




The terrestrial mammals of Mozambique: Integrating dispersed biodiversity data



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Background: The most comprehensive synopsis of the mammal fauna of Mozambique was published in 1976, listing 190 species of terrestrial mammals. Up-to-date knowledge of the country's biodiversity is crucial to establish the baseline information needed for conservation and management actions.

Objectives: The aim of this article was to present a list of terrestrial mammal species reported from Mozambique, based on primary occurrence data.

Method: We integrated existing knowledge, from dispersed sources of biodiversity data: the Global Biodiversity Information Facility portal, natural history collections, survey reports and literature. Data were updated and manually curated. However, none of the specimens upon which occurrences are based was directly observed. To partly overcome this impediment, we developed a species selection process for specimen data. This process produced the country's species checklist and an additional list of species with questionable occurrence in the country.

Results: From the digital and non-digital sources, we compiled more than 17 000 records. The data integrated resulted in a total of 217 mammal species (representing 14 orders, 39 families and 133 genera) with supported occurrence in Mozambique and 23 species with questionable reported occurrence in the country.

Conclusion: The diversity of species accounted for is considerable as more than 70% of species present in the southern African subregion are found in Mozambique. We consider that the current number of mammal species in Mozambique is still underestimated. The methodological approach for species selection for specimen data can be adapted to update species checklists of crucial importance to countries facing similar lack of knowledge regarding their biodiversity.

Introduction

Despite being one of the most studied groups, comprehensive knowledge on mammals' occurrence and their conservation status is still lacking. This is especially true in scientifically overlooked countries such as Mozambique (Amano & Sutherland 2013; Amori et al. 2012). Mozambique holds a rich although poorly known biodiversity (e.g. Dalquest 1965; Monadjem et al. 2010). Information on mammal occurrence and their conservation status in the country is particularly scarce and the only comprehensive 'atlas' regarding the mammal fauna of the country was published 42 years ago by Smithers and Tello (1976). The authors state that their work includes 'a limited amount of data' and the information regarding the species occurring in the northern provinces is incomplete. The lack of knowledge on Mozambique's biodiversity is partially explained by the country's political instability over the last decades. The War of Independence (1964–1974), and especially the civil war (1978–1992) seriously affected wildlife, even inside protected areas (Hatton, Couto & Oglethorpe 2001), hindering biodiversity studies in the country and blocking the documentation of Mozambican fauna. The repercussions for large mammals have been disastrous and include the local extinction of buffalo, hippopotamus and several antelope populations (Hatton et al. 2001). With the advent of peace, new efforts are being made by local authorities to conserve the country's biodiversity, resulting in new policy guidelines, the reopening of protected areas and the implementation of new monitoring actions (e.g. Agreco 2008). However, the lack of updated data on the diversity and distribution of Mozambican fauna still impedes the development of certain conservation actions and policies, as these strongly rely on reliable data to be effectively implemented. This problem is particularly difficult to overcome, as most of the available data on Mozambique's biodiversity dates to the colonial era (which ended in 1975), and it is scattered in foreign museums and institutions. Consequently, access to the data (especially old bibliography and specimens collected in the late 19th to early 20th century) is challenging, both for researchers and for local authorities.

Presently, and as a result of an international movement to make biodiversity data available, a series of online open-access biodiversity databases (e.g. Global Biodiversity Information Facility [GBIF]) provide wide and immediate access to species data from sources such as natural history collections (NHCs), field observations and monitoring reports. These data sets, which in most cases include both historical and recent species occurrences, allow integration and can be used for a myriad of purposes such as conservation strategies, biodiversity surveys and taxonomic studies (e.g. Beaman & Cellinese 2012; Jiménez-Valverde et al. 2010; Soberón & Peterson 2004). In this paper, we exploit this enhanced availability of biodiversity data and, through a simple approach to integrating existing knowledge from different sources of biodiversity occurrence data (NHCs, surveys and literature), we present a list of terrestrial mammal species reported from Mozambique. By making this compilation, we aim at contributing to a more profound knowledge of Mozambique's fauna, which we hope will promote further research to clarify the occurrence and distribution of the country's biodiversity.

Brief history of mammal studies in Mozambique

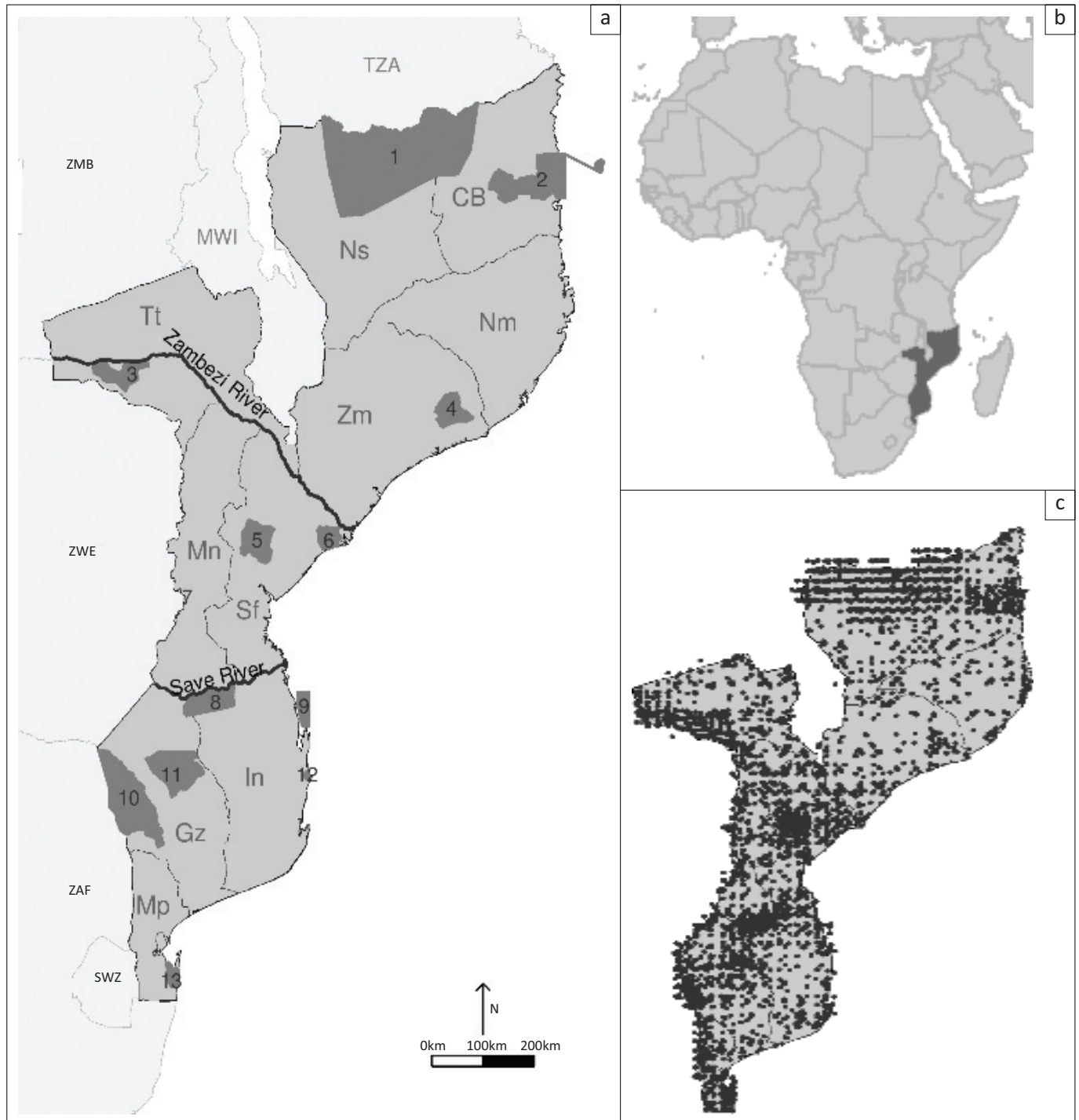
During the 19th century and beginning of the 20th century, scientific expeditions to Mozambique gathered important mammal collections presently held by European and North American museums. Because of their crucial contribution to the survey of Mozambique's biodiversity, some of these expeditions are worthy of mention. Wilhelm Peters visited the country in the mid-19th century (1842–1848) and, as a result of his work, several species new to science were described, along with the first records of species for the country (Peters 1852). Most of the specimens collected during W. Peters's expedition are currently held at the Museum für Naturkunde, previously called Berlin Zoological Museum (ZMB) Germany. Later, in the beginning of the 20th century, for the Rudd Exploration of South Africa expedition, C. Grant collected 129 specimens of 29 mammal species from Central and South Mozambique (Thomas & Wroughton 1908). Arthur Loveridge in his fifth expedition to East Africa (1948–1949) revisited the collection locality by W. Peters, Tete (Central Mozambique), and collected 11 mammal species. Portuguese zoological expeditions (*Missão Zoológica de Moçambique*) in 1948 and 1955, coordinated by Fernando Frade, resulted in Mozambique's most significant vertebrate collection currently held by a Portuguese institution, the Instituto de Investigação Científica Tropical, University of Lisbon (IICT-UL). The published catalogue of this collection indicates a total of 250 specimens representing 57 species and subspecies (Frade & Silva 1981). In 1965, an expedition sponsored by Jerry Vinson to the Zinave hunting camp, near the Save River (Central Mozambique), resulted in the collection of 54 species of mammals and the description of two bat species new to science (Dalquest 1965). Later, in 1968, a second expedition promoted by the same sponsor to Panzila (Central Mozambique) resulted in the collection of 47 mammal species (Dalquest 1968). Around the same time (1961–1972),

the Smithsonian Institution supported a project specifically targeted at surveying southern African mammals, the African Mammal Project (AMP; Schmidt, Ludwig & Carleton 2008). Coordinated by H.W. Setzer, this project included an eight-month field survey covering most of Central and South Mozambique. This expedition resulted in a valuable collection of over 3500 specimens, mainly comprising small mammals and most of which are housed at the National Museum of Natural History (USNM), Washington, DC. In 1968, R. van Gelder conducted an expedition that resulted in c.a. 200 specimens (Van Gelder 1969), which are currently held by the American Museum of Natural History, New York. In 1976, R. Smithers and J.L. Tello published the *Check List and Atlas of the Mammals of Moçambique*. The authors compiled information from some of the expeditions here enumerated along with more than 100 literature references.

With the advent of peace in the country in 1992 and the commitment to the United Nations Convention for Biological Diversity (CBD), the government began promoting field surveys, mainly in protected areas (e.g. Dunham 2004; Mesochina, Langa & Chardonnet 2008). Expeditions to the montane areas in North Mozambique, under the Darwin Initiative grant, registered the presence of mammal species and opportunistically collected small mammals (e.g. Bayliss et al. 2010; Timberlake et al. 2007). The Royal Museum for Central Africa, Belgium, supported the African Rodentia project (Terry et al. 2007), which includes a collection of rodents from Mozambique. The Chicago Field Museum of Natural History (FMNH) also holds a collection of mammals from Mozambique. Also noteworthy is a study of bat species that resulted in a few new species for the country's fauna (Monadjem et al. 2010). Mozambique's universities and research centres have also been participating in biodiversity surveys and studies (e.g. Gomes 2013; Schneider 2004).

Study area

Mozambique, located on the Indian ocean coast of southeast Africa, holds an extensive coastal territory of more than 800 000 square kilometres (Figure 1b). A large part of the country's topography is characterised by flat terrain, extending from coastal plains in the east to mountain ranges in the west. The climate is generally tropical and dry, but temperature and precipitation are highly variable throughout the country (McSweeney, New & Lizcano 2010). Accounting for these regional differences, biodiversity studies (as in Monadjem et al. 2010) tend to classify the country in three major biogeographic regions (Figure 1a): (1) North Mozambique, north of the Zambezi river, characterised by evergreen forests or deciduous woodlands, (2) Central Mozambique, between the Save and Zambezi Rivers, which has vegetation that varies from evergreen forest and moist deciduous forest, scrub and grasslands to a semi-arid woodland and savannah and (3) South Mozambique, south of the Save River, which is mostly flat terrain characterised by deciduous woodlands ranging from moist to semi-arid woodlands and savannah.



Notes: The country's protected areas are indicated with a number: (1) Niassa National Reserve, (2) Quirimbas National Park, (3) Mágoè National Park, (4) Gilé Reserve, (5) Gorongosa National Park, (6) Marrromeu Reserve, (7) Chimanimani National Reserve, (8) Banhine National Park, (9) Bazaruto National Park, (10) Limpopo National Park, (11) Zinave National Park, (12) Pomene National Reserve and (13) Maputo Special Reserve.

