143 |
| | *Nycticeinops* (1 species) | Twilight Bat | p. 149 |
| | *Pipistrellus** (8 species) | Pipistrelles | p. 151 |
| | *Scotoecus* (2 species) | Lesser House Bats | p. 167 |
| | *Scotophilus* (4 species) | House Bats | p. 171 |
| Family Miniopteridae | *Miniopterus* (3-5 species) | Long-fingered Bats | p. 177 |

* *Chaerephon* and *Mops* are included here in *Tadarida* sensu lato; *Neoromicia* is included here in *Pipistrellus* sensu lato.

When people think of bats, the first things that usually come to mind is that they are nocturnal, they can fly and see in the dark, and they are horrible, ugly and associated with evil. They are not horrible or evil. In fact, they are warm, furry, amazingly intelligent and potentially very friendly if they are handled gently and do not feel threatened.

Bats are the only mammals that are able to fly by beating their wings and this makes them very different from other mammals. They are nocturnal, can "see at night" either by means of echolocation (a sophisticated form of sonar) or by sight, and therefore they are able to exploit the skies at night to find food when competition from birds is minimal. They are a very successful order of mammals and the Order Chiroptera is the largest order of mammals in Malawi. There are 65-68 known species and they make up about 32% of Malawi's mammals. They are placed in ten families. Bats are often called megabats or microbats although these terms do not reflect the relationships between the different families. Megabats perceive their surroundings mainly by sight (not by echolocation) and they feed on fruits and other plant products. They belong to the family Pteropodidae and are also called Fruit Bats. Microbats perceive their surroundings mainly by echolocation, and most species feed on insects. They belong to all other families.

The vernacular names of bats are long and cumbersome, and they vary from place to place. Therefore, bats are usually referred to here by their scientific names, and genus and species profiles are in the alphabetical order of their scientific names.

**Wing morphology, flight, scuttling and climbing**.

The wings of bats have the same bones as the arms and fingers of humans, but the four fingers have become very elongated and they support the wing-membrane which spans the gaps between the fingers and also extends from the short thumb to the shoulder, and from the fifth finger to the ankle or the first or second toes. The first toe of a bat is the one on the outer side (unlike that in humans). The wing-membrane between the fingers is the hand-wing; that between the fifth finger and ankle is the arm-wing. Most bats also have an interfemoral membrane which spans the gap between the legs and usually, but not always, encloses the tail. The interfemoral membrane is often supported and manipulated by calcars – a calcar being a bony or cartilaginous spur projecting from the ankle. The length of the forearm (FA), the wing-bones between the elbow and the fingers, is a very useful indicator of the comparative size of a bat.

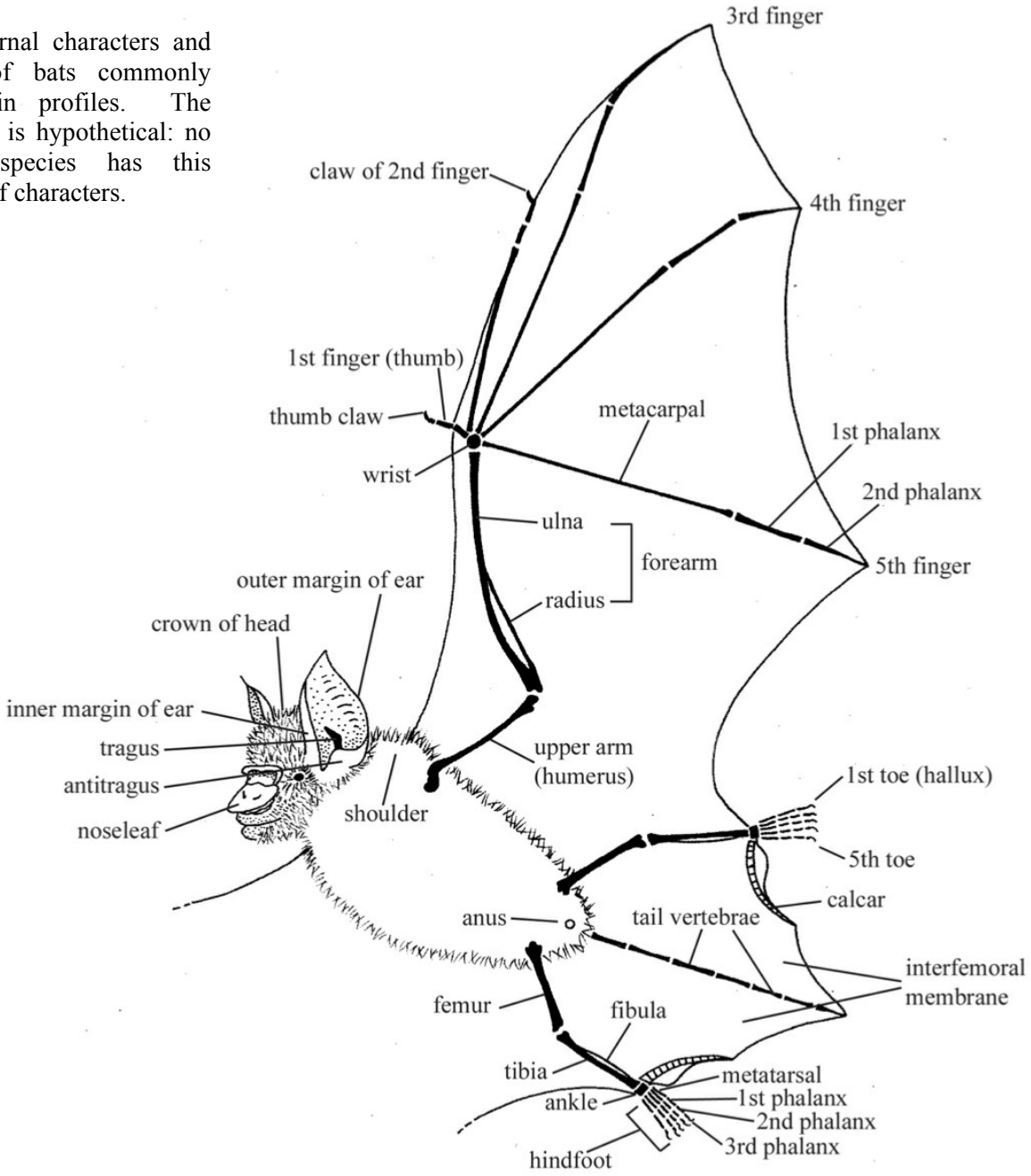



Fig. 3. External characters and limb-bones of bats commonly referred to in profiles. The illustrated bat is hypothetical: no family or species has this combination of characters.

The wings of bats are almost as varied as the wings of birds, and the flight of bats is equally varied. Two characters are of particular significance. Firstly, aspect ratio which is the length of the wing relative to its width: calculated by dividing the square of the wingspan by the area of the wings. Long narrow wings have high aspect ratios. Secondly, wing-loading which is the mass of the bat divided by the area of its wings. Both aspect ratios and wing-loadings are described as very low, low, medium, high or very high, where each increment is one fifth of the range found in African bats.

Wing-loading is correlated with the speed of a bat's flight, high speed being correlated with high wing-loading. Bats with high wing-loading fly fast and actually must fly fast to maintain flight. This explains why some bats have to dive down from their roosts to gain speed before they can start flying, and only bats with lower wing-loadings can take off from the ground. Manoevrability is a measure of the minimum space required for a turn at a given speed; the slower the speed the tighter the turn. Therefore manoeuvrability is favoured by low wing-loading which explains why light-weight bats with short broad wings can fly in very confined spaces that are cluttered by vegetation, rock-formations or building structures. Agility – the ability to make sharp turns and swerves while pursuing flying insects – is favoured by high wing-loading and fast flight. Energetic cost of flight is favoured by high aspect ratio, so bats with long narrow wings can fly for long distances whereas bats with short broad wings must rest after even very short flights.

Flying is undoubtedly the main way that bats move around, but some microbats can furl their wings closely against their forearms and retract their interfemoral membranes closer to their bodies, thereby freeing their limbs so they can scuttle over flat or gently sloping surfaces on their wrists and hindfeet. These bats can also climb up and down steep surfaces such as tree trunks in much the same way – often using their thumbs to get a good grip. Fruit Bats are also very competent climbers using their thumbs, wrists and toes to hang underneath branches while climbing along them. They also land on foliage and scramble over it.

**Eyesight and echolocation.**

Fruit Bats have comparatively large eyes which are well adapted for night-vision, and they do not echolocate except for a few species which do so by making clicks with their tongues. In contrast, microbats have comparatively small eyes but they are able to perceive their surroundings with truly remarkable clarity by emitting very short ultrasonic sounds and listening to the echoes that bounce back to their very sensitive ears. Echolocation enables microbats to perceive acoustic images that correspond to the visual images perceived by animals with good eyesight. Echolocation calls made by microbats are of two main types. Most microbats make calls whose pitch (frequency) changes, usually extremely rapidly. These are called frequency modulated or FM calls, and they enable FM bats to perceive how far away objects are, and also their shapes, sizes and textures. Using FM calls, a bat can even perceive a stationary, camouflaged moth on a tree-trunk. In contrast, bats in some families make calls which have a long component pitched at a constant frequency (CF). The echoes from CF calls are affected by Doppler shift if they are reflected from surfaces that are moving to and fro, and therefore bats making CF calls can easily detect insects that are fluttering their wings - and they feed on these insects.

**Food and foraging**

Most Fruit Bats feed on soft ripe fruits and some also eat buds, flowers, pollen and/or nectar. Foods far away are located by smell; close-up they are examined by sight as well. Most Fruit Bats obtain fruit and/or flower products by landing on the vegetation and then feeding. Some carry fruit to a nearby perch before eating it. Soft fruits are chewed and then only the pulp is swallowed: the rest, including the seeds, is spat out. Therefore, Fruit Bats play a very important role in pollinating trees and spreading the seeds of trees. Some trees have flowers specially adapted for pollination by bats. And, because Fruit Bats only eat soft, ripe fruits, they usually only take orchard fruits that are too ripe for commercial harvesting. Some Fruit Bats travel long distances every night between their roosts and sources of food. Some are nomadic and some make regular migrations over vast distances to find food.

All African microbats are insectivorous but some also eat other small arthropods such as spiders and scorpions, and one species – *Nycteris grandis* – also eats small vertebrates such as frogs, birds and even small bats. No African bats feed on blood. Because wing-morphology and the flying abilities of microbats are so diverse, it is not surprising that microbats forage in a variety of places and have many different ways of foraging. These are:

*Fast-hawking*. In open spaces high above ground. Insects are detected, pursued at high speed, and eaten during flight.

*Slow-hawking*. In semi-open spaces below or close to tree canopies, in small clearings and tunnels through vegetation, and closer to the ground than in fast-hawking.

*Moderately fast-hawking*. Intermediate between fast- and slow-hawking.

*Fly-catching*. Close to vegetation and the ground in moderately cluttered spaces. The bat hangs from a perch and waits for a flying insect to approach. The insect is then pursued during a short flight and taken back to the perch to be eaten.

*Gleaning*. Very close to the ground and/or vegetation in densely cluttered spaces. Non-flying prey is taken from surfaces including leaves, tree-trunks and walls, or the ground. Gleaners may hover while taking their prey or they may land on the ground to take it.

*Perch-hunting*. A general term referring to any foraging behaviour in which the bat hangs from a perch while searching for prey. Fly-catching and gleaning are often combined with perch-hunting.

*Trawling*. Refers to the taking of insects or small fish from water surfaces. The prey is taken by the claws of the hind-feet which act as grapnels.

*Chasing*. Refers to the detection and pursuit of non-flying prey, such as cockroaches and resting moths, by bats that are scuttling over horizontal or sloping surfaces or the ground.

**Day roosts and roosting behaviour**

Bats spend their days in day-roosts which are usually dark or shady. Day-roosts include caves, caverns under boulders, gaps under exfoliating rocks, mines and tunnels, hollow tree-trunks and hollow branches, hollow logs, gaps under loose bark, holes made by birds such as wood-peckers and barbets, road-culverts, cavities under the roofs of houses and other buildings, cracks and crevices in buildings of all sorts, nooks and crannies in and under thatch, and dense foliage of trees and shrubs. Not all day-roosts are dark; some bats hang from the branches of trees, and some cling to tree-trunks or the external walls of buildings (albeit usually in the shade). Some more unusual day-roosts include weaver-bird nests, the furled leaves of banana plants, and the burrows of animals. Some species hang freely from ceilings or twigs, using their toes to hold on; others hang in contact with vertical surfaces, and some crouch on flattish surfaces or squeeze into crevices. Some roost singly; others in groups ranging in size from two to vast colonies. Some bats move into different day-roosts every few days, but others show roost-fidelity and use the same roost, and often exactly the same place within a roost, for weeks at a time.

Some bats are tolerant and adaptable and can use a variety of day-roosts. Others need special humidities, temperatures, light levels, noise levels and proximity to sources of food. In some species, females roost apart from males, in special maternity roosts, when they are giving birth and lactating. It is extremely important that bats in maternity roosts are not disturbed by people.

**Torpor and hibernation**

Bats are warm-blooded animals and, because they are small, they require a lot of food to maintain a constant temperature at all times, even in the tropics. To get around this problem, some microbats go into torpor during the day, allowing their body temperatures to fall from about 34-39° C to approximately the ambient temperature. Torpid bats move very sluggishly and cannot fly, but they are perfectly healthy. At dusk, or if disturbed, they warm themselves up mainly by shivering.

In temperate regions, and at high altitudes in tropical regions, when temperatures are very low and insects very scarce, some microbats go into a deep state of torpor lasting for many days and nights. This is called hibernation and, while hibernating, bats survive by slowly metabolising reserves of fat.

**Reproductive strategies**

Each species of bat has evolved a reproductive strategy to maximise the number of offspring that can be successfully raised during a lifetime. The reproductive strategies of bats are determined by litter-sizes and

the timing and duration of events such as spermatogenesis, copulation, ovulation, gestation, parturition, lactation and reproductive inactivity. Litter-sizes in bats are limited because bats need to be able to fly throughout their pregnancies, and sometimes need to fly with young attached to their nipples and pelage. The majority of bats in Malawi have only one young/litter, but some have twins and some have litters of up to three. The majority of females have only one litter/year, but some have two or more litters/year. In Malawi, these females have a post-partum oestrus and mate again soon after the birth of their first litters so that they are sometimes simultaneously pregnant and lactating. The timing of reproductive events ensures that the two events that require the most energy (spermatogenesis and lactation) take place when food is most abundant. When food is maximally abundant for only a limited period, this may mean that sperm has to be stored in the male until it is time for mating. Alternatively, the interval between mating and the birth of the young has to be made longer than the minimum time needed for a fertilised egg to develop into a mature foetus. In Malawi, the interval between mating and giving birth can be lengthened in three ways – by storing sperm in the females until ovulation and fertilisation take place, or by lengthening the time between fertilisation and the implantation of the embryo, or by retarding the development of the embryo for some time during its gestation.

**Abundance**

Assessing the abundance of bats is very difficult because some are much harder to observe than others. This is because some roost in colonies in accessible places while other roost singly in places that are hard to locate, and also because some fly very high and are hard to catch or identify. In 1997, the comparative abundance of species in Malawi was estimated from the number of individuals recorded in reports published prior to 1997 together with the number of specimens, collected prior to 1997, in four museums which have good collections of Malawian bats (Happold & Happold 1997b). The comparative abundance of more abundant species was based on the number of captures made during nearly two years of intensive fieldwork conducted by D. & M. Happold in mid-1980s and mid-1990s. The following terms were used then and are used here in the profiles of bats:

Rarely-recorded – only 1-10 specimens.

Seldom-recorded – only 11-20 specimens.

Uncommonly-recorded – 21-50 recorded during two years of fieldwork.

Commonly recorded – 51-200 recorded during two years of fieldwork.

Very commonly-recorded – more than 200 recorded during two years of fieldwork.

**Identifying species of bats**.

It is easy to identify the family to which a species belongs, and usually easy to identify its genus, but distinguishing closely related species often requires looking at their teeth. Incisors are usually easy to see by gently opening the mouth with a twig of wood or something similar. It is also usually easy to count the number of premolar teeth and assess their comparative sizes, in the same way. But detailed examination of teeth is not possible when the bats are alive. Furthermore, some species can only be distinguished by examining their skulls. However, many species can be identified by the colour of their pelage and wings, and by other characters described in the relevant genus profiles. Size is also very relevant and the most important measurement for bats is the length of the forearm (FA) measured from the back of the elbow to the front of the wrist when the fingers are folded back (as they are when a bat is resting).

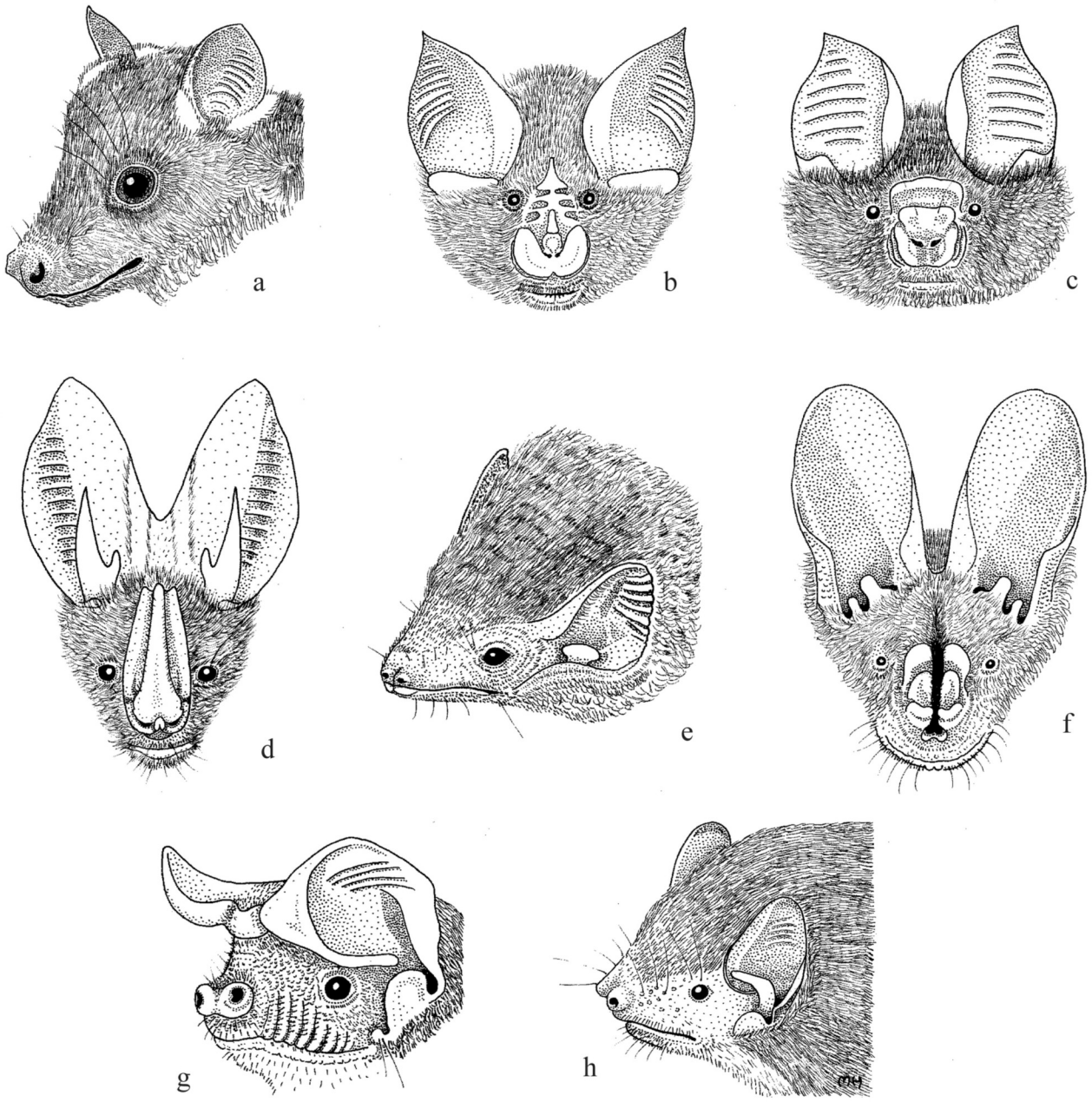



Fig. 4. Heads of bats in eight of the ten families represented in Africa. (a) Pteropodidae (*Epomophorus*), (b) Rhinolophidae (*Rhinolophus*), (c) Hipposideridae (*Hipposideros*), (d) Megadermatidae (*Lavia)*, (e) Emballonuridae (*Taphozous*), (f) Nycteridae (*Nycteris*), (g) Molossidae (*Tadarida*) and (h) Vespertilionidae (*Scotophilus*). Not illustrated are Rhinonycteridae (*Triaenops*) which resembles the Hipposiderid except that the noseleaf has three projections on its posterior rim (see Fig. 13), and Miniopteridae (*Miniopterus*) which is roughly similar to the Vespertilionid (*Scotophilus*).

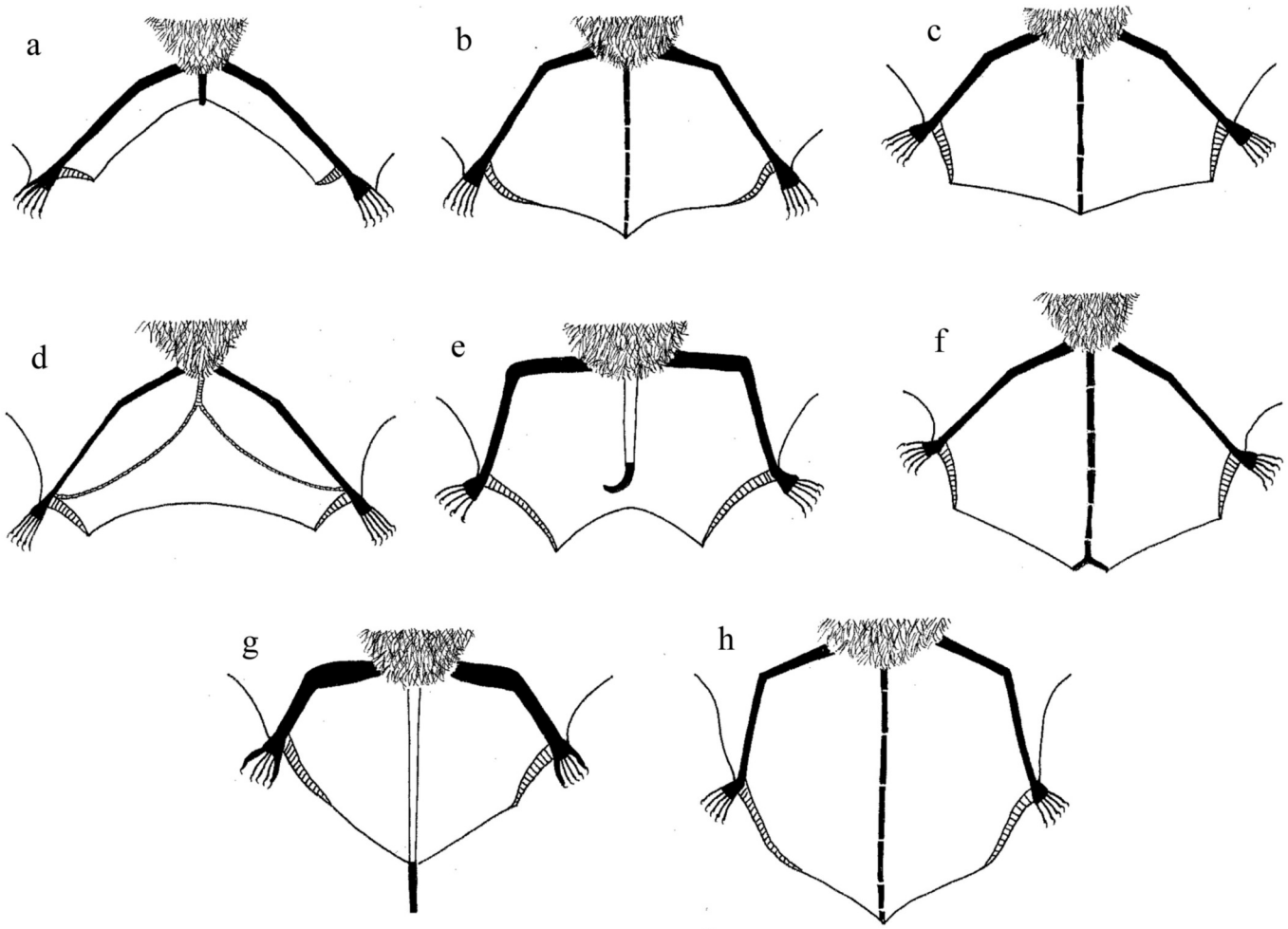



Fig. 5. Tails and interfemoral membranes of bats in the ten families represented in Malawi. (a) Pteropodidae, (b) Rhinolophidae, (c) Hipposideridae and Rhinonycteridae, (d) Megadermatidae, (e) Emballonuridae, (f) Nycteridae, (g) Molossidae and (h) Vespertilionidae and Miniopteridae.

**Families**

About 63-67 species of bats occur in Malawi. They belong to 30 genera in ten families. The families are distinguished most easily by the relative size of their eyes, the faces (in particular the presence or absence of a noseleaf and, if present, its shape) and the characteristics of their tails and interfemoral membranes – see Table-key 3.

**Key Reference** Happold, M. (2013a).

Table-key 3 to the families of bats (order Chiroptera) found in Malawi.

| Eyes | Noseleaf | Tail | Miscellaneous | Family |
|---|---|---|---|---|
| Relatively large | Absent | Tail absent or rudimentary Interfemoral membrane reduced to narrow band along margins of hindlimbs. | | Pteropodidae Fruit Bats |
| Relatively small | Absent | Tail present. Tail more-or-less completely enclosed by interfemoral membrane. | Second phalanx of third finger as long as the first, or twice as long | Vespertillionidae Vesper Bats |
| Relatively small | Absent | Tail present. Tail more-or-less completely enclosed by interfemoral membrane. | Second phalanx of third finger about three times as long as the first and angled forward giving that finger a bent appearance. | Miniopteridae Long-fingered Bats |
| Relatively small | Absent | Tail present. Terminal portion projecting freely well beyond the hind margin of the interfemoral membrane when the bats are not flying. | | Molossidae Free-tailed Bats |
| Relatively small | Absent | Tail present. Terminal portion of tail projecting upwards through centre of interfemoral membrane when bats are not flying. | | Emballonuridae Sheath-tailed Bats |
| Relatively small | Present. Very large, long and comparatively simple. | Tail absent. Interfemoral membrane very large. | | Megadermatidae False Vampire Bats |
| Relatively small | Present. Posterior component roughly triangular with an erect tip; anterior component roughly horseshoe-shaped. | Tail present. Tail more-or-less completely enclosed by interfemoral membrane. | | Rhinolophidae Horseshoe Bats |
| Relatively small | Present. Posterior component smoothly elliptical. | Tail present. Tail more-or-less completely enclosed by interfemoral membrane. | | Hipposideridae Leaf-nosed Bats |
| Relatively small | Present. Posterior component with three narrow pointed projections. | Tail present. Tail more-or-less completely enclosed by interfemoral membrane. | | Rhinonycteridae Trident Bats |
| Relatively large | Present. Only a longitudinal slit bordered by fleshy outgrowths | Tail present. Tail enclosed by interfemoral membrane; last vertebra T-shaped or Y-shaped. | | Nycteridae Slit-faced Bats |

## FAMILY PTEROPODIDAE - Fruit Bats

Fruit Bats, which do not use sophisticated echolocation to perceive their surroundings, are very easily distinguished because they have relatively large eyes. Furthermore, the tail is either absent or rudimentary, the interfemoral membrane is reduced to a narrow border along the inside margin of each hindlimb, there is a claw at the end of the second finger as well as the first, the ears are very short and well separated, and the margin of each ear forms a complete ring.

Five genera and ten species of Fruit Bats occur in Malawi. The genera can be distinguished mainly by the following characters:

Basal ear patches – a small patch of white or whitish pelage in front of, and just behind, the base of each ear. Absent or present. If present, conspicuous or inconspicuous.

Epaulettes on the shoulders of adult males - a tuft of long white or yellowish hairs on each shoulder, which can be hidden within a deep pouch or displayed during courtship as a conspicuous whorl. Absent or present.

Number of upper cheekteeth. Three or five.

FA (length of the forearm).

Number and shape of the palatal ridges.

*Eidolon*. Basal ear patches absent; epaulettes absent. Five upper cheekteeth. FA: 105-135 mm.

*Epomophorus*. Basal ear patches present. Epaulettes on shoulders of adult males. Five or six thick palatal ridges. Three upper cheekteeth. FA: 58-91 mm.

*Myonycteris*. Basal ear patches absent; epaulettes absent. Toes partly webbed (cf. *Rousettus*). Adult males with ruff of coarse hairs around the throat (cf. *Rousettus*). Five upper cheekteeth. FA: 72-90 mm.

*Plerotes*. Basal ear patches present but sometimes inconspicuous. No epaulettes. Head uniquely with a yellowish-white moustache and beard. Four or five upper cheekteeth. FA: 47-53 mm.

*Rousettus*. Basal ear patches absent; epaulettes absent. No ruff (cf. *Myonycteris*). Toes not webbed (cf. *Myonycteris*). Five upper cheekteeth. FA: 82-106 mm.

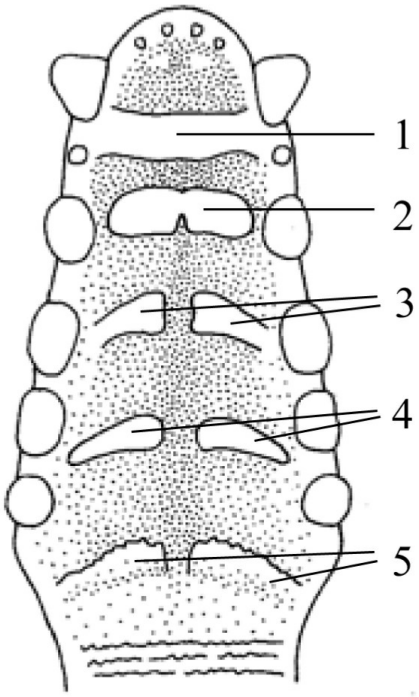



Fig. 6. Upper teeth and palatal ridges of a hypothetical fruit bat showing the main types of ridges that are used diagnostically (1 = thick, interdental, not divided. 2 = thick, interdental with medial groove. 3 and 4 = thick, interdental, divided by medial gap. 5 = thin, post-dental, irregularly serrated.

# Genus *Eidolon* - Straw-coloured Fruit Bats

There is only one species in Africa. They are the largest fruit bats in Malawi.

## *Eidolon helvum*

## African Straw-coloured Fruit Bat

Kasanka N. P., Zambia © C. & M. Stuart

**Malawian Name** Lichinji, Mleme.
Not confined to this species.

**Description** Large, yellowish fruit bat with no basal ear-patches; adult males without epaulettes, no ruff of coarse hairs (although longer, pale yellowish-brown to bright orange hairs on throat). Little sexual dimorphism. Dorsal pelage dull yellow, brownish-yellow, pale yellowish-grey to dark sepia-grey, or dull brown. Head darker than shoulders. Rump and a narrow line between the shoulder-blades are often darker and less yellow than the mid-dorsal region and adjacent to wing-membranes. Ventral pelage (except on throat) grading from pale yellow (buff) on flanks to pale brown mid-ventrally. Throat with ruff of longer (but not coarse) hairs, ranging from pale yellowish-brown to bright orange; breeding males brighter than females. Males without epaulettes. Head without markings; muzzle long, narrow, almost naked; cheeks only moderately extensible; lips fine and smooth. Ears rounded, naked, dark brown. Eyes large, orange-brown. Wing-membranes dark brown in marked contrast to dorsal pelage. Thumb very long with a powerful, sickle-shaped, hook-like claw. Legs conspicuously long. Interfemoral membrane narrow (especially near tail). Tail relatively long for a fruit bat.

**Similar Species** None

**Distribution** Probably occurs throughout Malawi, in both woodland savanna and forest habitats, at high and low altitudes, when and where fruiting trees are present but, as yet, there are no records from the Upper and Lower Shire Valleys. Recorded from Blantyre, Kasungu N. P., Likoma Island, Misuku, Mount Malosa, Mulanji Mountain, Nyika Plateau (Chowo Forest), Ruo River, Thyolo District, Zoa Tea Estate and Zomba. Elsewhere: widely distributed south of the Sahara, from Senegal to Ethiopia and south to N South Africa, but with only a few scattered records in the Horn of Africa, Namibia, Zimbabwe and most of South Africa.

**Habitat** Miombo woodlands, remnant lowland rain-forest, montane evergreen forest, riverine forest, ornamental gardens with large trees, and mosaics of farmlands and forest/woodland areas (including tea and tobacco estates), when and where trees are producing succulent fruits and flowers.

**Abundance** Very commonly-recorded in Malawi. Colonies of several hundred individuals have been seen roosting in tall trees in forests and parks, and in Chiwale palms (*Raphia farinifera*) in riverine forests. Migratory and therefore not likely to be present throughout the year. In Zambia, colonies of 5-10 million are known.

**Habits** African Straw-coloured Fruit Bats are among the most easily observed bats because they almost always roost during the day in tall trees, fully exposed to sunlight, and can be seen flying away in the evenings. In Malawi, they have been observed roosting in Chiwale palms near Thyolo and exotic pines on the South Viphya Plateau. When numerous, they can cause defoliation and damage. Their remarkably long thumbs and legs enable them to climb around roosts with great agility, and they always seem to be restless and noisy. They lick their wings and fan them when roosting in full sun. Unfortunately, they sometimes land on pylons and powerlines and get electrocuted.

These fruit bats have a medium-low aspect ratio and exceptionally high wing-loading and their flight is straight and comparatively non-agile. Slow, regular wingbeats are often interrupted by short

glides. They must dive 1-2 m to gain sufficient speed for flight, which might explain a preference for roosting in tall trees and for foraging in canopies. They make long-range migrations (see below). At dusk, individuals leave their roosts in groups and fly up to 100-200 m high as they travel to foraging grounds which may be many kilometres away. They eat a great diversity of flowers, fruits and leaves and they play a very important role in pollinating trees. Digestion is very rapid and seeds pass through unharmed which means that these fruit bats play an important role in the dispersal of seeds and, furthermore, the digestive juices may stimulate germination. In Kasungu N. P., they have been seen near *Syzygium cordatum* trees that were bearing fruit.

African Straw-coloured Fruit Bats roost in groups varying in size from tens to hundreds of thousands, sometimes ca. a million and, in Kasanka N. P., Zambia, a colony of up to five million assembles in Nov-Dec every year. However, these fruit bats are migratory, so they are not present throughout the year at many of their roosts. A lot is known about the very long migrations that they make north of the equator; they follow the rains from the rainforest zone into savanna habitats and then back again. South of the Equator, migratory movements are poorly described, but appear to be similarly coordinated with the seasonal progression of the rains to and from the rainforest zone into woodland savanna habitats. Malawi lies within a zone of prime habitat in which these fruit bats may be resident throughout the year. Further south, they are only present seasonally when their foods are available.

There have been no detailed or conclusive studies of social and reproductive behaviour apart from observing that they are colonial and spend a lot of time vocalising and quarrelling over roost-sites.

**Reproduction** No information for Malawi. Elsewhere: litter-size: normally one. Females give birth once/year. The interval between mating and giving birth is extended by a period of delayed implantation.

**Conservation** IUCN Category: Near Threatened. Although often seen in large numbers in Africa, populations are declining because of over-harvesting for food and for their supposed medicinal properties.

**Taxonomic Notes** *Eidolon helvum* (Kerr, 1792). Two subspecies. The subspecies in Malawi (and the whole of Africa) is *E. h. helvum*.

**Key Reference** Thomas & Henry (2013).

**Measurements**
*Eidolon helvum*

| | |
|---|---|
| FA: | 118.6 (105-135) mm, n = 97 |
| HB: | 186.4 (161-227) mm, n = 41 |
| T: | 14.6 (4-24) mm, n = 92 |
| E: | 27.8 (22-33) mm, n = 96 |
| Tib: | 50.2 (45-54) mm, n = 35 |
| HF: | 30.4 (24-37) mm, n = 28 |
| WT: | 208.3 (110-350) g, n = 13 |
| GLS: | 57.0 (51.9-59.9) mm, n = 41 |

Throughout biogeographic range (Thomas & Henry 2013).

# Genus *Epomophorus* - Epauletted Fruit Bats

There are five species of *Epomophorus* in Malawi. They all have a patch of white or whitish pelage at the front and the back of each ear; the only other fruit bat in Malawi which has basal ear patches is *Plerotes anchietae*, which is smaller (FA: 47-53 mm). The adult males have epaulettes but they are retracted within deep pouches except when males are displaying during courtship. The species of *Epomophorus* are distinguished by forearm length (FA) and by the number and shape of their thick palatal ridges. Males are, on average, larger than females but the FA measurements below are those of males and females combined and are limited to data from Malawi. Palatal ridges are conspicuous ridges on the palate which can be seen by gently prizing open a bat's mouth. Posterior to the thick ridges are a series of thin and serrated ridges of no diagnostic value. Most of the thick palatal ridges are interdental (i.e. between the rows of teeth) but there are either one or two which are post-dental (i.e. posterior to the last teeth). The thick ridges are either complete, or divided by a gap in the middle into two parts, or partly-divided by a medial groove.

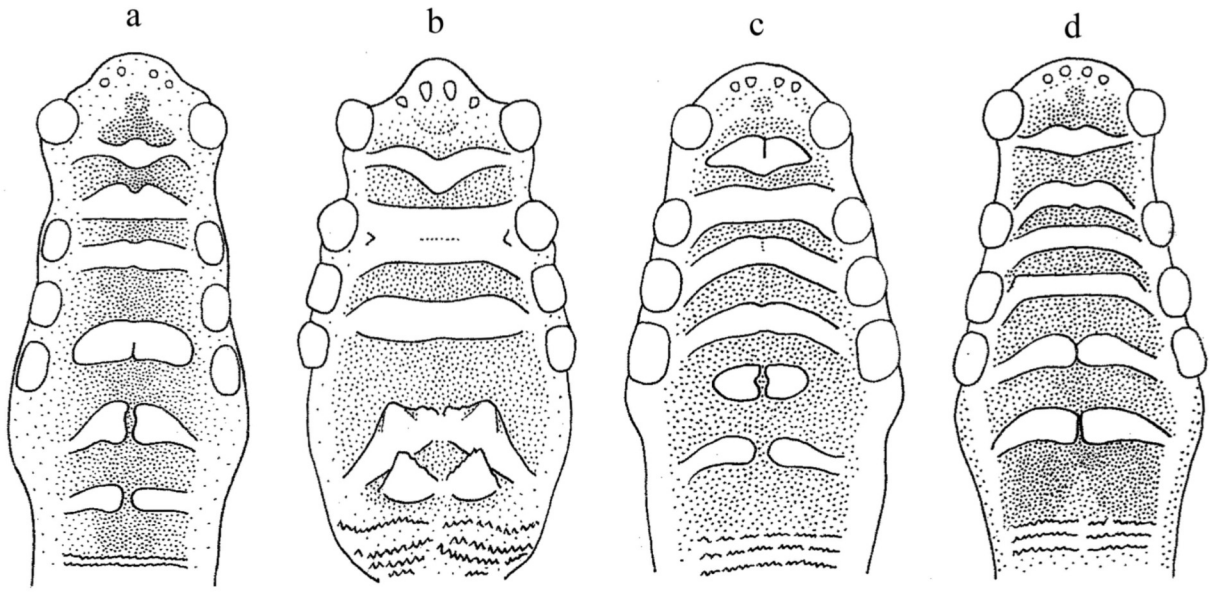



Fig. 7. Palatal ridges of four species of epauletted fruit bats, *Epomophorus*. (a) *E. crypturus*, (b) *E. dobsoni* (based on Bergmans 1997), (c) *E. cf. labiatus* and (d) *E. wahlbergi*.

*E. dobsoni.* FA: 81-94 mm. Five thick palatal ridges.

*E. wahlbergi.* FA: 78-91 mm. Six thick palatal ridges; only one post-dental.

*E. anselli.* FA: 68-77 mm (but data are limited). Six thick palatal ridges; two post-dental or one post-dental and one partly post-dental.

*E.* cf. *labiatus.* FA: 58-67 mm. Six thick palatal ridges; two post-dental.

*E. crypturus.* FA: 79-84 mm. Six thick palatal ridges; two post-dental.

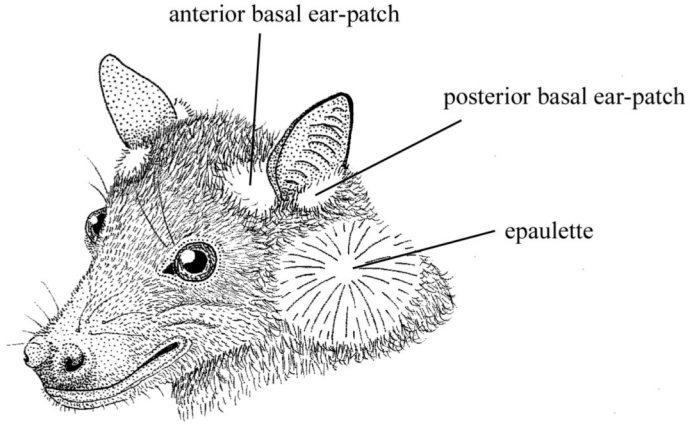



Fig. 8. Head of a male fruit bat in the genus *Epomophorus* showing anterior and posterior basal ear-patches and a displayed epaulette.

## *Epomophorus anselli*

## Ansell's Epauletted Fruit Bat

**Malawian Name** Lichinji, Mleme.
Not confined to this species.

**Description** Small, medium brown fruit bat with anterior and posterior basal ear-patches; adult males with epaulettes. A poorly-known species with only one adult male, one nearly adult female and one adult female known; identity of some other specimens awaits confirmation. Males apparently larger than females. Pelage soft. Dorsal pelage medium brown (fawn); hairs very slightly darker brown at base. Ventral pelage very pale brown mid-ventrally, becoming slightly darker on flanks; adult male with dark brown band high on the chest, running transversely between the epaulettes. Adult male with a white epaulette on each shoulder (retracted within pouch except when displayed). Ears rounded, naked, brown with dark brown rim. Muzzle moderately long and broad. Lips and cheeks fleshy and very expansible, especially in the male. Palate with six ridges of which, in the male, two are post-dental and in the females the fifth is partly inter-dental and the sixth post-dental. Wing-membranes brown. Tail very short.

**Similar Species**
*Epomophorus crypturus.* Slightly larger.
*Epomophorus dobsonii.* Only five thick palatal ridges.
*Epomophorus* cf. *labiatus.* Smaller (FA [males]: 59-67 mm, FA [females]: 58-65 mm.
*Epomophorus wahlbergi.* Only one thick post-dental palatal ridge, on average larger.

**Distribution** In Malawi, only known with certainty from the Central Plateau at 1000-1100 m but almost certainly also occurs in the northern Lake Shore at 485 m. Recorded definitely from Kasungu N. P. and almost certainly from Karonga. Elsewhere: only recorded from Ugano in SW Tanzania.

**Habitat** Miombo woodland and the edges of montane evergreen forest, where trees provide soft fruits. Details for Karonga not known but there are woodlands of baobabs (*Adansonia*), *Cordyla* and *Acacia albida* (now *Faidherbia albida*) in that area.

**Abundance** Rarely-recorded in Malawi. Only two specimens are known with certainty and there are only five others which might represent this species.

**Habits** Almost nothing is known about this species. The holotype was captured over a stream between two Water Berry trees *Syzygium cordatum* which were bearing fruit, but it is not known if they were feeding on these fruits.

**Reproduction** No information for Malawi. Elsewhere: no conclusive information.

**Conservation** IUCN Category: Data Deficient.

**Taxonomic Notes** *Epomophorus anselli* Bergmans and Van Strien, 2004. No subspecies.

**Key References** Bergmans (2013), Bergmans & van Strien (2004).

**Measurements**
*Epomophorus anselli*

| | |
|---|---|
| FA: | 77, 68, >74 mm |
| HB: | ca. 145, 104, - mm |
| T: | 4, 2, - mm |
| E: | 20, 19, - mm |
| Tib: | n. d. |
| HF: | n. d. |
| WT: | -, ca. 57, - gm |
| GLS: | 47.1, 38.7, >41.2 mm |

Malawi and Tanzania (measurements of three specimens: adult male, nearly adult female and adult female respectively, Bergmans 2013).

## *Epomophorus crypturus*

## Peters's Epauletted Fruit Bat

**Malawian Names** Lichinji, Mleme.
Not confined to this species.

Dzalanyama F. R., Malawi © DCD & M. Happold

**Description** Small to medium-sized, pale brown fruit bat with anterior and posterior basal ear-patches; epaulettes on mature males. Males on average larger than females. Pelage soft, slightly fluffy. Dorsal pelage usually pale brown (fawn), paler on shoulders and often suffused with yellow on head, neck and rump; hairs dark brown at base. Some individuals (usually males) are darker (almost sepia brown) and some much paler (as though bleached). Ventral pelage slightly to considerably paler than dorsal pelage; throat sometimes rusty-brown, especially in adult males. Mature males with a white epaulette on each shoulder (retracted within pouch except when displayed). Head dog-like with anterior and posterior white basal ear-patches. Muzzle long and broad, especially in males. Lips and cheeks fleshy and very expansible, especially in males. Ears rounded, naked, brown with dark brown rim. Eyes large, brown. Palate with four thick inter-dental and two thick post-dental ridges (cf. *E. wahlbergi)*. Wing-membranes brown. Tail absent or very short.

**Similar Species**
*Epomophorus anselli.* Apparently slightly smaller.
*Epomophorus dobsonii.* Only five thick palatal ridges.
*Epomophorus* cf. *labiatus.* Always smaller.
*Epomophorus wahlbergi.* Only one post-dental palatal ridge.

**Distribution** Probably widely distributed throughout Malawi in both woodland savannas and forests where and when fruiting trees are present, at altitudes of ca. 500-1300 m. Recorded from many localities including Blantyre, Chikwawa, Dzalanyama F. R., Karonga, Kasungu N. P., Kongwe Forest, Lake Malawi N. P., Likhubula, Livingstonia, Liwonde, Mitsidi (Manyowa Hill), Muona Mission, Namadzi District, Namazo Bay, Salima-Senga Bay, Thondwe District, Thyolo District, Zoa Tea Estate and Zomba. Elsewhere: recorded from E Angola to coast of S Tanzania, and south to E South Africa, but with large areas in Zambia and Mozambique lacking records.

**Habitat** Mostly found in open canopy miombo woodlands (sometimes with baobabs), riverine woodlands, other woodlands, remnants of lowland rainforest, ornamental gardens with large trees, and farmlands with remnant woodlands, when and where fruiting trees are present.

**Abundance** Uncommonly-recorded in Malawi. Elsewhere: common to very common, but local numbers are determined by the seasonal availability of fruits.

**Habits** During the day, Peters's Epauletted Fruit Bats hang, slightly apart, in the dense foliage of trees, in the shade. Clambering around branches during the day has not been reported. In Zimbabwe, they commonly roost in wild fig trees and sausage-trees (*Kigelia africana*). At one locality, two radio-tracked individuals roosted in different trees on five of six consecutive days. These fruit bats fly fast and direct in the open, but they can fly slowly with great manoeuvrability through dense foliage. They can hover briefly, and take off from the ground, but locomotion over the ground is extremely awkward.

Peters's Epauletted Fruit Bats feed opportunistically on the soft fruits and/or nectar of at least twenty species of trees (including wild figs). They

scramble about in the outermost parts of the tree, pull off a fig and then fly to a convenient perch from which they hang while eating. Fruits eaten include orchard and garden soft-fruits such as guavas, apricots, peaches, loquats and papayas, but not hard-fruits such as apples and pears. This implies that soft-fruits are only eaten when they are fully ripe and therefore over-ripe for commercial harvesting. When visiting flowers, individuals hang on with their feet, and often support themselves by flapping their wings while lapping nectar with their long tongues. These bats are nomadic and are only found when and where their foods are available.

Not much is known about the social and reproductive behaviour of Peters's Epauletted Fruit Bats other than that they roost in small to large groups. When they first return to their roosts, there is much bickering and they use the claws on their thumbs to strike at group members who attempt to come unacceptably close. Females roost with their young attached to their nipples and they carry their young while foraging until they become too heavy, and then the young are left at the roost. Males make loud monotonous bell-like calls which are repeated frequently, and it can be assumed that the males display their epaulettes while courting (see *Epomophorus wahlbergi*).

**Reproduction** Litter-size: 1 (n = 2). In Malawi and Zambia, lactation has been observed in Nov, Feb, Mar and Nov suggesting births can occur throughout the year. One female was simultaneously pregnant and post-lactating in Feb, indicating she gave birth more than once/year.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Epomophorus crypturus* Peters 1852. No subspecies. Referred to as *E. gambianus* by Happold & Happold (1997).

**Measurements**
*Epomophorus crypturus*

| | |
|---|---|
| FA (males): | 84.6 (81-87) mm, n = 10 |
| FA (females): | 80.0 (79-84) mm, n = 5 |
| HB (males): | 136.3 (127-150) mm, n = 4 |
| HB (females): | 132 (110-140) mm, n = 31* |
| T: | 1.5 (0 – 2) mm, n = 4 |
| E: | 24.5(21-28) mm, n = 4 |
| Tib: | 37, 32 mm, n = 2 |
| HF: | 20.2 (17-23) mm, n = 5 |
| WT (males): | 97 g, n = 1 |
| WT (females): | 89, 115 g, n = 2 |
| GLS (males): | 53.7 (51.8-54.6) mm, n = 6 |
| GLS (females): | 46.4 (46.2-46.6) mm, n = 3 |

Malawi. *Throughout biogeographic range (Happold, M. 2013b).

## *Epomophorus dobsonii*

## Dobson's Epauletted Fruit Bat

**Malawian Name** Lichinji, Mleme.
Not confined to this species.

**Description** Small fawn to grey-brown fruit bat with anterior and posterior basal ear-patches; epaulettes on mature males; five thick palatal ridges. Males on average larger than females. Pelage soft, slightly fluffy. Dorsal pelage pale yellowish-brown (fawn) to greyish-brown; hairs pale brown with greyish-brown at base and fawn to greyish-brown at tip. Some individuals (usually males) are darker (almost sepia brown) and some much paler (as though bleached). Ventral pelage dull cinnamon-brown suffused with grey, pale brown or creamy-brown; usually palest on throat and belly; males with chest darker greyish-brown; females with greyish throats. Mature males with a large yellowish-white epaulette on each shoulder (retracted within pouch except when displayed). Head dog-like. Lips fleshy and moderately expansible. Ears dark brown. Palate with three thick inter-dental ridges, and two thick post-dental ridges, each with two triangular projections, and three or four thin ridges. Wing-membranes dark brown. Tail absent or very short.

**Similar Species** None. All other species of *Epomophorus* have six thick palatal ridges.

**Distribution** Within Malawi, known from the Central Plateau, High Plateaux of the Northern Region, Shire Highlands and Lake Shore, at altitudes of 500-2300 m. Recorded from Kasungu N. P., Livingstonia, Misuku-Mughese Mission, Nkhata Bay, Nyika Plateau (Chelinda, Chipome Valley) and Zomba. Elsewhere: widespread in the Zambezian woodland zone, from Angola to S Tanzania. Outlying records north of 8° S in Tanzania and Rwanda are questionable.

**Habitat** Open and closed canopy miombo woodlands, montane evergreen forest, and semi-evergreen forest, where fruiting trees are present.

**Abundance** Seldom-recorded in Malawi. Elsewhere: moderately rare in collections but occurs in poorly surveyed areas and might be more common than records indicate.

Zambia © F. Willems

**Habits** It seems that nothing is known about the habits of Dobson's Epauletted Fruit Bats in Malawi or elsewhere.

**Reproduction** No information. Elsewhere: litter-size 1 or 2. No other information.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Epomophorus dobsonii* Bocage, 1899. Formerly referred to as *Epomops dobsonii* including by Happold *et al.* (1987), Ansell & Dowsett (1988) and Happold, M. (2013c). However, it is now placed in *Epomophorus* although it is not a typical representative of this genus. No subspecies.

**Key References** Bergmans (1989), Bergmans & Jachmann (1983), Happold, M. (2013c).

**Measurements**
*Epomophorus dobsonii*

| | |
|---|---|
| FA (males): | 88.0 (82-94) mm, n = 9 |
| FA (females): | 83.8 (81-88) mm. n = 5 |
| TL (males): | 155.0 (138-170) mm, n = 4 |
| TL (females): | 135.0 (130-140) mm, n = 4 |
| T: | 1.6 (0-9.5) mm, n = 6 |
| E: | 26.3 (24-30) mm, n = 8 |
| Tib: | n. d. |
| HF: | n. d. |
| WT: | n. d. |
| GLS (males): | 52.4 (45.8-55.3) mm, n = 8 |
| GLS (females): | 46.7 (45.5-47.3) mm, n = 4 |

Malawi, Tanzania and Zambia (Bergmans 1989).

## *Epomophorus* cf. *labiatus*

## "Little" Epauletted Fruit Bat

**Malawian Name** Lichinji, Mleme.
Not confined to this species.


Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Description** Small, pale brown fruit bat with anterior and posterior basal ear-patches; epaulettes on mature males. Males often darker and, on average, slightly larger than females. Pelage soft, fluffy, without sheen. Dorsal pelage (males) pale brown (fawn); hairs fawn merging into dark brown at base. Mature males with a white epaulette on each shoulder (retracted within pouch except when displayed). Dorsal pelage (females) pale brown (fawn); hairs beige with pale brown at tip. Ventral pelage (males) pale brown merging into pure white on abdomen; some males with dark brown shoulders and throat. Ventral pelage (females) pale fawn on chest merging into buff on abdomen. Head more puppy-like than dog-like with conspicuous anterior and posterior white basal ear-patches. Some males with dark chocolate-coloured band across throat from epaulette to epaulette. Muzzle longish and broad. Lips and cheeks fleshy and very expansible, especially in males; cheek pouches conspicuous even when empty. Ears light brown with dark brown rim. Eyes large, brown. Palate with six thick ridges, the fifth partly or fully post-dental and the sixth post-dental. Wing-membranes light brown, slightly translucent. Tail very short or absent.

**Similar Species**
*Epomophorus anselli.* Apparently larger (but data are limited).
*Epomophorus crypturus.* Larger.
*Epomophorus dobsonii.* Only five thick palatal ridges.
*Epomophorus wahlbergi.* Only one thick post-dental palatal ridge.

**Distribution** Widely distributed in woodland savanna habitats (when and where fruiting trees are present). Altitudes range from <100 to ca. 1350 m. Recorded from Blantyre, Chiromo, Kamuzu Academy, Karonga, Kasungu N. P., Lake Malawi N. P., Namadzi District, Namazo Bay, Nchalo, Nkhotakota, Nkhotakota W.R., Thondwe District, Vwaza Marsh G. R. and Zomba. Elsewhere: the distribution of *E.* cf. *labiatus* is uncertain.

**Habitat** Miombo woodlands, woodland/savannas with mixed species (and sometimes with baobabs), farmlands (including tobacco and maize farms with remnant miombo and/or riverine forest), and ornamental gardens with large trees, where fruiting trees are present. At Thondwe District, individuals were observed on the bank of a large dam with riverine forest and fig-trees immediately below a dam wall. At Namadzi District, they were observed in ornamental gardens surrounded by fields, remnant miombo woodlands and riverine forest. At Chiromo, they were found in an old, neglected ornamental garden with large trees on the bank of the Ruo River, with farmlands nearby.

**Abundance** Uncommonly-recorded in Malawi. Elsewhere: common to very common but local numbers determined by the seasonal availability of fruits.

**Habits** During the day, these fruit bats hang freely from branches of trees and shrubs (usually but not always under dense foliage) and under banana leaves. They cling to branches, with their thumbs and wings as well as their hindfeet, and they can climb head first, up or down rough surfaces, by moving their wings and hindfeet in alternation. During grooming, the tongue is protruded from the front or sides of the mouth and used to lick the face, genital region and both surfaces of the wings. The claws of the hindfeet are used to comb the dorsal and ventral pelage, and individuals also shake themselves during grooming. The flight of *E.* cf. *labiatus* is fast and direct when they are commuting between their roosts and feeding-grounds, but slow and manoeuvrable when foraging through the canopies of trees. They can hover briefly and take off from the ground.

These fruit bats feed on soft fruits of many endemic and cultivated trees. In Malawi, they feed on wild figs, sometimes at the same time as *E. cryptturus* and *E. wahlbergi.* They land on clusters of figs and use the thumbs and the second digits of their wings in conjunction to pull food towards the mouth and, subsequently, to hold and manipulate it while it is chewed. Food is initially packed into the expansible cheeks, carried to a perch and then chewed slowly, small amounts at a time. One hindfoot is sometimes used to manipulate food in the mouth. They may also land to eat fruit on the ground. They feed at intervals throughout the night.

These fruit bats roost singly or in groups. Adult males probably perform calling-displays as do other *Epomophorus* spp, but the larynx is not large and the calls can be heard by humans only when close by. The call is a soft bell-like "ping" uttered at intervals of 1-7 seconds. A similar "ping" made by an electronic watch elicited "pinging" by one individual in captivity.

**Reproduction** Litter-size: 1 (n = 7). Births have been recorded from Oct-Feb but no data for other months. Females do not reproduce in close synchrony. Three females were observed simultaneously pregnant and post-lactating indicating they gave birth more than once/year.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** Formerly referred to as *Epomophorus labiatus* (Temminck, 1837), but this taxon is now considered to represent several species and, therefore, specimens from Malawi are currently referred to as *E.* cf. *labiatus* pending renaming. Happold *et al.* (1987), Ansell & Dowsett (1988) refer to this species as *Epomophorus minor.* Happold & Happold (1997) and Happold, M. (2013d) refer to it as *E. labiatus.*

**Key Reference** Happold, M. (2013d).

**Measurements**
*Epomophorus* cf. *labiatus*

| | |
|---|---|
| FA (males): | 63.6 (59-67) mm, n = 19 |
| FA (females): | 60.9 (58-65) mm, n = 15 |
| HB (males): | 109 (105-113) mm, n = 4 |
| HB (females): | 94.8 (90-98) mm, n = 5 |
| T: | 2.0 (0-5) mm, n = 10 |
| E: | 18.5 (17-21) mm, n = 13 |
| Tib (males): | 27.6 (26-29) mm, n = 6 |
| Tib (females): | 25.8 (24-28) mm, n = 7 |
| HF: | 16.5 (17-18) mm, n = 11 |
| WT (males): | 54.4 (48-64) g, n = 4 |
| WT (females): | 40.6 (34-51) g, n = 10 |
| GLS (male)s: | 38.48 (35.4-40.3) mm, n = 16 |
| GLS (females): | 35.0 (33.2-37.7) mm, n = 15 |

Malawi (HC, NHMUK, ZMA, Happold *et al.* 1987).

## *Epomophorus wahlbergi*

## Wahlberg's Epauletted Fruit Bat

**Malawian Name** Lichinji, Mleme.
Not confined to this species.


Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Description** Small to medium-sized, pale brown fruit bat with anterior and posterior basal ear-patches; epaulettes on mature males. Males on average larger than females, sometimes darker, sometimes with band of brown pelage around epaulettes and across throat and around testes (when sexually active). Pelage soft, slightly fluffy, without sheen. Dorsal pelage usually pale brown (fawn), paler on shoulders, sometimes suffused with yellow on hindlimbs and around tail (especially in females); hairs dark brown at base. Ventral pelage slightly to considerably paler than dorsal pelage; sometimes suffused with grey. Mature males with a white epaulette on each shoulder (retracted within pouch except when displayed). Some males with a band of brown pelage around each epaulet and across the throat. Head dog-like, with anterior and posterior white basal ear-patches. Muzzle long. Lips and cheeks fleshy and very expansible, especially in males. Ears brown with dark brown rim. Eyes large, brown. Palate with five thick inter-dental and one thick post-dental ridge. Wing-membranes light brown and slightly translucent. Tail absent or very short.

**Similar Species**

*Epomophorus anselli.* Fifth palatal ridge post-dental in males, partly inter-dental in females. Apparently smaller on average (but data very limited).

*Epomophorus crypturus.* Two post-dental thick palatal ridges.

*Epomophorus dobsonii.* Only five thick palatal ridges.

*Epomophorus* cf. *labiatus*. Two thick post-dental palatal ridges. Smaller.

**Distribution** Probably occurs throughout Malawi in woodland savannas and forests, when and where fruiting trees are present (although not yet recorded from the Upper Shire Valley) at altitudes of <100 to ca. 1900 m. Recorded from many localities including Blantyre, Chikwawa, Chiromo, Karonga, Lake Malawi N. P., Likhubula, Misuku Hills, Mzuzu, Namadzi District, Ntchisi Mountain F. R., Thyolo District, South Viphya Plateau, Thondwe District, Wilindi Forest, Zoa Tea Estate and Zomba District. Elsewhere: recorded disjunctly from Gabon (and perhaps Cameroon and Equatorial Guinea) to Somalia, and southwards to Angola in the west and South Africa in the east.

**Habitat** Open and closed canopy miombo woodlands and other woodlands, riverine forest, remnants of lowland rainforest, miombo woodland near montane evergreen forest, ornamental gardens with large trees, and farmlands with remnant woodlands and riverine forest, when and where fruiting trees are present.

**Abundance** Commonly-recorded in Malawi. Elsewhere: probably fairly common throughout biogeographic range when and where fruiting trees are available.

**Habits** A lot is known about Wahlberg's Epauletted Fruit Bats, mainly from studies in Kenya but these observations almost certainly apply to Malawi. During the day, these bats usually hang in the foliage of trees with dense canopies (including evergreen trees in riverine woodlands, ornamental gardens and city parks). They also often hang from living fronds of palms or from the skirts of dead fronds surrounding the stems of *Borassus* palms. Roost-fidelity varies according to duration of residence in a particular area, and perhaps the safety of the roost. One roost was occupied continuously for at least five years and, although the number of individuals at this roost varied from 40 to 100 over this period, group-size usually remained stable for 1-2 weeks at a time.

Nomadic individuals perhaps return to familiar roosts in each locality they visit - some roosts have been occupied for several weeks during consecutive years, but the identity of the occupants was not determined. Some individuals switch between several roosts in one area, for the duration of their stay in that area - possibly to avoid predation or possibly in response to disturbance. Roosting bats hang from one or both feet, with the head either visible or tucked against the belly and covered by the wings. They are motionless for long periods, but may groom, stretch, yawn, or swing intermittently throughout each day.

The flight of these bats is moderately fast to slow with moderate manoeuvrability. They can hover briefly, glide short distances, and take off from the ground. Locomotion on the ground is clumsy and slow. In contrast, climbing up and down tree trunks is very competent; the forearms move in alternation with thumbs extended to find thumb-holds. They climb under slender branches, clinging with thumbs and toes and with limbs moving in alternation. They crash-land on foliage and bunches of fruit, but landing under a ceiling, palm-leaf or branch is accomplished by swooping upwards, hooking the thumbs to the perch with the last wing-stroke, swinging the feet up to grip the perch and then letting go with the thumbs.

Wahlberg's Epauletted Fruit Bats feed on soft fruits, pollen and nectar. Foraging begins around dusk and individuals move up to 4 km from their roosts to feeding areas. Nomadic movements occur where abundance of food fluctuates seasonally. Fruit is carried to a regularly used feeding perch, then chewed slowly while the tongue mashes the fruit against the palate. Large pieces of fruit are held in one foot while bites are taken, and the thumbs and second fingers of the wings are used to manipulate food. Pellets of skin, seeds and fibre are spat out (and can be analyzed to reveal the diet). They feed on figs and the soft pulpy ripe fruits, pollen and nectar, of many other trees and shrubs. Figs sometimes comprise most of the diet. They also eat cultivated fruits but usually when too ripe to have commercial value. They pollinate baobabs and probably many other trees. They chew the leaves of *Balanites* and swallow the juice possibly to obtain proteins. Remains of beetles and other insects have been found in stomach contents but although protein may be obtained in this way, this insectivory might be accidental.

Wahlberg's Epauletted Fruit Bats usually roost in mixed-sex groups throughout the year; group-size is three to over 100, sex ratio about equal in large or very large groups but individual males may roost with up to three adult females and young. They are rarely found roosting singly or in pairs. In Kenya, a detailed study of social interactions in a colony of 40-100 individuals was made during Jan each year, for five years. The bats return to their roosts at dawn, and most social interactions at the roost occurred at this time. These included nose-to-nose sniffing (and occasionally nose-licking), probably to allow group-members to recognize each other. Group-members clustered together but maintained a mean distance of 16.5 cm between neighbours. Individuals struck out with their clawed thumbs if approached too closely, and may half-open the wings, screech and occasionally bite. Mutual-grooming has not been seen, nor any other interactions between roosting adults. In Jan, the bats left precisely between 18:50 h and 19:00 h, and did not return until ca. 05:30 h next morning. They departed one by one and often in different directions. Aggregations occurred at fruiting trees, but it is not known if these were comprised of individuals that roosted together. Elsewhere, these bats are reported to leave their day-roosts for 1-2 hours and then return.

Courting males fly from the roost to perches, 2-20 m above ground, in nearby trees. Here, they inflate their cheeks and make a moderately loud gong-like honk repeated at intervals of about one second. The epaulettes are displayed, and the wings are half opened, quiver constantly and beat once or twice with each call. Rival males are usually separated by at least 50 m. When approached by females, the males double their call-repetition-rate and turn towards the approaching female. The approaching female hovers for nose-to-nose contact, and often utters a series of soft calls, each call being uttered in the interval between consecutive calls made by the male. Males call from one perch for 15-60 minutes or longer, then move to other perches. Individuals apparently have several preferred perches to which they return on consecutive nights.

Females give birth at their roosts in the presence of both male and female group-members. They give birth in the normal hanging posture but with the wings folded loosely. The neonate immediately clings to the mother, using the well-developed claws of its thumbs and toes and also its milk-teeth which are hooked to facilitate gripping the mother's nipples. The placenta is chewed within five minutes of its appearance. Mothers lick their vulvas, and extensively lick their neonates. During the first 30 minutes, the neonate is placed horizontally across its mother's chest, and is turned (or turns itself) around several times so that its head is at one or other of the nipples. Older juveniles either cling horizontally or vertically with the head upwards. At first, the neonate is carried (attached to nipples and pelage)

while the mother forages. When volant, the young follow their mothers and maintain contact by calling to each other: the mothers' calls are soft honks, the juveniles' calls are sparrow-like "tweets".

**Reproduction** Litter-size: 1 (n = 9). Females probably give birth more than once/year and not at any particular time of year. Births have been recorded from Sep-Mar, but there are no data for some months. Females are not in reproductive synchrony. Simultaneous pregnancy and lactation was observed in 2 of 5 females in Jan, but the percentage of females that breed more than once/year is not known. In KwaZulu Natal, South Africa, most (but not all) females give birth only once/year and births occur throughout the year. Gestation: 160 days.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Epomophorus wahlbergi* (Sundevall, 1846). No subspecies.

**Key References** Happold, M. (2013e), Wickler & Seibt (1976).

**Measurements**
*Epomophorus wahlbergi*

| | |
|---|---|
| FA (males): | 87.4 (85-91) mm, n = 5* |
| FA (females): | 82.0 (78-85) n = 12* |
| HB (males): | 146.0 (130-165) mm, n = 13 |
| HB (females): | 135.5 (115-152) mm, n = 34 |
| T (males): | 0 mm, n = 12 |
| T (females): | 2.0 (0-6) mm, n = 40 |
| E: | 23.4 (20-26) mm, n = 58 |
| Tib (males): | 37.8 (36-40) mm, n = 4 |
| Tib (females): | 34.4 (32-37) mm, n = 16 |
| HF: | 22.1 (19-26) mm, n = 22 |
| WT (males): | 110.4 (101-121) g, n = 5 |
| WT (females): | 94.5 (69-118) g, n = 40 |
| GLS (males): | 52.7 (49.9-55.0) mm, n = 20 |
| GLS (females): | 46.4 (42.8-48.6) mm, n = 30 |

Tanzania, Malawi, Zambia and Mozambique (Bergmans 1988).
*Malawi only.

# Genus *Myonycteris* - Collared Fruit Bats

Collared Fruit Bats are so-called because the males have a ruff of coarse hairs around their throats. They do not have basal ear patches or epaulettes. Their toes are partly webbed (cf. *Rousettus*). They have five upper cheekteeth.

There is only one species in Malawi. It was previously placed in the genus *Lissonycteris* and called a Soft-furred Fruit Bat.

## *Myonycteris angolensis*

## Angolan Collared Fruit Bat

**Malawian Name** Lichinji, Mleme.
Not confined to this species.

**Description** Small fruit bat with long silky dark brown pelage; no epaulettes; no white basal ear patches. Sexes similar in colour and size. Pelage soft, dense and without sheen. Dorsal pelage ranging from rich dark rusty-brown to dark golden-brown or greyish-brown (becoming darker on head and rusty-brown on hindlegs and wing margins in some individuals). Ventral pelage slightly paler and greyer. The ruff of stiff coarse hairs on the throat and sides of neck of males ends with a whorl on each shoulder; it is sometimes sticky. Females lack a ruff of coarse hairs, but the hairs in this region are sparser and longer than elsewhere. No markings on head. Muzzle comparatively short giving the head a puppy-like appearance; lips and cheeks expansible. Ears dark brown. Wing-membranes dark brown; attaching to second toe. Hindfeet with webbing between the proximal quarter or third of the first phalanges of the toes. Tail very short.

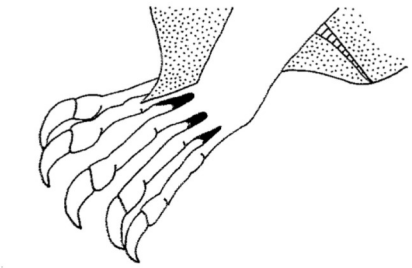


Fig. 9. Left hindlimb of *Myonycteris angolensis* showing the attachment of the wing to the second toe and the webbing between the proximal quarter or third of the first phalanges of the toes.

**Similar Species**

*Rousettus aegyptiacus*. Usually larger (FA: 82-106 mm). Dorsal pelage shorter; no ruff in adult males; toes not webbed; wing-membranes attaching to first toe or between first and second toes.

Tanzania © C.& M. Stuart

*R. lanosus*. Usually larger (FA: 85-95 mm). No ruff in adult males; toes not webbed; wing-membranes attaching to second toe or between first and second toes.

**Distribution** In Malawi, only recorded from Mwalingo at 1460 m in the Misuku Hills and on Zomba Plateau. Elsewhere: distributed very disjunctly from Senegal to the Ethiopian Highlands, and southwards in parts of Congo, Angola, E DR Congo, Uganda, Rwanda, W and SE Kenya, W and NE Tanzania, Zimbabwe and Mozambique.

**Habitat** In Malawi, montane evergreen forest.

**Abundance** Very rarely-recorded in Malawi. Not known in Malawi until 2007. Known in Malawi only from five individuals from Zomba Plateau and two others from the Misuku Hills. Elsewhere: uncertain, but apparently common in some areas where fruiting trees and suitable day-roosts are present.

**Habits** Nothing is known about the habits of Angolan Collared Fruit Bats in Malawi. Elsewhere: unlike all African fruit bats except *Rousettus* spp., these fruit bats are most often reported roosting during the day in caves and mine-adits, but there are four reports of them roosting in cave-like places - a hollow tree, an open tunnel-like space between huge rocks, a subterranean bunker and a hut. Roosting in foliage seems abnormal but there is a record of two under dead palm-leaves. Because they orientate visu-

ally, without echolocation, they roost where it is never totally dark. They hang freely from ceilings of caves, using footholds which can be reached from flight. They do not use their wings for any form of locomotion except flight and, unlike *Rousettus*, they do not clamber around or crawl into crevices.

Angolan Collared Fruit Bats predictably can fly slowly with great manoeuvrability. They feed mainly on the soft fruits of both endemic and introduced trees. They forage below the canopies of trees and land directly onto the fruit without clambering over branches to reach it. Like *Epomophorus* spp, they sometimes eat the fruits where they find them, and sometimes carry them in their expansible cheeks to a nearby perch where they chew them, swallow the juice and spit out the rest. Food in the mouth is manipulated with a hindfoot but not with the second fingers and thumbs. There seem to be no records of these bats visiting flowers.

Angolan Collared Fruit Bats roost in groups of 2-50 (rarely up to 100), and occasionally roost singly. Females near parturition or lactating roost in maternity-roosts in which adult males are absent or rare, and evidence from Liberia suggests that the adult males move away from some areas leaving the females behind until parturition and lactation are over. On Zomba Plateau, two males and one female were netted together.

**Reproduction** No information for Malawi. Elsewhere: litter-size: 1. No other conclusive information.

**Conservation** IUCN Category: Least Concern. However, the subspecies *L. c. goliath* is threatened by destruction of habitat and is likely to be taken from caves for “bushmeat”.

**Taxonomic Notes** *Myonycteris angolensis* (Bocage, 1898). Formerly referred to as *Lissonycteris angolensis* including by Bergmans (1997), Happold, M. (2013g) and Šklíba *et al.* (2007). Five subspecies of *angolensis* are recognised including *L. a. goliath* from the Zimbabwe-Mozambique border area south of Malawi, and *L. a ruwenzorii* from S Sudan, E DR Congo, Uganda, W Kenya, Rwanda and W Tanzania. However, *L. angolensis* from Zomba Plateau is intermediate in size between these two forms, and therefore the recognition subspecies when body size appears to decrease in a cline from south to north in this part of Africa, is dubious.

**Key References** Bergmans (1997), Happold, M. (2013f), Šklíba *et al.* (2007).

**Measurements**
*Myonycteris angolensis*

| | |
|---|---|
| FA: | 84.2 (80-90) mm, n = 10 |
| HB: | 146, 156 mm |
| T: | 6 mm |
| E: | 20 mm |
| Tib: | 35, 37 mm |
| HF: | 23.0 (19-25) mm, n = 9 |
| WT: | 91, 96 g |
| GLS: | 44.1 (42.2-46.0) mm, n = 7 |

Malawi, Zimbabwe (Bergmans 1997, Šklíba *et al.* 2007).

# Genus *Plerotes* - Broad-faced Fruit Bat

There is only one species in this genus. Broad-faced Fruit Bats are the smallest fruit bats in Malawi (FA: 47-53 mm) and they have a yellowish-white moustache and beard.

## *Plerotes anchietae*

## Anchieta's Broad-faced Fruit Bat

**Malawian Name** Lichinji, Mleme.
Not confined to this species.

**Description** Very small, pale greyish-brown fruit bat with a yellowish-white moustache and beard. Only 11 specimens known. Sexes apparently similar. Pelage soft. Dorsal pelage uniformly pale greyish-brown; hairs pale creamy-brown with darker, greyish-brown at tip. Ventral pelage pale creamy-brown. No mantle or collar of contrasting pelage. No epaulettes, but both sexes have a white spot on each shoulder and a whitish patch (sometimes inconspicuous) at the posterior base of each ear. Head with relatively broad muzzle. Eyes large, narrowly ringed with reddish-brown pelage and with band of reddish-brown pelage from each eye-ring to the nostril. Moustache of stiff yellowish-white hairs on upper lip, and beard of similar hairs on chin. Ears brown. Tongue with thread-like papillae covering the tip (as in *Megaloglossus woermanni*, a non-Malawian fruit bat, which laps nectar from flowers), but rather short (cf. greatly elongated in *Megaloglossus*). Wing-membranes brown; attaching to second toe. Interfemoral membrane, uniquely, no more than a narrow flange. No tail.

**Similar Species** None

**Distribution** In Malawi, recorded only from the Mondwe Valley (1760 m) in the Nyika N. P. Elsewhere: appears to have a disjunct distribution with a western range in Angola, and an eastern range in S DR Congo and N. Zambia.

**Habitat** Montane and submontane habitats. In the Mondwe Valley, two were recorded as they flew, two metres high, from an open savanna-*Brachystegia* woodland, over an area with high grass, towards a river.

**Abundance** Very rarely-recorded; only two specimens from Malawi. Elsewhere: extremely rarely collected.

**Habits** Nothing is known about the habits of Anchieta's Broad-faced Fruit Bats. The diet is not yet known (despite some reports to the contrary). The simplicity of the palatal ridges, the presence of thread-like papillae on the tip of the tongue, the delicacy of the skull and the weakness of the dentition suggest a diet of pollen and perhaps also nectar, and the moustache and beard of stiff hairs perhaps serve to transport pollen. However, the tongue is not particularly long nor as extensible as it is in nectar-feeding fruit bats such as *Megaloglossus* (Harrison 1960). Based on the short tongue and Seabra's indication that cheek-pouches are present, Harrison (1960) concluded that the diet of Anchieta's Broad-faced Fruit Bats is unlikely to be solely nectar, and he suggested that it might consist partly of soft fruit and partly of pollen. One specimen was caught at a fruiting *Parinari curassifolia* tree, although it is not known whether it was feeding on the fruit. Consequently, the diet of Anchieta's Broad-faced Fruit Bats is an intriguing mystery which should be investigated. An adult male and immature female were observed flying together in the Mondwe Valley.

**Reproduction** No information for Malawi or elsewhere.

**Conservation** IUCN Category: Data Deficient.

**Taxonomic Notes**
*Plerotes anchietae* (Seabra, 1900). No subspecies. Not listed by Sweeney (1959), Happold *et al.* (1987) and Ansell & Dowsett (1988).

**Key References** Bergmans (1989), Harrison (1960), Kock *et al.* (1998a) and Happold, M. (2013g).

**Measurements**
*Plerotes anchietae*

| | |
|---|---|
| FA: | 49.0 (47-53) mm, n = 11 |
| HB: | 82.4 (70-96) mm, n = 7 |
| T: | 0 mm, n = 7. |
| E: | 16.9 (15-18) mm, n = 7 |
| Tib: | 20.6 (19-24) mm, n = 5 |
| HF: | n. d. |
| WT: | 20, 20 g, n = 2 |
| GLS: | 27.6 (25.4-29.5) mm, n = 7 |

Throughout biogeographic range (Bergmans 1989, Kock *et al.* 1998). Includes some immature specimens.

## Genus *Rousettus* - Rousettes

Two species of *Rousettus* occur in Malawi.

*R. aegyptiacus*. Dorsal pelage sleek and shorter (longest hairs ca. 12 mm). Wings attached to the first toe or between the first and second toes. Dorsal side of each tibia almost naked. Widespread and not restricted to mountainous areas.

*R. lanosus*. Dorsal pelage shaggy and longer (longest hairs 16-18 mm). Wings usually attached to the second toe or occasionally between the first and second toes. Dorsal side of each tibia well furred. Found in mountainous areas.

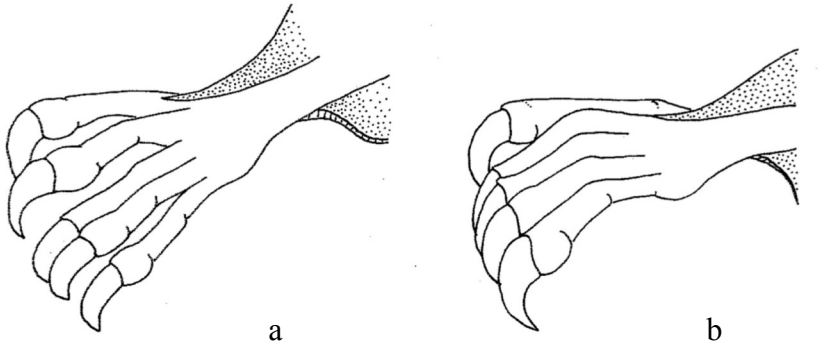



Fig. 10. (a) Left hindlimb of *Rousettus aegyptiacus* showing attachment of the wing to the first toe. (b) Left hindlimb of *Rousettus lanosus* showing the attachment of the wing between the first and the second toes. In some *R. lanosus*, the wing is attached to the second toe.

### *Rousettus aegyptiacus*

### Egyptian Rousette

**Malawian names** Lichinji, Mleme.
Not confined to this species.

Liwonde N. P., Malawi © DCD & M. Happold

**Description** Small to medium-sized, dark brown to greyish-brown fruit bat with no basal ear patches; no epaulettes; no ruff of coarse hairs and no webbing between toes. Males on average larger than females. Pelage short, soft, without sheen. Dorsal pelage dark sepia brown sometimes suffused with grey; paler and sparser on neck; hairs on back unicoloured, hairs on neck pale with darker tip. Ventral pelage slightly to considerably paler. Males with band of slightly stiffer, buff or yellowish pelage around neck and throat, but without a conspicuous coarse ruff (cf. *Myonycteris*). Head without markings; muzzle long; lips and cheeks not very expansible. Ears naked, brown, tip rounded. Wings blackish-brown, wing-membranes attaching to first toe or occasionally between the first and second toes. Dorsal side of tibia practically naked (cf. *R. lanosus*). Tail short, protruding up to 17 mm beyond interfemoral membrane.

**Similar Species**

*Rousettus lanosus.* Dorsal pelage longer, shaggy. Wing-membranes attaching to second toe (occasionally between first and second toes); tibiae dorsally well furred.

*Myonycteris angolensis*. Usually smaller (FA: 68-90 mm). Dorsal pelage fairly long; ruff of coarse hairs in adult males. Toes partly webbed.

**Distribution** Probably found throughout Malawi when and where fruiting trees (including banana plants) are present, but the records are from the

Central Plateau, Lake Shore, Phalombe Plain at base of Mulanje Mountain and the Upper and Lower Shire Valleys, at altitudes of <100-1300 m. Recorded from near Karonga, Lengwe N. P., Likhubula River, Liwonde N. P., Mulolo near Chiromo, Mulanje, Mwalingo near Chitipa, and Ngabu. Elsewhere: distributed disjunctly throughout most of sub-Saharan Africa but restricted to areas with fruiting trees and caves. Also occurs in the Nile Valley where man-made cave-like day-roosts are used.

**Habitat** Miombo, riverine forest and remnant lowland rainforest at Likhubula; miombo with baobabs and riverine forest and isolated rocky inselbergs at Liwonde N. P., mosaic of riverine woodland, tree savanna, thickets and thicket-clump savanna with baobabs at Lengwe N. P., and farmlands with banana plantations. Presumably all habitats have caves or cave-like day-roosts within reach.

**Abundance** Rarely-recorded in Malawi. Elsewhere: common; sometimes very abundant near large caves.

**Habits** Egyptian Rousettes have been particularly well studied, although not in Malawi. Unlike all other African fruit bats except *Myonycteris angolensis* and *Rousettus lanosus*, they roost during the day in caves and cave-like places, sometimes choosing dimly lit areas and sometimes total darkness. Exploiting totally dark caves is possible because these fruit bats, and at least two other species of *Rousettus*, can echolocate using clicks which are made with the tongue and emitted through the mouth. They do not echolocate with the sophistication of microbats, and they use their eyes to see their surroundings at night, as long as there is some light. The clicks have broad bandwidths with frequencies of 7-70 kHz and parts of the calls are audible to humans as clicks. These fruit bats have to live in colonies and huddle together to stay warm. They do not become torpid and do not hibernate.

Egyptian Rousettes have a very low aspect ratio, very high to exceptionally high wing-loading. Their flight is slow and agile at slow speeds, but manoeuvrability is poor. They sometimes glide when travelling from higher to lower localities, and they can hover briefly and take off from the ground. Locomotion on ground is slow and clumsy but climbing is efficient. They frequently hang from branches with one foot and one thumb on each side of the branch, and they move along the undersides of branches in this position, using all four limbs (cf. *Myonycteris angolensis*).

Egyptian Rousettes feed on fruits, nectar and probably pollen, and sometimes leaves. They have a highly developed sense of smell which helps them locate food. They are known to commute as much as 10-24 km between their roosts and foraging-grounds, and consequently they sometimes arrive much later than competing species which roost in trees nearby. They carry their fruits to feeding perches where hard-skinned fruits are peeled before the pulp is chewed and mashed against the palate. Up to 25% of gathered fruit is discarded, often because of attempted pilfering by other individuals. In South Africa, they make seasonal movements (probably nomadic) in search for food and marked bats have been recaptured at day-roosts which are 32-500 km apart. In contrast, in Uganda where food is available year-round, caves are inhabited by thousands of individuals throughout the year. These fruit bats eat ripe fruits of many native trees and shrubs and also ripe cultivated fruits. They are considered pests in some areas although damage to orchards is often exaggerated. They take nectar and probably pollen from flowers including those of *Bombax, Kigelia, Adansonia, Eriobotrya* and *Musa*, and pollinate at least some of these species.

Colonies of these bats contain 50-4000 or more individuals of both sexes. A cave may contain several clusters of huddled bats, but the composition and stability of clusters is apparently not known. Fluctuations in adult sex ratios of colonies are recorded in South Africa but females usually outnumber males by as much as 3 to 1 suggesting that this species is polygamous. During pregnancy and lactation, two caves in South Africa contained both males and females which suggests that the females do not form maternity colonies in separate caves. However, in captivity, males tended to form groups by themselves (ignoring the females and juveniles), and therefore, the possibility that occupants of a single cave segregate into maternity clusters and bachelor clusters needs investigation. There appears to be no other evidence of sexual separation, nor any records of day-roosts occupied exclusively by females with young.

Colonies remain active and noisy throughout much of the day. There is often competition for the darkest sites, and individuals will move from lighter to darker positions if light levels change during the day. Competition for particular positions within clusters is evident from aggressive interactions including screaming, striking out with the forearms, hooking an opponent and biting. Individuals are recognized primarily by their scent, and olfactory cues probably influence many social interactions. A wide range of vocalizations are made, many probably associated with communication.

Mating occurs at the roost. During birth, the female remains quiescent in the normal resting

posture. Eventually the head of the baby appears and then the baby slowly squirms its way out of the vagina, thus participating actively in its own delivery. The wings are freed first and then the legs. While still attached to the umbilical cord, it climbs down over the mother's pelage, searches for a nipple and attaches firmly with its milk-teeth. Only then is the placenta delivered and eaten. The baby remains attached to its mother for ca. 16 days and is carried when she forages. Later, juveniles are left in the day-roost, in clusters of other juveniles.

**Reproduction** Litter-size one (n = 13). Births have been observed in mid-Oct but no data for other months. Elsewhere: twins have been reported occasionally. Reproduction varies biogeographically – both one birth/year and more than once birth/year have been observed, and the timing of births can be either restricted to one season or aseasonal.

**Conservation** IUCN Category: Least Concern. However, threatened by loss of habitat and likely to be taken from caves for "bushmeat".

**Taxonomic Notes** *Rousettus aegyptiacus* (E. Geoffroy, 1810). Subgenus *Rousettus.* Four subspecies are recognised in Africa. The subspecies in Malawi is *R. a. leachii*.

**Key Reference** Happold, M. (2013h).

**Measurements**
*Rousettus aegyptiacus*

| | |
|---|---|
| FA ( males): | 94.9 (92-98) mm, n = 4 |
| FA (females): | 93.0 (86-98) mm, n = 10 |
| HB (males): | 132.4 (125-140) mm, n = 16 |
| HB (females): | 131 (124-138) mm, n = 19 |
| T (males): | 17.8 (15-22) mm, n = 16 |
| T (females): | 19.1 (16-24) mm, n = 20 |
| E: | 22.0 (19-250 mm, n = 42 |
| Tib: | n. d. |
| HF: | n. d. |
| WT (males): | 132 (88-166) g, n = 11 |
| WT (females): | 128.9 (108-166) g, n = 20 |
| GLS (males): | 43 mm, n = 1 |
| GLS (females): | 41.8 (40.2-42.9) mm, n = 8 |

Malawi, Tanzania, Zambia and Zimbabwe (Bergmans 1994, M. Happold *unpubl*.).

## *Rousettus lanosus*

## Long-haired Rousette

**Malawian name** Lichinji, Mleme.
Not confined to this species.

**Description** Small to medium-sized, brown fruit bat with no basal ear patches, no epaulettes; no ruff of coarse hair around the throat; no webbing between the toes. Sexes similar. Pelage shaggy, slightly coarse, underfur woolly; dorsal pelage extending over the tibiae. Dorsal pelage medium to dark greyish-brown to dark rusty-brown, sometimes with scattered paler hairs; hairs unicoloured. Ventral pelage slightly paler, sometimes with more scattered paler hairs. Adult males with longer, slightly stiffer hairs on neck and throat, but no conspicuous ruff of coarse hairs (cf. *Myonycteris*). Head without markings; muzzle long; lips and cheeks not very expansible. Ears naked, dark brown. Eyes blackish. Wing-membranes dark brown, attaching to second toe or occasionally between first and second toes. Dorsal surface of tibiae well furred (cf. *R. aegyptiacus*). Tail protruding up to 16 mm beyond interfemoral membrane.

**Similar Species**

*Rousettus aegyptiacus*. Dorsal pelage shorter, sleek; wing usually attaching to first toe (occasionally between first and second toes); tibiae dorsally practically naked.

*Myonycteris angolensis.* Usually smaller (FA: 68-90 mm). Ruff of coarse hairs in adult males; toes partly webbed.

**Distribution** In Malawi, only recorded from the Misuku-Mughese Mission (at up to 1900 m) and Nkhata Bay(ca. 500 m). These localities are at the most southerly limit of the known biogeographic range of this species. Elsewhere: found mainly in the Afromontane-Afroalpine areas of SW Ethiopia, S Sudan, E DR Congo, Rwanda, Uganda, Kenya and Tanzania.

**Habitat**

In Malawi, miombo woodland with several mountainous elevations with montane evergreen forest (Misuku-Mughesi Mission); and undifferentiated woodland (Nkhata Bay). Elsewhere: Long-haired Rousettes occur from 500-4000 m, but most locality records (72%) are between 1500-2500 m, indicating that this species is mainly, but not strictly, montane.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain.

**Habits** There is no information from Malawi. Elsewhere: like Egyptian Rousettes, these fruit bats roost during the day in caves and mine adits, sometimes in dimly lit areas and sometimes in total darkness, and it is probable that they also echolocate using clicks produced in the mouth. The fragility of the skull, and comparative weakness of the dentition, suggests that the Long-haired Rousettes eat very soft fruits, nectar and perhaps pollen. In Rwanda, a bat believed to be a Long-haired Rousette was seen feeding on a flower of *Lobelia gibberosa* at ca. 2900 m. These fruit bats roost in groups of up to several hundred individuals and, as they are known to exploit caves at high altitudes, they probably have to huddle together in clusters to maintain their body temperatures.

**Reproduction** No information for Malawi. Elsewhere: litter-size 1 (n = 1); no other conclusive information.

**Conservation** IUCN Category: Least Concern. However, threatened by habitat destruction and overharvesting for "bushmeat".

**Taxonomic Notes** *Rousettus lanosus* Thomas, 1906. Subgenus *Stenonycteris.* Two subspecies have been described but their validity is dubious. Not listed by Sweeney (1959), Happold *et al.* (1987) and Ansell & Dowsett (1988).

**Key Reference** Happold, M. (2013i)

**Measurements**
*Rousettus lanosus*

| | |
|---|---|
| FA: | 90 (85-95) mm, n = 71 |
| HB: | 145.0 (114-173) mm, n = 6 |
| T: | 19.7 (9-25) mm, n = 30 |
| E: | 21.7 (19-25) mm, n = 33 |
| Tib: | n. d. |
| HF: | n. d. |
| WT: | 118.8 (94-162) g, n = 31 |
| GLS: | 42.3 (39.4-44.8) mm, n = 62 |

Throughout biogeographic range (NHMUK, NMK, ROM, Bergmans 1994).

## FAMILY RHINOLOPHIDAE – Horseshoe Bats

Horseshoe Bats are so called because they have a conspicuous noseleaf with a wide anterior component which resembles the underneath of a horse's hoof, and a posterior component which is roughly triangular with an erect tip. The ears are short and leaf-shaped and do not have a conspicuous tragus. The tail is more-or-less completely enclosed by the interfemoral membrane. Some species have two colour phases – a grey-phase (when the pelage is greyish or brownish) and an orange-phase (when the pelage is orange). Because the premaxillae of the skulls are often lost during preparation, CrnC (cranio-canine length) is used instead of GSL. CrnC is the distance from the most posterior part of the skull to the front of the upper canines.

Horseshoe Bats echolocate by emitting CF calls which have a long constant frequency component, and they exploit the Doppler effect to detect moths and other insects that are fluttering their wings. Their wings have low to very low aspect ratios, and these bats have low to very low wing-loadings, so they can fly slowly with considerable manoeuvrability. They can hover briefly and take off from the ground. They cannot scuttle or climb. Most roost during the day in dark caves or cave-like day-roost, and they either hang freely from the ceilings or hang in contact with the sides.

All bats in this family belong to the genus *Rhinolophus.*

### Genus *Rhinolophus* - Horseshoe Bats

Eight species occur in Malawi. Important diagnostic characters include:

Lancet - the erect posterior component of the noseleaf. It can be subtriangular (i.e. roughly triangular) with sides that are either almost straight or slightly concave and a tip which is either rounded or bluntly-pointed, or hastate (arrow-shaped) with a wide base and relatively longer concave sides that taper to a bluntly-pointed tip.

Sella - the transverse structure arising immediately above the horseshoe component of the noseleaf. The front-facing surface can be naked or hairy, and its sides can be parallel, slightly concave or distinctly concave.

Connecting process - the longitudinal structure arising from the central component of the noseleaf. It can be rounded, subtriangular, or rising to a high pointed horn.

Lateral leaflets – narrow leaflets situated below the horseshoe component of the noseleaf. Present or absent.

Axillary tuft – a tuft of hairs in each armpit of an adult male. Present or absent.

NL (breadth) - Greatest breadth of the horseshoe - the anterior part of the noseleaf.

FA - Length of the forearm.

Premolar teeth. The anterior premolar may be present or absent. If present, it may lie in the toothrow (so the canine and posterior premolar are not in contact) or it may be displaced to the outside (lip side) of the toothrow (so the canine and posterior premolar are in contact or nearly so).

CF-frequency. The frequency of the constant frequency component of the echolocation call. A useful character (not given in profiles) if one has a suitable bat-detector. In the yellow box below, data are from Malawi unless stated otherwise.

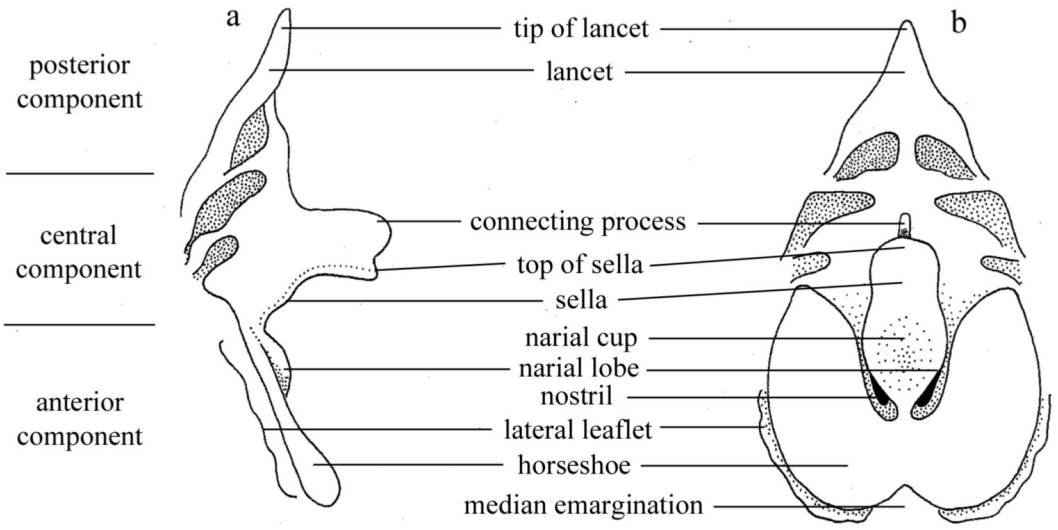



Fig. 11. (a) Lateral and (b) frontal views of a noseleaf of a horseshoe bat, *Rhinolophus*, showing the components as defined and referred to in the profiles of *Rhinolophus* spp.

*R. swinnyi*. FA: 41.7 (40-44) mm. Connecting process rounded, about same height as sella. Sella: narrowest part 1.2-1.3 mm. Known only from Ntchisi Mountain. CF frequency: 102-104 kHz.

*R. simulator*. FA: 44.6 (43-46) mm. Connecting process rounded, about same height as sella. Sella: narrowest part 1.4-1.8 mm. Anterior upper premolar within toothrow. Widespread. CF frequency: 84-86 kHz.

*R. blasii*. FA: 46.6 (43-47) mm. Connecting process rising to high, narrow, pointed horn. Adult males without axillary tufts. First phalanx of fourth finger relatively long (26 [24-28]% of fourth metacarpal). Anterior upper premolar within toothrow. CF-frequency 91-95 kHz.

*R. landeri*. FA: 47.0 (46-49) mm. Connecting process: subtriangular with tip either sharply or bluntly pointed. Adult males with reddish or reddish-brown axillary tufts. Horseshoe without lateral leaflets. Anterior upper premolar within toothrow. CF-frequency: no data from Malawi.

*R. darlingi*. FA: 48.6 (45-51) mm. Tibia 20-22 mm. Connecting process smoothly rounded, about same height as sella or slightly lower. Sella naked. Adult males without axillary tufts. Horseshoe with lateral leaflets. Anterior upper premolar outside toothrow or absent. CF-frequency (eSwatini): 86 kHz.

*R. clivosus*. FA: 53.2 (49-58) mm. Tibia: 21-27 mm. Connecting process: rounded but sometimes smoothly curved and sometimes slightly angular; slightly to clearly higher than sella. Sella naked. Adult males without axillary tufts. Horseshoe with lateral leaflets but they are sometimes rudimentary. Anterior upper premolar outside toothrow or absent. CF-frequency: 79-84 kHz.

*R. fumigatus*. FA: 52.4 (50-61) mm. Tibia: 20-25 mm. Connecting process: large, rounded, not higher than sella. Sella hairy. Anterior upper premolar outside toothrow or absent. CF-frequency: 55-58 kHz.

*R. hildebrandtii*. FA: 63.7 (60-68) mm. Tibia: 26-31 mm. Sella: hairy. Anterior upper premolar outside toothrow or absent. CF-frequency 35-38 kHz and 47-48 kHz.

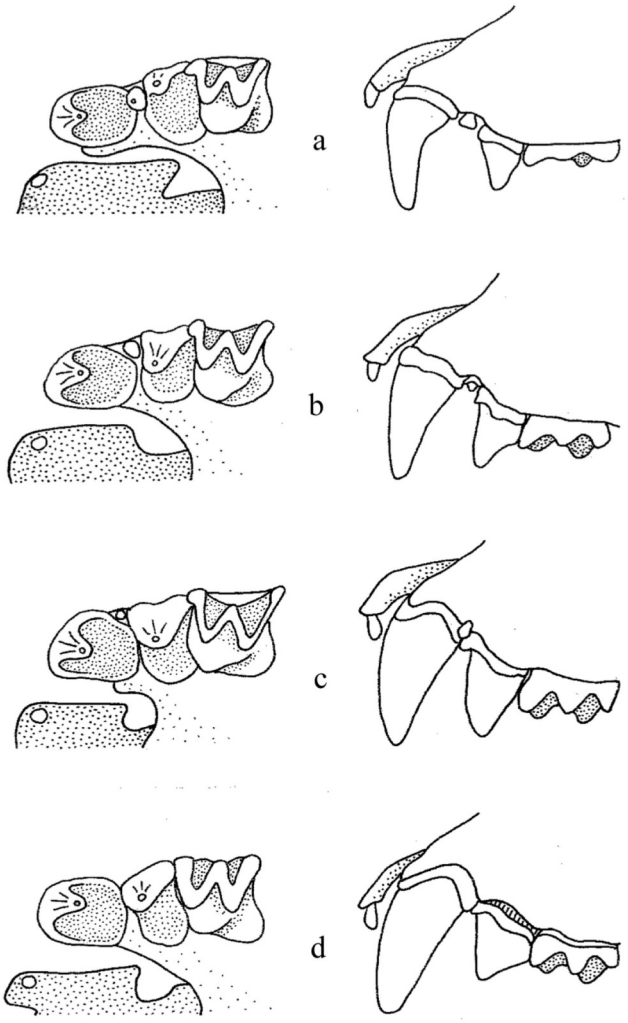



Fig. 12. Variations in the size and position of the upper premolars in Malawian horseshoe bats, *Rhinolophus*. Left: occlusal views of teeth on left side of upper jaw. Right: lateral views of labial (outer) side of the same teeth. The anterior upper premolar can be (a) within the toothrow so canine and posterior premolar are well separated, (b) partly displaced labially so canine and posterior premolar are almost in contact, (c) fully displaced labially so canine and posterior premolar are in contact, or (d) absent. The labial side is the side nearest the cheeks.

## *Rhinolophus blasii*

## Blasius's Horseshoe Bat (Peak-saddle Horseshoe Bat)

**Malawian Names** Liputiputi, Ndemiya, Namzeze.

Same for other microbats.

Zomba, Malawi © DCD & M. Happold

**Description** Small microbat with round, fluffy body; noseleaf (posterior component subtriangular with erect tip); small for a horseshoe bat. Sexes similar. Pelage dense, soft, fluffy. Dorsal pelage greyish-fawn to brownish-grey; hairs pale greyish-fawn or pale brownish-grey, with darker tip. Ventral pelage considerably paler. Only one individual in orange-phase has been recorded. No axillary tufts on adult males. Noseleaf with lancet subtriangular with slightly concave sides (sometimes hastate), tip rounded. Connecting process well developed, rising to high, narrow, pointed horn. Sella naked, wedge-shaped with sides converging towards top; top narrow and tilted forward. Horseshoe narrow (7.2 - 9.0 mm), not covering whole muzzle; lateral leaflets present; median emargination present but indistinct. Wings and interfemoral membrane dark greyish-brown. First phalanx of fourth finger relatively long (26 [24-28]% of fourth metacarpal) (cf. *R. landeri*). Anterior upper premolar tooth within the toothrow; posterior premolar not in contact with the canine.

**Similar Species**

*R. landeri.* Horseshoe narrower (6.0 - 8.0 mm). First phalanx of fourth finger relatively short (19-23% of metacarpal). Axillary tufts present in males.

**Distribution** Widely distributed in Malawi, mainly in woodland and montane habitats on or near mountains, from the High Plateaux of the Northern Region, to Dedza (near Dedza Mountain), the Shire Highlands and the base of Mulanje Mountain. Altitudes 500-2300 m. Recorded from Blantyre, Dedza, near Lake Malombe, Likhubula, Liwonde, Liwonde N. P., Misuku Hills, Mulanje F. R. (at 1200 m), Namadzi District, Nkhotakota G. R., Ntcheu, Ntchisi Mountain F. R. (rest house and Ntchisi Mountain), Nyika N. P. (Juniper Forest), Thondwe District, Thyolo District, Thyolo Mountain, Tinyadi Estate at base of Mulanje Mountain, South Viphya Plateau, Wilindi Forest, Zoa Tea Estate, Zomba and Zomba Plateau. Elsewhere: recorded from three isolated regions – in NW Africa, in Ethiopia and Somalia, and in south-central and southern Africa (from SE DR Congo and Tanzania, and southwards to NE South Africa). Also occurs in southern Europe and SW Asia.

**Habitat** Montane evergreen forest, juniper forest, lowland rainforest, miombo woodland (sometimes with baobabs and rocky inselbergs or hills), ornamental gardens with large trees, and farmlands with remnant miombo woodland and riverine forest.

**Abundance** Very commonly-recorded in Malawi. Elsewhere: uncertain.

**Habits** Blasius's Horseshoe Bats have been found during the day in caves, mine-adits and cave-like spaces under boulders. In South Africa, they hibernate in caves during the winter. At ambient temperatures of 21-24°C, they become torpid during the day. They cannot conserve water by producing concentrated urine; two captive bats under observation for one night drank five times, either by landing to lap water from a saucer or by scooping mouthfuls of water while in flight. They undoubtedly need to drink in the wild. These bats sometimes fly slowly with shallow wing-beats and some gliding, but they can also put on bursts of speed with sudden turns. They fly with great manoeuvrability, can take off from the ground and can hover briefly. They forage by slow-hawking, fly-catching from a perch, and by gleaning from foliage or from the ground. They forage along hedges and banks of vegetation, along pathways through dense vegetation, under tree-canopies in relatively uncluttered spaces and within canopies in dense clutter, close to buildings and

sometimes over grassy clearings. Foraging is often within 1-2 m of the ground but can be at least as high as ca. 6 m above ground. In Zambia, analysis of stomach contents indicated that the dry season diet was 100% moths and the wet season diet was 96.5% moths with some termites, flies, beetles and other insects. Very little is known about their social and reproductive behaviour. In southern Africa, they roost singly or in clusters of three or four with the individuals hanging apart. In Malawi, they often forage in groups of up to six. The composition of groups is variable and there is no clear evidence of harem formation from the very limited data available.

**Reproduction** Litter-size: 1 (n = 6). Females give birth, once/year, in the wet season (Nov to Jan), and lactate for approximately one month. Elsewhere: no conclusive information.

**Conservation** IUCN Category: Least Concern. The global population is large but although some populations are stable, others are declining. Probably stable in Malawi.

**Taxonomic Notes** *Rhinolophus blasii* Peters, 1867. Three subspecies. The subspecies in Malawi is *R. b. empusa*.

**Key Reference** Happold, M. (2013j).

**Measurements**
*Rhinolophus blasii*

| | |
|---|---|
| FA: | 46.6 (43-47) mm, n = 127 |
| TL: | 78.0 (75-81) mm, n = 25 |
| T: | 25.6 (20-28) mm, n = 25 |
| E: | 18.2 (16-20) mm, n = 36 |
| NL(breadth): | 8.1 (8.0-8.5) mm, n = 50 |
| Tib: | 19.3 (18-21) mm, n = 41* |
| HF: | 9.6 (8.5-11) mm, n = 40 |
| WT: | 8.8 (7-13) g, n = 165 |
| CrnC: | 19.0 (17.9-20.0) mm, n = 47* |

Malawi (Happold *et al.* 1987).
*Throughout African biogeographic range (Happold, M. 2013j).

## *Rhinolophus clivosus*

## Geoffroy's Horseshoe Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Zomba, Malawi © DCD & M. Happold

**Description.** Small microbat with round, fluffy body; noseleaf (posterior component subtriangular with erect tip); medium-sized for a horseshoe bat. Sexes similar. Pelage long, dense, very soft, fluffy. Dorsal pelage greyish-fawn to brownish-grey; hairs pale usually with darker tip. Ventral pelage beige to pale grey. Individuals in orange-phase have been recorded. No axillary tufts on adult males. Noseleaf with lancet hastate; tip rounded. Connecting process rounded but sometimes smoothly curved and sometimes slightly angular; slightly to clearly higher than sella. Sella naked, narrow, with concave sides: top broad and rounded. Horseshoe narrow-medium (7.9 - 9.6 mm), not covering whole muzzle; lateral leaflets present but sometimes rudimentary; median emargination is a shallow to moderately deep notch. Wings and interfemoral membrane dark grey. Anterior upper premolar tooth displaced outside the toothrow or absent; posterior premolar in contact with canine.

**Similar Species**

*Rhinolophus darlingi.* FA often shorter (47 [42-51] mm). Dorsal pelage greyer.

**Distribution** Widespread in Malawi at altitudes from <100-2300 m. Recorded from Chiromo, Chitipa, Chongoni F. R, Dzalanyama F. R., Kalimbuka, Lengwe N. P., Likhubula River, Liwonde N. P., Misuku-Mughese Mission, Mughese Forest, Mzuzu, Ntcheu, Ntchisi Mountain F. R. (rest house and Ntchisi Mountain), Nyika N. P. (Juniper Forest), Thyolo District, Zomba and Zomba Plateau. Elsewhere: distributed apparently very disjunctly from Algeria to Egypt and southwards through most countries on the eastern side of Africa to South Africa (except Tanzania). Also recorded from SW DR Congo, SW Angola and W Namibia.

**Habitat** Montane evergreen forest, juniper forest, closed canopy and open canopy miombo woodland (sometimes with baobabs and/or rocky inselbergs), riverine forest, thicket savanna with baobabs, ornamental gardens with large trees, and farmlands with remnant miombo woodland and/or riverine forest. At Zomba, found where there are rocky hills with caves under boulders.

**Abundance** Uncommonly-recorded in Malawi. Reported to be common in South Africa and locally abundant in Rwanda.

**Habits** Geoffroy's Horseshoe Bats roost during the day in caves (including those under boulders), abandoned mines and other cave-like places, and also in hollow baobabs. They hang freely from the ceilings or in contact with the walls. In Malawi, they become torpid during the day at ambient temperatures of 21-24°C. In South Africa, they hibernate for prolonged periods and are known to move as much as 10 km from cave to cave. They cannot conserve water by producing concentrated urine and are probably dependent on water for drinking in the wild. They forage by slow-hawking under canopies of trees and along banks of vegetation, and also by fly-catching and probably also by gleaning. Individuals hang from perches to eat, and these are marked by accumulations of discarded fragments of insects. In South Africa, these included fragments of moths and small beetles. In Malawi, they have been found roosting singly or in small groups. Group members hang slightly apart in clusters. Roosts usually contain individuals of both sexes, even when young are present,

but these data are too limited to reveal much about the social and reproductive behaviour of this species.

**Reproduction** Litter-size: 1 (n = 3). No other conclusive information for Malawi. Elsewhere: litter-size: 1. In Zimbabwe, mating takes place in the dry season and females give birth once/year at the beginning of the wet season in mid-Nov.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Rhinolophus clivosus* Cretzshmar, 1828. Six subspecies are recognised in Africa. The subspecies in Malawi is *R. c. augur*.

**Key Reference** Bernard & Happold (2013a).

**Measurements**
*Rhinolophus clivosus*

| | |
|---|---|
| FA: | 53.2 (49-58) mm, n = 41 |
| TL: | 90.7 (75-106) mm, n = 33 |
| T: | 31.4 (20-38) mm, n = 33 |
| E: | 21.1 (19-24) mm, n = 36 |
| NL(breadth): | 8.7 (7.9-9.6) mm, n = 15 |
| Tib: | 23.1 (21-27) mm, n = 24 |
| HF: | 11.4 (9-12) mm, n = 7 |
| WT: | 14.2 (10-19) g, n = 26 |
| CrnC: | 20.7 (18.1-22.8) mm, n = 57* |

Malawi, Tanzania, Zambia, Mozambique, Zimbabwe.
*Throughout biogeographic range (Csorba *et al.* 2003).

## *Rhinolophus darlingi*

## Darling's Horseshoe Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Limpopo Province, South Africa © C. & M. Stuart

**Description** Small microbat with round, fluffy body; noseleaf (posterior component subtriangular with erect tip); medium-sized for an African horseshoe bat. Sexes similar. Pelage soft, fluffy. Dorsal pelage grey, brownish-grey or greyish-brown; hairs cream or pale greyish-brown with grey, brownish-grey or greyish-brown tip. Ventral pelage paler, often pale grey. Individuals in orange-phase have not been recorded. No axillary tufts on adult males. Noseleaf with lancet large, subtriangular, sides slightly concave: tip bluntly pointed. Connecting process smoothly rounded, about same height as sella or slightly lower. Sella naked, sides concave, top broad and rounded. Horseshoe narrow (7.1-8.7 mm) but almost covering whole muzzle; lateral leaflets present; median emargination deep. Wings and interfemoral membrane translucent grey to black. Anterior upper premolar tooth displaced outside the toothrow or absent; posterior premolar in contact with the canine.

**Similar Species**

*Rhinolophus clivosus*. FA often longer (51.5 [42-59] mm). Dorsal pelage browner.

**Distribution** Recorded only from the Lake Shore (480 m) at Mangochi and the Phalombe Plain at the base of Mulanje Mountain (ca. 750 m) at Likhubula (CCAP Mission). Elsewhere: mainly recorded from Zimbabwe and N South Africa, with isolated records from Nigeria, N Tanzania, Angola, Namibia, Botswana and Mozambique.

**Habitat** No details available for Mangochi. Likhubula has miombo woodland and riverine forest.

**Abundance** Rarely-recorded. Elsewhere: apparently rare north of Zambezi R. but locally common near day-roosts in Zimbabwe, Namibia and South Africa.

**Habits** The day-roosts of Darling's Horseshoe Bats in Malawi are not known but elsewhere in southern Africa they have been found in caves, abandoned mine-adits, cavities and fissures in rock or in piles of boulders, large hollow trees, disused buildings (including under the floors of disused houses). They hang freely from the ceilings of these roosts. At least some roosts are dimly lit. In Zimbabwe, they enter torpor daily during the cool-dry season. Their flight is predictably similar to that of other horseshoe bats. Their diet and foraging habits are not known but, based on their wing-morphology and echolocation calls, they are predicted to forage in cluttered habitats. They usually roost in groups of "dozens of individuals", and in groups of 2-15; larger groups of about 20 (and about 160) have also been recorded. Group-members hang in clusters but without actually touching each other.

**Reproduction** No information for Malawi. Elsewhere: litter-size: usually 1; twins were recorded once in Zimbabwe. Data from Zimbabwe and South Africa suggest females give birth once/year.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Rhinolophus darlingi* K. Andersen, 1905. Two subspecies. The subspecies in Malawi is *R. d. darlingi*.

**Key Reference** Cotterill & Happold (2013a).

**Measurements**
*Rhinolophus darlingi*

| | |
|---|---|
| FA: | 48.6 (45-51) mm, n = 18 |
| TL: | 89.8 (83-96) mm, n = 12 |
| T: | 29.7 (26-34) mm, n = 12 |
| E: | 20.6 (20-22) mm, n = 11 |
| NL (breadth): | 8.1 (7.9-8.7) mm, n = 15 |
| Tib: | 20.9 (20-22) mm, n = 17 |
| HF: | n. d. |
| WT: | 12.3 (10-14) g, n = 10 |
| CrnC: | 19.3 (18.4-20.5) mm, n = 15* |

Zimbabwe and South Africa (Cotterill & Happold 2013a).
*Throughout biogeographic range (Csorba *et al.* 2003).

## *Rhinolophus fumigatus*

## Rüppell's Horseshoe Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Description** Small microbat with round, fluffy body; noseleaf (posterior component subtriangular with erect tip); medium to fairly large for an African horseshoe bat. Sexes similar. Pelage fairly long, dense, soft, fluffy. Dorsal pelage grey to greyish-brown; hairs greyish-fawn to pale greyish-brown, darker at tip. Ventral pelage slightly paler. Orange-phase has not been recorded. Adult males without axillary tufts. Noseleaf with lancet subtriangular, sides slightly concave, tip rounded. Connecting process large, rounded, not higher than sella. Sella liberally covered with longish hairs, broad, sides slightly concave or almost parallel; top broad and rounded. Horseshoe of medium breadth 10.0-11.5 mm; almost covering muzzle; lateral leaflets present; median emargination a distinct notch. Wings and interfemoral membrane dark grey to dark brown. Anterior upper premolar tooth displaced outside the toothrow or absent; posterior premolar in contact with canine.

**Similar Species**

*R. hildebrandtii*. Forearm larger (60-67 mm); tibia 26-31 mm.

**Distribution** Mostly recorded in the southern half of the country - at the southern edge of the Central Plateau, in the southern Lake Shore, Upper Shire Valley and Shire Highlands, but with some records elsewhere. Altitudes range from 480-1500 m. Recorded from Chileka, Chongoni F. R., Dzalanyama F. R., Lake Kaulime, Lake Malawi N. P., Likhubula, Liwonde N. P., Lunzu, Mwabve W. R., Namadzi District, Namazo Bay, Nchisi Mountain F. R., Thondwe District and Zomba. Elsewhere: *R. f. exsul* occurs in eastern Africa from C Sudan, S Ethiopia, E Uganda, Kenya and Tanzania, meaning that Malawi is at the southern edge of the biogeographic range of this subspecies.

**Habitat** Open and closed canopy miombo woodlands and other woodlands (sometimes with baobabs, often with rocky hills), ornamental gardens with large trees, and farmlands with remnant miombo woodland and riverine forest (and sometimes rocky hills).

**Abundance** Commonly-recorded in Malawi. Elsewhere: rare in Zimbabwe.

**Habits** Rüppell's Horseshoe Bats roost during the day in caves under piles of boulders near Zomba and, in southern Africa they have been found in caves, mine-adits and hollow baobab trees. They roost in complete darkness or in dimly lit places and hang freely with their bodies completely enclosed by their wings. In Malawi, they become torpid during the day at ambient temperatures of 21-24°C and do likewise in caves in Namibia. They cannot conserve water by producing concentrated urine and individuals offered water twice/day usually drank every time. The flight of these bats is highly manoeuvrable and varies in speed. They can take off from the ground but probably cannot hover. They forage by slow-hawking and fly-catching and probably also by gleaning. They fly-catch from a perch. In South Africa, their diet includes small to medium-sized beetles, moths and other insects. They roost singly or in small to very large groups. In Malawi, groups of 10-15 individuals have been observed. Rarely more than ten have been seen roosting together in Zimbabwe, but groups of 25-500 have been reported in Namibia. Group members hang in close contact with their

neighbours. Some samples taken from groups in Malawi contained only pregnant and/or lactating females which suggests that these bats establish maternity colonies.

**Reproduction** Litter-size: 1 (n = 9). In Malawi (and also in Zimbabwe) females probably give birth once/year at the beginning of the wet season (Nov-Dec).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Rhinolophus fumigatus* Rüppell, 1842. Six forms have been treated as subspecies but their status is uncertain. The subspecies in Malawi is *R. f. exsul*. Not listed by Sweeney (1959).

**Measurements**
*Rhinolophus fumigatus*

| | |
|---|---|
| FA: | 52.4 (50-61) mm, n = 36 |
| TL: | 92.3 (80-108) mm, n = 19 |
| T: | 29.1 (24-36) mm, n = 19 |
| E: | 24.4 (21-28) mm, n = 22 |
| NL (breadth): | 10.2 (10.0-11.5) mm, n = 19 |
| Tib: | 22.3 (20-25) mm, n = 24 |
| HF: | 13.1 (11-14) mm, n = 8 |
| WT: | 14.7 (11-21) g, n = 25 |
| CrnC: | 22.7 (21.6-24.3) mm, n = 60* |

Malawi, Tanzania, South Africa (HC, HZM, NHMUK, NMZB).
*Throughout biogeographic range (Csorba *et al.* (2003).

## *Rhinolophus hildebrandtii*

## Hildebrandt's Horseshoe Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.


Zomba, Malawi © DCD & M. Happold

**Description** Medium-sized microbat with compact fluffy body; noseleaf (posterior component subtriangular with erect tip); large for a horseshoe bat. Sexes similar. Pelage fairly long, dense, soft, fluffy. Dorsal pelage greyish-fawn to greyish-brown, sometimes suffused with cinnamon; hairs greyish-fawn to greyish-brown, darker at tip. Ventral pelage slightly paler than dorsal, sometimes silvery. No orange-phase. No axillary tufts on adult males. Noseleaf with lancet long, subtriangular, sides straight or slightly concave; tip rounded. Connecting process rounded, not higher than sella. Sella liberally covered with longish hairs, sides concave near base, parallel above, top broad and rounded. Horseshoe broad (12-15 mm), covering muzzle; lateral leaflets present; median emargination a distinct notch. Wings and interfemoral membrane dark greyish-brown. Anterior upper premolar tooth displaced outside the toothrow or absent; posterior premolar in contact with canine or almost so.

**Similar Species**
*R. fumigatus*. Smaller (FA: 47-61 mm; tibia: 19-24).

**Distribution**. Fairly widespread in Malawi at altitudes of <100 m to ca. 1500 m. Recorded from Chiromo, Kasungu, Liwonde N. P. (Southern Entrance Area), Mangochi, Misuku Hills, Mtimbuka, Mughese Forest, Mulanji-Chitakali, Namadzi District, Ntcheu, Nkhotakota G. R. (Chipata Camp), Ntchisi Mountain F. R. (rest house), Tembuku, Zomba and Zomba Plateau. Elsewhere: uncertain (see Taxonomic Notes).

**Habitat** Montane evergreen forest, open and closed canopy miombo woodlands (sometimes with baobabs), other woodlands, riverine forest, ornamental gardens with large trees, and farmland with remnant miombo and riverine forest. Some habitats are near rocky hills with boulder caves.

**Abundance** Uncommonly-recorded in Malawi. Elsewhere: no information.

**Habits** There is no information about where these bats roost during the day in Malawi. They become torpid during the day at ambient temperatures of 21-24°C. They can produce moderately concentrated urine but captive individuals drank regularly every day, so they are probably dependent on water for drinking in the wild. Their flight is very variable in speed, highly manoeuvrable and looks weak and fluttering. They can take off from the ground and probably can almost hover. They forage by perch-hunting and by slow-hawking under canopies of trees (either just above the ground or just above under-storey vegetation) or close to the outsides of canopies, and near buildings. There is no information about the social and reproductive behaviour of these bats in Malawi.

**Reproduction** No information for Malawi. Elsewhere: in Zimbabwe, litter-size: 1 (n = 17). Females give birth once/year at end of Oct (beginning of wet season) and lactate for at least three months.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Rhinolophus hildebrandii* Peters, 1878. Recently, four new species have been described from material formerly identified as *R. hildebrandtii* and *R. eloquens* from Zimbabwe, Mozambique and South Africa (Taylor, Stoffberg *et al.* (2012). Two of the new species were thought to occur in Malawi. However, these conclusions have been challenged and, pending resolution, we retain all large *Rhinolophus* from Malawi in *R. hildebrandtii*.

**Key Reference** Cotterill & Happold (2013b).

**Measurements**
*Rhinolophus hildebrandtii*

| | |
|---|---|
| FA: | 63.7 (60-68) mm, n = 16 |
| TL: | 111.7 (110-120) mm, n = 10 |
| T: | 36.16 (32-42) mm, n = 10 |
| E: | 33.4 (31-37) mm, n = 8 |
| NL (breadth): | 13.8 (12-15) mm, n = 12 |
| Tib: | 28.3 (26-31) mm, n = 11 |
| HF: | 14.1 (12-16) mm, n = 12 |
| WT: | 23.8 (20-26) g, n = 14 |
| CrnC: | 27.4 (26.1-28.7) mm, n = 44* |

Malawi.
*Throughout biogeographic range (Csorba *et al.* 2003).

## *Rhinolophus landeri*

## Lander's Horseshoe Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

**Description** Small microbat with round, fluffy body; noseleaf (posterior component subtriangular with erect tip); small for a horseshoe bat. Sexes similar. Pelage dense, soft, fluffy. Dorsal pelage greyish-fawn to greyish-brown; hairs pale greyish-fawn or pale brownish-grey with darker tip. Ventral pelage slightly paler. In orange-phase, dorsal pelage golden-brown, orange-cinnamon to bright rusty-red. Adult males with reddish or reddish-brown axillary tufts which are sometimes sticky with yellow secretion. Noseleaf with lancet hastate, tip bluntly pointed. Connecting process subtriangular with tip either sharply or bluntly pointed. Sella naked, narrow with slightly concave sides, top broad and rounded. Horseshoe narrow (6.8-8.3 mm) covering whole muzzle; no lateral leaflets; median emargination a distinct notch. Wings and interfemoral membrane dark greyish-brown to blackish-brown (grey-phase) or brown (orange-phase). First phalanx of fourth finger relatively short (21 [19-23] % of fourth metacarpal) (cf. *R. blasii)*. Anterior upper premolar tooth within toothrow; posterior premolar not in contact with canine.

**Similar Species**

*R. blasii*. Horseshoe wider (8.0-8.5 mm); connecting process rising to high horn. First phalanx of fourth finger relatively long (25.8 [24-28]% of fourth metacarpal. No axillary tufts.

**Distribution** Known from the Central Plateau and Lower Shire Valley at altitudes of <100 m to ca. 1500 m. Recorded from Chiromo, Ntcheu and Ntchisi Mountain F. R. Elsewhere: Sudan and Ethiopia and southwards to the former Transvaal and KwaZulu-Natal in South Africa.

**Habitat** Miombo woodland (sometimes with baobabs), and riverine forest.

**Abundance** Seldom-recorded in Malawi. Elsewhere: uncertain.

**Habits** Very little is known about Lander's Horseshoe Bats in Malawi. During the day, they have been found hanging freely from the roof in grass-roofed buildings, and in holes in the ground. Elsewhere: in southern Africa, they have been found in hollow baobabs, caves, mine-adits and piles of boulders. They have a low aspect ratio and very low wing-loading, and they can fly slowly with bursts of speed and great manoeuvrability. They can take off from the ground and can hover briefly. They have been observed foraging by slow-hawking within two metres of the ground in savanna in Kenya. Predictably, they also fly-catch and glean. In Zimbabwe, the remains of about 60 insects found under a roost included 92% moths, one butterfly and several Orthoptera. In southern Africa, they roost singly or in groups of less than 12, and group-members hang in clusters but without touching each other.

**Reproduction** No information for Malawi and no conclusive data for *R. l. lobatus* from elsewhere. One pregnant female, with one foetus, was taken in October in Zimbabwe.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Rhinolophus landeri* Martin, 1838. Three subspecies. Of these, *R. l. lobatus* occurs from Sudan and Ethiopia southwards (through Malawi) to the former Transvaal in South Africa. Some authors consider *lobatus* to be a distinct species.

**Key References** Happold, M. (2013k).

**Measurements**
*Rhinolophus landeri*

| | |
|---|---|
| FA: | 47.0 (46-49) mm, n = 9 |
| TL: | 82.5 (79-87) mm, n = 9 |
| T: | 26.4 (23-31) mm, n = 9 |
| E: | 19.0 (17-20) mm, n = 9 |
| NL(breadth): | 7.5 (6.6-8.3) mm, n = 9 |
| Tib: | n. d. |
| HF: | 6.9 (6-8) mm, n = 9 |
| WT: | 7.5 (7-9) g, n = 9 |
| CrnC: | 16.4 (16.2-16.5) mm, n = 9 |

Chihalatan and Malashane Caves, Mozambique (Taylor, Macdonald *et al.* (2018) as *R. lobatus.*

## *Rhinolophus simulator*

## Bushveld Horseshoe Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

**Description** Small microbat with round, fluffy body; noseleaf (posterior component subtriangular with erect tip); medium-small for an African horseshoe bat. Sexes similar. Pelage long, dense, very soft, fluffy. Dorsal pelage greyish-fawn to brownish-grey; sometimes yellowish; hairs with paler base. Ventral pelage notably paler, sometimes whitish. Orange-phase not known. No axillary tufts on adult males. Noseleaf with lancet subtriangular with sides hastate. Connecting process rounded, about same height as sella. Sella naked, sides almost parallel or slightly concave; narrowest part 1.4-1.8 mm (0.1 - 0.2 mm broader before preservation), (cf. *R. swinnyi).* Lobes at base of sella comparatively well-developed (cf. *R. swinnyi*). Horseshoe narrow (6.7–9.0 mm); lateral leaflets very indistinct; anterior margination a deep notch. Wings dark brown to dark greyish-brown, darker near body; interfemoral membrane almost black. Anterior upper premolar tooth within toothrow; posterior premolar and canine well separated.

**Similar Species**

*Rhinolophus swinnyi*. Ears on average shorter (17 [15 - 20] mm). Sella narrower (narrowest part 1.2-1.3 mm); lobes at base of sella low.

**Distribution** Known from the Nyika Plateau, Shire Highlands, Phalombe Plain and Upper Shire Valley at altitudes of 500-2300 m. Recorded from Liwonde N. P., Mulanji, Namadzi District, Nyika N. P. (Nganda), Thondwe District, Zomba and Zomba District. Elsewhere: *R. s. alticola* occurs in Guinea, Liberia, Nigeria and Cameroun; *R. s. simulator* occurs in eastern Africa from Ethiopia to KwaZulu-Natal in South Africa.

**Habitat** Open and closed canopy miombo woodland (sometimes with baobabs and/or isolated rocky inselbergs), ornamental gardens with large trees, and farmlands with remnant miombo woodland and riverine woodland, often with large dams, rocky hills and boulder-caves nearby.

**Abundance** Rarely-recorded in Malawi. Locally common in Zimbabwe where colonies of hundreds have been reported.

**Habits** In Malawi, Bushveld Horseshoe Bats roost during the day in caves under piles of boulders, and they seem to roost only in caves and mine-adits elsewhere. In Zimbabwe, they become torpid during the day in the cool-dry season but not in the hot-wet season. They cannot conserve water by producing concentrated urine and are presumably dependent on water for drinking in the wild. They have a low aspect ratio, very low wing-loading and rounded wing-tips. They can fly at variable speeds and displayed greater manoeuvrability in a very confined space than any other species of bat in Malawi. They forage by slow-hawking and, predictably, also by gleaning. In South Africa, they are known to take insects at lights and to come into houses. In Zambia, in the wet season, the stomachs of 34 individuals contained moths (73% by volume), beetles (13%), termites (8%), crickets (5%) and some other insects, and in the dry season, the stomachs of 18 individuals contained moths (87%) and midges (13%). These bats usually roost in colonies of several dozens, but colonies of ca. 150 and ca. 300 individuals have been seen in South Africa. Group-members often hang in clusters but without touching each other, but females with young attached, huddle closely together. A tunnel near Pietermarizburg, South Africa, was occupied by ca. 150 individuals of both sexes throughout most of the year but, in spring, the females migrated to maternity roosts elsewhere and then returned in late summer. The males remained throughout the year.

**Reproduction** No conclusive data for Malawi; one pregnant female with one foetus was recorded in early Nov, and one lactating female in mid-Nov. Elsewhere: in Zambia and Zimbabwe, litter-size: 1 (n = 25). In Zimbabwe, spermatogenesis takes place in the cool dry season (about May), sperm is stored in the males for at least three months, mating begins in late Jun, implantation begins in Jul, and births occur in the wet season (mid-Nov) after gestation of 90-130 days (depending on absence or occurrence of a period of retarded embryonic development). Lactation lasts less than seven weeks.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Rhinolophus simulator* K. Andersen, 1904. Two subspecies. In Malawi (and in eastern Africa from Ethiopia to Natal, South Africa) the subspecies is *R. s. simulator*.

**Key References** Cotterill (1998), Cotterill & Happold (2013c).

**Measurements**
*Rhinolophus simulator*

| | |
|---|---|
| FA: | 44.6 (43-46) mm, n = 7 |
| TL: | 71.4 (65-75) mm, n = 7 |
| T: | 25.8 (24-30) mm, n = 5 |
| E: | 19.8 (18-21) mm, n = 7 |
| NL(breadth): | 7.5 (7.0-8.0) mm, n = 5 |
| Tib: | 18.6 (18-19) mm, n = 7 |
| HF: | 8.4 (8-9) mm, n = 5 |
| WT: | 7.1 (5.4-9.5) g, n = 5 |
| CrnC: | 18.4 (17.3-19.3) mm, n = 60* |

Malawi, Zambia and South Africa (HC, NHMUK, NMZB).
*Throughout biogeographic range (Csorba *et al.* 2003).

## *Rhinolophus swinnyi*

## Swinny's Horseshoe Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

**Description** Very small to small microbat with round, fluffy body; noseleaf (posterior component subtriangular with erect tip); small for an African horseshoe bat. Sexes similar. Pelage long, dense, soft, fluffy. Dorsal pelage (grey-phase) greyish-fawn to brownish-grey; hairs with pale cream at base. Ventral pelage paler, sometimes off-white or cream. In orange-phase, the dorsal pelage is bright orange. No axillary tufts on adult males. Noseleaf with lancet subtriangular with markedly concave sides, sometimes almost hastate; tip bluntly pointed. Connecting process rounded, ca. same height as sella. Sella naked, sides slightly concave, narrowest point 1.2-1.3 mm. Lobes at base of sella comparatively low (cf. *R. simulator*). Horseshoe narrow (6.0 - 7.4 mm), not covering whole muzzle; no lateral leaflets; median emargination a deep notch. Wings and interfemoral membrane brown. Anterior upper premolar tooth within toothrow; posterior premolar and canine well separated.

**Similar Species**
*Rhinolophus simulator*. Sella broader (narrowest part 1.6-1.8 mm); lobes at base of sella higher.

**Distribution** Recorded only from Ntchisi Mountain F. R. (rest house and Ntchisi Mountain) in 1997 where the species identity was confirmed by its echolocation (Happold & Happold 1997). Elsewhere: Tanzania (Morogoro and Zanzibar) and south through Zambia, Zimbabwe and Mozambique to C and N South Africa, with an outlying record at the mouth of the Congo River (but see Taxonomic Notes).

**Habitat** In Malawi, only recorded from a montane evergreen forest and open canopy miombo woodland surrounding this montane forest.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain but not often encountered and probably uncommon.

**Habits** Very little is known about the habits of Swinny's Horseshoe Bats in Malawi. In Zimbabwe, they roost during the day in completely dark places in caves and old mines, where they hang freely from the ceilings. Their flight varies in speed and is highly manoeuvrable; they can take off from the ground and almost hover. They are predicted to forage by slow-hawking and possibly by gleaning. In Zambia, in the wet season, stomachs of 23 bats contained moths (55% by volume), beetles (26%), termites (6%) and also flies, midges, crickets, bugs and unidentified insects, and in the dry season, stomachs of nine bats contained moths (56%), midges (43%) and flies (1%). In Zimbabwe, no more than five individuals have been found in a single cave, and they hang in ones or twos scattered throughout the cave.

**Reproduction** Litter-size: 1 (n = 3). At Nchisi F. R., 3 of 4 females were heavily pregnant and one was lactating at beginning of wet season (early Nov); no data for other months. Elsewhere: no conclusive information.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Rhinolophus swinnyi* Gough, 1908. No subspecies. Recently, *R. swinnyi* was restricted to South Africa, and bats from elsewhere that had been identified as *R. swinnyi* were placed in *R. rhodesiae* Roberts, 1946. However, this decision has been challenged (Demos *et al*. 2019) and here we continue to refer to the Malawi material as *R. swinnyi.*

**Key Reference** Cotterill (2013a).

**Measurements**
*Rhinolophus swinnyi*

| | |
|---|---|
| FA: | 41.7 (40-44) mm, n = 24 |
| TL: | 72 (60-95) mm, n = 24 |
| T: | 24 (16-30) mm, n = 24 |
| E: | 17 (15-20) mm, n = 22 |
| NL(breadth): | 6.8 (6.0-7.4) mm, n = 6 |
| Tib: | 18.4 (17-21) mm, n = 7 |
| HF: | 8.8 (8-9) mm, n = 19 |
| WT: | 6.1 (4.5-8.3) g, n = 17 |
| CrnC: | 17.4 (17.0-18.2) mm, n = 15* |

Malawi, Zambia, Zimbabwe (Cotterill 2013a).
*Throughout biogeographic range (Csorba *et al.* (2003).

## FAMILY HIPPOSIDERIDAE - Leaf-nosed Bats

Leaf-nosed Bats in Malawi have a large noseleaf whose posterior component is smoothly elliptical (without any projections), a tail which is completely enclosed by the interfemoral membrane or projecting only slightly beyond it, and short, leaf-shaped ears which are well separated and lack a conspicuous tragus. Because the premaxillae of the skulls are often lost during preparation, CrnC (cranio-canine length) is used instead of GSL. CrnC is the distance from the most posterior part of the skull to the front of the upper canines.

Like Horseshoe Bats, Leaf-nosed Bats echolocate by emitting CF calls which have a long constant frequency component, and they exploit the Doppler effect to detect moths and other insects that are fluttering their wings. Their wings have low aspect ratios, and these bats have very low wing-loadings, so they can fly slowly with considerable manoeuvrability. They can hover briefly and take off from the ground. They cannot scuttle or climb. Most roost during the day in dark caves or cave-like day-roost, and they either hang freely from the ceilings or hang in contact with the sides.

There are two genera in Malawi – *Hipposideros* and *Macronycteris*. Both are called Leaf-nosed Bats of some sort.

*Hipposideros caffer*. FA: 47.7 (42-50) mm. Dorsal pelage (grey-phase) greyish.

*Hipposideros ruber*. FA: 51.5 (50-54) mm. Dorsal pelage (grey-phase) brownish.

*Macronycteris vitattus*. FA: 89-105 mm.

## Genus *Hipposideros* - Leaf-nosed Bats

Two species occur in Malawi, and they are difficult to distinguish except by examination of the nasal swellings of their skulls, but they can usually be distinguished by the characters in the yellow box above.

### *Hipposideros caffer*

### Sundevall's Leaf-nosed Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

South Africa © C. & M. Stuart

**Description** Small, dainty microbat with round body; noseleaf with posterior component roughly elliptical without projections. (Not easily distinguished from *H. ruber* except by examining the skull). Sexes alike. Pelage fluffy, dense, and silky. Grey-phase: dorsal pelage grey; hairs pale grey with grey tip; ventral pelage slightly paler. Orange-phase: dorsal pelage ranging from bright rusty-orange to pale. Ears short, broad, inner margin convex, outer margin convex becoming concave near tip; tip pointed. Noseleaf with two lateral leaflets on each side. Wings and interfemoral membrane dark grey in both phases.

**Similar Species**

*H. ruber*. Usually larger, especially where sympatric (FA: 51.1 [47-55] mm). Dorsal pelage (grey-phase) usually more brown than grey. Typically found in or near forests, less common in savanna woodlands.

**Distribution** Widespread in Malawi from the Misuku Hills, Central Plateau, and Shire Valleys (<100 m to ca. 1800 m), although most records are in the southern half of the country and below 500 m. Recorded from Chikonji, Chiromo, Kasungu N. P.,

Lengwe N. P., Liwonde N. P., Maperera, Mtimbuka, Mugesse Forest, Mwabvi, Ndipitakuti, Nsanje, Nkhotakota, Tembuka and Zomba. Elsewhere: very widely but disjunctly distributed in most countries south of the Sahara, with isolated populations in Morocco and isolated records in Algeria, Niger and Chad.

**Habitat** Open and closed canopy miombo woodland sometimes with isolated rocky inselbergs, thicket scrub savanna (sometimes with baobabs) and probably riverine forest.

**Abundance** Commonly-recorded in Malawi; some colonies of several hundred individuals have been reported. Elsewhere: apparently common to very abundant in optimum habitats where day-roosts are available.

**Habits** Not much is known about Sundevall's Leaf-nosed Bats in Malawi. At Chiromo, they have been found roosting during the day in buildings and culverts. In southern Africa, they roost in caves, small rock cavities and fissures, mine-adits (especially at the back where the microclimate is stable) and in hollow trees. They do not hibernate but become torpid for short periods during particularly cold weather. They have been seen sipping water from open water while in flight, which suggests dependence on this resource. These bats have a low aspect ratio and very low wing-loading and are able to fly either slowly or rapidly, and with agility and manoeuvrability. They can take off from the ground, hover briefly, and they turn by banking and by stalling-and-twisting. Moths can comprise 88% of the diet, but they also feed on lacewings, caddis-flies, winged termites, beetles and other insects and often come to electric lights to feed on the swarms of insects attracted by the lights. Some of these bats were seen foraging by slow-hawking 1-10 m over water; others flew along the face of an escarpment and gleaned from rocks and vegetation. One foraged about a metre above the ground and made frequent dives to the ground, presumably to glean fluttering insects that had landed on the ground. There is no information about the social behaviour of these bats in Malawi. In Zimbabwe, a group comprised of one adult male and seven lactating females and their young occupied a hollow baobab from late Dec to late Jan. The stability and composition of this group suggests a harem mating system. In South Africa, this species forms maternity colonies where the females give birth and suckle, but this behaviour does not fit with harem formation and, again, this might indicate that different species are involved.

**Reproduction** No conclusive data for Malawi. In Nigeria, Gabon, Kenya and South Africa, litter-size: 1, females give birth once/year during a parturition season of less than two months. In Natal, South Africa, mating and ovulation occur in early winter (late Apr), there is a period of retarded embryonic development lasting three months during the winter, and then births occur in early summer (early Dec) followed by lactation during Dec and Jan.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Hipposideros caffer* (Sundevall, 1846). Four subspecies. The subspecies in Malawi is *H. c. caffer*.

**Key Reference** Bernard & Happold (2013b).

**Measurements**
*Hipposideros caffer*

| | |
|---|---|
| FA: | 47.7 (42-50) mm, n = 63 |
| TL: | 81.9 (67-91) mm, n = 22 |
| T: | 33.3 (26-40) mm, n = 55 |
| E: | 14.7 (11-18) mm, n = 59 |
| NL(breadth): | 6, 6 mm, n = 2 |
| Tib: | 20.9 (20-22) mm, n = 9 |
| HF: | 8.2 (6-10) mm, n = 43 |
| WT: | 8.0 (5-11) g, n = 54 |
| CrnC: | 17.1 (16.7-17.4) mm, n = 12 |

Malawi, Tanzania, Zambia, Zimbabwe (sources include HC, NHMUK, NMMB and Happold *et al.* 1987).

## *Hipposideros ruber*

## Noack's Leaf-nosed Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Zomba, Malawi © DCD & M. Happold

**Description** Small, dainty microbat with round body; noseleaf with posterior component roughly elliptical without projections. (Not easily distinguished from *H. caffer* except by examining the skull). Sexes alike. Pelage fluffy, fine, silky. Grey-phase: dorsal pelage greyish-brown, sometimes suffused with cinnamon or gold, especially around head and ears; hairs fawn with brown at base and grey-brown or golden-brown at tip. Ventral pelage same as dorsal pelage or paler. Orange-phase: dorsal pelage bright rusty-brown with golden sheen to pale gold (hairs unicoloured); ventral pelage similar. Ears short, broad, inner margin convex, outer margin convex becoming concave near tip; tip pointed. Noseleaf similar to that of *H. caffer*. Wings and interfemoral membrane blackish-brown in both phases.

**Similar Species**

*H. caffer*. Usually smaller, especially where sympatric (FA: 46.8 42-52 mm). Dorsal pelage (grey-phase) grey. Typically found in savanna woodlands and bushveld, less common in forests.

**Distribution** In Malawi, known from the Central Plateau, Lake Shore, Shire Highlands, Phalombe Plain and the Upper and Lower Shire Valleys at altitudes of <100 m to ca.1600 m. Recorded from Chiromo, Kasungu N. P., Livingstonia Beach, Liwonde N. P., Malosa, Mulanji (Chipoka village), Mtimbuka, Nkhotakota, Nkhotakota G. R., Nsanje, Ntchisi Mountain F. R. (Ntchisi Mountain) and Zomba. Elsewhere: Gambia and Senegal to Ethiopia, and southwards to Angola, Zambia and Mozambique.

**Habitat** Montane evergreen forest, open and closed canopy miombo woodland, other woodlands (sometimes with baobabs), riverine forest, and ornamental gardens with large trees.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain but fairly common in collections and probably fairly common in suitable habitats.

**Habits** Not much is known about Noack's Leaf-nosed Bats in Malawi but there is some information from West Africa and East Africa where they have been found roosting during the day by hanging freely in hollow trees, caves, mine-adits, crevices, enclosed roofs, abandoned buildings, under bridges and in burrows of large animals. They avoid roosting where temperatures are high. In Malawi, captive individuals did not become torpid during the day when the ambient temperature was 21-24°C. These bats fly slowly with bursts of speed, considerable agility and manoeuvrability, and they can take off from the ground and hover briefly. They forage in cluttered environments and avoid open habitats. Their diet in Malawi is not known. Elsewhere, they apparently eat mostly beetles with some moths, flies and winged termites. Very little is known about their social behavior. In DR Congo, they roost in groups with individuals hanging apart but in close proximity to group members; occasionally males and females roost singly. Groups range in size from 5 to 71 individuals comprising males and females, with females usually outnumbering males by 2-3 to one. In some localities, males roost separately from females, suggesting the formation of maternity colonies.

**Reproduction** No information for Malawi. Elsewhere: litter-size 1; females give birth once/year during a period of less than two months. In Tanzania, mating, ovulation and fertilization occur at end of the long wet season and early dry season (Jun-Jul), followed by retarded embryonic development for about two months, births at end of the short wet season (Dec) and lactation in Dec-Feb.

**Conservation** IUCN Category: Least Concern. Threats include loss and degradation of forest habitat.

**Taxonomic Notes** *Hipposideros ruber* (Noack, 1893). The number of subspecies is controversial – either two or three – and at least one of these might represent a distinct species. The subspecies in Malawi is *H. r. ruber*.

**Key Reference** Happold, M. (2013l).

**Measurements**
*Hipposideros ruber*

| | |
|---|---|
| FA: | 51.5 (50-54) mm, n = 24 |
| TL: | 88.9 (82-94) mm, n = 12 |
| T: | 34.9 (32-37) mm, n = 11 |
| E: | 14.9 (13-16) mm, n = 7 |
| NL(breadth): | 6.5 (5.6-7.5) mm, n = 13 |
| Tib: | 21.8 (19-25) mm, n = 12 |
| HF: | 10.5 (10-11) mm, n = 4 |
| WT: | 10.3 (8.6-12.5) g, n = 9 |
| CrnC: | 18.9, 19.2 mm, n = 2 |

Malawi, Tanzania, Southern Africa (HC, HZM, NHMUK, SMNS and literature).

## Genus *Macronycteris* - Leaf-nosed Bats

The only species in Malawi is *Macronycteris vittatus* which is much larger than the other Leaf-nosed Bats.

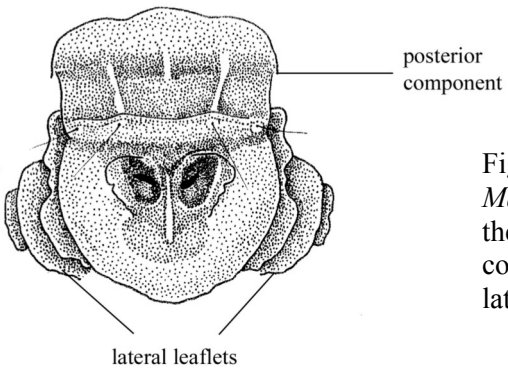



Fig. 13. Noseleaf of a representative of the genus *Macronycteris* (family Hipposideridae) showing the more-or-less smoothly curved posterior component without any projections, and three lateral leaflets (redrawn from Rosevear 1965).

### *Macronycteris vittatus*

### Striped Leaf-nosed Bat

**Malawian Name** Mleme (as for Fruit Bats which are similar in size).

Zomba, Malawi © DCD & M. Happold

**Description** Very large, powerful microbat with noseleaf; posterior component of noseleaf roughly elliptical without projections. Males on average larger than females. Pelage soft, not woolly, sparse on hindquarters. Grey-phase: dorsal pelage pale brown or reddish-brown; head, nape, rump and next to wings paler, greyer and with silvery frosting; hairs unicoloured or with darker base; some with silvery-grey at tip. Ventral pelage medium to pale brown, with silvery frosting; flanks white; armpits white or yellow, partly surrounded by C-shaped brown stripe that curves around the shoulder. Orange-phase: no information from Malawi. Ears brown; triangular, tapering to bluntly pointed tip with little or no concavity in outer margin below tip. Noseleaf with three lateral leaflets on each side. Wings and inter-femoral membrane brown.

**Similar Species** None in Malawi.

**Distribution** Known from the southern half of Malawi, in the Lake Shore, Shire Highlands, and Upper and Lower Shire Valleys, at altitudes of <100-1000 m. Recorded from Blantyre, Chintheche, Chiromo, Lengwe N. P., Liwonde N. P. Lake Malawi N. P. Namadzi District and Zomba. Elsewhere: Nigeria, Central African Republic and from Ethiopia southwards to Zimbabwe and NE South Africa and also Angola, Namibia and Botswana.

**Habitat** Open and closed canopy miombo woodlands and other woodlands (sometimes with baobabs and/or isolated rocky inselbergs or rocky hills), riverine forest, ornamental gardens with large trees, farmlands with remnant woodland and riverine forest.

**Abundance** Uncommonly-recorded in Malawi. Elsewhere: uncertain; very common in some localities.

**Habits** Striped Leaf-nosed Bats have not been well studied in Malawi. In Kenya and Zimbabwe, they usually roost in caves during the day, but have also

been seen in the roof of a traditional hut near Chiromo, under the eaves of buildings and in foliage. They either hang freely or in contact with walls, and sometimes tuck themselves into crevices. Roost-site fidelity was observed in Kenya. In Malawi (at 20-21°C) they do not become torpid during the day; they are not known to hibernate. When insects are maximally abundant, they accumulate heavy fat deposits in the body. These very large microbats have a low aspect ratio and high wing-loading, and they can fly at variable speeds with moderate manoeuvrability. Their flight is sometimes noisy with slow wingbeats. They can take off from the ground, but locomotion over ground is limited to clumsy "rowing" with the wings, and they climb by moving their arms and hindfeet in alternation.

Striped Leaf-nosed Bats probably feed mainly on large flying beetles which they catch by fly-catching and then crush the prey in their powerful jaws, but they also gorge on winged termites and, at some periods of the year near Chiromo, they came in hundreds apparently to feed on the large larvae of weevils in wild figs. In Kenya, these bats left their day-roosts about 30 minutes after sunset and flew to perches (ca. 6-7 m above the ground) that they used habitually for fly-catching. From here, the bats swooped down towards the prey, then carried it (apparently laboriously) to the perch where, for the next 3-8 minutes, it was chewed and eaten. An hour of intense foraging, with 1-2 flights per minute, was followed by an hour or more with only ca. three flights per hour. Even during periods of intense fly-catching, the bats spent 4-5 times longer at the perch than in flight and it is assumed that, for these large, heavy bats, fly-catching and the selection of large prey optimizes the energy return per unit of foraging time.

Striped Leaf-nosed Bats apparently forage singly but they typically roost in groups (colonies) of 50-400 individuals, although colonies of more than 100,000 are known in Zimbabwe. From Feb to Jun, breeding males defended roost-site territories (marked by patches of urine ca. 30 cm apart) on the exposed walls and ceilings. During this time, subadult males clustered into rock crevices within the cave, often alongside parous and subadult females. Mating occurred in Jun-Jul, when a female landed near a male on his territory. Territoriality ceased after the mating-season and, in Aug-Mar, the adult males clustered together in crevices. After the mating-season, pregnant females roosted elsewhere until late-Oct when they returned to the same cave to give birth and suckle. They established maternity roosts in extensive side chambers which had high temperatures and humidities and high levels of $CO_2$ and $NH_4$. When flying within the cave, mothers carried their young, but did not carry them while foraging; when carried, young bats fasten their teeth around a pubic nipple and cling to the mother's pelage with their hindfeet. Adult females were again absent from the cave in Mar-Apr, and it seems likely that they migrate at this time, and also during mid-pregnancy, to remote areas which have rainfall and abundant insects during these months.

**Reproduction** Litter-size: 1 (n = 2). Timing of events not known. Elsewhere: litter-size 1; females apparently give birth once/year during a period of less than two months. In C Zimbabwe, mating occurs during the cool dry season (mid-Jun to mid-Jul), births occur at the beginning of wet season (late Oct to early Nov) and lactation continues for at least 13 weeks until mid-Mar.

**Conservation** IUCN Category: Near Threatened. Threats include loss of habitat, fragmented populations, and disturbance in caves (by hunters, guano miners and recreational cavers) especially when bats are mating, giving birth and lactating.

**Taxonomic Notes**
*Macronycteris vittatus* (Peters, 1852). Formerly included in *H. commersoni*, then recently removed from the genus *Hipposideros* and placed in *Macronycteris*. No subspecies. Referred to as *H. commersoni* by Sweeney (1959), Happold *et al.* (1987), Ansell & Dowsett (1989) and Happold & Happold (1997). Referred to as *Hipposideros vittatus* by Happold, M. (2013n).

**Key Reference** Happold, M. (2013m) as *Hipposideros vittatus*.

**Measurements**
*Macronycteris vittatus*

| | |
|---|---|
| FA (males): | 101.4 (93-105) mm, n = 68 |
| FA (females): | 95.2 (89-101) mm, n = 39 |
| TL (males): | 143.2 (121-167) mm, n = 47 |
| TL (females): | 131.4 (116-151) mm, n = 15 |
| T (males): | 33.5 (25-39) mm, n = 50 |
| T (females): | 28.9 (22-35) mm, n = 19 |
| E: | 30.1 (24-35) mm, n = 70 |
| NL (breadth): | 13.4 (12-15) mm, n = 16 |
| Tib: | 42.1 (37-45) mm, n = 18 |
| HF: | 22 (19-24) mm, n = 10 |
| WT (males): | 96.4 (70-101) g, n = 25 |
| WT (females): | 76.5 (51-107) g, n = 8 |
| CrnC (males): | 34.4 (31.6-36.0) mm, n = 14 |
| CrnC (females): | 31.7 (29.9-32.8) mm, n = 8 |

Malawi, Tanzania, Zambia, Zimbabwe (HC, HZM, NHMUK, NMMB, ZFMK).

## FAMILY RHINONYCTERIDAE - Trident Bats

Until recently, Trident Bats were considered to be Leaf-nosed Bats, family Hipposideridae. Like Leaf-nosed Bats, they have a conspicuous noseleaf, but its posterior edge has three, tall, tapering projections. No other bats in Malawi have noseleaves with these trident-like projections. Otherwise, like other Leaf-nosed Bats in Malawi, the tail is completely enclosed in the interfemoral membrane, the ears are short and well separated and the tragi are inconspicuous. As for Leaf-nosed bats, CrnC replaces GSL.

Like Leaf-nosed Bats, Trident Bats echolocate by emitting CF calls, and they exploit the Doppler effect to detect moths and other insects that are fluttering their wings.

Only one genus occurs in Africa, including Malawi.

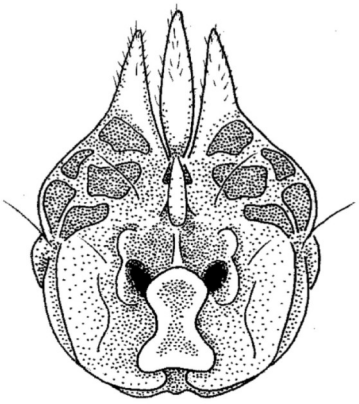


Fig. 14. Noseleaf of *Triaenops afer* (family Rhinonyceridae), showing the three, trident-like projections arising from the posterior component (based on Hill 1982).

### Genus *Triaenops* – Trident Bats

This genus currently contains three species – *T. afer* in Africa and the other two in the Middle East. Four other species that were previously placed in *Triaenops* are now placed in *Paratriaenops*, and these species only occur in Madagascar.

### *Triaenops afer*

### African Trident Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Satemwa Estate, Thyolo, Malawi © DCD & M. Happold

**Description** Small, round-bodied microbat with soft silky pelage. Sexes similar. Pelage soft, fine, dense, silky with conspicuous sheen. Grey-phase: dorsal pelage greyish-brown; hairs greyish-brown with browner tip. Ventral pelage pale greyish-brown to beige. Orange-phase: dorsal and ventral pelage a spectacular brilliant rusty-brown with golden sheen and a "shot-silk" appearance. Noseleaf (posterior component) with three tall projections. Ears small, widely separated, funnel-shaped, acutely pointed; height and breadth almost equal in dimensions; inner margin with central step-like emargination. Eyes minute. Muzzle broad and flat. Wings dark brown, slightly translucent. Interfemoral membrane dark brown.

**Similar Species** None in Malawi.

**Distribution** In Malawi, known from the Shire Highlands and Phalombe Plain, at ca. 1000 m. Recorded from Namadzi District and Thyolo District and from the road between Mulanje and Blantyre. Elsewhere: widespread from Ethiopia, Djibouti and Somalia southwards to Zimbabwe and Mozambique, with separate populations in Central African Republic, Uganda, Congo and Angola.

**Habitat** In the Namadzi District, African Trident Bats were netted near pools in a small river in

riverine forest, surrounded by tobacco and maize fields and remnant miombo woodland. In Thyolo District, one was netted on the bank of a large dam in a mosaic of tea plantations and remnants of open canopy woodland, lowland rainforest and riverine forest.

**Abundance** Rarely-recorded in Malawi. Elsewhere: very common in some coastal localities in East Africa where caves and mines are present.

**Habits** Very little is known about these spectacular bats in Malawi where they were first observed in 1994 (Happold & Happold 1997). During the day they hang freely in caves and mines; one cave in Mozambique was humid and very warm. They have narrower wings than most leaf-nosed bats; aspect ratio medium; wing-loading low. They fly slowly with fluttering, butterfly-like wingbeats and great manoeuvrability. They can take off from ground. They emerge from their day-roosts in the evening, sometimes before dark, and forage low over the ground and bushes often in cluttered environments. They apparently feed mostly on moths which they probably detect by their fluttering wings. In East Africa and Mozambique, African Trident Bats roost in very large groups (hundreds to thousands; possibly more). They hang, apart, in clusters.

**Reproduction** No information for Malawi. In Tanzania, litter-size 1 (n = 2), 2 of 6 females were pregnant in Dec and births were reported in Jan.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Triaenops afer* Peters, 1877. Formerly considered to belong to the family Hipposideridae, but now placed in the family Rhinonycteridae. Formerly referred to as a subspecies of *Triaenops persicus* but *afra* is now considered to be a distinct species. No subspecies. Referred to as *Triaenops persicus* by Happold & Happold (1997) when it was first recorded in Malawi.