Mozambique's provinces are identified with a two-letter code: Niassa (Ns), Cabo Delgado (CB), Nampula (Nm), Zambezia (Zm), Tete (Tt), Manica (Mn), Sofala (Sf), Inhambane (In), Gaza (Gz), Maputo (Mp). Mozambique is surrounded by six neighbouring countries, indicated in the figure by a three-letter code: Tanzania (TZA), Malawi (MWI), Zambia (ZMB), Zimbabwe (ZWE), South Africa (ZAF) and Swaziland (SWZ). km, kilometres.

FIGURE 1: (a) Map of Mozambique, with protected areas in dark grey and two rivers shown as dark lines that divide the country into three major biogeographical areas: North Mozambique, Central Mozambique and South Mozambique, (b) Inset with the location of Mozambique in the African continent, (c) Spatial representation of 8149 unique localities of occurrence of the primary species-occurrence data used to produce the species checklist of terrestrial mammal species reported from Mozambique.

Since the commitment to the CBD, ratified in 1994 (Resolution 2/94 of 24 August 1994), the total protected area for biodiversity in Mozambique has increased from 15% to 26% of the territory (Ministry for the Coordination of Environmental Affairs [MICOA] 2014). Some of the already-existent protected areas were extended (e.g. Niassa National

Reserve), but new areas such as Mágoè National Park (NP), the only protected area in Tete Province, were also created. In total, 13 NPs and national reserves (NRs) were recognised (Figure 1a), plus several forest and community reserves and official hunting areas. Furthermore, three transfrontier protected areas, the Great Limpopo Park, the Lubombo

Conservation Area, and the Chimanimani Conservation Area, were established with conservation areas in Zimbabwe, South Africa and Swaziland (Peace Parks Foundation 2016).

Research method and materials

Species data

Information on species occurrence was obtained by compiling data from the following sources (see Appendix 1): (1) the GBIF portal (GBIF 2009, 2018), (2) NHCs – museums were contacted via e-mail or data was directly downloaded from the institutions' online databases, (3) recent survey reports of the main protected areas and other places of ecological interest available online and (4) literature – including the species checklist of Smithers and Tello (1976).

The search of primary data, from online data sources, was performed using combinations of the following keywords: 'Mozambique', 'mammal', 'biodiversity', 'specimen', 'species', 'occurrence' and their translations into Portuguese, the official language of Mozambique.

Data cleaning and organisation

Data from the GBIF and natural history museums were provided in a computer-readable table format. Data from analogue sources, such as books, scientific articles and reports, were digitised to a table. When provided graphically on maps or grids the data was georeferenced and localities of occurrence were digitised to shapefiles using the geographic information system software Quantum GIS 1.7.4. 'Wrocław' (QGIS Development Team 2012). All data were organised and stored following the Darwin Core's protocols for standardisation of biological diversity documentation regarding taxonomic, geographic and temporal information (Wieczorek et al. 2012).

Firstly, retrieved records that fulfilled the following requisites were discarded: (1) did not contain taxonomic identification at species level, (2) represented introduced or commensal species, (3) had incomplete or no information regarding location of collection event, (4) were not collected in Mozambique or (5) were duplicates.

Secondly, to improve data quality, taxonomic and geographic information associated with each record was cleaned and standardised manually (Chapman 2005). Nomenclatural and taxonomic classification of species was standardised following Wilson and Reeder (2005), and variants in the scientific name of a species, either synonyms or orthographic errors, were referred to a valid scientific name. The names were then compared against the Integrated Taxonomic Information System database (ITIS 2017) to ensure that the most current name was being used.

Thirdly, the locality of occurrence and other geographic information were updated or complemented by using the database on the GeoNames portal (2012) and georeferenced

in the statistical software R (R Core Team 2016) using the distribution modelling package's geocode function, which sends requests to the Google API for geographical coordinates and corresponding uncertainty (Hijmans et al. 2016). Afterward, the coordinates of all localities of occurrence were manually curated. These were considered identical when latitude and longitude information (with two-digit precision) coincided. Records collected after the year 2000 were classified as recent.

Species selection process

The list of species obtained in our study is a result of the species-occurrence data gathered from the GBIF, NHC, survey reports and literature; none of the specimens upon which occurrences are based was directly examined. To partly overcome this impediment, we developed a species selection process for specimen data from GBIF records and museums. This refinement process was an attempt to distinguish between species definitely found and species with questionable occurrence in the country.

The aim of the species selection process was, as in other studies (e.g. Amori et al. 2016), to categorise the species detected in more than one data source as species with well-supported occurrence. Here, in addition to the number of collectors, we also accounted for the number of records collected and presence in Smithers and Tello (1976) (Figure 2 shows the decision framework). At the end of the selection process, two species lists were produced: a species checklist and a questionable occurrence list. A species-occurrence record was considered well supported and was entered into the species checklist when (1) the species was independently recorded by different collectors or (2) the species was recorded by a single collector, but was listed in Smithers and Tello (1976). The additional list that resulted from the selection process contains species with questionable occurrence in the country. The criteria upon which a species was included in this list were (1) the species was not listed in Smithers and Tello (1976) and its presence was only supported by a single record, (2) the species was not listed in Smithers and Tello (1976) and multiple records exist, but were all cited by a single author or (3) the species was listed with a single record in Smithers and Tello (1976).

For each taxon, we compiled the information on species authority, species global conservation status by the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (IUCN 2017), number of records collected, biogeographical areas of occurrence and information on last reference or record (see Appendix 2 for the species checklist and Appendix 3 for the questionable occurrence species list). Species accounts with detailed information regarding literature and museum references, recorded synonyms and the reported distribution in Mozambique are compiled in Online Appendix 1. Orders, families and species names are presented in alphabetical order.

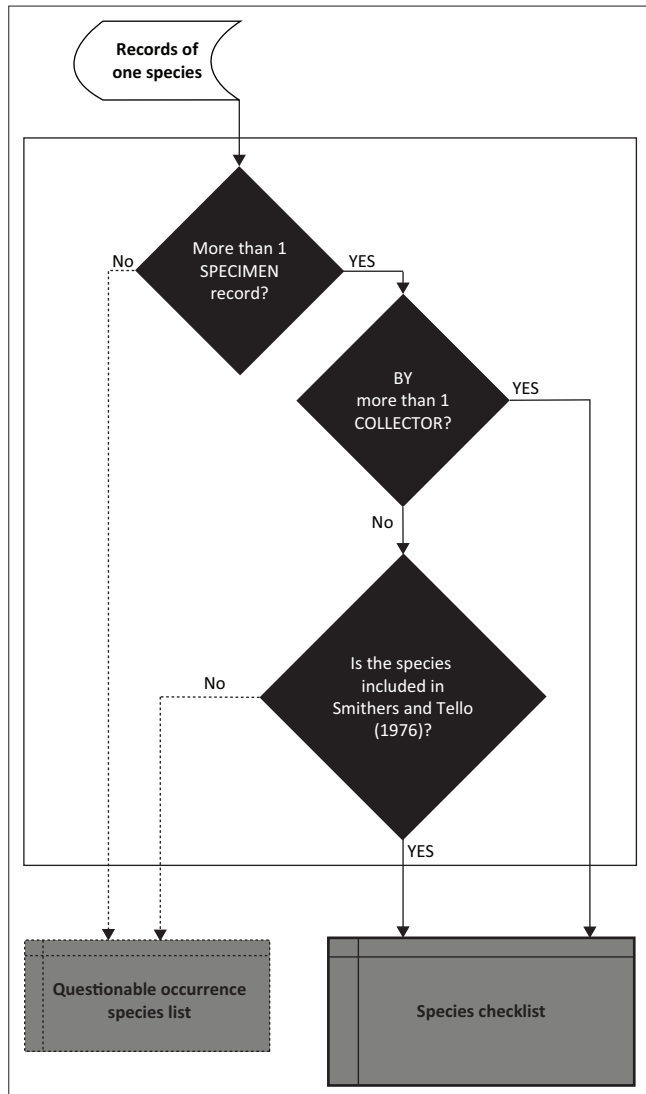


FIGURE 2: Species selection process framework – decision tree followed to establish whether the report of a species occurrence in the country was well supported.

Taxonomic completeness

To assess the degree of taxonomic completeness of the species checklist we used species accumulation curves (SAC; Moreno & Halffter 2000). We computed SAC for the complete set of mammal records from the species checklist and for each mammal order with more than two species listed.

Species-occurrence records were aggregated to a $\frac{1}{4}^{\circ}$ spatial resolution grid, and the total number of grid cells across the country was 1217. Using the grid cells as a surrogate measure of sampling effort, we calculated the cumulative number of species with the increase in the number of records for each of the country's cells (Lobo 2008). Species accumulation curves are expected to reach an asymptote when the probability of adding a new species to the list approaches zero. To smooth the curve of species richness the number of species accumulated was obtained by adding cells in a random order with 100 permutations (Lobo 2008). Species accumulation curves were computed with the function *specaccum* in the R package: *vegan* (Oksanen 2013).

To calculate the overall taxonomic completeness, we extrapolated the total species richness for the country, applying the non-parametric species richness estimator, first-order jackknife (Colwell, Xuan Mao & Chang 2004). The results were then compared to the total number of species in the species checklist. This non-parametric first-order jackknife was selected because it is less affected than other estimators by incidence-based data (Hortal, Borges & Gaspar 2006). The extrapolated species richness was calculated with the *specpool* function (R package: *vegan*).

Results

Data summary

The integration of species-occurrence data from the different data sources resulted in 17 014 records compiled, and of these approximately 12% were discarded. In total, 15 011 records of native terrestrial mammals, representing 8149 localities of occurrence reported from Mozambique, were used to produce the present species checklist.

From GBIF, the yielded data was provided by 35 institutions in a total of 4265 suitable records (Appendix 1). Eight national history museums contributed with 745 records, non-redundant with the retrieved GBIF data. Eleven national survey reports, representing the recent wildlife surveys, were selected: one at country level, two from NRs (Matthews & Nemané 2006; Mesochina et al. 2008) and eight from NPs (Appendix 1). In total, these reports contributed 5012 suitable records. Four additional reports from expeditions to montane areas in North Mozambique were included, from Mount Chipirone, Mount Mabú and Mount Namuli (Zambezia Province) and Mount Inago (Nampula Province), generating 84 suitable records (Appendix 1). Data digitised from Smithers and Tello's (1976) checklist represent 4577 records. A total of 17 research articles (Appendix 1) contributed a further 328 suitable records.

The geographical distribution of the localities of occurrence and the temporal coverage of data were analysed for patterns. Localities of occurrence are mainly distributed across Central Mozambique and South Mozambique, inside and near protected areas (Figure 1c). Localities of occurrence in North Mozambique are also mostly located inside and near protected areas and areas of scientific interest, such as the inselbergs and hills in the eastern Afromontane north of the Zambezi River. North Mozambique was identified as a main gap in the knowledge of Mozambique biodiversity back in 1976 (Smithers & Tello 1976). At that time, North Mozambique was an inaccessible region. During the 19th and 20th centuries species collection took place mostly in the southern areas and those around the Zambezi River. In recent years, however, growing political stability along with an increase in accessibility to North Mozambique has enabled more surveys and expedition events. Moreover, these new surveys to North Mozambique have revealed many new species and records for the country, for various taxonomic groups (e.g. Conradie et al. 2016; Monadjem et al. 2010; Portik et al. 2013; Van Noort et al. 2007).

Regarding the temporal coverage of the data, the earliest records compiled are from 1842 to 1848 and were collected during Wilhelm Peters's expedition. The latest records refer to a recent publication by Taylor et al. (2018; Figure 3). Records retrieved through GBIF were collected between 1892 and 2015. The period of the records from the other NHC is 1845–1991. The scientific literature included, besides Smithers and Tello's species checklist (1976), ranges from 1985 to 2018. Moreover, the national survey reports and reports from expeditions to montane areas in North Mozambique were all published after the year 2000, between 2004 and 2010. When we group the records in decades, the collecting effort is not regularly distributed over the years (Figure 3). Starting in 1840, there are peaks of collecting effort located in the 1960s, 1970s and 2000s; during these peaks species from all mammal orders were reported. On the other hand, for the periods 1860–1890 and 1990–2000 very few records of mammal occurrence were available, and very few species were reported.

The species lists

Following our compilation and species selection criteria, a total of 217 reported mammal species, representing 14 orders, 39 families and 133 genera, were found to have supported occurrence in Mozambique (Table 1; Appendix 2). The diversity of species is considerable as all families accounted for in the southern African subregion (Skinner & Chimimba 2005) are found in Mozambique, as well as above 87% of genera and approximately 71% of species (Table 1). Thirteen of the reported species are threatened by extinction (IUCN 2017; Table 2).

The species checklist comprises 14 981 records, representing 8141 localities of occurrence. Nearly a third of the species have fewer than 10 records; and approximately a quarter of the species did not have recent records (Table 2).

When compared with Smithers and Tello (1976), our work resulted in the addition of 37 species. These species belong to the following orders: Carnivora (2 species), Chiroptera (19 species), Eulipotyphla (2 species), Lagomorpha (1 species), Primata (2 species) and Rodentia (12 species; Table 1). For 17 species included in our species checklist, the only evidence of occurrence in Mozambique is Smithers and Tello (1976). They are Artiodactyla (1 species), Carnivora (6 species), Chiroptera (3 species), Eulipotyphla (1 species), Lagomorpha (1 species), Macroscelidea (1 species) and Rodentia (4 species). Also, in our work, from the species list by Smithers and Tello (1976), we excluded one extinct species and one exotic species, and further nine species in Smithers and Tello (1976) were only included in our questionable occurrence species list.

We additionally identified 73 taxonomic changes defined as changes in the scientific names and 43 distributional changes from Smithers and Tello (1976). We considered a distributional change when we gathered for a species a location of occurrence in a biogeographical region not reported in Smithers and Tello (1976). Most of the distributional changes (25 species) reflect new species records reported from

North Mozambique. In addition, since the publication of Smithers and Tello (1976), 11 species had their occurrence extended to Central Mozambique, and 7 species had their occurrence extended to South Mozambique.

We further present a list of reported species with questionable occurrence in the country, composed of 23 species from six orders: Artiodactyla (3 species), Chiroptera (8 species), Eulipotyphla (4 species), Macroscelidea (1 species), Pholidota (1 species) and Rodentia (6 species) (Appendix 3).

Taxonomic completeness

The total species richness extrapolated for Mozambique resulted in approximately 232 species. Hence, our species checklist, given the total of 217 species, is approximately 93.5% taxonomically complete (Table 2).

According to the extrapolated richness of each mammal order considered, the species checklist is incomplete for Chiroptera, with a taxonomic completeness of 84.5%, and close to completion for Eulipotyphla and Rodentia, with 90.0% and 98.1%, respectively (Table 2). For the other mammal orders, the extrapolated richness was equal to the number of species in the species checklist. For Artiodactyla and Carnivora, the SAC support this result by presenting a close asymptote shape, which indicates that these are well-represented groups (Appendix 4, Figure 1-A4).

Mammal orders accounts

Below we present a systematic account for each mammal order represented in our data set, with detailed and specific comments.

Afrosoricida (golden moles and tenrecs)

This order is represented by two species of golden moles (family Chrysochloridae), *Calcochloris obtusirostris* (Peters, 1851) and *Carpitalpa arendsi* (Lundholm, 1955). Data for both species are scarce (Appendix 2). The first records of *C. obtusirostris* resulted from the W. Peters expedition (Peters 1852) and represent the species type-locality 'Coastal Mozambique, Inhambane, 24°S', South Mozambique. This species is listed in Smithers and Tello (1976) and was last collected in 1989 (Downs & Wirminghaus 1997). The presence of the other golden mole, *C. arendsi*, a vulnerable species (IUCN 2017), is based on six records: five records compiled by Smithers and Tello (1976) and a single specimen collected in Central Mozambique during the Smithsonian expedition (USNM 365001).

Artiodactyla (even-toed ungulates)

Four families, comprising 25 species from 20 genera, occur in Mozambique: Bovidae (21 species), Giraffidae (1 species), Hippopotamidae (1 species) and Suidae (2 species). All of the species were previously reported from Mozambique by Smithers and Tello (1976). Except for the endangered *Redunca fulvorufula* (Afzelius, 1815), most species have been recently

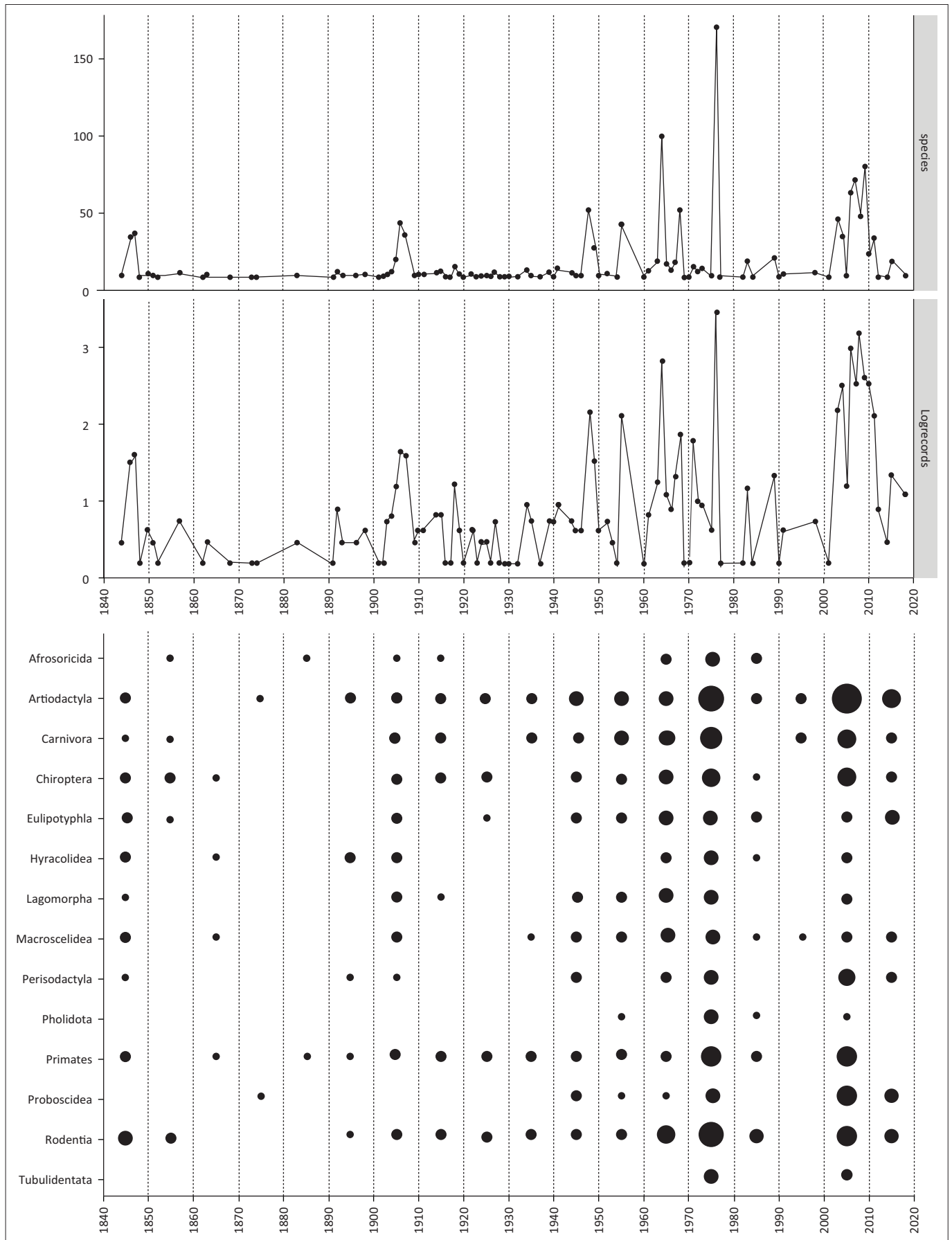


FIGURE 3: Description of the primary species-occurrence records of terrestrial mammal species from Mozambique per 10-year period from 1840 until April 2018 based on the number of species (top), the log₁₀-transformed number of records ('Logrecords'; middle), and mammal orders collected (bottom). Size of points in the bottom graph reflects the number of records per mammal order, per decade.

TABLE 1: Comparison of the number of terrestrial mammals from Mozambique in the present study with the last checklist published for Mozambique (Smithers & Tello 1976) and mammal diversity in the southern African subregion, according to Skinner and Chimimba (2005), per mammal order.

Order	Mozambique			Smithers and Tello (1976)			Southern Africa subregion		
	Families	Genera	Species	Families	Genera	Species	Families	Genera	Species
Afrosoricidae	1	2	2	1	2	2	1	8	18
Artiodactyla	4	20	25	4	20	26	4	24	37
Carnivora†	7	28	33	6	25	31	7	32	38
Chiroptera	7	28	71	7	21	56	7	27	77
Eulipotyphla	1	3	9	1	3	10	2	5	18
Hyracoidea	1	3	3	1	3	3	1	3	3
Lagomorpha	1	2	4	1	2	3	1	3	7
Macroscelidea	1	3	5	1	3	5	1	3	8
Perissodactyla	2	3	3	2	3	3	2	3	4
Pholidota	1	1	1	1	1	1	1	1	1
Primates	2	6	8	2	3	6	2	5	6
Proboscidea	1	1	1	1	1	1	1	1	2
Rodentia	9	32	51‡	9	29	41‡	8	38	85
Tubulidentata	1	1	1	1	1	1	1	1	1
Total¶	39	133	217	38	117	189	39	154	305

†, Family Phocidae not included.

‡, Commensal species were not included.

¶, The orders Cetacea and Sirenia not included.

recorded (Appendix 2). A total of three species are included in the questionable occurrence list (Appendix 3). These are discussed in detail further on.

Bovidae is the most documented family, with the highest number of records compiled, resulting in a good coverage of the species' spatial distribution in the country (Appendix 2). Three bovids were considered to have questionable occurrence: *Antidorcas marsupialis* (Zimmermann, 1780), *Litocranius walleri* (Brooke, 1879) and *Tragelaphus spekkii* (Sclater, 1863). These species have their occurrence in Mozambique based on a single museum specimen (see Appendix 3 for references). Only the sitatunga, *T. spekkii*, is denoted by Wilson and Reeders (2005) as having a distribution in Mozambique.

Damaliscus lunatus (Burchell, 1824) was given as extinct in Mozambique around the late 1970s (Tello 1989). For this reason, it was not included in this study's species checklist, albeit there exist records of its past occurrence in the country (12 records; Smithers and Tello 1976).

Several species have suffered from considerable range contractions and local extinctions in Mozambique. *Giraffa camelopardalis* (Linnaeus, 1758), recently ranked as vulnerable by IUCN (2017), was considered 'probably extinct' in the 1990s (East 1999), but reintroduction programmes since 2002 have returned the species to the country (Agreco 2008; Dunham et al. 2010; MICOA 2014; Whyte & Swanepoel 2006). *Hippopotamus amphibius* (Linnaeus 1758), also a vulnerable species (IUCN 2017), had a widespread distribution across all biogeographical regions in the 1970s (Smithers & Tello 1976), but recent aerial surveys indicate a more restricted distribution, along rivers inside protected areas and along the Zambezi River Basin (Agreco 2008).

Two Suidae species occur throughout the country: the warthog, *Phacochoerus africanus* (Gmelin, 1788), and the bush pig,

Potamochoerus larvatus (F. Cuvier, 1822). The occurrence of both species has been confirmed since the mid-19th century. From the year 2000 onwards, their presence has been observed in nine protected areas and their surroundings across all biogeographical areas (e.g. Agreco 2008).

Carnivora (foxes, weasels, hyenas, cats, civets, etc.)

Seven families, including 33 species from 28 genera, were identified as occurring in Mozambique: Canidae (4 species), Felidae (6 species), Herpestidae (9 species), Hyaenidae (3 species), Mustelidae (5 species), Nandiniidae (1 species) and Viverridae (5 species). Most carnivores reported were previously listed in Smithers and Tello (1976). Recent records are mainly based on sightings from surveys in protected areas (e.g. Grupo de Gestão de Recursos Naturais e Biodiversidade 2010; Mesochina et al. 2008). These surveys reveal the presence of only 21 carnivores (Table 2); moreover, some of these species were observed just a few times (Appendix 2).

Most canids reported have recent records except for the bat-eared fox, *Otocyon megalotis* (Desmarest, 1822). This species was only mentioned for South Mozambique (Banhine NP and adjacent areas) by Smithers and Tello (1976), and its current occurrence status in the country should be further investigated.

All six felids were previously mentioned in Smithers and Tello (1976) and had their occurrence confirmed by recent surveys in four protected areas (Dunham 2004; GRNB 2010; Mesochina et al. 2008; Stalmans & Peel 2009).

Nine species of Herpestidae are reported to occur in Mozambique. Four mongoose species have their current occurrence confirmed in the country (e.g. Mesochina et al. 2008; Stalmans & Peel 2009). The remaining five were last recorded before 1976 (Smithers & Tello 1976). Among these,

TABLE 2: Summary description of the reported species in the species checklist of terrestrial mammals from Mozambique, extrapolated species richness and taxonomic completeness.