**Key References** Benda & Vallo (2009), Happold, M. (2013n).

**Measurements**
*Triaenops afer*

| | |
|---|---|
| FA: | 54.0 (51-58) mm, n = 27* |
| TL: | 88.8 (82-102) mm, n = 36 |
| T: | 30.8 (25-38) mm, n = 53 |
| E: | 12.5 (10-14) mm, n = 25 |
| NL (length): | 13.1 (12.3-14.5) mm, n = 12 |
| Tib: | 19.3 (18-21) mm, n = 17 |
| HF: | 9.5 (8-12) mm, n = 51 |
| WT: | 11.9 (8-15) g, n = 40 |
| CrnC: | 19.5 (17.6-21.2) mm, n = 22 |

Throughout biogeographic range (HC, MNHN, NHMUK, RMCA and literature).
*Benda & Vallo (2009).

## FAMILY MEGADERMATIDAE - False Vampire Bats

There are four extant genera of False Vampire Bats; they are found in the tropics of the Old World and Australasia, but only one genus, *Lavia,* occurs in Malawi. It has no tail (but nevertheless a large interfemoral membrane), long ears whose inner margins are partly joined near their bases, very conspicuous bifid tragi, and a very large but comparatively simple noseleaf.

The common name of this family stems from an old and erroneous belief that these bats fed on blood as do the true Vampire Bats of the New World tropics. In Africa, there are no blood-sucking bats.

## Genus *Lavia* – Yellow-winged Bat

This genus contains only one species.

### *Lavia frons*

### Yellow-winged Bat

**Malawian name** Not known.

**Description** Medium-small microbat with a large noseleaf and very large interfemoral membrane but no tail; enormous ears which are partly joined. Sexes similar in colour. Pelage slightly shaggy. Dorsal pelage bluish-grey to slate-grey, suffused with greenish-yellow on lower back. Ventral pelage greyish-fawn; sometimes yellowish. Males produce yellow secretion from glands on lower back. Head appears very large because the ears are almost twice as long as the head and the noseleaf is very long and erect. Ears orange-yellow; basal halves joined by an interaural membrane. Tragus bifid, one branch long and pointed. Eyes relatively very large for a microbat. Wings very broad, variegated bright yellow, orange and pale brown; colour fades after death. Hindlimbs long. Interfemoral membrane yellowish-orange. No tail.

**Similar Species.** None in Malawi

**Distribution** In Malawi, known only from two specimens from the northern end of the Lake Shore at ca. 480 m. Recorded from Karonga and Karonga Beach. These localities are at the SE edge of the known biogeographic distribution. Elsewhere: distributed disjunctly from Senegal to Eritrea and W Somalia and southwards to Gabon, DR Congo and Tanzania, with marginal records in C Zambia.

**Habitat** No details available, but the natural vegetation of the area is open canopy woodland with baobabs, *Cordyla* and *Acacia albida* (now *Faidherbia albida*).

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain; moderately common in museum collections.

**Habits** Northern Malawi seems to be at the southern limit of the biogeographic range of Yellow-winged Bats, but climate change might bring them further south in the near future. In Kenya, these bats roost during the day in the foliage of trees usually 5-10 m above the ground in the crowns of acacia trees. On cool mornings, and after rain, they choose sunny perches and warm themselves in the sun, but they usually roost in the shade and move from perch to perch, or into low bushes, to find shadier positions as the sun moves. When the ambient temperature rises above 31°C, the wings are held slightly away from the body to facilitate cooling. They do not become torpid and they remain open-eyed and vigilant throughout the day. They fly away to other perches if approached by hornbills, other large birds and humans. Their predators include diurnal birds of prey such as kestrels, dusk-flying Bat Hawks, and tree-dwelling snakes, so constant vigilance is important. These bats have a very low aspect ratio, medium wing-loading and rounded wing-tips, and consequently, their flight is fairly slow, erratic and fluttering. They can negotiate clutter (such as branches and foliage) with very precise manoeuvrability. Their echolocation calls are low-intensity, broad width calls which are particularly well suited to cluttered environments.

Yellow-winged Bats are entirely insectivorous. They eat a variety of very small to relatively large, soft and hard-shelled insects, including mosquitoes, flies, winged termites, butterflies, moths, grasshoppers and beetles. Most foraging is done from favoured perches along a particular route which is exploited for several consecutive nights before a change is made. Individuals fly from perch to perch until a concentration of insects is located. Then they forage by opportunistic fly-catching and occasionally by gleaning from the ground. Flying insects appear

to be detected at long range by eyesight: the eyes have a tapetum lucidum which implies enhanced night-vision, and it seems likely that these bats can see insects silhouetted against the evening and night skies. When prey is detected, individuals make a precise and very brief (typically three seconds) flight to intercept the prey, and then return to the perch before eating. Yellow-winged Bats occupy an exclusive feeding niche and exploit diurnal insects to a greater extent than other species of bats. In East Africa, they are closely associated with *Acacia tortilis* (now *Vachelia tortilis*) which flowers and grows new leaves asynchronously in response to erratic dry-season rains: the trees attract insects which may be of crucial importance to Yellow-winged Bats during the dry seasons.

Yellow-winged Bats live in monogamous pairs, in territories which are defended by the male. In Kenya, the territories are 0.6 - 0.95 ha in area and contain 17-34 *Acacia* trees. Pairs roost together, less than a metre apart, and at least 20 m from the nearest neighbouring pair. Each pair has a primary roost (near the territorial boundary) where both bats spend most of the day and, although they may have moved to a shadier roost during the day, they return to the primary roost for a period of grooming, stretching and social interaction before beginning to forage. During a study from mid-Dec to early Jul, courtship was observed in May and early Jun when rain was frequent and insects abundant. Courtship includes brief "aerial ballets" during which the pair circle and chase each other, and longer displays during which the male flies tight figure-8s close to his perching mate. Mating apparently occurs while the pair are hanging from a perch. The single young clings to its mother continuously until about one week before it first flies and forages. It grips a pubic nipple in its mouth and holds the back of the mother's neck with its feet. Periodically, it turns the other way up to suck. Older juveniles occasionally release the pubic nipple, hold on by the feet only, and stretch, groom and flap their wings. Newly volant young forage with their parents and soon develop foraging strategies closely resembling those of the parents. They are weaned about 20 days after becoming volant but, for at least an additional 30 days, they share the parents' territory, synchronize grooming and foraging periods with those of the parents, and frequently huddle against the mother when roosting. Monogamy, territoriality, division of labour, opportunistic foraging and long mother-young associations are probably adaptations to habitats with low carrying capacities and seasonal shortages of food.

**Reproduction** No information for Malawi. Elsewhere: litter-size one. In Kenya, all of five females under observation gave birth in early Apr, and courtship and attempted mating occurred in May and early Jun (no data for other months). These data suggest females give birth twice/year during two distinct seasons.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Lavia frons* (E. Geoffroy, 1810). Three subspecies, but they are poorly defined and of dubious validity. If valid, the subspecies in Malawi is *L. f. rex*. Not recorded in Malawi until 1982 (Harrison 1982).

**Key References** Happold, M. (2013o), Vaughan & Vaughan (1986, 1987).

**Measurements**
*Lavia frons*

| | |
|---|---|
| FA: | 60.1 (57-65) mm, n = 24 |
| HB: | 68.5 (60-80) mm, n = 26 |
| T: | 0 mm |
| Interfemoral membrane: | 48.7 (44-58) mm, n = 7 |
| E: | 42.9 (39-46) mm, n = 28 |
| Tr: | 23.8 (21-26) mm, n = 20* |
| NL (length): | 22.1 (21-24) mm, n = 6 |
| Tib: | 32.2 (29-37) mm, n = 25* |
| HF: | 18.5 (16-20) mm, n = 25* |
| WT: | 25.6 (22-30) g, n = 7 |
| GLS: | 24.5 (22.1-26.2) mm, n = 10 |

Tanzania. *Throughout biogeographic range.

## FAMILY EMBALLONURIDAE - Sheath-tailed Bats

Sheath-tailed Bats are so called because the end of the tail projects upwards through the centre of the interfemoral membrane, into a sheath of skin, when the bat is not flying. They have short sleek pelage, a relatively long body, a triangular head with a pointed muzzle, moderately large ears, small but conspicuous eyes and no noseleaf. They have long, narrow wings.

There are three genera of Sheath-tailed Bats in Africa, but only one genus, *Taphozous,* is found in Malawi. Bats in this genus are called Tomb Bats because some of them roost in cavernous buildings, including tombs and temples in Egypt where they were first found.

## Genus *Taphozous* – Tomb Bats

This genus contains 14 species that are found in the Old World and Australasia. Five species occur in Africa, but only one occurs in Malawi.

### *Taphozous mauritianus*

### Mauritian Tomb Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Liwonde N. P., Malawi © DCD & M. Happold

**Description** Medium-sized, long-bodied, robustly-built microbat without a noseleaf and with the terminal portion of the tail projecting upwards from middle of the dorsal surface of the interfemoral membrane. Sexes similar in colour and size. Pelage sleek, soft and dense. Dorsal pelage grizzled dark and pale grey, suffused with pale-brown (fawn) in some individuals which can make the grizzling indistinct; hairs pale grey or pale greyish-brown at base with band of dark grey across terminal half and pale grey tip. Ventral pelage pure white (sometimes stained yellow). Head moderately flat, subtriangular (viewed dorsally) with a long, pointed muzzle and a deep depression between the eyes. Lower lip with a conspicuous grooved prominence. Eyes comparatively large for a microbat. Ears subtriangular, backward-pointing; shallow, almost reaching corner of mouth. Tragus very broad. Wings long and narrow; wing-membranes translucent and white with some colourless areas.

**Similar Species** None in Malawi

**Distribution** In Malawi, recorded mainly from the Central Plateau and the Upper and Lower Shire Valleys, with some records from the Lake Shore and Phalombe Plain, at altitudes of <100 m to ca. 1000 m. Recorded from Blantyre, Chikwawa, Chinguni Rest-house, Chiromo, Karonga, Kasungu N. P., Liwonde N. P., Malema (Camp), Nchalo, Nkhotakota, Thyolo and Zoa Tea Estate. Elsewhere: very widespread south of the Sahara except for most of Ethiopia and Somalia.

**Habitat** Open and closed canopy miombo woodland and other woodlands, sometimes near houses and other buildings.

**Abundance** Uncommonly-recorded in Malawi. Elsewhere: uncertain. Moderately common in

museum collections but populations appear low throughout much of the biogeographic range.

**Habits** Mauritian Tomb Bats are delightful creatures which are easier to observe in the wild than most bats because they roost during the day on the trunks and branches of trees, on rock faces and on the walls of buildings. Unlike other tomb-bats, they do not roost in caves or cave-like domiciles. They always choose places shaded by branches, eaves or protruding rocks. They cling onto their roosts with their hindfeet and thumbs without their bellies touching the roost, and they face downwards with their heads raised. Their grizzled pelage provides camouflage on natural surfaces. Each bat usually returns to the same roost every day, and their roost-sites often become stained with urine and/or glandular secretions. They are surprisingly tolerant of humans (as long as they ignore the bats and do not come too close). They have large eyes for a microbat, remain very vigilant (without echolocating) and, if they are disturbed, they scuttle very rapidly sideways like crabs to get out of sight if possible, or they fly away without needing to echolocate to "see" where they are going. They do not become torpid during the day so they are always able to leave in a hurry. This also means that they are able to scuttle after insects, and fly after passing butterflies, if they get hungry during the day. They conserve water by producing comparatively highly concentrated urine and captive bats did not drink.

Flight is fast and agile but with poor manoeuvrability. Their wings make a whirring sound during flight. Roosts are usually two or more metres above ground so the bats can dive downwards to gain speed for flight but, unlike free-tailed bats, they can take off from the ground if they have to. They leave their day-roosts at sunset or soon after and begin foraging by fast-hawking in open spaces between well-spaced trees, in clearings or above the trees and over rivers (5-40 m above water). They have been recorded foraging up to 550 m above ground. They feed mainly on moths which they catch and eat on the wing, and they can be seen making steep dives presumably to pursue moths which dive evasively when they hear the bat's echolocation calls. Although they are primarily moth-eaters, they will eat beetles, winged termites, flies and many other insects, suggesting that they are opportunistic feeders. After several hours of intensive activity, the bats fly to night-roosts for long periods of rest. The echolocation calls are varied and range from very shallow to steep FM calls, depending on what the bat is doing.

Mauritian Tomb Bats roost singly (adult males), or in groups of 2-6 (up to 12) bats of mixed composition. Groups may include several adult males and adult females, with or without unweaned juveniles or subadults. Group-members (except mothers with young) roost at least 10 cm apart, and up to several metres apart. They sometimes make brief contacts, including climbing over each other. Their vocalizations (audible to humans) include a single loud "ping" emitted in contexts of threat or alarm to repel conspecifics who come too close, a three-syllable call emitted at 2-3 second intervals when a group-member returns to the roost area, "twittering" emitted by mothers and their young (sustained if they are kept apart) and several other vocalizations of unknown meaning. Bonding between mothers and their young is evidently strong. Young often roost on their mother's back, and mothers fly with their young attached to their bellies until the young are able to fly.

**Reproduction** Litter-size: 1 (n = 1). Births occur in early wet season (Nov-Dec) and end of wet season (Mar-Apr) (no data for May-Nov) and one female was pregnant and post-lactating in Mar. These data suggest that females give birth twice/year in two distinct short seasons. Elsewhere: throughout the biogeographic range, litter size 1 and females give birth twice/year, in two distinct short seasons.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Taphozous mauritianus* E. Geoffroy, 1818. No subspecies.

**Key Reference** Happold, M. (2013p)

**Measurements**
*Taphozous mauritianus*

| | |
|---|---|
| FA: | 61.5 (59-64) mm, n = 29 |
| TL: | 104.0 (91-116) mm, n = 24 |
| T: | 22.4 (18-29) mm, n = 31 |
| E: | 17.6 (13-23) mm, n = 33 |
| Tib: | 25.4 (25-27) mm, n = 12 |
| HF: | 12.1 (10-14) mm, n = 19 |
| WT: | 26.4 (20-29) g, n = 11 |
| GLS: | 20.5 (19.9-21.0) mm, n = 12 |

Malawi, Tanzania (HC, NMMB, SMNS, ZFMK, Happold *et al.* 1987).

## FAMILY NYCTERIDAE - Slit-faced Bats

Slit-faced Bats are easily distinguished from bats in other families. They are called Slit-faced Bats because they have a longitudinal slit running down their faces (from forehead to nostrils). This is bordered by fleshy outgrowths which are often partly concealed by the pelage and therefore not very conspicuous. Slit-faced Bats have very long ears and a long tail which is completely enclosed by a large interfemoral membrane; the tail ends in a uniquely Y-shaped or T-shaped cartilaginous process.

Slit-faced Bats have broad wings (very low aspect ratios) and low to very low wing-loadings, so they can fly slowly with great manoeuvrability, but flying is energetically very costly so they spend minimal time in flight. They can hover and take off from the ground. They are known as whispering bats because they emit multiharmonic CF echolocation calls of short duration and low intensity, which are particularly suited for densely cluttered environments.

All bats in this family belong to the genus *Nycteris*.

### Genus *Nycteris* – Slit-faced Bats

Five species occur in Malawi. They are distinguished by the following characters.

Upper incisors – can be bicuspid (having two cusps) or tricuspid (having three cusps).

Length of forearm (FA).

Shape of tragus. This is the small cartilaginous structure projecting from the inner side of the ear just in front of the auditory meatus. The overall shape can be described as narrow, roughly half-moon shaped or pear-shaped, and the outline of the posterior margin can be either smoothly convex or deeply notched.

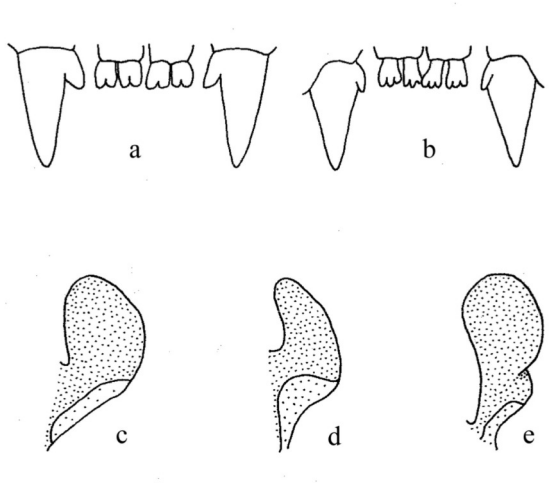



Fig. 15. Diagnostic characters of species of slit-faced bats, *Nycteris*. (a) Upper incisors bifid. (b) Upper incisors trifid. (c) Tragus broad with posterior margin smoothly convex; shape semi-lunate (as in *N. macrotis*). (d) Tragus narrow with posterior margin smoothly convex; shape not semi-lunate (as in *N. hispida*). (e) Tragus inverted pear-shaped with posterior margin deeply notched (as in *N. thebaica*). Left tragus illustrated; all drawn to same length.

*N. hispida*. Upper incisors tricuspid. FA: 34-44 mm.

*N. grandis*. Upper incisors tricuspid. FA: 60-67 mm.

*N. thebaica*. Upper incisors bicuspid. FA: 45.7 (33-50) mm. Tragus pear-shaped and deeply notched.

*N. woodi*. Upper incisors bicuspid. FA: 39.3 (36-42) mm. Tragus very narrowly half-moon shaped; posterior margin smoothly convex.

*N. macrotis*. Upper incisors bicuspid. FA: 49.0 (41-54) mm. Tragus half-moon shaped, posterior margin smoothly convex.

## *Nycteris grandis*

## Large Slit-faced Bat

**Malawian Name** Not known.

Liwonde N. P., Malawi © DCD & M. Happold

**Description** Small to medium-sized microbat with a noseleaf comprised of a longitudinal slit bordered by fleshy outgrowths; the largest slit-faced bat (FA: 52-65 mm); upper incisors tricuspid. Sexes similar. Pelage soft, fairly long and fluffy. Dorsal pelage greyish-fawn on crown and nape merging into greyish-brown on back and rump; hairs paler at base. Ventral pelage slightly paler. Ears relatively short for a slit-faced bat, 52 (46-59)% of FA. Tragus very narrow; posterior margin smoothly convex without notch. Eyes minute. Wings and interfemoral membrane blackish-brown.

**Similar Species.** Only one other species has tricuspid upper incisors.
*Nycteris hispida*. Much smaller, FA: 33-44 mm.

**Distribution** In Malawi, known only from the Upper and Lower Shire Valleys at altitudes of ca. 40 m and 500 m. Recorded from Chilembe, Chiromo, Liwonde District and Liwonde N. P. Elsewhere: forest habitats from Senegal to NE DR Congo, with a seemingly separate population in coastal forests of Kenya and Tanzania, and scattered records in Zambia, Zimbabwe and Mozambique.

**Habitat** Miombo woodland with scattered baobabs, and a small town with baobabs, other trees and nearby communal farmlands close to the river, in the Upper Shire Valley. In the Lower Shire Valley, at the deserted old town of Chiromo, there were empty buildings including some with intact roofs and dark rooms, neglected old ornamental gardens on the bank of the Ruo River, remnants of riverine forest with scattered baobabs, communal farmlands and swamps.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain. Only moderately common in museum collections, but these bats are difficult to find, detect and capture.

**Habits** Large Slit-faced Bats often roost in the hollow trunks of large standing trees - especially baobabs - but they occasionally roost in hollow logs, holes in the ground and between rocks, and in similar man-made sites such as culverts, mine adits and dark rooms in empty buildings (such as the ruins of the police station in abandoned Chiromo). They hang freely with their toes curled around whatever tiny footholds they can find in the ceilings. Roost-fidelity is probably a normal occurrence and even when roosts are disturbed, the occupants sometimes return after a few days. These bats do not become torpid during the day under normal temperature regimes.

Large Slit-faced Bats are the only bats in Africa which routinely feed on small vertebrates (including frogs, fish, birds and small bats) as well as insects and other arthropods. They forage by slow-hawking and perch-hunting (including both fly-catching and ground-gleaning), usually close to the ground, in forests, near edges of clearings, woodlands, over streams, rivers and marshes, and near lights where flying insects have aggregated. While perch-hunting, a bat hangs from the perch by one foot, and scans the surroundings by rotating its body through 180°, elevating and twisting its head, and tilting its ears back and forth. If prey is detected on the ground, the bat swoops down, envelopes it in the wings and then immobilizes it by biting the head. Then the prey is carried to a perch where it is eaten slowly, sometimes as much as an hour later. The bats use their wings to position the prey - frogs and edible bats are cupped in the wrist area of one wing and held to the mouth. Remains of arthropod prey, under feeding-perches in Zimbabwe, included moths, katydids, grasshoppers, locusts, praying mantises, beetles and sun spiders. The remains of small vertebrates included small bats (at least six species), birds, frogs (seven species) and fish (three species). In the wild, small vertebrates comprised ca. 80% of the diet by weight. Frogs were the most common prey (total numbers) in Mar-May and Aug- Sep; bats in Jun-Jul, and arthropods in Dec-Feb. As well as these seasonal changes, diets varied from year to year, suggesting

opportunistic feeding albeit with preferences for some foods.

Large Slit-faced Bats have been found roosting singly, in twos and in small groups including groups of one adult male with several pregnant or lactating females, and groups of several females with young. Groups containing more than one adult male do not seem to have been observed which suggests that these bats form harems. Adults do not roost in contact with each other. At night, young are left in the day-roost while their mothers forage, and mothers often use their day-roosts as feeding-perches at this time.

**Reproduction** No conclusive information for Malawi. At Liwonde N. P., 2 of 2 females were lactating in Mar, and 2 of 2 were post-lactating in Jun. There appears to be no year-round data for any locality in Malawi or elsewhere, so the timing of reproductive events cannot be determined.

**Conservation** IUCN Category: Least Concern. However, likely to be threatened by destruction of habitat and hollow baobab trees by humans and elephants.

**Taxonomic Notes** *Nycteris grandis* Peters, 1865. No subspecies. Not listed by Sweeney (1959).

**Key References** Fenton *et al.* (1983, 1987, 1990, 1993), Happold, M. (2013q).

**Measurements**
*Nycteris grandis*

| | |
|---|---|
| FA: | 63.8 (60-67) mm, n = 17 |
| TL: | 148.5 (137-164) mm, n = 12 |
| T: | 71.8 (64-84) mm, n = 16 |
| E: | 30.6 (24-34) mm, n = 17 |
| Tr: | 7.4 (6-10) mm, n = 5 |
| Tib: | 34.1 (32-36) mm, n = 9 |
| HF: | 15.6 (15-17) mm, n = 8 |
| WT: | 30.4 (25-43) g, n = 10 |
| GLS: | 25.2 (23.3-27.5) mm, n = 70* |

Malawi, Zambia and Zimbabwe (HC, NHMUK, NMMB).
*Throughout biogeographic range (Van Cakenberghe & De Vree 1993).

## *Nycteris hispida*

## Hairy Slit-faced Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

**Description** Small to very small microbat with a noseleaf comprised of a longitudinal slit bordered by fleshy outgrowths; one of the two smallest and most gracile species of slit-faced bat found in Malawi; upper incisors tricuspid; posterior margin of tragus smoothly convex. Sexes similar in colour: females slightly larger on average than males. Pelage fairly long and fluffy. Dorsal pelage variable: uniformly greyish-brown, dark beige or sepia brown; hairs unicoloured or with central portion paler. Ventral pelage paler to markedly paler than dorsal pelage; hairs darker at base. Ears relatively short for a slit-faced bat (58[50-70]% of FA). Tragus narrow; posterior margin smoothly convex without notch, upper margin rounded (cf. flattened in *N. woodi*). Eyes minute. Wings and interfemoral membrane blackish-brown.

**Similar Species** Only one other species has tricuspid upper incisors.
*Nycteris grandis.* Much larger, FA: 52-65 mm.
However, if the upper incisors are worn and not obviously tricuspid, *N. hispida* can be confused with *N. woodi*.

**Distribution** In Malawi, found mainly at lower altitudes (<100-500 m) in the Lake Shore and the Upper and Lower Shire Valleys, but also recorded in the Shire Highlands and on the Phalombe Plain (ca. 1000 m). Recorded from Chintheche, Liwonde N. P., Mangochi, Namadzi District, Upper Shire River, Zoa Tea Estate and Zomba. Elsewhere: very widespread from Mauritania to Sudan, Ethiopia and Somalia and southwards to Angola, Botswana and KwaZulu Natal in South Africa

**Habitat** Open and closed canopy miombo woodlands and other woodlands (sometimes with baobabs and/or rocky inselbergs), tobacco, maize and perhaps tea estates with remnant miombo woodland and riverine forests, and ornamental gardens with large trees at the base of Zomba Plateau.

**Abundance** Rarely-recorded in Malawi. Elsewhere: one of the most common slit-faced bats; very common north of 10° S.

**Habits** During the day, Hairy Slit-faced Bats hang freely from twigs of low bushes and trees, always in dense cover and complete shade. They also hang under open banana leaves, from the ridgepoles of grass- or mat-roofed houses, in hollow trees, dark cavities under exposed roots of trees in erosion gullies and ravines, disused huts, large burrows, caves, road culverts, and deep holes in the ground and in termitaria. Hairy Slit-faced Bats fly slowly with almost incredible manoeuvrability, and they are well known for their ability to dodge objects, moving and otherwise, so they are rarely caught. These little bats feed on small moths and other insects (including praying mantises), which they catch by slow-hawking and gleaning from foliage and walls (and probably from the ground). They are often attracted to lighted rooms and verandas, and other lights, where insects are abundant, and sometimes return regularly to such places. They are often found roosting singly, and less often in pairs and groups of 3-6. Family groups comprised an adult male and female, a juvenile and a reproductively inactive adult.

**Reproduction** No information for Malawi. Elsewhere: litter-size: 1. In Garamba N. P., DR Congo, the females appear to give birth twice/year in two distinct parturition seasons.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Nycteris hispida* (Schreber, 1775). Recognition of subspecies is controversial.

**Key Reference** Happold. M. (2013s).

**Measurements**
*Nycteris hispida*

| | |
|---|---|
| FA: | 38.7 (34-44) mm, n = 742* |
| TL: | 96.4 (89-106) mm, n = 49 |
| T: | 46.68 (41-57) mm, n = 55 |
| E: | 22.3 (16-24) mm, n = 58 |
| Tr: | n. d. |
| Tib: | 18.1 (14-24) mm, n = 258* |
| HF: | 9.4 (9-10) mm, n = 16 |
| WT: | 8.7 (6.0-12.3) g, n = 18 |
| GLS: | 16.5 (15.3-18.4) mm, n = 748* |

Throughout biogeographic range (Happold. M. 2013s.
*Van Cakenberghe & De Vree 1993).

## *Nycteris macrotis*

## Large-eared Slit-faced Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Liwonde N. P., Malawi © DCD & M. Happold

**Description** Small microbat with a noseleaf comprised of a longitudinal slit bordered by fleshy outgrowths; medium-sized for a slit-faced bat; upper incisors bicuspid. Sexes similar in colour, females on average slightly larger than males. Pelage fairly long, soft, fluffy. Grey-phase: dorsal pelage medium grey; hairs with basal half paler than terminal half. Ventral pelage pale silvery grey. Orange-phase: dorsal pelage brownish-orange to bright orange; some grey-phase individuals exhibit an infusion of orange or rufous in the brownish pelage, especially on head and around neck. Ears of medium relative length for a slit-faced bat (65 [54-80]% of FA). Tragus semi-lunate (half-moon shaped) with posterior margin smoothly convex. Eyes small. Wings and interfemoral membrane greyish-brown to dark grey.

**Similar Species**

*Nycteris woodi*. Usually smaller and less robustly built (FA: 39.3 [36-42] mm). Ears usually relatively longer (79.5 [73-89]% of FA).

**Distribution** In Malawi, found mainly in the Lake Shore and Upper and Lower Shire Valleys at altitudes of <100 m to ca. 500 m. Recorded from Chididi Mission, Chiromo, Chitala River, Kasungu N. P., Lake Malawi N. P., Lengwe N. P., Liwonde N. P., Mulanji, Namizimu F. R., Nkhata Bay and Zomba. Elsewhere: recorded disjunctly from Senegal to Cameroun and SW Chad, from Congo, Angola and DR Congo, and from Sudan, Ethiopia and Somalia southwards to NE Botswana, the Zambezi Valley in Zimbabwe and Malawi.

**Habitat** Open and closed canopy miombo woodlands, mosaics of mopane woodland and flood-plain grassland, other open canopy woodlands with baobabs near Lake Malawi, thicket savanna with baobabs, riverine forest and ornamental gardens with tall trees beside the Ruo River with abandoned buildings, roads with culverts, communal farmlands and marshes nearby.

**Abundance** Uncommonly-recorded in Malawi but, in Liwonde N. P., 8 of 12 culverts investigated were occupied by this species during the day. Elsewhere: comparatively uncommon in collections.

**Habits** In Malawi, Large-eared Slit-faced Bats have been found roosting during the day in dimly lit culverts under roads. The claws on their toes are able to hold on to the smallest projections or notches so the bats can hang freely from the ceilings of the concrete culverts. Although these bats occur in Zomba, we did not find any in the caves under boulders on nearby hills. But elsewhere in Africa, they have been found in caves, and also in hollow trees and logs, abandoned mines and burrows, dry wells, dark cellars and human dwellings. They are predicted to forage by hovering and gleaning, and their prey includes insects which are not likely to be taken on the wing. The stomachs of five individuals contained large grasshoppers, crickets and their relatives (51% by volume), scarab beetles (27%) and termites.

These bats usually roost singly or in small groups. In six culverts in Liwonde N. P. in Apr, three adult males (not in breeding condition) were roosting singly. One culvert housed a group comprised of one adult male with scrotal testes, one female with a neonate, one adult female (not palpably pregnant or lactating) and three subadult females. Another group included one adult male (testes scrotal), four adult females (not palpably pregnant nor lactating) and two escapees. Harem

formation is a possibility. Adults hang without touching neighbouring adults. In captivity, when a mother was resting, her baby hung head-downwards with its feet hooked into the mother's tail membrane. If disturbed, the mother flew away with the baby very firmly attached: the baby held on with its mouth attached to a nipple or pelage, its thumbs gripping the mother's pelage or wing-membrane, and its toes gripping her pelage or interfemoral membrane. The thumbs and feet are very well developed, even in neonates.

**Reproduction** No conclusive information for Malawi. From observations of lactating and post-lactating females, some births are inferred to occur in the wet season (ca. Dec) and some in the early dry season (ca. Apr, May). Females, even in the same colony, were not in close reproductive synchrony. Elsewhere: litter-size 1. In Tanzania, females gave birth more than once/year but the total number of births/year is not known.

**Conservation** IUCN Category: Least Concern. Threats include destruction of habitats and domiciles by humans and elephants.

**Taxonomic Notes** *Nycteris macrotis* Dobson, 1876. Probably four subspecies. The subspecies in Malawi is *N. m. oriana.*

**Key Reference** Cotterill & Happold (2013d).

**Measurements**
*Nycteris macrotis*

| | |
|---|---|
| FA: | 49.0 (41-54) mm, n = 47 |
| TL: | 113.6 (98-132) mm, n = 46 |
| T: | 54.7 (46-63) mm, n = 46 |
| E: | 32.0 (28-35) mm, n = 46 |
| Tr: | 10 mm, n = 1 |
| Tib: | 24.9 (23-26) mm, n = 23 |
| HF: | 13.3 (12-14) mm, n = 20 |
| WT: | 15.2 (11-17.5) g, n = 17 |
| GLS: | 20.5 (19.0-22.2) mm, n = 649* |

Malawi, Tanzania (HC, HZM, NHMUK).
*Throughout biogeographic range (Van Cakenberghe & De Vree 1985).

## *Nycteris thebaica*

## Egyptian Slit-faced Bat

**Malawian Name** Nanthuthu.
Not confined to this species.


Mokala N. P., South Africa © C. & M. Stuart

**Description** Small microbat with a noseleaf comprised of a longitudinal slit bordered by fleshy outgrowths; medium-small for a slit-faced bat; upper incisors bicuspid. Sexes similar in colour; females sometimes slightly larger than males. Pelage soft, fairly long, fluffy. Grey-phase: dorsal pelage greyish-fawn, greyish-brown to slightly pale sepia-brown; hairs unicoloured. Ventral pelage paler to much paler than dorsal, often greyish-white, sometimes silvery creamy-grey. Orange-phase: dorsal pelage bright orange. Ears of medium relative length for a slit-faced bat (70 [56-88]% of FA). Tragus inverted pear-shaped with deep notch in posterior margin, tip hairy. Eyes minute. Wings and interfemoral membrane dark grey or greyish-brown.

**Similar Species** None. No other slit-faced bat in Malawi has a pear-shaped tragus with its posterior margin deeply notched.

**Distribution** In Malawi, widely recorded in most biogeographic areas at altitudes mostly within the range <100-1000 m. Recorded from 20 km N of Balaka, Blantyre, Chiwpina (near Chilwa), Chiromo, Dedza Mountain, Ekwendeni Station, Karonga, Lake Malawi N. P., Lengwe N. P., Limbe, Livingstonia Beach, Liwonde N. P., Mangochi, Maperera, Misuku-Mughese Mission, Mtimbuka, Mzuzu, Namadzi District, Namizimu F. R., Nchisi Mountain F. R., Nkhotakota, Nkhotakota W. R., Thyolo District, Vwaza Marsh G. R., Zomba District and Zomba. Elsewhere: very widespread throughout most of Africa in suitable habitats.

**Habitat** Miombo woodlands, other woodlands and woodland savannas, and riverine forests, but not montane habitats.

**Abundance** Commonly-recorded in Malawi. Elsewhere: common in collections and thought to be common (at least locally) throughout much of the biogeographic range.

**Habits** In Malawi, Egyptian Slit-faced Bats have been found, during the day, roosting in caves, rock crevices, road culverts, pit latrines and the roofs of thatched buildings, where they usually hang freely. Elsewhere, they have been found in many other roosts including mines, hollow trees, cavities under roots, Aardvark burrows, wells, and many other places. Their amazing flying skills enable them to fly to roost-sites inaccessible to bats belonging to other families, but they sometimes share more accessible day-roosts with other species of bats. Some switching between different roosts was observed during an 8-day study in Zimbabwe; sometimes this was a response to the presence of predatory Large Slit-faced Bats, *Nycteris grandis*. Egyptian Slit-faced Bats fly slowly with great manoeuvrability and very often turn by stalling-and-twisting.

Egyptian Slit-faced Bats feed opportunistically on a very wide variety of insects, including moths of the Cotton Bollworm, and they also eat scorpions and sun spiders, geckos, small frogs and small fish (but, unlike *Nycteris grandis*, they probably only rarely eat vertebrates). Diet is influenced by seasonal changes in the abundance of different insects, biogeographic area and the condition of the bat. Dietary flexibility combined with versatile foraging behaviour explains why these bats can exploit a variety of habitats over a wide biogeographic range.

Egyptian Slit-faced Bats forage for volant and non-volant arthropods by slow-hawking, fly-catching, foliage-gleaning and ground-gleaning, in places of moderate to dense clutter including in, under, and just above tree canopies, in undergrowth, over streams, and near lights and buildings. They often forage very near ground close to their day-roosts. While fly-catching or ground-gleaning from a perch, they hang by one foot, rotate the body and

turn the head while listening for prey-generated sounds. In response to sounds, they direct the head towards the source, move the ears rapidly back and forth, and then attack - possibly using vision (in spite of their minute eyes) as well as echolocation to locate the prey's exact position. Flying insects are taken in flight. Non-volant prey is taken by hovering and gleaning from leaves, branches, walls, rock-faces and other surfaces. Alternatively, the bat will land on ground, envelop the prey with its wings and use the tail membrane to transfer it to the mouth. Small insects are eaten immediately but larger prey is taken back to the perch.

Egyptian Slit-faced Bats usually roost in groups of three to several hundred but occasionally roost singly or in pairs. Adults hang apart in loose aggregations. In eSwatini, thirteen of 15 culverts under a 3 km long road were occupied by six groups of females; the females tended to show fidelity to one culvert but occasionally roosted in adjacent culverts (A. Monadjem *pers. comm.*). Males also roosted in these culverts, but probably moved between non-adjacent culverts more often than the females, and a high intensity, broad bandwidth call (also audible to humans) is emitted by bats leaving the roost. Courtship behaviour includes "frenzied" flying, head-butting in flight and neck-biting. At dusk, mothers carry their young, attached to a nipple, away from the day roost, possibly to avoid predation by Large Slit-faced Bats, *N. grandis*

**Reproduction** Litter-size: 1 (n = 4). Females give birth once/year, at the beginning of wet season (Oct-Nov). Elsewhere: litter-size 1. In inland Kenya, coastal Tanzania and KwaZulu-Natal in South Africa, females give birth once/year in Nov.

**Conservation** IUCN Category: Least Concern. Threats include harvesting for “bushmeat” in caves including those on Dedza Mountain.

**Taxonomic Notes** *Nycteris thebaica* E. Geoffroy, 1818 (1813 in some publications). Six subspecies. The subspecies in Malawi is *N. t. capensis.*

**Key Reference** Bernard & Happold (2013c).

**Measurements**
*Nycteris thebaica*

| | |
|---|---|
| FA: | 45.7 (33-50) mm, n = 56 |
| TL: | 102.9 (82-120) mm, n = 81 |
| T: | 53.1 (43-59) mm, n = 79 |
| E: | 32.6 (27-37) mm, n = 80 |
| Tr: | 9.3 (8-10) mm, n = 4 |
| Tib: | 24.3 (21-26) mm, n = 16 |
| HF: | 10.8 (8-14) mm, n = 54 |
| WT: | 10.5 (7.2-16.5) g, n = 68 |
| GLS: | 19.1 (17.0-21.2) mm, n = 871* |

Malawi and Zimbabwe (AM, HC, KU, NHMUK, NMMB, SMNS, ZFMK and Happold *et al.* 1987). *Throughout biogeographic range (Van Cakenberghe & De Vree 1998).

## *Nycteris woodi*

## Wood's Slit-faced Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

**Description** Very small microbat with a noseleaf comprised of a longitudinal slit bordered by fleshy outgrowths; one of the two smallest and most gracile species of slit-faced bat found in Malawi; upper incisors bicuspid. Sexes similar. Pelage fairly long, fluffy. Dorsal pelage pale silvery-grey, grey, rusty-brown or brown, sometimes with paler pelage on back of head and shoulders and sometimes with darker patches on sides of muzzle and at bases of ears; hairs (in paler specimens) paler with terminal quarter same as dorsal colour; in brown specimens, hairs are brown with dark brown at base. Ventral pelage paler to much paler than dorsal pelage, sometimes pure-white. Ears grey, relatively long for a slit-faced bat (80 [74-89]% of FA). Tragus very narrowly semi-lunate; posterior margin smoothly convex, upper margin flattened (cf. rounded in *N. hispida*). Eyes minute. Wing-membranes of grey-furred individuals are translucent grey. Those of brown-furred individuals are correspondingly light reddish-brown.

**Similar Species**

*Nycteris macrotis*. Usually larger and more robustly built, and the ears are usually relatively shorter (65 [55-80]% of FA).

**Distribution** In Malawi, known only from the Lake Shore and Lower Shire Valley at altitudes of 60-500 m. Recorded from Chiromo, Lake Malawi N. P. and Nkhotakota. Elsewhere: occurs in C and E Zambia, in S and N Zimbabwe, and marginally along the Limpopo R in N South Africa, and there is one record in SW Tanzania and another in W Mozambique.

**Habitat** Woodlands including miombo and riverine forest, and other woodlands, often with baobabs and *Sterculia* trees which have hollow trunks when old.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain. Locally common in Zimbabwe. Considered one of the rarest African nycterids.

**Habits** During the day near Chiromo, Wood's Slit-faced Bats roosted in large hollows in trees including *Stercularia* whose trunks are completely hollow when the trees are large and old, and in hollow fallen trees and culverts. Occasionally they roosted in the roofs of houses and deep holes in the ground. They were never found in hollow palms probably because hollow palms were almost always occupied by numbers of House Bats (*Scotophilus*) and free-tailed bats (*Tadarida*). In other parts of its biogeographic range, Wood's Slit-faced Bats also roost in caves, rock-fissures, abandoned mines and human dwellings. These bats are adept at flying through very cluttered habitats and apparently forage there by gleaning. Sometimes moths comprise almost half of their diet (46% by volume), but they also eat scarab beetles, caterpillars, termites, bush katydids and other Orthopterans, and the percentage of each varies from season to season. In Zimbabwe, Wood's Slit-faced Bats are known to roost in small or large groups (colonies) of up to 50 individuals. One group, found in a mine-adit, was comprised of one adult male and four females.

**Reproduction** No information for Malawi. In Zimbabwe, litter-size 1 (n = 3) and limited data suggest that the females give birth once/year, in ca. Nov.

**Conservation** IUCN Category: Least Concern. Threats include loss of habitat, over-use of pesticides, and destruction of hollow baobabs used as roosts.

**Taxonomic Notes** *Nycteris woodi* K. Andersen, 1914. No subspecies. Not listed by Sweeney (1959).

**Key Reference** Cotterill (2013b).

**Measurements**
*Nycteris woodi*

| | |
|---|---|
| FA: | 39.1 (35-42) mm, n = 30 |
| TL: | 93.2 (86-103) mm, n = 26 |
| T: | 47.5 (40-55) mm, n = 26 |
| E: | 31.7 (28-35) mm, n = 26 |
| Tr: | n. d. |
| Tib: | 19.5 (16-22) mm, n = 32 |
| HF: | 9.0 (8-10) mm, n = 12 |
| WT: | 7.1 (6.5-9.0) g, n = 11 |
| GLS: | 17.4 (16.4-18.2) mm, n = 29 |

Throughout biogeographic range (Cotterill 2013b).

## FAMILY MOLOSSIDAE - Free-tailed Bats

Free-tailed Bats are so called because most of the tail projects freely well-beyond the posterior edge of the interfemoral membrane when the bat is not flying. This means that the hindlimbs are able to move freely without being hampered by the interfemoral membrane. When the wing-membranes are also furled tightly against the forearms, these bats can scuttle over flat surfaces and climb very efficiently. Free-tailed Bats do not have noseleaves. They have forward-pointing ears with creases enabling them to be folded up when the bats are not flying, and their inner margins are either widely separated, or just touching, or joined by a band of skin. In some species, there is an interaural crest of hairs between the ears. The head is broad and flattened, usually heavily jowled and with expansible upper lips which are wrinkled into vertical folds. In some species, some of the hairs on the lips and feet are spoon-shaped bristles called spoon-hairs.

Free-tailed Bats have high to very high aspect ratios and medium to very high wing-loadings. Consequently, they can fly for long periods without needing to rest and, like swifts, they forage and feed in open spaces high above the ground. Also, they can only fly fast so they must dive from their roosts to gain sufficient speed for flight, and they cannot take off from the ground. Their echolocation calls are more varied and adaptable than those of most other bats, and include both constant frequency and frequency modulated calls, for example, while searching for prey, pursuing it and then attacking it. Most species roost in caves or cave-like roosts, including under the roofs of buildings. Some roost in large colonies and, when they roost in peoples' houses, they are regarded as pests because they are smelly, noisy and produce large amounts of droppings. However, the most pestiferous species in Malawi feed on moths and help to control Cotton Bollworm.

There are six genera of Free-tailed Bats in Africa, but only two are found in Malawi – *Otomops* and *Tadarida* (including *Chaerephon* and *Mops* as subgenera). They are distinguished by their ears.

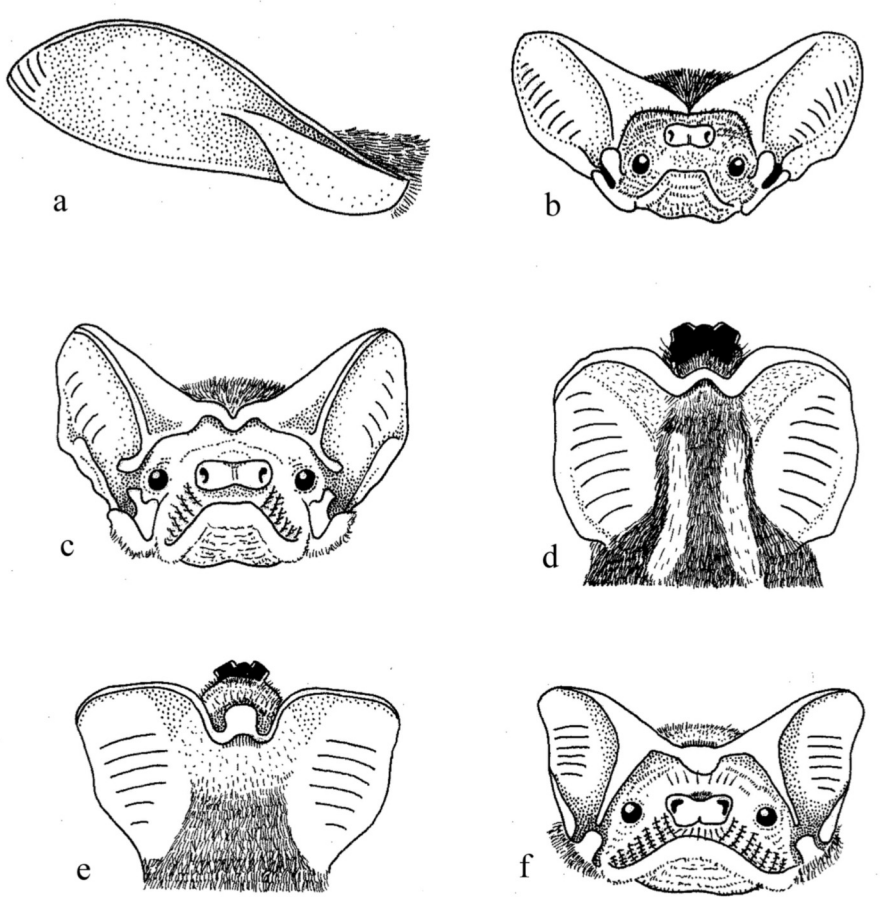



Fig. 16. Variations in the ears of Malawian bats in the family Molossidae. (a) Lateral view of the left ear of *Otomops martiensseni* showing the semi-circular flap extending forward from base of ear which can be folded down to seal auditory meatus (after Smithers 1983). (b) Ears whose inner margins meet at base of forehead to form a V-shaped valley (as in *Tadarida fulminans* and *T. ventralis*. (c and d) Ears which are wide apart but well joined across forehead by an interaural band with a V-shaped fold in the middle (as in *T. ansorgei* and *T. bivittata* (based on Eger & Peterson 1979). (e and f) Ears which are wide apart with inner margins joined by an interaural band with a backward-opening pocket-like invagination (interaural pocket) in middle (as in *T. condylura, T. nigeriae* and *T. pumila*).

*Otomops*. The ears project forward and are joined to the forehead and along the extended muzzle, and they are only moderately folded.

*Tadarida*. The ears have complex folding and the bases of their inner margins either meet (or almost meet) to form a V-shaped valley or are joined by a band of skin.

# Genus *Otomops* – Giant Mastiff Bats

This genus currently contains seven species but only one occurs in Africa, including Malawi. The others are found in Madagascar, India, Indonesia and New Guinea.

## *Otomops martiensseni*

## Large-eared Giant Mastiff Bat

**Malawian Name** Not known.

KwaZulu/Natal, South Africa © L.Wingate

**Description** Medium-sized microbat without nose-leaf and with terminal portion of tail projecting freely from posterior margin of interfemoral membrane; the largest African free-tailed bat (FA: 61-74 mm); ears joined to the muzzle. Sexes similar in colour. Pelage soft, dense. Dorsal pelage dark brown with dark rusty-brown tinge, or blackish-brown, darker on head and body, with pale brown or white band across shoulders, and a thin band of pale brown separating the dark dorsal pelage from the dark wing-membrane on each side. Ventral pelage dark brown, throat paler. Face pink; snout "pig-like". Upper lip expansible with many fine wrinkles and no spoon-hairs. Ears rounded, fairly stiff, projecting forward well beyond snout; inner margins joined together and to muzzle. Tragus minute. A semi-circular flap extends forward from base of ear; it can be folded down to seal auditory meatus. No interaural crest. Wings and interfemoral membrane blackish-brown.

**Similar Species** None.

**Distribution** In Malawi, recorded only from Mangochi Mountain and Ntchisi Mountain F. R. (rest house) at altitudes of 1500-1740 m. Elsewhere: recorded very disjunctly in the eastern side of Africa, from Djibouti to KwaZulu-Natal, with isolated records in Côte d'Ivoire, Ghana, Central African Republic, N DR Congo and Angola. The nearest records to Malawi are NE Tanzania and NW Zimbabwe.

**Habitat** On Mangochi Mountain, recorded in montane evergreen forest but likely to fly high above other habitats while foraging. In Ntchisi F. R., recorded in recently burnt open miombo woodland where the trees were mostly leafless and the understorey vegetation was completely absent. Likely to require caves or cave-like domiciles.

**Abundance** Rarely-recorded in Malawi. Elsewhere in Africa: not often recorded throughout the biogeographic range, except that colonies of several thousand are reported in East Africa, and they are reported as common in and near Durban, South Africa.

**Habits** These bats roost during the day in a wide variety of places including narrow horizontal and vertical crevices in rock-faces and buildings, cracks under exfoliating rocks, behind the bark of Acacia trees, in cracks in tree-trunks, hollow trees, roofs of houses and churches (often between tiles and insulation or between tiles and rafters), and crevices within caves. They cling in contact with the roost, usually tucked into narrow crevices. They can tolerate extreme roost temperatures, e.g. under corrugated iron roofs in South Africa which are below 0°C in winter and above 45°C in summer; but there is no evidence that they ever become torpid or hibernate. These bats have a high aspect ratio and medium wing-loading and are predicted to fly slower than other free-tailed bats. They forage for insects (including beetles and moths) by fast-hawking, and they have been observed flying high above the ground and also skimming over water to pick up water-beetles or to sip water. They occasionally roost singly or in pairs, but more often in groups of up to 50 or more, and sometimes in colonies of several hundred. Much noisy squeaking and chirping (audible to humans) occurs in the roosts prior to emergence of these bats at dusk. Maternity colonies are formed in summer in South Africa.

**Reproduction** No information for Malawi. Elsewhere in Africa: litter size 1, timing of events uncertain. In inland Kenya, births occur at the beginning of the wet season (Nov-Dec) and a very small number of pregnant females have been observed in Jan, Feb and May.

**Conservation** IUCN Category: Near Threatened. Probably not threatened in Malawi, but elsewhere, where populations are larger and more widely distributed, probably threatened by being disturbed in caves, especially while reproducing. Adapted well to urban areas and intensive agricultural operations in South Africa.

**Taxonomic Notes** *Otomops martiensseni* (Matschie, 1897). Two subspecies in Africa. The subspecies in Malawi is *O. m. icarus*. Not listed by Sweeney (1959).

**Key References** Fenton *et al.* (2002),Yalden & Happold (2013).

**Measurements**
*Otomops martiensseni*

| | |
|---|---|
| FA: | 63.8 (61-67) mm, n = 48 |
| TL: | 129.3 (127-132) mm, n = 4 |
| T: | 42.3 (39-45) mm, n = 4 |
| E: | 34.2 (31-38) mm, n = 4 |
| Tr: | n. d. |
| Tib: | 20.5, n = 1 |
| HF: | 13, 15 mm, n = 2 |
| WT: | 30.7 (26-38) g, n = 42 |
| GLS: | 25.8 (24.5-28.3) mm, n = 19 |

Zimbabwe and South Africa.

# Genus *Tadarida* - Tadarine Free-tailed Bats

Eight species of Tadarine Free-tailed Bats are found in Malawi. Some authors place them in three distinct genera – *Tadarida*, *Chaerephon* and *Mops*. However, it is probable that these taxa are not monophyletic, and their species composition depends on what diagnostic characters (including dental and skull characters) are given precedence. Pending resolution of the problems, it seems best to treat all of the Malawian species as members of the genus *Tadarida*, and to treat *Chaerephon* and *Mops* as subgenera.

Diagnostic characters of *Tadarida* include:

Inner margins of ears. Can be well separated, meeting to form a V-shaped valley, or wide apart but joined across the forehead by a band of skin and cartilage. This band of skin may have a V-shaped fold in the middle or a shallow pouch with an interaural crest.

Relative size of ears – a measure of how far the ears extend along the muzzle (or beyond it) when they are laid forward.

Ventral flank-stripe – a narrow band of pelage along the edge of the belly, close to the wing-membrane and sometimes extending onto it. Contrasting or not contrasting in colour with the colour of the belly.

Mid-ventral markings contrasting in colour with most of the ventral pelage. Present or absent.

Colour of wing-membranes and interfemoral membrane.

Plantar pad – a raised pad on the sole of the foot. Present or absent.

*T. fulminans*. Inner margins of ears meeting on forehead to form a V-shaped valley. Ventral flank-stripe white or cream. Ventral sides of legs white. Foot with plantar pad.

*T. ventralis*. Inner margins of ears meeting on forehead to form a V-shaped valley. No ventral flank-stripe in contrasting colour. Ventral sides of legs brownish. Foot usually without plantar pad.

*T. ansorgei*. Inner margins of ears joined by interaural band with V-shaped fold in middle. Cannot be distinguished from *T. bivittata* by external characters.

*T. bivittata*. Inner margins of ears joined by interaural band with V-shaped fold in middle. Cannot be distinguished from *T. ansorgae* by external characters.

*T. pumila*. Inner margins of ears joined by interaural band with a backward-opening pocket-like invagination in middle. FA: 38.1 (36-39) mm.

*T. condylura*. Inner margins of ears joined by interaural band with backward-opening pocket-like invagination in middle. FA: 46.8 (44-50) mm. Ventral pelage greyish-brown, pale fawn, pale orange, yellowish-white or whitish; mid-ventral markings white, varied in shape, sometimes absent. Ventral flank-stripe white or whitish

*T. nigeriae*. Inner margins of ears joined by interaural band with backward-opening pocket-like invagination in middle. FA: 48.0 (46-51) mm. Ventral pelage dark brown. Ventral flank-stripe white and very conspicuous.

*T. midas*. Inner margins of ears joined over muzzle by interaural band with a V-shaped fold and a forward-projecting pocket-like invagination which protrudes ca. halfway along muzzle. FA: 61.1 (59-64) mm.

## *Tadarida (Chaerephon) ansorgei*

## Ansorge's Free-tailed Bat

**Malawian Names** Not known.

**Description** Small microbat without noseleaf and with terminal portion of tail projecting freely from posterior margin of interfemoral membrane. Not easily distinguished from *T. bivittata*. Sexes similar in colour; males slightly larger on average than females. Pelage short, soft, dense, sparse on crown behind junction of ears and sometimes sparse on nape. Dorsal pelage greyish-brown or rufous, somewhat frosted and occasionally with white spots; hairs unicoloured or with pale grey at tip. Ventral pelage paler than dorsal pelage except on throat which is dark brown, conspicuously darker and denser than elsewhere, especially in males. Chin naked, in marked contrast with dense pelage on throat. No mid-ventral markings; no ventral flank-stripe in contrasting colour. Upper lip with 6-7 well-defined wrinkles on each side and many spoon-hairs. Ears reaching ca. halfway along muzzle when laid forward; inner margins joined by interaural band with V-shaped fold in middle. Interaural crest of dark hairs (ca. 2 mm) in shallow pouch, in both sexes; denser and more conspicuous in males. Wings semi-translucent, pale brown dorsally and ventrally; interfemoral membrane slightly darker.

**Similar Species**
*Tadarida bivittata*. Cannot reliably be distinguished by external characters.

**Distribution** In Malawi, known only from Ntchisi Mountain F. R. (rest house) (ZMA). Elsewhere: recorded very disjunctly from Côte d'Ivoire, Nigeria, Central African Republic and N Angola, and also disjunctly from Ethiopia and southwards to KwaZulu-Natal in South Africa.

**Habitat** The rest house in Ntchisi Mountain F. R. is surrounded by open canopy miombo woodland of hills and scarps.

**Abundance** Rarely-recorded in Malawi. Locally common in Zimbabwe.

**Habits** Nothing is known about Ansorge's Free-tailed Bats in Malawi. In Zimbabwe, they mostly roost during the day in small crevices which are high up in cracks and clefts in cliffs and rocky hills, but they also roost in crevices inside caves, mine-adits and occasionally buildings, and in expansion joints high up on concrete bridges. They scuttle backwards into these small crevices. In DR Congo, a colony roosted, in total darkness, in a crack in a hill rising ca 60 m above the surrounding bushveld, and the accumulation of 30 cm of guano in this day-roost indicated long-term residence. However, day-roosts in Zimbabwe are sometimes temporarily abandoned; departures do not appear related to seasonal changes, and it is not known if the bats move into nearby day-roosts or migrate further afield. These bats forage by fast-hawking, sometimes very high above ground. They feed on beetles and other insects. In NE DR Congo, they have been found roosting in groups of no more than 40 individuals, with males and females in roughly equal numbers, and with no segregation of sexes. In Zimbabwe, they usually roost in colonies of up to many hundreds and samples contained more males than females. Within roosts, groups of bats huddle tightly together in crevices, but are often restless and can be heard squeaking and jostling.

**Reproduction** No information for Malawi. In Zimbabwe, litter size 1 (n = 10) and the females appear to give birth twice/year in two distinct parturition seasons - at the beginning of the hot-wet season (Nov) and at the end of the hot-wet season (Apr).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Tadarida ansorgei* (Thomas, 1913). Subgenus *Chaerephon*. No subspecies. Not listed in other publications about Malawi.

**Key Reference** Cotterill (2013c).

**Measurements**
*Tadarida ansorgei*

| | |
|---|---|
| FA: | 45.9 (43-48) mm, n = 199 |
| TL: | 106 (99-119) mm, n = 87 |
| T: | 37 (32-46) mm, n = 86 |
| E: | 20.5 (15-23) mm, n = 87 |
| Tib: | 16.2 (15-17) mm, n = 12 |
| HF: | n. d. |
| WT (males): | 20.9 (19-23) g, n = 8 |
| WT (females): | 17.6 (15-20) g, n = 4 |
| GLS: | 19.6 (18.6-20.5) mm, n = 139 |

Throughout biogeographic range (Cotterill 2013c).

## *Tadarida (Chaerephon) bivittata*

## Spotted Free-tailed Bat

**Malawian Names** Not known.

**Description** (Based on material from southern Africa). A small microbat without noseleaf and with terminal portion of tail projecting freely from posterior margin of interfemoral membrane. Not easily distinguished from *T. ansorgei*. Sexes alike. Pelage short, soft, dense; sparse on crown. Dorsal pelage reddish-brown to greyish-brown, speckled with tiny white spots on crown, neck and back. Ventral pelage slightly paler; no mid-ventral markings; ventral flank-stripe same colour as flanks and not extending onto the wing-membrane. Throat either much darker than chest and belly or similar in colour. Upper lip with 5-8 well-defined wrinkles on each side and many spoon-hairs. Ears reaching ca. halfway along muzzle; inner margins joined by interaural band with V-shaped fold in middle. Males with interaural crest of very short (ca. 2 mm) dark hairs. Wings light reddish-brown and interfemoral membrane slightly darker. It is not yet clear if these variations in colour and markings indicate polymorphism or cryptic species or perhaps both (see below).

**Similar Species**
*Tadarida ansorgei*. Cannot reliably be distinguished by external characters.

**Distribution** In Malawi, only recorded from Mbalame Mountain (ZMA) and Nkhotakota in the Lake Shore biogeographic area, at 500 m (NHMZ). Elsewhere: recorded from scattered localities on eastern side of Africa, from Eritrea and Djibouti to Zimbabwe and SW Mozambique.

**Habitat** Miombo woodland, probably near exposed rocky outcrops of granite, basalt or sandstone which provide day-roosts.

**Abundance** Rarely-recorded in Malawi. Locally common near day-roosts in Zimbabwe.

**Habits** Nothing is known about the habits of this species in Malawi. In Zimbabwe, they roost by day, high up in rock crevices and occasionally in buildings. Their wings are long and narrow, and their flight and scuttling locomotion is assumed to be similar to that of other tadarine free-tailed bats. Their diet is not known. They roost in small groups or colonies, and individuals huddle together in crevices. In samples of bats taken as they emerged from their roosts, males outnumbered females but the reason for this is not known – perhaps males emerge earlier than females. Skulls have been recovered from pellets of Barn Owls (*Tyto alba*) found below the day-roosts of the bats. Mackinder's Eagle Owls (*Bubo capensis*) have been observed hawking free-tailed bats emerging from day-roosts of Spotted Free-tailed Bats in Zimbabwe.

**Reproduction** No conclusive information for Malawi or elsewhere.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Tadarida bivittata* (Heuglin, 1861). Subgenus *Chaerephon*. No subspecies. The relationship between *T. bivittata* and *T. ansorgei* is uncertain, and *bivittata* might contain cryptic species. Not listed in other publications about Malawi.

**Key Reference** Cotterill (2013d).

**Measurements**
*Tadarida bivittata*

| | |
|---|---|
| FA: | 49.5 (46-51) mm, n = 131 |
| TL: | 114.7 (106-129) mm, n = 136 |
| T: | 40.0 (32-48) mm, n =134 |
| E: | 19.0 (15-22) mm, n = 130 |
| Tib: | n. d. |
| HF: | 10.6 (9-13) mm, n = 39 |
| WT: | 18.1 (15-32) g, n = 104 |
| GLS: | 20.5 (19.5-21.3) mm, n = 128 |

Throughout biogeographic range (Cotterill 2013d).

## *Tadarida (Mops) condylura*

## Angolan Free-tailed Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Lengwe N. P., Malawi © DCD & M. Happold

**Description** Small microbat without noseleaf and with terminal portion of tail projecting freely from posterior margin of interfemoral membrane. Sexes almost similar. Pelage short, sparse; nape almost naked. Grey-phase - dorsal pelage blackish-brown, greyish-brown, pale grey or pale greyish-brown, sometimes with white flecks; hairs pale at base. Orange-phase - dorsal pelage orange (except on head). Ventral pelage greyish-brown, pale fawn, pale orange, yellowish-white or whitish; mid-ventral markings white, varied in shape, sometimes absent; ventral flank-stripe white or whitish. The full range of dorsal and ventral colours can be found in a single colony. Crown same colour as back. Upper lip with ca. seven well-defined wrinkles and many spoon-hairs. Ears blackish-brown; reaching ca. half way along muzzle when laid forward; inner margins joined by interaural band with backward-opening pocket-like invagination in middle. Males and females with interaural crest of short, brown feathery hairs arising from the invagination. Wings semi-translucent, greyish-brown near body becoming paler towards tip. Interfemoral membrane dark greyish-brown.

**Similar Species**

*Tadarida midas*. Much larger and heavier (FA 59-67 mm; WT 38-69 g).

**Distribution** Very widespread in Malawi at altitudes of <100-1000 m although most localities are below 500 m. Recorded from Chileka, Chintheche, Chiromo, Chitale, Karonga, Kasungu N. P., Lake Malawi N. P., Lengwe N. P., Liwonde N. P., Luwazi Mission, Nkhotakota, Nsanje, Salima, Sucoma, Zomba and Zomba District. Elsewhere: widely but disjunctly distributed south of the Sahara from Senegal to Somalia and south to Angola, Botswana and KwaZulu-Natal in South Africa.

**Habitat** Found in almost all Malawian natural habitats except montane habitats; also exploits farmlands (including cotton fields), towns and villages.

**Abundance** Very commonly-recorded in Malawi; greatly advantaged by its ability to exploit semi-urban environments and to roost in houses and other buildings. Elsewhere: common.

**Habits** Angolan Free-tailed Bats often roost during the day in the roofs of houses and other buildings. They are noisy, smelly and produce a lot of guano. They can be watched as they dive from the edges of roofs. However, as they dive, they are vulnerable to attack by waiting Bat Hawks and other birds of prey - and even Large-spotted Genets, that catch them as they scuttle across a roof to their take-off place. They can scuttle and climb very rapidly around their roosts – and undoubtedly catch cockroaches and other insects by chasing them. Angolan Free-tailed Bats also roost in crevices in hollow trees and palms, in caves, mines and the fabric of buildings. Incredibly, they often roost on rafters under corrugated iron roofs where temperatures and relative humidities can reach very challenging extremes such as >40°C during summer days in Uganda to <10° during winter nights in South Africa. They move their positions within such roosts as temperatures change and choose an environment with a temperature of 35-42°C and a relative humidity of 30-40% if possible. The ability of Angolan Free-tailed Bats to utilize thermo-challenging roosts reflects, in part, their tolerance of dehydration rather than their ability to maintain water balance.

The flight of Angolan Free-tailed Bats is always fast and agile but with very poor manoeuvrability. They leave their roosts 15-60 minutes after sunset and usually begin foraging, by fast-hawking in open spaces above tree canopies, over clearings and open water, and along fairly open waterways. They are often seen foraging between 10-100 m above ground, but also as low as 2-3 m above open ground. They combine circling (sometimes gaining

height) with long, straight flights and they make agile swerves and dives in pursuit of prey. They often forage in twos, the following bat flying lower than the leader, perhaps to catch moths which close their wings and fall, in response to the echolocation calls of the leader. They feed opportunistically on very hard-shelled beetles as well as soft-bodied insects. Sometimes they feed mainly on beetles, but they also take bugs, moths, dragonflies and other insects.

Angolan Free-tailed Bats forage singly, in twos or in large groups, and they roost in groups of 10-20 in small natural day-roosts, or in groups of several hundred in buildings. They huddle, sometimes three deep, with much jostling, climbing-over, pushing-under, twittering and squeaking (audible to humans) prior to settling down. Also, there is much movement and vocalizing for 1-2 hours prior to emergence. Composition of colonies and details of their social organization are not yet known.

**Reproduction** Litter size one (n = 32). Females give birth twice/year in Nov-Dec and again in Feb-Mar. There is a post-partum oestrus and mating after the first birth. Gestation: ca. 90 days. Elsewhere: litter size 1 and the females give birth twice/year, but the interval between consecutive births increases with decreasing latitude so that births always coincide with peaks in rainfall (Happold & Happold 1989b).

**Conservation** IUCN Category: Least Concern. This species has adapted well to semi-urban and agricultural environments because individuals like to roost, in large numbers, in roofs of houses and other buildings. However, they are sometimes threatened by spraying of pesticides and attempts to remove them from these roosts.

**Taxonomic Notes** *Tadarida condylura* (A. Smith, 1833). Subgenus *Mops*. Four subspecies. The subspecies in Malawi is *T. c. condylura*.

**Key References** Happold & Happold (1989b), Happold, M. (2013r).

**Measurements**
*Tadarida condylura*

| | |
|---|---|
| FA: | 46.8 (44-50) mm, n = 194 |
| TL: | 109.4 (96-120) mm, n = 49 |
| T: | 40.0 (34-47) mm, n = 50 |
| E: | 16.8 (13-24) mm, n = 40 |
| Tib: | 17.6 (16-19) mm, n = 54 |
| HF: | 12.9 (12-14) mm, n = 34 |
| WT: | 24.2 (16-34) g, n = 313 |
| GLS: | 19.6 (19.1-20.0) mm, n = 10 |

Malawi (Happold *et al.* 1987).

## *Tadarida (Tadarida) fulminans*

## Madagascan Free-tailed Bat

**Malawian Name**s Not known.

**Description** Medium-small microbat without nose-leaf and with terminal portion of tail projecting freely from posterior margin of interfemoral membrane; large for a Malawian free-tailed bat. Sexes different in colour, similar in size. Pelage velvety. Dorsal pelage (females) dark chocolate brown; no spots or flecking; hairs pale greyish-brown with dark chocolate brown tips. Ventral pelage (females) dark chocolate brown on flanks, paler on abdomen with white or cream mid-ventral band; ventral flank-stripe white or cream. Dorsal pelage (adult males) reddish-brown; no spots or flecking; hairs with basal half pale greyish-brown or creamy-fawn. Ventral pelage (adult males) reddish-brown on flanks, paler on abdomen with cream or yellowish mid-ventral band; ventral flank-stripe yellowish. Subadults same as adult females. Upper lip without well-defined wrinkles; comparatively few spoon-hairs. Ears dark brown, not reaching snout when laid forward; with inner margins meeting at base of forehead to form a V-shaped valley. Wing-membranes brown dorsally (paler over phalanges), whitish ventrally becoming browner towards tips. Interfemoral membrane dorsally brown, ventrally whitish, darkening towards margins. Ventral sides of legs naked and white (cf. *T. ventralis*). Foot with raised plantar pad on sole (cf. *T. ventralis*).

**Similar Species**

*Tadarida ventralis*. No ventral flank-stripe in contrasting colour. Foot usually without plantar pad.

**Distribution** In Malawi, only known from one individual recorded from Likabula River (ca. 750 m) at the base of Mulanje Mountain. Elsewhere: recorded from E DR Congo, Uganda, Rwanda, Kenya and Tanzania and southwards to NE South Africa. Also Madagascar.

**Habitat** In the vicinity of Likhubula River there is miombo woodland, riverine forest and tea plantations. The precipitous and often bare sides of the granite-syenite massif (Mulanje Mountain) above Likhubula undoubtedly provide day-roosts for this species.

**Abundance** Rarely-recorded in Malawi. Locally common but patchily distributed in Rwanda and Zimbabwe. Abundance probably determined by availability of day-roosts.

**Habits** Madagascan Free-tailed Bats roost during the day in narrow horizontal rock-crevices located either high up in vertical cliffs or under over-hangings. In Zimbabwe, most known roosts are on granite inselbergs, but one colony roosted in cracks in the ceiling of a dolomite cave. The bats scuttle around their roost-sites and scuttle backwards into crevices, using the tip of the tail to feel the way. In Malawi, Mount Mulanje is a granite-syenite massif whose precipitous sides almost certainly have the sort of crevices in which these bats roost. Madagascan Free-tailed Bats have a very high aspect ratio and very high to exceptionally high wing-loading; these bats and Giant Free-tailed Bats (*Tadarida ventralis*) have the narrowest wing-tips of any African free-tailed bat. Consequently, their flight is fast, agile, usually direct, but manoeuvarabilty is poor. The agile swooping flight as a bat returns to its day-roost, with air rushing over its wings, is very reminiscent of the flight of swifts. They emerge at dusk, remain active all night and do not return to their day-roosts until dawn. During the night, they forage for flying insects by fast-hawking in open spaces, and they are often seen over water which suggests that they need access to water for drinking. Madagascan Free-tailed Bats roost singly or in groups. No more than 20 individuals have been captured from any one day-roost but, in some cases, not all group-members were taken. Four captive adult males roosted separately, suggesting that they are territorial, and adult males have also been observed roosting singly in rock-crevices. In contrast, captive females huddled tightly together. Within day-roosts, there is much jostling and squeaking (audible to humans). Group-members emerge from the roost together and make shrill squeaks (audible to humans) as they dive away.

**Reproduction** No information for Malawi. Elsewhere: litter size 1 (n = 10). In Zimbabwe, the females appear to give birth more than once/year in distinct seasons but the number of births/year is not known.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Tadarida fulminans* (Thomas, 1903). Subgenus *Tadarida*. No subspecies. Not listed by Sweeney (1959).

**Key Reference** Cotterill (2013e).

**Measurements**
*Tadarida fulminans*

| | |
|---|---|
| FA: | 58.5 (56-61) mm, n = 50 |
| TL: | 144 (132-161) mm, n = 24 |
| T: | 57.5 (53-66) mm, n = 24 |
| E: | 23.5 (19-25) mm, n = 23 |
| Tib: | 21.2 (20-22) mm, n = 18 |
| HF: | 13.0 (11-15) mm, n = 14 |
| WT: | 34.6 (23-49) g, n = 58 |
| GLS: | 23.0 (21.6-24.4) mm, n = 39 |

Throughout African biogeographic range (Cotterill 2013e).

## *Tadarida (Mops) midas*

## Midas Free-tailed Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

**Description** Medium-sized microbat without nose-leaf and with terminal portion of tail projecting freely from posterior margin of interfemoral membrane; large for a Malawian free-tailed bat. Sexes almost similar. Pelage short, silky, sparse; nape almost naked. Grey-phase: dorsal pelage blackish-brown to greyish-brown, sometimes slightly frosted or flecked with pale grey; hairs with paler base and sometimes with white or pale grey tip. Crown same colour as back. Ventral pelage greyish-brown, pinkish-brown to silvery-grey, frosted; (subadults almost white); no mid-ventral markings; ventral flank-stripe white or paler than ventral pelage. Orange-phase: dorsal pelage reddish to almost orange. Upper lip with 5-6 well-defined wrinkles on each side and many spoon-hairs. Ears blackish-brown, extending just beyond snout when laid forward; inner margins joined over muzzle by interaural band with a V-shaped fold and a forward-projecting pocket-like invagination which protrudes ca. half way along muzzle. Males and females with interaural crest of longer, brown hairs arising from the interaural pocket. Wings and inter-femoral membrane dark brown

**Similar Species**
*Tadarida condylura*. Much smaller and lighter (FA: 45-51 mm; WT: 16-39 g).

**Distribution** In Malawi, known only from the Phalombe Plain (at 800 m), the escarpment between the Shire Highlands and the Upper Shire Valley (at 750 m), and the Lower Shire Valley (at < 100 m). Recorded from Chileka, Chiromo and Zoa Tea Estate. Elsewhere: recorded from very scattered localities from Senegal to Eritrea (but not from all countries, and southwards through S Sudan, NE DR Congo and W Kenya to N Nambia, Botswana and NE South Africa. The distribution often follows major rivers and rift valleys. Also occurs in Madagascar.

**Habitat** Miombo woodlands, riverine forests and other low altitude woodlands, often where there are villages, houses and other buildings, and farmlands including cotton fields.

**Abundance** Seldom-recorded in Malawi. Locally common in NE Botswana and Limpopo Valley, Zimbabwe. No other information.

**Habits** Midas Free-tailed Bats have been found roosting during the day in pitch-dark attics, in hollow cement bricks of the walls of buildings, in dimly lit expansion joints of bridges, under corrugated-iron roofs and, in Zaire, in very long, narrow fissures penetrating deeply into the trunks or large branches of trees. They also roost in narrow crevices in rocks, especially on cliff faces. Their flight is fast and agile with poor manoeuvrability, and they forage in open spaces including over canopies, open water and open plains. It seems that beetles are an important part of their diet, and they catch and eat them on the wing. There is no information about the social behaviour of Midas Free-tailed Bats in Malawi. In DR Congo, they roost in colonies of "dozens" and emerge together at dusk and also return together shortly before sunrise. They have also been seen foraging together in groups of about twelve individuals. In their roosts, they are restless and utter squeaks (audible to humans) at all hours of the day. In Botswana and Zimbabwe, colonies of "dozens" and also several hundreds have been reported.

**Reproduction** Litter size: 1 (n = 2). Births have been reported in Mar but there are no year-round data and the timing of events is not known. Elsewhere: no conclusive information.

**Conservation** IUCN Category: Least Concern. Probably threatened by destruction of woodland. In Malawi, this species has not adapted to semi-urban areas as well as *T. condylura* and *T. pumila*.

**Taxonomic Notes** *Tadarida midas* (Sundevall, 1843). Subgenus *Mops*. Two subspecies. The subspecies in Malawi is *T. m. midas*.

**Key Reference** Cotterill & Happold 2013d).

**Measurements**
*Tadarida midas*

| | |
|---|---|
| FA: | 61.1 (59-64) mm, n = 140 |
| TL: | 141.4 (126-150) mm, n = 167* |
| T: | 46.0 (37-55) mm, n = 167* |
| E: | 26.5 (23-32) mm, n = 167* |
| Tib: | 22.2 (20-24) mm, n = 23* |
| HF: | 13.0 (11-15) mm, n = 38* |
| WT: | 51.9 (39-69) g, n = 81 |
| GLS: | 27.4 (25.8-29.5) mm, n = 71* |

Malawi and Zimbabwe (NMMB, NMZB, Smithers & Wilson 1979).
*Throughout biogeographic range (Cotterill & Happold 2013d).

## *Tadarida (Chaerephon) nigeriae*

## Nigerian Free-tailed Bat

**Malawian Name**s Not known.

**Description** Small microbat without noseleaf and with terminal portion of tail projecting freely from posterior margin of interfemoral membrane. Sexes similar. Pelage short and dense; sparse between shoulder blades. Dorsal pelage blackish-brown; no spots, rarely flecking; hairs unicoloured. Ventral pelage dark brown; ventral flank-stripe white and very conspicuous. Upper lip with 5-7 well-defined wrinkles and many spoon-hairs. Ears blackish, almost reaching snout when laid forward; inner margins joined by interaural band with backward-opening pocket-like invagination in middle. In adult males, the pocket contains an interaural crest of dark brown or dark rusty-brown hairs ca. 6 mm long. Wing membranes whitish and semi-translucent dorsally and ventrally, or blackish; interfemoral membrane dark brown dorsally, paler ventrally. Skin on forearm dark brown dorsally extending narrowly onto wing-membrane as faint dark stripe.

**Similar Species** None.

**Distribution** In Malawi, known only from the Lake Shore (at 480 m) and the Shire Highlands (at 1000 m), but likely to be more widespread. Recorded only from Chintheche and Thondwe (Mpalanganga Dam). Elsewhere: the subspecies *T. n. spillmani* is recorded from Angola, S DR Congo, Zambia, S. Tanzania, N Botswana and Zimbabwe.

**Habitat** Miombo woodlands and other woodlands; farms with remnant riverine forest.

**Abundance** Rarely-recorded in Malawi. Elsewhere: *T. n. spillmani* is poorly represented in collections, but reported locally common in NE Botswana, Namibia and Zambia.

**Habits** Very little is known about this species in Malawi. In southern Africa, they have been found during the day under the exfoliating bark of dead trees (including trees standing in water); the moderately flattened skull of these bats (and other free-tailed bats) facilitates roosting such places. They have also been found roosting in a small cave and in Botswana, one roost under bark (see below) was shared with five adult pipistrelles. Nigerian Free-tailed Bats have a very high aspect ratio and high wing-loading and therefore their flight is predicted to be fast and agile but with poor manoeuvrability, and they are predicted to forage by fast-hawking on flying insects. They have been mist-netted over muddy pools in Botswana but it is not known if they were coming to drink or to forage. In Zimbabwe, a group of six emerged from a roost under bark and in Botswana, a colony roosting under bark included more than 25 adults (of which at least 13 were lactating females) as well as neonates and furred juveniles. In Zambia, they are sometimes found in colonies of 30-100 individuals.

**Reproduction** No information for Malawi. In Namibia, litter size 1 (n = 8). Limited data from southern Africa suggests births occur in the wet season, but year-round data are not available.

**Conservation** IUCN Category: Least Concern. However, in Malawi and elsewhere in southern Africa, roosts in trees are likely to be threatened by destruction of woodland.

**Taxonomic Notes** *Tadarida nigeriae* (Thomas, 1913). Two subspecies. The subspecies in southern Africa (including Malawi) is *T. n. spillmani*. First recorded in Malawi by Happold & Happold (1997).

**Key Reference** Cotterill & Happold (2013e).

**Measurements**
*Tadarida nigeriae*

| | |
|---|---|
| FA: | 48.0 (46-51) mm, n = 22 |
| TL: | 111.5 (103-122) mm, n = 13 |
| T: | 41.8 (35-48) mm, n = 13 |
| E: | 20.0 (18-23) mm, n = 13 |
| Tib: | 16.4 (14-19) mm, n = 11* |
| HF: | 11.1 (9-13) mm, n = 21* |
| WT: | 14.0 (12-16) g, n = 9 |
| GLS: | 19.6 (18.6-20.5) mm, n = 49* |

Southern Africa (NHMUK, NMZB, ROM, Smithers 1971).
*Throughout most of biogeographic range.

## *Tadarida (Chaerephon) pumila*

## Little Free-tailed Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Zomba, Malawi © DCD & M. Happold

**Description** Very small microbat without noseleaf and with terminal portion of tail projecting freely from posterior margin of interfemoral membrane. Sexes almost similar. Pelage short, velvety, sometimes greasy. Dorsal pelage usually dark chocolate brown but ranging from almost black to bright brown suffused with russet, no grizzling, no white flecks or spots; hairs with paler base. Ventral pelage similar or paler; mid-ventral markings very variable or absent; ventral flank-stripe white or whitish. Upper lip with 5-7 well-defined wrinkles, and many spoon-hairs. Ears black or dark brown; not reaching snout when laid forward; inner margins joined by interaural band with a backward-opening pocket-like invagination in middle. Adult males with interaural crest of short, brown hairs arising from the interaural pocket. Wings usually translucent and whitish or pale buff (sometimes dark brown). Interfemoral membrane blackish-brown.

**Similar Species** None.

**Distribution** In Malawi, widespread from north to south, in most biogeographic regions below 1050 m, including the Lake Shore (480 m) and Lower Shire Valley (< 100 m). Recorded from Chididi Mission, Chikonje, Chileka, Chintechi, Chitala River, Chiromo, Kasungu N. P., Lake Malawi N. P. (Cape Maclear, Mangochi, Monkey Bay), Lengwe N. P., Liwonde N. P., Lumenda, Luwazi Mission, Malosa, Matope, Mpyupyu Prison Farm, Mwalingo, Namazo Bay, Nkhata Bay, Nkhotakota, Nsanje, Upudu Village on Upper Shire River and Zomba. Elsewhere: widespread but disjunctly distributed south of the Sahara, mostly in savanna habitats, from Senegal to Eritrea, Ethiopia and Somalia, and southwards to Angola, Botswana and KwaZulu Natal in South Africa.

**Habitat** Found in almost all Malawian habitats except montane habitats; also exploits farmlands including cotton fields. Well adapted to towns, villages, game scout camps and housing for farm workers.

**Abundance** Very commonly-recorded in Malawi; greatly advantaged by its ability to exploit semi-urban environments and the ability to roost in houses. Elsewhere: common to very common.

**Habits** Like Angolan Free-tailed Bats, Little Free-tailed Bats are frequently encountered in Malawi because they roost under the roofs of houses and other buildings, as well as in hollow trees and palms, gaps in thatch, and in narrow cracks in tree trunks and brickwork. They are not known to roost in caves, or under or amongst rocks in Malawi. They show at least some roost-fidelity and sometimes they roost with Angolan Free-tailed Bats. When they roost in the roofs of house, they are sometimes considered to be pests; however, they feed on moths including the moths of the Cotton Bollworm and they have been seen in large numbers, foraging for these serious pests over Malawi's cotton fields. Like Angolan Free-tailed Bats, they often roost under corrugated iron roofs and experience challenging temperatures and humidities. The bats cling or crouch against sloping or horizontal surfaces and they prefer to tuck themselves into small crevices into which they scuttle backwards, using tactile hairs on their rumps, feet (and probably tails) for guidance. They are known to chase and eat cockroaches in their day-roosts. During the day, they become torpid if the temperature drops below 24°C. Because evaporative water loss is very high during flight, independence of drinking water in the wild is highly unlikely.

Little Free-tailed Bats have a high aspect ratio and medium wing-loading and their flight is fast and agile but with very poor manoeuvrability. They cannot hover or take off from the ground, and they must dive at least 1.5 m to gain sufficient speed for flight. Also, they must swoop upwards to reduce speed prior to landing. They eat moths, flies, beetles, winged-termites, bugs and a variety of other mainly soft-bodied insects. They emerge from their day-roosts soon after dusk – earlier on overcast

evenings, and later on moonlit evenings – and forage by fast-hawking high above tree canopies, over clearings and open water, and sometimes between well-spaced tree trunks and along fairly open waterways. They are often seen foraging about 50-70 m above the ground, and sometimes within 2-3 m of open ground. They combine circling (often gaining height) with long straight flights; and they swerve and dive in pursuit of prey.

Little is known about the social behaviour of Little Free-tailed Bats in Malawi. In Ghana, the social organization is based on harem formation. In contrast, a captive group of four males and six females from South Africa roosted in clusters which often included more than one male, and the dominant male did not exclude subordinate males from access to clusters of females suggesting that these bats did not form harems. One day-roost in Malawi contained 20-30 individuals at any one time during a nine-month study, but the composition of the colony was labile and the ratio of adult males to females in monthly captures of bats emerging at dusk was close to one male to four females.

**Reproduction** Litter size: 1 (n = 23). Most females give birth twice/year, in Nov and again in Jan, in the wet season. About. 44% have a third birth in March at the end of the wet season, and just a few have a fourth birth early in the cool dry season (May). There is a post-partum oestrus and the interval between consecutive births appears to be ca. 6o days, and lactation lasts for at least 3-4 weeks. Most females appear to breed in the breeding season following their birth, when they are 6-10 months old. The weight of one neonate was 25% of the weight of its mother. Elsewhere in Africa: litter size normally 1, very rarely 2. Females give birth 2-5 times/year, in distinct seasons, but the timing of events varies biogeographically to ensure that most (but not all) young are born in wet seasons (Happold & Happold 1989b).

**Conservation** IUCN Category: Least Concern. This species has adapted well to semi-urban and agricultural environments because likes to roost, in large numbers, in roofs of occupied house, and other buildings.

**Taxonomic Notes** *Tadarida pumila* (Cretzschmar, 1830-1831). Subgenus *Chaerephon*. No subspecies, but the species as a whole includes forms with white wings, white ventral flank-stripe and pale mid-ventral markings; others have dark wings and uniformly dark pelage. The white-winged form occurs in Malawi. Referred to as *T. limbata* by Sweeney (1959).

**Key References** Happold & Happold (1989b), Happold, M. (2013s).

**Measurements**
*Tadarida pumila*

| | |
|---|---|
| FA: | 38.1 (36-39) mm, n = 108 |
| TL: | 88.5 (72-95) mm, n = 25 |
| T: | 32.3 (29-37) mm, n = 42 |
| E: | 14.9 (14-17) mm, n = 24 |
| Tib: | 13.1 (12-15) mm, n = 27 |
| HF: | 8.9 (8-10) mm, n = 23 |
| WT: | 10.4 (7-16) g, n = 152 |
| GLS: | 16.5 (14.9-17.6) mm, n = 32 |

Malawi (Happold *et al.* 1989).

## *Tadarida (Tadarida) ventralis*

## Giant Free-tailed Bat

**Malawian Names** Not known.

**Description** Medium-sized microbat without nose-leaf and with terminal portion of tail projecting freely from posterior margin of interfemoral membrane; large for a Malawian free-tailed bat (FA: 60-67 mm). Sexes similar except males on average heavier than females. Pelage velvety, sometimes glossy. Grey-phase: dorsal pelage chocolate brown, rusty-brown or dark brown without spots or flecking; hairs with beige or cream at base. Ventral pelage paler with white or cream mid-ventral stripe; ventral flank-stripe same colour as flank but with longer hairs. Orange-phase: dorsal pelage orange-brown, ventral pelage yellowish. Upper lip without well-defined wrinkles and comparatively few spoon-hairs. Ears brown, extending to middle of muzzle when laid forward; inner margins meeting on forehead to form a V-shaped valley. No interaural crest. Wings and interfemoral membrane semi-translucent, dark brown to almost black. Ventral sides of legs naked and brownish (cf. *T. fulminans*). Foot without raised plantar pad on sole (cf. *T. fulminans*).

**Similar Species**
*Tadarida fulminans*. Ventral sides of legs naked and white. Foot with plantar pad.

**Distribution** In Malawi, recorded only on the Phalombe Plain, from one specimen collected at Zoa Estate at 800 m. Possibly also recorded from Limbuli Estate. Elsewhere: recorded, mostly from scattered localities, in Eritrea, Ethiopia, S Sudan, E DR Congo, Kenya, Tanzania Zimbabwe, Mozambique and the former Transvaal in South Africa.

**Habitat** Both localities are tea estates which probably have remnants of riverine forest, miombo woodland and lowland rainforest.

**Abundance** Rarely-recorded in Malawi. Elsewhere: very rarely collected.

**Habits** Nothing is known about the habits of Giant Free-tailed Bats in Malawi. In Kenya, two specimens were collected as they emerged from the roofs of houses, and a skull was recovered from an owl pellet underneath crevices in a large granitic overhang in S Zimbabwe. As in Madagascan Free-tailed Bats, the wingtips are extremely narrow and flight is predictably fast, direct and agile, but with poor manoeuvrability; individuals undoubtedly forage for flying insects in open spaces.

**Reproduction** No conclusive information for Malawi or elsewhere. A pregnant female with one foetus was collected in E Zambia in Nov.

**Conservation** IUCN Category: Data Deficient. Poorly known despite intensive sampling effort. The species has a wide biogeographic range but is probably threatened by pesticides and loss of habitat.

**Taxonomic Notes** *Tadarida ventralis* (Heuglin, 1861). Subgenus *Tadarida*. No subspecies. Not listed by Sweeney (1959).

**Key Reference** Cotterill (2013f).

**Measurements**
*Tadarida ventralis*

| | |
|---|---|
| FA: | 63.7 (60-67) mm, n = 49 |
| TL: | 153.3 (142-168) mm, n = 36 |
| T: | 58.3 (51-66) mm, n = 36 |
| E: | 24.7 (18-29) mm, n = 36 |
| Tib: | n. d. |
| HF: | n. d. |
| WT (males): | 45 (38-55) g, n = 23 |
| WT (females): | 39 (31-46) g, n = 10 |
| GLS: | 23.8 (23.4-26.1) mm, n = 51 |

Throughout biogeographic range (FMNS, HZM, LACM, NHMUK, NMZB, ROM).

# FAMILY VESPERTILIONIDAE – Vesper Bats

This family contains bats of many different sizes, colours and ear-shapes, but all have a comparatively plain face without a noseleaf, and a tail more-or-less completely enclosed by the interfemoral membrane. In Malawian genera, most species are brown, grey or blackish-brown with paler bellies, but some have unexpectedly colourful pelage and/or wings, and some have reticulated wings with a net-like pattern. The ears are well separated and have a conspicuous tragus.

There is greater diversity in the adaptations and habits of Vesper Bats than in any other family. Aspect ratios range from low to medium and wing-loadings from low to very high. Consequently, their flying abilities and foraging habits are very varied. Most are moderately adapted for scuttling and climbing. The majority of African Vesper Bats emit echolocation calls which are high intensity frequency modulated calls, but *Kerivoula* spp. are whispering bats whose calls are very low intensity. Echolocation calls are emitted from the mouth, so bats with open mouths and bared teeth are usually just having a good look at you. Vesper Bats exploit almost all sorts of day-roosts known to be used by bats, and they almost always cling in contact with the horizontal or sloping surfaces of their roosts. Therefore, they do not compete with bats which hang freely.

In Malawi, there are nine genera and 24 species of Vesper Bats. They are placed in three subfamilies; genus *Kerivoula* in subfamily Kerivoulinae, genus *Myotis* in subfamily Myotinae, and all other genera in subfamily Vespertilioninae, but the species are profiled in alphabetical order of scientific names, irrespective of subfamily affiliations. The genera are distinguished as follows in the yellow box below. It is difficult to distinguish the genera without looking at the number of upper incisors (which can be seen on live animals in hand).

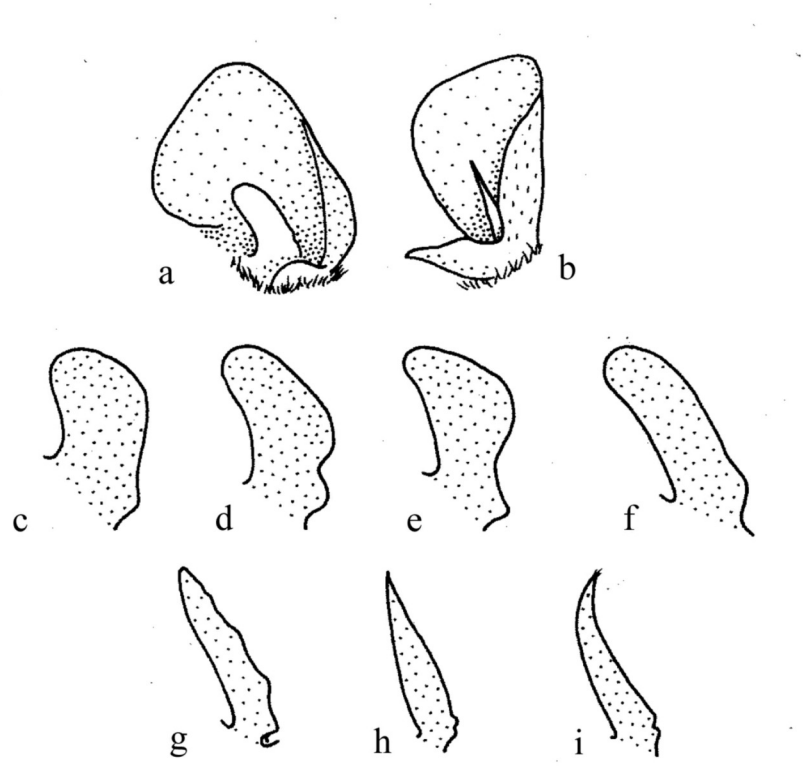



Fig. 17 . Ears and tragi of bats in the families Vespertilionidae and Miniopteridae to show differences between genera. (a) Ear not funnel-shaped. (b) Ear funnel-shaped (as in *Kerivoula*). Tragus short and blunt as in (c ) *Scotoecus*, (d ) *Laephotis*, (e) *Glauconycteris* and (f) *Miniopterus*. Tragus long and narrow but not sharply pointed as in (g) *Myotis*. Tragus long, narrow and sharply pointed as in (h) and (i) *Kerivoula* spp.

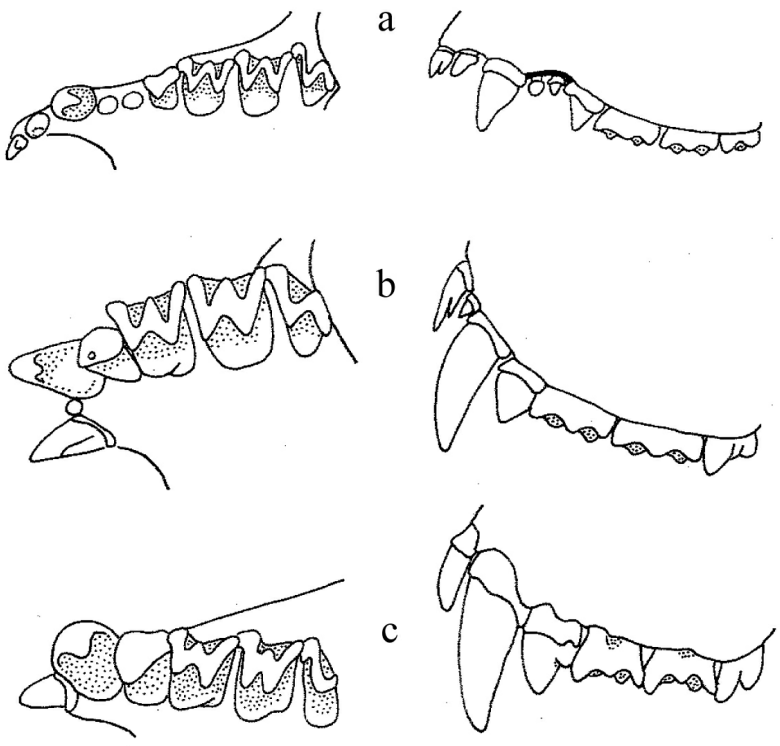



Fig. 18. Variations in the number of upper incisors and cheekteeth on each side in the family Vespertilionidae. Left: occlusal views of teeth on left side of upper jaw. Right: lateral views of the labial (outer) sides of the same teeth. (a) Two incisors and six cheekteeth (as in *Kerivoula*, *Myotis*). (b) Two incisors and four cheekteeth (as in *Eptesicus, Glauconycteris, Laephotis*). (c) One incisor and four cheekteeth (as in *Nycticeinops, Scotophilus*).

*Kerivoula*. Two upper incisors on each side. Six upper cheekteeth on each side. Ears funnel-shaped; tragus long, narrow and sharply pointed (cf. *Myotis*). Pelage frizzled (cf. not frizzled in the other genera). FA: 28-39 mm.

*Myotis* Two upper incisors on each side. Six upper cheekteeth on each side. Ears not funnel-shaped; tragus long and narrow but not sharply pointed (cf. *Kerivoula*). FA: 36-60 mm.

*Laephotis* Two upper incisor on each side. Four upper cheekteeth on each side. Ears relatively long, reaching well beyond snout when laid forward (cf. not reaching beyond snout in the other genera). Outer margin of ear not reaching mouth. FA: 33-39 mm.

*Glauconycteris*. Two upper incisors on each side. Four upper cheekteeth on each side. Ears relatively short. Outer margin of each ear reaches the mouth (cf. all other genera). Lower lip with lobe at posterior angle (cf. all other genera). With or without body pattern and reticulated wings. FA: 39-46 mm.

*Eptesicus*. Two upper incisors on each side. Four upper cheekteeth on each side. Ears relatively short. Outer margin of ear not reaching mouth. No body pattern; wings not reticulated. FA: 45-50 mm.

*Pipistrellus* (including *Neoromicia*). Two upper incisors on each side. Four or five upper cheekteeth on each side. Ears relatively short. Outer margin of ear not reaching mouth. No body pattern; wings not reticulated. FA: 28-38 mm.

*Scotophilus* One upper incisor on each side. Four upper cheekteeth on each side. Penis relatively short. FA: more than 41 mm.

*Nycticeinops* One upper incisor on each side. Four upper cheekteeth on each side. Penis relatively short (cf. *Scotoecus*). Upper canine with anterior surface rounded and not grooved (cf. *Scotoecus)*. FA: less than 35 mm.

*Scotoecus* One upper incisor on each side. Four or five upper cheekteeth on each side. Penis extremely long (cf. *Nycticeinops*). Upper canines with anterior surface flat and grooved (cf. *Nycticeinops*). FA: less than 35 mm.

Table-key 4 to the genera of vesper bats (family Vespertilionidae) found in Malawi.

| **Number of upper incisors** | **Number of upper cheekteeth** | **Ear length (relative length of ear). Ear characters.** | **Miscellaneous** | **FA (mm)** | **Genus** |
|---|---|---|---|---|---|
| 2 | 4 or 5 | 8-16 mm, short. Outer margin of ear not reaching mouth. Tragus relatively short. | No body pattern; wings not reticulated. | 28-38 | *Pipistrellus* |
| 2 | 4 | 18-22 mm, long. Outer margin of ear not reaching mouth. Ears reaching well beyond snout when laid forward (cf. not reaching snout in other genera. Tragus relatively short | No body pattern; wings not reticulated. | 33-39 | *Laephotis* |
| 2 | 4 | 8-15 mm, short. Outer margin of each ear reaches the mouth. Tragus relatively short. | With or without body pattern and reticulated wings. Lower lip with lobe at posterior angle (cf. all other genera). | 39-46 | *Glauconycteris* |
| 2 | 4 or 5 | 9-19 mm Outer margin of ear not reaching mouth. Tragus short and blunt. Tragus relatively short. | Penis extremely long (cf. *Nycticeinops*). Upper canines with anterior surface flat and grooved (cf. *Nycticeinops*). | 29-38 | *Scotoecus* |
| 1 | 4 | 16-17 mm, short. Outer margin of ear not reaching mouth. Tragus relatively short. | No body pattern; wings not reticulated. | 45-50 | *Eptesicus* |
| 1 | 4 | 16-17 mm, short. Outer margin of ear not reaching mouth. Tragus moderately short. | Penis relatively short. | 41-88 | *Scotophilus* |
| 1 | 4 | 16-17 mm, short. Outer margin of ear not reaching mouth. Tragus relatively short. | Penis relatively short (cf. *Scotoecus*). Upper canine with anterior surface rounded and not grooved (cf. *Scotoecus)* | 25-32 | *Nycticeinops* |
| 1 | 6 | 13-24 mm, short Ears not funnel-shaped; tragus long and narrow but not sharply pointed. | | 36-60 | *Myotis* |
| 1 | 6 | 10-15 mm, short. Ears funnel-shaped (cf. all other genera); tragus long, narrow and sharply pointed. | Pelage frizzled (cf. not frizzled in the other genera). | 28-39 | *Kerivoula* |

# Genus *Eptesicus* - Serotines

Subfamily Vespertilioninae. This genus contains about 23 species of which five occur in Africa. There is only one species in Malawi. Several species previously placed in *Eptesicus* and commonly called Serotines, have been removed from this genus and placed in *Pipistrellus* in the subgenus *Neoromicia*.

## *Eptesicus hottentotus*

## Long-tailed Serotine

Limpopo Province, South Africa © C. & M. Stuart

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

**Description** Small microbat without nose leaf and with tail more or less fully enclosed in interfemoral membrane; four upper cheekteeth on each side; two upper incisors on each side. Sexes similar. Dorsal pelage varying from pale brown to almost black, often with silky sheen; hairs dark at base with paler tips. Ventral pelage paler, often with creamy sheen; hairs with basal two-thirds blackish-brown, terminal third pale greyish-brown with cream or whitish tips. Ears dark brown to blackish, relatively short, tip rounded. Tragus about one-third of the ear length; broadest at base; posterior margin mostly straight but smoothly convex near tip; tip rounded. Wings and interfemoral membrane brown (when pelage is comparatively pale) to blackish-brown; no white hind-border. Tail with terminal vertebra slightly protruding beyond interfemoral membrane.

**Similar Species**

Malawian *Pipistrellus* (8 spp.). All much smaller (FA: less than 40 mm).

**Distribution** Known from the southern region of Malawi, on the edge of the Central Plateau (1100 m), on the Shire Highlands and Mulanje Mountain, and in the Lower Shire Valley (< 100 m). Recorded from Chiromo, Mulanji Mountain (Plateau), Ntcheu, Zomba and Zomba Plateau. Elsewhere: there are scattered records from Kenya, NE Zambia, SW Angola, Zimbabwe, NW Mozambique, Namibia and South Africa.

**Habitat** Montane habitat with evergreen forest and montane grasslands, miombo woodlands, ornamental gardens with large trees and (in contrast, at Chiromo), flat country with riverine forest along the Ruo River, houses and ornamental gardens with large trees, communal farmlands, cotton fields and marshes.

**Abundance** Rarely-recorded in Malawi. Elsewhere: locally abundant in NE Zimbabwe and at Cederberg, Western Cape Province, South Africa.

**Habits** Nothing is known about Long-tailed Serotines in Malawi, but there are some observations from Zimbabwe and South Africa. During the day they have been found in caves (wet and dry), abandoned mines, a small hollow in rocks at the entrance of an old mine (also inhabited by Natal Long-fingered Bats), and on the outside wall of a building. They have a low aspect ratio and medium wing-loading, and they are described as clutter-edge foragers that feed mainly on beetles. One was caught while flying low over a marsh. Six were captured partly over water and partly over land at the edge of the water. Long-tailed Serotines roost singly or in groups of unknown composition. Not more than five roosting together have been recorded.

**Reproduction** No conclusive information for Malawi or elsewhere in Africa. In NE Zimbabwe, 9 of 9 females were either heavily pregnant or lactating at beginning of the wet season (mid-Nov).

**Conservation** IUCN Category: Least Concern. Considered as threatened in Malawi (Happold & Happold 1997).

**Taxonomic Notes** *Eptesicus hottentotus* (A. Smith, 1833). Four subspecies have been recognized but their status is uncertain. If valid, the subspecies in Malawi is *E. h. bensoni*. Other species of *Eptesicus* recorded from Malawi in the past are now considered to represent *Pipistrellus (Neoromicia)*.

**Key Reference** Cotterill & Happold (2013f).

**Measurements**
*Eptesicus hottentotus*

| | |
|---|---|
| FA: | 46.5 (45-50) mm, n = 31 |
| TL: | 115 (105-125) mm, n = 7 |
| T: | 47.9 (46-51) mm, n = 17 |
| E: | 16.1 (16-17) mm, n = 17 |
| Tib: | 19.0 (17-21) mm, n = 4 |
| HF: | 9.3 (9-10) mm, n = 4 |
| WT: | 16.6 (11-20) g, n = 6* |
| GLS: | 19.6 (16.9-21.5) mm, n = 77 |

Malawi, Mozambique and Zimbabwe

# Genus *Glauconycteris* - Butterfly Bats

Subfamily Vespertilioninae. This genus contains 12 species, all endemic to sub-Saharan Africa. Two species occur in Malawi. They are easily distinguished because *G. variegata* has conspicuously reticulated wings (i.e. the bones and veins stand out as dark against a pale background) whereas the wings of *G. argentata* are only faintly reticulated near the body.

## *Glauconycteris argentata*

## Common Butterfly Bat

**Malawian Names** Not known.

**Description** Small to very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; four upper and five lower cheekteeth and two upper incisors on each side. Sexes similar. Pelage dense. Dorsal pelage (in savanna habitats) pale golden-fawn, pale cinnamon or pale greyish brown; paler on head; hairs tricoloured - beige with brown at base and golden-fawn to greyish-brown at tip. There is a paler dorsal flank-stripe which may be indistinct in some individuals. Ventral pelage darker and greyer than dorsal pelage. Head high-domed; muzzle short, broad, flattish. Ears rounded, brown; inner margin with moderately long, rounded, backward-pointing lobe at base; outer margin connecting with a smooth, broad, rounded, fleshy lobe on lower lip near corner of mouth. Eyes very small. Wings and interfemoral membranes translucent, pale brown; faintly reticulated near body.

**Similar Species** None in Malawi.

**Distribution** In Malawi, known only from one specimen from the Misuku Hills (ca. 1900 m). Elsewhere: recorded disjunctly, and not in all countries, from Cameroun and Equatorial Guinea to SW Kenya, and southwards to about 10°S. Not known from Zambia or Mozambique.

**Habitat** Presumably montane evergreen forest and/or miombo woodlands but no details are available. Recorded from rainforest, miombo and coastal forests elsewhere in Africa.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain; fairly common in collections.

**Habits** Nothing is known about these bats in Malawi, and almost nothing is known about them elsewhere except that, during the day, they have been found clinging to the undersides of palm fronds. One such roost of about 30 individuals was about seven metres above ground. One observer recorded that "They cling to the 'leaves' near the midrib in groups, only two to four on each leaf; they do not hang clear with their heads down but cling to the leaf with their tails towards the midrib, the head of the one nearest the midrib rests upon the back of the next bat in front of him." One roosting group of ca. 25 included four males and three females of which two were lactating and one was neither pregnant nor lactating.

**Reproduction** No conclusive information for Malawi or elsewhere.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Glauconycteris argentata* (Dobson, 1875). No subspecies. Not listed by Sweeney (1959).

**Measurements**
*Glauconycteris argentata*

| | |
|---|---|
| FA: | 41.7 (39-44) mm, n = 67 |
| TL: | 100.5 (94-114) mm, n = 62 |
| T: | 46.5 (41-53) mm, n = 63 |
| E: | 11.6 (8-14) mm, n = 63 |
| Tr: | 4.3 (3-5) mm, n = 4* |
| Tib: | 18.3 (17-20) mm, n = 61 |
| HF: | 7.5 (5-10) mm, n = 63 |
| WT: | 9.2 (6-12) g, n = 44 |
| GLS: | 12.9 (12.1-13.3) mm, n = 61 |

Throughout biogeographic range (NHMUK, Peterson & Smith 1973 in Happold, M. 2013t). *Kenya.

## *Glauconycteris variegata*

## Variegated Butterfly Bat

**Malawian Names** Liputiputi, Ndemiya, Namsimsi, Namzeze. Same for other microbats.

Chiromo, Malawi © DCD & M. Happold

**Description** A very beautiful, small to very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; four upper and five lower cheekteeth and two upper incisors on each side; flight-membranes conspicuously reticulated. Sexes similar. Pelage dense, soft. Dorsal pelage pale creamy-buff to yellowish-fawn sometimes becoming paler on head and neck; hairs pale creamy-buff or yellowish fawn with paler base, or creamy-white with brown base and yellowish-fawn tip. Ventral pelage yellowish-cream, sometimes suffused with pale grey especially on throat. Head high-domed; muzzle short, broad and flattish. Ears light brown; outer margin connecting with fleshy lobe near corner of mouth; inner margin with moderately long, backward-pointing lobe at base. Eyes very small. Wings and interfemoral membrane pale yellowish-orange with dark brown pigment outlining bones and venation (i.e. conspicuously reticulated).

**Similar Species** No other species in Malawi has conspicuously reticulated wings.

**Distribution** In Malawi, known only from the Phalombe Plain and Lower Shire Valley (<100 – 900 m), but this bat flies high and is probably hard to collect. Recorded from Chiromo, Luchenza and Thyolo. Elsewhere: known from scattered populations and isolated records from Senegal to Ethiopia and Somalia and southwards to N Namibia, N Botswana to N South Africa (but not yet recorded from all countries within this area).

**Habitat** At Chiromo, found in riverine forest in ca. 1920 and also, in 1994, in an abandoned ornamental garden with large trees on the bank of the Ruo River, with riverine forest, abandoned buildings, communal farmland and marshes nearby.

**Abundance** Rarely-recorded in Malawi. Elsewhere: rarely recorded and considered rare throughout its biogeographic range, but its habits make this species difficult to find and capture.

**Habits** At Chiromo one was found "on [the] branch of a tree in forest" in 1920, and it was the only individual found in five years. Elsewhere, including in Zimbabwe, they have been found roosting within dense clusters of leaves and, because their reticulated wings resemble dead leaves, roosting bats are very hard to see unless they move. They have also been found in the thatch of abandoned buildings. In Zimbabwe, one group roosted on the underside of the canopy of a Natal Mahogany tree (ca 7.5 m above ground) and returned to roost in the same cluster of leaves for several consecutive days, despite being disturbed every day. Variegated Butterfly Bats have a low aspect ratio, low to very low wing-loading and comparatively long pointed wing-tips. This implies that they can fly slowly as well as moderately fast. Manoeuvrability is moderate and they can take off from the ground. On overcast days, they sometimes leave their roosts up to two hours before sunset, and forage by moderately fast-hawking high above the ground in uncluttered environments: they "flutter swiftly, now and then increasing their speed with such spontaneous ease that one hardly notices the quickened beating of their wings as they gather their tiny insect prey." They can also forage close to clutter, such as between trees. Stomach contents and faeces, of perhaps no more than three individuals, contained moths. Variegated Butterfly Bats have been found roosting singly, in pairs and in groups of three to ca. 12, but there seem to be no records of the composition of all individuals in a group.

**Reproduction** No information for Malawi. Elsewhere: litter-size 1 (n = 5) or 2 (n = 1); the timing of events is not known. In Zimbabwe, pregnancies were recorded in Aug and births in Nov, but there are no data for other months.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Glauconycteris variegata* (Tomes, 1861). Two subspecies. The subspecies in Malawi is *G. v. variegata.*

**Key References** Happold, M. (2013u).

**Measurements**
*Glauconycteris variegata*

| | |
|---|---|
| FA: | 44.4 (42-46) mm, n = 7 |
| TL: | 106.8 (103-110) mm, n = 12 |
| T: | 46.9 (44-50) mm, n = 15 |
| E: | 13.8 (13-15 mm, n = 15 |
| Tr : | 3, 4 mm, n = 2 |
| Tib: | 20.8 (20-22) mm, n = 5 |
| HF: | 8.8 (8-10) mm, n = 3 |
| WT: | 12.3 (11-14) g, n = 17 |
| GLS: | 14.1 (13.7-14.5) mm, n =23* |

Malawi, Mozambique and Zimbabwe.
*Throughout biogeographic range (Peterson & Smith 1973).

# Genus *Kerivoula* - Woolly Bats

Subfamily Kerivoulinae. This genus contains 19 species of which seven occur in Africa. Woolly Bats are so-called because they have frizzled woolly pelage. Unlike all other genera of Vesper Bats, they have funnel-shaped ears with a long, narrow and sharply pointed tragus. They have two upper incisors and six upper cheekteeth on each side.

Woolly Bats are known as whispering bats because they echolocate by emitting very low-intensity calls. In this, they resemble slit-faced bats (*Nycteris)*. They have low aspect ratios and very low wing-loadings and can fly with great manoeuvrability in very cluttered habitats. They are probably gleaners. A closely-related species in the genus *Phoniscus* (from New Guinea and Australia) is a spider-specialist, which raises the possibility that Woolly Bats might also feed mainly on spiders.

Two species of *Kerivoula* occur in Malawi. They are not easily distinguished except by the colour of their dorsal pelage.

*K. argentata.* Dorsal pelage bright rusty-brown with conspicuous, almost iridescent, silvery frosting.

*K. lanosa*. Dorsal pelage variable, dark sepia brown, golden-brown, greyish-brown or pale grey with less obvious frosting (sometimes only faintly frosted).

## *Kerivoula argentata*

## Damara Woolly Bat

**Malawian Names** Not known.

Liwonde N. P., Malawi © DCD & M. Happold

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors and six upper cheekteeth on each side. Sexes similar. Pelage woolly and frizzled (many hairs with hooked tips), extending onto dorsal surface of forearm and tibia. Dorsal pelage bright rusty-brown with conspicuous, almost iridescent, silvery frosting; hairs pale chestnut with dark brown at base and terminal quarter rusty-brown, often with silvery or white tip. Ventral pelage pale grey or white. Head high-domed; muzzle long, narrow, flattened, mostly hidden by facial pelage; snout prominent. Eyes minute. Ears widely separated, funnel-shaped with sharply pointed tip; outer margin with concavity below tip. Tragus long (ca. 60% of ear length), narrow, tapering to sharp point. Wings and interfemoral membrane brown, translucent. Posterior margin of interfemoral membrane (between tips of calcars) with comb-like fringe of bristle-like hairs which curve inwards like hooks

**Similar Species**

*Kerivoula lanosa*. Dorsal pelage dark brown to pale grey (with frosting). Ventral pelage sepia brown, grey to whitish. On average, FA shorter (31.5 [30-34] mm).

**Distribution** In Malawi, known only from four widely separated localities on the Misuku Hills, Central Plateau and in Upper Shire Valley, at altitudes of 500 m to >1500 m. Recorded from Liwonde N. P., Misuku Hills (Mughese Forest), Ntcheu, and Ntchisi Mountain F. R. Elsewhere: recorded from S DR Congo, SW Kenya, Tanzania, Zambia, Mozambique, Zimbabwe, Namibia and South Africa and perhaps Angola.

**Habitat** Miombo woodlands and montane evergreen forest. At Ntchisi Mountain F. R., one was found in a ravine with montane forest. In southern Africa, they tend to exploit well-watered areas and riverine habitats in drier areas.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain; rarely encountered but this might reflect its habits and ability to avoid capture.

**Habits** The day-roosts of Damara Woolly Bats are most unusual. There are no records from Malawi but elsewhere they have been found most often in the nests of weaver birds including Southern Masked Weavers and Spectacled Weavers (both of which occur in Malawi). However, they have also been found roosting in exposed places including among clusters of dead leaves, on the rough bark of a tree, under the eaves of a hut, and on a wall sheltered by the eaves of a rondavel. Their frosted brown pelage provides roosting bats with effective camouflage: one cluster roosting under eaves resembled a mud-nest made by wasps. The long woolly pelage of these bats may help them to keep them warm when they roost outside in cold weather.

These bats have a low aspect ratio and very low wing-loading, and their flight is slow and resembles fluttering. They fly with very great manoeuvrability, are able to take off from the ground and can hover briefly. One individual sustained flight in a 1 x 1 x 1 m enclosure for 32 circuits and sometimes flew figure-8s (as did Bushveld Horseshoe Bat, *Rhinolophus simulator* and Hairy Slit-faced Bat, *Nycteris hispida*). There is no information about the diet and foraging habits of Damara Woolly Bats but, based on the shape of their wings, their slow and manoeuvrable flight and their "whispering" echolocation, they probably forage near the ground in habitats cluttered by vegetation. The capture of one individual about one metre above the ground supports this suggestion. They probably forage by gleaning and the possibility that they are "spider specialists" needs investigation.

Damara Woolly Bats (in southern Africa) roost singly, in pairs or in groups of up to six whose composition is not known. Up to three individuals have been found, tightly huddled together, in weaver bird nests, and groups of 4-5 have been found hanging in tightly packed clusters under eaves. One such group was comprised of five females.

**Reproduction** No information.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Kerivoula argentata* Tomes, 1861. Three subspecies. The subspecies in Malawi is *K. a. argentata.*

**Key Reference** Cotterill (2013g).

**Measurements**
*Kerivoula argentata*

| | |
|---|---|
| FA: | 35.1 (28-39) mm, n = 23 |
| TL: | 88.9 (74-102) mm, n = 27 |
| T: | 43.3 (40-52) mm, n = 27 |
| E: | 13.2 (11-15) mm, n = 31 |
| Tr: | 6.9 (6.3-7.5) mm, n = 3 |
| Tib: | 15.6 (14-17) mm, n = 8 |
| HF: | 10.3 (10-11) mm, n = 8 |
| WT: | 7.4 (5.5-10.5) g, n = 23 |
| GLS: | 15.7 (14.7-16.5) mm, n = 15 |

Malawi, Angola, Mozambique, Zimbabwe (Cotterill 2013g).

## *Kerivoula lanosa*

## Lesser Woolly Bat

**Malawian Names** Not known.

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors and six upper cheekteeth on each side. Sexes similar. Pelage fine, woolly and frizzled (many hairs with hooked tips). Dorsal pelage variable, dark sepia brown, golden-brown, greyish-brown or pale grey; hairs dark brown at base, many with a pale brown, cream, silvery or white tip giving pelage a frosted appearance (sometimes not very conspicuous). Ventral pelage similar or paler, sometimes whitish at least on chest and belly; hairs with basal half dark brown, medium greyish-brown or grey; some hairs with white tip. Head high-domed; muzzle long, pointed, hidden by facial pelage; snout prominent. Eyes minute. Ears widely separated, funnel-shaped with pointed tips, semi-translucent pale brown; outer margin with concavity below tip. Tragus long (68 [62-74])% of ear length), narrow, tapering to sharp point. Wings and interfemoral membrane semi-translucent, pale grey to pale brown; thumb long and slender. Posterior margin of interfemoral membrane (between tips of calcars) with comb-like fringe of bristle-like hairs which curve inwards like hooks.

**Similar species**

*Kerivoula argentata.* Dorsal pelage bright rusty-brown (with conspicuous frosting). Ventral pelage cream, dirty-white or white. On average, FA longer (35.1 [28-39] mm).

**Distribution** In Malawi, known only from the Phalombe Plain at Thyolo at ca. 900 m. Elsewhere: widespread scattered records from Liberia and Guinea to Ethiopia (but not from all countries) and southwards, on the eastern side of Africa to South Africa.

**Habitat** At Thyolo, the bats were found in a clump of bamboos in forest full of bamboos. In South Africa, they occur in well-watered areas, but they also exploit riverine habitats in dry areas.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain; poorly represented in collections but this might reflect its habits and ability to avoid capture.

**Habits** Lesser Woolly Bats, like Damara Woolly Bats, have been found roosting in the hanging grass nests made by weaver birds more often than anywhere else, but they also roost in foliage and some have been taken from the hanging nests made of cobwebs by sunbirds. The woolly texture of their pelage probably helps to keep them warm when the weather is cool. The wings of Lesser Woolly Bats are broad and therefore their flight is predictably slow and highly manoeuvrable (as for Damara Woolly Bats), and also because of their echolocation calls are predicted to enable them to glean prey from foliage. Possibly they are "spider specialists". In Botswana, a single female was found in a sunbird nest, and a male and two females were found together in a weaver bird's nest. Two nests in KwaZulu-Natal were occupied by two and three individuals of unknown sex.

**Reproduction** No information for Malawi. Elsewhere: in Botswana, a weaver bird nest was occupied by a female with two young assumed to be twins.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Kerivoula lanosa* (A. Smith, 1847). Four subspecies. The subspecies in Malawi is *K. l. lucia.* Referred to as *K. harrisoni* by Happold *et. al*. (1987) but *harrisoni* is now considered a synonym of *lanosa.*

**Key Reference** Cotterill (2013h).

**Measurements**
*Kerivoula lanosa*

| | |
|---|---|
| FA: | 31.5 (30-34) mm, n = 23 |
| TL: | 80.0 (74-90) mm, n = 16 |
| T: | 37.0 (30-42) mm, n = 22 |
| E: | 12.1 (10-14) mm, n = 22 |
| Tr: | 8.3 (7-9) mm, n = 6 |
| Tib: | 12.8 (12-15) mm, n = 15 |
| HF: | 6.8 (7.5-8.4) mm, n = 10 |
| WT: | 6.5 (4.5-8.0) g, n = 7 |
| GLS: | 12.6 (11.2-13.5) mm, n = 30 |

Throughout biogeographic range (DNMNH, HMZB, NHMUK and literature).

# Genus *Laephotis* - African Long-eared Bats

Subfamily Vespertilioninae. There are four species of *Laephotis*, found only in Africa, but only one species occurs in Malawi.

## *Laephotis botswanae*

## Botswanan Long-eared Bat

**Malawian Names** Not known.

Luwuwa Dam, Viphya Plateau, Malawi
© DCD & M. Happold

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; four upper and five lower cheekteeth and two upper incisors on each side. Sexes similar. Pelage soft, slightly shaggy on rump. Dorsal pelage chocolate brown; hairs blackish-brown with chocolate brown tip, distinctly bicoloured. Ventral pelage pale chocolate brown on throat and chest, becoming paler on abdomen and white in pelvic region; hairs (except in pelvic region) blackish-brown with paler tip. Hairs in pelvic region pure white. Ears dark brown, very large, roughly triangular with broad base and rounded tip; reaching well beyond snout when laid forward; inner margins almost meeting on forehead, but not joined. Ears may be held erect above the head or (when resting) held horizontally at right angles to head. Tragus long and curved, rounded at tip. Wings dark brown; arm-wing (between fifth finger and ankle) sometimes with whitish hind-border; interfemoral membrane dark brown.

**Similar Species** None in Malawi.

**Distribution** Occurs widely in Malawi, but apparently only at altitudes above ca. 800 m. Recorded from Likhubula, Namadzi District, Nkhotakota G. R., South Viphya Plateau (Luwawa Dam), Misuku-Mughese Mission, Ntchisi Mountain F. R. (rest house), Thondwe District, Zomba and Zomba Plateau. Elsewhere: recorded from scattered localities in Angola, S DR Congo, S. Tanzania, Zambia, N. Botswana, Zimbabwe and South Africa.

**Habitat** Open and closed canopy miombo woodlands, montane evergreen forest, and (in Namadzi District) maize/tobacco estates with remnant areas of riverine forest, miombo woodland, rocky hills, dambos, streams and dams.

**Abundance** Seldom-recorded in Malawi. Elsewhere: uncertain.

**Habits** A pair of Botswanan Long-eared Bats was found roosting under the bark of a broken limb of a tree in Zimbabwe; this is the only roost known. In Malawi, they become torpid during the day at ambient temperatures 21-24°C. Their kidneys cannot produce highly concentrated urine and they drank every day in captivity. These bats have a low aspect ratio and very low wing-loading, and their flight is highly manoeuvrable. They can take off from the ground but cannot easily climb or scuttle. They forage by slow-hawking. A light-tagged individual, released near a dam in an area with marshland, some woodland and farmland, and observed for 53 min, foraged mainly between 1-3 m over the marsh, making straight level traverses to and fro with some jerky zig-zagging and some wide circling, but no diving or swooping upwards or any other aerobatic manoeuvrers. It also foraged over tall grass in spaces between trees, and flew over a banana plantation, but did not fly above other trees and did not forage over the open water of the dam. The diet of *Laephotis* (assumed to be this species) in Zimbabwe includes beetles, moths and caddis-flies in the cool season, and moths only in wet season. There is no conclusive information about the social and reproductive behaviour of Botswanan Leaf-nosed Bats in Malawi or elsewhere.

**Reproduction** Litter-size: not known. Near Namadzi, 2 of 3 females were lactating and one was reproductively inactive in Dec, 2 of 2 were reproductively inactive in Jan, and 2 of 2 were post-lactating in Feb (no information for other months). Elsewhere: no information.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Laephotis botswanae* Setzer, 1971. No subspecies. First recorded in Malawi by Happold *et al.* (1987).

**Key Reference** Kearney (2013a).

**Measurements**
*Laephotis botswanae*

| | |
|---|---|
| FA: | 36.3 (33-39) mm, n = 20 |
| TL: | 92.9 (88-100) mm, n = 17 |
| T: | 42.3 (38-47) mm, n = 17 |
| E: | 20.3 (18-22) mm, n = 17 |
| Tr: | 9.1 (8.5-9.5) mm, n = 4 |
| Tib: | 15.3 (14-16) mm, n = 10 |
| HF: | 7.6 (6-8) mm, n = 13 |
| WT: | 6.9 (6-8) g, n = 10* |
| GLS: | 14.6 (14.1-15.5) mm, n = 22 |

Malawi, Zambia and Zimbabwe (Kearney 2013a).

# Genus *Myotis*, Myotises

Subfamily Myotinae. Three species of *Myotis* occur in Malawi. They are easily distinguished by size and by the colour of their pelage and wings.

*M. bocagii.* FA: 36-42 mm. Wings uniformly blackish-brown.

*M. tricolor.* FA: 48-52 mm. Wings dark blackish-brown with very faint pattern of dark reddish-brown over the finger-bones and adjacent to body.

*M. welwitschii.* FA: 55-60 mm. Wings very conspicuously black and orange.

## *Myotis bocagii*

## Rufous Myotis

**Malawian Names** Liputiputi, Ndemiya, Namsimsi, Namzeze. Same for other microbats.

Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Description** Small to very small, very beautiful, microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors and six upper cheekteeth on each side. Sexes alike. Pelage dense, fairly woolly. Dorsal pelage bright rufous; hairs tricoloured, cream with dark brown base and rufous tip. Ventral pelage cream; hairs bicoloured, blackish-brown with cream tip. Muzzle and naked skin around eyes dark brown. (In some specimens, the pelage on cheeks and around eyes is also brown, creating a dark "mask"). Ears blackish-brown, inner margin strongly convex, outer margin concave. Tragus relatively short (43 [39-45]% of ear length). Hindfoot of medium relative length (53 [47-60]% of tibia). Calcars moderately robust, extending half to two-thirds of distance to tip of tail. Tail with two vertebrae protruding beyond edge of interfemoral membrane. Wings uniformly dark blackish-brown without a pattern. Interfemoral membrane dark blackish-brown.

**Similar Species** None.

**Distribution** In Malawi, mostly found in the southern half of the country on the Shire Highlands, Phalombe Plain and Upper and Lower Shire Valleys, at altitudes of <100 m to ca. 1600 m. Recorded from Chiromo, Lengwe N. P., Liwonde N. P., Matope, Namadzi District, Nkhotakota, Thondwe District, Tekerani, Thyolo District and Zomba Plateau. Elsewhere: widely but disjunctly distributed south of the Sahara, from most countries from Senegal to C Ethiopia and southward to Angola and KwaZulu-Natal in South Africa.

**Habitat** Montane evergreen forest, various woodlands and woodland savannas, riverine forest and tea/tobacco/maize estates where remnants of natural vegetation have been conserved. At most, if not all, of the above localities there are large open dams, rivers or streams with pools.

**Abundance** Uncommonly-recorded in Malawi. Considered uncommon throughout most of its biogeographic range, but common in some localities where forest, banana plants and open water are present.

**Habits** These very beautiful bats sometimes roost during the day in the furled leaves of banana plants, wild bananas and strelitzias, in bunches of banana, and under the skirts of dead leaves of banana and plantain plants. They have also been found clinging to broad leaves in the dank, dark vegetation of a thickly overgrown swamp and one pair, when disturbed, flew from the sheath of an Arum lily into the sheath of another lily some distance away. They have also been found roosting among leaves of *Hyphaene* palms and in hollow trees.

The feeding and foraging behaviour of these bats is unusual. They feed on minute insects including moths, beetles, flies and Orthoptera, and

they usually catch their prey by trawling or slow-hawking over open water in dams and rivers, taking insects from the surface or just above the water. One light-tagged individual in Malawi foraged over a large farm dam for more than 1.5 hours with only one four-minute break after 55 minutes. This individual, and others, flew long straight or gently curving sweeps with occasional zig-zagging (usually within ca. 20 cm of the surface), with 5-6 dips/minute to take prey from the surface, and occasional upward swoops in pursuit of insects flying 1-2 m (sometimes up to 6 m) above the water. Most foraging was done more than 10 m from the edges of the dam. It may be that prey on or just below the surface is gaffed by the hindfeet which are moderately long.

The social behaviour of Rufous Myotises has not been studied in Malawi. A study in NE Gabon showed that these bats roosted in furled banana leaves in plantations along the Ivindo River, over which they foraged at night. They lived in harems comprised of one adult male and 2-7 adult females and their young, the entire group roosting together in one furled leaf.

**Reproduction** Litter-size: 1 (n = 2). It is not known if females give birth once/year or twice/year but limited data suggest that two births/year is unlikely unless both occur during the wet season (Nov-Mar). Elsewhere: litter size 1 (n = 10) or 2 (n = 1). In Gabon, females give birth twice/year, in Dec-Feb and Jun in the two drier seasons when insects are concentrated near rivers and marshes and provide optimal foraging for these bats.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Myotis bocagii* (Peters, 1870). Two subspecies in Africa. The subspecies in Malawi is *M. b. bocagii* (cf. *M. b. cupreolus* in Gabon). Referred to as *M. bocagei* by Sweeney (1959) and Happold *et. al.* (1987) but *bocagii* is the correct spelling.

**Key Reference** Happold, M. (2013v).

**Measurements**
*Myotis bocagii*

| | |
|---|---|
| FA: | 39.2 (36-42) mm, n = 44 |
| TL: | 90.4 (83-98) mm, n = 10 |
| T: | 41.8 (39-48) mm, n = 11 |
| E: | 14.3 (13-16) mm, n = 19 |
| Tr: | 6.3 (6.0-6.5) mm, n = 3 |
| Tib: | 19.7 (18-21) mm, n = 10 |
| HF: | 11.1 (10-12) mm, n = 10 |
| WT: | 8.0 (5.4-10.5) g, n = 37 |
| GLS: | 15.2 (14.7-15.9) mm, n = 6* |

Malawi (HC, Happold *et al.* 1987).
**M. b. bocagii*, Malawi, Angola, Ethiopia, Tanzania (NHMUK and literature).

## *Myotis tricolor*

## Temminck's Myotis

**Malawian Names** Not known.


Zomba, Malawi © DCD & M. Happold

**Description** Small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors and six upper cheek-teeth on each side. Sexes similar. Pelage dense, fairly woolly. Dorsal pelage rufous; hairs tricoloured, cream with grey to dark blackish-brown at base and rufous at tip. Ventral pelage paler; hairs tricoloured, creamy-fawn with dark blackish-brown at base and pale brown at tip. Muzzle light brown, almost naked. Ears brownish-black; tip rounded; outer margin with slight emargination midway. Tragus on average 56% of ear length. Hindfoot of medium relative length (51.6 [47-58]% of tibia). Calcars straight, extending half-way to tip of tail. Tail fully enclosed by membrane. Wings of living Malawian individuals are dark blackish-brown with dark reddish-brown over the finger-bones and adjacent to body: these markings are faint (cf. the striking black and orange markings of *M. welwitschii*). Interfemoral membrane reddish-brown.

**Similar Species**

*M. welwitschii*. Much larger (FA: 55-60 mm), wings with striking black and orange pattern.

**Distribution** In Malawi, known from scattered localities from the northern Lake Shore, Shire Highlands and Upper and Lower Shire Valleys, at altitudes of <100 m to 1450 m. Recorded from Chiromo, Karonga, Liwonde N. P., Zomba and Zomba Plateau. Elsewhere: recorded disjunctly on the eastern side of Africa from Ethiopia to S South Africa and from two very isolated localities in Liberia and SW DR Congo.

**Habitat** Open and closed canopy miombo woodlands, other woodlands and savanna woodlands, riverine forest and ornamental gardens with large trees.

**Abundance** Rarely-recorded in Malawi. Appears to be uncommon or rare throughout biogeographic range except for E. South Africa where recorded from many localities, and in colonies of up to 2000.

**Habits** Very little is known about Temminck's Myotis in Malawi. In South Africa, they roost during the day in moist caves and mine-adits. They hang freely from ceilings or cling in contact with walls. They are often found in larger caves, usually ones containing pools of water, where disturbance is minimal. In parts of South Africa, they migrate hundreds of kilometres between summer maternity caves and winter hibernation caves because different microclimatic conditions are required for these purposes. In one maternity cave, the roost-site temperature was 21°C and the relative humidity 85%. In Malawi, Temminck's Myotis do not become torpid during day at 21-24 °C but, in South Africa, they hibernate during winter. Captive bats drank regularly each day and this species is likely to need water for drinking in the wild except for some periods during the hibernation season.

These bats have been found in open spaces close to trees and that is probably where they forage for flying insects but, based on their morphology, they are predicted to forage by gleaning as well as slow-hawking. They do come to open water but probably only to drink. There is no evidence that they trawl for prey or forage over water (cf. *Myotis bocagii*). Details of their diet are not known.

There is no information about the social behaviour of these bats in Malawi. In South Africa, they usually roost huddled together in groups of a few dozen, but they have also been found in colonies of up to 2000 individuals. During winter, the groups and colonies include both sexes. In summer, the sexes segregate; the females move to maternity caves, sometimes in very large numbers, where they give birth and suckle their young. The roosting behaviour of males during summer is not known; they are rarely seen but one record suggests that they might roost singly at this time. In KwaZulu-Natal, females and volant young leave the maternity colonies in late Jan, and most of them migrate to winter hibernaculae where males and females reunite and

mate prior to hibernating. At this time, most maternity caves are deserted but some are also used as hibernaculae.

**Reproduction** No information for Malawi. In KwaZulu-Natal, South Africa, litter-size 1. Females give birth once/year. Mating occurs in autumn, sperm is stored by the females through winter, ovulation and fertilisation occur in Aug-Sept and births in Nov-Dec after gestation of ca. 63 days. Females lactate for ca. six weeks.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Myotis tricolor* (Temminck, 1832). No subspecies. First recorded in Malawi by Harrison (1982).

**Key Reference** Bernard (2013a).

**Measurements**
*Myotis tricolor*

| | |
|---|---|
| FA: | 49.1 (48-52) mm, n = 9 |
| TL: | 106.2 (100-110) mm, n = 8 |
| T: | 49.5 (45-53) mm, n = 8 |
| E: | 17.1 (15-19) mm, n = 8 |
| Tr: | 9.8 (9-10) mm, n = 8 |
| Tib: | 23.7 (23-24) mm, n = 5 |
| HF: | 11.8 (11.5-12.0) mm, n = 6 |
| WT: | 14.5 (12.4-16.0) g, n = 7 |
| GLS: | 18.3 (16.9-19.1) mm, n = 26* |

Malawi (HC, NHMUK, Happold *et al.* 1987).
*Throughout biogeographic range (Bernard 2013).

## *Myotis welwitschii*

## Welwitsch's Myotis

**Malawian Names** Liputiputi, Ndemiya, Namsimsi, Namzeze. Same for other microbats.


Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Description** Medium-small, very spectacular microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors and six upper cheekteeth on each side. Sexes similar. Pelage dense, woolly. Dorsal pelage rufous suffused with cream; hairs tricoloured, cream with blackish-brown base and orange tip. Ventral pelage cream slightly suffused with orange; hairs bicoloured, cream with blackish-brown at base. Muzzle naked, orange with black spots. Ears orange with small black spots and black edges. Tragus long, bluntly pointed, ca. half of ear length. Wings strikingly patterned - outer arm-wing and hand-wing black with the bones outlined in orange; inner arm-wing orange with small black spots. Hindfoot relatively short (47.4 [37-56]% of tibia. Calcars moderately robust, extending at least halfway to tip of tail. Tail fully enclosed by interfemoral membrane or with part of last vertebra projecting beyond the membrane. Interfemoral membrane orange with small black spots.

**Similar Species**

*M. tricolor*. Smaller (FA: 48-52 mm), wings dark blackish-brown with faint black and dark reddish-brown pattern but not a conspicuous black and orange pattern.

**Distribution** In Malawi, widely but disjunctly distributed on the Central Plateau, Shire Highlands and in the Upper and Lower Shire Valleys, at altitudes of <100 m to >2200 m. Recorded from Chiromo, Kasungu N. P., Livingstonia, Liwonde N. P., Namadzi District, Ntchisi Mountain F. R., Nyika Plateau and Thyolo. Elsewhere: known from the eastern half of Africa, from Ethiopia to NE South Africa and from Angola, and from the Simandou Range in Guinea and the Bamenda Highlands in Cameroun.

**Habitat** Montane evergreen forests (and probably montane grasslands), open and closed canopy miombo woodlands and nearby open grasslands, and riverine forests. Often, but not always, recorded near mountains.

**Abundance** Rarely-recorded in Malawi. Considered rare throughout its biogeographic range.

**Habits** During the day, these spectacular bats hang by themselves in trees and bushes and, when their wings are furled, they resemble dead leaves and are surprisingly well camouflaged. One was found in a furled leaf of a banana plant at Livingstonia in N Malawi, but none were found in furled banana leaves in the Zomba and Namadzi regions despite rigorous searching. There is no evidence that these bats forage by trawling (cf. *Myotis bocagii*). While foraging, they have been seen flying near the ground, well away from water, and into houses. Their diet in the wild is not known except that faecal pellets from one individual contained the remains of small beetles. In captivity, they seemed to prefer to eat soft-shelled insects. They have only been found roosting singly; nothing else is known about the social behaviour of these rarely-encountered bats.

**Reproduction** No information.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Myotis welwitschii* (Gray, 1866). No subspecies. Referred to as *M. welwitschi* by Sweeney (1959) but *welwitschii* is the correct spelling.

**Key Reference** Happold, M. (2013w).

**Measurements**
*Myotis welwitschii*

| | |
|---|---|
| FA: | 56.9 (55-60) mm, n = 6 |
| TL: | 118 (115-120) mm, n = 5 |
| T: | 58.8 (55-60) mm, n = 5 |
| E: | 21.0 (20-24) mm, n = 5 |
| Tr: | 11.5, n = 1 |
| Tib: | 24.2 (24-25) mm, n = 3 |
| HF: | 12.3 (12-13) mm, n = 3 |
| WT: | 15.3 (14-17) g, n = 3 |
| GLS: | 19.4 (18.6-20.8) mm, n = 15* |

Malawi (HC, NHMUK, WRUK, Happold *et al.* 1987).
*Throughout biogeographic range.

# Genus *Nycticeinops* - Twilight Bats

Subfamily Vespertilioninae. This genus contains only one species which occurs throughout most of sub-Saharan Africa, including Malawi.

## *Nycticeinops schlieffeni*

## Schlieffen's Twilight Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Lengwe N. P., Malawi © DCD & M. Happold

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; only one upper incisor on each side. Sexes similar. Pelage dense, soft, slightly fluffy, without sheen. Dorsal pelage bright cinnamon; hairs unicoloured. Ventral pelage slightly to considerably paler than dorsal pelage. Head slightly flattened; muzzle short with prominent lateral glandular swellings. Ears dark brown; relatively short for a vesper bat (not reaching snout when laid forward); inner margin slightly convex, outer margin slightly concave; tip rounded. Tragus length 43.7 (40-50)% of ear length. Eyes very small. Wings and interfemoral membrane dark brown with blackish-brown venation. Free edge of interfemoral membrane with faint white border in some individuals. Penis comparatively short (5.6 – 6.2 mm) (cf. *Scotoecus* spp.). FA: 31.3 (25-32) mm.

**Similar Species**

*Scotoecus hirundo.* Usually heavier (10.2 [8-15] g). FA usually longer 35.7 (33-38) mm). Dorsal pelage chocolate brown, or medium to pale sepia brown; ventral pelage greyish-white to off-white. Tragus less pointed. Penis extremely long (14-16 mm).

**Distribution** Found in the southern half of Malawi (below 13°S), on the Central Plateau and Upper and Lower Shire Valleys, at altitudes ranging from <100 m to 1500 m. Recorded from Chiromo), Kasungu N. P., Lengwe N. P., Liwonde N. P. and Ntchisi Mountain F. R. (rest house). Elsewhere: widely but disjunctly distributed throughout most of sub-Saharan Africa, except in rainforest, the Horn of Africa, south-west arid and high veld zones of southern Africa.

**Habitat** Open and closed canopy miombo woodlands and riverine forests. Exploits game scout camps and probably rural villages.

**Abundance** Uncommonly-recorded in Malawi. Elsewhere: uncertain; numerous in collections.

**Habits** In Malawi, Schlieffen's Twilight Bats have been found roosting during the day in hollow branches and under the corrugated iron roofs of houses. They cling to vertical, sloping and horizontal surfaces, or tuck themselves into cracks and crannies. Elsewhere, they have been found roosting in rock crevices and in crevices inside hollow trees, roofs and cellars. They become torpid during the day at ambient temperatures of 21-24°C. They can produce very concentrated urine, and captive bats (fed on winged termites) did not drink. However, in the Sudan, they have been observed drinking water from small expanses of water soon after sundown. They can fly fast or slowly with great manoeuvrability, and they can take off from the ground but cannot hover. Their scuttling locomotion is slow and awkward. In Malawi and Zimbabwe, they forage by slow-hawking, mostly 2-6 m above ground, in moderately cluttered spaces between tree-trunks and between canopies, and in more open spaces in clearings, over flood-plains and over water. They apparently feed opportunistically on a wide variety of small insects. In Zimbabwe in the wet season, they fed mainly on beetles but also ate flies, moths and bugs. In the dry season, they ate beetles (50% by weight), caddis flies and moths. Schlieffen's Twilight Bats occasionally congregate to forage. They have been reported to roost singly, in pairs or

in small groups and in large numbers. A maternity colony containing at least 40 post-lactating females and their young was found in the roof of a house in Kasungu N. P.

**Reproduction** Litter-size: 2 (n = 3) or 3 (n = 2). Females give birth once/year in Nov-Dec. In Kenya, litter-size 2 (n = 1) or 3 (n = 1), and the females give birth once/year in the short wet season. In NE South Africa, litter-size 2.8 (1–3) n = 11. Mating begins in early winter (Jun) and then sperm is stored in the females until ovulation occurs at end of Aug. The young are born ca. 11 weeks later.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Nycticeinops schlieffeni* (Peters, 1859). Originally placed in the genus *Nycticejus,* then placed in *Nycticeius* but now considered to be the only species in the genus *Nycticeinops*. Four subspecies were described on the basis of colour but their validity is dubious. Referred to as *Nycticeius schlieffeni* by Sweeney (1959) and Happold *et al.* (1987).

**Key Reference** Happold, M. (2013x).

**Measurements**
*Nycticeinops schlieffeni*

| | |
|---|---|
| FA: | 31.3 (25-32) mm, n = 37 |
| TL: | 74.5 (70-80) mm, n = 24 |
| T: | 29.3 (25-32) mm, n = 24 |
| E: | 12.8 (12-14) mm, n = 22 |
| Tr: | 5.0 (5.0-5.5) mm, n = 16 |
| Tib: | 12.8 (12-14) mm, n = 23 |
| HF: | 7.3 (7-8) mm, n = 20 |
| WT: | 5.9 (4.2-9) g, n = 31 |
| GLS: | 12.7 (11.9-13.6) mm, n = 35* |

Malawi (Happold *et al.* 1987).
*Throughout biogeographic range (BMNS, IRSN, SMNS and literature).

# Genus *Pipistrellus* – Pipistrelles

Subfamily Vespertilioninae. As defined by some authors, this genus contains ca. 80 species of which at least 28 species occur in Africa. The genus has been divided into seven subgenera, of which *P*. (*Pipistrellus)*, *P*. (*Neoromicia*) and (*P*. *Hypsugo*) occur in Africa and, currently, all three taxa are treated as distinct genera by many authors. However, the species composition of these taxa is controversial and, pending resolution of the problems, it seems best to treat all Pipistrelles as members of the genus *Pipistrellus*, and to treat *Neoromicia* and *Hypsugo* as subgenera. There are eight species of Pipistrelles found in Malawi, and they probably belong to only two of the subgenera. Pipistrelles in the subgenus *Neoromicia* were formerly placed in the genus *Eptesicus* (see Genus *Eptesicus*).

The species are not easy to distinguish, but the following characters are useful.

Colour of mid-ventral pelage.

Dorsal hairs – unicoloured, bicoloured (i.e. two bands of different colour) or tricoloured (thee bands of different colour).

Wing colour – dark or white.

Shape of tragus – hatchet-shaped (having a sharp angle on the posterior border above the basal notch) or not hatchet-shaped (i.e. having a smoothly-curved posterior border above the basal notch).

Anterior upper premolar – absent or present; if present, visible or not visible above the gum. If the anterior premolar is absent or not visible above the gum, only one premolar is visible; otherwise two premolars are visible.

FA (forearm length) – distinguishes *P. stanleyi* from *P. capensis* and *P. zuluensis*.

Occipital helmet (a backward pointing projection of the skull) – absent or well developed. If absent, the back of the head (braincase) feels smoothly rounded. If well developed, the helmet at the back of the head (braincase) can be felt by stoking the head from the front to the back of the neck. Distinguishes *P. capensis* from *P. zuluensis*.

Diagnostic characters of the species of *Pipistrellus* sensu lato, found in Malawi are given in the yellow box below. Only the first species has pure white ventral pelage; the other species are in alphabetical order.

*P. rueppellii*. Mid-ventral pelage pure white. Dorsal hairs bicoloured. Wings dark. Tragus with smoothly curved posterior border. Tragus not hatchet-shaped. Anterior upper premolar present, medium-sized and conspicuous.

*P. capensis*. Mid-ventral pelage whitish-grey or creamy-grey. Dorsal hairs bicoloured. Wings dark. Tragus not hatchet-shaped. Anterior upper premolar absent or not visible. FA: 31.8 (29-34) mm (cf. *P. stanleyi*). Occipital helmet well developed (cf. *P. zuluensis*).

*P. grandidieri*. Mid-ventral pelage pale brown, sometimes yellowish. Dorsal hairs unicoloured. Wings dark. Tragus not hatchet-shaped. Anterior upper premolar minute, sometimes not visible, sometimes absent.

*P. hesperidus*. Mid-ventral pelage pale brown to greyish-white. Dorsal hairs bicoloured. Wings dark. Tragus not hatchet-shaped. Anterior upper premolar present, medium-sized to minute, usually visible.

*P. nanus*. Mid-ventral pelage dark greyish-buff. Dorsal hairs bicoloured. Wings dark. Tragus hatchet-shaped. Anterior upper premolar present, medium-sized and visible.

*P. rendalli*. Mid-ventral pelage pale fawn to off-white. Dorsal hairs bicoloured or tricoloured. Wings white. Tragus not hatchet-shaped. Anterior upper premolar absent.

*P. stanleyi.* Mid-ventral pelage chocolate brown. Dorsal hairs bicoloured. Wing colour dark. Tragus not hatchet-shaped. Anterior upper premolar absent. FA: 35.3 (32-38) mm (cf. *P. capensis* and *P. zuluensis*).

*P. zuluensis*. Mid-ventral pelage greyish-brown. Dorsal hairs bicoloured or tricoloured. Wing colour dark. Tragus not hatchet-shaped. Anterior upper premolar absent except extremely rarely. FA: 31.2 (30-33) mm (c.f. *P. stanleyi*). Occipital helmet absent (cf. *P. capensis*).

## *Pipistrellus (Neoromicia) capensis*

## Cape Pipistrelle

**Malawian Names** Not known.


Zomba, Malawi © DCD & M. Happold

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors on each side; anterior upper premolar absent (except very rarely), canine and posterior premolar in contact or almost so. FA: 31.8 (29-34) mm; wings dark. Sexes alike. Pelage soft, dense. Dorsal pelage brown; hairs bicoloured (dark brown or black with brown tip). Ventral pelage whitish-grey or creamy-grey; hairs mostly bicoloured, brownish-black or black with much paler tip. Occipital helmet usually present so the back of the head does not feel smoothly rounded (cf. *P. zuluensis*). Ears subtriangular with rounded tip. Tragus not hatchet-shaped (posterior margin smoothly convex for most of its length; tip rounded). Wing-membranes dark-brown, occasionally with narrow white hind-border. Interfemoral membrane paler, more translucent, sometimes with yellowish border.

**Similar Species**

*Pipistrellus grandidieri.* Dorsal pelage unicoloured.

*Pipistrellus hesperidus.* Mid-ventral pelage moderately dark brown. On average larger, FA: 33.3 (30-37) mm.

*Pipistrellus nanus.* Tragus hatchet-shaped.

*Pipistrellus stanleyi.* Forearm on average longer (37.1 [36-39]) mm. Tail on average longer (39.6 [35-44] mm).

*Pipistrellus zuluensis.* Dorsal hairs bicoloured or tricoloured. Ventral pelage pale greyish-brown. Occipital helmet absent, therefore back of head feels smoothly rounded. With experience, the lack of helmet can be felt without extracting the skull.

**Distribution** In Malawi, known from the South Viphya Plateau, Central Plateau, Shire Highlands and edges of the Phalombe Plain, at altitudes ranging from 750 -1700 m. Recorded from Dzalanyama F. R. (rest house), Kasungu N. P., Likhubula, Namadzi District, Ntcheu, South Viphya Plateau, Thondwe District, Zomba and Zomba District. Elsewhere: very widespread south of the Sahara.

**Habitat** Open and closed canopy miombo woodlands, and tobacco/maize estates with remnant miombo woodland and riverine forest, streams and dams.

**Abundance** Commonly-recorded (but the records may include some *P. somalicus*). Elsewhere: common, perhaps because they can use man-made roosts.

**Habits** The daytime roosts of Cape Pipistrelles in Malawi are not known but elsewhere, they roost under the bark of trees, at the base of aloe leaves and in the roofs of houses where they tuck themselves between overlapping sheets of corrugated iron or between the iron and the rafters. In Malawi, they become torpid during the day at ambient temperatures of 21-24°C. Their kidneys can produce comparatively highly concentrated urine, and captive bats, fed on winged-termites, sometimes did not drink for up to 3.5 days. Cape Pipistrelles leave their day-roosts at dusk and have several bouts of foraging each night, with peaks of activity at dusk and just before dawn. They forage by slow-hawking in moderately clutter-free spaces including between tree trunks, around and over canopies (sometimes within a metre of the foliage), and over clearings fairly close to vegetation. They are attracted to concentrations of insects around vegetation, over water, over termite mounds when winged termites are emerging, and around lights and, in such situations, their flight is characterized by swerving and jinking and some direct pursuits. In Zimbabwe, in the wet season, they fed mainly on beetles, but also ate moths, bugs and flies but not caddis-flies, whereas in the dry season, they fed mostly on caddis-flies with only some beetles, moths and flies and no

bugs. There appears to be no conclusive information about their social and reproductive behaviour except that two individuals in captivity huddled together as though used to roosting in groups.

**Reproduction** There is no conclusive information for Malawi. In South Africa, litter-size 1, 2, 3 or 4 (usually 2). Females give birth once/year. Mating begins in late Mar, sperm is stored in the females until ovulation and fertilization occur in the second half of Aug, and young are probably born between late-Oct and mid-Nov after a gestation of ca. 12 weeks.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Pipistrellus capensis* (A. Smith, 1829). Subgenus *Neoromicia*. Six subspecies. The subspecies in Malawi is *P. c. gracilior*. Not listed by Sweeney (1959). Referred to as *Eptesicus capensis* by Happold *et al.* (1987) and as *P. (Neoromicia) capensis* by Ansell & Dowsett (1988).

**Key Reference** Kearney (2013b).

**Measurements**
*Pipistrellus capensis*

| | |
|---|---|
| FA: | 31.8 (29-34) mm, n = 18 |
| TL: | 76.3 (70-82) mm, n = 16 |
| T: | 30.0 (27-34) mm, n = 16 |
| E: | 12.3 (10-14) mm, n = 14 |
| Tr: | 6.0 (5-9) mm, n = 12 |
| Tib: | 12.5 (12-14) mm, n = 14 |
| HF: | 7.2 (7-8) mm, n = 14 |
| WT: | 6.0 (4.6-8.4) g, n = 18 |
| GLS: | 13.5 (12.9-14.1) mm, n = 15 |

Malawi (HC, NHMUK).

## *Pipistrellus (Neoromicia) grandidieri*

## Yellow Pipistrelle

**Malawian Names** Not known.

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors on each side; anterior upper premolar minute, not in toothrow, sometimes not visible above gum, sometimes absent; canine and posterior premolar in contact. Pelage short, silky with slight sheen. Dorsal pelage pale brown; hairs unicoloured. Ventral pelage very slightly paler and sometimes yellowish; hairs unicoloured. Ears brown. Tragus not hatchet-shaped (posterior margin smoothly convex with conspicuous basal lobe; tip rounded). Wings blackish-brown, slightly translucent, usually without white hindborder. Interfemoral membrane blackish-brown.

**Similar Species**
*Pipistrellus capensis.* Dorsal pelage bicoloured.
*Pipistrellus hesperidus.* Dorsal pelage dark brown, bicoloured (sometimes inconspicuously).
*Pipistrellus nanus.* Tragus hatchet-shaped.
*Pipistrellus stanleyi.* Dorsal pelage very dark chocolate brown to sepia-brown; bicoloured.
*Pipistrellus zuluensis.* Dorsal pelage medium brown, bicoloured or tricoloured.

**Distribution** In Malawi, known from the Shire Highlands at 1000 m, and the Phalombe Plain at the foot of Mulanje Mountain at ca. 750 m. Recorded from Likhubula and the Namadzi District (Kapalasa Farm). Not recorded in Malawi until 1994. Elsewhere: only known from isolated localities in Cameroun, Uganda, Burundi, Somalia, SE Kenya, NE Tanzania, Zanzibar I. and Angola.

**Habitat** At Likhubula, found in miombo woodland and riverine forest. In the Namadzi District, found in riverine forest beside a stream with pools on a tobacco/maize estate with well-conserved miombo woodland on rocky hills and termite mounds, dambos and ornamental gardens.

**Abundance** Rarely-recorded in Malawi. Elsewhere: apparently rare to extremely rare but might be more abundant than the records indicate.

**Habits** Almost nothing is known about these bats. One individual had a low aspect ratio and low wing-loading and its flight was only moderately manoeuvrable. Three individuals were recorded over a pool in montane evergreen forest and one over a stream in remnant riverine forest, but it is not known if they had come to drink or if they were foraging.

**Reproduction** No information for Malawi or elsewhere.

**Conservation** IUCN Category: Data Deficient.

**Taxonomic Notes** *Pipistrellus grandidieri* (Dobson, 1876). Subgenus *Neoromicia.* Formerly referred to as *Eptesicus flavescens,* then *flavescens* was found to be a *nomen dubium* and was replaced by *grandidieri.* Two subspecies. The subspecies in Malawi is *P. g. angolensis*. First recorded in Malawi by Happold & Happold (1997) as *E. flavescens.*

**Key Reference** Van Cakenberghe & M. Happold (2013b).

**Measurements**
*Pipistrellus grandidieri*

| | |
|---|---|
| FA: | 35.4 (33-38) mm, n = 24 |
| TL: | 84.7 (81-90) mm, n = 1 |
| T: | 31.7 (30-34) mm, n = 3 |
| E: | 10.8 (8-13) mm, n = 6 |
| Tr: | 4.4 (3.6-5.0) mm, n = 6 |
| Tib: | 13.4 (11-14) mm, n = 7 |
| HF: | 8, 10 mm. n = 2 |
| WT: | 7.4 (7.0-8.0) g, n = 3 |
| GLS: | 14.2 (13.8-14.7) mm, n = 7 |

Throughout biogeographic range (Van Cakenberghe & M. Happold (2013b).

## *Pipistrellus (Pipistrellus) hesperidus*

## Dusk Pipistrelle

**Malawian Names** Not known.

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors on each side; anterior upper premolar medium-sized to minute, usually visible above gum, within toothrow or displaced, canine and posterior premolar well separated or in contact. Sexes alike. Pelage dense, soft, slightly shaggy. Dorsal pelage dark brown; hairs blackish-brown at base merging into brown at tip, therefore the hairs are faintly bicoloured. Ventral pelage varying from slightly paler brown to greyish-white; hairs blackish-brown at base becoming pale chocolate brown or greyish-buff towards tip. In pelvic region, ventral pelage not noticeably paler; without pure-white hairs. Ears dark reddish-brown, subtriangular with rounded tip. Tragus not hatchet-shaped (posterior margin smoothly convex with small basal lobe; tip rounded). Wings and interfemoral membrane blackish-brown to almost black; no white hind-border.

**Similar Species**

*Pipistrellus capensis.* Mid-ventral pelage white, whitish, cream or buff. On average smaller, FA 31.8 (29-34) mm.

*Pipistrellus grandidieri.* Dorsal pelage always unicoloured.

*Pipistrellus nanus*. Tragus hatchet-shaped.

*Pipistrellus stanleyi*. On average larger FA 37.1 (36-39) mm, anterior upper premolar absent.

*Pipistrellus zuluensis*. Mid-ventral pelage pale greyish-brown.