Order	Total	Threatened	< 10 records	Recent	Species richness	Comp.
Afrosoricidae	2	1	1	-	-	-
Artiodactyla	25	3	1	24	25	100.0
Carnivora	33	4	6	21	33	100.0
Chiroptera	71	1	41	58	84 (±4.6)	84.5
Eulipotyphla	9	-	3	7	10 (±1)	90.0
Hyracoidea	3	-	1	2	3	100.0
Lagomorpha	4	-	2	2	4	100.0
Macroscelidea	5	-	-	2	5	100.0
Perissodactyla	3	1	-	3	3	100.0
Pholidota	1	1	-	1	-	-
Primates	8	-	1	7	8	100.0
Proboscidea	1	1	-	1	-	-
Rodentia	51	1	17	33	52 (±1)	98.1
Tubulidentata	1	-	-	1	-	-
Total	217	13	73	162	232 (±4.7)	93.5

Notes: Shown are the total number of species, the number of threatened species, the number of species reported with fewer than 10 records, the number of species reported from Mozambique after the year 2000 ('recent'), per mammal order. Species richness calculated using jackknife estimator; standard deviation in brackets. Taxonomic completeness calculated as (total number of species/species richness) × 100. Species are considered 'threatened' when they are classified as 'vulnerable', 'endangered' or 'critically endangered' by the IUCN (2017) Red List. Comp., taxonomic completeness.

two species' occurrences are based on a few records: *Paracynictis selousi* (De Winton, 1896), with just two records, and *Bdeogale crassicauda* (Peters, 1852), firstly collected in Mozambique by W. Peters, with 10 records.

Three Hyaenidae species are listed as occurring in Mozambique (Appendix 2). The hyena *Crocuta crocuta* (Erxleben, 1777), with a high number of records in the past and across the entire country (Smithers & Tello 1976), is the only species for which recent records exist, though only two records were found (Quirimbas NP; GRNB 2010). Only mentioned in Smithers and Tello (1976), the other two species have fewer than 10 records each: the near-threatened *Hyaena brunnea* (Thunberg, 1820) and the aardwolf, *Proteles cristata* (Sparrman, 1783), in Central and South Mozambique.

From the five Mustelidae species listed, two – *Aonyx capensis* (Schinz, 1821) and *Hydrictis maculicollis* (Lichtenstein, 1835) – have not been mentioned since Smithers and Tello (1976), but the remaining three mustelids have recent records in North Mozambique (GRNB 2010; Mesochina et al. 2008; Appendix 2).

The family Viverridae is represented by the subfamily Viverrinae with two genera: *Civettictis* (Pocock, 1915) (1 species) and *Genetta* (Cuvier, 1816) (4 species). The genus *Genetta* is taxonomically problematic with many nomenclatural changes over time (e.g. Coetzee 1977; Crawford-Cabral & Fernandes 2001). Therefore, in the present study, we followed the taxonomy and nomenclatural approach of Mills and Bester (2005), in which five genera are listed for the southern African region. Smithers and Tello (1976) consider just two species for Mozambique: *G. genetta pulchra* (Matschie, 1902); and *G. tigrina rubiginosa* (Pucheran, 1855).

Chiroptera (bats)

The order of bats is the most species-rich order in Mozambique, comprising 71 species from 28 genera (Table 1). Seven families occur in the country: Emballonuridae (2 species), Hipposideridae (5 species), Molossidae (10 species), Nycteridae (5 species), Pteropodidae (7 species), Rhinolophidae (16 species) and Vespertilionidae (26 species). Most of the species have been recently recorded in the country (58 species; Table 2). Three bats are only reported by Smithers and Tello (1976): *Cloeotis percivali* (Thomas, 1901) (2 records), *Tadarida ventralis* (Heuglin, 1861) (2 records) and *Myotis welwitschii* (Gray, 1866) (3 records).

The occurrence of *Rhinolophus capensis* (Lichtenstein, 1823) in Mozambique is rejected by Monadjem et al. (2010). The authors consider that specimens labelled as *R. capensis* (e.g. Smithers & Tello 1976) were based on misidentifications, as the species is endemic to South Africa. However, following the methodology herein proposed and given that this species was listed by Smithers and Tello (1976) and was reported in 2003 (FMNH 177108; FMNH 177109; FMNH 177214), this species is still included in our species checklist. Nevertheless, we advise a reappraisal of the previously listed specimens in order to clarify their taxonomic identification.

An additional eight bat species were considered as having questionable occurrence: *Epomophorus gambianus* (Ogilby, 1835), *Mops thersites* (Thomas, 1903); *Nyctalus noctula* (Schreber, 1774); *Nycteris woodi* (K. Andersen, 1914); *Pipistrellus rueppellii* (J. Fisher, 1829); *Scotoecus albofuscus* (Thomas, 1890); *Tadarida lobata* (Thomas 1891) and *Taphozous perforatus* (E. Geoffroy, 1818) (Appendix 3). Two of these species (*N. noctula* and *M. thersites*) are also rejected as being part of the Mozambican fauna by Monadjem et al. (2010).

Eulipotyphla (shrews, moles and solenodons)

Nine shrew species are known to occur in Mozambique (suborder Soricomorpha; family Soricidae; Table 1). Among those, seven species were recently recorded in the country: *Crocidura hirta* (Peters, 1852), *C. luna* (Dollman, 1910), *C. mariquensis* (A. Smith, 1844), *C. olivieri* (Lesson, 1827), *C. silacea* (Thomas, 1895), *Myosorex meesteri* (Taylor et al. 2013) and *Suncus megalura* (Jentink, 1888) (Appendix 2). The recent records of *Crocidura* (Wagler, 1832) include those collected (1) by the FMNH in 2003 and 2011 (FMNH 177083–177087; FMNH 177197–177207); (2) during surveys taken in Mount Namuli (Bayliss et al. 2014); and (3) during surveys inside Quirimbas NP (GRNB 2010; Schneider 2004).

The forest shrew *M. meesteri* was recently described as a new species (Taylor et al. 2013). The authors described this species based on three records, two from Gorongosa NP, Mozambique, and one from Mutare, Zimbabwe, and no records of *M. cafer* (Sundevall 1846) in Mozambique. In the past, the only species of the genus *Myosorex* (Gray, 1837) included as part of the Mozambique's fauna was *M. cafer*, with records from the same areas (Smithers & Tello 1976). The recent work by Taylor et al. (2013) proposed that populations formerly

classified as *M. cafer* should be renamed as *M. meesteri*. Given this, we only included in our species checklist the species *M. meesteri*.

Another species, the musk shrew, *C. silacea*, was not previously listed in Smithers and Tello (1976, Appendix 2).

Four shrew species were considered as having questionable occurrence, each one with a single record: identified as the black shrew, *Crocidura nigrofuscus* (Matschie, 1895), collected in North Mozambique (USNM 365077); *C. flavescens* (I. Geoffroy, 1827), reported by Smithers and Tello (1976); and two species of dwarf shrews, *Suncus lixus* (Thomas 1898) and *S. varilla* (Thomas, 1895), also reported by Smithers and Tello (1976) from Central and Southern Mozambique without reference to specimen records (Appendix 3).

Hyracoidea (hyraxes)

This order is represented by three species, all from the Procaviidae family, which are all listed in Smithers and Tello (1976; Table 1). Two of these species were recently reported from North Mozambique (Table 2): *Heterohyrax brucei* (Gray, 1868) at Mount Inago and Mount Namuli (Bayliss et al. 2010; Timberlake et al. 2009; FMNH 177240); and *Procavia capensis* (Pallas, 1766) at Mount Mabu, Quirimbas NP and Gilé NP (Bayliss et al. 2014; Dowsett-Lemaire & Dowsett 2009; GRNB 2010; Mesochina et al. 2008; Schneider et al. 2004; Appendix 2). Evidence of occurrence of the third species, *Dendrohyrax arboreus* (A. Smith, 1827), is based on three specimens collected in the mid-19th century in Central Mozambique, one deposited in the ZMB, Berlin (ZMB 1984), a second in the Muséum National d'Histoire Naturelle (MNHN), Paris (MNHN 1897-654), and a third at the National Museum of Zimbabwe, Zimbabwe (NMZB-MAM-0068820).

Lagomorpha (rabbits, hares and pikas)

Four lagomorph species were listed for Mozambique (Table 2). The hare *Lepus microtis* (Euglin, 1865), which has been recorded both in past expeditions to Mozambique (e.g. W. Peters' expedition and the Smithsonian Institute's AMP) and during recent surveys of Gilé NR and Quirimbas NP (GRNB 2010; Mesochina et al. 2008). The Cape hare, *L. capensis* (Linnaeus, 1758), although with consistent sampling in the past, does not have recent records, its last reference being Smithers and Tello's checklist (1976; Appendix 2). *Pronolagus crassicaudatus* (I. Geoffroy, 1832) is only listed in Smithers and Tello (1976) with three localities without reference to specimen material (Appendix 2). The fourth hare species, *P. rupestris* (A. Smith, 1834), was recently collected and identified in North Mozambique (FMNH 177246; Bayliss et al. 2010, 2014; Timberlake et al. 2009); this species' distribution is not designated for Mozambique, but for the adjacent countries of South Africa, Tanzania and Zambia (Wilson & Reeder 2005). The species name *P. rupestris* was previously incorporated in *P. crassicaudatus* (Wilson & Reeder 2005); thus a taxonomic revision is required to determine its taxonomic validity and identity.

Macroscelidea (elephant shrews)

Five species belonging to three different genera, all from the Macroscelididae family, are reported from Mozambique (Table 1). Three of these species were firstly described by W. Peters based on specimens collected during his expedition to Mozambique (Peters 1852): *Elephantulus fuscus* (Peters, 1852); *Petrodromus tetradactylus* (Peters, 1846); and *Rhynchocyon cirnei* (Peters, 1847). Two of these, the elephant shrew *P. tetradactylus* and the near-threatened *R. cirnei*, have been recently recorded as present in North Mozambique (Bayliss et al. 2014; Coals & Rathbun 2012; Mesochina et al. 2008; Appendix 2). Regarding the three species of the genus *Elephantulus* (Thomas & Schwann, 1906) – *E. brachyrhynchus* (A. Smith, 1836), *E. fuscus* and *E. myurus* (Thomas & Schwann, 1906) – no recent records have been reported since the reference in Smithers and Tello (1976).

One species, *Elephantulus intufi* (A. Smith 1836), was classified as having questionable occurrence in the country based on a single specimen from 'Tette' (Central Mozambique) housed in ZMB, Berlin (ZMB 84906; Appendix 3). This species is designated to occur in southwest Angola, Namibia, Botswana and the north of South Africa (Wilson & Reeder 2005). Because of lack of recent or additional records for Mozambique, a reassessment of the taxonomic identification of the specimen housed in ZMB is needed.

Perissodactyla (odd-toed ungulates)

In Mozambique, this order is represented by three species from the families Equidae (1 species) and Rhinocerotidae (2 species; Appendix 2). All species are listed in Smithers and Tello (1976) and have been recently reported in survey reports (Agreco 2008; Dunham 2010; Dunham et al. 2010; GRNB 2010; Whyte & Swanepoel 2006). The survival of the rhinoceros in the country is jeopardised. During the countrywide aerial survey in 2008 fewer than 10 individuals of the white rhinoceros, *Ceratotherium simum* (Burchell, 1817), and a single individual of the Critically Endangered *Diceros bicornis* (black rhinoceros) (Agreco 2008; Linnaeus 1758) were reported.

Pholidota (pangolins)

A single pangolin species was reported from Mozambique, the ground pangolin *Manis temminckii* (Smuts, 1832). A total of 17 records are reported by Smithers and Tello (1976) and its presence was recently found in Gilé NP (Mesochina et al. 2008; Appendix 2). One species, the pangolin *M. tricupis* (Rafinesque, 1821), was classified as having questionable occurrence in the country as its presence is based on a single specimen housed in the MNHN, Paris (MNHN 1851-519; Appendix 3). Little information is associated with this specimen, and as such the occurrence of this species in Mozambique deserves further investigation.

Primates (e.g. monkeys, apes)

Both families of non-human primates occurring in southern Africa, the Cercopithecidae and the Galagidae, are represented in Mozambique. A total of eight species

from six genera occur in the country (Table 1). Most of the species (7 species) have been previously reported by Smithers and Tello (1976) and were recently recorded at many protected areas (e.g. Agreco 2008; Dunham et al. 2010). The small-eared galago, *Otolemur garnettii* (Ogilby, 1836), is the only species that was neither listed in Smithers and Tello (1976) nor reported recently. Five specimen records of this species were compiled: three collected by W. Peters with unknown collection locality (ZMB 64281 – ZMB 64283); one specimen collected in 1948 during a Portuguese zoological expedition (IICT: CZ000000502); and another specimen collected during the Smithsonian Institute's AMP (USNM 352255). These latter two specimens are from South Mozambique.