**Distribution** Widespread in Malawi from the Misuku Hills to Zomba Plateau and the base of Mulanje Mountain, but only at altitudes of ca. 750 m to 1900 m. Not known from the Lake Shore and Shire Valleys. Recorded from Dzalanyama F. R., Likhubula, Namadzi District, Nkhotakota G. R., Ntchisi Mountain F. R. (rest house and Ntchisi Mountain), Nyika Plateau (Chelinda), South Viphya Plateau, Thondwe District, Thyolo District, Wilindi Forest, Zomba and Zomba Plateau. Elsewhere: Nigeria and from Eritrea to South Africa, with outlying records in Somalia, Angola and W Zimbabwe.

**Habitat** Miombo woodlands, montane areas with evergreen forest and montane grassland (sometimes with large dams), ornamental gardens with large trees, and tobacco/maize estates with remnant miombo woodland, riverine forest, dambos and large dams.

**Abundance** Commonly-recorded in Malawi. Elsewhere: common in certain areas but uncommon and localised at others.

**Habits** On the Nyika Plateau, Dusk Pipistrelles emerged at dusk from under the roofs of houses and from crevices in the outside wall of a house. In southern Africa, they are known to roost in cracks in rocks (including the vertical narrow spaces under exfoliating granite), behind loose bark on dead trees and in hollow trees. In Malawi, they become torpid during the day at ambient temperatures of 21-24°C. Their kidneys can produce comparatively highly concentrated urine. As their name implies, these bats emerge at dusk and forage by slow-hawking in moderately cluttered spaces including between tree-trunks, around and over canopies, over grass or dirt-roads, in clearings, around houses (probably to pursue insects attracted to lights) and near water. They fly very aerobatically especially when pursuing insects that are concentrated in swarms or near lights. They forage for several hours after sunset, and then have a smaller peak in activity at dawn. Dusk Pipistrelles roost in groups of up to 12 individuals. In South Africa, they have been observed foraging in groups, and mixed-sex groups of 2-10 have been mist-netted, often after the audible (to humans) calls of the first capture brought others around the net. Nothing else is known about their social and reproductive behaviour.

**Reproduction** Litter-size: 1 (n = 1) or 2 (n = 8). Limited data are consistent with females giving birth once/year in Nov-Dec. Elsewhere: no conclusive information.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Pipistrellus hesperidus* (Temminck, 1840). Subgenus *Pipistrellus.* Formerly considered to be *P. kuhlii* and referred to as such by Sweeney (1959), Happold *et al.* (1987), Ansell & Dowsett (1988) and Happold & Happold (1997). Specimens from Malawi referred to as *P. rusticus* in the past (including by Happold *et al.* (1987) and Ansell & Dowsett 1988) have been re-identified as

*P. hesperidus*, and currently there is no confirmed evidence that *P. rusticus* occurs in Malawi.

**Key Reference** Kearney (2013c).

**Measurements**
*Pipistrellus hesperidus*

| | |
|---|---|
| FA: | 33.3 (30-37) mm, n = 39 |
| TL: | 79.9 (73-87) mm, n = 27 |
| T: | 35.0 (31-40) mm, n = 39 |
| E: | 11.2 (9-13) mm, n = 37 |
| Tib: | 13.3 (12-15) mm, n = 39 |
| HF: | 7.7 (6-9) mm, n = 38 |
| WT: | 5.9 (4.5-8) g, n = 39 |
| GLS: | 12.7 (12.0-13.6) mm, n = 22 |

Malawi (HC).

## *Pipistrellus (Pipistrellus) nanus*

### Banana Pipistrelle (Banana Bat)

**Malawian Names** Chuchu**,** Mnalimpsimpsi, Namsinsi, Ndemia.

Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors on each side; anterior upper premolar medium-sized, visible above gum, somewhat displaced from toothrow; canine and posterior premolar not in contact. Sexes similar in colour; females on average larger than males. Pelage soft, dense, fairly fluffy, with silky sheen. Dorsal pelage chocolate brown or sepia brown, usually with golden sheen; hairs bicoloured, basal half blackish-brown, terminal half chocolate or sepia brown usually merging into golden-brown towards tip. Ventral pelage dark greyish-buff; hairs bicoloured, blackish-brown with greyish-buff at tip. Ears blackish-brown, subtriangular; tip rounded. Tragus hatchet-shaped (posterior margin making an obtuse-angle bend just above mid-height; no basal lobe; tip narrow and rounded). Wings blackish-brown; no white hind-border. Thumb very small with friction pad on wrist. Hindfeet very small with friction pad on sole. Interfemoral membrane blackish-brown; sometimes with the posterior margin pale or white.

**Similar Species** No other pipistrelle in Malawi has a hatchet-shaped tragus.

**Distribution** In Malawi, very widespread in all biogeographic areas, most often (but not always) where banana plants are found, at altitudes ranging from <100 m to ca. 1680 m. Recorded from many localities including Blantyre, Chileka, Chiromo, Chongoni F. R., Kasungu N. P., Lengwe N. P., Likhubula, Liwonde N. P., Misuku Hills, Mtimbuka, Mzuzu, Namadzi District, Namitete, Nchalo, Nkhotakota, Nsanji, Ntchisi F. R. (rest house and Ntchisi Mountain), Ntonda, Thondwe District, Thyolo District, Thyolo Mountain, South Viphya Plateau, Zoa Tea Estate, Zomba and Zomba Plateau. Elsewhere: very widespread south of the Sahara, except in the Horn of Africa and in most of Angola, Botswana and South Africa.

**Habitat** Found in all woodland, forest and farmland habitats in Malawi, especially where there are banana plants.

**Abundance** Very commonly-recorded in Malawi. On any single day, 27-49 individuals roosted in a 40x50 m plantation study area of 138 clumps of banana plants. Elsewhere: apparently common wherever banana plants or their relatives are abundant.

**Habits** Banana Pipistrelles are very unusual because they usually roost during the day in the furled leaves of banana plants, wild bananas (*Ensete*) and strelitzias. They have been reported in other roosts, but at least some of these records refer to other species, and others possibly refer to subspecies which might be cryptic species of *P. nanus*. Bananas were introduced to Africa 1000-2500 years ago and wild bananas and strelitzias are indigenous to Africa, so Banana Bats have had time to evolve special adaptations to roosting in furled leaves, such as friction pads on their wrists and feet which enable them to climb easily up the slippery leaves. There is little competition from other bats for these roosts – only three species of *Myotis* (*M. bocagii*, *M. scotti* and very rarely *M. welwitschii*) roost in furled leaves in some localities. Furled banana leaves are only occupied by Banana Bats if the entrance diameter is 7-24 cm (optimally 19-24 cm). Banana leaves unfurl rapidly and are suitable for only 1-3 days, but they are produced throughout the year by healthy plants. Roost-fidelity is not possible, but almost half of the males in one study showed fidelity to a small number (< 5) of clumps of "reliable" plants growing close

together which invariably had one or more suitable leaves at all times. Females did not show such fidelity and their roost-ranges were much larger. In localities where separate banana plantations may be one or more kilometres apart, some individuals apparently maintained at least two separate roost-ranges and alternated between them. Temperatures inside and outside furled leaves are similar, but relative humidities inside are 80-100%, even when they are as low as 35% outside. During the cool dry season, all individuals become torpid during the day but in the hot wet season, only some do. In Malawi, Banana Bats are found at some localities where night temperatures are sometimes too low for flying insects to be active, but these bats have very efficient kidneys, and perhaps the ability to reduce urinary water loss enables these bats to remain torpid for several days at such times. However, under normal temperature regimes, they fly down to gulp mouthfuls of water from pools and dams every day.

Banana Pipistrelles can fly slowly with great manoeuvrability in cluttered spaces, but faster and with great agility in open spaces. They eat mainly small beetles and moths and some flies, and they forage by slow-hawking in moderately uncluttered places such as clearings, gaps between trees, and around canopies of trees. Foraging is characterized by aerobatic swerving as small insects are pursued. Foraging begins at dusk and individuals do not return to their furled leaves until just before sunrise, but bouts of foraging appear to be interspersed with periods of inactivity.

Banana Pipistrelles often aggregate while foraging, but the composition of these aggregations is not known. In contrast, a lot is known about the social behaviour of these bats at their day-roosts. A study on the social behaviour of bats roosting in a banana plantation containing 138 clumps of dwarf banana plants arranged in a 40 x 50 m grid on a Kapalasa Farm near Namadzi showed that during parturition and lactation, females with young roosted separately from males, and the males roosted singly. At other times, adult males either roosted singly or in groups comprised of one (very rarely two) male(s) and 1-10 females. Formation of groups is not attributable to shortage of leaves; there were invariably more habitable clumps of banana plants (i.e. with two or more suitable leaves) than adult males, so competition for clumps by males was unlikely. On most occasions, each male was found with a different group of females, and each female with a different male, showing that group-membership is highly labile - which suggests that the mating system is promiscuous. Some males attracted more females than others, but what makes a male attractive to females, especially during the mating season, is not known. Males were not heard vocalizing to attract females to their roosts (unlike *P. helios* in East Africa). Banana Pipistrelles do not return to their roosts until dawn; there is no evidence that males are territorial, and they did not have injuries attributable to fighting. It might be that males are selected for the quality of the clumps of banana plants that they roost in; alternatively, each female might mate with many males and rely on sperm competition to obtain the best sire for her progeny.

**Reproduction** In Malawi, litter-size: 2 (n = 42). Females give birth once/year. Spermatogenesis occurs in the hot wet season (Feb-Apr), mating in the cool dry season (mid-Jun to early-Jul), sperm storage by the females until ovulation in Aug and sperm storage in the males until at least Sep. Young are born in the wet season (mid-Nov) ca. 10 weeks after fertilisation and 20 weeks after mating. Thus, both spermatogenesis and lactation occur in the hot wet season when insects are maximally abundant. Neonates are naked, their eyes are closed and each weighs about one gram. The young cling to the nipples and ventral pelage of the mother and are enclosed by her wings when she rests and carried when she flies. By Week 9, their diet includes insects as well as milk and they are just able to fly. They are weaned when 8-9 weeks old. Elsewhere: different reproductive strategies have been reported.

**Conservation** IUCN Category: Least Concern. Because Banana Pipistrelles roost in furled banana leaves, this is one of the few species that benefits from the conversion of natural habitats to subsistence farms and villages.

**Taxonomic Notes** *Pipistrellus nanus* (Peters, 1852). Subgenus controversial; placed here and in Happold (2013) in *Pipistrellus* but sometimes placed in *Neoromicia* or *Hypsugo.* Referred to as *P. africanus* by Ansell & Dowsett (1988). Seven subspecies have been recognized but their status and biogeographic ranges are uncertain, and some may be cryptic species. The subspecies in Malawi is *P. n. nanus.*

**Key References** Bernard *et al.* 1997*,* Happold, M. (2013y), Happold & Happold (1990, 1996).

**Measurements**
*Pipistrellus nanus*

| | |
|---|---|
| FA (males): | 30.9 (29-33) mm, n = 73 |
| FA (females): | 31.9 (28-34) mm, n = 120 |
| TL (males): | 72.5 (65-76) mm, n = 18 |
| TL (females): | 75.3 (60-82) mm, n = 24 |
| T (males): | 33.9 (30-38) mm, n = 18 |
| T (females): | 35.5 (30-40) mm, n = 24 |
| E: | 10.6 (10-12) mm, n = 41 |
| Tr: | 5.0 (4.0-5.5) mm, n = 22 |
| Tib (males): | 12.8 (10-14) mm, n = 18 |
| Tib (females): | 13.1 (12-14) mm, n = 23 |
| HF (males): | 5.9 (5-7) mm, n = 18 |
| HF (females): | 6.2 (5-8) mm, n = 23 |
| WT (males): | 3.7 (2.5-4.5) g, n = 83 |
| WT (females): | 3.8 (3.0-6.5) g, n = 164* |
| GLS: | 11.7 (11.2-12.1) mm, n = 20 |

Malawi (HC).
*Includes weights of 30 pregnant females, weights 4.0-6.5 g.

## *Pipistrellus (Neoromicia) rendalli*

## Rendall's Pipistrelle

**Malawian Names** Not known.


Chiromo, Malawi © DCD & M. Happold

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors on each side; anterior upper premolar absent; canine and posterior premolar in contact or almost so. Sexes similar in colour; females on average with slightly larger body measurements. Pelage fluffy, without sheen. Dorsal pelage medium brown to fawn, hairs fawn with dark brown at base. Ventral pelage pale fawn to off-white (flanks and anal region sometimes pure white); hairs with basal half dark greyish-brown, or pure white. Ears pale brown, subtriangular; tip rounded. Tragus not hatchet-shaped (posterior margin smoothly convex with triangular basal lobe; tip rounded). Wings and interfemoral membrane semi-translucent, white or creamy-white; skin over bones brownish-pink. Penis not extremely long (cf. *Scotoecus albofuscus*).

**Similar Species**

*Scotoecus albofuscus.* One upper incisor on each side; penis extremely long (ca. 9 mm).

**Distribution** In Malawi, known only from the Lower Shire Valley (<100 m) and from one individual collected adjacent to the Lake Shore at ca. 900 m, in the Karonga District. Recorded from Bangula (near Chiromo), Chiromo, and Malema Camp (near Ulamwe, Karonga District). Elsewhere: widespread south of the Sahara; recorded disjunctly from Senegal to Sudan and Somalia, and southwards to Mozambique, Botswana and E South Africa.

**Habitat** Recorded at Chiromo, a town with nearby cotton fields, marshes, miombo woodland, and riverine forest beside the Ruo River in 1914-1922 and again in 1995 by which time the town had been abandoned after severe floods; the cotton fields had been replaced by subsistence farms, and there were only empty buildings and old ornamental gardens near the river, and marshes with pools and adjacent grassland. Elephant Marsh on the floodplain of the Shire River is nearby.

**Abundance** Rarely-recorded in Malawi. Elsewhere: considered rare throughout its biogeographic range but perhaps not uncommon in some localities.

**Habits** In Malawi, Rendall's Pipistrelles have been found during the day, roosting among the fronds of *Hyphaene* palms and in a cotton plant. In DR Congo, they have been found in the dense foliage of low bushes and trees, and in huts and houses (especially after dry-season fires when the bushes and trees are leafless). There, they "clung to the brick walls or to the rafters or even to a single grass stalk hanging from the thatch"; they preferred the darkest and most secluded places. Rendall's Pipistrelles forage for small insects by slow-hawking, usually within two metres of the ground. They forage low over swamps and pools between Chiromo and Bangula, and perhaps they specialise in foraging over such places. In South Africa, they have been seen foraging over pans and rivers. However, there is no information about their diet except that, in Kenya, stomach contents of nine individuals in the dry season contained mainly moths, beetles and bugs with some Orthoptera and other insects. There is no information about their social and reproductive behaviour in Malawi. In DR Congo they have been found roosting in groups of up to six (group composition unknown).

**Reproduction** At Chiromo in Apr, 1 of 2 females was lactating and one was post-lactating, and neither was pregnant (no information for other months). In KwaZulu-Natal, South Africa, litter-size: 2 (n = 2) and one female was simultaneously lactating and pregnant in Dec.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Pipistrellus rendalli* (Thomas, 1889). Subgenus *Neoromicia*. Two subspecies. The subspecies in Malawi is *P. r. phasma*. Referred to as *Eptesicus rendalli* by Sweeney (1959), Happold *et al.* (1987) and Happold & Happold (1997).

**Key Reference** Van Cakenberghe & Happold (2013c).

**Measurements**
*Pipistrellus rendalli*

FA: 35.8 (33-38) mm, n = 16
TL: 93.4 (78-102) mm, n = 15
T: 40.1 (31-45) mm, n = 15
E: 11.9 (9-14) mm, n = 14
Tib: 14.1 (14-15) mm, n = 4
HF: 8 mm, n = 4
WT: 8.0 (6.0-10.8) g, n = 16
GLS: 14.0 (13.7-14.2) mm, n = 4

Malawi and Southern Africa (HC, HZM, NHMUK, Van Cakenberghe pers. comm.).

## *Pipistrellus (Pipistrellus) rueppellii*

## Rüppell's Pipistrelle

**Malawian Names** Not known.


Zomba, Malawi © DCD & M. Happold

**Description** Very small and very beautiful microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors on each side; anterior upper premolar medium-sized, clearly visible above gum, within toothrow or slightly displaced; canine and posterior premolar well separated. Sexes alike. Pelage soft, dense, sleek. Dorsal pelage moderately dark grey with silvery frosting; hairs dark smoky grey with pale grey at tip. Ventral pelage (except throat) pure white; hairs pure white. Throat either pure white or pale rusty-brown (cinnamon). Muzzle and ears black. Ears subtriangular, rounded at tip; outer margin with semi-circular lobule at base. Tragus not hatchet-shaped (posterior margin slightly and smoothly convex with small lobule at base; tip rounded). Wings translucent grey; pale hind-border present in at least some specimens. Interfemoral membrane translucent grey.

**Similar Species** No other pipistrelle has pure white ventral pelage.

**Distribution** In Malawi, found in diverse habitats at altitudes ranging from 450-500 m in the Upper Shire Valley, ca. 1000 m on the Phalombe Plain, 1450 m on the Shire Highlands and 1600 m on the South Viphya Plateau. Recorded from Liwonde N. P., Matope, South Viphya Plateau, Thyolo District, Upembe, Zomba and Zomba Plateau. Elsewhere: very widely but disjunctly recorded from North Africa to South Africa except not in most countries in West Africa and the Sahara, and not in Somalia and Namibia.

**Habitat** Montane evergreen forest near large dams and streams, miombo woodlands near open water, and tea/tobacco/maize estates with dams and remnants of miombo, riverine forest and/or lowland rainforest. Access to open water is probably essential.

**Abundance** Uncommonly-recorded in Malawi. Elsewhere: moderately common in some localised areas near open water.

**Habits** The day-roosts of Rüppell's Pipistrelles in Malawi are not known. They have been found under plaster on the wall of a ruin in Tanzania, and behind a notice board against a wall in Zimbabwe. In Malawi, they sometimes became torpid during the day at 21-24°C. Their kidneys cannot produce concentrated urine and they probably drink water every day. Their flight is slow and highly manoeuvrable in confined spaces but faster and more agile in open spaces. They often (perhaps almost always) forage by slow-hawking over the open water of lakes, dams, ponds and streams, or over the surrounding grassy or marshy verges. While foraging, they fly straight and fast with interruptions to swerve, dive or swoop upwards in pursuit of prey. They are spectacularly aerobatic! Faecal pellets of one individual from South Africa contained only the remains of beetles but they probably eat a variety of other insects as well. While foraging, these bats congregate in small numbers (up to several dozens) over water, and sometimes individuals follow each other. There are no other conclusive observations of their social and reproductive behaviour.

**Reproduction** There is no conclusive information for Malawi; juveniles were recorded in Dec and Mar, post-lactating females in Mar, and 12 of 12 females were reproductively inactive in Jan; no data for other months. Elsewhere: in W Zambia, juveniles were reported in Sep and Nov.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Pipistrellus rueppellii* (J. Fischer, 1829). Subgenus *Pipistrellus*. Subspecies uncertain. Not listed by Sweeney (1959).

**Key Reference** Happold, M. (2013z).

**Measurements**
*Pipistrellus rueppellii*

| | |
|---|---|
| FA: | 36.3 (34-38) mm, n = 27 |
| TL: | 87 (74-95) mm, n = 17 |
| T: | 38.7 (33-43) mm, n = 17 |
| E: | 12.9 (9-14) mm, n = 17 |
| Tr: | 6.2 (5.5-7.0) mm, n = 17 |
| Tib: | 15.8 (15-17) mm, n = 18 |
| HF: | 9.5 (8-10) mm, n = 17 |
| WT: | 7.7 (6.4-9.5) g, n = 27 |
| GLS: | 14.0 (13.4-14.4) mm, n = 6 |

Malawi (HC).

## *Pipistrellus (Neoromicia) stanleyi*

## Stanley's Pipistrelle

**Malawian Names** Not known.

**Description.** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors on each side; anterior upper premolar absent; canine and posterior premolar in contact or almost so. Sexes similar. Pelage fairly long, soft, dense. Dorsal pelage very dark chocolate brown to sepia-brown, often with slight golden sheen; hairs bicoloured, blackish-brown, with chocolate-brown or sepia-brown tip. Ventral pelage chocolate brown to pale sepia-brown on throat and chest, becoming paler on abdomen, and greyish-white in pelvic region; hairs mostly dark brown with paler tips. Colour of ventral pelage changes, like shot silk, depending on angle of view. Ears brown, subtriangular with rounded tip. Tragus not hatchet-shaped (posterior margin smoothly convex with shallow, folded basal lobe; tip rounded). Wings blackish-brown, slightly grey in some individuals, slightly translucent; usually with narrow white hind-border (sometimes with no hind-border, rarely with conspicuous hind-border). Interfemoral membrane paler and more translucent. FA: 35.3 (32-38) mm

**Similar Species**

*Pipistrellus capensis.* Forearm on average shorter (31.9 [28-38] mm), tail on average shorter (30.5 [25-38] mm).

*Pipistrellus grandidieri*. Dorsal pelage pale brown, unicoloured.

*Pipistrellus hesperidus*. On average smaller, FA: 33.3 (30-37) mm, anterior upper premolar present, medium-sized to minute, usually visible above gum.

*Pipistrellus nanus*. Tragus hatchet-shaped.

*Pipistrellus zuluensis*. Almost always smaller, FA: 29.9 (27-33) mm.

**Distribution** In Malawi, known only from the Central Plateau at 1100 m and the Upper Shire Valley at 500 m. Recorded from Kasungu N. P. and Liwonde N. P. Not found in Malawi until 1984 (Happold *et al.* 1987 as *Eptesicus melckorum*. Elsewhere: recorded from S Tanzania and parts of Zambia, Zimbabwe, Mozambique and the extreme NE of South Africa.

**Habitat** In Malawi, only known from open and closed canopy miombo woodland in two National Parks.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain but appears uncommon.

**Habits** Very little is known about Stanley's Pipistrelles. Their daytime roosts are not known. The foraging habits and diet of these bats are not known, and nothing is known about their social and reproductive behaviour.

**Reproduction** No information.

**Conservation** IUCN Category: Data Deficient.

**Taxonomic Notes** *Neoromicia stanleyi* Goodman, Kearney, Ratsimbazafy and Hassanin, 2017. *Neoromicia* is treated here as a subgenus of *Pipistrellus.* Specimens of this species were formerly placed in *Eptesicus* as *E. melckorum*, and subsequently referred to as *Pipistrellus* cf. *melckorum* pending renaming. No subspecies. Not listed by Sweeney (1959). Referred to as *Eptesicus melckorum* by Happold & Happold (1987, 1997), *Pipistrellus* sp. by Ansell & Dowsett (1988) and *P.* cf. *melckorum* by Kearney (2013d).

**Key Reference** Kearney (2013d) as *Pipistrellus* cf. *melckorum.*

**Measurements**
*Pipistrellus stanleyi*

| | |
|---|---|
| FA: | 35.3 (32-38) mm, n = 35* |
| TL: | 90.3 (78-101) mm, n = 7 |
| T: | 39.3 (35-44) mm, n = 7 |
| E: | 13.3 (10-16) mm, n = 7 |
| Tr: | 7.0, 7.5 mm, n = 2† |
| Tib: | 13, 16 mm, n = 2† |
| HF: | 8, 8 mm, n = 2† |
| WT: | 6.3 (5.6-6.7) g, n = 6 |
| GLS: | 14.5 (13.8-14.9) mm, n = 5 |

Malawi, Zambia and Zimbabwe (Kearney 2013d).
*Throughout biogeographic range (material not identified from chromosomes).
† Malawi (material not identified from chromosomes: HC).

## *Pipistrellus (Neoromicia) zuluensis*

## Zulu Pipistrelle

**Malawian Names** Not known.

Namibia © C. & M. Stuart

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors on each side; anterior upper premolar almost always absent (if present minute and hardly visible above gum; canine and posterior premolar in contact or almost so. Sexes similar. Pelage soft, dense, without sheen. Dorsal pelage medium brown, sometimes paler on rump; some individuals have a slightly orange hue; hairs blackish-brown (sometimes with paler middle section) and medium to pale brown at tip. Ventral pelage paler and more greyish; hairs very dark grey with pale greyish-brown or grey at tip. Ventral pelage not noticeably paler in pelvic region although some pure white hairs are present. Occipital helmet absent, so back of head feels smoothly rounded (cf. *P. capensis*). Ears brown, subtriangular; tip rounded. Tragus not hatchet-shaped (posterior margin smoothly convex for most of length but with shallow rounded angle just below mid-height) and with a prominent, folded, triangular basal lobe; tip rounded). Wings dark brown, slightly translucent, usually without white hind-border but sometimes with very narrow hind-border. Interfemoral membrane dark brown, slightly translucent; tail fully enclosed except for part of last vertebra.

**Similar Species**

*Pipistrellus capensis*. Dorsal hairs bicoloured; ventral pelage white, whitish or cream; occipital helmet usually present, therefore back of head does not feel smoothly rounded.

*Pipistrellus grandidieri*. Dorsal pelage pale brown, unicoloured.

*Pipistrellus hesperidus*. Mid-ventral pelage moderately dark brown.

*Pipistrellus nanus*. Tragus hatchet-shaped.

*Pipistrellus stanleyi*. Almost always larger, FA: 35.3 (32-38) mm.

**Distribution** In Malawi, known only from the Upper Shire Valley (500 m), at Liwonde N. P. Elsewhere: Ethiopia, Sudan and Kenya, Zambia, Zimbabwe, Botswana and NE South Africa with scattered records from Angola, Namibia and S South Africa.

**Habitat** Miombo woodland with isolated rocky hills and patches of tall grasses, riverine forest along a small river, scattered baobabs, an administration camp and game scouts' camp, and a youth hostel with thatched rondavels (Liwonde N. P.).

**Abundance** Seldom-recorded in Malawi. Elsewhere: uncertain.

**Habits** The day-roosts of Zulu Pipistrelles are not known. In Malawi, they became torpid during the day at ambient temperatures of 21-24° C. The kidneys of these bats are more efficient at producing very concentrated urine than any other species of bat. In the Namib Desert, captive bats exposed to prevailing desert conditions, but unable to fly, were able to rear young when deprived of water. However, because of the high rate of evaporative water loss from the wings during flight, Zulu Pipistrelles are unlikely to be independent of drinking water in the wild. In miombo woodland in Liwonde N. P., Zulu Pipistrelles forage by slow-hawking in spaces with moderate to high levels of clutter, including near canopies of trees, glades in woodland, open spaces between tree-trunks and lower branches, and clearings around buildings. Unlike many other species in this habitat, they are rarely encountered over a pool in the Likwenu River. The diet includes moths and beetles. Nothing is known about their social and reproductive behaviour.

**Reproduction** Litter-size: 2 (n = 1). In Liwonde N. P., one was pregnant in Oct, one was post-lactating in Nov, one was reproductively inactive in Dec, two were post-lactating and one was reproductively inactive in Feb. A juvenile was reported in Dec, and two subadults in Apr. The data are consistent with females giving birth once/year. Elsewhere: no conclusive information.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Pipistrellus zuluensis* (Roberts, 1924). Subgenus *Neoromicia*. Subspecies uncertain. First recorded in Malawi in 1984 (HZM). Referred to as *Eptesicus zuluensis* by Happold *et al.* (1987), Happold & Happold (1997) and *Pipistrellus (Neoromicia) zuluensis* by Ansell & Dowsett (1988).

**Key Reference** Happold. M. *et al.* (2013).

**Measurements**
*Pipistrellus zuluensis*

| | |
|---|---|
| FA: | 31.2 (30-33) mm, n = 9 |
| TL: | 76.3 (73-80) mm, n = 6 |
| T: | 32.9 (31-37) mm, n = 9 |
| E: | 11.1 (10-12) mm, n = 9 |
| Tib: | 13.1 (12-14) mm, n = 9 |
| HF: | 6.8 (5-8) mm, n = 9 |
| WT: | 4.3 (4-5) g, n = 9 |
| GLS: | 12.3 (12.0-12.7) mm, n = 4 |

Malawi (HC).

# Genus *Scotoecus* - Lesser House Bats

Subfamily Vespertilioninae. The number of species in this genus is controversial – 2-4 species in sub-Saharan Africa and one in Pakistan. Probably two species occur in Malawi. They are easily distinguished by the colour of their wings.

*S. albofuscus*. Wings white, semi-translucent, becoming brownish near body and around the edges.

*S. hirundo*. Wings dark brown, slightly translucent.

## *Scotoecus albofuscus*

## Light-winged Lesser House Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Chiromo, Malawi © DCD & M. Happold

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; one upper incisor on each side. Sexes apparently similar in colour and size. Pelage soft and dense. Dorsal pelage dark brown; hairs unicoloured. Ventral pelage slightly paler than dorsal pelage. Head somewhat flattened, muzzle broad, flat with nostrils opening sideways from small transverse pad. Ears widely separated, not protruding beyond snout when laid forward. Tragus short (just over one-third of E), rounded. Eyes small. Wings white, semi-translucent, becoming brownish with brown venation around edges and close to body; forearms and first, second and third fingers brown, fourth and fifth fingers white. Interfemoral membrane blackish-brown. Penis long (ca. 9 mm).

**Similar Species**

*Pipistrellus rendalli.* Two upper incisors on each side. Penis short.

**Distribution** In Malawi, known only from Chiromo at the confluence of the Shire and Ruo Rivers (at < 100 m), in the Lower Shire Valley. First recorded in 1916 (as *Scotoecus woodi*) and then again at the same locality in 1995. Elsewhere: known only from a few scattered localities from Gambia to Cameroun, and from Uganda and Kenya to KwaZulu-Natal in South Africa, but not recorded from all countries within this range.

**Habitat** Recorded from forests with *Hyphaene* palms near Chiromo in 1916 and in an unoccupied old ornamental garden near the Ruo River in 1995.

**Abundance** Rarely-recorded in Malawi. Considered rare throughout its biogeographic range.

**Habits** Little is known about these apparently rare bats. At Chiromo in 1914-1920, they roosted during the day among the leaves of low *Hyphaene* palms in forest, where they appeared to be moderately numerous, though rarely seen (R. C. Wood in Kershaw 1922). These bats have a low aspect ratio and medium wing-loading. They fly fast with very poor manoeuvrability. One individual could not turn tightly enough to maintain flight in a 3.5 x 3.5 m room. Based on this information, these bats probably forage by moderately fast-hawking in open spaces above the canopies of trees and moderately high above the ground. The stomachs of three individuals from Kenya contained mainly bugs and beetles, with some moths, flies and other insects. Nothing is known about their social behaviour except that several may be taken together nestling down among the leaves of the palms.

**Reproduction** No conclusive information for Malawi; at Chiromo, one female was post-lactating in early Apr. In KwaZulu-Natal, South Africa, a newly caught female gave birth to twins in late Nov.

**Conservation** IUCN Category: Data Deficient. Although widely distributed in Africa, rarely collected.

**Taxonomic Notes** *Scotoecus albofuscus* (Thomas, 1890). Two subspecies of dubious validity. If valid, the subspecies in Malawi is *S. a. woodi.* Referred to as *Nycticeius albofuscus* by Sweeney (1959).

**Key Reference** Happold, M. (2013aa), R. C. Wood in Kershaw (1922).

**Measurements**
*Scotoecus albofuscus*

| | |
|---|---|
| FA: | 30.0 (29-32) mm, n = 26 |
| TL: | 89.1 (77-95) mm, n = 25 |
| T: | 34.0 (30-41) mm, n = 25 |
| E: | 12.1 (9-15) mm, n = 25 |
| Tr: | 4.0, 4.4 mm, n = 2 |
| Tib: | 11.5 (10-13) mm, n = 3 |
| HF: | 8.5 (8-9) mm, n = 5 |
| WT: | 6.9 (5.0-9.5) g, n = 7 |
| GLS: | 13.5 (12.7-14.5) mm, n = 20 |

Malawi, Kenya, Tanzania, South Africa (HC, HZM, NHMUK, NMZB, ROM, SMF and literature).

## *Scotoecus hirundo*

## Dark-winged Lesser House Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Description** Very small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane, one upper incisor on each side. Sexes similar in colour; males on average slightly larger in some body measurements and with more massive teeth, longer upper toothrow and a wider gap between the third upper molars. Pelage soft, dense, with no sheen. Dorsal pelage chocolate brown or sepia brown; hairs unicoloured. Ventral pelage greyish-white to off-white. Head somewhat flattened; muzzle broad, flat, dark brown, almost naked. Nostrils opening sideways from small transverse pad. Ears widely separated, oval; tip rounded; not protruding beyond snout when laid forward. Tragus relatively short (41.9 [38-46]% of ear length); somewhat hatchet-shaped, anterior margin strongly concave; posterior margin with smooth, obtuse angle just above mid-height, tip rounded. Eyes very small. Wings and interfemoral membrane dark brown, slightly translucent. Penis relatively extremely long (14-16 mm).

**Similar Species**

*Nycticeinops schlieffeni.* FA: 28-35 mm. Dorsal pelage bright cinnamon; ventral pelage slightly paler. Tragus more pointed. Penis shorter (5.6 – 6.2 mm).

**Distribution** In Malawi, known only from the southern half of the country, on the Central Plateau, the Shire Highlands, Phalombe Plain and Upper and Lower Shire Valleys, from <100 -1500 m. Recorded from Chiromo, Dzalanyama F. R., Kasungu N. P., Likhubula, Liwonde N. P., Namadzi District, Ntchisi Mountain F. R. (rest house), Thondwe District, Thyolo District, Zomba District and Zomba. Elsewhere: recorded disjunctly from Senegal to Sudan, W Ethiopia and S Somalia, and southwards on eastern side of Africa, to W Angola and S Malawi.

**Habitat** Open and closed canopy miombo woodlands, riverine forest, and tea/tobacco/maize estates with conserved remnants of miombo woodland on rocky hills and termitaria, riverine forest beside streams, large dams, clusters of houses for farm labourers, and rural villages with subsistence farms.

**Abundance** Commonly-recorded in Malawi. Prior to 1993, rarely collected, but subsequently found to be the most commonly recorded species at Chiromo and Mpita Forest (Thondwe District), one of the four commonest species at Mpalanganga Dam (Thondwe District) and this species and *Pipistrellus nanus* were the most commonly recorded species on Kapalasa Farm (Namadzi District). Elsewhere: rarely collected and considered rare.

**Habits** Dark-winged Lesser House Bats were common around Zomba and Namadzi (Kapalasa Farm). During the day, they roosted under the corrugated iron roofs of huts and houses; natural day roosts are not known. They become torpid during the day at ambient temperatures of 21-24°C. These bats have a low aspect ratio and medium wing-loading, and they fly fast to very fast with agility but only moderate manoeuvrability. In Malawi, they forage by moderately fast-hawking in open spaces, above canopies of trees or over grassland, usually more than five metres above ground and often as high as about 25 m. They also fly as low as two metres between the trunks of eucalyptus trees in a plantation. They forage at high speed with long level flights interspersed with spectacularly aerobatic swerving, up and down or sideways. But their diet is not known. The social behaviour and mating strategy are not known, but captive bats huddled together amicably as though used to living in groups.

**Reproduction** Litter-size: 2 (n = 2). Females give birth once/year. Pregnancies have been observed in Sep-Nov, lactation in Nov-Jan, post-lactation in Jan-Mar and reproductive inactivity in Feb-Jun and Sep-Oct. Volant young have been observed in Dec-Mar. Elsewhere: at Masalani, Kenya, females give birth once/year, in Nov.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Scotoecus hirundo* (de Winton, 1899). The taxonomy of dark-winged *Scotoecus* is controversial. Here, all dark-winged forms are placed in *S. hirundo* pending revision with sexual dimorphism taken into consideration. Subspecies uncertain. Referred to as *S. albigula* and *S. hindei* by Happold *et al.* (1987) and Ansell & Dowsett (1988), but these were subsequently found to be conspecific and were referred to as *S. hirundo* by Happold & Happold (1997) and M. Happold (2013ac).

**Key References** Happold, M. (2013ab), Taylor & van der Merwe (1998).

**Measurements**
*Scotoecus hirundo*

| | |
|---|---|
| FA (males): | 35.7 (33-38) mm, n = 20 |
| FA (females): | 33.5 (31-35) mm, n = 8 |
| TL (males): | 93.7 (86-100) mm, n = 17 |
| TL (females): | 89 (77-95) mm, n = 14 |
| T (males): | 37.1 (33-41) mm, n = 18 |
| T (females): | 34.6 (30-39) mm, n = 17 |
| E (males): | 12.4 (11-19) mm, n = 16 |
| E (females): | 12.4 (11-14) mm, n = 14 |
| Tib (males): | 13.6 (13-15) mm, n = 15 |
| Tib (females): | 13.0 (12-14) mm, n = 17 |
| HF (males): | 8.6 (7-13) mm, n = 16 |
| HF (females): | 8.5 (8-9) mm, n = 16 |
| WT (males): | 11.1 (9.8-13.5) g, n = 17 |
| WT (females): | 10.2 (9-12) g, n = 18 |
| GLS (males): | 14.1 (12.6-16.1) mm, n = 44 |
| GLS (females): | 14.1 (12.1-16.1) mm, n = 47 |

Malawi (HC, Happold *et al.* 1987).

# Genus *Scotophilus* - House Bats

Subfamily Vespertilioninae. This genus contains 14 species of which six occur in Africa. Four species occur in Malawi. *Scotophilus nigrita* is larger than the others. The other species are best distinguished by a discriminant function (not included here) but they differ slightly in forearm length and colour of the pelage. In the yellow box below, the species are listed in order of increasing FA.

*S. viridis*. FA: 45.9 (41-51) mm. Ventral pelage usually yellowish but sometimes whitish or pale brown without any yellow. Dorsal pelage greenish-brown to medium brown.

*S. leucogaster*. FA: 49.3 (47-52) mm. Ventral pelage white to dirty medium brown (tinged with yellow in some individuals). Dorsal pelage pale to medium brown, not tinged with yellow or green.

*S. dinganii*. FA: 54.8 (50-57) mm. Ventral pelage bright yellow, yellow-buff or pale yellow. Dorsal pelage sepia-brown to blackish sepia-brown, slightly tinged with green.

*S. nigrita*. FA: 82.2 (78-88) mm.

## *Scotophilus dinganii*

## Yellow-bellied House Bat

**Malawian** Liputiputi, Ndemiya, Namzeze.
Same for other microbats.

Limpopo Province, South Africa © C. & M. Stuart

**Description** Small, heavily-built microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; one upper incisor on each side. Sexes similar in colour. Pelage smooth, soft and sleek. Dorsal pelage sepia-brown to blackish-sepia-brown, slightly suffused with green; hairs paler at base. Ventral pelage ranging from bright yellow to yellow-buff and pale yellow. Ears widely separated; inner margin strongly convex; outer margin almost straight. Tragus moderately long, tapering to bluntly rounded tip: inner margin concave. Eyes small. Wings and interfemoral membrane uniformly dark brown, semi-translucent.

**Similar Species**
*Scotophilus* spp. See diagnostic characters in yellow box above.
*Scotoecus hirundo*. Smaller (FA: 31-38).

**Distribution** Very widespread in Malawi and recorded from all biogeographic areas, from <100-1700 m, although as yet not recorded from the Nyika Plateau and the Misuku Hills. Recorded from Blantyre, Chididi, Chileka, Chinthechi, Chiromo, Dedza, Kasungu N. P., Kamuzu Academy, Liwonde N. P., Mangochi, Mikolongwe, Mulanje, Namadzi District, Nchalo, Nsanji, Ntcheu, Ntchisi Mountain F. R. (rest house), South Viphya Plateau, Thondwe District, Thyolo District, Zoa Tea Estate, Zomba and Zomba Plateau. Elsewhere: very widespread south of the Sahara from Gambia to Eritrea, Ethiopia and Somalia and southwards to Namibia and South Africa. However, only found around the edges of the Rain-forest Zone, and there are few records in the Horn of Africa and the South-West Arid Zone, and no records in the South-West Cape Zone.

**Habitat** Miombo and other woodlands, riverine forest, montane evergreen forest, lowland rain forest, tea/tobacco/maize estates with remnant natural vegetation, ornamental gardens with large trees, rural villages and small towns with trees and gardens.

**Abundance** Commonly-recorded in Malawi. Common in many areas and probably common throughout biogeographic range. Advantaged by ability to exploit village and semi-urban environments where houses and other buildings provide roosts.

**Habits** As their name implies, Yellow-bellied House Bats often roost during the day in narrow crevices in buildings (both occupied by humans and deserted), particularly under eaves and roofs of corrugated iron and in crannies in thatch. This might explain why these bats are abundant in farmlands and suburbs. But they also roost in small holes in trees and wooden lampposts (including nest-holes made by barbets and woodpeckers), and in crevices within hollow trees. They scuttle from landing and take-off sites to the nooks in which they roost. They prefer to rest on sloping or horizontal surfaces, but sometimes cling to vertical surfaces in their roosts. They are not known to roost with other species of bats. They tolerate high temperatures under iron roofs, and they do not become torpid during the day at ambient temperatures of 20-21°C. Seasonal fluctuations in abundance at particular localities have been observed, and in the Shire Highlands, captures/month were higher in the wet season (Nov-Feb) than in Mar-Jun and Sep-Oct (no data for Jul-Aug). Their kidneys can only produce low concentration urine; captive bats drank every day. In the wild, they drink, on the wing, from pools, streams and dams.

Yellow-bellied House Bats have a medium aspect ratio and wing-loading, and their flight is fast and agile but with poor manoeuvrability and they cannot fly slowly, but they can take off from the ground. They can scuttle very efficiently, head-first, over horizontal, sloping and vertical surfaces, but not as fast as free-tailed bats. They leave their roosts soon after sunset and begin foraging, by moderately fast-hawking, in moderately uncluttered spaces above canopies, in clearings and over fields, and sometimes near lights and inside houses. They are not known to forage as high as some free-tailed and sheath-tailed bats, and they often forage closer to trees, and as low as two metres from the ground. Foraging is characterized by long, straight or gently banked flights (during which prey may be captured), and abrupt aerobatic swerves and spectacular dives in pursuit of prey. Although individuals come to streams and dams to drink, there is no evidence, from their echolocation calls, that they pursue insects flying near the surface. In Zimbabwe and South Africa, they feed mainly on beetles and bugs, but other flying insects are taken opportunistically. In Kenya, three stomachs contained beetles (65% by volume), bugs (13%), Orthoptera (13%) and moths (5%).

Very little is known about the social and reproductive behaviour of these bats. Congregations of hundreds of bats were observed foraging where termites were swarming in Zimbabwe. Sightings of two individuals flying close together (tailing one-another) have been reported, and it is common to capture a male and female side-by-side in a mist-net. They occasionally roost singly but usually roost in groups of up to about twenty; several groups sometimes roost under one roof but in different parts. In KwaZulu-Natal, South Africa, they roost singly or in groups of 2-10 (composition not known), and some roosts are occupied for at least eight years.

**Reproduction** Litter-size: 2 (n = 3). Females give birth once/year in Nov-Dec and lactate in Nov-Jan. In South Africa also, females give birth once/year. In Kenya, births have been recorded in both wet seasons (Nov and also in Mar-Apr), during a year-round study but it was not proven that any individual female gave birth more than once/year.

**Conservation** IUCN Category: Least Concern. These bats roost in occupied houses and have adapted well to semi-urban and farmland environments.

**Taxonomic Notes** *Scotophilus dinganii* (A. Smith, 1833). No subspecies. This species was formerly referred to as *S. nigrita* until it was realised that *nigrita* was the prior name of *S. gigas*. Referred to as *S. nigrita* by Sweeney (1959).

**Key Reference** Happold, M. (2013ac).

**Measurements**
*Scotophilus dinganii*

| | |
|---|---|
| FA: | 54.8 (50-57) mm, n = 46 |
| TL: | 128.9 (120-137) mm, n = 13 |
| T: | 52.4 (50-57) mm, n = 25 |
| E: | 17.3 (15-20) mm, n = 26 |
| Tr: | 9.6 (9-10.5) mm, n = 23 |
| Tib: | 23.5 (22-25) mm, n = 27 |
| HF: | 11.2 (9.5-14.0) mm, n = 25 |
| WT: | 26.3 (21-34) g, n = 46 |
| GLS: | 20.8 (19.6-21.9) mm, n = 8* |

Malawi (HC, NHMUK, Happold *et al.* 1987).
*Malawi and Zambia.

## *Scotophilus leucogaster*

## White-bellied House Bat

**Malawian Names** Not known.

**Description** Small, heavily-built microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; one upper incisor on each side. Sexes similar. Pelage smooth, soft and sleek. Dorsal pelage medium sepia brown to pale brown (not tinged with green or yellow); hairs unicoloured or becoming slightly paler towards base. Ventral pelage white to dirty medium brown (might be tinged with yellow in some individuals). Ears widely separated; inner margin strongly convex; outer margin almost straight. Tragus tapering to bluntly rounded tip; inner margin concave. Eyes small. Wings and interfemoral membrane uniformly dark brown, semi-translucent,

**Similar Species**
*Scotophilus* spp. See diagnostic characters in yellow box above.
*Scotoecus hirundo*. Smaller (FA: 31-38).

**Distribution** In Malawi, known only from the Lower Shire Valley, at < 100 m. Recorded at Chiromo and Nsanje. Elsewhere: scattered localities throughout most of sub-Saharan Africa, except in the rainforest zone, DR Congo, the Horn of Africa, Tanzania and South Africa.

**Habitat** Woodland savannas, riverine forests and farmlands but no details available.

**Abundance** Rarely-recorded in Malawi. Elsewhere: uncertain. The most commonly recorded bat at Sengwa Wildlife Research Area, Zimbabwe.

**Habits** There is no information from Malawi where White-bellied House Bats occur in the far south, but there are interesting observations from Sengwa in Zimbabwe. There, they roosted during the day in hollow mopane trees, and radio-tracked individuals regularly switched roosts. These individuals foraged by moderately fast-hawking, 2-20 m above ground, in uncluttered open spaces above trees and over grasslands, and in moderately uncluttered spaces between tree-trunks and tree-canopies. They also foraged in mopane, miombo and riverine woodlands, and over flood-plains and the grassy edges of rivers. Foraging began when the bats left their roosts soon after dusk, and their stomachs were soon filled. The radio-tracked bats flew up to 3 km away from their roosts to find food and/or water. On bright moonlit nights, activity was reduced and the bats stayed near or under trees. At Sengwa, foraging only occurred during the first hour of the night. Possibly the restriction of foraging to the first hour of the night, and the avoidance of open spaces on moonlit nights, are ways of reducing predation from aerial predators. At Sengwa, White-bellied House Bats feed mainly on beetles, moths and bugs, but also eat other insects, and there is some evidence that beetles and bugs are particularly important in the wet season, and that moths only comprise a major part of the diet in the dry season. At Sengwa, they roosted in groups of 1-9 individuals, but their ages and sexes were not recorded.

**Reproduction** No information for Malawi. Elsewhere: in Zimbabwe, litter-size 2 and births have been observed in Nov and Dec.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Scotophilus leucogaster* (Cretzschmar, 1830). There are taxonomic problems associated with the names *leucogaster* and *viridis*, and therefore much confusion in the literature. Here, we consider *leucogaster* and *viridis* to be distinct species. *Scotophilus leucogaster* was not recorded from Malawi by Sweeney (1959), Happold *et al.* (1987) and Ansell & Dowsett (1988), but some specimens from southern Malawi, are now considered to represent *leucogaster*.

**Key Reference** Van Cakenberghe & Happold (2013d).

**Measurements**
*Scotophilus leucogaster*

| | |
|---|---|
| FA: | 49.3 (47-52) mm, n = 58 |
| TL: | 121 (110-129) mm, n = 61 |
| T: | 48.7 (42-55) mm, n = 61 |
| E: | 15.5 (13-18) mm, n = 61 |
| Tr: | n. d. |
| Tib: | 19.6 (18-21) mm, n = 8 |
| HF: | n. d. |
| WT: | 17.7 (12-25) g, n = 59 |
| GLS: | 17.1 (16-18) mm, n = 56 |

Zimbabwe and South Africa (Van Cakenberghe pers. comm.)

## *Scotophilus nigrita*

## Giant House Bat

**Malawian Names** Not known.

**Description** The largest African vesper bat. A large, heavily-built microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; one upper incisor on each side. Sexes similar in colour. Dorsal pelage blackish-brown, sepia brown, greenish-brown, rusty-brown or greyish-brown suffused with yellow; hairs unicoloured. Ventral pelage white to dirty medium brown (might be tinged with yellow in some individuals. Ears blackish-brown, widely separated; inner margin strongly convex with lobe at base; outer margin fairly. Tragus tapering to bluntly rounded tip; inner margin concave. Wings and interfemoral membrane blackish-brown.

**Similar Species** None.

**Distribution** In Malawi, known only from the Lower Shire Valley. Recorded from Chiromo at 60 m and Mtondo Ruo (presumably Mitondo) at 317 m. Elsewhere: known only from a few scattered localities in Senegal, Côte d'Ivoire to SW Nigeria, and in Sudan, SE DR Congo, SE Kenya, NW Tanzania, Zimbabwe and Mozambique.

**Habitat** Recorded at Chiromo prior to 1920, before the town and surrounding cotton fields were abandoned because of severe flooding in 1948; has not been recorded there since. Very little is known about this species. One comment (which referred to all species of *Scotophilus* at Chiromo) was that they live in hollow trunks or large holes in *Hyphaene*-palms which are very plentiful in the low country around the Shire River (R. C. Wood in Kershaw 1922).

**Abundance** Rarely-recorded in Malawi. Elsewhere: very rarely encountered and considered very rare.

**Habits** Very little is known about these bats. At Chiromo, one was found in a hollow, dead *Hyphaene*-palm, and others were seen over the bank of a river and another over a village at dusk. They are predicted to forage high above the ground. Some characteristics of the teeth of Giant House Bats suggest that they are strictly carnivorous, but other characteristic suggest that they are also insectivorous. There is no information about their social and reproductive behaviour.

**Reproduction** No information.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Scotophilus nigrita* (Schreber, 1774). Formerly referred to as *S. gigas*. Two subspecies. The subspecies in Malawi is *S. n. alvenslebeni.* Referred to as *S. gigas* by Sweeney (1959), but as *S. nigrita* by Happold *et al.* (1987) and Ansell & Dowsett (1988).

**Key References** Happold, M. (2013ad), R. C. Wood in Kershaw (1922).

**Measurements**
*Scotophilus nigrita*

| | |
|---|---|
| FA: | 82.2 (78-88) mm, n = 22 |
| TL: | 191 (187-195) mm, n = 15 |
| T: | 78 (64-92) mm, n = 15 |
| E: | 22 (20-24) mm, n = 15 |
| Tr: | n. d. |
| Tib: | 34.4, 35.4 mm, n = 2 |
| HF: | 17 (17-19) mm, n = 15 |
| WT: | 89 (88-91) g, n = 3 |
| GLS: | 29.9 (27.8-32.1) mm, n = 22 |

Throughout biogeographic range (AMNH, HZM, MNHN, NHMUK, RMCA, RMNH, SMF, USNM, ZMA, Van Cakenberghe pers. comm. and literature).

## *Scotophilus viridis*

## Green House Bat

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

Dzalanyama F. R., Malawi © DCD & M. Happold

**Description** Small, heavily-built microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; one upper incisor on each side. Sexes similar. Pelage smooth, soft and sleek. Dorsal pelage greenish-brown to medium-brown; hairs with paler base. Ventral pelage usually yellowish but sometimes whitish or pale brown. Ears widely separated, dark brown; inner margin strongly convex; outer margin almost straight. Tragus moderately long, tapering to bluntly rounded tip; inner margin concave. Eyes small. Wings and interfemoral membrane uniformly dark brown, semi-translucent.

**Similar Species**
*Scotophilus* spp. See diagnostic characters in yellow box above.
*Scotoecus hirundo*. Smaller (FA: 31-38).

**Distribution** Known from the southern half of Malawi, from the southern edge of the Central Plateau, the Shire Highlands and the Upper Shire Valley, at altitudes of 500-1200 m. Recorded from Dzalanyama F. R., Liwonde N. P. and Namadzi District. Elsewhere: widely distributed but only known from scattered populations in sub-Saharan Africa, from Gambia and Senegal to Sudan and W Ethiopia, and southwards in S Kenya, E Tanzania, Zambia, Zimbabwe, Mozambique and NE South Africa.

**Habitat** Open and closed canopy miombo woodlands, riverine forest and a tobacco/maize farm where remnants of miombo and riverine vegetation were conserved.

**Abundance** Uncommonly-recorded in Malawi. Elsewhere: uncertain; fairly common in some collections.

**Habits** The day-roosts of Green House Bats in Malawi are not known. In South Africa, they roost in hollow trees. In Malawi, they did not become torpid during the day at ambient temperatures of 21-24°C. These bats have a low aspect ratio and medium wing-loading, and their flight is fast and agile with moderate manoeuvrability. They can take off from the ground. Their locomotion on flat surfaces is efficient, and they are able to climb. The diet of these bats in Malawi is not known. In captivity, when fed on winged termites, they drank water at least twice/day, and they have been mist-netted on the banks of a pool in a river. In Malawi, foraging by slow-hawking was observed in clearings and moderately uncluttered spaces between tree trunks, mainly 2-7 m above ground. Foraging flights were characterised by swerving, diving and swooping upwards, and by the lack of aerobatic manoeuvring. In the Kruger N. P. South Africa, individuals moved, while foraging, towards the river and apparently drank before returning to their roosts within an hour. Radio-tracked bats travelled up to four kilometres from their roosts. In the dry season, beetles comprised about half of the diet, with flies, moths, wasps and bugs eaten less often.

**Reproduction** Litter-size: not known. Limited data suggest that females give birth once/year at the end of the dry season and beginning of wet season (Oct-Nov). In NE South Africa, litter-size 2 (n = 4). Females give birth once/year. Mating, ovulation and fertilization occur in autumn (Apr), there is retarded embryonic growth for ca. four months, and births occur in Nov.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Scotophilus viridis* (Peters, 1852). There are taxonomic problems with the name *viridis*. Here *viridis* is considered to be a distinct species. Subspecies: perhaps two. If valid, the subspecies in Malawi is *S. v. viridis*.

**Key Reference** Van Cakenberghe & Happold (2013e).

**Measurements**
*Scotophilus viridis*

| | |
|---|---|
| FA: | 45.9 (41-51) mm, n = 167* |
| TL: | 115.0 (110-120) mm, n = 7 |
| T: | 43.8 (31-51) mm, n = 9 |
| E: | 15.1 (13-16) mm, n = 10 |
| Tr: | 8.3 (8-9) mm, n = 6 |
| Tib: | 20.3 (16-20) mm, n = 11 |
| HF: | 10.6 (10-12) mm, n = 9 |
| WT: | 22.9 (18-29) g, n = 21 |
| GLS: | 17.1 (15.6-18.3) mm, n = 152* |

Malawi (HC).
*Throughout biogeographic range (DNMNH, FMNH, HC, IRSN, MNHN, NHMUK, RMCA, RMNH, SMF, USNM, ZFMK, ZMA).

## FAMILY MINIOPTERIDAE - Long-fingered Bats

Long-fingered Bats closely resemble Vesper bats in that they do not have a noseleaf and the tail is more-or-less completely enclosed by the interfemoral membrane. However, for Long-fingered Bats, the second phalanx of the third finger is about three times longer than the first (cf. as long as the first or twice as long as the first) and the third finger has a bent appearance. The tips of the wings can fold forward so the wing membranes can be furled close to the forearm to facilitate scuttling and climbing. The ears are short and well separated, not funnel-shaped, and the tragus is short and blunt. The pelage is thick, short and velvety.

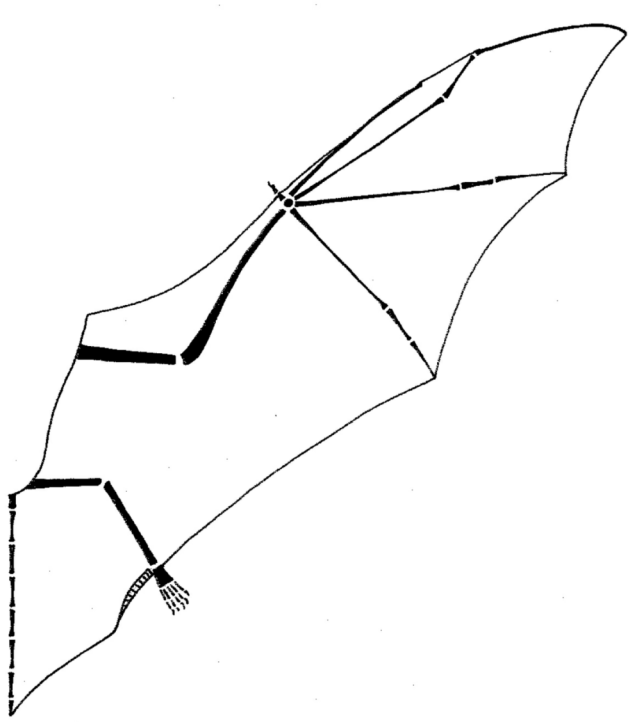


Fig. 19. Wing of a Long-fingered Bat, *Miniopterus*, showing the second phalanx of the third finger about three times as long as first phalanx, and the characteristic bend in the alignment of the metacarpal and the first and second phalanges which explains why *Miniopterus* spp. are also known as Bent-winged Bats.

### Genus *Miniopterus* – Long-fingered Bats

This genus contains about 20 species of which seven occur in Africa and the remainder in Madagascar, Comoros, across Eurasia to Japan and through the Indo-Australian archipelago to Australia. The number of species of Long-fingered Bats in Malawi is uncertain. There is one comparatively large species (FA: 44-51 mm), and probably four usually smaller species (FA 41-45 mm), but distinguishing the latter is problematical and they have been profiled together.

### *Miniopterus inflatus*

### Greater Long-fingered Bat

**Malawian Names** Not known.

**Description** Small microbat without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors and five upper cheek-teeth on each side; forehead high-domed; third finger looks bent; the largest African *Miniopterus,* FA: 48.2 (44-51) mm. Sexes similar. Pelage dense, silky. Dorsal pelage ranging from dark brown to medium brown; hairs uncoloured or with slightly paler tip. Ventral pelage slightly paler and slightly greyish. Head with high-domed forehead; muzzle fairly short and narrow. Ears subtriangular; tip bluntly rounded. Tragus with anterior and posterior margins straight and parallel; tip rounded. Wings long, narrow, dark brown or almost black; second phalanx of third finger ca. three times longer than the first; first phalanx of third finger angled forward so third finger appears bent. Interfemoral membrane same colour as wing.

**Similar Species** Other *Miniopterus* in Malawi are almost always smaller i.e. FA: 43.3 (41-45) mm.

**Distribution** In Malawi, known only from Likhubula at the base of Mulanje Mountain, at ca. 750 m. Elsewhere: *M. i. africanus* is widespread but in mostly isolated localities in Eritrea, Ethiopia, Kenya, Tanzania, Botswana and Namibia.

**Habitat** No details available. Likhubula has miombo woodlands and riverine forests and is close to the sheer sides of the granite-syenite massif, Mulanje Mountain.

**Abundance** Rarely-recorded in Malawi. Rare or uncommon in collections; probably uncommon throughout geographic range although large numbers have been found in a few maternity caves.

**Habits** Nothing is known about the habits of Greater Long-fingered Bats in Malawi. Elsewhere, they roost during the day in caves (including those formed by granite boulders) and mine-adits. Individuals often tuck themselves into crevices, but sometimes hang from ceilings. The wings of these bats are long and narrow with pointed tips, so predictably they forage for flying insects by moderately fast-hawking in open, uncluttered spaces including clearings, above trees and over water. They roost singly and sometimes in small groups and, in Gabon, females congregated to give birth and raise young in a maternity cave estimated to house about 40,000 individuals at this time. At other times, the numbers of Greater Long-fingered Bats in other caves in the area fluctuated from day to day, suggesting that individuals utilized many different caves and frequently moved from cave to cave.

**Reproduction** No information for Malawi. In Zimbabwe, litter-size 1 (n = 3), three pregnant females were observed in Oct.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Miniopterus inflatus* Thomas, 1903. Two subspecies. The subspecies in Malawi is *M. i. africanus*. First recorded in Malawi in 1990 (DNMNH).

**Key Reference** Happold, M. (2013ae).

**Measurements**
*Miniopterus inflatus*

FA: 48.2 (44-51) mm, n = 162*
TL: 111.7 (101-120) mm, n = 21
T: 53.8 (45-58) mm, n = 21
E: 11.6 (10-13) mm, n = 21
Tr: n. d.
Tib: 18.9 (18-21) mm, n = 162
HF: n. d.
WT: 10, 11 g, n = 2
GLS: 17.0 (16.4-17.8) mm, n = 162*

Kenya (ROM, J. Eger pers. comm.).
*Throughout biogeographic range (derived from Peterson *et al.* (1995).

## Other Long-fingered Bats from Malawi

## *Miniopterus fraterculus*
## *M. natalensis*
## *M. schreibersii* and/or
## *M. mossambicus*

Ntchisi F. R., Malawi © DCD & M. Happold

**Malawian Names** Liputiputi, Ndemiya, Namzeze. Same for other microbats.

**Description** This description covers all the other Long-fingered Bats known from Malawi. Small microbats without noseleaf and with tail more or less fully enclosed in interfemoral membrane; two upper incisors and five upper cheekteeth on each side; forehead high-domed; third finger looks bent; FA 41-45 mm. Sexes similar. Pelage thick, short and velvety. Dorsal pelage ranging from black to blackish-brown, brown, brownish-grey to very dark grey; hairs unicoloured. Dorsal pelage colour variable even in bats from the same colony. Ventral pelage slightly paler, hairs sometimes paler at tip. Ears short, triangular, partly concealed by pelage. Wings and interfemoral membranes black, blackish-brown, very dark grey or brownish-grey.

**Similar Species**

*Miniopterus inflatus.* Almost always larger, FA: 48.2 (44-51) mm.

**Distribution** In Malawi, small long-fingered bats have been found on the Central Plateau, Shire Highlands and Upper Shire Valley at altitudes of 500-1680 m, and in the Lower Shire Valley at 60 m. Recorded from Chiromo, Likhubula, Liwonde N. P., Ntchisi Mountain F. R. (rest house), Nkhotakota W. R., Thyolo District (Satemwa Estate), Zomba and Zomba Plateau. These records were originally recorded as *M. fraterculus*. *M. natalensis* or *M. schreibersii* (but recent research casts doubt on these identifications).

**Habitat** The above localities include montane evergreen forest on Zomba Plateau, open canopy miombo woodland in Liwonde N. P. and Ntchisi (rest house), open canopy miombo woodland with patches of montane evergreen forest at Nkhotakota G. R. (Chipata Camp), an ornamental garden in Zomba, and a tea estate with remnants of miombo woodland, lowland rainforest and riverine forest in the Thyolo District.

**Abundance** Uncommonly-recorded in Malawi (as *M. fraterculus),* seldom-recorded (as *M. schreibersii*). Elsewhere: uncommonly reported throughout biogeographic range.

**Habits** The bats from Satemwa Estate roosted during the day in a very dimly lit overflow tunnel in the bank of a large dam. There appear to be no other observations of roosts in Malawi. Elsewhere, both *M. fraterculus* and *M. natalensis* are usually recorded from caves, tunnels and mine-adits where they cling or hang freely from ceilings or tuck themselves into crevices. Sometimes, they also roost in houses, rock crevices and hollow trees. Individuals from Zomba, Zomba Plateau and Liwonde N. P. became torpid during the day at ambient temperatures of 21-24°C and in captivity they drank every day implying dependence on water for drinking in the wild.

The bats from Ntchisi Mountain F. R., Nkhotokota W. R. and Satemwa Estate had very high aspect ratios, low wing-loadings and roughly triangular wing-tips, and their flight was fast to slow with great manoeuvrability. Wing beats were shallow and irregular, and the bats frequently glided downwards at great speed. They can take off from the ground but are not known to hover. They turn by banking (minimum radius < 25 cm) and by stalling-and-twisting. They forage by fast-hawking in open spaces and also by slow-hawking in areas with moderate clutter. There is no conclusive information about the social and reproductive behaviour of these bats in Malawi.

**Reproduction** Litter-size 1 (n = 1). No other conclusive information. In KwaZulu-Natal, South

Africa, the females of *M. fraterculus* and *M. natalensis* give birth once/year.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** The taxonomy of small Long-fingered Bats in southern Africa has been revised recently, and it has not yet been possible to check the identity of all material from Malawi. Consequently, all of the data from Malawi has been combined in this profile, and it probably includes information for *Miniopterus fraterculus* Thomas and Schwann, 1906, *Miniopterus natalensis* (A. Smith, 1834), *Miniopterus schreibersii dasythrix* (Temminck 1840) and *Miniopterus mossambicus* Monadjem, Goodman, Stanley and Appleton, 2013.

**Key Reference** Monadjem *et al.* (2013).

**Measurements**
*Miniopterus* spp.

| | |
|---|---|
| FA: | 43.3 (41-45) mm, n = 18 |
| TL: | 98.9(95-101) mm, n = 13 |
| T: | 50.95 (45-56) mm, n = 11 |
| E: | 9.7 (9-11) mm, n =11 |
| Tr: | 5.2 (5.0-5.5) mm, n = 8 |
| Tib: | n. d. |
| HF: | 9.35 (8.5-11) mm, n = 14 |
| WT: | 7.9 (5.7-11.0) g, n = 6 |
| GLS: | 14.5 (13.9-15.5) mm, n = 6 |

Malawi (HC, Happold *et al.* 1987).

# ORDER RODENTIA – RODENTS

| | | | |
|---|---|---|---|
| Family Anomaluridae | *Anomalurus* (1 species) | Anomalures | p. 183 |
| Family Sciuridae | *Heliosciurus* (1 species) | Sun Squirrels | p. 185 |
| | *Paraxerus* (4 species) | Bush Squirrels | p. 188 |
| Family Gliridae | *Graphiurus* (5 species) | Dormice | p. 194 |
| Families Muridae and Nesomyidae | *Acomys* (1 species) | Spiny Mice | p. 205 |
| | *Aethomys* (4 species) | Veld Rats | p. 208 |
| | *Beamys* (1 species) | Pouched Rat | p. 215 |
| | *Cricetomys* (1 species) | Giant Pouched Rats | p. 217 |
| | *Dasymys* (1 species) | Shaggy Rats | p. 219 |
| | *Dendromus* (5 species) | African Climbing Mice | p. 221 |
| | *Gerbilliscus* (2 species) | Gerbils | p. 231 |
| | *Grammomys* (2 species) | Thicket Rats | p. 235 |
| | *Lemniscomys* (2 species) | Grass Mice | p. 238 |
| | *Lophuromys* (1 species) | Brush-furred Mice | p. 242 |
| | *Mastomys* (1 species) | Multimammate Mice | p. 244 |
| | *Mus* (2 species) | Pygmy Mice | p. 246 |
| | *Mylomys* (1 species) | Mill Rats | p. 250 |
| | *Otomys* (5 species) | Vlei Rats | p. 252 |
| | *Pelomys* (1 species) | Creek Rats | p. 259 |
| | *Praomys* (1 species) | Soft-furred Rats | p. 261 |
| | *Rattus* (1 species) | Rats | p. 263 |
| | *Rhabdomys* (1 species) | Four-striped Grass Mice | p. 265 |
| | *Saccostomus* (1 species) | Pouched Mice | p. 267 |
| | *Steatomys* (1 species) | Fat Mice | p. 269 |
| | *Thallomys* (1 species) | Acacia Rats | p. 271 |
| | *Uranomys* (1 species) | Brush-furred Mouse | p. 273 |
| | *Zelotomys* (1 species) | Broad-headed Mice | p. 275 |
| Family Bathyergidae | *Fukomys* (2 species) | Mole-rats | p. 277 |
| | *Heliophobius* (1 species) | Silvery Mole-rat | p. 282 |
| Family Hystricidae | *Hystrix* (1 species) | Crested Porcupines | p. 284 |
| Family Thryonomidae | *Thryonomys* (2 species) | Cane Rats | p. 286 |

The Order Rodentia is the second largest order of mammals in Malawi. It is represented by 54 species. Rodents are characterised by a pair of continuously growing chisel-like incisor teeth in both upper and lower jaws. Posterior to the incisors is a space with no teeth (the diastema) followed by 3-5 cheekteeth (premolars and molars - the number varying by family and species). Each of the cheekteeth is more-or-less flat with a varying number of cusps which wear down with increasing age. Canine teeth are absent. The jaw muscles are well-developed for cutting (incisors only) and for crushing and masticating (molars).

The Order is old, and has diversified into numerous families, genera and species and is distributed worldwide (except Antarctica). Species in the order show great diversity in form and ecology. Only a few of the families in the Order are represented in Africa, and only eight occur in Malawi. Most of families in Malawi are easily distinguished by the tails, habits and sizes of the species that belong to them (Table-key 5).

Tails are described as:

- Well-furred - if most of the tail is covered by long hairs, making the rodent bushy-tailed, brush-tailed or fluffy-tailed.
- "Naked" - if they are covered by minute scales and/or very short bristles except, perhaps for the end which sometimes has a pencil of short hairs.
- Quilled – if they have hairs modified to form thick, sharp spines or quills.
- Relatively long – more than 50% of HB.
- Relatively short – 15-40% of HB.
- Vestigial – less than 15% of HB and inconspicuous.

Habits are described as:

- Arboreal – if the rodent lives permanently well above ground in trees or shrubs (cf. scansorial).
- Terrestrial – if the rodent is active on the ground (although it may sleep in a burrow).
- Subterranean – if the rodent lives entirely underground.
- Scansorial – if the rodent is well adapted to climbing and scrambles or climbs through low vegetation, including grasses, close to the ground (cf. arboreal).
- Rupicolous – if it lives among rocks and boulders.

Activity is described as:

- Diurnal – if the rodent is active during the day (and sleeps at night).
- Nocturnal – if it is active during the night (and sleeps during the day).

Size is described as:

- very small (HB less than ca. 170 mm),
- small (HB ca. 170-300 mm),
- medium (HB ca. 300-420 mm),
- large (HB ca. 420-550 mm),
- very large (HB ca. 550-680 mm).

Table-key 5 to the families of rodents (order Rodentia) found in Malawi. (Data from Malawi only).

| **Tail Characteristics** | **Habits** | **Activity** | **Size - HB** | **Family** |
|---|---|---|---|---|
| Relatively long<br>Well-furred | Arboreal | Nocturnal | Small to medium<br>ca. 280-380 mm | Anomaluridae<br>Anomalures |
| Relatively long<br>Well-furred | Arboreal | Nocturnal | Very small<br>ca. 70-90 mm | Gliridae<br>Dormice |
| Relatively long<br>Well-furred | Arboreal | Diurnal | Very small to small<br>ca 140-270 | Sciuridae<br>Squirrels |
| Relatively long<br>(except two species)<br>"Naked" | Terrestrial<br>(some scansorial) | Nocturnal | Most very small,<br>one medium | Nesomyidae*<br>Pouched Rat, Pouched Mice, African Climbing Mice, Fat Mouse |
| Relatively long<br>(some relatively short)<br>"Naked" | Terrestrial<br>(some scansorial, some rupicolous | Mostly nocturnal, some nocturnal and diurnal, one mainly diurnal | Very small | Muridae*<br>Mice, Rats, Gerbils, Vlei Rats |
| Relatively short<br>"Naked" | Terrestrial | Nocturnal and diurnal | Large<br>423 – 531 mm | Thryonomidae<br>Cane Rats |
| Relatively short<br>Quilled | Terrestrial | Nocturnal | Very large<br>649–674 mm | Hystricidae<br>Porcupines |
| Vestigial<br>"Naked" | Subterranean | No information | Very small<br>100-170 mm | Bathyurgidae<br>Mole-rats |

*The families Nesomyidae and Muridae lack clear diagnostic features which distinguish them, except that the pelage of Murids is soft and smooth whereas the pelage of Nesomyids is harsh, rough and sometimes has soft spines.

## FAMILY ANOMALURIDAE – Anomalures

This small family comprises just three genera and seven species, all of them found in rainforest and other forested regions of Africa. Only one genus and one species, *Anomalurus derbianus*, occurs in Malawi. Anomalures were formerly known as flying-squirrels, but they are not squirrels (family Sciuridae). In fact, anomalures are more closely related to the porcupines and cane rats than to squirrels. Anomalures differ from all other rodents because they have a flap of skin between each forelimb and hindlimb, and between each hindlimb and the tail. This enables anomalures to glide from one tree to another, but they cannot actually fly. In all species except one, there are numerous large scales on the ventral surface of the basal part of the tail.

## Genus *Anomalurus* - Anomalures

This genus contains four species in Africa, but only one occurs in Malawi. Anomalures in this genus were formerly known as scaly-tailed squirrels, but they are not squirrels (family Sciuridae).

### *Anomalurus derbianus*

### Lord Derby's Anomalure

**Malawian Names** Imbeta, Liseu.

**Description** Large gliding squirrel-like rodent living in forest habitats. Dorsal pelage long, dense and fine in texture, greyish or brownish to reddish-brown flecked with silver, yellow or buff; hairs dark grey at base with subterminal ring and inconspicuous black tip. Ventral pelage dense, pure white, greyish or yellowish. Large membranes of skin (patagium, *pl*. patagia) stretch between the wrist and the ankle, and between the ankle and the basal end (ca. 5 cm) of the tail (interfemoral patagia). A cartilaginous spur projects outwards (within the membrane) from the elbow to the margin of patagium. Hairs on membrane similar in colour to dorsal pelage but shorter and sparser; ventral surface almost naked. Head roundish with relatively short, pointed muzzle and large eyes. Black mask surrounds eyes and ears; forehead and throat almost uniformly pale grey. Ears large, elliptical, erect and naked, surrounded at base with long black hair. Limbs long, feet powerfully built. Forefeet have four digits, hindfeet have five digits, all with thin, strong, sharp, curved claws. Upper surface of feet covered with hairs; black bristles cover hind claws. Tail long (ca. 90% of HB), narrow, short-haired at base widening to long-haired brush at tip; basal portion pale turning to black towards the tip; strong, pointed scales on basal ventral surface of tail.

**Similar Species** None. There is no other mammal with patagia in Malawi.

**Distribution** Known only from a single specimen (found in 1972) from Mugesse Forest (= Mughese F. R), near Chitipa. Northern Malawi is at the extreme southern end of the biogeographic range of the species. Elsewhere: widespread in rainforest (and montane forest) from West Africa to Uganda and Kenya, and throughout the Congo rainforest basin to N Angola and N Zambia.

**Habitat** Rainforest, riverine forest and montane forest where there are tall trees with hollows suitable for resting in during the day. May occur in some open areas provided there are suitable tall trees, e.g. forest which has been selectively logged.

**Abundance** No information for Malawi. Elsewhere: abundance depends on the characteristics of the forest. Studies in undisturbed rainforest in Gabon recorded a density of 27-54 individuals/km$^2$.

**Habits** Arboreal, nocturnal, folivorous. Lord Derby's Anomalures live almost entirely on rainforest trees and rarely descend to the ground. They clamber around the twigs and branches of trees (but not with the same agility as squirrels). When an individual wants to move to another tree, it leaps off the trunk of the tree with its limbs outstretched so that the patagia form a gliding membrane; the individual glides downwards at an angle (about 24 degrees from the horizontal) to the trunk of another tree. As it approaches the landing trunk, it assumes a vertical position so that it lands with all four feet contacting the trunk at the same time. After landing, the anomalure climbs quickly up the trunk with a 'humping gait' using its strong curved claws to grip the tree trunk. Glides vary in length, often up to ca. 50 m.

During the day, Lord Derby's Anomalures rest in holes and hollows in forest trees, often those that have lost their crowns and are open at the top. Suitable holes may be in many species of trees provided the size, position and entrance holes are suitable; some nesting holes have a high and a low entrance. Studies in Gabon have shown that a single individual may use up to six nesting holes over a period of several months. Anomalures leave the nest hole at dusk - and this is about the only time when they can be sighted as they glide from one tree to another.

Anomalures are herbivores, specializing in leaves, fruits and flowers, and soft bark. They have strong muscular jaws so that bark and woody branches can be chewed before the sap and other fluids can be swallowed.

The auditory bullae on the underside of the skull, and the large external ears, suggest that anomalures have a keen sense of hearing. Likewise, the large eyes suggest that sight is also an important sense.

Lord Derby's Anomalures are mostly solitary, although several (possibly up to 3) may nest together in a tree hollow. At dusk, individuals leave the nest hole separately, except for mothers with young. They return to a nesting hole before dawn. Home-ranges are quite extensive; a single radio-collared female in Gabon had a home-range of 3.37 ha. but she spent 50% of her time in only 11.3% of the total home-range.

**Reproduction** No information for Malawi. Elsewhere: embryo number: 1-3. Most mothers are seen with only one young. Young are born in a nesting hole. Neonates are fully furred and the eyes are open. The breeding season seems to vary with locality but, at all localities, reproduction appears to be in the early to mid wet season.

**Conservation** IUCN Category: Least Concern. Conservation threats include habitat destruction (e.g. logging, clearing for plantations and agriculture) and (to a lesser extent) hunting for bushmeat.

**Taxonomic Notes** *Anomalurus derbianus* (Gray, 1842).

**Key Reference** Ray (2013).

**Measurements**
*Anomalurus derbianus*

| | |
|---|---|
| HB: | 306 (283–379) mm, n = 11 |
| T: | 284 (227–327) mm, n = 11 |
| HF: | 56 (51–64) mm, n = 11 |
| E: | 40 (36–47) mm, n = 11 |
| WT: | 595.3 (588–605) g, n = 3 |
| GLS: | 58.7 (57.8–60.2) mm, n = 15 |

West Africa (Rosevear 1969).

## FAMILY SCIURIDAE - Squirrels

Squirrels occur throughout much of sub-Saharan Africa (and also Eurasia and the New World). The family is represented by ten genera and 37 species in Africa, but only two genera and five species occur in Malawi. They are medium-sized rodents (HB: 145–279 mm, T: 150–317 mm), arboreal and diurnal. They are very active, jumping with amazing ability from branch to branch and climbing up-and-down the trunks of trees. Some species (e.g. *Paraxerus* spp.) forage on the ground as well as in the trees. All species have long bushy tails, relatively large eyes and a shortish rostrum. The limbs are short, and each digit ends with a small pointed claw. Some species have a side-stripe (usually white) from shoulder to rump on each side. The commonest and most widespread species in Malawi are *Paraxerus cepapi* and *Heliosciurus mutabilis*.

The species of squirrels that occur in Malawi can be distinguished by the information given in Table-key 6.

Table-key 6 to the squirrels (family Sciuridae) found in Malawi.

| Tail longer than HB | Side-stripe | Dorsal pelage | Known distribution | Species |
|---|---|---|---|---|
| Yes | Absent | Brown or rufous brown flecked with cream. No dark patch. | Widespread. | *Heliosciurus mutabilis* |
| No | Present | Rusty brown or reddish-brown. No dark patch | Namwera, NE Mangochi only. | *Paraxerus flavovittis* |
| No | Absent | Bright rufous. Dark patch in centre of back. | Misuku Hills and Nyika Plateau, above 2000 m. | *Paraxerus lucifer* |
| No | Absent | Grizzled yellowish-brown. No dark patch. | Widespread. | *Paraxerus cepapi* |
| No | Absent | Grizzled dark brown. No dark patch. | Widespread. | *Paraxerus palliatus* |

### Genus *Heliosciurus* - Sun Squirrels

This genus contains six species which are widely distributed in sub-Saharan Africa except in arid and treeless areas. Only one species occurs in Malawi.

## *Heliosciurus mutabilis*

## Mutable Sun Squirrel

**Malawian Names** Gologolo, Kalikongwe.
Not confined to this species.

**Description** Large brown or rufous-brown squirrel, often with patches of contrasting colour on different parts of the body, which result in a scruffy unkempt appearance. Colour and pattern of pelage varies seasonally and geographically - see below. Pelage long (15–20 mm on mid-back) and slightly coarse. Dorsal pelage and flanks brown or rufous-brown, abundantly flecked with cream. No side-stripe. Dorsal hairs with five bands: brown at base, two paler bands and a broad buff band in centre, and cream at tip. Ventral pelage usually greyish-white and sparse; hairs long, cream or buff. No side-stripe. Head, cheeks and limbs similar to dorsal pelage. Fore- and hindlimbs (outer and inner surfaces) grey or brown. Tail long (117 [96-148]% of HB, n = 16), dark blackish-brown with up to ten obscure cream or buff bands. Tip of tail may be rufous or rich cinnamon (especially when pelage is old). Striking colour changes occur when moulting: newly moulted pelage is cinnamon, rufous or chestnut, and brightly coloured; as the pelage ages, it becomes brown or blackish-brown, and dull. In many individuals moulting occurs in patches, so the dorsal pelage appears as a patchwork of brown, black, cinnamon and rufous, partly bright, partly dull – a pattern quite unlike that seen in any other species of squirrel. Hence pelage shows seasonal changes in colour and pattern, as well as geographical variation. In Malawi, the following variation is visible in a series of specimens: (a) crown of head and upper back black, mid-back and flanks bright cinnamon, tail rufous with paler bands; (b) dorsal pelage cinnamon, flecked with buff; (c) crown of head, dorsal pelage and tail dark rufous or chestnut brown, flanks cinnamon flecked with pale buff, tail without any discernible bands.

**Similar Species**
*Paraxerus* spp. Tail shorter than HB (see Table-key 6).

**Distribution** Widespread in Malawi although few records in southern part of Central Plateau. Localities include Blantyre, Chinteche, Chiradzulu Forest, Lengwe N. P., Liwonde N. P., Mangoche Mountain, Mulanje, Mwabvi W. R., Mwanza, Namadzi District, Ntcheu, Nyamatika Station near Chididi, Ntchisi Mountain F. R., Thyolo Mountain, Vwaza Marsh G. R., Zoa Tea Estate, Zomba and Zomba Plateau. Elsewhere: S Tanzania, N and C Mozambique, E Zambia, E Zimbabwe, and coastal NE South Africa.

**Habitat** Miombo woodlands, thickets and scrublands. Some montane areas. Adapts well to trees in cities and town, and also in ornamental gardens.

**Abundance** Probably the commonest squirrel seen in Malawi (especially in urban environments). Elsewhere: no information.

**Habits** Arboreal, diurnal, herbivorous. During the day, Mutable Sun Squirrels may be seen running and scampering along the branches or in the canopy of trees. They are very active. Usually they are solitary; sometimes two of more may be seen chasing each other. At night, they rest in the hollows of trees. At times, they may descend to the ground and cross an open space to reach another tree. When disturbed or frightened, an individual will lie flat against a branch and remain very still. The diet consists of wild fruits, berries, nuts, green shoots and flowers; occasionally eggs and insects may be eaten.

**Reproduction** No information for Malawi. Elsewhere: very little information is recorded. In Zimbabwe, there is a single record of a pregnant female with four embryos in August (late dry season, 'winter').

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Heliosciurus mutabilis* (Peters, 1852). In the older literature this species in southern Africa was referred to *Heliosciurus rufobrachium* (e.g., Ansell 1978, Hayes 1978). Now *H. rufobrachium* is considered to be restricted to the rainforests of West and central Africa (north of the Congo River) and the 'southern equivalent' is *H. mutabilis*.

**Key Reference** Happold, D. C. D. (2013b).

**Measurements**
*Heliosciurus mutabilis*

| | |
|---|---|
| HB: | 231.3 (193–279) mm, n = 17 |
| T: | 268.7 (220–317) mm, n = 16 |
| HF: | 54.9 (48–64) mm, n = 17 |
| E: | 17.4 (15–22) mm, n = 15 |
| WT: | 358 (297-481) g, n = 5 |
| GLS: | 54.7 (52.5–56.0) mm, n = 8 |

Malawi (NMMB).

# Genus *Paraxerus* - Bush Squirrels

This genus contains 11 species widely distributed in sub-Saharan Africa except in arid areas and savannas north of the rainforest biotic zone. Four species occur in Malawi (see Table-key 6).

## *Paraxerus cepapi*

## Smith's Bush Squirrel

**Malawian Names** Gologolo, Kalikongwe, Kandindi, Tsinde. Not confined to this species.

Lengwe N. P., Malawi © DCD & M. Happold

**Description** Medium-sized yellowish-brown flecked squirrel without any bright colours or markings. Pelage coarse and short. Dorsal pelage flecked with black, buff and cinnamon hairs; hairs ringed with alternating bands of yellow and black, usually with black tip. No side-stripe. Ventral pelage dull white, tinged with pale yellow. Head with indistinct upper and lower white or buff eye-stripes; chin and upper lips white. Cheeks pale buff. Limbs short, similar in colour to flanks; well-developed digits with sharp claws. Hindfeet orange-buff. Hindlimbs with five toes, forelimbs with four toes, each toe with strong pointed claw (inner 1st digit of front limbs just a small bump, without claw). In males, scrotum black. Tail long (ca. 95% of HB), bushy; hairs white at base, with six alternating bands of black and yellowish-brown, yellowish-brown at tip.

**Similar Species**
*Helioscurus mutabilis*. Tail longer than HB.
Other *Paraxerus* spp. See table-key 6.

**Distribution** Widespread. Localities include Chikwawa, Chiromo, Deep Bay, Karonga, Lake Malawi N. P. (Cape Maclear), Lake Malombe, Lengwe N. P., Liwonde N. P., Mangochi, Mtimbuka, Mwabvi W. R., Mzimba, Nkhotakota W. R., Nyika N. P., Vwaza Marsh G. R. and Zoa.

Few records from the southern end of the Central Plateau. Elsewhere: W Tanzania southwards to S Angola, SE DR Congo, Zambia, S Mozambique, Zimbabwe, NW Botswana and NE South Africa.

**Habitat** Savanna woodlands and thickets, often on rocky hillsides. In Malawi, recorded in miombo and mopane woodlands where there are holes and hollows in the trees for nesting. May also occur in riverine forests. Does not occur in dense forest.

**Abundance** No details for Malawi, but probably the commonest squirrel in Malawi in savanna habitats.

**Habits** Arboreal, diurnal, mainly herbivorous. Smith's Bush Squirrels are usually seen scampering around in trees and thickets, although they will descend to the ground to forage. When moving, they run (often very quickly) along horizontal and slightly sloping branches with the tail in line with the body, and when leaping from branch to branch the tail acts as a balance and counterweight. When descending down a tree truck to the ground, they descend head-first. Grooming is frequently observed, e.g. licking the front paws, brushing the nose with front paws, lifting the hindfoot and then holding it with forepaws while licking it from heel to toes, and scratching the chin, behind the ears and the chest with the hindfoot. The flanks are combed with the forepaws, and the tail is cleaned by simultaneously licking and combing. When two individuals meet, they exhibit many contact behaviours: nose-to-nose and nose-to-anus contact, huddling together, climbing over each other, pushing under each other, chasing, and mutual grooming (male-female).

Bush Squirrels produce several different vocal sounds each associated with different situations or activities including extreme danger, minor danger, territorial defence, courtship and mating, mother-young interactions and being disturbed in a tree hollow. The movements of the tail, and the frequency of tail-flicking, indicate levels of perceived threat: a minor threat is indicated when the tail is held low and the tail hairs are erect; a major threat is indicated when the tail is flicked upwards and forwards

several times with the tail hairs erect. Often tail movements are accompanied by loud clicks or whistles. At night, Smith's Bush Squirrels rest in hollows in trees. During the day, much of the time is spent foraging, either in the trees and thickets, or on the ground. Bush squirrels feed opportunistically on leaves, seeds, berries, flowers of many species of plants, as well as insects and bird's eggs. They also feed on termites and other arthropods dug from termite mounds. Nuts and seeds may be buried for eating at a later date.

During the daytime, Bush Squirrels engage in all the activities listed above. One squirrel observed in Lengwe N. P. in Dec showed the following activities: moving around in thicket (17% of the time), resting in thicket or tree (37%), feeding on seeds and berries (26%), feeding on termites (14%), grooming (1%), and social interactions with other squirrels (4%). These proportions may vary greatly depending on season and the individual.

Bush squirrels are territorial and are either solitary or live in pairs (sometimes with their young). A study in South Africa, recorded a territory size of 0.3 – 1.26 ha in a thicket habitat although an individual may only utilize a small part of this area for feeding.

**Reproduction** No information for Malawi. Elsewhere: gestation: 56-58 days. Mean litter size 2 (1-3). Period for reproduction varies in different localities, e.g., in Botswana, pregnant females recorded in every month (except May and Sep); in South Africa, young are born in Oct–Jan. A female usually has only one litter/year. Neonates are comparatively precocial; eyes open on Day 7, they climb out of nest by Day 19, and are fully weaned by Day 29-42. Sexual maturity is attained at 6-10 months.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Paraxerus cepapi* (A. Smith, 1836). Many subspecies have been recognised throughout the geographic range of the species. In Malawi, two subspecies are recognised: *P. c. sindi* (S Malawi; ventral pelage white) and *P. c. yulei* (N. Malawi; ventral pelage grey).

**Key Reference** Pappas & Thorington (2013).

**Measurements**
*Paraxerus cepapi*

| | |
|---|---|
| HB: | 197.8 (145-205) mm, n = 9 |
| T: | 167.0 (150-190) mm, n = 10 |
| HF: | 41.6 (38-46) mm, n = 9 |
| E: | 18.9 (15-21) mm, n = 8 |
| WT: | 190.0 (168-212) g, n = 3 |
| GLS: | 44 (43–45) mm, n = 8* |

Malawi (HC, NHMUK, NMMB, Lawrence & Loveridge 1953).
*Botswana (Smithers 1971).

## *Paraxerus flavovittis*

## Striped Bush Squirrel

**Malawian Name** Not known.

**Description** Arboreal squirrel with white side-stripe. Dorsal pelage rusty-brown; hairs black with rusty-brown subterminal bands and (often) black at tip. Flanks similar to dorsal pelage with white stripe from shoulder to rump on each side (the only squirrel in Malawi with a side-stripe). Ventral pelage greyish-white. Shoulders and outer surface of forelimb orangy-yellow or ochre. Hindlimbs similar to flanks tending to brownish towards base of tail. Forehead from ears to nose and upper lips bright orangy-brown. Two white stripes, one above and one below each eye, extending to base of ear. Ears visible, inner surface bare, with very short pale hairs. Tail (ca. 88% of HB), with long hairs; greyish-brown with some brownish-orange hairs at tip.

**Similar Species** None. No other squirrel in Malawi has a white side-stripe.

**Distribution** Known from a single specimen from Namwera, NE of Mangochi, close to the border between Malawi and Mozambique. Elsewhere: E and SE Tanzania and N and NE Mozambique (north of the Zambezi River).

**Habitat** Woodland savanna, often found in areas with *Uapaca* trees (Sugar Plum or Wild Loquat) which produce large edible fruits.

**Abundance** No information for Malawi, probably rare. Common in some parts of Tanzania.

**Habits** Arboreal, diurnal, omnivorous. No detailed information but probably similar to *Paraxerus cepapi*.

**Reproduction** No information.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Paraxerus flavovittis* (Peters, 1852).

**Key Reference** Schennum & Thorington (2013a).

**Measurements**
*Paraxerus flavovittis*

| | |
|---|---|
| HB: | 172.7 (165–176) mm, n = 6 |
| T: | 168.8 (160–175) mm, n = 4 |
| HF: | 39.2 (35–40) mm, n = 6 |
| E: | 16.6 (15–18) mm, n = 5 |
| WT: | n. d. |
| GLS: | 40.1 (38.6–42.2) mm, n = 8* |

Mozambique (Lumbo, Hinton 1920 in Schennum & Thorington 2013a).
*Tanzania (NHMUK).

## *Paraxerus lucifer*

## Black-and-red Bush Squirrel

**Malawian Name** Kasira.

**Description** Large squirrel with bright brownish-red colouration. Dorsal pelage bright rufous or russet with large dark patch of rufous-black in center of back from shoulders to rump, extending to basal part of tail. Flanks rufous. Head, cheeks and chin similar to dorsal pelage. Ventral pelage sparce, whitish-grey. Fore and hindlimbs bright russet or rufous. Tail moderately long (ca. 90% of HB) with long hairs, bright rufous tinged with black on upper surface; rufous laterally and ventrally.

**Similar Species**
*Paraxerus palliatus* (the only other squirrel with any rufous colouration in Malawi). No black patch in centre of back; ventral pelage bright rufous (brick-red).

**Distribution** In Malawi, recorded only from the Misuku Hills and Nyika Plateau. Elsewhere: SW Tanzania (Poroto Mountains, Rungwe Mountains [Nkuka Forest]), E Zambia (Chowo Forest, Nyika Plateau).

**Habitat** Montane forests over ca. 2000 m.

**Abundance** No information for Malawi.

**Habits** Arboreal, diurnal, probably omnivorous. Very little is recorded about this species because it is rarely seen and has a small biogeographic range. Tends to be rather noisy and has a loud and distinctive call.

**Reproduction** No information.

**Conservation** IUCN Category: Data Deficient. Because of its small biogeographic range, and habitat requirements (forests on mountains), any destruction of its habitat is of great conservation concern.

**Taxonomic Notes** *Paraxerus lucifer* (Thomas, 1897).

**Key Reference** Schennum & Thorington (2013b).

**Measurements**
*Paraxerus lucifer*

| | |
|---|---|
| HB: | 222 (201–241) mm, n = 10 |
| T: | 202 (186–218) mm, n = 10 |
| HF: | 52.2 (48–55) mm, n = 13 |
| E: | 19.7 (15–22) mm, n = 12 |
| WT: | 496 (300–675) g, n = 7* |
| GLS: | 55.6 (53.8–56.4) mm, n = 12 |

Zambia (Nyika Plateau, Ansell & Ansell 1973).
*Includes three individuals of 675 g.

## *Paraxerus palliatus*

## Red Bush Squirrel

**Malawian Names** Gorogoro, Kalege, Kalikongwe, Sinde. Not confined to this species.


Mapanga Limbe, Malawi © Bentley Palmer

**Description** Medium to large arboreal squirrel with rufous or russet ventral pelage. Dorsal pelage dark glossy brownish, grizzled with buff or oatmeal; hairs dark grey or black on basal half, banded with black and cinnamon. No dark patch on back (cf. *P. lucifer*). Flanks same as back. Ventral pelage bright rufous (brick-red), sometimes with small white patches. Crown of head, cheeks, lips chin and around ears rufous. Fore- and hindlimbs, and fore- and hindfeet rufous. Tail long (ca. 90% of HB), bushy, same colour as dorsal pelage at base; bright rufous on terminal two-thirds.

**Similar Species**

*Paraxerus lucifer* (the only other squirrel with any rufous colouration in Malawi). Has a black patch in centre of its back; ventral pelage whitish-grey.

**Distribution** Disjunctly distributed from north to south, from ca. 100-2000 m. Localities include Lengwe N. P., Liwonde N. P., Mulanje Mountain, Ntchisi Mountain F. R., Nyika Plateau, Port Herald (now Nsanje), Ruo River, Thyolo Mountain and Viphya Plateau. Elsewhere: coastal forests and inland riverine forests along the east coast of Africa from S Somalia to KwaZulu-Natal in South Africa. Also E Zimbabwe (Chirinda Forest on Mount Selinda).

**Habitat** Woodland, evergreen forests, and thickets and low and high altitudes. Prefers forest with plenty of undercover.

**Abundance** No information for Malawi. Elsewhere: in coastal forest in South Africa, density was 2.15 - 4.32 squirrels/ha.

**Habits** Arboreal, diurnal, omnivorous. Although individuals spend most of the time in trees than the understorey of forest, they also forage on the ground. Mostly they are solitary except when a female is reproductively active and is accompanied by a male, or when a female has young. The home-range is ca. 3.2 ha for males and 2.2 ha for females; males may travel longer distances when searching for females. Red Bush Squirrels communicate with tail flicking (as does *Paraxerus cepapi*) and by vocal sounds; recorded sounds include murmuring, hisses, growls, clicking, trilling, 'chuck-chuck-chuck' (alarm call) and a deep bark (when danger is close). Urine marking is used to indicate home-range. When disturbed, Red Bush Squirrels head for cover in thickets or undercover or its nest. In some localities, if threatened on the ground, an individual will shelter in hollow logs or under fallen trees. At dusk, squirrels retreat into nests in hollows and holes in trees, often in small groups (mean 3.2 ± 1.2 individuals). The diet is similar to that of other squirrels, i.e. nuts fruits, berries (and lesser amounts of roots leaves and flower buds) and insects including termites. Diet varies seasonally.

**Reproduction** Litter size: 1-2. Gestation: 60-65 days. In South Africa, young are born during the warmer and wetter months (Aug – Mar). In the wild, each female may have 1-2 litters/year. Neonates are blind with a fine covering of fur. Eyes open on Day 7-10. Young first leave the nest on ca. Day 18 and are weaned on ca. Day 40. The young are chased away by the female when several months of age and then have to forage by themselves.

**Conservation** IUCN Category: Least Concern. As for all squirrels, suitable habitat is essential for their survival.

**Taxonomic Notes** *Paraxerus palliatus* (Peters, 1852). There are seven recognised subspecies throughout the biogeographic range of the species, each showing differences in pelage colour and size. In Malawi, one subspecies is recognised: *Paraxerus palliatus palliatus* (as described above).

**Key References** Smithers (1983), Thorington *et al.* (2013).

**Measurements**
*Paraxerus palliatus ornatus*

| | |
|---|---|
| HB: | 221.5 ± 9.2 mm, n = 30 |
| T: | 203.8 ± 8.6 mm, n = 86 |
| HF: | 51.8 ± 1.7 mm, n = 103 |
| E: | 20.6 ± 1.4 mm, n = 75 |
| WT: | 368.2 ± 22.4 g, n = 104 |
| GLS: | 50.9 ± 1.6 mm, n = 11 |

South Africa (Ngoye forest) (Viljoen 1989 in Thorington *et al.* 2013)
Measurements given as ± 1 S.D
This subspecies is the largest of the subspecies (see above).

## FAMILY GLIRIDAE - Dormice

The family Gliridae is widespread in Africa and contains two genera and 16 species. It is represented in Malawi by six species in the genus *Graphiurus*. All species are small (HB: 69–122 mm, T: 54–98 mm), grey in colour with large rounded ears, a long bushy tail, and short limbs ending in small claws. In some respects, they look like small squirrels, but they are nocturnal. Most live in trees and bushes, and sometimes individuals may be found in houses and other human dwellings.

### Genus *Graphiurus* - African Dormice

Species of dormice are primarily distinguished by differences in the skull and teeth. It is not easy to identify them from their external characters, but the following are useful:-

Dorsal and ventral colours – may be clearly delineated or merge on the flanks.

Eye-mask. This is a narrow or broad dark stripe extending from the muzzle to the ears, encircling the eyes. In some species, the eye-mask is only a thin dark line encircling the eyes.

Pale lateral-stripe. A stripe of contrasting pale pelage extending from the cheek to the shoulder. May be present, absent or inconspicuous.

Postauricular patch. A small patch of cream or white pelage at the posterior base of the ear.

The species of dormice occurring in Malawi can be distinguished by the information in Table-key 7.

Table-key 7 to the dormice (family Gliridae) found in Malawi.

| Dorsal and ventral colours clearly delineated | Eye-mask | Pale lateral stripe | Post auricular patches | Distribution Habitat | HB | Tail | Species |
|---|---|---|---|---|---|---|---|
| yes | conspicuous | present | Usually present | Northern Malawi. Woodland savanna. | 82.4 (75–92) mm | Tip faintly or conspicuously white. Hairs longer at tip. ca. 82% of HB | *G.kelleni* |
| yes | conspicuous | present | Usually present | Widespread. Woodland savanna. Commonest species. | 98.8 (75–115) mm | Tip white. Hairs longer at tip. ca. 76% of HB | *G.microtis* |
| yes | conspicuous | present | Sometimes present, faint | Southern Malawi. Rocky habitats. | 107.1 (95–122) mm | Tip white. Distal half very bushy ca 74% of HB | *G.platyops* |
| No | Not conspicuous | Inconspicuous | Absent | Zomba Plateau. Garden near montane forest. | 70 mm | Tip not white. Distal half bushy. 93% of HB | *G.lorraineus** |
| No | Not conspicuous | Absent or inconspicuous | Absent or faint | Southern Malawi. Woodland savanna. | 74.3 (69–84) mm | Tip not white. 92% of HB | *G. johnstoni* |
| No | Conspicuous in some populations | Absent | Usually absent | Northern Malawi Misuku Hill, Nyika Plateau. Forest habitats. | 91.5 (81–103) mm | Tip usually not white or only faintly white. ca. 84% of HB | *G.murinus* |

*Based on one specimen only.

## *Graphiurus johnstoni*

## Johnston's African Dormouse


Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Malawian Names** Kadyamkwikwe, Kadyamlamu, Kasepembe, Kawundi. These names refer to all dormice.

**Description** Small dormouse. Dorsal pelage blackish-grey. Dorsal pelage soft and short (rump hairs 5–6 mm, guard hairs up to 8–9 mm). Ventral pelage grey to creamy-grey, sometimes suffused with buff. Dorsal and ventral pelage colours not clearly delineated on flanks. Head colour matches that of dorsal pelage. Cheeks cream or grey suffused with cream, but this colour does not extend to the shoulders as a distinct pale lateral stripe although a faint stripe is sometimes visible. Eyes large; eye-mask inconspicuous. Ears brown, short and rounded. Postauricular patches not present or inconspicuous. Long black vibrissae. Hindfeet cream with dark metatarsal streak. Head domed when viewed from side (cf. *G. platyops*). Digits on fore- and hindfeet long, capable of grasping twigs. Tail long (ca. 92% of HB), hairs shorter at base (2–3 mm) and longer at tip (up to 19 mm). Tail appears splayed because the hairs project laterally. Tail colour generally matches that of dorsal pelage and is uniform in colour; white hairs sparse or absent; tip of tail not white.

**Similar Species** Other species of *Graphiurus* (see Table-key 7).

**Distribution** Recorded only in and close to Zomba, Namadzi District, and (perhaps) in the Ntcheu District. Elsewhere: no records of occurrence outside Malawi so limits of biogeographic range are uncertain.

**Habitat** One individual was found in the roof of a house (in 1984) on Kapalasa Farm, a tobacco estate near Namadzi. The surrounding habitat was patches of undisturbed miombo woodland, ornamental gardens, and fields of tobacco and maize.

**Abundance** No information. Rarely encountered.

**Habits** Nocturnal, arboreal, omnivorous.

**Reproduction** No information.

**Conservation** IUCN Category: Data Deficient. The very small biogeographic range and very few sightings of this species are cause for concern.

**Taxonomic Notes** *Graphiurus johnstoni* Thomas, 1898. Ansell & Dowsett (1988) included *johnstoni* as a subspecies of *G. kelleni* (i.e. *G. kelleni johnstoni*).

**Key Reference** Holden, M. E. (2013a).

**Measurements**
*Graphiurus johnstoni*

| | |
|---|---|
| HB: | 74.3 (69–84) mm, n = 3 |
| T: | 68.5 (65–75.5) mm, n = 3 |
| HF: | 16 (15–17) mm, n = 4 |
| E: | 11.8 (11–12) mm, n = 4 |
| WT: | n. d. |
| GLS: | 23.3, 23.9 mm, n = 2 |

S Malawi (Holden, M. E. 2013a).

## *Graphiurus kelleni*

## Kellen's African Dormouse

**Malawian Names** Kadyamkwikwe, Kadyamlamu, Kasepembe, Kawundi.
These names refer to all dormice.

**Description** Small dormouse. Dorsal pelage various shades of brown, beige or grey, sometimes with golden or reddish hue, with darkening of pelage towards the mid-line of the head and back in some individuals. Dorsal pelage silky, sleek in some populations, thick in others (rump hairs 6–7 mm, guard hairs up to 11 mm). Ventral pelage usually white or cream, lightly or moderately suffused with grey. Dorsal and ventral pelage colours clearly delineated. Head colour usually matches that of dorsal pelage, sometimes paler towards muzzle. Eyes large; eye-mask conspicuous. Ears brown, medium or large, rounded. Cheeks cream or white, forming part of a pale lateral stripe that extends from cheeks to shoulders. Cream or white postauricular patches usually present. Head domed when viewed from side (cf. *G. platyops)*. Hindfeet white, or white with dark metatarsal streak. Tail moderately long (ca. 82% of HB), tail hairs shorter at base (2–3 mm) and longer at tip (up to 20 mm). Dorsal tail colour matches that of dorsal pelage, often laterally fringed with white hairs; tip of tail faintly or conspicuously white. Ventral tail colour usually paler than dorsal tail colour.

**Similar Species** Other species of *Graphiurus* (see Table-key 7).

**Distribution** In Malawi, recorded only from a garden area near the Game Post in Nyika N. P. and from Chia (south of Nkhotakota). Elsewhere: widespread in savanna regions of West Africa, Angola and parts of Zimbabwe, E Zambia, N Tanzania and Kenya. All areas well separated from each other.

**Habitat** The only record from Malawi is from a garden (see above). Elsewhere: the species has been recorded in woodland savanna, riverine woodland, rocky areas including caves, disturbed areas and human dwellings, as well in or near Dom Palms (*Hyphaene thebaica*), thorn trees (Acacias) and miombo (*Brachystegia*) trees.

**Abundance** There is very little information, but considered to be rare in most localities in Malawi and elsewhere.

Tanzania © C. & M. Stuart

**Habits** Arboreal, nocturnal, and omnivorous. In other parts of the biogeographic range, these dormice frequently nest in crevices under bark, or in holes in savanna trees. Two nest holes have been recorded at 0.5 m and 1 m above ground, and one nest was made of leaves and grass. Several individuals were found in nests of weaver-birds on Acacia trees and in the mud nests of swallows under roofs of caves or on the undersides of rocks. A few individuals have been caught in wood piles, and in the roofs of African huts.

**Reproduction** There are no long-term data for any locality in Malawi or elsewhere. In Zimbabwe, lactating females have been recorded in Dec and young in Apr, and in NW Zambia lactating females have been found in Sep and Oct, and young in Jan.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Graphiurus kelleni* (Reuvens, 1890). No subspecies are recognised, but there are many synonyms (due partly to the difficulty of defining the species).

**Key Reference** Holden, M. E. (2013b).

**Measurements**
*Graphiurus kelleni*

| | |
|---|---|
| HB: | 82.4 (75–92) mm, n = 14 |
| T: | 68.3 (54–81) mm, n = 13 |
| HF: | 16.0 (15.3–16.5) mm, n = 14 |
| E: | 14.8 (14–16) mm, n = 14 |
| WT: | 19.1 (10.9–23.5) g, n = 8* |
| GLS: | 24.0 (23.1–24.5) mm, n = 13 |

Zambia (Balovale, Holden, M. E. 2013b).

## *Graphiurus lorraineus*

## Lorraine's African Dormouse

**Malawian Names** Kadyamkwikwe, Kadyamlamu, Kasepembe, Kawundi. These names refer to all dormice.

**Description** Small dormouse. Dorsal pelage medium grey; hairs dark grey with pale grey, beige or black tip, 6 mm long. Ventral pelage slightly paler than dorsal pelage; hairs dark grey with pale grey or cream tip. Dorsal and ventral colours not clearly delineated. Crown of head colour matches that of dorsal pelage; cheeks, chin and throat similar to ventral pelage but more creamy-white. Eyes large, dark. Eye-mask not conspicuous. Ears naked. Postauricular patch absent. Head domed when viewed from side (cf. *G. platyops)*. Hindfeet pale creamy-grey. Tail uniformly grey; hairs short at base, becoming increasingly longer towards tip and becoming bushy on terminal half; terminal hairs 20 mm. Tail 93% of HB.

**Similar Species** Other species of *Graphiurus* (see Table-key 7).

**Distribution** In Malawi, recorded only from Zomba Plateau (The Stables). This record extends the known range substantially towards the SE. Elsewhere: Sierra Leone to Togo, and SE Nigeria to S South Sudan and southwards to Gabon, NE Angola to C Zambia.

**Habitat** The specimen from Zomba Plateau was caught by a domestic cat near 'The Stables' (ca. 1500 m) and was probably caught in or near montane forest or thickets along the forest edge. Elsewhere: Gallery forests, forest margins, woodland savanna and farmlands in the rainforest and rainforest-savanna mosaic zones.

**Abundance** Uncertain. Only one specimen known from Malawi.

**Habits** Arboreal, nocturnal, and omnivorous. No information for Malawi. In other parts of the biogeographic range, some individuals spend much time on the ground although these dormice are predominantly arboreal and have apparently never been trapped on the ground. They have been found nesting in rocky caves, abandoned nests of swallows, and in nests found amongst epiphytic ferns. They probably also nest in cavities in trees, and have been caught in or near buildings (occupied and abandoned). They feed on fruits, seeds, nuts and insects (including flying termites and earwigs). Lactating females are often caught with young, and females have also been found nesting with “well-grown young”.

**Reproduction** No information for Malawi. In West Africa, litter-size 2-7 (mostly 2-4).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Graphiurus lorraineus* Dollman, 1910. No subspecies are recognised. Described as a valid species, but subsequently considered a subspecies or synonym of *G. murinus* by some authors. Appears closely related to *G. johnstoni.* First recorded in Malawi in 1994 (D. C. D. Happold *unpubl*.).

**Key Reference** Holden, M. E. (2013c).

**Measurements**
*Graphiurus lorraineus*

| | |
|---|---|
| HB: | 70 mm |
| T: | 65 mm |
| HF: | 16 mm |
| E: | 12 mm |
| WT: | 17 g |
| GLS: | n. d. |

Malawi. HC. Adult F from Zomba Plateau, identified by M. E. Holden.

## *Graphiurus microtis*

## Noack's African Dormouse

**Malawian Names** Kadyamkwikwe, Kadyamlamu, Kasepembe, Kawundi.
These names refer to all dormice.

**Description** Small dormouse. Dorsal pelage various shades of brown, beige or grey, sometimes with golden or reddish hue, with darkening towards the mid-line of head and back in some individuals. Dorsal pelage usually sleek, but moderately thick in some populations (rump hairs 6–8 mm, guard hairs up to 13 mm). Ventral pelage usually white or cream, slightly or moderately suffused with grey. Dorsal and ventral pelage colours clearly delineated. Head colour usually matches that of dorsal pelage, sometimes becoming paler towards muzzle. Cheeks cream or white, forming part of a pale lateral stripe that extends from cheeks to shoulders. Eyes large; eye-mask conspicuous. Ears brown, medium or large, rounded. Cream or white postauricular patches usually present. Head domed when viewed from side (cf. *G. platyops*). Hindfeet white, or white with dark metatarsal streak. Tail moderately long (ca. 76% of HB), hairs shorter at base (5–8 mm) and longer at tip (up to 26 mm). Tail colour generally matches that of dorsal pelage but with white hairs usually mixed throughout tail; tip of tail white.

**Similar Species** Other species of *Graphiurus* (see Table-key 7).

**Distribution** A few scattered records throughout Malawi including Nyika Plateau (Chipome Valley and Nganda). Elsewhere: widespread in Zambia, Botswana, NE Angola, and SW Mozambique; range extends northwards to W and Tanzania, Burundi, Rwanda, Uganda, SW Kenya and S South Sudan. Isolated records from Chad, C Sudan and Ethiopia.

**Habitat** On Nyika Plateau, found in open canopy miombo woodland with tall grasses and shrubs near a stream, and in "alpine meadows with shrub patches at the river banks." In Zimbabwe, prefers Acacia, *Colophospermum* and *Ziziphus* trees where there are holes in the trunks. Also likes to rest in houses, African (thatched) huts and barns. Individuals have also been found among rocks, in caves, in tall grass and amongst debris. The species appears to be able to live in a large variety of habitats but is probably absent from high altitudes.


Zambia © C. & M. Stuart

**Abundance** Probably the commonest species of dormouse in Malawi. No detailed information is available.

**Habits** Arboreal, nocturnal and herbivorous/omnivorous. Nests in hollows of trees are lined with fine grass and leaves. Sometimes nests are made in the abandoned nests of weaver birds. In South Africa, the diet is recorded as Acacia beetle larvae, millipedes, insects, fruit, seeds and nuts. In Uganda (and probably elsewhere), these dormice are solitary or live in pairs. At times, they (males especially) are aggressive to conspecifics. (Although dormice look furry and cuddly - to humans – they bite viciously if handled!).

**Reproduction** In Malawi, a pregnant female was found in Oct. Elsewhere: gestation: ca. 24 days. Litter size: 3-7.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Graphiurus microtis* (Noack, 1887). The definition of this species has changed over time, and other species may have been included in '*microtis'* in the past. Some of the information recorded for *'G. murinus'* in the past may refer to taxa that are now considered to be separate species. For Malawi, this includes *johnstoni* and *kelleni*, both now considered to be valid species.

**Key Reference** Holden, M. E. (2013c).

**Measurements**
*Graphiurus microtis*

| | |
|---|---|
| HB: | 98.8 (75–115) mm, n = 33 |
| T: | 75.2 (62–86) mm, n = 28 |
| HF: | 16.9 (14–20) mm, n = 33 |
| E: | 15.5 (13–21) mm, n = 31 |
| WT: | 29.5 (17.6–42.5) g, n = 21 |
| GLS: | 27.4 (25.5–29.1) mm, n = 28 |

Zimbabwe (Holden, M. E. 2013d).

## *Graphiurus murinus*

## Forest African Dormouse

**Malawian Names** Kadyamkwikwe, Kadyamlamu, Kasepembe, Kawundi.
These names refer to all dormice.

**Description** Small dormouse. Dorsal pelage various shades of golden- or greyish-brown, sometimes with reddish or coppery hue, with darkening of pelage towards the mid-line of head and back in some individuals. Dorsal pelage soft, silky, sometimes thick (rump hairs 7–8 mm, guard hairs up to 13 mm). Ventral pelage grey, lightly suffused with white or cream. Dorsal and ventral pelage colours usually not clearly delineated. Head colour matches that of dorsal pelage. Cheeks cream or white; no pale lateral stripe that extends from cheeks to shoulders. Eyes large; eye-mask conspicuous in some populations. Ears brown, medium-sized, rounded. Postauricular patches usually not present. Head domed when viewed from side (cf. *G. platyops*). Hindfeet usually white with dark metatarsal streak. Tail moderately long (ca. 84% of HB), tail hairs shorter at base (2–4 mm) and longer at tip (up to 21 mm). Tail colour generally uniform, matching that of dorsal pelage. White hairs are sometimes mixed inconspicuously throughout tail pelage in some populations, tip usually not white although some populations exhibit a very faint white tip.

**Similar Species** Other species of *Graphiurus* (see Table-key 7).

**Distribution** In Malawi, recorded only from Wilindi Forest in the Misuku Hills (and probably also from Nyika Plateau – but as yet only recorded from the Zambian Nyika). Elsewhere: recorded from Ethiopia to South Africa in a number of discrete isolated populations that form a 'thin line' through montane forests in highland habitats.

**Habitat** Primarily a forest species. In Malawi, recorded only from two highland forest habitats (but without full details). The specimen from the Zambian Nyika was found in 'remnant forest' i.e. remnant montane evergreen forest. In other part of the biogeographic range, recorded mostly at altitudes of 1000–4100 m, and occasionally at sea level in coastal forests (in South Africa only). These dormice are very adaptable and found in many types of forest (Afromontane, plateau, riverine, coastal). Less commonly they have been recorded from montane grassland where there are rocks, giant groundsels, or trees.


Eastern Cape, South Africa © C. & M. Stuart

**Abundance** No information for Malawi. Elsewhere: considered 'common' in some regions, uncommon in others. Individuals are rarely caught on the ground (0 – ca. 2% of captured animals), but larger numbers are encountered in the vegetation at heights of more than 0.5 m above ground.

**Habits** Arboreal, nocturnal, omnivorous. Frequently nests in holes and crevices in forest trees. In other parts of the biogeographic range, nests have been found among epiphytic ferns and mosses of giant forest trees, in beehives, in swallows' nests, and less commonly, in human dwellings. Nests are often composed of strips of grass, bark and other material, which is finely shredded and formed into a round hollow ball. The diet includes a wide variety of foods including insects and other invertebrates, seeds, leaves, stems, fruit and occasionally small vertebrates. In many studies, insects comprised the majority of food items.

**Reproduction** No information for Malawi. Elsewhere: litter-size: 1–5. Most often 3–4 embryos or nestlings are reported. In Kenya, pregnant females were collected in Sep and Nov. In Zambia, a pregnant female was captured in Jul.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Graphiurus murinus* (Desmarest, 1822). Four currently recognised species were previously included within *G. murinus*; these are *kelleni*, *lorraineus, johnstoni* and *murinus*. Hence data originally applied *to G. murinus* may, in fact, may apply only to *G. kelleni. G. lorraineus* or *G. johnstoni*.

**Key Reference** Holden, M. E. (2013e).

**Measurements**
*Graphiurus murinus*

| | |
|---|---|
| HB: | 91.5 (81–103) mm, n = 21 |
| T: | 76.6 (69–85) mm, n = 19 |
| HF: | 18.5 (16–20) mm, n = 21 |
| E: | 13.3 (11.5–16) mm, n = 7 |
| WT: | 17 g, n = 1 |
| GLS: | 26.4 (25.2–28.8) mm, n = 19 |

Kenya (Mt Kenya 1829–3353 m, Holden 2013d).

## *Graphiurus platyops*

## Flat-headed African Dormouse (Rock Dormouse)

**Malawian Name** Not known.

**Description** Small dormouse with flattened head. Pelage soft and dense. Dorsal pelage bluish-grey; guard hairs black, some with pale tips. Ventral pelage greyish-white; hairs grey on basal half, greyish-white on terminal half. Cheeks white forming part of a pale lateral stripe which extends from cheek to shoulder. Head broad and flat when viewed from side (not domed as in other species of dormice). Eye-mask conspicuous. Postauricular patches sometimes present but faint. Limbs short. Feet greyish-white, four digits on fore-foot, five digits on hindfeet, each with claw. Tail long (ca. 74% of HB) and well covered with hairs. Tail same colour as dorsal pelage but heavily flecked with white hairs giving it a whitish appearance. Hairs 5-7 mm at base of tail, becoming longer (up to 30 mm) at tip. Tip of tail white.

**Similar Species** Other species of *Graphiurus.* See Table-key 7.

**Distribution** Known only from a single male specimen from Zoa collected in 1961. Elsewhere: recorded from a few scattered localities in Zimbabwe, N South Africa, Botswana and Mozambique.

**Habitat** Rocks and crevices in exfoliated granite boulders are optimal habitats (hence the alternative vernacular name – Rock Dormouse). Also found in piles of wood and in buildings.

**Abundance** Very rare in Malawi (known from a single specimen [see above]). Elsewhere: generally considered to be rare, but because it is rarely encountered it may be commoner than records suggest. There are only ca. 50 specimens known from the whole of the biogeographic range of the species.

**Habits** Terrestrial, nocturnal, omnivorous. Very little is known about this species – it is secretive and rarely seen. For each locality where it has been recorded, there are only one or two specimens. All habitats where it has been found have small crevices where individuals can hide. The flattened head is presumed to allow an individual to squeeze into the smallest of gaps in rocks. Usually active at night, but occasionally also in the early hours of the morning. In Zimbabwe, the diet is seeds, vegetable material and insects. Flat-headed Dormice make a variety of vocalizations, some of which imply agonistic behaviour. The individual from Zoa "emitted a powerful musky smell."

**Reproduction** No information for Malawi. Elsewhere: very little information. A female from Zimbabwe contained two embryos in February. In Zambia, one female contained six embryos in February, and juveniles were present in Nov and Dec.

**Conservation** IUCN Category: Least Concern. Since so little is known about this species, it would be more appropriate to categorize it as 'Data Deficient'.

**Taxonomic Notes** *Graphiurus platyops* Thomas, 1897. No subspecies recognised.

**Key Reference** Holden, M. E. (2013e).

**Measurements**
*Graphiurus platyops*

| | |
|---|---|
| HB: | 107.1 (95–122) mm, n = 18 |
| T: | 78.7 (65–98) mm, n = 15 |
| HF: | 21.1 (18–25) mm, n = 21 |
| E: | 15.2 (13–18) mm, n = 19 |
| WT: | 45.7 (30.4–52.8) g, n = 5 |
| GLS: | 30.4 (28.6 – 32) mm, n = 19 |

Zimbabwe and NE South Africa (Holden 2013e).

## FAMILIES MURIDAE and NESOMYIDAE – Rats and Mice

Rats and mice are placed in two families, Nesomyidae and Muridae, but there are no clear diagnostic features which distinguish them.

All living **Nesomyids** are confined to sub-Saharan Africa. They are placed in four subfamilies of which only two are represented in Malawi.

Subfamily Cricetomyinae - Pouched Rats and Pouched Mice. This subfamily contains three genera – *Beamys* (1 species), *Cricetomys* (2 species, one in Malawi) and *Saccostomus* (2 species, one in Malawi). They are called Pouched Mice because they have internal cheek pouches in which they carry food from where they forage back to the burrow.

Subfamily Dendromurinae – African Climbing Mice, Fat Mice and others. This subfamily contains six genera of which two occur in Malawi. *Dendromus* (11 species; 5 in Malawi) and *Steatomys* (8 species, 1 in Malawi). Climbing Mice, *Dendromus,* are very small mice which have modified feet for climbing on grass stems and a very long, thin, semi-prehensile tail. Fat Mice, *Steatomys,* are small mice, best known for their ability to store large quantities of fat when food is abundant (and hence to become fat and rotund in shape); the fat is utilized for energy in the dry season when food is scarce.

Living **Murids** are found almost worldwide now although they were originally confined to the Old World. This family is huge. It contains ca. 150 genera and 730 species of which ca. 50 genera and 264 species occur in Africa, and 18 genera and 29 species occur in Malawi. They are placed in five subfamilies of which four are represented in Malawi.

Subfamily Deomyinae – Brush-furred Rats and Brush-furred Mice (*Lophuromys, Uranomys*), Spiny Mice (*Acomys)* and others. All have either stiff or slightly spiny pelage. In Brush-furred Rats and Brush-furred Mice, the fur is like a fine grade artist's watercolour paint brush. In Spiny Mice, many dorsal hairs have evolved into soft spines; but Spiny Mice are never as spiny as hedgehogs or porcupines.

Subfamily Gerbillinae – Gerbils. A large subfamily with 16 genera and ca. 101 species of which 12 genera and 51 are found in Africa, especially the in semi-arid and arid habitats. Only one genus (*Gerbilliscus)* and two species occur in Malawi. They are slender gracile rodents, sandy coloured above and white below, with relatively long hindfeet and a very long slightly hairy tail usually with a pencil of longer hairs at the tip.

Subfamily Murinae – Rats and mice. The largest subfamily. Contains ca. 124 genera and 543 species of which 31 genera and 145 species occur in Africa. There are 13 genera and 24 species in Malawi. They are the 'typical' rats and mice. Although similar in general morphology, they vary greatly in size, colour and colour markings, habitat, and lifestyle. Most are terrestrial, but species of *Grammomys* and *Thallomys* are arboreal. Many species are very abundant (at some times of the year), others are seldom encountered.

Subfamily Otomyinae – Vlei Rats. A rather specialised subfamily containing two genera and 17 species which evolved in sub-Saharan Africa. There is one genus (*Otomys*) and five species in Malawi. All Malawian species live in wet grasslands (vleis) where the environment is cool. They have short bodies, long shaggy fur and short tails. The structure of their teeth is very different to that of the other murids; the cheekteeth have multiple transverse ridges (similar to the molar teeth of elephants) which crunch the thick coarse stems of grasses on which they feed. They occur in only a few localities and (except for one species) are rare.

The genera of Nesomyid and Murid rodents can be distinguished by the information in Table-key 8. The characters which distinguish rats and mice need no explanation. The profiles of Malawian genera in both families are presented in the alphabetical order of their scientific names (irrespective of the family they belong to), and likewise the species within each genus.

Table-key 8 to the genera of rats and mice (families Muridae and Nesomyidae) found in Malawi.

| Pelage striped | Tail with pencil | HB (in mm) | Size of HB | Relative length of tail | Miscellaneous | Genus (number of species in Malawi) |
|---|---|---|---|---|---|---|
| Yes | No | 55-95 | very small | medium to long | One dark mid-dorsal stripe in four species but at least sometimes absent in Malawian specimens of one species. | *Dendromus* (5) |
| Yes | No | 106.5 (95–125)<br>116 (107–123) | small | medium to long | Both with black mid-dorsal stripe, one also with four lines of pale spots on each flank. | *Lemniscomys* (2) |
| Yes | No | 110.1 (102-118) | small | medium-short | No black mid-dorsal stripe; two black stripes on each flank, each with pale edges. | *Rhabdomys* (1) |
| No | Often | 162.3 (139–179)<br>122.9 (105-140) | medium to large | medium to long | | *Gerbilliscus* (2) |
| No | No | 54.8 (45–68)<br>68.9 (60 -75) | very small | Medium-short to medium | Dorsal pelage soft | *Mus* (2) |
| No | No | 81.2 (70–95) | very small | medium | Dorsal pelage spiny | *Acomys* (1) |
| No | No | 90.8 (80-106) | small | short | Pelage soft, glossy, sleek. Ventral pelage pure white. Dorsal pelage medium brown, tending to blackish-brown, paler rusty-brown on flanks | *Steatomys* (1) |
| No | No | 104.0 (90–127) | small | short | Pelage soft, smooth. Ventral pelage pure white. Dorsal pelage grey | *Saccostomus* (1) |
| No | No | 108 (101–119) | small | short | Pelage stiff. Ventral pelage dirty-white, sometimes tinged with pale cinnamon. Dorsal pelage grey to grey-brown, speckled with pale brown and black | *Uranomys* (1) |
| No | No | 95.8 (85-135) | small | medium-long | Ventral pelage white. | *Praomys* (1) |
| No | No | 120 (104–130) | medium-small | short | Pelage stiff. Dorsal pelage blackish-brown or dark reddish brown, slightly speckled. Ventral pelage pale brown tinged with cinnamon. | *Lophuromys* (1) |
| No | No | 126.7 (115–137) | medium | Short to medium | Pelage soft. Dorsal pelage medium brown to cinnamon-brown, slightly flecked with buff. Ventral pelage off-white, pale grey to brownish-grey. Upper incisors pro-odont. | *Zelotomys* (1) |
| No | No | 114 (100–135) | medium-small | medium | Pelage soft, sleek. Dorsal pelage grey very lightly suffused with fawn and black. Ventral pelage greyish-white. Upper incisors orthodont. | *Mastomys* (1) |
| No | No | 131 (124-148) | medium | medium | Not arboreal. Pelage slightly shaggy. Dorsal pelage flecked with black, pale brown and golden-brown. Ventral pelage greyish-white, tinged with cream. Each upper incisor with one groove. | *Pelomys* (1) |
| No | No | 134 (110–155) | medium | medium | Not arboreal. Pelage shaggy. Dorsal pelage greyish-brown with black guard hairs. Ventral pelage creamy-grey. Each upper incisor without grooves in front surface. | *Dasymys* (1) |
| No | Yes, slight | 105.4 (90–120)<br>122 (105–140) | small to medium | long | Arboreal. Not commensal. Dorsal pelage gingery-brown or cinnamon-brown, or dull olive-brown. | *Grammomys* (2) |
| No | No | 140.3 (130–155) | medium-large | medium | Arboreal (trees). Pelage moderately sleek. Dorsal pelage greyish-fawn on back, merging into whitish-grey on side. Ventral pelage pure white | *Thallomys* (1) |
| No | No | 125 (110–160) | medium-large | long | Not arboreal. Commensal. Dorsal pelage dark brown or blackish-brown, usually darker along mid-dorsal line. | *Rattus* (1) |

*Continued on next page*

*Continued from previous page*

| Pelage striped | Tail with pencil | HB (in mm) | Size of HB | Relative length of tail | Miscellaneous | Genus (number of species in Malawi) |
|---|---|---|---|---|---|---|
| No | No | 122.3 (110–150)<br>139.5 (135-146)<br>119 (115-123)<br>161.5 (144-177) | medium to large | Short to long (mostly medium) | Pelage moderately sleek | *Aethomys* (4) |
| No | No | 152.7 (140-168)<br>159.9 (127-186)<br>158 (150–165)<br>178.0 (147–201)<br>143.3 (120-171) | medium to large | Short to medium | Pelage shaggy. Each upper incisor with one or two grooves in the front surface. | *Otomys* (5) |
| No | No | 148.1 (122-173) | large | medium | Dorsal pelage warm grey, sometimes with a russet tinge on rump and back. Ventral pelage pure white. | *Beamys* (1) |
| No | No | 160 (122–194) | large | medium | Uniquely, only three functional toes on forefeet. Pelage shaggy. Dorsal pelage brown, heavily streaked with black and ochre. Ventral pelage off-white. Each upper incisor with one groove in the front surface. | *Mylomys* (1) |
| No | No | 326 (273-407) | Extremely large | medium | | *Cricetomys* (1) |

Comparative size based on HB: very small = 55-86 mm, small = 87 – 116 mm, medium = 117 – 147 mm, large = 148 – 178 mm, extremely large = ca. 326 mm. Small to medium refers to genera with species in both size categories; and likewise medium to large. Medium-small refers to species with representatives in both size categories.
Relative length of tail: short = less than 75% of HB, medium = 75-125% of HB, long = more than 125% of HB. Short to medium refers to genera with species in both relative length categories, and likewise short to long and medium to long. Medium-long refers to species with representatives in both relative length categories.
This table-key is based on Malawian data whenever it is available, although this means sample sizes are sometimes unreliably small.

## Genus *Acomys* – Spiny Mice

Family Muridae, subfamily Deomyinae. This genus contains about 15 species widely distributed in Africa, and four more in the Middle East. Only one species occurs in Malawi. It is a very small mouse with spiny pelage (see Table-key 8).

## *Acomys spinosissimus*

## Least Spiny Mouse

**Malawian Names** Chinyerere, Kachenzi, Kasengula, Sakachenzi.

Liwonde N. P., Malawi © DCD & M. Happold

**Description** Very small mouse with conspicuous, backward-pointing, black-tipped, spiny hairs protruding through the soft pelage on the back and rump. The spiny hairs are often shed if the mouse is handled. Dorsal pelage greyish-fawn suffused with orange, to bright russet-brown; hairs pale grey to almost white with orange, cinnamon or russet at tip. Pelage on back and rump streaked with black because many hairs are longer and thickened to form soft spines; spiny hairs white at base becoming pale grey and then cinnamon with black at tip. Some individuals have a patch-like pattern of grey and russet dorsal pelage. Ventral pelage pure white, without spines. Dorsal and ventral colours clearly delineated. Head similar in colour to back; chin and throat white; white spot below each eye. Ears naked, rounded and moderate in size. Eyes large and black, protruding. Fore- and hindlimbs are short. Fore- and hindfeet white dorsally, naked and unpigmented below. Tail of medium relative length (100 [84-123]% of HB, n = 58), scaly with sparse, short black bristles; slightly paler ventrally but not distinctly bicoloured. Males are, on average, slightly larger than females. During the moult, faded old hairs are replaced by brighter and darker new hairs. The junction between old and new hairs as the moult proceeds from the rump to the head is very clear cut.

**Similar Species** None. This is the only Spiny Mouse in Malawi.

**Distribution** Widespread in Malawi, especially in the Upper and Lower Shire Valleys. Localities include Blantyre, Chiromo, Kasungu N. P., Lake Malawi N. P., Lengwe N. P., Likhubula, Liwonde N. P., Mangochi Mountain, Matope, Misuku Hills, Mpemba, Mwabvi W. R., Namadzi District, Ntcheu, Nchisi Mountain F. R. (Ntchisi Mountain), Nkhotakota G. R. (Chipata Mountain), Nyika N. P. (Chipome Valley, Sawi River) and Viphya. Absent from high plateaux and other montane regions. Elsewhere: recorded in S Tanzania, Zambia, Zimbabwe, S Mozambique and N South Africa.

**Habitat** Least Spiny Mice are almost always associated with rocks and boulders in grassland habitats, from ca. <100-1530 m. Less often, found in dry deciduous thicket-bush. They do not normally occur in riverine grasslands nor in miombo and mopane woodlands where boulders are absent. They can survive in habitats that have long hot dry seasons when there is no drinking water, and where the grass is burned each year.

**Abundance** Abundance (as a % of the small rodent community) and density varies greatly in different localities and habitats. In Malawi, Least Spiny Mice comprised 46% of small rodents in rocky miombo woodland at Liwonde N. P. (total n = 106, 7 spp., most abundant species) and 24% of the small rodents in thicket clump savanna at Lengwe N. P. (total n = 222, 9 spp., second most abundant species). Density varied seasonally and in each month within each season: 2-9/ha (dry season) – and 3-16/ha (wet season) in Liwonde N. P., and 0-9/ha (dry season) to 2-10/ha (wet season) in Lengwe N. P. Numbers and density varied greatly depending on whether the grasses were burned or not burned in the dry season. These numbers are higher than those from a similar study in Zimbabwe.

**Habits** Terrestrial, nocturnal, insectivore/herbivore. During the day, Least Spiny Mice hide under boulders and rocks and in rocky crevices. The simple nest is made of leaves and dry grass. Despite their short limbs, they are very agile, running and climbing over rocks quickly and easily. They do not burrow, except to forage. At certain times of year, there may be many months when free water is not available and survival depends on water in their food; conservation of water is likely to be as efficient as in other species of *Acomys*. Least Spiny Mice live in groups and nest

together; they exhibit many elements of social behaviour, especially when rearing young (see below). In Malawi, an analysis of diet (for 44 individuals) showed that Least Spiny Mice feed mostly on insects (mainly beetles, but also ants, tipulid larvae, cockroaches) and diplopods (centipedes). Other foods include 'white material' (probably roots), and smaller amounts of fruit and green plant cells (from grasses or leaves). 'Feeding tunnels' leading to roots, have been found in some localities.

In Malawi at the end of the dry season (Sep–Oct), population numbers are small, mostly composed of subadults plus a few old adults. At beginning of the wet season, subadults become adult, reproduction commences and the first young enter population. By end of the wet season and beginning of the dry season (Mar–Jun), all old adults have died, populations are mainly composed of young and subadults, and population numbers reach their peak (about 3-4 times minimum numbers of the dry season). Longevity in the wild is not more than ca. 12 months.

**Reproduction** In Malawi, reproduction is seasonal. Most pregnancies and births occur during the wet season (Dec–Apr), although some females may give birth during the early dry season (May). Mean embryo number: 3.2 (range 2–5, mode 3 and 4, n = 17). The number of embryos increases with size of mother, the largest females having the largest number of embryos in a litter. A large female may produce three litters in a single breeding season. Neonates are large, naked, and altricial. Eyes and ears open, and a fine covering of hair is visible, on Day 7. Weaned at Day 26. The spiny hairs are soft in young animals and do not harden until close to sub-adulthood. Maturity is reached at ca. 2-3 months. Females 'nipple-drag' their young until Day 12. In some species of *Acomys*, several females give birth to their young in a single nest, and females look after the young of other females; it is not known whether this behaviour is present also in *A. spinosissimus*.

**Conservation** IUCN Category: Least Concern. A common and widely distributed species.

**Taxonomic Notes** *Acomys spinosissimus* Peters, 1852. Sweeney (1949) and Hanney (1965) referred to this species as *Acomys cahirinus* (a name now restricted to Spiny Mice in parts of N Africa).

**Key Reference** Happold, D. C. D. (2013c).

**Measurements**
*Acomys spinosissimus*

| | |
|---|---|
| HB: | 81.2 (70–95) mm, n = 66 |
| T: | 81.3 (67–92) mm, n = 58 |
| HF: | 15.3 (14–18) mm, n = 66 |
| E: | 13.4 (11–16) mm, n = 64 |
| WT: | 22.9 (16–31) g, n = 66 |
| GLS: | 25.7 (25.1–26.7) mm, n = 10 |

Malawi (HC, D. C. D. Happold *unpubl.*).

# Genus *Aethomys* – Veld Rats

Family Muridae, subfamily Murinae. This genus contains 11 species endemic to sub-Saharan Africa, found in woodland savanna and grassland habitats. Four species occur in Malawi. They are medium to large rats with moderately sleek pelage, tails of short to long relatively length (see Table-key 8). One species has orthodont upper incisor teeth, which means that they are orientated more-or-less at right-angles to the toothrow. Three species have opisthodont upper incisors which point slightly backwards. The four species can be distinguished by the information in Table-key 9.

Table-key 9 to the species of Veld Rats (*Aethomys* spp.) found in Malawi.

| Relative length of tail | Upper Incisor teeth | HB in mm | Known distribution | Species |
|---|---|---|---|---|
| Much longer than HB | opisthodont | 122 (105-150) n=25 | Widespread | *A. chrysophilus* |
| Much longer than HB | opisthodont | 119 (115-123) n=6 | Mulanje Mountain | *A. namaquensis* |
| Much shorter than HB | opisthodont | 139 (135-146) n=4 | Viphya Plateau, Dedza, Ntchisi | *A. kaiseri* |
| Much shorter than HB | orthodont | 161.5 (144-177) n=4 | Misuku Hills, Nyika Plateau, Ntchisi Mountain F. R., Likhubula, Zomba, Zomba Plateau. | *A. nyikae* |

## *Aethomys chrysophilus*

## Red Veld Rat

**Malawian Name** Chiradzulu, Mohakadzi, Mphokosi, Mphutsa.


Liwonde N. P., Malawi © DCD & M. Happold

**Description** Medium-sized robust rodent. Pelage soft, moderately dense, not sleek. Dorsal pelage reddish-brown or chestnut mixed with black or brownish-black hairs; hairs grey at base, half with a black tip and half with reddish-brown or chestnut tips. Ventral pelage white; hairs grey with white tips. Dorsal and ventral colours merging on lower flanks. Cheeks similar to dorsal pelage or sandy-buff. Chin and throat white. Eyes moderately large, without any dark rim around eyes. Ears, large, naked, with some short hairs on inner surface. Upper surface of fore- and hindfeet covered with white or pale yellow-orange hairs; soles naked and unpigmented. Forefeet with four digits; hindfeet with five digits. Tail dark, scaly with short sparse black bristles; no terminal pencil of long hairs (cf. *Gerbilliscus* spp.). Tail relatively long, 132 (119-148)% of HB, n = 21. Upper incisor teeth opisthodont; anterior surface without grooves (cf. *Gerbilliscus*).

**Similar Species**

*Aethomys namaquensis*: dorsal pelage more heavily suffused with dark grey and black. Only known from high plateaux of Mulanje Mountain.

Other species of *Aethomys* in Malawi have relatively short or medium tails (see Table-key 9).

*Gerbilliscus leucogaster*: pelage sleek. Dorsal pelage rich chestnut or dark rufous-brown, suffused with black, resulting in a slightly flecked appearance, especially mid-dorsally; ventral pelage pure white with clear delineation between lateral and ventral colours. Tail often tipped with pencil of longer hairs. Upper incisors grooved.

**Distribution** Very widely distributed in Malawi from north to south, but not in montane habitats. Localities include Chitipa, Dedza, Lake Malawi N. P. (Cape Maclear), Lengwe N. P., Likhubula, Liwonde N. P., Mangochi Mountain, Matope, Mpemba, Mulanje, Nkhata Bay, Ntchisi Mountain F. R. (Ntchisi Mountain), Nkhotakota, Ntcheu, Nyika N. P. (1800-2134 m), Zoa and Zomba Plateau. Elsewhere, widespread in savanna habitats in Tanzania, Mozambique, Zambia, Zimbabwe, Namibia and SW Angola. Small populations in C Kenya and South Africa (along the Botswana border).

**Habitat** A habitat generalist that occupies a variety of woodland-savanna habitats, especially open canopy miombo woodland. Prefers habitats with abundant cover in the form of rocks, logs, thorn fences around agricultural plots, termitaria and/or dense grass.

**Abundance** Abundance (as a % of the small rodent community) and density varies greatly in different localities and habitats. In Malawi, Red Veld Rats comprised 17% of small rodents in rocky open canopy miombo woodland at Liwonde N. P (total n = 106, 7 spp., third most abundant species) and 18% of the small rodents in thicket clump savanna at Lengwe N. P. (total n = 222, 9 spp., fourth most abundant species). Density varies seasonally: from 0-5/ha (dry season) to 0-3/ha (wet season) in Liwonde N. P., and 0-2/ha (dry season) and 0-2/ha (wet season) in Lengwe N. P.

**Habits** Terrestrial, nocturnal, omnivorous. Although mainly terrestrial, individuals clamber about on rocks, and may climb into low shrubs. When disturbed, they run into holes under rocks and bushes. Nests are made of whole or broken leaves, long unshredded grass stems, and (if available) bird feathers. Food (mainly nuts) are often hoarded in the nests. Analysis of diet in Malawi (n = 72) showed that 87% of samples contained vegetable material, 35% contained insects and 4% contained vertebrate remains (Hanney 1965). The vegetable material was very diverse: 'white material' (? roots), leaves, liverworts or mosses, fruits, grain and bark. Insect foods included adult insects, beetle larvae, and caterpillars. Red Veld Rats live in savannas which are seasonally dry and often burned, so the ability to eat many sorts of food is of great survival value. A study in

Zimbabwe also showed that Red Veld Rats are omnivorous; the diet there was 25% insects, 40% seeds and 35% vegetation (Gliwicz 1987), with greater dependence on seeds in the dry season (10% insects, 75% seeds, 15% vegetation).

**Reproduction** In Malawi, reproductive activity began in Nov-Dec, and young (< 40 g) were caught in Jan and Feb and a single female caught in Apr was both pregnant and lactating which suggests reproductive activity from at least Feb to May. This limited data suggests that reproductive activity lasted for most of the wet season. Elsewhere, breeding may extend into the dry season. Gestation: 26 days, but up to 31 days if female also lactating. Litter size (in Malawi): 3.2 (range 2-5). Neonates are altricial; they have no fur although dorsal surface deeply pigmented. Eyes open Day 10–14. Weaned Day 26–33. Young are permanently attached to nipples until ca. 12-16 days. Adult weight: 74-80 days. Minimum age at sexual maturity in females (in captivity): 82 days.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Aethomys chrysophilus* (de Winton, 1897). No subspecies. Sweeney (1959) referred to this species as *Rattus chrysophilus*.

**Key Reference** Linzey, Kesner & Chimimba (2013).

**Measurements**
*Aethomys chrysophilus*

| | |
|---|---|
| HB: | 122.3 (110–150) mm, n = 25 |
| T: | 158.6 (129–183) mm, n = 25 |
| HF: | 27.6 (24–29) mm, n = 25 |
| E: | 19.3 (18–21) mm, n = 25 |
| WT: | 66.8 (41–122) g, n = 25 |
| GLS: | 36.1 (32.6–37.7) mm, n = 23* |

Malawi (HC, D. C. D. Happold, *unpubl.*).
* South Africa (DNMNH).

## *Aethomys kaiseri*

## Kaiser's Veld Rat

**Malawian Name** Not known.


Tanzania © C. & M. Stuart

**Description** Medium-sized rodent with warm yellowish-brown pelage. Dorsal pelage yellowish-brown or rich warm brown; hairs grey at base with ochre or brown tips; pure black hairs result in darker colour along middorsal line. Flanks paler becoming yellowish-grey on lower flanks. Ventral pelage off-white; hairs with basal third grey. Head similar in colour to back; short black vibrissae. Ears darkly pigmented, with sparse dark brown hairs. Fore- and hindlimbs short, grey. Forefeet with four digits; hindfoot with five digits; all with claws. Tail of medium relative length (87 [86-89]% of HB, n = 4), ringed with scales, with numerous very short bristles, brown above, pale below. Upper incisor teeth opisthodont.

Similar Species
*Aethomys nyikae:* upper incisors orthodont. Apparently more widely distributed in Malawi.
Other species of *Aethomys* in Malawi have relatively long tails (see Table-key 9).

**Distribution** Only known from a few localities in Malawi including Dedza, Ntchisi and Viphya Plateau; also recorded from two localities in NE Zambia close to the Malawi border (Makutu Mountains west of the Nyika Plateau). Elsewhere: recorded in SW Uganda, S Kenya, Tanzania, Zambia, SE DR Congo, and E Angola.

**Habitat** Grasslands, shrubs and rocks, where there is thick ground cover. In Malawi, found in stream valleys with thick rank vegetation cover.

**Abundance** Uncertain; appears to be less common than *A. chrysophilus*. This species has rarely been found in Malawi. In SW Uganda, considered to be 'very rare'.

**Habits** Terrestrial, nocturnal, omnivorous. Very little is known about this species. In Malawi, the diet includes 'white material', insects and green vegetation. Preyed upon by owls near Dedza.

**Reproduction** In Malawi, one female collected in May was in reproductive condition and had produced at least two previous litters. Elsewhere: little is known about reproduction in wild populations. In Uganda, pregnant females were found in Oct, Nov, Jan and Apr, and females were lactating in May, Jun and Nov. In Uganda: Gestation: 26–28 days. Mean litter-size: 2.6 (1–4). Weight at birth ca. 6.1 g. Fully haired Day 3. Eyes open Day 8–10. Weaned Day 26. Average weight at weaning: 47.8 g. Young nipple-cling from birth to Day 12. A pair in captivity produced litters at intervals of 32, 40 and 37 days.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Aethomys kaiseri* (Noack, 1887). Previous studies referred to this species as *Aethomys walambae*. The name *walambae* is now considered to be a synomym of *kaiseri*. No subspecies.

**Key Reference** Linzey, Chimimba & Kesner (2013a).

**Measurements**
*Aethomys kaiseri*

HB: 139.5 (135-146) mm, n = 4
T: 121.8 (118–126) mm, n = 4
HF: 27.0 (26-28)) mm, n = 4
E: 21.0 (20–22) mm, n = 4
WT: 109.8 (92–132) g, n = 4
GLS: 36.4 (34–38) mm, n = 9*

Malawi (Viphya Plateau. NHMUK).
*Zambia (Ansell & Ansell 1973).

## *Aethomys namaquensis*

## Namaqua Veld Rat

**Malawian Name** Khoswe (not confined to this species).

Lichenya Plateau, Mulanje Mountain, Malawi
© DCD & M. Happold

**Description** (based on specimens from Mulanje Mountain). Medium-sized rat with long tail. Pelage long, soft and dense. Dorsal pelage pale brown to cinnamon, heavily suffused with black and dark grey especially mid-dorsally; short hairs dark grey tipped with cinnamon or grey, long guard hairs grey at base with terminal third black. Flanks similar to back but paler. Ventral pelage greyish-white; hairs pale grey tipped with greyish-white. Crown and forehead same as mid-dorsal pelage; cheeks paler. Lips, chin and throat whitish-grey. Long black or white vibrissae on nasal region. Ears with brown pigmentation. Eyes very dark brown. Fore- and hindfeet unpigmented with dense short white hairs. Tail relatively long 134 (130-141)% of HB, n = 6 in Malawi, scaly, with numerous short black bristles becoming longer and denser towards tip. Upper incisors opisthodont.

**Similar Species**

*Aethomys chrysophilus*: dorsal pelage reddish-brown or chestnut, less suffused with black and brownish-black. Widely distributed but not in montane habitats.

Other species of *Aethomys* in Malawi have relatively short or medium length tails (see Table-key 9).

**Distribution** In Malawi, recorded only from the plateaux and higher altitudes of Mulanje Mountain. Elsewhere: widely distributed south of ca. 15˚S in SW Angola, Namibia, Zambia (extreme south near border with Zimbabwe), Zimbabwe, C Mozambique, eSwatini, Lesotho and South Africa. Not recorded from arid areas.

**Habitat**. In Malawi, associated with rocky grassland areas and montane herbs and shrubs at higher altitudes (not recorded from longer grasslands or forests on Mulanje Mountain). Elsewhere: further south, the species shows wide habitat tolerance occurring in sandy area, rocky areas, open scrub with scattered trees, and open woodland, and on the edges of pans. Recorded from almost sea level to over 2000 m.

**Abundance** On Mulanje Mountain, comprised one third of small rodents found amongst rocks, boulders and tussock grass (3 individuals out of 9 animals). In southern Africa, very common in suitable rocky habitats (e.g. 63–87% of the small mammal fauna on a talus slope in W Zimbabwe, and the most common small mammal [38%] in rock-laden grassy slopes in N Mozambique).

**Habits** Terrestrial, nocturnal, semi-arboreal, mostly opportunistic. Builds grass-stick nests in rock crevices and in upright or fallen hollow trees. In non-rocky habitats, grass-sticks are piled over the entrance to burrows under brush or other debris. Nocturnal, with slightly higher activity just after dusk and just before dawn. Diet appears to vary with location: on Mulanje Mountain, stomach contents contained green plant cells, grain (seed) husks, and cells and spores of bracken. In other parts of the biogeographic range, the proportions of each component of the diet varied in different localities and seasons e.g. grass and foliage (60–90%), seeds (2–40%) and insects (0–8%). Namaqua Rock Rats are social animals, several individuals living in the same nest.

**Reproduction** No information for Malawi. In southern Africa, the reproductive season is seasonal but varies in different localities. In Mozambique births occur from Dec to Apr/Mar, and in Botswana and Zimbabwe from Sep-May with a peak in Mar and Apr. Reproduction appears to occur only during the wet season (with peaks at the end of the wet season) when conditions for rearing the young are optimal. Gestation: greater than 22 days. Litter-size: 3.1 (2–7) in Botswana, and 3.3 (1-5) in Transvaal, South Africa. Birth-weight: 2.5 g. Neonates altricial. Nipple-cling to mother until Day 16–21. Eyes open Day 10–12. Weaned Day 21–26.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Aethomys namaquensis* (Smith, 1834).

**Key Reference** Kesner, Linzey & Chimimba (2013).

**Measurements**.
*Aethomys namaquensis*

| | |
|---|---|
| HB: | 119 (115-123) mm, n = 6 |
| T: | 159.5 (154-174) mm, n = 6 |
| HF: | 27.8 (27-30) mm, n = 6 |
| E: | 17.9 (17-19) mm, n = 6 |
| WT: | 60 (53-68) g, n = 3 |
| GLS: | 31.3 (27.1-34.9) mm, n = 2730* |

Malawi (Mulanje Mountain. HC, NHMUK, NMMB).
*Southern Africa (Chimimba *et al.* 1999 in Kesner, Linzey & Chimimba 2013).

## *Aethomys nyikae*

## Nyika Veld Rat

**Malawian Name** Not known.

**Description** Large rodent. Pelage soft. Dorsal pelage cinnamon, heavily suffused with grey or black; hairs dark grey at base, with cinnamon or black tip. Flanks more greyish than back. Ventral pelage greyish-white (not pure white); hairs dark grey at base, white at tip. Crown of head and upper cheeks same as dorsal pelage. Lower cheeks, chin and throat same as ventral pelage. Ears rounded, lightly covered with short cinnamon hairs. Limbs short. Fore- and hindfeet white. Tail scaly and conspicuously ringed; dorsal surface with short black bristles; ventral surface with short white bristles. Tail of short to medium relative length 76.3 (71-86)% of HB, n = 3). Upper incisors orthodont (cf. other *Aethomys* in Malawi).

**Similar Species**

*Aethomys kaiseri:* Upper incisors opisthodont. Apparently less widely distributed in Malawi.

Other species of *Aethomys* in Malawi have relatively long tails (see Table-key 9).

**Distribution** In Malawi, recorded from only a few localities including, Likhubula, Misuku Hills, Ntchisi, Nyika Plateau, Zomba and Zomba Plateau. Elsewhere: recorded from parts of NE Angola, SW DR Congo and N Zambia, mainly at higher altitudes.

**Habitat** Grasslands with bushes and trees, as well as cultivated areas. Recorded in termite mounds in open woodland, from the edge of montane forest in bracken or grass, and along a riverbank in alpine grassland with patches of shrubs (2200–2300 m).

**Abundance** Little information. In Malawi (Nyika Plateau), the original series included 15 *A. nyikae*, and only one *A. chrysophilus*. Owl pellets collected at Dedza included the skulls of 22 *A. nyikae* and 3 A. *chrysophilus*, suggesting that in suitable locations *A. nyikae* is common.

**Habits** Terrrestrial and nocturnal. No other information is available from Malawi.

**Reproduction** No information for Malawi. Elsewhere: in S Uganda (captivity), litter-size 2.6 (1-4). Neonates altricial. Eyes open Day 8-10. Young exhibit nipple-clinging until Day 12. Weaned Day 26. Young attain mean weight of 80 g (i.e. one half adult weight) by Day 40.

**Conservation** IUCN Category: Least Concern (formerly Vulnerable).

**Taxonomic Notes** *Aethomys nyikae* (Thomas, 1897). Sweeney (1959) referred to this species as *Rattus nyikae*. No subspecies.

**Key Reference** Linzey, Chimimba & Kesner (2013b).

**Measurements**
*Aethomys nyikae*

| | |
|---|---|
| HB: | 161.5 (144-177) mm, n = 4 |
| T: | 123 (103–155) mm, n = 3 |
| HF: | 28.0 (26–31) mm, n = 4 |
| E: | 20.7 (20–22) mm, n = 3 |
| WT: | 90.2 (56–106) g, n = 13* |
| GLS: | 35.1 (34–38) mm, n = 8* |

Malawi (Ntchisi, NMMB). *Zambia (Ansell & Ansell 1973).

# Genus *Beamys* – Pouched Rat

Family Nesomyidae, subfamily Cricetomyinae. This genus contains only one (or perhaps two) species, confined to evergreen forests of eastern Africa.

## *Beamys hindei*

## Long-tailed Pouched Rat

**Malawian Name** Chidiubaya.

Mzuzu, Malawi © DCD & M. Happold

**Description** Large rat with soft grey dorsal pelage, pure white ventral pelage, and a whitish blotched tail. For most measurements, males are larger on average than females. Pelage dense, soft, short and sleek. Dorsal pelage warm grey, sometimes with a russet tinge on rump and back; dorsal hairs medium grey with warm grey tips. Ventral pelage, chin and throat pure white. Face pointed, ears small and rounded; vibrissae long and black; eyes black, small. Some individuals have white blaze on forehead. Cheek pouches inside mouth (as in *Cricetomys gambianus*). Limbs short, fore- and hindfeet white. Forefeet with four digits; hindfeet with five digits, rather short and thickset. Tail of medium relative length (86.9 [81-93]% of HB, n = 11), scaly, thick (especially at base), whitish often with irregular dark blotches. Dorsal pelage of juveniles pale grey. Pelage colour varies with age and season of the year, sometimes becoming brownish of reddish-brown, rather than grey.

**Similar Species**

*Mylomys dybowskii*. Dorsal pelage brown, heavily streaked with black and ochre; ventral pelage off-white. Only known in Malawi from Nyika Plateau (ca. 2200 m).

**Distribution** Widespread from far north to far south. Localities include Chididi, Chididi District, Limbuli Estate (Mulanje), Mangoche Mountain, Misuku, Mulanje, Mzuzu, Nsanje, Ntchisi Mountain F. R. (Ntchisi Mountain), Nyika N. P., Viphya Plateau and Zoa. Altitude range: ca. 50–2100 m. Elsewhere: recorded from coastal forests within about 100 km of coast from S Kenya to S Tanzania (*B. h. hindei)*, and extreme SW Tanzania, NE Zambia and (perhaps) parts of N Mozambique (*B. h. major*). There appears to be a gap in the biogeographic distribution between the two subspecies.

**Habitat** Evergreen and montane forests, and forests close to streams, especially where there is soft soil and leaf litter. Sometimes found in bamboo thickets and banana plantations if close to streams (e.g. near Zoa).

**Abundance** Rarely recorded and, in Malawi, usually no more than 1-2 individuals are found at any one study site. In Kenya (Arabuko-Sokoke), the density was 14-30 individuals/ha.

**Habits** Mostly terrestrial, nocturnal, omnivorous. Although mostly terrestrial, individuals may climb to forage for fruits. The tail, although heavy and used for balance may be semi-prehensile at times. During the day, individuals curl up on a bed of leaves in their underground nests. At night, these pouched rats forage for food and also collect food in their cheek pouches; the food is brought to food stores where it is kept until eaten. Food stores found in burrows near Zoa contained many sorts of seeds and fruits (including, maize, mango, grenadillo, cowpeas, cassava fruits and seeds, beans and avocado). Insects and meat may be eaten if available. Burrows are quite complex, with many tunnels, and chambers for nesting and/or storage. There is some evidence that Long-tailed Pouched Rats are copraphagous, and they seem to require free water for drinking (hence they are restricted to habitats where water is available).

**Reproduction** In Malawi, pregnant females have been recorded in Nov–May during the wet season and the beginning of the dry season. Elsewhere: gestation: 22–23 days. Eyes of young open Day 21. Weaned Day 35–40. Minimum interval between births: 62 days. Litter-size: 2.8 (1–5). Neonates have pink-coloured skin and a fine down of grey hairs;

WT: 3.2 (2.1–4.3) g. Growth is rapid - at four weeks young are still sucking and weigh ca. 43 g.

**Conservation** IUCN Category: Least Concern. Populations are small and widely dispersed, and their forest habitats are being modified or reduced in area by human activities.

**Taxonomic Notes** *Beamys hindei* Thomas, 1909. Two subspecies: one subspecies in Malawi: *B. h. major*. The type specimen of *B. h. major* (as *Beamys major*) was collected at Mulanje in 1904.

**Key Reference** Happold, D. C. D (2013d).

**Measurements**
*Beamys hindei major*

| | |
|---|---|
| HB: | 148.1 (122-173) mm, n = 15 |
| T: | 128 (94-145) mm, n=15 |
| HF: | 23.5 (21-25) mm, n = 15 |
| E: | 19.3 (16-23) mm, n = 15 |
| WT: | 83.4 (40-117) g, n = 7 |
| GLS: | 28.2 (35-41) mm, n = 12 |

Malawi (NHMUK, NMMB).