Proboscidea (elephants)

The compiled data on the occurrence of the elephant *Loxodonta africana* (Blumenbach 1797) in Mozambique are mainly based on observation records. Specimen data from expeditions during the 19th and 20th century also exist, but in low numbers (14 specimens from six institutions; Appendix 3). In a national monitoring report, six elephant populations were identified (Agreco 2008). The species has been poached over the years, and even inside protected areas this species is in danger of extinction (Ntumi et al. 2009).

Rodentia (e.g. mice, rats, squirrels and porcupines)

This order is one of the most species-rich in Mozambique, with 51 species from 31 genera (Table 1). Nine families were identified in the country: Anomaluridae (1 species), Bathyergidae (3 species), Gliridae (3 species), Hystricidae (1 species), Muridae (27 species), Nesomyidae (8 species), Pedetidae (1 species), Scuridae (5 species) and Thyronomyidae (2 species).

About half of the rodent species have recent records of occurrence (Table 2). Four rodent species are only referred to in Smithers and Tello (1976) and with few records: *Anomalurus derbianus* (Gray 1842); *Gerbilliscus boehmi* (Noack, 1887); *Otomys auratus* (Wroughton, 1906); and *Thyronomys gregorianus* (Thomas, 1894). On the other hand, seven listed species were not previously reported by Smithers and Tello (1976): *Dendromus nyikae* (Wroughton, 1909); *Graphiurus microtis* (Noack, 1887); *Grammomys macmillani* (Wroughton, 1907); *Mus neavei* (Thomas, 1910); *Aethomys ineptus* (Thomas & Wroughton, 1908); *Beamys major* (Dollman, 1914); and *Praomys delectorum* (Thomas, 1910).

The presence of the Mozambican endemic *Paraxerus vincenti* (Hayman, 1950) was recently confirmed (FMNH 183736; FMNH 183737; Timberlake et al. 2009). Known records of this Endangered species are from Mount Namuli (North Mozambique; Wilson & Reeder 2005).

A total of four Muridae and two Nesomyidae species were classified as having questionable occurrence: *Aethomys kaiseri* (Noack, 1887), *A. silindensis* (Roberts, 1938), *Gerbilliscus*

validus (Bocage, 1890), *Mastomys coucha* (Smith, 1834), *Dendromus mesomelas* (Brants, 1827) and *Steatomys krebsii* (Peters, 1852) (Appendix 3).

As it was not our objective to compile introduced species or commensal species, they were not incorporated in the species checklist. However, we would like to mention that records from three non-native species were gathered during this study. These were recently recorded during the 'African Rodentia' project: *Rattus rattus* (Linnaeus, 1758) with 75 records, *R. norvegicus* (Berkenhout, 1769) with 18 records and *Mus musculus* (Linnaeus, 1758) with 248 records (see Appendix 4 for specimen identifiers). The three species were recorded through all biogeographical regions indicating that the respective populations are well established in the country.

Tubulidentata (aardvarks)

This order is represented in Mozambique by a single species, the aardvark, *Orycteropus afer* (Pallas, 1766). Most of the records compiled for the species are listed in Smithers and Tello (1976). Recent reports refer to its presence at Quirimbas NP and Gilé NR, North Mozambique (GRNB 2010; Mesochina et al. 2008).

Discussion

The present study integrated mammal occurrence records from several data sources and thus contributed to an update of the checklist of the terrestrial mammals of Mozambique, pinpointing species and specimens in need of occurrence and taxonomic re-evaluation. In addition, the methodological approach presented here can be easily adapted to produce species checklists of crucial importance to countries facing a similar lack of knowledge regarding the elements of their biodiversity.

The diversity of terrestrial mammals found for Mozambique is yet most likely an underestimation of the country's mammal diversity, despite the 14% increment in the number of species in comparison with Smithers and Tello (1976). In fact, when compared with the number of species listed for adjacent countries, such as South Africa (247 species; Groombridge & Jenkins 1994) or Zimbabwe (270 species; Groombridge & Jenkins 1994), again, it is apparent that there are still a considerable number of species unaccounted for.

To uncover the potential mammalian diversity of Mozambique, further surveys are critical, especially surveys aiming at specific groups, namely the less-known ones. Our study shows that Afrosoricidae, Hyracoidea, Lagomorpha, Macroscelidea and Rodentia were less sampled over the years; also, only half of these smaller mammals were recently reported, and most of them with fewer than 10 records across the country. The work of Monadjem et al. (2010), which targeted the order Chiroptera, shows how surveys aiming at specific groups are important to fill gaps in knowledge. This work identified 50 bat species, with seven being new records for the country.

Although most mammalian orders have a fairly stable taxonomy, our data highlights the need for a re-evaluation of the identity of some species reported from Mozambique. For example, as described before, some of the listed species of the problematic Viverridae family do not have their identity and occurrence confirmed because of lack of specimen reappraisal; also, for the hare species *P. rupestris* we are cautious about its taxonomic validity and identity. Certainly, when a species presence is based on museum specimens their reappraisal is possible. Nowadays, this evaluation can count on techniques spanning from classical morphometric analysis to modern molecular analysis (Ceríaco, Marques & Bauer 2016; Moratelli & Wilson 2014). The reappraisal of these already-collected specimens will state their identity, clarify the species occurrence throughout the country and contribute to an augmented knowledge of the country's conservation value. In this way, to increase the knowledge of Mozambique's mammal diversity, we plead for attention from mammalogists to the need to study these specimens.

Lastly, and considering that most records integrated in our compilation are from European and North American institutions, the work hereby presented would greatly improve with the integration of data from African institutions. Therefore, an effort should be made to make these important collections accessible online, in light of what is surfacing in natural history museums in South Africa and Zimbabwe, currently contributing information to the GBIF data portal (Coetzer, Hamer & Parker-Allie 2012).

Conclusion

The establishment of species checklists is of utmost importance to the definition of conservation policies and promotes the documentation and protection of biodiversity (Amori et al. 2012). We hope that the species checklist compiled here should serve as a taxonomic resource and baseline for researchers, decision-makers, conservationists and students interested in the Mozambican fauna. The data presented is crucial for biodiversity assessments, as required by the CBD, and furthermore highlights the potential mammal diversity still to be uncovered in Mozambique.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

I.Q.N. and C.B.S. were responsible for the study conception and design. I.Q.N. handled the acquisition of data and the analysis and took the lead in drafting the article. C.B.S. contributed to the interpretation of the results. M.L.M. made a critical revision of the article. All authors discussed the results and implications and commented on the manuscript at all stages. All authors gave their approval for the final version to be published.

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Appendix 1: List of the data sources for primary species-occurrence data of terrestrial mammal species reported from Mozambique.

TABLE 1-A1: Natural history collections.

Acronym	Institution	Locality
AMNH	American Museum of Natural History†	New York, USA
BRTC	Texas Cooperative Wildlife Collection†	College Station, USA
CAS	California Academy of Sciences†	San Francisco, USA
EMBL	European Molecular Biology Laboratory†	Heidelberg, Germany
FMNH	Field Museum of Natural History†	Chicago, USA
HSUWM	Humboldt State University Wildlife Museum†	Arcata, USA
IICT	Instituto de Investigação Científica Tropical	Lisbon, Portugal
ISM	Illinois State Museum†	Illinois, USA
KU	University of Kansas Biodiversity Research Center†	Lawrence, USA
LACM	Los Angeles County Museum of Natural History†	Los Angeles, USA
MACN	Museo Argentino de Ciencias Naturales†	Buenos Aires, Argentina
MCZ	Museum of Comparative Zoology, Harvard University†	Harvard, USA
MHNG	Muséum d'histoire naturelle de la Ville de Genève†	Geneva, Switzerland
MNCN	Museo Nacional de Ciencias Naturales	Madrid, Spain
MNHN	Museum National d'Histoire Naturelle	Paris, France
MSU	Michigan State University Museum†	East Lansing, USA
MUP	Museu de História Natural da Universidade do Porto	Oporto, Portugal
MVZ	Museum of Vertebrate Zoology, University of California†	Berkeley, USA
MZNA	Museum of Zoology, University of Navarra†	Navarra, Spain
NHMMUK	The Natural History Museum	London, England
NHMW	Naturhistorisches Museum Wien†	Vienna, Austria
NMR	Natural History Museum Rotterdam†	Rotterdam, Netherlands
NMZB	Natural History Museum of Zimbabwe†	Bulawayo, Zimbabwe
NRM	Naturhistoriska Riksmuseet†	Stockholm, Sweden
OSU	Museum of Biological Diversity, Ohio State University†	Columbus, USA
RBINS	Royal Belgian Institute of Natural Sciences†	Brussels, Belgium
RMCA	Royal Museum for Central Africa†	Tervuren, Belgium
RMNH	Rijksmuseum voor Natuurlijke Historie†	Leiden, Netherlands
ROM	Royal Ontario Museum†	Toronto, Canada
SAMA	South Australian Museum†	Adelaide, Australia
SMF	Senckenberg Naturmuseum Frankfurt†	Frankfurt, Germany
SNOMNH	Sam Noble Oklahoma Museum of Natural History†	Norman, USA
TTU	Museum of Texas Tech University†	Lubbock, USA
UNSM	University of Nebraska State Museum†	Lincoln, USA
USNM	National Museum of Natural History†	Washington, DC, USA
UWBM	University of Washington Burke Museum†	Seattle, USA
WAM	Western Australian Museum†	Perth, Australia
ZMB	Museum für Naturkunde	Berlin, Germany

†, Data downloaded from Global Biodiversity Information Facility – www.gbif.org

TABLE 2-A1: Unpublished survey reports (in chronological order).

Survey area	References
Mozambique – countrywide survey	Agreco G.E.I.E., 2008, <i>National Census of Wildlife in Mozambique – Final Report</i> , Author and Ministério da Agricultura da República de Moçambique, Maputo.
 Gorongosa National Park	Dunham, K.M., 2004, <i>Aerial Survey of Large Herbivores in Gorongosa National Park</i> , The Gregory C. Carr Foundation, Cambridge, MA.
Mareja Community Reserve	Schneider, M.F., 2004, <i>Checklist of Vertebrates and Invertebrates of Mareja Reserve</i> , Universidade Eduardo Mondlane and International Union for the Conservation of Nature, Mozambique, Maputo.
Maputo Special Reserve	Matthews, W.S. and Nemané, M., 2006, <i>Aerial survey report for Maputo Special Reserve</i> , Ezemvelo KwaZulu-Natal Wildlife, Ministério do Turismo, Reserva Especial de Maputo, Maputo.
Limpopo National Park	Whyte, I. and Swanepoel, B., 2006, <i>An Aerial Census of the Shingwedzi Basin Area of the Limpopo National Park</i> , Ministério do Turismo, Maputo.
Zinave National Park	Stalmans, M., 2007, <i>Parque Nacional de Zinave, Moçambique - Wildlife survey. Projecto Áreas de Conservação Transfronteira e Desenvolvimento do Turismo</i> , Ministério do Turismo, Maputo.
Mount Chiperoone	Timberlake, J., Bayliss, J., Alves, T., Baena, S., Harris, T. and Sousa, C., 2007, <i>The Biodiversity and Conservation of Mount Chiperoone, Mozambique</i> , Darwin Initiative Award 15/036, Royal Botanic Gardens, Kew, London.
Gilé National Reserve	Mesochina, P., Langa, F. and Chardonnet, P., 2008, <i>Preliminary Survey of Large Herbivores in Gilé National Reserve, Zambezia Province, Mozambique</i> , Direcção Provincial do Turismo da Zambézia and IGF Foundation, Paris.
Banhine National Park	Stalmans, M. and Peel, M., 2009, <i>Parque Nacional de Banhine, Moçambique – Wildlife survey. Projecto Áreas de Conservação Transfronteira e Desenvolvimento do Turismo</i> , Ministério do Turismo, Maputo.

Table 2-A1 continues on the next page →

TABLE 2-A1 (Continues...): Unpublished survey reports (in chronological order).