# Genus *Cricetomys* – Giant Pouched Rats

Family Nesomyidae, subfamily Cricetomyinae. This genus contains at least two (possibly four) species, widespread in sub-Saharan Africa. Only one species occurs in Malawi. It is the only extremely large rat in Malawi (see Table-key 8).

## *Cricetomys gambianus*

## Gambian Giant Pouched Rat

**Malawian Names** Bwampini, Gwime, Kunda, Ngwime.

Zomba, Malawi © DCD & M. Happold

**Description** Extremely large rat with basal half of tail blackish-brown and terminal half white - the largest murid rodent in Africa. Pelage moderately sleek with a slight sheen. Dorsal pelage greyish-brown with scattered black hairs, especially on back; becoming paler (fawn) on flanks. Ventral pelage white to off-white, not clearly delineated from colour of flanks. Pelage variable in colour depending on age and location. Head wide with elongated muzzle; very long black vibrissae. Crown same colour as back; cheeks same as flanks. Eyes relatively small. Ears relatively large and conspicuous, naked, mostly grey but unpigmented and pink at inner base. Limbs relatively short compared to body size. Forefeet and hindfeet broad and well developed, brown with unpigmented digits; forefoot with a rudimentary thumb. Tail of medium relative length (107.8 [101-118]% of HB, n = 4); basal half dark blackish-brown with short dark bristles, terminal half white with short white bristles.

**Similar Species** None.

**Distribution** Very widespread throughout Malawi, from low to high altitudes and in all biogeographic areas. Localities include Blantyre, Chikangawa, Karonga District, Lengwe N. P., Mulanje, Mwabve W. R., Nsanje, Ntcheu, Nyika N. P., Thondwe, Thyolo Mountain, Zoa Tea Estate and Zomba District. Elsewhere: recorded in a wide range of savanna and urban habitats from Senegal to southern Sudan, South Sudan and East Africa, and then south to Angola, Zambia, Mozambique, Zimbabwe and northern South Africa. Not present in rainforest (where replaced by a similar species *Cricetomys emini*) and semi-desert and desert environments.

**Habitat** Recorded from a wide range of habitats including woodland savannas and grasslands, farmlands, plantations, evergreen forests beside streams, gardens and urban areas.

**Abundance** Generally considered to be common throughout most of its biogeographic range.

**Habits** Terrestrial, nocturnal, omnivorous. Although terrestrial, Gambian Giant Pouched Rats can clamber about in thickets and low branches of shrubs (while foraging) and can also clamber around small human-made structures. On the ground, they walk and run on all fours, with the tail held out horizontally behind. When clambering, the tail is used for balance and support. When foraging, the cheek pouches are filled with nuts and seeds and taken back to the burrow where they are deposited in a 'food store'. When the pouches are full, the cheeks expand outwards as if there is a huge balloon on either side of the head. A study in Malawi found the following items in food stores: velvet beans, cowpeas, pumpkin seeds, groundnuts, mango seeds, maize seeds and cobs, pods of several species of trees, and pieces of tree roots. Food varies with season and locality and may include insects at some times of the year. Gambian Giant Pouched Rats are copraphagous.

Gambian Giant Pouched Rats dig extensive burrows in moist soil. A burrow is usually excavated with the strong incisor teeth, rather than by the front feet. There is normally one entrance hole (sometimes as many as four) which is sealed with a small mound of soil; this leads to several chambers for nesting and/or storage of food. These chambers are mostly lined with leaves (not grass). There is also a latrine chamber. At the opposite end to the entrance, there are one or more vertical sealed shafts (pop-holes) which act as escape hatches.

Gambian Giant Pouched Rats live a solitary life, and mostly there is only a single individual in each burrow (or a mother with her young). In contrast, an adult male and an adult female, when kept in captivity in a large room exhibited, amicable behaviour, but two males frequently fought each other. They are very inquisitive animals, and when in a new environment, they explore and investigate any new object.

Gambian Giant Pouched Rats exhibit several forms of social communication, e.g. they urinate after leaving the nest and while exploring and foraging, and they also defaecate on top of the faeces of other individuals. Cheek-rubbing (of secretions, including saliva) against solid objects may also provide information about an individual. They emit several vocal noises (all rather quiet): 'squeaks', 'high squeaks' and 'piping', all of which appear to indicate mood rather than communication with conspecifics.

Gambian Giant Pouched Rats have a highly developed sense of smell and have been trained, very successfully, to hunt for land-mines.

**Reproduction** In Malawi, young have been recorded between Sep and May, suggesting that breeding takes place during the wet season (Morris 1963). Gestation: 32–42 days. Litter-size: 3 (range 1–5). Average weight at birth: 16–27 g, depending on litter-size. Neonates are altricial; they are hairless, weigh ca. 20 g, and their eyes are closed. Growth is rapid: sparse covering of hair by Day 10, first walking on Day 16, and first eating of solid food on Day 18. The eyes open on Day 20, and young begin to collect food in cheek pouches at ca. Day 25 and are coprophagous by Day 25. Adult weight is attained by ca. 70 days and sexual maturity at about 20 weeks.

**Conservation** IUCN Category: Least Concern. Conservation concerns include habitat destruction and hunting for 'bushmeat'.

**Taxonomic Notes** *Cricetomys gambianus* Waterhouse, 1840. Subspecies: none. Formerly seven subspecies were recognised but now the species is considered to show clinal variations in size and colour. Some authorities consider that Giant Pouched Rats from southern Africa (including Malawi) belong to a separate species, *C. ansorgei*.

**Key Reference** Duplantier & Granjon (2013).

**Measurements**
*Cricetomys gambianus*

| | |
|---|---|
| HB: | 324.3 (317-337) mm, n = 4 |
| T: | 348.8 (322–380) mm, n = 4 |
| HF: | 72.8 (68–82) mm, n = 4 |
| E: | 40.3 (36–45) mm, n = 3 |
| WT: | n. d. |
| GLS: | 66.4 (58.8–70.5) mm, n = 34* |

Malawi (NMMB, Lawrence & Loveridge 1953).
*Senegal (Duplantier & Granjon 2013).

# Genus *Dasymys* – Shaggy Rats

Family Muridae, subfamily Murinae. This genus contains five species, all endemic to sub-Saharan Africa where they are found in wetland habitats with dense ground cover. Only one species occurs in Malawi. It is a medium-sized rat with a relatively medium length tail (no pencil) and has shaggy pelage (see Table-key 8).

## *Dasymys incomtus*

## Common Shaggy Rat

**Malawian Name** Not known.

Nchisi F. R., Malawi © DCD & M. Happold

**Description** Medium-sized rodent with long soft shaggy dark brown pelage. Dorsal pelage dark greyish-brown streaked with black; hairs dark grey tipped with dark cinnamon or black; guard hairs long, black, 10-20 mm in length. Dense underfur. Ventral pelage creamy-grey; hairs grey tipped with cream; thick underfur. Colour of dorsal pelage merges into ventral colour on flanks; posterior part of flanks and rump brownish-cinnamon with fewer black hairs. Head broad with short muzzle. Crown of head same colour as dorsal pelage, paler on cheeks. Eyes black. Ears darkly pigmented with very small cinnamon hairs; front of ears usually obscured by cinnamon-ginger hairs from cheek. Very long black vibrissae. Fore- and hindlimbs short; digits non-pigmented with short pale hairs. Tail long (93.0 [87-98]% of HB, n = 3), scaly, with many small dark bristles dorsally and pale bristles ventrally. Upper incisor teeth without grooves in the front surface (cf. *Otomys* spp.).

**Similar Species** In Malawi, only *Dasymys, Mylomys* and *Otomys* have long shaggy pelage; *Pelomys fallax* has slightly shaggy pelage (see Table-key 8).

*Otomys* spp. Tails relatively short (ca. 46-66% of HB); each upper incisor with 1-2 longitudinal grooves in the front surface.

*Mylomys dybowskii*. Dorsal pelage brown, heavily streaked with black and ochre. Tail longer (152 mm, n = 1). Only recorded on Nyika Plateau.

*Pelomys fallax*. Pelage brownish and conspicuously flecked; each upper incisor with one groove.

**Distribution** Recorded at scattered localities including Nyika Plateau, Misuku Hills, Chikangawa, Kasungu, Nkhotakota, Ntcheu, Dedza, Zomba Plateau, Mulanje Mountain, Liwonde, Lake Chilwa, Matope, Mwanza. There are many records in Upper Shire Valley but only a few in Lower Shire Valley. Elsewhere: recorded in large areas of eastern, central and southern Africa including S Sudan, Ethiopia, DR Congo, Uganda, Kenya, Tanzania (except SE), NE Angola, N Botswana (including the Caprivi Strip), Zambia, Zimbabwe, and N and coastal South Africa. Not recorded in semi-arid and arid regions.

**Habitat** Moist grassy areas, semi-aquatic regions, reedbeds and marshes. All habitats must be moist and/or close to water.

**Abundance** Mostly uncommon or rare (or at least rarely encountered using normal survey methods). In moist grassland and montane forest on Zomba Plateau, three individuals (1.4%) were encountered out of a total of 215 small rodents (8 spp.). Owl pellets on Zomba Plateau contained remains of this species: one sample contained the remains of 12 individuals (out of 101 individuals, 8 spp), and a second sample contained 8 individuals (out of a total of 46 individuals, 7 spp.); this suggests that Common Shaggy Rats may be more abundant than suggested by conventional surveys. They are, perhaps, trap-shy.

**Habits** Terrestrial, nocturnal/diurnal, semi-aquatic, herbivorous. Shaggy Rats swim well and readily take to water, swimming with a 'dog-paddle' stroke. In southern Africa, they are crepuscular and diurnal. Nests of Common Shaggy Rats in Malawi were built 2–20 m from water; each nest consisted of two parts, an upper part on the surface of the ground and a lower part in a depression. Entrance to the nest was concealed in the depression, and it led to well-defined runways radiating out from the entrance. In two nests, the entrance led to an underground burrow that opened below water level. Nests are built of fresh grass. In captivity, both sexes are aggressive,

suggesting a solitary life-style in the wild; females tolerate unfamiliar males only when they are in oestrus. The diet comprises succulent stems and fruiting heads of semi-aquatic grasses and reeds, and occasionally insects.

**Reproduction** The only information for Malawi is one pregnancy in Jun (Nyika) and two sucking young in Aug (Lake Chilwa) suggesting that temperature does not determine when breeding occurs provided water is present (as is normal in marches and damp habitats). In Zimbabwe, breeding occurs during the warm wet summer months (Aug–Mar). Gestation (in captive population): ca. 29 days. Litter-size: 2–4 over most of biogeographic range (larger in South Africa). Neonates are altricial and weigh ca. 8 g. Weaned ca. Day 24. Young nipple-cling until Day 30. Onset of sexual maturity in males ca. Week 6, and first matings occur at Week 8. Females first complete oestrus cycle and conception in ca. Week 18-19, suggesting that only females born early in the breeding season are likely to reproduce in the season of their birth.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Dasymys incomtus* (Sundevall, 1847). Three subspecies recognised; in Malawi, the subspecies is *D. i. incomptus*.

**Key Reference** Pillay (2013).

**Measurements**
*Dasymys incomtus*

| | |
|---|---|
| HB: | 134 (110–155) mm, n = 11 |
| T: | 128.8 (119–137) mm, n = 5 |
| HF: | 28.5 (27–30) mm, n = 6 |
| E: | 18.2 (16–20) mm, n = 6 |
| WT: | 69.4 (42–110) g, n = 5* |
| GLS: | 37.9 (34.3–41.6) mm, n = 17† |

Malawi (HC, NHMUK, D. C. D. Happold, *unpubl.*).
*includes three subadults.
†South Africa (DM, Taylor 1998 in Pillay 2013).

# Genus *Dendromus* – African Climbing Mice

Family Nesomyidae, subfamily Dendromurinae. This genus contains 11 or 12 species, all are endemic to sub-Saharan Africa. Five species occur in Malawi. Climbing Mice are very small (see Table-key 8). They are adapted for climbing grasses. They have semi-prehensile tails which can be wrapped around stems (but climbing mice cannot hang by their tails). Digit 5 (outer toe) on the hindfeet is long and opposable and has either a nail or a claw. Four of the species in Malawi have one dark mid-dorsal stripe. The species found in Malawi can be distinguished by the information in Table-key 10.

Table-key 10 to the species of African Climbing Mice (*Dendromus* spp.) found in Malawi.

| **Dark mid-dorsal stripe** | **Digit 5 of hindfoot** | **Colour of dorsal pelage (excluding mid-dorsal stripe)** | **Colour of ventral pelage and base of ventral hairs** | **Miscellaneous** | **Species** |
|---|---|---|---|---|---|
| Usually absent in Malawi. | With claw | orange-brown or cinnamon-brown | Creamy-white or whitish. Hairs white at base. | T 129 [115-141]% of HB<br>HB: 61.7 (57–68) mm | *D. mystacalis* |
| Present | With claw | Rich brown | Silvery-white. Hairs grey at base. | T ca. 124% of HB<br>HB: 73.8 (64-80) mm | *D. nyasae* |
| Usually present | With claw | Rufous-brown | off-white; hairs dark at base | T 141 [133-146]% of HB<br>HB: 71.3 (68–74) mm | *D. mesomelas* |
| Present | With nail | Dorsal pelage dull cinnamon-brown, sometimes flecked with ashy-grey | Greyish-white. Hairs grey at base. | Black patch on crown of most individuals.<br>Ears with dark-brown pigmentation and short dark-brown hairs. | *D. melanotis* |
| Present | With nail. | pale to dark cinnamon suffused with grey | Creamy-white. Hairs usually creamy-white but sometimes grey at base. | No black patch on crown.<br>Ears with brown pigmentation and short brown hairs. | *D. nyikae* |

## *Dendromus melanotis*

## Grey African Climbing Mouse

**Malawian Name** Not known.

Limpopo Province, South Africa © C. & M. Stuart

**Description** Very small mouse with dark mid-dorsal stripe and a relatively medium to long tail: adapted for climbing grasses. The darkest of the Malawian *Dendromus*. Pelage soft and dense. Dorsal pelage dull cinnamon-brown, sometimes flecked with ashy-grey and with some longer black-tipped hairs; hairs mostly grey with terminal third cinnamon-brown. Dark mid-dorsal stripe present; usually 3–4 mm in width, extending from between shoulders to base of tail. Ventral pelage shorter than dorsal pelage, greyish-white; hairs grey at base, whitish-grey at tip. Head with pointed muzzle and long vibrissae. Crown and cheeks same as dorsal pelage. Black patch on crown of head. Ears small and rounded, with dark-brown pigmentation and dark-brown hairs; there is a small white patch at base of ears in some individuals. Inconspicuous brown patch in front of each eye in some individuals. Limbs short. Forefeet with three long functional digits (as in other *Dendromus*); Digits 1 and 5 greatly reduced but not absent. Hindfoot with five digits; Digit 1 short with nail, Digit 5 with nail (not claw) (cf. *D. mesomelas, D. nyasae*). Tail relatively medium to long (118 [104-140]% of HB, n = 8), with numerous brown bristles, brownish above, paler below.

**Similar Species** Only one other *Dendromus* in Malawi has a nail on Digit 5 of the hindfoot.

*Dendromus nyikae.* No black patch on crown; ears with brown pigmentation and brown hairs.

**Distribution** In Malawi, recorded only from higher altitude localities (High Plateaux of Northern Region and Shire Highlands ). Localities: Blantyre, Misuku, Nyika Plateau (Chelinda, Zambian Nyika]) and Zomba. Not yet recorded from Zomba Plateau but maybe expected there. Elsewhere: widely distributed in southern Africa (S Angola, Zambia, Zimbabwe, Botswana, S Mozambique, eSwatini, and NE South Africa with extensions to coastal areas to just north of Cape Town). There are also a few scattered records from Ethiopia to West Africa, but identification is uncertain.

**Habitat** Inhabits a wide range of grasslands. In Malawi, only recorded from montane grasslands and other grasslands at higher altitudes.

**Abundance** No information from Malawi – rarely recorded. In South Africa (Transvaal), it is quite common (3rd most common small mammal in high altitude grasslands).

**Habits** Scansorial/terrestrial, nocturnal, granivorous/insectivorous. Very little is known about this species. It prefers tall grasslands where it can climb grass stems to forage on the seed heads at the top of grass stems. Studies in South Africa suggest that it makes burrows up to 50 cm deep under the soil, and it also makes grass nests attached to grass stems and thin twigs of vegetation. Its diet is mainly seeds and insects.

**Reproduction** No information for Malawi. Elsewhere: young are born in grass nests (see above). In southern Africa, reproduction is possibly confined to the wet season. In South Africa, pregnant females with 2–8 embryos have been collected between Nov and Apr, and juveniles captured at the end of the wet season during Apr and May.

**Conservation** IUCN Category: Least Concern. However, in Malawi, montane grasslands are under

threat from grazing domestic animals and the establishment of pine plantations.

**Taxonomic Notes** *Dendromus melanotis* Smith, 1834. No subspecies.

**Key Reference** Monadjem, A. (2013a).

**Measurements**
*Dendromus melanotis*

| | |
|---|---|
| HB: | 68.7 (55–79) mm, n = 10 |
| T: | 79.4 (72–95) mm, n = 9 |
| HF: | 17.5 (15–20) mm, n = 10 |
| E: | 13.7 (12–15) mm, n = 7 |
| WT: | 7.4 (6–10) g, n = 11 |
| GLS: | 21.3 (20.0–22.2) mm, n = 5 |

Malawi (NHMUK, NMMB).

## *Dendromus mesomelas*

## Brants's African Climbing Mouse

**Malawian Name** Not known.

Western Cape, South Africa © C. & M. Stuart

**Description** Very small mouse usually with dark mid-dorsal stripe and a relatively long tail; adapted for climbing grasses. Pelage soft, woolly. Dorsal pelage rufous-brown; hairs dark grey with rufous-brown to gingery-brown at tip. Dark mid-dorsal stripe usually present, of variable intensity, extending from between shoulders to base of tail; absent in some individuals. Ventral pelage off-white; hairs dark grey with whitish tip. Head with pointed nose and long vibrissae; no black patch on crown. Ears small and rounded with dark-brown pigmentation and pale-brown hairs. Limbs short. Forefeet with three long functional digits; Digit 1 greatly reduced and Digit 5 absent. Hindfoot with five digits; Digit 1 short with nail, Digit 5 long and opposable with claw. Tail relatively long (141 [133-146]% of HB, n = 3), brownish above, paler below and sparsely haired.

**Similar Species** Only two other *Dendromus* in Malawi have a claw on Digit 5 of the hindfoot.

*D. mystacalis*. No dark mid-dorsal stripe in most specimens from Malawi. Dorsal pelage orange-brown or cinnamon-brown. Tail, on average, relatively shorter (129 [115-141]% of HB). HB smaller (61.7 [57–68] mm.

*D. nyasae*. Dorsal pelage rich brown. Tail relatively shorter (ca. 124% of HB); tail of holotype markedly shorter (85 mm).

**Distribution** In Malawi, recorded only in a few high altitude localities including Misuku Hills, Nyika Plateau. Elsewhere: scattered disjunct populations in C Tanzania, NW Zaire, NW Botswana, S Mozambique, eSwatini, and S and E South Africa.

**Habitat** Found in a wide range of grassland habitats mostly in temperate environments. In southern Africa, also inhabits swamps and damp grasslands as well as afromontane forest. Prefers wet moist habitats and is absent from hot, low-lying river basins, arid savannas and miombo woodlands. Occurs only at higher altitudes in the northern part of its biogeographic range than in the southern part of the range.

**Abundance** No information.

**Habits** Terrestrial/scansorial, nocturnal, granivorous/insectivorous. Mostly nocturnal but may also be active during the day. As for the other species of *Dendromus*, its limbs and tail are modified for a semi-scansorial existence. Long, slender digits used to grip and climb thin stalks while the long, semi-prehensile tail provides balance and support. Also burrows amongst rocks. Weaves a grass nest, which may be placed either above or below ground. Sometimes occupies nests of birds, e.g. Weaver Birds (*Ploceus* spp.). Believed to be more terrestrial than other members of the genus. In eSwatini, it feeds mainly on seeds; consumption of arthropods is minimal and perhaps limited to the wet season.

**Reproduction** In Malawi, pregnant females have been collected in the dry season. Embryo numbers: 2, 4 and 6 (only three records). In southern Africa, reproduction is perhaps confined to the wet season.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Dendromus mesomelas* (Brants, 1827). Originally described in the genus *Dendromys*. No subspecies currently recognised. Ansell & Dowsett (1988) included *D. nyasae* in *D. mesomelas*, but *nyasae* is now considered to be a distinct species.

**Key Reference** Monadjem, A. (2013b).

**Measurements**
*Dendromus mesomelas*

| | |
|---|---|
| HB: | 71.3 (68–74) mm, n = 4 |
| T: | 99.3 (97–102) mm, n = 4 |
| HF: | 19.0 (18–20) mm, n = 4 |
| E: | 14.3 (14–15) mm, n = 3 |
| WT: | 11.8 (10–13) g, n = 4 |
| GLS: | 22.4 (20.8–24.7) mm, n = 9 |

Malawi (NHMUK). *South Africa (De Graaff 1981 in Monadjem 2013b).

## *Dendromus mystacalis*

## Chestnut African Climbing Mouse

**Malawian Names** Kamoko, Kapamzimbi. Not confined to this species.

Thondwe, Malawi © DCD & M. Happold

**Description** Very small mouse with or without a dark mid-dorsal stripe, with a relatively long tail; adapted for climbing grasses. Pelage soft. Dorsal pelage orange-brown or cinnamon-brown, slightly paler on flanks. Dark mid-dorsal stripe absent in 14 specimens from Malawi, faint or very faint in eight and present in only one from Malawi (see also Taxonomic Notes), but present in specimens from other parts of Africa. Ventral pelage white (or creamy in museum specimens); hairs pure white or cream. Head with pointed nose and long vibrissae. Ears small and rounded, well-covered with cinnamon hairs. Limbs short. Forefeet with three long functional digits; Digit 1 greatly reduced, Digit 5 absent. Hindfoot with five digits; Digit 1 short with nail, Digit 5 long and opposable with claw. Tail usually relatively long (129 [115-141]% of HB, n = 13), brownish above, paler below, and sparsely haired.

**Similar Species** Only two other *Dendromus* in Malawi have a claw on Digit 5 of the hindfoot.

*D. nyasae*. Dark mid-dorsal stripe present. Tail usually longer (91.8 [84-105] mm.

*D. mesomelas*. Dark mid-dorsal stripe usually present. Dorsal pelage rufous-brown. Ventral hairs dark at base. Tail, on average, relatively longer (141 [133-146]% of HB). HB longer (71.3 (68–74) mm).

**Distribution** Widely but sparsely distributed in Malawi. Records include Blantyre, Chitipa, Likhubula, Mount Malosa, Nsanje, Ntchisi F. R. (Ntchisi Mountain), Nyika Plateau, Thondwe, Thyolo and Zomba. Elsewhere: isolated populations in N and C Ethiopia, small parts of E DR Congo, Uganda, Kenya and Tanzania; and a large geographic range in southern Africa (Angola, Zambia, S Mozambique, Zimbabwe, eSwatini and NE South Africa).

**Habitat** Savanna grasslands where there is dense vegetation close to the ground.

**Abundance** No information.

**Habits** Scansorial/terrestrial, nocturnal, omnivorous. This Climbing Mouse clambers around in the dense grassy vegetation and also in the twigs and small branches of low shrubs. One nest found near Zomba was ca. 10 cm diameter and made of shredded grass stems and broad blades of grass and had two leaves of maize incorporated into the outer layer. Nests may also be built in small shrubs. Nests are used for resting, and also for rearing young. Individuals have also been found in the disused nests of Weaver Birds. This species is omnivorous; in eSwatini, for example, the diet (assessed from stomach contents) is 44% vegetable material, 40% seeds, and 16% arthropods. Foraging occurs on the ground and on tall dense grass.

**Reproduction** No information for Malawi. In Zimbabwe, pregnancies have been recorded between Jan and Mar. Embryo number: usually 3 or 4.

**Conservation** IUCN Category: Least Concern. Conservation threats include habitat modification (e.g. grazing by domestic animals, agriculture)

**Taxonomic Notes** *Dendromus mystacalis* Heuglin, 1863. The species in Malawi was first described as *Dendromus whytei* from Chitipa, but *whytei* was later considered to be a subspecies of *Dendromus mystacalis*. Lawrence & Loveridge (1953) refer to this species as *Dendromus whytei whytei* and note that the dorsal stripe is obsolescent in this form. Hanney (1965) refers to this species as *Dendromus mystacalis whytei* (but does not comment on the presence/absence of a dorsal stripe). Currently no

subspecies of this species are recognised. It has been suggested that *mystacalis* is a species complex.

**Key Reference** Monadjem, A. (2013c).

**Measurements**
*Dendromus mystacalis*

| | |
|---|---|
| HB: | 60.8 (57–68) mm, n = 13 |
| T: | 78.2 (70–86) mm, n = 13 |
| HF: | 16.4 (14–18) mm, n = 12 |
| E: | 12.9 (11–14) mm, n = 11 |
| WT: | 7.7 (5–11) g, n = 9* |
| GLS: | 20.1 (19.2–21.0) mm, n = 5 |

Malawi (NHMUK, NMMB).
*eSwatini (formerly Swaziland) (Monadjem 2013c).

## *Dendromus nyasae*

## Kivu African Climbing Mouse

**Malawian Name** Not known.

**Description** (based on the holotype). Very small mouse with a dark mid-dorsal stripe and a relatively medium-sized tail; adapted for climbing grasses. Dorsal pelage typically rich brown tending to be darker on anterior part of body; hairs ash-grey at base, brown at tip. Flanks more tawny. Ventral pelage white mixed with slaty-grey; hairs slaty-grey with short band of white at tip. Chin and throat with pure white patches. Forefeet – no information. Hindfeet with five digits; Digit 1 short, Digit 5 long, opposable, with short claw. Tail dark brown above, a little paler below; of medium relative length (106% of HB, n = 1).

**Similar Species** Only two other *Dendromus* in Malawi have a claw on digit 5 of the hindfoot.

*D. mystacalis*. Dorsal pelage orange-brown or cinnamon-brown. Dark mid-dorsal stripe absent in most specimens from Malawi, but present in specimens from elsewhere.

*D. mesomelas*. Tail relatively longer (141 [133-146]% of HB). Tail markedly longer than that of the holotype of *D. nyasae*.

**Distribution** In Malawi, recorded from Nyika Plateau (the type locality) and 'highlands in S Malawi'. Hanney (1965) records *D. mesomelas nyasae* Thomas from Mulanje Mountain (as Mlanje Plateau), Thyolo and Zomba Plateau. Elsewhere: E and W slopes of Ruwenzori Mountains and the Kivu region of E DR Congo (but these might be another species – see Taxonomy).

**Habitat** The altitude of the type locality is 6500 ft (1981 m). Elsewhere: recorded at altitudes of 1300-4200 m, where there is moist, dense vegetation suitable for climbing. Habitats include grassy vegetation near the edges of swamps, bamboo forests near edges of swamps, and afroalpine vegetation.

**Abundance** No information for Malawi. Elsewhere: abundant in optimal habitats.

**Habits** Mostly scansorial, nocturnal, granivorous/insectivorous. Adapted for climbing grasses, stems and twigs, as are other species of *Dendromus*. Builds spherical nests of grass and leaves which are fastened between stalks and twigs ca. 30-80 cm above ground. Feeds on insects and seeds; sometimes only insects.

**Reproduction** No information for Malawi. Near Lake Kivu, mean litter-size 4. Most births occur in the wet season (Sep-May). Gestation probably 23-27 days. Neonates are altricial; walking and climbing begin at Day 22-24. Weaning begins Day 24, and young are totally weaned and adult-like in appearance (although smaller) by Day 35.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Dendromus nyasae* Thomas, 1916. No subspecies. Animals from the Kivu region are treated as a distinct species, *D. kivu*, by Dieterlen (2013) but not by others: the relationship between *kivu* and *nyasae* clearly needs further investigation.

**Key Reference** Dieterlen (2013a).

**Measurements**
*Dendromus nyasae* (Holotype)

| | |
|---|---|
| HB: | 80 mm |
| T: | 85 mm |
| HF: | 20.5 mm |
| E: | not recorded |
| WT: | not recorded |
| GLS: | 22.5 mm |

Malawi (Nyika Plateau).

## *Dendromus nyikae*

## Nyika African Climbing Mouse

**Malawian Name** Kapamzimbi (not confined to this species).


Zomba Plateau, Malawi © DCD & M. Happold

**Description** Very small mouse with a dark mid-dorsal stripe and usually a relatively long tail; adapted for climbing grasses. Pelage soft, dense. Dorsal pelage pale to dark cinnamon suffused with grey; hairs grey with cinnamon or greyish-cinnamon at tip. Dark mid-dorsal stripe present; black, extending from between shoulders to base of tail, usually very conspicuous, sometimes rather inconspicuous. Ventral pelage usually pure creamy-white; hairs in some individuals medium grey at base, with small white tip. Throat and chest yellow or rufous in some individuals (perhaps only males; perhaps because of glandular secretions). Head same as dorsal pelage, without black patch on crown (cf. *D. melanotis*). Ears rounded, conspicuous, brown with short brown hairs. There is a small white patch below each ear. Hindfoot with five digits; Digit 1 short with nail, Digit 5 very long and opposable with nail. Tail usually relatively long (126 [108-155]% of HB, n = 17), scaly with small pale bristles; longer hairs at tip.

**Similar Species** Only one other *Dendromus* in Malawi has a nail on Digit 5 of the hindfoot.

*Dendromus melanotis*. Black patch on crown; ears with dark brown pigmentation and dark-brown hairs.

**Distribution** Widely distributed but only in highland and montane areas. Localities include Chitipa, Dedza Mountain, Likhubula, Misuku Hills, Mulanje Mountain, Ntchisi Mountain F. R. (Ntchisi Mountain), Nyika Plateau, Shire Highlands, Thyolo Mountain, Viphya Plateau and Zomba Plateau. Elsewhere: recorded from Angola, SW DR Congo, Zimbabwe, and N South Africa; isolated populations in Tanzania.

**Habitat** Long grass in grassland savannas and on plateaux, mostly at higher altitudes. May occur in grassland habitats within pine plantations. On Nyika Plateau, some individuals were found in unoccupied standard beehives. Does not enter forested habitats except very rarely (see also below).

**Abundance** Rather uncommon, although may be locally abundant. Comprised 9% of grassland small rodents on Zomba Plateau. Numbers were highest where the montane grasslands were tall (i.e. 40–80 cm depending on time of year and location), and lowest (or absent) where grasslands were short and after burning. Elsewhere: no information.

**Habits** Scansorial/terrestrial, nocturnal, omnivorous. Nyika Climbing Mice (like other species in the genus) are adapted for climbing on thin tall grass stems. Their small size, semi-prehensile tail and grasping feet allow them to climb up and down grass stems from the seedheads to ground level. When climbing, the hindfeet are held almost at right angles to the body. A grass stem is grasped by the forefeet as a human hand would; the flexible Digits 1-4 of the hindfeet encircle the stem and the opposable Digit 5 curls around the stem to meet Digits 1-4. The tail is stretched out from the rump at various angles to provide balance, or the tip is wound several times around a stem to provide an extra holding point. Climbing up and down stems can be swift, and these mice can reach across gaps (equivalent to at least the length of head and body) to adjacent stems. If disturbed, they climb downwards, not upwards. Nyika Climbing Mice dig burrows which are simple tunnels in the soil with a nest chamber lined with dead leaves. Some stomachs contained white vegetable material and some contained grain husks and insects (including beetles). When foraging for seeds near the top of grass stems, the weight of the animal breaks the stem so the seed head falls over; the stem is quickly nibbled and the seed tumbles down to where the mouse can reach the seeds. When feeding on the heads of grasses, they are susceptible to predation by Grass Owls - *D. nyikae* and *Otomys angoniensis* being the most numerous species found in owl-pellets on Zomba Plateau (Happold & Happold 1986). Nyika Climbing Mice make a high-pitched squeal when disturbed.

**Reproduction** Almost no information. In Malawi, one pregnant female was found in November with four embryos, and a female with young was found in May. Elsewhere: no information.

**Conservation** IUCN Category: Least Concern. Conservation threats are disturbance and reduction of suitable undisturbed grasslands.

**Taxonomic Notes** *Dendromus nyikae* Wroughton, 1909. Subspecies: none

**Key Reference** Happold, D. C. D. (2013e).

**Measurements**
*Dendromus nyikae*

| | |
|---|---|
| HB: | 71.9 (60–95) mm, n = 20 |
| T: | 87.2 (80–99) mm, n = 18 |
| HF: | 17.3 (16–19) mm, n = 21 |
| E: | 14.2 (11–18) mm, n = 20 |
| WT: | 11.3 (8–16) g, n = 13 |
| GLS: | 22.8 (21.7–24. 4) mm, n = 6 |

Malawi (HC, NHMUK, NMMB, D. C. D. Happold, *unpubl*.).

## Genus *Gerbilliscus* - Gerbils

Family Muridae, subfamily Gerbillinae. This genus contains 12 species formerly placed in a subgenus of the genus *Tatera*. They are widely distributed in sub-Saharan Africa, except in the rainforest biotic zone. Two species occur in Malawi. Gerbils are medium to large in size with medium to long tails which often have a pencil - longer hairs at the terminal end which extend and come to a point beyond the last vertebra (see Table-key 8). Pencils increase air-resistance and make the tails more effective as a rudder and counterweight when gerbils are turning while moving fast.

*Gerbilliscus boehmi.* HB: 162.3 (139–179) mm, tail with basal half or two thirds dark brown above, terminal half or third white with white pencil.

*Gerbilliscus leucogaster.* HB: 122.9 (105-140) mm; tail uniformly dark brown above, white below, with dark pencil.

### *Gerbilliscus boehmi*

### Boehms's Gerbil

**Malawian Names** Nsakanjira, Nsatanjira, Tchaswala.

**Description** Large, dark-coloured mouse with very long white-tipped tail. Pelage soft, moderately dense, sleek; no underfur. Dorsal pelage medium brown, flecked with black and ochre, darker on mid-dorsally than on flanks; hairs medium grey at base, with black tip (mid-dorsally) or ochre tip (flanks). Ventral pelage white with sharp delineation between colour of flanks and ventral pelage; hairs pure white. Crown, forehead and nasal region dark brownish-black; cheeks cinnamon; lips, chin and throat white. Hairs of cheeks and shoulders often tipped with cinnamon. Eyes large. Ears large, rounded, with short black hairs. Hindlimbs longer than forelimbs. Forefeet, hindfeet and inner surface of limbs white. Soles of hindfeet naked and darkly pigmented. Tail very long (ca. 130% of HB), thin; basal half or two-thirds with short hairs, dark brown above, white below; terminal half or third pure white above and below, often with small pencil of longer white hairs. Anterior face of incisors with two faint longitudinal grooves (cf. *G. leucogaster*).

**Similar Species**

*Gerbilliscus leucogaster*: HB: 122.9 (105-140) mm; tail uniformly dark brown above, white below, with dark pencil. Front face of upper incisors with one groove.

**Distribution** Widely distributed north of Ntcheu although known from only a few localities including Chitipa, Dedza, Misuku Hills, Nkhata Bay, Nkhotakota, Ntcheu, Nyika N. P. (? below the plateau) and South Viphya Plateau. Elsewhere: recorded from SW Kenya and S Uganda to N Mozambique, Malawi, S DR Congo and W Zambia. Probably also present in Moxico Province of E Angola. Not known from east of L. Malawi or from the lowland areas of the Luangwa Valley in Zambia.

**Habitat** Open canopy miombo woodland, mostly at higher altitudes, where there is good cover of grass and herbaceous plants; also in grassy plains (Uganda) and 'bush' habitats. Exploits moister habitats than *G. leucogaster*. Individuals have also been found in old banana plantations and old millet fields in some parts of its biogeographic range.

**Abundance** Much less common that *G. leucogaster* in Malawi. Elsewhere: although widespread, usually uncommon or rare.

**Habits** Terrestrial, nocturnal, omnivorous. Burrows have one or two entrances and are not marked by a pile of excavated soil. Boehm's Gerbils sometimes use burrows of other *Gerbilliscus* spp., or those of mole-rats. Habitat and altitudinal range suggest that moderate climatic temperatures are required for survival. They are omnivorous, feeding primarily on vegetable material and insects. Preyed upon by owls at Dedza and elsewhere in the biogeographic range.

**Reproduction** Very little detailed information. In Malawi, breeding has been recorded in early wet season (Nov) and end of wet season (May). Embryo number: 2–5 (n = 2).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Gerbilliscus boehmi* (Noack, 1887). This species was formerly placed in the genus

*Tatera*. The genus *Tatera* is now restricted to non-African species.

**Key Reference** Happold, D. C. D. (2013f).

**Measurements**
*Gerbilliscus boehmi*

| | |
|---|---|
| HB: | 162.3 (139–179) mm, n = 12 |
| T: | 215.5 (190–234) mm, n = 12 |
| HF: | 40.8 (38–47) mm, n = 11 |
| E: | 24.3 (21–26) mm, n = 12 |
| WT: | 146 g, n = 1 |
| GLS: | 43.5 (42.0–45.2) mm, n = 10 |

Throughout biogeographic range (Bates 1988 in Happold, D. C. D. 2013f)
Females only; limited data suggests males are slightly larger.

## *Gerbilliscus leucogaster*

## Bushveld Gerbil

**Malawian Names** Dondwe, Dowole, Lipanya, Tonondo.


Liwonde N. P., Malawi © DCD & M. Happold

**Description** Medium-sized mouse with a very long tail which is uniformly dark dorsally, pale ventrally, and often has a pencil of dark hairs at tip. Pelage soft, moderately dense and sleek. Dorsal pelage (including crown of head) rich chestnut or dark rufous-brown, suffused with black, resulting in a slightly flecked appearance, especially mid-dorsally; dorsal hairs slate-grey on basal two-thirds, changing to buffy-white, then pale rufous-buff or black at tip. Pelage becoming bright orange and unflecked on flanks. Ventral pelage pure white from chin to tail tip, with clear delineation between lateral and ventral colours. Head narrow, with pointed nose, long vibrissae, sides of muzzle white. Eyes large. Ears elongated, dark brown, rounded at tips. Hindlimbs longer than forelimbs, elongated hindfeet; outer pelage same colour as dorsal pelage, inner pelage pure white. Fore- and hindfeet pure white, five digits each; Digit 5 on forefoot reduced. Tail relatively long (126 [104-140])% of HB, n = 25), covered with dense short hairs, brownish on dorsal surface, white underneath, often with slight darker terminal pencil of longer hairs. Anterior face of incisors with one groove (cf. *G. boehmi*).

**Similar Species**

*Gerbilliscus boehmi*. HB: 162.3 (139–179) mm, tail with basal half or two thirds dark brown above, terminal half or third white with white pencil. Anterior face of upper incisors with two faint grooves.

*Aethomys chrysophilus*. Pelage not sleek. Dorsal pelage reddish-brown or chestnut mixed with black or brownish-black hairs; ventral pelage white; dorsal and ventral colours merge on lower flanks. Tail dark, scaly with short sparse black bristles; no terminal pencil of long hairs.

**Distribution** Very widespread, especially in the southern half of Malawi, in the Lake Shore, the Upper and Lower Shire Valleys, Shire Highlands and Phalombe Plain. Not recorded from montane regions. Localities include Blantyre, Chiradzulu Mountain, Chiromo, Chitipa, Karonga, Lake Chilwa, Lake Malawi N. P. (Cape Maclear), Lengwe N. P., Liwonde N. P., Malosa Mountain, Mangochi, Matope, Mchinji, Mtimbuka, Mwabve W. R., Mwanza, Ntchisi, Thyolo, Zoa, Zoa Tea Estate and Zomba. Elsewhere: widespread from DR Congo and S Tanzania southwards to South Africa (but not recorded in W Namibia or the southern part of South Africa).

**Habitat** Grasslands and woodland savannas on light sandy soils or sandy alluvium. More abundant in habitats on hillsides in open canopy miombo woodland with high density of grasses and rocks (Liwonde N. P.) rather than similar habitats with periods of low grass cover and few rocks, and thicket-clump savanna (Lengwe N. P.). Also occurs in farmlands.

**Abundance** Moderately common in suitable habitats in Malawi. In a study area in Liwonde N. P., comprised 18% of small terrestrial rodents and was the second most numerous rodent after *Acomys spinosissimus*, but it was encountered only during the dry season. Population numbers were highest in the late wet season and crashed in the dry season. In Lengwe N. P., it comprised only 3% of small terrestrial rodents.

**Habits** Terrestrial, nocturnal, vegetarian/insectivore. Individuals move extremely rapidly through dense *Hyparrhenia* grass and can leap from rock to rock (up to 1.25 m/leap). During the day, they shelter in burrows that have several pop-holes through which an individual can exit. In suitable habitats, e.g. the lake shores, individuals may live in colonies; in one such colony, a burrow had about 20 pop-holes close together. These gerbils feed on a variety of foods; in Malawi, the diet of 12 individuals comprised 33% fruit, 33% 'white material', 17% seeds, and 42% insects. It is likely that the diet changes with the seasonal variations in resources, and if the habitat is burned during the dry season.

**Reproduction.** In Malawi, pregnant females and young in the nest have been recorded in Mar, May, Jun and Oct. i.e. the end of the wet season and early part of the dry season. Mean embryo number 4.6 (3-7). Extensive studies of the species in Zimbabwe have shown that reproduction occurs throughout the year, with peaks in Dec–Jan and Apr–May and is associated with the wet season; in most places, breeding ceases in cool dry season. Gestation: 28 days. Embryo number: 4.5 (2–9) over range of habitats. Mean litter size: 5.0. Mean birth-weight: 3.6 g. Growth rate in first 32 days: 0.9 g/day. Incisors erupt on Day 5–6. Eyes open on Day 16–21. Young weaned by Day 28. The annual reproductive capacity of a female is 28 young/year in mixed woodland habitat, and 12 young/year in miombo woodland habitat.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Gerbilliscus leucogaster* (Peters, 1852). This species was formerly placed in the genus *Tatera* (e.g. Hanney 1965, Ansell & Dowsett 1988, Happold & Happold 1990b, 1991, 1992a). The genus *Tatera* is now restricted to non-African species. No subspecies are recognised.

**Key Reference** Dempster (2013).

**Measurements**
*Gerbilliscus leucogaster*

| | |
|---|---|
| HB: | 122.9 (105-140) mm, n = 26 |
| T: | 153.1 (141-180) mm, n = 25 |
| HF: | 32.2 (29–35) mm, n = 26 |
| E: | 19.6 (17–21) mm, n = 25 |
| WT: | 71.1 (43-94) g, n = 25 |
| GLS: | 37.3 (33.3–40.5) mm, n = 23* |

Malawi (HC, D. C. D. Happold, *unpubl*.).
*South Africa and Namibia (Dempster 2013).

## Genus *Grammomys* – Thicket Rats

Family Muridae, subfamily Murinae. This genus contains 11 species. They are widely distributed in sub-Saharan Africa in many rainforest and savanna habitats. There are two species in Malawi. Thicket rats are scansorial or arboreal and have relatively long, semi-prehensile tails (see Table-key 8).

*G. dolichurus.* Pelage moderately sleek. No white patch behind each ear. HB: 105.4 (90–120) mm. Widespread

*G. ibeanus.* Pelage rather long. Sometimes with a white patch behind each ear. HB: 122 (105–140) mm. Nyika Plateau, Viphya Plateau, and Zomba.

### *Grammomys dolichurus*

### Woodland Thicket Rat

**Malawian Names** Lichambiri, Sonthe, Sontho.

Zomba, Malawi © DCD & M. Happold

**Description** Small arboreal mouse, with dull gingery-brown dorsal pelage and an extremely long tail with an inconspicuous pencil. Pelage soft and moderately sleek. Dorsal pelage gingery-brown or cinnamon-brown suffused with grey and black; hairs dark grey at base, gingery-brown on terminal third, often with back tip. Guard hairs grey tipped with black. Ventral pelage usually pure white or cream, clearly delineated from dorsal pelage, often with thin band of creamy-yellow between dorsal and ventral colours. Head gingery-brown. No white patch behind each ear (cf. *G. ibeanus*). Eyes without black eye-ring (cf. *Thallomys paedulcus*). Chin and throat white. Ears fairly large, round, naked, with grey-brown pigmentation. Vibrissae black. Fore- and hindfeet white. Forefoot with four digits; Digit 1 reduced to stump without claw. Hindfeet relatively short; Digit 5 long, adapted for grasping small twigs. Tail extremely long (152 [126-174]% of HB, n = 33), scaly, with short brown or black bristles and longer black hairs forming inconspicuous pencil at tip.

**Similar Species**

*Grammomys ibeanus*. Pelage longer and softer; sometimes with white patch behind each ear; on average larger (HB: 122 [105–140] mm).

*Thallomys paedulcus*. Dorsal pelage greyish; eyes surrounded by black eye-ring; almost always larger (HB: 140.3 [130–155] mm); tail black, of medium relative length, no pencil of longer hairs at tip.

**Distribution** In Malawi, widespread especially south of ca. 14˚50' S (i.e., south of a line from Ntcheu to Mangochi). Localities include Blantyre, Chididi, Chiromo, Chitipa, Dzalanyama F. R., Kasungu, Lengwe N. P., Likhubula, Liwonde District, Mangoche Mountain, Matope, Misuku, Misuku Hills, Mulanje Mountain (Lichenya and Thuchila Plateaux), Nyika N. P. (Chelinda), Thyolo, Thyolo Mountain, Viphya Plateau (Luwawa Dam), Zoa, Zomba, Zomba District, Zomba Plateau. Elsewhere: widespread from South Sudan through most of eastern Africa to the coastal region of eastern South Africa, and westwards to Zambia and Angola.

**Habitat** Montane evergreen forest, montane grasslands with shrubs, woodland savannas and gallery forests within savanna. Recorded in many habitats where climbing into vegetation such as shrubs, thickets, tangles, tall grasses and reeds, is possible.

**Abundance** Uncertain because most surveys of small mammals only assess ground-living species. Although probably fairly abundant in suitable arboreal habitats, Woodland Thicket Rats comprise only a small proportion of small mammals captured on the ground. For example, in Malawi, 0.2% in *Acacia* woodlands, 1.2 – 1.6% in plateau grasslands on Zomba Plateau and 1% in thicket habitats at Lengwe

N. P. Elsewhere: abundance is equally low, e.g. 1% in *Pennisetum* grassland and 'grassbush' of E DR Congo, 3% in Majanga Forest, Uganda, and 3.7% in afromontane forests of KwaZulu–Natal, South Africa.

**Habits** Arboreal, nocturnal, herbivorous. This species is one of the best adapted small rodents for arboreal life. Individuals are very agile, running along twigs and jumping from twig to twig and branch to branch. Adaptations for climbing include the long and opposable Digit 5 on the hindfoot which allows the digits to completely encircle a small twig; likewise, the long digits of the forefoot can almost encircle a twig. The extremely long tail provides balance, and the tip of the tail is sometimes wrapped around twigs and small branches although is not fully prehensile. They only descend to the ground when they have to cross gaps between suitable trees, bushes and tangles.

Spherical nests (20–30 cm in diameter) with a single entrance are made of grasses and leaves; nests are built up to four metres above ground and lined with finely shredded grass. Other nests have been found in the axils of banana leaves and pineapple plants. Occasionally, Woodland Thicket Mice have been found in the abandoned nests of birds (barbets and weavers).

Examination of stomach contents in Malawi showed that the diet was mostly green vegetable material, with some fruit and wood fibres. Woodland Thicket Rats are not known to eat insects.

**Reproduction** Reproductive activity varies depending on locality and climate. In Malawi, pregnant and lactating females have been recorded in Feb, Mar and May (wet season) and juveniles have been found in nests in Feb and Jul. Gestation: ca. 24 days. Embryo number: 4.6 (3–6), n = 5. Neonates are precocial and covered with fine greyish hairs. Mean weight at birth: 4.2 g. Mothers nipple-drag their young. Eyes open and young climb at Day 15. Growth and development rapid. Adult size attained at ca. Day 40. Reproductive maturity attained when weight ca. 30 g (i.e. ca. 75% of adult weight). Rapid development of young, especially the early separation of the toes and development of the grasp reflex, are probably adaptations to arboreal life.

**Conservation** IUCN Category: Least concern.

**Taxonomic Notes** *Grammomys dolichurus* (Smuts, 1832). No subspecies. This species was originally placed in the genus *Thamnomys*, and then transferred to the genus *Grammomys*. Referred to as *Thamnomys dolichurus* by Happold & Happold 1991. The 'race' *surdaster*) (Sweeney 1959) is now considered to be a synonym.

**Key Reference** Happold, D. C. D. (2013g).

**Measurements**
*Grammomys dolichurus*

| | |
|---|---|
| HB: | 105.4 (90–120) mm, n = 34 |
| T: | 159.8 (139–181) mm, n = 33 |
| HF: | 22.8 (19–25) mm, n = 34 |
| E: | 17.2 (14–20) mm, n = 34 |
| WT: | 38.8 (23–55) g, n = 18 |
| GLS: | 28.9 (28.2–31.4) mm, n = 16 |
| GWS: | 14.2 (13.0–15.5) mm, n = 16* |

Malawi (HC, NHMUK, NMMB).
*S Sudan, E DR Congo, Tanzania (Happold, D. C. D. 2013g).

## *Grammomys ibeanus*

## East African Thicket Rat

**Malawian Name** Not known.

**Description** Medium-sized, dull olive-brown arborial mouse with an extremely long tail with an inconspicuous pencil. Pelage rather long and soft. Dorsal pelage dull olive-brown becoming brownish-grey on flanks; hairs dark slate-grey with terminal third reddish-brown to dull olive-brown. Ventral pelage white or cream. Colours of dorsal and ventral pelage clearly delineated; often separated by a thin line of yellow. Eyes without black eye-ring (cf. *Thallomys paedulcus*). Ears comparatively large. Sometimes with a white patch behind each ear. Fore- and hind-feet with yellowish-red hairs; toes sometimes with silvery hairs. Tail very long (ca. 150% of HB), covered with short hairs and with longer hairs (up to 10 mm) forming an inconspicuous pencil at tip.

**Similar Species**

*Grammomys dolichurus*. Pelage shorter; no white patch behind each ear; on average smaller (HB: 105.4 [90–120] mm).

*Thallomys paedulcus*. Dorsal pelage greyish; eyes surrounded by black eye-ring; almost always larger (HB: 140.3 [130–155] mm, tail black, medium relative length, no pencil of longer hairs at tip.

**Distribution** Recorded only from Katsakaminga (near Dedza), Nyika Plateau, Viphya Plateau and Zomba. Specimens reported from Lengwe N. P. by Happold & Happold (1991) (as *Thamnomys cometes*) were subsequently reidentified as *Grammomys dolichurus*. Elsewhere: recorded from a few scattered localities in Uganda (Mt Elgon), South Sudan (Imatong Mts), Kenya (both sides of the Rift Valley), Tanzania (rim of Ngorongoro crater, region of L. Manyara, W Usambara Mts, and Mt Poroto), and NE Zambia (Zambian Nyika, Mafinga Mountains).

**Habitat** Montane forest, bracken, thick undergrowth and (occasionally) inside houses. Mostly found in high altitude habitats. On Nyika Plateau, found in open canopy miombo woodland with tall grasses and shrubs near streams, and in montane grassland, at ca. 1500-2300 m.

**Abundance** Considered to be rare in Malawi. However, in montane grassland with patches of shrub near the bank of a stream on the slopes of Mount Nganda (Nyika N. P. at 2200-2300 m), they comprised 26% (wet season, 11 spp.) and 21% (dry season, 9 spp.) of small mammals.

**Habits** Arboreal and nocturnal. Very little is known about this species, but probably it has a similar life-style to that of *G. dolichurus*, as well as being able to live in high altitude meadows and shrubs.

**Reproduction** Limited information suggests that reproduction in Nyika N. P. occurs during the wet season from Nov to Apr. Embryo number (Malawi): 2.9 (2-5), n = 6. Females probably have 2-3 litters during their lifetime.

**Conservation** IUCN Category: Least Concern. The very limited biogeographic range and paucity of suitable habitat are conservation concerns.

**Taxonomic Notes** *Grammomys ibeanus* Osgood, 1910. No subspecies. This species was referred to as *Grammomys cometes* by Ansell & Dowsett (1988), as *Thamnomys cometes* by Hanney (1965) (but was not listed by Sweeney [1959]). It has had a complicated taxonomic history. It was originally placed in the genus *Thamnomys* and later transferred to the genus *Grammomys*. Also, the specific name *cometes* was found to be a synonym of the previously described *ibeanus*, so the correct name, as currently understood, is *Grammomys ibeanus*.

**Key Reference** Dieterlen (2013b).

**Measurements**
*Grammomys ibeanus*

| | |
|---|---|
| HB: | 122 (105–140) mm, n = 8 |
| T: | 182 (160–202) mm, n = 8 |
| HF: | 25.9 (24–27) mm, n = 8 |
| E: | 20.5 (17–23) mm, n = 8 |
| WT: | 53 (35–65) g, n = 7 |
| GLS: | 32.0 (30.1–33.0) mm, n = 6 |

South Sudan (Imatong Mts) and Uganda (Mt Elgon) (Dieterlen 2013b).

# Genus *Lemniscomys* – Grass Mice

Family Muridae, subfamily Murinae. This genus contains 11 species, endemic to Africa and found in grasslands both north and south of the Sahara. They are very beautiful, small mice with striped pelage, and Digit 5 of the forefoot is vestigial (cf. the other striped grass mouse, *Rhabdomys*) (see Table-key 8). Two species occur in Malawi.

| |
|---|
| *L. rosalia.* One black mid-dorsal stripe; no markings on flanks. |
| *L. striatus.* One black mid-dorsal stripe and four lines of pale spots on each flank. |

## *Lemniscomys rosalia*

## Single-striped Grass Mouse

**Malawian Names** Lingwere, Mphera, Ngwawi.

Lengwe N. P., Malawi © DCD & M. Happold

**Description** Small mouse with a black mid-dorsal stripe. Pelage fairly long, smooth and sleek. Dorsal pelage dark brown becoming bright chestnut on flanks and rusty-red in sacral region, heavily streaked with black; hairs grey at base with brown, bright chestnut, pale chestnut or black at tip. A narrow black mid-dorsal stripe extends from neck to base of tail; stripe very obvious in some individuals, faint in others. Ventral pelage white to off-white; hairs white. Head with pointed nose and long vibrissae. Crown same colour as dorsal pelage, without any mid-dorsal stripe. Ears medium-sized, rounded; back of ears with sparse short chestnut hairs; inner surface covered by short, bright chestnut hairs. Eyes moderately large with a band of orange above and below each eye which almost meet to form an eye-ring; eye-rings often conspicuous. Muzzle and upper lips brownish-orange. Limbs medium-sized; same colour as flanks. Forefeet with three functional digits; Digits 1 and 5 greatly reduced. Hindfeet with three elongated digits; Digit 1 and Digit 5 shorter. Tail of medium-long relative size (118 [102-139]% of HB, n = 13); scaly, dark above, brownish-orange laterally, and pale below.

**Similar Species** None.

**Distribution** Recorded in savanna habitats in central and southern parts of Malawi (including Chididi, Chiromo, Kasungu, Lake Malawi N. P. (Monkey Bay), Lengwe N. P., Likhubula, Liwonde N. P., Matope, Mpemba, Mwabvi W. R., Nsanje, Ntchisi, Thyolo, Zoa and Zomba. Elsewhere: recorded in S Kenya and N Tanzania, Zambia, SW Angola, N Namibia, Zimbabwe, N Botswana, S Mozambique, eSwatini, and parts of NE South Africa. The Kenyan and Tanzanian populations are well separated from populations further south.

**Habitat** Lives in a wide range of savanna habitats: woodland savanna, grassy savanna, thicket-clump savanna, and farmlands in savanna. Requires dense cover, preferably tall grasses. Not found in highland or montane habitats, nor in forests.

**Abundance** Mostly rather uncommon in Malawi. In open canopy miombo woodland in Liwonde N.P, it was the least abundant small rodent (3%) during Sep-Jun (1984-85), and was present in only two of the nine trapping periods. In Lengwe N.P., it comprised 1% of small rodents in thicket-clump savanna during Sep–Jun, and was present in only six out of nine trapping periods. In Mozambique, it comprised 0% in Oct, Jan and Apr, and ca. 8% in Jul. In Zimbabwe, it was never found in miombo, mopane and thicket habitats during the course of a one-year study although it was known to be present in small numbers in similar habitats in a previous year during the cool dry season, (see also below).

**Habits** Terrestrial, diurnal and nocturnal. This species of Grass Mouse occurs only, as its name implies, in grassland or similar habitat where there is a lot of cover. Grass Mice are rather 'nervous' mice and, when disturbed, they disappear quickly along the

runways in and under the grass. They build nests of grasses in or close to grass clumps. In South Africa, individuals also construct burrows and runways which lead to areas where food is obtained. Individual home-ranges do not overlap; males have larger home-ranges than do females. The social organization of these grass mice is uncertain. In South Africa, burrows and nests may be inhabited by a single individual, or a pair, or a family group. However, individuals kept in captivity exhibited aggression towards each other.

At Matope, owls preyed on these grass mice. Remains in owl pellets were obtained in every bi-monthly collection, sometimes only a few, but very many in Oct-Nov at the end of the dry season.

**Reproduction** The only information for Malawi is the record of recently born young in December. In South Africa, the time of reproduction varies greatly in different localities but it occurs mostly during the warm wet summer months. Litter size: 2-5 (Zimbabwe), 4.5 (3-7) (South Africa). The data suggest that grass mice are opportunistic with respect to reproduction – hence great variation in the timing and size of litters (depending on local conditions) throughout their biogeographic range.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Lemniscomys rosalia* (Thomas, 1904). No subspecies currently recognized. Sweeney (1959 and Hanney (1965), as well as other authors in the past, referred this species as *Lemniscomys griselda* (now known to be a different species of grass mouse which occurs only in Angola and W Zambia).

**Key Reference** Monadjem (2013d).

**Measurements**
*Lemniscomys rosalia*

| | |
|---|---|
| HB: | 106.5 (95–125) mm, n = 14 |
| T: | 124.7 (100–146) mm, n = 13 |
| HF: | 27.0 (25–29) mm, n = 14 |
| E: | 16.4 (14–19) mm, n = 14 |
| WT: | 52.5 (19–70) g, n = 25 |
| GLS: | 31.4 (30.0–33.5) mm, n = 5 |

Malawi (HC, NHMUK, NMMB, D. C. D. Happold, *unpubl*.).

## Striated Grass Mouse

### *Lemniscomys striatus*

**Malawian Name** Not known.


East Africa © C. & M. Stuart

**Description** Small-medium sized mouse with a black mid-dorsal stripe and several lines of pale spots merging into stripes on its sides. Pelage fairly long, smooth and sleek. Dorsal pelage (background colour) dark brown often flecked with ochre, with a black mid-dorsal stripe from neck to base of tail and four or five longitudinal rows of pale cinnamon spots merging to form punctated stripes, on each flank. Additional spots not arranged in lines on lower flanks. Shape and clarity of spots very variable. Some individuals have rufous or cinnamon on rump and base of tail. Ventral pelage cream; hairs cream. Flank and ventral colours merge. Head rather narrow and pointed. Crown and cheeks cinnamon heavily flecked with black. Eyes moderately large with a band of pale cinnamon above and below each eye which almost meet to form an eye-ring. Ears large and rounded; well covered with short cinnamon hairs. Forefoot with three functional toes. Tail of medium-long relative length (ca. 125% of HB), dark above, pale below, with sparse short hairs.

**Similar Species** None.

**Distribution** In Malawi, recorded only from the Chitipa District in the Misuku Hills. Elsewhere: widely distributed in moist savannas of West and Central Africa; recorded from Sierra Leone to S Sudan and Uganda, W Kenya and N Tanzania, NE Zambia, S DR Congo (south of the rainforest zone) and N Angola (including Cabinda). Malawi is at the extreme SE corner of the biogeographic range of the species.

**Habitat** Found where there is dense cover of grasses or herbs in regions of moderate rainfall (1500–2000 mm/year). Found in woodland savannas, grassland savannas, rice fields, farmlands, abandoned fields and plantations (provided there is adequate grass cover). The habitat is very similar to that of *L. rosalia*.

**Abundance** No information for Malawi. Elsewhere: it may be very common (in optimal habitats) or quite rare. Percentage abundance in well-studied rodent populations ranges from 5% in E DR Congo to 48% in parts of Cote d'Ivoire. Many seemingly suitable habitats do not seem to contain any Striated Grass Mice.

**Habits** Terrestrial, crepuscular, omnivorous / herbivorous. No information for Malawi. In other parts of the biogeographic range, Striated Grass Mice make runways in grasslands and nests are built of finely shredded grasses on the surface under dense cover (in this respect, similar to *L. rosalia*). Body weight varies seasonally (usually 20% higher in wet season than dry season). Liver and body fat levels increase (especially in females) during the wet season and decrease during the dry season when the fat is utilized. Increase in fat level is closely correlated with rainfall and with the quantity and quality of food. Striated Grass Mice are adaptable: their populations exhibit seasonal changes in numbers (see above), they breed opportunistically, and move from one type of grassland to another as conditions dictate. In Uganda, the most frequently eaten foods (especially during the dry season) were grass stems and inflorescences; seeds were eaten occasionally, but leaves were rarely eaten. During the wet season, insects (mainly termites) formed a major part of the diet (62–100% in some months). Insects formed an important source of protein during the breeding season.

**Reproduction** No information for Malawi. Elsewhere: the times of reproduction vary greatly in different localities but always occurs when resources are abundant and conditions are optimal for rearing young. For example, in Côte d'Ivoire, pregnancy rates vary seasonally: 70–100% during early wet season (Apr–Jun) and late wet season (Oct–Nov); 6–40% during mid wet season (Jul–Sep); and 0% during

dry season (Dec–Mar). In Uganda, where rainfall occurs in all months of the year, there are two peaks of rainfall: Mar–May and Aug–Dec. Pregnancies were recorded in Apr–Jun and Sep–Dec, beginning from about one month after onset of rainfall peaks.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Lemniscomys striatus* (Linnaeus, 1758). The validity of subspecies is uncertain. There may be five subspecies; if so, the subspecies in Malawi is *L. striatus massiacus* which also occurs in Kenya, Uganda, Tanzania, Burundi, Rwanda, and South Sudan.

**Key Reference** Happold, D. C. D. (2013h).

**Measurements**
*Lemniscomys striatus*

| | |
|---|---|
| HB: | 116 (107–123) mm, n = 10 |
| T: | 143 (133–152) mm, n = 10 |
| HF: | 25 (23–27) mm, n = 10 |
| E: | 16 (15–17) mm, n = 10 |
| WT: | 41.6 (31–48) g, n = 10 |
| GLS: | 28.4 (26.1–30.9) mm, n = 10 |

Uganda (NHMUK).

# Genus *Lophuromys* – Brush-furred Rats

Family Muridae, subfamily Deomyinae. This genus contains 15 species, widely distributed, in moist grasslands, swamps, marshes, farmlands and grassy patches in rainforests, in tropical Africa. There is only one species in Malawi. It is a medium-small mouse with slightly stiff pelage and a relatively short tail (see Table-key 8).

## *Lophuromys flavopunctatus*

## Yellow-spotted Brush-furred Rat

**Malawian Names** Chitawa, Kundwelu, Sithwa.

Zomba Plateau, Malawi © DCD & M. Happold

**Description** Medium-small very dark reddish-brown mouse with thickset body, slightly speckled pelage and relatively short tail. Pelage stiff (as in a water-colour paint brush) but sleek. Dorsal pelage blackish-brown or dark reddish brown, with a slightly speckled appearance; most hairs yellowish or reddish-brown at base with dark tip; some with brown or reddish-brown tip. Ventral pelage pale brown tinged with cinnamon; hairs dull brown at base. In subadults, ventral pelage is more reddish than in adults. Head similar to dorsal pelage; eyes dark and relatively small; ears very darkly pigmented and naked. Fore- and hindfeet brown or dark brown; claws long, mostly dark. Tail relatively short (54 [45-63]% of HB, n = 16); dark and naked with scattered dark bristles above, dark with whitish bristles below.

**Similar Species** None. No other small rodent has such dark reddish-brown pelage, small eyes and relatively short tail.

**Distribution** Confined to higher altitudes where there is dense cover. Recorded from Kandoli Hills (near Nkhata Bay), Likhubula, Mangochi Mountain, Misuku Hills, Mulanje Mountain (several plateau localities), Nyika Plateau, Thyolo Mountain, Viphya Plateau and Zomba Plateau. Elsewhere: widespread in DR Congo (Congo basin [300 m] to Afro-alpine [4,500 m]) and scattered localities where rainfall is above ca. 800 mm/year, and habitats ca. 1000 m in Ethiopia, Kenya, Uganda, Tanzania, Zambia, and N Mozambique. (See also Habitat).

**Habitat** Recorded in forest tangles, montane grassland and bracken on the edges of montane evergreen forest, and damp swampy grasslands. Not recorded where montane grasslands have been burned but will re-colonise after grasses have sprouted and provide good cover. (see Abundance below). In other parts of the biogeographic range, confined to permanently moist habitats such as montane and riverine forests and their adjacent belts of bush, grass and swamp.

**Abundance** A common species in suitable habitats, and often one of the most numerous species of small rodent in some communities. On two study areas of grasslands, bracken and forest edge on Zomba Plateau, the species was the third most numerous small rodent (19%, 8 spp) after *Mus triton* and *Praomys delectorum*. The numbers of individuals present on the two study areas varied each month from about 6-10 in the dry season to 18-22 in the wet season (see below). Densities over the course of one year varied from 9-40/ha to 19-31/ha. Elsewhere: Yellow-spotted Brush-furred Rats are equally abundant or more abundant compared with Zomba Plateau; the recorded abundance ranged from 19-53% of small mammals, even where there are as many as 16 species of small mammals on a study site. Within their optimal environment, these Brush-furred Rats are very successful.

**Habits** Terrestrial, nocturnal and diurnal, omnivorous. In Malawi, in optimal habitats (moist soil, dense tangled vegetation), individuals develop a complex network of surface runways. Activity occurs during the day and night, but diurnal activity predominates when conditions are suitable. These mice show very strong habitat selection; in grasslands 76% of all captures were in unburnt grassland (cf. burnt grasslands), all captures in bracken were in unburnt bracken; tangles on the forest edge were overwhelmingly preferred to the forest itself. As a

consequence, individuals live in different parts of the habitat depending on the season, the amount of cover, and whether or not the grasses are burned. The social organization is uncertain; many individuals have mutilated ears and injuries to the tail, and conspecifics in captivity hide under grass and often fight amongst themselves suggesting that there is considerable agonstic behaviour and that, in the wild, they live a solitary existence (except when mating and rearing young). The mean home-range for resident individuals on Zomba Plateau was 3161m$^2$ (range = 1800-4500 m$^2$), although the home-range is likely to be larger during the dry season when resources are reduced and when/if the grasslands are burned.

The diet is very varied. In Malawi, the diet (based on percentage of stomachs in which any particular item of food was found) was 81% insects (beetles, larvae, ants, and lesser amounts of grasshoppers, termites, cockroaches), 39% earthworms, 11% seeds and 8% vertebrate remains. The rats forage in and under the surface litter, using the long claws of their forelimbs to scratch under the soil, decaying grass and rotting logs, and to hold the prey once it is caught.

On Zomba Plateau, these Brush-furred Rats were not preyed upon by Grass Owls. Instead, the owls preyed upon eight other species of small mammals that live in the montane grasslands and bracken habitats; it is likely that the strong odour and rather harsh pelage of the brush-furred rats provided adequate protection against predation.

**Reproduction**. In Malawi, pregnancies were recorded during the late dry season, throughout the wet season, and at the beginning of the dry season (Oct–May), with the highest pregnancy rates in Nov–Mar. Litter-size varies depending on the environment and also on the size of the female. The youngest pregnant female had a HB length of 110-114 mm, but with increasing age and increasing HB length (to a maximum of 135-139 mm), the proportion of females being pregnant increased to 55% of the female population and these females had at least two (or maybe three litters) during the breeding season. No female survived long enough to breed in a second breeding season. Litter-size: 2.4 (1-4); 12% of females had four embryos, 51% of females had 3 embryos, 25% had 2 embryos and 35% had one. Gestation: 30–31 days. Neonates are altricial and grow rapidly. Well covered with hairs by Day 3–6. Eyes open by Day 4–7. Walking by Day 5, and looking like a small adult by Day 9. Adult pelage was evident by Day 30–35. Sexually mature by Day 50–70 when HB = 110-120 mm. This pattern of reproduction had a large effect on population structure: in Sep, all individuals were subadult (there were no adults); during Oct–Dec, these subadults became adult, and by Jan, the first young were present. During Feb–Mar, more young were born and the number of adults decreased (died). In Apr-Jun, no more young were born, and the number of adults continued to decline; so by Sep, all the adults had died and the young (now subadults and 6-8 months old) continued to grow and mature.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Lophuromys flavopunctatus* Thomas, 1888. No subspecies (even though there is considerable variation in the colour of the pelage throughout the biogeographic range).

**Key Reference** Dieterlen (2013c), Happold & Happold (1986, 1989c).

**Measurements**
*Lophuromys flavopunctatus*

| | |
|---|---|
| HB: | 120 (104–130) mm, n = 17 |
| T: | 63.4 (54–75) mm, n = 20 |
| HF: | 20.4 (19–22) mm, n = 23 |
| E: | 16.2 (14–20) mm, n = 23 |
| WT: | 56 (41–80) g, n = 22 |
| GLS: | 30.2 (26.8–31.3) mm, n = 56* |

Malawi (HC, D. C. D. Happold unpubl.).
*E DR Congo (Dieterlen 1976 in Dieterlen 2013c).

# Genus *Mastomys* – Multimammate Mice

Family Muridae, subfamily Murinae. This genus contains eight species, endemic to sub-Saharan Africa, and widespread in grasslands, woodland savannas, cultivated areas and human dwellings and stores. Females have two rows of nipples, each with 8-12 nipples, running almost contiguously from the axilla (armpit) to the inguinal area between the hindlimbs. Only one species occurs in Malawi.

## *Mastomys natalensis*

## Natal Multimammate Mouse

**Malawian Names** Kapuku, Liwondo, Mpuku. Also Khoswe which is not confined to this species.

Lengwe N. P., Malawi © DCD & M. Happold

**Description** Medium-sized greyish mouse with a relatively long tail. Pelage soft, dense and sleek. Dorsal pelage and crown of head grey, suffused with fawn and black; hairs dark grey with fawn, or black tips. Flanks paler. Ventral pelage greyish-white. Dorsal and ventral colours separated by soft line of pinkish-buff, but the colours are not clearly delineated. Head with pointed muzzle, upper lips and chin white. Ears rather large, rounded at tip, pigmented with dark grey; almost naked. Eyes moderately large and bulbous. Fore- and hindlimbs short; five digits, upper surface white, palms unpigmented, soles lightly pigmented. Tail long (111 [96-127]% of HB, n = 15), scaly with scattered bristles, dark above, slightly paler below. Adult females have up to 24 nipples, arranged in two rows of 12 (sometimes less). Upper incisor teeth orthodont (pointing more-or-less straight down (cf. pro-odont [angled forward] in *Zelotomys*).

**Similar Species**

*Zelotomys hildegardeae*. Tail buffy off-white often slightly darker at base and tip, relatively shorter (79 [72-90]% of HB); females with 10 nipples arranged in five pairs; upper incisor teeth pro-odont.

**Distribution** Widely distributed. Localities include Blantyre, Chikangawa, Dedza, Kandoli Hills (near Nkhata Bay), Karonga, Kasupe, Lake Chilwa, Lengwe N. P., Likhubula, Liwonde N. P., Mangochi Mountain, Matope, Misuku Hills, Mpemba, Mulanje, Ntchisi Mountain F. R., Nyika N. P. (Chipome Valley), Thyolo Mountain, Viphya Plateau and Zomba Plateau. Not recorded from Zomba Plateau, Mulanje Mountain, or Nyika Plateau (except Chipome Valley in miombo woodland at 1530 m). Elsewhere: very widespread throughout most of Africa south of the Sahara (except natural rainforest habitats) from Senegal to Ethiopia and Somalia, and in all countries south to Namibia, Botswana and E South Africa.

**Habitat** Widespread in grasslands, woodland savanna, thicket-clump savanna, agricultural land, and around villages, settlements and gardens. Does not occur in rainforest or montane habitats.

**Abundance** At certain times of year, Multimammate Mice are very common in savanna habitats and agricultural fields. A study in thicket-clump savanna in Lengwe N. P. showed that, on a yearly basis, these mice comprised 47% of all small rodents (10 spp., n = 227) and hence were the commonest species (Happold & Happold 1991). However, the numbers of individuals fluctuated widely every month from 0/ha in the dry season to monthly maxima of 7-12/ha during the wet season and early dry season; the highest numbers and densities were at the beginning of the wet season (Jan, Feb) and at the end of the wet season/beginning of the dry season (May, Jun). The population crashed from extreme high to extremely low very quickly in the first 1-2 months of the dry season. Conversely, other seemingly suitable areas of savanna in Malawi have low densities of these mice. Multimammate Mice are classic examples of a 'boom and bust' population cycle. They can become serious pests in agricultural fields and food stores when their populations are high.

**Habits** Terrestrial, nocturnal, herbivorous and omnivorous. Multimammate Mice dig burrows but also utilize cracks in the soil and burrows made by other species. They are active at night. They are extremely agile mice, moving quickly and jumping over obstacles. Their diet is 66% 'white matter' (presumably the endosperm of seeds), 38% green material (leaves and stems), 9% fruits, and 31% arthropods (insects, spiders, fly larvae) and sometimes slugs or snails. In agricultural fields and stores, they eat maize cobs and maize seeds.

**Reproduction** The most remarkable aspect about reproduction in this species is the speed at which populations can increase in number during the wet season. This is possible because gestation is short, litters are large, females can conceive again a few days after parturition, and females can have several litters during a single breeding season. Gestation: 21-22 days. Litter size: 9.4 (7-13) to 13.6 (11-17) depending on the size (HB) of the female. Neonates are altricial. Eyes open at Day 15. Weaned at Day 21. The young remain subadult during the season of birth and, usually, do not breed until the beginning of next breeding season. These characteristics of reproduction have a very strong effect on population dynamics and structure. In Lengwe N. P. the population in thicket–clump savanna was composed primarily of subadults at end of dry season (Nov) when population numbers are at their lowest. Most of these subadults matured very quickly when the rains commenced (Nov, Dec). Young began to enter the trappable population about a month later (Jan), and soon formed the majority of the population (as older young and subadults) as the old adults died. By mid- to late dry season, all young had become subadults (although by now there were very few of them because of high mortality during the dry season). Population turnover was rapid due to dispersal of young, immigration of new animals from elsewhere and mortality of animals of all age-groups; individuals rarely lived for more than 12 months.

**Conservation** IUCN Category: Least Concern. A very abundant species with a wide biogeographic distribution. Cooked Multimammate Mice are often offered for sale along roadsides - several of them skewered on sticks - during the end of the wet season.

**Taxonomic Notes** *Mastomys natalensis* (Smith, 1834). No subspecies. There is great chromosomal variation within the species currently recognised as *Mastomys natalensis*. It may be that there are other valid species (not yet recognised or determined) within '*M. natalensis*'.

**Key Reference** Leirs (2013).

**Measurements**
*Mastomys natalensis*

| | |
|---|---|
| HB: | 114 (100–135) mm, n = 17 |
| T: | 123.8 (110–165) mm, n = 16 |
| HF: | 23.6 (21–28) mm, n = 17 |
| E: | 19.3 (18–20) mm, n = 16 |
| WT: | 54.9 (44–80) g, n = 17 |
| GLS(male): | 28.5 (22.9–34.8) mm, n = 754* |

Malawi (HC, D. C. D. Happold *unpubl.*).
*Tanzania (RMCA, Leirs 2013).

# Genus *Mus* – Pygmy Mice and Old World Mice

Family Muridae, subfamily Murinae. In Africa, this genus contains about 20 species which occur in all habitats except rainforests and arid deserts. There are only two species in Malawi. They are very small, delicate mice with plain, soft pelage and relatively medium-short tails without pencils (see Table-key 8). The Common House Mouse, *Mus musculus*, although introduced to several countries in Africa, has not been recorded from Malawi.

*M. minutoides*. Ventral pelage pure white. HB: 54.8 (45–68) mm. Widespread except at higher altitudes.

*M. triton*. Ventral pelage grey. HB: 68.9 (60 -75) mm. Higher altitudes only.

## *Mus minutoides*

## Tiny Pygmy Mouse

**Malawian Names** Katolo, Pido, Pinji. Not confined to this species.

Namadzi (Kapalasa Farm), Malawi © DCD & M. Happold

**Description** Very small delicate brownish-grey mouse, with pale cinnamon flanks, white ventral pelage and relatively short tail. Pelage short, sleek and slightly coarse; hairs 3-4 mm. Dorsal pelage cinnamon-brown, heavily suffused with very dark grey on back and rump; hairs grey with subterminal band of cinnamon and black tip. Flanks less dark, usually cinnamon-brown. Ventral pelage white; hairs pure white. Dorsal and ventral colours moderately clearly delineated. Crown of head and cheeks same as dorsal pelage. Muzzle pointed. Eyes black. Chin, lips and throat white. Ears rounded, darkly pigmented, sparsely covered with short fine cinnamon hairs. Fore- and hindlimbs small, slender, white; four digits on forefoot, five digits on hindfoot; Digits 2–4 elongated. Tail relatively medium-short (80[72-90]% of HB, n = 12), upper surface with brown pigment and sparse brown bristles; ventral surface unpigmented with pale bristles.

**Similar Species**

*Mus triton*. Ventral pelage grey; on average larger (HB: 68.9 [60 -75] mm); higher altitudes only.

*Uranomys ruddi*. Larger (HB: 108 [101–119] mm, T: 63 [55–68] mm); pelage stiff.

**Distribution** Widespread in Malawi. Localities include Blantyre, Chididi, Chikwawa, Chiromo, Likhubula, Limbe, Mangochi, Matope, Mulanje Mission, Mwabvi W. R., Namadzi District, Ntcheu, Ntchisi Mountain F. R., Nyika N. P. (lower slopes), Thyolo, Thyolo Mountain, Zoa, Zomba and Zomba District. Not recorded from higher altitudes. Elsewhere: widespread but sparsely distributed in Zambia, S Mozambique, Zimbabwe, eSwatini, Lesotho, South Africa (coastal SE and S), and extreme SW Namibia.

**Habitat** Tolerates a wide range of habitats; recorded in short and tall grasslands, rocky outcrops, cultivated fields, newly hoed soil, suburban gardens, young pine plantations and on the fringe of wetlands.

**Abundance** Rarely encountered in Malawi. Elsewhere: considered to be abundant. For example, in certain *Acacia* woodlands in eSwatini, there were 28 individuals/ha. Population numbers fluctuate greatly during the course of a year.

**Habits** Terrestrial, nocturnal, omnivorous. These very small mice burrow in grass and litter, and during the day can hide under fallen trees and branches, and any old vegetation that gives protection. Occasionally they may be found in buildings and food stores. They also dig small narrow burrows in soil. The young are born in spherical nests made of grasses.
Tiny Pygmy Mice are omnivorous. In Malawi, stomach contents contained 'white vegetable material' (presumably mainly from seeds) and arthropods (termites, spiders and caterpillars). In eSwatini, the proportion of food items in the diet was 44% vegetable material, 40% seeds and 16% arthropods.

**Reproduction** In Malawi, pregnant or lactating females have been found in Feb, Apr and Jul (wet season and early dry season). In eSwatini, reproduction peaks during the main part of the season (Nov–Feb) but may continue throughout the year. Mean litter size 4.5 (KwaZulu–Natal, South Africa) and 4.0 (1–7) in captivity. Gestation (in captivity): 18–19 days. Neonates are altricial and hairless. Incisors erupt Day 7–9. Young weaned Day 18. Sexual maturity attained Day 42. Mean interval between litters: 22 days. In some localities, population numbers fluctuate greatly during the course of a year (because of large litter size and low survival rates; few individuals survive for more than one year).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Mus minutoides* A. Smith, 1834. Although several subspecies have been recognised in the past, none are currently considered valid.

**Key Reference** Monadjem (2013e).

**Measurements**
*Mus minutoides*

| | |
|---|---|
| HB: | 54.5 (48–67) mm, n = 13 |
| T: | 42.5 (40–45) mm, n = 12 |
| HF: | 12.5 (12–14) mm, n = 13 |
| E: | 9.4 (9-10) mm, n = 13 |
| WT: | 6.2 (4–12) g, n = 16 |
| GLS: | 18.8 (17.5–20.4) mm, n = 4* |

Malawi (NHMUK).
*South Africa (Roberts 1951 in Monadjem 2013e).

## *Mus triton*

## Grey-bellied Pygmy Mouse

**Malawian Names** Pido, Sibwe, Tsibwi (not confined to this species).

**Description** A very small dark greyish mouse with grey ventral pelage and relatively short tail, found at high altitudes. Pelage moderately long (7-8 mm), dense and smooth. Dorsal pelage darkish-brown or dark grey, slightly flecked with buff or yellow; hairs dark grey at base, with black subterminal band and with black or buff or yellow at tip; dorsal hairs 7–12 mm. Rump generally darker with more black-tipped hairs. Ventral pelage medium grey to greyish-white (not pure white), sometimes tinged with yellow; hairs dark grey at base, buff, off-white or white at tip. Ventral and dorsal colours inconspicuously delineated by thin buff or yellowish line (adults only). Eyes black. Ears dark with sparse covering of short brownish hairs. Fore- and hindfeet pale; palms pale and naked, soles brown and naked. Tail usually relatively short (72.8 [64-80]% of HB, n = 18), covered with short bristles, dark above, paler below.

**Similar Species**

*Mus minutoides*. Ventral pelage white; on average smaller (HB: 54.8 [45–68] mm); not recorded from higher altitudes.

**Distribution** Widespread at higher altitudes where annual rainfall is at least 960 mm. Localities include Blantyre, Chikangawa, Dedza District, Likhubula, Mangochi, Misuku Hills, Mpemba, Mulanje Plateau, Ntcheu, Ntchisi Mountain F. R., Nyika N. P. (near Chelinda), Thyolo Mountain, Viphya Plateau and Zomba Plateau (Chingwe's Hole). Elsewhere: recorded from Ethiopia (Bale Mts), South Sudan (Imatong Mts only), NE and N DR Congo, Uganda, Rwanda, Burundi, Kenya, Tanzania, Mozambique (Tete district) and Angola (mainly N and NE). In much of eastern Africa, restricted to isolated mountain and highland areas.

**Habitat** Restricted to montane grasslands at high altitudes. Shows a preference for grassland (61% of captures) and bracken (31%) on Zomba Plateau; rarely found in tangles along the forest edge (7%) and never found in the montane evergreen forest. On Nyika Plateau, preferred *Phillipia* vegetation to the grasslands (which were lacking in cover). May also occur in cultivations at higher altitudes.

Zomba Plateau, Malawi © DCD & M. Happold

**Abundance** In montane grasslands on Zomba Plateau, *Mus triton* was the most abundant species, comprising 37% of small mammals during the course of a year (8 spp. rodents, 1 sp. shrew) (Happold & Happold 1989c). Population numbers remained more or less constant throughout the year, although population structure changed seasonally. Abundance varied by locality at any one time: for example, in Apr-May, Grey-bellied Pygmy Mice comprised 9% of the small mammals on Nyika Plateau (where *Rhabdomys dilectus* (as *R. pumilio*) and *Lophuromys flavopunctatus* were the commonest species), 20% on Zomba Plateau (where *Lophuromys flavopunctatus*, *Mus triton* and *Praomys delectorum* were the commonest species) and just 2% on Mulanje Mountain (where *Lophuromys flavopunctatus*, *Rhabdomys dilectus* and *Praomys delectorum* were the commonest species.

**Habits** Terrestrial, nocturnal, omnivorous. Grey-bellied Pygmy Mice are entirely terrestrial (and do not climb into the grasses as do *Dendromus* spp. in the same habitat. They build grass nests, and probably excavate burrows under the grasses.

Montane grasslands are often burned at the beginning or middle of the dry season, so the landscape is a mosaic of burnt and unburnt grasslands. Grey-bellied Pygmy Mice are very selective in their choice of grasslands. Although their numbers decline immediately after fire, they re-colonize within the following month and numbers increase as the new grasses grow. Presumably insects also re-colonize the burnt areas and are easy prey for the mice. The numbers of the other common small rodents (*Lophuromys flavopunctatus*, *Praomys delectorum* and *Dendromus nyikae*) decline in numbers (or are non-existent) until the grasses re-grow and have the same structure as in the unburnt grasslands. The converse occurs in the unburnt grasslands: the

numbers of *Lophuromys flavopunctatus* increase (presumably because of migration away from the burnt areas) and the numbers of *Mus triton* decline.

Principal food is insects (mainly beetles and sometimes ants; sometimes white vegetable material (? roots) and earthworms. Details of the social organization of these mice are uncertain; mostly they are encountered singly, but sometimes they are encountered as male-female pairs.

Grass Owls preyed on Grey-bellied Pygmy Mice on Zomba Plateau (and no doubt elsewhere). They accounted for only 8% and 13% in two separate samples of owl pellets. Because of their small size, these mice comprised only 1-2% of the biomass of the owls' diet. From the owl's point of view, other larger species rodents were much 'better' prey!

**Reproduction** In Malawi, one study recorded pregnancies from Apr-Jul (late wet season and early dry season), and another study (on Zomba Plateau) recorded juveniles from Jan to Jun (no samples Jul and Aug, and no juveniles in Sep–Dec). Litter size: 6.0 (5-7). Females are unlikely to produce more than three litters during their lifetime. Gestation and development rate: unknown. The reproductive season varies in different parts of the biogeographic range.

The reproductive characteristics of Grey-bellied Pygmy Mice determine the demographic structure of the population. On Zomba Plateau, during late dry season, most individuals in population are subadults (WT: 9–10 g). By early wet season (Nov), subadults are now adults and some females are pregnant (WT: 12–20 g). During the wet season (Dec–Mar), the population is composed of juveniles, subadults and adults (range 8–24 g). Mortality of most adults occurs between Jun and Sep (dry season, often cool). The proportion of young in population varies seasonally: 0% in late dry season, 15–20% in early wet season, 43–45% in late wet season, and 11% in early dry season by which time young have become subadults and reproduction has ceased.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Mus triton* (Thomas, 1909). No subspecies recognised.

**Key Reference** Dieterlen & Happold (2013).

**Measurements**
*Mus triton*

| | |
|---|---|
| HB: | 68.9 (60 -75) mm, n = 20 |
| T: | 51.1 (46-65) mm, n = 20 |
| HF: | 15.6 (14-16) mm, n = 20 |
| E: | 10.7 (9-13) mm, n = 20 |
| WT: | 10.6 (7-16) g, n = 20 |
| GLS: | 21.8 (20.5-22.7) mm, n = 27* |

Malawi (Zomba Plateau, D. C. D. Happold *unpubl.*)
*DR Congo (Lwiro, Dieterlen & Happold 2013)

# Genus *Mylomys* – Mill Rats

Family Muridae, subfamily Murinae. This genus contains only two species, one known only from Ethiopia, the other widespread in eastern and central Africa (including Malawi) in grasslands and forest-grassland mosaics. The species in Malawi is a large rat, with a relatively medium length tail with no pencil, shaggy pelage and, uniquely, only three functional digits on the forefeet (see Table-key 8).

## *Mylomys dybowskii*

## Dybowski's Mill Rat

**Malawian Name** Not known.

Nyika N. P., Malawi © Senkenberg Museum, Germany

**Description** Large rat with a strong and rather thick, relatively medium length tail, and only three functional toes on the front feet. Pelage shaggy, long and dense. Dorsal pelage brown, heavily streaked with black and ochre; hairs long (10-15 mm), dark grey or black, with short yellow or blackish tip. Scattered black guard hairs (up to ca. 19 mm), especially on back. Tips of hairs on rump and at base of tail russet. No mid-dorsal black stripe. Flanks paler, with fewer black hairs than on back. Ventral pelage off-white, shorter than dorsal pelage; hairs off-white. Colour of dorsal and ventral pelage clearly delineated. Head uniformly similar in colour to dorsal pelage. Lower cheeks, chin and chest off-white. Small patches of yellowish or orange hairs on nose, around the eyes and at the front base of ears in some individuals. Ears large and rounded at tip; pigmented and sparsely covered with short pale brown and black bristles. Hairs on cheek may obscure base of ear. Fore- and hindfeet similar in colour to dorsal pelage. Forefeet small, with only three functional digits (Digits 2, 3 and 4) – a unique characteristic of the genus; well-developed palmar pads. Hindfeet long and strong with five digits, Digits 2, 3 and 4 long (up to 10 mm including long curved 3 mm claws); Digits 1 and 5 shorter, only just reaching to bases of Digits 2, 3 and 4. Tail of medium relative length (ca. 92% of HB), ringed with small scales, bicoloured, dark and pigmented with short blackish bristles above, paler with whitish or yellowish bristles below. Each upper incisor with one groove in the front surface.

**Similar Species** In Malawi, only *Mylomys*, *Dasymys* and *Otomys* have long, shaggy pelage.

*Dasymys incomptus*. Dorsal pelage dark greyish-brown streaked with black. Tail shorter (128.8 [119–137] mm). Widespread.

*Otomys* spp. Ventral pelage not off-white.

**Distribution** In Malawi, recorded only from Nganda on slopes of Nganda Mountain in Nyika N. P. (2200-2300 m). Elsewhere: recorded in five disjunct (but quite large) areas: West Africa (Ivory Coast); C Cameroun; CAR (just north of the Congo River); Congo (near the Atlantic coastline); NE DR Congo, South Sudan, Uganda, W and C Kenya, and Rwanda. Also two isolated populations in Tanzania (Mahali Mts. and ?Poroto Mts).

**Habitat** In Malawi, this species has been found only in montane grasslands with patches of shrubs along the edges of a stream; it has also been recorded in montane grasslands (at 2300 m) in NE and E DR Congo. Elsewhere, it is recorded from moist and tall grasslands with scattered trees, and forest-mosaic (at lower altitudes) and cultivated land. The montane habitat in Malawi seems a rather unusual habitat for this species.

**Abundance** Presumably rare; only recorded once in Nyika N. P. even though there have been many surveys for small mammals in this national park. Elsewhere: generally considered rare although abundant in some locations (e.g. in Uganda).

**Habits** Terrestrial, mostly diurnal, herbivorous. Probably fast-running. The rather short forefeet and the long hindfeet suggest that leaping may be possible. Grass nests are normally constructed on the ground. Contents of 25 stomachs from W Uganda

contained only grass leaves and stems; two stomachs from cultivated land in E DR Congo contained a homogeneous green pulp, mostly of green beans, grass and herbs.

**Reproduction** The single specimen known from Malawi (see above) was a pregnant female, with four embryos, caught in April. In Uganda, reproduction occurs in most months of the year; pregnancies have been recorded in all months except Jan and Feb (no samples), Jul and Aug. Embryo number: 4.3 (2–6). Very young animals found in all months except Mar, Apr, Sep and Nov. The dorsal pelage in young animals is dull blackish-brown, usually without yellowish tinge, and ventral pelage is greyish; subadults have a slight warm glossy yellowish tinge (and may be confused with young *Pelomys fallax*).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Mylomys dybowskii* (Pousargues, 1893).

**Key References** Chitaukali *et al.* (2001), Dieterlen (2013d).

**Measurements**
*Mylomys dybowskii*

| | |
|---|---|
| HB: | 127 mm |
| T: | 152 mm |
| HF: | 27 mm |
| E: | 20.0 mm |
| WT: | 86 g |
| GLS: | n. d. |

Malawi. The pregnant female from Nyika N. P. Specimens from Queen Elizabeth N. P., Uganda were, on average, larger (HB: 160 (122–194) mm, n = 87). Other parameters within same ranges.

# Genus *Otomys* – Vlei Rats

Family Muridae, subfamily Otomyinae. This genus contains at least 15 species found in semi-arid, montane and mesic grassland savannas in southern Africa, and in montane and mesic grassland savannas in isolated areas in other parts of sub-Saharan Africa. Five species occur in Malawi. They are medium to large rats with relatively short to medium length tails with no pencils, shaggy pelage and grooved upper incisors (which give these rats an alternative name – groove-toothed rats) (see Table-key 8). The premolar and molar teeth are specially adapted for masticating abrasive, silica-rich grasses – they have a row of transverse cusps each of which, when worn, forms a transverse ridge of bone and dentine across the tooth. These are referred to as laminae.

The Malawian species are distinguished by three dental characters (as well as skull characters), but only the incisors can be seen in hand-held living animals.

The number of grooves in the anterior face of the lower incisor – the possibilities being (a) a single, deep medial groove, (b) one medial groove plus faint trace of a second lateral groove, (c) one medial groove plus a shallow but distinct lateral groove, (d) two well-defined grooves approximately equal in depth.

The number of laminae on the upper third molar ($m^3$). There can be 6, 7, 8 or 9 complete laminae.

The number of laminae in the lower first molar ($m_1$). There can be 4 or 5 (rarely an intermediate state in which the anterior lamina is subdivided, possessing a small projection.

The colour of the dorsal pelage, and the distribution of the species, can also help to distinguish the species.

The species can be distinguished by the information in Table-key 11.

Table-key 11 to the species of Vlei Rats (*Otomys* spp.) found in Malawi

| **Number of grooves on each lower incisor tooth** | **Dorsal Pelage** | **Laminae on molar teeth** | **Known distribution Habitat** | **Species** |
|---|---|---|---|---|
| One | Dark blackish-brown with coppery tinge | $M^3$ with five or six.<br>$M_1$ with four. | Nyika Plateau.<br>? montane grassland | *O. denti* |
| One | Dark blackish-brown (without coppery tinge) | $M^3$ with six (occasionally seven).<br>$M_1$ with five. | Mugesse Forest.<br>Wet montane forest | *O. lacustris* |
| Two (one deep, one shallow) | Dark blackish-brown | $M^3$ usually with seven.<br>$M_1$ with four. | Widespread.<br>Montane grasslands and swampy vegetation, above 1000 m | *O. angoniensis* |
| Two (one deep, one shallow) | Dark brown | $M^3$ usually with seven.<br>$M_1$ with four. | Nyika Plateau.<br>Dense, moist grassland and scrub | *O. tropicalis* |
| Two (both deep) | Speckled tawny-brown | $M^3$ with seven.<br>$M_1$ with four. | Nyika Plateau.<br>A swamp and a rocky area | *O. uzungwensis* |

## *Otomys angoniensis*

## Angoni Vlei Rat

**Malawian Names** Thili, Thiri. Not confined to this species.


Zomba Plateau, Malawi © DCD & M. Happold

**Description** Large stocky rat with dense shaggy pelage, large blunt head, relatively short tail and each lower incisor with one deep and one shallow groove. Pelage long (15-20 mm), soft and fine, with abundant guard hairs. Dorsal pelage dark blackish-brown with brown flecks; hairs grey at base, brownish at tip; guard hairs black (15-20 mm). Flanks similar to dorsal pelage with brown flecks more prominent on anterior flanks. Ventral pelage dark grey flecked with buff. Head large. Ears small, well-haired, held close to head; lower part of ears obscured by long hairs on side of face. Eyes black. Forefeet blackish-brown; Digits 2-4 long; Digit 1 vestigial; hindfeet blackish-brown with five digits, Digits 1 and 5 shorter than Digits 2, 3, and 4. Tail relatively short (56 [46-66]% of HB, n = 4), scaly, dark above and paler below. Each upper incisor with a single groove. Each lower incisor with one deep and one shallow groove. $M^3$ usually with seven laminae (occasionally six); $M_1$ with four laminae.

**Similar Species** In Malawi, only *Dasymys, Mylomys* and *Otomys* have long shaggy pelage.
*Dasymys incomptus*. Tail relatively long (93.0 [87-98]% of HB); upper incisors without longitudinal grooves in the front surface.
*Mylomys dybowskii*. Ventral pelage off-white.
Other *Otomys* spp. See Table-key 11.

**Distribution** Recorded from Blantyre, Chitipa, Dedza Mountain (owl pellets), Likhubula, Misuku Hills, Mulanje Mountain (Lichenya Plateau, Thuchila Plateau), Nyika N. P. (Nyika Plateau), Thyolo Mountain, Viphya Plateau, Zoa and Zomba Plateau. Elsewhere: the most widespread of all species of *Otomys*, although populations in each country are discrete and isolated; recorded from N South Africa, eSwatini, N Zimbabwe, S Mozambique, W Angola, NW Zambia, E DR Congo, Rwanda, E Tanzania and S Kenya.

**Habitat** The preferred habitats in Malawi are montane grasslands and swampy vegetation, at altitudes above 1000 m, especially where the grasslands are damp and tall, and close to water. Studies on Viphya Plateau and Zomba Plateau, where pine (*Pinus* spp.) plantations have been established on montane grasslands, showed that Angoni Vlei Rats survive until the plantations are 2-3 years of age; after that, the quality of the grass declines and fallen pine needles cover the ground, and then Angoni Vlei Rats are no longer present. In other parts of the biogeographic range, they also occur at higher altitudes, but in South Africa they also live in some drier habitats at lower altitudes.

**Abundance** Because the species is rarely captured in Malawi, accurate assessment of abundance is not possible. They may be more abundant than shown by conventional survey methods; e.g. on Zomba Plateau, they were the most numerous prey of African Grass-owls, comprising 47% of small mammals in owl pellets. Elsewhere: in optimal habitats, they may be abundant (e.g. 30/ha on the highlands of Mount Kenya).

**Habits** Terrestrial, nocturnal and diurnal, herbivorous. Angoni Vlei Rats burrow through grasslands, swamps, and fallen grass litter where they form 'runways' and are well camouflaged by their dark pelage. They are either solitary or live in pairs or small family groups. In Malawi, they are entirely herbivorous, eating only the stems and leaves of green grasses, although in Kenya, they include herbs and bark in the diet. When feeding, they nip the grass stems and often leave sections of cut stems wherever they have been feeding. They are coprophagous and produce elongated green faecal pellets. Because of their grass diet, they have a specialized alimentary canal, including a very long intestine and a large complex caecum; in this respect they are like miniature cows or elephants!

**Reproduction** In Malawi, collections over the course of the year suggest that Angoni Vlei Rats breed during most of the year (although pregnant females were encountered only in May, Jul and Nov).

In South Africa, details of litter-size and growth are as follows. Embryo number 2-3 (1–5). In captivity, gestation 37 days. Litter-size 3.1 (2–5). Neonates are precocial with erupted incisors and are capable of nipple-clinging immediately after birth. Minimum age at sexual maturity is five weeks for females and eight weeks for males.

**Conservation** IUCN Category: Least Concern. However, the isolation of populations, and limited areas of suitable habitat are causes for concern.

**Taxonomic Notes** *Otomys angoniensis* Wroughton, 1906. No subspecies.

**Key Reference** Taylor (2013a).

**Measurement**
*Otomys angoniensis*

| | |
|---|---|
| HB: | 158.0 (139-184) mm, n = 7 |
| T: | 88.8 (80-111) mm, n = 4 |
| HF: | 28.3 (27-29) mm, n = 4 |
| E: | 21.0 (21) mm, n = 4. |
| WT: | 111.7 (90-140) g, n = 3 |
| GLS: | 34.8 mm, n = 1 |

Malawi (HC, Hanney 1965).

## *Otomys denti*

## Dent's Vlei Rat

**Malawian Names** Thili, Thiri. Not confined to this species.

**Description** Large stocky rat with dense shaggy coppery-tinged pelage, large blunt head, relatively short tail and each lower incisor with one groove. Pelage long (15-17 mm), soft and fine, with abundant guard hairs. Dorsal pelage dark blackish-brown with coppery tinge (distinctly different to other *Otomys* spp.); hairs dark grey at base with black or coppery tip. Guard hairs black (20 mm). Ventral pelage paler than dorsal pelage, without black guard hairs. Ears darkly pigmented, with short sparse dark hairs. Fore- and hindfeet darkly pigmented. Tail relatively short (52.8 [47-56]% of HB, n = 7), black above and below (i.e. not bicoloured). Each upper and lower incisor with one groove. $M^3$ with five or six laminae; $M_1$ with four laminae.

**Similar Species** In Malawi, only *Dasymys, Mylomys* and *Otomys* have long shaggy pelage.
*Dasymys incomptus*. Tail relatively long (93.0 [87-98]% of HB); upper incisors without longitudinal grooves in the front surface.
*Mylomys dybowskii*. Ventral pelage off-white.
Other *Otomys* spp. See Table-key 11.

**Distribution** In Malawi, recorded only from Nyika N. P. (Plateau). Elsewhere: recorded from a narrow band of montane areas on either side of the Rift Valley from E DR Congo, SW Uganda, Rwanda, Burundi, Tanzania (Usambara and Uluguru Mountains) and NE Zambia (Zambian Nyika).

**Habitat** On Nyika Plateau (see above), most individuals were encountered in montane grassland close to water, some were found in swampy ground, and a few were found about 366 m from water. They have also been recorded in an unburnt pine plantation (*Pinus patula*) at Chelinda on the Nyika Plateau. In SW Uganda, and E DR Congo, the species is also found in bamboo and montane forests and in grass-herb habitats above 1850 m.

**Abundance** In Malawi, known only from fifteen specimens collected on the Nyika Plateau. Elsewhere: no information.

**Habits** Terrestrial, nocturnal, herbivorous. No other information available; probably similar to *O. angoniensis* with which it co-exists on the Nyika Plateau. In Uganda, the diet is leaves, shoots, roots and a few insects.

**Reproduction** In Malawi, pregnant females were recorded in May, Jun and Nov (not known if samples were obtained in other months). Embryo number: 1 and 4. In Uganda, most females had a single embryo, and one had two embryos. Neonates have their eyes open, a good covering of hair, and the incisor teeth already erupted.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Otomys denti* Thomas, 1906. Referred to as *O. kempi* in some previous publications (e.g. Sweeney 1959).

**Key Reference** Taylor (2013b).

**Measurements**
*Otomys denti*

| | |
|---|---|
| HB: | 159.9 (127-186) mm, n = 9 |
| T: | 83.6 (60-104) mm, n = 9 |
| HF: | 28.1 (25.5-30) mm, n = 9 |
| E: | 21.6 (20-23) mm, n = 9 |
| WT: | 125.9 (113-133) g, n = 3 |

Malawi (Nyika Plateau, NMMB).

## *Otomys lacustris*

## Lake Vlei Rat

**Malawian Name** Not known - perhaps the same as for the Angoni Vlei Rat.

**Description** Large stocky rat with very dark moderately shaggy pelage, large blunt head, relatively short tail and each lower incisor with one groove. Pelage long (ca. 15 mm), glossy and smoother than that of other species of *Otomys*. Dorsal pelage dark blackish-brown; hairs black or brown with narrow rusty subterminal band and black tip. Guard hairs thin, black, up to 20 mm. Flanks slightly paler. Ventral pelage shorter, and paler, sometimes with a buffy streak along mid-ventral line. Ears darkly pigmented, with slight covering of hair; often obscured by long hairs on side of face. Fore- and hindlimbs brown. Tail relatively short (ca. 65% of HB*)*, dark with scales and small black bristles. Each upper and lower incisor with one groove. $M^3$ with six (occasionally seven) laminae. $M_1$ with five laminae.

**Similar Species** In Malawi, only *Dasymys, Mylomys* and *Otomys* have long shaggy pelage.
*Dasymys incomptus*. Tail relatively long (93.0 [87-98]% of HB); upper incisors without longitudinal grooves in the front surface.
*Mylomys dybowskii*. Ventral pelage off-white.
Other *Otomys* spp. See Table-key 11.

**Distribution** In Malawi, recorded only from Mugesse Forest (1,600–1,880 m) in the Misuku Hills. Elsewhere: recorded from only a few localities in Zambia (Mbala) and Tanzania (Ukinga Mts, Poroto Mts, Ufipa Plateau, Uzungwe Mts and Rungwe District).

**Habitat** Montane habitats. Found in wet forest close to a small stream in Mugesse Forest, Malawi); and in 'forest' on the Ufipa Plateau, Tanzania.

**Abundance** Unknown. In Malawi, known only from three specimens from Mugesse forest.

**Habits** No information. Presumably the habits of this species are similar to those of other species of *Otomys*.

**Reproduction** No information.

**Conservation** IUCN Category: Vulnerable.

**Taxonomic Notes** *Otomys lacustris* Allen and Loveridge, 1933. Originally recorded in Malawi as *O. anchietae*, a species now considered to occur only in NE Angola. Ansell & Dowsett (1988) refer to this species as *O. anchietae.*

**Key Reference** Clausnitzer (2013).

**Measurements**
*Otomys lacustris*

| | |
|---|---|
| HB: | 158 (150–165) mm, n = 4 |
| T: | 102.5 (90–110) mm, n = 4 |
| HF (c.u.): | 30.6 (30–31) mm, n = 4. |
| E: | 21 (20–22) mm, n = 4 |
| WT: | n. d. |
| GLS: | 38.6 (36.8–39.9) mm, n = 3 |

Tanzania (Dieterlen & Van der Straeten 1992 and Taylor & Kumirai 2001 in Clausnitzer 2013).

## *Otomys tropicalis*

## Tropical Vlei Rat

**Malawian Name** Not known - perhaps the same as for the Angoni Vlei Rat.

**Description** Large stocky rat with dense shaggy pelage, large blunt head, relatively short tail and each lower incisor with one deep and one shallow groove. Pelage soft, fine and thick. Dorsal pelage dark brown. Flanks brown. Ventral pelage slaty-grey; hairs grey with buff tip. Ears of medium length, well haired, somewhat paler than body. Tail relatively short (ca. 46% of HB), black above, dull white below. Each upper incisor with single groove. Each lower incisor with one deep groove and one faint or very faint groove (occasionally absent). $M^3$ with seven (occasionally eight) laminae; $M_1$ with four laminae.

**Similar Species** In Malawi, only *Dasymys, Mylomys* and *Otomys* have long shaggy pelage.
*Dasymys incomptus*. Tail relatively long (93.0 [87-98]% of HB); upper incisors without longitudinal grooves in the front surface.
*Mylomys dybowskii*. Ventral pelage off-white.
Other *Otomys* spp. See Table-key 11.

**Distribution** In Malawi, known only from a single specimen from Nyika N. P. Elsewhere: NE DR Congo (Garamba N. P.), Uganda (Kampala, Mt Elgon, Ruwenzori Mts), Kenya (Mt Kenya, Aberdare Ranges, Mt Nyiru), South Sudan (Imatong Mountains) and Burundi (Tora, Ntentamaza).

**Habitat** No information for Malawi. Lives in dense, moist grassland and scrub habitats, including alpine heath, as well as cultivated areas (e.g. coffee and banana plantations). Not recorded in natural forested habitats except where these are highly degraded as a result of fire or destruction of the forest. In NE DR Congo, lives at altitudes of ca. 1200–1750 m.

**Abundance** No information for Malawi. Elsewhere: common in suitable habitats.

**Habits** Terrestrial, crepuscular, herbivorous. No information for Malawi; presumably the habits of this species are similar to those of other species of *Otomys*.

**Reproduction** No information for Malawi. Elsewhere: litter-size usually 1 or 2, always less than 4.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Otomys tropicalis* Thomas, 1902. Not listed in Ansell & Dowsett (1988).

**Key Reference** Taylor (2013c).

**Measurements**
*Otomys tropicalis*

| | |
|---|---|
| HB: | 178.0 (147–201) mm, n = 10 |
| T: | 81.5 (69–94) mm, n = 10 |
| HF: | 28.7 (26–33) mm, n = 10 |
| E: | 23.3 (20–24) mm, n = 7 |
| WT: | 111.3 (81–133) g, n = 9 |
| GLS: | 39.0 (29.0–43.5) mm, n = 52 |

Throughout biogeographic range (DNSM, MNHN, NHMUK, Taylor & Kumirai 2001 in Taylor 2013c).

## *Otomys uzungwensis*

## Uzungwe Vlei Rat

**Malawian Names** Thili, Thiri. Not confined to this species.

**Description** (based on the type description). Medium-large stocky rat with dense moderately shaggy pelage, large blunt head, relatively short tail and each lower incisor with two deep grooves. Pelage moderately shaggy with long guard hairs. Dorsal pelage buffy-brown heavily streaked with black, rump somewhat redder, flanks somewhat paler and greyer. Ventral pelage pinkish-buff, somewhat greyer on throat. Colours of dorsal and ventral pelage merge along the flanks. Eyes surrounded by more-or-less well-defined ochre eye-ring. Ears grey, short, prominent and rounded. A few individuals have a minute patch of slightly paler hairs behind the ears. Feet peppered with buffy and dark brown hairs. Tail bicoloured, dark above, buffy below; relatively short (49 [46-52]% of HB, n = 4). Each upper incisor with single groove; each lower incisor with two deep grooves. $M^3$ with seven laminae; $M_1$ with four laminae.

**Similar Species** In Malawi, only *Dasymys, Mylomys* and *Otomys* have long shaggy pelage.
*Dasymys incomptus*. Tail relatively long (93.0 [87-98]% of HB); upper incisors without longitudinal grooves in the front surface.
*Mylomys dybowskii*. Ventral pelage off-white.
Other *Otomys* spp. See Table-key 11.

**Distribution** In Malawi, known only from near Chelinda and Nganda on the Nyika Plateau. Elsewhere: first recorded from Dabaga and Iringa in the Udzungwa Mountains (formerly Uzungwe Mountains) in the Iringa District, Tanzania and subsequently recorded from the Poroto Mountains in the Mbeya Region of Tanzania and the Nyika Plateau in Zambia as well as Malawi. The Nyika Plateau is the southern-most known locality of this species.

**Habitat** On the Nyika Plateau in Malawi, two were found in a bog and one in a rocky area ca. 800 m from water, at ca. 2134 m, and one was found in "alpine meadows with shrub patches at river banks" at 2200-2300 m. Elsewhere, said to inhabit subtropical or tropical grasslands and swamps at altitudes of 1800-2750 m.

**Abundance** Only three specimens known from Malawi (all from Nyika Plateau). Elsewhere: no information.

**Habits** No information.

**Reproduction** No information for Malawi or elsewhere.

**Conservation** Category: Near Threatened. Habitat destruction, the limited biogeographic range, and small population size in Malawi are causes for concern.

**Taxonomic Notes** *Otomys uzungwensis* Lawrence and Loveridge, 1953. Relegated to a subspecies of *Otomys typus* by Misonne 1974 and referred to as such by Hanney (1965), but currently considered to be a distinct species.

**Key Reference** Lawrence and Loveridge (1953).

**Measurements**
*Otomys uzungwensis*

| | |
|---|---|
| HB: | 170.6 (155-195) mm, n = 5 |
| T: | 82.5 (80–90) mm, n = 4 |
| HF: | 25.4 (25–26) mm, n = 5 |
| E: | 23.4 (20–25) mm, n = 5 |
| WT: | n. d.. |
| GLS: | 38.8 (38.4–38.9) mm, n = 4 |

Malawi (n = 1), Tanzania (n = 4) (NHMUK, Lawrence and Loveridge 1953).

# Genus *Pelomys* – Creek Rats

Family Muridae, subfamily Murinae. This genus contains five species, widely distributed in savanna habitats in eastern and central Africa. One species occurs in Malawi. It is a medium sized rat with a relatively medium length tail with no pencil, slightly shaggy pelage, and each upper incisor has one groove (see Table-key 8).

## *Pelomys fallax*

## East African Creek Rat

**Malawian Names** Bvumbi, Lilende, Mawpini, Mende.

Zomba Plateau, Malawi © DCD & M. Happold

**Description** Medium-sized rat with slightly shaggy, conspicuously flecked pelage, distinctly bi-coloured tail, and conspicuously grooved upper incisors. Pelage long, slightly shaggy with abundant black-tipped guard hairs. Dorsal pelage flecked with black, pale brown and golden-brown hairs, darker mid-dorsally becoming less black and more conspicuously flecked on flanks; hairs dark grey with brown or golden tip; guard hairs longer, grey at base with black tip. A mid-dorsal black stripe (from neck to base of tail) may be present in juveniles but is usually absent in adults. Ventral pelage greyish-white, tinged with cream in some places; hairs grey at base with cream or beige tip. Head rather pointed; crown, cheeks and muzzle same colour as flanks; chin and throat same as ventral pelage. Nasal region sometimes rufous. Ears rounded, darkly pigmented, densely covered with short orange-brown hairs; base of ears often obscured by orange or black hairs. Limbs short and dark; forefeet with four digits: Digit 1 absent or vestigial; Digits 2, 3 and 4 long, with long claws; Digit 5 very short with nail. Hindfeet with Digits 2, 3 and 4 long with long claws; Digits 1 and 5 short with short claws. Tail of medium relative length (107 [97-123]% of HB, n = 9), thick at base tapering to tip, distinctly bicoloured (black above, whitish below). Each upper incisor with one deep groove.

**Similar Species**

*Dasymys incomptus*. Pelage greyish and not flecked; upper incisor teeth not grooved.

**Distribution** Widespread in high rainfall areas of Malawi; recorded from Blantyre District, Chikangawa, Chiromo, Chitipa (= Fort Hill), Chididi, Dedza, Kasungu, Ntchisi Mountain F. R., Limbe, Matope, Misuku Hills, Mount Malosa, Mulanje Mountain, Nkhotakota, Nyika Plateau, Thyolo, Viphya Plateau, Zoa, and Zomba Plateau. Elsewhere: recorded from S Kenya, SW Uganda, Tanzania, Rwanda, Burundi, E and S DR Congo, N Angola, Zambia, Mozambique, N Botswana, N Zimbabwe and NE Namibia (Caprivi Strip).

**Habitat** Creek Rats are one of the few species of African rodents that live in creeks, flood plains, marshes, swamps, stream banks and in long damp grass where moisture is always available. Hence their distribution is patchy and discontinuous. In some parts of their biogeographic range, they live at higher altitudes in montane grasslands where the climate is mild and rainfall is high.

**Abundance** Mostly uncommon and only a few individuals are known from any one locality in Malawi. Elsewhere: in E DR Congo, near Lake Kivu, Creek Rats comprised only 3% of the small rodents (5 spp.).

**Habits** Terrestrial, nocturnal and diurnal, herbivorous. Very little information for Malawi. In Botswana, Creek Rats occur only in swampy areas, and they are almost entirely diurnal, whereas in Uganda, where the environment is generally moist, they are considered as 'equally diurnal and nocturnal'. The colouration and pattern of the pelage appears to provide excellent camouflage during daylight hours. Creek Rats run quickly and hide under grass if disturbed. In some parts of their biogeographic range, they dig their own burrows, often in dry ground adjacent to wet places. Nests of grass are

either built amongst grass debris, or in burrows. In the Okavango swamps, Botswana, individuals were often observed sunning themselves on the fringe of the reed-beds, and now and again they took short plunges into the water and swam from one patch of vegetation to another. They appear to be good swimmers, and are rather wary and, if alarmed, disappear behind the reeds. Creek Rats feed on leaves, shoots, stems of various grasses and swamp vegetation, often leaving behind small piles of cut grass stems (a behaviour also seen in some other species of grass-eating rodents, e.g. *Thyronomys* spp.). In Malawi, the contents of three stomachs contained only green vegetation, one contained white material (presumably from seeds) and one contained insect remains. The remains of Creek Rats have been found in owl pellets at Dedza.

**Reproduction** Gestation: not known. Embryo number: 5.5 (4–7). Neonates are altricial and the skin is darkly pigmented with a fine covering of hair. Dorsal stripe visible on Day 4-5, eyes open on Day 10. Half of adult weight by Day 65, and 75% of adult weight by Day 105.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Pelomys fallax* Peters, 1852.

**Key Reference** Dieterlen (2013e).

**Measurements**
*Pelomys fallax*

| | |
|---|---|
| HB: | 131 (124-148) mm, n = 10 |
| T: | 138 (122-152) mm, n = 10 |
| HF: | 28 (26-30) mm, n = 10 |
| E: | 17 (16-19) mm, n = 10 |
| WT: | 77 (58-92) g, n = 6 |
| GLS: | 35.1 (32.0–38.2) mm, n = 51* |

Malawi (HC, NHMUK).
*DR Congo (Dieterlen 2013e).

# Genus *Praomys* – Soft-furred Mice

Family Muridae, subfamily Murinae. This genus contains about 16 species. They are endemic to tropical Africa and most live in forests. Only one species occurs in Malawi. It is a small mouse with soft pelage, a relatively medium-long tail (without a pencil) and white ventral pelage (see Table-key 8).

## *Praomys delectorum*

## Delicate Soft-furred Mouse

**Malawian Name** Chithwa.

Zomba Plateau, Malawi © DCD & M. Happold

**Description** Small delicate mouse with soft, smooth, dense pelage and relatively medium-long tail. Dorsal pelage dark brownish-grey from nose to base of tail; hairs dark brownish-grey with paler tips. Flanks slightly paler. Ventral pelage white; ventral hairs dark grey, white at tip. Chin and throat same as ventral colouration. Head narrow, with pointed nose, long black vibrissae and large eyes. Ears elongated, rounded at tips, naked, dark grey; very mobile, held upwards and forwards from head. Fore- and hindfeet unpigmented with sparse short white hairs; forefeet with four digits (Digit 1 almost vestigial); hindfeet with five digits (Digit 1 short). Tail relatively medium-long (132.7 [101-153]% of HB, n = 20), thin, with many small dark scales and short dark bristles.

**Similar Species** None in montane habitats.

**Distribution** Confined to montane habitats above ca. 1700 m (Misuku Hills*, Mulanje Mountain, Nyika Plateau, Thyolo Mountain, Viphya Plateau and Zomba Plateau). Elsewhere: recorded from montane and highland habitats in Tanzania (Mt Kilimanjaro, Mt Meru, Ngorogoro Crater, Southern Highlands, Uzungwa Mts, Uluguru Mts, Usambara Mts, Rungwe Highlands) and perhaps other 'Eastern Arc' mountains. Present in Zambia (Makutu Mts, Mafinga Mts); Mozambique (Namuli Mt), and SE Kenya (Shimba Hills). *but see Taxonomy.

**Habitat** Montane evergreen forests, and tangles along margins of montane forests, in highland regions where average annual rainfall is not less than ca. 2000 mm. May also occur in bracken adjacent to montane forest, mostly during the wet season, but rarely found in grassland adjacent to forest even when grasses are tall and dense. This species shows a strong preference for montane forest habitats compared with all other montane habitats (grasslands, bracken, etc.). Delicate Soft-furred Mice do not live in pine plantations.

**Abundance** In Malawi, common in suitable habitats, especially at the end of the reproductive season. On Zomba Plateau, comprised 29–33% of small mammals (the second most numerous species after *Mus triton*) trapped in forest/grassland mosaic habitats, and 50–88% in montane forest habitats.

**Habits** Terrestrial, nocturnal, herbivorous/omnivorous. They are terrestrial but may also scramble on fallen logs and other debris. They make their burrows under fallen logs and the roots of large trees. In captivity, several individuals can be kept together, suggesting a communal social organization. They forage on the ground in leaf-litter. Analysis of stomach contents (in Malawi) showed that 78% of stomachs contained vegetable material (bark, leaves, and 'white material' presumably from fruits) and 82% contained insects (caterpillars and adult insects).

**Reproduction** On Zomba Plateau, pregnancies occurred during late dry season and wet season (Sep–Apr) but mostly in Dec– Feb. Young animals enter the population during late wet season and early dry season (Feb–Apr). Litter-size: 4 (2–6). Population numbers are low at end of dry season (Aug–Nov), increasing to maximum (up to 10 times minimum) at the end of wet season and beginning of early dry season (Mar–Jun). Young form 50–80% of the population in the late wet season. A female may produce up to three litters in single breeding season. Individuals rarely survive for more than about six months.

**Conservation** IUCN Category: Least Concern. One conservation concern is that suitable habitat is restricted to montane areas, and hence populations are discrete and isolated. Habitat destruction (e.g. logging of forests for agriculture and plantations) may lead to local extinctions.

**Taxonomic Notes** *Praomys delectorum* (Thomas, 1910). No subspecies. Hanney (1965) referred to this species as *Praomys jacksoni*, and Sweeney (1959) referred to it as *Rattus delectorum*. *Praomys jacksoni* now refers to the species of *Praomys* restricted to the Congo basin. The individuals referred to above from Misuku Hills may represent *P. melanotus* (the common species of *Praomys* found in the Southern Highlands of S. Tanzania).

**Key Reference** Happold, D. C. D. (2013i).

**Measurements**
*Praomys delectorum*

| | |
|---|---|
| HB: | 95.8 (85-135) mm, n = 20 |
| T: | 126.1 (117-140) mm, n = 20 |
| HF: | 22.6 (21-24) mm, n = 20 |
| E: | 19.4 (17-24) mm, n = 20 |
| WT: | 28.3 (21–43) g, n = 20 |

Malawi (HC, NHMUK, D. C. D. Happold unpubl.).

## Genus *Rattus* - Rats

Family Muridae, subfamily Murinae. One of the most widespread genera in the world. The genus contains perhaps as many as 66 species. Two species have been introduced to Africa, but only one occurs in Malawi. This species is a medium-large rat with a relatively long tail (no pencil), dark brown or blackish-brown dorsal pelage and it is commensal and not arboreal (see Table-key 8).

### *Rattus rattus*

### Black Rat

Zomba, Malawi © DCD & M. Happold

**Malawian Name** Khoswe (same as for *Aethomys namaquensis*, and *Mastomys natalensis*).

**Description** Medium-large rat, with blackish dorsal pelage and relatively long scaly naked tail. Pelage coarse and dense, moderately sleek. Dorsal pelage blackish, slightly suffused with fawn; hairs medium grey at base, with fawn or black tip. Many long dark guard hairs scattered throughout dorsal pelage; guard hairs with basal half pale grey, terminal half black. Flanks slightly paler and greyer. Ventral pelage dark grey (but see Taxonomy for colour variations). Dorsal and ventral colours merge. Some individuals from Nyika Plateau have a white patch on chest, and a yellow-bellied form was recorded from near Mangoche. Ears naked prominent. Fore- and hind-feet with sparse grey hairs dorsally; naked with grey pigmentation ventrally. Digits well developed. Fore-foot with four digits; hindfoot with five digits. Tail relatively long (128 [125-130]% of HB, n = 7), thin, with scales arranged in rings along length of tail and many short dark bristles.

**Similar Species** None.

**Distribution** Widespread in human habitations throughout Malawi. Localities include Blantyre, Chididi, Chikwawa, Chiradzulu Mountain, Chiromo, Karonga, Kasungu, Lake Chilwa, Lengwe N. P., Likhubula, Mangochi, Misuku Hills, Mpemba, Mulanje Mountain, Namadzi, Nyika Plateau (Chelinda), Thyolo, Zoa, Zomba Plateau, and Zomba. Elsewhere: recorded on every continent of the world except Antarctica, and in most African countries south of the Sahara (as well as parts of the North African coast); in some African countries it is widespread; in others it is recorded from only one or two localities.

**Habitat** Human dwellings, sheds, food stores in cities, towns and villages; very occasionally Black Rats are found in 'natural' habitats and then only close to human habitations. They were introduced to Africa during the 1800s and gradually dispersed along the trade routes; they reached Tabora in Tanzania in 1895, and then dispersed southwards into Malawi. They may also have reached Malawi via the Zambezi and Shire rivers from the late 1800s onwards.

**Abundance** In optimal habitats, Black Rats may be very common, although population numbers may vary greatly between years and between seasons. When abundant, they can become major pests.

**Habits** Nocturnal and diurnal, terrestrial and scansorial, omnivorous. Black Rats are agile climbers, and frequently live in roofs of houses, under wooden floors, and high up in multi-storey buildings. Their boldness, lack of fear of humans and ability to eat many sorts of foods allow them to live in close association with humans where they may cause damage to buildings and food stores. These characteristics, coupled with their high reproductive rate, result in rapid increases in population numbers when conditions are suitable, and increase their impact as a pest species. Although they are rarely seen, their presence is indicated by their large faecal pellets and by stains along runways (produced by urine and secretions from skin glands). Black Rats invade natural habitats in Africa very infrequently (although they may occur in abandoned farmlands close to urban settlements), hence they do not compete with, or displace, indigenous species of rodents in natural habitats. However, because of their larger size and competitive supremacy, Black Rats have displaced *Mastomys natalensis* (and other *Mastomys* spp.) as the major rat

pest in houses in some parts of Africa. They are social animals and many individuals can live together in close proximity.

**Reproduction** No specific information for Malawi. Elsewhere: reproduces prolifically. When conditions are suitable (as in human habitations where food and water are available at all times), breeding occurs throughout the year, e.g. in Uganda, Zimbabwe and Nigeria. Continuous reproduction, large litter-sizes and rapid development can result in rapid increases in population numbers within a short period of time; hence populations are very responsive to changing environmental conditions. Gestation: ca. 21 days, or 23–29 days (for lactating females). Litter-size: 6 (5–10). Growth and development are rapid – fine fur all over body by Day 8, eyes open Day 10–14; solid food eaten Day 15–18, weaned Day 30; sexual maturity Day 100–120. Females may have many litters per year (up to one litter/month).

**Conservation** IUCN Category: Least Concern. Control of Black Rats is essential to reduce the damage they cause to buildings and food supplies, and to minimize the spread of disease.

**Taxonomic Notes** *Rattus rattus* Linnaeus, 1758. No subspecies, although there are 'races' or 'colour forms': *frugivorous* - ventral pelage white or lemon-yellow, *alexandrinus* - ventral pelage grey-brown, *rattus* - ventral pelage dark grey. There is no information on which form, or forms, occur in Malawi.

**Key Reference** Happold, D. C. D. (2013j).

**Measurements**
*Rattus rattus*

| | |
|---|---|
| HB: | 125 (110–160) mm, n = 8 |
| T: | 160 (142–200) mm, n = 7 |
| HF: | 30.4 (29–33) mm, n = 8 |
| E: | 18.4 (16–21) mm, n = 8 |
| WT: | 67.4 (42–130) g, n = 8 |
| GLS: | 39.3 (36.9–41.4) mm, n = 6* |

Malawi (HC, D. C. D. Happold unpubl.).
*DR Congo (ZFMK).

# Genus *Rhabdomys* – Four-striped Grass Mice

Family Muridae, subfamily Murinae. This genus contains two species. They are endemic to sub-Saharan Africa; widespread in southern Africa and the eastern side of the continent as far north as Uganda. One species occurs in Malawi. It is a small mouse with striped pelage - no black mid-dorsal stripe but two black stripes on each flank, each with pale edges (see Table-key 8).

## *Rhabdomys dilectus*

## Mesic Four-striped Grass Mouse

**Malawian Name** Mphera.

Lichenya Plateau, Mulanje Mountain, Malawi
© DCD & M. Happold

**Description** Small beautiful mouse with four black and two cream stripes on its back. Pelage harsh with numerous, black guard hairs. Dorsal pelage (background colour) yellowish-brown flecked with buff; hairs black at base, yellowish-brown at tip. There is one cream lateral stripe, extending from the base of an ear to the base of the tail, on either side of the mid-dorsal line; each is bordered on both sides by a black stripe – therefore there is a total of four black stripes which gives the genus its vernacular name. No black mid-dorsal stripe (cf. *Lemniscomys*). Flanks yellowish-brown flecked with buff and black. Ventral pelage paler than dorsal pelage, without black guard hairs. Head similar in colour to dorsal pelage, with a longitudinal median black stripe from between eyes to between ears. Eyes black with inconspicuous cinnamon eye-ring. Ears well covered with short reddish-brown or orange hairs. Chin, throat and abdomen paler than head, or off-white; base of hairs dark grey. Fore- and hindfeet short, paler than dorsal pelage, soles of hindfeet darkly pigmented. Tail relatively medium-short (81 [60-90]% of HB, n = 11) with sparse short hairs, black above, yellowish-brown or grey below.

**Similar Species** None. No other mouse in Malawi has four black stripes.

**Distribution** In Malawi, known from only two localities, both at higher altitudes – Nyika Plateau and Mulanje Mountain. Elsewhere: recorded as scattered populations in high veld and montane regions in E. Zimbabwe and in highland and mountainous regions of Tanzania, Kenya, and Uganda (Mt Elgon only). There is a general trend that populations at higher latitudes (i.e. further away from the Equator) are able to live at lower altitudes than populations nearer to the Equator that occur only at higher altitudes.

**Habitat**. In Malawi, short montane grasslands, bracken, shrubby tangles on the edge of montane forest, in *Phillipia* shrubland on the edge of swamps, and in tall grassland where there are dense patches of *Helichrysum* (everlasting flowers). All habitats are above 2000 m and with at least 1300 mm of rain/year. In Zimbabwe, Mesic Four-striped Grass Mice live in the high veld as well in higher montane regions (e.g. Inyanga Mountains), and on Mount Elgon (Uganda), they are found only in grasslands in the Afro-alpine Zone. They do not occur in montane forest.

**Abundance** On Nyika Plateau, in montane grasslands (sometimes with rocks), Mesic Four-striped Mice comprised 35% and 62% of small rodents in two study areas, and were the most abundant small mammal. On Lichenya Plateau (Mulanje Mountain), they comprised 22% and were the second most abundant species (after *Lophuromys flavopunctatus*). These percentages equate to ca. 3 individuals/ha and 9 individuals/ha on Nyika Plateau, and 2/ha on Lichenya Plateau. Elsewhere: on Mount Elgon in Uganda, density varied each month (depending on location, climate and stage in the reproductive cycle) from 5-10/ha in the dry season and 0-5/ha in the wet season. Other recorded densities are 14/ha and 2/ha on Mount Kilimanjaro in Tanzania.

**Habits** Terrestrial, diurnal and nocturnal, omnivorous. Mesic Four-striped Mice show a strong preference for the habitats listed above and are never found in montane forests (where *Praomys delectorum* was

the most abundant species). There is no information in Malawi about how these mice respond to fire, but on Mount Elgon, there was no significant difference in the numbers in burnt and unburnt grasslands, once the grasses had regrown in the burnt areas. In this respect, Four-striped Grass Mice responded in a similar way to *Mus triton* on Zomba Plateau (where *R. dilectus* is not present). On Mount Kilimanjaro, they were especially common around mountain huts where they foraged on food left by humans.

Mesic Four-striped Grass Mice are social animals, and several may live together amicably. They make round grass nests in dense herbage close to the ground. They are active in daylight and at night. The other species of *Rhabdomys* - *R. pumilio* – which lives in xeric environments in southern Africa (see above) is much more social and lives in large groups and higher densities than *R. dilectus*. (In contrast to *R. dilectus*, *R. pumilio* has been studied in great detail.)

On Nyika Plateau, analysis of stomach contents showed that the diet comprised green plant material (50% of stomachs), white material (seeds etc. 43%) and insects 33%). On Mount Elgon, the diet consisted of seeds, lichens, herbs, grasses and invertebrates.

**Reproduction** Very little information. In Malawi, embryos or young in a nest have been recorded in Nov, Mar, May and Nov (end of wet season and dry season). Litter-size: 4.5 (2-7).

**Conservation** IUCN Category: Least Concern. The populations of *R. dilectus* are isolated from each other, and therefore prone to local extinction (except perhaps in some parts of E. Zimbabwe). Destruction of their habitat is therefore a major conservation concern.

**Taxonomic Notes** *Rhabdomys dilectus* (de Winton, 1897). Previous publications (e.g. Sweeney 1969, Ansell & Dowsett 1988) and Happold & Happold (1989a) have referred to this species as *Rhabdomys pumilio*. The name *dilectus* was originally used as a subspecific name – *Rhabdomys pumilio dilectus*. Recent research, using genetical and biochemical characters, has shown that the correct name for the species in Malawi (and also Tanzania, Kenya and Uganda) is *R. dilectus*. The name *R. pumilio* (Xeric Four-striped Grass Mouse) is now restricted to the species in dry and semi-arid environments in South Africa, Namibia and Angola. The information given here refers only to *R. dilectus* in Zimbabwe and countries further north (see Distribution).

**Key Reference** Happold & Happold **(**1989b), Happold D. C. D. (2013k) as *Rhabdomys pumilio*.

**Measurements**
*Rhabdomys dilectus*

| | |
|---|---|
| HB: | 110.1 (102-118) mm, n = 13 |
| T: | 90.7 (64-106) mm, n = 12 |
| HF: | 21.2 (20-29) mm, n = 13 |
| E: | 13.3 (12-16) mm, n = 12 |
| WT: | 45.6 (36-62) g, n = 12 |
| GLS: | n. d. |

Malawi (HC, NHMUK).

# Genus *Saccostomus* – Pouched Mice

Family Nesomyidae, subfamily Cricetomyinae. This genus contains two species, widely distributed in savanna habitats in east and southern Africa. The southern species occurs in Malawi. It is a small mouse with a relatively short tail, grey dorsal pelage and pure white ventral pelage, and well-developed cheek pouches (see Table-key 8).

## *Saccostomus campestris*

## Cape Pouched Mouse

**Malawian Names** Dugu, Chatute, Jugu, Takula, Tsambe.

Lengwe N. P., Malawi © DCD & M. Happold

**Description** Small, thickset warm-grey mouse with white belly and relatively short tail. Pelage soft, thick, dense, smooth. Dorsal pelage grey lightly suffused with fawn, with some longer black-tipped hairs along mid-dorsal line; hairs dark grey at base, medium grey or fawn-grey at tip. Ventral pelage pure white; dorsal and ventral colours clearly delineated. Chin, throat, lower cheek and base of muzzle white. Head broad, with short blunt muzzle. Eyes, small, black. Well-developed internal cheek pouches extending almost as far back as the shoulders; very conspicuous when full of seeds. Ears short and rounded, darkly pigmented. Limbs short and stocky. Fore- and hindfeet white; four digits on forefeet (Digit 1 reduced in size without claw); five digits on hindfeet. Tail relatively short (39 [25-47]% of HB, n = 23), without scales, dark above, white below, with sparse short bristles. Scrotum large and very prominent in mature males. Young animals are darker than adult animals.

**Similar Species**

*Steatomys pratensis*. Dorsal pelage sleek. On average smaller (HB: 90.8 [80-106] mm). Tail relatively much longer (ca. 60% of HB). No cheek pouches. Scrotum of adult males not prominent. Sometimes very fat.

**Distribution** Widespread particularly in the southern half of the country from about Liwonde and Ntcheu southwards. Localities include Chididi, Chikwawa, Chiromo, Karonga, Lengwe N. P., Limbe, Liwonde N. P., Mangoche, Maperewa, Matope, Mikolongwe, Mpemba, Mulanje Mountain (Nalipili rest house), Mulanje Mission, Mwanya River, Nankundah (near Zomba), Ntcheu, Nyika N. P. (Chipome Valley at ca. 1530 m), Viphya Plateau, Zoa Tea Estate, Zomba and Zomba District. Not recorded at higher altitudes (i.e. Mulanje Mountain, Nyika Plateau, Zomba Plateau). Elsewhere: widespread south of a line (ca. 9˚00' S) from C Angola, SE DR Congo, Zambia to S Tanzania, except in coastal regions from SW Angola to Namibia, and parts of W South Africa and E South Africa.

**Habitat** Grasslands, grassy woodlands (e.g. open canopy miombo and mopane woodlands), farmlands and other cultivated areas, and thicket-clump savanna. Shows a preference for sandy areas with bushes and grassland.

**Abundance** Common (in the trappable population) at preferred localities and certain seasons of the year. In thicket-clump savanna in Lengwe N. P., mostly uncommon in the trappable population during the dry season because they aestivate (0–1 trappable individuals/ha), but more abundant during and immediately after the wet season (up to 6/ha). During a ten-month period, they comprised 11% of the trappable small mammal community, ranging from 0 to 1% in drier months and up to 28% in wetter months (see also below).

**Habits** Terrestrial, nocturnal, herbivorous/granivorous. These small pouched rats dig burrows in sandy soil, and sometimes in old termite mounds. When active at night, they range widely, collecting seeds and small fruits in their cheek pouches, in the same way as *Cricetomys gambianus*. The burrows are used for nesting, and for storing the seeds and small fruits of many species

of shrubs and trees (and occasionally grasses). When active during the wet season, they collect and store seeds, and also gain weight (stored body fat). During the dry season, they stay in the burrows; energy requirements are reduced, body temperature drops, and they utililize the energy from their stored body fat and from food already stored in the burrow. This is called aestivation. Because of their small size and short limbs, they walk and run slowly in a waddling gait. Although primarily herbivores, they are opportunistic and feed on insects at some times of the year. A study in South Africa (Kruger National Park) found that the diet comprised 31% insects, 12% herbage (fresh grasses etc.) and 57% seeds during the dry season, and 9% insects, 12% herbage and 79% seeds in the wet season. Individuals live singly or in pairs or family groups. In captivity, individuals showed amicable behaviour towards conspecifics, although a female with young may show minor aggression towards a male and chase him away. Alternatively, a few days after parturition, mother and father share the nest with the young. When resting in a nest, an individual curls up on its side with its head twisted to face its tail, and its tail curled round towards the head.

**Reproduction** In Malawi, pregnant females were found in Apr-May (warm late wet season), Aug-Sep (cool dry season) and Dec-Jan (warm early wet season). Gestation: 20–21 days. Litter-size: 5.1 (3-9). Elsewhere: litter-size varies geographically, e.g. 4.8 (2–8) in South Africa, 7 (5–10) in Botswana, and 6.7 (1–10) in Zimbabwe. Neonates are thinly covered with short hairs and weigh ca. 2.8 g. Weaned Day 19–25 when 11-15 g. Females can produce their first litter at Day 96.

**Conservation** IUCN Category: Least Concern. Because of its wide biogeographic range, the only conservation threat is habitat destruction.

**Taxonomic Notes** *Saccostomus campestris* Peters, 1846. No subspecies recognised. One previously recognised subspecies (*S. c. mearnsi*) was included within this species, but now *mearnsi* is considered to be a separate allopatric species occurring to the north of *S. campestris* (i.e. N Tanzania, Kenya, S Somalia and SW Ethiopia).

**Key Reference** Perrin (2013c).

**Measurements**
*Saccostomus campestris*

| | |
|---|---|
| HB: | 104.0 (90–127) mm, n = 23 |
| T: | 39.6 (29–45) mm, n = 23 |
| HF: | 17.8 (16–20) mm, n = 23 |
| E: | 15.4 (14–18) mm, n = 23 |
| WT: | 42.8 (32–62) g, n = 19 |
| GLS: | 30.7 (29.0–33.5) mm, n = 17* |

Malawi (HC, NHMUK).
*Malawi and Zambia (NHMUK).

## Genus *Steatomys* – Fat Mice

Family Nesomyidae, subfamily Dendromurinae. This genus contains eight species, endemic to Africa and widespread in savanna habitats south of the Sahara. They are called Fat Mice because they can lay down substantial amounts of subcutaneous fat which enables them to become torpid when conditions get cold. One species occurs in Malawi. It is a small mouse with a relatively short tail, brown dorsal pelage and pure white ventral pelage (see Table-key 8).

### *Steatomys pratensis*

### Common Fat Mouse

**Malawian Names** Chingowe, Kabeta, Kabwanda, Kafula, Nsana

Thondwe, Malawi © DCD & M. Happold

**Description** Small mouse with relatively short tail; often very fat. Pelage short, soft, glossy and sleek. Dorsal pelage rusty-brown heavily suffused with grey or black, becoming paler and more rusty-brown on flanks; hairs grey with rusty-brown or black at tip. Ventral pelage pure white; hairs white. Dorsal and ventral colours clearly delineated. Head similar in colour to back; cheeks orange-brown. Eyes black and beady. Ears relatively large, naked. Vibrissae short and fine, some black, some white. Upper and lower lips, throat, fore- and hindfeet white. Forefeet with four digits, each with a long claw; hindfeet with five digits, each with a long claw. Tail relatively short (52.2 [44-61]% of HB, n = 3), thin, brown dorsally and whitish-grey ventrally, almost naked. Adults tend to be fat to extremely fat especially at the end of the wet season.

**Similar Species**

*Saccostomus campestris.* Dorsal pelage smooth. On average larger (HB: 104.0 [90–127] mm). Tail relatively much shorter (39 [25-47]% of HB). Internal cheek pouches. Scrotum of mature males very prominent.

**Distribution** Widespread in the southern half of the country (south of ca. 13˚S). Southern localities include Blantyre, Chididi, Chiromo, Lengwe N. P., Likhubula, Liwonde N. P., Matope, Ntcheu, Songwe, Tengani, Thondwe, Thyolo and Zomba. There are only two records in the northern half of the country (Chitipa, and Nyika N. P. (Chipome Valley). Elsewhere: S Tanzania, S Zambia, Zimbabwe, N South Africa, eSwatini and small areas of SW DRC, NE Angola and C Namibia.

**Habitat** Woodlands and grasslands, farmlands, and tall grasslands that are seasonally flooded. In Malawi recorded from ca. 50-1500 m. Not recorded in montane habitats.

**Abundance** In Malawi and elsewhere, abundant in some localities, but rare in others. Because they aestivate in the dry season (and are rarely encountered at this time) they may be more numerous than surveys suggest.

**Habits** Terrestrial, nocturnal, herbivorous. Common Fat Mice tend to be solitary or to live in pairs. They dig extensive burrows in sandy soil. In Malawi, excavated burrows extended over ca. 220 cm and to a depth of ca. 90 cm; each had numerous blind tunnels, a nesting chamber, and 1-3 entrance holes (some blocked at the surface).

Common Fat Mice feed on seeds, vegetable material and arthropods. Some food (small plant tubers) is stored in the nesting chamber. During the wet season, when food is abundant, Common Fat Mice accumulate fat in their bodies which is utilized to produce energy in the dry season of the year. One male individual examined in June in Lengwe N. P. contained 7 g of subcutaneous fat and 3 g of abdominal fat, comprising ca. 30% of its body weight. At this time of year, Common Fat Mice look very plump!

During the dry season, Common Fat Mice spend a lot of time underground in their burrows; they aestivate for many days or weeks and, at these times they are torpid, inactive, their body metabolism is reduced, and they live off their stored body fat.

Owls prey extensively on Common Fat Mice at most times of the year, especially (in Malawi) in April-May when the mice appear to spend more time above ground than below ground.

**Reproduction** In Malawi, a litter of 7 was born on 13 March. Neonates were altricial and weighed ca. 2.5 g. Eyes opened Day 20. Weaned Day 33. In Zimbabwe, litter-size: 3.2 (1-9). Pregnant females found in Feb, Apr, May, Sep and Oct. Gestation: not known.

**Conservation** IUCN Category: Least Concern. Biogeographic distribution is widespread, including in human-modified landscapes (agricultural areas). In some regions, Common Fat Mice are eaten by humans because of their high fat content.

**Taxonomic Notes** *Steatomys pratensis* Peters, 1846. No subspecies. Previously, several names (considered to be subspecies) were recognized, including *nyasae* from Likhubula at the base of Mt Mulanje.

**Key Reference** Monadjem (2013f).

**Measurements**
*Steatomys pratensis*

| | |
|---|---|
| HB: | 90.8 (80-106) mm, n = 5 |
| T: | 44.6 (27-55), mm, n = 5 |
| HF: | 16.8 (16-18) mm, n = 4 |
| E: | 16 (15-17) mm, n = 4 |
| WT: | 28.7 (18-35) g, n = 3 |

Malawi (HC, D. C. D. Happold *unpubl.*).

# Genus *Thallomys* – Acacia Rats

Family Muridae, subfamily Murinae. This genus contains four species, widely distributed in arid and savanna habitats in eastern and southern Africa, where *Acacia* trees are present. They are arboreal. Only one species occurs in Malawi. It is a medium-large rat with a relatively medium length black tail (no pencil) and pure white ventral pelage (see Table-key 8).

## *Thallomys paedulcus*

## Sundevall's Acacia Rat

**Malawian Names** Lipuku, Sontho.

**Description** Medium-large, greyish arboreal rat, with a black tail of medium relative length. Pelage texture long, fine, soft, and fluffy; hairs 15-17 mm. Dorsal pelage greyish-fawn on back, merging into whitish-grey on flanks; hairs grey at base tipped with greyish-fawn or black. Ventral pelage, lips, chin and cheeks pure white. Eyes moderately large with a black eye-ring; the black colour extending to the muzzle. Long vibrissae, black or white. Ears large, prominent, wide; with sparce short greyish-fawn hairs. Fore- and hindfeet white with short strong claws. Tail of medium relative length (115.3 [100-131]% of HB, n = 4), well covered with short black bristles for most of the length; tail conspicuous because most of it is black.

**Similar Species**

*Grammomys* spp. Dorsal pelage brownish; no black eye-ring; almost always smaller (HB: 90-140 mm), tail relatively long and with inconspicuous pencil of longer hairs at tip.

**Distribution** Recorded only in the southern half of Malawi - on the Central Plateau, Lake Shore and Upper and Lower Shire Valleys. Localities include Chididi, Chiromo, Kasungu, Liwonde, Mangochi and Matope. Elsewhere: Angola, Botswana, Zimbabwe, Mozambique (south of the Zambezi R.), eSwatini, S Zambia, S DR Congo, Tanzania, Kenya, S Ethiopia and S Somalia. In southern Africa, distribution is widespread, but localized throughout most of the biogeographic range.

**Habitat** Woodland savannas, especially where there are Acacia trees (hence the vernacular name of Acacia Rat).

**Abundance** No information from Malawi. Elsewhere: locally common in some suitable habitats, although rare in others.

**Habits** Arboreal, nocturnal, herbivorous. Acacia Rats, together with some species of *Grammomys* (also present in Malawi) are the most arboreal of African murid rodents. They live almost permanently in trees, resting in crevices and holes in the trunk of a tree, and even under loose bark. They build nests made of intertwined twigs and other vegetation high up on the outside branches of Acacia trees. There is a record of an individual nesting in a hole at the top of a *Hyphaene* palm near Chiromo. Often when resting on a branch, the long black tail drops vertically downwards and is easily recognizable.

At dusk, Acacia Rats emerge from their holes to forage. They run along the branches with great agility, using the long tail for balance; it seems that certain branches are used as "highways" leading to areas where they forage. The "highways" are marked by secretions from glands. Acacia Rats live in small groups, typically a pair with their latest young (and perhaps with young from a previous litter). The diet is mainly the young leaves, flowers, green twigs and the outer case of the seed pods of Acacia trees. Acacia Rats have a very complex stomach (more complex than in most other rodents) which, aided by microflora, is able to detoxify the chemicals in the food. Predators include the Giant Eagle-owl *Bubo lacteus.*

**Reproduction** In Malawi, pregnant or lactating females have been recorded in Jan, Apr and May (possibly no data for other months). Litter-sizes of 2 and 4 have been recorded. Elsewhere: reproduction takes place in the warmer and wetter months of the year. In Zimbabwe, pregnancies have been recorded in Aug, Nov and Dec, and in Botswana (where sampling occurred throughout the year), pregnancies were recorded in Oct, Feb, Mar and Apr. Mean litter-size: 2.7 (South Africa, in captivity). Neonates are altricial and hairless. Incisors erupt Day 1; ear pinna open on Day 1; eyes open on Day 15; efficient walking Day 15; weaning occurs on Day 28–31; minimum age at maturity (age at first litter) Day 107. Mothers nipple-drag until Day 25.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Thallomys paedulcus* (Sundevall, 1846). No subspecies. There is considerable variation in pelage colour, length of hairs and the extent of the black eye ring in different parts of the biogeographic range; in some parts, there is seasonal variation in pelage colour and texture.

**Key Reference** Perrin (2013d).

**Measurements**
*Thallomys paedulcus*

| | |
|---|---|
| HB: | 140.3 (130–155) mm, n = 6 |
| T: | 166.2 (157–179) mm, n = 5 |
| HF: | 25.3 (24–27) mm, n = 6 |
| E: | 20.8 (19–22) mm, n = 6 |
| WT: | 72.3 (55–85) g, n = 6 |
| GLS: | 32.8 (30.2–34.6) mm, n = 9 |

Zambia and South Africa (DNMNH, HZM).

# Genus *Uranomys* – Rudd's Brush-furred Mouse

Family Muridae, subfamily Deomyinae. There is currently only one species in this genus. It is widespread but disjunctly distributed in savanna habitats from West Africa to the eastern side of Africa (west Ethiopia to Zimbabwe). It is a small, relatively short-tailed mouse with stiff pelage (see Table-key 8).

## *Uranomys ruddi*

## Rudd's Brush-furred Mouse

**Malawian Name** Not known.

**Description** Small mouse with small limbs, relatively short tail and stiffened hairs on back and rump. Pelage short and stiff (as in a watercolour paint brush); dorsal hairs not easily rubbed the wrong way. Dorsal pelage grey to greyish-brown, flecked with rufous-brown and black; hairs dark grey with rufous-brown tip, or with pale brown subterminal band and black tip. Centre of back almost black. Dorsal hairs not spiny as in Least Spiny Mice (*Acomys* sp.). Ventral pelage dirty-white, sometimes tinged with pale cinnamon; hairs mostly grey with whitish tip. Colour of flanks merges gradually with colour of ventral pelage. Head rather slim and pointed, with small eyes and small ears. Chin, throat, chest and limbs white. Limbs short. Tail relatively short (52 [49-56]% of HB, n = 3), brownish, with scales and numerous very small black bristles. Skin thin and fragile; many individuals have damaged ears, and the tail is frequently shortened or completely absent. Incisor teeth pro-odont.

**Similar Species**

*Mus minutoides*. Smaller (HB: 54.8 [45–68] mm, T: 41.0 [38–49] mm), pelage soft.

**Distribution** In Malawi, recorded only from Likhubula, Matope, Mkhoma (Dowa district) and Thyolo. Elsewhere: widespread in West Africa with scattered small isolated populations. In central and eastern Africa, recorded in Uganda, Zimbabwe, N Cameroon, Central African Republic, Chad, NE DR Congo, C Tanzania and W Ethiopia. Although recorded in many countries of Africa, all populations are discreet and isolated.

**Habitat** Grasslands and wooded grasslands. The optimal habitat has abundant grasses, few trees and moist soil, which provides moist or semi-swampy conditions. Also occurs in farmland (where soil is moist and friable) and in oil palm plantations (where there are moist grasses and grass litter). One individual in Malawi was found "in hole of Mole-rat on wooded hills", and others were found close to a river swamp where there were many ant and termite mounds.

**Abundance** No information for Malawi. Generally rare and seldom encountered, but quite common at a few study sites in West Africa, e.g. 29% of small rodents in grass savanna at Lamto, Côte d'Ivoire, 31% in farmland at Ibadan, Nigeria, and 44% in grass swamp at Ibadan,

**Habits** Terrestrial, nocturnal, insectivorous. Rudd's Brush-furred Mice dig burrows, using their short strong feet. An excavated nest (in Côte d'Ivoire) was about 15 cm below ground, and had a nest chamber 6–8 cm in diameter lined with fresh cut grass. Entrance holes were plugged. Individuals in captivity (in Nigeria) burrowed under litter and grass when disturbed. They blocked the entrances to their burrows and nest boxes with soil which was sometimes glued together with fluid (? saliva). The pro-odont incisor teeth may be used for catching and holding insect prey, in a similar manner to shrews.

Rudd's Brush-furred Mice are primarily insectivorous: the contents of two stomachs from Malawi contained the remains of adult insects, dipteran larvae, and ant pupae. Vegetable foods include cassava (manioc) and bulbs of savanna plants. Stored food has not been found in burrows.

**Reproduction** No information for Malawi. In Côte d'Ivoire, pregnancies have been recorded in all months, and juveniles have been found in all months except Oct, Feb and Aug. Peak of reproductive activity was in late wet season (Aug–Dec). Mean number of embryos varied seasonally: 4.3–5.7 (late wet season), 2.6–3.7 (dry season and early wet season).

**Conservation** IUCN Category: Least Concern. However, although its biogeographic range is large, its rarity (in most habitats) and loss of suitable habitat are causes for concern.

**Taxonomic Notes** *Uranomys ruddi* Dollman, 1909. No subspecies. Interestingly, two specimens from Malawi were designated as type specimens:

*Uranomys woodi* from Thyolo (as Cholo) and *Uranomys tenebrosus* from Mkhoma (near Dowa). Later, both *woodi* and *tenebrosus* were considered to be subspecies of the earlier described *Uranomys ruddi*. Currently, none of the subspecies are considered to be valid.

**Key Reference** Happold, D. C. D. (2013l).

**Measurements**
*Uranomys ruddi*

| | |
|---|---|
| HB: | 107.5 (87-134 mm, n = 4 |
| T: | 59.3 (54-69) mm, n = 3 |
| HF: | 18.3 mm, n = 1 |
| E: | 17.5 mm, n = 1 |
| WT: | n. d. |
| GLS: | 27.0 (25.9-30.1) mm, n = 5 |

Malawi (Hinton 1921, Hanney 1965).

## Genus *Zelotomys* – Broad-headed Mice

Family Muridae, subfamily Murinae. This genus contains two species, *Z. hildegardeae* in grassland habitats in eastern and central Africa (including Malawi), and *Z. woosnami* in arid and semi-arid habitats in southern Africa. The species in Malawi is a medium-sized mouse with a relatively short tail, soft pelage and pro-odont upper incisors. Superficially, it strongly resembles *Mastomys natalensis* (see Table 8). There is considerable variation in the colour of *Z. hildegardeae* but we have not traced any specimen resembling the painting in Nell (2013). The following description is based on the holotype (from Kenya), two specimens from Malawi (Nyika Plateau and Viphya Plateau) and five specimens from Zambia (Ndola), in the NHMUK. The specimen from Nyika Plateau is identified as *Z. hildegardeae;* the specimens from Viphya Plateau and Ndola were originally identified as *Z. shortridgei* but *shortridgei* is currently considered to be a synonym of *hildegardeae.*

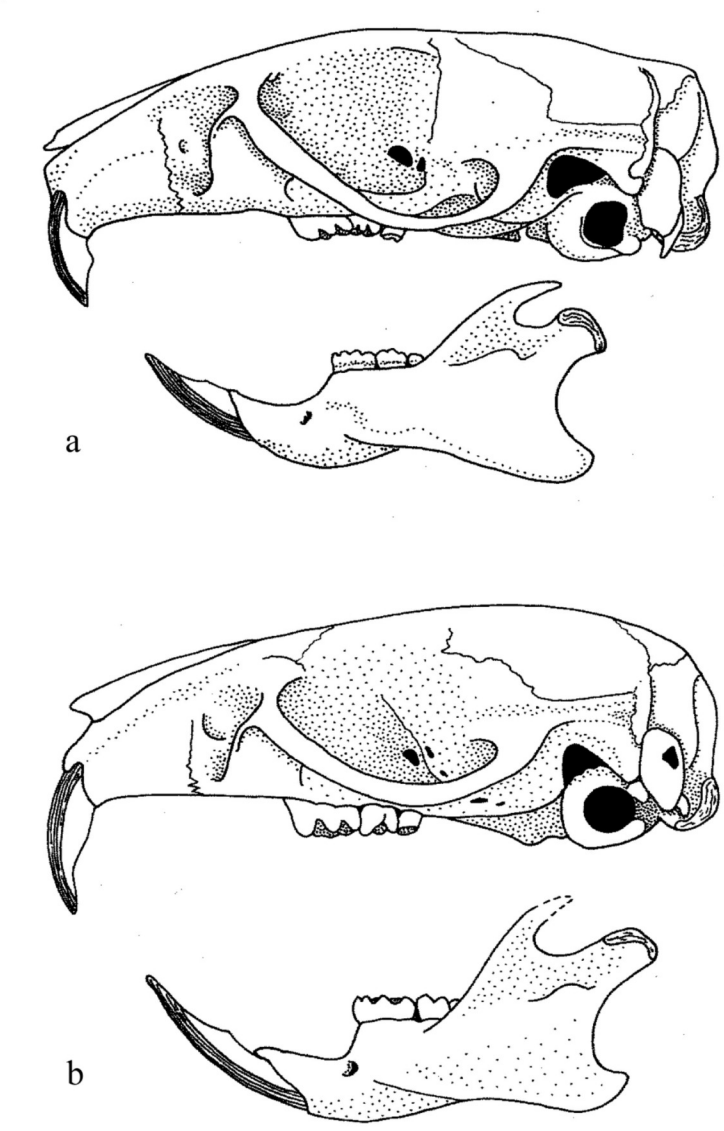



Fig. 20. Skulls of (a) *Mastomys* showing orthodont upper incisors and (b) *Zelotomys* showing pro-odont upper incisors.

## *Zelotomys hildegardeae*

## Hildegarde's Broad-headed Mouse

**Malawian Name** Not known.

**Description** (Malawi, Zambia and holotype). Medium-sized mouse with slightly broadened skull and long pro-odont incisors. Pelage soft, slightly silky without sheen. Dorsal pelage reddish-brown or brownish-grey: hairs dark grey at base with reddish-brown at tip. Ventral pelage off-white, pale grey or brownish-grey; hairs grey at base, off-white, pale grey or brownish-grey at tip. Colours of dorsal and ventral pelage merge on flanks except in the specimen from Nyika in which the colours are faintly delineated and the holotype in which the colours are moderately delineated. Head somewhat broadened (greatest width skull ca. 56-58% of GLS). Crown similar in colour to dorsal pelage. In the holotype, the cheeks, snout and chin are the same colour as the ventral pelage. In the other specimens, the cheeks are either the same colour as the crown or just slightly paler. Vibrissae dark. Ears small, oval, darkly pigmented, sparsely haired with scattered short pale brown hairs. Feet off- white or buffy-brown. Forefeet with four digits, each with claw. Hindfeet with five digits, each with claw; Digit 1 and Digit 5 much shorter than Digits 2, 3 and 4. Tail rather solid and stumpy, buffy off-white often slightly darker at base and tip; mostly naked and ringed with small scales; hairs sparse and short, white to greyish-brown. Tail 79 (72-90)% of HB, n = 7. To humans, the secretions from glands in the skin have a strong unpleasant smell, as have some species of shrews. Upper incisor teeth ungrooved, long and pro-odont. Females have 10 nipples, arranged in five pairs; the most anterior pair is anterior to the forelimbs.

The illustration in Mammals of Africa, Vol. III, p. 568, is erroneous.

**Similar Species**

*Mastomys natalensis*. Tail dark dorsally, relatively longer (111 [96-127]% of HB); females with up to 24 nipples arranged in 12 pairs; incisor teeth orthodont.

**Distribution** In Malawi, recorded only from Nyika Plateau (Chelinda, Chipome Valley, Nganda) and Viphya Plateau. Elsewhere: recorded from N Angola, N Zambia, Tanzania, W Kenya, W Uganda, Rwanda, Burundi, NE DR Congo and South Sudan; perhaps also E CAR.

**Habitat** On the Nyika Plateau, recorded from a pine plantation and near houses at Chelinda, in montane grasslands with patches of shrubs along the edges of a stream at Nganda (2200-2300 m) on the SW slopes of Nganda Mountain, and in miombo woodland, tall grasses and shrubs at river banks, (ca. 1530 m) at Chipome Valley.

**Abundance** Rare. At Nganda on Nyika Plateau, they comprised 2.5% and 3% of terrestrial small rodents when surveyed in a wet season and a dry season respectively. In Uganda, Rwanda and E DR Congo, they comprised between 0.3% and 2.6% of small rodents in four surveys in grasslands.

**Habits** Terrestrial, nocturnal, insectivorous. There is almost no information about this species. The pro-odont incisors suggest an insectivorous diet: contents of stomachs have included Orthoptera, "insects", and "remains of insects and fruits". Hildegarde's Broad-headed Mice make a high-pitched whistling noise; the function of this is not known.

**Reproduction** No information for Malawi. In Kenya, pregnant females have been recorded in Jun and Nov, and in Uganda, in Feb, Mar, May–Jul (but no information for other months). Litter-size (Kenya and Uganda): 4.6 (3–7).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Zelotomys hildegardeae* (Thomas, 1902). No subspecies.

**Key References** Chitaukali *et al.* (2001), Delany 1975.

**Measurements**
*Zelotomys hildegardeae*

| | |
|---|---|
| HB: | 126.7 (115–137) mm, n = 7 |
| T: | 100.3 (90–110) mm, n = 7 |
| HF: | 22.8 (22–25) mm, n = 7 |
| E: | 16.4 (16–18) mm, n = 7 |
| WT: | 71.4 g, n = 1 |
| GLS: | 31.4 (30.6-32.3) mm, n = 9* |

Malawi (n = 2, NHMUK),
Zambia (n = 5, NHMUK).
*Kenya, Uganda, Malawi (NHMUK)

## FAMILY BATHYERGIDAE – Mole-rats

The family Bathyergidae contains about 15 species, but only three are recorded from Malawi. As their vernacular name indicates, they are entirely subterranean in their habits and rarely come to the surface. They live in complex burrow systems, have cylindrical bodies and short strong limbs; the eyes are very small and vestigial, and external ears are absent. They have huge forward-angled incisor teeth which protrude through the lips and are always visible outside the mouth (a unique characteristic). Consequently mole-rats can use their incisors to scrape through soil and bite through roots without getting soil into their mouths. They feed on roots and bulbs. (In contrast, moles of the northern Hemisphere belong to the Order Soricomorpha [as do the shrews] and they feed on arthropods and worms). The family Bathyergidae occurs only in Africa.

### Genus *Fukomys* – Mole-rats

This genus, described in 2006, contains about 17 species that were formerly placed in the genus *Cryptomys*. However, *Cryptomys* has been split into two genera – *Fukomys* (widespread and mostly north of the Zambezi River) and *Cryptomys* (restricted to south of the river). Both genera are endemic to Africa. Species of *Fukomys* are found in western, central and southern Africa except in the Sahara, Horn of Africa and in the tropical rainforests. Two species occur in Malawi in widely separated localities.

*F. cf darlingi*. Ventral pelage brown, with white mid-ventral stripe. Southern Malawi only (Nsanje, Chididi and in hills west of Chididi).

*F. whytei*. Ventral pelage greyish-buff to whitish without a pale mid-ventral stripe. Northern Malawi only (north of Kasungu N. P. and the Bua River).

## *Fukomys* cf. *darlingi*

## Mashona Mole-rat

**Malawian Name** Not known.


Nsanje, Malawi © R. Šumbera

**Description** Dorsal and ventral pelage greyish-brown, darker in colour on back (and sometimes on forehead). Pelage dense and short. Ventral pelage brown, with white stripe on ventral mid-line, variable in width and length. Head broad with variably shaped white patch on forehead; long white vibrissae. Eyes very small. Incisor teeth project forwards through the lips. Limbs short. Tail relatively short (ca. 9% of HB) covered with very short hairs.

**Similar Species**

*Fukomys whytei.* Ventral pelage greyish-buff to whitish without a pale mid-ventral stripe.

*Heliophobius argenteocinereus*. Pelage long (20–25 mm) and silky.

**Distribution** In Malawi, recorded only from Chididi (75 m) and in the hills to the west of Chididi (600-650 m), and Nsanje (50 m). These are the only known localities for this species north of the Zambezi River. Elsewhere: recorded south of the Zambezi river in N Zimbabwe and adjacent parts of E Mozambique.

**Habitat** No information for Malawi. In Zimbabwe, recorded in sandy and granitic soils in *Brachystegia* and *Julbernardia* grasslands and woodlands. Also occurs in some dambos (swamps) with tall grasses, agricultural fields and wastelands.

**Abundance** No information for Malawi. Elsewhere: common in suitable habitats.

**Habits** Subterranean, herbivorous. All field studies of this species have been made on individuals and colonies in Zimbabwe. These social mole-rats live in small families of 5-9 individuals, comprising a reproductive pair and their young of several litters. Within the family, the reproductive male and female are the most dominant, and other males tend to be dominant over females. The complex underground burrows consist of numerous tunnels, feeding areas, resting areas and food stores. Tunnels range from being fairly shallow (e.g. 12 cm deep) to fairly deep (e.g. ca. 75 cm deep). Mounds of soil ('mole-hills') on the surface indicate where the mole-rats are actively burrowing. Most 'mole-hills' are formed during and just after the wet season (November to May/June) when the soil is soft; some burrowing may occur during the dry season. Mashona Mole-rats feed a variety of bulbs, bulb-like bases of grasses, and rhizomes. In agricultural fields, they feed on subterranean parts of cassava and sweet potato.

**Reproduction** No information for Malawi except that one female from Nsanje was pregnant with three embryos in August. In Zimbabwe, reproduction is aseasonal. The females solicit the male when she is in oestrus. Gestation: ca. 56-61 days. Litter-size: 2 (1-3). Neonates are naked and blind, and weigh 7-8 g. Pelage first appears at ca. Day 4, eyes open on Day 14-19, and solid food is first eaten on Day 14. Weaning occurs at ca. Day 45.

**Conservation** IUCN Category: Least Concern. Although there appears to be no conservation threats in the main areas of distribution, this species is rare in Malawi and recorded only from Nsanje and Chididi.

**Taxonomic Notes** *Fukomys darlingi* (Thomas, 1895). Formerly referred to as a subspecies of *Cryptomys hottentotus* but now considered to be a separate species (*darlingi*). Ansell & Dowsett (1988) maps this species as *Cryptomys hottentotus* but notes that the Nsanje records are far removed from other records in the north of the country and might represent *Cryptomys hottentotus darlingi* (a prediction now known to be correct). Thus the '*Cryptomys hottentotus'* map in Ansell & Dowsett (1988) actually maps what are now considered to be two species: *F. whytei* in the north of Malawi, and *F.* cf. *darlingi* at Nsanje in the far south. The taxonomic status of the Nsanje individuals is uncertain; they appear to belong to the "*darlingi* clade" although further studies may indicate that they represent a

separate species – hence, at the present time, they are referred to as *Fukomys* cf. *darlingi*.

**Key References** Bennett (2013), Long (1973).

**Measurements**
*Fukomys* cf. *darlingi*

| | |
|---|---|
| HB: | 147.5 (135-170) mm, n = 6. |
| T: | 17.7 (16-18) mm, n = 6 |
| HF: | 25.5 (24-28) mm, n = 6 |
| E: | 0 mm, n = 6 |
| WT: | 125 (93-183) g, n = 6 |
| GLS: | n. d. |

Malawi (Nsanje, R. Šumbera pers. comm.).

## *Fukomys whytei*

## Whyte's Mole-rat

**Malawian Names** Mfuko, Kamzumi. Not confined to this species.


S Tanzania © R. Šumbera

**Description** Medium sized mole-rat. Pelage short (3-4 mm) and soft, much shorter than for *Heliophobius argenteocinereus*). Dorsal pelage greyish-buff to whitish; hairs dark grey on basal half, gingery-brown on terminal half. Ventral pelage similar to dorsal colour. Small head spot present or absent. Limbs short. Forefeet with five digits; Digits 2 and 3 long, Digit 4 half as long as Digits 2 and 3, Digits 1 and 5 short (not reaching level of other digits). Tail very short (ca. 13% of HB), covered by short hairs with long (6-8 mm); pale hairs at tip. Both sexes are about the same size, although males are heavier than females.

**Similar Species**

*Fukomys* cf. *darlingi*. Ventral pelage brown, with white mid-ventral stripe.

*Heliophobius argenteocinereus*. Pelage long (20–25 mm) and silky.

**Distribution** Recorded originally from Karonga, but now known to occur in many localities in northern Malawi (north of Kasungu N. P. and the Bua River). Localities include Chintheche, Kasungu N. P., Misuku and Nyika N. P. Elsewhere: recorded from S Tanzania and NE Zambia, not far from the Malawi border.

**Habitat**. The localities where Whyte's Mole-rats have been found vary greatly. Karonga is in the Lake Shore biogeographic area (480 m) and is characterized by grasslands, miombo woodlands, agricultural fields, a long dry season (Apr-Sep) and a hot wet season (Nov–Mar). Specimens from the Nyika N. P. come from a valley below the plateau (ca. 1560 m) with miombo woodland; here the soil is hard and dense with poor subterranean food resources.

**Abundance** No information.

**Habits** Subterranean, herbivorous. The burrows are complicated and include separate chambers for food storage, nesting, and for depositing faeces. Burrows excavated near Karonga were constructed under fields of cassava and sugar cane, uncultivated fields and in bamboo thickets. There were many tunnels, 10-80 cm below the surface; at the lower depths, the temperature and relative humidity remained almost constant (ca. 27˚C and 72%) when the soil at the surface was hot and dry (49˚C and 20%). Some tunnels (including foraging tunnels) extended a long way from the central part of the burrow. Whyte's Mole-rat is a colonial species but very little is known about the social life of these mole-rats; in captivity several individuals from the same family can be kept together without displaying agonistic behaviour.

**Reproduction** In Malawi, one female gave birth in Sep. Neonates are hairless, the eyes are closed and the incisor teeth are prominent. Weight at birth: 7.6 (6.5 – 9.8) g, (n = 4). Litter-size: 2 (n = 2).

**Conservation** IUCN Category: Not listed. Conservation concerns may be small biogeographic range and habitat destruction and disturbance.

**Taxonomic Notes** *Fukomys whytei* (Thomas, 1897). No subspecies. Although this species was described as *Cryptomys whytei* in 1897, the taxon *whytei* was for many years considered to be a subspecies (or race or synonym) of *C. hottentotus* – the Common Mole-rat of Zimbabwe and South Africa. Modern genetical and biochemical studies have shown that *whytei* is very different to *hottentotus*, and hence it has been reinstated as a valid species. Ansell & Dowsett (1988) record *whytei* as a subspecies of C. *hottentotus*. Recent studies indicate that *F. whytei,* as understood here, may comprise more than one species, each one having its own non-overlapping biogeographic distribution on the central plateau.

**Key Reference** Burda *et al.* (2005).

**Measurements**
*Fukomys whytei*

| | |
|---|---|
| HB (males): | 142.5 ±12.6 mm, n = 4 |
| HB (females): | 143.5 ± 3.4 mm, n = 4 |
| T (males): | 17.7 ± 2.1 mm, n = 4 |
| T (females): | 17.7 ± 1.3 mm, n = 4 |
| HF (males): | 24.6 ± 2.4 mm, n = 4 |
| HF (females): | 23.1 ± 0.6 mm, n = 4 |
| E: | 0 mm, n = 4 |
| WT (males): | 132 ± 22.4 g, n = 4 |
| WT (females): | 121.5 ± 10.7, g, n = 4 |
| GLS (males): | 40.3 ± 1.0 mm, n = 4 |
| GLS (females): | 34.8 ± 1.0 mm, n = 4 |

Malawi (Karonga, Burda *et al.* 2005).

# Genus *Heliophobius* – Silvery Mole-rat

This genus is currently considered to contain only one species.

## *Heliophobius argenteocinereus*

## Silvery Mole-rat

**Malawian Names** Mfuko, Namfuko.
Not confined to this species.

Thondwe, Malawi © DCD & M. Happold

**Description** Dark sturdily built mole-rat with very short fluffy tail and large short forefeet. Pelage long (20–25 mm), dense and silky. Dorsal pelage dark grey with silvery-grey to fawn sheen (depending on the angle of light and age of the individual); hairs dark grey with silvery-grey tip. Ventral pelage paler than dorsal pelage. Head, cheeks, eye region and lateral parts of head same colour as dorsal pelage. Eyes very small, surrounded by bare patch of skin. Ears without any external pinna (just the oral opening surrounded by pale skin). Nasal region and upper lip with short pale hairs, flattish, and with short pale vibrissae. The long upper and lower incisors project forward through the upper and lower lips and are clearly visible outside the mouth. Fore- and hindfeet very short and strong. Forefeet broad, pale with short white hairs and five digits, Digits 1 and 5 shorter than Digits 2, 3, and 4. Hindfoot similar to forefoot, Digits 3 and 4 longer than Digits 1, 2 and 5; fringe of stiff hairs on outer edge. Tail very short (ca 8-9% of HB), covered with short grey hairs. Some individuals in some populations have a white patch (of varying size) on the forehead.

**Similar Species**
*Fukomys whytei, Fukomys darlingi.* Pelage short.

**Distribution** In Malawi, Silvery Mole-rats are recorded throughout most of the country from the Nyika Plateau to the far south. Localities include Blantyre, Bua river, Bvumbwe, Chididi, Chikonje (near Chiromo), Dowa, Limbe, Magomero, Mtimbuka, Mulanje, Mwabvi W. R., Ntchisi F. R., Nyika Plateau, Tekerani, Thyolo, Zoa, Zomba, and Zomba Plateau. Elsewhere: recorded from S Kenya, N Mozambique (north of the Zambezi river), Tanzania, NE Zambia, and SE DR Congo.

**Habitat** *Combretum* and *Brachystegia* woodlands, rocky hillsides and montane grasslands. On Nyika Plateau, at Nganda on SW slopes of Nganda Mountain, found in montane grassland with shrub patches on river banks. Frequently burrows under crops of bananas and vegetables. Occurs in a wide range of soils from well-drained easily worked sandy soils to heavy 'cotton soils' that are very hard when dry but sticky and waterlogged when wet.

**Abundance** No detailed information. On the Shire Highlands, in optimal habitats, there may be an average density of up to 4.8 -5.2 individuals/ha.

**Habits** Subterranean, herbivorous. Silvery Mole-rats (like *Fukomys* spp.) are highly adapted for subterranean life. They live in extensive burrows which they construct themselves. Mean burrow lengths are 73 m (range 22–138 m) at Blantyre, and 105 m (range 39–188 m) at Mulanje. Nest chambers are slightly deeper (300 mm) and contain a hollow ball of nesting material (grass, husks of corms, skins of tubers); deeper still is a bolt-hole (up to 540 mm) where a mole-rat can retreat when threatened. Toilet areas are in blind-ending tunnels. When burrowing, a mole-rat uses its strong forefeet alternately, scratching the soil backwards under its body; the hindfeet, with the feet angled outwards, are used in synchrony to push the soil further back, thus blocking the passage just excavated. All digging movements are slow. The presence of Silvery Mole-rats is indicated by mounds of soil on the surface; excavated soil is kicked by the mole-rat along a blind alley up to the surface. When moving above ground (when searching for new habitats or looking for mates),

mole-rats walk with an awkward quadrupedal gait. Although these mole-rats live underground for most of the time (where it is permanently dark and temperature and humidity remain fairly constant) they show a unimodal (and occasionally bimodal) pattern of activity during each 24 h period. It seems as if slight changes in burrow temperature (less than 3˚C) cause the patterns of activity and inactivity.

Food is obtained while burrowing underground. The principal foods are bulbs, tubers and swollen roots. Two tubers, *Vigna* sp. (wild pea) and *Dolichos* sp. (wild bean) are the preferred food and appear to be the key species determining the occurrence of Silvery Mole-rats near Blantyre. In Malawi, other species such as wild gladiolus (*Gladiolus dallenii*), a grass (*Imperata cylindrica*) and African Potato (*Hypoxis* sp.), as well as a variety of cultivated root crops, have also been found in food stores (either in special chambers or blind-ending tunnels). About 30 different plant species (mostly geophytes underground) were consumed by Silvery Mole-rats on the Shire Highands. In captivity, animals are strongly selective, preferring bulbs and tubers (including domestic potatoes) which they peel before eating. They practise coprophagy, seizing faecal pellets with their incisors as they are voided from the anus.

Silvery Mole-rats are solitary, and they aggressively defend their burrows against conspecifics. They make several vocal sounds: a deep abrasive grating (emitted in short syllables) while digging, and high short pitched squeaks when investigating the environment. When threatened they face the source of anger, uttering deep squeaky grunts with the mouth wide open and the incisor teeth facing forwards. When sleeping, a mole-rat curls into a ball, with the head under the body, lying either on its side or upright.

**Reproduction** In Malawi, reproduction is seasonal. Mating occurs during the beginning of the cold dry season (Apr–Jun) and young are born when it is hot and dry (Aug–Oct). Gestation: 87–101 days. Litter size: 3.2 (2–5). At birth, mean weight of young 12.8 g. First solids eaten Day 8–11. Eyes open Day 13–14. Weaned at ca. 2 months. Mean adult weight ca. 12 months. Females are thought to breed when 9-10 months of age and to have one litter/year.

**Conservation** IUCN Category: Least Concern. Hunted for food in some areas; may be an agricultural pest in some farmlands.

**Taxonomic Notes** *Heliophobius argenteocinereus* Peters, 1846. No subspecies are currently recognised although eight subspecies have been recognised in the past. However, many populations are biogeographically isolated, long-distance movements between populations are unlikely, and molecular and genetic studies suggest that some of the isolated populations may be specifically or subspecifically distinct. There are at least five genetically divergent clades within the genus.

**Key Reference** Jarvis (2013).

**Measurements**
*Heliophobius argenteocinereus*

| | |
|---|---|
| HB: | 142 (104-202) mm, n = 28 |
| T: | 11.8 (7-19) mm, n = 20 |
| HF: | 30.1 (23-36) mm, n = 27 |
| E: | 0 (0-0) g, n = 19 |
| WT: | 78.0 (70-87) mm, n = 4 |
| GLS: | n. d. |

Malawi (HC, NMMB).

## FAMILY - HYSTRICIDAE – Porcupines

The family Hystricidae is represented by two genera and three species in Africa. Of these, only one species, in the genus *Hystrix,* occurs in Malawi. It is a very large rodent (WT: 18-22 kg), easily recognized by the long black coarse bristles on the body. Especially noticeable are the hairs on the back, rump and tail (usually referred to as 'quills'); these are longer and thicker than the bristles, pointed at the tip, and have black and white banding along their length. The quills are erectile and can be shaken and rattled when the porcupine is threatened or attacked. The head is large with strong masticatory muscles. See profile for more details

## Genus *Hystrix* – Crested Porcupines

This genus contains about eight species widely distributed in Africa, the Middle East, India, SE Asia and Indonesia. Two species occur in Africa, but only one in Malawi. The closely related North African Porcupine *Hystrix cristata* occurs only to the north of Malawi. There is a slight overlap in the biogeographic distributions of the two species in Tanzania.

### *Hystrix africaeaustralis*

### Cape Crested Porcupine

**Malawian Names** Chinungu, Ndinu, Nungu.

Liwonde N. P., Malawi © Bentley Palmer

**Description** Extremely large rodent, with very long stiff bristles and spines (quills). Dorsal pelage with long stiff black or white bristles anteriorly, and with long smooth quills on midback and rump. Quills with alternating wide black and narrow white bands (usually four or five of each), ending in long white pointed tip; length varying to a maximum of ca. 30 cm, on rump. Nuchal crest (on neck and shoulders) formed of long wiry hairs, up to 45 cm, mostly white with black base. Crest and quills erectile when animal is frightened or threatened. Head, neck and limbs with coarse dark bristles (up to 50 mm). Mid-line of rump white. Head rather broad with short muzzle, swollen nasal region and long dark vibrissae. Eyes small and dark. Ears short, darkly pigmented. Limbs with short black hairs, relatively short and broad; five digits on each foot (Digit 1 of forefoot greatly reduced), each with claws. Tail very short, covered with short weak quills, usually hidden beneath quills of rump; some tail quills are modified to form ‘rattle-quills’ or ‘wine-glass quills’ (ca. 6 cm long, 5–7 mm diameter), which rattle when the tail is shaken.

**Similar Species** None.

**Distribution** Widespread throughout the whole of Malawi in all biogeographic areas. Elsewhere: wide-spread throughout central and southern Africa from S DR Congo eastwards to Rwanda, Burundi, S Uganda and S Kenya and the then southwards to S South Africa.

**Habitat** Cape Crested Porcupines live in many sorts of woodland savannas, as well as in montane areas. Common in rocky hill country. May also occur in farmlands and forest plantations. On Nyika Plateau, one was found at Mondwe Valley (1760 m) in open canopy miombo woodland with tall grasses and shrubs near stream.

**Abundance** Comparatively common in suitable habitats, although rarely seen because of its nocturnal habits. Discarded quills are often the only evidence of the presence of porcupines.

**Habits** Almost nothing is known about Cape Crested Porcupines in Malawi – most of this information refers to porcupines in Zimbabwe and South Africa. Terrestrial, nocturnal and omnivorous. During the day, porcupines rest in caves, natural crevices and burrows. They are good diggers and may excavate their own burrows or take over burrows made by

other animals (e.g. Aardvarks). Burrows may be complex with several chambers. The gait is either a shuffling plantigrade walk or (if frightened or in danger) a clumsy gallop. Studies in South Africa have shown that Cape Crested Porcupines may have a significant effect on their environment due to their habit of chewing the bark and roots of many species of trees and digging for food. They are especially fond of the bark of some species of trees; by removing the bark, such trees are more susceptible to fire and may be killed during subsequent savanna fires. The combination of fire and Cape Crested Porcupines has a strong effect on the species composition and structure of savanna habitats and may help to maintain the mosaic of grasslands and woodland patches. Furthermore, digging for food disturbs the soil and increases the chances of seed germination; seedling density and diversity may be higher where Cape Crested Porupines have been digging than on flat hard soil surfaces.

Cape Crested Porcupines live in monogamous pairs, usually with their young. Family groups live together in burrows, although a group may split up while foraging at night. The size and duration of a family group seems to depend on opportunities for young to disperse when they become mature. Family groups (in South Africa) may, on occasion, be large – up to 14 individuals have been found in a single burrow – and composed of two (or more?) pairs with young.

Home-ranges are large. In *Burkea* savanna in South Africa, mean home-range area in summer was 215 ha, although only about 80 ha of the range (the 'core area') were used extensively. Home-ranges of different individuals overlapped, especially during winter, although the core area was used exclusively by a single individual. Hence individuals are probably territorial with a small territory, advertised by scent marking, within a larger home-range. Winter home-ranges and territories are smaller than those in summer (e.g. 142 ha and 55 ha, respectively). Each territory has 1–3 burrow systems. Cape Crested Porcupines that live and feed in crop areas have larger ranges than those living in natural savanna, and without any seasonal differences in area.

When disturbed or threatened, Cape Crested Porcupines may turn their backs on the source of aggression, and run backwards towards the aggressor with the long back quills held erect and the ' rattle quills' on the tail rattling.

Cape Crested Porcupines feed primarily on roots, bark, bulbs, tubers, berries and other fruits, and the shoots of herbs. They forage above ground, digging for roots and bulbs. They can cause damage to crops and forestry plantations.

**Reproduction** No information for Malawi. Elsewhere: the breeding season varies in different localities. In South Africa (30°S), births occur mostly in spring and summer (the drier and warmer months of the year), from Aug to Mar with a peak in Jan. In Zimbabwe, pregnant females have been recorded in Aug, Sep and Nov. Most females more than 24 months of age (88–95%) are reproductively active during the breeding season, but most young females are less reproductively active. Gestation: 93–94 days. Litter-size (captivity, South Africa) 1.5 (1–3), n = 165, 58% of the females had a single young, 32% had twins and 9% had triplets. Neonates are altricial. Their eyes are closed, they weigh 300–440 g, and their backs are covered with soft spines and soft bristles. Lactation usually lasts 101 days but may continue for 163 days. Litter interval (in captivity) is 385 (269–500) days; hence mothers give birth to only one litter/year. Young remain in the burrow for 7–9 weeks, a much longer period of time compared with other rodents, emerging for the first time when their quills have hardened. Increase in body weight is linear until a weight of 11–12 kg is attained at about 52 weeks; thereafter, there is a slow increase in weight to the full adult size of 12–18 kg. Sexual maturity occurs at 12–24 months of age.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Hystrix africaeaustralis* Peters, 1852.

**Key References** Happold, D. C. D. (2013m), Smithers (1983).

**Measurements**
*Hystrix africaeaustralis*

| | |
|---|---|
| HB: | 655 (649–674) mm, n = 3 |
| T: | 105, 130 mm, n = 2 |
| HF: | 99 (89–102) mm, n = 4 |
| E: | 40 (39–41) mm, n = 4 |
| WT (males): | up to 18 kg |
| WT (females): | up to 22.6 kg |
| GLS: | 160, 161 mm n = 2* |

Southern Africa (De Graaff 1981 in Happold, D. C. D. 2013j) and Kenya (NMK).

## FAMILY THRYONOMIDAE – Cane Rats

The family Thryonomyidae contains only one genus and two species and is endemic to Africa. Both species are very large (TL: 550 -700 mm; WT: 3-5 kg), only slightly smaller than porcupines. They have large wide blunt heads with large incisor teeth and wide molars (suitable for chewing the coarse grass which they feed on). The pelage is coarse blackish-brown, and the tail is relatively short. Cane rats live in savannas and prefer moist swampy areas where there are tall grasses, and also in sugar cane fields (where they are pests). Because of their large size and succulent flesh, they are hunted by humans in many parts of their biogeographic range.

Both species occur in Malawi. Of these, *T. swinderianus*, is the largest, commonest and most widespread.

### Genus *Thryonomys* - Cane Rats

There are only two species in this genus and both occur in Malawi.

*T. gregorianus*. Smaller and lighter: total length 410-575 mm; weight 1.4–2.4 kg. Each upper incisor with three longitudinal well-separated grooves spread more-or-less right across the tooth.

*T. swinderianus*. Larger and heavier: total length 654-792 mm; weight 3.2 -5.2 kg. Each upper incisor with three longitudinal grooves packed close together on the inner half of the tooth.

## *Thryonomys gregorianus*

## Lesser Cane Rat

**Malawian Names** Nchenzi, Ngunusi. Not confined to this species.

**Description** Extremely large rodent (although smaller than *Hystrix* spp. and *T. swinderianus*), with large blunt head and coarse dense brownish pelage. Similar in form and colour to *T. swinderianus*, although smaller and heavier. Tail short (ca. 36% of HB). Skull strongly built. Upper incisor teeth broad (total width: 10–12 mm), orange on outer surface, each with three longitudinal well-separated grooves, the outer groove nearer to the outside than to the midline.

**Similar Species**

*Thryonomys swinderianus*. Larger, heavier. Each upper incisor with three longitudinal grooves packed close together on the inner half of the tooth.

**Distribution** Recorded in only a few localities in Malawi (including Dedza region, Nyika Plateau, and perhaps Mwabvi W. R.). Elsewhere: recorded from S South Sudan, Uganda, Burundi, Rwanda, W Kenya, Tanzania, Zambia, Botswana and Zimbabwe. Presence in Mozambique is uncertain. Isolated populations in Cameroon, DR Congo and Ethiopia.

**Habitat** Grasslands, tussock grasslands, swamps and rocky habitats in savanna habitats. Found in drier habitats than *T. swinderianus*.

**Abundance** Uncertain. Appears to be less common than *T. swinderianus*.

**Habits** Terrestrial, nocturnal, herbivorous. Most habits are probably similar to those of *T. swinderianus*, but Lesser Cane Rats are not semi-aquatic and appear to be more solitary. Elsewhere: in W DR Congo, well-defined paths are made in long grass, often forming 'tunnels' (10–12 cm wide and 15–18 cm high) overhung by vegetation.

In E DR Congo, Lesser Cane Rats feed on the stems of many sorts of plants, including the grasses *Pennisetum, Hyparrhenia, Setaria, Melinis* and *Exotheca*, bracken *Pteridium* and wild ginger *Afromomum*. In cultivated areas, they feed on cassava, stems of maize and sugarcane. They are copropha-gous (as are Greater Cane Rats).

**Reproduction** No information for Malawi. Elsewhere: there is little information. In Uganda, one pregnancy was recorded in Aug; in Kenya, two pregnancies in Nov; and in Zimbabwe, one pregnancy in May and one in Nov. Embryo number in these countries: 2.7 (2-3) n = 5.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Thryonomys gregorianus* Thomas, 1894.

**Key References** Happold, D. C. D. (2013n), Smithers (1983).

**Measurements**

*Thryonomys gregorianus*

| | |
|---|---|
| TL (males): | 519 (410-575) mm, n = 7 |
| TL (females): | 518 (495-540) mm, n = 3 |
| T (males): | 144 (110-175) mm, n = 7 |
| T (females): | 132 (125-140) mm, n = 3 |
| HF (males): | 60 (55-90) mm, n = 7 |
| HF (females): | 62 (70-75) mm, n = 3 |
| E (males): | 29 (27-30) mm, n = 7 |
| E (females): | 29 (25-31) mm, n = 3 |
| WT (males): | 1.9 (1.4-2.4) kg, n = 7 |
| WT (females): | 1.9 (1.7-1.9) kg, n = 3 |
| GLS: | 81.9 (75.2-89.6) mm, n = 10* |

Zimbabwe (Smithers & Wilson 1979).
*East Africa (MRAC, NMK).

## *Thryonomys swinderianus*

## Greater Cane Rat

**Malawian Names** Nchenzi, Ngunusi. Not confined to this species.

**Description** Extremely large rodent (surpassed in size only by the Cape Crested Porcupine), with large blunt head and coarse dense brownish pelage. Dorsal pelage deep brown to rufous-brown, flecked with yellow and black. Dorsal hairs thick and coarse, mostly brown, with yellowish terminal band and (usually) black tip. Flanks similar to dorsal pelage merging into greyish-white ventral pelage. Body thickset. Head blunt with broad flattened muzzle; eyes small; mouth situated ventrally, set back from the enlarged nasal region; ears short and rounded, with short hairs and often partly obscured by cheek hairs. Limbs short and strong with well-developed claws. Forefeet with five digits: Digit 1 short, Digit 5 rudimentary. Hindfeet with four digits: Digit 1 absent, Digit 5 very small. Tail short (ca. 36% of HB, thick at base tapering to tip, densely covered with short bristles similar in colour to dorsal pelage. Skull strongly built. Upper incisor teeth broad, orange on outer surface, each with three longitudinal grooves packed close together on the inner half of the tooth. Males tend to be heavier than females.

**Similar Species**

*Thryonomys gregorianus*. Smaller and lighter. Each upper incisor with three longitudinal well-separated grooves spread more-or-less right across the tooth.

**Distribution** Uncertain in Malawi because records cannot be accepted unless the identity of the species has been determined from its body measurements, weight and/or information about its incisor teeth. The two species cannot reliably be distinguished from sight records. Most records are from south of Lake Malawi (see also Habitat). Elsewhere: distributed widely throughout West Africa (moist savannas, rainforest patches), westwards to DR Congo (north of the Congo River) and East Africa, and southwards to Zambia, SE DR Congo and N and E South Africa.

**Habitat** Swamps, reed-beds, semi-aquatic habitats and long grass savannas where grass cover is dense. Also occurs in habitats subject to seasonal flooding, and in fields of sugarcane, maize and guinea corn (where it may become a serious pest). Large thick grass stems (for food), a moist environment, and plenty of cover are essential for this species.

South Africa © C. & M. Stuart

**Abundance** Probably common in suitable habitats in Malawi, although rarely seen. The commonest evidence of cane rats is the piles of droppings and many short pieces of grass stem (cut at 45˚ to the length of the stem) where a cane rat has been foraging (see below).

**Habits** Terrestrial, diurnal and nocturnal, herbivorous. Although Greater Cane Rats are primarily nocturnal, they may be active during the day in sheltered environments and on dull days. Although they have short limbs, they run quickly when disturbed, often 'freezing' after running for some distance. They make runways through dense grasses and reeds, and they are good swimmers. During the day, an individual rests in a 'form', a simple depression in the grass often lined with cut grass stems (in much the same way as a hare), and occasionally in a rock crevice or burrow excavated by a large mammal. Eyesight is not particularly good, but hearing is very acute. Greater Cane Rats produce several vocal sounds, each of which is emitted as a specific communication signal to other individuals: the 'boom', sometimes accompanied by thumping with the hindfeet, is a warning signal when there is disturbance or potential danger; the 'growl' is a threat signal used during agonistic behaviour and sometimes by a male during courtship; the 'wheet' is a contact call by young, the 'squeak' indicates fear and may also indicate appeasement, and the 'quirr' is probably for close-contact communication with other Greater Cane Rats. Each of these vocalizations may vary in emphasis, duration, repetition and amplitude depending on the motivation of the animal and the context in which each is given. The diversity of methods of communication suggests that Greater Cane Rats have a well-developed social organization.

Greater Cane live in small groups, although some groups may be large (e.g. 15 individuals). Little

is known about the composition of groups. In captivity, observations suggest that the social unit is a single male with one or two females and their young. Greater Cane Rats exhibit many social interactions with conspecifics. Males determine their dominance by nose-pushing. When two males approach each other, they touch their noses and then push against each other. One of them may, alternatively, attempt to push against the cheek of his opponent, temporarily knocking him off-balance. If one individual relaxes for a moment, the other quickly flips round and tries to knock his opponent on the rump with his rump. These nose-pushes and rump-pushes continue until the loser jumps away and flees. The opponents do not attempt to bite with their incisors during these contests, nor do they threaten by gnashing their teeth (as do many species of rodents). Mutual grooming occurs between members of a group. An individual solicits grooming by turning its head so the throat is exposed. When two members approach each other and display in this manner, mutual grooming may commence. Grooming of the throat appears to be especially pleasurable. The tail is used to express submission. Wagging the tail from side to side appears to inhibit aggression by the individual to whom the signal is made. Youngsters have been observed to wag the tail when approached by an adult from behind, and males wag their tails when courting females.

Greater Cane Rats are coprophagous (as are many Lagomorphs and *T. gregorianus*), and the caecum is enlarged and used for fermentation of food. These characteristics enable them to feed on grasses and stems with a high fibre content. In the dry season, when grasses are dead and particularly high in fibre, cane rats adapt by increasing the size of the caecum and colon, and the frequency of coprophagy. Even though the daily intake of food is increased, protein intake and the rate of growth is reduced. The ability of these cane rats to extract nutrients from low quality fibrous food enables them to survive when only coarse dry grass is available. Greater Cane Rats have a unique way of cutting thick stems: the side of the head is placed along the length of the stem but rotated so that the outer edge of the incisor teeth touches the stem. In this way, the incisor teeth bite at an angle of about 45 degrees to the long axis of the stem. The fallen piece of stem is then picked up in the mouth, grasped on either side of the mouth and sliced through the middle with the incisors. The two cut ends, each held in a forefoot, are fed into the mouth and sliced into small pieces by the incisors. Short bouts of incisor-slicing are alternated with bouts of cheekteeth-chewing, with a predominantly sideways action.

**Reproduction** No information for Malawi. Elsewhere, reproductive activity varies depending on locality and climate. For example, in Ghana, pregnancies occur in all months, in Botswana young have been recorded in Jun and Aug, and in Zimbabwe young have been recorded in Aug and Nov but information is lacking for all other months. Gestation (in captivity): 155 (137–172) days, n = 33. Embryo number varies depending on locality and age of mother, e.g. 3 (1–5), n = 18 (in captivity, South Africa); 3.8 (4–6), n = 6 (Gauteng, South Africa). Neonates are precocial, fully furred and the eyes are open, and they can follow their mother within an hour of birth. A female suckles her young while lying on her belly, taking some of the weight of her body on her fore- and hindlimbs. The lateral position of the nipples allows the young to suck from either side. In captivity, growth rates and adult weights are greater for females than for males; females reach adult size at ca. Day 300, and males at ca. Day 390. Sexual maturity is attained at about seven months and a female gives birth to her first litter when she is about one year old. Females probably produce two litters each year.

**Conservation** IUCN Category: Least Concern. There are no major conservation concerns except that over-hunting by local people for bushmeat may cause reductions in population numbers (especially where human population numbers are high).

**Taxonomic Notes** *Thryonomys swinderianus* (Temminck, 1827).

**Key References** Happold, D. C. D. (2013o), Smithers (1983).

**Measurements**
*Thryonomys swinderianus*

| | |
|---|---|
| TL (males): | 715 (670–792) mm, n = 5 |
| TL (females): | 666 (654–670) mm, n = 3 |
| T (males): | 188 (180–192) mm, n = 6 |
| T (females): | 183 (165–195) mm, n = 3 |
| HF (males): | 94 (80–100) mm, n = 6 |
| HF (females): | 89 (88–90) mm, n = 3 |
| E (males): | 33 (30–35) mm, n = 6 |
| E (females): | 35 (34–45) mm, n = 3 |
| WT (males): | 4.5 (3.2–5.2) kg, n = 6 |
| WT (females): | 3.6 (3.4–3.8) kg, n = 3 |
| GLS: | 90.6 (86.5–95.1) mm, n = 4* |

Zimbabwe (Smithers & Wilson 1979).
*Nigeria (Rosevear 1969 in Happold, D. C. D. 2013o).

# ORDER LAGOMORPHA – HARES, ROCK HARES, RABBITS AND PIKAS

| | | | |
|---|---|---|---|
| Family Leporidae | *Lepus* (1 species) | Hares | p. 291 |
| | *Pronolagus* (1 species) | Rock Hares | p. 293 |

The order Lagomorpha contains two extant families of which only one is represented in Africa, including Malawi.

## FAMILY LEPORIDAE - Hares, Rock Hares and Rabbits

Representatives of the family Leporidae are found almost worldwide; they have been introduced into Australia, South America, New Zealand and many oceanic islands where they did not occur naturally. The family contains 11 genera and about 61 species, of which five genera and 13 species occur in Africa, but only two genera and two species occur in Malawi – a hare and a rock hare.

Hares and rock hares categorised as "small mammals" but they are larger than most. They are easily recognised because they have long ears, large powerful hindlimbs and a short, fluffy tail which often points upwards and presses close to the animal's rump. If disturbed, they bound away at high speed, using the hindlimbs in synchrony to propel the hare forward into each leap.

External characters which are used to distinguish species of hares and rock hares include the nuchal patch (a patch of hair on the back of the neck which often contrasts in colour with that of the surrounding pelage) and the gular patch or gular collar. The gular patch is a patch of hair on the throat which often contrasts in colour with the surrounding pelage; if it extends dorsally onto the neck, it is called a gular collar.

Lagomorphs have two pairs of upper incisors (c.f. only one pair in rodents). There is a functional pair of large, cutting incisors in front which are referred to as the principal incisors, and a non-functional pair of much smaller incisors behind them. In all species of *Lepus* except one, the front surface of each principal incisor has a deep groove filled with cement. In *Pronolagus,* the front surface of each principal incisor has a shallow groove which is not filled with cement.

*Lepus victoriae* (African Savanna Hare). Hindlimbs much larger than forelimbs. Dorsal pelage greyish-brown, not becoming reddish-brown on rump. Tail colour black or dark brown above, white or off-white laterally and ventrally; looks white when pointing upwards. Widely distributed; found in scrub, bush and grassland, including montane grassland.

*Pronolagus rupestris* (Smith's Red Rock Hare). Hindlimbs only slightly larger than forelimbs. Dorsal pelage greyish-brown becoming reddish-brown on rump and around base of tail. Tail colour usually dark rufous; sometimes with black tip; looks dark rufous when pointing upwards. Not widely distributed; only found where there are rocks and boulders.

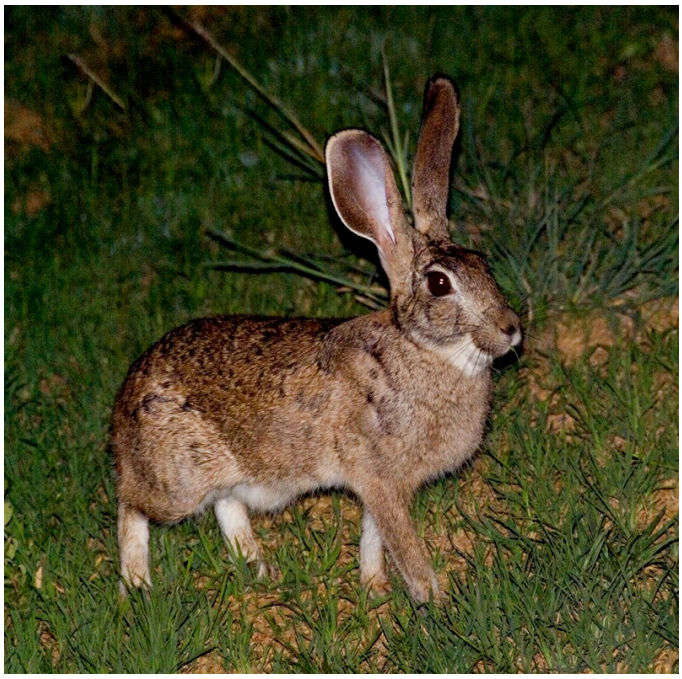
## Genus *Lepus* - Hares

The genus *Lepus* contains more species than any other genus in the order Lagomorpha, but there is only one species in Malawi.

### *Lepus victoriae*

### African Savanna Hare

**Malawian Names** Kalulu, Nkalulu, Sungula.


North West Province, South Africa © C. & M. Stuart

**Description** Pelage soft but slightly coarse with short underfur. Dorsal hairs up to 20 mm. Dorsal pelage greyish-brown, conspicuously grizzled with black and pale buffy-brown; hairs beige at base, terminal half black or black with subterminal band of pale brown. Underfur beige. Flanks buff, with fewer black-tipped hairs than dorsal pelage; underfur whitish-grey. Ventral pelage white or buff, with white underfur except on chest and neck where pelage is pale brown or rusty-brown merging into reddish-orange on nuchal patch. Chin white. Gular collar rufous or buffy. Throat buffy-brown. Head with large eyes and relatively long ears (ca. 114% of GLS), brownish, grizzled, outer surface with wide fringe of white or buff hairs along inner margin, and narrow fringe of white hairs along outer margin, except at tip; tip black on both outer and inner surfaces, amount of black variable. Lips, cheeks and around eyes greyish, without black-tipped hairs. Nuchal patch orange to brownish-orange. Forelimbs long and slender, buffy-brown. Hindlimbs cinnamon-brown, long and powerfully built for bounding at high speed; cinnamon-brown above, brown below. Soles of feet with dense brown hairs. Tail fluffy, relatively short (ca. 19% of HB), usually held close to rump, pointing upwards. Tail colour black or dark brown above, white or off-white laterally and ventrally; seen from behind, looks white when pointing upwards. Each principal incisor tooth with wide deep groove filled with cement.

**Similar Species** *Pronolagus rupestris* (see yellow box above).

**Distribution** Widespread although there are few records from the southern end of the Central Plateau. Records include Chikangawa, Chilwa Plains, Kasungu N. P., Lengwe N. P., Liwonde N. P., Mwabvi W. R., Namadzi, Nyika N. P., Vwaza Marsh G. R. and Zoa. Elsewhere: ranges from Mauretania and Senegal across the savannas of West Africa to Sudan, and south through East Africa to Angola, Zambia, Mozambique, N Botswana and N South Africa.

**Habitat** Scrub, bush and grassland, including montane grasslands. Ranges from ca. 100 m (e.g. Lower Shire Valley) to ca. 2400 m (e.g. Nyika N. P.).

**Abundance** No information from Malawi. Elsewhere: records are uncertain because it is difficult to distinguish species of hares, especially from sight records. Abundance varies with habitat; in Serengeti N. P., Tanzania, abundance varied from 0.4 hares/km$^2$ in short grass savanna to 3.1hares/km$^2$ in *Themeda* savanna, 10.4 hares/km$^2$ in *Pennisetum* savanna, and 18.6 hares/km$^2$ in medium height grassland with >50% shrub cover.

**Habits** Terrestrial, nocturnal and herbivorous. African Savanna Hares are difficult to observe because they run for cover when disturbed. After they settle, they crouch down in the grass and are almost invisible. Almost nothing is known about this species in Malawi. In other parts of their biogeographic range, they are usually seen singly or in pairs in the headlight of a car at night, or running along the side of a road. When grazing on grass, they have a slow quadrupedal gait, but when disturbed the

powerful hind limbs enable them to bound forward at speed. Hares have good eyesight and hearing; the external ears can be twisted from side to side to face the direction of a sound. Savanna hares feed almost exclusively on the leaves and stems of grasses and occasionally on the leaves of herbaceous plants. They are attracted to areas where grasses are spouting after rains, and after fire, because they only eat fresh green herbage. When resting, they crouch close to the ground and so are almost invisible amongst the grasses; likewise the young are born in a 'nest', referred to as a form, amongst the grasses. Hares do not dig burrows, or rest in abandoned burrows of other species.

**Reproduction** No data for Malawi. Elsewhere: in Kenya, African Savanna Hares breed throughout the year (and this is likely to be the case in Malawi). Litter-size: 1.6 (1 -2). Neonates are fully-furred and their eyes are open. In Kenya, a female may have 6-8 litters/year (many more than hares in temperate climates).

**Conservation** IUCN Category: Least Concern. African Savanna Hares require habitats where there is fresh green grassy vegetation throughout the year. They can adapt to agricultural habitats, and may also graze on lawns in suburban gardens.

**Taxonomic Notes** *Lepus victoriae* Cuvier, 1823. Ansell & Dowsett (1988) referred to this species as *L. saxatalis*, and Sweeney (1959) and Hayes (1978) referred to it as *Lepus whytei*.

**Key Reference** Happold, D. C. D. (2013p).

**Measurements**
*Lepus victoriae*

| | |
|---|---|
| HB: | 495 (415–575) mm, n = 13 |
| T: | 92 (68–121) mm, n = 13 |
| HF: | 113 (103–127) mm, n = 13 |
| E: | 102 (93–119) mm, n = 13 |
| WT: | 2.31 (1.36–3.17) kg, n = 5 |
| GLS: | 89.2 (84.9–93.6) mm, n = 5 |

Kenya (NHMUK).

# Genus *Pronolagus* - Rock Hares

The genus *Pronolagus* contains only three or four species that occur mainly in southern Africa. Only one species occurs in Malawi, and it is the only species that also occurs in eastern Africa.

## *Pronolagus rupestris*

## Smith's Red Rock-hare

Northern Cape, South Africa © C. & M. Stuart

**Malawian Names** Chizumbwe, Kafumbwe, Kajolombwe.

**Description** Pelage thick and dense, woolly and frequently characterized by a reddish undertone. Dorsal pelage grizzled greyish-brown becoming rufous (i.e. reddish-brown) on rump around base of tail; most hairs pale cinnamon at base with subterminal white band and black tip. Flanks paler; hairs mostly with white tip and some with black tip. Ventral pelage pale rufous to whitish-rufous. Head and cheeks grey or greyish-brown. Ears long (ca. 114% of GLS) similar in colour to head with many small off-white or brown hairs. Gular patch brownish. Nuchal patch small, rufous. Forelimbs rufous, contrasting with body colour. Hindlimbs rufous. Soles of feet very densely covered with dark grey hair. Tail fluffy, relatively short (ca. 19% of HB); usually held close to rump, pointing upwards. Tail colour usually dark rufous; sometimes with black tip; seen from behind, looks dark rufous when pointing upwards. Each principal incisor tooth with groove (close to inner margin of tooth) not filled with cement.

**Similar Species** *Lepus victoriae* (see yellow box above).

**Distribution** Restricted to a few localities where there are rocks and boulders (including Dedza Mountain, Mulanje Mountain, Mwabvi W. R., Nyika Plateau, Viphya Plateau and Zomba Plateau). Elsewhere: there are two disjunct biogeographic ranges: (1) NW South Africa. (2) E Zambia (Zambian Nyika?, Makutu Hills close to Malawi border), C Tanzania, SW Kenya.

**Habitat** Grasslands in both mesic and semi-arid areas. Only recorded where there are rocky hills, boulders and inselbergs and where there are rock crevices and plenty of cover.

**Abundance** No data for Malawi. Generally considered to be uncommon or rare, although in South Africa may be fairly abundant in some localities. Because these rock-hares are restricted to rocky areas, abundance is partly determined by the size of each patch of suitable habitat.

**Habits** Little is known about this species in Malawi. In South Africa and Kenya, they are terrestrial, nocturnal and herbivorous. They can run and jump on and over rocks (unlike *Lepus,* hares). During the day, they usually rest under cover, but will flee away with great speed if disturbed. They are solitary animals, and usually seen singly or in pairs. They emit a range of calls: a 'tu .... tu" noise at night, and the young make a 'churring' sound when disturbed under a rock. Smith's Red Rock-hares eat the leaves and stems of selected species of grasses. They deposit their faeces on 'middens' (large heaps of faecal pellets) which accumulate in size over time (a behavioural trait that presumably advertises the presence of different individuals). Faecal pellets are large and dish-shaped.

**Reproduction** No data for Malawi. In South Africa, breeding is assumed to occur from Sep to Feb. Gestation: ca. 38 days. Litter-size: 1-2. The young are born in a shallow nest on the ground, lined by fur.

Neonates are altricial, i.e. blind and without hair (cf. *Lepus* spp.).

**Conservation** IUCN Category: Least Concern. Conservation concerns include fragmented populations and small areas of suitable habitat, especially in Malawi, Tanzania and Kenya.

**Taxonomic Notes** *Pronolagus rupestris* (A. Smith, 1834).

**Key References** Happold, D. C. D. (2013q), Smithers (1983).

**Measurements**
*Pronolagus rupestris*

| | |
|---|---|
| HB: | 447 (380–535) mm, n = 15 |
| T: | 86 (50–115) mm, n = 15 |
| HF: | 92 (85–100) mm, n = 15 |
| E: | 94 (80–105) mm, n = 15 |
| WT: | 1.62 (1.35–2.05) kg, n = 18 |
| GLS: | 80.7 (75.1–85.3) mm, n = 67 |

South Africa (Robinson & Dippenaar 1983 in Happold, D. C. D. 2013q, Smithers 1983).

# ORDER PRIMATES – PRIMATES



There are somewhere between 376 and 522 species of living primates in the world – the discrepancy reflects the extent to which primate taxonomy is controversial! However, there seems to be consensus that primates can be classified into two main groups – the first containing lemurs, galagos and lorisids, and the second containing tarsiers and simians (apes and monkeys).

Primates are essentially tropical and most are arboreal and this is reflected in the special adaptations which distinguish them from other mammals. They have relatively large brains, forward pointing eyes and stereoscopic vision, nails rather than claws, fingers which can be spread out and, in most species, an opposable thumb so the hand can grasp things, spreadable toes on a foot which can also grasp things, and comparatively slow foetal growth, longer gestations and longer lives. Many primates also have colour vision and comparatively greater flexibility in their shoulder joints. They are well adapted for living in trees and can climb, leap from branch to branch and from tree to tree. Also, they can swing from branch to branch while hanging on with their forelimbs - this is called brachiation. Many primates also have long tails, but only some in South and Central America have prehensile tails which they can wrap around a branch and hang from. However, some primates – humans, other great apes and baboons - are primarily terrestrial and their locomotion on the ground includes walking on their hindlimbs (bipedalism) and walking on four limbs with the hands curled so it is the knuckles which contact the ground (knuckle-walking). Primates eat a wide variety of foods. Most include fruits in their diets but some are adapted for eating other foods such as leaves, gums, seeds, nuts, eggs, insects, grass and even meat. Primates exemplify a wide variety of social organizations. Some are solitary, some monogamous and some live in groups of various compositions. They communicate with olfactory signals, visual signals including gestures and facial expressions, and vocalizations. And they have well-developed cognitive skills and the ability to use and make tools, although these are not unique to primates or even mammals.

Africa has representatives of both of the main groups of primates – galagos in the family Galagidae and pottos in the family Lorisidae and apes and monkeys in two families, Hominidae (humans. gorillas, chimpanzees and bonobos) and Cercopithecidae (Old World Monkeys). Malawi, too, has representatives of both groups – four galagos, a baboon and two monkeys.

## FAMILY CERCOPITHECIDAE – Old World Monkeys

This is the largest family of primates in Africa. According to some, there are 15 genera and 68 species, and these include baboons, colobus monkeys, macaques, mangabeys, mandrill, drill, Patas Monkey, savanna monkeys, Vervet and several other monkeys. Malawi has comparatively few primates, probably because it is the rainforest biotic zone which has the greatest abundance and diversity of primates, and the neither the rainforest biotic zone nor the surrounding rainforest-savanna mosaics extend as far as Malawi. Three genera and three species occur in Malawi.

*Cercopithecus mitis*, Blue Monkey. Slender, arboreal. Muzzle short. Face blue-grey, without a very conspicuous white band across forehead. Pelage on cheeks grizzled blue-grey, long, so head (frontal view) appears wide. Found in evergreen forests, montane forests, riverine forests, thicket forests, and pine plantations. Not present in savanna habitats.

*Chlorocebus pygerythrus*, Vervet monkey. Slender, arboreal. Muzzle short. Face black with very conspicuous straight white or buff band across forehead. Pelage on cheeks grizzled greyish-brown, short, so head (frontal view) appears narrow. Found in woodland savannas, grasslands where there are patches of trees, and nearby riverine forests.

*Papio cynocephalus*, Yellow Baboon. Robustly built, terrestrial. Muzzle long.

## Genus *Cercopithecus* - Arboreal Guenons

This genus contains about 20 species of long-tailed, arboreal monkeys referred to, collectively, as arboreal guenons, but individually as monkeys of some sort. They are medium-sized cercopithecids, comparatively slender and have short faces and short muzzles. Only one species occurs in Malawi.

### *Cercopithecus mitis*

### Blue Monkey, Gentle Monkey

**Malawian Names** Lichiru, Nchima, Ncima.

Nyika N. P., Malawi © E. Darbey

**Description** (subspecies *erythrarchus,* Zomba Plateau). Slender, long-tailed, arboreal monkey. Dorsal pelage grizzled dark bluish-grey except on the back and rump; pelage on back suffused with russet and becoming strongly russet on rump and around base of tail. Ventral pelage pale grey (details below). Head rounded, muzzle short, cheek pelage long so head, viewed from front, looks wide. Top of head and cheeks grizzled blue-grey; muzzle much paler. No very conspicuous white band across forehead (cf. *Chlorocebus pygerythrus*). Eyes forward-looking; iris orange. Skin around eyes, on nostrils and lips very dark blackish-grey. Ears relatively short but clearly visible. Chin and throat yellowish-grey; chest pale grey; belly slightly darker than chest. Forelimbs black; hands black. Hindlimbs grizzled steely blue-grey to heel on outer side, grey on inner side; feet grizzled black and grey dorsally, soles naked with black pigmentation. Tail very long, black for most of its length; russet at base and around anus; tail fur short. Ischial callosities black.

The subspecies *moloneyi* differs in having dark reddish-brown pelage on the rump, a cream throat, pale grey thighs, and the ventral surface of the tail is reddish.

**Similar Species** None – see yellow box above.

**Distribution** Scattered localities in all biogeographic areas where there are forest habitats. Localities include Chikwawa, Chiradzulu Mountain, Fort Lister, Lake Malawi N. P., Lengwe N. P., Mangoche Mountain, Misuku Hills (Matipa Forest), Mulanje Mountain, Mwavbi W. R., Nkhata Bay, Nkhotakota W. R., Ntchisi F. R. (Ntchisi Mountain), Nyika Plateau (at 1500 m and higher), Thyolo Mountain, Viphya Plateau (near Mzimba) and Zomba Plateau. Elsewhere: recorded from SW Ethiopia, Somalia (only along the Jubba and Shabeele rivers), scattered localities in East Africa, NE and SE DR Congo, N Zambia, and scattered localities in Mozambique and E South Africa.

**Habitat** In Malawi, recorded in montane evergreen forest, semi-evergreen forest, riverine forests, thicket clumps, and pine plantations (often adjacent to natural forest). Not present in savanna habitats except in thickets in Thicket Savanna at Lengwe N. P.

**Abundance** Almost no information for Malawi (see also Habits); not common because suitable habitats are uncommon and restricted in area. Throughout most of its biogeographic range, may be quite common in suitable habitats (e.g., 0.7 individuals/ha or 4.3 groups/km$^2$).

**Habits** Diurnal. Mainly arboreal but sometimes descend to the ground for foraging and drinking.
Very social. Often observed in groups of 10-25 (at least in other parts of Africa) but groups are probably smaller in Malawi. Groups are typically comprised of one adult male, several adult females, and young of various ages. Mutual grooming is common, especially among females; mothers also groom their young and the young of others. Groups defend their home-range (typically 15-25 ha). Aggressive behaviour includes growling and chasing, but rarely fighting.

Blue Monkeys make about 10 vocalizations: many sorts of 'grunts' are used so individuals can keep in contact and indicate submission and domi-

nance within the group; chirps indicate alarm; and the adult male's loud 'booms', 'kas', and 'pyows' indicate alarm/disturbance/presence. Calls given at dusk, when members of a group are settling down for the night, are often the easiest way of knowing that Blue Monkeys are present, because they can be difficult to detect when resting or high up in the trees.

On Zomba Plateau, in the 1980s, there were an estimated 12 groups, totalling 130-200 individuals. Family groups (of 8-20 individuals) comprised an adult male, several adult females and their offspring. Other groups comprised young adults, or old adults, or lone males.

Blue Monkeys are diurnal, and most active in the early morning and late afternoon. In hot weather, they rest during the middle of the day. When active, most of the time is spend foraging for food, eating, playing and grooming. At night, they sleep on the branches of trees, high above the ground.

They feed on a large variety of foods; primarily fruits, young leaves, and invertebrates. On Zomba Plateau, Blue Monkeys eat the flowers, fruits, bark and leaves of 27 species of evergreen trees; some of these are 'preferred species' and constitute the bulk of the diet when available. Additionally, they feed on the bark of seven species of *Pinus* and, hence, cause considerable damage in pine plantations.

**Reproduction** No information for Malawi. In equatorial forests in Kenya, births occur in all months, with ca. 64% of births in the dry season (Jan–Mar). Pregnancies and early lactation tend to coincide with the time when fruits and insects are abundant. Young are born singly, twins are rare; fully furred at birth with eyes open. Young infants are constantly carried by their mothers for the first 2 weeks; thereafter, juveniles and female 'babysitters' also care for the young. Suckling may continue for up to 2.5 years; adult size is attained at ca. 6.5 years, and a female gives birth to her first young at ca. 7.2 (range 4.6 -10.6) years.

**Conservation** IUCN Category: Data Deficient (for subspecies *francescae*).

**Taxonomic Notes** *Cercopithecus mitis* Wolf, 1822. Referred to as *Cercopithecus albogularis* (vernacular name: Blue Monkey) by Ansell & Dowsett (1988). This species is a very complex one with 17 subspecies throughout Africa, each distinguished by variations in colour and pattern on the tail, body, face and limbs. Three subspecies are said to occur in Malawi: *C. m. moloneyi* (Moloney's Monkey) in the far north, *C. m. francescae* (Red-eared White-collared Monkey) west of Lake Malawi (except in far. north) and *C. m. erythrachus* (Samango Monkey) in the south. The taxon *nyasae,* referred to as a 'race' of *C. mitis* by Sweeney (1959), is now considered to be a synonym of *erythrachus.* Although the vernacular name of the species (as a whole) is 'Blue Monkey' or 'Gentle Monkey', each of the subspecies has its own vernacular name.

**Key Reference** Lawes *et al.* (2013).

**Measurements**
*Cercopithecus mitis erythrarchus* (males)

| | |
|---|---|
| HB: | 555 (445-650) mm, n = 13 |
| T: | 726 (601-866) mm, n = 15 |
| HF: | 154 (140-178) mm, n = 10 |
| E: | 39 (35-40) mm, n = 7 |
| WT: | 6.9 (2.7-10.0) kg, n = 35 |
| GLS: | 117 (113-122) mm, n = 5 |

Females are 87%-94% (linear measurements) and 55% (weight) less than for males.
Throughout range for the subspecies (including Malawi) (Lawes *et al.* 2013).

## Genus *Chlorocebus* – Savanna Monkeys

According to some authorities, this genus is considered to contain six species whose vernacular names are Grivet Monkey, Tantalus Monkey, Green Monkey, Vervet Monkey, Malbrouck and Djam-Djam, but the genus is not yet clearly defined and its species-composition is still controversial. The six species referred to above are all semi-terrestrial, grey, greenish or brownish monkeys with black faces surrounded by white facial ruffs. As a group, they are very widespread in savanna habitats in sub-Saharan Africa and along the Nile Valley in Sudan, but each species occurs in only part of the whole region and their biogeographic ranges probably do not overlap. None of the species occur in rainforest, other forests and deserts. Only one species occurs in Malawi and it is easily distinguished from the only other monkey in Malawi (see yellow box above).

### *Chlorocebus pygerythrus*

### Vervet Monkey

**Malawian Names** Chitumbiri, Mbwengu, Pusi.

Zomba Plateau Road, Zomba, Malawi
© DCD & M. Happold

**Description** Medium-sized terrestrial/arboreal long-tailed Vervet Monkey. Pelage moderately long and shaggy, especially along lateral line. Dorsal pelage greyish-brown to olive-grey, tinged with rusty-brown and grizzled with black and white. Ventral pelage greyish-white, including throat and chest, and inner surfaces of legs. Forehead and top of head similar to dorsal pelage; face around eyes, nostrils, and lower lips naked and black; eyebrows white forming very conspicuous white band across the forehead. Cheeks with greyish-white pelage which forms a ruff around the face. Eyes dark brown. Ears small, black, often hidden by fur. Fore- and hindlimbs grizzled grey on outer surface; inner surface paler. Feet and hands almost naked with black or dark grey pigmentation, each with five digits. Ischial callosities (on either side of anus) black. Tail long (ca. 130 % of HB), similar in colour to dorsal pelage, whitish ventrally; tip black. In males, there is a patch of rusty-red hairs under base of tail, scrotum pale blue, penis red. In females, vulva area blue.

**Similar Species** None (see yellow box above).

**Distribution** Very widespread in savanna and woodland-savanna habitats in all biogeographic areas of Malawi, in protected areas and also in towns (including Blantyre and Zomba), gardens, farmlands and remnant woodland-savanna and savanna. Protected areas where Vervet Monkeys occur are Kasungu N. P., Lake Malawi N. P., Lengwe N. P., Liwonde N. P., Majete W. R., Mwabvi W. R., Nkhotakota W. R., Nyika N. P., and Vwaza Marsh G. R.

Elsewhere: recorded throughout the eastern side of Africa from S Ethiopia and S Somalia to South Africa.

**Habitat** Woodland savannas, thicket savanna, grasslands where there are patches of trees, riverine forests, rocky hillsides. Individuals may enter farmlands to eat the crops.

**Abundance** Quite common in suitable habitats in Malawi. Elsewhere: abundance varies widely. In some habitats they are very numerous, but in others the numbers have declined. When this happens, different groups join up to form larger groups.

**Habits** Terrestrial, partly arboreal and diurnal. Because Vervet Monkeys are so easy to see, there have been many studies of them. Vervet Monkeys are more adapted (morphologically) to life on the ground rather than in the trees (cf. *Cercopithocus mitis*). They are very social animals, living in small groups of 2-10 adults or in large groups of 50-60 individuals. There is great variation in the size of groups depending on locality and time of year. Within any group, there is a dominance hierarchy; in mixed sex-groups, the dominant male displays his dominance by

loud vocalizations and displaying his genitalia. As is the case for most monkeys, Vervet Monkeys do not associate with other species of monkeys although they may forage close to troops of baboons.

Vervet Monkeys are omnivorous and forage in the trees and on the ground. They feed on flowers, fruits, leaves, seeds and pods of many species of plants, varying the precise constituents of the diet during different seasons of the year. They also feed on arthropods (insects, termites, beetles, etc.), as well as bird's eggs and fledglings.

**Reproduction** In Malawi, small young have been recorded in Mar and Dec. Elsewhere: Vervet Monkeys are seasonal breeders, the exact time depending on the locality and season. For example, in Amboseli (Kenya) where rainfall is strongly seasonal, most births occur during Oct–Dec. In Segara (Kenya), where rainfall is less seasonal, 75% of births occur in Jan-Mar with other births occurring around these months. Gestation: ca. 160 days. Females give birth to a single young every 1-2 years. Weaning begins at ca. 3 months and is complete by about 18 months. In Amboseli, females begin to reproduce at ca. 4.4 years of age, although this is extended to 5.1 to 5.7 years of age where resources and water are limited. The young monkey clings to the underside of the mother, holding on with fore- and hindlimbs and with its tail between the mother's hindlimbs and curled around the mother's tail.

**Conservation** IUCN Category: Least Concern. Vervet Monkeys are an adaptable and widespread species which live in many habitats.

**Taxonomic Notes** *Chlorocebus pygerythrus* (F. Cuvier, 1821). Previously referred to as *Cercopithecus pygerythrus* (e.g. by Ansell & Dowsett 1988) or *Cercopithecus aethiops* (e.g. Sweeney 1959 and Hayes 1978). Five subspecies are recognised throughout the biogeographic range; the subspecies in Malawi is *C. p. rufoviridis* (Reddish-green Vervet Monkey).

**Key Reference** Isbell & Enstam Jaffe (2013).

**Measurements**
*Chlorocebus pygerythrus pygerythrus* (males)

| | |
|---|---|
| HB: | 490 (n.d.) mm, n = 30 |
| T: | 652 (600-750) mm, n = 30 |
| HF: | 144 (133-170) mm, n = 30 |
| E: | 38 (31-42) mm, n = 30 |
| WT: | 5.5 (3.9-8.0) kg, n = 35 |
| GLS: | n. d. |

Females are 87%-92% (linear measurements) and 75% (weight) less than for males.
N Botswana (Smithers 1971).

## Genus *Papio* - Baboons

According to some authorities, this genus contains five species, but this is controversial. They are endemic to sub-Saharan Africa and Arabia. In Africa, baboons are found almost everywhere south of the Sahara, in habitats ranging from evergreen forests to semi-deserts, and from sea level to >3300 m. They only seem to require food, resting places on cliffs, rock faces or in trees, and surface water for drinking. Baboons are larger, heavier more robustly built than monkeys and have long faces and prominent muzzles, and tails which are shorter than the HB and carried with a characteristic curve or bend. Males are much larger and heavier than females and have more prominent brow ridges. Baboons are seen more often on the ground than in trees.

Until recently, it was thought that two species occurred in Malawi – *P. cynocephalus* and *P. ursinus* (Chacma Baboon), but the latter is currently considered to occur only in southern Africa.

### *Papio cynocephalus*

### Yellow Baboon

**Malawian Names** Lijani, Mkwere, Nkhwere, Nyani, Nyano.

Liwonde N. P, Malawi © Bentley Palmer

**Description** Large terrestrial diurnal primate with long limbs and a moderately long tail. Dorsal pelage pale brown to yellowish brown, tending to russet in some localities (e.g. Lengwe N. P.). Ventral pelage white or yellowish-brown. Colours of dorsal and ventral pelage merge on flanks. Head dog-like with elongated muzzle; top of head similar in colour to back, with well-developed browband. Skin around eyes, on muzzle and upper and lower lips black with greyish-white hairs at margins. Large nostrils. Eyes, deep-set under brows, dark. Ears prominent, with dark pigmentation. Fore- and hindlimbs long; outer surfaces similar in colour to dorsal surface, inner surfaces paler, grey to whitish-grey. Skin of hands and feet with black pigmentation. Ischial callosities (on either side of anus) white or grey, becoming large and pink or red in females when they are in oestrus. Scrotum grey. Tail long (ca. 66% of HB); similar in colour to the dorsal pelage. The basal third is angled upwards, then the tail curves downwards (with an acute bend).

**Similar Species** None (see yellow box above).

**Distribution** Very widespread in all biogeographic areas of Malawi. Localities include Blantyre, Chikwawa District, Dedza, Kasungu N. P., Lake Malawi N. P. (Cape Maclear), Lengwe N. P., Likhubula River, Liwonde N. P., Majete W. R., Mangoche, Misuku Hills, Mtimbuka, Mulanje Mountain, Mwabvi W. R., Nkhotakota W. R., Ntchisi Mountain F. R. (Ntchisi Mountain), Nyika N. P., Vwaza Marsh G. R., Zomba and Zomba Plateau. Elsewhere: recorded from S Ethiopia and S Somalia through SE Kenya to Angola, S DR Congo Zambia and Mozambique (north of the Zambezi river).

**Habitat** Open savanna and woodland savannas (mostly where miombo (*Brachystegia*) and Acacia trees are common), thicket savanna, pine forests and farmlands. Although Yellow Baboons forage in the open, they require trees to provide shady resting places and for sleeping in at night. They need to be fairly close to water so they can drink every 1-2 days.

**Abundance** Very varied, depending on locality. In Malawi, Yellow Baboons have been sighted singly, or in groups ('troops') of up 30 individuals. In East Africa, troops may contain as many as 60-70 individuals when environmental conditions are good.

**Habits** Yellow Baboons have been well-studied and hence there is a lot of information about them. They are very social animals, living in mixed-sex, multi-

male or multifemale groups. Females tend to remain in their natal group, whereas males may leave and join another group if there are reproductive opportunities there. Large groups may split into smaller groups at times, and small groups may join to form a larger group. Within a group there is a dominance hierarchy, with the oldest females being at the top of the hierarchy; younger females are ranked according to their mother's place in the hierarchy. Social relationships are extremely complex in a baboon society, and there are many behavioural traits (postures, vocalizations, mutual grooming, contact, huddling, etc.) which establish and maintain the relationships within a group. Many of these behavioural traits may be observed in Malawi (e.g. at the Main Water Hole in Lengwe N. P.).

Baboons are omnivores and eat a very wide range of foods. They are very opportunistic and change their diet seasonally depending on what is available. Foods include leaves, fruits and flowers of many species of trees and shrubs, insects and bird's eggs; and they also feed on the meat of dead vertebrates when available. Groups living near human settlements scavenge from refuse heaps and will catch and eat chickens. Yellow Baboons are also observed in pine plantations where they climb trees but they do not have the same agility as Blue Monkeys; whether they damage pine trees is uncertain.

Yellow Baboons are diurnal and spend the night resting and sleeping in trees (to avoid nocturnal predators). During the day, they forage for food; this activity may take up quite a sizeable proportion of the day, especially when resources are spread out or in poor supply. Yellow Baboons are inquisitive and alert by nature, always on the outlook for new resources and danger. Individuals also spend time grooming, resting on their haunches (with forearms resting on the knees and the hands hanging downwards), and travelling to new foraging and living areas.

**Reproduction** In Malawi (e.g. Lengwe N. P.) females with young attached were seen regularly at the water hole in Dec and Jan (no data for other months). Elsewhere: when conditions are good, Yellow Baboons breed throughout the year. In less favourable localities and conditions, reproductive activity is reduced. After a gestation of ca. 180 days, a single young is born (twins are very rare). The young clings to the ventral pelage when the mother moves around (e.g. when foraging), and later rides on the mother's rump. Mothers (and later 'aunties') take good care of the young. Weaning occurs at ca. 12-18 months of age and adulthood is attained at 7-8 years of age.

**Conservation** IUCN Category: Least Concern. Yellow Baboons are a widespread, successful and adaptable species; the only conservation threat is destruction of suitable habitat.

**Taxonomic Notes** *Papio cynocephalus* (Linnaeus, 1766). Three subspecies; one subspecies (*P. c. cynocephalus*) in Malawi. Sweeney (1959) and Hayes (1978) list two species of baboons in Malawi (Yellow Baboon *Papio cynocephalus*) and Chacma Baboon (*Papio ursinus*), but the Chacma Baboon is now restricted to southern Africa (S Angola, Namibia, SE Zambia, S. Mozambique and South Africa).

**Key Reference** Altman *et al.* (2013).

**Measurements**
*Papio cynocephalus*

| | |
|---|---|
| HB (males): | 730 (620-840) mm, n = 6 |
| HB (females): | 620 (550-680) mm, n = 4 |
| T (males): | 600 (450-660) mm, n = 6 |
| T (females): | 500 (380-560) mm, n = 4 |
| HF: | n. d. |
| E: | n. d. |
| WT (males): | mean 25.8 kg, n = 20* |
| WT (females): | mean 11.9 kg, n = 18* |
| GLS: | n. d. |

Various localities (NHMUK, Napier 1981 in Altman *et al.* (2013).
*Kenya (Amboseli N. P., Altmann *et al.* 1993 in Altman *et al.* (2013).

## FAMILY GALAGIDAE – Galagos (Bushbabies)

Galagos are small, long-tailed, nocturnal and mainly arboreal primates with relatively large eyes. The eyes have a tapetum lucidum which causes the eyes to shine very brightly if light from a spotlight is shone into them at night. The long tails are not prehensile. The hindlimbs of galagos are longer than their forelimbs and the hands have long fingers adapted for grasping. Furthermore, the palms of the hands and soles of the feet have six prominent pads with ridges to prevent them from sliding and slipping on smooth bark. Consequently, galagos can move very rapidly by leaping from branch to branch and, if one can pick up and follow the eye-shine with a spotlight, galagos are amazing to watch.

The taxonomy of galagos is complex and still evolving. According to some authorities, the family contains six genera and ca. 18 species. Distinguishing species by external characters such as size and colour is difficult, particularly at night, but galagos communicate with vocal sounds, some of which are species-specific and therefore species are most reliably identified in the field by their specific vocalizations.

Malawi may have three genera and four species of galagos, but the presence of one species is controversial. They can be distinguished by the information in Table-key 12. They are profiled in the alphabetical order of their scientific names.

Table-key 12 to the species of galagos (family Galagidae) found in Malawi (see also Similar Species).

| **HB (in mm)** | **Tail characteristics** | **Disribution in Malawi. Habitat.** | **Species** |
|---|---|---|---|
| 313 (255-400) | ca. 140% of HB<br>Thickly furred, bushy.<br>Colour: same as dorsal pelage or paler; sometimes with black tip. | Widespread.<br>Miombo woodlands, mixed thicket woodland-savanna and thicket savanna. | *Otolemur crassicaudatus*<br>Large-eared Greater Galago |
| 148.3 (125-172) | ca. 150% of HB<br>Slender. Not bushy; not becoming wider towards tip.<br>Colour: pale grey, not becoming darker towards tip | Possibly widespread in southern Malawi.<br>Open canopy miombo woodlands, especially where Acacias grow, forest fringes, dry woodlands. | *Galago moholi*<br>Southern Lesser Galago |
| 153.4 (116-174) | ca. 150% of HB<br>Bushy. Distal 80% wider.<br>Colour: darker than dorsal pelage with distal 10-50% blackish. | Southern Malawi.<br>Moist evergreen forests and transitional woodlands. | *Paragalago granti*<br>Mozambique Dwarf Galago |
| 132 (125–138) | ca. 136% of HB<br>Bushy or not bushy. About same width from base to tip.<br>Colour: similar to dorsal surface but terminal one-third is darker. | Misuku Hills.<br>Submontane and montane moist forests at 600-2600 m. | *Paragalago orinus*<br>Mountain Dwarf Galago |

## Genus *Galago* – Lesser Galagos

This genus contains four species of which only one occurs in Malawi.

### *Galago moholi*

### Southern Lesser Galago

**Malawian Names** Chipimbi, Kamundi, Kapimbi, Kaundi. Not confined to this species.

Limpopo Province, South Africa © C. & M. Stuart

**Description** Medium-sized galago with large head, large eyes, and long tail; often confused with *Paragalago granti*. Dorsal pelage pale grey suffused with varying amounts of rusty-brown. Ventral pelage white sometimes with yellowish tinge. Flanks similar to dorsal pelage, sometimes with yellowish line where dorsal and ventral colours meet. Head broad, with large ears pointing away from head at 45˚; back of ears with grey fur; front surface of ears naked with pale grey pigmentation, top edge pale (cf. blackish in *P. granti*). Eyes enormous, orange in colour and situated in front of face; each eye surrounded by a diamond-shaped black eye-ring. Muzzle short and square; nasal profile (viewed from side) is straight (cf. concave in *P. granti*). White stripe on head from between eyes to nostrils. Outer surfaces of fore- and hindlimbs similar to dorsal surface but suffused with pale yellow. Hindlimbs longer and more powerfully built than forelimbs. Hands and feet with long slender digits, each ending with a flat nail, except for the second toe which has a grooming claw. Fingers and thumbs opposable, capable of gripping twigs and small branches. Tail long (151 [109-181]% of HB, n = 50) and comparatively slender; covered from base to tip with a grizzled mix of pale brown and grey hairs; not bushy.

**Similar Species**

*Paragalago granti*. Tail bushy and black-tipped. Ears black behind and on the front edge. Found in denser and moister vegetation, and usually higher up in taller trees. They leap from branch to branch less often, and land on their hands or on their hands and feet together.

**Distribution** In Malawi, there are only a few records scattered throughout the country, but because *G. moholi* is easily confused with *Paragalago granti*, many of these records need confirmation. It is perhaps widespread in wooded habitats. Localities confirmed by J. Masters (*pers. comm.*) are Blantyre, Chididi Mission and base of Mlakha Hill (near Nsanje). Localities which need confirmation are Lilongwe, Liwonde N. P., Mwabvi W. R., Ntcheu and Vwaza Marsh G. R. Elsewhere: widespread in S DR Congo, Zambia, Angola, N. Namibia, Zimbabwe, NE Botswana, W Mozambique, and N South Africa.

**Habitat** Open canopy miombo woodlands, particularly where Acacia trees grow, mopane and perhaps other habitats such as savanna bushlands and forest fringes. Acacia trees are favoured (because gum is an important part of the diet and Acacias exude abundant amounts of gum). Southern Lesser Galagos are less common in miombo woodlands dominated by *Brachystegia* and Mopani woodlands. Also recorded in gardens and they sometimes sleep in buildings.

**Abundance** No information for Malawi. Elsewhere: said to be common in suitable habitats. In one study area in Zambia, there were at least 50 individuals/km$^2$ (Lumsden & Masters 2001; in SE Tanzania, encounter rates were 1.2 – 4.9 individuals/hour.

**Habits** Nocturnal and arboreal; only occasionally terrestrial. Southern Lesser Galagos are extremely

agile in trees and are able to leap from branch to branch and from tree to tree. Their long limbs, long fingers and long toes enable them to climb and run along branches and twigs, and the long tail acts a rudder when leaping. This leaping is described as ricochetal because of its erratic changes in direction. These galagos kick off with their powerful hindlimbs and then swing the hindlimbs forward and land feet first (cf. *P. granti*). On the ground, when moving from tree to tree, they hop rapidly on their hindlimbs.

Southern Lesser Galagos are omnivorous. Their diet consists of approximately equal amounts of invertebrates and gums exuded from a variety of trees (but mostly from Acacias). Diet varies seasonally and depending on the availability of gum. Feeding on gums increases during the dry season, when insects are less available, and decreases during the wet season when insects are numerous.

Southern Lesser Galagos have glands on the chest (and also on the scrotum in males) which produce secretions. These secretions are rubbed on to the surfaces of branches to mark and maintain the boundaries of home-ranges. 'Urine-washing' is also used as a means of marking. In South Africa, the home-ranges of males (mean 7.2 ha) are larger than those of females (4.6 ha). The home-ranges of females do not overlap, but those of males overlap with those of other males and also with those of females. The size of the home-range of a female is probably determined by the availability of resources (food, shelter) whereas that of males enables them to find a larger number of females to mate with during the breeding season.

Social interactions are complex. Although non-gregarious, social interactions when individuals meet depend on sex, age, relationship and dominance. Interactions are normally brief, and include chasing, mutual grooming, genital sniffing, and play. During the daytime, they sleep in nests, holes in trees or on branches or forks in trees. Nests are platforms made of fresh leaves and small twigs and are often in very thorny Acacias. Each nest can support up to eight animals. Adult males sleep alone ca. 70% of the time and females sleep alone ca. 44% of the time, but sometimes, one male and one female will sleep together, and when females have young, two sometimes sleep together with their young. Southern Lesser Galagos communicate with a variety of calls. Some express anxiety or alarm when predators are near. Other calls advertise the presence of an individual, others are used to attract conspecifics and others to maintain contact with infants. One call made by *G. moholi* is distinctly different from any call made by *P. granti*; it is a regularly repeated, loud, monotonous, lower-frequency tonal 'bark' which advertises the presence of the caller and its territory.

**Reproduction** No information for Malawi. In NE South Africa, most births occur in Sep during the early part hot wet season when insects are abundant. Sometimes females may give birth to a second infant in Feb (end of hot wet season). Gestation: ca. 120 days; females usually give birth to twins. The mother usually gives birth in a tree hole (not on a nest platform). The young leave the hole for the first time when ca. 10 days old, and they continue to suck until ca. 11 weeks of age. Maturity is attained at ca. 200 days (females) and ca. 326 days (males).

**Conservation** IUCN Category: Least Concern. Recorded as still common in optimal areas, but fragmentation of suitable woodlands results in reduced area of distribution and abundance. Southern Lesser Galagos are unable cross open savannas to colonize nearby woodlands

**Taxonomic Notes** *Galago moholi* A. Smith, 1836. Formerly considered to be a subspecies of *G. senegalensis*, but *moholi* is now regarded as a distinct species, and *G. senegalensis* is the very similar Northern Lesser Galago which occurs to the north of Malawi in savanna habitats from Senegal to Ethiopia and southwards to Tanzania. Hough (1959) and Hayes (1978) refer to Malawian animals as *Galago senegalensis* - the Night-Ape or Lesser Galago. Sweeney (1959) refers to two 'races' of *G. senegalensis*: (1) *moholi* (which is now raised to specific status), and (2) *nyasae* (a very uncertain taxon which might be composed of three new as yet undescribed taxa [Grubb *et al*. 2003]), but the holotype (which is broken) looks like *Paragalago granti* (J. Masters *pers. comm*.).

**Key References**. Génin *et al.* (2016), Lumsden & Masters 2001, Pullen & Bearder (2013).

**Measurements**
*Galago moholi*

| | |
|---|---|
| HB: | 148.3 (125-172) mm, n = 50 |
| T: | 223 (174-250) mm, n = 50 |
| HF: | 57.2 (50-78) mm, n = 50 |
| E: | 36.6 (25-45) mm, n = 50 |
| WT: | 153.5 (110-184.2) g, n = 50 |
| GLS: | 39.4 ± 0.19 mm, n = 50 |

Throughout biogeographic range (F. Génin and J. Masters pers. comm.)

# Genus *Otolemur* - Greater Galagos

This genus is currently considered to contain two species distributed in eastern and SE Africa. They are larger than other galagos. Only one species occurs in Malawi.

## *Otolemur crassicaudatus*

## Large-eared Greater Galago

**Malawian Names** Changa, Likomba.

Limpopo Province, South Africa © C. & M. Stuart

**Description** Large galago with big ears, large eyes and a long fluffy thick-furred tail. Dorsal pelage grey tinged with brown, fluffy and dense. Ventral pelage paler; whitish on throat and chest. Head similar in colour to dorsal pelage, roundish with very large naked ears and large dark eyes. Ears rounded, slightly darker on tips. Muzzle large and robust, darkly pigmented. Outer surfaces of limbs similar in colour to dorsal pelage. Hindlimbs only a little longer than forelimbs (cf. *Galago* and *Paragalago*). Hands and feet naked and black, each with five digits. Digits long and well developed (for grasping small branches and twigs), and with nails. Tail very long (141 [128-156]% of HB, n = 10), with very thick bushy fur, similar in colour to dorsal pelage, sometimes with a dark tip.

**Similar Species** None (see Table-key 12).

**Distribution** Widespread throughout Malawi in all biogeographic areas except the high plateaux, with more records from the south than the north. Localities include Blantyre, 38.6 and 40.2 km SW of Chikwawa, 8 km N of Chikwawa, 3.2 km ENE of Chikwawa, Chiradzulu Mountain, Deep Bay, Karonga, Kasungu N. P., Lake Malawi N. P. (Monkey Bay), Lengwe N. P., Mount Mulanje (just above Likhubula), Michirul, Mpatamanga (?Mpatamanga Gorge), Mpimba, Mtimbuka, Mwabvi W. R., Salima, Shire Highlands (near Thondwe), Vwaza Marsh G. R. and Zomba. Elsewhere: widespread from SW Kenya, S DR Congo, Angola, Zambia and Mozambique to N. South Africa. Occurs from sea level (in dune forests) up to 2000 m.

**Habitat** Open canopy woodlands, especially miombo woodlands, mixed thicket woodland-savanna of drier uplands, thicket savanna of poorer areas, and riverine forests. Dense vegetation and safe places for resting in trees during the day are essential.

**Abundance** No detailed information for Malawi. Elsewhere: recorded as 'locally common'. The arboreal and nocturnal habits of these galagos make it difficult to have reliable evidence about abundance and density.

**Habits** Arboreal, nocturnal, and occasionally terrestrial. Walks on branches of trees and can leap between trees (up to ca. 3 m). They do not land feet-first on a branch. The dexterous hands and feet allow these galagos to hang upside down from a branch while foraging. On the ground, they move quadrupedally, but can move bipedally if distressed.

During the day, Large-eared Greater Galagos rest and sleep on branches or in tangles of creepers (where they are usually invisible to humans). They rest singly, or in very small groups of 2-6 comprised of a mother and her offspring and sometimes also an adult male. At night they forage, usually singly, in the trees (when their eye-shine may be seen in the light of a torch). These galagos are omnivorous and opportunistic, feeding on a wide variety of fruits, gums and invertebrates. The diet varies with season and locality, e.g. in South Africa, the diet comprised 33% fruit, 62% gum and 5% invertebrates when fruit was abundant, but 41% gum and 59% invertebrates where fruit was absent. In Malawi (Lengwe N. P.), one individual was observed eating many winged termites which had fallen to the ground under an electric light after emergence at ca. 9 pm one night in December (Happold & Happold 1992b). The galago

took termites from the ground directly into its mouth without using its hands.

Large-eared Greater Galagos are the most gregarious galagos. They live in dispersed groups. Adult females occupy separate territories which they share with their offspring – including those of several generations. Males tend to disperse, and their ranges overlap with those of females. At sleeping sites, mothers with offspring may be joined by an adult male. All age/sex groups (except for territorial males) engage in social grooming which enhances social cohesion. Large-eared Greater Galagos communicate mostly by vocalizations. Their loud child-like cries are frequently heard at night. Their calls are described as a loud series of cries similar to those of a crow or raven, trailing towards the end. They also make 'whistles', 'yaps' and 'cackles' when alarmed, and 18 other distinctly different calls have been reported. Other means of communication between individuals include scent-marking (from scent glands on the sternum to advertise territories), urination, and foot-rubbing. The young begin to emit vocal sounds at ca. three days of age, gradually increasing their repertoire as they grow older.

**Reproduction**. No information for Malawi. Elsewhere: gestation is ca. 132 days. A female has either singletons (30%), or twins (60%) or triplets (10%) (20 animals in captivity). Young are born in Nov at the beginning of the wet season (South Africa) or in Aug-Sep (Zimbabwe). Neonates weigh ca. 40 g and their eyes are open. When very young, the mother carries each baby, one at a time, in her mouth. From ca. eight days of age, the young cling to the back of their mother. Young are weaned when ca. 10 weeks of age and are more or less independent by 17 weeks of age.

**Conservation** IUCN Category: Least Concern. Destruction of suitable habitat for wood extraction and farming, and hunting for food and traditional medicine, are conservation threats.

**Taxonomic Notes** *Otolemur crassicaudatus* (É. Geoffroy, 1812). Originally described in the genus *Galago*. Three subspecies are listed by Bearder & Svoboda (2013). These include *O. c. montieri* (which occurs in Malawi and has larger ears and a longer tail than the other subspecies). Some authorities consider *montieri* to be a distinct species but there is no evidence from skull morphometrics, chromosomes, allozymes of mitochondrial DNA to support this (J. Masters *pers. comm.*). Ansell & Dowsett (1988) map *O. c. montieri* in the north of Malawi (south to ca. 14.30 S) and a hybrid population *(O. c. montieri* x *O. c. crassicaudatus*) in the south of the country. (*O. c. crassicaudatus* is considered to be the subspecies in South Africa). In this profile, data from all subspecies are combined.

**Key Reference** Bearder & Svoboda (2013).

**Measurements**
*Otolemur crassicaudatus*

| | |
|---|---|
| HB: | 313 (255-400) mm, n = 360 |
| T: | 410 (300-550) mm, n = 375 |
| HF: | 93 (70-108) mm, n = 340 |
| E: | 62 (48-72) mm, n = 344 |
| WT: | 1131 (567-1814) g, n = 157 |
| GLS: | n. d. |

Throughout biogeographic range (Olson & Nash in Bearder & Svoboda 2013).

# Genus *Paragalago* – Dwarf Galagos

All species of dwarf galagos used to be placed in the genus *Galagoides* but, in 2017, genetic evidence showed that *Galagoides* contained two clades (a western clade and an eastern clade) that did not share an exclusive common ancestor. Therefore, the five species in the eastern clade were removed from *Galagoides* and placed in a new genus – *Paragalago*.

Species in *Paragalago* are medium to small galagos (60-250 g). They have longer snouts than species in the genus *Galago* (including *G. moholi*) and concave nasal profiles. They are distinguished from species in the genus *Galagoides* mainly by cranial and dental characters but they also have different vocalizations and behaviour. Species of *Paragalago* tend to leap more often than species of *Galagoides*, but not as often or as extensively as species of *Galago* (Masters *et al.* 2017).

Two species, *P. granti* and *P. orinus,* occur in Malawi (see Table-key 12).

## *Paragalago granti.*

## Mozambique Dwarf Galago

**Malawian Names** Chipimbi, Kamundi, Kapimbi, Kaundi. Not confined to this species.

**Description** Small galago with large forward-facing eyes and long well-furred bushy tail with a black tip; often confused with *Galago moholi*. Dorsal pelage and outer surfaces of fore- and hindlimbs pale brown with buffy-brown tips and with a slight pinkish tint. Ventral pelage and inner surface of limbs yellow to creamy-buff. Head broad, with large ears pointing away from head at 45˚; ears blackish behind and also at top of front surface (the black edge is conspicuous when viewed from the front). Eyes enormous; each eye surrounded by a conspicuous black eye-ring which extends forward along the snout. White stripe between the eyes (as in *G. moholi*). The snout is narrow and pointed and the nasal profile (viewed from side) is concave (cf. *G. moholi*). Hindlimbs longer and more powerfully built than forelimbs. Hands and feet with long slender digits, each ending with a flat nail, except for the second toe which has a grooming claw. Fingers and thumbs opposable, capable of gripping twigs and small branches. Tail long (144 [110-191]% of HB, n = 50), bushy, terminal 80% wider than basal 20%, darker than dorsal pelage and blackish on terminal 10-50%.

**Similar Species**

*Galago moholi.* Tail pale grey, well-furred but not bushy, not becoming darker towards tip. Ears grey behind and in front; front surface without black at the top edge. Lands feet-first when leaping from branch to branch.

**Distribution** Found in southern Malawi on the Shire Highlands, Phalombe Plain and Lower Shire Valley biogeographic areas, from ca. 120-1000 m. Localities confirmed by J. Masters (*pers. comm.*) are 40.2 km SW of Chikwawa, Thyolo, Thyolo Mountain and Zomba. Also recorded at Likhubula (Tea Research Foundation Forest) by Bearder & Karlsson (2009). Ansell & Dowsett (1998) map *P. granti* (as *Galagoides zanzibaricus*) in five quarter-degree squares in southern Malawi, but do not give any locality names and this map might contain erroneous information. Elsewhere: recorded in SE Tanzania, coastal and southern Mozambique, E Zimbabwe and NE South Africa.

**Habitat** Moist evergreen forest and transitional woodland. Elsewhere, said to inhabit lowland evergreen and semi-evergreen forest, dry coastal forest, thicket and scrub. The type locality was described as more-or-less undulating sandy flats, densely bushed and timbered.

**Abundance** No data for Malawi. In SE Tanzania, encounter rates were 1.2 – 4.9 individuals/hour.

**Habits** Nocturnal and arboreal; only occasionally terrestrial. Like *G. moholi*, they leap from branch to branch and from tree to tree, but they leap less often and are not specialized ricochetal leapers (cf. *G. moholi*). They are more quadrupedal and, when they leap from branch to branch, they land either on their hands or on their hands and feet together (i.e. they do not land feet-first). They rarely descend to the ground.

Mozambique Dwarf Galagos feed on insects, fruits, flowers, nectar and gums exuded from trees including *Combretum*. They forage from the tops of trees to the leaf litter (where they search for insects), and usually forage alone. They sleep during the day in holes in trees 3 – 5.5 m above ground, and make nests of green leaves, lianas and fibres. In South Africa, four sleeping sites were found to be occupied by groups of three females, one by a female and her

infant, and one by a male. Other nests have contained as many as five individuals of mixed sex.

They appear to live in dispersed groups comprised of one adult male with one or two adult females. They usually forage alone but communicate with a variety of vocalizations including alarm calls, and social contact calls. Calls have been described as buzz screeches, clear high-pitched yaps, and incremental calls (which are made up of repeated short highly modulated units given in groups of increasing number of units). Incremental calls are uttered near sleeping sites and sporadically throughout the night. They are markedly different to the regularly repeated, monotonous, lower-frequency tonal loud calls made by *G. moholi*. Mozambique Dwarf Galagos call from dusk to dawn but call most frequently during the two hours after dusk (when emerging from nests) and two hours before dawn (when gathering at nests for daytime sleeping). A population in Kalwe F. R. near Nkhata Bay called 20-30 times each hour through the night as individuals kept in communication with each other. Calls occur at about the same frequency on moonlit and non-moonlit nights.

**Reproduction**. No information for Malawi. A female with two foetuses was recorded in South Africa.

**Conservation** IUCN Category: Least Concern. Conservation concerns similar to those of *P. orinus*.

**Taxonomic Notes** *Paragalago granti* (Thomas and Wroughton, 1907). The name of this galago has been changed many times since it was described as *Galago granti* in 1907. First, it became a subspecies of *Galago senegalensis*, then a subspecies of *Galago zanzibaricus* or *Galagoides zanzibaricus*. Finally, it was reinstated as a distinct species, but it was then placed in a new genus (see Genus *Paragalago*). It is referred to as *Galagoides zanzibaricus granti* by Ansell & Dowsett (1988), and as *Galago senegalensis* (Lesser Galago or Senegal Galago) by Sweeney (1959), Hayes (1978) and Hough (1989). A form referred to as the Malawi Bushbaby, *Galagoides nyasae* Elliot, 1907, is currently considered to be part of *Paragalago granti*.

**Key References**. Génin *et al.* (2016), Honess *et al.* (2013) as *Galagoides granti,* Masters *et al.* (2017), Rovero *et al.* 2009.

**Measurements**
*Paragalago granti*

| | |
|---|---|
| HB: | 153.4 (116-174) mm, n = 50 |
| T: | 220.5 (163–254) mm, n = 50 |
| HF: | 58.6 (50–67) mm, n = 50 |
| E: | 38.2 ± 0.41 mm, n = 50 |
| WT: | 146.8 (74-203) g, n = 20 |
| GSL: | 42. 3 ± 0.24 mm, n = 50 |

Throughout biogeographic range (F. Génin and J. Masters pers. comm.)

## *Paragalago orinus*

## Mountain Dwarf Galago

**Malawian Names** Chipimbi, Kamundi, Kapimbi, Kaundi. Not confined to this species.

**Description** Very small galago with large forward-facing eyes and long well-furred tail. Dorsal pelage dark brown to reddish-brown. Ventral pelage and inner surfaces of limbs creamy-white. Head similar in colour to neck, forehead darker with longitudinal white stripe from forehead to nostrils. Ears large, rounded at tip, pointing away from head at 45˚, back surface dark brown, front surface with yellow pigmentation. Eyes huge, forward-facing, brownish. Each eye surrounded by a thin dark eye ring. Snout upturned; nasal profile concave. Fore and hindlimbs with long fingers and toes, each ending with small nail, except for the second toe which has a grooming claw. Fingers and thumbs opposable, capable of gripping onto twigs and small branches. Tail long (164 [136-190]% of HB, n = 3), sometimes entirely reddish-brown, sometimes with basal two-thirds brown and terminal third black. Tail sometimes bushy and sometimes covered with short hairs; about the same width from base to tip.

**Similar Species** None. *Galago moholi* and *Paragalago granti* are larger; see also Table-key 12.

**Distribution** In Malawi, known only from two specimens collected in Mugesse Forest (= Mughese Forest) in the Misuku Hills; the highest part of this forest is 1888 m. This is the southern-most locality that the species has been recorded. A record from Nyika Plateau at 2200 m possibly represents *P. orinus* but this needs confirmation. Elsewhere: recorded at high altitudes on some of the Eastern Arc Mountains which form a chain of mountains from NE to SW Tanzania. All these areas have a high annual rainfall.

**Habitat** In Malawi and elsewhere, inhabits submontane and montane moist evergreen forests at altitudes of 600-2600 m. Mountain Dwarf Galagos occur in the canopy, middle storey and understorey of the forest, especially where there are tangles of lianas and vines.

**Abundance** No information for Malawi. In Tanzania, abundance (as measured by the number of individuals observed per hour when walking slowly through the habitat at night) ranges from 1.2 – 4.7. No measurements of density are available because these galagos are so difficult to see in the canopy.

**Habits** Nocturnal, arboreal, omnivorous. Mountain Dwarf Galagos run and climb on twigs and small branches using all four limbs. They are very active and quick in their movements, often leaping from branch to branch. They descend down tree trunks headfirst, and at times will forage briefly on the forest floor. The diet is mainly gums, nectar, and insects including moths and cockroaches. They forage in all strata of forests. They live in dispersed groups, forage alone but maintain contact with conspecifics with high-pitched contact calls. Some calls have been described as two-three squeaking calls: dum-dum ... dum-dum ....; the second lower in pitch that the first.

**Reproduction** Very little information available; assumed to be similar to other species of the genus.

**Conservation** IUCN Category: Near Threatened. Conservation concerns are the fragmentation and destruction of suitable habitat, and the small geographic distribution of this species.

**Taxonomic Notes** *Paragalago orinus* (Lawrence and Washburn, 1936). Originally described as a subspecies of *Galago demidovii*, a species in Central and West Africa. Subsequently placed in the genus *Galagoides,* but currently placed in *Paragalago.* Ansell & Dowsett (1988) refer to this species as *Galagoides zanzibaricus* subsp.

**Key References** Perkin *et al.* (2002), Perkin *et al.* (2013) as *Galagoides orinus*, Rovero *et al.* (2009).

**Measurements**
*Paragalago orinus*

| | |
|---|---|
| HB: | 132 (125–138) mm, n = 4 |
| T: | 180 (169–199) mm, n = 4 |
| HF: | 46 (43–48) mm, n = 4 |
| E: | 30 (25–32) mm, n = 4 |
| WT: | 90 (74–98) g, n = 3 |
| GLS: | 39 mm, n = 1* |

Eastern Arc Mountains, Tanzania (Perkin *et al.* 2013). *locality not given.

# ORDER PHOLIDOTA – PANGOLINS

| | | | |
|---|---|---|---|
| Family Manidae | *Smutsia* (1 species) | Ground Pangolins | p. 310 |

Pangolins are unmistakable mammals with long muzzles, long tails and conspicuous scales instead of fur on the dorsal surfaces of their bodies. Some are arboreal and some terrestrial. They are specially adapted for feeding on ants and termites - they have powerful front limbs and claws for digging into termite mounds and ant nests, and a long tongue coated with sticky saliva for lapping up termites and ants. Pangolins are found in Africa and Asia in a wide variety of habitats. All are placed in the family Manidae.

## FAMILY MANIDAE - Pangolins

This family contains two genera – *Phataginus* (Tree Pangolins) with two species in Asia and two in Africa, and *Smutsia* (Ground Pangolins) also with two species in Asia and two in Africa. Only one genus and one species occurs in Malawi.

### Genus *Smutsia* – Ground Pangolins

Ground pangolins have stout bodies, short and stumpy hindlegs, a tail which is shorter than HB and scales covering the outer surfaces of the forelimbs and hindlimbs as well as the top of the head, back and tail. Two species occur in Africa but only one in Malawi.

### *Smutsia temminckii*

### Temminck's Ground Pangolin

**Malawian Names** Ngaka, Nkaka.

Liwonde N. P., Malawi © Bentley Palmer

**Description** An unmistakable mammal covered mainly by large plate-like scales (instead of hair). Dorsal surface (and flanks, tail and outer surface of legs) covered with overlapping large scales. The scales point backwards, and each scale overlaps the next most posterior scale. Scales are not present on ventral surface, inner surfaces of legs, nor on the throat and face. Each scale is brown or greyish-brown; the larger dorsal scales are tinged with reddish-brown or yellowish-brown along the outer surface. Scales are widest at the point where a scale is overlapped by the preceding scale. Scales vary in size - widest on the upper surface of back (maximum width ca. 50 mm) and tail (45-50 mm), becoming smaller in size on the neck (ca. 30 mm) and head (10 mm). Scales have faint ridges on the surface, orientated along the length of the scale. Scales are not present around the eyes, ears, mouth and nostrils. Eyes relatively smallish. Ears without pinnae. Mouth small and toothless; lower jaw delicate. Limbs short and thick. Each forefoot ends with five digits and long thick curved claws; the middle three claws are much longer (ca. 6 cm) than those on the outer two digits (ca. 3 mm). Hindfeet shorter than forefeet, thickset, each with five nails. Tail long (ca. 94% of HB); very wide at base narrowing slightly towards terminal end.

**Similar Species** No other species in Malawi is similar to this pangolin.

**Distribution** There are very few records in Malawi and most are from the 1950s and 1960s. There is a single record from the far north (Misuku Hills) and it is likely to occur in Vwaza Marsh W. R. It is also recorded from Kasungu N. P. but all other records are from the south of the country (Dedza, Lengwe N. P., Liwonde N. P., Mwabvi W. R., Ntcheu, Thyolo and Zomba). Elsewhere: widespread from eastern Chad and Sudan south through East Africa to Angola, Botswana, Zimbabwe, Mozambique and northern South Africa.

**Habitat** Mostly found in woodland savannas including open canopy miombo woodlands and mopane woodland, but also found in thicket savanna of poorer areas and perhaps in seasonally wet grasslands and dambos. The rainfall is 250-1400 mm/annum in suitable habitats. Except for the record in the Misuku Hills, not found in forests or at high altitudes. Suitable habitats must have termite mounds and nests, and the nests of species of ants that comprise most of the pangolin's diet (see below).

**Abundance** In Malawi, there are few records (all rather old) of the species so it is not possible to provide any meaningful assessment of abundance. Presumed to be very rare. Elsewhere: records are fragmentary, although in South Africa (where they have been studied more intensely) they may be more common than in their other parts of their biogeographic range. (See also Conservation below.)

**Habits** Terrestrial, mostly nocturnal, and myrmecophagous. Temminck's Ground Pangolins normally walk bipedally on the hindlimbs with the body held parallel to the ground and the weight of the heavy tail acting as a counterbalance, although occasionally they walk on all fours especially when in hilly country and on soft sand banks. When threatened, pangolins roll into a ball (in the same manner as hedgehogs) so the head and ventral surface is protected. The thick covering of scales gives protection against predators and abrasive vegetation and rocks. Adult pangolins are mostly nocturnal although young and subadults are partly diurnal and crepuscular. When not out and about, pangolins rest under rocks, litter and vegetation, and in the abandoned burrows of Common Warthogs (*Phacochoerus africanus*). Pangolins utilize several burrows within their home-range, and often mark a burrow with urine and faeces. They do not dig their own burrows. Pangolins sometimes roll around in water, probably to dislodge ectoparasites living under the scales.

When foraging, a pangolin walks in a zig-zag fashion, keeping its nose close to the ground. When a nest of ants or termites is located, it uses it long powerful claws and forelimbs to scratch open the nest galleries. Although pangolins spend much of their time foraging, only about 16% of the time is spent feeding, and each feeding bout lasts for only about one minute (or less). One of the reasons for this is that they are very selective in their choice of food. In one study in South Africa, the pangolins consumed only four species of ants and one species of termite out of a total of 53 species of ants and four species of termites that were available. Similarly, pangolins in NW Zimbabwe, where there were 50 species of ants and five species of termites, pangolins preyed upon only 15 species of ants and five species of termites. Of these, ants comprised 97% of the diet, and termites just 3%, and one species of ant comprised 72 - 83% (depending on the season) of all ants eaten even though it formed only 5% of the ant fauna of the study area.

One of the most interesting adaptations of all species of pangolins is the small skull, delicate slender and long rod-shaped tongue with a flattened tip. When foraging for ants or termites, the pangolin positions its head close to the ground or into a chamber of an ant's nest. The tongue is extended to its full length (perhaps 20-50 cm beyond the lips) in a series of darting in-and-out movements. The saliva on the tongue captures the prey which is quickly brought into the mouth and swallowed without being chewed. There is a very complex arrangement of muscles and bones that allows this rapid tongue movement.

Temminck's Ground Pangolins live a solitary existence except when males and females mate and when females are looking after their young. They are territorial. Home-ranges (assessed from their den locations) in Zimbabwe were 10.3, 10.7 and 11 $km^2$ for three males, and 5.6, 5.9 and 7.5 $km^2$ for three females. Foraging ranges were likely to be larger.

**Reproduction** No data for Malawi. Elsewhere: gestation: ca. 140 days. Females give birth to a single young each year or perhaps only every second year. Neonates have the eyes open and the scales soft. In South Africa, births have been recorded at different seasons, and there seems to be no clear-cut 'breeding season'. When about four weeks old, the young leaves the burrow for the first time, rides on its mother's back, and begins to eat ants and termites. Weaning occurs at ca. five months; a captive individual weighed 1 kg at three months of age, and 5 kg

at one year. The young stays with its mother for 3-6 months, depending on the region.

**Conservation** IUCN Category: Vulnerable. The greatest threat to pangolins is loss of habitat containing sufficient ants and termite nests to provide food. They are also killed for traditional medicine (mainly after being exported to Asia). In South Africa, they may be killed, inadvertently, by electric fences.

**Taxonomic Notes** *Smutsia temminckii* (Smuts, 1832). Formerly placed in the genus *Manis* with *Smutsia* considered to be a subgenus of *Manis*. Referred to as *Manis temminckii* by Ansell & Dowsett (1988).

**Key Reference** Swart (2013).

**Measurements**
*Smutsia temminckii* (males)

| | |
|---|---|
| HB: | 431 (297-565) mm, n = 18 |
| T: | 405 (290-585) mm, n = 18 |
| HF (c.u.): | 60 (52-70) mm, n = 11 |
| E: | no external pinnae |
| WT: | 9.4 (2.5-17.1) kg, n = 42 |

Zimbabwe (Swart 2013).

# ORDER CARNIVORA - CARNIVORES



The Carnivores are the third largest order in Malawi. The order contains seven families and 27 species. It is a very diverse order – Malawian species range in size from the small Slender Mongoose (WT: ca. 0.5 kg) to the large African Lion (WT: 100-170 kg). Their common characteristics are that they all eat animal prey, have specialized teeth to cut and masticate their prey, and strong muscles on the head and jaws. Of particular importance are the carnassial teeth (last upper premolar and first lower molar) which are well-developed (to a greater or lesser extent depending on the family) and capable of cutting and shearing flesh, bones and the hard shells of invertebrates. However, the families and species are amazingly diverse with respect to their social behaviour and ecology. They vary in foraging behaviour (digging, chasing), social behaviour (solitary, gregarious), time of activity (diurnal, nocturnal), habitat (aquatic, grasslands, forests), and diet (from small soft invertebrates to large herbivores). As a result, each species has its own ecological niche which helps to reduce competition between the species. As an order, the Carnivora are very successful but their numbers are regulated primarily by the abundance of their prey and hence they are never as abundant as their prey.

## FAMILY CANIDAE – Dogs, Foxes, Jackals and Wolves

All four of these canids occur in Africa. They are medium to large long-legged running carnivores. In Malawi, however, the family is represented by only two genera, each with a single species. They are entirely terrestrial and live in grassland and woodland savannas. The characteristics of the family are short pelage, long limbs, long upright-pointing ears, and usually a long bushy tail. The claws are non-retractile and rounded at the tip (as in the mongooses). The muzzle is elongated; the large strong muscles of the head and jaws are adaptations for catching, killing and masticating prey (as in the felids). Canids, in general, live in small family groups (e.g. jackals) or in packs (e.g. African Wild Dogs). Domestic dogs *Canis lupus familiaris* (common and widespread in Malawi) belong to this family; they are not indigenous to Malawi (or Africa) and have evolved from a wolf-like ancestor in Europe and Siberia; after domestication, they were introduced into Africa by humans. The two canids in Malawi are easily distinguished.

*Canis adustus* (Side-striped Jackal). Pelage greyish-brown with white stripe on flank. Tail very bushy. Much smaller; WT: 7-12 kg.

*Lycaon pictus* (African Wild Dog). Pelage with irregular brown, black and white blotches. Tail moderately bushy only on terminal half. Much larger: WT: 18-27 kg.

## Genus *Canis* – Dogs, Jackals and Wolves

This genus contains six or seven wild species of which four (three jackals and the Ethiopian Wolf) occur in Africa, but only one jackal occurs in Malawi. There are also domestic dogs but they are not indigenous.

### *Canis adustus*

### Side-striped Jackal

**Malawian Names** Kambwe, Likule, Nkhandwe.

Liwonde N. P., Malawi © Bentley Palmer

**Description** Medium-sized dog-like carnivore, mostly greyish-brown with a long bushy tail almost always ending in a white tip. Dorsal pelage thick and dense, greyish-brown often strongly flecked with white, brown or black. White stripe on flank from shoulders to rump, sometimes bordered by thin black stripe on lower side. Intensity and size of white and black stripe very varied; obvious on some individuals, barely visible on others. Ventral pelage similar to dorsal pelage, or paler. Head with pointed muzzle and large upward-pointing ears. Nasal region black; upper and lower lips white. Inner surface of ears with long white hairs. Limbs long and slender, ginger or cinnamon in colour, sometimes flecked with white. Tail with long fluffy hairs; hairs cinnamon tipped with black on dorsal and ventral surface; tip almost always white (variable in length from ca. terminal 10% to completely absent). Five digits on forefoot (Digit 1 high up on forefoot); four digits on hindfoot); all digits with non-retractile claws.

**Similar Species** None. In Malawi, the only other indigenous 'dog-like' mammal is the African Wild Dog *Lycaon pictus* (see yellow box above).

**Distribution** Widespread in Malawi in all biogeographic areas and at altitudes ranging from(ca. 100 m in the far south to 2000 m in the far north (including the Misuku Hills and Nyika Plateau. Localities include Kasungu N. P., Lengwe N. P., Liwonde N. P., Mwabvi W. R., Nyika N. P. and Vwaza March G. R. Elsewhere: widespread throughout woodland and grassland savannas of West Africa (Senegal to Ethiopia) and southwards through East Africa to Central Africa (Angola to Zimbabwe and Mozambique). Not present in rainforest habitats nor in much of southern Africa (where replaced by the Black-backed Jackal *Canis mesomelas*).

**Habitat** Open canopy woodlands and grasslands, including montane grasslands. In some localities, may live close to human settlements. However, Side-striped Jackals tend to prefer grassland habitats to woodland habitats, but they will move into woodlands where they share the habitat with another species of jackal (if present) – which is not the case in Malawi).

**Abundance** Little information for Malawi. Side-striped Jackals were "occasionally seen" in Liwonde N. P. in 1976. Elsewhere: generally common in eastern and central Africa, but uncommon in West Africa. In N Zimbabwe, the density has been recorded as 20-30 adults/100 km$^2$, increasing to 80-100 animals/100 km$^2$ during the breeding season.

**Habits** Terrestrial, mostly nocturnal but occasionally diurnal, carnivorous and omnivorous. During the day, these jackals shelter in abandoned burrows, (such as those of Aardvarks), in cavities under piles of boulders and probably in any vegetation that provides substantial cover and likewise buildings on farms and urban areas. Side-striped Jackals are opportunistic feeders, preying on small mammals, birds, reptiles, insects, carrion and wild fruits. This flexibility means that food is always available within a relatively small area regardless of season. They are well known to scavenge around camps and on the kills of larger predators. Normally, jackals forage alone or in pairs, but they will feed together where there is a single large source of food (e.g. at kills of large predators).

In Zimbabwe, home-ranges in game parks varied from 0.2 $km^2$ to 1.2 $km^2$, depending on the season, but were larger (4 $km^2$) in farmlands. Mostly a home-range was occupied by a male-female pair. The central part of the home-range (the core area) was used exclusively by the resident pair; the remainder was utilized to a lesser extent by up to four neighbouring pairs. Within its home-range, a jackal traveled on average 10.3 km/12-hour night (3.4- 31.7 km) (straight line measurements). Population densities varied greatly at different times of the year, from 20-30 individuals/100 $km^2$ to 60-90 individuals/100 $km^2$ during the breeding season. Most activity is nocturnal, although jackals may be seen during the day in undisturbed areas where they are not persecuted by people.

The social unit of Side-striped Jackals is a mated pair which often remains stable for several years. Both members of the pair raise their young (see below). After the young leave the burrow, they remain with their parents as a family group; later the young disperse.

**Reproduction** No information for Malawi. The time of reproduction varies depending on locality. In Zimbabwe, young are born in Sep and Oct. Females have only one litter/year. Gestation: 57-60 Days. Litter-size: 5.8 (3-8), (n = 16). Young are born in a den – usually an abandoned burrow of another species. Neonates are blind and covered with short pelage. As the young grow and are weaned, both male and female parents feed them with regurgitated meat, or small prey. The young are weaned at ca. 10 weeks and are probably independent before they are a year old. Mortality of young is high and it is estimated that only about two young of each litter survive for more than two months. In any one year, about 80% of adult females give birth but due to mortality, the productivity is only ca. 1.8 young/adult/year. In the wild, average lifespan is 3-4 years.

**Conservation** IUCN Category: Least Concern. Jackals are carriers of rabies, and therefore their numbers are controlled when populations are large.

**Taxonomic Notes** *Canis adustus* Sundevall, 1847. No subspecies are recognised.

**Key References** Loveridge & Macdonald (2013), Smithers (1983).

**Measurements**
*Canis adustus*

| | |
|---|---|
| TL: | 1078.5 (960-1170) mm, n = 100 |
| T: | 357.5 (305-410) mm, n = 100 |
| HF c.u.: | 170.0 (153-190) mm, n = 100 |
| E: | 87.0 (80-97) mm, n = 100 |
| WT: | 8.9 (7.3-12.0) kg, n = 100 |

Zimbabwe (Smithers 1983).

## Genus *Lycaon* – African Wild Dog

There is only one species in this genus.

### *Lycaon pictus*

### African Wild Dog

**Malawian Names** Lisogo, Mbinzi, Mbulu, Mphumphi.

Luangwa N. P., Zambia © Bentley Palmer

**Description** Large dog-like carnivore with long legs and multicoloured brown, black and white pelage. Pelage with irregular yellowish-brown, black and white blotches on back, flanks, legs, and belly. The pattern is unique to each individual (and hence useful for recognizing individual animals). Crown of head yellowish-brown (sometimes whitish-grey) with black longitudinal stripe merging into black around the eyes, muzzle, cheeks, chin and throat. Ears very large and rounded, mostly black with long white hairs on inner surface; held up-right above head. Fore and hind limbs long, each limb with five digits; claws non-retractile. Tail relatively moderately short (25-35% of HB), terminal half bushy; yellowish-brown at base with black markings or rings on middle section, and white at tip.

**Similar Species** None. No other species of carnivore has multi-coloured pelage with brown, black and white blotches.

**Distribution** In Malawi, at the present time, very rare and probably migratory (see Historical Distribution below). Recent records (post 1975) are Kasungu N. P., Mwabvi W. R., Nkhotakota W. R., Nyika N. P. and Vwaza Marsh G. R. Wild Dogs (from South Africa and Mozambique) were introduced into Liwonde N. P. and Majete W. R. in 2021. Elsewhere: scattered populations in savanna areas from Chad, South Sudan and Ethiopia, southwards through East Africa to Zambia and Botswana and South Africa (Kruger N. P.).

*Historical Distribution* African Wild Dogs were probably found throughout most of Malawi where there were suitable open savannas and large populations of prey species. Even so, they were probably migratory, moving across (modern) national borders because each pack requires a large home-range. Early records include Zomba Plateau and many localities on the Shire Highlands, the lower Shire Valley, and open areas of the Central Plateau. The 1932 edition of *The Handbook of Nyasaland* records that 'packs of five to as many as twenty individuals roam districts where game is still found'. In 1984, Mwabvi W. R. was part of the home-range of several packs of African Wild Dogs, and during the period 1988-1992 many packs were sighted in Kasungu N. P. For example, in Kasungu N. P. in 1991, there were 21 sighting of dogs, and the packs ranged in size from one to 60 individuals. Wild Dogs have also been recorded in the past from Vwaza Marsh G. R. In Nyika N. P., they were recorded as being "often seen" in 1954, but “rarely seen” by 1995. Wild Dogs have not been sighted in Liwonde N. P. since 1975. There are no records of Wild Dogs in Lengwe N. P. (because the thicket-clump savanna is too dense).

**Habitat** Woodland savannas and grasslands, including montane grasslands. Habitat selection is determined to a great extent by the availability of prey and also by the ‘openness' of the habitat which enables Wild Dogs to run freely after prey.

**Abundance** In Malawi, very rare with only occasional sightings. Not resident (see above). Elsewhere: African Wild Dogs have never been abundant or common. At the present time (2021), they are much less common than in previous years, and they have a very patchy distribution within the biogeographic range of the species. A recent survey suggests that there are less than 8000 individuals in Africa, in about 750 packs. The largest populations are in an area that includes N Botswana, E Namibia,

W Zimbabwe, Zambia, S Tanzania and N Mozambique.

**Habits** Terrestrial, diurnal and nocturnal, carnivorous. African Wild Dogs usually spend the day sleeping with their pack members on the ground in shady places often close to water, but females give birth and raise their pups in dens which include disused burrows of Aardvarks and Porcupines, small caves and cavities under boulders.

African Wild Dogs live in packs that vary greatly in number (see above). They are very social animals, living the whole of their lives in the company of other individuals. Consequently, they have developed many complex forms of communication, including vocalizations (both within and between packs), food-begging, dominance and submission postures, and greeting behaviour when individuals and packs meet. Members of a pack collaborate with one another when hunting, resulting in a higher success rate than hunting alone or in very small groups. Scent-marking (by deposition of urine and faeces) is used to mark territorial boundaries.

Home-ranges are large and they vary in size depending on the habitat and density of prey. The mean is ca. 600 $km^2$, ranging from 150 $km^2$ in Kruger N. P. (South Africa) to ca. 2000 $km^2$ in arid habitats of the Kalahari and in the Serengeti N. P. where the prey makes seasonal migrations. The home-ranges of packs may overlap, and if one pack enters the territory of another pack, aggression and fighting may occur. Dispersing individuals or small packs may move hundreds of kilometers away from their natal home-range to areas where there are no resident packs.

Packs of African Wild Dogs chase their prey with great tenacity. They can run for many kilometers at a time, both during the day and the night. When the prey is exhausted, it is pulled to the ground usually by a single member of the pack, and then overpowered by other members of the pack. All members of the pack then feed on the prey. The species of prey depends on locality. A study in Kasungu N. P. showed that packs of Wild Dogs successfully hunted Puku (5 kills), Reedbuck (4), Common Duiker (3), Buffalo (1), and Kudu (1). In Eastern Africa, they commonly prey on Thomson's Gazelles, Common Wildebeest, Lichtenstein's Hartebeest and Impala. Often prey are several times larger (both in size and weight) than individual dogs, and hence collaboration is essential for killing larger prey.

African Wild Dogs move by a quick walk or trot and can also gallop. When running fast, they can reach speeds of ca. 60 km/h. They are capable of running fast for many kilometers (a characteristic not seen in any other large carnivore).

The tri-colour markings, and unique markings of each individual, have led to speculation about the function of these markings. It has been suggested that they allow dogs to recognize individual pack members; or they might enable dogs to maintain visual contact with others when hunting, or they might camouflage the dogs by breaking the outlines of their bodies.

**Reproduction** No information for Malawi. Elsewhere: African Wild Dogs give birth to young annually. Gestation: 71-73 days. Litter-size: 8-11. Young are born in dens (see Habits) and remain there until they are weaned at the age of about nine weeks. During this time, the mother stays with her young and other members of the pack bring food to her. Sexual maturity attained in the second year of life. Mortality among young is high – about 50%. Adults in the wild live for up to six years (e.g. in Selous N. P., Tanzania) and as long as 11 years in some localities (e.g. Kruger N. P., South Africa, and in Botswana). In a pack, it usually only the dominant male and female who reproduce on an annual basis, hence the annual fecundity of a pack (assuming a female has 10 young and 50% die in the first year) is only five individuals. Subdominant females may breed in some years. Population numbers can increase and decrease rapidly depending on locality and prey numbers.

**Conservation** IUCN Category: Endangered. Reduction in the area of suitable habitat and in the population numbers of prey, and conflict between Wild Dogs and humans (and their domestic animals), have caused a large decline in numbers in recent years. Populations of mature individuals are decreasing; the IUCN estimated in 2012 that there were only 1400 individuals in the whole of Africa. Conservation threats include predation on domestic animals (when natural prey numbers are reduced), human activities (hunting, road kills, snares, poison, etc.), movements away from protected areas into agriculture areas when hunting, competition for food with other large carnivores, and epidemic diseases (e.g. rabies).

**Taxonomic Notes** *Lycaon pictus* (Temminck, 1820). No subspecies are currently recognised, although many subspecies were recognised in the past. Differences between individuals and packs are now considered to be a result of clinal variation.

**Key References** Kato (1996), McNutt & Woodroffe (2013), Smithers (1983), Van Lawick & Van Lawick-Goodall (1970).

**Measurements**
*Lycaon pictus*

| | |
|---|---|
| HB: | 986.4 (880-1068) mm, n = 41 |
| T: | 333.2 (270-390) mm, n = 41 |
| HF c.u.: | 218.4 (170-318) mm, n = 35 |
| E: | 129.0 (110 – 160) mm, n = 40 |
| WT: | 22.7 (18.0–27.0) kg, n = 39 |

Kenya (Laikipia and Samburu Districts) (McNutt & Woodroffe 2013).

## FAMILY MUSTELIDAE – Otters, Ratel, Weasels and allies

This large family contains otters, the Ratel, the Zorilla and weasels which occur in Africa, as well as polecats, minks, stoats, badgers and martens which occur in other parts of the world.

In Malawi, the family is represented by five genera (each with only one species) which are placed in three subfamilies. The family as a whole has several unique skull and teeth characteristics (not visible externally), although externally the species in each subfamily look very different from those of other subfamilies. Phylogenetically, the Lutrinae (otters) and Ictonychinae (weasels) are closely related, and the Mellivorinae (Ratel) is more distantly related to other subfamilies which are not represented in Africa. The five mustelids found in Malawi can be distinguished by the information in the yellow box below.

*Aonyx*, African Clawless Otter, Lutrinae. Semi-aquatic. Throat and chest white or greyish-white without any markings; cheeks and lips white. Digits clawless or with rudimentary nails; webbing between front digits rudimentary.

*Hydrictis*, Spotted-necked Otter, Lutrinae. Semi-aquatic. Throat and chest whitish or slightly paler than dorsal pelage with irregular black and/or whitish markings; cheeks and lips brown. Digits with claws, front digits partly webbed.

*Mellivora*, Ratel, Mellivorinae. Terrestrial. Medium-sized. Stocky body with moderately long legs and short tail. Black with a white "mantle" over the crown of head, back and tail.

*Ictonyx*, Zorilla, Ictonychinae. Terrestrial. Long body with moderately long legs and shaggy pelage. Black with four white stripes. Tail bushy, white but flecked with many black hairs. No white cap on head.

*Poeciligale*, African Striped Weasel, Ictonychinae. Terrestrial. Very long body with very short legs and short pelage. Black with four white stripes. Tail bushy; white with a few black hairs. White cap on head.

# Genus *Aonyx* – Clawless Otters

This genus contains two species, both endemic to sub-Saharan Africa, but only one occurs in Malawi.

## *Aonyx capensis*

## African Clawless Otter

**Malawian Names** Chiwawu, Katumbu, Kauzi, Mbiti. Not confined to this species.

© C. & M. Stuart

**Description** A large dark otter with uniformly white cheeks, neck, throat and chest. Males, on average, larger and heavier than females. Pelage thick, short, dense and lustrous. Pelage with very dense underfur. Dorsal pelage, limbs, flanks and tail dark brown. Ventral pelage on belly slightly paler than dorsal pelage. Head broad, same colour as dorsal pelage, paler on muzzle. Upper and lower lips, cheeks (below ears), throat and chest pure white (without any markings (cf. Spotted-necked Otter). Ears small and rounded on side of head. Fore- and hindlimbs short and wide. Fore- and hindlimbs with five digits; Digits 1 and 5 shorter than Digits 2, 3 and 4. All digits without claws or with very small rudimentary, hardly visible nails. Almost no webbing between digits of forefeet; digits of hindfeet webbed for half their length (cf. Spotted-necked Otter). Tail moderately long (ca. 40% of HB), very thick at base, tapering to tip.

**Similar Species**

*Hydrictis maculicollis* (Spotted-necked Otter). Throat and chest whitish or slightly paler than dorsal pelage with irregular black and/or whitish markings; cheeks and lips brown. Digits with claws, digits of front feet partly webbed, digits of hindfeet webbed to their tips.

**Distribution** In Malawi, localities include Kasungu N. P., ), Lake Malawi N. P., Liwonde N. P., Nyika N. P. (rivers flowing off the plateau), Thyolo District (Nswadzi River)*, Vwaza Marsh G. R. and Zomba Plateau. Also found in rivers, marshes and wetlands at many localities around Lake Malawi and the Shire River as far south as Nsanje. Elsewhere: very widespread in savanna habitats from Senegal to Ethiopia, and southwards to Angola, Zambia, Zimbabwe, Mozambique and South Africa. Not recorded in the Congo basin, nor in arid areas of southern Africa (Namibia, Botswana).

**Habitat** Streams, rivers and freshwater lakes, especially where there are rocks, boulders and reed-beds which provide adequate cover. Clawless Otters have also been recorded in farm dams and other water impoundments. Preferred freshwater habitats in South Africa are those with a moderately flowing current (cf. fast flowing and static water), shallow water, adequate food resources, and an absence of pollution, boating, human activities, and pumping for irrigation.

**Abundance** Because these otters are rarely seen, an assessment of abundance in Malawi is difficult. They are likely to be more widespread and common than the few records suggest. Elsewhere: maybe "fairly common to rare". The availability of their preferred prey (crabs) may determine where these otters are found and their abundance.

**Habits** Semi-aquatic, partly diurnal and nocturnal, carnivorous. In South Africa, Clawless Otters are active for about three hours after dawn, and for about two and a half hours after sunset. During the day, they rest in holes, under rocks and other sheltered places; they also dig their own burrows (called dens or holts) which are about 2-3 m in length.

African Clawless Otters are well adapted for semi-aquatic life. They swim extremely well. The density and texture of the pelage insulate the body, the streamlined form of the body is propelled easily through the water, the thick tail acts as a rudder, and the wide hindfeet (and partly webbed digits) provide propulsion. While swimming, the forelimbs are held

back along the body or used to catch prey. Otters can walk and run on land, although they never move far from water.

African Clawless Otters are usually solitary except when females are mating and raising young. Sometimes they may be observed in pairs or small groups of 3-5 individuals. Females are probably territorial, but home-ranges of males overlap with those of other males. Home-range length (along a stream, river or lake shore) in South Africa varies from 4.9 to 54.1 km (river length), and the effective area of water for hunting is 4.9 – 1063 ha.

These otters feed primarily on crabs, but will also feed on fish, frogs and (aquatic?) insects. Diet varies in different localities and is dependent on the relative abundance of crabs or fish where the otter lives. Prey is usually caught by capturing it with the forefeet and it is killed with a bite (usually on the head). The prey is usually carried in the mouth to land, where it is eaten beginning at the head and working backwards along the body. Crabs are eaten whole. Often the presence of otters is known only by the presence of their faeces (called 'spraints'), easily recognized because they contain the 'shells' of crabs and the scales of fish. Faeces are deposited at 'latrines'.

African Clawless Otters make a variety of vocal sounds which are used for communication and to express emotion – squeaks, whines, chirrups, hisses and growls, and a loud 'Hah' when alarmed. Both adults and young engage in play behaviour which strengthens bonds between individuals.

**Reproduction** No information for Malawi. Elsewhere: young are born during a 2-3 month period which varies greatly in different localities. In Zimbabwe, juveniles are recorded in Mar and Apr, and in Zambia births are estimated to occur in Jul and Aug. Gestation is 60-64 days. Young are born with a thin covering of hair, eyes are closed, and the webbing between the digits is visible. The young remain in the den and are weaned at Week 8.

**Conservation** IUCN Category: Least Concern. This assessment is for the whole of Africa. The situation in Malawi is not known.

**Taxonomic Notes** *Aonyx capensis* (Schinz, 1821).

**Key Reference** Somers & Nel (2013).

**Measurements**
*Aonyx capensis*

| | |
|---|---|
| HB (males): | 1265 (1130–1380) mm, n = 13 |
| HB (females): | 1233 (1140–1330) mm, n = 7 |
| T (males): | 505 (445–570) mm, n = 13 |
| T (females): | 483 (450–495) mm, n = 7 |
| HF c.u. (males): | 159 (150–170) mm, n = 13 |
| HF c.u. (females): | 147 (145–160) mm, n = 7 |
| E (males): | 32 (30–36) mm, n = 7 |
| E (females): | 30 (31–33) mm, n = 4 |
| WT (males): | 14.1 (10.0–18.0) kg, n = 16 |
| WT (females): | 11.7 (10.0–13.8) kg, n = 9 |
| GLS (males): | 132.1 (119.6-142.7) mm, n = 24 |
| GLS (females): | n. d. |

South Africa (Van der Zee 1979, Stuart 1981 [females only; excluding WT], Arden-Clarke 1983 and Somers & Nel 2004, all in Somers & Nel 2013).

# Genus *Hydrictis* – Spotted-necked Otter

This genus contains only one species, found in most tropical and subtropical regions of sub-Saharan Africa. The Spotted-necked Otter was formerly placed in the genus *Lutra.*

## *Hydrictis maculicollis*

## Spotted-necked Otter

**Malawian Names** Chiwawu, Katumbu, Kauzi, Mbiti. Not confined to this species.

© C. & M. Stuart

**Description** Small otter (smaller than the African Clawless Otter) with brown cheeks, and the throat and chest patterned with irregular black and/or whitish markings. Males, on average, larger and heavier than females. Pelage sleek and dense with short, whitish underfur. Dorsal pelage, flanks, limbs and tail dark chocolate-brown to reddish-brown. Throat and chest whitish-grey to almost the same colour as the dorsal pelage, with irregular markings. The markings a very variable. In some individuals, there are bold dark spots on a whitish background. At the other extreme, there are small white spots on a background just a little paler than the dorsal pelage colour. Head broad with small muzzle and short rounded ears on side of head; crown, cheeks and lips brown. Ears small and rounded, on side of head. Limbs short and robust. Fore- and hindlimbs each with five digits; Digits 1 and 5 shorter than Digits 2, 3 and 4. All digits with a creamy white claw ca. 10 mm long, and with well-developed webbing between the digits which extends to the tip of each digit. Tail relatively moderately long (ca. 57% of HB in males, ca. 69% of HB in females), thick at base narrowing to the tip; slightly dorso-ventrally flattened.

**Similar Species**

*Aonyx capensis* (African Clawless Otter). Throat and chest white without any markings; cheeks and lips white. Digits clawless or with rudimentary nails; webbing between front digits rudimentary.

**Distribution** In Malawi, most records are in the Upper and Lower Shire rivers and their catchments. Localities include Lake Chilwa*, Lake Malawi N. P. (e.g. Otter Point), Lengwe N. P., Likoma Island*, Liwonde N. P., Mangoche, Zoa Tea Estate and Zomba*. (*old records). Elsewhere: widely distributed throughout most of the southern part of West Africa, eastwards to South Sudan and Ethiopia and throughout all the wetter areas of Central Africa (including all of the Congo basin), Angola and W Zambia.

**Habitat** Very similar to that of the African Clawless Otter but exploits deep water as well as shallow water for swimming and hunting.

**Abundance** Limited information for Malawi, although may be locally common (e.g. Lake Malawi N. P.). Elsewhere: abundance is varied. Where there are many fish (e.g. in African lakes), these otters may be common, but where there are few fish, they are rare or non-existent. In the Drakensberg of South Africa, where there are mountain streams and lakes, there was an estimated one otter/1-2 km of stream, and in less suitable areas there was only an estimated one otter /6-11 km of stream.

**Habits** Semi-aquatic, partly diurnal and nocturnal, carnivorous. In many respects the habits of these otters are similar to those of African Clawless Otters. Spotted-necked Otters are active during the three hours after dawn and then before sunset; on moonlight nights, activity may continue until about 21:00h. During the day, they rest in sheltered places. They excavate dens ('holts') where there is soft soil; these dens are well spaced out along the banks of a river or stream (see above). In Lake Malawi N. P., these otters rest in spaces between the rocks on the foreshores of the lake and islands.

Spotted-necked Otters feed mainly on fish and occasionally on crabs, amphibians and insects (aquatic dragonfly nymphs). The composition of the prey varies depending on locality and season of the year. In South Africa, for example, fish formed the main part of the diet during autumn and winter; at this time, they do not feed on crabs which have retreated into rock crevices. In contrast, crabs formed the main part of the diet in spring and summer. When hunting, otters catch their prey in the mouth (cf. *Aonyx capensis*). They return to the surface for a few seconds to eat before diving again (and dive when a hunt has been unsuccessful). Foraging dives last for 16-25 secs in deep water and 5-20 secs in shallow water. Large fish are taken to the land to eat.

These otters are more social than African Clawless Otters. When fish are abundant (as in central African lakes), these otters live in small groups of about three individuals, and occasionally small groups join up to form larger groups of 10-20 individuals. Group-members indulge in mutual grooming. Where food resources are scarce, the otters are solitary or live in small groups.

In South Africa, the average home-range was 8.7 $km^2$ for males and 3.4 $km^2$ for females. Mean length of river within the home-range was 14.8 km. There is no evidence that these otters are territorial.

Spotted-necked Otters deposit their faeces (spraints) in latrines (as do Cape Clawless Otters). Faeces and latrine sites are similar to those of the Cape Clawless Otter.

**Reproduction** No information for Malawi. Elsewhere: births tend to occur at the end of the dry season or early wet season, so the months of birth vary in different localities.

**Conservation** IUCN Category: Near Threatened. Populations are declining throughout most of the biogeographic range due to loss of habitat, increased urbanization, pollution and hunting, and the introduction of invasive species of fish.

**Taxonomic Notes** *Hydrictis maculicollis* (Lichtenstein, 1835). Formerly referred to as *Lutra maculicollis* (e.g. by Sweeney 1959, Hayes 1978, Smithers (1983) and Hough (1989). Five subspecies are recognised: the Malawian subspecies is *H. m. maculicollis* (which also occurs in Mozambique and South Africa).

**Key References** d'Inzillo Carranza & Rowe-Rowe (2013), Smithers (1983).

**Measurements**
*Hydrictis maculicollis*

| | |
|---|---|
| HB (males): | 698 (650–760) mm, n = 5 |
| HB (females): | 588 (570–606) mm, n = 4 |
| T (males): | 397 (350–440) mm, n = 5 |
| T (females): | 406 (335–440) mm, n = 4 |
| HF c.u. (males): | 118 (113–122) mm, n = 3 |
| HF c.u. (females): | 113 (111–115) mm, n = 3 |
| E: | 18 (15–21) mm, n = 7 |
| WT (males): | 5.7 (4.5–6.6) kg, n = 5 |
| WT (females): | 4.3 (3.8–4.7) kg, n = 4 |
| GLS (males): | 107.1 (105–108.5) mm, n = 3 |
| GLS (females): | 95.9 (94.2–97.5) mm, n = 2 |

South Africa (Perrin & d'Inzillo Carranza 1999 and Roberts 1951 in d'Inzillo Carranza & Rowe-Rowe 2013).

## Genus *Ictonyx* - Zorilla

This genus contains only one species

### *Ictonyx striatus*

### Zorilla

**Malawian Names** Chinyelu, Kanyimbi (same name as for African Striped Weasel).


Northern Cape, South Africa © C. & M. Stuart

**Description** Small elongated, slender, black carnivore with white stripes. Males, on average, larger and heavier than females. Pelage long and shaggy with a slight sheen. Dorsal pelage black, with four irregular wavy white stripes from neck to base of tail; hairs ca. 40 mm, either black or white to base; dark brown underfur. Ventral pelage, flanks, neck and chest black or blackish-brown. Head black or brownish-black with three distinct white patches – one on crown and one behind each eye; considerable variation between size of white patches, and occasionally white patches may join to form a white band across width of head. Ears small and rounded, held close to body, mostly black and with fringe of white hairs along top. Limbs short, brownish-black; five short digits each with a sharp non-retractile claw. Tail long (ca. 55-60% of HB), moderately bushy, tapering toward tip, predominantly white but flecked with many black hairs. Tail hairs course and shaggy, mostly white with black at base, 30-80 mm.

**Similar Species**

*Poecilogale albinucha* (African Striped Weasel). Pelage shorter, white stripes bold and clear-cut, head black with white cap, tail white with very few black hairs. On average, smaller and always lighter.

**Distribution** In Malawi, probably widespread although most records are from the southern region. Localities include Blantyre, Kasungu, Kasungu N. P., Limbuli Estate (Mulanje), Luchenza, Zoa and Zomba District. Elsewhere: widespread throughout savanna and semi-arid habitats in West, Eastern, Central and southern Africa.

**Habitat** Zorillas occur in many habitats including open grasslands, woodland savannas, bush savannas, montane grasslands, and semi-arid environments (along water courses where there are scattered bushes). Not found in rainforest.

**Abundance** No information for Malawi. Considered to be common over much of its biogeographic range. However, because this species is rarely seen, exact assessment of abundance is difficult. The only assessment of abundance is one individual/5-10 $km^2$ in East Africa.

**Habits** Terrestrial, nocturnal, carnivorous. Zorillas are lithe, active and ferocious little carnivores. They hide in burrows, rock crevices, hollow logs or in thick vegetation during the day, and hunt at night. Their diet is primarily small murid rodents, amphibians, birds and arthropods (e.g. spiders, millipedes, centipedes, scorpions, beetles, grasshoppers), and it varies greatly in different seasons and at different localities. In many studies in southern Africa, the diet was about 60% insects. Zorillas are very proficient predators. When hunting, they move at a fast walk over the ground, using sight and smell to find suitable prey. Small prey (insects) are caught in the mouth, but larger prey are captured in the forefeet and then killed by biting the neck or head. Zorillas may kill domestic chickens.

Zorillas are solitary animals, although pairs, and pairs with young, are recorded occasionally. They are aggressive animals, often fighting amongst themselves. When threatened, the hairs on the body and tail are erected, a strong unpleasant fluid is ejected from the perineal glands, and a sharp loud 'bark' is uttered. Zorillas also utter a variety of vocal

calls to indicate greeting, threat (e.g. towards another Zorilla), dominance and submission, and distress.

Little is known about the home-ranges of zorillas, or their social organization. It is thought that they are polygamous.

**Reproduction** No information for Malawi. In South Africa, pregnant females and juveniles have been recorded in many months of the year (e.g. Oct and Nov in KwaZulu-Natal, and in Apr, Aug, Sep, Nov and Dec in other parts of South Africa). Females can breed when ca. 10 months of age. Gestation: 36 days. Litter-size: 1-3 (in the wild). Neonates are altricial, the eyes are closed, and the dark dorsal stripes are visible on the pink skin of the back and flanks. Eyes open during Week 6, and lower canines erupt at about Day 32 when young start to eat solid food. Young are fully mobile and can capture and kill prey by Week 8, and they attain adult size by Week 20. Longevity in the wild is thought to be about five years (although longer in captivity).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Ictonyx striatus* (Perry, 1810). No subspecies are recognised although there is considerable variation in pelage colour and pattern (especially with respect to the pattern of white and black on the head).

**Key Reference** Stuart & Stuart (2013a).

**Measurements**
*Ictonyx striatus*

| | |
|---|---|
| HB (males): | 340 (280–380) mm, n = 30 |
| HB (females): | 331 (290–365) mm, n = 8 |
| T (males): | 207 (165–255) mm, n = 32 |
| T (females): | 191 (175–200) mm, n = 10 |
| HF c.u. (males): | 54 (47–66) mm, n = 28 |
| HF c.u. (females): | 49 (44–53) mm, n = 10 |
| E (males): | 28 (22–34) mm, n = 32 |
| E (females): | 25 (20–30) mm, n = 10 |
| WT (males): | 793 (486–1200) g, n = 21 |
| WT (females): | 576 (428–700) g, n = 4 |

South Africa (Northern Cape, Western Cape and Eastern Cape, Stuart 1981 in Stuart & Stuart 2013a).

# Genus *Mellivora* – Ratel (Honey Badger)

This genus contains only one extant species which occurs in Africa (including Malawi) and SW Asia.

## *Mellivora capensis*

## Ratel (Honey Badger)

**Malawian Names** Chimbuli, Chiuli, Mkuli, Tsapitenyi.

Zimbabwe © C. & M. Stuart

**Description** A very striking black and white carnivore of medium size, very solidly built and with short limbs and strong claws. Males, on average, larger than females. Pelage, coarse, thick and long, hairs dense especially on dorsal surface. Dorsal pelage (from crown of head above eyes and ears to base of tail) white, greyish-white or creamy-white; hairs either black at base and white at tip, or pure white or cream; ca. 20-40 mm long. This is often referred to as a 'mantle'. Ventral pelage, lower part of neck, chest and limbs pure black; hairs sometimes sparse on ventral surface. Muzzle black with large nostrils. Eyes black. Ears small and hardly visible, mostly black, and with fringe of long white hairs along the top (merging into the colour of the mantle). Limbs short, thick and strong, with large wide fore- and hindfeet, large plantar pads, and large strong pointed non-retractile claws (up to 50 mm). Tail short (ca. 30% of HB), densely covered with long black hairs.

**Similar Species** None, This is the only small carnivore with pure black flanks, legs and most of head and a very obvious white mantle on the dorsal surface.

**Distribution** In Malawi, widespread, especially in the north and south of the country. Most records are sight records; very few are museum records. Localities include Kasungu N. P., Liwonde N. P., Mwabvi W. R. and Nyika N. P. Elsewhere: one of the mostly widely distributed species throughout of the continent; although not recorded in Algeria (except a small area in west of country), Libya, Egypt and N Sudan.

**Habitat** Ratels are tolerant of a wide range of habitats, including woodland savannas, grasslands, montane habitats and semi-arid environments. Within its biogeographic range, recorded from sea-level to ca. 4000 m and where annual rainfall is 50-2000 mm/year.

**Abundance** No information for Malawi. Elsewhere: they are considered to be rare, although may be common in some localities. Estimations of abundance are difficult because Ratels are nocturnal, and difficult to detect using normal survey methods.

**Habits** Terrestrial, nocturnal, carnivorous. During the day, Ratels rest in burrows or other sheltered places – these maybe burrows excavated by the Ratels themselves or made by Porcupines or Aardvarks. They are active at night. They walk with a rather lumbering gait, stopping frequently when foraging for food either to examine holes and crevices or to sniff wind-borne scents. They can also trot quickly and have some ability to climb (e.g., when raiding the nests of bees - see below). Ratels are extremely strong for their size, because of their very muscular forelimbs and shoulders. They can break into the nests of ants and termites by digging and scraping with their powerful claws, and they are can excavate large amounts of soil and rocks while searching for prey.

The diet is varied and changes with the seasons; they are opportunistic feeders eating whatever prey is available at the time. The prey varies in size from insects to rodents and snakes, and even the young of some ungulates. In the southern Kalahari (a habitat with rainfall of 109-305 mm/year at one locality, to 17-145 mm/year at another), 59 food items were identified, of which the seven most numerous were gerbils (3 spp.), a mouse (*Rhabdomys*), skinks, scorpions, geckos (3 spp.), cobras and other snakes, and Springhares. Ratels also consumed Tsama melons and bee larvae in the hot wet season. As one prey item becomes scarce, Ratels change to another more abundant prey item. This

flexibility in diet is one of the reasons why Ratels are such a successful species and have such a widespread geographic distribution.

In the southern Kalahari, adult Ratels have large home-ranges; for males, the average is 541 (229-698) km$^2$ and for females it is 126 (85-194) km$^2$. The home-range of an adult male overlaps with those of young males, and with the home-ranges of several females. In more mesic environments, the home-ranges are smaller (probably because food resources are less spread out). This large range provides the male with access to many females. Ratels establish a dominance hierarchy. Larger older males are dominant over younger males. Although these younger and subordinate males may father some of the young.

Ratels have many means of intraspecific communication. Four sorts of vocalizations have been recorded: a 'rattle grunt' (used by males when interacting with females and young), a high pitched 'squeal rattle' (used by young males and females in the presence a male), a 'high pitched purr' (used as a contact call between a mother and her young) and a 'threatening rattle-roar' (used to repel threats). All these vocal sounds are accompanied (to a greater or lesser extent depending on the situation) by visual signals including the stance and posture of the body, raising or lowering of the tail, and erection of the hairs on the body. Scent marking by depositing faeces in latrines, by rubbing secretions from the anal glands on the ground, and by urinating into holes (females only) help to establish the social relationships and sexual condition between individuals.

One of the best known and intriguing things about Ratels is their association with the Honeyguide bird. The Ratel is said to be 'guided' by the Honeyguide to a nest of wild bees which it then breaks apart so it can feed on the bees, larvae, wax and honey. The Honeyguide also benefits by feeding on the wax. There has been much discussion about how this association evolved; it is obviously mutual and probably opportunistic, and is a learned relationship.

**Reproduction** No information for Malawi. In southern Africa, there is no evidence of a distinct breeding season, and there is a lack of information from other parts of the biogeographic range. Gestations of 50-70 days (in the wild), and 62-72, 153 and163 days (in captivity) have been recorded (which suggests that under some circumstances, delayed implantation or retarded development might occur). Litter-size: 1-2. Neonates are altricial, blind and hairless. Development is slow; the characteristic black and white pelage is visible at Week 3-5, and sexual dimorphism in size is evident at Month 6-8. In the wild, Ratels probably live for 6-8 years.

**Conservation** IUCN Category: Least Concern. Conservation concerns include persecution by agriculturalists and local apiarists (because Ratels are considered to be pests), hunting for body parts used in traditional medicines, slow reproductive rate (and hence population replenishment is slow), and many conservation areas are too small to include their very large home-ranges.

**Taxonomic Notes** *Mellivora capensis* (Schreber, 1776). Ten subspecies have been described based on variation of the colour of the mantle. Currently, none are considered to be valid.

**Key Reference** Begg *et al.* (2013).

**Measurements**
*Mellivora capensis*

| | |
|---|---|
| HB (males): | 686 (580–790) mm, n = 15 |
| HB (females): | 637 (580–690) mm, n = 12 |
| T (males): | 197 (160–230) mm, n = 19 |
| T (females): | 187 (180–220) mm, n = 14 |
| Sh. ht (males): | 394 (350–430) mm, n = 19 |
| Sh. ht (females): | 327 (320–370) mm, n = 14 |
| WT (males): | 9.3 (8.0–11.2) kg, n = 19 |
| WT (females): | 6.1 (5.2–7.1) kg, n = 14 |

South Africa (S Kalahari, C. M. Begg 2001 in Begg *et al.* 2013)

# Genus *Poecilogale* – African Striped Weasel

There is only one species in this genus.

## *Poecilogale albinucha*

## African Striped Weasel

**Malawian Names** Chinyelu, Kanyimbi (same name as for Zorilla).

Northern Cape, South Africa © C. & M. Stuart

**Description** Small, very elongated, slender, black carnivore with white stripes and a white cap. Pelage short and soft with a slight sheen; hairs ca. 10 mm. Males, on average, larger and heavier than females. Dorsal pelage black, with four distinctive off-white, cream (or yellowish-cream) stripes on back and flanks, two on each side of the mid-dorsal line. On each side, the two stripes join (on the neck) to form a single stripe which then merges with the single stripe on the opposite side to form the all-white cap on the crown of the head. Similarly, the stripes merge on the rump to form a cream-coloured area at the base of the tail. Sparse short brownish underfur. Ventral pelage black or brownish black. Head black, except for cream-coloured cap above the eyes and ears. Ears small, blackish and barely visible on side of head, partly covered dorsally by long cream hairs which form part of the cap. Limbs black and short, with five digits on each foot, each with a long sharp non-retractile claw. Tail moderately long (53-58% of HB), white, with long hairs (ca. 40 mm).

**Similar Species**

*Ictonyx striatus* (Zorilla). Pelage longer, black and white stripes not so bold or clear-cut, head with black with white patches (but no white cap), tail white but flecked with many black hairs. On average, larger and always heavier.

**Distribution** Within Malawi, known from the north and south of the country, but almost no records from the central Plateau. Localities include near Karonga, Misuku Hills, near Nsanje (Port Herald), Nyika Plateau (Chowo Forest), and Zomba. Elsewhere: widespread south of the Equator - S Uganda, SW Kenya, Tanzania, S DR Congo, Angola, Zimbabwe and South Africa; also occurs marginally in E Botswana and W Mozambique.

**Habitat** Very varied. African Striped Weasels have been found mainly in grassland savannas in areas where rainfall is more than 600 mm/year. They have also been in recorded, in various parts of the biogeographic range, in shrublands, montane forests (e.g. Malawi), cultivated fields and pastures, and in some semi-arid localities with <500 mm rain/year.

**Abundance** In Malawi, very rarely recorded probably because the species is secretive: it may be more common than records suggest. Elsewhere: 'rare to common' throughout its biogeographic range. Probably only common where rodent populations are large throughout most of the year.

**Habits** Terrestrial, nocturnal, carnivorous. African Striped Weasels may dig their own burrows but they often rest in burrows excavated by rodents. They walk and run quickly, arching the elongated back upwards as they move. They forage at night and are only occasionally seen during the day. They are ferocious hunters and extremely fast and agile. They use scent and sight to locate prey and are capable of killing rodents and other prey twice their size. Prey is killed by a bite to the head or neck. The diet is primarily rodents, but shrews and birds are also eaten; unlike Zorillas, they are not known to eat amphibians and insects. Studies in captivity suggest that African Striped Weasels are mostly solitary and territorial, although a male and a female will share a burrow. Small groups of a female and her young have been observed. Faeces are used for scent marking. African Striped Weasels have a wide range of behaviours and means of communication. Reproductive behaviour between a male and a female (only when she is receptive) includes 'dancing', bouncing around and wrestling, followed by a long copulation

in the burrow. There are also vocal forms of communication (similar to those recorded for Zorillas). When threatened, a weasel emits a loud 'bark scream', the hairs on the neck are erected, and an unpleasant smelling fluid is sprayed from the anal glands.

**Reproduction** No information for Malawi. In southern Africa, most births occur in the warm wet season (Nov–Mar) – the time of year when rodent prey is most abundant. Gestation: 31-33 days. Litter-size: 2-3. Neonates are altricial with eyes closed and without any covering of hair. Canine teeth erupt on Day 35, and eyes open on Day 51-54. Young are capable of killing (small) prey at Week 13 and maturity is attained at Week 20. A female is unlikely to breed more than once each year. (All data from animals in captivity).

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Poeciligale albinucha* (Gray, 1846). Although six 'subspecies' have been described, none are recognised at present.

**Key Reference** Stuart & Stuart (2013b).

**Measurements**
*Poecilogale albinucha*

| | |
|---|---|
| HB (males): | 290 (286–345) mm, n = 6 |
| HB (females): | 268 (264–299) mm, n = 11 |
| T (males): | 155 (128–163) mm, n = 6 |
| T (females): | 157 (136–166) mm, n = 11 |
| HF c.u. (males): | 36 (33–39) mm, n = 6 |
| HF c.u. (females): | 32 (30–36) mm, n = 11 |
| E (males): | 18 (15–19) mm, n = 6 |
| E (females): | 16 (14–18) mm, n = 11 |
| WT (males): | 263 (218–355) g, n = 6 |
| WT (females): | 173 (116–257) g, n = 11 |

Zimbabwe (Skinner & Chimimba 2005 in Stuart & Stuart 2013b).

## FAMILY NANDINIIDAE – Two-spotted Palm Civet

The family Nandiniidae contains only one species, the Two-spotted Palm Civet. The family is characterized by a unique suite of skull characteristics (none of which are visible externally). Two-spotted Palm Civets live only in rainforest and other habitats with dense trees. They are arboreal and only rarely descend to the ground. Superficially, they resemble genets; they are small very agile omnivores, the pelage is covered with black spots on a brownish background and has two white spots, one on each shoulder (see species profile below). The tail is long and furry, and the pads on the paws are well developed; the sharp claws are retractile (as in felids). Two-spotted Palm Civets are closely related to carnivores in the families Viverridae and Felidae and, formerly, they were placed in the Viverridae. However, skull characteristics and recent genetic evidence suggests they should be placed in a separate family – the Nandiniidae.

### Genus *Nandinia* – Two-spotted Palm Civet

There is only one species in this genus.

### *Nandinia binotata*

### Two-spotted Palm Civet

**Malawian Names** Denga, Golopati, Nkanganya.

**Description** (subspecies *gerrardi).* Small somewhat cat-like arboreal carnivore with many dark spots or blotches on back and sides, an indistinct white spot on each shoulder, and a long, ringed tail. Males, on average, larger and heavier than females. Pelage short, dense and woolly. Dorsal pelage various shades of greyish-brown, yellowish-brown to blackish-brown with somewhat inconspicuous irregular-shaped black spots and blotches on back and flanks, and smaller spots on shoulders and flanks. White spot (very indistinct in Malawian palm civets) on each upper shoulder (hence name: *bi-notata*). Ventral pelage similar to dorsal, usually paler, without spots or dark markings. Head broad, with small muzzle and black vibrissae. Small rounded ears stick out laterally from side of head. Eyes very large, forward facing, each with bright yellow or orange iris. Forelimbs broad, with large naked plantar pads, and five digits with partly retractile sharp pointed claws. Hindlimbs similar, with elongated plantar pads. Tail relatively long thick and bushy (99 [84-116]% of HB, n = 9), similar in colour to body with 9-15 brown to black rings (less well marked on ventral side). Subspecies in other parts of Africa have three black stripes on the neck and a clearly visible white spot on each shoulder, and the tails have 7-15 black rings.

**Similar Species**

*Genetta maculata* (Large-spotted Genet) and *G. angolensis* (Miombo Genet), see Family Viverridae yellow box below.