Survey area	References
Mount Namuli	Timberlake, J., Dowsett-Lemaire, F., Bayliss, J., Alves, T., Baena, S., Bento, C., Cook, K., Francisco, J., Harris, T., Smith, P. and Sousa, C., 2009, <i>Mt. Namuli, Mozambique: biodiversity conservation</i> , Darwin Initiative Award 15/036, Royal Botanic Gardens, Kew, London.
Mount Mabu	Dowsett-Lemaire, F. and Dowsett, R., 2009, <i>The avifauna and forest vegetation of Mt. Mabu, northern Mozambique, with notes on mammals. Final report (October 2008)</i> , Dowsett-Lemaire miscellaneous Report 66.
Mount Inago	Bayliss, J., Monteiro, J., Fishpool, L., Congdon, C., Bampton, I., Bruessow, C., Matimele, H., Banze, A., and Timberlake, J., 2010, <i>Biodiversity and Conservation of Mount Inago, Mozambique. Report produced under Darwin Initiative Project: Monitoring and Managing Biodiversity Loss in South-east Africa's Montane Ecosystems D.I.No.15/036</i> , Malawi.
Mágoè National Park	Dunham, K.M., 2010, <i>Part 4 - Aerial Survey of Wildlife south of Lake Cabora Bassa Wildlife Survey Phase 2 and Management of Human-Wildlife Conflicts in Mozambique</i> .
Zinave National Park and surrounds	Dunham, K.M., Van der Westhuizen, E., Van der Westhuizen, H.F. and Gandiwa, E., 2010, <i>Aerial Survey of Elephants and other Large Herbivores in Gonarezhou National Park (Zimbabwe), Zinave National Park (Mozambique) and surrounds: 2009</i> , Parks and Wildlife Management Authority, The Transfrontier Conservation Areas Co-ordination Unit, Frankfurt Zoological Society.
Quirimbas National Park	Grupo de Gestão de Recursos Naturais e Biodiversidade (GRNB), 2010, <i>Biodiversity Baseline of the Quirimbas National Park, Mozambique – Final Report</i> , Author, Universidade Eduardo Mondlane, Maputo.

BOX 1-A1: Scientific literature (in chronological order).

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Chimimba, C.T., 2001, 'Geographic variation in the Tete veld rat <i>Aethomys ineptus</i> (Rodentia: Muridae) from southern Africa', <i>Journal of Zoology</i> 254, 77–89.
Monadjem, A., Schoeman, M.C., Reside, A., Pio, D.V., Stoffberg, S., Bayliss, J. et al., 2010, 'A recent inventory of the bats of Mozambique with documentation of seven new species for the country', <i>Acta Chiropterologica</i> 12(2), 371–391.
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Taylor, P.J., Stoffberg, S., Monadjem, A., Schoeman, M.C., Bayliss, J. & Cotterill, F.P.D., 2012, 'Four new bat species (<i>Rhinolophus hildebrandtii</i> complex) reflect Plio-Pleistocene divergence of dwarfs and giants across an Afrotropical archipelago', <i>PLoS One</i> 7(9), e41744.
Colangelo, P., Verheyen, E., Leirs, H., Tatars, C., Denys, C., Dobigny, G. et al., 2013, 'A mitochondrial phylogeographic scenario for the most widespread African rodent, <i>Mastomys natalensis</i> ', <i>Biological Journal of the Linnean Society</i> 108(4), 901–916.
Monadjem, A., Goodman, S.M., Stanley, W.T. & Appleton, B., 2013, 'A cryptic new species of <i>Miniopterus</i> from south-eastern Africa based on molecular and morphological characters', <i>Zootaxa</i> 3746(1), 123–142.
Taylor, P.J., Kearney, T.C., Kerbis Peterhans, J.C., Baxter, R.M. & Willows-Munro, S., 2013, 'Cryptic diversity in forest shrews of the genus <i>Myosorex</i> from southern Africa, with the description of a new species and comments on <i>Myosorex tenuis</i> ', <i>Zoological Journal of the Linnean Society</i> 169(4), 881–902.
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Taylor, P.J., Macdonald, A., Goodman, S.M., Kearney, T., Cotterill, F.P.D., Stoffberg, S. et al., 2018, 'Integrative taxonomy resolves three new cryptic species of small southern African horseshoe bats (<i>Rhinolophus</i>)', <i>Zoological Journal of the Linnean Society</i> . https://doi.org/10.1093/zoolinnean/zly024

Appendix 2

TABLE 1-A2: Checklist of the terrestrial mammals reported from Mozambique.

Higher taxonomic level and valid species name	Authority	Status	Records	Occurrence	Last reference	
Order	Afrosoricida					
Family	Chrysochloridae					
	<i>Calcochloris obtusirostris</i>	(Peters, 1851)	LC	39	C, S	Downs and Wirminghaus (1997)
	<i>Carpitalpa arendsi</i>	Lundholm, 1955	VU	6	C	Smithers and Tello (1976)
Order	Artiodactyla					
Family	Bovidae					
	<i>Aepyceros melampus</i>	(Lichtenstein, 1812)	LC	334	N, C, S	GNRB (2010)
	<i>Alcelaphus lichtensteinii</i>	(Peters, 1849)	LC	187	N, C, S	AGRECO (2008)
	<i>Cephalophus natalensis</i>	A. Smith, 1834	LC	180	N, C, S	GNRB (2010)
	<i>Connochaetes taurinus</i>	(Burchell, 1823)	LC	185	N, C, S	GNRB (2010)
	<i>Hippotragus equinus</i>	(É. Geoffroy Saint-Hilaire, 1803)	LC	45	N, C, S	Dunham (2010)
	<i>H. niger</i>	(Harris, 1838)	LC	283	N, C, S	GNRB (2010)
	<i>Kobus ellipsiprymnus</i>	(Ogilby 1833)	LC	280	N, C, S	GNRB (2010)
	<i>Neotragus moschatus</i>	(Von Dueben, 1846)	LC	115	N, C, S	GNRB (2010)
	<i>Oreotragus oreotragus</i>	(Zimmerman, 1783)	LC	59	N, C, S	GNRB (2010)
	<i>Ourebia ourebi</i>	(Zimmerman, 1783)	LC	157	N, C, S	GNRB (2010)
	<i>Philantomba monticola</i>	(Thunberg, 1789)	LC	24	N, C	GNRB (2010)
	<i>Raphicerus campestris</i>	(Thunberg, 1811)	LC	139	N, C, S	GNRB (2010)
	<i>R. sharpei</i>	Thomas, 1897	LC	71	N, C, S	Dunham et al. (2010)
	<i>Redunca arundinum</i>	(Boddaert, 1785)	LC	684	N, C, S	Stalmans and Peel (2009)
	<i>R. fulvovufula</i>	(Afzelius, 1815)	EN	4	S	Smithers and Tello (1976)
	<i>Sylvicapra grimmia</i>	(Linnaeus, 1758)	LC	963	N, C, S	GNRB (2010)
	<i>Syncerus caffer</i>	(Sparrman, 1779)	LC	229	N, C, S	GNRB (2010)
	<i>Taurotragus oryx</i>	(Pallas, 1766)	LC	202	N, C, S	GNRB (2010)
	<i>Tragelaphus angasii</i>	Gray, 1849	LC	338	N, C, S	Dunham et al. (2010)
	<i>T. scriptus</i>	(Pallas, 1766)	LC	225	N, C, S	GNRB (2010)
	<i>T. strepsiceros</i>	(Pallas, 1766)	LC	475	N, C, S	GNRB (2010)
Family	Giraffidae					
	<i>Giraffa camelopardalis</i>	(Linnaeus, 1758)	VU	46	C, S	GNRB (2010)
Family	Hippopotamidae					
	<i>Hippopotamus amphibius</i>	Linnaeus, 1758	VU	290	N, C, S	GNRB (2010)
Family	Suidae					
	<i>Phacochoerus africanus</i>	(Gmelin, 1788)	LC	463	N, C, S	GNRB (2010)
	<i>Potamochoerus larvatus</i>	(F. Cuvier, 1822)	LC	203	N, C, S	GNRB (2010)
Order	Carnivora					
Family	Canidae					
	<i>Canis adustus</i>	Sundevall, 1847	LC	28	N, C, S	GNRB (2010)
	<i>C. mesomelas</i>	Schreber, 1775	LC	38	N, C, S	GNRB (2010)
	<i>Lycaon pictus</i>	(Temminck, 1820)	EN	56	N, C, S	GNRB (2010)
	<i>Otocyon megalotis</i>	(Desmarest, 1822)	LC	5	S	Smithers and Tello (1976)
Family	Felidae					
	<i>Acinonyx jubatus</i>	(Schreber, 1775)	VU	53	N, C, S	Andresen et al. (2012)
	<i>Caracal caracal</i>	(Schreber, 1776)	LC	42	N, C, S	Stalmans and Peel (2009)
	<i>Felis silvestris</i>	Schreber, 1775	LC	56	N, C, S	GNRB (2010)
	<i>Leptailurus serval</i>	(Schreber, 1776)	LC	70	N, C, S	Mesochina et al. (2008)
	<i>Panthera leo</i>	(Linnaeus, 1758)	VU	98	N, C, S	GNRB (2010)
	<i>P. pardus</i>	(Linnaeus, 1758)	VU	137	N, C, S	GNRB (2010)
Family	Herpestidae					
	<i>Atilax paludinosus</i>	(G. [Baron] Cuvier, 1829)	LC	31	N, C, S	Smithers and Tello (1976)
	<i>Bdeogale crassicauda</i>	Peters, 1852	LC	10	N, C	Smithers and Tello (1976)
	<i>Galerella sanguinea</i>	Ruppell, 1836	LC	75	N, C, S	Timberlake et al. (2009)
	<i>Helogale parvula</i>	(Sundevall, 1847)	LC	27	N, C, S	Mesochina et al. (2008)
	<i>Herpestes ichneumon</i>	(Linnaeus, 1758)	LC	18	N, C, S	Stalmans and Peel (2009)
	<i>Ichneumia albicauda</i>	(G. [Baron] Cuvier, 1829)	LC	32	N, C, S	Smithers and Tello (1976)
	<i>Mungos mungo</i>	(Gmelin, 1788)	LC	79	N, C, S	Timberlake et al. (2009)
	<i>Paracynictis selousi</i>	(de Winton, 1896)	LC	2	C	Smithers and Tello (1976)
	<i>Rhynchogale melleri</i>	(Gray, 1865)	LC	17	N, C, S	Smithers and Tello (1976)

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TABLE 1-A2 (Continues...): Checklist of the terrestrial mammals reported from Mozambique.

Higher taxonomic level and valid species name	Authority	Status	Records	Occurrence	Last reference	
Family	Hyaenidae					
	<i>Crocuta crocuta</i>	(Erleben, 1777)	LC	95	N, C, S	GNRB (2010)
	<i>Hyaena brunnea</i>	(Thunberg, 1820)	NT	7	C, S	Smithers and Tello (1976)
	<i>Proteles cristata</i>	(Sparrman, 1783)	LC	8	C, S	Smithers and Tello (1976)
Family	Mustelidae					
	<i>Aonyx capensis</i>	(Schinz, 1821)	NT	14	N, C, S	Smithers and Tello (1976)
	<i>Hydrictis maculicollis</i>	(Lichtenstein, 1835)	NT	4	C, S	Smithers and Tello (1976)
	<i>Ictonyx striatus</i>	(Perry, 1810)	LC	42	N, C, S	Mesochina et al. (2008)
	<i>Mellivora capensis</i>	(Schreber, 1776)	LC	43	N, C, S	GNRB (2010)
	<i>Poecilogale albinucha</i>	(Gray, 1864)	LC	8	N, C, S	FMNH: 177236
Family	Nandiniidae					
	<i>Nandinia binotata</i>	Gray, 1830	LC	23	N, C	FMNH: 177254
Family	Viverridae					
	<i>Civettictis civetta</i>	(Schreber, 1776)	LC	75	N, C, S	GNRB (2010)
	<i>Genetta angolensis</i> †	Bocage, 1882	LC	2	N, C	Mesochina et al. (2008)
	<i>G. genetta</i>	(Linnaeus, 1758)	LC	9	C, S	Smithers and Tello (1976)
	<i>G. maculata</i> †	Pucheran, 1855	LC	53	N, C, S	IICT: CZ000000579
	<i>G. tigrina</i>	(Von Schreber, 1776)	LC	94	N, C, S	Timberlake et al. (2009)
Order	Chiroptera					
Family	Emballonuridae					
	<i>Coleura afra</i>	(Peters, 1852)	LC	14	N	Smithers and Tello (1976)
	<i>Taphozous mauritanus</i>	E. Geoffroy, 1818	LC	8	N, C, S	Smithers and Tello (1976)
Family	Hipposideridae					
	<i>Cloeotis percivali</i>	Thomas, 1901	LC	2	N, C	Smithers and Tello (1976)
	<i>Hipposideros caffer</i>	(Sundevall, 1846)	LC	112	N, C, S	Monadjem et al. (2010)
	<i>H. ruber</i> †	(Noack, 1893)	LC	73	N	Bayliss et al. 2014
	<i>H. vittatus</i>	Peters, 1852	NT	31	N, C, S	Monadjem et al. (2010)
	<i>Triaenops persicus</i>	Dobson, 1871	LC	95	N, C, S	Monadjem et al. (2010)
Family	Molossidae					
	<i>Chaerephon ansorgei</i>	(Thomas, 1913)	LC	3	N, S	Monadjem et al. (2010)
	<i>C. bivittatus</i>	(Heuglin, 1861)	LC	4	C, S	Smithers and Tello (1976)
	<i>C. nigeriae</i>	Thomas, 1913	LC	10	-	NMZB series
	<i>C. pumilus</i>	(Cretzschmar, 1826)	LC	194	N, C, S	Monadjem et al. (2010)
	<i>Mops condylurus</i>	(A. Smith, 1833)	LC	389		Monadjem et al. (2010)
	<i>M. niveiventer</i>	Cabrera & Ruxton, 1926	LC	3		Smithers and Tello (1976)
	<i>Sauromys petrophilus</i>	(Roberts, 1917)	LC	16		Monadjem et al. (2010)
	<i>Tadarida aegyptiaca</i>	(E. Geoffroy, 1818)	LC	44		Monadjem et al. (2010)
	<i>T. fulminans</i> †	(Thomas, 1903)	LC	8		Taylor et al. 2013
	<i>T. ventralis</i>	(Heuglin, 1861)	DD	2		Smithers and Tello (1976)
Family	Nycteridae					
	<i>Nycteris grandis</i>	Peters, 1865	LC	2	N, C	Monadjem et al. (2010)
	<i>N. hispidia</i>	(Schreber, 1775)	LC	9	N, C, S	Monadjem et al. (2010)
	<i>N. macrotis</i> †	Dobson, 1876	LC	4	N, C, S	Monadjem et al. (2010)
	<i>N. thebaica</i>	E. Geoffroy, 1818	LC	166	N, C, S	Monadjem et al. (2010)
	<i>N. vinsoni</i>	Dalquest, 1965	DD	2	C	Smithers and Tello (1976)
Family	Pteropodidae					
	<i>Eidolon helvum</i>	(Kerr, 1792)	NT	8	N, C, S	Timberlake et al. (2009)
	<i>Epomophorus crypturus</i>	Peters, 1852	LC	37	N, C, S	Monadjem et al. (2010)
	<i>E. labiatus</i> †	(Temminck, 1837)	LC	1	N	Monadjem et al. (2010)
	<i>E. wahlbergi</i>	(Sundevall, 1846)	LC	117	N, C, S	Bayliss et al. (2014)
	<i>Lissonycteris angolensis</i>	Bergmans, 1997	LC	9	N, C	Monadjem et al. (2010)
	<i>Myonycteris relicta</i> †	Bergmans, 1980	LC	1	C	Monadjem et al. (2010)
	<i>Rousettus aegyptiacus</i>	(E. Geoffroy, 1810)	LC	65	N, C, S	Bayliss et al. 2014
Family	Rhinolophidae					
	<i>Rhinolophus blasii</i>	Peters, 1866	LC	9	N, C	Bayliss et al. 2014
	<i>R. capensis</i>	Lichtenstein, 1823	LC	4	N, C	FMNH: 177109
	<i>R. clivovus</i>	Cretzschmar, 1828	LC	17	N, C	Bayliss et al. 2014
	<i>R. darlingi</i>	K, Andersen, 1905	LC	5	N, C	Smithers and Tello (1976)
	<i>R. deckenii</i> †	Peters, 1837	NT	1	C	Monadjem et al. (2010)
	<i>R. denti</i>	Thomas, 1904	LC	3	N, C	Smithers and Tello (1976)
	<i>R. fumigatus</i>	Ruppell, 1842	LC	12	N, C	Monadjem et al. (2010)

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TABLE 1-A2 (Continues...): Checklist of the terrestrial mammals reported from Mozambique.

Higher taxonomic level and valid species name	Authority	Status	Records	Occurrence	Last reference
<i>R. gorongosae</i>	Taylor et al. 2018		1	C	Taylor et al. (2018)
<i>R. hildebrandtii</i>	Peters, 1878	LC	79	N, C, S	Bayliss et al. (2010)
<i>R. lobatus</i>	Peters, 1852	LC	60	N, C, S	Monadjem et al. (2010)
<i>R. mabuensis</i> †	Taylor et al. 2012		3	N	Taylor et al. (2012)
<i>R. cf. maendeleo</i> †	Kock, Csorba, Howell, 1999	DD	1	N	Monadjem et al. (2010)
<i>R. mossambicus</i> †	Taylor et al. 2012	LC	6	N, C	Taylor et al. (2012)
<i>R. rhodesiae</i>	Roberts, 1946		1	C	Taylor et al. (2018)
<i>R. simulator</i>	K, Andersen, 1904	LC	11	N, C	Monadjem et al. (2010)
<i>R. swinnyi</i>	Gough, 1908	LC	19	N, C, S	Bayliss et al. (2010)
Family	Vespertilionidae				
<i>Eptesicus hottentotus</i>	(A. Smith, 1833)	LC	8	N	Monadjem et al. (2010)
<i>Glauconycteris variegata</i>	(Tomes, 1861)	LC	7	C, S	Monadjem et al. (2010)
<i>Kerivoula argentata</i>	Tomes, 1861	LC	6	N, C, S	Monadjem et al. (2010)
<i>K. lanosa</i>	(A. Smith, 1847)	LC	2	C, S	Monadjem et al. (2010)
<i>K. cf. phalaena</i> †	Thomas, 1912	LC	2	N	Bayliss et al. 2014
<i>Laephotis botswanae</i> †	Setzer, 1971	LC	3	N	Bayliss et al. 2014
<i>Miniopterus fraterculus</i>	Thomas & Schwann, 1906	LC	23	N, C, S	Bayliss et al. 2014
<i>M. inflatus</i>	Thomas, 1903	LC	34	N, C	Monadjem et al. (2010)
<i>M. mossambicus</i>	Monadjem et al., 2013		6	N	Monadjem et al. (2013)
<i>M. natalensis</i>	(A. Smith, 1833)	LC	79	N, C, S	Bayliss et al. 2014
<i>Myotis bocagii</i>	(Peters, 1870)	LC	10	N, C	Monadjem et al. (2010)
<i>M. tricolor</i>	(Temminck, 1832)	LC	15	N, C	Bayliss et al. 2014
<i>M. welwitschii</i>	(Gray, 1866)	LC	3	C, S	Smithers and Tello (1976)
<i>Neoromicia capensis</i>	A. Smith, 1829	LC	8	C, S	Monadjem et al. (2010)
<i>N. melckorum</i>	(Roberts, 1919)	DD	3	C	Smithers and Tello (1976)
<i>N. nana</i>	Peters, 1852	LC	257	N, C, S	Monadjem et al. (2010)
<i>N. rendalli</i>	Thomas, 1889	LC	3	N, C, S	Monadjem et al. (2010)
<i>N. zuluensis</i> †	Roberts, 1924	LC	4	N, C	Monadjem et al. (2010)
<i>Nycticeinops schlieffenii</i>	(Peters, 1859)	LC	38	N, C, S	Monadjem et al. (2010)
<i>Pipistrellus hesperidus</i>	Temminck, 1840	LC	11	N, C, S	Monadjem et al. (2010)
<i>P. rusticus</i>	(Tomes, 1861)	LC	1	N	Timberlake et al. (2009)
<i>Scotoecus albigula</i> †	Thomas, 1909	LC	4	N, C, S	Monadjem et al. (2010)
<i>Scotophilus dinganii</i>	(A. Smith, 1833)	LC	41	N, C, S	Monadjem et al. (2010)
<i>S. leucogaster</i> †	Cretzschmar, 1830	LC	1	S	Monadjem et al. (2010)
<i>S. nigrita</i>	(Schreber, 1774)	LC	4	C	Smithers and Tello (1976)
<i>S. viridis</i>	(Peters, 1852)	LC	56	N, C, S	Monadjem et al. (2010)
Order	Eulipotyphla				
Family	Soricidae				
<i>Crocidura cyanea</i>	(Duvernoy, 1838)	LC	14	N, C, S	Smithers and Tello (1976)
<i>C. fuscomurina</i>	(Heuglin, 1865)	LC	9	N, C, S	Smithers and Tello (1976)
<i>C. hirta</i>	Peters, 1852	LC	144	N, C, S	GNRB (2010)
<i>C. luna</i>	Dollman, 1910	LC	72	N, C	Bayliss et al. 2014
<i>C. mariquensis</i>	(A. Smith, 1844)	LC	9	N, C, S	Timberlake et al. (2009)
<i>C. olivieri</i>	(Lesson, 1827)	LC	23	N, C	FMNH: 177207
<i>C. silacea</i> †	Thomas, 1895	LC	26	N, C, S	Bayliss et al. 2014
<i>Myosorex meesteri</i>	Taylor et al., 2013		33	N, C	Taylor et al. (2013)
<i>Suncus megalura</i>	Jentink, 1888	LC	4	N, C	Smithers and Tello (1976)
Order	Hyracoidea				
Family	Procaviidae				
<i>Dendrohyrax arboreus</i>	(A. Smith, 1827)	LC	9	C	Smithers and Tello (1976)
<i>Heterohyrax brucei</i>	(Gray, 1868)	LC	22	N, C, S	Bayliss et al. (2010)
<i>Procavia capensis</i>	(Pallas, 1766)	LC	30	N, C, S	Bayliss et al. 2014
Order	Lagomorpha				
Family	Leporidae				
<i>Lepus capensis</i>	Linnaeus, 1758	LC	45	N, C, S	Smithers and Tello (1976)
<i>L. victoriae</i>	Thomas, 1893	LC	143	N, C, S	GNRB (2010)
<i>Pronolagus crassicaudatus</i>	(I. Geoffroy, 1832)	LC	3	N, C, S	Smithers and Tello (1976)
<i>P. rupestris</i> †	(A. Smith, 1834)	LC	4	N	Bayliss et al. 2014
Order	Macroscelidea				
Family	Macroscelididae				
<i>Elephantulus brachyrhynchus</i>	(A. Smith, 1836)	LC	53	N, C, S	Smithers and Tello (1976)

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TABLE 1-A2 (Continues...): Checklist of the terrestrial mammals reported from Mozambique.