**Distribution** In Malawi, recorded from a few localities in the north, and also in the south (from ca. 15˚ 30' S southwards). Localities include Misuku Hills (Matipa Forest), Nyika Plateau, Mulanje Mountain, 'Lower Shire Valley' [probably the forested hills above the valley], Mwabvi W. R., Thyolo Mountain and Zomba. Elsewhere: widespread in rainforest, riverine forest and some montane forests in West Africa, Central Africa (including all the Congo Basin), and Uganda, and selected montane forests in E Tanzania, NE Zambia, SW Mozambique and E Zimbabwe.

**Habitat** Lowland rainforest, closed canopy miombo woodland and montane evergreen forest up to ca. 2500 m. In eastern Africa, occurs in isolated, discontinuous montane forests, gallery forests, and logged secondary forests.

**Abundance** Difficult to assess because Two-Spotted Palm Civets live high up in the trees in dense forest. Probably rare in Malawi because of lack of suitable habitat. Elsewhere: thought to be widespread and locally abundant. In the main part of the biogeographic range, density was ca. 5 individuals/km$^2$.

**Habits** Nocturnal, mostly arboreal, carnivorous/frugivorous. Palm Civets are mostly nocturnal, and rest during the day in holes and crevices in forest trees. They are very good, agile climbers. The large roughened pads on their feet, and their sharp claws, enable them to climb along branches. They can also descend to the ground (head-first) where they run, awkwardly, to another tree (or forest patch). They can also jump from

branch to branch; the long tail is held out, and moved from side to side, as a counterweight.

Palm Civets feed on small vertebrates (mainly rodents, small birds and eggs) and invertebrates (e.g. millipedes, termites). They also feed to a large extent on fruits. In Gabon (where Palm Civets have been studied extensively), 86% of stomachs contained fruit, and 32% contained vertebrate and invertebrate prey (n = 22 stomachs). Likewise, in Zimbabwe, 60% of stomachs contained vegetable material, 30% bird remains, 10% small rodent remains, and 10% termites. There is no information on the quantitative amounts of each type of food eaten.

Studies in Gabon show that Palm Civets are usually solitary, except when a mother is with her young. Males have large home-ranges (mean 85 ha, range 34-153 ha), while those of females are smaller (mean 45 ha, range 29-70 ha). The sizes of home-ranges for males (which do not overlap) appear to be related to the number of available females, and not to the availability of food resources. Within a male's home-range, there may be several females, each of which has her own discrete home-range that does not overlap with that of any other female.

Scent-marking plays a role in communication. The perineal gland is rubbed on branches; the odour can persist for several months. Palm Civets also produce a variety of loud cries and calls for intra-specific communication.

**Reproduction** No information for Malawi. In Gabon, most births occur in Sep-Jan (end of wet season and beginning of dry season). Gestation: ca. 64 days. Litter-size: 2-3. Neonates weigh about 56 g and have a slight covering of hair; their eyes and ears are closed. Adult size and weight is attained at 6-8 months.

**Conservation** IUCN Category: Least Concern. Conservation concerns include destruction of forest habitats, fragmentation of habitats and persecution (because palm civets attack domestic poultry). In some regions, they are used for traditional medicine, food, and ornaments.

**Taxonomic Notes** *Nandinia binotata* (Gray, 1830). Four subspecies are recognised; only one subspecies, *N. b. gerrardi*, occurs in Malawi (and also in Tanzania, Mozambique and NE Zambia and E Zimbabwe (see description).

**Key Reference** Van Rompaey & Ray (2013).

**Measurements**
*Nandinia binotata*

| | |
|---|---|
| HB (males): | 486 (398–625) mm, n = 34 |
| HB (females): | 457 (370–610) mm, n = 38 |
| T (males): | 538 (430–762) mm, n = 34 |
| T (females): | 504 (340–701) mm, n = 38 |
| HF c.u. (males): | 88 (76–100) mm, n = 29 |
| HF c.u. (females): | 82 (66–95) mm, n = 36 |
| E (males): | 39 (29–48) mm, n = 28 |
| E (females): | 37 (27–43) mm, n = 35 |
| WT (males): | 2.09 (1.30–3.00) kg, n = 18 |
| WT (females): | 1.94 (1.20–2.70) kg, n = 19 |
| GLS (males): | 100.6 (86.4–110.9) mm, n = 24 |
| GLS (females): | 94.7 (84.4–103.2) mm, n = 30 |

Throughout biogeographic range (Van Rompaey & Ray 2013).

# FAMILY VIVERRIDAE – Civets, Genets and Linsangs

Viverrids occur in Africa, Europe and Asia. Africa has one species of civet, ca. 14 species of genets and two species of linsangs of which only the civet and two species of genets occur in Malawi. The two genera are very different and are usually placed in separate subfamilies. The African Civet (subfamily Viverrinae) is a medium-sized terrestrial carnivore (WT: ca. 8-13 kg) with long coarse pelage with large irregular black spots and lines, thick bushy tail with a long dorsal ridge of black hairs, and non-retractile claws. Genets (subfamily Genettinae) are small semi-arboreal carnivores (WT: ca. 2 kg) which forage in trees as well as on the ground. They have brownish pelage with black spots and stripes, large eyes, tall pointed ears, semi-retractile claws, well-developed metatarsal pads, and a long tail with numerous black rings. However, despite the differences described above, viverrids are closely related morphologically and phylogenetically.

The viverrids which occur in Malawi, and the closely related Two-spotted Palm Civet, can be distinguished with information in the yellow box below.

*Nandinia* (Two-spotted Palm Civet). Somewhat cat-like. Mostly arboreal. Dorsal pelage greyish-brown with many small, somewhat inconspicuous, black spots and blotches. Tail 100-110% of HB, thick and bushy, with 9-15 dark rings. HB: 370-625 mm, WT: ca. 1-3 kg.

*Civettictis* (African Civet). Neither cat-like not dog-like. Terrestrial. Dorsal pelage grey, beige or dirty white with many conspicuous black spots and blotches arranged in irregular lines, and sometimes with black lines. Tail 50-65% of HB, quite thick and bushy, dorsal half black, ventral half ringed. HB: 645-834 mm; WT: ca. 10-13 kg.

*Genetta* (Genets). Very cat-like. Semi-arboreal. Dorsal pelage beige, ochre or brown with conspicuous black or brown spots, stripes or blotches. Tail 84-100% of HB, conspicuously ringed. HB: 440-500 mm; WT: ca. 2 kg.

## Genus *Civettictis* - African Civet

There is only one species in this genus.

### *Civettictis civetta*

### African Civet

**Chichewa Names** Chombwe, Fungwe, Vungo, Zukazuka.

Limpopo Province, South Africa © C. & M. Stuart

**Description** Moderately large, carnivore with grey or whitish pelage with many black markings. Pelage long and course. Dorsal pelage mostly grey, beige or sometimes dirty white, with many black spots or blotches arranged in irregular lines (often vertical on flanks and horizontal on rumps and thighs); spots may join to form stripes. Underfur brownish-grey. Thick crest of erectile black hairs along mid-dorsal line (hairs 90-100 mm). Prominent dark black stripe from behind each ear extending diagonally across neck to upper chest, and large black patch on throat extending upwards onto side of neck. Head with pointed muzzle; grizzled grey, with wide black band around muzzle (including eyes); white lips surrounding black nose. Ventral pelage similar to dorsal pelage, with smaller spots. Limbs black, each with five digits and non-retractile claws; limbs are slender and the pads of the feet are small. Tail fairly thick and bushy, (58 (50-65)% of HB, n = 6), with long black hairs on dorsal surface (extension of the mid-dorsal crest) and 5-8 black bands on ventral side of tail. There is considerable individual variation in the black markings.

**Similar Species** None (see yellow box above). *Genetta* spp. also have spotted pelage but are more cat-like in form and much smaller.

**Distribution** Widespread in all parts of Malawi. Records include Kasungu N. P., Lake Malawi N. P., Lengwe N. P., Liwonde N. P., Mangochi Mountain, Mwabvi W. R., Nkhotakota W. R., Nyika N. P., Vwaza Marsh G. R., Thyolo and district, Zoa Tea Estate and Zomba. Elsewhere: very widespread in most of Africa south of the Sahel Savanna Zone; within this vast region, absent only in the Horn of Africa, arid areas of Namibia, most of Botswana, and most of South Africa (except the extreme NE of the country).

**Habitat** African Civets tolerate a very wide range of habitats. They have been recorded in secondary forests, woodland savannas, bushlands of many sorts, marshes and highlands, gardens and farmlands. They do not occur in dense rainforest, nor in arid habitats.

**Abundance** No detailed information for Malawi. Generally considered common, but rarely seen because of their secretive habits.

**Habits** Terrestrial, nocturnal, carnivorous and omnivorous. During the day, civets rest in thick bush or grass, in hollow logs, or in holes made by other animals. They are active at night. They trot briskly when on the move, with the back slightly arched and the head low. They may occasionally scramble on low branches. Surprisingly, they are good swimmers. Because they are predominately nocturnal and secretive, they are seldom seen.

Like other viverrids, African Civets are opportunistic feeders and hence their diet is very varied and changes depending on the season and availability of different prey. In one study in Zimbabwe, in a sample of 97 scats, mammals (mostly rodents and hares) were found in 84%, fruits in 81%, arthropods in 76%, birds in 22% and reptiles in 10% of the scats. In another part of Zimbabwe, in a sample of 27 stomachs, insects were found in 59%, fruit (at least seven species) in 52%, murid rodents in 41%, reptiles in 22%, birds in 15%, amphibians in 11% and millipedes in 11% of the stomachs. In other parts of the biogeographic range, grass, leaves, fish, amphibians, crabs, snails, and many sorts of arthropods are eaten. African Civets are solitary except during the breeding season. Very little is known about the use of space by civets – whether they have overlapping ranges or are territorial. Scent marking (both from scats and urine) is used for marking the home-range/territory.

Scats are deposited along trails or in 'latrines' that may be used by several individuals. Scent marking is also used to indicate and advertise the sexual status of individuals.

**Reproduction** No information for Malawi. In southern Africa, reproduction occurs during the warm wet summer months. Females may have 2-3 litters/year. Gestation: 60-81 days. Litter-size (in captivity): 1-5. Neonates are fully furred (although the colour pattern of the pelage is unclear) and the eyes are open. Solid food (brought by the mother) is eaten from about Week 8, and young are weaned at Week 14-16. Captive females attained sexual maturity when ca. one year old and gave birth to young when ca. 14 months old.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Civetticus civetta* (Schreber, 1776). No subspecies are currently recognised despite the great range of pattern and colour of the pelage.

**Key References** Ray (2013b), Smithers (1983), Smithers & Wilson (1979).

**Measurements**
*Civettictis civetta*

| | |
|---|---|
| TL (males): | 1296 (1225–1374) mm, n = 8 |
| TL (females): | 1296 (1250–1370) mm, n = 11 |
| T (males): | 462 (416–500) mm, n = 8 |
| T (females): | 469 (423–492) mm, n = 11 |
| HF c.u. (males): | 140 (135–148) mm, n = 8 |
| HF c.u. (females): | 139 (130–148) mm, n = 11 |
| E (males): | 58 (55–60) mm, n = 8 |
| E (females): | 58 (54–63) mm, n = 11 |
| WT (males): | 10.9 (9.5–13.2) kg, n = 8 |
| WT (females): | 11.6 (9.7–12.7) kg, n = 11 |

Zimbabwe (Smithers & Wilson 1979).

## Genus *Genetta* - Genets

The taxonomy of genets is controversial. According to one authority, there are 14 species in sub-Saharan Africa, in a wide variety of habitats, and there one species in the Maghreb (NW Africa), on the Arabian Peninsula and (introduced) in SW Europe. They are the most cat-like viverrids. Two species occur in Malawi. They can be distinguished by the information in yellow box below.

*Genetta angolensis* (Miombo Genet). Forelegs and hindlegs black. Tail bushy. Blotches on back and rump numerous but small; brown or black. Mid-dorsal stripe black; hairs 40-70 mm and erectile.

*Genetta maculata* (Large-spotted Genet). Forelegs and hindlegs pale (same as background colour of body); lightly spotted. Tail not bushy. Blotches on back and rump fewer but large; rusty-brown or dark

### *Genetta angolensis*

### Miombo Genet (Angolan Genet)

**Chichewa Names** Himba, Mbendu, Mwili, Nsimba. Same as for Large-Spotted Genet.

**Description** Medium-sized slender very cat-like arboreal carnivore with numerous black spots on body, a long black-ringed tail, and black legs. Pelage with comparatively long hairs (40 mm on back to 70 mm on rump). Dorsal pelage beige, ochre or brown with bold, irregularly-shaped spots, stripes or blotches, usually roughly in 3-4 lines on each side; larger near mid-dorsal line, smaller ventrally. Thick black mid-dorsal stripe from neck to rump (forming a crest of erectile black hairs posteriorly). Ventral pelage, chest and throat pale, without spotting. Head pale beige to ochre above eyes, sometimes with black mid-dorsal stripe from crown of head to muzzle; muzzle pointed, white, with black stripe from inner corner of each eye to upper lip. Ears pointed, sticking outwards from side of head. Limbs dark brown to black, without spots. Five digits on each foot with semi-retractile pointed claws. Tail long and bushy (91 (84-97)% of HB, n = 8), beige with 6-9 black rings; on dorsal surface, the rings widen and fuse to become an extension of the black mid-dorsal line of the body; tip black. There is considerable individual and geographic variation in the pelage color and in the intensity and size of the spots and blotches.

**Similar Species**

*Genetta maculata* (Large-spotted Genet). Legs beige, ochre, or cream (see also yellow box above).

*Nandinia binotata* (Two-spotted Palm Civet). See yellow box above).

**Distribution** In Malawi, the only records are from Namwera (probably from the forests of the Mangochi Hills, east of Mangochi) and the "Shire Highlands" (exact locality not specified). Elsewhere: known from three discrete areas: C Angola, W Zambia and SW DR Congo, and S Tanzania and N Mozambique.

**Habitat** Miombo (*Brachystegia*) woodland and savanna-forest mosaics, especially where annual rainfall exceeds 1000 mm/year.

**Abundance** In Malawi, only known from one (or possibly two) localities. Very rare; much rarer that the Large Spotted Genet which is the common and widespread genet in Malawi. Elsewhere, poorly known although stated to be locally common in some parts of C Angola.

**Habits** Semi-arboreal, nocturnal, omnivorous. Very little is known about this genet. The diet includes insects (especially grasshoppers), fruits and grasses (n = 1, Zambia). During the day, may rest in the abandoned burrows of Aardvarks.

**Reproduction** No information.

**Conservation** IUCN Category: Least Concern. However, the rather limited distribution and apparent rarity are conservation concerns.

**Taxonomic Notes** *Genetta angolensis* Bocage, 1882. No subspecies.

**Key References** Crawford-Cabral (2013), Hill & Carter (1941).

**Measurements**
*Genetta angolensis*

| | |
|---|---|
| HB (males): | 491.5 (465-550) mm, n = 4 |
| HB (females): | 441.8 (416-456) mm, n = 4 |
| T (males): | 448.8 (400-510) mm, n = 4 |
| T (females): | 396.8 (380-414) mm, n = 4 |
| HF c.u. (males): | 92.3 (87-98) mm, n = 4 |
| HF c.u. (females): | 83.3 (80-90) mm, n = 4 |
| E (males): | 53.5 (47-59) mm, n = 4 |
| E (females): | 52.0 (49-58) mm, n = 4 |
| WT (males): | 2.1 kg, n = 1 |
| WT (females): | n. d. |
| GLS (males): | 89.4, 92.4 mm, n = 2 |
| GLS (females): | 87.7 mm, n = 1 |

Malawi, Angola, Zambia (NHMUK, Hill & Carter 1944, Lawrence & Loveridge 1953).

## *Genetta maculata*

## Large-spotted Genet (Rusty-spotted Genet)

**Chichewa Name** Himba, Mbendu, Mwili, Nsimba. Same as for Miombo Genet.

Botswana © J. Carlyon

**Description** Medium-sized slender very cat-like arboreal carnivore with a striking pattern of blotches and spots on body, a long black-ringed tail and beige legs. Pelage short and soft; dorsal hairs ca. 15 mm. Background colour of dorsal pelage variable - beige, ochre, or cream. Back and flanks with large irregular spots or blotches, rusty-brown (sometimes with a black border), or pure black (especially on lower flanks and rump). Spots arranged in 3-5 lines on each flank, and randomly arranged on lower flank and rump. Rusty-brown or black mid-dorsal stripe from shoulders to base of tail (which may form a crest of non-erectile hairs along the mid-dorsal line). Ventral pelage and chest dirty cream, beige or greyish-white, without spots. Head wide at crown narrowing to pointed muzzle; large upright ears, rounded at tip; thin black stripe from back of crown to between eyes. Eyes large, brown, each with a large white patch below. Muzzle black (very obvious below the white sub-ocular patch. Limbs similar in colour to background colour of dorsal pelage, with small spots on outer surface. Five digits on each foot with sharp pointed semi-retractile claws. Tail long and slender, not bushy, 91.5 (87-100)% of HB, n = 5, similar in colour to flanks with 8-10 rusty-brown or black rings; tip rusty-black.

**Similar Species**

*Genetta angolensis* (Miombo Genet). Legs dark brown to black (see also yellow box above).

*Nandinia binotata* (Two-spotted Palm Civet). See yellow box above).

**Distribution** Widespread within Malawi although some records in the north of the country cannot be verified. Localities include Blantyre, Chikwawa, Chileka, Liwonde N. P., Magomero, Matope, Mzimba, Mwabvi W. R, Nkhotakota, Ntcheu District and Zoa Tea Estate. Elsewhere: widespread from Ghana eastwards to Ethiopia, and all countries southwards to Angola, Botswana, Zimbabwe and Mozambique.

**Habitat** Montane evergreen forest, riverine forest, Miombo (*Brachystegia*) woodlands, thickets and other woodland habitats. May also occur in wooded suburban habitats and gardens. Not found in semi-arid and grassland habitats.

**Abundance** No information for Malawi but considered to be relatively common throughout most of its biogeographic range. In eSwatini (formerly Swaziland), more abundant in protected areas (4.5/km$^2$) than on private ranches (0.3/km$^2$).

**Habits** Semi-arboreal, nocturnal, carnivorous/omnivorous. Large-spotted genets rest in trees, hollow logs and many other structures that give protection and darkness during the day. This genet may be seen in thickets, in trees, and while it is walking on the ground. It is a good climber, both on branches of trees, and on thin twigs and creepers.

The diet includes a wide range of animal prey as well as fruits, seeds and berries. This genet is an opportunistic feeder, eating what is available, changing the diet depending on the season. Throughout its biogeographic range, it is reported to feed on terrestrial and aquatic gastropods, bivalves, centipedes and millipedes, spiders, scorpions, insects, crustaceans, fish, amphibians, reptiles (including lizards and snakes), small birds and eggs, and mammals – especially rodents. In one study in Zimbabwe, in a sample of 136 stomachs, murid rodents (mostly *Mastomys* spp.) were found in 68%, insects in 40%, birds in 15%, arachnids in 9%, reptiles in 8%, wild fruits in 8%, shrews in 3%, centipedes in 3%, amphibians in 2%, lagomorphs in 1% and fish in 1% of the stomachs. At Lengwe N. P., a genet climbed onto the flat roof of a building and caught free-tailed bats (*Tadarida condylura* and *T. pumila*) as they scuttled over the roof, from their roost under the roof, to the edge of the roof from which they could dive and then fly away. Large-

spotted Genets will kill domestic poultry if the opportunity arises.

The social organization of these genets is uncertain. Males seem to defend territories (or have home-ranges) that overlap those of several females. Likewise, females are probably territorial. Radio-tracking has shown that males may have home-ranges as large as 500 ha, whereas those of females were about 25 ha; however home-ranges vary greatly depending on habitat (and food resources). Home-ranges are marked by secretions from the perianal glands, by faeces (deposited in 'latrines') and urine. For most of the time, Large-spotted Genets are solitary, except when pairs live together during the breeding season.

**Reproduction** No information for Malawi. The breeding season varies greatly throughout the biogeographic range. Births have been recorded from Aug to Feb in Zimbabwe, and young (estimated to be four weeks old) were found in Oct and Nov in Zambia. The data from southern Africa suggest that the breeding season extends from Aug to May. Gestation: 70-77 days. Mean litter-size: 2.9 (2-5), n = 10. Neonates have the eyes shut, and a sparse covering of hair; the pattern of spots and lines is readily discernable. Young can catch their prey when ca. 28 weeks of age.

**Conservation** IUCN Category: Least Concern. These genets are considered to be pests by farmers because they may kill domestic poultry.

**Taxonomic Notes** *Genetta maculata* (Gray, 1830). Referred to (incorrectly) as *Genetta rubignosa* (by Sweeney 1959, Ansell & Dowsett 1988 and Happold & Happold 1989d), *Genetta pardina* (by Hough 1959), *Genetta tigrina* (by Lawrence & Loveridge 1953 and Hayes 1978) and *Genetta genetta* (Hayes 1978). See also genus profile.

**Key References** Angelici & Gaubert (2013), Smithers & Wilson (1979).

**Measurements**
*Genetta maculata*

| | |
|---|---|
| TL (males): | 939 (845–1020) mm, n = 32 |
| TL (females): | 916 (865–1010) mm, n = 28 |
| HB (males): | 475 mm, n = 1* |
| HB (females): | 474.5 (448-499) mm, n = 4* |
| T (males): | 451 (415–530) mm, n = 32 |
| T (females): | 454 (395–495) mm, n = 28 |
| HF s.u. (males): | 86 (81–90) mm, n = 32 |
| HF s.u. (females): | 84 (80–89) mm, n = 28 |
| E (males): | 45 (41–50) mm, n = 32 |
| E (females): | 44 (41–48) mm, n = 27 |
| WT (males): | 1.8 (1.4–2.3) kg, n = 28 |
| WT (females): | 1.7 (1.5–2.0) kg, n = 28 |
| GLS: | 88.9 (85.5-91.0) mm, n = 3† |

Zimbabwe (Smithers & Wilson 1979).
*Malawi, Zambia (NHMUK).
†Mozambique Crawford-Cabral 1973 in Angelici & Gaubert (2013).

## FAMILY HERPESTIDAE - Mongooses

Mongooses are small to medium-sized terrestrial carnivores. They have short limbs, are usually uniform in colour (although some species have stripes on the body and white tips to the tail), small, rounded ears held close the head, and non-retractile claws. Some species are solitary, and others are highly social and gregarious. Some are diurnal (and hence easily seen), others are nocturnal (and less easily seen).

They forage opportunistically and eat a wide variety of prey from small vertebrates (rodents, birds, lizards, amphibians) to crustaceans, insects and other arthropods. They have small canine teeth and comparatively well-developed carnassial teeth which break bones and crush the shells of crabs and insects.

In Malawi, the family is represented by nine species - more species than in any other family in the Order Carnivora. Probably, also, the family contains the greatest numbers of individuals because mongooses are widespread and occupy many ecological niches. The family is divided into two subfamilies: the Herpestinae (solitary mongooses – genera *Atilax, Herpestes, Bdeogale, Rhynchogale* and *Ichneumia*) and the Mungotinae (social mongooses – genera *Mungos* and *Helogale*). Here, however, the genera are profiled alphabetically.

Most of the mongooses that occur in Malawi can be distinguished from the information in Table-key 13. Additional information is given under Similar Species. Further information in the descriptions includes details of the pelage, the digits and claws, and the upper lip. The hairs of the pelage usually have bands of different colours, and the pelage may also be a mix of hairs of different colours and lengths. Consequently, the colour of the pelage as seen from a distance is often different to its grizzled appearance close up. Similarly, the colour of the base or basal half of hairs on the tail is often different to the colour of the terminal half or tip, so that when the hairs lie flat, only the tip colour shows, but when the hairs are erect and fluffed out, both colours show. One species has dark bands (stripes) across the back; for all other species, the dorsal pelage is uniformly coloured. Most species have five digits (toes) on each foot but Digit one may be absent. If present, it is short and situated above the plantar surface – that part of the foot which contacts the ground – and it does not normally show in the mongoose's footprints (spoor). The upper lip is also described; in some species the lip is split by a vertical slit in the centre, in others there is a shallow vertical groove in the centre which parts the fur on the lip, or the lip may be smooth and not slit.

Table-key 13 to the species of mongooses (family Herpestidae) found in Malawi.

| **Activity** | **Dorsal pelage. Colour** | **Colour of most of tail. Tail characteristics.** | **HB or TL range (mm) Social organisation** | **Species** |
|---|---|---|---|---|
| Diurnal | Banded<br>Brown with 10-14 vertical black stripes | Same as body colour.<br>Tip darker.<br>T ca. 60% of HB | HB: 300-400<br>Gregarious | *Mungos mungo*<br>Banded Mongoose |
| Diurnal | Not banded.<br>Greyish, reddish or chestnut brown | Same as body colour.<br>Slightly bushy, black at tip.<br>T ca. 87% of HB | HB: 260-333<br>Mostly solitary | *Herpestes sanguineus*<br>Slender Mongoose |
| Diurnal | Not banded.<br>Grizzled greyish-brown (variable). | Same as body colour.<br>Slightly bushy, tapers slightly towards tip.<br>T ca. 71% of HB | TL: 340-410<br>Gregarious | *Helogale parvula*<br>Dwarf Mongoose |
| Diurnal | Not banded.<br>Grizzled greyish-brown. | Same as body colour.<br>Bushy at base, becoming slender with black tassel at tip.<br>T ca. 91% of HB | TL: 1005-1168<br>Mostly solitary, sometimes in small groups | *Herpestes ichneumon*<br>Egyptian Mongoose |
| Nocturnal and crepuscular | Not banded.<br>Dark chestnut brown, almost black in some, shaggy. | Same as body colour.<br>Tapering towards tip. | HB: 465-640<br>Solitary or in small family groups | *Atilax paludinosus*<br>Marsh Mongoose |
| Nocturnal | Not banded.<br>Grey to greyish-brown. | White from base to tip | HB: 519-1040<br>Mostly solitary, sometimes in small groups | *Ichneumia albicauda*<br>White-tailed Mongoose |
| Nocturnal | Not banded.<br>Speckled grey or oatmeal | Same as body colour.<br>Bushy at base, narrow white tip. | HB: 328-455<br>Mostly solitary. | *Paracynictus selousi*<br>Selous's Mongoose |
| Nocturnal | Not banded.<br>Looks black. | Black with pale brown showing through.<br>Thick, bushy, black at tip. | HB: 385-420<br>Mostly solitary. | *Bdeogale crassicauda*<br>Bushy-tailed Mongoose |
| Nocturnal | Not banded.<br>Medium brown. | Same as body colour at base.<br>Terminal half usually black. | TL: 572-892<br>Mostly solitary. | *Rhynchogale melleri*<br>Meller's Mongoose |

## Genus *Atilax* – Marsh Mongoose

Subfamily Herpestinae. This genus contains only one species, the Marsh Mongoose, which is very widely distributed in sub-Saharan Africa, in habitats with plenty of cover which are close to rivers, streams, lakes, dams, swamps or marshes.

### *Atilax paludinosus*

### Marsh Mongoose

**Malawian Names** Kaka, Khakhakha, Likhakhakha, Lipwisa.

Western Cape, South Africa © C. & M. Stuart

**Description** Large, shaggy, uniformly dark brown mongoose, with comparatively long legs. Males, on average, larger than females. Pelage dense and glossy, coarse with thick underfur and long guard hairs. Dorsal pelage (from distance) rich dark chestnut brown (tending to black in some individuals); close-up, looks slightly flecked; guard hairs very numerous, rich chestnut brown with irregular pale bands and (usually) a black tip; long (20-30 mm on mid-back, 30-40 mm at base of tail). Ventral pelage similar to dorsal pelage, often with more flecking; fewer guard hairs. Underfur pale ginger-brown, very dense. Crown of head and cheeks, neck and throat, similar to dorsal pelage, sometimes greyish-brown. Upper lip with central, shallow, vertical groove which parts the hairs. Ears small, close to head, well-covered with numerous short greyish-brown hairs. Limbs slender and comparatively relatively long, blackish brown (darker than dorsal pelage) with very short hair; each foot with five digits, each with a strong curved claw; Digits 2-5 relatively long, Digit 1 short and situated above the plantar surface. No webbing between digits (cf. all other mongooses). Tail (ca. 65-70% of HB), dark chestnut brown or blackish (similar to dorsal pelage), bushy near base (hairs ca. 30 mm) but tapering to pointed tip.

**Similar Species** (see Table-key 13).

*Bdeogale crassicauda* (Bushy-tailed Mongoose). Looks black from a distance. Pelage fairly long but not shaggy. Feet with only four digits. Tail black at tip.

*Rhynchogale melleri* (Meller's Mongoose). Pelage not shaggy. Terminal half of tail usually black.

**Distribution** Widely distributed within Malawi, although not many records. Localities include near Chikwawa, Kasungu N. P., Mbasi Creek (NW corner of Lake Malawi), Fort Songwe (not located but presumably on the Songwe River) and Vua. Elsewhere: very widely distributed throughout Africa south of the Sahara Desert and the Sahel Biotic Zone, except for Namibia, Botswana, and the Horn of Africa and the drier regions of South Africa.

**Habitat** Mostly found close to rivers, streams, dambos, dams and other aquatic habitats where there is also riparian vegetation. Occasionally and temporarily, Marsh Mongooses may be found some distance from water. Recorded over a wide range of altitudes, from close to sea level to more than 3000 m (e.g. Mount Kenya, Ethiopia).

**Abundance** No information for Malawi. Generally considered to be common in some habitats, although rarely sighted. The only available assessment of density is 1.8 individuals/km$^2$ (KwaZulu-Natal, South Africa).

**Habits** Terrestrial, crepuscular and nocturnal, omnivorous. During the day, they rest in dense vegetation (grass, tangles, bushes) close to water. They are active around sunrise and the early hours of the morning, and at sunset and the early hours of the night. Marsh Mongooses are the most aquatic of all mongooses: they are good swimmers and when active spend much of their time paddling around in shallow water hunting for prey. Their long digits (without webs) are very sensitive and are used to "feel" for prey under stones and in mud, both under water and on land (see also below).

Marsh Mongooses feed mainly on crabs,

amphibians, fish and other aquatic prey. They are very opportunistic and will also eat rodents, birds, eggs, and fruits when available. The diet varies depending on locality and season. For example, in the highlands of South Africa, in a sample of 210 scats, there were crustaceans (crabs) in 43%, mammals in 14%, amphibians in 14%, birds in 14%, fish in 2% and insects in 2% of the scats. In contrast, in the lowlands of South Africa, in a sample of 349 scats, there were crustaceans in 21%, mammals in 15%, amphibians in 17%, birds in 2%, fish in 0% and insects in 19% of the scats.

Marsh Mongooses are usually solitary but form small family groups during the breeding season. Home-ranges vary in size depending on locality and the geographical arrangement of suitable watery habitat. A female in CAR had a home-range of 54 ha (along a 5 km stretch of stream); in Kwa-Zulu- Natal, a male had a home-range of 131 ha, and female had a home-range of 204 ha. Home-ranges may overlap; however, females avoid males except during the mating season.

Marsh Mongooses have many ways of communicating. Scents from anal glands, from faeces (often deposited in 'latrines') and by urination provide information about the presence of an individual and its sexual condition. Other means of communications are vocal and behavioural. Vocal communications include three agonistic and two amicable calls, and behavioural interactions include cheek-rubbing, allog-rooming and mother-young interactions.

**Reproduction** No information for Malawi. In southern Africa, reproduction is seasonal, with mating from Aug to Feb. Gestation: ca. 10.5 weeks. Mean litter-size (in the wild): 2.5 (2-3). Neonates are fully furred but their eyes and ears are closed. Eyes open at ca. Day 11. Weaning commences at Week 4, but young suck until ca. Week 8. Young are able to capture and kill rodent prey at ca. Week 17 and adult weight is attained at ca. Week 27. Young stay with their mother until ca. Week 20 when they are able to catch all their own prey.

**Conservation** IUCN Category: Least Concern. Drainage of wetlands and riverine vegetation, and hunting for bushmeat in some countries are conservation concerns.

**Taxonomic Notes** *Atilax paludinosus* (G. Cuvier, 1829). No subspecies currently recognised, although 16 synonyms are recorded.

**Key Reference** Baker & Ray (2013).

**Measurements**
*Atilax paludinosus*

| | |
|---|---|
| HB (males): | 554 (471–640) mm, n = 20 |
| HB (females): | 515 (465–570) mm, n = 10 |
| T (males): | 355 (319–405) mm, n = 21 |
| T (females): | 338 (310–385) mm, n = 10 |
| HF c.u. (males): | 105 (95–115) mm, n = 22 |
| HF c.u. (females): | 102 (95–107) mm, n = 10 |
| E (males): | 33 (25–39) mm, n = 21 |
| E (females): | 30 (25–37) mm, n = 10 |
| WT (males): | 3.0 (2.0–3.8) kg, n = 18 |
| WT (females): | 2.6 (2.0–3.2) kg, n = 19 |
| GLS (males): | 109 (103–117) mm, n = 18 |
| GLS (females): | 106 (102–108) mm, n = 8 |

South Africa (Northern Cape, Western Cape and Eastern Cape provinces, Stuart 1981 in Baker & Ray 2013).

# Genus *Bdeogale* – Bushy-tailed Mongoose and others

Subfamily Herpestinae. This genus contains four species: they occur in eastern and central Africa, in forested habitats. There is no vernacular name for this genus. Only one species occurs in Malawi.

## *Bdeogale crassicauda*

## Bushy-tailed Mongoose

**Malawian Names** Khare dimbiri, Msalgela, Msangela, Nyenga.

**Description** Large shaggy uniformly blackish-brown or black mongoose with dark shaggy black-tipped tail. Males, on average, larger than females. Pelage long and dense, slightly coarse. Dorsal pelage (from distance) looks black; close-up, looks medium brown to blackish-brown, heavily flecked with black; hairs with alternate pale and dark banding on basal half and black on terminal half, 30-40 mm. Underfur very dense, ochre or beige (hairs ca. 20 mm). Ventral pelage slightly paler than dorsal pelage; hairs shorter (20-30 mm). Head similar to dorsal pelage, hairs short (ca. 5 mm) lying close to head. Nose, chin, throat and chest dark brown. Upper lip with central, shallow, vertical groove which parts the hairs. Ears small, held close to head; front of ear partly covered by hairs of cheek. Limbs black and relatively rather long (when compared with other species of mongoose); each foot with four digits (Digit 1 absent), each digit with a sharp pointed claw. Tail relatively short (ca. 64% of HB), colour (except for tip) similar to dorsal pelage; thick and bushy at base, tapering to a point; hairs pale brown at base, black on terminal half. When the tail hairs are erect, the tail looks extremely bushy and both colours are visible. Tip of tail pure black.

**Similar Species** See table-key 13.

*Atilax paludinosus* (Marsh Mongoose). Dark chestnut brown to almost black. Pelage shaggy. Feet with five digits (although one is higher than the plantar surface). Tail not black at tip.

*Rhynchogale melleri* (Meller's Mongoose). Dorsal pelage medium brown. Upper lip without a slit. Feet with five digits (although one is higher than the plantar surface).

**Distribution** Recorded in only a few localities throughout Malawi including near Kasungu, Lengwe N. P., Mulanje Mountain and Nyika N. P. Elsewhere: recorded from S Kenya, E Tanzania, SE Zambia, NE Zimbabwe and N Mozambique.

**Habitat** No details for Malawi. Lives in many habitats throughout its biogeographic range, e.g. Miombo woodlands, rocky outcrops, riverine woodlands and grasslands. At higher altitudes, e.g. in Tanzania, Bushy-tailed mongooses have been recorded in bamboo and montane forests.

**Abundance** No information for Malawi. Elsewhere: generally thought to be uncommon, and rarely observed in the wild. However, camera-traps frequently capture images of this species and so Bushy-tailed Mongooses are probably more common than previously assumed. In North Luangwa N. P. (Zambia), this species was the most frequently observed species (by direct observations and camera traps) of the nine species of mongooses known from the park.

**Habits** Terrestrial, nocturnal, omnivorous. Bushy-tailed Mongooses are mainly nocturnal but also diurnal in some circumstances; during the day, it is assumed that they rest in burrows made by other species. They have long legs and move with a running gait. Their diet (as assessed by analysis of stomach contents) includes insects (especially termites), millipedes, spiders, scorpions, snails, reptiles, amphibians, mice and herbage. It is probably that (like other mongooses) they are opportunistic, eating mainly insects in the wet season (when insects are abundant) and other foods in the dry season (when insects are often scarce). Bushy-tailed mongooses are solitary, but are occasionally seen in small groups (e.g. mother and young).

**Reproduction** There is almost no information about reproduction in this species. It is assumed that females give birth during the warm wet season.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Bdeogale crassicauda* Peters, 1852. Four subspecies provisionally recognised; the subspecies in Malawi is *B. c. crassicauda*.

**Measurements**
*Bdeogale crassicauda*

| | |
|---|---|
| HB (males): | 407 (390–420) mm, n = 3 |
| HB (females): | 380, 385 mm, n = 2 |
| T (males): | 230 (220–240) mm, n = 3 |
| T (females): | 220, 240 mm, n = 2 |
| HF c.u. (males): | 78 (77–79) mm, n = 3 |
| HF c.u. (females): | 75, 75 mm, n = 2 |
| WT (males): | 1.3 (1.1–1.6) kg, n = 3 |
| WT (females): | 1.1, 1.5 kg, n = 2 |

Tanzania (Arusha N. P., Martinoli *et al.* 2006 in Taylor 2013a).

# Genus *Helogale* – Dwarf Mongooses

Subfamily Mungotinae. Although up to 11 species of *Helogale* have been recognised in the past, only two are currently recognised. They are endemic to sub-Saharan Africa. One species occurs in Malawi.

## *Helogale parvula*

## Dwarf Mongoose

**Malawian Name**s Kambumbu, Kasisibi. Not confined to this species.

Kruger N. P., South Africa © C. & M. Stuart

**Description** Very small mongoose (the smallest of all mongooses) with low-slung body and uniformly greyish-brown grizzled pelage. Males and females similar in size. Pelage, dense and slightly coarse, with thick short underfur. Dorsal pelage (from distance) looks black or very dark brown; close-up, looks grizzled with flecks of grey, beige and ochre against a dark background; hairs grey, brown or rusty-brown at base with black and whitish-grey banding, and black tip. Hairs short (ca. 5 mm on back, up to 10 mm on rump). Ventral pelage, chin and throat, orange-grey to cinnamon, not flecked. Crown of head darker than dorsal pelage. Upper lip with central shallow vertical groove which parts the hairs. Ears small, close to side of head, covered with short cinnamon or pale brown hairs. Eyes brown (blue in young). Area around eyes muzzle and lips sparsely covered with very short hairs. Limbs relatively short, russet, cinnamon or pale brown. Each foot with five digits, four digits with long thick curved claws; Digit 1 short and situated above the plantar surface. Tail 71 (65-76)% of HB, n = 7), slender, thickly haired but not shaggy, same colour as body, tapering slightly towards tip. (There is great variation in pelage colour throughout biogeographic range, from pale brown, to ginger-brown, dark brown and almost black*)*.

**Similar Species**

*Herpestes sanguineus* (Slender Mongoose). Mostly solitary. Tail with conspicuous black tip. Upper lip with central, vertical slit.

**Distribution** Widely distributed throughout Malawi, although not many records. Localities include Kasungu N. P., Lengwe N. P., Mwabvi W. R., Mweru, Nkhotakota W. R. and Nyika N. P. (Plateau, Mlombuji). Elsewhere: occurs along the eastern side of Africa from Ethiopia and Somalia, through East Africa to Angola, Zambia, Zimbabwe, Mozambique and NE South Africa.

**Habitat** Open canopy miombo woodlands and thicket savanna of poorer areas, where there are termitaria, hollow logs and thickets which may be used as 'dens'. The quality of the habitat for Dwarf Mongooses is determined by the number of suitable den sites. Dwarf mongooses are not found in forest or arid habitats

**Abundance** No information for Malawi. Elsewhere: may be quite common in good quality habitats, e.g. 5–8 individuals/km$^2$.

**Habits** Terrestrial, diurnal, insectivorous. Dwarf Mongooses usually spend the night in holes in termite mounds, but also sleep in rock crevices and occasionally in hollow logs. They are almost entirely insectivorous, the principal prey being beetles, termites and grasshoppers. Insect prey is either caught on the ground or dug up from under the soil and litter. Prey is pinned down with the forepaws, bitten on the head, and then eaten. Some other foods may be taken occasionally: mice, birds' eggs, small snakes and berries.

Dwarf Mongooses live in groups of 2-21 individuals (mean group size nine). The members of a group forage at the same time; individuals spread out over a small area (10-200 m$^2$). Within the group, there are many social interactions and co-operation between individuals. Each group usually contains more females than males, as well as the young of the year; because females have 2-4 litters/year, there are likely to be young of several ages within a group (see also below). Within a group there is a dominance

hierarchy. There is a dominant male (the 'alpha' male) who forms a life-long bond with a female to form the dominant pair who are usually the oldest individuals in the group. All other members are sub-dominant and reproductively suppressed, and they help with the raising of the young of the dominant pair.

The members of the group cooperate in many activities. They share a home-range, forage together and, when foraging, one individual acts as a 'guard'. Members of the group also 'baby-sit', groom and feed the young, and also groom each other. Group members communicate with a variety of vocalizations. A quiet 'boop' keeps foraging individuals in touch, and the twittering sounds of young denote play and establish mother-young cohesion. There are also 'alarm calls' which warn the group of the presence of predators.

The group's home-range is marked by scent-marking with secretions from the anal glands and cheek glands, and by the deposition of faeces and urine in communal latrines. Home-ranges in Serengeti N. P. (where these mongooses have been well studied) averaged 27.4 ha; group home-ranges overlapped only slightly at the margins and often remained the same for several years. One density estimate in the Serengeti N. P. was 81 individuals/km$^2$.

**Reproduction** No information for Malawi. Elsewhere: young are born when insects are most abundant; in Serengeti N. P. this is from Nov to May (and occasionally in Oct and in Jun). Usually, young are born in dens in termitaria, and group members of both sexes help the parents to raise the young by feeding, grooming, guarding and 'baby-sitting' them. Gestation: 49-53 days. Mean litter-size: 3.3 (although up to seven young may be born in captive females). Females produce 2-4 litters/year. Lactation lasts for ca. 56 days.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Helogale parvula* (Sundevall, 1847). There is large variation in pelage colour throughout the biogeographic range. As a result, 15 subspecies have been described but none are recognised currently.

**Key References** Creel (2013), Smithers (1983).

**Measurements**
*Helogale parvula*

| | |
|---|---|
| TL: | 379.3 (340–410) mm, n = 53 |
| T: | 165.6 (152–188) mm, n = 43 |
| HF c.u.: | 46 (41–59) mm, n = 42 |
| E: | 17.5 (14–21) mm, n = 40 |
| WT: | 267.2 (213–341) g, n = 24 |
| GLS: | 46.0–50.0 mm, n = 35* |

Botswana (Smithers 1983).
*Southern Africa (Roberts 1951 in Creel 2013).

## Genus *Herpestes* – Common Mongooses

Subfamily Herpestinae. This genus contains 14 species distributed in Africa, India and Asia. There are five species in Africa, two in Malawi.

### *Herpestes ichneumon*

### Egyptian Mongoose (Large Grey Mongoose)

**Malawian Names** Lukoti, Msalagela, Nyenga. Not confined to this species.

Western Cape, South Africa © C. & M. Stuart

**Description** Large mongoose with uniformly greyish-brown pelage heavily streaked with beige and black, relatively short dark legs, and long tail ending in a black tassel. Males and females similar in size. Pelage long and coarse. Dorsal pelage (from distance) greyish-brown; close-up, streaked with both beige and black giving a grizzled appearance; dorsal hairs long with beige or black tips. Ventral pelage similar to dorsal, but shorter; sometimes ginger-brown. Head long and narrow, similar in colour to dorsal pelage. Upper lip with central vertical slit. Ears short and rounded, often well covered anteriorly by long cheek hairs. Eyes pale or brown. Limbs relatively short, dark brown or black; each foot with five digits, four large, each ending in a small curved claw; Digit 1 short and situated above the plantar surface. Tail ca. 91% of HB, similar in colour to dorsal pelage, very shaggy at base but becoming very slender towards tip and ending with a black tassel.

**Similar Species** None (see Table-key 13).

**Distribution** In Malawi, recorded from only a few localities but in most biogeographic areas; probably more widespread than records suggest. Localities include Chinteche, Lengwe N. P., Liwonde N. P., Mwabvi W. R., Ntcheu, Nyika N. P., Thondwe and Zoa Tea Estate. Elsewhere: very widespread throughout Africa (including the Nile Valley) although absent from the Sahara and surrounding arid regions, the Horn of Africa, the rainforest zone, and the arid regions of southern Africa (Angola, Botswana, S Zimbabwe, and most of South Africa except in mesic areas near the coast).

**Habitat** Woodlands and grasslands including montane grasslands, often near streams or rivers. In various parts of the biogeographic range, they have been found in woodland savannas and grasslands, mostly where there is dense vegetation, rivers, swamps or marshes, as well as in agricultural lands and gardens.

**Abundance** Considered rare or uncommon in Malawi. Elsewhere, the only estimates of density are 1.2 individuals/km$^2$ in South Africa, and 0.1 individuals/km$^2$ in East Africa.

**Habits** Terrestrial, diurnal, omnivorous. There is no information about where Egyptian Mongooses sleep. They are terrestrial, move with a trotting gait and often stand up on their hindlegs to survey their surroundings. Unusually for a mongoose, they also swim well and sometimes forage in shallow water.

Egyptian Mongooses are mostly solitary, although sometimes they are seen in small groups of 2-3 individuals (usually a mother and her young) and in family groups of 4-6. Very little is recorded about the habits of this species in Africa, but it has been well studied in Spain (where it was introduced by the Arabs in the 11th-13th centuries AD). There, home-ranges of adults are ca. 3.5 km$^2$. Females defend the core area of the range, and males are territorial over the whole of the home-range. Male home-ranges overlap those of several females. Egyptian Mongooses use secretions from the perianal glands and faeces (deposited in 'latrines') to mark the boundaries of the home-range. Five vocal calls have been recorded: a contact call, (a short duration call emitted by every member of a group to maintain contact during foraging; an alarm call (a deep, sharp growl); an aggression call (a soft strong barking or spitting call, emitted during mating and fighting); an intimi-

dating call (a soft, continuous growl usually during mating); and a sharp pain call.

**Reproduction** There is little information for Malawi or elsewhere. The times of reproduction vary throughout the biogeographic range. In southern Africa, young are probably born in the warm wet summer months. Gestation: 60-75 days. Litter-size: 2-4. Young remain with their mother until at least one year of age.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Herpestes ichneumon* (Linnaeus, 1758). No subspecies are currently recognised although many names have been given in past reflecting the wide range of pelage colouration in different parts of the biogeographic range.

**Key References** Palomares (2013), Smithers (1983).

**Measurements**
*Herpestes ichneumon*

| | |
|---|---|
| TL: | 1087.6 (1005–1168) mm, n = 18 |
| T: | 521.9 (452–576) mm, n = 18 |
| HF c.u.: | 111 (105–115) mm, n = 18 |
| E: | 36.9 (30–42) mm, n = 18 |
| WT: | 3.3 (2.6–4.1) kg, n = 18 |
| GLS: | 103.0-105.5 mm. n = 5* |

Zimbabwe (Smithers & Wilson 1979).

## *Herpestes sanguineus*

## Slender Mongoose

**Malawian Names** Likongwe, Kandindi, Nyenga. Not confined to this species.

KwaZulu/Natal, South Africa © C. & M. Stuart

**Description** Small, lithe, low-slung, slender uniformly reddish-brown mongoose, with short limbs and long neck, and long moderately bushy tail with a conspicuous black tip. Males, on average, heavier than females. Pelage short and sleek, slightly coarse. Dorsal pelage (from distance) rusty-brown to rich chestnut-brown; close-up, pelage looks grizzled with black and beige; hairs dark greyish-brown with bands of chestnut-brown and beige, ending with black tip. Flanks may be slightly paler. Ventral pelage similar to dorsal pelage, less grizzled, tending towards orange. Crown of head and neck similar to dorsal pelage; chin and throat same as ventral pelage. Upper lip with central vertical slit. Ears wide and short, held close to side of head, sparsely covered with short beige and black hairs. Eyes yellowish-orange. Limbs relatively short, same colour as body; each foot with five digits, each with a sharp claw; Digit 1 short and situated above plantar surface. Tail 88 (68-103)% of HB, n = 10, similar in colour to back except ending with conspicuous black tip, moderately bushy, hairs erectile. When walking, the back is held parallel to ground or slightly arched, and the tail extends backwards in line with the back with the tip of tail raised upwards in a gentle curl. Pelage colour varies in different parts of the biogeographic range and in different habitats. The amount of variation in Malawi is not known.

**Similar Species**

*Helogale parvula* (Dwarf Mongoose). Gregarious. Tail does not have black tip. Upper lip with central shallow vertical groove which parts the hairs.

**Distribution** Widespread in Malawi in all biogeographic areas. Localities include Chididi, Karonga, Kasungu N. P., Lake Malawi N. P., Lengwe N. P., Liwonde N. P., Majete W. R., Misuku Hills, Mulanje, Mwabvi W. R., Nyika N. P., Salima, Shire Highlands, Thyolo Mountain, Viphya Plateau (Chikangawa), Vwaza Marsh G. R. and Zomba. Elsewhere: very widely distributed from Senegal to Ethiopia and the Horn of Africa, and in almost all countries southwards to South Africa. Not present in rainforest habitats of Nigeria, Cameroun, Gabon and the Central African Republic.

**Habitat** Lives in a wide range of savanna, woodland and bushland habitats, and also occurs in montane habitats (up to ca. 2700 m in Ethiopia).

**Abundance** No detailed information for Malawi but considered very common. One of the most abundant (and frequently seen) mongooses in Africa. In Serengeti N. P. (Tanzania), population densities were 3-6 individuals/km$^2$ over a period of several years.

**Habits** Terrestrial, diurnal, omnivorous. Slender Mongooses are diurnal, and activity ceases at sunset. During the night, and when a female has young, they rest in 'dens' which include burrows excavated by other species, cavities under piles of rocks, hollow logs, and holes in termitaria. Slender Mongooses are very active and lithe. They often travel along roads (hence are often seen). When walking and hunting, the nose is held to the ground (as in the Egyptian Mongoose). Unlike other mongooses, they are excellent climbers, and will run up tree trunks and along branches like squirrels. In Lengwe N. P., several Slender Mongooses were observed climbing around in small trees, and later descending to the ground with the head facing downwards. When pursued, the tail is held upright (probably as a danger signal to other individuals).

The diet of Slender Mongooses is mainly insects and small vertebrates. In in a sample of 60 stomachs from Botswana and Zimbabwe, there were insects (mainly grasshoppers, termites, beetles and ants) in 73% of the stomachs, lizards (several spp.) in 27%, and murid rodents (mostly *Mastomys*, *Rhab-*

*domys* and *Pelomys*) in 25% of the stomachs. In other parts of the range, wild fruits and berries are also consumed. Slender Mongooses also like the eggs of birds and are known to 'steal' eggs from domestic chickens.

Slender Mongooses are mostly solitary. In Serengeti N. P., males occupy territories of ca. 50 ha which overlap with the territories of several females. Females occupy territories of ca. 25 ha which do not overlap with those of other females. Sometimes there are amicable arrangements whereby several males (often closely related) use the same home-range, overlapping with many females; these arrangements exclude males from other home-ranges, and may last for several years. Social relationships appear to be dynamic and to take many forms. Slender Mongooses use secretions from the anal glands and faeces to mark the boundaries of the home-ranges. They exhibit many amicable and aggressive displays.

**Reproduction** No information for Malawi. In southern Africa, Slender Mongooses breed during the warm wet season (Oct–Feb). Gestation: 60-70 days. Litter-size: 2-4. Eyes open at Week 3. Growth is rapid and young reach two-thirds of adult weight by Day 50. Mothers move their young every 3-4 days to a new den. Both mothers and fathers are very protective of their young.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Herpestes sanguineus* (Rüppell, 1835). Referred to as *Galerella sanguinea* by Ansell & Dowsett (1988), and *Galerella sanguineus* by Hough (1989). No subspecies currently recognised. The great variation in pelage throughout the biogeographic range resulted in 49 named subspecies which are now considered to be synonyms.

**Key References** Hoffmann & Taylor (2013), Smithers (1983).

**Measurements**
*Herpestes sanguineus*

| | |
|---|---|
| HB (males): | 291.8 (260–333) mm, n = 6 |
| HB (females): | 292.0 (282–300) mm, n = 4 |
| T (males): | 248.3 (228–262) mm, n = 6 |
| T (females): | 265 (250–291) mm, n = 4 |
| HF c.u. (males): | 55.7 (52–57) mm, n = 6 |
| HF c.u. (females): | 55.3 (53–59) mm, n = 4 |
| E (males): | 23.8 (16–27) mm, n = 6 |
| E (females): | 22.0 (17–24) mm, n = 4 |
| WT (males): | 637 (523–789) g, n = 24* |
| WT (females): | 459 (373–565) g, n = 15* |

Malawi, Mozambique, Zambia, Botswana (NHMUK, NMMB, Lawrence & Loveridge 1953). *Zimbabwe (Smithers & Wilson 1979).

# Genus *Ichneumia* – White-tailed Mongoose

Subfamily Herpestinae. This genus contains only one species. It is very widespread in sub-Saharan Africa in woodland and savanna habitats, and also occurs on the Arabian Peninsula.

## *Ichneumia albicauda*

## White-tailed Mongoose

**Malawian Names** Khali, Khare kachewere, Nyenga.

KwaZulu/Natal © J. Carlyon

**Description** Large mongoose with grey or greyish-brown body, black legs and bushy white tail (the largest mongoose in Malawi). Males, on average, with larger HB. Pelage long, coarse and shaggy; hairs long (40-50 mm, to ca. 90 mm on mid-dorsal line. Dorsal pelage (from distance) grey or greyish-brown, tending to black on mid-dorsal line; close-up, pelage looks grizzled; hairs grey or dull yellow with white banding and black tip. Ventral pelage paler, white to pale brown, without (or with only a few) black tipped hairs. Dense underfur. Head similar to dorsal pelage, wide with pointed muzzle. Upper lip with central vertical slit (cf. *Rhynchogale*, Meller's Mongoose). Ears small and rounded. Limbs relatively long, black or dark chocolate brown (in stark contrast to the rest of the body), with five digits on each foot; Digit 1 small and situated above plantar surface. Claws long and strong. Tail 77 (69-85)% of HB, n = 5, and bushy, white (with some long black hairs near base), tapering slightly towards tip; hairs of the tail are erectile and, when erect make the tail look like a bottlebrush. (In some parts of the geographic range, the tail is black but all known Malawi specimens have white tails). When standing and walking, the hindquarters are higher than the forequarters.

**Similar Species** None. No other mongoose in Malawi has a tail which is white from base to tip (except for a few black hairs near the base).

**Distribution** Recorded from only ca. seven localities but in most biogeographic areas except the Shire Highlands, Phalombe Plain and Mulanje Mountain. Localities include Chiromo, Kasungu N. P., Liwonde N. P., Mangochi, Misuku Hills, Perekezi F. R. (Mzimba District) and Vwaza Marsh G. R. Elsewhere: very widespread from Senegal to Sudan, and southwards to Angola, S DR Congo, Zambia, Mozambique and Zimbabwe; occurs marginally in parts of Botswana and E South Africa. Not recorded in rainforest habitats, nor in arid areas where water is scarce or absent.

**Habitat** Grasslands and woodland savanna (including open canopy miombo woodlands), bush-land, and agricultural areas. White-tailed Mongooses have a wide habitat tolerance and adapt easily to habitats modified by humans (and may be seen in and around towns and villages).

**Abundance** Rarely recorded in Malawi (only three specimens and a few sight records) which suggests that this species is rare or uncommon. In Serengeti N. P., densities may be as high as 4.3 individuals/km$^2$. The number of suitable denning sites may partly determine the abundance of this species.

**Habits** Terrestrial, nocturnal, insectivorous. White-tailed Mongooses are active at night. During the day, they rest in 'dens', usually in the abandoned holes of larger mammals or in disused termitaria. They tend to forage alone, sniffing and digging for insects, and pouncing on small vertebrate prey. When foraging, they tend to move in a zig-zag fashion with the head held low. They feed mostly on insects, mainly termites, beetles, grasshoppers and beetle larvae. Occasionally, they eat earthworms, wild fruits and birds. In a sample of 65 stomachs from Zimbabwe, there were insects in 86%, amphibians in 31%, murid rodents in 18% and reptiles in 15% of the stomachs.

White-tailed Mongooses are primarily solitary animals, although small groups (mother and young) may be seen in the breeding season. Contact between individuals seems to be minimal. Individuals may sniff each other's noses or genitalia if they meet. Allogrooming is rare. Agonistic behaviour has

been observed only with outsiders. Unlike other mongooses, they rarely utter vocal sounds, except for a loud 'bark' when threatened.

Males appear to have territories, as do females; a male's territory may overlap with the territories of several females. Territories are marked by scent-marking. Territory size seems to be influenced by locality and the availability of food, e.g. in Bale (Ethiopia), territories of males averaged 3.17km$^2$ whereas in Serengeti N. P. (Tanzania) they averaged 0.97km$^2$ - probably because food is more abundant in Serengeti N. P. than in Bale.

**Reproduction** No information for Malawi. Elsewhere: reproduction is seasonal. In Zimbabwe, pregnant and/or lactating females have been recorded in Sep to Feb, whereas in East Africa young are born during the wet seasons (Mar to May and in Nov to Dec). Litter-size: 1-4. No details are available for growth of young and time to maturity.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Ichneumia albicauda* (G. Cuvier, 1829). Six subspecies have been named, based on variations in pelage colour throughout the biogeographic range. The validity of these subspecies is controversial.

**Key References** Smithers (1983), Taylor (2013b).

**Measurements**
*Ichneumia albicauda*

| | |
|---|---|
| HB (males): | 680 (574–1040) mm, n = 18 |
| HB (females): | 574 (519–591) mm, n = 25 |
| T (males): | 421 (346–470) mm, n = 19 |
| T (females): | 442 (392–485) mm, n = 25 |
| HF c.u. (males): | 139 (130–147) mm, n = 19 |
| HF c.u. (females): | 138 (130–148) mm, n = 25 |
| E (males): | 46 (42–50) mm, n = 19 |
| E (females): | 45 (37–50) mm, n = 25 |
| WT (males): | 4.49 (3.63–5.22) kg, n = 14 |
| WT (females): | 4.14 (3.62–4.99) kg, n = 25 |
| GLS (males): | 116.0–118.0 mm, n = 3* |
| GLS (females): | 108.0–114.0 mm, n = 5* |

Zimbabwe (Smithers & Wilson 1979).
*South Africa (Roberts 1951 in Taylor 2013b).

## Genus *Mungos* – Banded Mongooses

Subfamily Mungotinae. This genus contains two species, only one of which has dark bands across its back. Both are endemic to sub-Saharan Africa; one occurs only in West Africa; the other is widespread mainly in savanna habitats. Only the widespread banded species occurs in Malawi.

### *Mungos mungo*

### Banded Mongoose

**Malawian Names** Kasulu, Lisulu, Msulu, Msulwe.

Liwonde N. P., Malawi © Bentley Palmer

**Description** Small to medium-sized mongoose with 10-14 dark transverse bands across the back from behind shoulders to base of tail on each side (the only species of mongoose in Malawi with such markings). Males, on average, slightly larger and heavier than females. Pelage short and slightly course. Dorsal pelage, of head and shoulders, grizzled (pale to dark brown flecked with white or cream). Back and rump cream to beige with 10-14 dark brown or black transverse bands each extending from mid-dorsal line to mid-flank; band width and inter-band width approximately equal. Ventral pelage similar in colour to head and shoulders. Upper lip smooth, without groove or slit. Ears small and rounded, placed on side of head, covered with very short hairs. Limbs similar in colour to head and shoulders; each foot with five digits; Digits 2, 3, 4, and 5 each with a long claw; Digit 1 small with smaller claw, situated above the plantar surface. Tail 64 (57-74)% of HB, n = 10, fairly thin, similar in colour to dorsal pelage, tapering gradually to dark tip; tail hairs can be erected (e.g. when an individual is threatened).

**Similar Species** None. No other mongoose in Malawi has banded dorsal pelage.

**Distribution** Recorded throughout most of Malawi, especially in the Shire River Valley (but most records are from the early 20th century). Localities include Chiromo, Kasungu N. P., Lengwe N. P., Liwonde N. P., Malosa Mountain, Mangoche Mountain, Mpimbi, Mwabvi W. R., Mwanemba, Mzimba, Ntcheu, Salima, Vwaza Marsh G. R., and Zomba. Elsewhere: recorded from suitable habitat from Senegal to the Horn of Africa, and southwards through East Africa and S DR Congo to Angola, Zambia, Mozambique, and parts of Botswana, Zimbabwe and NE South Africa.

**Habitat** Woodland savannas (including miombo woodlands) and grasslands, mixed thicket woodland-savanna of the drier uplands, thicket savanna of poorer areas (e.g. thicket-clump savanna at Lengwe N. P.), often close to water. Not known from montane habitats.

**Abundance** No information for Malawi. Estimates from other parts of the southern African range are 3 individuals/km$^2$ (Serengeti N. P.) and 2.4/km$^2$ (KwaZulu-Natal (South Africa). Because Banded Mongooses are social animals (and seen in groups – see below), the impression that they may be abundant is not strictly correct.

**Habits** Terrestrial, diurnal, insectivorous / omnivorous. Banded Mongooses are active during the day and spend the night in 'dens' which are mostly holes in abandoned termitaria. They also use cavities under rocks, hollows under the roots of trees and burrows of other animals as dens, and may take temporary shelter in thick vegetation, hollow logs and under fallen trees.

Banded Mongooses are opportunistic foragers, and their diet varies depending on what is available. The diet is mainly insects and other invertebrates, as well as small reptiles, eggs, and wild fruits. In a sample of 14 stomachs from Zimbabwe and Botswana, there were insects in 71%, reptiles in 43%, wild fruits in 36%, and amphibians, scorpions, camel spiders, myriapoda, and spiders in 7% of the stomachs. Not only were insects found in most stomachs, they contributed the greatest mass of the food in each stomach. In Uganda (Queen Elizabeth NP) where millipedes are very abundant, a similar study of 120 faecal samples (10 each month for 12 months)

showed that the three most frequently eaten foods were millipedes (present in 96% of the samples), beetles in 88% and adult ants (in 69%).

Banded Mongooses are social animals. They live in groups that are highly cohesive and group-members co-operate in many ways. Group size varies in different localities. In Lengwe N. P., group size (at the Main waterhole) is typically 12 to 16 individuals (range 8-23), similar to the group sizes recorded at other localities. A group consists of several adult males and females, and their young. There is no dominance hierarchy within a group except among males when females are in oestrus. Interactions between group-members are mostly amicable; aggressive behaviour is seen only when a group is defending its home-range from a neighbouring group.

The home-ranges of groups of Banded Mongooses vary from 0.3 km$^2$ to 2.0 km$^2$ in Uganda, to >2 km$^2$ in southern Africa. Within the home-range, a group may have many dens and move from one den to another every few days. When foraging within the home-range, individuals spread out and search for food independently; however, individuals keep in contact with group-members by emitting low grunts every few seconds.

Vocal sounds are an important means of intra-specific communication. Besides the low grunts made while foraging, there are many different alarm calls that alert group-members to potential danger (e.g. predators) and they indicate the magnitude of the danger. When danger is nearby and the group is threatened, group-members huddle together, some individuals resting on the backs of other members to get a better view; some stand up on their hindlimbs and act as guards for the group. There are also contact calls, and aggression calls which are made when a neighbouring group is nearby. Scents in urine and faeces are used to mark boundaries of home-ranges, and to provide information about the presence and status of an individual. Group-members scent-mark each other – this facilitates cohesion within the group and identifies an individual as a member of the group. Anyone watching a group of Banded Mongooses cannot help but be impressed by the constant interactions between individuals.

**Reproduction** No information for Malawi. In southern Africa, reproduction is restricted to the warmer wetter months of the year (Oct–Feb). Gestation: ca. 9 weeks. Litter-size: 3.2 (1-6). Neonates are blind and the skin is dark in colour with a few short hairs; the banding (typical of an adult) is barely visible. Growth of young is rapid. No other information available.

Reproduction in Banded Mongooses can be described as communal and cooperative. Within each group, most of the adult females have pups (which is unusual in mongooses), and reproduction is synchronized so that all of the pups are about the same age. About 85% of the pups are sired by the three oldest males in the group. Before the pups are old enough to leave the den, one mother in a group is left on guard and she suckles all the young while the rest of the pack forages. On their return, all lactating females suckle the young – regardless of who is the mother. During Weeks 3-4, young begin to forage with adult group-members. Mortality of young less than three months of age is ca. 50% (probably mostly due to predation). Females do not conceive until about one year of age.

**Conservation** IUCN Category: Least Concern.

**Taxonomic Notes** *Mungos mungo* (Gmelin, 1788). There is considerable variation in colour and banding throughout the biogeographic range, and many subspecies have been described; none are considered to be valid at the present time.

**Key References** Cant & Gilchrist (2013), Smithers (1983).

**Measurements**
*Mungos mungo*

| | |
|---|---|
| HB (males): | 366 (300–400) mm, n = 85 |
| HB (females): | 361 (330–385) mm, n = 76 |
| T (males): | 220 (193–310) mm, n = 101 |
| T (females): | 219 (194–240) mm, n = 86 |
| HF c.u. (males): | 70 (53–75) mm, n = 101 |
| HF c.u. (females): | 69 (53–74) mm, n = 86 |
| E (males): | 27 (23–26) mm, n = 12 |
| E (females): | 25 (22–26) mm, n = 5 |
| WT (males): | 1450 (890–1880) g, n = 111 |
| WT (females): | 1370 (990–1740) g, n = 48* |
| GLS: | 72.5 (66.1–77.7) mm, n = 24 |

Throughout range (Cant & Gilchrist 2013).
* Non pregnant females only.

## Genus *Paracynictis* – Selous's Mongoose

Subfamily Herpestinae. This genus contains only one species.

# *Paracynictis selousi*

# Selous's Mongoose

**Malawian Name** Nyenga. Not confined to this species.

**Description** Medium-sized, uniformly pale grey, shaggy mongoose with dark 'socks', and white-tipped tail. Pelage long and soft, not coarse as in other species of mongooses; hairs 10-15 mm on head, 20-30 mm on rump, 50-60 mm on tail. Dorsal pelage (from distance and close-up) speckled grey or oatmeal, densely flecked with white and dark brown; hairs varied in colour; some beige with one or two black bands, and either with or without black tip; some oatmeal on basal half and black on terminal half; others pure black. Dense underfur; hairs grey-brown at base, oatmeal on terminal half. Ventral pelage similar to dorsal pelage; hairs shorter. Head relatively small, with narrow pointed muzzle, grizzled grey on crown and cheeks. Nostrils small, black, surrounded by stiff black vibrissae. Upper lip with central vertical slit (cf. *Rhynchogale*, Meller's Mongoose). Eyes large and dark. Ears wide and short, gently rounded; partly hidden by long pale cheek hairs. Limbs relatively moderately long; upper forelimbs and upper hindlimbs (and rump) similar in colour to flanks; lower parts of limb with dark blackish-brown 'socks'. Each foot has four digits each with a long, curved, strong claw (especially those on forefeet); Digit 1 absent. Tail ca. 70-80% of HB, thick and shaggy, tapering towards tip; hairs long, creamy-grey at base, black in middle, and creamy-grey at tip. From a distance, tail looks a grizzled mix of black and creamy-grey, edged with white and with a white tip.

**Similar Species** None (see Table-key 13)

**Distribution** In Malawi, recorded from only a few localities on the Central Plateau and Lake Shore. Localities include Mzimba, Perekezi F. R. and Salima, and there is a plausible but unconfirmed record from Liwonde N. P. Elsewhere: recorded from S Angola, S and NE Zambia, Zimbabwe, N Botswana and extreme NE South Africa.

**Habitat** No details for Malawi. Elsewhere, found in woodland savannas and grassland savannas, and seasonally flooded plains where rainfall is 400-1000 mm/year. Prefers sandy soils.

**Abundance** Rare to uncommon throughout its biogeographic range. Rarely seen.

**Habits** Terrestrial, nocturnal, insectivorous / carnivorous. Because this mongoose is rarely observed, little is known of its habits. During the day, they sleep in burrows. In sandy soils, they excavate their own burrows, but in hard soils they utilize burrows dug by other species. If alarmed, they will seek shelter in any hole. They are not known to climb into trees. When foraging, they walk quickly with their noses close to the ground, and they spend a lot of time digging and scratching in litter and around tufts of grasses. Selous's Mongooses are opportunistic feeders. They feed on a wide variety of insects (grasshoppers, termites, beetles) as well as spiders and scorpions. In a sample of 51 stomachs from Zimbabwe and Botswana, insects were present in 86%. However, in Botswana, when the population numbers of small rodents increased during the wet season, rodents became an important part of the diet. They will also eat lizards, snakes, amphibians and birds. They are primarily solitary, although occasionally pairs and a mother with her young have been seen.

**Reproduction** Very little is known about reproduction in this species. In Botswana and Zimbabwe, young are born during the warm wet summer months (Aug-Mar). Litter-size: 2-4.

**Conservation** IUCN Category: Least Concern. The rarity of the species is cause for concern, and lack of information makes it difficult to accurately assess its conservation status.

**Taxonomic Notes** *Paracynictus selousi* (De Winton, 1896). Two subspecies are recognised, but only one (*P. s. selousi*) occurs in Malawi. This species is not referred to by Sweeney (1959), Hayes (1978) or Hough (1989.

**Key References** Smithers (1983), Stuart & Stuart (2013c).

**Measurements**
*Paracynictis selousi*

| | |
|---|---|
| HB (males): | 397 (445–455) mm, n = 22 |
| HB (females): | 419 (328–443) mm, n = 25 |
| T (males): | 377 (288–435) mm, n = 21 |
| T (females): | 325 (307–367) mm, n = 23 |
| HF c.u. (males): | 116 (106–124) mm, n = 20 |
| HF c.u. (females): | 112 (103–120) mm, n = 25 |
| E (males): | 43 (39–48) mm, n = 20 |
| E (females): | 45 (41–50) mm, n = 20 |
| WT (males): | 1.75 (1.39–2.16) kg, n = 18 |
| WT (females): | 1.75 (1.26–1.87) kg, n = 21 |
| GLS: | 84.0-87.0 mm, n = 4* |

Botswana (Smithers 1971).
*Southern Africa (Roberts 1951 in Stuart & Stuart 2013c).

# Genus *Rhynchogale* – Meller's Mongoose

Subfamily Herpestinae. This genus contains only one species.

## *Rhynchogale melleri*

## Meller's Mongoose

**Malawian Names** Kanyada, Khare, Nyenga. Not confined to this species.

**Description** Medium-sized uniformly brown mongoose, usually with a shaggy, grizzled dark brown tail becoming black towards tip. Males, on average, larger than females. Pelage coarse and dense, lying close to body, without sheen and with dull texture; hairs shorter on neck (10-20 mm), longer on rump (30-40 mm). Dorsal pelage (from distance) looks brown; close-up, looks grizzled with pale brown, medium-brown and black hairs: hairs pale brown at base, dark brown or pale brown on terminal half. Guard hairs black; underfur dense and pale brown. On each side of the neck, there is a crest-like parting of the pelage (difficult to see from a distance but useful for identification). Ventral pelage slightly paler than dorsal pelage. Head similar to dorsal pelage; muzzle looks swollen. Upper lip smooth without a vertical slit (cf. *Paracynictus,* Selous's Mongoose, and *Ichneumia,* White-tailed Mongoose). Ears wide and short. Fore- and hindlimbs long and slender, usually darker than dorsal pelage and flanks (but not black (cf. Selous's Mongoose and White-tailed Mongoose). Each foot with five digits, Digit 1 very small and higher up on limb; Digits 2-5 of front feet with short, curved sharp claws, Digits 2-5 of hindfeet with stouter, less-curved claws. Tail ca. 70-74% of HB, n = 2; very shaggy especially near the body, and hairs growing from the underside of the tail are longer and form a fringe which hangs down. The basal half of the tail looks dark brown but becomes darker and then black on terminal half. Tail hairs are whitish, ochre or pale brown at base with dark brown or black tip; when the tail hairs are erected, the pale colour is visible. Tail colour varies in different parts of the biogeographic range; the tip may be black, brown or white. In Malawi, the tip is usually black but one white-tipped specimen has been recorded.

**Similar Species**

*Atilax paludinosus* (Marsh Mongoose). Pelage very shaggy. Terminal half of tail same colour as basal half. Dependent on nearby water in its habitat.

*Bdeogale crassicauda* (Bushy-tailed Mongoose). Dorsal pelage looks black. Upper lip with central shallow vertical depression which divides the hairs. Feet with only four digits.

**Distribution** In Malawi, recorded in scattered localities in all biogeographic areas except the high plateaux. Localities include Chongoni Mountain (at 1219 m), Mwera Hill near Ntchisi Mountain, Mulanje, Ntcheu, Salima and Zomba. Elsewhere: recorded throughout Zambia, C and S Tanzania, Zimbabwe and Mozambique, and also in a very small area of NE eSwatini and NE South Africa.

**Habitat** Found in woodland savannas including open canopy miombo woodlands (and marginally in grassland savannas and dambos), especially where there is dense cover, water and termitaria. Also found in grasslands among rocks in semi-montane habitat (e,g. Chongoni Mountain).

**Abundance** Rare or uncommon throughout biogeographic range.

**Habits** Terrestrial, nocturnal, insectivorous. The habits of Meller's Mongooses are not well known. They are strictly nocturnal. Young have been found in a small cave and in an Aardvark burrow, suggesting that adults might spend the day such places, but this needs confirmation. Meller's Mongooses forage at night, on the ground. They are thought to feed mainly on termites. In a sample of 23 stomachs from Zimbabwe, 10 (43%) contained only termites, 1 contained mostly termites, and the remainder contained mostly a mixture of termites and grasshoppers. Also found were a centipede, a few beetles, a frog and a snake. Wild fruits have been recorded, but the importance and frequency of fruit is the diet is unknown. Meller's Mongooses are primarily solitary animals but nothing is known about their use of space and their social and reproductive behaviour.

**Reproduction** No information for Malawi. It is thought that Meller's Mongooses breed during the warm wet season in southern Africa. In Zimbabwe,

a pregnant female with three embryos was found in Nov and a female with two young was found in Jan.

**Conservation** IUCN Category: Least Concern. The rareness of the species is a conservation concern.

**Taxonomic Notes** *Rhynchogale melleri* (Gray, 1865). No subspecies recognised.

**Key References** Smithers (1983), Stuart & Stuart (2013e).

**Measurements**
*Rhynchogale melleri*

| | |
|---|---|
| TL (males): | 827 (572-892) mm, n = 15 |
| TL (females): | 824 (825-875) mm, n = 8 |
| T (males): | 360(312-385) mm, n = 15 |
| T (females): | 358 (320-377) mm, n = 8 |
| HF c.u. (males): | 102 (97–106) mm, n = 15 |
| HF c.u. (females): | 98 (95–103) mm, n = 8 |
| E (males): | 38 (31–43) mm, n = 15 |
| E (females): | 37 (35–40) mm, n = 8 |
| WT (males): | 2.31 (1.75–2.67) kg, n = 15 |
| WT (females): | 3.07 (2.41–2.84) kg, n = 8 |
| GLS (males): | 90.5–94.0 mm, n = 6* |
| GLS (females): | 88.0–88.5 mm, n = 3* |

Zimbabwe (Smithers 1983).
*NE South Africa (Rautenbach 1982 in Stuart & Stuart 2013e).

## FAMILY HYAENIDAE - Hyaenas

The Hyaenidae is represented in Malawi by just one species. Hyaenas (including the other two species of hyaenas in Africa – Brown Hyaena, Striped Hyaena) are large powerfully built carnivores (WT: 30-70 kg) with large heads, extremely powerful jaws and masticatory muscles. The forelimbs are longer than the hind-limbs (so the back slopes downwards from shoulders to base of tail), the pelage is spotted or striped, tail is short, the claws are non- retractile, and the head is usually held level with (or below the level of) the shoulders. Hyaenas are hunters and scavengers; their strong jaws enable bones to be cracked and chewed, and their digestive systems can digest old rotting carcasses not eaten by other large carnivores.

### Genus *Crocuta* – Spotted Hyaena

There is only one species in this genus. It is the only hyaena found in Malawi.

### *Crocuta crocuta*

### Spotted Hyaena

**Malawian Names** Chimbwe, Fisi, Lituna, Mfisi.

Mfuwe, S Luangwa, Zambia © Bentley Palmer

**Description** An unmistakable, large, heavily-built, dog-like carnivore. Shoulders higher than rump, neck thickset; head, shoulders and base of tail form a more-or-less straight line sloping downwards from back of head to base of tail. Males, on average, larger than females. Pelage short and coarse. Pelage greyish-brown to paler brown, ochre or beige with numerous irregular small black spots and blotches on neck, body and upper parts of limbs (but not on throat or head). Longer hairs on neck and shoulders form a slight mid-dorsal mane; hairs usually brown or ginger-brown in colour. Head large and broad, same colour as body, without spots. Ears wide, large, rounded with short whitish hairs on inner surfaces. Muzzle, lips and nasal region black. Eyes black. Legs solidly built; paws large each with four digits and non-retractile claws. Tail very short (ca. 18% of HB), same colour as body at base, with black tip. Sexes are difficult to distinguish because the elongated clitoris of the female looks very similar to the erected penis of the male.

**Similar Species** None in Malawi.

**Distribution** In Malawi, currently restricted to National Parks and other conservation areas, and localities where human population numbers are low (see also below). Now mainly encountered in the north (e.g. Kasungu N. P., Nkhotakota W. R., Nyika N. P., Vwaza Marsh G. R.,), and in the Shire Valley (e.g. Lengwe N. P., Liwonde N. P., Majete W. R. and Mwabvi W. R. Also recorded from Lake Malawi N. P., Mulanje and Zomba. Elsewhere: widespread in savanna and semi-arid regions throughout sub-Saharan Africa.

*Historical Distribution*: Old records (pre-1988) indicate that hyaenas were widespread throughout Malawi in the past (see also Abundance).

**Habitat** Very varied ranging from woodland savanna (including open canopy miombo woodlands), mixed thicket woodland savanna, thicket savanna of poorer areas and occasionally montane grasslands. Access to water (rivers, pools) is essential.

**Abundance** In Malawi, the presence of hyaenas is mostly indicated by their calls (see below) or by the presence of white-coloured droppings; there are no quantitative estimates of abundance. Elsewhere: (especially in East Africa), they may be common; estimates range from 0.006/km$^2$ to 17/km$^2$ depending on locality, season and abundance of prey.

**Habits** Spotted Hyaenas are mainly nocturnal, although in cooler weather they may hunt at dawn and dusk. During the heat of the day, they rest in deep shade or in dens such as caves and cavities under boulders. They are opportunistic scavengers and predators. They are well known to feed on prey that has been killed by other large predators (lion, leopard) or animals that have died from natural causes. Less well known is that they are accomplished killers of large herbivores (especially when several individual hyaenas hunt cooperatively). In Kruger N. P. (South Africa), they hunt Wildebeest, Kudu, Impala and Common Warthog; and in Masai Mara (Tanzania) they hunt Topi, Thomson's Gazelle, and Wildebeest (when on migration). When large mammals are unavailable, they will feed on rodents and insects. Prey is detected by sight and smell. When hunting, hyaenas exhibit great stamina; they run with a galloping gait and may pursue a prey for many kilometers at speeds of up to 60 km/h.

Spotted Hyaenas are highly social animals. They live in groups (clans) varying in size from just few individuals to 90 individuals. Clan size varies depending on habitat and resources, being largest where there is abundant prey. Within a clan there is a linear social hierarchy amongst males, and also amongst females. Females are always dominant over males and have first access to prey. The composition of a clan varies over time: males (especially) disperse from the clan to join other clans, and very large clans may split when resources decline. Females tend to remain in their natal clan and hence many individuals are related to each other.

Each clan defends its own communal territory against neighbouring clans. The area of a clan territory depends on the number of individuals in the clan, and the resources available to the clan. Thus territories can expand and contract, just as the number of individuals increases and decreases. In Kenya and Tanzania during the annual migration of wildebeest, gazelles and zebras, a clan may follow the migratory herds and temporarily leave its territory.

Spotted Hyaenas produce a variety of characteristic vocal sounds. The best known is described as a 'whoop' (which rises in pitch and can be heard many kilometers away), which provides information about the status of an individual. Likewise, the ‘laugh’’ and ‘giggle’ indicate mood and status. When two clan members meet, they partake in elaborate greeting rituals which maintain the social hierarchy; they stand side-by-side, facing in opposite directions, with the nearest hindleg raised, and then lick and sniff each other’s anogenital region. An erect penis or clitoris signals submission.

**Reproduction** No information for Malawi. Elsewhere: reproduction occurs in most months of the year. Gestation: ca. 110 days. Litter-size: 1-2 (occasionally 3). Neonates weigh ca. 1.5 k; the eyes are partly open, ears are folded, and deciduous teeth have erupted. Their short pelage is dark and lacks spots; at ca. four months of age, the pelage becomes paler and spots are visible. Lactation lasts for at least nine months (sometimes for a whole year). Cubs are born in a den by themselves or in a communal den which contains cubs of several ages. The milk of hyaenas has a high protein content (ca. 15% - the highest protein content in the milk of any terrestrial carnivore), a high fat content, and high energy density. The cubs of high-ranking females grow faster, have a higher survival rate, and a shorter time to maturity than the cubs of low-ranking females. Females become mature when 2-5 years of age and may produce a litter every 18 months when resources are optimal.

**Conservation** IUCN Category: Least Concern. Population numbers and biogeographic range have declined in recent years. Population numbers are high only in certain conservation areas. In some parts of Africa (mostly agricultural areas), Spotted Hyaenas are regarded as vermin, and may be shot.

**Taxonomic Notes** *Crocuta crocuta* (Erxleben, 1777). Many subspecies have been described, but currently none are recognised. However, there are variations in mitochondrial DNA between populations in western, southern and eastern Africa that may define three subspecies.

**Key Reference** East & Hofer (2013).

**Measurements**
*Crocuta crocuta* (males)

| | |
|---|---|
| TL: | 1587 (1465–1735) mm, n = 9 |
| T: | 249 (227–280) mm, n = 9 |
| HF c.u.: | 230 (220–245) mm, n = 9 |
| E : | 112 (100–125) mm, n = 8 |
| HT (shoulders): | 802 (775–870) mm, n = 10 |
| HT (hindquarters): | 669 (605–720) mm, n = 9 |
| WT: | 62.5 (54.0–70.0) kg, n = 11 |

South Africa (Kruger N. P., Henschel 1986 in East & Hofer 2013).

## FAMILY FELIDAE – Cats

The cat family is represented in Malawi by six species in four genera. They range in size and weight from the Wildcat (shoulder height: ca. 35 cm; WT: 3-6 kg) to the Lion (shoulder height: ca. 120 cm, WT: 100-170 kg). Three species (Wildcat, Caracal and Serval) can be grouped as small, the Leopard and Cheetah are large and, compared with other felids in Malawi, the Lion is extremely large (see yellow box below). All are adapted for catching living prey, either by chasing it or by stealth. They live in grasslands, woodland savannas and thickets. All cats are very strong for their size and weight and some species are capable of catching and killing prey larger than themselves. Typically, felids have elongated bodies, fairly long legs, rounded heads, large paws with fully retractile very sharp pointed claws, and long tails. The pelage is either uniformly coloured (Lion, Caracal), tabby (Wildcat), or beautifully patterned with dark spots or stripes (Leopard, Cheetah, Serval). The skull has relatively small incisors, large canines, well-developed carnassial teeth (for shearing or slicing through flesh and tough sinews), and powerful jaw muscles. Most species are either solitary or live in small family groups; lions, however, are social and collaborate when hunting prey.

The six felids which occur in Malawi can be distinguished from the information in yellow box below. A rosette is a round brown spot surrounded by 4-5 black spots, some of which may coalesce into crescents around the central spot. A 'tear streak' is a dark line from the inner corner of the eye to the back of the upper lip. Tabby markings are a combination of dark vertical lines on the forehead, horizontal lines on the cheeks, dark patches and incomplete rings which can be bold or indistinct on the legs, and some dark rings on the tail. Shoulder heights and weights refer to felids from southern Africa (Stuart & Stuart 2015).

Wildcat (*Felis silvestris*). Small; shoulder height ca. 35 cm, weight 2.4-6.2 kg. Pelage with tabby markings (faint to bold spots, stripes and blotches, mostly on legs and tail); strongly resembles a domestic tabby cat. Back of ears rusty-brown.

Caracal (*Caracal caracal*). Small; shoulder height ca. 40-45 cm; weight 7-19 kg. Pelage plain. Ears long and upright, with a tuft of long black hairs at the tip. Back of ears black.

Serval (*Leptailurus serval*). Small; shoulder height ca. 60 cm; weight 8-13 kg. Pelage marked with many black spots and longitudinal black stripes on neck and shoulders; no rosettes and no conspicuous black 'tear streak'. Ears large, not tufted. Back of each ear with two black bands separated by a white band. Tail relatively short with 6-7 black rings and black tip.

Cheetah (*Acinonyx jubatus*). Large; shoulder height ca. 80 cm; weight 40-60 kg. Pelage marked with many black spots; head with a very conspicuous black 'tear streak' from corner of each eye to the upper lip. Back of ears black with a white tip. Tail relatively long, with basal half spotted and terminal half usually ringed with black bands.

Leopard (*Panthera pardus*). Large; shoulder height 70-80 cm; weight 17-90 kg. Pelage marked with many dark spots and rosettes. No black 'tear streak'. Back of each ear with two black bands separated by a white band. Tail relatively long with irregular black spots and some rosettes.

Lion (*Panthera leo*). Extremely large; shoulder height ca. 120 cm; weight 150-225 kg. Pelage plain. Males with a long shaggy mane. Tail with small black tuft at tip.

### Genus *Acinonyx* - Cheetah

This genus contains only one extant species although 10,000 years ago, cheetah-like felids were widely distributed across Africa, Asia and North America. At least twice in the past, population numbers of cheetahs have crashed and, as a result, there has been inbreeding and a dangerous decline in genetic diversity, and also an increased persistence of undesirable mutations. Cheetahs also have a low rate of reproductive success. Consequently, the ability of cheetahs to adapt to climatic and other changes in the environment is reduced and, once again, they are facing extinction. They occur in Malawi but are very rare and are probably not permanent residents.

## *Acinonyx jubatus*

## Cheetah

**Malawian Names** Kakwiyo, Kambulumbulu, Nkalamgonza.


Liwonde N. P., Malawi (ex RSA) © Bentley Palmer

**Description** A large, elegant felid, built for high-speed pursuit of prey, with numerous small black spots on body and legs, a long spotted tail usually with black bands on terminal half, and a well-defined black 'tear streak' from inner corner of each eye to posterior end of upper lip. Pelage on neck, back, flanks and outer surfaces of limbs orange-brown or beige, with many small black spots (diameter ca. 2-3 cm), always separate but close to neighbouring spots. Chest, ventral pelage and inner surfaces of limbs paler with black spots. Head rounded; small black spots on cheeks and forehead and well defined black 'tear streak'. Ears relatively small; inner ear beige, back of ear black with a white tip. Eyes yellow or yellowish-brown. Limbs relatively long, slender and strong with non-retractile claws (cf. other felids in Malawi). Front paws with five digits; Digits 2-5 large, Digit 1 situated above the plantar surface. Hind paws with only four digits. Tail long and thin (ca. 55% of HB), orange-brown at base tending to white at tip, with black spots on basal half and usually ringed with 3-4 thick black bands on terminal half. Each individual has a unique pattern of markings on the head (useful for field studies).

**Similar Species** For details, see yellow box above.

Leopard (*Panthera pardus)*. Pelage with rosettes. No 'tear streak'. More robustly built. Legs relatively shorter and thicker.

Serval (*Leptailurus serval*). No conspicuous tear streak that can be seen from a distance. Longitudinal black stripes on top of neck and shoulders. Tail ca. 35-40% of HB.

**Distribution** In Malawi, recorded only in the past and only in a few localities (see below). Elsewhere: occurs in isolated scattered populations mainly in eastern Africa and southern Africa, but also in southern Algeria, Niger, Burkina Faso and northern Benin, and northern Egypt.

*Historical Distribution*: Historical records (pre-1988) show that cheetahs were recorded in several localities in Central and Northern regions of Malawi, mostly along the Zambian border, and near the Lake. These localities include 'Angoniland', Bua River, Kasungu N. P., Nyika N. P., Songwe River, and Vwaza Marsh G. R. However, most of these old records are not substantiated, and some may be incorrect because servals and leopards were sometimes mistakenly identified as cheetahs. All records refer to sightings of only one or two individuals at a time. The evidence suggests that cheetahs are 'scarce' and are not permanent residents in Malawi, and that all individuals have been temporary nomadic visitors.

*Present Distribution*: Recorded in Kasungu N. P., Nyika N. P. and Vwaza Marsh G. R. until the late 1980s; subsequently considered extinct in Malawi. Then, in May 2017, seven cheetahs from South Africa were re-introduced into Liwonde N. P. (where they may have occurred historically), and in July 2018 four cheetahs (also from South Africa) were introduced into Majete W. R. (where they were not recorded historically). There are no recent records of cheetahs occurring naturally in the wild in Malawi.

**Habitat** Open grasslands and woodland savanna, especially open canopy miombo and Acacia woodlands. Habitat needs to be fairly open so that cheetahs can hunt and chase their prey (see below). Not found in forest or thicket savanna.

**Abundance** Very rare and only occasionally recorded in Malawi in the past (see also above).

**Habits** Terrestrial, diurnal, carnivorous. No information for Malawi. The information below comes from studies in East Africa, Zambia and South Africa. Cheetahs hunt mainly during the day. They rest and sleep in shady places under trees or in dense vegetation. They do not normally climb trees.

Cheetahs are opportunistic carnivores feeding mostly on small to medium-sized ungulates. Their prey varies depending on locality and availability; the preferred prey are Impala, reedbuck and Lesser Kudu in South Africa, Puku in Zambia, and Thomson's

Gazelles in Tanzania. They prefer young individuals (which are easier to catch than adults).

Cheetahs are well adapted for extremely fast running over short distances; they are the fastest land mammal and can accelerate from 0 to 112 km/ph in three seconds. The adaptations include a flexible spine and elongated limb bones which enable very long strides, long muscular tail, and many physiological adaptations for sprinting. They are able to sustain speeds of 85-100 kph for up to ca. 500 m.

Cheetahs hunt alone or in small groups (typically 2-3 individuals). They hunt by sight and smell. When hunting, cheetahs prefer to hide in vegetation (e.g. tall grasses) from where they can see their potential prey. They select a prey individual which is alone or in a small group and well away from others. The selected prey is approached by stealth, either by sitting quietly or crouching in the grass and gradually moving slowly forwards, or by walking slowly towards the prey when the prey is unaware of the predator(s). When close to the prey, the cheetah leaps forward with great speed. To be successful, the prey must be knocked over (by tripping it or by knocking it over) and then killed by a bite to the neck or head or by suffocation. If the prey is not caught and killed within ca. 500 m, the chase is abandoned. Cheetahs feed very quickly, eating the favoured parts first, before lions, hyenas, wild dogs and vultures arrive to steal the prey.

Female cheetahs live singly, except when they have cubs. Males, in contrast, live singly or in small groups (2-3). When a female is in oestrus, males stay close to her (and to her cubs) forming larger groups. Cheetahs have large home-ranges, partly because of their habit of following migratory ungulates. In the open plains of Serengeti N. P. (Tanzania), females may have a home-range of up to 800km$^2$. In contrast, males are either 'resident' or 'non-resident'. Resident males live in a small home-range of ca. 37 km$^2$ which they mark with urine; and 'non-resident' males are nomadic, have a large home-range (up to 700 km$^2$), do not mark with urine, and are often in poor condition. In woodland savanna habitats, which do not support migratory ungulates, home-ranges of cheetahs are smaller than on the plains. Cheetahs rarely make any vocal sounds. They do not roar.

**Reproduction** No information for Malawi. Elsewhere: females give birth to young in sheltered lairs (e.g. in long grass, under bushes, or among rocks). Gestation: ca. 93 days. Litter-size: 1-6 (usually 3, rarely 8). Neonates are altricial, the eyes are closed and the pelage is greyish without spots. Eyes open Day 10-12. Milk teeth erupt ca. Day 52. Weaned ca. 4 months. Adult teeth present ca. 8-9 months. Young may be carried from place to place while very young, and will accompany their mother on hunts when ca. 3-4 months. Young reach maturity at ca. 21-24 months, and females can produce a first litter at ca. 2.4 years. There is high mortality of young as a result of predation when they first emerge from the lair (up to 50%). Survival of young is higher when lions are not present.

**Conservation** IUCN Category: Vulnerable. Population numbers of cheetahs have declined throughout their biogeographic range in recent years because of habitat clearance, reduction in prey numbers, hunting, and genetic and physiological problems. They are regarded as pests in some areas because they are thought to kill domestic sheep and goats. Conservation remedies include large protected areas, adequate numbers of prey, and re-introductions from captive populations to parts of their former biogeographic range.

**Taxonomic Notes** *Acinonyx jubatus* (Schreber, 1775). Many subspecies have been described, but none are recognised at the present time. However, there is biogeographic variation in pelage colour within the African continent that may justify the recognition of four subspecies. If valid, the individuals reintroduced into Malawi (*A. j. jubatus*) are the same subspecies as those in South Africa. The so-called 'king cheetah' (which has stripes as well as spots) is a genetic abnormality, not a separate species.

**Key References** Caro (2013), Smithers (1983).

**Measurements**
*Acinonyx jubatus*

| | |
|---|---|
| HB (males): | 1225 (1130–1360) mm, n = 24 |
| HB (females): | 1245 (1130–1400) mm, n = 16 |
| T (males): | 680 (630–740) mm, n = 24 |
| T (females): | 660 (600–730) mm, n = 19 |
| WT (males): | 41.4 (28.5–51.0) kg, n = 23 |
| WT (females): | 35.9 (21.0–43.0) kg n = 19 |
| Sh. ht. (males): | 88.1(83-94) cm, n = 7* |
| Sh. ht. (females): | 84.7 (79-94) cm, n = 6* |

Tanzania (Serengeti N. P., Caro 1994 in Caro 2013).
*Namibia (Smithers 1983).

# Genus *Caracal* - Caracal

This genus contains only one species. The Caracal was traditionally placed in the genus *Felis,* but molecular evidence indicates that it is more closely related to the Serval and to the African Golden Cat (*Profelis*) which does not occur in Malawi.

## *Caracal caracal*

## Caracal

**Malawian Name** Nkaranungoza.

Limpopo Province, South Africa © C. & M. Stuart

**Description** A small felid, with plain pelage and, uniquely, with long upright ears each with a tuft of long black hairs at the tip. Males, on average, larger and heavier than females. Pelage short and dense. Dorsal pelage, flanks and outer surfaces of limbs beige to greyish-orange. Ventral pelage and inner surfaces of limbs paler than dorsal pelage with faint spots. Head similar to dorsal pelage, sometimes with single longitudinal dark stripe on forehead. Eyes orange or greenish with a narrow band of white below each eye, and a faint dark streak from inner corner of each eye to nostril. Small black spots on upper lips, and long white vibrissae. Chin and throat white. Ears long thin and pointed, held upright or at a slight angle to top of head; inner surface with many long white hairs; back of ears black (with a few white hairs) and with tuft of long (45 mm) coarse black bristles at tip (which makes ears appear longer than they actually are). Limbs long and well-built with large paws and retractile claws; hindlimbs longer than forelimbs so top of pelvis is higher than shoulders. Front paws with five digits and sharp, curved claws (Digit 1, situated above the plantar surface, has a particularly strong, stout claw). Hind paws with four digits. Tail relatively short (ca. 30% of HB), same colour as dorsal pelage without any rings or spots, and of similar thickness from base to tip.

**Similar Species** None. No other small felid in Malawi has plain pelage and elongated ears each with a long black tuft. For details, see yellow box above.

**Distribution** In Malawi, mostly recorded from a few localities on the Central Plateau and some of the high Plateaux of the Northern Region but has been recorded from at least one locality in the Shire Valley and may occur more widely (see Abundance). Localities include Kasungu N. P., Lengwe N. P., Nyika N. P.; Viphya Plateau and Vwaza Marsh G. R. Elsewhere: occurs throughout most woodland savannas south of the Sahara Desert, but absent from the rainforest and most of the central Sahara. Also present in suitable habitats in North Africa from Morocco to Tunisia, and Egypt.

**Habitat** Occurs in a wide variety of savanna habitats – open grasslands, woodland savannas and thickets, particularly in drier regions as long as there is some cover. May occur in montane habitats. No details for Malawi but the locality records suggest that it is probably found in open canopy miombo woodlands, mixed thicket woodland-savanna, seasonally wet grasslands and thicket savanna of poorer areas.

**Abundance** No details for Malawi; rarely seen and assumed to be rare or very uncommon. Usually rare or uncommon in most parts of the biogeographic range, although common in some habitats in South Africa.

**Habits** Terrestrial and arboreal, nocturnal, carnivorous. Caracals are principally nocturnal, although in protected areas they may sometimes hunt in the early morning and late afternoon. Caracals feed mainly on small mammals, but birds, reptiles and invertebrates are sometimes consumed. They are capable of hunting many sorts of prey, some of which are much larger than themselves, e.g. they can take small antelope up to 50 kg in weight. Caracals are opportun-

istic hunters, and their diets vary in different localities. For example, in a sample of 116 scats from the Kgalagadi Transfrontier Park (South Africa), there were six species of small rodents in 81% of the scats, Springhares in 31%, beetles in 23% and hares, various small carnivores, small ungulates, bustards and other birds in 0.3 - 6% of the scats. No information for Malawi. Caracals usually hunt alone, locate prey by hearing and sight, and then either stalk it and pounce, or stalk and then chase it at high speed for a short distance. They kill larger prey by biting the throat, the nape or both. They are also adept at swiping birds out of the air.

Caracals are usually solitary animals, except when males and females live together for a few days during the mating season, and when a female has young. In South Africa, each individual has a home-range that varies depending on the individual and the habitat; e.g. in the Karoo, home-ranges are 11.8 – 26.7 $km^2$, and in the Mountain Zebra N. P., they are 3.9 - 6.5$km^2$. Home-ranges of females overlap, but most females spend most time in the smaller core area of the home-range. Male home-ranges are normally larger than those of females. In general, home-ranges are larger in drier habitats than in wetter habitats.

Caracals make many kinds of vocal sounds (e.g. growling, purring, spitting, coughing and barking). They also carry out scent marking by spraying urine and defaecating on pathways and roads. Unlike some small carnivores, they do not defaecate in latrines.

**Reproduction** No information for Malawi. The timing of reproduction varies in different localities. In southern Africa, most litters are born between Oct and Feb, although litters have been recorded in all months. Females probably have only one litter each year. Gestation: 78-81 days. Mean litter-size: 2.2 (1-4). At birth, eyes are closed, ears are flattened against the head, and there is a sparse covering of fur. Eyes open by Day 10, and ears become erect (as in adults) by ca. Day 21. Full milk dentition present at ca. Day 50; solid food taken from ca. Day 25 – 56, and weaning (in captivity) at ca. Day 100 – 170. Reproduction begins at about 15 months of age.

**Conservation** IUCN Category: Least Concern. Conservation concerns include loss of suitable habitat, hunting for bushmeat and trophies, and persecution during predator control.

**Taxonomic Notes** *Caracal caracal* (Schreber, 1776). Traditionally included in the genus *Felis*, and referred to as *Felis caracal* by many authors including Sweeney (1959), Hayes (1978) and Ansell & Dowsett (1988). Seven subspecies have been described based mainly on variations in pelage colour (paler in drier habitats, darker in moister habitats) but none are currently recognised.

**Key References** Smithers (1983), Stuart & Stuart (2013f).

**Measurements**
*Caracal caracal*

| | |
|---|---|
| HB (males): | 868 (750–1080) mm, n = 97 |
| HB (females): | 819 (710–1029) mm, n = 94 |
| T (males): | 264 (210–340) mm, n = 99 |
| T (females): | 252 (180–315) mm, n = 101 |
| HF c.u. (males): | 193 (170–215) mm, n = 101 |
| HF c.u. (females): | 180 (160–208) mm, n = 101 |
| E (males): | 80 (65–92) mm, n = 98 |
| E (females): | 76 (60–94) mm, n = 100 |
| Sh. ht.: | 40-45 cm* |
| WT (males): | 12.9 (7.2–19.0) kg, n = 77 |
| WT (females): | 10 (7.0–15.9) kg, n = 63 |

South Africa (Stuart & Stuart 2013f).
*Southern Africa (Stuart & Stuart 2015).

## Genus *Felis* – Small Cats

At one time, most living felids were placed in the genus *Felis* but, currently, on the basis of genetic evidence, only species closely related to domestic cats have been retained in this genus. The genus contains four species and all occur in Africa although only one species (*Felis nigripes,* Black-footed Cat) is endemic to Africa. The other species also occur elsewhere in the Old World. Only one species occurs in Malawi.

### *Felis silvestris*

### Wildcat

**Malawian Names** Bonga, Bvumbwe, Chiulu, Vumbwi.

South Africa © C. & M. Stuart

**Description** The smallest representative of the cat family in Malawi. Similar in appearance to a large domestic tabby cat. Males on average, larger and heavier than females. Pelage texture soft, fine and smooth; hairs ca. 20 mm. Dorsal pelage dark to pale brownish-grey, darker mid-dorsally from near shoulders to base of tail; hairs dark at base, with wide creamy-cinnamon mid-section, and banded white-black tip. Lower flanks and ventral surface much paler, tinged with pale ginger or cinnamon. Some individuals may have faint darker blotches on pelage. Head similar in colour to mid-dorsal pelage with tabby markings - a few vertical dark stripes on forehead and two horizontal dark stripes on each cheek. Chin and throat paler and tinged with cinnamon. Long white vibrissae. Ears roughly triangular in shape; back of ears rich rusty-brown; long white hairs on inner surface. Limbs similar in colour to flanks, with indistinct dark patches and incomplete black rings which can be bold or indistinct; black streak on back of lower part of hindlimbs. Plantar surfaces of feet with thick dense black fur, almost obscuring the foot pads. Front paws with five digits (Digit 1 situated above plantar surface); hind paws with four digits. Claws retractile and very sharp. Tail ca. 50-60% of HB, same colour as dorsal pelage, with 2-3 bold or indistinct black rings near the tip, and a black tip. There is great individual variation in the colour and patterning of the pelage.

**Similar Species** No other indigenous felid has tabby markings.

Feral domestic cats (*Felis catus*) with tabby markings have relatively shorter legs and the backs of their ears are not rich rusty-brown. The two species interbreed and hybrids are not easily recognized.

**Distribution** In Malawi, recorded in several localities scattered throughout the country (see also Abundance). Localities include Lengwe N. P., Liwonde N. P., Ntchisi Mountain F. R., Nyika N. P. and Vwaza Marsh G. R. Elsewhere: widespread except in the rainforests of West and Central Africa and (probably) the most arid regions of the Sahara Desert.

**Habitat** Woodlands of various types, especially in hilly country and where there are suitable places to hide in during the day (e.g. caves, burrows excavated by other species, dense vegetation, holes in termite mounds). Known to occur from sea level up to ca. 3800 m (Mt Kenya and Ethiopia).

**Abundance** No information for Malawi. Elsewhere: said to be common in some places but rare in others. Its nocturnal activity and secretive nature make it very difficult to assess abundance of this species. Although there are a limited number of sight records

and specimens in museums, the species is probably more common than the records suggest.

**Habits** Terrestrial, nocturnal, carnivorous. Wildcats are mainly terrestrial although they are good climbers and sometimes climb trees when hunting and to avoid danger. They are almost always nocturnal and do not become active until well after sunset. During the day, they probably shelter in places similar to where they give birth – in abandoned burrows, cavities under rocks, under dense undergrowth and tall grass.

Wildcats usually hunt at night, although they may hunt in the early morning when the night is cold. They usually hunt by themselves, but sometimes pairs and family groups hunt together. Typically, they move slowly over the ground while listening and searching for prey, and then they stalk it, crouch, and finally rush forward and pounce. Wildcats are opportunistic hunters. In samples of 58 stomachs from Zimbabwe and 80 from Botswana, seven or eight species of murid rodents were found in 70-75% of the stomachs. Birds were found in 10-20%; other mammals, reptiles, amphibians, arthropods and fruits were found much less frequently. The diet of Wildcats depends largely on the abundance each sort of prey.

Wildcats are mainly solitary animals, except during the mating season and when a mother is accompanied by her young. In the Kalahari, the home-range for four males was ca. 9.8 km$^2$, and for three females was ca. 6.1 km$^2$. Home-ranges of males overlapped with those of several females, whereas intra-sexual overlap is very limited (especially for males). Home-ranges are smaller in more mesic habitats than in the Kalahari. Communication is probably similar to that of the other small felids. Urine and scats are used to indicate home-ranges and reproductive condition. Urine spraying seems to be of particular importance to female Wildcats; one study recorded up to 183 sprays/night.

**Reproduction** No information for Malawi. In southern Africa, most births occur in Sep-Mar. Gestation: 56-65 days. Litter-size: 3 (1-5). Eyes open at ca. Day 10-14. Young begin to hunt with their mother when 4-12 weeks of age. Survival to five months of age is 50-66% (n = 4 litters). Maturity is attained at ca. 11 months.

**Conservation** IUCN Category: Least Concern. Conservation concerns are that Wildcats interbreed with domestic and feral cats and hence the genetic purity of the species may be compromised. In southern Africa, Wildcats are shot during predator control programmes.

**Taxonomic Notes** *Felis silvestris* Schreber, 1777. Sweeney (1959), Hayes (1978) and Ansell & Dowsett (1988) refer to wildcats in Malawi as *Felis lybica.* The relationship between *Felis lybica* (Near Eastern Wildcat), *F. silvestris* (European Wild Cat), *F. cafra* (Southern African Wildcat) and two Asian wildcats is uncertain. Currently, all are considered to be subspecies of *F. silvestris,* so the wildcat in Africa is *Felis silvestris lybica*, but the status of *cafra* needs further investigation.

**Key References** Smithers (1983), Stuart *et al.* (2013).

**Measurements**
*Felis silvestris*

| | |
|---|---|
| HB (males): | 601 (545–665) mm, n = 21 |
| HB (females): | 550 (460–620) mm, n = 15 |
| T (males): | 305 (275–360) mm, n = 21 |
| T (females): | 295 (250–355) mm, n = 16 |
| HF c.u. (males): | 138 (120–150) mm, n = 21 |
| HF c.u. (females): | 133 (120–150) mm, n = 14 |
| E (males): | 62 (55–70) mm, n = 20 |
| E (females): | 64 (55–72) mm, n = 15 |
| Sh. ht.: | ca. 35 cm* |
| WT (males): | 4.9 (4.0–6.2) kg, n = 10 |
| WT (females): | 3.7 (2.4–5.0) kg, n = 10 |

South Africa (Stuart 1981 in Stuart *et al.* 2013).
*Southern Africa (Stuart & Stuart 2015).

# Genus *Leptailurus* - Serval

This genus contains only one species. *Leptailurus* was formerly considered to be a subgenus of *Felis*.

## *Leptailurus serval*

## Serval

**Malawian Names** Chiwalawala, Ndusi, Nduzi, Njusi, Njuzi.

Mkomazi N. P., Tanzania © C. & M. Stuart

**Description** A small, elegant spotted felid with longitudinal black lines on neck and shoulders, relatively large ears, long legs and relatively short, ringed tail. Males, on average, larger and heavier than females. Pelage short and sleek. Dorsal pelage and flanks ochre to beige, with many black spots and a few longitudinal black stripes on the neck and shoulders. Ventral pelage paler with small black spots. Outer surfaces of limbs pale ochre with black spots (spots larger on upper limb, smaller on lower limb); inner surfaces paler with small black markings on the lower limb, and a ring of black around the upper part of each forelimb. Head similar in colour to dorsal pelage with a faint black vertical line above each eye, and a faint narrow 'tear streak' from the inner corner of each eye to the back of the upper lip. No conspicuous black 'tear streak' (cf. Cheetah). Nose black. Cheeks with very small black spots. Eyes large, copper-brown. Ears (the most noticeable characteristic of servals) very large; inner ear white with very long white hairs; back of ear ochre on basal third, upper two-thirds black with white transverse band dividing the black into two bands. The front feet have five digits (Digit 1 situated above the plantar surface); the hind feet have four digits. The claws are retractile. Tail relatively short (ca. 35-40% of HB), ochre with 6-7 black rings and black tip.

**Similar Species** For details, see yellow box.

Cheetah (*Acinonyx jubatus*). Conspicuous black 'tear streak' easily seen from distance. No longitudinal black stripes on top of neck and shoulders. Tail ca. 55% of HB.

Leopard (*Panthera pardus*). Spots on back and flanks arranged in rosettes. No longitudinal black stripes on top of neck and shoulders. Other markings similar. More robustly built. Legs thicker and relatively shorter. Ears relatively small.

**Distribution** Widespread throughout Malawi. Recent records include Lengwe N. P., Liwonde N. P., Mwabvi W. R. and Nyika N. P. Elsewhere: recorded in most areas of Africa south of ca. 14-15˚N, but not in rainforest habitats of West and Central Africa, and not in the arid areas of the Horn of Africa, Angola, Botswana and South Africa. There is one relict population in Morocco.

**Habitat** Grasslands and woodland savannas (especially where grass is long), wetlands and flood plains close to water. May occur in montane grasslands at higher altitudes and also in farmlands provided there is sufficient cover to hide in during the day.

**Abundance** In Malawi, rarely seen, so abundance is difficult to assess. Elsewhere: very varied in different localities. In protected habitats of the continent, where prey is abundant, may be quite common.

**Habits** Terrestrial, crepuscular/nocturnal, carnivorous. Servals can climb trees but are mainly terrestrial. They are mostly active at dawn, dusk and during the night, but are sometimes active during the day (particularly in protected areas). During the day, they rest in long grass and dense cover that provides safety from danger, and their spotted pelage camouflages them well.

Servals prey mainly on small mammals and birds. They have exceptionally good senses. Prey is located in long grass mainly by listening for movements of the prey with their large ears orientated

towards the source of the sounds. Having located prey, they stalk it and then pounce. They are extremely agile and can leap 2 m in height and 3.6 m forward onto the prey and then pin it to the ground with the front paws. They are also known to sprint after birds and then leap high into the air to catch them, and they also use their long, slender forelimbs to hook prey out of burrows and hollows in trees, and to scoop fish out of water. They will also excavate small burrows, such as those of mole-rats. They rarely hunt in trees but will pursue prey that attempts to escape by climbing, but seldom climb more than 2 m high.

Servals feed mainly on small mammals and birds, but they are opportunistic predators and also eat fish, frogs, reptiles, insects, crabs and eggs. The diet varies greatly depending on locality and time of year. In a sample of 65 stomachs from Zimbabwe, rodents occurred in 97%, the commonest species being Angoni Vlei Rats and Multimammate Mice, with lesser numbers of five other species of murid rodents. In KwaZulu-Natal, Angoni Vlei rats and Four-striped Grass Mice were the commonest prey (in both frequency of occurrence and number of individuals), and there were also six other species. Hunting success (in Ngorongoro N. P., Tanzania) was 50%, rising to 62% for mothers with young. Servals killed 15-16 times every 24 hours which indicates that servals are very major predators on small mammal populations.

Servals are usually solitary, except when males and females come together for a few days during the mating season, and when a female has young. Their home-ranges are large. In KwaZulu-Natal, a male and four females had overlapping ranges in a study area of ca. 30 $km^2$, but they were rarely present in the study area at the same time. Servals rarely show aggression to others in the home-range; instead, they just avoid each other. Young servals move away from their mother's home-range, eventually to establish their own home-ranges. The number of servals in an area is partly determined by the abundance of prey. They use scent marking (urine and faeces), and secretions from facial glands to mark their home-ranges. Servals exhibit many behavioral postures (arched back, raised tail, barred teeth and flattened ears) to indicate aggression and mood. Vocal sounds are soft and quiet – purrs, 'meows' (similar to a domestic cat), growls and hisses.

**Reproduction** No information for Malawi. The timing of reproduction depends on the locality but occurs mostly in the warm wet season when rodent populations are at their highest. In southern Africa, pregnant females are recorded from Nov to Mar. Gestation: 65-75 days. Litter-size: 1-5 (normally 2-3). Neonates are altricial; eyes are closed, and the soft short grey pelage has no distinct markings. Eyes open on Day 7-10 and solid food is first eaten at about Day 14-21. From about three months of age, young accompany their mother when she is foraging. At 6-8 months of age, the young become independent although they stay within the mother's home-range until about one year of age.

**Conservation** IUCN Category: Least Concern. Conservation concerns are habitat destruction and hunting for skins and traditional medicine.

**Taxonomic Notes** *Leptailurus serval* (Schreber, 1776). Formally placed in the genus *Felis.* Referred to as *Felis serval* by Sweeney (1959), Hayes (1978) and Hough (1989). There is considerable variation in colour, and in the size and patterning of spots, within and between populations. This has resulted in the description of many subspecies (from six to 17 according to different specialists). However, no subspecies are recognised at the present time.

**Key References** Hunter & Bowland (2013), Smithers (1983).

**Measurements**
*Leptailurus serval*

| | |
|---|---|
| TL (males): | 1111 (960–1205) mm, n = 23 |
| TL (females): | 1097 (970–1230) mm, n = 23 |
| T (males): | 314 (280–380) mm, n = 23 |
| T (females): | 290 (254–330) mm, n = 23 |
| HF c.u. (males): | 193 (180–205) mm, n = 23 |
| HF c.u. (females): | 182 (165–194) mm, n = 23 |
| E (males): | 91 (83–97) mm, n = 23 |
| E (females): | 86 (80–97) mm, n = 23 |
| Sh. ht.: | ca. 60 cm* |
| WT (males): | 11.1 (8.6–13.5) kg, n = 20 |
| WT (females): | 9.7 (8.6–11.8) kg, n = 23 |

Zimbabwe (Smithers & Wilson 1979).
*Southern Africa (Stuart & Stuart 2015).

# Genus *Panthera* – Roaring Cats

This genus contains five species – the Lion and Leopard in Africa, and the Tiger, Jaguar and Snow Leopard which do not occur in Africa. In all of these large felids, the hyoid apparatus which supports the tongue, upper vocal tract and larynx, is not completely ossified (made of bone): one component is elastic and this enables these felids to roar although they cannot purr. In contrast, felids with completely ossified hyoids can purr but they cannot roar. Both the Lion and the Leopard occur in Malawi.

## *Panthera leo*

## Lion

**Malawian Names** Lisimba, Mkango, Nkhalamu.

Male. Majete N. P., Malawi © Bentley Palmer

**Description** An extremely large powerfully-built felid with plain pelage. Males mostly larger and heavier than females. Dorsal pelage uniformly tawny-brown or beige, ventral pelage paler. Adult males have mane of longer hair on neck, throat, cheeks and chest, usually darker in colour than dorsal pelage (sometimes black). When viewed from the front, the mane forms a ruff around the head. Head large; ears small (often hidden by mane in males); back of ears black. Eyes yellow, directed forward; wide nostrils; very large canine teeth. Limbs powerful; paws large with extremely sharp, highly curved retractile claws. Front paws with five digits, Digits 2-5 large, Digit 1 situated above the plantar surface. Hind paws with only four digits. Tail long (45-50% of HB); tawny brown or beige, with small black tuft at tip. Young individuals have pale spots (especially on ventral pelage); these disappear prior to maturity although may still be visible in some females.

**Similar Species** None. The only other large felids – Leopard, Cheetah – have many spots on pelage.

**Distribution** Widespread in Malawi, but now mainly found in some protected areas (see below). Elsewhere in Africa: widespread in sub-Saharan Africa in savanna and semi-arid habitats; not present in forest environments.
*Historical distribution*: old records (late 1800s) indicate that lions were 'widespread' and 'plentiful' in Malawi, especially in regions where there was plenty of potential prey. Hearing lions roaring at night was not uncommon. Travellers noted that they were especially numerous around Elephant Marsh in the Lower Shire in the late 1800s and early 1900s. Lions entered villages and towns where they preyed on domestic cattle, sheep and goats. They also preyed, from time to time, on humans. Because of the dangers that lions posed to humans and domestic animals, baits were placed to attract lions so that they could be shot.
*Present Distribution*: Lions are now normally found only in protected areas where there is adequate prey, but they are great wanderers and occasionally leave the protected areas. Recent records (ca. 1990 - present) are from Kasungu N. P., Liwonde N. P., Mwabve W. R., Nyika N. P. and Vwaza Marsh G. R. They used to occur in Lengwe N. P. but are not found there now. Ten lions were translocated from South Africa into Liwonde N. P. in 2018 (to supplement the very small population), and into Majete W. R. in 2012.

**Habitat** Lions can live in many habitats, but not rainforest and other densely forested areas. Grassland savannas, woodland savannas, and thicket savannas are optimal habitats. Lions occur (or occurred) at many altitudes in Malawi, from 100 m (e.g. Nsanje) to 1800 m (Zomba Plateau) and 2300 m (Nyika Plateau).

**Abundance** Lions are never abundant because their population numbers are determined by the numbers

of large prey. In Malawi, there are no detailed assessments of abundance in the past, other than general comments. A survey in Kasungu N. P. in 1983, recorded 20-40 lions but, since then, population numbers have declined to ca. 6-10 individuals (early 2000s). This decline in numbers is typical for all areas of Malawi. Population numbers rise and fall as nomadic individuals enter and leave Malawi.

**Habits** Terrestrial, diurnal and nocturnal, carnivorous. Lions are primarily nocturnal and spend most of the day asleep in cool places, usually in shade under trees where they are well camouflaged, but sometimes they rest on termite mounds or other high places from which they can watch for prey, intruding lions or other danger. They can climb and sometimes rest in trees, especially when young. They must avoid overheating which is why they hunt mainly at night, or around sunrise and sunset, and have only short bursts of activity. Lions need to have access to water unless they can obtain adequate fluid from their prey.

Lions prey mainly on a wide range of medium-sized to large herbivorous mammals, but also eat rodents, hares, birds and reptiles (including crocodiles), and they also scavenge opportunistically on the fresh kills of hyaenas and other predators, and will also eat putrid carrion. Lions often hunt cooperatively. They are opportunistic hunters and prefer to hunt where it is easiest to capture their prey – either by ambush or stealth. They are expert stalkers, taking advantage of any available cover and instantly freezing if the prey becomes anxious and stops feeding. Lions can run fast (up to ca. 60 kph) but will not chase prey for more than ca. 200 m. The species of prey varies depending on locality and season of the year. For example, in Serengeti N. P., on a yearly basis, seven ungulate species (African Buffalo, Common Wildebeest. Zebra, Common Warthog, Thomson's Gazelle, Hartebeest and Topi) account for 90% of prey; however, Wildebeest are the commonest prey during the migration season, and Thomson's Gazelle and Common Warthog are the commonest prey during the dry season. Switching to different species of prey in different localities and seasons has been recorded in all studies of lions. Cooperative hunting has the advantage that it increases the chances of catching and killing a prey, but it means that the prey has to be shared.

Lions are social animal. They live in groups (prides) except for some solitary males which are nomadic. Prides may be small, e.g. 1-2 adult females with their dependent young, or large (up to 30) consisting of several adult females, their young (of various ages) and 1-4 adult males. Sometimes prides merge to form even larger prides. The numbers in a pride partly depend on the area of the home-range of the pride, and the availability of prey.

The home-ranges of prides in Serengeti N. P. (where prey is abundant) vary in size from 20-500 $km^2$, but in less favourable environments, home-ranges may be a large as 2000 $km^2$. Home-ranges of prides may overlap, although each pride maintains a central 'core area' which is defended against other prides. Both males and females defend the core area, although some males may belong to more than one pride. These complex social organizations ensure that each pride has adequate resources, and that conflict between prides is minimal. Core areas are marked by roaring, urine-marking and the presence of faeces.

The basic unit of social organisation is the pride. The adult females, one of whom is dominant, are all related to each other. They and their cubs (from different litters and of different ages) may be joined by one or more adult males which compete for the females during oestrus. Subadult females tend to stay with their maternal pride, but young males leave to join all-male prides, and (if possible) to form their own pride or join an established pride. Within a pride, one of the adult males is dominant over any other male and is also dominant over all of the females. The dominant male feeds before the females although it is usually the females which do the killing. When a male establishes himself in a pride (having ousted the former dominant male), he will attempt to kill all the cubs, so that – in time – all the cubs will be his progeny.

**Reproduction** No information for Malawi. Elsewhere: reproduction appears to be non-seasonal (with peaks of reproduction at some localities), and females within a pride tend to produce litters at much the same time. Females may suckle cubs born to other females. Gestation: ca. 110 days. Litter-size: 2.6 (1-4). The mother leaves the pride to give birth and rejoins the pride when the cubs are about six weeks old. Neonates are altricial. Cubs are weaned at ca. six months of age and reach maturity when about two years of age. Females usually breed every two years. Cubs are very playful, and they learn their hunting skills from their mothers.

**Conservation** IUCN Category: Vulnerable. Population numbers have declined greatly throughout Africa during the last century because of loss of habitat, reduction in the population numbers of species of prey, and hunting by humans. Adequate numbers of lions (and other major predators) are essential for ensuring that the 'predator-prey rela-

tionship' is kept in balance so that the health of the ecosystem is maintained.

**Taxonomic Notes** *Panthera leo* (Linnaeus, 1758). Many subspecies have been named but none are currently recognised. However, populations of lions from western and central Africa (which have very little genetic diversity) are distinguishable from those in eastern and southern Africa (which have large genetic diversity).

**Measurements**
*Panthera leo*

| | |
|---|---|
| HB (males): | 1938 (1840–2080) mm, n = 12 |
| HB (females): | 1711 (1600–1840) mm, n = 38 |
| T (males): | 882 (825–935) mm, n = 10 |
| T (females): | 805 (720–895) mm, n = 37 |
| HF c.u. (males): | 804 (762–837) mm, n = 7 |
| HF c.u. (females): | 689 (633–775) mm, n = 36 |
| Sh. ht: | ca. 120 cm* |
| WT (males): | 155.5, 169.0 kg, n = 2 |
| WT (females): | 111.0 (90.5–138.0) kg, n = 4 |

Tanzania (Serengeti N. P., West & Packer 2013).
*Southern Africa (Stuart & Stuart 2015).

# *Panthera pardus*

## Leopard

**Chichewa Name** Chisuwi, Kambuku, Kimbwe, Nyalubwe, Nyalugwe.

Luangwa N. P., Zambia © Bentley Palmer

**Description** A large, robustly-built felid, with beautiful beige or golden pelage marked with dark spots arranged in rosettes. Males, on average, larger and heavier than females. Dorsal pelage beige or golden brown thickly covered with brown spots each surrounded by a circle of 4-5 black spots forming a rosette; some of the black spots coalesce to form black crescents around the central brown spot. Rosettes less well defined on flanks and hindquarters, and are replaced by plain black spots on neck, legs, and chest. Ventral pelage and inner sides of limbs paler, often white, with black spots. Head broad; forehead and cheeks similar in colour to body with many small black spots; muzzle short, golden brown without markings; upper lip white with long white vibrissae. Ears short, pointed, rounded at tip; back of ear ochre on basal third, upper two-thirds black with white transverse band dividing the black into two bands (same as Serval). Limbs thick and powerful, with large paws and retractile claws; front paws with five digits (Digit 1 situated above plantar surface); hind paws with four digits. Tail long (ca. 60% of HB), of similar thickness from base to tip; golden brown above, white below, with irregular black spots and some rosettes.

**Similar Species** For details, see yellow box.

Cheetah (*Acinonyx jubatus*). Conspicuous black 'tear streak' easily seen from distance. Spots never arranged in rosettes. Less robustly built. Legs slender and relatively long.

Serval (*Leptailurus serval)*. Spots never arranged in rosettes. Longitudinal black stripes on top of neck and shoulders. Other markings very similar. Less robustly built. Legs slender and relatively long. Ears relatively large.

**Distribution** Probably widespread in Malawi although rarely seen. Elsewhere: widely distributed in savanna and rainforest biomes south of about 15˚N, including semi-desert regions. Isolated populations occur in Morocco and northern Niger.

*Historical Distribution*: Leopards in Malawi were more widespread and more numerous in the past than at the present time. Their spoor was frequently seen on lateritic roads, around houses and near enclosures where domestic animals (especially chickens, goats and sheep) were kept. There were also many instances of humans being killed and eaten by leopards. Leopards were seldom seen, but their presence and predations during the night were a constant threat to humans and domestic animals. Control of leopards in some localities (by placing a live or dead bait and then shooting the leopard when it came to the bait) was considered necessary in many places.

*Present Distribution*: There are many areas where leopards are no longer present. Now they are only found in protected areas, and areas where human population numbers are small. These localities include Kasungu N. P., Lengwe N. P., Liwonde N. P., Majete W. R., Mwabvi W. R., Nkhotakota W. R., Nyika N. P., Vwaza Marsh G. R., and (rarely) Zomba Plateau. They are no longer such a threat to humans as they were in the historical past.

**Habitat** Leopards occur in many sorts of habitat. Favoured habitats are woodland savannas, but leopards also occur in scrubland, rainforest, montane forest, rocky areas and semi-desert and even high up on mountains (hence their widespread distribution in Africa).

**Abundance** Leopards are the most abundant large felid in Africa. Population numbers vary greatly. Published records range from 12 -30/100km$^2$ (where prey is abundant, e.g. East Africa)

to 1.5-9/100km$^2$ (where prey is scarce, e.g. rainforest, fynbos in South Africa, semi-desert). Estimates for Malawi are unavailable but are likely to be low except in some protected areas (e.g. Nyika N. P.).

**Habits** Terrestrial and arboreal, nocturnal and diurnal, carnivorous. Leopards are the most arboreal of the felids. They hunt on the ground but they are extremely good climbers, and often pull their prey into trees so other carnivores are unable to feed on them. They are primarily nocturnal but are occasionally seen moving around during the day. During the hottest time of day, they rest in the shade of trees or rocks, or in hollow trees, caves and disused burrows, or they lie spread-eagled over the thick branches of trees. Their spotted pelage provides good camouflage especially in dappled light; consequently, leopards are very difficult to see.

Leopards feed on a very wide range of prey (one assessment suggests that, in Africa as a whole, there are 92 species of prey). Prey species vary depending on locality, the abundance of the prey species, and the ease of obtaining the prey (while expending the minimum of energy). Leopards are very opportunistic, switching from one species to another in different seasons if abundance changes. In most studies, leopards show a preference for 1-3 species of ungulates weighing 10-40 kg; e.g. in many South African localities, Impala, Bushbuck and Common Duiker are the preferred prey. In a sample of 55 kills in Serengeti National Park, Thomson's Gazelles were the commonest prey (27%), followed by Impala (16%), Reedbuck (11%), juvenile Zebra (7%), and 16 other species, including Wildebeest, Grant's Gazelle, and Baboons (4% or less). In contrast, in a sample of 44 scats from Mount Kenya, Rock Hyraxes occurred in 66% of the scats, *Otomys* sp. (a small rodent) in 52%, and Common Duiker in 2%. No information for Malawi. Leopards hunt alone by stalking, chasing or by ambushing the potential prey on a well-used game trail. Prey is killed either by suffocation or by a bite on the back of the skull or neck.

Leopards are solitary and seldom socialize except when mating and when a mother has cubs. Males and females have separate home-ranges, and these ranges frequently overlap. The size of a home-range depends on the abundance of prey. Home-ranges of males tend to be larger than those of females. Home-ranges (measured by radio-tracking) varied from 14– 52 $km^2$ in Kenya, and from 25-136 $km^2$ in Tanzania. Home-ranges are larger in Namibia (a less productive environment with fewer prey) averaging 188$km^2$ (females) to 451 $km^2$ (males). Where overlap of home-ranges occurs, individuals hunt at different times, thus reducing the chances of conflict. Leopards communicate their presence by urine-spraying and cheek-rubbing (on to vegetation), depositing faeces (scats) on trails, and scraping the ground with their hindfeet. They also produce a characteristic 'sawing roar' or 'rasping' call which sounds remarkably like someone sawing wood. This call, usually made at dawn and dusk, advertises occupancy of the home-range and also an individual's readiness for courtship. Although mostly solitary, courting pairs and sometimes other pairs who know each other, partake in amicable behaviour which includes a vocalization described 'chuffing'. Agonistic behaviour includes growling, snarling, spitting, and displays such as arching the back, flattening the ears, and barring the teeth. If fighting occurs, it may be fatal to one or both participants.

**Reproduction** Leopards breed throughout the year, although in some localities there is peak at the time when prey is most abundant. Young are born in dens, caves or thick vegetation. Gestation: 90-110 days. Litter-size: 1-3 (although up to six has been recorded in captivity). Neonates are altricial; eyes open on Day 6-10. Weaning occurs at ca. Day 100, and young become independent at about one year of age. They attain sexual maturity at 24-28 months but do not breed until ca. 35 months at the earliest. Female subadults may stay in their mother's home-range, but males normally disperse to a new home-range (where they may find sexually mature females). Mortality of subadults ranges from 18-53% (depending on locality and the abundance of prey).

**Conservation** IUCN Category: Vulnerable. Biogeographic range and population numbers are declining; leopards are hunted because they are a threat to humans and domestic animals, and their skins and body parts are valuable (for ceremonies and ornaments).

**Taxonomic Notes** *Panthera pardus* (Linnaeus, 1758). Many subspecific names have been given to Leopards on the African continent but all African leopards are now considered to be *P. p. pardus*. (Other subspecies occur in the Middle East and Asia)

**Key References** Hunter *et al.* (2013), Smithers (1983).

**Measurements**
*Panthera pardus*

| | |
|---|---|
| HB (males): | 1107 (920–1250) mm, n = 21 |
| HB (females): | 1030 (950–1050) mm, n = 8 |
| T (males): | 678 (510–800) mm, n = 20 |
| T (females): | 677 (640–740) mm, n = 8 |
| HF c.u. (males): | 219 (190–252) mm, n = 20 |
| HF c.u. (females): | 206 (190–220) mm, n = 7 |
| E (males): | 73 (65–100) mm, n = 20 |
| E (females): | 70 (65–72) mm, n = 7 |
| Sh. ht.: | 70-80 cm* |
| WT (males): | 30.9 (20.0–45.0) kg, n = 27 |
| WT (females): | 21.2 (17.9–26.0) kg, n = 9 |

South Africa (Northern Cape, Western Cape and Eastern Cape provinces, Stuart 1981 in Hunter *et al.* 2013).
*Southern Africa (Stuart & Stuart 2015).

# ORDER TUBULIDENTATA – AARDVARK

| Family Orycteropodidae | *Orycteropus* (1 species) | Aardvark | p. 376 |
|---|---|---|---|

This is the only order of mammals which is represented by only one family, and only one extant species – the Aardvark. Aardvarks eat mainly ants and termites and, in some ways, they resemble other mammalian ant-eaters such as pangolins, armadillos and South American anteaters. In the past, all of these mammals were placed in one order, the Edentata. However, more detailed anatomical studies showed that the resemblance between these ant-eating mammals was the result of convergent evolution, and the Aardvark was placed in an order of its own. Then, molecular evidence showed that the Aardvark belongs to the super-order Afrotheria – mammals, including sengis, hyraxes and elephants, which had a monophyletic origin in Africa.

## FAMILY ORYCTEROPODIDAE - Aardvark

This family once contained at least four genera, but only one is extant.

### Genus *Orycteropus* - Aardvark

This genus contained three, or perhaps four, species, but only *Orycteropus afer* is still extant. It is very widely distributed throughout most of sub-Saharan Africa, including Malawi.

### *Orycteropus afer*

### Aardvark

**Malawian Names** Godi, Ngengo, Nkumba-kumba, Nsele, Sere.

© C. & M. Stuart

**Description** Large nocturnal, semi-fossorial mammal, about the size of a large pig, with arched back, elongated muzzle, long pointed ears, thickset strong limbs and a stout tail. Males, on average, larger and heavier than females. Pelage mostly sparse and short so the skin is visible. Dorsal pelage grey; skin greyish but often stained by the soil into which they have burrowed. Pelage longer and darker on limbs. Head elongated and thin; muzzle elongated ending in a pig-like snout. The tongue is very long, thin, sticky and extensible. Eyes small and dark. Ears long, thin and tubular, pointed at tip; held upright except during burrowing. Back strongly arched; head held low. Limbs very thickset, rather short, with huge nail-like claws (especially on fore-limbs). Forelimbs with four digits, hindlimbs with five digits; some degree of webbing between digits. Tail relatively short (ca. 34% of HB) very thick and round at base tapering to a point at tip; hairs very sparse; terminal end drags along ground at times. Aardvarks do not have incisor or canine teeth, but they have 2-4 peg-like upper and lower premolars, and three upper and lower molars which are 8-shaped in occlusal view. The teeth grow continuously. The teeth are unlike those of any other mammal; they lack enamel; each tooth is formed of many tightly packed vertical tubules of dentine (up to 1500 tubules in a large molar tooth) – hence the name Tubulidentata.

**Similar Species** None.

**Distribution** In Malawi, recorded in many parts of the country including highland areas, in all biogeo-graphic areas except the high plateaux of the northern region above ca. 1800 m. Localities include Kasungu N. P., Lengwe N. P., Liwonde N. P., Vwaza Marsh G. R. and possibly Mwabvi W. R. Probably locally extinct in many localities where it was once recorded, e.g. Zomba. Elsewhere: occurs widely and sparsely throughout most of Africa south of the Sahara. However, within the biogeographic distribution, Aardvarks are only found in suitable habitats (see below).

**Habitat** Habitats must contain many nests of ants and termites. These may be available in grasslands, woodland savannas, thickets and forests. Aardvarks have been recorded from near sea level to montane

habitats at ca. 3000 m, but in Malawi they have not been recorded above 1800 m. They are found in flat or slightly undulating country, and do not exploit marshy and rocky habitats.

**Abundance** No information for Malawi. Abundance is difficult to assess because Aardvarks are nocturnal and rarely seen. Said to be common in some places. One indicator of abundance is the number of Aardvark burrows in an area, although often many burrows may be unoccupied.

**Habits** Terrestrial, semi-fossorial, nocturnal, insectivorous. Aardvarks are primarily nocturnal and spend much of the night foraging, but in localities where it is cold at night they forage in the early morning. They spend the day and sometimes some of the night in burrows which they dig for themselves. They are very well adapted for digging. Their forelimbs (and hindlimbs to a lesser extent) are powerful and muscular, with strong wide nail-like claws. The structure of the limb bones, joints, and muscles are adapted for strength, and enable Aardvarks to dig quickly and efficiently in many types of soils. They can dig with amazing rapidity. The structure and size of burrows varies: some are shallow (dug while foraging for food), others are deeper (used for temporary shelters) or very deep (for permanent residence). Most burrows have a single entrance, and the deepest burrows may be 3 m deep and up to 10 m in length. In these burrows, individuals are protected from heat during the day and cold at night.

The digging activities of Aardvarks are beneficial to other species. Abandoned burrows are used as 'dens' by warthogs, jackals, hyaenas, mongooses, porcupines, some species of bats and several species of snakes. Digging into termitaria allows some species of shrews to live in the cavities within the termitaria and to feed on termites. The soil excavated from burrows provides new habitats for plant colonization and the burrows and scratchings allow water to penetrate the ground when the topsoil is hard and compact.

Aardvarks feed mainly on ants and termites. When foraging, they keep their noses to the ground and when they smell a nest of ants or termites, they begin to dig rapidly. Each feeding bout lasts from ca. 10 seconds to two minutes, depending on the abundance of prey, and when one nest has been exploited, the Aardvark moves on to find another. Careful observations have shown that an Aardvark exploits an average of 25 nests per hour and may visit up to 200 nests during a single night. When a nest is found, the long, sticky tongue is flicked into the narrow tunnels of the nest and the prey is drawn into the mouth and then crunched between the teeth before it is swallowed. The 'bite' is weak because the mandibles are thin and the jaw muscles are small. In Africa as a whole, Aardvarks feed on about 12 genera of ants and nine genera of termites. One study in South Africa recorded that Aardvarks ate four ants to one termite; one species of ant comprised 70% of all prey eaten, and one species of termite comprised 20% of the diet. However, the species eaten and the proportion of ants to termites depends on the locality and time of year. Termites are eaten more often in the wet season (when they are active and abundant) and less often in the dry season (when they are scarce). In some localities, Aardvarks sometimes also feed on beetles and the fruit of wild cucumbers.

Aardvarks are solitary. Whenever two individuals meet, they sniff each other and may rear up on their hindlimbs; interactions last only a few minutes and slightly longer when mating occurs. They do not share their burrows with conspecifics, except when a mother is looking after her young. Adults make a soft grunting noise, and young make a 'bleating' noise when alarmed.

Home-ranges vary in size depending on the density of ant and termite nests, being larger when prey is scarce. In southern Africa, home-ranges of 2–4.7 $km^2$ have been recorded, with limited overlap between home-ranges. When necessary, an individual may travel several kilometers to find a new area in which to live.

**Reproduction** No information for Malawi. The timing of births varies in different localities; e.g. Oct-Nov in DRC and May-Aug in southern Africa. Gestation (in captivity): 35 weeks. Litter-size: 1 (occasionally 2). Neonates are naked and weigh 1.4–1.9 kg. In captivity, young grow quickly, attaining 10 kg at Week 7, and 40 kg (ca. 75% of adult weight) at Month 7; growth in the wild is much slower. Hair is visible at Week 5-6. Young begin to eat prey at Week 14 and are weaned by Week 16. Sexual maturity occurs at ca. two years of age.

**Conservation** IUCN Category: Least Concern. Although comparatively common, Aardvarks are hunted in some localities and are considered to be pests in some agricultural areas.

**Taxonomic Notes** *Orycteropus afer* Pallas, 1766. Although about 18 subspecies have been described on the basis of size, colour and minor morphological differences, none are recognized now.

**Key Reference** Taylor (2013).

**Measurements**
*Orycteropus afer*

| | |
|---|---|
| TL (males): | 1600 (1490–1750) mm, n = 15 |
| TL (females): | 1580 (1400–1730) mm, n = 16 |
| T (males): | 544 (443–620) mm, n = 15 |
| T (females): | 539 (464–630) mm, n = 16 |
| HF c.u. (males): | 256 (240–268) mm, n = 15 |
| HF c.u. (females): | 247 (225–280) mm, n = 16 |
| E (males): | 180 (167–210) mm, n = 15 |
| E (females): | 177 (165–185) mm, n = 16 |
| WT (males): | 53.3 (41.3–64.5) kg, n = 15 |
| WT (females): | 51.4 (40.4–57.7) kg, n = 16 |

Zimbabwe (Smithers & Wilson 1979).

# ORDER HYRACOIDEA - HYRAXES

| | | | |
|---|---|---|---|
| Family Procaviidae | *Dendrohyrax* (1 species) | Tree Hyrax | p. 380 |
| | *Heterohyrax* (1 species) | Bush Hyrax | p. 382 |
| | *Procavia* (1 species) | Rock Hyrax | p. 384 |

Hyraxes (known as Dassies in southern Africa) are moderately small mammals with stout bodies, short legs, no visible tail, small ears and soft, dense pelage. They have a superficial resemblance to guinea-pigs (*Cavia* spp.) of the family Caviidae and they were once thought to be closely related to these rodents. This explains the family name Procaviidae which means "before guinea-pigs". Subsequently, it was realized that hyraxes were closely related to elephants, dugongs and manatees, and it is now believed that all of these mammals, together with sengis, otter-shrews, golden moles and the aardvark, belong to the superorder Afrotheria which had a monophyletic origin in Africa.

Hyraxes do not have canine teeth - the large, tusk-like teeth at the front of the mouth are incisors. In elephants, it is the same upper incisors which grow into their very long tusks.

The fossil record suggests that the order contains five families of which only one, the Procaviidae, is extant.

## FAMILY PROCAVIIDAE - Hyraxes

The family Procaviidae contains three extant genera – *Dendrohyrax*, *Heterohyrax* and *Procavia*. The number of species in these genera is controversial, but all three genera are represented in Malawi by one species. They can be distinguished from the information in the yellow box below.

*Dendrohyrax arboreus*. Lives in trees. Nocturnal. Dorsal pelage brownish-black with small elongated white patch (sometimes faint) on mid-dorsal line. No marks around each eye.

*Heterohyrax brucei*. Lives on rocky outcrops but sometimes forages in trees. Primarily diurnal. Dorsal pelage grizzled brownish-grey with elongated yellowish patch (sometimes faint) on mid-dorsal line. White eyebrow above each eye.

*Procavia capensis*. Lives on rocky outcrops; occasionally forages in trees. Primarily diurnal. Dorsal pelage greyish to yellowish-brown with elongated black patch (sometimes faint) on mid-dorsal line. Pale eyebrow above each eye.

# Genus *Dendrohyrax* – Tree Hyraxes

This genus contains three species; only one occurs in Malawi. Unlike hyraxes in other genera, all are nocturnal and arboreal.

## *Dendrohyrax arboreus*

## Southern Tree Hyrax

**Malawian Name** Mbira, Mpyaya, Ntechele. These names also apply to Bush Hyrax.

Mutinondo, Zambia © F. Willems

**Description** Small arboreal rabbit-sized mammal, with a slightly arched back, relatively large head, no tail, short legs and wide short feet. It is hard to imagine a mammal less likely to live in trees. Males and females similar in size. Pelage moderately long, soft and rather shaggy. Dorsal pelage grizzled brownish-black; hairs brownish-ochre with black tip. A small elongated white patch (sometimes very faint) on middle part of mid-dorsal line contains glands and erectile hairs. Throat, underside of neck and ventral pelage creamy-white. Head large, similar in colour to body or darker, with some whitish hairs in some individuals; large eyes, long black vibrissae, and black nostrils. Ears small and compact, rounded at tips. Limbs very short. Feet wide, black, with well-developed naked, rubbery pads with glands that secrete a fluid which keeps the pads permanently moist. Forefeet with four digits, each ending in a flat nail, Digit 4 very short. Hindfeet with three digits, Digit 1 with claw (for grooming), Digits 2 and 3 with nails. Tail absent.

**Similar Species** None (see yellow box above).

**Distribution** In Malawi, recorded in only a few places, from montane forests in the north to thickly forested areas in the Upper Shire Valley and Lower Shire Valley, where there is forest with large trees. Has been recorded from Chapananga, Chikwawa, Liwonde N. P., Mangoche, Misuku, Mulanje, Mzimba, Nsanje, Nyika N. P. and Thyolo, but these are old records. Possibly occurs in Majete W. R. Elsewhere: moderately widespread in East Africa, S DR Congo, Zambia and NE Angola.

**Habitat** Mature woodlands and forests as well as riverine forests in drier habitats. Large trees which provide cover, cavities for nesting and food requirements, are essential.

**Abundance** Difficult to assess. No information for Malawi. Elsewhere: most records of occurrence (and abundance) are based on calls heard at night (see Habits). In optimum habitat (e.g. Virunga Mts in Rwanda and DRC) density may be as high as 13/ha, but in eastern and southern Africa, Tree Hyraxes are much less numerous.

**Habits** Arboreal, nocturnal, folivorous/frugivorous and solitary. Tree Hyraxes spend almost all their lives in large, tall forest trees. Their small and compact size and wide feet with moist pads allow them to walk and clamber on tree trunks and branches with amazing agility. They do not jump from branch to branch as do squirrels, galagos and monkeys. The moisture produced by the glands of the feet helps to provide a good grip on the substrate. During the day, Tree Hyraxes rest in hollow cavities of trees, or in dense cover provided by foliage or creepers. They sometimes emerge to bask in the sun.

Tree Hyraxes are mainly folivores and frugivores. Most of their food is foraged high up in trees, although they will descend to the forest floor to feed on fallen fruits. Studies suggest that Tree Hyraxes feed only on a limited number of plant species, and prefer to eat the mature leaves and tips of woody twigs. Feeding on abundant but sometimes low quality food, maximizes energy intake while minimizing energy used for searching for food.

Although seemingly placid and retiring, Tree Hyraxes raise the hairs of the large dorsal gland when excited or threatened. If attacked, they bite with their

two large forward-facing upper and lower incisor teeth and can inflict serious wounds.

Tree Hyraxes are primarily solitary except when mating and when mothers associate with their young.

Tree Hyraxes are very vocal at night – their loud call has been described as "a series of cackling barks followed by piercing screams". These calls are means of communication between individuals. Because Tree Hyraxes are rarely seen, their loud calls are a good way of assessing the number of individuals in a forest. The eyes of hyraxes (unlike those of galagos) do not reflect a light shone into them so they cannot be detected with a spotlight.

**Reproduction** No information for Malawi. The timing of births is uncertain. Gestation: ca. 7-8 months (very long for such a small mammal). Litter-size: 1-3. Neonates are precocial and weigh ca. 200g at birth. Young remain in the trees with their mother. Weaning occurs at 3-7 months, and maturity is attained at 20-30 months.

**Conservation** IUCN Category: Least Concern. Conservation concerns are degradation and loss of habitat, and hunting. Many patches of forest are too small to support a viable population.

**Taxonomic Notes** *Dendrohyrax arboreus* (A. Smith, 1827). Eight subspecies are recognized of which one, *D. a. mimus,* occurs in Malawi, NE Zambia and WC Tanzania.

**Key references** Milner & Gaylard (2013), Smithers (1983), Sweeney (1959).

**Measurements**
*Dendrohyrax arboreus*

| | |
|---|---|
| HB: | 475 (428-520) mm, n = 9 |
| T: | 0 mm |
| HF (s.u.): | 63 (59-67) mm, n = 10 |
| E: | 32 (29-36) mm, n = 8 |
| WT: | 2.00 (1.17–2.65) kg, n = 14* |

Southern Africa (Bothma 1967 in Smithers 1983). *Rwanda (Milner & Harris 1999 in Milner & Gaylard 2013).

# Genus *Heterohyrax* – Bush Hyrax

This genus is currently considered to contain only one species. The type species was originally placed in the genus *Dendrohyrax*, but *Heterohyrax* Gray, 1868 is now considered to be a valid genus.

## *Heterohyrax brucei*

## Bush Hyrax
## (Yellow-spotted Hyrax)

**Malawian Names** Mbira, Mpyaya, Ntechele. These names also apply to the Tree Hyrax.

Namaso/Nkudzi Bay, Malawi © Bentley Palmer

**Description** Small, rock-living, rabbit-sized mammal with a slightly arched back, relatively large head, no tail, short legs and wide short feet. Females, on average, larger than males. Pelage short, slightly coarse. Dorsal pelage grizzled; dark brown flecked with pale brown, or pale brown flecked with beige; hairs dark brown with pale brown subterminal band and black tip. Long black guard hairs extend above pelage on head and body; these are probably tactile. An elongated yellowish patch (sometimes faint) on mid-dorsal line contains glands and erectile hairs. Throat, underside of neck and ventral pelage creamy-white. Head similar in colour to body (or paler in some individuals) with a long white eyebrow above each eye which is easily seen at a distance. Eyes large and dark. Ears large and rounded, often with whitish hairs on inner surface. Nostrils black; long black vibrissae. Feet similar to those of *Dendrohyrax*. No tail.

**Similar Species** (see yellow box above).

*Procavia capensis.* Elongated mid-dorsal patch black. Dark patch around each eye. No conspicuous white eyebrow. Ventral pelage paler than dorsal pelage but not creamy-white.

**Distribution** In Malawi, found in many localities from north to south. More widespread than *Procavia capensis,* the other rock-dwelling hyrax. Localities include Blantyre, Chiradzulu Mountain, Kasungu N. P., Mangoche Mountain, Monkey Bay, Mulanje Mountain, Mwabvi W. R., Nyika N. P., Thyolo Mountain, Upimbi, Vwaza Marsh G. R. and Zomba Plateau, but not likely to occur in all of these localities now. Elsewhere: very widespread from N Sudan southwards on the eastern side of the continent to Zimbabwe and N South Africa.

**Habitat** Rocky hills, rocky outcrops and inselbergs in savannas habitats. Rocks with crevices and piles of boulders which provide shelter and safety, are essential. The cavities in and between the rocks need to be about 11 cm in height – enough to allow hyraxes to get in but small enough to prevent potential predators from entering. These cavities provide a more or less constant temperature (17-25˚C) and humidity (30-40%), and also safety from fire.

**Abundance** No information for Malawi. Elsewhere, Bush Hyraxes may be very abundant in suitably rocky areas. In the Matobo N. P. (Zimbabwe), densities were 1.2 -2.6/ha of rocky hill (kopje) in normal years, and 4.5/ha of rocky hill after good rains. In Serengeti N. P. (Tanzania), densities were as high as 75/ha of suitable habitat.

**Habits** Rupicolous, diurnal, folivorous/frugivorous and social. Bush Hyraxes, like Rock Hyraxes, live on rocky outcrops where there are many rocks and boulders with cavities and crevices where they shelter and sleep. Bush Hyraxes are diurnal. They spend the day sunbathing, resting in cavities in the rocks, and feeding. After emerging from the night-time shelter, they warm themselves by sunbathing on the rocks and huddling together in the sunshine; in the middle of the day, they retreat into the cool of cavities, and emerge again in late afternoon. As the evening cools, and dusk begins, they return to their night-shelters until the next morning. Bush Hyraxes, and also Rock Hyraxes, have comparatively low metabolic rates so they sunbathe and move in and out of cool places to

as a means of thermoregulating. While sunbathing, they are vulnerable to aerial predators, but they have a shield (umbrachulum) over the pupils of the eyes which enables them to stare straight at the sun while looking out for eagles.

Bush Hyraxes feed mainly on twigs and bark, buds, leaves, flowers and fruits of woody trees and shrubs. In the Serengeti N. P., Bush Hyraxes eat 64 species of woody plants but spend more than 90% of their foraging time on just 2-11 of these species. In the wet season, in addition, they graze (to a small extent) on grasses close to the rocks. Most foraging occurs in the morning (before about 11:00 h) and in the afternoon (between 15:30 and 18:00 h). Bush Hyaxes are agile climbers and can climb vertical trunks and clamber along branches to feed on the outer twigs and leaves. They forage only on trees and bushes on the rocky outcrop itself and within about 20 m around the base of the rocky area. Bush Hyraxes obtain most of their water from their food, and conserve water by producing only small amounts of concentrated urine and comparatively dry faeces. Both Bush Hyraxes and Rock Hyraxes defaecate and urinate in latrines. The urine leaves characteristic white and brown streaks on the rocks and cliffs below the latrines – a good indication that hyraxes are living there.

Bush Hyraxes live in groups. These vary in size, and are typically composed of a territorial adult male, many females, and their young. The young stay with their mothers in nursery groups. The subadult females join the adult females when they mature (when ca. 16 months old); young males leave the nursery when 12-30 months old and either become 'peripheral males' or disperse to other rocky areas. A population of Bush Hyraxes is 'contained' within its rocky outcrop. Those individuals that disperse increase the gene pools on another rocky outcrops reducing the likelihood of inbreeding.

Bush Hyraxes exhibit many forms of amicable behaviour. They huddle in groups (which also helps to maintain body temperature on cool mornings), and they produce many different communication calls some of which indicate distress, threat, and danger from a nearby predator. During the breeding season, territorial males exhibit agonistic behaviour to other males, by chasing, growling snapping and raising the hairs around the mid-dorsal gland.

Bush Hyraxes are very alert, especially when avian predators are nearby. When a predator is sighted, one of more individuals emit a loud shrill call to alert other individuals of danger; on hearing this call, every individual scuttles to safely among the rocks. Verreaux's Eagles are the main predators of Bush Hyraxes; other predators include other species of eagles, leopards and some snakes.

In regions where the distributions of Bush Hyraxes and Rock Hyraxes overlap (as in southern Malawi) both species live together amicably and share the same habitat. They do not interbreed.

**Reproduction** No information for Malawi. Bush Hyraxes breed once each year. In Zimbabwe (and probably also in Malawi), young are born in March (towards the end of the wet season). Gestation: 6.5-7.5 months. Litter-size varies biogeographically: e.g. mean 1.6 (Tanzania) to mean 2.1 (Zimbabwe). Older females have larger litters than younger females. Neonates are precocial and weigh ca. 195 g (the weight being larger in small litters than in large litters). Young are weaned at ca. 3 months and are mature at 16-17 months; males probably do not breed until they are much older and own their own territories.

**Conservation** IUCN Category: Least Concern. In some parts of their biogeographic range, the skins of Bush Hyraxes are used for making 'karosses' (traditional capes and blankets).

**Taxonomic Notes** *Heterohyrax brucei* (Gray, 1868). Originally described as a species of *Dendrohyrax* and referred to as *Dendrohyrax brucei* by Sweeney (1959) and Hayes (1978). Many subspecies (24) have been described based on variations in the colour of the pelage. Pelage colour ranges from brownish-grey to reddish-brown, depending on locality. The validity of these subspecies is controversial. If valid, the subspecies in Malawi (and NE Zambia) is *H. b. manningi*.

**Key References** Barry & Hoeck (2013), Smithers (1983).

**Measurements**
*Heterohyrax brucei*

| | |
|---|---|
| HB (males): | 497 (465–530) mm, n = 5 |
| HB (females): | 516 (485–560) mm, n = 12 |
| T: | 0 mm |
| HF s.u. (males): | 68 (65–70) mm, n = 5 |
| HF s.u. (females): | 69 (65–73) mm, n = 12 |
| E (males): | 32 (30–33) mm, n = 5 |
| E (females): | 32 (29–34), n = 12 |
| WT (males): | 3.01 (2.72–3.18) kg, n = 5 |
| WT (females): | 3.01 (2.32–3.63) kg, n = 12 |

Zimbabwe (Smithers & Wilson 1979).

# Genus *Procavia* – Rock Hyrax

The number of species in this genus is controversial – some authors consider that there is only one (*Procavia capensis*); others think there are at least five more.

## *Procavia capensis*

## Rock Hyrax

**Malawian Names** Mbira nkhonkho, Tundugulu.


South Africa © C. & M. Stuart

**Description** Small, rock-living, rabbit-sized mammal with a slightly arched back, relatively large head, no tail, short legs and wide short feet. Females, on average, larger than males. Pelage dense, short, slightly coarse. Dorsal pelage greyish to yellowish-brown flecked with black; hairs pale brown with chocolate brown base and black tip. Long black guard hairs extend above pelage on head and body; these are probably tactile. An elongated black patch (sometimes faint) on mid-dorsal line contains glands and erectile hairs. Cheeks, throat, underside of neck and ventral pelage paler than dorsal pelage (not creamy-white cf. Bush Hyrax). Head with dark markings around eye; eyebrow pale (cf. white in Bush Hyrax). Eyes large and dark. Ears large and rounded, often with whitish hairs on inner surface. Nostrils black; vibrissae long, black. Dorsal surface of limbs darker than dorsal pelage. Feet similar to those of *Dendrohyrax*. No tail.

**Similar Species**

*Heterohyrax brucei*. The elongated mid-dorsal patch is yellowish. Conspicuous white eyebrow above each eye. No dark patch around each eye. Ventral pelage creamy-white.

**Distribution** In Malawi, recorded only from the Dedza region southwards on both sides of the Shire River including all the highland areas, but not recorded in the Lower Shire Valley. Localities include Chikala (ca. 40 km E of Zomba), Chiradzulu Mountain, Chongoni Mountain (near Dedza), Fort Lister, Mulanje Mountain and Ntcheu, but all these are old records. Not recorded from any of the national parks and wildlife reserves. Elsewhere: very widely distributed in arid, semi-arid and savanna habitats throughout much of Africa except for northern Africa, much of the Sahara, and a very wide gap across central Africa. South of this gap, found in SW Angola, W Namibia, South Africa, the eastern edge of Botswana, and from SW Zimbabwe to southern half of Malawi.

**Habitat** Similar to that of the Bush Hyrax: rocky hills and rocky outcrops, inselbergs, boulder fields, and rocky escarpments. Crevices in and between boulders are essential because they provide shelter from cold and heat, and from predators. Preferred crevices face away from the prevailing winds.

**Abundance** No information for Malawi. In suitable rocky areas, Rock Hyraxes can be very abundant. Abundance is related to the area of suitable habitat, number of suitable microhabitats (crevices, fissures in rock, spaces between boulders), season of year, and availability of food. Records of abundance range from 0.73-0.94/ha in Matobo N. P. (Zimbabwe) to 5-56/ha in Serengeti N. P. (Tanzania

**Habits** Rupicolous, diurnal, folivorous/frugivorous and social (as is the Bush Hyrax). Rock Hyraxes spend the night in crevices and cavities under rocks and boulders, but if rocky outcrops become over-populated, they may move further afield and find shelter in abandoned burrows, holes in stone walls and culverts under roads. They are not able to dig burrows. They are primarily diurnal, but their activities are influenced by the ambient temperature, and they are sometimes active at night. When they first emerge in the morning, they warm themselves in the sun, often huddling together or on top of each other. They spend most of the day resting, grooming them-

selves and dust-bathing, and only ca. two hours foraging and feeding.

Rock Hyraxes often forage and feed in the mid-morning and then again in mid-afternoon, but their foraging regimes are largely dependent on the ambient temperature. On moonlit nights in warm weather, they will forage before dawn and after sunset. Foraging sessions usually last no more than an hour, and then they return to the safety of their rock shelters. They usually forage within ca. 20 m of their rock shelters unless food is scarce. Rock Hyraxes graze on grasses and sometimes climb into bushes and trees to browse on leaves, shoots, buds and berries. In Serengeti N. P., Rock Hyraxes feed on 79 species of plants. Their diet changes according to season: in the wet season, they feed mostly on grasses (78% of diet, ca. 24 spp.), and in the dry season, when grasses are poor in nutrients, they do more browsing (57% of the diet). Their ability to change diet makes Rock Hyraxes more adaptable than Bush Hyraxes.

Rock Hyraxes are gregarious, living in family groups. A 'typical' family group comprises one adult territorial male, several adult females, subadult males (before they disperse), subadult females, and juveniles. Family groups can consist of up to 80 individuals but they are usually smaller. The sizes of family groups, and the number of groups on a rocky area, depends on many environmental factors (see Abundance above). Group members co-operate in many ways. They huddle together to keep warm, they often forage in groups, and they have sentinels who vocalize to warn of potential danger when the group is foraging or sunbathing and resting outside their shelters.

Rock Hyraxes exhibit very little intra-specific aggression; most interactions are amicable and result in close bonding between individuals but some elements of agonistic behaviour establish and maintain the social structure of the groups. Males – especially territorial males - show aggression towards other males during the mating season and when defending a territory. Adult males which do not hold territories are called 'peripheral males'; they live outside a territory and will attempt to takeover a territory if an opportunity arises. Young males are either ‘early dispersers’ which leave their maternal home-range when 16-24 months old, or ‘late dispersers’ which leave when 28-30 months old. Most dispersers attempt to move to another rocky area (even though this might entail crossing an intervening inhospitable habitat).

Rock hyraxes use visual, auditory and olfactory signals for intra-specific communication. Different postures signal either appeasement or aggression. Raising the hairs around the mid-dorsal gland signals dominance, threat and alarm; flattening these hairs signals submission. There are many vocal signals – growls, snorts etc.; the most frequently heard is a loud piercing bark that indicates that danger is nearby. Urine and faeces in latrines provide strong olfactory signals which advertise the presence of the colony, and males sniff the urine of adult females to ascertain whether they are in reproductive condition.

In regions where the distribution of Rock Hyraxes overlaps with that of Bush Hyraxes (as in southern Malawi), both species live together amicably and share the same habitat, but they do not interbreed.

**Reproduction** No information for Malawi. Rock Hyraxes breed once each year. The timing of births depends on locality. In Serengeti N. P., most births are from Mar to May. Within a single colony, all females give birth within a 3-week period. Gestation: 212-240 days. Litter-size in Serengeti N. P: 2.4 (1 - 4). Neonates are precocial, weigh ca. 200 g, are fully active within a few days. Weaning occurs at ca. 3 months (but varies between individuals and depends on the number in the litter); some young ingest solid food when ca. 2 weeks old. Males and females are sexually mature at 16-17 months. Upon maturity, females join the adult family group and the males disperse (see above).

**Conservation** IUCN Category: Least Concern. Conservation concerns include hunting for food and skins (in non-protected areas).

**Taxonomic Notes** *Procavia capensis* (Pallas, 1766). Seventeen subspecies have been described; some may be invalid, others may represent separate species. The subspecies in Malawi is *P. c. johnstoni.*

**Key References** Hoeck & Bloomer (2013), Smithers (1983).

**Measurements**
*Procavia capensis*

| | |
|---|---|
| HB (males): | 484 (395–578) mm, n = 41 |
| HB (females): | 496 (439–539) mm, n = 33 |
| HF: | 65.6 mm, n = 63 |
| E: | 32.0 mm, n = 63 |
| T: | 0 mm |
| WT (males): | 3.0 (1.8–4.5) kg, n = 66 |
| WT (females): | 3.2 (2.0–5.4) kg, n = 57 |

Tanzania (Serengeti N. P., Hoeck & Bloomer 2013).

# ORDER PROBOSCIDEA – ELEPHANTS

| Family Elephantidae | *Loxodonta* (1 species) | African Elephants | p. 386 |
|---|---|---|---|

The order Proboscidea contained about ten families, but only one, the family Elephantidae, is extant. The name of the order refers to the proboscis or trunk which was a characteristic of elephants and also of all extinct proboscideans known at the time. These include mastodons and woolly mammoths. However, it is now known that some extinct proboscideans did not have trunks.

The trunk is a fusion of the nose and the upper lip. It contains two nostrils and has two finger-like tips, and an enormous number of muscles. Consequently, it is very versatile and has many functions including picking up small objects (such as nuts and fruits) on the ground, grasping tree-trunks to shake the tree or pull it over, rolling and supporting large objects on to the tusks to be carried, sucking up water prior to squirting it into the throat or over the body, serving as a snorkel while the elephant swims, smelling objects or air-borne scents, and touching, guiding, caressing and supporting babies or older elephants in need.

Many extinct proboscideans (including mastodons and mammoths) and living elephants have tusks which are modified upper incisor teeth or, in some extinct species, modified lower incisor teeth. Elephants use their tusks as weapons, for digging in search of water, pushing trees over so upper foliage can be eaten, stripping back off trees, and uprooting vegetation. They are, unfortunately, made of dentine which is highly prized as ivory and elephants are now classified as Endangered or Critically Endangered partly because so many are killed for their ivory.

Proboscideans are closely related to hyraxes, order Hyracoidea, and both orders belong to the super-order Afrotheria which had a monophyletic origin in Africa.

## FAMILY ELEPHANTIDAE - Elephants

The family Elephantidae is the only family in the order Proboscidea which is extant, and it contains only three living species. These are the Asian Elephant, *Elephas maximus*, and two African elephants, *Loxodonta africana*, the Savanna Elephant, and *L. cyclotis,* the Forest Elephant. Elephants are among the most intelligent mammals.

### Genus *Loxodonta* – African Elephants

It is currently thought that the Savanna Elephant and the Forest Elephant represent two distinct species but *cyclotis* was considered to be a subspecies of *L. africana* until 1931 when it was suggested that it was a separate species. Since then, this suggestion has been supported by morphological, ecological and molecular data. However, in some parts of central Africa, there is evidence of hybridization; some authorities think this is ancient and that the two forms have had time to evolve into separate species, but others think it is recent and that the two forms are still subspecies.

It is the Savanna Elephant which occurs in Malawi.

## *Loxodonta africana*

## Savanna Elephant

**Malawian Names** Ndembo,Njobvu, Nkwinyimbi (old elephant), Zovu.

Liwonde N. P., Malawi © Bentley Palmer

**Description** The largest and heaviest land mammal and the only mammal in Malawi with a long prehensile trunk, very large ears and (normally) tusks. Males are usually 30% taller than females (shoulder height in adults: males: 275-300 cm, females 225-250 cm), double the weight of females and have longer and more massive tusks. Pelage absent. The skin is grey, with a few coarse black bristles, and is often deeply wrinkled. The back is slightly concave between the shoulders and the pelvis, but then slopes downwards to base of tail. Head large with high domed forehead, and with long highly muscular trunk (see above). Eyes small, usually dark brown, pale brown, yellowish or grey. Ears huge, usually held close to side of neck but can be spread out and may be flapped when the elephant is overheated, alarmed or threatened. Tusks project forward with a slightly upward curve; size of tusks varies depending on sex and age. Limbs very thickset (to support huge weight of body), ending in flat rounded feet with small short nails (normally 4 on forefoot, 3 on hindfoot). The bones of each foot are relatively small; an elephant walks on 'tip-toes', the foot bones being supported by a large 'cushion' formed of fatty adipose tissue and fibrous connective tissue, and by a sheath of thick fibrous material and thick skin. Tail relatively short ending in a tuft of thick coarse black bristles.

**Similar Species** None in Malawi.

**Distribution** In Malawi, currently mostly restricted to some National Parks and some other protected areas. They are currently found in Kasungu N. P., Liwonde N. P., Majete W. R., Nkhotakota W. R., Nyika N. P. and Vwaza Marsh G. R. Some herds are occasionally migratory and may occur outside these protected areas. Elsewhere: occurs in many savanna and semi-arid area of Africa (but not in rainforest where replaced by the Forest Elephant *L. cyclotis*). The distribution of Savanna Elephants has diminished greatly in recent years, as has their abundance (see also below).

*Historical Distribution* The earliest written records (from ca. 1860 onwards) state that elephants were numerous throughout Malawi. They were especially numerous in 'Elephant Marsh' (so named by David Livingstone in 1859 because of the huge herds of elephants which lived there. On one occasion, Livingstone saw about 800 elephants at a single locality! However, since guns were introduced into Malawi (and the rest of Africa) there has been a dramatic decline in the distribution of elephants (and their abundance).

*Present Distribution* Confined to the protected areas listed above and consequently each population is well separated from the others.

**Habitat** Savanna Elephants live in a wide range of habitats from sea level to montane regions, including grasslands, swamps, and grassland and woodland savannas. Because they can feed on so many sorts of vegetation (see below), Savanna Elephants are able find food in many diverse habitats. Optimal habitats provide shade and water. Elephants have the capacity to migrate over long distances from one habitat to another to find food and water if none are available locally (e.g. as a result of droughts, and seasonal variations in the availability of food).

**Abundance** On the African continent in the early 20th century, there were ca. 10 million elephants; in the early 21st century, there were an estimated 450,000 (a decline of ca. 95%). The same pattern of decline has occurred in Malawi and currently the remaining populations are fragmented. There is almost no numerical information about elephant abundance in Malawi until 1980-1990 (but plenty of comments such as “very common”). In eight protected areas, the estimated abundance in the 1980s was 500 (Kasungu N. P.), 400 (Nkhotakota W. R.),

400 (Liwonde N. P.), 250 (Vwaza March G. R.), 125 (Majete G. R.), 75 (Nyika N. P.) and 'occasional' (Mwabvi G. R.) – a total of ca. 1750 individuals. Elephants are not recorded from Lake Malawi N. P. and Lengwe N. P. These numbers are small compared with a few years previously, e.g. in ca. 1955, there were an estimated 2000 elephants in Nkhotakota W. R. In recent years, some elephants were removed from Liwonde N. P. where they had become too numerous: 70 individuals were translocated to Majete G. R. in 2006 (where they were locally extinct), and 520 were translocated to Nkhotakota G. R. in 2017/2018 (where only ca. 100 elephants remained). It is important to remember that it is very difficult to assess the abundance of elephants, and all estimates have wide margins of error.

**Habits** Savanna Elephants are primarily diurnal but are also active at night when they need to spend more time foraging and when they are threatened during the day by their proximity to humans. They have only one gait – a walk. They cannot trot or gallop. When moving around foraging, or going from place to place, their walking is slow (ca. 5 km/h) and this speed can be maintained for many hours when travelling from one feeding ground to another. When threatened, the 'walk' can be speeded up to ca. 40 km/h for a short distance (far faster than a human can run). Elephants can sit on their haunches to slide down slopes, and (despite their size and weight) they can lie on one side on the ground.

Savanna Elephants feed on many types of vegetation. Food is obtained by plucking sheaves of grasses by curling the trunk around the vegetation and then pulling it up to the mouth, and by browsing on leaves, twigs, small branches and fruits using the tip of the trunk to clasp the food and pull it to the mouth. Fruit fallen to the ground can be picked up delicately with the finger-like tips at the end of the trunk. Sometimes, a large elephant will use its head and tusks to push and uproot trees so the fruits, flowers and leaves in the canopy become accessible at ground-level. In Kasungu N. P., elephants feed on 35 species of trees, of which 13 are 'preferred' species. The preferred species are especially rich in fibre and in protein. Most food is browsed at 3-4 m above the ground in areas where the tree density is reasonably open (i.e. 100 trees/ha). The average food consumption/day is 250-300 kg for adult males, and 150-170 kg/day for adult females. Digestion in elephants is rather inefficient and they produce large balls of faeces full of fibre. To obtain all this food, elephants feed for up to 16 hours/day.

African Elephants are classified as social animals although some adult males are solitary. Females live in family units (sometimes referred to as 'maternal herds') composed of an adult female (the matriarch) with her calves and her older daughters with their calves. A family unit typically contains from 12-20 individuals. At times (e.g. at waterholes and when feeding in optimal localities), several family units (mostly genetically related) join to form 'bond-groups' (or 'kin-groups'). Young females stay with their family units and one of them will become the matriarch when her mother dies or becomes too old; other females, with their offspring, may split from their natal family unit to form a new unit and one of them will become the new matriarch. Young males leave the family unit when 12-16 years of age and join a bachelor herd; such herds comprise up to 35 males ranging in age from adolescence to reproductively active adults. Old post-reproductive males are often solitary. In general, elephants are very amicable towards their young and those belonging to their family unit; aggressive behaviour occurs only when an individual is threatened (e.g. by humans), when a mother is protecting her young calf, and when adult bulls are in reproductive condition.

Because elephants have enormous appetites, they need large home-ranges. Home-range size varies. As a generalization, elephants in lower rainfall areas have larger home-ranges than those in areas of high rainfall: e.g. home-ranges of female elephants in Tsavo N. P. (Kenya, 300 mm/year) are ca. 2380 km$^2$ and in the Zambezi Valley (Zimbabwe, 800 mm/year) are ca. 156 km$^2$. In Kasungu N. P., where there are miombo woodlands, grassy dambos, streams and swamps, home-ranges are comparatively very small. Elephants are not territorial.

Elephants have a close-knit social structure which is maintained by a dominance hierarchy and a very complex system of communication. The matriarch of the family unit is the oldest female, and she is the 'repository of the social knowledge' of her family unit which she learned from her mother, and which she passes down to her oldest female offspring. An old matriarch (over 50 years of age) can distinguish the calls of individuals with whom she frequently associates from the calls of 'unknown' individuals - and this knowledge determines her response. The matriarch also has the knowledge of where to forage, where to find water, how to move from place to place, and how to respond to seasonal changes in the environment. She also passes this knowledge on to the younger members of her family unit and she teaches them how to behave responsibly. Loss of the matriarch (by whatever means) causes a huge disruption to the social life of the family unit.

Sometimes there are large gatherings of elephants composed of several family units with many young of various ages and several males (both reproductive and non-reproductive) e.g. at waterholes when water is scarce.

Being very social animals, elephants utilize many forms of communication: visual, tactile, auditory, olfactory. All communications have a specific meaning and many of them can be observed when watching a herd for a few hours. Visual and tactile communication is very varied and complex, and may be grouped into eight functional categories:

(1) Group Defence: when threatened by a predator or another source of danger, elephants group together, especially when young are present. Adults raise their heads, spread their ears, and wave their trunks to catch scents. They stay alert and attentive, and there is much trumpeting and screaming; if provoked, one or more individuals may charge towards the source of danger.

(2) Sexual: for most of their lives, males and females live in separate social groups – males are either solitary or live in bachelor herds, and females live in family units. Males compete for access to females in oestrus when they are in musth (a period of several weeks/year when testosterone levels are high, secretions are exuded from suborbital glands, and aggressive behaviour is common). Only dominant males (usually the largest and oldest) have access to the oestrus females. Males test the reproductive status of a female by smelling her genitalia and urine. During these sexual encounters, males produce 'musth–rumbles' to advertise their presence and status, and females produce 'rumbles' – sometimes there is a 'female chorus' when several females call in unison. Sexual encounters are often accompanied by a lot of noise.

(3) Mother-offspring bonding provides safety and reassurance to calves, and allows them to suck. A calf pushes against its mother's legs and makes many sounds (rumbles, cries, grunts) when wanting to suck. Calves also make a series of calls when in distress; these calls elicit prompt responses from the mother - she caresses her calf with her trunk, and shepherds it to safety; when a herd is threatened, mothers cluster together with their calves protected in the centre of the cluster. A mother caresses her calf with her trunk and feet; she curls the trunk around the calf to help it out of trouble, sprays water over the calf when hot, and steers the calf by holding its tail with the tip of her trunk.

(4) Conflict: ear-spreading, ear folding, head shaking, sparring, chasing, charging (often accompanied by trumpeting), ramming an opponent.

(5) Social integration (when greeting others in the herd): when elephants meet, there are elaborate greeting ceremonies such as head-raising, ear-lifting, social rubbing, embracing, and clustering close to each other. There are mild threat displays by females within the herd which reinforce herd rank dominance.

(6) Play: Young elephants are very playful. They play with each other by trunk-wrestling, shoving, butting, chasing other species, and rolling in water. They also make a variety of sounds (trumpeting, snorting etc.) which are juvenile forms of the noises made by adults.

(7) Ambivalence/Displacement: these are behavioural displays which are out of context, such throwing dust, and plucking at vegetation but not eating it.

(8) Apprehension: twisting the trunk back and forth, swinging one foot, touching head or face with tip of trunk, tip of trunk curled upwards.

A very important aspect of communication is the production of sound. Some sounds are made by forcing air through the tip of the trunk (e.g. snorts, nasal trumpeting, trumpeting). Other sounds are produced in the larynx; these are (1) sonic noises that can be heard by humans (cries, shrieks etc.), and (2) seismic infrasonic noises which are too low to be heard by humans. Infrasonic noises (rumbles) are transmitted to the ground (via the bones of the forelimbs and the fatty cushion of the foot); these sounds can be 'heard' by other elephants up to 2.5 km away. Infrasonic sounds are very varied with respect to frequency, duration and loudness; they convey information about the position, status and reproductive condition of the individual producing the sound.

Although growth to maturity and reproduction takes many years (see below), elephant populations can increase rapidly when protected in a protected area and in the absence of poaching. This may result in habitat destruction. When this happens, elephants can either migrate to new areas searching for food (rarely possible at the present time), or they may die (due to overcrowding and shortage of food), or - if humans intervene - they can be translocated elsewhere (see above) or culled.

**Reproduction** No detailed information for Malawi. Elsewhere: gestation: ca. 23 months (cf. nine months in humans). Litter-size: 1 (twins very rare in most populations, e.g. only 0.08% in Amboseli N. P., Kenya). Neonates are precocial and stand within ca. 15 minutes of birth; weight at birth ca. 120 kg, shoulder height 79 cm (females) and 85 cm (males). Calves usually weaned at ca. 4 years when the mother gives birth to her next calf. Inter-birth interval varies according to locality (ca. 3-9 years) – the longest interval being in nutritionally-stressed populations. Growth is rapid and males are mostly larger than females at 4-5 years and thereafter. Adult size (shoulder height) and weight are attained at 30-40 years (females), but males continue to grow until ca. 50 years of age. Tusks are first visible externally at 2-3 years of age and continue to growth in length, circumference and weight throughout life.

**Conservation** IUCN Category: Endangered. Principal conservation concerns are reduction of suitable habitat (due to human encroachment into elephant habitat, urbanization and agriculture), poaching (for meat, ivory and other and trophies), and human conflict. Elephants are protected in many National Parks and Game Reserves, but most (70%) of the present biogeographic range in Africa is outside protected areas.

**Taxonomic Notes** *Loxodonta africana* Blumenbach, 1797. No subspecies (assuming *cyclotis* is a valid species – see above). Although many taxonomic names have been associated with the species (mostly as subspecies), none are currently considered to be valid.

**Key References** Jachmann (1986), Poole *et al.* (2013).

**Measurements**
*Loxodonta africana*

| | |
|---|---|
| Sh. ht (males): | 290 -370 cm |
| Sh. ht (females): | 250–300 cm |
| HF (males): | 360-540 mm |
| HF (females): | 340-470 mm |
| WT (males): | up to 6048 kg |
| WT (females): | up to 3232 kg |

Kenya (Amboseli N. P., Lee & Moss 1995 in Poole *et al.* 2013).

# ORDER PERISSODACTYLA – ODD-TOED UNGULATES



The perissodactyls are known as the odd-toed ungulates. Originally, all mammals had pentadactyl limbs with five fingers and five toes but, in some mammals, some of the five digits lost the function of supporting the body. They became smaller and situated above the plantar surface (so they did not contact the ground during locomotion) and some became vestigial and others were lost. In some mammals, hoofs evolved at the end of the weight-bearing digits, and these mammals are the ungulates. The odd-toed ungulates have ended up with an uneven number of weight-bearing digits – one in animals such as horses, zebras and asses which have one hoof on each leg, and three in the case of rhinoceroses. In contrast, the artiodactyls or even-toed ungulates, such as pigs, goats and antelopes, have two weight-bearing hoofs on each leg.

The order Perissodactyla contains three extant families – the Equidae and Rhinocerotidae which occur in Africa and elsewhere, and the Tapiridae (Tapirs) which occur only in South and Central America and SE Asia. Both of the families occurring in Africa are represented in Malawi.

## FAMILY EQUIDAE –Asses, Zebras and Horses

All equids are fast-running, diurnal grazers. In these mammals, the reduction in the number of digits is maximal – the central digit is large and ends in a hoof, and all that remains of the other digits is a pair of sliver-like bones called splints. Other bones in the pentadactyl limbs have also been modified during the evolution of the equids. The ulna became reduced in size and fused with the radius, the fibula became reduced and fused with the tibia, and consequently it is the radius and the tibia which are weight-bearing. Also, only the middle metacarpal and middle metatarsal bones (both greatly elongated), and the bones of Digit 3 in the feet, have been retained. This means that the knees of equids are equivalent to the wrists of humans, and the hocks are equivalent to the ankles.

The eyes face sideways and there is no overlapping of the visual field so equids do not have binocular vision, but they have all-round vision which helps them to see approaching predators. They have chisel-like incisor and canine teeth for biting and pulling off the leaves of grasses, and continuously growing cheekteeth, with complex folds of enamel, for grinding the grass. There is a wide gap between the canines and the cheekteeth. The digestive tract is simple. Food passes only once through a simple stomach. Equids do not ruminate and chew cud.

The family Equidae has only seven living species and all are placed in the genus *Equus*.

### Genus *Equus* – Asses and Zebras

In Africa, the family Equidae is represented by three species of zebras and the African Wild Ass, but only one species of zebra occurs in Malawi. There are no naturally occurring horses in Africa.

The most noticeable characteristic of zebras is that their pelage has black stripes on a white background. However, the patterns of stripes vary greatly depending on the density of stripes in different parts of the body, the relative width of the black stripes and the white gaps between the stripes, the presence or absence of stripes on different parts of the body, the ways in which vertical stripes on some parts of the body meet horizontal stripes on other parts of the body, the presence or absence of shadow stripes (paler brownish stripes between the black stripes), whether or not any of the stripes are broken into lines of dots or dashes, whether or not any of the stripes fork into two stripes, and whether or not some of the black stripes merge together to create large areas of black pelage. The pattern of stripes is different in the three species. Furthermore, there are geographical variations in the stripe-patterns of all three species which has led to the naming of at least two subspecies within each species. The most common species is *Equus quagga*, and this species has six subspecies including *E. q. crawshayi* which occurs in Malawi and parts of Zambia, Tanzania and Mozambique.

*Equus quagga*

## Plains Zebra

**Malawian Names** Boli, Liduwi, Mbidzi, Mbunda.

Nyika N. P., Malawi © Bentley Palmer

**Description** (subspecies *crawshayi* – see Taxonomic Notes below). A large horse-like mammal with conspicuous black stripes on a white background. Males, on average, larger than females. Pelage background colour white; maybe pale reddish-brown on back and flanks after rolling in soil or mud. Neck and back with black, vertical, very clearly defined stripes. Stripes on each side of the neck, chest and flanks meet on the mid-ventral line (although in some individuals the most anterior and most posterior stripes on the chest and flanks do not meet). There are ca. ten black stripes on the neck and ca. nine which meet or almost meet under the belly. Stripes on the rump and thighs are wide and horizontal; stripes on the rump bend and become vertical when they reach the flank. No shadow stripes between the black stripes. Neck with upright mane (with stripes) on mid-dorsal line. Head with vertical or curved stripes on cheeks and muzzle; longitudinal stripes on forehead; muzzle region black. Ears tall and rounded, black with orange-brown at tip. Limbs long and sturdy with many horizontal black stripes along the length of each limb to just above the hoofs. Limbs have a terminal single digit (Digit 3), enclosed by a thick rounded 'nail' (hoof). Tail ca. 23% of HB, with black rings on upper part, and long coarse black hairs on lower part. The pattern of stripes is unique for each individual and therefore individuals can be recognized easily. In Kenya, researchers convert stripe-patterns into "bar codes" so that photographs of individuals can be identified using computer programmes.

**Similar Species** None. This is the only large mammal with highly visible black stripes.

**Distribution** Currently, very restricted in Malawi (see below). Elsewhere: widely distributed in savanna regions of eastern Africa from South Sudan to northern South Africa.
*Historical Distribution*: In the late 1890s, zebras in British Central Africa were "still extremely common" in all areas that are now Malawi. The plains of the Upper Shire River contained huge herds of zebras (and many species of antelopes); they were especially numerous around Lake Shirwa (= Lake Chilwa). Old records show that Zebras occurred from the far north (i.e. Nyika Plateau, Vwaza Marsh) southwards to Nkhotakota, Kasungu, Dedza, Ntcheu, Liwonde, Zomba, Mulanje and the Lower Shire Valley (Lengwe, Majete, Mwabvi).
*Present Distribution*: Zebras are locally extinct in most of the localities listed above. They now occur only in Nyika N. P and Vwaza Marsh G. R., and possibly also occur in Kasungu N. P., Nkhotakota W. R. and Majete W. R. Recently, Zebras have been re-introduced into Liwonde N. P., Majete W. R. and Nkhotakota W. R., and into some private game parks.

**Habitat** Grassland savannas and woodland savannas where water is available.

**Abundance** In Malawi, rare except on the Nyika Plateau (herds small – up to ca. 10 individuals).
Very abundant in some localities (e.g. East Africa) where, together with other species, they form large herds.

**Habits** Zebras are quadrupedal with four gaits – walk, trot, canter and gallop. They feed exclusively on grass (90%) and herbs (10%). The species of plants that are eaten depends on their availability, and this changes seasonally. They can be non-selective foragers, although usually 3-4 species of grasses are preferred if available. Zebras like short grass and will congregate on recently burnt savanna to graze on the new shoots. They also feed on long grasses trampling them underfoot so they re-shoot and open up the herb layer which now becomes suitable for other species, such as antelopes. In the wet season, they feed mainly on the green leaves and leaf sheaves of

grasses, and in the dry season, they feed on the coarse dry fibrous stems of low nutritional quality that are avoided by other species. Zebras are not ruminants which chew cud (cf. antelopes).

Zebras are social and live in family groups (herds). Herds are composed of a male (stallion), one or several females (mares) and their young. Stallions may also form single-sex groups, or may live singly. Under some circumstances, herds may join temporarily to form larger congregations, which later separate into their original herds. On the Nyika Plateau, herd size (in the 1960s and 1980s) was usually 4-7 individuals, and up to 30 individuals when several herds joined up. Herds are non-territorial and so are able to move at will - hence home-ranges can be very large. In Serengeti N. P., home-ranges of *E. q. boehmi* (when not migrating) are 400-600 km$^2$, and up to 2000 km$^2$ during the annual migration.

Family herds are a stable social organization. Females tend to stay in the same herd throughout their life; the stallion (who has exclusive mating rights to the females in his herd) remains until he is replaced by a stronger younger male. Young females leave the parental herd at 1-2.5 years of age (often at oestrus, when they join newly established herds); young males leave at 1-4 years of age and either join a stallion herd or try to form a new herd. In regions where Zebras co-exist with Common Wildebeest the two species mingle for their mutual advantage.

Zebras have many vocal and behavioural displays which promote cohesion and maintain relationships between individuals. (These are very easy to observe when watching zebras). When meeting, two individuals make nose-to-nose contact and sniff each other, and often stand side by side, sometimes with the head resting on the shoulders of another individual; greetings are accompanied by jerking of the head up and down with the neck stretched forward. Threat is indicated by lowering the head, directing the ears backwards and baring the teeth. Zebras make 3-syllable barking sounds when trying to keep in contact – the calls of individuals are distinct. Short snorts are warning calls. The sense of smell is very important in zebra societies. When males sniff piles of droppings and when they are assessing the reproductive condition of females, they curl the upper lip backwards and the lower lip downwards and inhale (with the nostrils closed) so pheromones and other scents can be analyzed by special sense organs in the mouth (a behaviour called flehmen).

**Conservation** IUCN Category: Least Concern. Plains Zebras are common in some parts of their biogeographic range, although numbers have declined in some countries. In Malawi, population numbers have been drastically reduced; recent introductions should help to increase numbers and restock areas where they became locally extinct.

**Taxonomic Note** *Equus quagga* Boddaert, 1785. The zebra in Malawi was referred to as *Equus burchellii* by Sweeney (1959), Hayes (1978), Ansell & Dowsett (1988) and Hough (1989). However, recent studies have placed the Plains Zebras into *E. quagga* (which originally contained only the Quagga of South Africa which became extinct in 1883). Thus *E. quagga* now comprises six subspecies, two of which are *E. q. burchellii* (formerly Burchell's Zebra, *E. burchellii*) and *E. q. crawshayi* (formerly Crawshay's Zebra, *E. burchellii crawshayi*). The subspecies in Malawi is *crawshayi*, not *burchellii* as stated by earlier authors. (The subspecies *burchellii* is now restricted to South Africa, Botswana and Namibia.). In some publications, *crawshayi* is spelt incorrectly as *crawshaii*.

**Key References** Klingel (2013a), Lemon (1968).

**Measurements**
*Equus quagga boehmi*

| | |
|---|---|
| TL (males): | 2521 (2365–2675) mm, n = 13 |
| TL (females): | 2513 (2250–2600) mm, n 8 |
| T (males): | 475 (430–515) mm, n = 13 |
| T (females): | 460 (430–490) mm, n = 8 |
| E (males): | 168 (155–178) mm, n = 13 |
| E (females): | 169 (160–177) mm, n = 8 |
| Sh. ht (males): | 1164 (1120–1215) mm, n = 13 |
| Sh. ht (females): | 1134 (1065–1205) mm, n = 8 |
| WT (males): | 247.8 (220.4–284.0) kg, n = 13 |
| WT (females): | 219.1 (175.5–241.5) kg, n = 8 |

Tanzania (Serengeti N. P., Sachs 1967 in Klingel 2013a).
Measurements not available for *E. q. crawshayi.*

## FAMILY RHINOCEROTIDAE - Rhinoceroses

Rhinoceroses (rhinos) are large very heavily built mammals with a massive body, short sturdy legs and a large head with one or two horns arising from the midline of the nasal area. The horns are composed of keratin. They have very thick skin which is almost naked and either wrinkled, furrowed or pleated so as to resemble armour plating. They include both grazing and browsing species. In rhinos, the number of digits has been reduced to three, each ending in a hoof, and there is a large pad between the hoofs which is also weight-bearing. In the forelimbs, both the radius and ulna are weight-bearing, and three of the metacarpals are retained but they are not as elongated as they are in equids. Similarly, in the hindlimbs, both the tibia and fibula are weight-bearing and three of the metatarsals are retained. Like Equids, rhinos can walk, trot, canter and gallop and can attain speeds of 50-55 km/h – which makes them very dangerous if they charge people or vehicles.

The eyes are small and face outwards, giving them a wide visual field, but their eyesight is poor and they rely more on their sense of smell to detect sources of danger. However, they have few natural enemies. The teeth are mainly for grinding grass and foliage. The incisors and canines are absent or vestigial except for the lower incisors of Asian rhinos which are well developed into tusks, and there is a gap in front of the premolar teeth. The digestive tract is simple, there is only one stomach and rhinos do not ruminate and chew cud.

The family Rhinocerotidae has five living species (placed in four genera) of which three are found in Asia. In Africa, there are only two living species – the White Rhinoceros (*Ceratotherium simum*) and the Black Rhinoceros (*Diceros bicornis*). Only the latter occurs in Malawi.

### Genus *Diceros* – Black Rhinoceros

This genus contains only one living species.

### *Diceros bicornis*

### Black Rhinoceros

**Malawian Names** Chipembele, Chipembere.

Liwonde N. P., Malawi © Bentley Palmer

**Description** A very large and heavily built mammal with short thick limbs and two large horns arising from the midline of the upper surface of the muzzle. Males and females similar in size and weight. Pelage absent; skin medium to dark grey but often coloured by sand or dried mud. Body rotund with large ribcage so that skin maybe slightly wrinkled close to the ribs. Head very large; ears tall and rounded at tip with fringe of bristles along top edge. Eyes dark and relatively small. Upper lip wrinkled with triangular hooked tip (hence alternative name – Hook-lipped Rhinoceros). The most obvious features of the head are the two horns. The anterior horn above the mouth points forward (often extending in front of the mouth); it is circular and thick at base tapering to a sharp point. The posterior horn, above the eye, is shorter and is also circular at base tapering to a point. Both horns are made of keratin (the same substance as hair, hooves and fingernails) - not bone. Limbs relatively short and thick, each with three hoofs all of which touch the ground. Tail ca. 20% of HB; thin without any tuft at the tip. Incisor and canine teeth are absent; there are three molar-like premolars and three molars on each side of each jaw.

**Similar Species** None in Malawi. The only other large African mammal with two large horns on the front of the head is the White Rhinoceros (not present in Malawi).

**Distribution** Formerly widespread in Malawi but became extinct (see also below). Elsewhere: Black Rhinos were widespread and common throughout most of sub-Saharan Africa but are now extinct in most of their former biogeographic range. Wild populations are present now only in parts of South Africa, Namibia, Zimbabwe and Kenya.
*Historical Distribution*: In the early days of the Central African Protectorate, Black Rhinos were widespread in most of the area which is now Malawi except in montane regions. By 1988, the only known individuals were recorded in Kasungu N. P. (10-20 animals) and Mwabvi W. R. (6-7 animals). Within a few years, Black Rhinos were extinct in Malawi because of habitat loss and poaching.
*Present Distribution*: In 2003, seven Black Rhinos from Natal (South Africa) were introduced to Majete W. R., and in 2015, 17 Black Rhinos (also from Natal) were introduced to Liwonde N. P.

**Habitat** Savanna habitats with dense thickets and shrubs (including 'valley bushveld' and 'thornveld' in South Africa). In some areas, lives on the edges of forest where undergrowth is well-developed. Good quality browse is the main factor influencing rhinoceros numbers and density (see also below).

**Abundance** In Malawi, Black Rhinos were considered to be uncommon even though widespread in the late 1890s and early 1900s (see also above). They became extinct because of poaching in the late 1980s. The only individuals in Malawi in 2020 were introduced from South Africa.

**Habits** Black Rhinos are primarily diurnal but, because they have a very thick skin and a low surface-area to body-weight ratio, thermoregulation is difficult and they must avoid activity during the hottest time of day. They attempt to keep cool by resting in shady and/or breezy places (such as the tops of ridges), and by wallowing in pools or mud. They need to drink but usually travel to water near dawn or dusk or during the night when it is cool and, if they have far to travel, they only drink every 2-3 days. They also do much of their feeding at night as well as in the early morning and late afternoon.

Black Rhinos are browsers; they feed on a variety of leaves, shoots and fruits. Food is plucked from the trees and shrubs and pulled into the mouth by the mobile upper lip. There are no incisor and canine teeth, so the food is then bitten off by the cheek teeth. Black Rhinos mostly browse at 0.5–1.5 m above the ground, occasionally as high as 2 m. They feed on a large variety of species of plants (maybe up 100 during the course of a year) but most of the diet is composed of about 20 species. Food is digested mainly by fermentation in the caecum which is very large.

Black Rhinos are mostly solitary except when a mother has a calf. Home-ranges vary in size depending on the quality of food resources. In high quality habitats, home-ranges are 43-44 $km^2$, whereas in semi-arid habitats of poor-quality forage, home-ranges average 380 $km^2$. Females occupy home-ranges that may overlap with those of other females and males. Within a home-range, dominant adult males establish a territory to exclude other males. In spite of being solitary for most of the time, rhinos will congregate in small groups around important limiting resources such as waterholes and favoured fruiting plants, and immature males may congregate with other immature males and adult females.

Social communication is important in rhino society. Rhinos use scent marking by scattering dung and by urination. Females in oestrus advertise their sexual status by the special scent of the urine. Rhinos tend to maintain long-term bonds and related individuals may join up for short periods of time. Rhinos are well-known to be aggressive and unpredictable. Males will chase a subordinate male from his territory, and often the subordinate is injured or killed. When threatened, or uncertain about a situation, rhinos will often charge towards the threat accompanied by a puffing snort. Sight is poor, so information about the surroundings is perceived mostly by scent and sound.

Adult Black Rhinos are occasionally attacked by Lions and Spotted Hyaenas, but the attacks are seldom successful. However, there are records of calves being killed by these predators. Black Rhinos may also have aggressive encounters with elephants and buffalos at waterholes during droughts. Black Rhinos are well known to charge humans but this aggression probably depends on how often the rhinos are harassed or threatened, and some charges may also be solely investigatory.

**Reproduction** Rhinos breed at most times of the year; there may be seasonal peaks of births (determined by rainfall and/or temperature), but timing may also be related to the nutritional status of the female. Gestation: ca. 450 days (ca. 15 months). Litter-size: 1. Neonates are precocial; they weigh 25-40 kg and can stand and walk within few hours. Weaning: ca. 2 years. Calves remain close to their mothers, walking beside or just behind them. Sexual maturity: 4-7 years (females), 7-10 years (males). Females breed every 2.5-4 years.

**Conservation** IUCN Category: Critically Endangered. In the whole of Africa there were an estimated 850,000 individuals at the beginning of the 1900s. Since then, Black Rhinos have suffered a dramatic decline in population numbers. By 1960, only an estimated 100,000 remained as a result of hunting and habitat loss. Between 1960 and 1995, large-scale poaching caused a dramatic 98% collapse in numbers. In 2010, there were only about 5000 individuals, most of them in South Africa and Namibia. Most of the poaching is to obtain horns which are erroneously believed, by Asians, to have medicinal properties.

**Taxonomic Notes** *Diceros bicornis* (Linnaeus, 1758). Four subspecies; the subspecies in southern Africa (including Malawi, but excluding Namibia and western South Africa) is *D. b. minor*. One subspecies, the Western Black Rhino of West Africa (*D. b. longipes*) is now considered extinct. The validity of the subspecies is uncertain.

**Key References** Emslie & Adcock (2013), Smithers (1983).

**Measurements**
*Diceros bicornis*

| | |
|---|---|
| HB: | 2900–3800 mm |
| T: | 600–700 mm |
| E: | n. d. |
| Sh. ht: | 1.4–1.7 m |
| Anterior horn length: | 500–1300 mm |
| Posterior horn length: | 20–55 mm |
| WT: | 800 - 1300 kg |

Throughout biogeographic range (many sources).

# ORDER ARTIODACTYLA – EVEN-TOED UNGULATES



The artiodactyls are known as the even-toed ungulates because they have two weight-bearing hoofs (cf. one or three in the order Perissodactyla). The weight-bearing hoofs are at the end of Digits 3 and 4. The other three digits are either absent, vestigial or they point backwards and do not contact the ground during locomotion.

The artiodactyls are closely related to whales and dolphins in the order Cetacea, and recently the two orders have been combined into a new taxon, the order Cetartiodactyla. Here, however, we continue to use the familiar old name for the terrestrial, even-toed hoofed mammals which occur in Africa.

There are ten families of living artiodactyls, of which six are represented in Africa, but only four occur in Malawi – the Suidae (pigs), Hippopotamidae (hippos), Giraffidae (giraffes) and Bovidae (buffalo, antelopes). The families which occur in Africa but not in Malawi are the Tragulidae (Chevrotains) and the Cervidae (deer). The families are presented in the traditional sequence (as above) but the genera within each family are in the alphabetical order of their scientific names.

## FAMILY SUIDAE – Pigs and hogs

This family contains five genera of which four genera and six species occur in Africa but only two genera, *Phacochoerus* and *Potomochoerus,* and two species occur in Malawi. Some are known as hogs. Pigs and hogs have four digits with hoofs on each leg, but only the hoofs of Digits 3 and 4 touch the ground and are weight-bearing. In all pigs and hogs, the nostrils are surrounded by a partly cartilaginous mobile oval disc (called a rhinarium), they have leathery skin with either sparse or moderately dense bristle-like hairs, and simple non-ruminating stomachs which means that they do not chew cud. There are wart-like lumps on the head which are referred to as warts although they are not true warts; the number of warts, and their position, are of diagnostic value. There is a mane of long hairs along the mid-dorsal line; its colour is of diagnostic value.

Unlike most other artiodactyls, pigs and hogs have both upper and lower incisors and upper and lower canines. The upper canine teeth are large and curve upwards and outwards, and they occlude against the lower canine teeth. In *Phacochoerus*, the upper canines have become tusks and they rub against the lower canines

in such a way that they are able to grow long and their tips and edges are kept sharp. In contrast, in *Potamochoerus*, the upper canines are worn by rubbing against the lower canines (and also against the ground while rooting) in such a way that their front surfaces become flat and they do not form tusks. In *Phacochoerus*, the premolar and molar teeth erupt sequentially so that, as the most anterior teeth are worn down and lost, they are replaced by the teeth which erupt later from behind. The third molar is the last to erupt, and it is much larger than the anterior molars and it does not stop growing and becoming longer; in mature animals, it is the only cheektooth which is retained.

Male pigs and hogs are called boars, females are sows, very young ones are piglets, and social groups are called sounders.

The two species which occur in Malawi can be distinguished by the information in the yellow box below.

*Phacochoerus africanus* (Common Warthog). Upper canines developed into conspicuous, upturned tusks, especially in boars. Head dark grey, almost naked; with a prominent wart below each eye and a less prominent wart on the muzzle behind each tusk. Body almost naked. Mid-dorsal mane black. Tail held erect when running.

*Potomochoerus larvatus* (Bushpig). Upper canines not forming conspicuous tusks. Head with whitish pelage on forehead and cheeks. Older boars with a flattish wart on each side of the muzzle and at the angle of each jaw. No prominent wart below each eye. Body well covered with reddish-brown hairs (or perhaps sometimes greyish-brown hairs). Mid-dorsal mane mostly white. Tail held down when running.

## Genus *Phacochoerus* - Warthogs

This genus is currently considered to contain two living species: *P. aethiopicus* (Desert Warthog) described in 1766 and *P. africanus* (Common Warthog) described in 1788. However, in 1915, all warthogs were placed in *P. aethiopicus*, and it was not until 1993 that it was widely accepted that *africanus* should be reinstated as a distinct species. *Phacochoerus aethiopicus* occurred in South Africa and also in arid parts of E Kenya, E Ethiopia and N and S Somalia, but it became extinct in South Africa prior to 1890. *Phacochoerus africanus* has a much wider distribution and much more is known about it. This is the species that occurs in Malawi.

## *Phacochoerus africanus*

## Common Warthog

**Malawian Names** Liphango, Kaphulika, Mbango, Mnjiri, Njeri.

Liwonde N. P., Malawi © Bentley Palmer

**Description** A grey-coloured pig with relatively large head, well-developed tusks and a straight, tasseled tail which is held upright when running. Boars, on average, larger than sows and have larger tusks and warts (see below). Overall colour is due to the grey skin, covered with sparse grey or black bristles. There is a dark grey to black mane on the mid-dorsal line; long and thick on neck and shoulders, shorter on back and rump. Head relatively large; ears large and pointed; large wart on cheek on either side of the eye and smaller wart on each side of muzzle. White whiskers grow along the lower edge of the cheeks. The nostrils are surrounded by an oval rhinarium (as in all pigs). There are huge tusks (upper canine teeth) on each upper mandible; each tusk curves outwards and upwards above muzzle. There are smaller tusks (lower canine teeth) on the lower mandibles. Tusks and warts are especially well-developed in males. Limbs grey, relatively long, each with four digits ending in a small hoof, but only the hoofs of Digits 3 and 4 touch the ground. Tail grey (ca. 40% of HB), straight, with small tassel of coarse black hairs at tip. Young Common Warthogs are same colour as parents (without any markings of a different colour). After wallowing in mud (a favourite occupation), the mud dries on the skin and the warthog takes on the colour of the local soils.

**Similar Species** None (see yellow box above).

**Distribution** In the past, recorded throughout Malawi from north of the Nyika Plateau to Nsanje and Mwabvi W. R. in the south. Distribution less widespread and patchy at the present time. Occurs in all national parks, wildlife reserves and in Vwaza Marsh G. R. Elsewhere: widely distributed in savanna habitats throughout Africa from Senegal to Ethiopia and South Sudan, and southwards to N South Africa.

**Habitat** Common Warthogs occur in a wide range of savanna grasslands and woodlands, usually near to perennial waterholes and wallows. Suitable habitats must also have burrows dug by aardvarks or other animals, sink-holes or caves in which warthogs can sleep. They avoid forests and very dense thickets, although they will forage in grassy glades in or on the edges of forest. After savanna fires, warthogs move into burned areas to feed on the new grass shoots.

**Abundance** No details for Malawi; small populations occur in some conservation areas.

**Habits** Common Warthogs are active (foraging, moving about, drinking, wallowing) mainly during early morning and late afternoon. When on the move, they trot quickly, with the tail held vertically like a flag. At night, they rest in burrows – usually abandoned burrows of Aardvarks. They can modify these burrows, but it is not certain that they can dig whole burrows by themselves. Burrows are also used to escape from predators (as are culverts under roads). A group may utilize several burrows over a short period of time moving from burrow to burrow as conditions dictate. On any night, a burrow is usually occupied by a single group. Warthogs often wallow in mud in low-lying hollows or at the edges of waterholes, and emerge covered in mud. It is likely that they wallow to cool themselves, to protect the skin from sunburn, biting insects and dehydration, to remove ectoparasites and to provide camouflage.

Common Warthogs feed primarily on the blades, seeds and roots of grasses. In all studies in different parts of Africa, these warthogs have been shown to eat a wide variety of grass species (varies by locality and season of the year). During the wet season, they feed on the green blades of grasses, but during the dry season they feed mostly on the roots and rhizomes of grasses. In southern Africa, Common Warthogs grazed on 34 species of grasses, although normally only 2-8 species form the majority of the diet and the preferred species vary from locality to locality. They rarely feed on fruits, tubers

and bulbs. When foraging, warthogs crop the grass and dig down into the soil using the dorsal edge of the rhinarium to nudge soil aside and expose the roots; this behaviour is called rooting. They do not use their tusks for digging or for uprooting grasses. Warthogs often 'kneel down' on their 'wrists' so that the rhinarium and mouth are closer to the ground. Warthogs like to drink free water each day but can survive for several days without water if there is adequate in the grasses and roots.

Common Warthogs are mostly social animals which live in small groups known as sounders: these are typically comprised of an adult female with her young (and sometimes also the subadults from a previous litter), or young bachelor males. Groups comprised of a female and her young are called matriarchal sounders. Adult males tend to be solitary. Groups may join up, when conditions are good, to form 'clans' of up to 18 individuals, but the size of a sounder is limited by the size of the burrow in which all the group-members sleep. Home-ranges of matriarchal sounders vary in area from ca. 24 ha in South Africa to ca. 600 ha in East Africa; the area may be extended or reduced according to the seasonal availability of food and water. The home-range of a sounder is not defended and may overlap with the home-ranges of other sounders. Scent-marking (with secretions from the preorbital glands rubbed onto tree trunks and bushes) is used to advertise the boundaries of the home-range.

The bond between a mother and her young is especially strong and lasts for about a year when a new litter is born and young males leave the group. When two warthogs meet, the ears are held at the side of the body, and they make nose-to-nose contact, nose-to-mouth contact and may also sniff glandular areas. If the warthogs are friendly, amicable behaviour may follow; this includes pressing against each other's bodies and placing the chin on the other's back. Amicable behaviour also includes allogrooming and one individual may lie on its side or back to solicit grooming by another individual. Playing is commonly observed amongst piglets (which appear to be having lots of fun!). Adult males fight fiercely when threatened or when challenging the dominance of another individual; fights involve rushing towards to opponent, head-to-head clashing with the snout and tusks, and using the tusks to hit the opponent's head, neck and flanks. The warts on the head may serve to protect the eyes and parts of the head that are essential for feeding.

In 1985, it was ascertained that ticks from warthogs in Liwonde N. P. did not carry the swine fever virus.

**Reproduction** No information for Malawi. Elsewhere: the timing of reproduction varies in different parts of Africa and is dependent on when the wet season occurs. In SE Tanzania (and probably Malawi), mating occurs from Mar-Apr and births occur in Sep-Oct. Gestation: ca. 170 days. Litter-size: 1-4 (usually 3, but sometimes 8). Piglets are born in a burrow. Neonates are pink in colour without any markings. The mother suckles her piglets for ca. 3-4 months, and thereafter the piglets accompany the mother when she is foraging. Maturity is attained at 17-20 months, and females produce their first litter at ca. 24 months. Adult size and weight are reached at 36-48 months.

**Conservation** IUCN Category: Least Concern. The large biogeographic range and high rate of reproduction has maintained good populations of Common Warthogs in many parts of Africa. However, their range is smaller now than in the past, and shooting in agricultural areas controls their numbers.

**Taxonomic Notes** *Phacochoerus africanus* (Gmelin, 1788). Referred to as *Phacochoerus aethiopicus* by Sweeney (1959), Hayes (1978), Ansell & Dowsett (1988) and Hough (1989). For a long time, the name *P. aethiopicus* referred to both species of warthogs but it is now restricted to the Desert Warthog of arid parts of Kenya, Ethiopia and Somalia (see Genus *Phacochoerus*).

**Key Reference** Cumming (2013).

**Measurements**
*Phacochoerus africanus*

| | |
|---|---|
| HB (males): | 1323 (1165–1440) mm, n = 56 |
| HB (females): | 1182 (1090–1268) mm, n = 74 |
| T: | ca. 450 mm* |
| Sh. ht (males): | 682 (612–720) mm, n = 56 |
| Sh. ht (females): | 598 (543–657) mm, n = 74 |
| WT (males): | 79.6 (59.3–103.9) kg, n = 56 |
| WT (females): | 56.5 (44.6–69.1) kg, n = 74 |

South Africa (Hluhluwe G. R., KwaZulu–Natal, Mason 1985 in Cumming 2013).
*Southern Africa (Stuart & Stuart 2015)

# Genus *Potamochoerus* – Bushpig and Red River Hog

This genus contains two species, the Bushpig (*P. larvatus*), and the Red River Hog (*P. porcus*) which occurs in forest habitats in West Africa and Central Africa. These species were considered conspecific and referred to as *P. porcus*, until 1993 when *larvatus* was shown to be distinct. Only the Bushpig occurs in Malawi.

## *Potamochoerus larvatus*

## Bushpig

**Malawian Names** Liguluwe, Nguluwenjasi, Ngulube, Nguluwe.

Liwonde N. P., Malawi © Bentley Palmer

**Description** (based on individual from Liwonde N. P.). A reddish-brown pig with a hairy body, a well-developed white mid-dorsal mane and large head with whitish forehead and cheeks. Boars, on average, larger than sows. Pelage coarse; hairs bristle-like. Pelage of sides reddish-brown (cinnamon); ventral pelage and limbs dark blackish-brown. There is a mane of long white erectile hairs (ca. 60 mm) from neck to base of tail. Head relatively large with elongated muzzle, nostrils surrounded by a rhinarium; forehead and posterior half of cheeks white or whitish; anterior half of cheeks and muzzle blackish. Older boars with a flattish wart (usually large) on each side of the muzzle and a much smaller wart on each cheek. Sows have a small wart on each side of the muzzle, but no warts on the cheeks. Ears long, dark, pointed at tip; tip and edges fringed with black hairs. Eyes small. Upper canine teeth not developed into large tusks (cf. warthog); lower canines have a sharp point and sharp edges and they project upwards outside the upper lips (but not very conspicuously) and are used as weapons. Limbs with four digits on each foot, each ending in a small hoof; hoofs of Digit 3 and Digit 4 are large and weight-bearing; Digits 2 and 5 point backwards and their small hoofs do not touch the ground. Tail ca. 30% of HB; thin, straight and almost hairless with small black tuft at tip. The tail hangs down even when running (cf. Warthog). Piglets (up to ca. 24 weeks of age) have longitudinal white stripes (complete or incomplete) on the flanks.

**Similar Species** None (see yellow box above).

**Distribution** Once widespread in Malawi, from ca. 100 m in the Lower Shire Valley to ca. 2500 m on the Nyika Plateau, especially where there was cover and water, but much less widespread now. Currently reported from Kasungu N. P., Lengwe N. P., Liwonde N. P., Nkhotakota W. R., Nyika N. P. and Vwaza Marsh G. R. Also recorded from Lake Malawi N. P., Majete W. R., Mangoche Mountain, Matipa Forest in the Misuku Hills, Mwabvi W. R., Ntchisi Mountain, Zomba and Zomba Plateau, but unlikely to occur in some of these localities now. Elsewhere: recorded throughout eastern Africa from Ethiopia and South Sudan to South Africa, including southern parts of DRC and Zambia. Introduced on Madagascar (which is the type locality of *P. larvatus*) and the Comoro Islands.

**Habitat** Bushpigs are recorded from many habitats in Malawi, e.g. thicket-clump savanna, open canopy miombo woodlands, swamps, dense woodlands, riverine and montane forests, and farmlands. Suitable habitats must have dense cover and be close to water.

**Abundance** No detailed information for Malawi, although Bushpigs were said to be "usually common and often a pest to cultivation" in the past. Because Bushpigs are secretive and mostly nocturnal, they are rarely seen.

**Habits** Terrestrial, nocturnal and crepuscular, omnivorous, social. Bushpigs are primarily nocturnal, but are sometimes active during the day in protected areas - e.g. they have been seen at the Main Waterhole in Lengwe N. P. during the day. They rest and sleep in any dense cover available. Like Warthogs, they wallow in mud for the same reasons, and also bathe in shallow water. They can swim well and can cross rivers in this way.

Bushpigs are omnivorous. In South Africa, the diet consisted of subterranean plant structures (roots, rhizomes, bulbs tubers, etc.) 40%, above-ground vegetation (grasses, herbs, ferns) 30%, fruits (13%), animal matter (9%) and fungi (8%). They are opportunistic feeders and the species of plants in the diet varies from place to place. They obtain these foods by grazing and browsing up to 50 cm above ground, by superficial rooting in leaf litter and shallow soil, and by deep rooting in moist or loose soil to a depth of ca. 50 cm. Rooting is done with the rhinarium, but the protruding lower canine teeth are worn down during rooting. When Bushpigs feed in agricultural fields, they can cause great damage to maize, sugar cane, and many other crops.

Bushpigs live in family groups ('sounders'); these are typically comprised of a boar and one sow, and their young from one or two litters. Sometimes there are solitary individuals, either adult males, or dispersing subadults. Bushpigs are monogamous, and the male-female bond lasts well beyond the rearing of the young. Group-sizes range from 2-10 individuals, but it is only the dominant sow that breeds. Bushpig sounders are territorial; in Knysna Forest, South Africa, the average size of a territory is 7.2 $km^2$.

Bushpigs have a wide range of communication sounds and signals. Group cohesion and social status within the sounder is maintained by various vocal sounds - grunts, squeals, snarls and snorts. Boars mark trees and vegetation with secretions from glands close to their canines to advertise their presence. Territories are marked by depositing faeces in 'latrines' and they are defended by the sows who are more aggressive and territorial than the boars. At times, serious fights break out between females and they often result in injury or death. Males assert their dominance by chasing, pushing with the nose, and snapping at each other.

Bushpigs may be infested with ticks, and they are sometimes seen during the day with several Red-billed Oxpecker birds (*Buphagus erythrorynchusi)* clinging to their heads and bodies while searching for ticks on the skin.

**Reproduction** No information for Malawi. Elsewhere: gestation: 17 weeks. Litter-size (in the wild): 3-4. At birth, piglets are covered with bristles (see above), and the eyes are open; weight: 600-1000 g. Lactation lasts for up to 5.5 weeks, and maturity is attained at 17-22 months. Piglets are born in Nov–Feb (South Africa) and Oct–Mar (Zambia) – when fresh vegetation is available for the piglets. The piglets are born in shallow hollows in the ground; if the weather is cold and/or wet, the hollow is lined with a large nest of grass, sticks and leaves. They begin to leave the hollow or nest within one to three days. One or both parents remain close to the piglets and guard them.

**Conservation** IUCN Category: Least Concern. In some parts of southern African, Bushpigs are shot to control their numbers, and are hunted for "bushmeat".

**Taxonomic Notes** *Potamochoerus larvatus* (F. Cuvier, 1822). Prior to 1993, considered to be conspecific with *P. porcus* (see Genus *Potamochoerus*). Referred to as *Potamochoerus porcus* by Sweeney (1959), Hayes (1978), Ansell & Dowsett (1988) and Hough (1989). Other names used in the past, pertaining to the species in Malawi, are *Potamochoerus choeropotamus nyasae* (from Zomba) and *Potamochoerus johnstoni* (from 'North Nyasa District' – exact locality unknown). According to Seydack (2013), two subspecies occur on mainland Africa; *P. l. koiropotamus* in Malawi.

Key **References** Seydack (2013), Smithers (1983).

**Measurements**
*Potamochoerus larvatus*

| | |
|---|---|
| HB (males): | 1256 (1100–1540) mm, n = 80 |
| HB (females): | 1207 (1090–1410) mm, n = 74 |
| T (males): | 402 (335–432) mm, n = 6* |
| T (females): | 361 (305–432) mm, n = 4* |
| E (males): | 175 (151–203) mm, n = 6* |
| E (females): | 178 (161–190) mm, n = 4* |
| Sh. ht: | 560-700 mm |
| WT (males): | 72.3 (55.0–93.0) kg, n = 84 |
| WT (females): | 68.9 (54.0–85.0) kg, n = 104 |

South Africa (Western and Eastern Cape, Seydack 1983 in Seydack 2013).
*Zimbabwe (Smithers & Wilson 1979).

## FAMILY HIPPOPOTAMIDAE - Hippopotamuses

There are only two genera and two living species in this family – *Hippopotamus amphibius* (the well-known Common Hippopotamus which is widespread) and *Choeropsis liberiensis* (the Pygmy Hippopotamus which occurs in a small part of West Africa. Hippopotamuses, usually referred to as hippos, are the only artiodactyls which spend much of their lives in water. Their ears, eyes and nostril are situated high on the head so the rest of the body can be submerged, and the ears and nostril can be closed by sphincter muscles to keep water out when hippos submerge themselves completely. They can hold their breath for up to six minutes. However, despite being so well adapted for a semi-aquatic lifestyle, hippos cannot swim! Their bodies are so dense that they sink in freshwater and they move by walking on the beds of the rivers and lakes where they live. They can, however, swim in the sea. Like pigs and hogs, hippos have four digits on each leg but, unlike pigs, all four digits touch the ground and are weight bearing, and all four end in a broad, heavy nail-like hoof. Hippos are large mammals with relatively short legs and tail, and a huge head with a very wide mouth and formidable lower tusks. Although they are not carnivorous, more humans are killed by hippos than by any other mammal or reptile in Africa, and hippos are known to attack and kill crocodiles. Hippos are herbivorous but they do not ruminate and chew cud.

Like pigs (but unlike most other artiodactyls), hippos have both upper and lower incisors and upper and lower canines. These teeth keep growing. There are two upper and one or two lower incisors. The inner incisors are larger and function as small tusks; they are not used to bite vegetation. It is the hard edges of the lips which crop grass. The lower canines are the largest teeth and have developed into tusks which are used as weapons. They occlude against the smaller upper canines, and this keeps their tips and edges sharp; they may protrude as much as 30 cm above the gum in Common Hippos. There are three or four upper and lower premolars and three upper and lower molars which are adapted for grinding food.

Adult male hippos are called bulls, females are called cows, young are called calves, and a group of hippos can be called a school, bloat, pod or siege.

Only one genus of hippos occurs in Malawi.

### Genus *Hippopotamus* – Common Hippopotamus

There is only one living species in this genus.

## *Hippopotamus amphibius*

## Common Hippopotamus

**Malawian Names** Bokho, Mvuu.


Liwonde N. P., Malawi © Bentley Palmer

**Description** An unmistakable large semi-aquatic mammal, grey in colour with a huge head, wide mouth, formidable tusks and relatively short limbs. Bulls, on average, larger than cows, and have heavier neck muscles and larger lower canines (tusks). Skin colour dark grey, sometimes with patches of reddish brown on ears, cheeks, neck and ventral surface, and around the eyes. The body is very wide across the back, rotund in shape, and bulky. Skin sparsely covered with short fine hairs (hardly visible at a distance). Head massive; jaws able to open to angle of 150° so the tusk-like lower canines are exposed. Ears small and slightly pointed; can be folded closed when the hippo submerges. Eyes small and set high and wide on side of head. Nostrils situated on top of the rhinarium; can be closed when the hippo submerges. Mouth huge with very wide thick upper lips covered by thick bristles. Limbs short and stocky, with four digits (joined by small webs) on each foot; each digit ending in a nail-like hoof which is weight bearing. Tail ca. 10% of HB, with a few short black bristles. Skull very wide at the back, narrow in the middle, and wide at the front to accommodate the large canine and incisor teeth.

**Similar Species** None. The only very large semi-aquatic mammal in Malawi.

**Distribution** Recorded from all biogeographic areas of Malawi except in montane areas, but only in grasslands near rivers, lakes or swamps with deep pools. Less widespread now than in the past (see below). Elsewhere: widespread in lakes, swamps and larger rivers with nearby grasslands throughout Africa from ca. 15˚N to NE South Africa. Absent in desert areas and most rainforest regions.
*Historical distribution*: The earliest written records (from ca. 1860 onwards) stated that hippos (and crocodiles) were very numerous in the rivers and lakes of the country (Lake Malawi, Lake Chilwa). Travellers on the Shire River commented on the vast numbers of hippos (especially in Elephant Marsh). They posed a great danger to fishermen in small boats and canoes, and there are many stories of hippos capsizing boats. Local people hunted hippos for food. By the 1930s, hippo numbers had fallen dramatically because of hunting and shooting.
*Present distribution*: Confined to suitable areas of Lake Malawi, certain sections of the Lower and Upper Shire River, and some of the larger rivers flowing into Lake Malawi. Most populations now occur in protected areas including Kasungu N. P., Lake Malawi N. P., Liwonde N. P., Mwabvi W. R., Nkhotakota W. R. and Vwaza Marsh G. R.

**Habitat** Hippopotamuses require water where they can immerse themselves during the heat of the day (to prevent sunburn and over-heating), and they require reedbeds and/or patches of savanna grassland for foraging at night. These habitat requirements limit the number of places where hippos can live. Hippos may visit vegetable gardens and crops at night and can be a major pest.

**Abundance** The only assessment known from the whole of Malawi is 10,000 individuals in 2004 (see also above). A survey in 1993 in the Upper Shire River (from Zalawe northwards to where the Shire River exits Lake Malawi – a distance of 106 km - recorded 1234 individuals in 96 schools. These numbers are very similar to those of four years earlier, suggesting that the population is stable; numbers increased in some parts of the river, and declined in other parts.

**Habits** Semi-aquatic, nocturnal/diurnal, herbivorous, social. Hippos usually spend most of the day partially submerged in water, and at night they leave the water to graze on grasses. However, when the water is cold, they spend more time on land (basking in the sun), and in hot weather they spend more time in the water to stay cool and avoid biting insects. Being able to submerge themselves in water is essential for the hippo's well-being. Their skin is very sensitive and easily damaged, sunburnt and cracked

by being dried out, so keeping it moist is essential. Secretions (from skin glands) help to prevent sunburn, assist in thermoregulation, and act as an antiseptic. The secretions impart a reddish-brown colour to the skin (especially noticeable on the head) and this led to the erroneous legend that hippos sweat blood. They do not sweat water either.

Hippos cannot float in fresh water. When in rivers and lakes, hippos may stand or lie on the bottom, with back and/or head above the surface, or often with only the ears, eyes and nostrils above water. They can also remain completely submerged for several minutes (max: 5-6 mins) before lifting the head to surface to breath and to view the surroundings. Hippos cannot swim in freshwater; they move around by walking on the bottom. In this way, they create well-worn trails on the substrate and, in marshes such as in the Okavango Delta, they open wide passageways through the vegetation which facilitate the flow of water and provide important different microhabitats. When on land, hippos usually walk slowly because of the great weight they carry. However, surprisingly, hippos can trot fast (said to be up to 30 k/ph.) if fleeing from danger or when attacking. If necessary (e.g. when a river or pool dries up) a hippo can travel considerable distance to find a (temporary) new home.

Hippos forage for savanna grasses on the banks of the river or lake; at times- particularly on cool nights - they may forage several kilometers from the water. When leaving the water, they create well-worn paths to the grazing grounds. Hippos eat a variety of species of grass - the actual species vary depending on location and season of the year. They are selective feeders, not eating some species of grass and very rarely eating dicotyledonous (flowering) plants. When grasses are in short supply, they may browse on the leaves of shrubs, and eat water lilies and waterweeds. Hippos clip the grass with their wide horny lips, and then chew the grass with their large cheekteeth. When hippos are numerous, they can cause overgrazing and a reduction in grass cover; this leads, in turn, to bush encroachment, less grass and a smaller area for grazing, and a reduction in the number of hippos. There is a very delicate ecological balance between number of hippos, the area of the grazing grounds, the extent of bush encroachment, and bush fires (which kill trees and bushes and allow grasslands to spread).

Hippos are social animals. They live in groups ('schools') of males, females and young; the number of individuals in a school varies greatly depending on suitability of the habitat and the size of the available grazing grounds. Males establish linear territories along the shoreline of a lake or river; these territories (in Uganda) vary from 50 m to 500 m of shoreline depending on the habitat and the number of male hippos. Territorial males are very tolerant of conspecifics and allow subdominant males (provided they do not challenge his dominance), females and young to live peacefully within his territory. The same individual may hold the same territory for many years. Territories are marked by the physical presence of the dominant individual, by ritualized defaecation (the tail is used for spraying the faeces), by urination, and by displays of dominant behavior (chasing, fighting, yawning). The territory is primarily to allow the dominant male to have mating rites to all the females in his territory.

When fights do arise between males, they can be very vicious; males can open the mouth very wide (up to ca. 150˚) and they slash with their lower canines and incisors and can inflict severe injuries on any opponent.

Hippos are very vocal (a very obvious character when watching hippos (e.g. at Mvuu in Liwonde N. P.). When surfacing, air is expelled from the lungs with a loud 'hiss' or blast, and water droplets are blown into the air. They also make a wide range of snorts, grunts, honks, chuckles and squeals which may be heard several kilometers away. Often, many individuals vocalize at the same time (making a cacophony of noise). There are many visual interactions between individuals. Dominance is expressed by raising the head and opening the mouth so the tusks are visible; submission is expressed by lowering the head with the mouth closed.

**Reproduction** No information for Malawi. Elsewhere: births may occur at any time of the year, although in some parts of southern Africa there is a peak from Oct-Mar. Gestation: ca. 240 days. The mother gives birth in reedbeds or other quiet places close to the water. Litter-size: 1 (very occasionally 2). Weight at birth: 30-50 kg. Neonates are precocial, and can swim within a few hours of birth, but mother and young do not join their school until ca. Week 2. Small young may rest on the mother's head when she is in the water. Weaning: ca. 6-8 months (sometimes 12 months). Young may begin to eat grass at 4-8 weeks. Reproductive maturity attained when 4-7 years of age.

**Conservation** IUCN Category: Vulnerable. Common Hippopotamuses have suffered a massive decline in numbers over the last century because of poaching, hunting for food and trophies, and loss and degradation of their habitat. Reasonably sized populations are still present in some protected areas.

**Taxonomic Notes** *Hippopotamus amphibius* Linnaeus, 1758. Skull characteristics vary in different parts of Africa. Five subspecies have been described but their validity is controversial.

**Key References** Klingel (2013b), Smithers (1983).

**Measurements**
*Hippopotamus amphibius*

| | |
|---|---|
| HB (males): | 3120 (2600–3500) mm, n = 54 |
| HB (females): | 2990 (2590–3370) mm, n = 156 |
| T: | ca. 300-500 mm * |
| Sh. ht (males): | 1500 (1290–1720) mm, n = 32 |
| Sh. ht (females): | 1440 (1100–1580) mm, n = 36 |
| WT (males): | 1546 (955–1999) kg, n = 86 |
| WT (females): | 1385 (995–1850) kg, n = 192 |

South Africa (Kruger N. P., Pienaar *et al.* 1966 and Whyte pers. comm. in Klingel 2013b).
*Southern Africa (Stuart & Stuart 2015)

## FAMILY GIRAFFIDAE – Giraffes and Okapi

This family contains only the giraffes and the Okapi. It is one of the four families of artiodactyls in Africa which are ruminants, meaning that they regurgitate food as cud and chew it for a second time (see below). Both the giraffes and the Okapi are browsers with elongated legs and necks (giraffes significantly more so than Okapi) enabling them to reach higher foliage than other browsing species. Like most other artiodactyls (except pigs and hippos) each leg has two digits, each ending in a hoof. Also, they do not have upper incisors or canines; instead, they have a hard dental pad which the lower incisors bite against. They do not have true horns, but male Okapis and both male and female giraffes have a pair of ossicones on the top of the head which resemble skin-covered short horns. Some male giraffes may even have a third median ossicone on the forehead. Ossicones begin as disks of fibro-cartilage lying against the parietal and frontal bones of the skull. Soon after birth, the ossicones begin to grow and become ossified (bony) and, after 4-4.5 years in males, and 7 years in females, they become fused to the bones of the skull. Ossicones are well vascularized and may play a role in thermoregulation.

### Genus *Giraffa* - Giraffes

Giraffes are the tallest living terrestrial animals, and the largest ruminants. They have beautifully patterned yellowish and brownish pelage, very long legs and neck, and are unmistakable. Long ago, some people believed that giraffes were the result of conjoining camels and leopards – hence the specific name *camelopardalis*.

This genus originated in Asia and ancestral giraffes were once widespread across Asia and Europe. The earliest known fossils of giraffes in Africa are from late Miocene beds, and Africa once had three or four species which became extinct, as well as those which are still living.

Until recently, it was considered that *Giraffa camelopardalis* was the only living species in the genus although, in the past, northern and southern giraffes were placed in separate species. However, recent studies suggest that there are four distinct living species and seven subspecies (Fennessy *et al.* 2016). The new taxa include *G. tippelskirchi thornicrofti,* Thornicroft's Giraffe which occurs in the Luangwa Valley in eastern Zambia, and the South African Giraffes (*G. giraffa giraffa and G. g. angolensis*) which occur in N South Africa, S Botswana, S Zimbabwe, SW Mozambique and Angola. Thornicroft's Giraffe from Zambia occasionally cross the border into Malawi. South African Giraffes have been introduced into Malawi in recent years.

Giraffes have the same number of cervical (neck) vertebrae as most mammals, but their seven vertebrae have become elongated and are linked by ball and socket joints giving the neck great flexibility and strength. Similarly, some of the bones in the legs have also become extremely elongated. These include the radius and ulna which are fused (in the front leg above the knee), the tibia (in the hind leg above the hock), metacarpals 3 and 4 which are fused, and metatarsals 3 and 4 which are also fused. It is these fused metacarpals and metatarsals which are the long lower-leg bones of the front and hind limbs respectively. In the pastern of each leg, only the bones of digits 3 and 4 are retained as weight-bearing bones, and each ends in a hoof. Because the long leg bones must carry the heavy weight of the giraffe's body, neck and head, they are thick-walled, extra dense and straight to give added strength. The leg bones are supported by strong ligaments and tendons and there are comparatively few muscles in the legs themselves. The muscles which operate the legs are located in the body above the legs.

The unique anatomy of the giraffes necessitates several special physiological adaptations. For example, the left side of the heart has developed thicker muscle to increase its strength so that it cannot only pump blood throughout the body but can also generate the high blood pressure required to enable blood to reach the brain when the head is held high. Also, there are special adaptations which prevent excess blood flooding into the brain when the head is lowered (as when the giraffe is drinking), and which prevent fainting when the head is raised again. Furthermore, the skin of the lower legs has become thick and tight (like a compression sock) to prevent the blood pooling in them.

## *Giraffa tippelskirchi thornicrofti* and *G. giraffa*

## Giraffes

**Malawian Names** *Kadyamsonga, Nyamalikiti, Twiga.*

Thornicroft's Giraffe, Luangwa N. P., Zambia
© Bentley Palmer

**Description** All giraffes are large mammals with an extremely long neck and legs and a striking pattern of irregularly shaped dark patches (brownish) on a yellowish background. Males, on average, taller and heavier than females. Pelage short. The sizes and shapes of the dark patches, their proximity to each other, and how their shapes change on different part of the body, create the overall differences in markings that have resulted in the naming of subspecies. In Thornicroft's Giraffe (*G. t. thornicrofti*) which used to wander into Malawi from Zambia, there are many dark brown patches with irregular shapes on a cream background, with some larger and more elongated patches on the neck, much smaller patches on the cheeks and upper legs, and only a few paler patches on the belly and lower legs (see photo). In South African Giraffe (*G. giraffa giraffa*) which has been introduced recently to Malawi, the pelage markings are similar, but small patches extend down the legs to the hoofs and there are no patches on the cheeks. Both species have a mane of erect short reddish hairs on the mid-dorsal surface of the neck. Both species have a pair of knob-like ossicones on the top of the head in both sexes; larger in males. Muzzle elongated. The eyes are relatively large and face sideways. The ears are rounded and project sideways from the head. The tongue is black, long and thin, extendable and prehensile. The legs are very long and each has two hoofs (see Genus *Giraffa*). The tail is moderately long, thin, marked with small dark patches, and ends with a tassel of long black hairs.

**Similar Species** None.

**Distribution** Giraffes are not considered to be indigenous to Malawi, although vagrant individuals of *G. tippelskirchi* have been recorded in western Malawi close to the Malawi-Zambian border (see below). Elsewhere: *G. tippelskirchi* occurs in Tanzania and Zambia.
*Historical Distribution*. Checklists of the mammals of Malawi from the earliest days of British colonization (1897) do not include the giraffe. Very occasionally (e.g. in 1976), individuals crossed the border from NE Zambia, but have never settled or formed a breeding population. Such individuals would have been the subspecies *thornicrofti*.
*Present distribution*. In Malawi, in 2018, thirteen individuals (*G. giraffa giraffa* – the South African Giraffe) were translocated from South Africa to Majete W. R.; they have also been introduced to Liwonde N. P. There is no historical evidence that giraffes (of any taxon) ever occurred in the area now designated as Majete W. R. or Liwonde N. P.

**Habitat** Woodland savannas. In Zambia, giraffes mainly occur where Acacia, *Combretum* and *Colophospermum* trees are abundant. They do not occur in rainforest, grassland savanna or arid environments.

**Abundance** In Malawi, rare and found only in Majete W. R. and Liwonde N. P. (see above). Elsewhere: abundance is mainly determined by the distribution and quality of good quality forage. Densities throughout the biogeographic range vary from ca. 2.6/km$^2$ in high-quality areas to ca. 0.05/km$^2$ (or lower) in low-quality areas (see also Conservation below).

**Habits** No information for Malawi. Elsewhere, Giraffes are more active during the day than during the night, but they also feed and move around at night. They require less sleep than other mammals; deep sleeping lasts for just a few minutes at a time and a total of two hours/day is sufficient. They usually rest and sleep while standing up, although they can lie down with the lower forelimbs bent under the upper forelimbs and with the hindlimbs

tucked to one side. Giraffes have only two gaits: 'walking' and galloping. They cannot trot. When 'walking', the limbs on the same side swing forward almost in synchrony. Galloping is a fast gait, similar to that of a horse. Giraffes can gallop at 60 km/h for very short distances, and at 50 km/h for several kilometers.

Giraffes are browsers feeding on the leaves, small twigs, flowers and small fruits of trees. They are selective feeders, carefully browsing on the food that is most delectable at the time. They are able to feed on very thorny trees. The long prehensile tongue is extended from the mouth, carefully avoiding any thorns nearby, and wrapped around the leaf or twig; the tongue is pulled back into the mouth and the food is nipped off between the lower incisors and the dental pad. Browsing by giraffes often results is a 'browse line' so the tree becomes umbrella-shaped. In most habitats, the diet changes seasonally; sometimes herbs and grasses are eaten as they sprout after the rains. Giraffes obtain most of their water requirements from their food, but they sometimes drink from pools or streams by spreading the forelimbs widely sideways so the head can be lowered to the water level. They also lick soils which are rich in minerals.

Giraffes are social animals. Groups typically contain 5-8 individuals, although as many as 30 individuals have been recorded when several groups join together. Group composition is labile; individuals leave and join other groups. Groups usually consist of females and young, or males and females; adult males are often solitary. They are not territorial. The average home-range in East Africa is ca. 63 $km^2$ for males and ca. 85 $km^2$ for females; home-ranges in South Africa are smaller; home-range size is dependent on the quality of the habitat.

Most interactions between giraffes are amicable, although males may show agonistic behaviour towards other males. Dominance amongst males is determined by 'necking' in which one male swings his neck – with some force - against the neck of another male. This test of strength continues until one male gives up and leaves, and the other assumes dominance and the right to mate with females. During courtship, males test the urine of females (by flehmen as do many species of ungulates) and uses his forelimbs to tap the hindlimbs of the female. Giraffes can produce many vocal noises (although they are 'quiet' most of the time); adults can snort, cough, sneeze, hiss, moan, growl and whistle. Females bellow to their calves, and calves can bleat, snort, moo and mew. At night, giraffes also hum to each other. All of these sounds are audible to humans.

**Reproduction** No information for Malawi. Elsewhere: births can occur during any months. Gestation: ca. 15 months (450 days). Litter-size: 1. At birth, calves weigh ca. 100 kg, and are ca. 1.5 m in height. They are precocial, and capable of standing and walking within a few hours of birth. Weaning occurs at ca. 9-12 months of age although young begin to eat solid food and ruminate after ca. 3-4 months. Calves stay close to their mothers for protection from predators (mostly lions). Males become reproductively active when ca. seven years old. Females give birth to their first calves when ca. six years old. An adult female can give birth to a young every 19-20 months (600 days).

**Conservation** IUCN Category: Vulnerable (all species combined). In most parts of Africa, populations have declined during the last 30 years (e.g. In East Africa, *G. c. camelopardalis* has declined from an estimated 20,500 in 1979/1981 to an estimate of 600 individuals in 2018. This decline is primarily the result of habitat loss, civil unrest, illegal hunting, and ecological changes resulting from human activities.

**Taxonomic Notes** *Giraffa tippelskirchi* Matschie, 1898. The individuals which migrated from Zambia into parts of western Malawi for short periods of time in the past were *G. t. thornicrofti* (Lydekker, 1911). Ansell & Dowsett (1988) refer to this taxon as *G. camelopardalis thornicrofti*.

*Giraffa giraffa* (von Schreber, 1784). The subspecies introduced into Malawi is *G. g. giraffa* (South African Giraffe) from South Africa.

**Key References** Ciofolo & Le Pendu (2013), Fennessy *et. al.* (2016), Smithers (1983), Winter *et al.* (2019).

**Measurements**
*Giraffa giraffa*

| | |
|---|---|
| TL (males): | 5050 (4860–5270) mm, n = 15 |
| TL (females): | 4440 (4160–4750) m, n = 16 |
| Ht (top of head): | 3900 – 5200 mm* |
| T (males): | 1231 (970-1500) mm, n = 4† |
| T (females): | 860 (750-900) mm, n = 4† |
| Sh. ht (males): | 3310 (3130–3470) mm, n = 15 |
| Sh. ht (females): | 2800 (2720–2920) mm, n = 16 |
| WT (males): | 1191.8 (973–1395) kg, n = 18 |
| WT (females): | 828.4 (703–950) kg, n = 18 |

South Africa (Hall-Martin 1975 in Ciofolo & Le Pendu 2013).
*Southern Africa, (Stuart & Stuart 2015).
†Botswana (Smithers 1983).

## FAMILY BOVIDAE – buffalos, antelopes and others

Bovids are distinguished from other artiodactyls by the presence of horns, either in males only or in both sexes. This is the largest family in the order Artiodactyla and contains more species than any other family of large mammals. These species include domestic sheep, goats and cattle as well as the buffalos and antelopes which occur in the wild, and they range in size from the African Buffalo (shoulder height > 1000 mm) to the tiny Suni (shoulder height < 500 mm). In Africa, the family is represented by 31 genera and ca. 86 species. In Malawi, there are 14 genera and 19 species; 11 of these genera are represented by only one species in Malawi.

The horns which characterize bovids, do not branch and they are not deciduous (i.e. not shed and replaced each year); if they are damaged or lost, they cannot be repaired or replaced. Bovid horns are comprised of a sheath of keratin covering a bony core that grows from the frontal bones of the skull. They vary in shape and size and are important in taxonomy and the identification of genera (see below). Horns have many functions. They are used in several different ways as weapons: to stab into the body of an opponent or predator, to clash against an opponent's horns, to push against an opponent's horns, or to entangle with an opponent's horns prior to wrestling. Horns may also be used to strip bark from trees, to root in the ground, and to radiate heat as a means of thermoregulation.

In all bovids, it is only Digits 3 and 4 on each leg which have a hoof; digits 2 and 5 (referred to as lateral hoofs) are situated well above the hoofs and they project backwards as small knobs or are absent. All bovids are well covered by pelage, but the pelage may be wool which normally never stops growing, or hairy fur which is moulted annually. Hairy pelage ranges from short and sleek to long and shaggy. It may be plain (i.e. the colour is either uniform or it changes gradually from one part of the body to another), or it may be patterned with markings in contrasting colours. Pelage colour is an important means of distinguishing species and is sometimes a means of distinguishing the sexes. Many antelopes have a preorbital gland which opens in the area adjacent to the nasal corner of each eye or approximately midway between the eye and the nostril. Secretions from this gland contain pheromones and are rubbed on grasses, twigs and saplings, and sometimes on other parts of the body, as a means of olfactory communication. Sexual dimorphism is conspicuous in most species; the sexes may differ in size, colour and the presence or absence of horns.

Bovids are herbivorous and either grazers or browsers or both. They are all ruminants which regurgitate food and chew it a second time as cud. In all species, the upper incisors and canines are lost (replaced by a dental pad) and the premolars and molars keep growing to compensate for being worn down by the coarse foods they eat. There are three incisors and a small canine on each side of the lower jaw which are used for biting off grass and leaves; they occlude against the dental pad. The eyes of bovids face outwards so there is all-round vision but no binocular vision.

The horns of bovids help to distinguishing the genera and species. The characteristics of horns which are important are:

(a). The surface of the horn. May be 'smooth', or 'ringed' (with bands of thicker horn), or 'keeled' (with a low longitudinal ridge). Rings may occur from the base to near the tip, or only nearer to the base of the horn.

(b). The shape of the pair of horns as seen from the front and the shape of a single horn as seen from the side. A horn can be straight, curved smoothly or with a sharp angle (kink), twisted (as in a screw) or curved in a spiral (as in a corkscrew). In Spiral-horned Antelope (*Tragelaphus* spp.), the horns are always keeled and always twisted (so the keel spirals around the horn). The horns may also curve into a corkscrew-like spiral (but in some species they are straight).

(c). The horns may arise from the top of the skull (in which cases the bases are well separated) or from a raised bony pedicle (in which case the bases may be separated or in contact). In African Buffaloes, the bases of the horns meet in the middle of the forehead to form a wide bony covering over the skull referred to as a boss.

The family Bovidae contains animals which differ greatly in many characters, including the shape of their horns. The phylogenic and taxonomic relationships between members of this family are still poorly understood. They have been separated into different subfamilies and into separate tribes within the subfamilies. Here is one classification as it applies to bovids in Malawi.

| SUBFAMILY | TRIBE | VERNACULAR NAME | GENUS |
|---|---|---|---|
| Bovinae | Bovini | African Buffalo | *Syncerus* (1 species) |
| | Tragelaphini | Spiral-horned Antelopes | *Tragelaphus* (4 species) |
| Antilopinae | Neotragini | Suni | *Nesotragus* (1 species) |
| | Cephalophini | Duikers | *Philantomba* (1 species) |
| | | | *Sylvicapra* (1 species) |
| | | | *Cephalophus* (1 species) |
| | Ourebiini | Oribi | *Ourebia* (1 species) |
| | Reduncini | Reedbuck | *Redunca* (1 species) |
| | | Puku and Waterbuck | *Kobus* (2 species) |
| | Oreotragini | Klipspringer | *Oreotragus* (1 species) |
| | Aepycerotini | Impala | *Aepyceros* (1 species) |
| | Alcelaphini | Hartebeest | *Alcelaphus* (1 species) |
| | | Wildebeest | *Connochaetes* (1 species) |
| | Hippotragini | Roan and Sable Antelopes | *Hippotragus* (2 species) |

The species of bovids in Malawi can be distinguished from the information in the yellow box below. The species have been separated into groups based on their shoulder height (where <50 cm = small, 50-100cm = medium sized, >100 cm = large), and the shape of the horns (smooth, ringed or keeled, smoothly curved, kinked, twisted, or curved like a corkscrew).

SMALL WITH SHORT STRAIGHT HORNS.

*Nesotragus moschatus*, Suni. Plain greyish-brown. Back arched (hindquarters higher than shoulders). Horns (males only) short, straight, backward-pointing, ringed. No tuft between the horns. Lower Shire Valley only.

*Philantomba monticola*, Blue Duiker. Plain dark rufous-brown with rufous-cinnamon flanks and a darker brown patch from nose to top of head. Horns (males and sometimes females) very short, widely separated, straight, backward-pointing with basal half ringed. Longer hairs between horns but no conspicuous tuft.

*Cephalophus harveyi*, Harvey's Duiker. Plain rich reddish-brown with slightly paler flanks and chest, and black area from nose to top of head. Horns (both sexes) very short, widely separated, straight, backward-pointing, with basal half ringed. Tuft of black and dark reddish-brown hairs between horns. Northern Malawi. Forest habitats adjacent to grasslands.

MEDIUM-SIZED WITH SHORT STRAIGHT HORNS

*Sylvicapra grimmia*, Common Duiker. Plain greyish-fawn with slightly paler ventral pelage, bright chestnut forehead, black stripe from the nose to just above the eyes, and black socks. Short, widely separated, straight, backward-pointing horns, with basal third or half ringed. Tall tuft of black and/or chestnut hairs on top of head. Widespread. Woodlands, thickets and some montane grassland.

*Raphicerus sharpei*, Sharp's Grysbok. Plain, reddish-fawn liberally flecked with white. Arched back (highest over hindquarters). Large ears with black and white bands radiating across inner surface. Horns (males only) very short, straight, slightly backward-pointing, ringed at base. Widespread. Bushland, scrub, thickets, medium-height grasslands, riverine vegetation.

*Oreotragus oreotragus*, Klipspringer. Plain, yellowish-brown grizzled with black and white and suffused with grey on rump. Hoofs short and pointed so Klipspringers appear to stand and move on tiptoes. Back slightly higher over hindquarters. Ears large with black and white marking on inner surface. Horns (males only) short, straight, slightly backward-pointing but arising well in front of ears so they appear to be fairly upright; basal third ringed.

*Ourebia ourebi*, Oribi. Plain brownish-orange with whitish ventral pelage, a conspicuous circular black patch below each ear and black tipped tail. Horns (males only) widely separated, short, with basal half ringed. Front view: horns almost parallel; appearing to point straight up; reaching just above ears.

MEDIUM SIZED WITH LONGER, CURVED HORNS

*Aepyceros melampus*, Impala. Three horizontal bands of colour on sides (golden-brown, paler golden-brown, white), a vertical black stripe on each buttock. Horns (in males) smoothly curved, ringed and elegant; front view lyre-shaped; side view: each horn rises upwards. then turns backwards and finally curves smoothly upwards.

*Kobus vardoni*, Puku. Plain golden-brown antelope (without any black stripes). Horns (in males) lyre-shaped in front view (as in Impala).

*Redunca arundinum*, Southern Reedbuck. Plain pale brown or greyish-fawn with creamy-white belly, a small circular black patch below each ear, a dark stripe on front edge of forelegs, a fluffy tail (brown above, white below). Horns (males only) are smoothly curved and ringed on basal two-thirds. Front view: V-shaped with sides curving inwards. Side view: )-shaped.

*Tragelaphus scriptus*, Bushbuck. Chestnut to dark brown pelage marked with conspicuous whitish spots on lower flanks and hindquarters, faint vertical whitish stripes across the back, and black, white and chestnut markings on legs. Horns (males only) of medium relative length, backward-pointing, twisted, straight or slightly curved.

LARGE WITH LONG, HEAVILY RINGED, SMOOTHLY CURVED HORNS

*Hippotragus equinus* (Roan Antelope). Plain reddish-brown with striking black and white markings on the head; ventral pelage similar to dorsal pelage, sometimes darker between forelimbs; ears with conspicuous black tuft at the tip. Horns (both sexes) long, heavily ringed except at tip, curving smoothly upwards, outwards and backwards. Front view: V-shaped with sides curving slightly outwards especially near the tips. Side-view: each horn curves smoothly upwards and backwards like the arc of a circle.

*Hippotragus niger* (Sable Antelope). Plain black (M) or dark chestnut (F) with white markings on the head; ventral pelage white, clearly demarcated from dark colour of flanks; ears with inconspicuous black tips. Horns (both sexes) very long to extremely long, heavily ringed curving smoothly upwards and then backwards. Horns often described as scimitar-shaped.

*Kobus ellipsyprimnus* (Waterbuck). Plain greyish-brown to dark brown with a conspicuous white band on the rump and hindquarters (elliptical when viewed from behind), a shaggy white bib, and long, heavily ringed horns (males only) which, when viewed from the side, curve smoothly backwards, upwards and then forwards (i.e. curved in opposite direction to those of *Hippotragus* spp.).

LARGE WITH WIDE-SPREADING, SMOOTH, 'COWLIKE' HORNS

*Connochaetes taurinus* (Common Wildebeest). Ungainly grey antelope with dark vertical stripes on neck and front half of flanks, a mane of long hairs, shoulders higher than rump, and wide-spreading, smooth, 'cowlike' horns with upturned tips in both sexes.

*Syncerus caffer*, African Buffalo. Heavily-built, plain dark grey cow-like mammal, with short neck, low hump over the shoulders, stocky legs and massive, laterally wide-spreading horns with upturned tips in both sexes. The second largest artiodactyl in Malawi.

LARGE WITH KINKED HORNS

*Alcelaphus buselaphus*, Lichtenstein's Hartebeest. Plain brown, with a shoulder hump, white buttocks, and horns (both sexes) which are ringed, and have one smooth curve and one angular curve (kink) and arise from a low bony pedicle. Well-developed shoulder hump so back appears to slope down towards the tail.

LARGE WITH ‘SPIRAL HORNS’

*Tragelaphus angasii*, Nyala. Conspicuously sexually dimorphic, with vertical stripes on flanks and hindquarters; males grey with white stripes, larger and with horns; females bright chestnut with white stripes, smaller and without horns; horns long, keeled, twisted and curved in a shallow spiral with one complete turn.

*Tragelaphus oryx*, Common Eland. A large pale cinnamon or beige cow-like antelope with vertical white stripes (sometimes faint) on back and flanks, solidly built (especially males); prominent shoulder hump, and relatively short straight twisted horns. The largest artiodactyl in Malawi.

*Tragelaphus strepsiceros*, Greater Kudu. Majestic, long-legged, brown to greyish-brown with vertical white stripes on flanks and hindquarters, and a low hump over the shoulder. Horns (males only) very long, keeled, twisted and curved into a very conspicuous corkscrew-like spiral with two complete turns in adults.

Tragically, the numbers of bovids in Malawi has decreased enormously since the mid 1800s when some of the European residents, explorers and government officials made observations. These people included Henry Faulkner (who travelled up the Shire River in 1868), H. L. Duff (a colonial officer who lived in Zomba from 1898-1902), Sir Harry Johnston (First Commissioner of British Central Africa) and Rodney C. Wood (First Game Warden in Nyasaland). Many of the observations made by these people have been published in Happold (2011) and are included here in species profiles in ‘Historical Distribution.’

The species of bovids in Malawi are presented in the alphabetical order of their scientific names.

# Genus *Aepyceros* - Impala

Subfamily Antelopinae. Tribe Aepycerotini. This tribe contains only the genus *Aepyceros*, and this genus contains only one species.

## *Aepyceros melampus*

## Impala

**Malawian Name** Nswala.

Male. Liwonde N. P., Malawi © Bentley Palmer

**Description** Medium-sized graceful antelope with long neck and slender legs; three horizontal bands of colour on sides (including white belly), a vertical black stripe on each buttock, horns (in males) smoothly curved, ringed and elegant; front view lyre-shaped. Males, on average, larger than females and only males have horns; pelage colour same in both sexes. Pelage short and smooth. Dorsal pelage mostly golden-brown to chestnut-brown but sharply divided into two horizontal bands on flanks - lower half paler than upper half. Ventral pelage, buttocks and inside of upper limbs white to creamy-white. Vertical black line on each buttock and small black spot on flank just in front of the hindquarters. Head mostly same colour as upper dorsal colour with slender muzzle. Eyes large with white eyebrow. Preorbital gland; no information. Upper and lower lips and throat white. Ears large, rounded at tip, chestnut or black on upper outer surface, white on inner surface. Limbs long and slender, pale golden-brown; black patch of hairs (which cover the meta-tarsal glands) on back of the fetlock of each hindleg. Small white patch above each black hoof. Tail ca. 20% of HB, similar in colour to back with black line on upper surface (extending onto rump) and long white hairs on sides and at tip.

Horns (males only) large and graceful, smoothly curved, basal ¾ ringed; tip smooth. Front view: lyre-shaped. Side view: each horn rises upwards, turns backwards and finally curves smoothly upwards. Horns in young males are straight, then bracket-shaped, and attain their lyrate shape only when adult.

**Similar Species**

*Kobus vardoni,* Puku. No vertical black line on each buttock; no conspicuous black patch on the back of the fetlock of each hindleg.

**Distribution** Restricted to a few protected areas, although much more widespread and abundant in former times (see below). Elsewhere: recorded in eastern Africa from Kenya southwards through Mozambique and Zambia to E Botswana, Zimbabwe and N South Africa.

*Historical Distribution*: Widespread in the Shire Valley on both sides of the river – very common in some localities (“herds up to sixty individuals”) and absent in others. The Upper Shire Valley, from the lake southwards, contained huge herds of wildlife: one visitor writing about the Upper Shire in 1868 recorded “waterbuck, pallahs [impalas] reedbuck and gazelle might be seen wherever I looked, as far as the eye could reach". In the early 1900s, “impala are common in most parts of the Protectorate”.

*Present Distribution*: All Impala are now contained within protected areas: in 1989, Vwaza Marsh G. R. (600), Liwonde N. P. (>300), Lengwe N. P. (ca. 200), Kasungu N. P. (100), Mwabvi W. R. (ca. 50), Nkhotakota W. R. (occasional sightings), Majete W. R. (occasional sightings). They no longer occur in Lake Malawi N. P.

**Habitat** Open canopy woodlands and grassland savannas, floodplains especially where nutrient rich

soils support good quality grass. Impala are especially fond of Mopani woodlands (e.g. in Liwonde N. P.). They require water on a regular basis and hence only live within a few kilometers of lakes and rivers.

**Abundance** Although abundant in former times (see above), numbers are much lower now (although there is some evidence that population numbers may be increasing in some protected areas). Elsewhere: impala may be very numerous (e.g. densities vary from 1/km$^2$ [Mkomasi, Tanzania] to 7/km$^2$ [Kruger N. P.] and 135/km$^2$ [Lake Kariba, Zimbabwe]. Densities vary depending mainly on whether the habitat is protected (or not), and the quality of the grasslands and water.

**Habits** Most activities of Impala take place during the day; at night the herd lies down in an open space. When disturbed, impala flee with great speed and with many high graceful leaps over both real and imaginary objects. While in mid-air, they often kick backwards with the hindlimbs – a display called 'empty kicking'.

Impala obtain food by grazing and also by browsing. The typical diet of Impala is 45% herbs and shrubs, 45% grasses and 10% fruit. The proportion of each type of food varies with the season; browse comprises a higher percentage of the diet in the dry season (when grasses are dry, tough and less nutritious) and the percentage of grass rises during the wet season (when new highly nutritious grass is available). Sex and social status may also determine the proportion of each food type that is eaten.

Impala live in herds that vary in composition and size according to the season of the year and the locality. In southern Africa, Impala become sexually active during one short period each year referred to as the rut. Before the rut, Impala are not territorial and most live in breeding herds comprised of adult males, adult females and juveniles of both sexes. At this time, there are also bachelor herds comprised of adult and juvenile males, and a few males are solitary. At the beginning of the rut, many adult males in both sorts of herds become aggressive and establish individual territories. Each of these males marks his territory by rubbing secretions from glands on to vegetation and by roaring and snorting at intruders who try to enter his territory. Territory holders also display and threaten other males by stiff legged walking, horn presentation and occasionally combat. Territory size depends on population density (e.g. 8-13 ha when density is high and 17-58 ha when density is low). The home-ranges of breeding herds are very large (70–297 ha depending on the locality), and they overlap the territories of several males. At the peak of the rut, the territorial males attempt to herd females from these breeding herds into their territories and, once a male has acquired a herd of females in his territory, he keeps checking to ascertain which females are in oestrus and then mates with them. In southern Africa (and probably in Malawi), the rut lasts for two months or less, the peak of the rut lasts for about a month, and most matings occur between one full moon and the next. After the rut, adult males cease being territorial, and breeding herds which include several adult males form again. After the birth of young, some females form nursery herds (without males) but these are temporary. In contrast, in East Africa, territorial behaviour and rutting occur almost year-round.

In Malawi, herd sizes are usually smaller than in other countries. In the mopane woodlands of Liwonde N. P. (October 1984), a herd of 10 individuals was observed (one adult male, one subadult male and eight adult females), as well as herds of three and five bachelor males, and two single males. In June, a herd of 16 females and one adult male was observed. A report in April 1978 recorded a herd of ca. 100 individuals.

Impala have many behavioural traits which promote cohesion between herd members. For example, allogrooming takes place between adult males and females, between adults and young, and between young. Also, most of the activities of the herd are synchronized, e.g. feeding, resting, ruminating, and grooming.

**Reproduction** Births are reported to occur in Malawi during the wet season, with a peak around Dec and Jan. In southern Africa the peak is Nov to Jan. In contrast, in East Africa, births occur throughout the year. Gestation: 27-28 weeks. Littersize: 1 (very occasionally 2). Neonates are precocial and weigh ca. 5 kg. They are weaned when 17-25 weeks old. They attain ca. 75% of adult weight when about two years of age. Females are mature at ca. 18 months; males are mature at ca. 12 months but do not reproduce until able to establish a territory. Non-breeding males congregate in bachelor herds. Female Impala breed prolifically - ca. 95% of adult females breed every year.

**Conservation** IUCN Category: Least Concern. Many Impala live on private lands and ranches (especially in southern Africa) where they are hunted for meat.

**Taxonomic Notes** *Aepyceros melampus* (Lichtenstein, 1812). Two subspecies are recognised; the subspecies in Malawi (and all of

eastern Africa) is *A. m. melampus*. The second subspecies occurs only in a small area of SW Angola and NW Namibia.

**Key References** Fritz & Bourgarel (2013), Smithers (1983).

**Measurements**
*Aepyceros melampus melampus*

| | |
|---|---|
| TL (males): | 1625 (1386–1805) mm, n = 25 |
| TL (females): | 1548 (1438–1670) mm, n = 25 |
| T (males): | 298 (239–327) mm, n = 25 |
| T (females): | 274 (225–304) mm, n = 25 |
| E (males): | 148 (132–165) mm, n = 25 |
| E (females): | 144 (132–158) mm, n = 25 |
| Sh. ht (males): | 873 (785–925) mm, n = 28 * |
| Sh. ht (females): | 800 (790–810) mm, n = 12 * |
| Horn length: | mean 500 mm, maximum 810 mm† |
| WT (males): | 54.5 (46.8–65.9) kg, n = 25 |
| WT (females): | 40.9 (31.8–51.8) kg, n = 25 |

Zimbabwe (Smithers & Wilson 1979).
* Tanzania (Sachs 1967 in Fritz & Bourgarel 2013).
† Southern Africa (Stuart & Stuart 2015).

# Genus *Alcelaphus* - Hartebeest

Subfamily Antelopinae. Tribe Alcelaphini. This tribe is represented in Malawi by only two genera, *Alcelaphus* (Hartebeest) and *Connochaetes* (Wildebeests). The genus *Alcelaphus* contains only one species (*A. buselaphus*) but, within this species, horn-shape and pelage colour vary considerably in different parts of the biogeographic range. Consequently, many subspecies have been described and each has been given its own vernacular name. The subspecies which occurs in Malawi is *A. b. lichtensteinii* – Lichtenstein's Hartebeest – and all information in the following profile, except for Habits, pertains to this subspecies. Under Habits, some information pertains to Coke's Hartebeest (*A. b. cokii*) from Kenya and other subspecies. Lichtenstein's Hartebeest is considered to be a distinct species – *Alcephalus lichtensteini* - by some authorities, and the only species in a distinct genus - *Sigmocerus lichtensteinii* – by some authorities (see Taxonomic notes).

## *Alcelaphus buselaphus lichtensteinii*

## Lichtenstein's Hartebeest

**Malawian Names** Ngondo, Ngosi, Nkhozi, Nkosi.

Lichtenstein's Hartebeest, Liwonde N. P.
© Bentley Palmer

**Description** A large brown antelope with a shoulder hump, white buttocks and horns (in both sexes) which are ringed, have one smooth curve and one angular curve (kink), and arise from a low bony pedicle. There is a well-developed shoulder hump and so the back appears to slope down towards the tail. Males, on average, shorter at shoulder height, and heavier than females; similar in colour and horn-shape. Pelage short and smooth. Dorsal pelage pale yellowish- brown (fawn) with a dark reddish-brown 'saddle' from shoulder to rump. Ventral pelage same as flanks. Buttocks (including region above the tail) pale or whitish. Head elongated and thin, similar in colour to flanks (without any darkening of colour on forehead and muzzle). Eyes brown sometimes with a pale stripe between the eyes and/or pale marks under each eye. Prominent preorbital gland below front of eye. Muzzle, nostrils and lips dark brown. Ears brown on outer surface, and with long white hairs on inner surface. Limbs fawn or beige, with black stripe on front edge of the lower legs. Tail ca. 25% of HB, white at base, with long black hairs on distal two-thirds. Some individuals have a large black patch on the flank caused by secretions from the preorbital gland when the head is rubbed against the flank.

Horns (in both sexes) arise from a low bony pedicle (not directly from the surface of skull) and the bases are close together. Horns very wide at base, tapering to a sharp tip, with prominent rings except near tip. Front view: approximately circular with gap at top; tips of horns not always visible. Side view: roughly 'Z-shaped'; each horn slopes slightly backwards at base, then curves smoothly forwards and finally makes an approximately right-angled turn (kink) backwards.

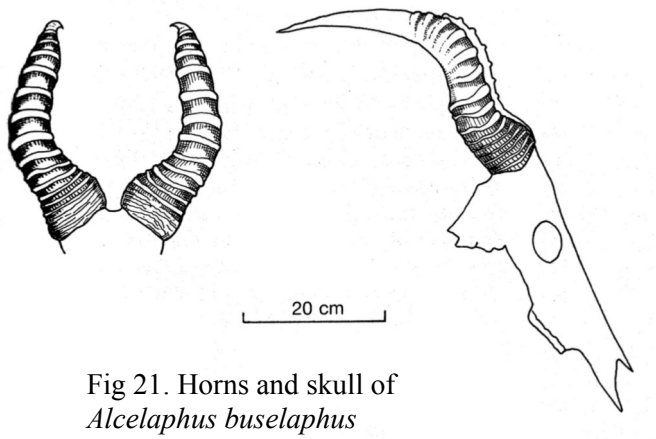



Fig 21. Horns and skull of *Alcelaphus buselaphus*

**Similar Species** None (see yellow box above). The elongated head and structure of the horns in Lichtenstein's Hartebeest is unique in Malawi.

**Distribution** Restricted to a few localities in north and Central Malawi (see also below). Elsewhere: Tanzania, SE DR Congo, N. Mozambique and Zambia with isolated populations in S. Mozambique, E Zimbabwe and NE South Africa.

*Historical Distribution* Probably occurred throughout the miombo woodlands of Malawi. In 1867, on the plains close to the Upper Shire River, "there were herds of antelopes (including Hartebeest) as far as the eye could see". In 1906, Hartebeest were considered as "by far the commonest antelope . . . . in British Central Africa." They were the commonest antelope on the Phalombe Plain a few miles from Zomba. In 1929, during surveys for tsetse flies, Hartebeest were common on the upper Bua River where scores of antelope of many species were present.
*Present Distribution* Hartebeest no longer occur at most of the localities where they were recorded pre-1975. In 1989, nearly all Hartebeest were restricted to protected areas, i.e. Vwaza Marsh G. R. (ca. 700 individuals), Kasungu N. P. (ca. 400), and occasional sightings in Nyika N. P. (woodlands at lower altitudes), Nkhotakota W. R., Majete W. R. and Mwabvi W. R. (Previously also recorded from Lengwe N. P. and Liwonde N. P., but not in 1989).

**Habitat** Woodlands, grasslands and floodplains. Hartebeest prefer woodlands that are not too dense and are adjacent to grasslands. In Malawi, they live in miombo and mopane woodlands where the land is flat and has a ground cover of short to medium height grasses.

**Abundance** In Malawi, this species is far less numerous and less widely distributed than in the past (see above), and there are only two protected areas where population numbers are (probably) stable – Kasungu N. P. and Vwaza Marsh G. R.

**Habits** There is little information for Lichtenstein's Hartebeest; so this section also contains information for Coke's Hartebeest and other subspecies. Hartebeest are most active in the early morning and late afternoon but may be active throughout the day in cooler weather. They are primarily grazers, although they may browse during the dry season when grass quality is poor. They graze on medium-length grasses. In Nairobi N. P., Coke's Hartebeest feed on short grasses on the hillsides during the wet season, and then move into wetter areas during the dry season. Although some water is obtained from grasses and dew, Hartebeest require a regular supply of drinking water (from rivers and water holes).

Hartebeest have a number of interesting adaptations that have aided their widespread pan-African distribution. They are very vigilant while feeding (which helps protect them from predators and hunters) and have amazing endurance and running speed so they can move quickly away from potential danger. They thermoregulate by panting (not sweating) and can allow their body temperature to increase temporarily in hot weather thus conserving water. Their narrow muzzles enable them to be very selective when grazing and they select only the most nutritious parts of the grass (usually leaves, not stems). Consequently, they are able to find nourishing food even when most of the grass has become withered and dry (as in dry seasons and in arid regions) and they are able to continue grazing after other antelopes have been forced to switch to browsing.

Hartebeest live in small herds of up to 10 individuals. Female herds consist of adult females and their young of various ages. There are also bachelor herds comprising subadult males. Adult males defend territories and try to attract (and retain) female herds that pass through the territory. In Zambia, territories of Lichtenstein's Hartebeest are 150-520 ha in area. In Nairobi N. P., the home-ranges of herds of female Coke's Hartebeest are 370-550 ha in area and they overlap the territories of 20-30 males. If a territory has good grazing (and water nearby) female herds may stay almost indefinitely in one territory.

Males which hold a territory exhibit agonistic behaviour towards other males. Males fight by butting their horns together and pushing each other backwards and forwards (with considerable ferocity) until one of them overpowers the other. A territory holder advertises the boundaries of his territory by rubbing his horns on the ground, and by rubbing secretions from the preorbital glands on grass stems and other vegetation. Sometimes a male will stand on top of a termite mound as a visual display to other individuals, and from there he can also survey his territory. Males show elaborate displays while checking that a female is reproductively receptive.

Females retire into scrubland to give birth and the calf will hide itself and only emerge when the mother comes to suckle it. Then the mother stimulates it to urinate and defecate and consumes both urine and faeces to remove evidence of the calf's presence, and when she departs the calf hides again. This behaviour is called lying up and it lasts for ca. two weeks.

**Reproduction** No detailed information for Malawi. Elsewhere: there is usually one breeding season/year. Lichtenstein's Hartebeest give birth to young from Jul–Sep in Zambia, Mozambique and Zimbabwe, although in the Luangwa Valley (N Zambia) the principal months when young are born are Oct-Nov. Gestation: ca. 8 months. Neonates are precocial (and are able to stand 30 minutes after birth) and weigh ca. 15 kg at birth. Young are weaned at 7-8 months. Females become sexually mature at 16-18 months and give birth to their first young at ca. 3 years of

age. Subadult males join bachelor herds when about 2.5 years of age (by which time they are sexually mature) but do not mate until they have acquired a territory i.e. probably not before 3-4 years of age when horns are well-developed.

**Conservation** IUCN Category: Least Concern. This classification is mainly the result of quite large populations in a few conservation areas outside Malawi. Within Malawi, Lichtenstein's Hartebeest is a rare species now; distribution is restricted and numbers are low. In other parts of the biogeographic range, conservation concerns include habitat reduction, competition with grass-eating domestic livestock, and hunting for sport and bushmeat.

**Taxonomic Notes** *Alcelaphus buselaphus* (Pallas, 1766). Large variation in horn shape and pelage colour has resulted in many names being used for this species. Currently, seven subspecies are recognised (one of these - from Africa north of the Sahara - is now extinct). The subspecies in Malawi (and in the woodland regions of south-central Africa) is *Alcelaphus buselaphus lichtensteinii* (Lichtenstein's Hartebeest). This Hartebeest was referred to as *Alcelaphus lichtensteinii* by Sweeney (1959), Hayes (1978), and Hough (1989) and as *Sigmoceros lichstensteinii* by Ansell & Dowsett (1988).

**Key References** Gosling & Capellini (2013), Smithers (1983).

**Measurements**
*Alcelaphus buselaphus lichtensteinii*

| | |
|---|---|
| TL (males): | 2380 (2090–2540) mm, n = 6 |
| TL (females): | 2360 (2010–2420) mm, n = 5 |
| T (males): | 480 (400-510 mm, n = 6* |
| T (females): | 450 (410-470) mm. n = 5* |
| E (males): | 210 (200-230) mm, n = 6* |
| E (females): | 210 (1`90-230) mm, n = 5* |
| Sh. ht (males): | 1230 (1220–1360) mm, n = 6 |
| Sh. ht (females): | 1250 (1190–1300) mm, n = 5 |
| Horn length: | mean 520 mm, maximum 619 mm† |
| WT (males): | 177.1 (156.7–203.9) kg, n = 10 |
| WT (females): | 166.3 (160.4–181.2) kg, n = 10 |

Zambia (Wilson 1966c in Gosling & Capellini 2013).
*Zambia (Smithers 1983).
†Southern Africa (Stuart & Stuart 2015).

## Genus *Cephalophus* – Forest Duikers

Subfamily Antelopinae. Tribe Cephalophini. This tribe contains three genera – *Cephalophus*, *Philatomba* and *Syvicapra*. They are all small antelopes with short straight horns in one or both sexes, and a tuft of hairs on top of the head, between the ears. They are known as duikers – an Afrikaans word meaning diver. The tribe is represented in Malawi by one species from each genus. The genus *Cephalophus* contains 16 species but only once species occurs in Malawi.

### *Cephalophus harveyi*

### Harvey's Duiker (Red Duiker)

**Malawian Names** Kasenye (also refers to Sharpe's Grysbok), Kasese, Zombang'oma.

Lilongwe N. R., Malawi © DCD & M. Happold

**Description** A small antelope with rich reddish-brown pelage, a black area from nose to top of head, very short, widely separated, straight, backward-pointing, ringed horns in both sexes, and a tuft of black and dark reddish-brown hairs between the horns. Sexes similar. Pelage smooth and glossy. Dorsal pelage chestnut-red to brick red, becoming slightly paler on lower flanks. Ventral pelage on throat, belly and inguinal region white. Head similar to back with black stripe on nasal region widening to black patch on forehead and top of head; darker colouration may extend on to dorsal surface of neck. Dark reddish-brown and black head tuft between ears. Nose, muzzle and chin black. Eyes relatively large, dark. Preorbital gland with straight, longitudinal slit-like opening approximately midway between each eye and nostril. Ears large, rounded at tip; outer surface dark brown; inner surface with short white hairs. Limbs delicate. Hoofs small and black; lateral hoofs small. Tail ca. 13% of HB, sparsely covered with blackish-chestnut hairs above and white below and at tip.

Horns (both sexes) very short, well separated, straight; heavily ringed on basal half, smooth on terminal half.

**Similar Species** (see yellow box above).

*Philantomba monticola*, Blue Duiker. No conspicuous tuft of black and dark brown hairs between horns. Dorsal pelage dark rufous-brown with rufous-cinnamon flanks. Larger, Sh. ht: 379-429 mm.

*Sylvicapra grimmia*, Common Duiker. Dorsal pelage greyish-fawn. Larger, Sh. ht: 520-550 mm. Horns normally in males only.

*Ourebia ourebi*, Oribi. Dorsal pelage brownish-orange; conspicuous circular black patch below each ear and black tipped tail.

**Distribution** In Malawi, found only in the north; most records are from the Nyika and Viphya Plateaux and other plateaux north of about 12˚ 30' N; also Chintheche, Nkhata Bay and Ntchisi Mountain F. R. There are also a few records from the Upper and Lower Shire regions - including Chiromo and Tuchila River – but these records are considered erroneous by Wilson (2001) and Ansell & Dowsett (1988). Elsewhere: recorded from central and NE Tanzania and a few isolated localities in Kenya and S Ethiopia; also Chowo Forest, E Zambia – on the Zambian Nyika Plateau.

**Habitat** Forest habitats such as montane evergreen forest, closed canopy miombo woodland, relict and gallery forests adjacent to grasslands; pine plantations. In other parts of the biogeographic range, lives in montane forest, bamboo thickets and miombo woodland where water is available.

**Abundance** No detailed information for Malawi. Said to be "common in suitable areas of montane and lower altitude forest in the north of Malawi" in the past. In other parts of the biogeographic range, densities of 2-13/km$^2$ have been recorded; they are determined by the type of forest and the level of disturbance and hunting.

**Habits** Very little is known about Harvey's Duikers. They are most active in the early morning and late afternoon. They are browsers which feed on a wide variety of leaves and fruits. The only detailed study (n = 3) showed that 90% of the contents of the rumen was leaves. On the Nyika Plateau, Harvey's Duikers leave patches of montane forest and move onto recently burned grassland to feed on the newly sprouting forbs and other plants. An interesting inter-species association is that these duikers sometimes forage on the fruits dropped by colobus monkeys, and in Tanzania they may join ground-foraging Sanje Mangabeys *Cercocebus sanjei*. There are some unusual observations of these duikers being groomed by monkeys.

Harvey's Duikers are mostly solitary (except when a female associates with her young), but occasionally they are seen in pairs. Three adult males were seen together, once, on Nyika Plateau but this appears to be a temporary association which is only maintained if females are absent. When disturbed, they make a "shrill fluty whistle".

**Reproduction** No information for Malawi except on the Nyika Plateau where newborn young have been observed in Dec, Feb, Mar and Aug.

**Conservation** IUCN Category: Least Concern. The species is protected in several reserves, but populations are considered to be 'decreasing' due to over-hunting and habitat destruction.

**Taxonomic Notes** *Cephalophus harveyi* (Thomas, 1893). The taxonomy of this species is uncertain. Sweeney (1959), Hayes (1978), Ansell & Dowsett (1988) and Hough (1989) refer to this species as *Cephalophus natalensis* (Natal Red Duiker) and Wilson (2001) refers to it as *C. n. harveyi.* Both *C. harveyi* and *C. natalensis* are 'red duikers' and are closely related, and there may be hybrids between the two species. Kingdon & Rovera (2013) refer to the 'Red Duiker' in Malawi as *C. harveyi*. (The Natal Red Duiker, *Cephalophus natalensis,* has a different biogeographic range and occurs from southern Tanzania southwards along the coast to South Africa). The relationship between the two species needs further study.

**Key References** Kingdon & Rovero (2013), Wilson (2001).

**Measurements**
*Cephalophus harveyi*

| | |
|---|---|
| TL (males): | 870 (800-890) mm, n = 4 |
| TL (females): | 900 (861-916) mm, n = 5 |
| T (males): | 101 (90-107) mm, n = 4 |
| T (females): | 103 (89-113) mm, n = 5 |
| E (males): | 74 (71-78) mm, n = 4 |
| E (females): | 78 (74-82) mm, n = 5 |
| Sh. ht (males): | 412 (391-429) mm, n = 4 |
| Sh. ht (females): | 410 (379-411) mm, n = 5 |
| Horn length (males): | 70 (45-80) mm, n = 8* |
| Horn length (females): | 35 (20-44) mm, n = 7* |
| WT (males): | 10.9 (8.9-12.0) kg, n = 4 |
| WT (females): | 11.6 (9.2-12.3) kg, n = 5 |

Malawi (Nyika, Wilson 2001).
**Cephalophus natalensis*, South Africa (Wilson 2001).

# Genus *Connochaetes* - Wildebeests

Subfamily Antelopinae. Tribe Alcelephini. This tribe is represented in Malawi by two genera, *Alcelaphus* (Hartebeest) and *Connochaetes* (Wildebeests). The genus *Connochaetes* contains two species, but only *C. taurinus* occurs in Malawi. This species is usually considered to contain five subspecies of which two have been recorded in Malawi – *C. t. cooksoni* (Cookson's Wildebeest; an extremely rare vagrant from Zambia) and *C. t. johnstoni* (Nyassa Wildebeest or Johnston's Wildebeest; once common but now locally extinct).

## *Connochaetes taurinus*

## Common Wildebeest

**Malawian Names** Nyumbu, Sindi, Tsindi.

*Connochaetes taurinus johnstoni*, Niassa G. R. © C. Begg

**Description** *C. t. cooksoni.* A large ungainly grey antelope with dark vertical stripes on neck and front half of flanks, a mane of long hairs, shoulders higher than rump, and wide-spreading smooth 'cowlike' horns with upturned tips in both sexes. Males, on average larger and heavier than females and with wider horns. Pelage mostly smooth but shaggy under neck. Pelage on neck, body and legs bluish-grey to brownish-grey with dark grey or blackish vertical stripes (5-8) on neck, and on front half of flanks (8-10), of varying lengths. Sparse mane of long black hairs from back of head to mid-back. Long black or grey hairs on mid-ventral line of chin, throat and upper neck. Hindquarters and rump usually paler than body, without any stripes. Head large and elongated, black from base of horns to muzzle, including upper and lower lips and nostrils; cheeks bluish-grey (same as neck). Some individuals have a bright chestnut-coloured patch on forehead immediately anterior to the horns. Eyes dark. Preorbital glands present but covered by hair. Ears short; outer surface blackish-brown; inner surface white; ears often hidden from view by horns. Fore- and hindlimbs pale brown; lateral hoofs prominent. Tail ca. 25% of HB with black hairs laterally and long black hairs on the lower half (rather like the tail of a horse) reaching well below the hocks. Young are brownish-beige, with short black mid-dorsal mane, and without stripes. (See also Reproduction and Taxonomic Note.)

Horns (in both sexes) small, black, smooth without any spirals or twists, extending outwards and slightly downwards from head before turning upwards and inwards (roughly in the same manner as the horns of a cow); bases of horns thickened and join on middle of forehead to form a small boss (as in African Buffalo, but much smaller); tips pointed. The horns first appear at ca. 1 month and remain small and straight until 3-4 months of age; they begin to grow sideways and upwards at ca. 10 months, and the tips curl inwards at ca. 16 months. Adult size and shape are reached at 24 months.

*C. t. johnstoni*. Similar to *C. t. cooksoni* except that *C. t. johnstoni* was described as having a horizontal white band (chevron) across the forehead between the eyes which divides the black colouration into two roughly equal halves. Although the chevron was considered a definitive character of *johnstoni,* the thickness and width of the chevron shows individual variation (see Taxonomic Notes).

**Similar Species** None (see yellow box above). No other species has the ungainly appearance of this species.

**Distribution** Wildebeest have not been recorded in Malawi recently. In the past, the two subspecies in Malawi had different distributions. *C. t. cooksoni* occurred in the north-west of the country near to Zambian border (see also below). *C. t. johnstoni* occurred east of Lake Malawi and southwards on to the Blantyre Highlands. Elsewhere: both *johnstoni* and *cooksoni* have very limited biogeographic distributions compared with the other subspecies of *Connochaetes taurinus; cooksoni* is fairly common in the Luangwa Valley of Zambia, and *johnstoni* is still

present in S Tanzania and N Mozambique. Other subspecies are moderately widespread in S Kenya, Tanzania, Zambia, and most parts of southern Africa. *Historical Distribution* *Connochaetes t. cooksoni*: has been recorded only twice in Malawi – in Vwaza Marsh G. R. and Kasungu N. P. Considered to be an extremely rare vagrant from the Luangwa Valley in Zambia. All records are pre-1975. In contrast, *Connochaetes t. johnstoni*: was often recorded around the Mozambique–Malawi border, from near Mangochi and Lake Chiuta southwards to Lake Chilwa and the Phalombe Plain around Mulanje Mountain to where the escarpment descends to the Lower Shire Valley. All these localities are above 500 m. (Also, one individual was recorded on the Mozambique side of the Ruo river, not far from Chiromo). In 1922, *johnstoni* was "found in large herds in the South Nyasa and Zomba districts near the Portuguese border" but by 1932 the subspecies was rare and individuals "hardly ever entered Nyasaland . . . from PEA". By ca. 1925-1930, *johnstoni* in Malawi was probably locally extinct, although records suggest that herds were still present on the Mozambique-Malawi border (where there were hardly any human inhabitants) in the 1950s.
*Present Distribution* No longer present in Malawi.

**Habitat** Grassland savannas and woodland savannas. Preferred habitat in Malawi of *C. t. johnstoni* (when the species was relatively common) was in dambos and swamps around Lake Chuita and Lake Chilwa, and on the grasslands of the Phalombe Plain and around Mulanje Mountain; here the soil is rich in sodium and possibly the high salt content in the grasses was attractive to *johnstoni*. In southern Tanzania, *johnstoni* prefers miombo woodlands where there are open grasslands. In other parts of the species biogeographic range, Wildebeest are migratory, but it is not known to what extent *C. t. johnstoni* are sedentary or migratory. The habitat of *C. t. cooksoni* in Kasungu N. P. and Vwaza Marsh G. R. was probably similar to that of *C. t. johnstoni*.

**Abundance** In Malawi, *Connochaetes taurinus* is either locally extinct (*C. t. johnstoni*) or an extremely rare vagrant from Zambia (*C. t. cooksoni*). See also Distribution. The species, as a whole, is widespread in eastern and southern Africa and is very numerous in some localities.

**Habits** Very little is known about the subspecies *johnstoni* and *cooksoni* compared with other subspecies, i.e. *C. t. taurinus* (southern Africa) and *C. t. mearnsi* and *C. t. albojubatus* (Kenya, Tanzania). Wildebeest are grazers preferring to feed on the leaves of short grasses (3-10 cm tall); their wide muzzles allow them to pluck grasses quickly and efficiently. They do not browse, even during the dry season. They usually require access to drinking water. In many localities, Wildebeest mingle with Zebras probably because this provides mutual protection against predators and/or because Zebras feed on taller coarser grass than Wildebeest and in doing so make the grasses shorter and more palatable for Wildebeest.

Wildebeest are social animals living in small herds (although for the migratory subspecies in Kenya and Tanzania, very large herds are common especially during the migration season). In the Ngorongoro Crater (Tanzania), when not migrating, females of all ages (together with their young) live in female herds, yearling males and older males which are not reproductively active live in bachelor herds, and reproductively active males establish territories which they defend against other males. A typical female herd contains ca. ten females with their young and occupies a home-range of ca. 100 ha. The home-range of a female herd may overlap with the territories of 4-5 territorial males, and a female may mate with one or more of these territorial males. Bachelor herds comprised of non-breeding males of all ages (from young to former territorial males), may contain several hundred individuals. In Niassa N. P. (Mozambique), female herds contain up to ca. 15 individuals.

Wildebeest calves do not lie up as many other species do. Instead, they accompany their mothers as soon as they can stand, and they can keep up with herd movements after two days. However, they are left to rest alone or in creches while the mother feeds or visits a source of water.

**Reproduction** No information for Malawi. Elsewhere: the birth of young is highly synchronized. In southern Africa, young are born just before the beginning of the wet season, typically in Nov-Dec. In SW Zambia, they are born from late Oct-Nov. Neonates are precocial and weigh 14-25 kg at birth. The reproductive strategy of Wildebeest is to have as many young as possible within just a few weeks so that, during the parturition season, there are more very young Wildebeest than predators can eat, and this results in a better survival rate of the young in the population as a whole. The young are weaned at ca. 8 months and form their own groups at ca. 9 months of age.

**Conservation** IUCN Category: Least Concern (for the species as a whole). No category for subspecies *johnstoni* and *cooksoni*. Both of these subspecies

have small biogeographic ranges and small population numbers. Conservation concerns are reduction in suitable habitat (mainly because of agriculture) and hunting for food and trophies. Re-establishment of *johnstoni* in its former range in Malawi is not possible because all the land where it previously occurred is now utilized for agriculture and human habitations. In 1997-1998, efforts were made to introduce *johnstoni* from southern Tanzania into Liwonde N. P.; however, these efforts failed and *johnstoni* was not re-introduced into Malawi.

**Taxonomic Notes** *Connochaetes taurinus* (Burchell, 1824). Five subspecies are recognized. Two subspecies have been recorded from Malawi: *C. t. cooksoni* (north-west Malawi) and *C. t. johnstoni* from Lake Chilwa and the Phalombe Plain (see above). The original description of *johnstoni* stated that the white chevron was a defining character; however, individuals within the region where *johnstoni* are currently present may or may not possess the chevron. In Selous N. P. (Tanzania - north of the Rufiji River) only 1% of '*johnstoni*' have a chevron (small and brownish in colour) whereas a higher number of individuals (but not all) of '*johnstoni*' south of the Rufiji River in Tanzania have a visible white chevron. In Niassa G. R. (N Mozambique, east of the Malawi border), photographs show that 100% of individuals have the clearly defined white chevron. This situation maybe because individuals without the chevron in Tanzania may not be *johnstoni* but a (migratory) subspecies from further north, or they may be hybrids between pure *johnstoni* and another subspecies, or perhaps *johnstoni* is polymorphic with a higher proportion of individuals with a white chevron in the south of the biogeographic range than in the north of the range. A genetic study is required to resolve the true status of *johnstoni*.

**Key References** Estes (2013a), Smithers (1983).

**Measurements**
*Connochaetes taurinus mearnsi*
(no information available for *C. t. johnstoni or C. t. cooksoni*)

| | |
|---|---|
| TL (males): | 2495 (2330–2760) mm, n = 40 |
| TL (females): | 2346 (2270–2415) mm, n = 11 |
| T (males): | 623 (565–730) mm, n = 40 |
| T (females): | 587 (550–635) mm, n = 11 |
| E (males): | 202 (183–230) mm, n = 40 |
| E (females): | 195 (187–207) mm, n = 11 |
| Sh. ht (males): | 1226 (1110–1340) mm, n = 40 |
| Sh. ht (females): | 1171 (1070–1230) mm, n = 11 |
| Horn length: | mean 600 mm (tip to tip along both horns)* |
| WT (males): | 201.1 (171.0–242.0) kg, n = 40 |
| WT (females): | 163.0 (140.8–242.0) kg, n = 11 |

Tanzania (Serengeti N. P., Sachs 1967 in Estes 2013).
*Southern Africa (Stuart & Stuart 2015).

# Genus *Hippotragus* – Horse-like Antelopes

Subfamily Antilopinae. Tribe Hippotragini. This tribe is represented in Malawi by the genus *Hippotragus* which contains two species – the Roan and Sable Antelopes. Both species occur in Malawi. They are known as the Horse-like Antelopes because they have some horse-like characters (see below).

## *Hippotragus equinus*

## Roan Antelope

**Malawian Names** Chilembwe, Mlembwe, Mpalapala (also refers to Sable Antelope), Mpheremba.

Nyika N. P., Malawi © Bentley Palmer

**Description** A large, plain reddish-brown antelope with striking black and white markings on the head, longish ears with a black tuft at the tip, and very long, heavily ringed horns which curve smoothly upwards and backwards. Has some horse-like characters – shoulders (withers) higher than rump, a swayed back, and a short but obvious mane. Males, on average, larger and heavier than females; males have longer horns. Pelage mostly short and smooth but longer along lower half of neck. Dorsal pelage plain reddish-brown to chestnut-brown (paler in young animals). Hairs of mane on neck and withers are stiff and erect, beige with black tips. Ventral pelage similar to dorsal pelage, sometimes darker between forelimbs. Head black, with a longish white oblong-shaped patch above the eye on each side of the forehead extending from base of horns to cheek; a white patch behind the eye; a white muzzle and chin, and black nostrils. These white facial markings are extremely conspicuous when seen from the front and the side. Eyes dark. Preorbital glands: no information. Ears donkey-like, long and pointed with long black tuft at the tip; outer surface pale brown, inner surface covered by long white hairs. Limbs brown (without any markings); buttocks paler. Lateral hoofs prominent. Tail thin (ca. 20% of HB), reaches down to hock, dark with black tassel at tip.

Horns (in both sexes) are long, black or brown, heavily ringed except near the sharply pointed tip. They arise from the forehead and then curve gently and evenly backwards over neck. Front view: V-shaped with sides curving slightly outwards especially near the tips. Side-view: each horn curves smoothly upwards and backwards like the arc of a circle. Horns buds become visible at ca. 15 months; they are ca. 18 cm and straight at 1 year, 35 cm and curving backwards at ca. 4 years, and reach ca. 50 cm (full size) at ca. 6 years.

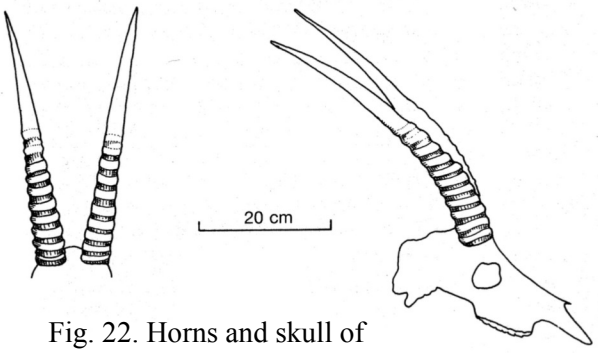



Fig. 22. Horns and skull of *Hippotragus equinus.*

**Similar Species**

*Hippotragus niger* (Sable Antelope). Dorsal pelage black (M) or dark chestnut (F). Ventral pelage white clearly delineated from dark colour of flanks. Ears: outer surface orange-cinnamon; inner surface white with long white hairs; very inconspicuous black tuft at tip.

**Distribution** Central and Northern Provinces northwards from about 14˚S (see also below). Elsewhere: widespread in savanna habitats in four disconnected regions: from Senegal to S Sudan and South Sudan; Tanzania; Zambia, Angola, S DR Congo, N

Zimbabwe, N Botswana and N Namibia; and small region of S Zimbabwe, N South Africa and SW Mozambique.

*Historical Distribution* Widespread on the Central Plateau (but not Lake Shore); old records include the high plateaux of Viphya and Nyika, along the Bua River and around Ekwendeni. There is one record of the species on the Phalombe Plain near Zomba (in 1903). Other records from the early 1900s (Majete W. R. and Lengwe N. P.) are erroneous – there is no evidence that Roan Antelope ever occurred in the Upper and Lower Shire Valleys.

*Present Distribution* Mostly confined to the following protected areas - Kasungu N. P., Nkhotakota W. R., Nyika N. P. and Vwaza Marsh G. R.

**Habitat** Woodlands savannas and grasslands where the grasses are of medium height. In Nyika N. P., Roan Antelope live on the open short montane grasslands, herblands and bracken communities of the plateau, and descend into the lower altitude miombo woodlands during coldest part of the year (Jun–Sep). Individuals on Nyika Plateau have the unusual habit of wading into the dams, dipping their heads below the surface and browsing on the waterweeds. Roan Antelope move into burned areas when the highly-nutritious new grass shoots begin to sprout. Tall grass cover (to hide calves) and access to water are also important habitat requirements.

**Abundance** In 1989, population estimates were 700 in Vwaza Marsh W. R., 550-600 in Nyika N. P., 500 in Kasungu N. P., and 100 in Nkhotakota G. R. (Bell 1989).

**Habits** Roan Antelope are active and feed from sunrise to mid-morning and again from late afternoon until nightfall. During the hottest part of the day, they rest in shade. They are predominantly grazers but browse on shrubs to a limited extent in the dry season. Nutritional ecology has not been studies in Malawi. In South Africa, Roan Antelope prefer grasslands rather than woodland savanna for grazing. They are very selective in their choice of habitat (with respect to grass species and tree species, and the height of the grass), and these preferences change seasonally (wet v. dry and burnt v. unburnt). They feed on medium to long grass and avoid areas where the grass is short because of over-grazing by other species or for any other reason. Breeding herds (see below) use different parts of the habitat to the bachelor herds; pregnant and lactating females select grasses with the highest nutritional value.

Roan Antelope have a social organization which has some unique features. Roan either live in breeding herds or bachelor herds, or they are solitary. Breeding herds are composed of adult females and their young and a dominant male. The females establish a status hierarchy at the top of which is the alpha female who is followed by the rest of the herd (including the dominant male) wherever she goes. The dominant male defends the females in his herd against intrusions by other males; this may result in conflict and either the dominant male intimidates the intruder, or he is ousted and replaced by his attacker. Because the dominant males defend their females but not a demarcated area where they live, Roan are not considered to be territorial animals. Subadult males leave the breeding herd to join all-male bachelor herds. Solitary individuals are old males whose herd has been taken over by a younger male. Herd size, in most parts of the biogeographic range, is usually 5-12, although herds in Nyika N. P. are unusual in having up to 40 individuals (Bell 1989). The home-range varies depending on locality and quality of the habitat; the typical home-range area of a breeding herd is 1000-2000 ha, and slightly smaller for a bachelor herd. Breeding herds often occupy the same home-range for many years, e.g. for eight years in Kruger N. P. and over 30 years was recorded once in East Africa.

Females leave the herd and hide in dense vegetation to give birth. Calves lie up for 2-6 weeks before joining the herd.

**Reproduction** No details for Malawi. In most localities, births occur over a period of about two months at the end of the wet season(s); there may be two birthing times in tropical regions, but only one (Jan-Mar) in South Africa. Gestation: 270-290 days. Litter-size: 1. Neonates are precocial and weigh 15-18 kg. Calves are weaned at 4-6 months. A female can give birth to her first young at ca. three years of age and may conceive again 2-3 weeks after giving birth.

**Conservation** IUCN Category: Least Concern. The biogeographic range and numbers of Roan Antelope have declined in recent years because of hunting and loss of habitat because of farming and the introduction of domestic cattle. Some herds thrive well on private ranches in South Africa.

**Taxonomic Notes** *Hippotragus equinus* (É. Geoffroy Saint-Hilaire, 1803). Six subspecies are recognised; the subspecies in Malawi is *H. e. cottoni* which also occurs in other countries of Central Africa (Angola, N Botswana, N Zimbabwe, N Namibia, Zambia and S DR Congo).

**Key References** Chardonnet & Crosmary (2013), Smithers (1983).

**Measurements**
*Hippotragus equinus*

| | |
|---|---|
| TL (males): | 2730 mm, n = 1 |
| TL (females): | 2630 mm, n = 1 |
| T (males): | 540 mm, n = 1 |
| T (females): | 530 mm, n = 1 |
| E (males): | 310 mm, n = 1 |
| E: (females): | 290 mm, n = 1 |
| Sh. ht: | 1400 (1100-1500) mm† |
| WT (males): | 280.0 (241.0–298.1) kg, n= 12* |
| WT (females): | 258.2 (222.4–280.0) kg n = 8* |
| Horn length: | ca. 350-500 mm* |

Namibia (Caprivi, Rautenbach 1982 in Chardonnet & Crosmary 2013).
*E Zambia (Wilson 1968 in Chardonnet & Crosmary 2013).

## *Hippotragus niger*

## Sable Antelope

**Malawian Names** Likudzi, Mbalapi, Mphalapala (also refers to Roan Antelope), Tonde.

Male. Liwonde N. P., Malawi © Bentley Palmer

Males, females and young. Liwonde N. P., Malawi © Bentley Palmer

**Description** A large, plain black (M) or dark chestnut (F) antelope with white markings on the head and very long to extremely long, heavily ringed horns which curve smoothly upwards and backwards. Horns often described as scimitar-shaped. Less horse-like than Roan Antelope – shoulders (withers) only slightly higher than rump, back straight, but the erect mane (extending from top of head to the withers) is very obvious. Males and females dimorphic.

*Males*: Strongly built with thick neck and chest. Dorsal pelage black sometimes tinged with dark brown (but always looks black from distance); brown to brownish-black in sub-adults. Hairs of mane black (sometime with flecks of chestnut). Ventral pelage white, clearly delineated from dark colour of flanks; white pelage extending to buttocks and inside surface of thighs. Head black with a white stripe from the nasal corner of each eye to the muzzle and a white area covering the chin to the front of the cheek. Eyes dark. Preorbital gland rudimentary. Ears moderately long and pointed; outer surface orange-cinnamon; inner surface white with long white hairs. Limbs black except on inside of thighs. Hoofs black; lateral hoofs prominent. Tail ca. 25% of HB, reaching to hocks, black with short hairs, ending in black tassel at tip.

Horns extremely long, thick at base but tapering to sharp tip; heavily ringed with up to 30 rings, except near tip. Front view: narrowly V-shaped. Side view: each horn curves upwards and then backwards in a smooth arc over the neck; in some old adult males, the curve is almost semi-circular.

*Females*: Smaller. Dorsal pelage brown to deep chestnut (never as dark as in males). Ventral pelage as in males. Head dark chestnut with white markings as in males. Horns shorter and less curved than in males.

*Young*: Dorsal pelage medium brown, darkening in colour in the first year, and reaching adult colouration by about 4 years. Horns (males): 2 months – 2-3 cm long, straight; 12 months - 35 cm long, straight; 20-30 months – 40-50 cm long, straight; 30-40 months - 65-70 cm long, slightly curved; adult [5 years] 85-110 cm long, curved; 5+ years – up to 120-160 cm long, fully curved. Horns smaller in females.

**Similar Species**

*Hippotragus equinus* (Roan Antelope). Dorsal pelage reddish-brown. Ventral pelage similar to dorsal pelage, sometimes darker between forelimbs. Ears: outer surface pale brown; inner surface covered by long white hairs; conspicuous black tuft at tip.

**Distribution** Recorded in many parts of Malawi from ca. 11˚S southwards towards to Nsanje (see below). Elsewhere: widespread in East-central Africa from S Tanzania to S DR Congo, Zambia,

Mozambique, Zimbabwe, NE Botswana and NE South Africa.

*Historical Distribution* Widespread from about Vwaza Marsh (11˚S) southwards to the western parts of Central Region and most of the Upper Shire and Lower Shire Valleys. In the early 1900s the Shire Highlands and Phalombe Plain were "especially full" of Sable Antelope. They were described in 1897 as "extremely common in Nyasaland" and "one of the commonest antelopes in the Shire Highlands".

*Present Distribution* Confined to National Parks and other protected areas - Dzalanyama F. R., Kasungu N. P., Lengwe N. P., Liwonde N. P., Majete W. R., Mwabvi W. R., Namizimu F. R., Nkhotakota W. R. and Vwaza Marsh G. R. Probably does not occur outside protected areas at the present time.

**Habitat** Sable Antelope have very precise habitat requirements: woodland savanna and grasslands (often on wooded hills) where there are widely spaced deciduous trees and an understorey of short grass. They also need access to floodplain grasslands which have new grass after burning. In Malawi, in the wet season, Sable Antelope occur in open canopy miombo woodlands with grasses 10-30 cm tall. In the dry season they move into the moister grasslands. In Liwonde N. P., most Sable Antelope are seen in the mopane woodlands (*Colophospermum mopane*) in the wet season, and on the floodplains and dambos close to the Shire River in the dry season.

**Abundance** In 1989, estimates in protected areas were ca. 900 individuals in Liwonde N. P., ca. 500 in Kasungu N. P., ca. 250 in Nkhotakota W. R., ca. 200 in Mwabvi W. R., ca. >500 in Majete W. R., ca. 20 in Vwaza Marsh G. R., and there were occasional sightings in Lengwe N. P. and Dzalanyama F. R. (Bell 1989). Densities in other parts of the biogeographic range vary from 1.4/km$^2$ to ca. 4/km$^2$ (depending on the season).

**Habits** Sable Antelope forage mainly in early morning and late afternoon, and also sporadically during the night. Details of diet are not known for Sable Antelope in Malawi. They are predominantly grazers but browse to some extent during the dry season when the nutritional value of grass decreases. They are attracted to burnt grasslands as soon as fresh green grass is present, but as these grasses grow and become less palatable, they move to unburnt grasslands and feed on 'hay'. When grazing, they are highly selective, feeding on only a few species of preferred grasses. They are dependent on drinking water.

The social organization of Sable Antelope is different from that of Roan Antelope because adult male Sable Antelope are territorial. Females live in breeding herds comprised of adult females and their young; the females establish an age-related status hierarchy with a senior female who leads the way when the herd moves and is one of the most vigilant members of the herd. The status of the females is determined by the outcome of aggressive behaviour including horn-presentation, prodding and chasing. The females also maintain a distance of 3-4 m between individuals, even when resting. Breeding herds (subspecies *H. n. kirkii*) contain an average of 15.2 individuals. However, a herd of ca. 200, mostly females and subadults, was seen near the Shire River in Liwonde N. P. in October 1984 (*pers. obs.*). Young males leave the breeding herd when they are ca. three years old, and either live in bachelor herds which usually contain less than ten individuals, or they live alone. Adult males are territorial. Territories have areas of 4-9 km$^2$ and a male defends his territory by scraping the ground with his forefeet, by defaecating, and by patrolling the boundaries of his territory and often thrashing at shrubs and small trees. If another male enters his territory, the resident male advertises his presence, particularly by up-and-down movements of the horns while standing side-by-side with the intruder (head to tail); the tail is extended backwards and the dominant male raises his tail highest, and perhaps there will be a brief (ritualized) fight while kneeling. Within the home-range of a breeding herd there may be several territories held by territorial males, and these males attempt to keep females within their territories so they can mate with any that come into oestrus. A male checks for females in oestrus by sniffing, urine-testing (flehmen), and by touching the female's hind-quarters with one of his front limbs.

Females give birth in secluded places, and the calves lie up for up to 8 weeks before joining the female herd.

**Reproduction** No detailed information for Malawi: two calves and several half-grown young were seen in Liwonde N. P. in Jun (*pers. obs.*). In Zimbabwe (one wet season/year), most births occur in Feb–Apr, and in Kenya (two wet seasons/year) there is no fixed birthing season. Gestation: 240-270 days. Litter-size: 1. Neonates are precocial and weigh 19-20 kg at birth. Weaned at ca. 8 months.

**Conservation** IUCN Category: Least Concern. Conservation concerns include fragmentation of populations, and loss of suitable habitat. In South

Africa, Sable Antelope have been introduced onto private ranches outside their natural biogeographic range.

**Taxonomic Notes** *Hippotragus niger* (Harris, 1838). Four subspecies are recognised. The subspecies in Malawi is *H. n. kirkii* which also occurs in Mozambique, Zambia, SE DR Congo, E Angola and W Tanzania.

**Key Reference** Estes (2013b).

**Measurements**
*Hippotragus niger*

| | |
|---|---|
| HB (males): | 1924 (1877–1985) mm, n = 4 |
| T (males): | 465 (425–515) mm, n = 4 |
| E (males): | 237 (225–265) mm, n = 4 |
| Sh. ht: | ca. 1350 mm* |
| Horn length: | see above (in description) |
| WT (males): | 191.0, 260.0 kg, n = 2 |

Botswana (Smithers 1971).
*Southern Africa (Stuart & Stuart 2015).

# Genus *Kobus* - Kobs

Subfamily Antilopinae. Tribe Reduncini. This tribe is represented in Malawi by two species of *Kobus* and one species of *Redunca*. The genus *Kobus* contains five living species of which two, Waterbuck and Puku, occur in Malawi. These species are easily distinguished. The Puku is medium-sized and has plain golden-brown pelage while the Waterbuck is large and is greyish brown with a conspicuous elliptical white band around its rump and hindquarters.

The Waterbuck, *Kobus ellipsiprimnus*, contains two subspecies of which only the Common Waterbuck, *K. e. ellipsiprimnus*, occurs in Malawi.

## *Kobus ellipsiprymnus ellipsiprymnus*

## Common Waterbuck

**Malawian Names** Chuzu, Nakodzwe, Ndogolo.

Liwonde N. P., Malawi © Bentley Palmer

**Description** (*K. e. ellipsiprymnus).* A large, plain greyish-brown to dark brown antelope with a conspicuous white band on the rump and hindquarters (elliptical when viewed from behind), a white bib, and long, heavily ringed horns (males only) which, when viewed from the side, curve smoothly backwards, upwards and then forwards. Males, on average, larger than females, similar in colour but only males have horns. Pelage coarse, and moderately long and shaggy. Pelage (on back, flanks, neck and belly) plain greyish-brown to dark brown, sometimes lightly flecked with white or grey. There is a clearly defined white elliptical band from upper hindlimb over the top of the rump (and above the base of the tail) to the upper hindlimb on the opposite side. This characteristic is unique to the subspecies *ellipsiprymnus*. Head similar in colour to body, with russet-brown patch on forehead just anterior to horns; wide white eyebrows (often extending anteriorly onto muzzle), and white around nostrils and upper and lower lips. Nostrils black. There is a shaggy white 'bib' from throat to upper neck. Eyes dark. No preorbital glands. Ears large, rounded at tip; outer surface brown; inner surface covered by long white hairs. Limbs strong and thickset, similar in colour to body. Lateral hoofs prominent. Tail ca. 17% of HB, thin, brown or blackish above, whitish below, with tassel of black, brown and sometimes white hairs at tip.

Horns long, heavily ringed (up ca. 25 rings) except at tip. Front view: U-shaped with rounded sides and slightly converging tips; tips wide apart (a distance equivalent to ca. 0.5 – 0.7 of the length of the horn). Side view: each horn points backwards at same angle as the line from nose to forehead, and then curves smoothly upwards and then forwards.

**Similar Species** None (see yellow box above). No other antelope has a conspicuous white band on the rump and hindquarters (elliptical when viewed from behind) and a shaggy white bib.

**Distribution** Recorded throughout Malawi except in the northern montane regions (see below). Elsewhere: recorded in many savanna regions of Africa south of the Sahara but not recorded in rainforest or semi-arid habitats.

*Historical Distribution* Formerly recorded throughout most of Malawi except the extreme north (montane habitats). In the late 1890s and early 1900s, Waterbuck were described as common near Chiromo and in the Upper Shire Valley: e.g., "waterbuck (*and other antelopes*) as far as the eye can see" and "common in most parts of the Protectorate". In 1929, there were still large herds of Waterbuck in the valley of the Bua River, and in 1957 they were still recorded near Chiromo.

*Present Distribution* Waterbuck numbers have declined in recent years, and they are now found only in a few protected areas. In 1982-1985, estimates of

population numbers were: Liwonde N. P. (ca. 500), Nkhotakota W. R. (100-200), Kasungu N. P. (50-100), and Majete W. R. (ca. 100) and Vwaza Marsh G. R. (none, although 1-2 in 1982) (Bell 1989).

**Habitat** Waterbuck are restricted to areas of grasslands close to water where the grasses are rich in nutrients, and to woodlands within a few kilometers of water. They occur only in areas where the annual rainfall is ca. 750 mm/year. In the wet season, they spend more time in grassy woodlands, but congregate close to water in the dry season. In Liwonde N. P., Waterbuck are often seen in the dambos and mopane woodlands bordering the Shire River.

**Abundance** Apart from the population numbers given above, there is no detailed information for Malawi. Elsewhere: densities range from 0.23/km$^2$ (parts of South Africa) to 0.4–1.8/km$^2$ in other parts of Africa (in suitable habitats only).

**Habits** Waterbuck forage during both day and night. Waterbuck are predominantly grazers; several studies have suggested that the diet is 90-98% grass. Waterbuck feed on a variety of grasses – these vary according to the locality. During the wet season, they feed on grasses of medium height and also on protein–rich short grasses that have sprouted after burning. Their large size means they must eat a lot, and hence they spent a lot of time grazing, often walking and grazing at the same time. In the dry season, when grasses are nutrient-deficient, they browse on the leaves and shoots of shrubs and small trees. Water is required every day; Waterbuck are unable to tolerate dehydration, even for a short time.

The social behaviour of *K. e. defassa* has been well studied in Uganda by Spinage (2013) and studies in Zimbabwe suggest that the behaviour of *K. e. ellipsiprymnus* is similar. The social organization results in the formation of breeding herds (comprised of adult females and their young), bachelor herds, spinster herds, and territories held by individual adult males who are at least five years old. Territories are held throughout the year and they are defended more often by intimidating displays than by conflicts. The defending male will stand side-on to the intruder with his head held high, his horns tilted towards the intruder, and his tail held horizontally. Conflict can be avoided if the intruder shows submission by holding his head low with the head stretched out and the horns directed backwards. If the intruder does not show submissive behaviour, the territory holder male will lock horns with the intruder and conflict occurs. Conflicts can result in serious injuries and death. However, a submissive male may either leave the territory, or be allowed to remain (but not mate with any female). The size of a male's territory depends on the population density, the quality of the habitat, and the age of the male (older males have larger territories). In Uganda, territories range in size from 4-146 ha.

Breeding herds in Uganda can have 1-70 (mean 5.3) members. In South Africa they usually have 6-12 members but can have up to 30. Adult females in breeding herds do not have a status hierarchy and they frequently wander in and out of the herd. In Uganda, the home-ranges of breeding herds are 200-600 ha and are large enough to accommodate the territories of several males. The females visit these territories. The territory holder may attempt to prevent females leaving, but this is never successful. However, he will examine the females by nuzzling their hindquarters to induce urination, and the urine is examined by the flehmen behaviour. If the female is in oestrus, mating will follow. Pregnant females leave the breeding herd to give birth and then, for about three weeks, the calf lies up in a hiding place and is only visited once a day to be suckled on very concentrated milk. However, the females respond to alarm bleats and will defend their calves if necessary. Females come into oestrus again 21 days after giving birth and may mate with the territorial male, but territorial males do not defend the calves.

Some females drive their daughters away when they are about 18 months old and these young females form spinster herds. They may stay in the spinster herd for up to four years, or they may break away and emigrate. Females in spinster herds become sexually mature when about two years old and, after a temporary association with a territorial male, they become established in a breeding herd.

As soon as young males start developing horns, they are driven away from their mothers by the territorial male, and they form bachelor herds which stay within the home-range of the breeding herd and are tolerated by the territorial male. These young males become sexually mature when 3-4 years old, but do not become heavy enough to be able to defeat a territorial male and take over his territory until they are 6-7 years old.

In Liwonde N. P., the following animals were observed: in Oct., 3FF and 3 subadults. In Nov, 1M and 24 FF. In Dec, 28 FF; 11 FF; 1 M alone; 26 MM and 8 FF with 2 subadults; 26 FF. In Jun, 7 FF; 1 M alone; 5 MM.

**Reproduction** No details for Malawi. The time of reproduction varies. In warmer climates, births occur during many months of the year; in cooler

climates (e.g. South Africa), most births occur in the warmer and wetter months. Gestation: ca. 280 days. Litter-size: 1 (very occasionally 2). Neonates are precocial and weigh 13-14 kg at birth. Young are weaned at ca. Day 270. Young females are sexually mature at ca. 20 months.

**Conservation** IUCN Category: Least Concern. Population numbers of Waterbuck have decreased in recent years. Conservation concerns are fragmentation of habitats and populations, and over-hunting for trophies.

**Taxonomic Notes** *Kobus ellipsiprymnus* (Ogilby, 1833). Two subspecies recorded. One subspecies, *Kobus ellipsiprymnus ellipsiprymnus,* occurs in Malawi (and also in eastern Africa from E Kenya southwards to NE South Africa and eSwatini). The relationship between this subspecies and the second subspecies (*K. e. defassa*) in northern sub-Saharan Africa (Senegal to Ethiopia, Uganda, W Kenya W Tanzania, W. Zambia) is uncertain.

**Key References** Smithers (1983), Spinage (2013).

**Measurements**
*Kobus ellipsiprymnus ellipsiprymnus*

| | |
|---|---|
| HB (males): | 2080 mm, n = 1 |
| HB (females): | 2050 mm, n = 1 |
| T (males): | 360 mm, n = 1 |
| T (females): | 330 mm, n = 1 |
| E (males): | 190 mm, n = 1 |
| E (females): | 160 mm, n = 1 |
| Sh. ht (males): | 1290 mm, n = 1 |
| Sh. ht (females): | 1220 mm, n = 1 |
| Horn length (males): | mean 750 mm*, maximum 997 mm† |
| WT (males): | 276 (224–309) kg, n = 10 |

Southern Africa (Roberts 1951 in Spinage 2013).
*Southern Africa (Stuart & Stuart 2015).
†South Africa (Rowland Ward in Spinage 2013).

## *Kobus vardoni*

## Puku

**Malawian Names** Mseula, Nseula.

Male. Kasungu N. P., Malawi © C. & M. Stuart

**Description** A medium-sized, plain golden-brown antelope (without any black stripes), with lyre-shaped horns (males only). Males, on average, larger than females. Pelage sometimes shaggy. Dorsal pelage golden-brown becoming paler brown on flanks with a horizontal band of slightly darker golden-brown just above the belly. Ventral pelage whitish. Head golden-brown with indistinct pale ring around each eye which sometimes extends to base of ears, whitish lips and chin; no nasal stripe or blaze. Preorbital gland opens just in front of the eye. Ears golden-brown on outer surface (with small black tip); long white hairs on inner surface. Limbs sturdy, golden brown on outer side, paler (or whitish) on inner side; without black stripe on front of forelimbs. Lateral hoofs black and clearly visible. Tail ca. 20% of HB, golden brown on upper surface, white on lower surface.

Horns (males only) large and graceful, smoothly curved, basal ¾ heavily ringed; tip smooth. Front view: lyre-shaped or similar; horns diverge widely outwards then curve vertically upwards, or they diverge outwards, then curve slightly inwards and finally diverge slightly again. Side view: each horn rises upwards, then turns backwards and finally curves smoothly upwards and then slightly forwards.

**Similar Species**

*Aepyceros melampus*, Impala. Three distinct horizontal bands of colour on sides; a vertical black stripe on each buttock, a black patch on back of the fetlock of each hindleg.

*Redunca arundinum*, Southern Reedbuck. Dorsal pelage pale brown or greyish-fawn; small circular black patch below each ear; dark stripe on front edge of forelimbs; tail very fluffy; horns (males) front view V-shaped with sides curving inwards, side view )-shaped. Shared distribution: Kasungu N. P., Vwaza Marsh G. R. and Nyika N. P. (where very common).

**Distribution** Recorded in only a few localities in north and central Malawi. Elsewhere: known only from a few scattered localities in Tanzania, Zambia, Angola, S DR Congo and along the Upper Zambezi River and Chobe River floodplain.

*Historical Distribution* Recorded in many riverine and swampy habitats in N and C Malawi, including the upper Bua River ("very common"), the Rusa River, the Songwe River, Vwaza Marsh and the Lifupa area of Kasungu N. P. In 1929, Rodney Wood (First Game Warden of Nyasaland) recorded that the Bua River catchment was "alive with Puku, literally hundreds of them .... very tame .... camped with Puku and Waterbuck all around." Puku have always been very numerous around Lake Mweru and in the valley of the Luangwa river (Zambia).

*Present Distribution* In 1989, only known from Kasungu N. P. (ca. 20 individuals), Vwaza Marsh G. R. (ca. 15), and Nyika N. P. (1-2). The individuals on the Nyika Plateau were in very atypical habitat and were not permanent residents. Some of the recent records in Malawi may have been individuals that had moved temporarily into Malawi from Zambia.

**Habitat** Dambos and floodplains with high quality grasses. In the wet season, Puku move into nearby woodlands. They require moist areas, which support a good cover of grasses, but (unlike Lechwe – *Kobus leche* - which do not occur in Malawi) they do not like standing in water. The selection of habitat (dambo, burned grasslands, woodlands close to dambos) changes seasonally and is closely related to the quality and moisture content of the grasses) (see below).

**Abundance** Puku are now rare in Malawi. The populations are very small and probably depend on

immigration from Zambia. In Zambia, Puku are abundant in the swamps and river systems of the Luangwa Valley and other swampy areas (although far less abundant than in the past).

**Habits** Puku are mainly active in the early morning and late afternoon, with some activity persisting for ca. an hour after sunset. They feed entirely on short grasses in dambos and in woodlands adjacent to dambos. Puku select different habitats seasonally; in each habitat they feed on different species of grasses. They move into areas recently burned when new green nutritious grasses begin to sprout.