Higher taxonomic level and valid species name	Authority	Status	Records	Occurrence	Last reference
<i>E. fuscus</i>	(Peters, 1852)	DD	18	N, C	Smithers and Tello (1976)
<i>E. myurus</i>	Thomas & Schwann, 1906	LC	11	N, C, S	Smithers and Tello (1976)
<i>Petrodromus tetradactylus</i>	Peters, 1846	LC	122	N, C, S	Timberlake et al. (2009)
<i>Rhynchocyon cirnei</i>	Peters, 1847	LC	32	N	Bayliss et al. 2014
Order	Perissodactyla				
Family	Equidae				
<i>Equus quagga burchelli</i>	(Gray, 1824)	NT	257	N, C, S	GNRB (2010)
Family	Rhinocerotidae				
<i>Ceratotherium simum</i>	(Burchell, 1817)	NT	15	C, S	AGRECO (2008)
<i>Diceros bicornis</i>	(Linnaeus, 1758)	CR	38	N, C, S	AGRECO (2008)
Order	Pholidota				
Family	Manidae				
<i>Manis temminckii</i>	Smuts, 1832	VU	21	N, C, S	Mesochina et al. (2008)
Order	Primates				
Family	Cercopithecidae				
<i>Cercopithecus mitis</i>	Wolf, 1822	LC	64	N, C, S	GNRB (2010)
<i>Chlorocebus pygerythrus</i>	Cuvier, 1821	LC	129	N, C, S	GNRB (2010)
<i>Papio cynocephalus</i>	(Linnaeus, 1766)	LC	60	N, C	GNRB (2010)
<i>P. ursinus</i>	(Kerr, 1792)	LC	101	N, C, S	Dunham et al. (2010)
Family	Galagidae				
<i>Galago moholi</i>	A. Smith, 1836	LC	57	N, C, S	GNRB (2010)
<i>Otolemur crassicaudatus</i>	(E. Geoffroy, 1812)	LC	186	N, C, S	Dowsset-Lemaire et al (2009)
<i>O. garnettii</i> †	(Ogilby, 1836)	LC	5	S	USNM: 352255
<i>Paragalago granti</i> ‡	(Thomas & Wroughton 1907)	LC	54	N, C, S	Timberlake et al. (2009)
Order	Proboscidea				
Family	Elephantidae				
<i>Loxodonta africana</i>	(Blumenbach, 1797)	VU	545	N, C, S	GNRB (2010)
Order	Rodentia				
Family	Anomaluridae				
<i>Anomalurus derbianus</i>	(Gray, 1842)	LC	2	N	Smithers and Tello (1976)
Family	Bathyergidae				
<i>Cryptomys darlingi</i>	Thomas, 1895	LC	60	C, S	Smithers and Tello (1976)
<i>C. hottentotus</i>	(Lesson, 1826)	LC	12	C, S	FMNH: 214827
<i>Heliophobius argenteocinereus</i>	Peters, 1846	LC	16	N	FMNH: 183861
Family	Gliridae				
<i>Graphiurus microtis</i> †	(Noack 1887)	LC	7	C, S	USNM: 352929
<i>G. murinus</i>	(Desmarest, 1822)	LC	25	N, C, S	FMNH: 183735
<i>G. platyops</i>	Thomas, 1897	LC	3	C, S	Smithers and Tello (1976)
Family	Hystricidae				
<i>Hystrix africaeaustralis</i>	Peters 1852	LC	52	N, C, S	GNRB (2010)
Family	Muridae				
<i>Acomys ngurui</i>	Verheyen et al., 2011		12	N	Petruzela et al. (2018)
<i>A. selousi</i>	de Winton, 1896		1	S	Petruzela et al. (2018)
<i>A. spinosissimus</i>	Peters, 1852	LC	264	N, C, S	Petruzela et al. (2018)
<i>Aethomys chrysophilus</i>	(de Winton, 1897)	LC	272	N, C, S	Mazoch et al. (2017)
<i>A. ineptus</i>	(Thomas & Wroughton, 1908)	LC	2	C, S	Mazoch et al. (2017)
<i>Dasymys incomtus</i>	(Sundevall, 1847)	LC	43	N, C, S	Timberlake et al. (2009)
<i>Gerbilliscus boehmi</i>	(Noack, 1887)	LC	4	N	Smithers and Tello (1976)
<i>G. inclusus</i>	Thomas & Wroughton, 1908	LC	21	N, C	FMNH: 214890
<i>G. leucogaster</i>	(Peters, 1852)	LC	148	N, C, S	RMCA: 100289
<i>Gerbillurus paeba</i>	(A. Smith, 1836)	LC	3	C, S	Smithers and Tello (1976)
<i>Grammomys cometes</i>	(Thomas & Wroughton, 1908)	LC	25	C, S	FMNH: 214896
<i>G. dolichurus</i>	(Smuts, 1832)	LC	90	N, C, S	FMNH: 214907
<i>G. macmillani</i> †	(Wroughton, 1907)	LC	8	C	USNM: 366061
<i>Lemniscomys rosalia</i>	(Thomas, 1904)	LC	171	N, C, S	FMNH: 214908
<i>Lophuromys flavopunctatus</i>	Thomas, 1888	LC	35	N	Bayliss et al. (2014)
<i>Mastomys natalensis</i>	(Smith, 1834)	LC	212	N, C, S	Colangelo et al (2013)
<i>Micaelamys namaquensis</i>	(A. Smith, 1834)	LC	35	N, C, S	Timberlake et al. (2009)
<i>Mus minutoides</i>	Smith, 1834	LC	103	N, C, S	Timberlake et al. (2009)
<i>M. neavei</i> †	(Thomas, 1910)	DD	4	N	USNM: 366998
<i>M. triton</i>	(Thomas, 1909)	LC	99	N, C, S	Bayliss et al. (2014)

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TABLE 1-A2 (Continues...): Checklist of the terrestrial mammals reported from Mozambique.

Higher taxonomic level and valid species name	Authority	Status	Records	Occurrence	Last reference	
	<i>Otomys angoniensis</i>	Wroughton, 1906	LC	26	N, C, S	Timberlake et al. (2009)
	<i>O. auratus</i> §	Wroughton, 1906	NT	5	C	Smithers and Tello (1976)
	<i>Pelomys fallax</i>	(Peters, 1852)	LC	50	N, C, S	FMNH: 183810
	<i>Praomys delectorum</i> †	(Thomas, 1910)	LC	83	N	Bayliss et al (2014)
	<i>Rhabdomys dilectus</i>	(de Winton, 1897)	LC	32	C, S	FMNH: 214913
	<i>Thallomys paedulus</i>	(Sundevall, 1846)	LC	25	N, C, S	Smithers and Tello (1976)
	<i>Uranomys ruddi</i>	Dollman, 1909	LC	11	C	Smithers and Tello (1976)
Family	Nesomyidae					
	<i>Beamys major</i>	Dollman, 1914	LC	7	N	Bayliss et al. 2014
	<i>Cricetomys gambianus</i>	Waterhouse, 1840	LC	32	N, C, S	FMNH: 214880
	<i>Dendromys melanotis</i>	Smith, 1834	LC	22	N, C, S	FMNH: 214883
	<i>D. mystacalis</i>	Heuglin, 1863	LC	12	N, C, S	Timberlake et al. (2009)
	<i>D. nyikae</i> †	Wroughton, 1909	LC	3	C, S	USNM: 367214
	<i>Saccostomus campestris</i>	Peters, 1846	LC	259	N, C, S	FMNH: 214881
	<i>Steatomys parvus</i>	Rhoads, 1896	LC	2	N	Smithers and Tello (1976)
	<i>S. pratensis</i>	Peters, 1846	LC	40	N, C, S	Smithers and Tello (1976)
Family	Pedetidae					
	<i>Pedetes capensis</i>	(Forster 1778)	LC	52	C, S	Smithers and Tello (1976)
Family	Sciuridae					
	<i>Heliosciurus mutabilis</i>	(Peters, 1852)	LC	50	N, C, S	Bayliss et al. (2014)
	<i>Paraxerus cepapi</i>	(A. Smith, 1836)	LC	98	N, C, S	FMNH: 89995
	<i>Paraxerus flavovittis</i>	(Peters, 1852)	LC	15	N	FMNH: 34140
	<i>P. palliatus</i>	(Peters, 1852)	LC	62	N, C, S	GNRB (2010)
	<i>P. vincenti</i>	Hayman, 1950	EN	5	N	Timberlake et al. (2009)
Family	Thryomyidae					
	<i>Thryonomys gregorianus</i>	(Thomas, 1894)	LC	3	C	Smithers and Tello (1976)
	<i>T. swinderianus</i>	(Temminck, 1827)	LC	34	N, C, S	GNRB (2010)
Order	Tubulidentata					
Family	Orycteropodidae					
	<i>Orycteropus afer</i>	(Pallas, 1766)	LC	77	N	GNRB (2010)

Notes: The table presents, for each species, information on the conservation status according to the IUCN (2017); the number of records compiled; the documented distribution given the biogeographical areas: N, North Mozambique; C, Central Mozambique; S, South Mozambique; and the last known reference of occurrence. As assessed by the IUCN, the following labels are used to indicate each species' conservation status: CR, critically endangered; EN, endangered; VU, vulnerable; NT, near threatened; LC, least concern; and DD, data deficient. Source references are detailed in Appendix 1. IUCN, International Union for the Conservation of Nature.

†, Species not included in Smithers and Tello (1976).

‡, Recent taxonomic change: Masters, J.C. et al., 2017, 'A new genus for the eastern dwarf galagos (Primates: Galagidae)', *Zoological Journal of the Linnean Society* (e-published).

§, Recent taxonomic change: Engelbrecht, A., Taylor, P.J., Daniels, S.R. & Rambau, R.V., 2011, 'Cryptic speciation in the southern African vlei rat *Otomys irroratus* complex: evidence derived from mitochondrial cytb and niche modelling', *Biological Journal of the Linnean Society* 104, 192–206.

Appendix 3

TABLE 1-A3: Questionable occurrence species list of Mozambique's terrestrial mammal fauna.

Higher taxonomic level and valid species name	Authority	Status	Records	Occurrence	Last reference	
Order	Artiodactyla					
	<i>Antidorcas marsupialis</i>	(Zimmermann, 1780)	LC	1	N	MNCN: 5124
	<i>Litocranius walleri</i> †	(Brooke, 1879)	NT	1	-	SNOMNH: 19828
	<i>Tragelaphus spekii</i> †	(Sclater, 1863)	LC	1	N	UNSM: 15192
Order	Chiroptera					
	<i>Epomophorus gambianus</i>	(Ogilby, 1835)	LC	1	N	MHNG-MAM-1971.002
	<i>Mops thersites</i> ‡	(Thomas, 1903)	LC	1	N	Smithers and Tello (1976)
	<i>Nyctalus noctula</i> ‡	(Schreber, 1774)	LC	1	N	Smithers and Tello (1976)
	<i>Nycteris woodi</i> †	(K. Andersen, 1914)	LC	1	C	USNM: 365176
	<i>Pipistrellus rueppellii</i> †	(J. Fischer, 1829)	LC	1	C	ROM: 51088
	<i>Scotoecus albobfuscus</i>	(Thomas, 1890)	DD	1	S	Smithers and Tello (1976)
	<i>Tadarida lobata</i>	(Thomas, 1891)	LC	1	C	FMNH: 214722
	<i>Taphozous perforatus</i>	(E. Geoffroy, 1818)	LC	1	C	Smithers and Tello (1976)
Order	Eulipotyphla					
	<i>Crocidura nigrofusca</i> †	(Matschie, 1895)	LC	1	N	USNM: 365077
	<i>Crocidura flavescens</i>	(I. Geoffroy, 1827)	LC	1	S	Smithers and Tello (1976)
	<i>Suncus lixus</i>	(Thomas, 1898)	LC	1	S	Smithers and Tello (1976)
	<i>S. varilla</i>	(Thomas, 1895)	LC	1	C	Smithers and Tello (1976)
Order	Macroscelidea					
	<i>Elephantulus intuffi</i> †	(A. Smith, 1836)	LC	1	C	ZMB: 84906
Order	Pholidota					
	<i>Manis tricuspis</i> †	(Rafinesque, 1821)	VU	1	N	MNHN: 1851-519
Order	Rodentia					
	<i>Aethomys kaiseri</i> †	(Noack, 1887)	LC	1	N	USNM: 366090
	<i>A. silindensis</i>	(Roberts, 1938)	DD	1	C	Smithers and Tello (1976)
	<i>Dendromus mesomelas</i>	(Brants, 1827)	LC	1	C	Smithers and Tello (1976)
	<i>Gerbilliscus validus</i> †	(Bocage, 1890)	LC	1	C	IICT: CZ000000397
	<i>Mastomys coucha</i>	(Smith, 1834)	LC	1	C	MCZ: 46303
	<i>Steatomys krebsii</i> †	(Peters, 1852)	LC	2	C	USNM: 367225

Notes: The table presents for each species information on the conservation status (IUCN 2017); the number of records compiled; the documented distribution given the biogeographical areas: N, North Mozambique; C, Central Mozambique; S, Southern Mozambique; and the last known reference of occurrence. As assessed by the IUCN, the following labels are used to indicate each species' conservation status: CR, critically endangered; EN, endangered; VU, vulnerable; NT, near threatened; LC, least concern; and DD, data deficient. References of the sources are in Appendix 1.

†, Species not listed in Smithers and Tello (1986).

‡, Species identified as errors in taxa identification (Monadjem et al. 2010).

Appendix 4

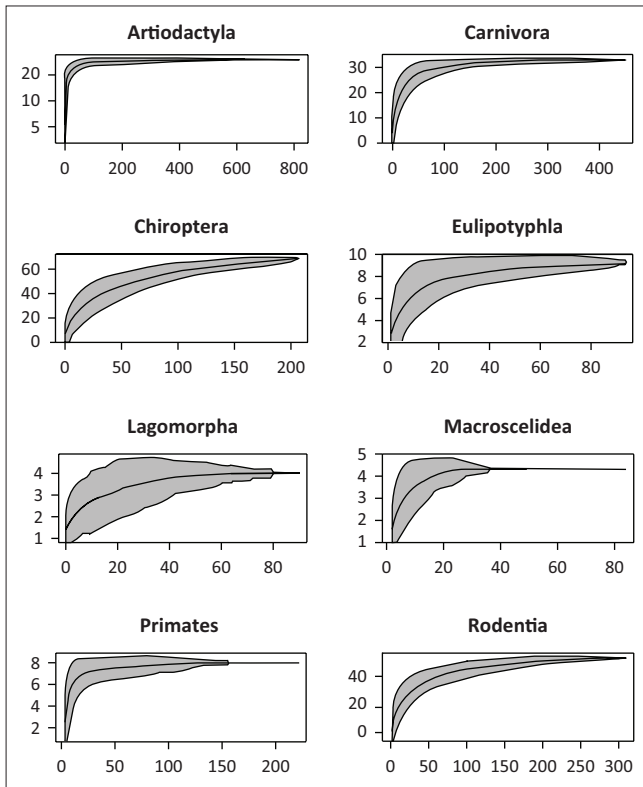


FIGURE 1-A4: Species accumulation curves representing the cumulative number of species with the increase in the number of records for Mozambique's grid cells ($1/4^\circ$), for each mammal order with more than two species of terrestrial mammals reported from Mozambique, were computed using the grid cells as a surrogate measure of sampling effort. To smoothe the curve of species richness the number of species accumulated was obtained by adding cells in a random order with 100 permutations.