The social behaviour of Puku has been studied in NE Botswana and Zambia. In these localities, the social organization results in the formation of breeding herds (comprised of adult females and their young), bachelor herds, and territories held by adult males. Breeding herds comprise 2-23 adult and juvenile females and are labile in membership. Adult males establish territories in more open areas, and they hold them for periods as variable as a few days to several months. Territories are defended against intruding sexually active males more often by displays than by conflicts. The defending male faces the intruder while wagging his tail rapidly. If the intruder does not show submission, clashing of horns occurs and then the intruder usually moves away and is chased out of the territory. Alternatively, the territory holder may be displaced by the intruder. Territorial males sometimes allow sexually inactive males to remain in their territories.

Breeding herds move over the territories of several territorial males, and the males may attempt to keep the females in their territories if they are in oestrus but these attempts do not always succeed. The females select males who are in the best physical condition and they also select the best territories. If a female in oestrus moves into a male's territory and chooses to stay, mating will follow. Calves lie up by concealing themselves in dense vegetation for ca. a month and during this time they do not associate with their mothers except to suck when she visits them once in the morning and again in the evening. Mothers do not defend their calves and males do not participate in parenting. When they are about a month old, calves join their mothers' breeding herd and often form loose associations of 2-3 calves.

Bachelor herds which may contain up to 40 individuals, are comprised of adult and young males. They have home-ranges which are separate from those of breeding herds and the territories of adult males. Solitary males are probably individuals who have been displaced from a territory.

**Reproduction** In the Luangwa Valley (ca. 100 km south-west of Vwaza Marsh G. R.), births occur between Jan and Sep, but 68% occur during the wet season (Jan-Apr) when there are nutritious grasses and plenty of vegetation where the young calves can hide. Gestation: ca 240 days. Litter size: 1. Neonates are precocial and weigh ca 5 kg. Young are weaned at ca. seven months. Females are mature at ca. two years, and males at ca. three years.

**Conservation** IUCN Category: Near Threatened. The population numbers of Puku have declined over all of its range in recent years. Conservation concerns are fragmentation of habitat, invasion of habitat by domestic cattle, and poaching.

**Taxonomic Notes** *Kobus vardoni* (Livingstone, 1857). No subspecies are recognised.

**Key References** Jenkins (2013).

**Measurements**
*Kobus vardonii*

| | |
|---|---|
| HB (males): | 1398 (1295-1460), mm, n = 5 |
| HB (female): | 1311 (1260-1420) mm, n = 6 |
| T (males): | 283 (270-290) mm, n = 5 |
| T (females): | 291 (265-320) mm, n = 6 |
| E (males): | 153 (145-159) mm, n = 5 |
| E (females): | 145 (135-151) mm, n = 6 |
| Sh. ht. (males): | 809 (800-815) mm, n = 4 |
| Sh. ht. (females): | 778 (735–830) mm, n = 6 |
| Horn length: | mean 450 mm. |
| | maximum 562 mm* |
| WT (males): | 73.8 (67.5-77.5) kg, n = 3 |
| WT (females): | 61.2 (47.6-77.9) kg, n = 5 |

Zambia (Ansell 1960, 1964 in Smithers 1983).
*Southern Africa (Stuart & Stuart 2015).

## Genus *Nesotragus* - Suni

Subfamily Antelopinae. Tribe Neotragini. This tribe is represented in Malawi only by the genus *Nesotragus* and this genus has only one species. Some authorities in the past, including Smithers (1983) and Ansell & Dowsett (1988), placed the Suni in the genus *Neotragus* together with two species of Dwarf Antelopes, but *Nesotragus* is currently considered to be valid.

### *Nesotragus moschatus livingstonianus*

### Suni (Livingstone's Suni)

**Malawian Names** Dukutu, Kadumba, Insa (also refers to Blue Duiker), Puru.

Female. Lengwe N. P., Malawi © Bentley Palmer

**Description** A small plain greyish-brown antelope with arched back (hindquarters higher than shoulders), and short straight backward-pointing ringed horns (males only), and no tuft between the horns. Males and females similar in colour, size and weight. Pelage short and smooth. Dorsal pelage plain greyish-brown to pale chestnut-brown, faintly flecked with white hairs. Ventral pelage creamy-white merging into colour of flanks. Throat, lower chest and the upper inner surfaces of limbs white. Head mostly similar in colour to dorsal pelage, crown darker and narrow black blaze from between eyes to nose. Eyes relatively large, dark, surrounded by bare skin. Large longitudinal slit-like opening of preorbital gland in front of each eye. Muzzle and nostrils black. Ears relatively large, rounded at tip; outer surface brown; inner surface flesh-coloured (pinky-brown) with brown around the rim. Limbs slender and delicate, similar in colour to flanks; hoofs small and pointed, each with a black 'sock' above each hoof and long black hairs between the hoofs; lateral hoofs (digits 2 and 5) absent. Tail ca. 16% of HB, bushy, black above, creamy-white on sides and below; wagged frequently from side to side.

Horns short (ca. same length as ears), backward-pointing, more-or-less straight (only a very slight forward curve) with highly visible rings except near tip.

**Similar Species** None (see yellow box above). No other small antelope has such an arched back and occurs in the Lower Shire Valley.

**Distribution** Recorded only in a few localities in the Lower Shire valley (Chiromo, Lengwe N. P., Majete W. R., Mwabwi W. R.). Old specimens labelled as from “Thyolo” and “Blantyre” are thought to have come from the wooded hills below the Shire Valley escarpment. Other specimens collected many years ago from “Deep Bay”, “Mulanje”, “Liwonde N. P.”, “Lake Nyasa” and “Chipata Mountain” are erroneous - the specimens were misidentified. Elsewhere: recorded from S Kenya, E Tanzania, Mozambique and extreme NE South Africa.

**Habitat** Thickets, thicket-clump savanna and forests. Thick undercover is essential. Elsewhere: Suni occur from near sea-level to ca. 2700 m.

**Abundance** Maybe fairly abundant in optimal habitats; the secretive nature of Suni prevents accurate assessment of abundance. A ground survey in Lengwe N. P. suggested 13-17/km$^2$; however, this must be for only small areas of optimum habitat (not the whole of the N. P.). In KwaZulu-Natal, South Africa, density was recorded as 0.9/km$^2$.

**Habits** Suni are mainly active in the early morning and late afternoon although they are active earlier in the afternoon in cool weather. They shelter in dense thickets during the hottest times of day. They are cryptic and very secretive, preferring to remain in thick cover. When disturbed, a Suni 'freezes', or creeps way quietly with the head held low. If really frightened, it runs in a fast zig-zag fashion into thick cover before stopping and 'freezing'. They make a high-pitched *chee-chee* vocalization while fleeing.

Suni are predominantly browsers. They feed mainly on low-growing leaves of small shrubs in undergrowth and forests, but also eat growing and fallen fruits, mushrooms and some grasses. In southern Africa, they are not known to graze but one study in East Africa recorded that the diet was comprised of 84% leaves, 4% stems, 6% fruit and 6% grasses. In Mozambique, the number of species eaten ranged from 49 (early wet season) and 53 (late wet season) to 41 (dry season). Suni are very selective in what they eat; because they are so small in size and have small weak jaws, all of their food must be of high nutritional quality and easy to forage and to digest. They have a high metabolic rate and, unlike larger antelope, they feed for short periods, then ruminate and then recommence feeding. They obtain all their water requirements from their food and do not need to drink, but they come to waterholes in Lengwe N. P. and have been observed there, standing almost submerged, while feeding on water weeds (Hayes 1978).

In southern Africa, Suni are mostly seen alone, but his might be because they are secretive and difficult to see. They are also known to live in pairs (with or without young); in a study in East Africa, 50% of encounters were of pairs. In KwaZulu-Natal, males defend non-overlapping territories of 0.5-1 ha which have well-defined borders, and females have territories of 0.9-4 ha which often occur almost entirely within the territory of a male.

Females give birth in secluded places and the young lie up in thick vegetation and emerge only when the mother makes a soft bleating sound. Then the calf is suckled, stimulated to urinate and defaecate, and the mother consumes the excreta to remove evidence of the calf's presence.

Suni utilize secretions from numerous scent glands for communication (and hence smell 'musky' to humans). Pedal glands (between the hoofs of the forelimbs) mark the trails in thickets, and secretions from the preorbital glands are rubbed onto twigs and cut stems. Both males and females defaecate on communal middens. Individuals also communicate by uttering the *chee chee* call when frightened, and by frequently wagging their white tails to advertise their presence.

**Reproduction** No information for Malawi. In Tanzania, there is a peak of births in Nov–Feb (wet months after the long dry season) when newly sprouted leaves and grass provide abundant food. Animals in captivity breed in most months of the year. Gestation: 170-190 days. Litter-size: 1. Neonates are precocial and weigh 700-800g. Young begin to nibble grass when only a few days old and are weaned early (no age available). Females mature at 12 months, and males at ca. 14 months. Females give birth to their first young at ca. 16 months. Inter-birth interval is 6-7 months.

**Conservation** IUCN Category: Least Concern. Conservation concerns are fragmentation and destruction of habitat and hunting (especially by domestic dogs). In Malawi, Suni have a very small biogeographic range and suitable habitat is very limited.

**Taxonomic Notes** *Nesotragus moschatus* (von Dueben, 1846). Two subspecies are recognised; one subspecies *N. m livingstonianus* occurs in Malawi. This subspecies is sometimes referred to as 'Livingstone's Suni'. The species was placed in the genus *Neotragus* in some previous publications about Malawi including Ansell & Dowsett (1988) and Hough (1989).

**Key References** Kingdon & Hoffmann (2013a), Smithers (1983).

**Measurements**
*Nesotragus moschatus*

| | |
|---|---|
| TL (males): | 699 (659–727) mm, n = 6 |
| TL (females): | 692 (663–716) mm, n = 3 |
| T (males): | 97 (91–110) mm, n = 6 |
| T (females): | 96 (93–98) mm, n = 3 |
| E (males): | 80 (77–84) mm, n = 6 |
| E (females): | 75 (72–78) mm, n = 3 |
| Sh ht: | ca. 350 mm * |
| Horn length: | mean 80 mm, maximum 133 mm* |
| WT (males): | 5.0 (4.5–5.2) kg, n = 6 |
| WT (females): | 5.4 (5.1–5.9) kg, n = 3 |

Mozambique (Smithers 1983).
*Southern Africa (Stuart & Stuart 2015).

# Genus *Oreotragus* - Klipspringer

Subfamily Antelopinae. Tribe Oreotragini. This tribe contains only one genus and one species.

## *Oreotragus oreotragus*

## Klipspringer

**Malawian Names** Chingoma, Chinkhoma, Chiwalama, Mbuzi mawe.

Female. Nyika N. P., Malawi © Bentley Palmer

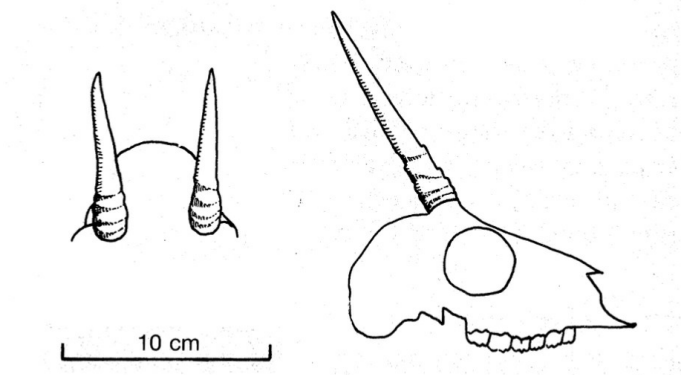



Fig. 23. Horns and skull of *Oreotragus oreotragus*

**Description** Medium-sized, compact, agile antelope with pointed hoofs, grizzled pelage, and small, slightly backward-pointing, horns (males only) which arise well in front of the ears. This rock-dwelling antelope appears to stand and move on tiptoes. Back slightly higher over hindquarters. Females, on average, a little larger and heavier than males, and only males have horns. Pelage coarse and rough; hairs thick and springy, hollow, and comparatively long (ca. 35 mm), and they do not lie smoothly against the body. Dorsal pelage yellowish-brown grizzled with black and white; hairs white at base (20 mm), followed by black band (10 mm), and tipped with white, yellow or yellowish-brown. Hindquarters tinged with grey. Ventral pelage whitish-grey. Pelage colour varies according to locality, sex and season. An individual from Zomba Plateau had rich russet pelage on neck and shoulders turning to grey on rump. Head comparatively small and blunt; forehead with dark brown patch at top (just in front of horns in males); nose black; muzzle, lips and chin whitish except just above nose. Eyes relatively large, dark with whitish eye-ring. Preorbital gland opening in round black patch adjacent to nasal corner of each eye. Ears large, rounded at tip, outer surface dark grey or greyish-brown, inner surface black with lines of white hair. Limbs grey with short black hoofs shaped in such a way that Klipspringers appear to stand and move on tiptoes. Lateral hoofs present. Tail ca. 9% of HB, same colour as rump above, paler below.

Horns (males only) widely separated, short, straight, backward-pointing but more upright than in other medium-sized antelopes; smooth except for up to six rings on basal third. Horns arise from top of forehead, well in front of ears. They begin to grow at age 5-6 months and attain adult size and length at ca. 17-18 months.

**Similar Species** None. This is the only antelope adapted to living on rocks and which has coarse rough pelage.

**Distribution** Recorded throughout most of Malawi where suitable habitat is present (see below); occurs in most national parks and wildlife reserves where there is rocky habitat. These protected areas include Kasungu N. P., Liwonde N. P., Majete W. R., Mwabvi W. R., Nyika N. P. and Vwaza Marsh G. R. Also recorded from Monkey Bay, Mulanje Mountain, Ntcheu District and Zomba Plateau. There is also an old record from Domwe Island (and perhaps other islands) in Lake Malawi. Elsewhere: known from the Red Sea Hills (E Sudan) and Ethiopia southwards

along the eastern side to Africa to South Africa, with separate populations in W Angola and W Namibia. One outlier population in C Nigeria.

**Habitat** Klipspringers live only where there are rocks, boulders and cliffs; these may be on rocky hills in savanna, on inselbergs, or on mountains. In some locations, dense thickets and trees at the base of rocky slopes are also utilized.

**Abundance** No information for Malawi. Elsewhere: densities range from 0.01 – 0.1/km$^2$ (in small areas of suitable habitat) to 0.15-0.3/km$^2$ (in extensive areas). Hence populations may be quite small where suitable habitat is limited.

**Habits** Klipspringers are the only antelopes which are found exclusively on rocky habitats. They are extremely agile and can jump from rock to rock and run up and down rocky slopes. They are able to do this because the body is small and compact, the digits of the fore- and hindfeet are rotated downwards so only the tips of the hoofs (digits 3 and 4) support the weight (rather like a ballerina), the hoofs are rubbery and do not slide on rock surfaces, and the limbs can be bunched together so only a very small area of rock is required to support the animal. The strength in the hindlimbs enables Klipspringers to leap from rock to rock. They are active in the early morning and late afternoon, and rest in the shade of rocks and bushes during the hottest time of day. Occasionally, they forage at night on flat ground adjacent to their rocky habitats.

Klipspringers are browsers feeding mostly on young leaves, flowers, flower buds and fruits, all of which are high in energy and protein; new green grasses are eaten only very occasionally. In South Africa, on a daily basis, the diet in the wet season was mainly fruit and flowers from 8 (4-13) species of shrubs. The diet varies depending on what is seasonally available. Observations in South Africa showed that Klipspringers are selective in the plant species (and which part of the plant) they feed on. In one study, over the course of a year, they fed on 41 species of plants, and in a second study they fed on 62 species. More time is spent browsing in the dry season (when food availability and quality is low) than in the wet season (when food is abundant). Klipspringers obtain water from their food, although in the dry season they may drink from rock pools.

Klipspringers live in male-female pairs, and at times are accompanied by their young. Sometimes pairs join together to form larger groups, but these associations are temporary. Pair-bonds are very stable and long-lasting and persist even outside the breeding season. The two individuals synchronize their activities for most of the time, stay close to each other (± 5 m), although they spread out when foraging. Pairing ends only when one of the pair dies. The longest recorded stable relationship of a pair is ca. nine years.

Pairs occupy a territory that varies greatly in size depending on the locality and the area of suitable habitat (e.g. 1.5 ha [Tsavo NP] to 90 ha [Namibia]); the smallest territories are in high rainfall areas, and the largest in low rainfall areas. A territory may adjoin 2-4 neighbouring territories. Klipspringers mark their territories using secretions from the preorbital glands which are rubbed frequently on to twigs and vegetation, and by depositing faeces and urinating on middens. They often guard their territory by standing on a high point within the territory, and display by horning bushes and low branches. Aggressive defence of a territory is uncommon, but males (and occasionally females) have been observed attacking intruders of both sexes. Attacks can result in severe goring and exhaustion. Both sexes produce a loud high-pitched whistle (especially when alarmed); sometimes pairs produce a duet-call, the female calling after the male.

Young are born in the shelter of rocks or vegetation, and lie up for up to three months before joining the parental pair.

**Reproduction** No information for Malawi. In Zimbabwe, pregnant females have been recorded from May-Oct (the cooler seasons of the year), and in Zambia, they were recorded in all months except Jan and Feb. Fecundity and dates of pregnancy vary between populations and locality. Gestation: 5 months. Litter-size: 1. Weaned: 4-5 months.

**Conservation** IUCN Category: Least Concern. Although populations are never large at any one locality, the extensive biogeographic distribution and presence of many local populations suggests that the species is not threatened. Their habitat (rocky hills) is of little use to humans, although browsing by goats is a conservation concern in some places.

**Taxonomic Note** *Oreotragus oreotragus* (Zimmermann, 1783). Eleven subspecies have been named, but their validity is questionable.

**Key References** Roberts (2013), Smithers (1983).

**Measurements**
*Oreotragus oreotragus*

| | |
|---|---|
| HB (males): | 862 (820–920) mm, n = 13 |
| HB (females): | 905 (883–1000) mm, n = 10 |
| T (females): | 84 (65–103) mm, n = 10 |
| E (males): | 93 (87–100) mm, n = 13 |
| E (females): | 92 (85–99) mm, n = 10 |
| Sh ht: | 500-600 mm* |
| Horn length: | mean 80 mm,* |
| | maximum 162 mm† |
| WT (males): | 10.6 (9.1–11.6) kg, n = 13 |
| WT (females): | 13.2 (10.5–15.9) kg, n = 10 |

Zimbabwe and Botswana (Smithers 1983).
*Southern Africa (Stuart & Stuart 2015).
†South Africa (Rowland Ward in Roberts 2013).

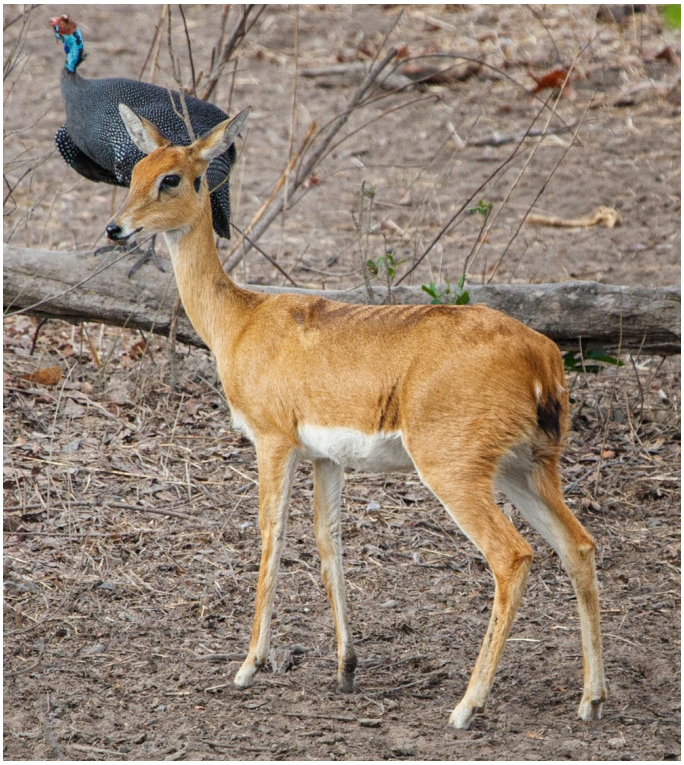
# Genus *Ourebia* - Oribi

Subfamily Antelopinae. Tribe Ourebini. This tribe contains only one genus and one species.

## *Ourebia ourebi*

## Oribi

**Malawian Names** Chikosimbi, Chosimbi, Chowe.



Female. Liwonde N. P., Malawi © Bentley Palmer

**Description** A medium-sized antelope (about the size of the Common Duiker) with plain brownish-orange pelage and a round black circular patch below each ear; white belly; black-tipped tail; horns (males only) widely separated, short, straight, backward-pointing with basal third ringed. Females on average slightly larger and heavier than males. Pelage short and sleek. Dorsal pelage brownish-orange becoming very slightly paler on flanks. Ventral pelage on throat, chest, belly and inner surface of buttocks white; clearly delineated from colour of flank. Neck long and thin, same colour as flanks. Head same colour as back, becoming paler on muzzle and cheeks. Muzzle finely pointed; nose black; lips white. No tuft of longer hairs on top of head. Conspicuous circular patch of black skin (subauricular gland) on cheek below each ear (as in Southern Reedbuck). Eyes relatively large, dark, with long black eyelashes and white eyebrows which extend in front of eyes. Preorbital glands large with a slit-like opening in front of each eye. Ears large, rounded at tip; inner surface pale brown; outer surface pale brown but covered by long white hairs. Limbs long and thin, similar in colour to flanks; two black pointed hoofs on each limb, and two very small lateral hoofs. Tail ca. 12% of HB), brownish-orange above, whitish below, with longer black hairs at tip.

Horns (males only) widely separated, short and thin, almost straight, tapering to sharp tip; ringed on basal half, smooth on terminal half. Front view: horns almost parallel; pointing straight up; reaching just a little above the ears. Side view: each horn points backwards from top of head and then curves very slightly upwards.

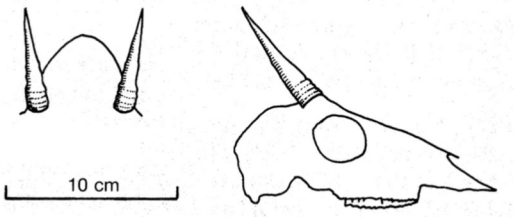



Fig. 24. Horns and skull of *Ourebia ourebi*

**Similar Species** (see yellow box above).
*Cephalophus harveyi*, Harvey's Duiker. Dorsal pelage rich reddish-brown; no circular black patch below each ear; tail not black-tipped.
*Sylvicapra grimmia*, Common Duiker. Dorsal pelage greyish-fawn with slightly paler ventral pelage; no circular black patch below each ear.

**Distribution** Only recorded from a few localities in central and southern Malawi (including Kasungu N. P., and Liwonde N. P.). A record from Nkhotakota W. R. is plausible but unproven. In the early 1900s, they were common on the Phalombe Plains, but are extinct there now. Old records from Nyika Plateau and Lengwe N. P. are erroneous. Has been introduced to Kuti W. R. near Salima. Elsewhere: widespread in Guinea savanna from Senegal to South Sudan and E Ethiopia, and southwards from Uganda to Zambia, W Tanzania and E Angola; a few isolated outliers in southern Africa.

**Habitat** Grasslands and wooded savannas where rainfall is above ca. 500 mm/year and where water is available (either as free water or in food). Oribi prefer short to medium grasslands (100-1000 mm in height). They often associate with larger mammals which graze and trample tall grasses thus stimulating the production of the short grass suitable for the Oribi.

**Abundance** In Malawi, in the 1890s and early 1900s, Oribi "were common everywhere". At the present time, they are rarely seen except in some protected areas (see above). Densities in other parts of their biogeographic range are typically 2-10/km$^2$ in suitable habitats. Density is very varied depending on the abundance and evenness of rainfall and the quality and quantity of preferred forage.

**Habits** Oribi forage and are most active in the early morning and from late afternoon to nightfall. In the middle of the day, they rest in tall grass or in shade under trees and shrubs. When disturbed, Oribi make a loud piercing whistle and look head-on to the source of the disturbance. Then they bounce away in a very characteristic manner - with the legs held straight and the tail held erect. They also stot, and their white tails and buttocks signal alarm to other Oribi.

Oribi are predominantly selective grazers which feed on fresh grasses, but they eat herbs, legumes and leaves when grass is unavailable. The preferred species of grass varies depending on locality and season of the year. Oribi like to graze on newly spouted grass in recently burnt areas. Grass comprises 82-90% of the diet. This diet is unusual for such a small herbivore and contrasts greatly with the diet of the duikers and other small herbivorous bovids; the fore-stomach of Oribi is greatly enlarged to allow for the fermentation of grass, as it is in the larger grazing bovids.

The social behaviour of Oribi has been well studied, particularly in the Serengeti N. P. and South Africa, and found to be extremely variable across the biogeographic range of the species, and even within one area such as the Serengeti N. P. Oribi are most often encountered singly, in pairs, in pairs with their young, in groups comprised of a male with up to four females, and loose temporary associations of up to a dozen individuals of both sexes. Sightings of single animals do not always mean that the animals are living singly – their associates might just be out of sight at the time. Adult males establish territories which they mark with dung and urine and secretions from scent glands (preorbital, subauricular, pedal, inguinal, and on the front limbs) which advertise an individual's presence, status, and sexual condition. The territorial males also patrol the perimeters, chase intruders and spar with neighbours. Territories are held for varying lengths of time in different localities – year-round in Serengeti N. P., seasonally in South Africa. In Serengeti N. P., mean territory size is 60 ha (10 ha in 'good' habitat - 90 ha in 'poor' habitat). There are no data for Malawi. Territories are inhabited by one or several adult females and their young, and sometimes also by other subordinate 'auxiliary' males who help with territorial marking and defence. When a female comes into oestrus, she is closely followed by the dominant territorial male and kept in isolation from the other males, but sometimes a female is courted by more than one male. Probably, the dominant male monopolizes matings, but the mating system needs further investigation using genetic methods to determine which males sire the offspring. Pregnant females hide their young in cover provided by rocks, shrubs or grass, and the young are left alone except for several periods of up to 30 minutes when the mother returns to suckle the young. Occasionally, the young are also visited by the other occupants of the territory and there is some evidence that males act as sentinels and partake in other aspects of parental behaviour. The young lie up for 2-10 weeks before joining their mothers and moving about with the other group members.

**Reproduction** No detailed information for Malawi. In Serengeti N. P., births occur in all months but there is a peak (Mar-May) during the long wet season when new short grass is available. In southern Africa, most births occur in the warm wet summer months: Nov-Dec in South Africa, Oct-Dec in Zimbabwe. Gestation: ca. 210 days. Litter-size: 1. Many females have a post-partum oestrus and become pregnant again very shortly after giving birth. Neonates are precocial. Young attain near-adult size in ca. 7 months and sexual maturity in ca. 10-14 months.

**Conservation** IUCN Category: Least Concern. Most populations are in conservation areas. Conservation concerns include destruction and loss of habitat.

**Taxonomic Notes** *Ourebia ourebi* (Zimmermann, 1783). Several subspecies have been described on the basis of variation in colour, but most are probably invalid.

**Key References** Brashares & Arcese (2013), Smithers (1983).

**Measurements**
*Ourebia ourebi*

| | |
|---|---|
| HB (males): | 1000 (930–1050) mm, n = 14 |
| HB (females): | 1050 (1010–1110) mm, n = 8 |
| T (males): | 120 (80–150) mm, n = 14 |
| E (males): | 120 (100–130) mm, n = 14 |
| Sh. ht (males): | 640 (600–660) mm, n = 16 |
| Sh. ht (females): | 650 (630–690) mm, n = 8 |
| Horn length: | mean 100 mm*,<br>maximum 190 mm† |
| WT (males): | 17.0 (15.0–20.0) kg, n = 13 |
| WT (females): | 19.0 (17.0–21.0) kg, n = 5 |

Tanzania (Jongejan *et al.* 1991 in Brashares & Arcese 2013).
*Southern Africa (Stuart & Stuart 2015).
†Zomba (Roland Ward in Brashares & Arcese 2013).

## Genus *Philantomba* – Blue Duikers

Subfamily Antelopinae. Tribe Cephalophini. This tribe contains three genera – *Cephalophus*, *Philantomba* and *Sylvicapra*, all known as duikers. The tribe is represented in Malawi by one species from each genus. The genus *Philantomba* was formerly considered to be either a subgenus of *Cephalophus* or a synonym of *Cephalophus*, but it is now considered distinct and more closely related to *Sylvicapra. Philantomba* contains two species, one of which occurs in Malawi. Although members of this genus are referred to as Blue Duikers, only one species (*P. monticola)* has the vernacular name Blue Duiker. It is so called because, in some lights, the pelage of some individuals has a blueish sheen. *Philantomba monticola* has a very wide distribution in Africa and there is great variation in the colour of individuals from different localities. This has resulted in the naming of 13 subspecies which are currently recognized. The subspecies in Malawi is *P. m. hecki*.

### *Philantomba monticola*

### Blue Duiker

**Malawian Names** Chisulu, Insa, Kadumba, Tungwa. Probably not confined to this species.

Eastern Cape, South Africa © C. & M. Stuart

**Description** (*P. m. hecki*). A small dark rufous-brown antelope with rufous-cinnamon flanks and very short, widely separated, straight, backward pointing horns (males and sometimes females), and a darker brown area from nose to top of head; no conspicuous tuft of longer hairs between the horns. Males and females similar in size. Pelage soft, dense with slight sheen. Dorsal pelage rufous-brown to dark brown becoming rufous-cinnamon on flanks. Ventral pelage, chest, throat and chin pale cinnamon to dull white; dorsal and ventral colours merge. Head paler in colour than back, with dark brown stripe on nasal region widening to dark brown patch on forehead and top of head. Hair between ears sometimes longer and forming a small tuft (not always visible). Eyes relatively large, dark, with a pale band above and below each eye. Preorbital glands large, with a horizontal, slightly arched, slit-like opening in front of each eye. Ears large, rounded at tip; outer surface dark brown, inner surface white with long white hairs on front rim. Limbs slender, outer surface similar in colour to flanks or paler, inner surface pale cinnamon to dull white; very slender black pointed hoofs. Tail ca. 14% of HB, dark above, white below.

Horns (males and some females) very short, well separated, straight, backward pointing, ringed near base.

**Similar Species**

*Cephalophus harveyi*, Harvey's Duiker. Tuft of black and dark brown hairs between horns. Dorsal pelage rich reddish-brown with slightly paler flanks. Smaller, Sh. ht: 320-350 mm.

**Distribution** Restricted to a few montane localities, and a few forested regions near Lake Malawi. It has been recorded from Chimaliro F. R., Chintheche, Chongoni F. R., Chiradzulu Mountain, Jembya F. R., Mafinga Hills F. R., Misuku Hills, Mulanje Mountain, Nkhata Bay, Nyika Plateau, Thyolo Mountain, Uzumara Mountain, Viphya Plateaux (N and S) and Zomba Plateau (Wilson 2001). Records in Lengwe N. P. and Mwabvi W. R. are erroneous. Elsewhere: widespread in rainforest and forested areas of Africa from the Nigeria-Cameroon border, southwards to Angola and eastwards to Tanzania/Malawi including Pemba, Mafia and Zanzibar Islands. Within this area, populations are separated and restricted to suitable forests.

**Habitat** In Malawi, moist forested habitats including montane evergreen forest, semi-evergreen forest and closed canopy miombo woodland. Generally, mature evergreen and secondary rainforest, gallery forests along rivers, and relict forests in savannas. Usually found in habitats with dense undergrowth, including

thickets, but they also live in comparatively open rain-forest.

**Abundance** No detailed information for Malawi but considered to be rare. Elsewhere: population density in optimal habitats maybe 10-21/km$^2$.

**Habits** Blue Duikers are small and secretive and hence rarely seen. They are able to move easily through dense undergrowth. If disturbed, they run away and make a "loud sneezing whistle" but they also react to danger by freezing and then skulking away slowly and quietly. They forage and are most active in the early morning, late afternoon and evening. In the middle of the day, they ruminate and rest in the densest patches of forest. Blue duikers are predominantly browsers but sometimes graze on new shoots of grasses when they sprout after fires. A study in Zimbabwe recorded that the diet was composed of 75% fruits, 15% browsed leaves, 5% flowers and 5% fungi. Studies in other parts of the continent recorded the same proportions of these foods, although in Natal 75% of the diet was leaves. Many species of plants are represented in the diet, the actual species varying according to locality. Blue Duikers are very selective feeders, ensuring that any food eaten has the best nutritional value.

Blue Duikers live in monogamous pairs which occupy small home-ranges. Home-ranges vary in size (according to the vegetation) averaging 2-6 – 11.9 ha; when there is a high density of individuals, home-ranges decline to 2.5-4 ha. Occasionally, additional adult females are found in the home-range of a pair, and individuals in adjacent home-ranges often spend time together. Natural features (streams, fallen trees, trails of larger species) often form the boundaries of home-ranges.

Bonds between pairs are strong and life-long, and pairs occupy the same home-range throughout their lives. Both partners mark their home-range with secretions from preorbital glands. They do not stay together all the time, but they feed and rest within hearing distance. When partners meet, they groom and mark each other (by rubbing their preorbital glands together). They also communicate by 'sneeze-whistles' (when running away from danger), snorts (when excited), groans (when seeking contact), stamping with the forefeet (advertising sexual condition) and rubbing the horns on thick plant stems (advertising status). The tail is flicked back and forth very frequently; the white part is easily visible in the dim light of the forest and may be a contact signal between individuals.

Calves lie up for ca. three months before following the mother and joining the pair. Subadult animals disperse away from the parental home-range and establish their own home-ranges. Dispersal distances are mostly less than one kilometer. When larger aggregations are formed, they are usually composed of related individuals; however, adult males do not tolerate other adult males in their home-ranges.

**Reproduction** Most studies suggest that Blue Duikers breed throughout the year, but to a lesser extent in the drier seasons. Gestation: ca. 170 days. Litter-size: 1. Weight at birth: ca. 590-950 g; neonates are precocial and able move about within a few hours of birth. Weaned: ca. 5 months. Sexual maturity: ca. 8-13 months (females), 11-14 months (males). Inter-birth interval ca. 202-260 days. Females may be pregnant and lactating at the same time.

**Conservation** IUCN Category: Least Concern. A widespread species which appears to maintain its population numbers except where heavily hunted for bush-meat.

**Taxonomic Notes** *Philantomba monticola* (Thunberg, 1789). Eleven subspecies occur on mainland Africa; *P. m. hecki* occurs in Malawi, E Zambia and N Mozambique. This duiker was formerly placed in the genus *Cephalophus*, and it is referred to as *Cephalophus monticola* by Sweeney (1959), Hayes (1978), Ansell & Dowsett (1988) and Hough (1989).

**Key References** Hart & Kingdon (2013), Wilson (2001).

**Measurements**
*Philantomba monticola*

| | |
|---|---|
| TL (males): | 675 (630–700) mm, n = 10 |
| TL (females): | 680 (650–710) mm, n = 8 |
| T (males): | 88 (79–91) mm, n = 10 |
| T (females): | 88 (83–95) mm, n = 8 |
| E (males): | 56 (50–59) mm, n = 10 |
| E (females): | 55 (50–60) mm, n = 8 |
| Sh. ht (males): | 340 (320–350) mm, n = 10 |
| Sh. ht (females): | 340 (330–350) mm, n = 8 |
| Horn length: | mean 30 mm*, maximum 73 mm† |
| WT (males): | 4.8 (3.9–5.4) kg, n = 10 |
| WT (females): | 5.3 (4.0–6.5) kg, n = 8 |

Zimbabwe (Chirinda Forest, Wilson 2001).
*Southern Africa (Stuart & Stuart 2015).
†D. R. Congo (Rowland Ward in Hart & Kingdon 2013).

# Genus *Raphiceros* – Grysboks and Steenbok

Subfamily Antelopinae. Tribe Raphicerini. This tribe contains two genera, *Dorcatragus* and *Raphiceros* but only *Raphiceros* is represented in Malawi. This genus contains three species – the Steenbok and two species of Grysboks, but only Sharpe's Grysbok occurs in Malawi.

## *Raphiceros sharpei*

## Sharpe's Grysbok

**Malawian Names** Goro, Kasenye (also refers to Harvey's Duiker), Mtungwa

Male. Majete W. R., Malawi © Bentley Palmer

**Description** Medium-sized antelope with arched back (highest over hindquarters), plain reddish-fawn pelage heavily flecked with white, large ears with black and white bands radiating across outer surface, and very small, slightly backward-pointing horns with rings at base and sharp tips (males only). The smallest of the medium-sized group of antelopes. Males and females similar in colour and size. Pelage longish (ca. 30 mm), glossy and coarse. Dorsal pelage and flanks reddish-fawn (almost orange) liberally flecked with white hairs. Ventral pelage, chest, lower part of neck and upper inner surfaces of limbs whitish. Head same colour as dorsal pelage with small black stripe from nose to between eyes. Eyes dark with faint white eye-ring. Small preorbital gland opening in small patch of black naked skin in front of the nasal corner of each eye. Ears relatively long and large (longer than horns), rounded at tip; outer surface pale grey; inner surface brown or black with bands of white hair extending from edge towards centre. Limbs slender and delicate; outer surfaces similar colour to flanks; two small black pointed hoofs on each leg; lateral hoofs absent. Tail ca. 8% of HB, well haired, similar in colour to rump, flecked with long white hairs.

Horns (males only) widely spaced, very short and cone-shaped, backward-pointing but angled slightly upwards from line of forehead; ringed at base, tapering to sharp tip.

**Similar Species** None (see yellow box above). No other antelope has reddish-fawn (almost orange) pelage that is liberally flecked with white.

**Distribution** Widespread in Malawi and recorded from all biogeographic areas except the montane areas and Phalombe Plain. Localities include Chikwawa, Karonga District, Kasungu N. P., Lake Malawi N. P., Lengwe N. P., Liwonde N. P., Majete W. R., Mpimbi, Mwabvi W. R., Nkhotakota W. R., Nyika N. P. (but not montane areas), and Vwaza Marsh G. R. Elsewhere: recorded from W and S Tanzania to Mozambique, Zambia, Zimbabwe, eSwatini and NE South Africa.

**Habitat** Open canopy miombo woodland, mopane woodland, bushland, scrub, thickets in thicket savannas, grasslands (of medium height) and riverine forest where there is good undercover. May also occur in rocky habitats with thick cover between the rocks and boulders.

**Abundance** No detailed information for Malawi. Elsewhere: densities of 0.3-0.7/km$^2$ have been recorded. The secretive and nocturnal habits of Sharpe's Grysbok make it very difficult to assess their abundance.

**Habits** Very little is known about Sharpe's Grysbok – they are shy and secretive. They are predominantly nocturnal but also crepuscular and occasionally forage in the early morning and late afternoon. In the middle of the day, they rest in dense cover. If disturbed, they run away crouched low to the ground (rather than bounding away through or over the vegetation). They have been found hiding in Aardvark

burrows, and have been seen taking to water and swimming well. Sharpe's Grysbok are mainly browsers but graze occasionally on grasses; analysis of stomach contents in SE Zimbabwe indicated a diet of 70% browse (mainly leaves, with some fruit) and 30% grass.

The social behaviour of Sharpe's Grysbok is very poorly understood. They have been observed singly, occasionally in pairs, and as single females with one young. Droppings have been found in small middens which are used for long periods, suggesting they are sedentary throughout the year.

**Reproduction** No information for Malawi. In Zimbabwe, pregnant females have been recorded in many months of the year. Gestation: ca. 28 weeks. Litter-size: 1. Weight at birth (captivity): 790-863g. Neonates are precocial and active within a few hours of birth.

**Conservation** IUCN Category: Least Concern. Destruction of suitable habitat (by humans and large mammals, e.g. elephants) is of conservation concern.

**Taxonomic Notes** *Raphiceros sharpei* (Thomas, 1897). This species was first collected in "Southern Angoniland" by Sir Arthur Sharpe (Commissioner of BCA 1896-1907 and Governor of Nyasaland 1908-1910) after whom the species was named. It was subsequently found to be present throughout many countries in eastern and southern Africa (see above). Two subspecies have been named, but their validity is questionable.

**Key References** Hoffmann & Wilson (2013), Smithers (1983).

**Measurements**
*Raphicerus sharpei*

| | |
|---|---|
| TL (males): | 751 (710–800) mm, n = 12 |
| TL (females): | 757 (725–800) mm, n = 11 |
| T (males): | 58 (50–70) mm, n = 12 |
| T (females): | 59 (45–70) mm, n = 11 |
| E (males): | 90 (83–98) mm, n = 12 |
| E (females): | 91 (85–98) mm, n = 11 |
| Sh. ht: | ca. 500 mm * |
| Horn length: | mean 60 mm, |
| | maximum in southern Africa 63.5 mm* |
| WT (males): | 7.3 (6.8–8.9) kg, n = 12 |
| WT (females): | 7.7 (6.4–8.9) kg, n = 11 |

SE Zimbabwe (Smithers & Wilson 1979).
*Southern Africa (Stuart & Stuart 2015).

# Genus *Redunca* - Reedbucks

Subfamily Antelopinae. Tribe Reduncini. This tribe contains three genera of which *Kobus* and *Redunca* are represented in Malawi. The genus *Redunca* contains three species of Reedbucks of which only one occurs in Malawi.

## *Redunca arundinum*

## Southern Reedbuck

**Malawian Names** Mphoyo, Mkhamuka, Ndope, Nsengo.

Male, Nyika N. P., Malawi © Bentley Palmer

**Description** Medium-sized, plain pale brown or greyish-fawn antelope with creamy-white belly, a small circular black patch below each ear, a dark stripe on front edge of forelegs, a fluffy tail (brown above, white below) and smoothly curved horns (males only) which angle outwards from the head with forward-pointing tips. Males, on average, larger and heavier than females. Pelage rough and slightly coarse. Dorsal pelage and flanks pale brown or greyish fawn, paler on lower chest and neck. Ventral pelage, inner surfaces of legs and buttocks creamy-white. Head similar in colour to neck with white on lips and on throat. Nose black. Eyes dark. No preorbital glands. Ears large, wide, narrowing to a tip; outer surface dark brown or chestnut; inner surface covered with long dense white hairs. Small circular patch of black skin (subauricular gland) on cheek below each ear (as in Oribi but smaller). Limbs sturdy, with dark brown or black stripe on front edge of forelimbs. Hoofs thin and elongated. Tail ca. 16 % of HB, fluffy, brown above, white on sides and below. Tail can be raised to make a conspicuous white signal.

Horns (males only) large, strongly ringed on basal two-thirds, terminal third smooth. Front view: approximately V-shaped with sides slightly curved inwards, especially at top. Side view: )-shaped; each horn points backwards, then curves very smoothly forwards (as though following the circumference of a circle). Pale bulbous area at base of each horn (= growth tissue of horn).

**Similar Species**

*Kobus vardoni*, Puku. Dorsal pelage golden-brown; no black patch below each ear; no dark stripe on front edge of forelimbs; tail not fluffy; horns (males) front view lyre-shaped, from the side each horn rises upwards, then turns backwards and finally curves smoothly upwards and then slightly forwards. Shared distribution: Kasungu N. P., Vwaza Marsh G. R. and very rarely Nyika N. P.

**Distribution** Formally widespread throughout Malawi (see below). Elsewhere: widespread in Central Africa from S Gabon and Angola westwards through S DRC to S Tanzania, Mozambique, Zimbabwe and parts of NE South Africa.

*Historical Distribution*: Formally widespread throughout most of Malawi from the extreme north to Nsanje in the south, and found in all biogeographic areas. Three quotes illustrate the abundance of Southern Reedbuck in the early years of the 1900s: "Reedbuck is everywhere extremely plentiful ... Indeed I can not call to mind any neighbourhood in B.C.A. where Reedbuck can not be found in considerable numbers", "very abundant on elevated plateaux of gentle undulating surface" and "Generally distributed . . . particularly in the large open Elephant Marsh near Chiromo where . . . they were found in hundreds".

*Present Distribution*: Restricted to protected areas, e.g. Nyika N. P., Viphya Plateau, Kasungu N. P.,

Nkhotakota W. R., Lengwe N. P. (scarce), Liwonde N. P., Majete W. R. (scarce) and Vwaza Marsh G. R.

**Habitat** Open grasslands (and marginally in adjacent woodlands), dambos, and montane grasslands. Except in montane habitats, tall grass and availability of water are essential habitat requirements.

**Abundance** Formerly very abundant in Malawi (see above) but now less common and less widely distributed. In recent years, population numbers on Nyika Plateau have increased. Aerial surveys in 1998 in Nyika N. P. where Southern Reedbuck are common, estimated the density to be 1.9/km$^2$.

**Habits** Activity patterns of Southern Reedbuck vary depending on the weather and the quality of their food. When conditions are good, they are mainly nocturnal, but they become more active during the day in the dry season when they need to spend more time grazing (because the nutritional value of the grass has deteriorated) and visiting sources of drinking water. At such times, during the daytime, an individual grazes for about three hours, ruminates for about 3 hours, and then rests for the remaining time. Southern Reedbuck feed almost entirely on grass although they will also eat small amounts of herbs and browse on leaves if grass quality is poor. In Kruger N. P., they feed on seven species of grass throughout the year, supplemented by an additional six species of grass with a high water content during the winter months. They need access to water for drinking and are sometimes forced to move to new areas if local sources dry up.

Southern Reedbuck are sometimes seen in groups of up to 20 individuals, but these are temporary associations. Mostly, they live in pairs (with their young if any) but the duration of pair-bonds is not known. They are not known to establish bachelor or spinster groups. Pairs live in a territory defended by the male who chases intruding males away and prevents them from mating with his female. The male's threatening behaviour includes standing on a termite mound or similar high place and keeping watch, adopting a 'proud' posture with head held high, whistling, stotting, defecating and urinating. Males may also stand close together with their heads close to the ground, and this may lead to horn-locking and pushing against each other, or even to conflict when the males charge each other and clash horns. However, fighting is never so fierce that contestants are seriously injured. Pairs do not seem to keep in close physical contact, especially if the female is suckling a calf, but they make auditory, visual and probably olfactory signals which keep them aware of each other. They rest several metres apart. Mutual grooming apparently does not occur.

When disturbed or frightened, Southern Reedbuck run with a characteristic bouncy trot or gallop. When in long grass, they may 'pronk' (jumping up and down more or less on one spot) in order to survey the habitat above the grasses. They emit nasal whistles by forcing air through the nostrils; these whistles have a number of functions: to alert others to potential danger, to keep in touch with other individuals, and to advertise a territory. At times, there may be a chorus of whistles (easily heard by humans).

The extent to which males are territorial varies in different localities. In some highland areas, territories are only held during the rut. And, in at least one locality, the males do not have territories but, instead, have a social hierarchy and the dominant males compete to mate with females in oestrus. Pregnant females seclude themselves for ca. a month prior to giving birth, and the calf lies up for ca. three months. During this period, the mother only visits for the purpose of suckling, and the calf moves into a new hiding place after each visit. When they are ca. three months old, the calves join their mothers. Young females mature and leave their mothers' home-range during their second year – about the time the mothers give birth again. Young males mature more slowly and are tolerated longer, but they make submissive displays to the resident adult male.

**Reproduction** Gestation: ca. 7.5 months. Litter-size: 1. No other information available.

**Conservation** IUCN Category: Least Concern. Conservation concerns include reduction in the biogeographic range and fragmentation of habitat.

**Taxonomic Notes** *Redunca arundinum* (Boddaert, 1785). Several subspecies have been described, but only two are currently recognised – *R. a. arundinum* south of the Zambezi River and *R. a. occidentalis* north of the Zambezi River (including in Malawi).

**Key References** Kingdon & Hoffmann (2013b), Smithers (1983).

**Measurements**
*Redunca arundinum*

| | |
|---|---|
| TL (males): | 1600 (1560–1785) mm, n = 16 |
| TL (females): | 1580 (1380–1690) mm, n = 20 |
| T (males): | 254(215–300) mm, n = 16 |
| T (females): | 250 (200–300) mm, n = 20 |
| E (males): | 161 (153–180) mm, n = 16 |
| E (females): | 159 (140–170) mm, n = 20 |
| Sh ht (males): | ca. 950 mm* |
| Sh ht (females): | ca. 800 mm* |
| Horn length: | 33.6 (27-37) cm, n = 6† |
| WT (males): | 51.8 (42.7–68.2) kg, n = 16 |
| WT (females): | 38.2 (31.8–50.9) kg, n = 20 |

Zimbabwe (Smithers 1983).
*Southern Africa (Stuart & Stuart 2015).
†Malawi (Nyika Plateau, pers. obs.)

# Genus *Sylvicapra* – Common Duiker

Subfamily Antelopinae. Tribe Cephalophini. This tribe contains three genera – *Cephalophus*, *Philantomba* and *Sylvicapra*, all known as duikers. The tribe is represented in Malawi by one species from each genus. The genus *Sylvicapra* contains only one species.

## *Sylvicapra grimmia*

## Common Duiker

**Malawian Name** Gwape (not confined to this species), Hisa, Nyisya.

Female, Liwonde N. P., Malawi © Bentley Palmer

**Description** A medium-sized, plain greyish-fawn antelope with bright chestnut forehead, a black stripe from the muzzle to above the eyes, black socks and short, widely separated, straight, backward-pointing horns (males only) and a conspicuous tuft of black or brown hairs on top of head. Males and females similar in size and colour. Pelage slightly coarse, smooth with sheen. Dorsal pelage fawn-brown, grizzled and slightly suffused with grey; hairs grey on basal half, brown on terminal half, some with small blackish tip. No mid-dorsal stripe. Ventral pelage of chest and belly whitish. Head with bright chestnut forehead, whitish around eyes and on muzzle, blackish around preorbital gland, sandy-brown on cheeks and with black stripe from the nose to just above the eyes. There is a tall thin tuft of long stiff black and/or chestnut hairs on top of the head (between the horns in males). Eyes relatively large, dark. Large, conspicuous preorbital gland with a black crescent-shaped slit-like opening between the nasal corner of the eye and the muzzle. Ears very large; outer surface greyish-brown; inner surface pale with fringe of long white hairs along front edge. Limbs long and thin similar in colour to dorsal pelage, with thin black line on front edge of forelimbs, and a black 'sock' above each hoof; inner surfaces of limbs same colour as ventral pelage. Hoofs black; lateral hoofs present. Tail ca. 14% of HB; slightly bushy, brown to black above, whitish below. (Individuals from Nyika are brighter and more reddish in colour than elsewhere in Malawi - and may be confused with *Cephalophus harveyi*.)

Horns (males only) short, straight, pointing backwards approximately in same line as forehead; tips slightly further apart than bases; ringed on basal third or basal half, smooth on terminal two-thirds or half; tapering to pointed tip.

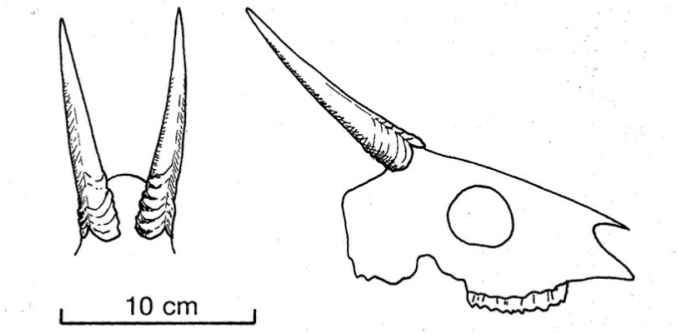



Fig. 25. Horns and skull of *Sylvicapra grimmia.*

**Similar Species** (see yellow box above).

*Cephalophus harveyi,* Harvey's Duiker. Dorsal pelage rich reddish-brown with slightly paler flanks. Smaller, Sh. ht: 379-429 mm.

*Ourebia ourebi*, Oribi. Dorsal pelage brownish-orange, ventral pelage whitish; conspicuous circular black patch below each ear and black tipped tail.

**Distribution** Widespread in woodlands, thickets and some montane grasslands throughout Malawi in all biogeographic areas. They occur in all of the national parks, and also in Majete W. R., Mwabvi W. R., Nkhotakota W. R., Ntchisi Mountain F. R. and Vwaza Marsh G. R. Other localities include Chiromo, Chitala River, Karonga, Mangoche Mountain, Mulanje Mountain, Namadzi District, Zoa Tea Estate and Zomba Plateau. Elsewhere: widespread in most savanna and woodland habitats; not present in arid and semi-arid regions, or in rainforest. They are less widespread at the present time than in the past mainly because of loss of habitat and human activities.

**Habitat** Common Duikers can live in a wide range of habitats provided there is there is cover where they can hide. Hence, they are found throughout Malawi in miombo woodlands, thickets, shrublands, dambos and montane grasslands. They may also occur in agricultural areas (provided bushy cover is nearby), and close to human habitations.

**Abundance** Reported very common in Malawi (Wilson 2001) but likely to be much less abundant now, except in protected areas. In Zimbabwe, densities in different vegetation types varied from ca. 2 – 3/km$^2$, and at one locality, the density was 9/km$^2$. The solitary social behaviour (see below) does not allow densities to be as high as those of gregarious social ungulates.

**Habits** Common Duikers are most active in the early morning and again in the late afternoon and well into the night. In areas where they are often disturbed, they are mainly nocturnal. They rest and ruminate in tall grass or sheltered by bushes. If approached by humans, they freeze for as long as possible, then bound away with characteristic zig-zagging jumps. Their alarm call is a nasal snort.

Common Duikers feed mainly on browsed leaves, flowers, fruits, seeds and occasionally roots of small herbs, but they also glean fallen leaves from larger plants and feed on fruits of trees dropped by monkeys, some species of fungi, resin exuded from Acacias, and flying termites emerging from their nests. In E Zambia, 44 spp. of leaves of trees and shrubs, 33 spp. of fruits, 15 spp. of flowers were found in 191 rumens. Common Duikers also eat cultivated crops such as beans, tomatoes, groundnuts and sweet potatoes, and they sometimes eat meat including various birds, mice and lizards which they hunt and kill, and insects such as mopane caterpillars. They have been observed killing domestic ducklings and turkey chickens by striking them with the forelegs, and then eating them, but it is not known how often meat eating occurs They rarely eat grass. Individual duikers are very ecologically flexible and can adapt quickly to changing conditions, and they also have the advantage of being independent of water for drinking. As a result, Common Duikers are a particularly successful species and have a widespread distribution.

Common Duikers are usually solitary except when a male is attracted to a female in oestrus, and when a female is suckling her young. Courtship behaviour of males includes chasing, biting the female's hindquarters, constant flicking of the tongue, flehmen, laufschlag (tapping the female's flanks with a foreleg), marking the vegetation with secretions of the preorbital gland, mounting without penetration, and finally mating. A pair may stay together while the female is in oestrus, but then they separate unless drawn together by a source of food such as a tree dropping fruit.

Home-range sizes vary according to the availability of food; in Zambia, for example, two adult males had non-overlapping home-ranges of ca. 13 and 16 ha, and females had overlapping home-ranges of ca. 13 ha. The home-range is marked by rubbing secretions from the preorbital glands on to twigs and grass stems.

Females give birth under cover of dense vegetation. The calf lies up in the vicinity but the mother visits 4-8 times/day for suckling, imprinting and bonding. It is not recorded for how long a calf lies up, but calves begin eating leaves when they are ca. two weeks old and are guided to feeding places by the mother. They are weaned after 3-4 months, but maternal care persists for up to six months.

**Reproduction** No information for Malawi. In E. Zambia, there is no defined season of parturition; in SE Zimbabwe (where there is less rainfall) there is a peak of births. Gestation (in captivity): 200 (189-216) days. Litter-size: 1. Neonates are precocial and active within a few hours of birth (see above). Young males sexually active at 3-4 months, females sexually active (first oestrus) at ca. 8 months. There is often a post-partum oestrus and the average inter-birth interval in southern Africa is ca. 237 days, indicating that females are can be pregnant and lactating at the same time.

**Conservation** IUCN Category: Least Concern. The species is widespread and very adaptable to habitat change. It is hunted for "bushmeat" in many countries.

**Taxonomic Notes** *Sylvicapra grimmia* (Linnaeus, 1758). Many subspecies have been described (based on differences in dorsal and ventral colouration, presence/absence of mid-dorsal stripe, presence/absence/size of black face stripe ('blaze') on forehead, and presence/absence of stripe on front edge of each forelimb). The validity of subspecies is controversial. If valid, the subspecies in Malawi is *S. g. orbicularis*. The name *shirensis* (mentioned by Sweeney 1959) is a synonym of *orbicularis*.

**Key References** Wilson (2001, 2013).

**Measurements**
*Sylvicapra grimmia*

| | |
|---|---|
| TL (males): | 1002 (1000–1060) mm, n = 14 |
| TL (females): | 1020 (910–1080) mm, n = 12 |
| T (males): | 110 (100–120) mm, n = 14 |
| T (females): | 120 (90–150) mm, n = 12 |
| E (males): | 101 (97–108) mm, n = 14 |
| E (females): | 100 (98–115) mm, n = 12 |
| Sh. ht (males): | 530 (520–540) mm, n = 14 |
| Sh. ht (females): | 530 (520–550) mm, n = 12 |
| Horn length: | mean 110 mm*, maximum 181 mm† |
| WT (males): | 14.5 (13.2–15.0) kg, n = 14 |
| WT (females): | 15.5 (13.2–18.2) kg, n = 12 |

Malawi (Nyika Plateau, Wilson 2001).
*Southern Africa (Stuart & Stuart 2015).
†South Africa (Rowland Ward in Wilson 2013).

# Genus *Syncerus* – African Buffalo

Subfamily Bovinae, Tribe Bovini. This subfamily is represented in Africa by two tribes – the Bovinae (represented by the genus *Syncerus,* African Buffalo) and the Tragelaphini (represented by the genus *Tragelaphus*, Spiral-horned Antelopes, see below). The genus *Syncerus* contains only one species but four subspecies are recognized (the subspecies in Malawi being *S. c. caffer*).

## *Syncerus caffer*

## African Buffalo

**Malawian Names** Njati.

Liwonde N. P., Malawi © Bentley Palmer

**Description** (*S. c. caffer*) A large, heavily-built, plain dark grey cow-like mammal, with short neck, a low hump over the shoulders, stocky legs and massive, laterally wide-spreading horns with upturned tips in both sexes. Males, on average, larger and heavier than females, with more massive horns and a fold of skin under the chin. Pelage short, coarse, sparse and grey. Head massive with wide forehead, wide muzzle and dark grey nostrils. Eyes dark. No preorbital glands. Ears large, wide, and fringed with dark hairs; extend outwards below the horns and usually droop. Limbs relatively short and stocky; hoofs large and rounded, lateral hoofs very prominent. Tail ca. 30% of HB, thin, black with black tassel at tip which reaches the hocks.

Horns very thick but tapering to sharp points; roughened but not keeled or ringed. The bases of the horns meet in the middle of the forehead to form a wide bony covering over the skull referred to as a boss. Front view: each horn curves over the forehead and downwards to level of ears, then curves smoothly upwards and inwards before ending in a sharp smooth point. (Horns are straight in young animals; the size, shape and curvature can be used to age individuals.)

**Similar Species** None in Malawi.

**Distribution** In Malawi, although widespread in the past, now restricted to National Parks and other protected areas. Elsewhere: widespread throughout the continent in savanna grasslands and woodlands, and also in some rainforest regions (*S. c. nanus*)
*Historical Distribution* In the early years of the BCA, Buffalo were recorded as "very abundant" all over the country, especially in marshy areas, e.g. Elephant Marsh where they existed in their "thousands", and close to rivers and swamps.

*Present Distribution* Confined mostly to National Parks and other protected areas including all national parks (except Lake Malawi N. P.) and Majete W. R. (introduced), Mwabvi W. R., Nkhotakota W. R. and Vwaza Marsh G. R.

**Habitat** In Malawi, miombo woodlands, woodland/savanna-mixed species, seasonally wet grasslands and dambos, perennially wet grasslands and swamps, thicket savanna of poorer areas (e.g. thicket clump savanna in Lengwe N. P.), and occasionally in montane evergreen forest. Generally, grassland savannas, woodland savannas, thickets and marshy areas. Rarely found at higher altitudes. Access to cover (forest, thickets, reedbeds), food and water is essential.

**Abundance** No detailed information for Malawi, although abundance is much less than in former times. In Lengwe N. P. in the 1980s, herds of up to 90 Buffalo (males, females and young) were observed at waterholes. In other parts of their biogeographic range, they may be very abundant forming 'super herds' of several hundred individuals (but see also below).

**Habits** Buffalo are active during the day, spending most of time grazing, ruminating and moving from one grazing area to another. They drink mainly in the early morning and in the evening. They like to wallow in mud which then dries on the pelage and provides protection from the sun and from biting

insects. Buffalo are grazers, feeding mainly on grasses and sedges; only rarely do they eat herbs or browse. They prefer green grasses taller than ca. 10 cm, but they can also eat dry grass that is high in fibre and low in protein during the dry season. When foraging, they play an important ecological role by breaking the stalks of old grasses which then sprout to form new 'grazing lawns' suitable for other species. Buffalo move from grasslands where they graze in the wet season, to moister swamps in the dry season.

African Buffalos mostly live in herds comprised of males, females and young; males sometimes live in bachelor herds, and old bulls sometimes live singly. Herds of 2500 and 3000 have been recorded in Botswana and Zimbabwe respectively, although these may be temporary associations of several smaller herds whose home-ranges overlap. A herd is typically comprised of 15-20% infants and juveniles, 13-18% 2-3 year old subadults, 25-40% adult males and 32-45% adult females. At Lengwe N. P., a herd of ca. 95 came to a waterhole, others were seen in herds of 8, 32 (males, females and 2 young) and two (both males) and one other was seen singly (pers. obs.). The composition of herds remains fairly stable, and females tend to remain in the herd to which they were born. In contrast, young males tend to disperse and sometimes form bachelor herds. Herds may split into smaller groups, or may merge to form larger herds, and adult bulls often move from one herd into another. Herds remain in particular areas for longer than the life spans of individuals within the herd. Bulls establish a status hierarchy and status is indicated by ritualized dominant and submissive postures; fighting is rare. Herd movements may be led by either bulls or cows, and the lead animals may stop the herd simply by stopping themselves, or by giving a signal to stop by standing and blocking the way forward. However, many decisions (such as where to spend the night, which direction to go to find food) are joint decisions made by cows in the herd who participate in behaviour referred to as 'voting'. After a period of rest, individual cows rise and adopt a posture with the head pointing in a particular direction. Sometimes, most of the voters point in the same direction, and the herd will move in that direction. Sometimes there is little consensus and this may lead to the herd splitting for a few days.

Individuals in a herd stay close to one another to minimize predation by large predators (i.e. lions, hyaenas) and, if one individual is attacked, others may come to its aid.

When a cow is in oestrus, she is 'consorted' by a bull who follows her, performs flehmen, and tries to lay his chin on the base of her tail. If the female is unreceptive, she walks away. If she is receptive, the bull may attempt to mount, but is usually supplanted by a more dominant bull. Cows remain with the herd to calve. If the herd moves on, the mother will rejoin the herd as soon as the calf is strong enough. For protection, the mother will always stay with the herd and move with it; at such times, the calf will walk behind its mother and suck from behind. Calves, especially females, form associations with calves of the same age, and these associations may last for many years.

**Reproduction** In Malawi, young are recorded at end of wet season (Mar-Apr). Throughout the biogeographic range, young are born during the wet season. Gestation: ca. 11 months. Litter-size: 1 (very rarely 2). Young are precocial. Neonates weigh ca. 30 kg and can follow their mothers within a few hours of birth. Weaning occurs at ca. 6. months of age. Adult weight is attained in 3.5-5 years. There is a high mortality of calves under the age of one year. Females usually produce a calf once every two years.

**Conservation** IUCN Category: Near Threatened (and close to Vulnerable). Although African Buffalo appear to be numerous when seen in large herds, population numbers in Africa as a whole have declined greatly in the last 30 years (and are still declining). Estimates suggest a decline of 18% over the last 30 years for *S. c. caffer*.

**Taxonomic Notes** *Syncerus caffer* (Sparrman, 1779). Four subspecies, of which only one, the Cape Buffalo (*S. c. caffer*) occurs in Malawi.

**Key Reference** Prins & Sinclair (2013).

**Measurements**
*Syncerus caffer caffer*

| | |
|---|---|
| TL (males): | 3387 (3200–3600) mm, n = 8 |
| TL (females): | 2895 (2860–2930) mm, n = 2 |
| T (males): | 789 (670–900) mm, n = 8 |
| T (females): | 767 (755–780) mm, n = 2 |
| E (males): | 244 (230–265) mm, n = 8 |
| E (females): | 252 (235–270) mm, n = 2 |
| Horn length: | up to 160 cm on outer curve (males) |
| Sh. ht (males): | 1448 (1360–1530) mm, n = 8 |
| Sh. ht (females): | 1383 (1350–1415) mm, n = 2 |
| WT (males): | 750.8 (660.7–849.2) kg, n = 8 |
| WT (females): | 446.6 (425.7–467.5) kg, n = 2 |

Tanzania (Serengeti N. P., Sachs 1967 in Prins & Sinclair 2013).

## Genus *Tragelaphus* – Spiral-horned Antelopes

Subfamily Bovinae, Tribe Bovini. This subfamily is represented in Africa by two tribes – the Bovinae (represented by the genus *Syncerus,* African Buffalo) and the Tragelaphini (represented by the genus *Tragelaphus*). The genus *Tragelaphus* is considered to contain nine species by some authorities, but the taxonomy of these species is controversial and the genus has been split into several genera in the past, including *Taurotragus* which contained the elands, and *Strepsiceros* which contained the Greater Kudu. Here, all spiral-horned antelopes are considered to belong to *Tragelaphus.* This genus is represented by four species in Malawi.

### *Tragelaphus angasii*

### Nyala

**Malawian Name** Boo.

Male. Majete W. R., Malawi © Bentley Palmer

Females. Lengwe N. P., Malawi
© DCD & M. Happold

**Description** A large sexually dimorphic antelope with vertical stripes on flanks and hindquarters; males grey with white stripes, larger than females, and with horns; females bright chestnut with white stripes, smaller and without horns; horns long, keeled, twisted and growing in a shallow spiral with one complete turn.

*Males*: pelage long and shaggy especially on neck, belly and buttocks; mane of short, erect black hairs (tipped with white) on mid-dorsal line from top of head to base of tail; mane of long black hairs on mid-ventral line from throat to groin. Pelage (neck, back, sides and belly) purplish-grey with long white vertical stripes (usually 10-12) on flanks and rump – width, number and visibility of stripes very varied; some vertical stripes may end with a small white dot. Head purplish-grey to blackish except for orange-chestnut area on crown, a short white line in front of each eye (forming half of a chevron on the forehead), two small white patches on each cheek, and white lips. Muzzle and nostrils dark grey. Eyes dark surrounded by slightly paler pelage. No preorbital glands. Ears large; inner surface grey; outer surface, naked and pinkish. Limbs beige below knees and hocks, with black and white markings on the inner surface above each joint. Fetlocks, pasterns and hoofs black, with small white patch above each hoof; lateral hoofs small. Tail ca. 25% of HB, dark above, whitish below, with many long black hairs reaching level of hocks.

Horns long, keeled, with faint rings and white tips, twisted, and growing in a shallow spiral with one complete turn. Front view: the horns spread outwards, then curve sharply inwards and finally curve smoothly upwards so tips are vertical (i.e. slightly lyre-shaped). Side view: each horn slopes backwards in same line as the nose-to-crown, then curves smoothly upwards so tip is vertical.

*Females*: pelage uniformly short and sleek except for a mane of short black hairs along the mid-dorsal line from top of head to base of tail. Pelage mostly bright chestnut with well-defined vertical white stripes from mid-dorsal line to lower flanks, extending from shoulders to rump; number of stripes variable (usually 8-15 in Lengwe N. P.). Neck slightly greyer, ventral pelage paler than dorsal pelage. Head similar in colour to body with bright chestnut crown and a narrow black blaze down the middle of the face, two white spots between eyes (absent in some individ-

uals) and one or two white spots on each cheek in some individuals. Limbs chestnut or beige with some white patches; fetlocks, pasterns and hoofs black. Tail ca. 25% of HB, bushy, chestnut above, white below, tip black, reaching level of hocks.
*Young* (both sexes): smaller paler versions of females. Young males develop straight horns (without a spiral) at 4-5 months of age while still retaining the female colouration. With increasing age (as horns develop), the colour of the body changes to that of the adult male – beginning with the neck and gradually extending to the hindquarters.

**Similar Species** (see yellow box above).
*Tragelaphus scriptus*, Bushbuck. Pelage chestnut to dark brown marked with conspicuous whitish spots on lower flanks and hindquarters, faint vertical whitish stripes across the back; mid-dorsal line (shoulders to rump) with longer chestnut-brown or whitish hairs (i.e. no black hairs). Males with horns.
*Tragelaphus strepsiceros*, Greater Kudu, females and young males only. Pelage mostly fawn, cinnamon-brown to greyish-brown, with 7-10 white vertical stripes on the flanks and top of hindquarters; mid-dorsal line with longer white or grey hairs.

**Distribution** Recorded only in the Lower Shire Valley, mostly south of Chikwawa (see also below). Elsewhere: recorded in S Mozambique, SE and N Zimbabwe, extreme NE South Africa and a few scattered localities in eSwatini (introduced into ranches).
*Historical Distribution* One early record stated that Nyala occurred in "Western and Upper Shire districts and the Lake Mweru District". This is now known to be incorrect; there are no records from the Upper Shire Valley, or from Lake Mweru – which is in N Zambia. Another record stated that Nyala occurred from "Nsanje in the south to Mangochi ...." but there is no reliable evidence that Nyala ever occurred in the Upper Shire Valley or close to Mangochi.
*Present Distribution* In Malawi, known only from the Lower Shire region (west of the river), in Lengwe N. P. and Mwabvi W. R.

**Habitat** In Malawi, found in thicket savanna of poorer areas, as at Lengwe N. P. In Lengwe N. P., Nyala are most strongly associated with the thicket-clump savanna, but they also occur in riverine forest, thickets, woodland savanna and grassland savanna. Nyala require dense cover for protection, for resting in during the heat of the day and for escaping danger. They occur in flat and hilly landscapes, up to about 400 m, and prefer to be near water (streams or waterholes) although this is apparently not essential.

**Abundance** In Malawi, there are no historical assessments of abundance except that, in the 1930s, they were considered "very limited" and found only in a small area. In the late 1960's, there were ca. 300 in Lengwe N. P., and by 1982, the estimated population there was 4,300. This was considered to exceed the carrying capacity of the Park, and therefore numbers were culled over the years to limit the number to 2000 (see also below). In Mwabvi W. R., the population was ca. 100. in 1989 (Morris 2006).

**Habits** Most studies of Nyala have taken place in South Africa. They are primarily nocturnal, but in protected areas they will venture out of the thickets in the early morning and late afternoon to feed and to visit waterholes. They are quiet shy antelopes. When disturbed they move quickly, without noise, into the nearby thicket-clumps. Nyala are browsers and grazers, their diet changing according the season. In most localities, grasses comprise about one-third of the diet and browse about two-thirds. However, in Lengwe N. P., Nyala are primarily browsers, but they increase their intake of grass in the wet season (Munthali 1991). They have also been observed feeding on fallen petals and fruits (R. C. Wood in Happold 2011). Nyala can survive without free water for several months but will drink daily (or every few days) if water is available.

The social organization of Nyala is such that adult females and their young live in female groups, young males live in ephemeral bachelor groups, and adult males are mainly solitary. Female groups are comprised of 2-3 adult females which are usually related, and their young. They are not territorial, and their home-ranges overlap with those of other female groups and those of adult males. In South Africa, home-ranges are ca. 1 $km^2$ to ca. 5.5 $km^2$. When a female comes into oestrus, she may be visited by several males which display to each other and spar by clashing horns as a means of establishing dominance. Serious flights are very rare. The female may consort with a succession of males as more dominant males replace the less dominant males, and eventually she will mate with the most dominant male. Females give birth where there is plenty of cover, and each calf lies up for ca. 18 days before following its mother into her female group. Young females remain with their mothers until they have calves of their own. In contrast, young males leave their mothers' groups when 14-24 months old and associate with other young males but these associations do not last for more than a few days. As they

become older, they become increasingly more dominant and solitary. Nyala are not territorial and loose temporary associations of up to ca. 30 individuals occur at waterholes.

Nyala are usually silent but they have three vocalizations. Their alarm call is a deep bark and their Malawian name, Boo, is an onomatopoeic imitation of this bark. Calves bleat if distressed, and females make a soft, throaty clicking sound when tending to their calves and also when in oestrus.

**Reproduction** No details for Malawi. When conditions are favourable, the population in Lengwe N. P. can increase by 19%/year. In South Africa (where there is no long dry season as in Malawi) births are recorded in most months of the year with peaks in Oct-Nov (after the end of the short dry season). Females may become pregnant again very soon after parturition. Gestation: ca. 220 days. Litter-size: 1 (very occasionally 2). Neonates are precocial and weigh ca. 5.6 kg. Young weaned ca. 7 months. Most males become sexually mature by ca. two years but do not breed until ca. five years of age. Females become sexually mature at 2.5 - 3 years (or four years when environmental conditions are poor).

**Conservation** IUCN Category: Least Concern. However, in Malawi, Nyala may be considered threatened because of their small population numbers, very small biogeographic range, agricultural developments and poaching close to the only two localities where they survive. Lengwe N. P. was gazetted as a G. R. in 1928 primarily to conserve the small population of Nyala.

**Taxonomic Notes** *Tragelaphus angasii* Angus, 1849. No subspecies are recognised.

**Key references** Anderson (2013), Munthali (1991).

**Measurements**
*Tragelaphus angasii*

| | |
|---|---|
| HB (males): | 1676 (1590–1980) mm, n = 20 |
| HB (females): | 1432 (1323–1463) mm, n = 19 |
| T (males): | 427 (370–470) mm, n = 22 |
| T (females): | 360 (342–399) mm, n = 10 |
| Sh. ht (males): | 1121 (1040–1210) mm, n = 17 |
| Sh. ht (females): | 966 (825–1060) mm, n = 8 |
| Horn length (adult males only): | mean 600 mm*, maximum 835 mm† |
| WT (males): | 107.5 (92.5–126.5) kg, n = 13 |
| WT (females): | 61.8 (54.9–68.1) kg, n = 8 |

Mozambique (Zinave N. P., Lobão Tello & Van Gelder 1975 in Anderson 2013).
*Southern Africa, Stuart & Stuart 2015.
†Rowland Ward in Anderson (2013).

## *Tragelaphus oryx*

## Common Eland

**Malawian Names** Mbunju, Mpefu, Mponja, Nsefu, Ntchefu.

Male. Liwonde N. P., Malawi © Bentley Palmer

**Description** A large pale cinnamon or greyish-beige cow-like antelope with vertical white stripes (sometime faint) on back and flanks; solidly built (especially males); prominent shoulder hump, and straight twisted horns. The largest artiodactyl in Malawi. Males larger and heavier than females, with massive forequarters, larger horns and a very large dewlap. Pelage short and sleek. Pelage (back and sides) pale cinnamon or beige, becoming grey with age. Very narrow mid-dorsal black stripe from behind head to base of tail, sometimes becoming a small vertical black mane on hump and/or neck. Vertical white stripes on flank (typically seven stripes but variable and sometimes thin and faint) between hump and hindquarters or base of tail. Ventral pelage (belly) either black, or paler to near white. Neck (in males) thickset, darker in colour with large pendulous dewlap extending from throat to between the forelegs; in females, beige with small (or no) dewlap. Head with dark brown or orange brush-like patch of longer hair on forehead, a wide black blaze down the middle of the face, and a white mark in front of each eye. Eyes large and dark. No preorbital glands. Ears comparatively small, pointed at tip; outer surface grey; inner surface partly white. Limbs strong, beige on outer surface, pale on inner surface, with a large black patch on back edge of each forelimb just above the knee, and a small white patch above each hoof. Lateral hoofs prominent. Tail 23-25% of HB, thin, beige with tassel of long black hairs at tip, reaching to hocks. Calves have white stripes as in adults.

Horns thick at base, tapering to tip, with a prominent keel; twisted through two complete turns, but the horns grow straight (i.e. not in a spiral as in Nyala and Greater Kudu). Front view: approximately V-shaped; side view, each horn points straight backwards (almost in same line as the forehead-to-nose line). Horns in juveniles are small and straight – twists develop (at about 18 months of age) as the horns lengthen.

**Similar Species** None. This is the only species that has a very large heavy cow-like shape and large, straight, twisted horns.

**Distribution** In Malawi, although widespread in the past, Common Eland occur now only in a few protected areas (see also below). Elsewhere: widespread in savanna and semi-arid habitats throughout most of Africa south of the Equator.

*Historical Distribution* Eland were recorded in almost all parts of Malawi, in all biogeographic areas, from the far north near the Tanzania border to Ntcheu in the south. In 1906, they were recorded as "fairly common in the Shire Highlands, the valley of the Shire river, in the Henga Valley (of the South Rukura River east of Rumphi), in the neighbourhood of Deep Bay (now Chilumba Bay), and more or less all over the Protectorate" (Duff 1906). They used to occur in the Upper Shire Valley (including the area now known as Liwonde N. P.) but became locally extinct in the 1920s.

*Present Distribution* By the 1980s, populations were restricted to a few protected areas (i.e. Nyika N. P. (population ca. 1200), Kasungu N. P. (ca. 250), Nkhotakota W. R. (ca. 200), Vwaza Marsh G. R. (ca. 75) and Majete W. R. (occasional) (Bell 1989). In the early 2000s, Common Eland were re-introduced to Liwonde N. P.

**Habitat** In Malawi, found in montane grasslands and shrublands, and open canopy miombo woodland. In Nyika N. P., most individuals occur on the plateau grasslands and shrublands and in the higher altitude miombo woodlands; some individuals descend into the lower altitude woodlands at the colder times of the year. Generally, Eland can live in a variety of habitats from semi-desert (e.g. Namibia) to savanna woodlands, and montane shrubland and grasslands. (They do not occur in forests, deserts or swamps).

**Abundance** Estimates of abundance in Nyika N. P. are varied depending on locality, season of the year, and when the estimate was made (see also above). Recent estimates are ca. 1200 (in 1975), ca. 500 (1978) and ca. 3500 (1989). Density varies throughout the biogeographic range, and in Nyika N. P., may be ca. 0.6-1.0/km$^2$ (higher than in most localities). Numbers have increased where there has been adequate protection.

**Habits** On Nyika Plateau, Common Eland are most active in the early morning and late afternoon. Common Eland are primarily browsers, but at some times and places, they may graze on grass and herbs. They browse on leaves and shoots from almost ground level to two metres above the ground and they will move into recently-burnt grasslands to feed on newly-sprouting grasses. A study in Kenya (analysis of stomach contents) recorded a diet of ca. 40% browse and ca. 60% grass in the wet season, and ca. 90% browse and <10% grass in the dry season. The species of plants eaten by Eland in Malawi are not recorded; however, studies in a dry area of southern Africa show that in the dry season, Eland browsed on ca. 13 species of plants and 12 species of grasses. Eland prefer plants which have a high protein value, a small amount fibre, and are green and fresh. They are very selective choosing the most nutritious foods even if such foods are not common. Eland can live in areas where free water is scarce or non-existent provided there is adequate water in their food. This is possible because they can allow the body temperature to increase from 33.9 C to 41.2 C when it is hot (and so evaporation of water is not needed to maintain a constant body temperature), and later the excess body heat is dissipated by radiation during night. Although Eland are very large, they can move surprisingly quickly; they can also jump over 2-3m tall fencing – an almost unbelievable feat for such a big mammal.

The social organization of Common Eland is unusual because, although they almost always live in herds, long-term stable relationships do not appear to exist and adults move freely from one herd to another. Solitary animals are almost always old males. Herds are very varied in size. In Nyika N. P., herds of up to 50 individuals are not uncommon. Sometimes several herds join together temporarily to form larger aggregations (there is one record of 300 individuals). Herds may be comprised of small groups of adult males, or groups of adult females, or large groups of males and females. Groups of adults with young and subadults tend to be the largest groups. In large groups, the subadults tend to form a 'sub-group' within the larger herd.

There is no evidence of territoriality in Eland but there is a dominance hierarchy within a herd. The dominant male makes threatening looks, points his horns forward, and lunges with his horns, and submissive individuals normally move away. Displays are not ritualized (as in some other antelopes). Young males often lock horns and push against each other until one demonstrates submission, but serious fighting is rare unless two or more older males are competing for a female in oestrus. When this happens, the males charge from 1-2 m away, and then push and manoeuvre to throw the opponent off balance. This can result in serious injuries. Females in oestrus are followed by the dominant male who stimulates urination, examines it by flehmen and often places his head on the female's rump or close to her side. If she stands still, mounting and mating follow. Calves can run within a few hours of birth, but they lie up away from the herd for a few days before following the mother back to the herd. For the first few months, they stay close to their mothers, but then congregate with other young in a 'creche' (surrounded by adult animals of the herd).

Eland are not very vocal; males 'bellow' to show their dominance, and they make a deep 'gruff ' sound when alarmed. Females communicate with their calves by making clicking sounds, mooing and whimpering. An unusual sound (made by males only?) is a loud clicking noise when walking; it seems that this noise is mechanical but how it is made is uncertain. Its function might be to advertise the size and social status of the individual.

Eland are nomadic. Herds may move many kilometers on a daily basis in search of food, and herds living in montane habitats (such as Nyika N. P.) descend to lower altitudes during the cool season (when temperatures are low and food may be limited and of poor quality). Consequently, Eland may have very large home-ranges (the size being largest in semi-arid habitats and smallest in mesic habitats). In southern Kenya, the home-ranges for adult males were 20-60 km$^2$ (on an annual basis), and 175-280 km$^2$ for females and juveniles. In the dry season, both adult males and females were comparatively sedentary (5-39 km$^2$ for males, 9-58 km$^2$ for females). The quality of the food in the habitat and the time of the year have a large influence on the home-range. The home-ranges of Eland in Nyika N. P. are not known.

**Reproduction** No information for Malawi. Eland breed in most months of the year. In Kenya, for example, births occur in all months with a slight

peak in Sep–Dec. In southern Africa where rainfall occurs in the summer, there is a peak in births in early summer (Aug-Oct). Gestation: ca, 273 days. Litter-size: 1 (occasionally 2). Neonates are precocial and weigh (in captivity) ca. 27 kg (males) and 25 kg (females). Weaning: 4-5 months. Females mature at ca. 18 months of age and conceive for the first time at 18-39 months. Males mature at 36-48 months.

**Conservation** IUCN Category: Least Concern. Eland are widespread and maintain their population numbers in protected areas. Many individuals have been translocated to private farms and estates in southern Africa where they flourish in semi-natural conditions.

**Taxonomic Notes** *Tragelaphus oryx* (Pallas, 1766). Prior to 2005, usually placed in the genus *Taurotragus*. Three subspecies have been recognised but their validity is uncertain. If valid, the subspecies in Malawi is *T. o. livingstonii* which is distinguished by the well-defined white stripes on the flanks (not present in the other subspecies). Referred to as *Taurotragus oryx* by many authorities including Sweeney (1959), Smithers (1983) and Ansell & Dowsett (1988).

**Key References** Smithers (1983), Thouless (2013).

**Measurements**
*Tragelaphus oryx*

| | |
|---|---|
| HB (males): | 2510 (2390–2630) mm, n = 5 |
| HB (females): | 2270 (2200–2330) mm, n = 5 |
| T (males): | 620 (570–720) mm, n = 5 |
| T (females): | 530 (500–550) mm, n = 5 |
| E (males): | 220 (210–240) mm, n = 5 |
| E (females): | 210 (190–230) mm, n = 5 |
| Sh. ht (males): | 1422 (1355–1500) mm, n = 6* |
| Sh. ht (females): | 1296 (1245–1330) mm, n = 6* |
| Horn length (males): | 650-710 mm, n = 3† |
| Horn length (female): | 600 mm, n = 1† |
| WT (males): | 494 (450–540) kg, n = 5 |
| WT (females): | 344 (317–370) kg, n = 5 |

Kenya (Athi-Kapiti Plains, Hillman 1979 in Thouless 2013).
*Tanzania (Serengeti, Sachs 1967 in Thouless 2013).
†Nyika Plateau (pers. obs.).

## *Tragelaphus scriptus*

## Bushbuck

**Malawian Names** Balala, Mbawala, Mpatu.

Male. Liwonde N. P., Malawi © Bentley Palmer

**Description** (*T. s. delamerei* for Malawi). Medium-sized graceful antelope with chestnut to dark brown pelage marked with conspicuous whitish spots on lower flanks and hindquarters, faint vertical whitish stripes across the back, a white band across base of neck, and black, white and chestnut markings on legs; horns (males only) of medium relative length, backward-pointing, twisted, straight or slightly curved. Back arched. Males, on average larger and heavier than females. Pelage smooth with a crest of longer, chestnut-brown, white or grey hairs along mid-dorsal line of the back (not always easily seen). Pelage colour and pattern varies regionally within Malawi (see below). Dorsal pelage and flanks chestnut-brown (tending to dark brown or even black on chest in males); marked with conspicuous white spots on lower flanks and hindquarters and several vertical stripes across the back which may be distinct or almost invisible. Ventral pelage on belly dark brown in males, pale brown in females. Head similar in colour to flanks, with narrow dark grey or black blaze, sometimes with an irregular short white line in front of each eye, and two white patches on each cheek. Upper and lower lips white, and white patch on throat. Neck bluish-grey. Nose black. Eyes dark. No preorbital glands. Ears moderately large; outer surface chestnut, inner surface paler with black patch and fringe of long white hairs on anterior edge. Limbs very deep chestnut or black with highly visible white patches on legs and just above hoofs. Tail bushy, ca. 17% of HB, pale chestnut above, white below; hairs erectile when bushbuck is startled.

Horns (males only) moderately long (much longer than ears), backward-pointing, tapering to a pointed tip, keeled, twisted, almost straight or curved into a very inconspicuous spiral. Each horn has a single twist so the keel spirals once around the horn. Front view: roughly U-shaped, sometimes with sides diverging, then narrowing and finally diverging at tips (i.e. slightly lyre-shaped). Side-view: each horn slopes straight backwards. Horns straight in young males.

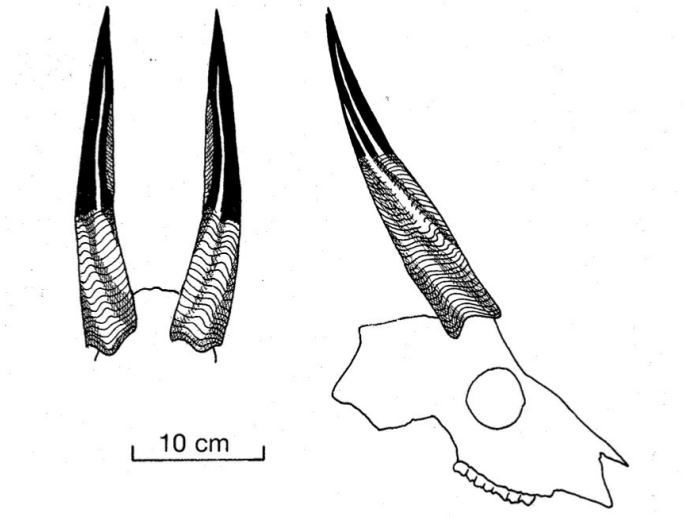



Fig. 26. Horns and skull of *Tragelaphus scriptus.*

Pelage colour and the pattern of stripes and spots vary in different localities, even within Malawi. Individuals from Nyika are pale brown, with a shaggy mid-dorsal crest, and without vertical stripes on flanks; individuals from Nkhotakota are as described above, and those from the south of the country are mostly darker in colour (see also Taxonomy).

**Similar Species**

*Tragelaphus angasii*, Nyala, females and young males only. Pelage bright chestnut with conspicuous white stripes on flanks and hindquarters; mid-dorsal line (top of head to base of tail) with longer black hairs; no horns (FF) or straight horns (young MM).

**Distribution** Recorded throughout most of Malawi in all biogeographic area and from low to high altitudes. Elsewhere: widespread from ca. 15˚N southwards to South Africa. Not present in arid and

semi-arid habitats (e.g. Namibia, large areas of Botswana and in NW, C and W South Africa).

*Historical Distribution* Recorded in all parts of the country from extreme north to extreme south; however there are fewer locality records from the Central Region than from the Northern and Southern Regions. In the early years of the 1900s, Bushbuck were described as "extremely common throughout British Central Africa". They were particularly abundant on the "Zomba uplands", in the "low forest country of the lake shore and the Shire river basin" and "on the high mountain plateaux of Mlanje and Zomba".

*Present Distribution* Bushbuck no longer occur in many localities of the Central Region and Phalombe Plain where they were recorded as present pre-1975. They still occur in all national parks and other protected areas including Majete W. R., Mwabvi W. R., Nkhotakota W. R, Vwaza Marsh G. R. and some forest reserves.

**Habitat** Woodlands, montane forests, grasslands and thickets where there are patches of dense cover (e.g. along the edges of forests). Rare in pure miombo woodlands. They can also live near human habitations and farmlands, provided cover is nearby. In Malawi, they occur (or used to occur) from ca. 100 m to highland areas (ca. 1800-2000 m), such as Zomba Plateau, Lichenya Plateau (Mulanje Mountain) and Nyika Plateau.

**Abundance** In 1989, Bushbuck were recorded as "common and widespread" in protected areas such as Nyika N. P. (forest edges at lower altitudes), Vwaza Marsh G. R., Kasungu N. P. (valleys), Liwonde N. P., and Mwabvi W. R. The only detailed estimate of number is that, in 1989, there were 1003 individuals in 104 km$^2$ of "old Lengwe", (i.e. 10/km$^2$). Although Bushbuck were very common 100-130 years ago, their population numbers (and biogeographic range) are much smaller now than in the past.

**Habits** Bushbuck move around mostly at dawn and dusk. In protected areas, they feed during the day as well as at night, but they feed mostly at night if they are likely to be disturbed by diurnal predators and humans. If disturbed, they retreat quickly into dense cover and their cryptic colouration and patterning provide very good camouflage that helps them to avoid predation. When frightened, they give a sharp deep warning 'bark', which probably alerts other Bushbuck to potential danger.

Bushbuck are grazers and browsers. They feed on grasses and herbs during the wet season, choosing species of plants that are nutritious and with a low fibre content. In the dry season, they browse on the leaves of a few selected shrubs and trees, and also eat seedpods and fallen fruit if available. Hiding (lying still under cover) and ruminating occupies at least 50% of the 24-hour cycle, more so during the day than at night.

The social organization of Bushbuck is such that both males and females usually live singly, in pairs or in mother-offspring family groups, or in female-female associations. Associations between adult males are unusual and ephemeral, but young males may associate in bachelor groups. Occasionally, several individuals may congregate, without being bonded in any way, at a favoured resource, e.g., a fruiting tree or a meadow with fresh succulent grasses. It seems that home-range sizes vary considerably in different localities and habitats, e.g. 0.25-2.0 ha in Kenya (Nairobi N. P.), 6.3-26.5 ha in Uganda (Queen Elizabeth N. P.). The extent to which territories are defended also varies in different localities.

In Uganda, clans of related females share a home-range which they defend against non-related females. Adult males also have home-ranges within which there is a' territory' that is defined by scent–marking; territories of males do not overlap. Younger males do not have territories.

Interactions between individuals are mostly friendly, except when a younger male trespasses on the 'territory' of a dominant male; the dominant male raised his head and neck and hairs on the mid-dorsal mane are erected. Males may rub their horns in mud (probably redirected aggression when his status is being challenged). Bushbuck exhibit many contact behaviours (e.g. nose-to-nose contact, neck-pressing, urine smelling, nose-to-anus contact, mutual grooming)

Territorial males attempt to herd and monopolize females in oestrus but young non-territorial males also attempt to mate with these females. Females give birth in dense cover. For the first four months of life, young lie up in dense cover before accompanying their mother into more open areas. Young males leave the home-range of the mother when ca. six months old and may associate with other young males until old enough to start challenging territorial males and attempting to take over a territory. In contrast, females stay with their mothers and other related females in clan-held home-ranges (see above).

**Reproduction** No information for Malawi. Throughout the biogeographic range, births have been recorded throughout the year albeit with peaks in some seasons. In Zambia (and probably in

Malawi), there is a peak early in the wet season. Gestation: mean 25-26 weeks, range 24-35 weeks. Litter-size: 1 (occasionally 2). Neonates are precocial and weigh 3-4 kg. Males begin to develop horns ca. 7 months, become mature at ca. 10 months, but do not breed until ca. 2 years old. Females become mature at 14-19 months.

**Conservation** IUCN Category: Least Concern. *Tragelaphus scriptus* is a successful species, with a widespread distribution and the ability to survive in farmlands and other modified habitats. Conservation concerns are hunting for 'bushmeat' and for sport, and reduction in suitable habitat.

**Taxonomic Notes** *Tragelaphus scriptus* (Pallas, 1766). This species is polymorphic and many subspecies have been described. Plumptre & Wronski (2013) place these in two groups – the *scriptus* group and the *sylvestris* group - which possibly represent two different species. The form in Malawi (which also occurs in SE Kenya, E Tanzania, Mozambique and NE South Africa) is treated as subspecies, *T. s. delamerei*. However, Bushbuck in the north of Malawi may belong to (or intergrade with) *T. s ornatus* (the subspecies in Zambia). Both *ornatus* and *delamerei* belong to the *sylvestris* group.

**Key Reference** Plumptre & Wronski (2013).

**Measurements**
*Tragelaphus scriptus (sylvestris* group)

| | |
|---|---|
| HB (males): | 1250-1540 mm, n = 8 |
| HB (females): | 1070-1380 mm, n = 3 |
| T (males): | 210 (190–240) mm, n = 8* |
| T (females): | 200 (190–220) mm, n = 13* |
| E (males): | 135 (121–152) mm, n = 8* |
| E (females): | 136 (127–152) mm, n = 13* |
| Sh. ht (males): | 770-910 mm, n = 8. |
| Sh. ht (females): | 620–760) mm, n = 3 |
| Horn length: | mean 327 mm, maximum 514 mm† |
| WT (males): | 42.0 (29.0–54.0) kg, n = 15* |
| WT (females): | 28.0 (24.0–34.0) kg, n = 16* |

East Africa (Grubb 1985 in Plumptre & Wronski 2013).
**T. s. ornatus*, Zambia, Wilson & Child (1964) in Plumptre & Wronski (2013).
†South Africa, Rowland Ward in Plumptre & Wronski (2013).

## *Tragelaphus strepsiceros*

## Greater Kudu

**Malawian Names** Namukhoma, Ndandala, Ntandala, Ngoma.

Male. Majete W. R., Malawi © Bentley Palmer

**Description** Large, majestic, long-legged, brown to greyish-brown antelope with vertical white stripes on flanks and hindquarters, a low hump over the shoulder, and very large horns (males only) which curve into a conspicuous corkscrew-like spiral. Sexes alike in colour. Males, on average, larger than females and males have a mane of long black-tipped hairs along the mid-ventral line of the neck, a higher shoulder-hump and horns. The hump over the shoulders is the highest part of the back and the back is slightly swayed. Pelage smooth except for crest of stiff, short white or grey hairs along the mid-dorsal line from top of head to base of tail. Pelage mostly fawn, cinnamon-brown to greyish-brown, with 7-10 white vertical stripes on the flanks and top of hindquarters; stripes on flanks extend from mid-dorsal line to belly; stripes on hindquarters shorter. Pelage becomes greyer with age. Head similar colour to flanks, with white stripe across forehead between eyes; two white marks on each cheek (sometimes obscure), upper and lower lips white; muzzle dark brown or blackish brown. Eyes dark. No preorbital glands. Ears long and wide; outer surface brown; inner surface with long white hairs on lower part of anterior edge. Limbs long and slender; with black patch above the knee on the back of each foreleg. Lateral hoofs small. Tail ca. 21% of HB, not reaching hocks, slightly bushy, brown above, white below (very obvious when tail is raised as an alarm signal) and sometimes with brown or black tip.

Horns (males only) very long and magnificent, rising upwards and outwards from top of head in obvious spirals. Each horn is keeled, twisted, and curved into a corkscrew-like spiral. In adult males, the horns have completed two spirals. Horns in young males (up to about one year) are straight), they then begin to spiral as they grow in length - one spiral (3 years), one and a half spirals (ca. 5 years), and two spirals (7+ years).

**Similar Species** (see yellow box above). Male Greater Kudu are the only species with long corkscrew shaped horns. Female Greater Kudu are similar to:-

*Tragalaphus angasii*, Nyala, females and young males only. Pelage bright chestnut with 8-15 conspicuous white stripes on flanks and hindquarters; mid-dorsal line with longer black hairs.

**Distribution** Widespread in Malawi, in all biogeographic areas except the high plateaux of the Northern Region and Mount Mulanje, although fewer records in Central Region than in Northern and Southern Regions. Elsewhere: occurs on the eastern side of the continent from Ethiopia to Namibia, Botswana, Zimbabwe and NE South Africa.
*Historical Distribution* Widespread from extreme NW to extreme south near Nsanje. In 1906, Kudu (originally spelt 'Koodoo') were not considered to be "plentiful" (compared with many other species of antelopes). However, they were common "in the districts of South Nyasa and the Upper Shiré, notably near Monkey Bay on the lake and Mweru on the river". In 1959/1960, still "fairly common" in the region of Nsanje and Mwabvi W. R.
*Present Distribution* Greater Kudu have disappeared from many of the localities where they were recorded pre-1975. Kudu are now restricted to protected areas, including Kasungu N. P., Lengwe N. P., Liwonde N. P., Majete W. R., Mwabvi W. R., Nkhotakota W. R., Nyika N. P. (woodlands at lower altitude) and Vwaza Marsh G. R.

**Habitat** Woodlands - especially those on rich soils which have many species of fine-leaved trees and shrubs. Miombo woodlands are less favoured habitats. Greater Kudu also utilize areas of secondary growth in woodlands which have been modified by

elephants and agriculture. During the wet season, they prefer hilly woodlands, but during the dry season they may move into woodlands along the edges of rivers and other sources of water. Not recorded from montane habitats and wetlands.

**Abundance** In 1989, estimated numbers were ca. 1000 (Majete W. R.), ca. 750 (Liwonde N. P.), ca. 500 (Vwaza Marsh G. R.), ca. 300 (Lengwe N. P.), ca. 300 (Mwabvi W. R.), an unknown number in Nyika N. P. woodlands, and occasional sightings in Nkhotakota W. R.

**Habits** Greater Kudu are active during day and night. Most foraging takes place during early morning and from late afternoon into the night, and they sleep before dawn. Activity is highest during the dry season when nutritious food is scarce, and lowest during the wet season when nutritious food is abundant. Greater Kudu are cryptic, their colouration and patterning merging into the colours and shadow patterns of their woodland habitats. When alarmed, members of the herd scatter, with the white undersurface of the tail clearly visible (as a warning signal). When running through dense woodland, the male holds his head upwards and forwards so that his long horns rest along his back. Males produce a very loud bark when alarmed.

Greater Kudu are primarily browsers. They feed on the leaves and small twigs of a very large number of species of woody plants (shrubs and trees) and also on forbs, fruits and seed pods (when available). In the early wet season, they may also feed on short nutritious grasses. They are very selective in their choice of foods, favouring species that are palatable, with a high protein content and a low tannin content. Males use their horns to pull branches and leaves within reach. They can survive without free water for several days but will drink from water holes when available. They are often seen at the Main Hide waterhole at Lengwe N. P.

The social organization of Greater Kudu is such that females with young live in clans, adult and subadult males associate together in loose groups, and old males become increasingly solitary (Owen-Smith 2013). Female clans occupy large home-ranges, the size depending on the habitat and the quality and quantity of resources (food, water); home-ranges vary from 3-25 $km^2$ in Kruger N. P., South Africa; but can be as small as 1 $km^2$ in succulent thicket habitats. Home-ranges of female herds may overlap although they have apparently undefended core areas which do not overlap. Young females mostly stay with their mother's clan whereas young males disperse. In South Africa, young and adult males typically associate in groups of 3-4 and up to 12; groups of up to 25 have been observed elsewhere. During the mating season, one or more adult males join a female clan; one male will be the dominant male (and will have the mating rights to the females). Conflict between individuals seems to be minimal. When males meet, they face each other side on; the dominant male raises his head, and the hairs on his mane; the submissive male hold his head low. If two males lock horns, they push and twist as a test of strength; the loser disentangles himself and departs. When a male encounters a female in oestrus, he follows her, and tests her urine (flehmen); if she is receptive, the male stands beside the female, stretching his neck over her back, and mating occurs when the female is ready. Young are born and then hide themselves in dense cover and they lie up for the first 8-10 weeks after birth. The mother visits the area about once a day, calls to the calf and it comes out of hiding to be suckled. The mother then licks the calf to stimulate urination and defecation, and she consumes both to remove evidence of the calf's presence. When young join the female clan, they tend to congregate as a sub-unit rather than staying close to their mothers.

**Reproduction** No details for Malawi. The breeding season varies with locality. In northern Zambia (and probably also in Malawi), young are born mainly in Jan-Apr, with some calves born as late as May when there is plenty of nutritious food. Gestation: ca. 260-270 days. Litter-size: 1. Neonates are precocial and weigh 16 kg. Young are weaned at 6-7 months of age. Females can give birth for the first time when 3-4 years old and can produce (on average) one young/year.

**Conservation** IUCN Category: Least Concern. Populations appear to be maintaining their numbers, even though Greater Kudu are hunted for food and for their horns. In South Africa, Greater Kudu are well represented on private ranches.

**Taxonomic Notes** *Tragelaphus strepsiceros* (Pallas, 1766). Three or four subspecies have been recognised by some authorities on the basis of the number and pattern of the stripes. However, the variation in stripes is so great *within* populations that the subspecies are probably not valid.

**Key Reference** Owen-Smith (2013).

**Measurements**
*Tragelaphus strepsiceros*

| | |
|---|---|
| HB (males): | 2170 (2060–2490) mm, n = 33 |
| HB (females): | 1970 (1520–2160) mm, n = 68 |
| T (males): | 450 (400–520) mm, n = 33 |
| T (females): | 410 (350–470) mm, n = 68 |
| E (males): | 260 (245–290) mm, n = 33 |
| E (females): | 240 (210–255) mm, n = 68 |
| Sh. ht (males): | 1340 (1220–1430) mm, n = 17 |
| Sh. ht (females): | 1240 (990–1390) mm, n = 48 |
| Horn length (along curve): | mean 1200 mm*, maximum 1876 mm† |
| WT (males): | 249.0 (174.0–344.0) kg, n = 94 |
| WT (females): | 160.0 (112.0–210.0) kg, n = 97 |

Southern Africa (Owen-Smith 2013).
*Stuart & Stuart (2015).
† Rowland Ward in Owen-Smith (2013).

Distribution of large mammals in the national parks, wildlife reserves and Vwaza Marsh G. R. in Malawi.

Y= known to occur. ? = occurrence needs confirmation. (+) = old record; no longer present.
RI = recently introduced.

| Species | Kasungu N. P. | Lake Malawi N. P. | Lengwe N. P. | Liwonde N. P. | Nyika N. P. | Majete W. R. | Mwabvi W. R | Nhkotakota W. R. | Vwaza Marsh G. R. |
|---|---|---|---|---|---|---|---|---|---|
| Blue Monkey | | Y | Y | | | | Y | Y | |
| Vervet Monkey | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Yellow Baboon | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Southern Lesser Galago | | | | ? | | | ? | | ? |
| Large-eared Greater Galago | Y | Y | Y | | | | Y | | |
| Mozambique Dwarf Galago | | | | | | | | | |
| Mountain Dwarf Galago | | | | | ? | | | | |
| Temminck's Ground Pangolin | (+) | | (+) | (+) | | | (+) | | ? |
| Side-striped Jackal | Y | | Y | Y | Y | | Y | | |
| African Wild Dog | Y | | | RI | Y | RI | Y | Y | Y |
| African Clawless Otter | Y | Y | | Y | Y | | | | Y |
| Spotted-necked Otter | | Y | Y | | | | | | |
| Zorilla | Y | | | | | | | | |
| Ratel | Y | | | Y | Y | | Y | | |
| African Striped Weasel | | | | | Y | | | | |
| Two-spotted Palm Civet | | | | | Y | | Y | | |
| African Civet | Y | Y | Y | Y | Y | | Y | Y | Y |
| Miombo Genet | | | | | | | | | |
| Large-spotted Genet | | | Y | Y | | | Y | Y | |
| Marsh Mongoose | Y | | | | | | | | |
| Bushy-tailed Mongoose | | | Y | | Y | | | | |
| Dwarf Mongoose | Y | | Y | | Y | | Y | Y | |
| Egyptian Mongoose | | | Y | Y | Y | | Y | | |
| Slender Mongoose | Y | Y | Y | Y | Y | Y | Y | | Y |
| White-tailed Mongoose | Y | | | Y | | | | | Y |
| Banded Mongoose | Y | | Y | Y | | | Y | | Y |
| Selous's Mongoose | | | | ? | | | | | |
| Meller's Mongoose | | | | | | | | | |
| Spotted Hyaena | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Cheetah | (+) | | | RI | (+) | RI | | | (+) |
| Caracal | Y | | Y | | Y | | | | Y |
| Wildcat | | | Y | Y | Y | | | | Y |
| Serval | | | Y | Y | Y | | Y | | |
| Lion | Y | | | Y | Y | RI | Y | | Y |
| Leopard | Y | | Y | Y | Y | Y | Y | Y | Y |
| Aardvark | Y | | Y | Y | | | ? | | Y |
| Southern Tree Hyrax | | | | (+) | (+) | ? | | | |

| Species | Kasungu N. P. | Lake Malawi N. P. | Lengwe N. P. | Liwonde N. P. | Nyika N. P. | Majete W. R. | Mwabvi W. R | Nhkotakota W. R. | Vwaza Marsh G. R. |
|---|---|---|---|---|---|---|---|---|---|
| Bush Hyrax | Y | Y | | | Y | | Y | | Y |
| Rock Hyrax | | | | | | | | | |
| Elephant | Y | | | Y | Y | Y | | Y | Y |
| Plains Zebra | ? | | | RI | Y | RI | | RI | Y |
| Black Rhinoceros | | | | RI | | RI | | | |
| Common Warthog | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Bushpig | Y | (+) | Y | Y | Y | (+) | ? | Y | Y |
| Common Hippopotamus | Y | Y | | Y | | | Y | Y | Y |
| Thornicroft's Giraffe | | | | | | | | | |
| South African Giraffe | | | | | | RI | | | |
| Impala | Y | (+) | Y | Y | | Y | Y | Y | Y |
| Lichtenstein's Hartebeest | Y | | (+) | (+) | Y | Y | Y | | Y |
| Harvey's Duiker | | | | | Y | | | | |
| Common Wildebeest | (+) | | | (+) | | | | | (+) |
| Roan Antelope | Y | | | | Y | | | Y | Y |
| Sable Antelope | Y | | Y | Y | | Y | Y | Y | Y |
| Common Waterbuck | Y | | | Y | | Y | | Y | (+) |
| Puku | Y | | | | (+) | | | | Y |
| Suni | | | Y | | | Y | Y | | |
| Klipspringer | Y | Y | | Y | Y | Y | Y | | Y |
| Oribi | Y | | | Y | | | | ? | |
| Blue Duiker | | | | | | | | | |
| Sharpe's Grysbok | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Southern Reedbuck | Y | | Y | Y | Y | Y | | Y | Y |
| Common Duiker | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| African Buffalo | Y | | Y | Y | Y | RI | Y | Y | Y |
| Nyala | | | Y | | | | Y | | |
| Common Eland | Y | | | RI | Y | Y | | Y | Y |
| Bushbuck | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Greater Kudu | Y | | Y | Y | Y | Y | Y | Y | Y |

Y = known to occur. ? = occurrence needs confirmation. (+) = old record; no longer present. RI = recently introduced.

# GAZETTEER

| Locality | Co-ordinates | Altitude (in metres) |
|---|---|---|
| Angoniland (Central Plateau; no precise co-ordinates) | | |
| Balaka | 14.59 S 34.57 E | 600 |
| Bangula | 16.33 S 35.07 E | 60 |
| Blantyre | 15.47 S 35.00 E | 1070 |
| Blantyre Highlands (no precise co-ordinates) | | |
| Bua River (no precise co-ordinates) | | |
| Bvumbwe | 15.55 S 35.04 E | |
| Cape Maclear | 14.02 S 34.50 E | 500 |
| Chapananga | 15.59 S 34.27 E | |
| Chelinda | 10.35 S 33.48 E | 2300 |
| Chia (S of Nkhotakota) | 13.05 S 34.19 E | |
| Chididi | 16.54 S 35 10 E | 600 |
| Chididi Mission | 16.54 S 35.10 E | 610 |
| Chikangawa | 11.50 S 33.48 E | 1700 |
| Chikwawa | 16.01 S 34.47 E | 120 |
| Chileka | 15.39 S 34.55 E | 750 |
| Chilembe | 15.05 S 35.10 E | |
| Chilumba Bay | 10.26 S 34.15 E | |
| Chilwa Plains (? Phalombe plain; no precise co-ordinates) | | |
| Chimaliro F. R. | 12.27 S 33.32 E | 1435 |
| Chinguni Rest House (near Liwonde) | ca. 15.03 S 35.13 E | 500 |
| Chintheche | 11.49 S 34.10 E | 483 |
| Chipome Valley (Nyika Plateau) | 10.20 S 33.50 E | ca. 1530 |
| Chiradzulu Forest | 15.40 S 35.13 E | 881 |
| Chiradzulu Mountain | 15.41 S 35.10 E | |
| Chiromo | 16.32 S 35.09 | 60 |
| Chitala River | 13.55 S 34.15 E | 604 |
| Chitala (? = Chitale) | 13.40 S 34.16 E | 608 |
| Chitipa (formerly Fort Hill) | 09.42 S 33.16 E | 1300 |
| Chiwawa | 16.03 S 34.47 E | 120 |
| Chiwpina (near Chilwa) | ca. 15.19 S 35.37 E | ca. 650 |
| Chongoni F. R. | 14.18 S 34.13 E | |
| Chongoni Mountain | 14.12 S 34.12 E | >2000 |
| Chowo Forest (Nyika Plateau, Zambia) | 10.35S 33.41E | 2180 |
| Dai Village – not located | | 640 |
| Dedza | 14.22 S 34.20 E | 1600 |
| Dedza Mountain | 14.20 S 34.20 E | 2198 |
| Deep Bay (=Chilumba Bay) | 10.26 S 34.15 E | 480 |
| Domwe Island | ca. 13.58 S 34.49 E | 480 |
| Dowa | 13.39 S 33.56 E | 1350 |
| Dzalanyama F. R. | ca.14.15 S 33.25 E | |

| Locality | Co-ordinates | Altitude (in metres) |
|---|---|---|
| Dzalanyama F. R. (rest house) | ca. 14.18 S 33.29 E | ca. 1200 |
| Ekwendeni | 11.22 S 33.53 E | 1200 |
| Ekwendeni Station | 11.22 S 33.53 E | 1200 |
| Elephant Marsh | 16.23 S 35.03 E | |
| Fort Lister | 15.50 S 35.42 E | 1829 |
| Fort Songwe (not located but presumably on or near the Songwe River) | 09.22 S 33.04 E to 09.43 S 33.56 E | |
| Gulomoti (= Golomoti) | 14.25 S 34.36 E | |
| Henga Valley (= valley of South Rukuru River east of Rumphi, no precise co-ordinates) | | |
| Jembya F. R. (Northern Region) | ca. 10.06 S 33.26 E | |
| Kakia (Blantyre; not located more precisely) | | |
| Kalimbuka | 15.23 S 35.19 E | |
| Kalwe F. R. near Nkhata Bay | 11.36 S 34.15 E | 558 |
| Kamuzu Academy | 13.02 S 33.40 E | 1150 |
| Kandoli Hills nr Nkhata Bay | 11.34 S 34.16 E | 745 |
| Kapalasa Farm (Namadzi District) | 15.31 S 35.11 E | 1000 |
| Kapino Estate (Namadzi District) | 15.31 S 35.11 E | 1000 |
| Karonga | 09.56 S 33.56 E | 485 |
| Karonga Beach | 09.57 S 33.56 E | 480 |
| Kasungu | 13.02 S 33.29 E | 1100 |
| Kasungu N. P. (Administration Camp) | 13.05 S 33.09 E | 1000 |
| Kasupe (see Machinga) | | |
| Katsakaminga | 14.20 S 34.24 E | |
| Kuti W. R. (near Salima) | 13.41 S 34.26 E | ca. 500 |
| Kongwe Forest | 13.35 S 33.55 E | 1428 |
| Lake Chiuta | 14.47 S 35.52 E | 700 |
| Lake Kaulime | 10.34 S 33.45 E | 2350 |
| Lake Malawi N. P. (Cape Maclear) | 14. 02 S 34.50 E | 500 |
| Lake Malombe | ca. 14.38 S 35.15 E | 472 |
| Lengwe N. P. | ca. 16.15 S 34.45 E | 100 |
| Lengwe N. P. (The Chalets) | 16.13 S 34.46 E | 100 |
| Lichenya Plateau (Mulanje Mountain) | 15.58 S 35.31 E | 1975 |
| Likhubula | 15.57 S 35.29 E | 750 |
| Likhubula (CCAP Mission) | 15.47 S 35.24 E | ca. 750 |
| Likhubula River | ca. 16.02 S 35.30 E | ca. 640 |
| Likoma Island | 12.04 S 34.44 E | 500 |
| Lilongwe | 13.59 S 33.46 E | 1100 |
| Limbe | 15.49 S 35.03 E | 1200 |
| Limbuli Estate (Mulanje) | 16.04 S 35,44 E | 600 |
| Livingstonia | 10.36 S 34.06 E | 1200 |
| Livingstonia Beach | 13.43 S 34.37 E | 480 |
| Liwonde | 15.03 S 35.13 E | 500 |
| Liwonde N. P. (Mvuu Camp) | 14.53 S 35.18 E | 480 |

| Locality | Co-ordinates | Altitude (in metres) |
|---|---|---|
| Liwonde N. P. (Southern Entrance Area) | 15.02 S 35.15 E | 500 |
| Luchenza | 16.00 S 35.18 E | 900 |
| Lumenda | 16.18 S 34.40 E | |
| Lunzu | 15.39 S 35.01 E | 800 |
| Luwawa Dam (Viphya Plateau) | 12.07 S 33.44 E | 1600 |
| Luwazi Mission | 11.31 S 34.09 E | 650 |
| Machinga | 15.10 S 35.17 E | 700 |
| Mafinga Hills F. R. | ca. 09.57 S 33.21 E | |
| Magomero | 15.34 S 35.16 E | 900 |
| Malema Camp (near Ulamwe, Karonga District) | 10.01 S 33.55 | |
| Malosa | 15.12 S 35.20 E | 900 |
| Malosa Mountain (= Mount Malosa) | 15.15 S 35.18 E | 2077 |
| Mangoche Mountain | ca. 14.30 S 35.30 E | 1580-1750 |
| Mangochi | 14.29 S 35.16 E | 480 |
| Maperera | 16.07 S 34.53 E | <100 |
| Matope | 15.21 S 34.57 E | 500 |
| Mbalame Mountain | 14.09 S 33.55 E | |
| Mbasi Creek (NW corner of Lake Malawi) | | |
| Mchinji (formerly Fort Manning) | 13.48 S 32.53 E | 1200 |
| Michirul | 15.42 S 34.34 E | |
| Mikolongwe | 15.51 S 35.13 E | 900 |
| Misuku | 09.40 S 33.32 E | 1500 |
| Misuku Hills | ca. 09.40 S 33.27 E | 1900 |
| Misuku Hill (Matipa Forest) | 09.39 S 33.26 E | >2000 (highest) |
| Misuku-Mughese Mission up to 1900 m | 09.41 SS 33.27 E | ca. 1500-1900 |
| Mitondo | 16.17 S 35.04 E | 90 |
| Mitsidi (Manyowa Hill). Not located. | | |
| Mkhoma | 14.02 S 34.06 E | 1200 |
| Mlakha Hill | 16.49 S 35.08 E | |
| Mondwe Valley (Nyika N. P.) | 10.24 S 33.50 E | 1760 |
| Monkey Bay | 14.04 S 34.55 E | 480 |
| Mount Malosa | 15.15 S 35.19 E | 1900 |
| Mpalanganga Dam (Thondwe District) | 15.27 S 35.15 E | 1100 |
| Mpatamanga Gorge | 15.43 S 34.44 E | 300 |
| Mpemba | 15.53 S 34.56 E | |
| Mpimba (not located) | | |
| Mpimbi | 15.18 S 35.04 E | 450 |
| Mpyupyu Prison Farm | 15.22 S 35.27 E | 717 |
| Mtimbuka | 14.18 S 35.08 E | 472 |
| Mugesse Forest (? = Mughese Forest) | 09.39 S 33.32 E | 1625 |
| Mulanje | 16.02 S 35.30 E | 640 |
| Mulanje (Chipoka village) (Not located) | | |
| Mulanje Mission | 16.02 S 35.28 E | 731 |
| Mulanje Plateau | ca. 15.58 S 35.38 E | |

| Locality | Co-ordinates | Altitude (in metres) |
|---|---|---|
| Mulanje Mountain (Lichenya Plateau) | 15.59 S 35.32 E | 1800-2000 |
| Mulanje Mountain (Nalipili rest house) | 16.01 S 35.29 E | 853 |
| Mulanje Mountain (Thuchila Plateau) | 15.53 S 35.36 E | 1800-2000 |
| Mulanje-Chitakali | ca. 16.02 S 35.30 E | |
| Mulanji F. R. (No precise co-ordinates) | | 1200 |
| Mulolo (near Chiromo) (not located) | | |
| Muona Mission | 16.24 S 35.09 E | 76 |
| Mwabve | ca. 16.41 S 35.01 E | 100 |
| Mwabvi W. R. | 16.40 S 35.02 E | 100 |
| Mwalingo (near Chitipa, Misuku Hills) | 09.40 S 33.32 E | 1460 |
| Mwanemba = Mwenembwe | 10.41 S 34.00 E | |
| Mwanya River (not located) | | |
| Mwanza | 15.36 S 34.31 E | 600 |
| Mweru (not located) | | |
| Mzimba | 11.54 S 33.36 E | 1350 |
| Mzuzu | 11.27 S 34.02 E | 1350 |
| Namadzi | 15.38 S 35.10 E | 1027 |
| Namadzi District (Kapalasa Farm) | 15.31 S 35.11 E | 1000 |
| Namazo Bay | 14.10 S 34.59 E | 522 |
| Namitete | 13.58 S 33.19 E | 1200 |
| Namizimu F. R. | 14.07 S 35.18 E | 1055 |
| Namwera NE of Mangoche | 14.22 S 35.30 E | 900 |
| Nankhundah | ca. 15.22 S 35.15 E | 1200 |
| Nchalo | 16.16 S 34.55 E | <100 |
| Ndipitakuti (not located) | | |
| Ngabu | 16.28 S 34.55 E | <100 |
| Nganda (Nyika Plateau) | 10.26 S 33.51 E | 2200-2300 |
| Nkhata Bay | 11.36 S 34.18 E | 500 |
| Nkhotakota | 12.56S 34.18 E | 500 |
| Nkhotakota W. R. (Chipata Camp) | 13.04 33.56 E | ca. 1350 |
| Nsanje | 16.55 S 35.16 E | <100 |
| Ntcheu | 14.49 S 34.38 E | 1100 |
| Ntchisi | 13.20 S 34.00 E | 1500 |
| Ntchisi Mountain | 13.22 S 34.01 E | 1642 |
| Ntchisi Mountain F. R. (rest house) | 13.23 S 34.00 E | 1500 |
| Ntonda | 15.18 S 35.29 E | 900 |
| Nyika N. P. (Chipome Valley) | 10.20 S 33.50 E | ca. 1530 |
| Nyika N. P. (Game Post) | 10.43 S 33.39 E | 1935 |
| Nyika Plateau (Chelinda) | 10.35 S 33.49 E | 2300 |
| Nyika Plateau (Juniper Forest) | 10.45 S 33.55 E | 2300 |
| Nyika Plateau (Mlombuji) | 10.42 S 33.35 E | 1675 |
| Otter Point (Lake Malawi N. P.) | ca. 13.58 S. 34.49 E | ca. 480 |
| Perekezi F. R. (Mzimba District) | 12.02 S 33.36 E | |
| Port Herald (see Nsanje) | | |

| Locality | Co-ordinates | Altitude (in metres) |
|---|---|---|
| Rumphi | 11.01 S 33.52 E | 1100 |
| Ruo River | 16.06 S 35.39 E | 760 |
| Salima | 13.47 S 34.27 E | 500 |
| Salima-Senga Bay | 13.43 S 34.38 E | 480 |
| Satemwa Estate (Thyolo District) | 16.05 S 35.05 E | 1000 |
| Sawi River (Nyika Plateau) | 10.20 S 33.53 E | ca. 1500 |
| Shire Highlands (near Thondwe) | 15.30 S 35.15 E | |
| Songwe | 16.01 S 35.42 E | |
| Sucoma | 16.14 S 34.53 | |
| Sucoma Game Ranch (not located) | | |
| Tembuku | 14.28 S 35.16 E | |
| Tengani | 16.43 S 35.15 E | 60 |
| Thekerani | 16.19 S 35.16 E | 350 |
| Thondwe | 15.29 S 35.14 E | 1100 |
| Thondwe (Mpalanganga Dam) | 15.27 S 35.15 E | 1000 |
| Thuchila Plateau (=Tuchila Plateau) | 15.55 S 35.21 E | 700 |
| Thuchila River (tributary of Ruo River) | | |
| Thyolo | 16.04 S 35.09 E | 900 |
| Thyolo Mountain | 16.06 S 35.03 E | 1219 |
| Tinyadi Estate (base of Mulanje Mountain) | 15.51 S 35.35 E | 815 |
| Upembe (not located) | | |
| Upimbi (not located) | | |
| Upudu Village on Upper Shire River | ca. 14.32 S. 35.16 E | 800 |
| Uzumara Mountain | ca. 10.52 S 34.07 E | |
| Viphya Plateau (Luwawa Dam) | 12.07 S 33.44 E | 1700 |
| Viphya Plateau (North) | ca. 11.32 S 33.53 E | 1500-1800 |
| Viphya Plateau (South) | ca. 12.23 S. 33.42 E | 1500-1800 |
| Vua | 10.16 S 34.08 E | |
| Vwaza Marsh G. R. | ca. 11.00 S 33.26 E | |
| Wilindi Forest | 09.42 S 33.29 E | 1900 |
| Zoa | 16.14 S 35.13 E | 800 |
| Zoa Tea Estate | 16.14 S 35.12 E | 800 |
| Zomba | 15.23 S 35.19 E | 800-900 |
| Zomba Plateau | 15.20 S 35.19 E | 1500-2087 |
| Zomba Plateau (Chingwe’s Hole) | 15.20 S 35.16 E | 1900 |
| Zomba Plateau (The Stables) | 15.22 S 35.19 E | 1650 |

# GLOSSARY

*adj*. = adjective.
*cf*. = *confer*; compare with; as opposed to.
*Lat*. = Latin.
*pl.* = plural.
*q.v.* = *quod vide*, "which see".
*sing*. = singular

**aestivation:** state of torpor (*q.v.*) induced by warm temperatures and dry conditions (e.g. hot dry season); usually associated with a reduced metabolic rate and inactivity. *cf.* hibernation.

**agility:** in bats, the rate at which a turn can be initiated during flight.

**agonistic:** describes social behaviour which repels conspecific animals, such as fighting, threatening, chasing.

**allogrooming:** grooming another individual. *cf.* mutual grooming (*q.v.*).

**allopatric:** having non-overlapping biogeographic ranges; describes populations of the same, or different, species that are biogeographically separated. *cf.* sympatric (*q.v.*).

**altricial:** (*adj*.) born in an undeveloped state (e.g. blind, furless, unable to walk). *cf.* precocial.

**aspect ratio:** describes the width of a wing relative to its length. Calculated by dividing the square of the wingspan by the wing area. Narrow wings have high aspect ratios.

**auditory meatus (*pl.* auditory meati)**: the external opening of the ear; the passage leading from the tympanic membrane (ear drum) to the external ear.

**bicuspid:** having two points or cusps (particularly of teeth).

**bifid:** divided by a shallow notch.

**binocular vision:** the type of three-dimensional vision that is possible when an animal's two eyes face the same direction and have overlapping visual fields. Enables judgement of distance.

**biogeographic:** relating to the distribution of a species.

**bipedal:** movement not using the forelimbs; body supported only by the two hindlimbs.

**blastula:** a hollow ball of undifferentiated cells (derived from a fertilized ovum by cell division), which represents one of the earliest stages of embryonic development.

**c.u.**: (Lat. *cum unguis* = with nail) measurement of the hindfoot when the length of the nail or the claw is included in the measurement. Usually, the hindfoot is measured without the claw because claws may be broken or worn, and when length of the claw is included, it is conventional to record as "HF (c.u.)". cf. s.u. (*q.v.*). However, in bats, it is conventional to include the claw without adding c.u. See also HF (in bats).

**calcar:** bony or cartilaginous spur arising from the ankle and, in bats, helping to support the hind margin of the interfemoral membrane (*q.v.*). Also called calcanium.

**call shape:** (in bats) the shape of an echolocation call as seen in a sonogram of the call, when frequency is plotted against time.

**caravanning:** (in shrews) behaviour of young when they form a line behind their mother, each young holding on to the rump of the individual in front.

**carnassial teeth:** (in carnivores) a pair of self-sharpening, bladelike teeth which slide past each other and shear through tough skin, tendons, ligaments and bones.

**cauda epididymides:** the ducts at the posterior end of the testes which carry sperm from the testes to the vas deferens, which, in turn, carries sperm to the penis. Sometimes used to store sperm prior to copulation.

**CF calls:** (in bats) echolocation calls which have a long component pitched at a constant frequency.

**CF frequency:** (in bats) the frequency of the constant frequency component of CF calls (*q,v).*

***cf.*** (in general usage): compare or compare with. In the context of descriptions, implies a difference or contrast. e.g. In *P. rueppelli*, mid-ventral pelage white (cf. *P. stanleyi* in which the ventral pelage is brown).

***cf.*** (in taxonomy): precedes the specific name if there is uncertainty in the assignment.

**cheekteeth:** the premolar and molar teeth together.

**CI:** see condyloincisive length.

**clade:** branch of a phylogenetic tree containing the set of all organisms descended from a common ancestor.

**cline (*adj.* clinal)**: in context of biogeographic variation, a gradual and sequential change of a character(s) without a significant break such as would justify division into separate subspecies or species.

**clutter:** (in bats) the amount of objects in the vicinity of a bat which reflect echoes from the bat's echolocation calls.

**comparatively:** used in the context of describing the size of one character compared with the size of the same character in a different species. Sizes described as small, medium or large (if range is divided into three) or very small, small, medium, large, very large (if range is divided into five).

**condyloincisive length (CI):** (in shrews) the length of the skull from the anterior end of the longest incisor tooth to the most posterior part of the skull (i.e. the posterior end of the occipital condyles).

**connecting process:** the longitudinal structure arising from the central component of the noseleaf in bats in the family Rhinolophidae, that extends from the back of the sella (*q.v.*) to the base of the lancet (*q.v.*). Its shape, viewed laterally, is a diagnostic character.

**conspecific:** belonging to the same species.

**convergent evolution:** the evolution of similar characters in unrelated animals as a result of adaptations to similar environmental conditions or to serve similar functions.

**copraphagy:** the behavioural practice of eating faeces as they are voided from the anus.

**crepuscular:** active during twilight, when light intensity is higher than at night but lower than during the day. *cf.* diurnal (*q.v.*), nocturnal (*q.v.*).

**CrnC:** (in bats) cranio-canine length**,** the distance from the most posterior part of the skull to the front of the upper canines. Often used instead of greatest length of skull in bats of the families Rhinolophidae and Hipposideridae because, in these bats, the premaxillae are often lost during preparation of skulls.

**cryptic species:** two or more species given the same name because they are so similar morphologically that they have not been recognised as distinct species.

**cursorial:** pertaining to running. In bats, refers to scuttling or crawling in which the folded wings and hindlimbs are used for quadrupedal locomotion over a substrate (as opposed to flying, swimming or any other form of locomotion).

**cusp:** a prominence or sharp point such as on the occlusal (*q. v.*) surface of some teeth.

**dambo:** local name for a seasonally waterlogged, grass-covered, low-lying area.

**delayed implantation:** a means of lengthening the interval between copulation and parturition by delaying the implantation of the blastula *(q.v.)*, so that both copulation and parturition can occur in the most optimal seasons. Development to blastula stage is followed by a period of halted development lasting several weeks or months; then the blastula implants and embryonic development proceeds normally, usually without any further interruption, until the young is born.

**dimorphism (*adj.* dimorphic):** the existence, within a species or population, of individuals having two different forms (including colours). e.g. sexual dimorphism when males and females have different colours or forms.

**diphyly:** the derivation of a taxon from two separate lines of descent. *cf.* monophyly.

**distal:** the end of any structure which is furthest away from the mid-line of the body or furthest from the point of its attachment.

**diurnal:** active in daytime, when light intensity is high (*cf.* crepuscular (*q.v.*), nocturnal (*q.v.*).

**Doppler effect:** variation in the pitch of a sound heard from a source of given frequency caused by any relative motion between the source and the observer.

**Doppler shift:** (in bats) in context of echolocation, the change in pitch (frequency) of an echo resulting from the movement of the bat towards or away from the object reflecting the echolocation call, or from the movement of an object towards or away from the bat, or a combination of both. Used by some species to detect insects whose wings are fluttering.

**dorsoventral (*adj.* dorsoventrally)**: from dorsal to ventral surface; from back to belly of an animal.

**Eastern Arc Mountains:** a chain of very old mountains running in a southwest direction from the Taita Hills in SE Kenya to the Udzungwa Mountains in SW Tanzania; they are similar geomorphologically and ecologically.

**erectile:** able to be erected, e.g. erectile hairs, erectile spines.

**exfoliating:** shedding flakes (e.g. of bark), or breaking into thin slabs (e.g. of granitic rock).

**extant:** living at the present time. *cf.* extinct.

**eye-ring:** a ring of pelage or skin around an eye in a colour contrasting with the pelage further away from the eye.

**F. R.**: Forest Reserve.

**FA:** in bats, the length of the forearm from the elbow to the distal end of the wrist when the wing is folded. See also forearm.

**fetlock:** in ungulates, the joint just above the pastern in the leg.

**first toe:** (in bats) the toe furthest from the mid-line (= outer toe); this is because the hindlimbs of bats are rotated so that the knees point backwards instead of forwards. In contrast, the first toe of all other five-toed mammals is the toe nearest the mid-line.

**flank:** the side of the body of a mammal.

**flehmen:** (in ungulates) the behaviour whereby an adult male sniffs the vulva and urine of a female to determine if she is in oestrus. The male's nose is

then pointed upwards and wrinkled and the lips are retracted which ensures that scent molecules reach the organs of Jacobsen (located in the soft tissue of the nasal septum) where they are analysed.

**fly-catching:** (in bats) the foraging behaviour of bats which hang from a perch while they are searching for flying insects, then fly from the perch to catch the prey in mid-air, and then return to the perch to eat and/or to resume searching.

**folivore (*adj.* folivorous):** an animal which eats leaves.

**forearm:** (in bats) the wing-bones between elbow and fingers, comprised of radius, ulna and carpals. See also FA.

**fossorial:** adapted for digging; burrowing. *cf.* subterranean (*q.v.*).

**frequency modulation:** (in bats) in context of echolocation, increasing or decreasing frequency (pitch) during the emission of a call so that the call-shape *(q.v.)* is not a straight, horizontal line.

**frugivore (*adj.* frugivorous)**: an animal which eats fruit.

**G. R.**: Game Reserve.

**gallery forest:** type of forest outlier (in a savanna region) found in narrow sheltered valleys and ravines on hillsides, where soils are moist enough, and conditions humid enough, to support rain-forest trees.

**gestation:** the development of embryo/foetus which takes place in the uterus; the period during which this development takes place. The gestation period is defined as the interval between conception and parturition (birth). Strictly speaking, the gestation period is not the interval between copulation (mating) and parturition (birth) although many authors take it to be this interval. The gestation period (*sensu stricto*) may be lengthed by reproductive delays such as delayed implantation *(q.v.)* and retarded embryonic development *(q.v.)*. The interval between copulation and parturition can be lengthed by delayed fertilization combined with sperm storage *(q.v.)* by the females.

**gleaning:** (in bats) the taking of resting or non-flying prey from surfaces including foliage, tree-trunks, walls and ground. Hover-gleaners glean while hovering or flying slowly. Foliage-gleaners specialize in taking prey from foliage and tree-trunks and are usually hover-gleaners. Ground-gleaners often land to catch prey but may also take it while flying slowly.

**GLS:** the greatest length of the skull as measured from its most posterior point to the most anterior part. For shrews, replaced by CI (*q.v.*) For bats in families Rhinolophidae and Hipposideridae, replaced by CrnC (*q.v.*).

**granivore (*adj.* granivorous):** an animal which eats grains and seeds

**gregarious:** living together in groups, flocks, herds.

**grizzled:** streaked with grey hairs.

**guard hairs:** long, thin, bristle-like hairs, mainly on the back and flanks, which project beyond the soft hairs of the pelage; when present, conspicuous but never as numerous as soft hairs; probably tactile in function.

**gular:** pertaining to the throat, as in gular gland, gular pouch, gular region.

**harem:** a social group comprised of one adult male and several adult females with which he mates. May also include their progeny.

**hastate:** shaped like an arrow-head or spear-head; having a wide base and relatively longer, concave sides that taper to a bluntly-pointed tip.

**HB:** length of head and body, from tip of snout to base of tail.

**HF:** (in bats) the length of the hindfoot measured from back of heel to tip of longest claw. See also c.u and s.u.

**hibernaculum (*pl.* hibernacula)**: a place, domicile or roost where an animal hibernates.

**hibernation:** a state of inactivity, usually lasting for weeks or months, accompanied by a reduction of the metabolic rate, lowering of body temperature and reduced rate of breathing. Occurs when the ambient temperature is low and food is scarce. *cf.* aestivation, *cf.* torpor.

**hind-border:** in bats, the posterior edge of the wing, a term used when the edge is white or pale, in contrast to rest of the wing membrane. May extend from wing-tip to ankle, or be limited to the arm-wing or hand-wing.

**hock:** the joint in the hindleg of an ungulate between the two longest parts of the leg.

**holotype:** the single specimen designated or indicated as "the type" by the author at the time of publication of the original description of a new species or subspecies. The holotype illustrates the definitive characters of that new species or subspecies. Also called type or type specimen.

**home range:** the area (expressed in square meters, or square kilometres) routinely used by an animal for its day-to-day activities and requirements, and which contains the resources required for survival and reproduction. Within the home range, there may be a "core area" which is utilised more frequently than other parts (e.g. 80% or 90% of known time-based observations).

**implantation:** the embedding of a blastula *(q.v.)* in the lining of the uterus.

**inguinal:** situated in the groin.

**inner:** nearest to mid-line of body, e.g. inner incisor, inner margin of ear.

**inselberg:** isolated rocky hill standing alone in a plain.

**interaural:** between the ears.

**interfemoral membrane:** (in bats) the flight membrane stretching from one hindleg to the other, sometimes enclosing or partly enclosing the tail, sometimes reduced to a very narrow flange around inside edge of legs. Also called uropatagium.

**interspecific:** between different species.

**intraspecific:** within one species; between members of the same species.

**ischial callosities:** (in Old World Primates) pads of tough, fatty, horny skin attached to the flattened parts of the ischium (one of the bones of the pelvis) and visible on the buttocks around the anus.

**IUCN:** International Union for the Conservation of Nature.

**keratin:** in vertebrates, the protein that makes up hair, nails, scales, horns, claws, hoofs and the outer layer of skin.

**lamina (*pl.* laminae)**: in the context of premolar and molar teeth, a transverse row of cusps which, when worn, form a transverse ridge of bone and dentine across the tooth. The number of laminae on a tooth is sometimes of diagnostic value.

**lancet:** (in bats) the erect, subtriangular, posterior component of the noseleaf of bats in the family Rhinolophidae; its shape is of diagnostic value.

**lateral hoofs:** (in artiodactyls) backward-projecting hoofs at the end of Digits 2 and 5 which are located higher than the weight-bearing hoofs and do not touch the ground during locomotion. Often reduced in size to small knobs or may be absent.

**laufschlag:** (in artiodactyls) the courtship behaviour in which the male touches the female's underside with a stiff foreleg.

**lek:** a traditional site where males gather for the sole purpose of attracting and courting females, and to which females come for the sole purpose of mating with the male of their choice.

**localized movements:** movements of an animal within part or all of its home-range within a single day or within a limited period of time. *cf.* migration (*q.v.*), *cf.* nomadic movements (*q.v.*).

**longitudinal:** lengthwise; running in a head to tail direction. *cf.* transverse (*q.v.*).

**lying up:** (in artiodactyls) the behaviour of the young of many species which are born in a precocial (*q.v.*) state and then hide themselves under cover for a period of days, weeks or months before following the mother and joining her herd or associates. While lying-up, the young are seldom visited by the mother and only for the purposes of suckling, bonding and removing urine and faeces.

**manoeuvrability:** (in bats) refers to the space required by an individual to alter its flight path while flying at a fixed speed; inversely proportional to minimum radius of turn which the bat can attain, and also to wing-loading *(q.v.)* (Norberg & Rayner 1987).

**maternity colony:** (in bats) a congregation of females which are giving birth and/or caring for their young, from which adult males are excluded (or exclude themselves). Also called nursery colony.

**mesic:** describes habitats which have a moderate or well-balanced supply of moisture. *cf.* xeric.

**metacarpals:** the long bones of the hand, situated between the carpal bones of the wrist and the proximal *(q.v.)* phalanges (*q.v.*) of the fingers; the most proximal of the long bones which comprise the fingers in the wings of bats. These are also the long bone(s) in the lower half of the front legs of ungulates (*q.v.*).

**metatarsals:** the long bones of the foot, situated between the tarsal bones of the ankle and the most proximal (*q.v.)* phalanges (*q.v.*) of the toes; very elongated in saltatorial *(q.v.)* species (e.g jerboas). Also, the long bone(s) in the lower half of the hind legs of ungulates (*q.v.*).

**migration:** movements of species which travel, predictably and more-or-less directly, from one habitat to another (and back again), along predetermined routes, in response to seasonal changes in climate, food supply or any other resource. *cf.* localised movements, *cf.* nomadic movements.

**milk teeth:** teeth (usually simple) occurring in newborn mammals, or appearing soon after birth, and preceding the permanent teeth of the adult animal. Also called deciduous teeth.

**miombo:** a vernacular name applied to trees in the genus *Brachystegia*; a type of savanna woodland in the Zambezian region where *Brachystegia* spp. are the commonest trees or one of the commonest trees.

**monogamy:** a mating system in which one male mates with one female and vice versa: having only one mate at a time.

**monophyletic:** describes a taxonomic group, descended from a common ancestor that was itself a member of that taxonomic group, and including *all* the descendants of that ancestor (Groves 2001).

**monophyly:** derivation of taxa from a common ancestor. *cf.* diphyly.

**mopane:** a vernacular name applied to the tree *Colophospermum mopane*; a type of savanna woodland in which *Colophospermum mopane* is the commonest species of tree.

**mutual grooming:** refers to two animals grooming each other simultaneously. *cf.* allogrooming (*q.v.*).

**muzzle:** the snout, nose and jaws of a mammal.

**myrmecophagy (*adj*. myrmecophagous):** feeding on ants and termites.

**n:** the size of a sample.

**n. d.** no data.

**N. P.**: National Park.

**natal:** pertaining to the place or time of an animal's birth.

**neonate:** a newly-born animal.

**nipple-clinging:** (in rodents) the behaviour of neonates and unweaned young which remain semi-permanently attached to the nipples of the mother (including while she is foraging) for a period of several days to several weeks. In some species, here is a gap between the two deciduous upper incisor teeth which assists in nipple-clinging.

**nipple-dragging:** (in rodents) the behaviour of a mother when she is dragging her neonates and unweaned young, firmly attached to her nipples, when she is active outside her nest. (*cf.* nipple-clinging).

**NL length:** (in bats) the length of the noseleaf.

**nocturnal:** active during the night, when light intensity is at its lowest; between sunset and sunrise. *cf*. crepuscular (*q.v.*), *cf*. diurnal (*q.v.*).

**nomadic movements:** irregular and unpredictable movements, from one locality to another, made by species living in unpredictable habitats. *cf*. localized movements (*q.v.*), *cf*. migration (*q.v.*).

***nomen dubium*:** when the available evidence is not sufficient to permit the identification of a species, its name is considered to be a *nomen dubium* and therefore not available for taxonomic purposes.

**noseleaf:** (in bats) fleshy outgrowth on the dorsal surface of the muzzle of bats in some families which modifies their echolocation calls.

**nuchal:** on the back of the neck.

**occlusal:** pertaining to the biting surface of a tooth.

**olfactory:** pertaining to the sense of smell.

**omnivore (*adj*. omnivorous):** an animal which eats a wide range of foods.

**opisthodont:** describes incisor teeth which are directed posteriorly (*cf.* pro-odont (*q.v.*), *cf*. orthodont (*q.v.*)

**opportunistic:** taking advantage of any resources, such as foods, which turn up more-or-less by chance.

**opposable:** of the thumb or first digit, capable of facing and touching the other digits on the same hand or foot, thereby enabling the hand or foot to grasp and/or hold something.

**orange-phase:** (in bats) in some species, the pelage of some individuals is orange or russet (orange phase) whereas in other individuals it is grey or greyish-brown (grey-phase). The reasons for this are not understood.

**orbit:** bony cavity (eye-socket) in which the eye is situated.

**orthodont:** describes incisor teeth which are directed more or less in a vertical plane (*cf.* pro-odont (*q.v.*), *cf.* opisthodont (*q.v.*)

**ovulation:** the release of female gametes (ova, eggs) from the ovary.

**owl pellets:** waste material, normally in an ovoid shape, regurgitated by owls, which contains undigested fragments of bone, hair, feathers and scales, etc. from the prey. For mammalogists, useful in determining indirectly the species of small mammals in a habitat.

**palatal ridges:** fleshy ridges crossing the roof of the mouth from side to side.

**palpably pregnant:** describes a pregnant female whose pregnancy has been detected only by feeling the foetus, not by dissection. It is not possible to detect the early stages of pregnancy by palpation.

**papilla (*pl.* papillae)**: a small projection or protuberance.

**parous:** having given birth.

**parturition:** the act of giving birth.

**pastern:** the sloping part of the leg of an ungulate (*q.v.*) between the fetlock (*q.v.*) and the hoof.

**pectoral:** pertaining to, or situated on, the chest.

**pedal glands:** glands situated in the feet opening between the hoofs

**pelage:** the hairy, woolly or furry covering of the body in mammals. The pelage variously consists of hairs, guard hairs and underfur according to the species.

**pencil:** (in rodents) hairs on terminal end of tail which form a small slight tuft; hairs usually rather short (5-10 mm); hairs may extend beyond the end of the bony tail. (e.g. *Gerbillus, Tatera, Taterillus, Grammomys*).

**perch-hunting:** (in bats) any foraging behaviour in which the bat hangs from a perch while searching for its prey and then returns to the perch to eat and/or to resume searching. Includes fly-catching *(q.v.)* and some types of gleaning *(q.v.)*.

**perianal glands:** (in carnivores) paired glands on either side of the anus.

**perineal:** pertaining to the area between the anus and the external genitalia.

**phalanx (*pl.* phalanges)**: one of the bones in a finger or toe; the bone(s) ending with a hoof in ungulates (*q.v.*).

**pheromone:** a chemical, produced by an animal, which changes the behaviour of a conspecific animal.

**phylogeny (*adj.* phylogenetic)**: the evolutionary history and line of descent of a species or higher taxonomic unit.

**pilosity:** the amount and/or quality of hair on an anatomical structure. In shrews, pilosity refers to the presence or absence of long hairs on the tail; expressed as a percentage of the length of tail which has long hairs. In bats, pilosity is described as 'naked' or 'hairy'.

**pinna (*pl.* pinnae)**: the external ear.

**plantar:** pertaining to the sole of the foot.

**polygamy:** a mating system in which both males and females mate with several individuals of the opposite sex. *cf.* monogamy (*q.v.*), cf. polygyny (*q.v.*).

**polygyny:** a mating system in which one male mates with several females.

**polymorphism (*adj.* polymorphic):** the existence, within a species or population, of individuals having different forms (including colours).

**polyphyletic:** describes a taxon (*q.v.*) derived from two or more ancestral sources; not of a single, immediate line of descent (Mayr *et al.* 1953).

**pop-hole:** a vertical shaft which allows animals to enter or leave a burrow after the original sloping entrance tunnel has been deliberately blocked up.

**post-partum:** immediately, or very soon after, giving birth.

**postauricular:** behind the ear.

**preorbital:** in front of (anterior) to the orbit (*q.v.*).

**precocial:** describes young in which fur covers the body, eyes and ears are open, and adult-like movements are possible immediately or very soon after birth. *cf.* altricial.

**prehensile:** able to grasp and/or wrap around something. A prehensile tail can support the weight of the animal. *cf.* semi-prehensile tail.

**premaxilla:** one of a pair of bones at the anterior end of the skull which bears the incisor teeth.

**premolars:** teeth located between the canine and the molar teeth, always preceded by milk teeth. The number of premolars on each side of each jaw varies in different species and are absent in some species.

**preorbital:** anterior to the orbit (*q.v.*); anterior to the eye.

**pro-odont:** describes incisor teeth which are directed anteriorly. *cf.* opisthodont (*q.v.*), *cf.* orthodont (*q.v.*).

**proximal:** nearest to the body or to the mid-line of the body; nearest to the point of attachment. *cf.* distal.

**pubic nipples:** (in bats) pair of nipples found in the pubic region of bats in the families Rhinolophidae, Hipposideridae and Megadermatidae which provide holdfasts for the young.

**punctated:** marked or divided into dots, spots or short dashes.

**radius:** one of the two bones of the lower forelimb (the forearm of bats) between the humerus (upper arm) and the wrist.

**relatively:** used here in the context of describing the size of one character relative to the size of a different character in the same species. Usually expressed as a percentage. e.g. Tail 80-90% of HB. *cf.* comparatively (q.v.).

**relict forest:** a forest that persists where local conditions are favourable after the disappearance of forest from the surrounding area as a result of climate change or human activity. Relict forests include those at the base of inselbergs (q.v.) which are watered by rainwater running off the inselberg, and forests growing in graveyards and sacred sites which are protected. Sometimes known as forest islands.

**retarded embryonic development:** a means of lengthening the interval between copulation and parturition so that both events can occur in the most optimal seasons. The implanted embryo enters a period of retarded (slowed) growth which may last 4-8 months, after which development proceeds normally.

**reticulation:** having a net-like pattern.

**rhinarium:** the naked, moist skin around the openings of the nostrils. In pigs, expanded into a partly cartilaginous mobile oval disc.

**ricochetal:** describes saltatorial (*q.v.*) locomotion with erratic changes of direction often exploited by small animals which need to dodge predators in open habitats.

**ridge:** in teeth, a ridge connecting two cusps. Also called a commissure.

**riverine forest:** forest growing along the banks of a river or stream where conditions are moister than in the surrounding area. Sometimes referred to as "fringing forest".

**roost-fidelity:** (in bats) returning to roost at the same place, day after day.

**rostrum:** the part of the skull in front of the orbits (*q.v.*) which contains the teeth, palate and nasal cavities.

**rumination:** (in artiodactyls) the process whereby animals swallow partly chewed vegetation (while they are grazing or browsing) and then regurgitate it later, as cud, for further chewing and mixing with saliva. These mammals are called ruminants.

**rupiculous:** rock-living.

**rut:** (in artiodactyls) an annual period of sexual activity.

**s.u.:** (*Lat. sine unguis* = without claw). Sometimes added as a suffix to the hindfoot measurement

(HF) to emphasise that the foot has been measured without the claw. However, since this is the standard method of measurement, most authors write "HF", not "HF (s.u.)". *cf.* c.u. (*q.v.*)

**saltatorial:** adapted for leaping and/or locomotion by leaping (often using the hindlimbs only.

**scansorial:** describes animals which climb or scramble over logs and in vegetation close to the ground.

**scrotum:** an external sac containing the testes and epididymides in male mammals.

**scuttling:** (in bats), rapid cursorial, quadrupedal locomotion over the ground (or similar surfaces) in which the limbs move quickly.

**sella:** (in bats) the transverse structure arising immediately above the horseshoe component of the noseleaf of bats in the family Rhinolophidae and sometimes overhanging the top of the horseshoe. The shape of the front face of the sella viewed from the front, and the pilosity of the front face of the sella, are diagnostic characters.

**semi-prehensile tail:** able to wrap around something but not able to support the weight of the animal. *cf.* prehensile.

***sensu lato*:** (*Lat.*) in a broad sense.

***sensu stricto*:** (*Lat.*) in a restricted sense.

**septum:** a dividing wall separating two cavities.

**sexual dimorphism:** observable (phenotypic) difference(s) (e.g. in colour, size or form) between the males and females of a species or higher taxon.

**side-stripe:** longitudinal stripe(s) of contrasting colour on each flank, usually from shoulder to rump or to upper part of hindlimbs. Maybe bordered by additional side-stripe above and below. Number of side-stripes varies from one (as in some squirrels) to about eight (as in some species of *Lemniscomys*). Most side-stripes are continuous, but in some species of *Lemniscomys*, some side-stripes are broken into spots and streaks.

**solitary:** describes an animal which lives alone except when it mates or, in the case of a female, when she is rearing her young. Describes a social organization in which the animals live alone except when mating and when females are rearing young.

**Southern Africa:** South of the Cunene and Zambezi rivers (Namibia, Botswana, Zimbabwe, southern Mozambique and South Africa (Smithers 1983).

**sperm storage:** storage of sperm in the cauda epididymides *(q.v.)* of males for some time before copulation, or in the reproductive tract of females for an extended period before ovulation takes place. A type of reproductive delay which, in females, lengthens the length of gestation *(q.v.)*

**spermatogenesis:** the formation of sperm in the testes.

**spoon-hairs:** (in bats) short, spoon-shaped, bristle-like hairs with tips flattened and slightly curved; e.g. on lips and feet of some bats in the family Molossidae.

**stotting:** (in artiodactyls) leaping high into the air with the legs held stiffly.

**sub, sub-:** prefix meaning under, signifying beneath or ventral to (as in anatomical features) or south of (as in sub-Saharan); or less than (as in subsonic); or not quite, nearly, almost, somewhat (as in subequal, subtriangular). In taxonomy, indicates a group just below the status of the taxon following it (e.g. a genus may contain two or more subgenera).

**subspecies:** a biogeographically localised and isolated subdivision of a species, which differs genetically, morphologically and taxonomically from other subdivisions of the species.

**subterminal:** just below the terminal end (or tip) of something such as a hair.

**subterranean:** living permanently below the ground. *cf.* fossorial (*q.v.*)

**suckling:** the act of a mother giving her young milk directly from her breast (mammary glands). Mothers suckle; their young suck.

**sympatric:** having over-lapping biogeographic ranges; describes populations of two or more species whose biogeographic ranges are partly or wholly overlapping. *cf.* allopatric (*q.v.*)

**synonym:** one of two or more different names for the same taxon.

**systematics:** the science of arranging organisms in a way which reflects their evolutionary relationships; such relationships may be expressed as a phylogeny (*q.v.*). Often defined (incorrectly) as a synonym of taxonomy (*q.v.*).

**T:** length of tail, measured from anterior of the first tail vertebra to the posterior end of the last tail vertebra (excluding any tuft, bristles, pencil etc. at tip of tail).

**tapetum lucidum:** light-reflecting layer in the retina of the eyes of some vertebrates.

**taxon (*pl.* taxa)**: any defined unit (e.g. order, family, genus, species, subspecies) in the classification of organisms.

**taxon (*pl.* taxa):** any defined unit (e.g. order, family, genus, species, subspecies) in the classification of organisms.

**taxonomy:** the science of biological nomenclature; the study of the rules, principles and practice of classifying and naming species and other taxa.

**terminal:** the end of any structure which is furthest away from the mid-line of the body or furthest from the point of its attachment.

**termitarium (*pl.* termitaria)**: a place where termites live. Often a large mound of modified hard soil.

**terrestrial:** living on land. *cf.* arboreal (q.v.), aquatic, subterranean (q.v.).

**territorial:** describes animals which hold territories (*q.v.*), and behaviour associated with the establishment and defence of a territory.

**territory:** an area defended by an individual against certain other members of the species, usually by overt aggression or advertisement; territory is marked by the urine, faeces or glandular secretions of the territory's owner.

**thermoregulation:** regulation of body temperature, either by metabolic or behavioural means (or both simultaneously) so that body temperature is kept more-or-less constant.

**Tib:** (in bats) the length of the hindleg from the knee to the distal end of ankle, usually measured from top of knee to base of ankle when both knee and ankle are flexed (bent).

**tibia (*pl.* tibiae)**: one of the two bones forming the lower leg (the shin bone); part of hindlimb between knee and ankle.

**TL:** total length from tip of snout to posterior end of tail (*cf.* HB, T). Equivalent to the head and body length and tail length added together.

**toothrow:** the row of teeth from canine to most posterior molar; the line passing through the middle of the majority of these teeth (in occlusal view [*q.v.*]) indicating their alignment (used as reference line to determine if a tooth has become displaced to one side).

**torpor:** (*adj*: **torpid**) a state in which there is reduction of metabolic rate and a lowering of body temperature when ambient temperature declines; arousal from torpor occurs when ambient temperature increases and without high energy costs to the individual. Torpor lasts for only short periods of time (hours or days). *cf.* hibernation

**Tr:** in bats, length of tragus, usually from tip to junction of posterior margin with the ear. Different methods and effects of preservation contribute to the wide ranges given for some species.

**tragus:** a cartilaginous structure, usually small, projecting from the inner side of the external ear just anterior to the auditory meatus. In bats, its shape and relative size is often of diagnostic importance.

**transverse:** in a direction across the body from side to side. *cf.* longitudinal.

**trap-shy:** describes animals that are reluctant to enter live-traps.

**tricuspid:** having three points or cusps (particularly of teeth).

**type description:** the original, published description of a species or any other taxon *(q.v.)*.

**type locality:** the locality from which a holotype *(q.v.)*, was collected.

**type specimen:** see holotype *(q.v.)*

**underfur:** a layer of dense, sometimes woolly, pelage situated close to the skin and below the soft hairs and guard hairs of the visible pelage. Usually found in mammals exposed to low ambient temperatures.

**ungulate:** a mammal with hoofs.

**unicuspid:** having one cusp or point (particularly of teeth).

**vagrant:** an individual which has been found well outside the normal biogeographic range of its species, e.g. a bat or bird which has been windborne, or an animal which has been transported as a stowaway on a ship, to a distant locality.

**vascularized:** infiltrated with capillaries.

**veld:** Africaans word, used mainly by Southern African biologists, to refer to grassland vegetation.

**vestigial:** small and imperfectly developed; a structure having a smaller and more simple form than the corresponding structure in an ancestral species.

**vibrissae (*pl.* vibrissae)**: long stiff hairs on the face, especially around nostrils and lips; often associated with the perception of tactile sensation; “whiskers”.

**vlei:** Southern African term for a marsh or swamp.

**volant:** able to fly.

**wing-loading:** (in bats) the mass of the bat divided by its wing-area.

**WT:** weight (mass) of an individual.

**xeric:** describes habitats which are low in moisture such as deserts, semi-deserts and arid areas. *cf.* mesic.

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# INDEX TO THE SCIENTIFIC NAMES OF GENERA AND SPECIES

# INDEX TO THE VERNACULAR NAMES OF SPECIES

David Happold, born in England, studied at Cambridge University and University of Alberta (Canada). He then taught biology at University of Khartoum (Sudan) and studied small mammals in nearby desert habitats. Three years later, he moved to University of Ibadan (Nigeria) and spent 11 years studying the ecology, reproduction and demography of small mammals in rainforest and savanna habitats. He wrote *The Mammals of Nigeria, Ecology of African Mammals* (with M. J. Delany), other books and many papers.

Meredith, born in Australia, went to Monash University (Victoria) and wrote her Ph.D. thesis on the social behaviour of closely related native rodents from diverse habitats.

David and Meredith married in 1971 and subsequently carried out much research together. In 1977, they moved from Nigeria to Canberra where David lectured in Zoology at the Australian National University and Meredith became a Visiting Fellow. In 1984-85, they spent a year in Malawi studying rodents and shrews in montane and savanna habitats, and began several projects on bats. They returned in 1993-94, this time working mostly on bats. They travelled widely and observed other mammals whenever possible. Altogether, they published 22 papers on Malawian mammals. Subsequently, they wrote many profiles for the definitive series *Mammals of Africa:* David edited Volume III (rodents and hares) and Meredith and David edited Volume IV (shrews and bats). They have also written two semi-autobiographical books, *Africa from East to West* by David, and *Journey Among Animals* by Meredith.

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May 1994

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